

Assessment of the Fort St. John Drinking Water Supply: Source Wa- ter Characteristics

James Jacklin, March 2004¹

Introduction

In British Columbia, drinking water quality is becoming a significant public issue. We all want to have confidence in the quality of the water we consume. Its protection is also important to local purveyors, who act as our water suppliers, and to provincial government ministries responsible for water management. Within the Omineca-Peace region of B.C., our most common potable source is ground water, although many communities do make use of rivers, streams or lakes. Our basic drinking water quality is determined by a number of factors including local geology, climate and hydrology. In addition to these, human land use activities such as urbanization, agriculture and forestry, and the pollution they may cause, are becoming increasingly important influences. Environmental managers have a responsibility to control land use development so as to minimise the effects of these activities on source water quality.

The province's Drinking Water Protection Act, enacted in October, 2002, places the responsibility for drinking water quality protection with the B.C. Ministry of Health and local water purveyors. However, through the B.C. Environmental Management Act, the British Columbia Ministry of Environment (MOE) is responsible for managing and regulating activities in watersheds that have a potential to affect water quality. Accordingly, the Ministry

plans to take an active role in protecting drinking water quality at its source.

MOE implemented a raw water quality and stream sediment monitoring program at selected communities in the Omineca-Peace region in 2002. Community sites were selected using a risk assessment process that considered:

- whether the source supply was surface water or ground water,
- the level of water treatment,
- the population size served,
- the potential for upstream diffuse and point-source pollution,
- the availability of current, high-quality and representative data on each raw water source,
- whether past outbreaks of waterborne illness had been reported,
- the ability/willingness of local purveyors to assist with sampling.

Through this process and with available funding, a total of 18 community water supplies in the Omineca-Peace region were selected for monitoring during 2002/03.

This brief report will summarise water quality data collected from the Fort St. John raw potable water source (ground water) (Plate 1). The data are compared to current provincial drinking water quality guidelines meant to protect finished water if no treatment other than disinfection is present. This comparison should identify parameters with concentrations that represent a risk to human health. It is intended that this program will lead to the identification of human activities responsible for unacceptable source water quality, and that it will assist water managers to develop measures to improve raw water quality where needed.



Plate 1. The City of Fort St. John's water treatment plant. Water samples were collected from a raw water tap inside this building.

¹A template report was prepared for the author by Todd D. French of TDF Watershed Solutions, Research & Management and Bruce Carmichael, Ministry of Environment.

