



Drinking Water Quality Sampling Program for the Town of Happy Valley- Goose Bay, Newfoundland and Labrador, May 2010 to February 2011

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Government of Newfoundland & Labrador
Department of Environment and Conservation
Water Resources Management Division
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**Drinking Water Quality Sampling Program for the Town of Happy Valley-Goose Bay,
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Summary

In spring 2010, the Water Resources Management Division (WRMD) of the Newfoundland and Labrador Department of Environment and Conservation in partnership with the Town of Happy Valley Goose Bay began an intensive drinking water sampling program in the area of Happy Valley-Goose Bay that is serviced by water from both the Well Field and Spring Gulch. The additional sampling in the community was a result of concern from citizens and Town council.

Happy Valley-Goose Bay receives water from two sources – water from Spring Gulch, which is purchased from the Department of National Defence, and water sourced from a Well Field of five groundwater wells located near the Churchill River. The Well Field provides approximately 65% of the Town's total water needs, while Spring Gulch supplies the remaining 35%. Spring Gulch is the sole supply of water at the base and in the north part of Town, while water from the Well Field blended with Spring Gulch water supplies the rest of the Town. No part of Happy Valley-Goose Bay is supplied solely from the Well Field.

A total of 53 samples were collected in the Town from fourteen locations throughout the part of Town that receives the blended water supply. Samples were collected four times from each site between May 2010 and February 2011. Sampling sites were selected to provide a representative distribution throughout the area of Town that is supplied by water from both Spring Gulch and the Well Field. Additionally, samples were collected at the Water Treatment plant and from dedicated taps from Spring Gulch and the Well Field at the Sandhills Reservoir, prior to the water being blended for distribution.

Water quality results for all samples collected are within *Guidelines for Canadian Drinking Water Quality* (GCDWQ), with minor exceptions. These minor exceedences were all at or near the Guideline values and were for aesthetic parameters.

Major ion chemistry indicates that water from Spring Gulch is a carbonate-bicarbonate water type, while water from the Well Field is a sodium-chloride water type. The chemistry of water from the Well Field dominates the blended water chemistry, which could affect aesthetic qualities of the water with regards to taste. This blended water is of high quality and meets all standards for water quality with regards to the GCDWQ.

Public Water Supplies for Happy Valley Goose Bay

The Town of Happy Valley-Goose Bay is serviced by two ground water sources: Spring Gulch, and the Well Field. Spring Gulch is located adjacent to the Canadian Air Forces Base, 5 Wing Goose Bay (the base). The treatment at this location includes UV, chlorination and fluoride. It is managed solely by the Department of National Defense. Water from Spring Gulch is distributed to all buildings on the base. A portion of the treated water is sold to the Town of Happy Valley-Goose Bay and distributed to commercial and residential dwellings in the upper area of Happy Valley-Goose Bay. This portion of water makes up about 35% of the total water use by the Town. The area serviced by the Spring Gulch source was not part of the additional sampling program conducted by the WRMD and the Town of Happy Valley Goose Bay.

The Well Field is the second water supply for the Town and was connected in 2002. The Well Field and the Water Treatment plant are located approximately 6 kilometers (km) west of the Town on the Trans Labrador Highway route 500. The Well Field consists of five deep wells. Water from the wells is pumped into the Water Treatment plant where the treatment process includes alum, potassium permanganate, chlorine, lime and fluoride. Iron and manganese are removed via green sand filtration. The treatment plant is managed by the Town of Happy Valley Goose Bay. Water from the Well Field is pumped into Town to the Sandhill Reservoir and makes up about 65% of the water used by the Town. At the reservoir, water from the two sources, Spring Gulch and the Well Field, is blended. The blended supply is distributed to areas of the Town below the reservoir including a large number of commercial and residential dwellings. It is in this area of the Town where the additional sampling took place during 2010-2011.

Spring Gulch

The source of water from Spring Gulch is an impoundment of Spring Gulch Brook. Spring Gulch Brook flows from a small, discrete watershed located up-gradient from the base at

Goose Bay. The source of water for Spring Gulch Brook is a combination of precipitation, surface runoff and recharge from local groundwater (or base flow) discharge. Water from Spring Gulch has quick travel times from recharge points, which means the water is not in contact for long periods of time with sediment or other material.

The Well Field

The Well Field is located in an area covered by extensive and thick glaciofluvial deposits, consisting of proglacial or ice contact sands and gravels that form fans, deltas, outwash plains, terraces, and kames. These sediments have been deposited on red bed sandstones (bedrock). These sandstones are believed to be similar in age and structure to those occurring in western Newfoundland where evaporate deposits such as gypsum, anhydrite and halite are known to exist at depth (Fracflow, 2005). Such deposits provide a natural source of high salinity to groundwater that has come into contact with those rock types.

In the area of the Happy Valley – Goose Bay Well Field, thin layers of clayey silt are present in the river bank and visible in part of the river bed. The presence of these thin clayey silt layers beneath part of the river bed is significant in that they limit the infiltration of river water into the aquifer as groundwater is being produced at the Well Field.

