This report is incomplete.

The original, printed version had missing pages. We apologize for the inconvenience.

VULCAN WELL EVALUATION SUMMARY

by: G.M. Gabert

May 1962

Alberta Research Council
Open File Report 1962-1

25 p's

Vulcan Well Evaluation Summary

17 - 24 - W4

by

G.M. Gabert

May 29, 1962

Alberta
RESEARCH COUNCIL

MEMORANDUM

RESEARCH COUNCIL OF ALBERTA, UNIVERSITY OF ALBERTA, EDMONTON

TO Mr. D. H. Lennox

FROM P. Meyboom

DATE June 26, 1961.

Re: Water supply, Vulcan

Some comments on the letter of C. C. Parker, Whittaker & Co., dated June 9, 1961.

1. If the pump test data are plotted on semi-logarithmic paper and analyzed by means of the modified Theis non-equilibrium formula, the transmissibility of the aquifer appears to be 1020-1240 gpd/ft. which is considerably higher than the transmissibility of the Paskapoo formation within the town limits (170 gpd/ft.). The drawdown graph shows a characteristic succession of steps, each of which suggests stabilization of pumping level. Six steps of apparent stabilization can be recognized in the pump test, varying in duration from 30 minutes to 3 hours. The least apparent stabilization has obviously been interpreted as a true equilibrium between recharge and discharge, but the remainder of the drawdown graph does not justify this assumption, and consequently, the calculation of specific capacity has no validity.

The periods of apparent stabilization during the pumping test are probably not related to aquifer conditions, but rather to variations in pumping rate. According to the information that is submitted by the engineering firm, the average pumping rate is 99 gpm. However, the meter-readings indicate a pumping rate of 80 gpm. from 11.45 a.m. - 1:35 p.m. on February 1, whereas the average pumping rate from 1:35 p.m. to 11:05 p.m. of the same day amounts to 106 gpm. Judging from the drawdown graph the pumping rate of 80 gpm. is valid for 200 minutes. followed by a pumping rate of 120 gpm. per minute from 200 - 500 minutes. Pumping tests with variations in discharge exceeding 1 - 5% have no value for hydrologic interpretation as the assumptions of the mathematical model are no longer valid.

If it were to be assumed that the pumping test had some value, the safe pumping rate from this well varies between 40 and 50 gpm., which has been calculated by the conventional safe yield computation:

$$Q = \frac{\text{Transmissibility x available drawdown}}{2110} \times 70\%$$

in which: T = 1020 gpd/ft - 1240 gpd/ft

drawdown = 120 feet.

Summarizing, it may be stated that the variations in pumping rate render it impossible to interpret correctly the results of the pumping test. If pumping test data were assumed to be reliable, the safe yield of this aquifer would be 50 gpm at the most, but probably less. The estimate submitted by the engineering firm is based on the wrong assumption that the principle of specific capacity can be applied to a non-equilibrium pumping test, and as a result their estimate of safe yield is nearly five times too high.

Contents

VULCAN WELL EVALUATION SUMMARY

Introduction

Constant-rate and step-drawdown tests were conducted on 5 wells at the Town of Vulcan, Alberta, during the period from May 8 to May 13, inclusive, to evaluate the potential long range production capacity of the wells.

A step-drawdown test was conducted on each well to establish its efficiency at various pumping rates and evaluate the well design.

A constant-rate test was performed on well #3 in order to calculate the aquifer coefficients which are necessary to estimate future pumping levels for extended periods of continuous pumping.

Step-Drawdown Test Results

The step-drawdown tests indicate that the five wells are not efficient or designed for pumping rates exceeding 7 gpm when each well is pumped separately. At pumping rates lower than 7 gpm the wells function satisfactory.

Constant-Rate Tests Results

The average transmissibility of the water bearing materials was calculated from the time-drawdown data obtained from this test. The average transmissibility determined was 246 gpd/ft., which means the aquifer yields its water slowly to a well.

Observations of drawdowns in wells number 1, 2, 4, and 5 during the constant-rate and step-drawdown tests revealed that interference occurs between wells number 1, 2, 3, and 4. Well No. 5 was not influenced by the pumping of the other four wells.

Table I indicates that the predicted pumping levels in the aquifer under conditions of continuous pumping at a constant rate conform rather closely to the actual drawdowns which occur for a given pumping period.