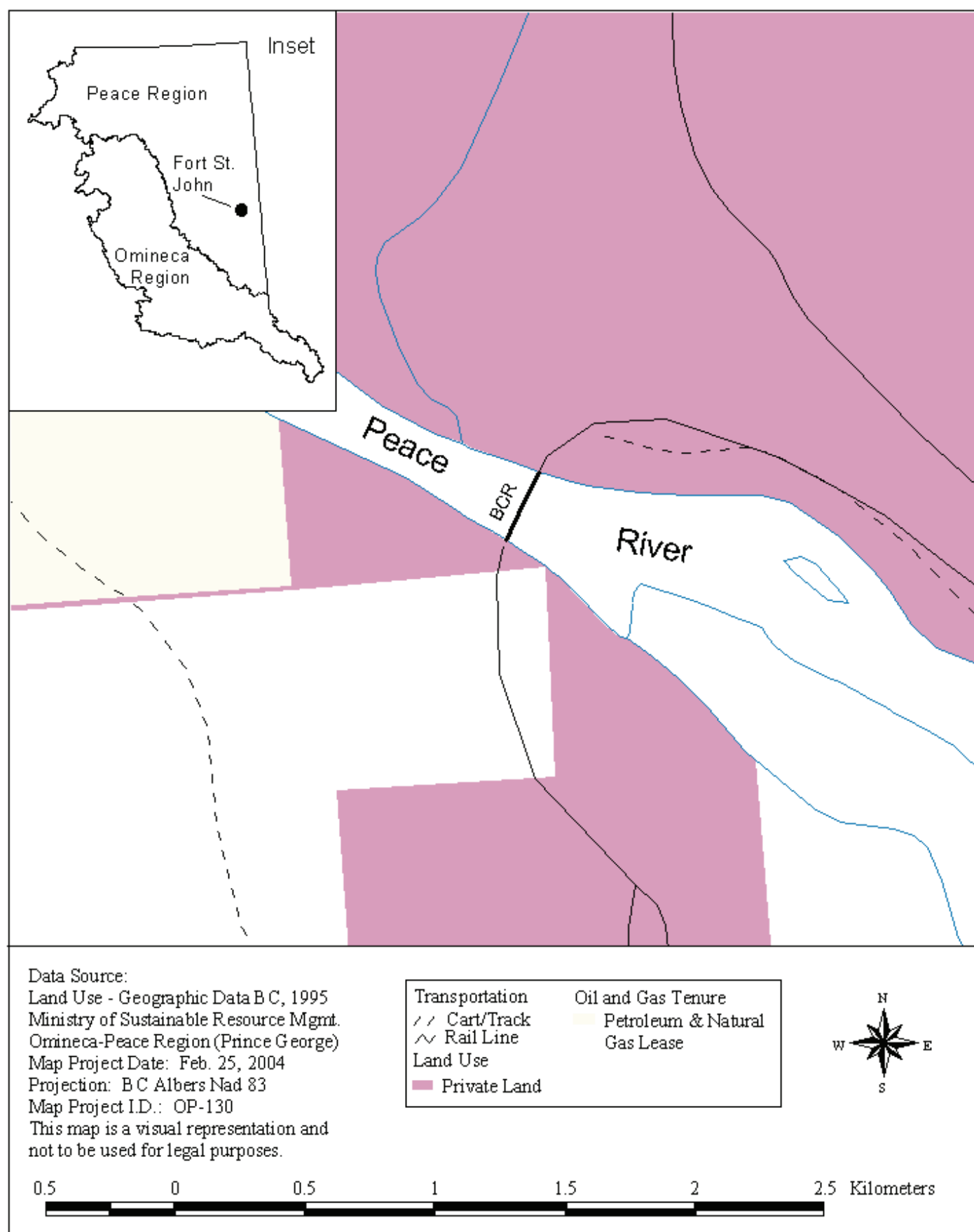


Figure 1. Fort St. John water well area and nearby land use practices. Although no specific well location was provided, it was indicated by the staff of the Fort St. John water treatment plant that the wells are located within 500 ft (152 m) of the B.C.R. bridge over the Peace River.

Site Description

Watershed Overview

The Fort St. John drinking water supply, which consists of four deep wells near the Peace River and B.C.R bridge, is located approximately 11 km from the city water treatment plant (Figure 1). These wells are located within the Boreal Black and White Spruce biogeoclimatic zone, which has long, extremely cold winters and a short, cold summer growing season. The terrain has rolling topography and is dominated by both upland forests and muskeg. Common trees in this zone include white spruce, black spruce, lodgepole pine and trembling aspen (B.C. Ministry of Forests, 1998).

The predominant land use in the vicinity of the wells is agriculture, however oil & gas, urban development and forestry are also present throughout the watershed. Since the four wells are influenced by the Peace River, possible land-use impacts on quantity, as well as water quality, may be of concern

At present, the water demand on the Fort St. John waterworks wells is high, with water withdrawal rates frequently changing depending on demand from local water users (Schlosser, p.c.). The withdrawal rates for each of these wells differs, so concern over production rates is high. According to water licensing information provided by Lands and Water B.C., the City of Fort St. John waterworks authority has been allocated a withdrawal rate of 1.386×10^9 gallons/year (approximately 6.30×10^6 m³/year).

Drinking Water Supply & Treatment

The City of Fort St. John and associated water users draw their domestic water supplies from four wells approximately 11 km from the water treatment plant, located near the Peace River. As measured with a GPS, the geographic co-ordinates of the water treatment plant (where the samples were collected) are 56°13.788'N/120°49.335'W. At the plant, the water from all four wells is combined and then treated by pre-chlorination followed by green sand, potassium permanganate and fluoridation (Schlosser, p.c.). Based on 2001 statistics, the City of Fort St. John water supply serves approximately 16,000 people located within the community, as well as serving the airport and Charlie Lake School.

