Assessment of the Bear Lake Community Drinking Water Supply: Source Water Characteristics

James Jacklin, March 2004[1]

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.

Plate 1. A view of the Bear Lake raw water tap where water samples were collected.

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 Community of Bear Lake 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.

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

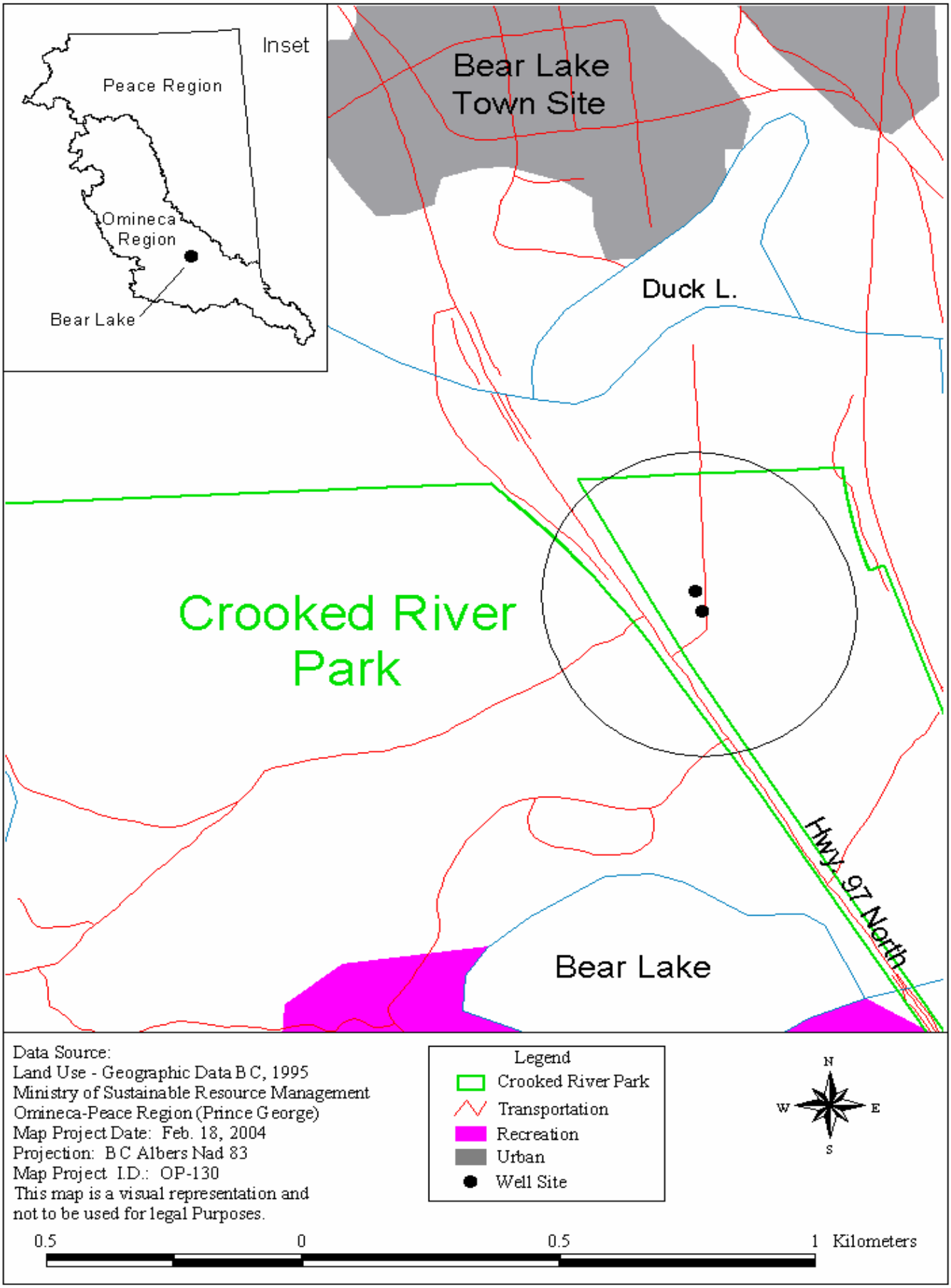

Figure 1. Bear Lake water wells and nearby land use practices. A 300 m radius surrounds the wells indicating the zone where contamination is most probable to occur.