The recharge area for the Well Field is likely extensive, and includes areas up gradient and north of the Churchill River. Figure 1 is a groundwater level contour map in the vicinity of Goose Bay. Flow of groundwater is from areas of recharge to areas of discharge to the river. Water from these wells has had significant contact time with the sediments that make up the aquifer, or water-bearing material. As groundwater flows through an aquifer it is naturally filtered. Long residence time underground means that groundwater is naturally filtered and is usually free from disease-causing microorganisms. This long residence time also means groundwater dissolves many of the minerals in which it is in contact.

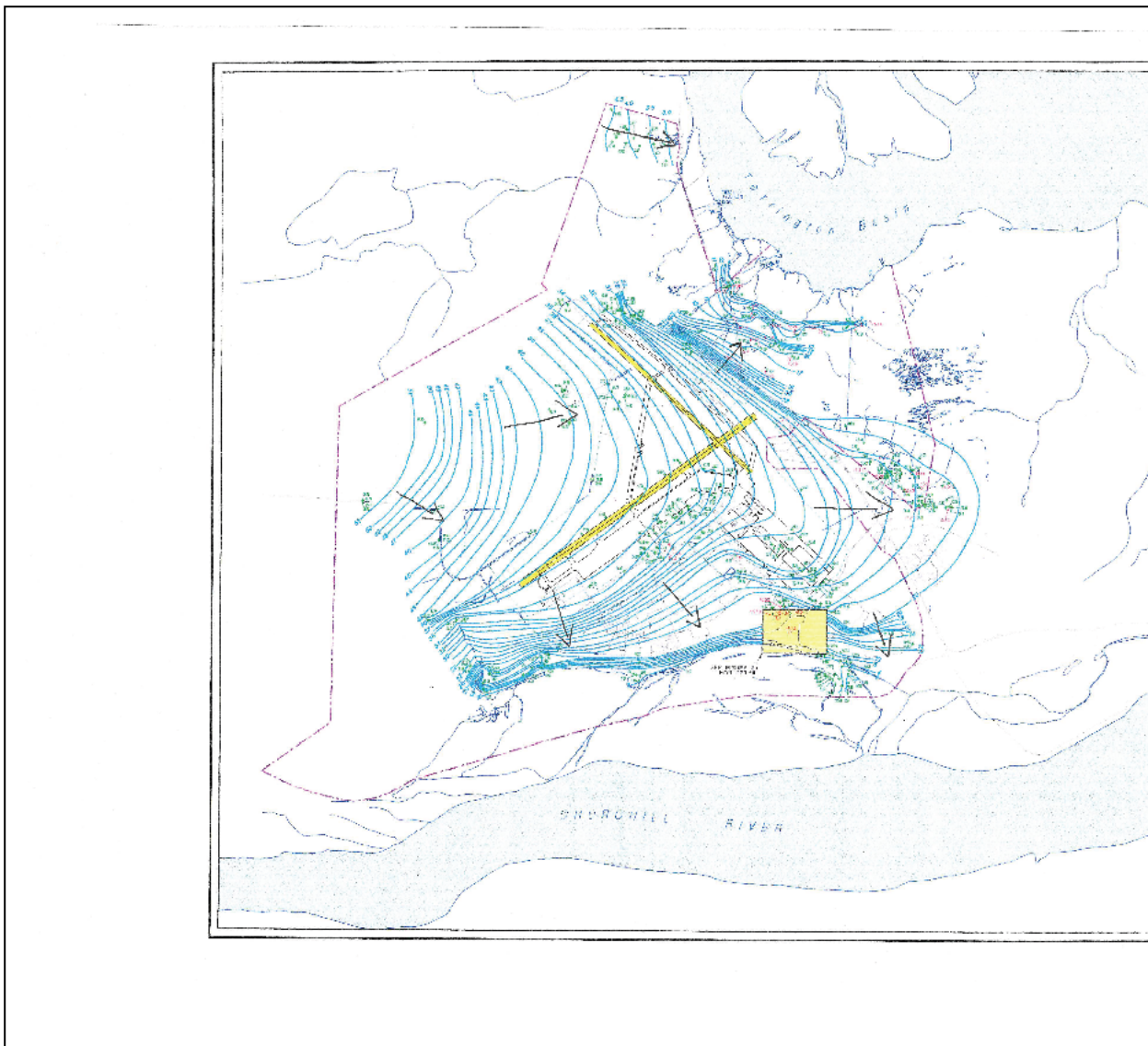


Figure 1.—Water table map of groundwater in the vicinity of Happy Valley-Goose Bay, Labrador.

Additional Sampling Program

Regular sampling by the WRMD takes place on a seasonal basis (four times annually) at two locations in Town: 1) Loring Drive for the Spring Gulch source and 2) Grenfell Street for the Well Field blended source. These two locations are chosen based on the position along the distribution lines (approximately 2/3 of the way through the distribution system). These locations continued to be sampled throughout the additional sampling program in 2010-11.

The WRMD consulted with the Town of Happy Valley-Goose Bay regarding the details of the additional sampling program and the additional locations were decided based upon spatial

distribution, concerned citizen inquiries, known problem areas such as dead ends in the distribution lines, and age of distribution lines. Residential dwellings were preferred over commercial dwellings. One school was also selected.