The city has no current concerns regarding the quality of the existing water system, however do have concerns regarding quantity. Because the water wells are located both within and beside the river, they are influence significantly by fluctuations in the annual Peace River hydrological cycle. Low river and well levels during the sum-

mer months are of greatest concern to the city, as less water is available for community consumption. At present, there are no water restrictions on the community water supply, and the only solution to low water levels is to use more wells (Schlosser, p.c.).

Materials & Methods

Review of Previous Data

Historical data relevant to the Fort St. John source water supply assessment have been included in this report. The data were copied from both Fort St. John and Northern Health Authority (NHA) computer and paper files.

Sample Collection & Analyses for the 2002/03 Water Monitoring Program

Water Quality

An experienced consultant and/or MOE staff member collected water samples in laboratory certified polyethylene bottles for a variety of chemical and bacterial analyses. Representative grab samples were collected from the raw water tap (Plate 2) inside the water treatment plant (site E249365 - Water Source ID Tag 1344). The chemical results, analytical detection levels and drinking water quality guidelines are provided in Table 1, Appendix A.

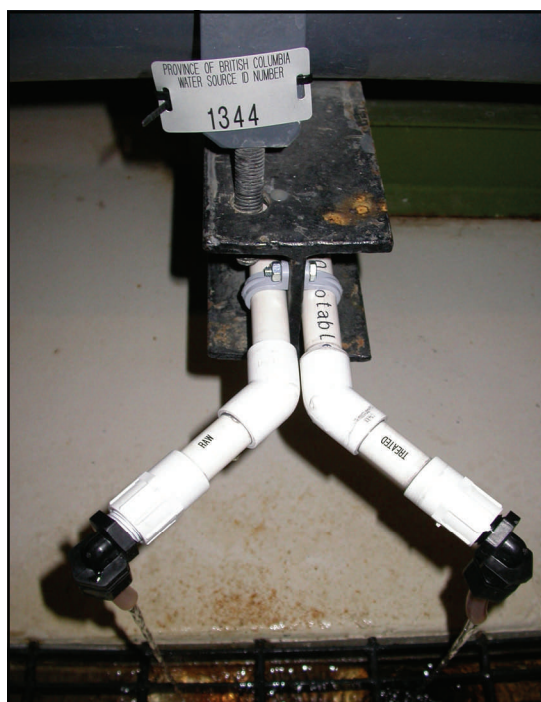


Plate 2. A picture of the raw water tap inside the Fort St. John water treatment plant.

Bottles used for general ion analyses were rinsed three times with source water prior to sample collection. Metal and bacterial bottles were not rinsed and metal samples

were lab preserved. There was no need to flush the source water prior to sample collection (as per most sites collected from a tap), as the raw water tap is always running. Water samples were shipped by overnight courier in coolers with ice packs to CanTest Ltd. (from September 2002–March 2003) and JR Laboratories Inc. (April 2003 to September 2003) for bacteria and PSC Environmental Services Ltd. for chemistry. Bacterial samples were analysed using membrane filtration. Metals analysis made use of ICPMS technology.

Quality Assessment (QA)

To ensure accuracy and precision of data, quality assurance and control (QA/QC) procedures were incorporated into the monitoring program. This included use of rigorous sampling protocols, proper training of field staff, setting of data quality objectives and the submission of QA samples to the lab. Field QA included duplicate and blind blank samples. Blank samples detect contamination introduced in the field and/or in the lab. A comparison of duplicate results measures the effect of combined field error, laboratory error and real between-sample variability. The blind blank and duplicate program accounted for roughly 20% of the overall chemistry and bacterial sample numbers.

Results

Review of Previous Data

Bacteriology

The NHA sampled the Fort St. John raw water supply from the water treatment plant 220 times between January 1998 and August 2002 (Fort St. John changed their water source in January 1998 from Charlie Lake to filtration wells by the Peace River). The results of this raw water bacterial program are presented in Table 2, Appendix A.