Table I: A comparison of estimated drawdowns in the aquifer and actual drawdowns measured at the end of 24 hours of continuous pumping at a rate of 5.2 gpm.

Well No.	Status	Estimated Drawdowns	Actual Drawdowns
2	Observation	44.5'	46.0'
3	Pumping	7.5'	7.8'
4	Observation	5.1'	3.9'

During the pumping test the top of the lower aquifer was considered to be 142 feet. The maximum safe pumping rate is that rate which will not draw the water below the top of the lowest water bearing zone over an extended period of continuous pumping at a constant rate. For estimating future pumping rates 90 feet of available drawdown was considered a maximum in the calculations.

Table II: Estimate future pumping levels in the aquifer at various distances from the center of a pumping well.

Radial Distance from center of pumping well (ft.)	Continuous Constant pumping Rate (gpm)	Length of Pumping Period	Estimated Drawdowns in Aquifer (ft.)
0.25	5.2	1 day	44.5
10	5.2	1 day	26.6
100	5.2	1 day	15.5
1000	5.2	1 day	4.6
0.25	5.2	30 days	49.5
10	5.2	30 days	34.8
100	5.2	30 days	23.7
1000	5.2	30 days	12.6
0.25	5.2	90 days	55.4
10	5.2	90 days	37.5
100	5.2	90 days	26.4
1000	5.2	90 days	15.4

Table II (cont'd)

Radial Distance from center of pumping well (ft.)	Continuous Constant pumping Rate (gpm)	Length of pumping period	Estimated Drawdowns in Aquifer (ft.)
0.25	5.2	5 years	62.7
10	5.2	5 years	45.0
100	5.2	5 years	33.9
1000	5.2	5 years	22.5
0.25	6	1 day	51.5
10	6	1 day	30.8
100	6	1 day	17.9
1000	6	1 day	5.3
0.25	6	30 days	57.1
10	6	30 days	40.3
100	6	30 days	27.3
1000	6	30 days	14.6
0.25	6	90 days	64.1
10	6	90 days	43.4
100	6	90 days	30.5
1000	6	90 days	17.6
0.25	6	5 years	72.5
10	6	5 years	52.0
100	6	5 years	39.0
1000	6	5 years	26.0
0.25	7	1 day	60.0
10	7	1 day	35.8
100	7	1 day	20.9
1000	7	1 day	6.2
0.25	7	30 days	66.5
10	7	30 days	47.0
100	7	30 days	31.9
1000	7	30 days	17.0
0.25	7	90 days	74.6
10	7	90 days	50.5
100	7	90 days	35.5
1000	7	90 days	20.5

Table II (cont'd)

Radial Distance from center of pumping well (ft.)	Continuous Constant pumping Rate (gpm)	Length of pumping period	Estimated Drawdowns in Aquifer (ft.)
0.25	7	5 years	84.5
10	7	5 years	60.6
100	7	5 years	45.6
1000	7	5 years	30.3
0.25	10	1 day	85.7
10	10	1 day	51.2
100	10	1 day	29.8
1000	10	1 day	24.5
0.25	10	30 days	95.0
10	10	30 days	67.0
100	10	30 days	45.6
1000	10	30 days	24.2
0.25	10	90 days	106.6
10	10	90 days	72.2
100	10	90 days	50.8
1000	10	90 days	29.3
0.25	10	5 years	120.6
10	10	5 years	86.6
100	10	5 years	65.2
1000	10	5 years	46.6

Table III: 24 hour interference due to the pumping of each well at various constant rates

Pumping Well No.	Well influenced by pumping	Radial Distance from pumping well (ft.)	Interference in feet of drawdown at various pumping rates — Pumping rate gpm 5.2	6	7
1	2	414	8.7	10.1	11.7
	3	1300 *	3.6	4.2	4.9
	4	1800 *	2.2	2.5	2.9
2	1	414	8.7	10.1	11.7
	3	930	5.1	5.9	6.8
	4	1400 *	3.1	3.6	4.2
3	1	1300 *	3.6	4.2	4.9
	2	930	5.1	5.9	6.8
	4	523	7.5	8.7	10.1
4	1	1800 *	2.2	2.5	2.9
	2	1400 *	3.1	3.6	4.2
	3	523	7.5	8.7	10.1

* Estimated Distances

Table IV: 90 day interference due to the pumping of each well at various constant rates