Water samples were also taken at the Water Treatment plant and the Sandhill reservoir where water is blended before distribution to the lower areas of the Town. Four samples at each of the 14 locations were scheduled throughout the 2010-2011 seasons.

Table 1: Sampling locations and dates

Sample Type	Location	Spring Sample (May 17)	Summer Sample (Aug. 10)	Fall Sample (Nov. 12)	Winter Sample (Feb. 9)
Regular Sampling	Grenfell Street	x	x	x	x
	Loring Drive	x	x	x	x
Additional Sampling (residential)	Blake Drive	x	x	x	x
	Voisey's Drive	x	x	x	x
	Terrington Lane	x	x	x	x
	Roberts Road	x	x	x	x
	Mitchell Street	x	x	x	x
	Cartwright Crescent	x	x	x	x
	Elizabeth Avenue	x	‡	x	x
	Corte Real Road	x	‡	x	x
Additional Sampling (operational)	Sandhill Reservoir, intake from Spring Gulch	x	x	x	x
	Sandhill Reservoir, intake from wellfield	x	x	x	x
	Sandhill Reservoir, outtake blended supply	x	x	x	x
	Water Treatment Plant at Well Field	†	x	x	x

†: Sample not taken for operational reasons

‡: Sample not taken because residents were not home

A total of 53 samples were taken in the Town between May 2010 and February 2011. Three samples were missed. The spring sample at the Water Treatment Plant was not taken for

operational and scheduling reasons, while two of the residential samples were not taken in the summer season because the dwelling occupants were not available on the sampling day.

Sampling Results

The chemical results of these samples are summarized in the Appendix. Water quality results for all samples collected are within *Guidelines for Canadian Drinking Water Quality* (GCDWQ), with minor exceptions.

Minor elevated concentrations of secondary or aesthetic parameters were detected in water samples collected from three sites – Elizabeth Avenue, Cartwright Crescent, and the Sandhill Well Field tap. Samples from Elizabeth Avenue collected in May and November 2010 indicated slightly elevated concentrations of iron (Fe), with concentrations of 0.37 microgram per liter ($\mu\text{g/L}$) and 0.38 $\mu\text{g/L}$, respectively. Values for Fe sampled from Cartwright Crescent were also slightly elevated in samples collected in August and November, 2010, and February, 2011. Concentrations of Fe were 0.37 $\mu\text{g/L}$, 0.32 $\mu\text{g/L}$ and 0.37 $\mu\text{g/L}$. The guideline value for Fe is 0.3 $\mu\text{g/L}$, indicating these are not significant exceedences.

The other site that showed slightly elevated concentrations of secondary or aesthetic parameters was the Sandhill-Well Field tap. A sample collected in May has concentrations of Fe at 0.56 $\mu\text{g/L}$, while the sample collected in November has elevated Turbidity – a value of 1.2 NTU was measured, while the guideline value for turbidity is 1 NTU. This level of exceedence is also not significant.

Major Ion Chemistry

Figure 2 is a Piper diagram, on which is plotted the chemical composition of samples of water from Spring Gulch, from the treatment plant and treated Well Field, and from the blended supply. Piper diagrams are trilinear representations of the ions found in the water (cations and anions) and are used in order to classify water types.

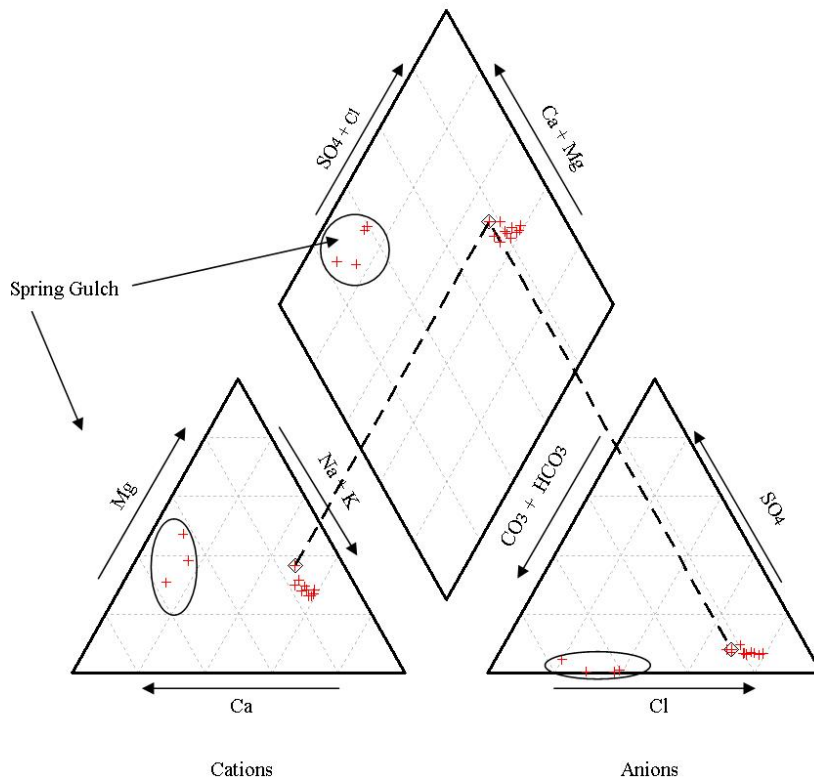


Figure 2.— Piper diagram of water from Spring Gulch, treated water from the Well Field, and blended water, Happy Valley-Goose Bay, Labrador.