All 220 samples were tested for both total and fecal coliforms. Total coliforms were detected on seven occasions and had a concentration range of <1–21 CFU/100 mL, and fecal coliforms were detected on one occasion at a density of 1 CFU/100 mL. There is currently no recommended drinking water guideline for total coliforms. Furthermore, total coliforms are found naturally in many water bodies and do not necessarily indicate harmful land use activities. They do however suggest that coliforms may be present in the system and that further testing may be warranted. Fecal coliforms do not appear to be a problem in the Fort St. John source water.

Water Chemistry

The historical chemistry data collected by the City of Fort 4 St. John is presented in Table 3, Appendix A. Samples

were collected from August 2000 to August 2002, and were collected from the raw water tap in the water treatment plant.

Review of the data indicates there were drinking water exceedances by three parameters, including specific conductance, iron and manganese. Additionally, the water was very hard. There did not appear to be any QA data associated with these samples.

Water Monitoring Program (2002/03)

Quality Assessment (QA)

The field blank and duplicate results indicate that minimal field or lab contamination of samples with bacteria occurred and that acceptable precision in bacterial sampling and analysis was observed. There were some differences between bacterial duplicates during both April and May, however this is likely due to heterogeneous water conditions resulting from spring runoff rather than poor precision (these variable duplicates were not collected from Fort St. John).

The six water chemistry field blank samples that were prepared either the same day or within one day of the Fort St. John collections tested positive for some parameters. The concentration of most of these parameters was either very close to or less than 5-fold the minimum detectable concentration, an acceptable threshold as per the lab acceptance criteria. Four parameters exceeded these acceptance criteria significantly and are listed below in Table 4.

Table 4. Blind blank samples that tested strongly positive (\geq 5-fold MDL) for chemical contamination.

Date	Parameter	Measured Concentration	MDL
Jan. 15/03	Sulfate	3.1 mg/L	0.5 mg/L
Apr. 29/03	Strontium-T	0.034 µg/L	0.005 µg/L
May 27/03	Strontium-T	0.048 µg/L	0.005 µg/L
May 27/03	Strontium-D	0.029 µg/L	0.005 µg/L

Although the levels of some of these blank results are equal to or greater than the actual concentrations observed in Fort St. John on some dates, the values are usually well below provincial raw drinking water guidelines by greater than two orders of magnitude. The contamination that did occur may have resulted during the deionization process in the lab or during the transfer of the deionized water between bottles in the field. Regardless, these levels of blank contamination should not limit the comparison of data to water quality guidelines.

The five water chemistry duplicate samples that were prepared either the same day or within one day of the Fort St. John collections did have some values outside the lab acceptance criteria of 25% relative percent difference (Table 5, Appendix A). The differences that are present may be

due to problems with collection and/or analytical precision. All of the parameters but one that did have differences greater than 25% between the duplicates occurred well below recommended drinking water guidelines. The one parameter that did exceed provincial guidelines is iron. Although this particular sample was not collected from Fort St. John, it does draw attention to the iron data for this date.

Bacteriology

The 2002/03 bacterial data are summarised in Table 6. There are currently no drinking water quality guidelines for *E. coli*, *Enterococci* and fecal coliforms in water treatment systems that undergo complete water treatment. Fort St. John uses pre-chlorination followed by green sand, potassium permanganate and fluoridation

Table 6. Results of bacterial analyses for the Fort St. John raw water supply. Units are CFU/100mL.

Date	Total Coliform	<i>E. coli</i>	<i>Enterococci</i>	Fecal Coliform
Provincial Guideline	No Provincial Guideline	No Upper Limit	No Upper Limit	No Upper Limit
Oct. 7/03	<1	<1	<1	<1
Jan. 15/03	<1; <1	<1; <1	<1; <1	<1; <1
Mar. 5/03	<1	<1	<1	<1
Apr. 30/03	<2	<2	<2	<2
May 28/03	<1	<1	<1	<1
Aug. 20/03	<1	<1	<1	<1

All samples collected from this water supply contained no detectable bacteria. This suggests that bacterial densities are low throughout the year in the Fort St. John raw water supply.

Water Chemistry

In 2002/03, ground water samples were collected on six different dates. The water samples were analysed for 15 general parameters as well as for the ICPMS low level metals package that includes 27 metals in the total form.