Pumping Well No.	Well influenced by pumping	Radial Distance from pumping well (ft.)	Interference in feet of drawdown at various pumping rates — Pumping rate gpm 5.2	6	7
1	2	414	19.6	22.7	26.4
	3	1300 *	14.0	16.2	18.9
	4	1800 *	12.6	14.6	17.0
2	1	414	19.6	22.7	26.4
	3	930	15.7	18.2	23.7
	4	1400 *	13.6	15.7	18.2
3	1	1300 *	14.0	16.2	18.9
	2	930	15.7	18.2	23.7
	4	523	18.4	21.3	24.8
4	1	1800 *	12.6	14.6	17.0
	2	1400 *	13.6	15.7	18.2
	3	523	18.4	21.3	24.8

Table V: Total interference in each well with all wells pumping at 5.2 gpm for a period of 1 day and 90 days.

Well No.	Pumping Period	Total Interference in feet
1	1 day	14.5
2	1 day	16.9
3	1 day	16.2
4	1 day	12.8
1	90 days	46.2
2	90 days	48.9
3	90 days	48.1
4	90 days	44.6

Water Quality

The chemical quality of the water is acceptable in all the wells except well No. 5. This water in well No. 5 is not acceptable for a public supply due to the nitrate content. Pumping this well for several days may eliminate the nitrates or reduce their concentration to an amount not dangerous for public use.

The pumping of well No. 3 for 27 hours improved its chemical quality, particularly by reducing the sulphate concentration.

Conclusions and Recommendations

1. Continuous pumping of a well in this aquifer at 5.2 gpm for a period of 90 days causes a drawdown of 55.4 feet (Table II) in the aquifer at the well perimeter. If wells 1, 2, 3, and 4 are pumped continuously at 5.2 gpm for a 90 day period, there will be an additional drawdown of nearly 50 feet (Table 5) in each well due to interference. This gives a total drawdown in each well that exceeds the total available drawdown of 90 feet.

Therefore, wells 1, 2, 3, and 4 cannot be pumped continuously at a constant rate of 5.2 gpm for a 90 day period.

2. Table II indicates that if each well was separately pumped continuously at 7 gpm for a 90 day period, the drawdown in each well would be very close to the maximum drawdown available. Thus if 2, 3, or 4 wells were pumped and were influenced by one another to the extent that these 4 wells are, each well should not be pumped over 5 gpm, a maximum rate for extended periods of continuous pumping.

3. Well No. 5 was not influenced by the pumping of wells No. 1, 2, 3, and 4. However, for a 90 day continuous pumping period the maximum rate at which well no. 5 can be pumped is 7 gpm.

Future Prospects for a Groundwater Supply

The Town of Vulcan should be aware that the prospects for drilling high capacity wells with an acceptable water quality are not good in the vicinity of the town. The recent pumping test indicates that wells yielding water from the same aquifer will have to be spaced at least 1000 feet apart, instead of the previously suggested 500 feet, in order to ensure minimum interference. Closely spaced wells will have to be pumped at low rates and thus a well field will be required to obtain a large quantity of water over a long period of time.

Unfortunately, drillers' logs for test holes and well previously drilled at Vulcan do not give reliable information on the thickness, depth, and availability of the various water bearing formations encountered. A future test drilling program should be carefully planned and properly supervised during its initial stage to ensure that each hole is properly sampled in order to obtain a detailed log of the formations encountered. In addition, an electric log may be run on several test holes to aid in establishing the exact position of waterbearing formations encountered during drilling. A competent water well driller experienced in this type of test drilling is a necessity for such a program.

Detailed, reliable information obtained from a well planned, properly executed test drilling program may result in improved well design and completion, and a more satisfactory performance from a single well or group of wells.

G. M. Gabert
Groundwater Division
Research Council of Alberta
May 29, 1962.

Appendix A

C. C. Parker, Whittaker & Company Ltd.

R E P O R T

on

INVESTIGATION FOR EXTENSION OF WATER SUPPLY

TOWN OF VULCAN

SCOPE OF WORK

The existing water supply for the Town of Vulcan, with a population of 1340 persons, comes from five or six wells located in the vicinity of the townsite. The water is pumped from the wells to an elevated storage tank (50,000 gallons) and thence, by gravity, to the distribution system.

The wells provide an aggregate flow of 65 US GPM which does not meet the present demand. Several of the larger users, the hotel, hospital, etc., have individual supply.