Site Description

Watershed Overview

The Community of Bear Lake, which is located approximately 75 km north of Prince George, has a drinking water supply that consists of two wells, located in the Crooked River Provincial Park. This area lies within the Sub-Boreal Spruce biogeoclimatic zone, which is characterized by gently rolling terrain, dense coniferous forests and extremes in the annual temperature range of ˉ40°C to 30°C (B.C. Ministry of Forests, 1998).

The predominant land-use activity in the vicinity of Bear Lake is forestry and recreation. The abundance of cutblocks scattered throughout the area, as well as the local sawmills, may pose risk to regional water quality. The recreational activities, especially those within the Crooked River Provincial Park, may also pose risk to water quality.

According to Hardy Nickel, who previously worked with the Regional District of Fraser Fort George (RDFFG), the two water wells each have a rated capacity of 450 gal/min (2046 L/min), withdrawing approximately 2.7 million gallons/month (12300 m^3/month), 100,000 gallons (455 m^3) of that supplying the local mills. The wells draw water from glaciofluvial deposits consisting of dominantly sands and gravels (Table 1). The sands and gravels in the upper soil layers suggest an unconfined aquifer. This implies that the well is particularly sensitive to land-use activities where chemicals or contaminants could easily leach into the ground, compared to a well with an overlying clay or bedrock layer. The static water level, at the time of well construction, was 83 feet (25.3 m).

Table 1. Lithology profile from one of the Bear Creek community wells (well tag number 791). Data from the aquifer database of B.C..

Depth (Ft)	Grain Size
0-30	sand medium and moist
30-80	sand medium to fine wet
80-82	gravel some fines
82-125	gravel sand fines till
125-158	gravel coarse fines
158-170	gravel coarse and sand

At present, no major waste disposal permits are located close to the Bear Lake wells. There is a tile field that may cause an impact to water quality, however it is located approximately 400-500 m away from the wells so is not considered a major concern.

Drinking Water Supply & Treatment

The Community of Bear Lake draws its domestic water from a ground water supply, consisting of two wells, located within the Crooked River Provincial Park. These two wells are situated approximately 30 m apart, and were constructed in 1977 and 1979. As measured with a GPS unit, the geographic co-ordinates of the pump house are 54.4843N/122.6745W. From the pump house, the water is transported to a small holding reservoir north of town and subsequently transported to approximately 300 Bear Lake water users. There is currently no community treatment on the source water.

There are no current concerns regarding the Bear Lake water system (Nickel, p.c.). A report prepared for the RDFFG in November of 2002 by L&M Engineering states that there is a problem regarding water pressure throughout the system. Their suggestion to help correct this problem was to increase the size of the holding reservoir.

Materials & Methods

Review of Previous Data

Historical data relevant to the Community of Bear Lake source water supply assessment have been included in this report. The data were copied from Northern Health Authority (NHA) and RDFFG computer and paper files. Furthermore, one chemistry sample was collected by Moncor Geological Engineering & Hydrogeology in November 2002.

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 inside the Bear Lake pump house (site E249359 - Water Source ID Tag 1339). The chemical results, analytical detection levels and drinking water quality guidelines are provided in Table 2, Appendix A.

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. Prior to sampling the raw water tap, the source was flushed for 5 minutes in order to minimize contamination by system piping. 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 and the RDFFG sampled the Bear Lake raw water supply from numerous locations around the community 19 times between January 1995 and August 2002. The results of this raw water bacterial program are presented in Table 3, Appendix A.

All 15 samples were tested for both total and fecal coliforms. Total coliforms were detected on one occasion, August 7th, 2001 at a density of 76 CFU/100mL. There is currently no recommended water quality guideline for total coliforms. Furthermore, total coliforms are found naturally in many water bodies and do not necessarily indicate harmful land use activities. However, the presence of these bacteria do suggest that further sampling may be necessary to ensure that no harmful bacteria are in the system. Fecal coliforms were never detected.