Water from Spring Gulch, shown in the circles above, plots mostly within an area where there is no dominant type of water chemistry identifiable. One sample plots near the calcium

(Ca) and Magnesium (Mg) cation fields, as well as in the CO₃ plus HCO₃ (bicarbonate) anion field. This means the water from Spring Gulch can be classified as close to calcium-bicarbonate water. Water from Spring Gulch is “softer” than water from the Well Field or the blended supply. It is closer in composition to rainwater or surface water than to the composition of groundwater.

Samples of water from the Well Field and the blended water plot closely together on this diagram. This indicates that the signature of the groundwater source dominates the water quality characteristics of the blended supply. These samples plot near the sodium (Na) and chloride (Cl) fields, and indicate a sodium-chloride water type. This water is also “harder” than the water from Spring Gulch, which can affect the aesthetic quality of water.

The optimum range of hardness in drinking water is from 80 to 100 milligrams per liter (mg/L). Water with hardness greater than 200 mg/L is considered poor in most regions of the province and water with hardness greater than 500 mg/L is normally considered unacceptable for domestic purposes. Hardness of water samples collected as part of this study range from a low of 9 mg/L, measured in a sample from Spring Gulch to 74 mg/L, measured in a sample collected at the Water Treatment plant (Well Field water).

Concentrations of total dissolved solids (TDS) can also affect the taste of water. Water can be classified based on TDS. Groundwater is classified as “fresh” with TDS values that range from 0 to 1,000 mg/L. The Guideline value for TDS is 500 mg/L.

Concentrations of TDS in water vary owing to different mineral solubility in different geological regions. The concentration of TDS in water in contact with granite, siliceous sand, well-leached soil or other relatively insoluble materials is usually below 30 mg/L. TDS values measured for this project range from 24 mg/L (Spring Gulch water) to 343 mg/L measured in a sample at the Water Treatment plant (Well Field). The average TDS value is 167 mg/L.

The differences in TDS reflect the different water sources. TDS from samples collected from Spring Gulch sourced water are all below 35 mg/L. The recharge area of Spring Gulch Brook consists mostly of glaciofluvial sands, which are silica rich and fairly insoluble. The groundwater that supplies the Well Field, while also from glaciofluvial deposits, is from deeper

sediments that also contain interbedded clays and silts. The source of the well water has been in contact with these sediments longer, therefore has dissolved more of the minerals contained in these sediments.

Conclusions

In order to address concerns expressed by citizens and the Town Council of Happy Valley-Goose Bay with respect to their drinking water supply, Water Resources Management Division of the Newfoundland and Labrador Department of Environment and Conservation, in partnership with the Town, sampled water in the area of Happy Valley-Goose Bay that is serviced by water from both the Well Field and Spring Gulch. Fifty-three samples were collected between May 2010 and February 2011. Based on the review of the laboratory tests of these samples, WRMD reached the following conclusions:

- 1) Water quality results for all samples collected are within GCDWQ for drinking water quality, with minor exceptions. These minor exceedences were all at or near the Guideline values and were for secondary or aesthetic constituents.
- 2) Major ion chemistry indicates that water from Spring Gulch is near a carbonate-bicarbonate water type, while water from the Well Field is a sodium-chloride water type. These water types are the result of different recharge regimes and water sources, and indicate the major ions present in these water sources. Taste and suitability of water for drinking water is affected by these ions.
- 3) Hardness and TDS in drinking water can also affect taste. The ranges of both these parameters for all samples collected are within GCDWQ; however, the differences between the two sources of water are distinct, which could affect perception of taste when comparing drinking water in the Town.
- 4) The chemistry of water from the Well Field dominates the blended water chemistry, which could affect aesthetic qualities of the water with regards to taste. This blended water is of high quality and meets all standards for drinking water quality with regards to the GCDWQ.

- 5) WRMD will continue its regular drinking water quality monitoring program, but no additional testing will be carried out.

- 6) No additional treatment of the Town's drinking water supply is required or recommended at this time.

Fracflow Consultants, 2005. *Use of Dual Pump Systems and Inclined Wells to Optimize Potable Water Recovery and Hydrocarbon Remediation in Coastal Aquifers.*