The quality of the water is unsatisfactory, having a high concentration of objectionable salts, nitrates and sulphates (Glauber Salts).

It has been necessary to investigate, test and analyze all the available sources of water in the district, to obtain an adequate source of potable water within the economic range of the community.

BASIC DESIGN

We established the necessary criteria for the study from sound engineering principles in accord with Health Regulations, and other basic requirements, as follows :-

1. **Population Trend**

   Vulcan is the centre of a trading area with a radius of 30 to 35 miles. It is the County seat for the County of Vulcan.

   There are no large industrial plants in the area, but some expansion may come from the presence of producing gas wells and their subsidiary extraction processing.

   The estimated population for 1985, based on a plotted curve for the increase of the past fifteen years, is 3500. This figure has been used for our calculations throughout this report.

2. **Quantity of Water**

   Water demand is estimated to be in U.S. Gallons.

1961		1985
233,000 gal.	Maximum daily demand	787,500 gals.
357,600 gal.	Fire demand	561,300 gals.
590,600 gal.	TOTAL	1,348,800 gals.

3. **Storage**

   The reserve storage required is calculated to be 600,000 U.S.Gallons. This computation takes into account the existing 50,000 gallon elevated storage and a continuous pumping capacity of 250 gpm.

   Supply line sizing has been determined, based on 250 U.S. gpm against a head of 160 feet and the 6" dia. main will suffice.

4. Quality of Water

Chemical analyses of water from the local wells, surface water sources etc., indicate that there are several problems in the provision of a potable supply. These are :-

1. Reduction of Total Solids content.
2. Reduction of Sulphate content.
3. Reduction of Iron Manganese content.

Various methods of treatment have been studied, individually or in combination, to arrive at a satisfactory supply within the economic range for initial and operational costs.

The most efficient treatment that is within a reasonable cost range, is a combination filter and aerating plant. The filter selected is designed to remove iron and magnesium and will, in this process, combined with aeration, reduce the quantity of salts to a reasonable maximum.

PHYSICAL STUDY

SOURCES OF WATER

a) Town Wells

A complete study of the possible wells in the vicinity of the townsite was made, using information obtained locally and from the Research Council of Alberta. The flow from wells in the area is small and it would require a large number of wells in series to meet the demand.

The quality of the water obtained from the existing wells varied widely, and treatment would be necessary as mentioned.

b) Airport Wells

The Town of Vulcan recently acquired the use of several wells that formed the source of supply for the RCAF Station, about 4.75 miles from the townsite.

A pump test on Well #1 was made early in February last and computations from the observations, indicate that these wells will produce 160 US gpm, which, combined with the production of wells at the airport and the town wells, and the proposed storage reservoir, will supply town needs adequately.

The quality of the water is comparable to that discussed and treatment will be required to reduce the total solids, sulphates and iron content.

c) Surface Water - Snake Creek

There is a potential source of surface water in the Snake Creek drainage basin. This would have to be developed in conjunction with the P.F.R.A. who would provide the impounding reservoir.

The length of the supply line would exceed that from the Airport by 2.25 miles approximately, and treatment would be the same problem due to salts in the ground water.

The cost analysis of this proposed source has been compared with the cost of the other installations.

The selection of a source of water hinges on the economics of the system to be proposed as there is no apparent advantage in quality of the product of either source, and sufficient water is available at either (b) or (c).

DESIGN

SOURCE - Airport Wells - SCHEME B

1. Use - Well #1 (RCAF) 160 gpm
   Well #2 (RCAF) 40 gpm

   Use additional wells from townsite or airport as required. These wells should be pumped periodically to maintain quality (2 or 3 times weekly) 50 gpm

   Total: 250 gpm

2. Repairs to Wells at Airport.

   Well #1 - Casing is corroded and rust particles are evident in discharge. The casing should be replaced and the well sealed off at 30 foot level.

   Well #2 - This well to be flushed and gravel packed to overcome turbidity now prevalent.

3. Pipe Line - 6" diameter main to treatment plant and reserve storage. Pipe salvaged from existing line at airport satisfactory and less costly.

4. Pump to elevated storage from treatment plant and reserve.

   A direct by-pass from reserve storage to the system for fire flow is feasible.

