

# Cluculz Lake Drinking Water Quality Program: Source Water Characteristics

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Ministry of  
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## 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 important to local purveyors who act as community water suppliers, and to provincial government ministries responsible for water management. It is also becoming important to single family households monitoring their own water supply.

The province's *Drinking Water Protection Act* (DWPA), enacted in 2002, places the responsibility for drinking water quality protection with the B.C. Ministry of Health and local water purveyor's, when a system supplies water to more than one residence (single family intakes are not addressed by the DWPA). 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 MOE plans to take an active role in protecting drinking water quality at its source.

MOE implemented a source water quality and stream sediment monitoring program at selected communities in the Omineca-Peace region in 2002. Since that time source protection programs have been conducted on well over thirty rivers and streams, all of which supply drinking water to individual communities.

As a continuation of the joint MOE and Northern Health (NH) effort in source water protection, it was decided that, beginning in 2004, spot checks would be done on regional lakes to identify contamination issues that may exist (focusing on bacteria). Through discussions involving MOE, NH and the Regional District of Bulkley-Nechako (RDBN), Cluculz Lake was considered to be a high priority due to the abundance of residential houses and related development, and the fact

that many shoreline homes withdraw water from the lake for drinking purposes apparently with no form of water treatment.

This brief report will summarise water quality data collected from Cluculz Lake during June, July and October 2007, and compare that data to current provincial drinking water quality and recreational water quality guidelines. 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 current lake water quality conditions, and assist local citizens, health authorities and MOE to develop measures to improve poor water quality.

## **Site Description**

### **Watershed Overview**

Cluculz Lake is located approximately 40 km west of Prince George, B.C. The lake has several inflow streams which all flow out of the lake at Cluculz Creek (FishWizard, 2005). The lake has a surface area of 25.2 km<sup>2</sup> (Figure 1), a shoreline perimeter of 53 km, a mean depth of 29 m and a maximum depth of 60 m (FishWizard, 2005).

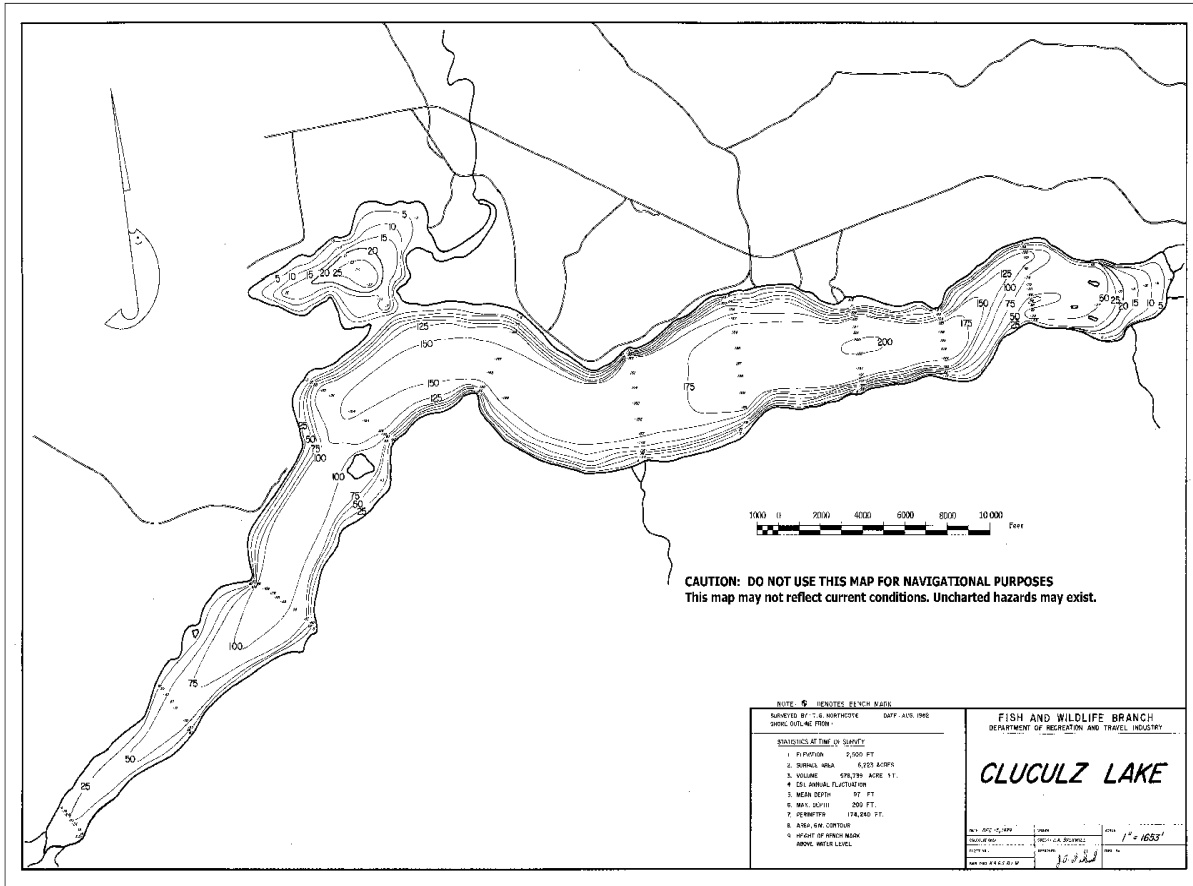


Figure 1. Bathymetric map of Cluculz Lake.