Water Resources Management Division
June 24, 2011

Appendix

May 17, 2010					WATER TREATMENT PLANT	SANDHILL WELL FIELD	SANDHILL MIXED	SANDHILL SPRING GULCH	MEALY MTN. COL.	MITCHELL ST	CARTWRIGHT CRES.	CORTE REAL RD	BLAKE DRIVE	ROBERTS ROAD	FRIENDSHIP CENTER	TERRINGTON LANE	EDIZABETH AVE	HOTEL NORTH
ANALYTE	UNIT	MRI	Guide line	Type	2011-6015-01-TI-SP	2011-6016-01-TI-SP	2011-6017-01-TI-SP	2011-6018-01-TI-SP	2011-6019-02-TI-SP	2011-6020-02-TI-SP	2011-6021-03-TI-SP	2011-6022-04-TI-SP	2011-6023-04-TI-SP	2011-6024-03-TI-SP	2011-6025-03-TI-SP	2011-6026-03-TI-SP	2011-6027-04-TI-SP	2011-6028-03-TI-SP
Alkanity as CaCO3	mg/L	5				32	13	9	28	26	25	20	31	16	15	16	24	12
Bromide	mg/L	0.25				<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25
Chloride	mg/L	1	250	A		103	26	2	61	69	65	46	81	24	22	22	47	2
Colour	TCU	2	15	A		<2	7	6	3	4	10	7	2	6	9	6	10	8
Conductivity	uS/cm	5				460	133	38	287	308	280	208	347	128	117	117	214	39
Dissolved organic 'C'	mg/L	0.5				1.3	2.1	2.3	1.7	1.6	1.6	1.7	1.5	2	2.2	2	1.6	2.2
Fluoride	mg/L	0.1	1.5	C		0.37	0.68	0.73	0.6	0.58	0.58	0.63	0.54	0.7	0.7	0.71	0.64	0.78
Hardness as CaCO3	mg/L	1				79	27	12	53	50	50	37	69	27	22	22	40	12
N-NH3 (ammonia)	mg/L	0.02				<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
N-N02 (Nitrite)	mg/L	0.1	10	C		<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
N-N03 (Nitrate)	mg/L	0.1				<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
pH		1	6.5-8.5	A		7.33	7.16	7.1	7.4	7.47	7.25	7.24	7.42	7.21	7.17	7.18	7.24	7.11
Sulphate	mg/L	1	500	A		12	5	<1	8	8	8	6	9	4	4	4	6	3
Total dissolved solids	mg/L	5	500	A		299	87	25	187	200	182	135	226	83	76	76	139	25
Total kjeldahl nitrogen	mg/L	0.1				<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
total phosphorus	mg/L	0.01				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.04	<0.01	<0.01	<0.01
Turbidity	NTU	0.1	1	C		0.6	0.6	0.7	0.3	0.3	0.5	0.4	0.3	0.5	6.5	0.8	0.5	0.6
Aluminum	mg/L	0.01				0.01	0.03	0.03	0.01	0.01	0.01	0.02	0.01	0.03	0.08	0.03	0.02	0.03
Antimony	mg/L	0.0001	0.006	C		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Arsenic	mg/L	0.001	0.01	C		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Barium	mg/L	0.01	1	C		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01
Boron	mg/L	0.01	5	C		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01
Calcium	mg/L	1				10	4	3	8	7	7	5	11	4	4	4	6	3
Cadmium	mg/L	0.0001	0.005	C		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	mg/L	0.001	0.05	C		0.002	<0.001	<0.001	0.001	0.002	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	0.001	1	A		0.01	0.036	0.004	0.091	0.087	0.068	0.103	0.085	0.082	0.104	0.085	0.074	0.034
Iron	mg/L	0.03	0.3	A		0.56	0.12	0.08	0.08	0.06	0.28	0.11	0.07	0.08	1.03	0.13	0.37	0.11
Lead	mg/L	0.001	0.01	C		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Magnesium	mg/L	1				13	4	1	8	8	8	6	10	4	3	3	6	1
Manganese	mg/L	0.01	0.05	A		0.04	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.07	0.01	<0.01	<0.01
Mercury	mg/L	0.0001	0.001	C		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Nickel	mg/L	0.005				<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.005	<0.005
Potassium	mg/L	1				4	2	1	3	3	3	2	3	2	2	2	2	1
Selenium	mg/L	0.001	0.01	C		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Sodium	mg/L	2	200	A		49	12	<2	27	29	30	19	35	12	10	10	22	3
Strontium	mg/L	0.001				0.128	0.043	0.017	0.084	0.083	0.076	0.061	0.099	0.041	0.04	0.039	0.059	0.019
Uranium	mg/L	0.001	0.02	C		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	mg/L	0.01	5	A		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TOC	mg/L	0.5				1.2	2	2.4	1.5	1.5	1.7	1.7	1.5	2	2.3	2.1	1.5	2.3