Of the chemical parameters tested through the duration of this study, only one exceeded the provincial guidelines for raw drinking water and one was of note.

Manganese, Total ($\mu\text{g/L}$) - The mean and maximum total manganese concentrations were 45.8 and 61.8 $\mu\text{g/L}$, respectively. The drinking water aesthetic guideline is 50 $\mu\text{g/L}$. Manganese can colour water and form colloidal material that can be difficult to remove. It is found naturally in many ground water supplies.

Water hardness, which can often be a problem in ground water supplies, had a mean concentration of 205 mg/L CaCO_3 . This is considered very hard ($>180 \text{ mg/L CaCO}_3$), above the optimum range of 60-120 mg/L CaCO_3

for a drinking water supply. This hardness is due to the presence of calcium and magnesium in the water. Hard water can reduce the toxicity of some metals, but can also leave scale deposits on piping. Some anthropogenic sources that contribute to water hardness are mining and industrial effluents (RIC, 1998). Additionally, high values are found naturally in many ground water supplies, resulting from the dissolution of calcium and magnesium bearing rocks and minerals.

The data from 2002/03, as well as the historical chemistry data, indicate that chemical parameters in the Fort St. John water supply are generally low for drinking water use. There do however appear to be problems regarding both water hardness and manganese levels, both of which probably result from the dissolution of minerals and rocks in the ground.

A complete list of the results as well as their corresponding guideline is attached in Table 1, Appendix A. The 2002/03 raw water quality data set is attached in Table 7, Appendix A.

Conclusions & Recommendations

Review of the Fort St. John ground water data indicates an overall good raw drinking water quality. Most water soluble contaminants were present at concentrations well below drinking water guidelines. The two parameters of note are hardness and manganese. Hardness is mainly an aesthetic concern, and occurs at high concentrations in many ground water samples. High manganese levels, which also occur naturally in many ground water supplies, can cause a black precipitate to form in the water. The Fort St. John water treatment plant currently uses green sand and potassium permanganate in their treatment process, which would help reduce the manganese levels in the treated water.

Based on the lack of information regarding the wells, a 300 m radius is arbitrarily assigned as the zone where contamination is most likely (Mike Wei, Senior Hydrogeologist, MOE, p.c.). Since the lithology profile of the well has been described as sands and gravels by Mr. Schlosser, it is probably unconfined and therefore more susceptible to land use activities compared to a confined aquifer (dominantly clays and bedrock). The sands and gravels would probably have a high permeability, thus allowing contaminants to move at a higher rate through the ground compared to material that has a low permeability. Because of this, a 300 m radius site assessment may be useful to indicate where there is potential for contamination.

Since Charlie Lake is currently used as a back up supply to the Fort St. John water wells, it may be useful to collect periodic water quality samples to ensure a desired source water quality is present.

Acknowledgements

We thank Mr. Joe Schlosser (City of Fort St. John) for his useful insight and direction around the water supply. Mr. Todd French is recognized for his help in designing and implementing the project (TDF Watershed Solutions, Research & Management). The NHA for their help in planning the project.

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Contact Information

For more information regarding either this short report, watershed protection and/or drinking water, please contact the Ministry of Environment (Contact: Bruce Carmichael (Prince George), 250-565-6455) or the Northern Health Authority (Contact: Bruce Gaunt (Prince George), 250-565-2150 or Caroline Alexander (Fort St. John), 250-787-3355).

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Appendix A

Table 2. 2002/03 sample parameters, summaries of current results and associated B.C. drinking water guidelines.