Water Chemistry

The historical chemistry data collected by the NHA and RDFFG between 1995 and 2002 (a total of 4 samples) showed no parameters that were over provincial drinking water guidelines. Most existed at below detectable concentrations. Given the small sample size of the data set, it is not possible to make strong conclusions regarding chemical's presence in the system; however the data do suggest that the parameter concentrations were generally very low when tested. For a complete list of the parameters tested and their results, refer to Table 4 in Appendix A.

The one chemistry sample collected by Moncur Geological Engineering & Hydrogeology showed similar results to those by the NHA and RDFFG. All parameters from this collection were well below recommended drinking water quality guidelines. For a list of the parameters and their results, refer to Table 5 in Appendix A.

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.

The six water chemistry field blank samples that were prepared either the same day or within one day of the Bear Lake 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. Eight parameters exceeded these acceptance criteria significantly and are listed below in Table 6.

Table 6. Blind blank samples that tested strongly positive ($\geq$ 5-fold MDL) for chemical contamination.

Date	Parameter	Measured Concentration	MDL
Oct. 2/02	Copper-Diss.	0.27 µg/L	0.05 µg/L
Oct. 2/02	Lithium-Tot.	0.36 µg/L	0.05 µg/L
Oct. 2/02	Strontium-Diss.	0.048 µg/L	0.005 µg/L
Mar. 20/03	Copper-Tot.	0.37 µg/L	0.05 µg/L
Mar. 20/03	Nitrate+Nitrite	0.013 mg/L	0.002 mg/L
Mar. 20/03	Lead-Tot.	0.06 µg/L	0.01 µg/L
Mar. 20/03	Strontium-Tot.	0.1 µg/L	0.005 µg/L
May 6/03	Copper-Tot.	0.36 µg/L	0.05 µg/L

Although the levels of some of these blank results are equal to or greater than the actual concentrations observed in Bear Lake 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 Bear Lake collections did have some values outside the lab acceptance criteria of 25% relative percent difference (Table 7, Appendix A). The differences that are present may be due to problems with collection and/or analytical precision. All of the parameters that did have differences greater than 25% between the duplicates occurred well below recommended drinking water guidelines.

Bacteriology

The 2002/03 bacterial data are summarised in Table 8. Drinking water quality guidelines for *E. coli, Enterococci* and fecal coliforms are all 0 CFU/100mL in drinking water supplies that undergo no treatment.

Most samples collected from this water supply contained no detectable bacteria. The May 6th sample did have positive results for *Enterococci*, however the concentration was very low and may have been affected by holding temperatures and/or sample holding time. Generally, the Bear Lake water supply does not have high concentrations of bacteria.

Table 8. Results of bacterial analyses for the Community of Bear Lake raw water supply. Units are CFU/100mL.

Date	Total Coliform	*E. coli*	*Enterococci*	Fecal Coliform
Provincial Guideline	No Provincial Guideline	0 CFU/100 mL	0 CFU/100 mL	0 CFU/100 mL
Oct. 2/02	<1	<1	-	<1
Jan. 13/03	<1	-	<1	<1
Mar. 20/03	<1	<1	<1	<1
May 6/03	1	<2	**2**	<2
May 29/03	<2	<2	<2	<2
Aug. 14/03	<1	<1	<1	<1

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, none exceeded the provincial guidelines for raw drinking water. Colour was the only parameter to have a maximum concentration greater than 75 % the guideline value. The colour of water is a measure of its dissolved compounds (attributed to the presence of organic and inorganic materials). High colour levels are regarded as a pollution problem in terms of aesthetics, and can be produced by agricultural and industrial effluents. Colour can also originate naturally from organic soils and wetlands.

Water hardness, which can often be a problem in ground water supplies, had a mean concentration of 97 mg/L $CaCO_3$. This is considered medium hard (60 mg/L to < 120 mg/L) and is considered to be in the optimum range for a drinking water supply.

The data from 2002/03, as well as the historical chemistry data, indicate that chemical parameters in the Bear Lake water supply are generally low for drinking water use.

A complete list of the results as well as their corresponding guideline is attached in Table 2, Appendix A. A list of the raw data from the 2002/03 program is attached in Table 8, Appendix A.