August 10, 2010					WATER TREATMENT PLANT	SANDHILL WELL FIELD	SANDHILL MIXED	SANDHILL SPRING GULCH	MEALY MTN. COL.	MITCHEL L ST	CARTWRIGHT CRES.	CORTE REAL RD	BLAKE DRIVE	ROBERT S ROAD	FRIENDS HIP CENTER	TERRINGTON LANE	ELIZABETH AVE	HOTEL NORTH
ANALYTE	UNIT	MRI	Guide line	Type	2011-6015-01-TI-SP	2011-6016-01-TI-SP	2011-6017-01-TI-SP	2011-6018-01-TI-SP	2011-6019-02-TI-SP	2011-6020-02-TI-SP	2011-6021-03-TI-SP	2011-6022-04-TI-SP	2011-6023-04-TI-SP	2011-6024-03-TI-SP	2011-6025-03-TI-SP	2011-6026-03-TI-SP	2011-6027-04-TI-SP	2011-6028-03-TI-SP
Alkanity as CaCO3	mg/L	5			21	23	18	13	24	16	22		33	20	31	21		15
Bromide	mg/L	0.25			<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25		<0.25	<0.25	<0.25	<0.25		<0.25
Chloride	mg/L	1	250	A	35	36	30	3	31	25	40		37	32	78	34		2
Colour	TCU	2	15	A	<2	3	2	4	<2	3	7		3	3	<2	<2		<2
Conductivity	uS/cm	5			173	181	154	37	162	135	193		206	162	340	170		47
Dissolved organic 'C'	mg/L	0.5			1.9	1.2	1.2	1.3	1.3	1.3	1.3		1.3	1.2	1.2	1.3		1.4
Fluoride	mg/L	0.1	1.5	C	0.72	0.72	0.75	0.87	0.77	0.8	0.7		0.78	0.74	0.12	0.74		0.85
Hardness as CaCO3	mg/L	1			37	37	31	12	36	27	37		3	33	65	33		12
N-NH3 (ammonia)	mg/L	0.02			<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.07		<0.02	<0.02	<0.02	<0.02		<0.02
N-N02 (Nitrite)	mg/L	0.1	10	C	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10		<0.10	<0.10	<0.10	<0.10		<0.10
N-N03 (Nitrate)	mg/L	0.1			<0.1	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10		<0.10	<0.10	<0.10	<0.10		<0.10
pH		1	6.5-8.5	A	7.04	6.98	6.94	6.86	7.08	7.08	7.08		7.61	6.98	7	7.12		7.24
Sulphate	mg/L	1	500	A	5	6	5	<1	5	5	6		6	5	9	5		<1
Total dissolved solids	mg/L	5	500	A	112	118	100	24	105	88	125		134	105	221	111		31
Total kjeldahl nitrogen	mg/L	0.1			<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10		<0.10	<0.10	<0.10	<0.10		<0.10
total phosphorus	mg/L	0.01			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		0.01	<0.01	<0.01	0.01		<0.01
Turbidity	NTU	0.1	1	C	0.7	0.5	0.2	0.4	0.4	0.3	0.4		0.2	0.3	0.1	0.3		0.4
Aluminum	mg/L	0.01			0.02	0.01	0.01	0.02	0.01	0.01	0.01		0.01	0.01	<0.01	0.01		0.02
Antimony	mg/L	0.0001	0.006	C	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005		<0.0005
Arsenic	mg/L	0.001	0.01	C	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001	<0.001		<0.001
Barium	mg/L	0.01	1	C	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		<0.01	<0.01	<0.01	<0.01		<0.01
Boron	mg/L	0.01	5	C	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		<0.01	<0.01	0.01	<0.01		<0.01
Calcium	mg/L	1			5	5	4	3	6	4	5		7	5	8	5		3
Cadmium	mg/L	0.0001	0.005	C	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001		<0.0001	<0.0001	<0.0001	<0.0001		<0.0001
Chromium	mg/L	0.001	0.05	C	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001	<0.001		<0.001
Copper	mg/L	0.001	1	A	0.185	0.006	0.042	0.004	0.17	0.124	0.138		0.105	0.14	0.244	0.148		0.06
Iron	mg/L	0.03	0.3	A	0.1	0.22	0.06	0.08	0.08	0.06	0.37		0.07	0.06	<0.03	0.06		0.11
Lead	mg/L	0.001	0.01	C	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001	<0.001		<0.001
Magnesium	mg/L	1			6	6	6	1	5	4	6		5	5	11	5		1
Manganese	mg/L	0.01	0.05	A	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01		<0.01	<0.01	<0.01	<0.01		<0.01
Mercury	mg/L	0.0001	0.001	C	<0.0003	<0.0001	<0.0003	<0.0002	<0.0003	<0.0003	<0.0003		<0.0001	<0.0002	<0.0001	<0.0003		<0.0002
Nickel	mg/L	0.005			<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005		<0.005
Potassium	mg/L	1			2	3	2	1	2	2	2		2	2	4	2		1
Selenium	mg/L	0.001	0.01	C	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001	<0.001		<0.001
Sodium	mg/L	2	200	A	20	17	14	<2	16	12	19		18	16	37	16		<2
Strontium	mg/L	0.001			0.055	0.057	0.05	0.018	0.052	0.044	0.054		0.061	0.048	0.103	0.053		0.02
Uranium	mg/L	0.001	0.02	C	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001	<0.001		<0.001
Zinc	mg/L	0.01	5	A	0.01	<0.01	<0.01	<0.01	0.03	<0.01	<0.01		<0.01	<0.01	0.01	<0.01		<0.01
TOC	mg/L	0.5			2	1.3	1.2	1.4	1.2	1.3	1.2		1.3	1.2	1.2	1.3		1.3