Cluculz Lake is well developed (Figure 2) with 734 privately owned shoreline residences, and approximately 503 of those are permanent residences(RDBN). According to the Regional District of Bulkley-Nechako, the lake has already exceeded its shoreline subdivisional potential though there are still a few larger lots which are currently zoned to allow for further development. In addition to residential development, there are recreational, agriculture and range, and forest harvesting activities in the vicinity of the lake.

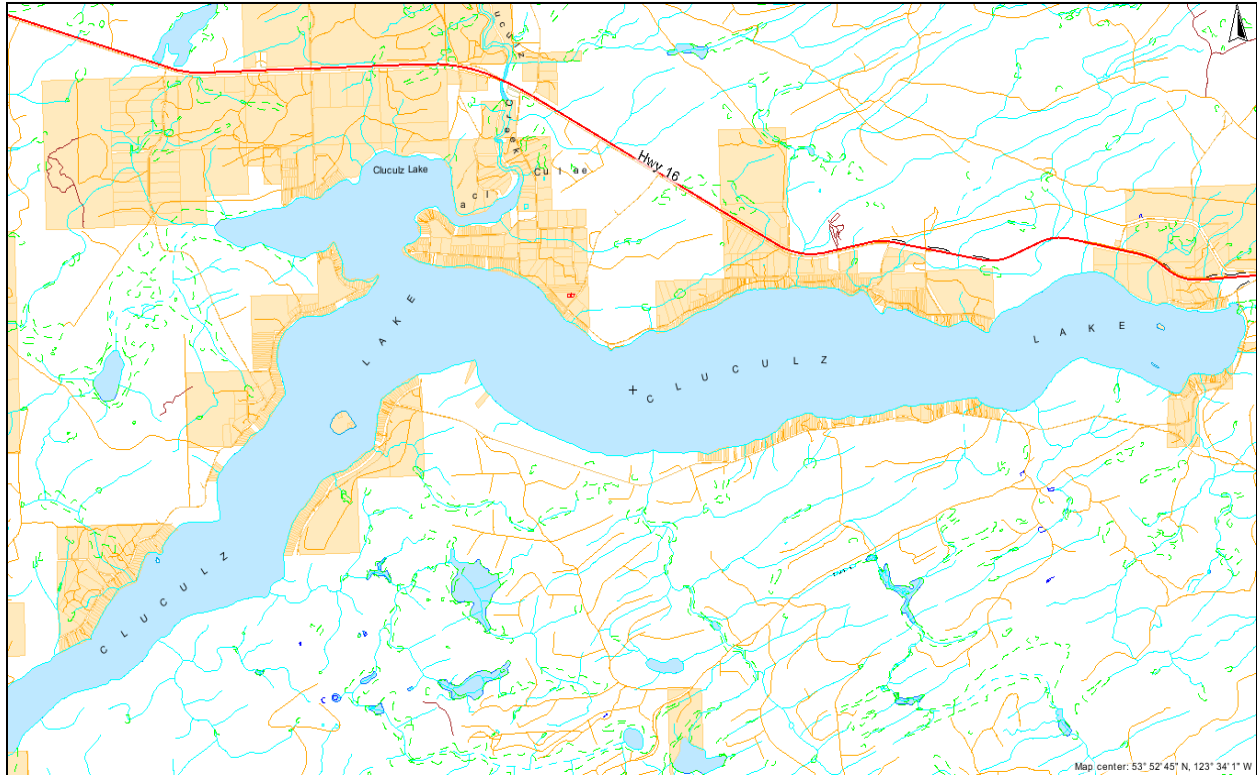


Figure 2. Shoreline development on Cluculz Lake (2009).

At present, two effluent permits have been issued by MOE under the *Environmental Management Act* with relevance to Cluculz Lake. One is at Somerset Estates which services a development of 87 lots. This permit allows for 110.8 m<sup>3</sup>/day of sewage to be treated by a drainfield. The second is for the Lakeside Resort and Attic Pub. The pub and other buildings burned down several years ago and the property was converted to a campground strata with pads for 58 trailers and other recreational vehicles. The permit allows for 4575 m<sup>3</sup>/year of sewage to discharge to lagoons and spray irrigation, though the spray irrigation has never been used. As well, an additional group permit for a lagoon system which serves approximately 5 homes, and several private permits have been issued by NH (Table 1). For definitions of each system type, refer to the Regional District of Fraser-Fort George Lakeshore Guidelines, 2004.

Table 1. Cluculz Lake residential onsite sewage system types (Tone, NH).