Conclusions & Recommendations

Review of the Community of Bear Lake ground water data indicates an overall high raw drinking water quality. Water soluble contaminants were present at concentrations well below drinking water guidelines. The only parameter that was > 75% the provincial raw water guideline was colour. However, this parameter affects the aesthetics of water and is not usually associated with health problems unless disinfection is used.

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 indicates dominantly sands and gravels, the aquifer is probably unconfined therefore being more easily susceptible to leaching materials compared to aquifers with an upper confining layer. Because of this, it is recommended that a site assessment be done on land use activities within this zone to indicate where there is potential for contamination.

Because the Community of Bear Lake currently uses no form of water treatment, it is also recommended that periodic bacterial samples are collected to ensure that levels do not exceed recommended criteria. Due to the high permeability generally associated with sands and gravels, bacteria and parasites from the feces of animals and/or septic systems could easily contaminate the water, which in turn may affect water quality.

Acknowledgements

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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	8.2	8.0	0.12	0.1	6.5-8.5	aesthetic objective
Colour (TCU)	6	5	15	7	4.1	5	≤ 15	aesthetic objective
Specific Conductance (µS/cm)	6	179	216	198	15.8	1	≤ 700	maximum acceptable concentration
Turbidity (NTU)	5	0.1	0.28	0.16	0.082	0.1	≤ 5	maximum acceptable concentration
Hardness Total (mg/L)	6	88.6	109	97.2	7.98		≤ 500 $CaCO_3$ (Diss.)	aesthetic objective
Alkalinity (mg/L)	6	72	99.1	84.4	11.51	0.5		
Residue Non-Filterable (mg/L)	6	4	6	4	0.8	4		
Total Organic Carbon (mg/L)								
TOC	6	0.5	1.5	0.7	0.45	0.5	≤ 4	maximum, to control THM production
Anions (mg/L)								
Chloride Dissolved	6	11.1	13.5	12.2	1.04	0.5	≤ 250	aesthetic objective
Fluoride Dissolved	6	0.02	0.04	0.03	0.008	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	0.048	0.07	0.06	0.008	0.002	45 (Nitrate)	maximum acceptable concentration
Phosphorus Total	1	0.02	0.02	0.02	0.000	0.002		
Phosphorus Total-Diss.	2	0.017	0.017	0.017	0.000	0.002		
Sulphate (mg/L)								
Sulphate	6	0.9	1.3	1.0	0.15	0.5	≤ 500	aesthetic objective
Metals Total (ug/L)								
Aluminum-T	6	0.3	1.4	0.9	0.38	0.3	≤ 200 (Diss.)	maximum acceptable concentration
Antimony-T	6	0.032	0.085	0.053	0.019	0.005	≤ 6	interim maximum acceptable concentration
Arsenic-T	6	0.7	0.9	0.8	0.10	0.1	≤ 25	interim maximum acceptable concentration
Barium-T	6	35.3	61.6	49.6	11.00	0.02	≤ 1000	maximum acceptable concentration
Beryllium-T	6	0.02	0.02	0.02	0.000	0.02		
Bismuth-T	6	0.02	0.05	0.03	0.013	0.02		
Cadmium-T	6	0.01	0.01	0.01	0.000	0.01	≤ 5	maximum acceptable concentration
Calcium-T (mg/L)	6	28.9	36.3	32.1	2.92	0.05		
Chromium-T	6	0.2	1.9	1.0	0.60	0.2	≤ 50	maximum acceptable concentration
Cobalt-T	6	0.005	0.021	0.008	0.006	0.005		
Copper-T	6	0.05	0.25	0.16	0.068	0.05	≤ 1000	aesthetic objective
Iron-T (mg/L)	5	0.005	0.114	0.030	0.047	0.005	≤ 0.3	aesthetic objective
Lead-T	6	0.06	0.39	0.19	0.109	0.01	≤ 10	maximum acceptable concentration
Lithium-T	6	0.53	0.72	0.62	0.082	0.05		
Magnesium-T (mg/L)	6	3.98	4.45	4.12	0.175	0.05	≤ 100 (Diss.)	aesthetic objective
Manganese-T	6	0.008	0.154	0.068	0.059	0.008	≤ 50	aesthetic objective
Molybdenum-T	6	0.09	0.44	0.26	0.132	0.05	≤ 250	maximum acceptable concentration
Nickel-T	6	0.05	0.05	0.05	0.000	0.05		
Selenium-T	6	0.2	0.4	0.3	0.10	0.2	≤ 10	maximum acceptable concentration
Silver-T	6	0.02	0.02	0.02	0.000	0.02		
Sodium-T (mg/L)	5	3.03	3.59	3.31	0.219	0.05	≤ 200	aesthetic objective
Strontium-T	6	95	125	109	10.882	0.005		
Thallium-T	6	0.002	0.004	0.002	0.001	0.002	≤ 2	maximum acceptable concentration
Tin-T	6	0.01	0.25	0.06	0.096	0.01		
Uranium-T	6	0.082	0.093	0.088	0.004	0.002	≤ 100	maximum acceptable concentration
Vanadium-T	6	0.83	1.4	1.12	0.206	0.06	≤ 100	maximum acceptable concentration
Zinc-T	6	1.3	21.4	11.6	8.16	0.1	≤ 5000	aesthetic objective