November 12, 2010					WATER TREATMENT PLANT	SANDHILL WELL FIELD	SANDHILL MIXED	SANDHILL SPRING GULCH	MEALY MTN. COL.	MITCHELL ST	CARTWRIGHT CRES.	CORTE REAL RD	BLAKE DRIVE	ROBERTS ROAD	FRIENDSHIP CENTER	TERRINGTON LANE	ELIZABETH AVE	HOTEL NORTH
ANALYTE	UNIT	MRI	Guide line	Type	2011-6015-01-TI-SP	2011-6016-01-TI-SP	2011-6017-01-TI-SP	2011-6018-01-TI-SP	2011-6019-02-TI-SP	2011-6020-02-TI-SP	2011-6021-03-TI-SP	2011-6022-04-TI-SP	2011-6023-04-TI-SP	2011-6024-03-TI-SP	2011-6025-03-TI-SP	2011-6026-03-TI-SP	2011-6027-04-TI-SP	2011-6028-03-TI-SP
Alkanity as CaCO3	mg/L	5			36	33	30	14	39	35	34	35	38	33	33	31	38	14
Bromide	mg/L	0.25			<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25
Chloride	mg/L	1	250	A	107	72	63	2	79	83	81	87	76	76	79	70	82	3
Colour	TCU	2	15	A	<2	2	<2	<2	<2	<2	2	2	<2	<2	<2	<2	5	4
Conductivity	uS/cm	5			438	314	280	40	361	366	357	379	343	336	349	310	370	44
Dissolved organic 'C'	mg/L	0.5			1.2	1.3	1.3	1.5	1.3	1.4	1.3	1.3	1.3	1.3	1.8	1.3	1.2	1.5
Fluoride	mg/L	0.1	1.5	C	0.1	0.34	0.39	0.73	0.34	0.29	0.32	0.27	0.33	0.31	0.29	0.34	0.38	0.69
Hardness as CaCO3	mg/L	1			74	53	46	9	71	73	60	64	65	70	70	53	62	14
N-NH3 (ammonia)	mg/L	0.02			<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
N-N02 (Nitrite)	mg/L	0.1	10	C	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
N-N03 (Nitrate)	mg/L	0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
pH		1	6.5-8.5	A	7.03	7.14	7.07	7.04	7.34	7.25	7.29	7.17	7.34	7.16	7.21	7.19	7.27	7.14
Sulphate	mg/L	1	500	A	12	9	8	<1	9	10	9	10	9	9	9	8	9	<1
Total dissolved solids	mg/L	5	500	A	285	204	182	26	235	238	232	246	223	218	227	201	241	29
Total kjeldahl nitrogen	mg/L	0.1			<0.1	<0.1	0.14	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.27	<0.1	<0.1	<0.1	0.1
total phosphorus	mg/L	0.01			<0.01	0.01	0.02	0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01
Turbidity	NTU	0.1	1	C	0.2	1.2	0.4	0.6	0.3	0.4	0.7	0.5	0.5	0.3	0.5	0.4	0.8	0.7
Aluminum	mg/L	0.01			<0.01	<0.01	0.02	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02
Antimony	mg/L	0.0001	0.006	C	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Arsenic	mg/L	0.001	0.01	C	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Barium	mg/L	0.01	1	C	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Boron	mg/L	0.01	5	C	0.02	0.01	0.01	<0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	<0.01
Calcium	mg/L	1			10	8	8	2	12	11	9	9	11	10	10	8	11	4
Cadmium	mg/L	0.0001	0.005	C	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	mg/L	0.001	0.05	C	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	0.001	1	A	0.267	0.007	0.032	0.004	0.11	0.134	0.109	0.19	0.11	0.151	0.153	0.084	0.102	0.137
Iron	mg/L	0.03	0.3	A	<0.03	0.29	<0.03	0.06	<0.03	<0.03	0.32	0.07	<0.03	<0.03	<0.03	<0.03	0.38	0.11
Lead	mg/L	0.001	0.01	C	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Magnesium	mg/L	1			12	9	8	1	10	11	10	11	9	11	11	8	10	1
Manganese	mg/L	0.01	0.05	A	<0.01	0.02	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.01	<0.01
Mercury	mg/L	0.0001	0.001	C	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Nickel	mg/L	0.005			<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Potassium	mg/L	1			4	3	3	1	3	4	3	3	3	4	4	3	3	1
Selenium	mg/L	0.001	0.01	C	<0.005	<0.005	<0.005	<0.001	<0.005	0.001	<0.005	<0.005	<0.005	<0.001	<0.005	<0.005	<0.005	<0.001
Sodium	mg/L	2	200	A	47	32	28	<2	35	39	35	37	35	36	37	32	37	<2
Strontium	mg/L	0.001			0.122	0.087	0.077	0.019	0.114	0.109	0.111	0.119	0.112	0.097	0.113	0.1	0.116	0.02
Uranium	mg/L	0.001	0.02	C	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	mg/L	0.01	5	A	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.01
TOC	mg/L	0.5			1.2	1.2	1.2	1.5	1.2	1.2	1.2	1.2	1.3	1.2	1.3	1.3	1.1	1.3