SOURCE - Snake Creek - SCHEME C

1. Impounding Reservoir - To be built in conjunction with or by P.F.R.A.

2. Intake Structure - normal for lake.

3. Pumping from reservoir to treatment plant and reserve storage - Supply line 7 miles long approximately.

4. Treatment etc., to distribution system as in Scheme B.

C. C. Parker, Whittaker & Company Ltd.

COST ESTIMATES

B. AIRPORT SUPPLY

	Total Cost	Cost to Town Under Winter Works
1. Pipe Salvage	$35,210.91	$23,252.07
2. Supply Line	38,194.58	26,577.74
3. Treatment Plant & Equipment	33,689.00	30,320.00
4. Reservoir	38,146.00	34,330.00
Sub-Total	145,240.49	114,479.81
10% Contingencies	14,524.51	14,524.51
	159,765.00	129,004.32
Engineering 6%	9,585.00	9,585.00
TOTAL	$169,350.00	$138,589.32

C. SNAKE CREEK PROJECT

Total Cost Pipeline	177,036.00
Storage and treatment	93,923.00
	$270,959.00

NOTE:- This does not include the cost of the impounding dam or property acquisition.

C. EMERSON NOBLE
CHEMICAL ENGINEER
DIRECTOR INDUSTRIAL LABORATORIES
PROVINCIAL ANALYST

UNIVERSITY OF ALBERTA
QUAECUMQUE VERA

EDMONTON, ALBERTA
CANADA

May 16, 1962

WATER ANALYSIS REPORT
CHEMICAL

Submitted by	Secretary-Treasurer	Date received	May 14, 1962
Address	Town of Vulcan	Date reported	
	Vulcan, Alberta	Source of Sample	Vulcan Well # 1
Container No.	D 1	Serial No.	
		Lab. No.	62 - 4370

PARTS PER MILLION

Slotted from ~~60 to 75 ft~~ Not known
Water struck at ~~[illegible]~~
55: 145-15

Total Solids	858
Ignition Loss	98
Hardness	50
Sulphates	245
Chlorides	17
Alkalinity	305
Nature of Alkalinity	Bicarbonate of soda, lime
Nitrites	trace
Nitrates	1.2
Iron	0.2
Fluorine	

REMARKS:

Soda - 18.9 grains/gallon. [illegible] e Aluminum and ham
plants. Water is chemical [illegible]

C. Emerson Noble
Provincial Analyst

CEN:pl
cc Research Council

C. EMERSON NOBLE
CHEMICAL ENGINEER
DIRECTOR INDUSTRIAL LABORATORIES
PROVINCIAL ANALYST

UNIVERSITY OF ALBERTA
QUAECUMQUE VERA

EDMONTON, ALBERTA
CANADA

May 16, 1962

WATER ANALYSIS REPORT
CHEMICAL

Submitted by: Secretary-Treasurer
Address: Town of Vulcan, Vulcan, Alberta
Container No.: A 6

Date received: May 14, 1962
Date reported:
Source of Sample: Vulcan Well # 2
Serial No.:
Lab. No.: 62 - 4371

PARTS PER MILLION

Slotted 60 to 150 ft
Water at 68 + 145 to 150 ft

Total Solids	912
Ignition Loss	50
Hardness	50
Sulphates	312
Chlorides	26
Alkalinity	275
Nature of Alkalinity	Bicarbonate of soda, lime and magnesium
Nitrites	trace
Nitrates	0.6
Iron	0.3
Fluorine	

50
312
26
275
0.6
14.07665

13.07665
1.00000
7.00000
0.73000
0.50000
0.04200

22.02665
7.10429
55.41340
5.00966
39.07360
0.30441

REMARKS:

Soda - 16.7 grains/gallon. Soda may corrode Al plants. Water is chemically suitable.