Table 3. Historical bacteriological data from the Bear Lake raw water supply. The samples were collected from numerous locations, all of which have no water treatment. The provincial guideline for fecal coliforms is 0 CFU/100 mL.

Date		Total Coliforms (CFU/100 mL)	Fecal Coliforms (CFU/100 mL)
May 2/01	Fire Hall	<1	<1
Feb. 19/02	Fire Hall	<1	<1
Jun. 3/02	Fire Hall	<1	<1
Jun. 5/02	Fire Hall	<1	<1
Jul. 8/02	Fire Hall	<1; <1	<1; <1
Aug. 20/02	Fire Hall	<1; <1	<1; <1
Aug. 7/01	Reservoir	76	<1
Jul. 25/01	Unknown	<1	<1
Sep. 12/01	Unknown	<1	<1
Nov. 19/01	Unknown	<1	-
Jan. 25/02	Unknown	<1	<1
Feb. 19/02	Unknown	<1	<1

Table 4. Historical chemistry data collected from the Bear Lake ground water supply.

Parameter	Unit	School 25-Jan-01	Grizzly Inn 05-Jan-95	Grizzly Inn 25-Feb-98	Pump Station 12-Mar-02
pH	(pH Units)	8.23	7.4	8.06	7.7
True Colour	(Col. Unit)		<5		
Specific Conductance	(µS/cm)	168	173	181	183
Turbidity	(NTU)	0.1	0.1	0.07	
Hardness - Total	(mg/L)	80.9	85.9		84
Alkalinity - Total as CaCO3	(mg/L)				69
Bromide - Diss.	(mg/L)	<0.05		<0.05	
Chloride - Diss.	(mg/L)	10.7	8.1	11	11.1
Fluoride - Diss.	(mg/L)	0.05	<0.1	0.03	<0.1
NO2 + NO3	(mg/L)		0.08		
Phosphorus - Tot.	(mg/L)	<0.05			
Sulfate	(mg/L)	0.8			0.9
Aluminum - Tot.	(µg/L)	<50	<20	<50	
Antimony - Tot.	(µg/L)	<50	<15	<1	
Arsenic - Tot.	(µg/L)	<50	<0.5	1	
Barium - Tot.	(µg/L)	35	36	46	
Beryllium - Tot.	(µg/L)	1	1	1	
Bismuth - Tot.	(µg/L)		<20		
Boron-Tot.	(µg/L)	<10	<8	<10	
Cadmium - Tot.	(µg/L)	<5	<0.1	<0.2	
Calcium - Tot.	(mg/L)	26.1	28.4	27.9	25.1
Chromium - Tot.	(µg/L)	<5	3	8	
Cobalt - Tot.	(µg/L)	<5	<3	<5	
Copper - Tot.	(µg/L)	<5	2	5.1	
Iron - Tot.	(mg/L)	<5		<3	0.001
Lead - Tot.	(µg/L)	<50	<1	<0.5	
Magnesium - Tot.	(mg/L)	3.8	3.64	3.6	3.6
Manganese - Tot.	(µg/L)	<1	<2	<1	<1
Molybdenum - Tot.	(µg/L)	<10	<4	<10	
Nickel - Tot.	(µg/L)	<20		<8	
Potassium - Tot.	(mg/L)	0.4	<0.4	0.4	<0.6
Selenium - Tot.	(µg/L)	<50	<0.5	<1	
Silver - Tot.	(µg/L)	<10	<10	<10	

Table 4 continued.