Parameter	# of Values	Min.	Max.	Mean	Std. Dev.	MDL	D.W. Guideline	Guideline Type
General								
pH	6	7.9	8.3	8.1	0.14	0.1	6.5-8.5	aesthetic objective
Colour (TCU)	6	5	5	5	0.00	5	≤ 15	aesthetic objective
Specific Conductance (µS/cm)	6	381	406.5	394.4	10.82	1	≤ 700	maximum acceptable concentration
Turbidity (NTU)	4	0.56	0.75	0.62	0.090	0.1	≤ 5	maximum acceptable concentration
Hardness Total (mg/L)	5	200	213	205.	6.5		≤ 500 CaCO ₃ (Diss.)	aesthetic objective
Alkalinity (mg/L)	6	159	177	166	6.5	0.5		
Residue Non-Filterable (mg/L)	6	4	5	4	0.4	4		
Total Organic Carbon (mg/L)								
TOC	6	0.6	2.2	1.3	0.55	0.5	≤ 4	maximum, to control THM production
Anions (mg/L)								
Chloride Dissolved	6	0.7	1.5	1.0	0.32	0.5	≤ 250	aesthetic objective
Fluoride Dissolved	6	0.05	0.065	0.054	0.007	0.01	≤ 1.5	maximum acceptable concentration
Bromide Dissolved	6	0.1	0.1	0.1	0.00	0.1		
Nutrients (mg/L)								
Nitrate+Nitrite	6	0.026	0.046	0.035	0.009	0.002	≤ 45 (Nitrate)	maximum acceptable concentration
Phosphorus Total	2	0.002	0.002	0.002	0.000	0.002		
Phosphorus Total-Diss.	2	0.002	0.002	0.002	0.000	0.002		
Sulphate (mg/L)								
Sulphate	6	38	47.5	44.3	3.76	0.5	≤ 500	aesthetic objective
Metals Total (ug/L)								
Aluminum-T	6	0.3	1.3	0.8	0.34	0.3	≤ 200 (Diss.)	maximum acceptable concentration
Antimony-T	6	0.021	0.058	0.038	0.013	0.005	≤ 6	interim maximum acceptable concentration
Arsenic-T	6	0.1	0.3	0.2	0.06	0.1	≤ 25	interim maximum acceptable concentration
Barium-T	6	91.9	108	99.7	5.69	0.02	≤ 1000	maximum acceptable concentration
Beryllium-T	6	0.02	0.02	0.02	0.000	0.02		
Bismuth-T	6	0.02	0.12	0.04	0.041	0.02		
Cadmium-T	6	0.01	0.01	0.01	0.000	0.01	≤ 5	maximum acceptable concentration
Calcium-T (mg/L)	6	60.4	64.3	62.3	1.78	0.05		
Chromium-T	6	0.2	0.6	0.3	0.17	0.2	≤ 50	maximum acceptable concentration
Cobalt-T	6	0.005	0.099	0.028	0.036	0.005		
Copper-T	6	0.13	0.31	0.22	0.069	0.05	≤ 1000	aesthetic objective
Iron-T (mg/L)	5	0.076	0.215	0.149	0.064	0.005	≤ 0.3	aesthetic objective
Lead-T	6	0.01	0.595	0.108	0.239	0.01	≤ 10	maximum acceptable concentration
Lithium-T	6	4.5	5.245	4.9	0.27	0.05		
Magnesium-T (mg/L)	5	11.5	13	12.3	0.64	0.05	≤ 100 (Diss.)	aesthetic objective
Manganese-T	6	21.6	61.8	45.8	13.56	0.008	≤ 50	aesthetic objective
Molybdenum-T	6	0.96	1.29	1.18	0.128	0.05	≤ 250	maximum acceptable concentration
Nickel-T	6	0.05	0.28	0.09	0.094	0.05		
Selenium-T	6	0.2	0.5	0.4	0.11	0.2	≤ 10	maximum acceptable concentration
Silver-T	6	0.02	0.02	0.02	0.000	0.02		
Sodium-T (mg/L)	5	4.29	5.12	4.69	0.325	0.05	≤ 200	aesthetic objective
Strontium-T	6	157.5	175	167.1	6.82	0.005		
Thallium-T	6	0.002	0.003	0.002	0.001	0.002	≤ 2	maximum acceptable concentration
Tin-T	6	0.01	0.11	0.03	0.040	0.01		
Uranium-T	6	0.658	0.769	0.729	0.039	0.002	≤ 100	maximum acceptable concentration
Vanadium-T	6	0.06	1.18	0.39	0.435	0.06	≤ 100	maximum acceptable concentration
Zinc-T	6	0.1	0.5	0.3	0.17	0.1	≤ 5000	aesthetic objective

Table 2. Historical bacteriological data collected by the NHA at the water treatment plant from January 1998-August 2002. Units are CFU/100mL.