C. Emerson Noble
Provincial Analyst

CEN:pl
cc Research Council

C. EMERSON NOBLE
CHEMICAL ENGINEER
DIRECTOR INDUSTRIAL LABORATORIES
PROVINCIAL ANALYST

UNIVERSITY OF ALBERTA
QUAECUMQUE VERA

EDMONTON, ALBERTA
CANADA

May 16, 1962

WATER ANALYSIS REPORT
CHEMICAL

Submitted by: Secretary -Treasurer
Date received: May 14, 1962
Address: Town of Vulcan
Vulcan, Alberta
Date reported:
Source of Sample: Vulcan, Well #3, Sample
Container No.: 352
Serial No.: At beginning of pumping
Lab. No.: 62 - 4367

PARTS PER MILLION

Slotted 70 to 180 ft
Water at 80 + 145 to 150 ft

Total Solids	1064
Ignition Loss	56
Hardness	50
Sulphates	404
Chlorides	19
Alkalinity	270
Nature of Alkalinity	Bicarbonate of soda, lime and magnesium
Nitrites	nil
Nitrates	nil
Iron	nil
Fluorine	

50
404
19
270
0
16.03580
15.03500
1.00000
10.10000
0.03500
5.40000
0.00000
93.70000
0.03600
32.98700
3.04144
53.67000
0.00000

REMARKS:

Soda - 16.3 grains/gallon. Soda may corrode Alu plants. Water is chemically suitable.

C. Emerson Noble
Provincial Analyst

CEN:pl
cc Research Council

C. EMERSON NOBLE
CHEMICAL ENGINEER
DIRECTOR INDUSTRIAL LABORATORIES
PROVINCIAL ANALYST

UNIVERSITY OF ALBERTA
QUAECUMQUE VERA

EDMONTON, ALBERTA
CANADA

May 16, 1962

WATER ANALYSIS REPORT
CHEMICAL

Submitted by: Secretary-Treasurer

Address: Town of Vulcan
Vulcan, Alberta

Container No.: D 29

Date received: May 14, 1962

Date reported:

Source of Sample: Vulcan Well # 3

Serial No.: After 24 hours of pumping at

Lab. No.: 62 - 4372 52 gpm

PARTS PER MILLION

Total Solids	824
Ignition Loss	72
Hardness	50
Sulphates	253
Chlorides	26
Alkalinity	245
Nature of Alkalinity	Bicarbonate of soda, lime and magnesium
Nitrites	nil
Nitrates	nil
Iron	0.2
Fluorine	

REMARKS:

Soda - 14.5 grains/gallon. Water is chemically suitable.

C. Emerson Noble
Provincial Analyst

CEN:pl
cc Research Council

C. EMERSON NOBLE
CHEMICAL ENGINEER
DIRECTOR INDUSTRIAL LABORATORIES
PROVINCIAL ANALYST

UNIVERSITY OF ALBERTA
QUAECUMQUE VERA

EDMONTON, ALBERTA
CANADA

May 16, 1962

WATER ANALYSIS REPORT
CHEMICAL

Submitted by Secretary Treasurer

Address Town of Vulcan
Vulcan, Alberta

Container No. 225

Date received May 14, 1962

Date reported

Source of Sample Vulcan Well # 4

Serial No.

Lab. No. 62 - 4368

PARTS PER MILLION

Slotted from 100 to 180 ft
Water at 130 ft

Total Solids	930
Ignition Loss	36
Hardness	50
Sulphates	362
Chlorides	15
Alkalinity	240
Nature of Alkalinity	Bicarbonate of soda, lime and magnesium
Nitrites	trace
Nitrates	trace
Iron	0.2
Fluorine	

REMARKS:

Water is chemically suitable.

C. Emerson Noble
Provincial Analyst

CEN:pl

C. EMERSON NOBLE
CHEMICAL ENGINEER
DIRECTOR INDUSTRIAL LABORATORIES
PROVINCIAL ANALYST

UNIVERSITY OF ALBERTA
QUAECUMQUE VERA

EDMONTON, ALBERTA
CANADA

May 16, 1962

WATER ANALYSIS REPORT
CHEMICAL

Submitted by Secretary-Treasurer

Address Town of Vulcan
Vulcan, Alberta

Container No. D 43

Date received May 14, 1962

Date reported

Source of Sample Vulcan Well # 5

Serial No.

Lab. No. 62 - 4369

Slotted from 60 to 175 ft
Water at 75, 85 & 150 ft.

	PARTS PER MILLION
Total Solids	1910
Ignition Loss	218
Hardness	110
Sulphates	667
Chlorides	64
Alkalinity	135
Nature of Alkalinity	Bicarbonate of soda, lime and magnesium
Nitrites	trace
Nitrates	23
Iron	0.3
Fluorine	

REMARKS:

Soda - 24.2 grains/gallon. Water is chemically
to high nitrates.

C. Emerson Noble
Provincial Analyst

CEN:pl
cc Research Council

Appendix B