Parameter	Unit	School 25-Jan-01	Grizzly Inn 05-Jan-95	Grizzly Inn 25-Feb-98	Pump Station 12-Mar-02
Strontium - Tot.	(µg/L)	97	97	105	
Tellurium - Tot.	(mg/L)		<0.02		
Thallium - Tot.	(µg/L)		<20		
Tin - Tot.	(µg/L)	<50	<20	<50	
Titanium - Tot.	(mg/L)	<2	<3	<2	
Vanadium - Tot.	(µg/L)	<10	<3	<10	
Zinc - Tot.	(µg/L)	3	<2	<2	
Zirconium - Tot.	(mg/L)		<0.003		

Table 5. Historical water chemistry data collected by Moncur Geological Engineering & Hydrogeology in November 2002. There is no known QA data associated with this list.

Parameter	Unit	Well #2	Parameter	Unit	Well #2	Parameter	Unit	Well #2
pH	(pH Units)	7.9	Boron-Tot.	(mg/L)	<0.05	Phosphorus-Tot.	(mg/L)	0.20
Specific Conductance	(µS/cm)	193	Cadmium - Tot.	(mg/L)	<0.0002	Potassium - Tot.	(mg/L)	0.48
Alkalinity CaCO3	(mg/L)	90.2	Calcium - Tot.	(mg/L)	31.7	Silica-Tot.	(mg/L)	12.4
Fluoride - Diss.	(mg/L)	<0.05	Chromium - Tot.	(mg/L)	0.001	Silver-Tot.	(mg/L)	<0.0001
Nitrate-N	(mg/L)	<0.04	Cobalt - Tot.	(mg/L)	<0.001	Sodium-Tot.	(mg/L)	3.8
Nitrite-N	(mg/L)	<0.002	Copper - Tot.	(mg/L)	<0.001	Strontium-Tot.	(mg/L)	0.12
Sulfate	(mg/L)	<1	Iron - Tot.	(mg/L)	0.12	Tin-Tot.	(mg/L)	<0.001
Aluminum - Tot.	(mg/L)	0.007	Lead - Tot.	(mg/L)	<0.001	Titanium-Tot.	(mg/L)	<0.001
Antimony - Tot.	(mg/L)	<0.001	Magnesium - Tot.	(mg/L)	4.73	Vanadium-Tot.	(mg/L)	0.001
Arsenic - Tot.	(mg/L)	<0.001	Manganese - Tot.	(mg/L)	<0.001	Zinc-Tot.	(mg/L)	<0.005
Barium - Tot.	(mg/L)	0.006	Molybdenum - Tot.	(mg/L)	<0.0005	Hardness ($CaCO_3$)	(mg/L)	99
Beryllium - Tot.	(mg/L)	<0.001	Nickel - Tot.	(mg/L)	<0.001			

Table 7. Duplicate samples that exceeded precision acceptability criteria (≤25% difference when >5-fold MDL). All concentrations in µg/L unless otherwise indicated.

Parameter	MDL (µg/L)	October/02			January/03			March/03			May/03			May/June/03		
		Conc. 1	Conc. 2	RPD %	Conc. 1	Conc. 2	RPD %	Conc. 1	Conc. 2	RPD %	Conc. 1	Conc. 2	RPD %	Conc. 1	Conc. 2	RPD %
Aluminum-D	0.3	31.2	13.5	**79.2**												
Chromium-T	0.2	2.1	4.3	**68.8**												
Copper-T	0.05				0.55	0.78	**34.6**	1.69	2.32	**31.4**						
Iron-Tot. (mg/L)	0.005													10.7	12.25	**25.3**
Vanadium-T	0.06	1.94	3.35	**53.3**							0.28	0.57	**68.2**			
Zinc-T	0.1	2.8	1.1	**87.2**	4.4	6.4	**37.0**									
Zinc-D	0.1															

RPD %=Relative Percent Difference
**Data are presented for the purpose of batch specific QA assessment. Most QA samples were not collected at Bear Lake.*

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Table 8. 2002/03 raw drinking water data collected from the Bear Lake well.