February 2, 2011					WATER TREATMENT PLANT	SANDHILL WELL FIELD	SANDHILL MIXED	SANDHILL SPRING GULCH	MEALY MTN. COL.	MITCHELL ST	CARTWRIGHT CRES.	CORTE REAL RD	BLAKE DRIVE	ROBERTS ROAD	FRIENDSHIP CENTER	TERRINGTON LANE	ELIZABETH AVE	HOTEL NORTH
ANALYTE	UNIT	MRI	Guide line	Type	2011-6015-01-TI-SP	2011-6016-01-TI-SP	2011-6017-01-TI-SP	2011-6018-01-TI-SP	2011-6019-02-TI-SP	2011-6020-02-TI-SP	2011-6021-03-TI-SP	2011-6022-04-TI-SP	2011-6023-04-TI-SP	2011-6024-03-TI-SP	2011-6025-03-TI-SP	2011-6026-03-TI-SP	2011-6027-04-TI-SP	2011-6028-03-TI-SP
Alkanity as CaCO3	mg/L	5			44	36	35	21	43	36	38	37	43	39	40	35	52	16
Bromide	mg/L	0.25			<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25
Chloride	mg/L	1	250	A	117	90	77	2	97	95	92	101	95	100	101	82	91	2
Colour	TCU	2	15	A	2	2	<2	3	2	<2	4	2	2	2	2	2	3	3
Conductivity	uS/cm	5			528	368	339	40	407	387	376	410	453	409	412	340	424	38
Dissolved organic 'C'	mg/L	0.5			1.2	1.1	1	0.9	1	1.1	1.1	1	1.1	1.1	1.1	1.2	1.2	0.9
Fluoride	mg/L	0.1	1.5	C	0.1	0.45	0.48	0.65	0.52	0.48	0.5	0.46	0.47	0.46	0.46	0.51	0.53	0.69
Hardness as CaCO3	mg/L	1			97	70	60	16	80	73	73	77	91	73	77	64	79	12
N-NH3 (ammonia)	mg/L	0.02			<0.02	<0.02	<0.02	<0.02	0.02	<0.02	<0.02	<0.02	<0.02	0.03	<0.02	<0.02	0.03	<0.02
N-N02 (Nitrite)	mg/L	0.1	10	C	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
N-N03 (Nitrate)	mg/L	0.1			<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.29	<0.10	<0.10	<0.10	<0.10	<0.10
pH		1	6.5-8.5	A	7.22	7.21	7.21	7.12	7.36	7.29	7.25	7.26	7.4	7.3	7.32	7.34	7.17	7.11
Sulphate	mg/L	1	500	A	14	12	9	1	11	10	10	11	12	11	11	9	11	1
Total dissolved solids	mg/L	5	500	A	343	239	220	26	265	252	244	267	294	266	268	221	276	25
Total kjeldahl nitrogen	mg/L	0.1			<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.12	<0.10	<0.10	0.11	<0.10
total phosphorus	mg/L	0.01			0.01	0.01	0.02	0.02	0.01	<0.01	0.02	0.02	0.01	0.02	0.02	0.01	<0.01	0.02
Turbidity	NTU	0.1	1	C	2	0.6	0.4	0.9	0.3	0.3	0.9	0.4	0.2	0.3	0.3	0.5	0.6	1.4
Aluminum	mg/L	0.01			0.32	0.01	0.01	0.02	<0.01	0.01	0.01	<0.01	<0.01	0.01	0.01	0.01	<0.01	0.03
Antimony	mg/L	0.0001	0.006	C	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Arsenic	mg/L	0.001	0.01	C	<0.005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.005	<0.005	<0.005	<0.001	<0.001	<0.001	<0.005	<0.001
Barium	mg/L	0.01	1	C	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Boron	mg/L	0.01	5	C	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Calcium	mg/L	1			14	10	9	3	14	11	11	11	15	11	11	9	12	3
Cadmium	mg/L	0.0001	0.005	C	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	mg/L	0.001	0.05	C	0.002	0.002	0.001	<0.001	0.002	0.001	0.002	0.001	0.001	0.002	0.001	0.001	0.001	<0.001
Copper	mg/L	0.001	1	A	0.219	0.008	0.044	0.002	0.079	0.115	0.094	0.135	0.107	0.118	0.157	0.17	0.061	0.07
Iron	mg/L	0.03	0.3	A	0.55	0.11	0.05	0.12	0.05	0.03	0.34	0.09	0.04	0.04	0.06	0.05	0.29	0.2
Lead	mg/L	0.001	0.01	C	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Magnesium	mg/L	1			15	11	9	2	11	11	11	12	13	11	12	10	12	1
Manganese	mg/L	0.01	0.05	A	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Mercury	mg/L	0.0001	0.001	C	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Nickel	mg/L	0.005			<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Potassium	mg/L	1			4	3	3	1	3	3	3	3	4	4	4	3	4	1
Selenium	mg/L	0.001	0.01	C	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Sodium	mg/L	2	200	A	61	40	36	<2	42	43	41	46	50	44	43	36	46	<2
Strontium	mg/L	0.001			0.137	0.089	0.088	0.016	0.113	0.099	0.092	0.102	0.117	0.1	0.101	0.085	0.109	0.016
Uranium	mg/L	0.001	0.02	C	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	mg/L	0.01	5	A	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TOC	mg/L	0.5			1.3	1.1	1	0.8	1.1	1.1	1.1	1.1	1.2	1	1.1	1.1	1.1	0.9