Parameter	Concentration Range	Average Concentration	n
Total Coliforms	<1-21	1.2	220
Fecal Coliforms	<1-<2	1	220

Table 3. Historical chemistry data collected by the City of Fort St. John from August 2000-August 2002. All data was collected from the raw water tap in the water treatment plant. All values are mg/L unless otherwise indicated.

Parameter	Concentration Range	Average Concentration	n
pH (pH units)	7.4-8.2	7.96	26
Specific Conductance (µS/cm)	280-750	460	26
Hardness-T	156-343	236	26
Alkalinity	125-262	192	26
Total Dissolved Solids	160-435	273	22
Cyanide	0.002-0.104	0.006	25
Chloride-D	0.6-3.6	1.38	26
Fluoride-D	0.1-0.2	0.12	26
NO ₂ + NO ₃	0.04-0.4	0.33	26
Phosphorus-T	0.01-0.48	0.13	20
Sulfate	29-126	60.8	26
Arsenic-T	0.001-0.005	0.005	26
Barium-T	0.034-0.117	0.082	26
Boron-T	0.01-0.05	0.023	14
Cadmium-T	0.001-0.01	0.001	26
Calcium-T	47.3-97.7	69.9	26
Chromium-T	0.001-0.008	0.003	25
Copper-T	0.002-0.097	0.011	25
Iron-T	0.015-2	0.59	26
Lead-T	0.006-0.01	0.009	26
Magnesium-T	9.4-24.1	15.09	26
Manganese-T	0.023-0.302	0.147	20
Mercury-T	0.0001-0.0001	0.0001	25
Potassium-T	0.6-1.4	0.84	26
Selenium-T	0.001-0.005	0.004	18
Silver-T	0.001-0.002	0.001	22
Sodium-T	2.8-18.7	5.97	26
Titanium-T	0.001-0.003	0.001	20
Zinc-T	0.001-0.013	0.005	20

Table 5. Duplicate samples that exceeded precision acceptability criteria ($\leq 25\%$ difference when > 5 -fold MDL). All concentrations in µg/L unless otherwise indicated.

Parameter	MDL (µg/L)	October/02			January/03			March/03			April/03		
		Conc. 1	Conc. 2	RPD %	Conc. 1	Conc. 2	RPD %	Conc. 1	Conc. 2	RPD %	Conc. 1	Conc. 2	RPD %
Aluminum-D	0.3							3.7	6.5	55			
Antimony-T	0.005	0.058	0.045	25	0.038	0.029	27						
Cobalt-T	0.005							0.062	0.04	43			
Copper-D	0.05	1.34	0.63	72									
Iron-D (mg/L)	0.005							0.026	0.047	58			
Lithium-D	0.05	0.05	0.33	147									
Nickel-T	0.05							0.35	0.47	29			
Phosphorus-T (mg/L)	0.002										0.084	0.012	150
Phosphorus-T-D (mg/L)	0.002										0.013	0.002	147
Thallium-D	0.002										0.012	0.009	29
Vanadium-T	0.06	0.94	0.61	43				1.31	0.84	44			

RPD % = Relative Percent Difference

*Data are presented for the purpose of batch specific QA assessment. Most QA samples were not collected at Fort St. John.

Table 7. 2002/03 raw water quality dataset collected from the Fort St. John drinking water supply.

Date	Total Coliform (CFU/100mL)	Fecal Coliform (CFU/100mL)	Enterococci (CFU/100mL)	E. Coli (CFU/100mL)	pH
07-Oct-02	<1	<1	<1	<1	8.3
15-Jan-03	<1	<1	<1	<1	8.2
15-Jan-03	<1	<1	<1	<1	8.2
05-Mar-03	<1	<1	<1	<1	7.9
30-Apr-03	<2	<2	<2	<2	8.1
28-May-03	<1	<1	<1	<1	8.1
20-Aug-03	<1	<1	<1	<1	8.2