Date	Total Coliform (Col./100mL)	Fecal Coliform (Col./100mL)	Enterococci (Col./100mL)	E. Coli (Col./100mL)	pH (pH Units)
02-Oct-02	<1	<1		<1	7.9
13-Jan-03	<1	<1	<1		8
20-Mar-03	<1	<1	<1	<1	7.9
06-May-03	1	<2	2	<2	8
29-May-03	<2	<2	<2	<2	8.1
14-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	186	<4		101	89
<5	179	<4	<0.1	88.6	72
15	187	<4	<0.1	92	75
5	204	<4	0.2	90.8	76.1
<5	214	6	<0.1	102	99.1
<5	216	<4	0.28	109	95.1

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	11.6	0.04	1.5	0.061	
<0.1	13.4	0.03		0.07	
<0.1	11.9	0.03	<0.5	0.063	
<0.1	13.5	0.02	<0.5	0.064	
<0.1	11.4	0.02	<0.5	0.055	0.017
<0.1	11.1	0.02	<0.5	0.048	

Phosphorus - Tot. (mg/L)	Sulfate (mg/L)	Aluminum - Tot. (µg/L)	Antimony - Tot. (µg/L)	Arsenic - Tot. (µg/L)	Barium-T (µg/L)
	1	<0.3	0.085	0.9	55.1
	1.3	0.8	0.06	0.9	35.3
	1	1.2	0.056	0.9	41.2
	0.9	1.4	0.043	0.9	43.7
0.02	0.9	1.1	0.032	0.7	61.6
0.02	1	1	0.039	0.7	60.6

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	0.05	<0.01	33.6	1.5	<0.005
<0.02	<0.02	<0.01	28.9	<0.2	<0.005
<0.02	<0.02	<0.01	30.2	0.8	<0.005
<0.02	0.04	<0.01	29.8	0.7	0.021
<0.02	<0.02	<0.01	34	1	<0.005
<0.02	<0.02	<0.01	36.3	1.9	0.006

Copper - Tot. (µg/L)	Iron - Tot. (mg/L)	Lead - Tot. (µg/L)	Lithium - Tot. (µg/L)	Magnesium - Tot. (mg/L)	Manganese - Tot. (µg/L)
<0.05		0.15	0.6	4.09	<0.008
0.12	0.114	0.39	0.53	4	<0.008
0.16	0.008	0.18	0.53	4.03	0.094
0.16	0.016	0.17	0.64	3.98	0.154
0.25	0.005	0.06	0.7	4.16	0.037
0.2	0.007	0.17	0.72	4.45	0.106

Molybdenum - Tot. (µg/L)	Nickel - Tot. (µg/L)	Selenium - Tot. (µg/L)	Silver - Tot. (µg/L)	Sodium - Tot. (mg/L)	Strontium - Tot. (µg/L)
0.28	<0.05	0.4	<0.02		112
0.09	<0.05	0.4	<0.02	3.03	95
0.21	<0.05	<0.2	<0.02	3.19	108
0.17	<0.05	0.3	<0.02	3.27	99.3
0.44	<0.05	<0.2	<0.02	3.59	115
0.38	<0.05	<0.2	<0.02	3.45	125

Thallium - Tot. (µg/L)	Tin - Tot. (µg/L)	Uranium - Tot. (µg/L)	Vanadium - Tot. (µg/L)	Zinc - Tot. (µg/L)
0.004	0.05	0.082	1.05	12.4
<0.002	0.25	0.084	1.31	2.5
0.002	<0.01	0.09	1.4	18.2
<0.002	<0.01	0.087	1.08	21.4
0.002	<0.01	0.093	0.83	1.3
<0.002	<0.01	0.092	1.04	13.6