True Colour (Col. Unit)	Specific Conductance (µS/cm)	Residues - NonFilt. (mg/L)	Turbidity (NTU)	Hardness - Total (mg/L)	Alkalinity - T as CaCO ₃ (mg/L)
<5	394	<4		200	166
<5	409	<4		213	169
5	404	<4		213	169
5	382	<4	0.75	202	161
<5	400	5	0.58		163
5	403	<4	0.57	212	177
5	381	<4	0.56	200	159

Bromide - Diss. (mg/L)	Chloride - Diss. (mg/L)	Fluoride - Diss. (mg/L)	Carbon - Tot. Org. (mg/L)	NO ₂ + NO ₃ (mg/L)	Phosphorus - Tot. Diss. (mg/L)
<0.1	1	0.06	1.1	0.028	
<0.1	0.8	0.07	1.2	0.051	
<0.1	0.9	0.06	0.9	0.042	
<0.1	0.7	0.05	2.2	0.043	
<0.1	1.5	0.05	1.6	0.039	
<0.1	1.4	0.05	1.2	0.026	<0.002
<0.1	0.9	0.05	0.6	0.028	<0.002

Phosphorus - Tot. (mg/L)	Sulfate (mg/L)	Aluminum - Tot. (µg/L)	Antimony - Tot. (µg/L)	Arsenic - Tot. (µg/L)	Barium - Tot. (µg/L)
	43.6	1.3	0.058	<0.1	108
	47.2	<0.3	0.038	0.2	102
	47	<0.3	0.029	0.2	101
	42.5	0.9	0.021	0.3	91.9
	47.3	0.8	0.037	0.2	101
<0.002	47.5	0.6	0.031	0.2	94.6
<0.002	38	0.6	0.049	0.2	101

Beryllium - Tot. (µg/L)	Bismuth - Tot. (µg/L)	Cadmium - Tot. (µg/L)	Calcium - Tot. (mg/L)	Chromium - Tot. (µg/L)	Cobalt - Tot. (µg/L)
<0.02	0.12	<0.01	61	0.4	<0.005
<0.02	<0.02	<0.01	63.9	<0.2	<0.005
<0.02	<0.02	<0.01	64.7	<0.2	<0.005
<0.02	<0.02	<0.01	60.8	<0.2	0.029
<0.02	<0.02	<0.01	64	<0.2	<0.005
<0.02	<0.02	<0.01	63.5	<0.2	0.024
<0.02	<0.02	<0.01	60.4	0.6	0.099

Copper - Tot. (µg/L)	Iron - Tot. (mg/L)	Lead - Tot. (µg/L)	Lithium - Tot. (µg/L)	Magnesium - Tot. (mg/L)	Manganese - Tot. (µg/L)
0.15		<0.01	4.63	11.5	21.6
0.13	0.145	0.67	5.26	12.9	44.9
0.13	0.143	0.52	5.23	13.1	44.7
0.24	0.213	<0.01	4.5	12.1	45.7
0.23	0.215	<0.01	4.93		54.5
0.27	0.099	<0.01	5	12.9	61.8
0.31	0.076	<0.01	4.93	12	46.5

Molybdenum - Tot. (µg/L)	Nickel - Tot. (µg/L)	Selenium - Tot. (µg/L)	Silver - Tot. (µg/L)	Sodium - Tot. (mg/L)	Strontium - Tot. (µg/L)
1.29	<0.05	0.4	<0.02	4.77	175
0.98	<0.05	0.4	<0.02	4.85	156
0.94	<0.05	0.3	<0.02	4.85	159
1.24	<0.05	0.4	<0.02	4.45	171
1.11	<0.05	0.5	<0.02	4.77	161
1.21	<0.05	0.5	<0.02	5.12	172
1.29	0.28	0.2	<0.02	4.29	166

Thallium - Tot. (µg/L)	Tin - Tot. (µg/L)	Uranium - Tot. (µg/L)	Vanadium - Tot. (µg/L)	Zinc - Tot. (µg/L)
<0.002	<0.01	0.747	0.13	0.2
<0.002	0.01	0.727	1.19	0.5
<0.002	0.01	0.732	1.17	0.5
<0.002	0.11	0.718	<0.06	0.3
<0.002	<0.01	0.769	0.6	0.2
0.003	<0.01	0.754	0.12	0.5
0.003	0.02	0.658	0.22	<0.1