<b>Onsite System Type</b>	<b>Number of each system</b>
Conventional	122
Deep Trench	5
Extended Field	16
Lagoon	17
Pit Privies	111
Raised Mound	5
Seepage Bed	1
Package Treatment Plant with Conventional Field	5
Holding Tank	8
Pressure Distribution	1
Unknown	4

As indicated, only 378 of 734 residences have permits for an onsite sewage system. This indicates that many residences, approximately 49% of all lots and 24% of permanent residences, may not have an onsite sewage system, or do have an onsite sewage system but do not have a permit issued by the MOE or NH. In addition, the large number of pit privy records with NH (38% of all records are for pit privies) is concerning. These systems are prone to overloading and have the potential to negatively impact nearby waterways with bacteria and nutrients. Most of the pit privy records date back to the 1970's and 1980's so it is possible that some have been abandoned and/or closed in favour of an updated waste disposal system without updating the records however, it is difficult to corroborate this given the lack of records (Tone, NH). Also, because of the majority of the available records being dated there is a possibility that some of the systems may not have been installed according to regulations which is a cause for concern by reason of potential system failings that can negatively impact the lake (Tone, NH).

## Drinking Water Supply & Treatment

There is no identified community water system for Cluculz Lake, but rather many individual private intakes, as observed by MOE staff during sampling. Individual households are not subject to the *Drinking Water Protection Act*, which only applies to multi-user systems (DWPA, 2001). Although an in-depth survey has not been undertaken with respect to the number of houses that actually use a water treatment system, anecdotal data suggests that many households do not treat their water.

The primary concern with the use of Cluculz Lake as a domestic water supply is that surface water and shallow wells tend to be more susceptible to outside sources of contamination, compared to deep wells. With the abundance of septic systems, wildlife, range animals, domestic pets and humans surrounding the lake, fecal contamination is possible.

In general, surface waters such as streams and lakes are more likely to contain disease-causing organisms than groundwater (BC Healthfile #49b, 2000). Because of this, water treatment is recommended for any resident of British Columbia who receives their drinking water directly from a surface source (BC Healthfile #49a, 2000).

## Materials and Methods

### Water Quality

Two experienced MOE staff members collected water samples from Cluculz Lake in laboratory certified polyethylene bottles for bacterial analyses. Samples were collected approximately 20-50m out from shore (approximating a similar location to a water intake, depending on the location and depth), at approximately two-thirds the water depth using a Van Dorn Sampler. Sites were sampled for bacteria only. Bacterial samples were collected 5 times in 30 days in

order to calculate the geometric mean for direct comparison with Provincial Water Quality Guidelines for potability and recreational usage.

Bottles used for collection of bacterial samples were not field rinsed. Water samples were shipped by overnight courier in coolers with ice packs to Cantest Laboratories Inc. Bacterial samples were analysed using membrane filtration.

## Quality Assessment (QA)

To ensure accuracy and precision of data, quality assurance and control (QA/QC) procedures were incorporated into the monitoring program. These included the use of sampling protocols, properly trained 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 9% of the overall bacterial sample number. Furthermore, bacterial detection limits, as reported here, have a 95% confidence level as indicated by Cantest Laboratories Inc.

## Results

### Quality Assessment

The field blank results indicate that no field or lab contamination of bacterial samples occurred. Furthermore, most bacterial duplicates were identical. There were slight differences between bacterial duplicates at sites C5 and C7 (Figure 3) in June/July 2007 (Appendix A), however, the differences are small, and may be due to natural variability in the water column. Regardless, when there were slight variations in duplicates, at least one, if not both concentrations exceed



recommended bacterial water quality guidelines for source water that undergoes no treatment (0 CFU/100mL) (WQG, 2006).

## Bacteriology

The Cluculz Lake bacterial data are summarised in Appendix B according to site. The data are compared to the recommended water quality guideline for a source drinking water that undergoes no treatment (0 CFU/100mL for *E. coli*, *Enterococci* and fecal coliforms) and to guidelines for recreational use ( $\leq 77/100\text{mL}$  geometric mean for *E. Coli*,  $\leq 20/100\text{mL}$  geometric mean for *Enterococci*, and  $\leq 200/100\text{mL}$  geometric mean for fecal coliforms) (WQG,2006).

Bacterial data were collected from seventeen random sites (two sites were "clean" sites away from residential development) on the central basin of Cluculz Lake during two cycles of 5 samples in 30 days (5/30) events in 2007 (Figure 3). Although the original project proposal called for sampling in May and July, this was later changed to June/July and October due to staff availability. There was a problem during the summer 5/30 cycle on the July 12 sample date. The lab utilized the Most Probable Number analysis on the *Enterococci* water samples rather than the Membrane Filtration analysis which had been requested. Because of the MPN methodology, a series of dilutions is done on the water sample which in turn raised the method detection limit (MDL) from <1 to <10.

After discussions with a Water Quality Network Specialist, it was suggested the best way of dealing with this issue was to run the 90<sup>th</sup> percentile calculations replacing the <10 with 1 vs. 5 vs. 10, then to compare the final results. In the June/July data, when the <10 was replaced with 1, six sites had a 90<sup>th</sup> percentile calculation that exceeded the drinking water guideline for systems that use chlorination. When the <10 was replaced with both a 5 and a 10, all sites exceeded the recommended chlorination guideline.

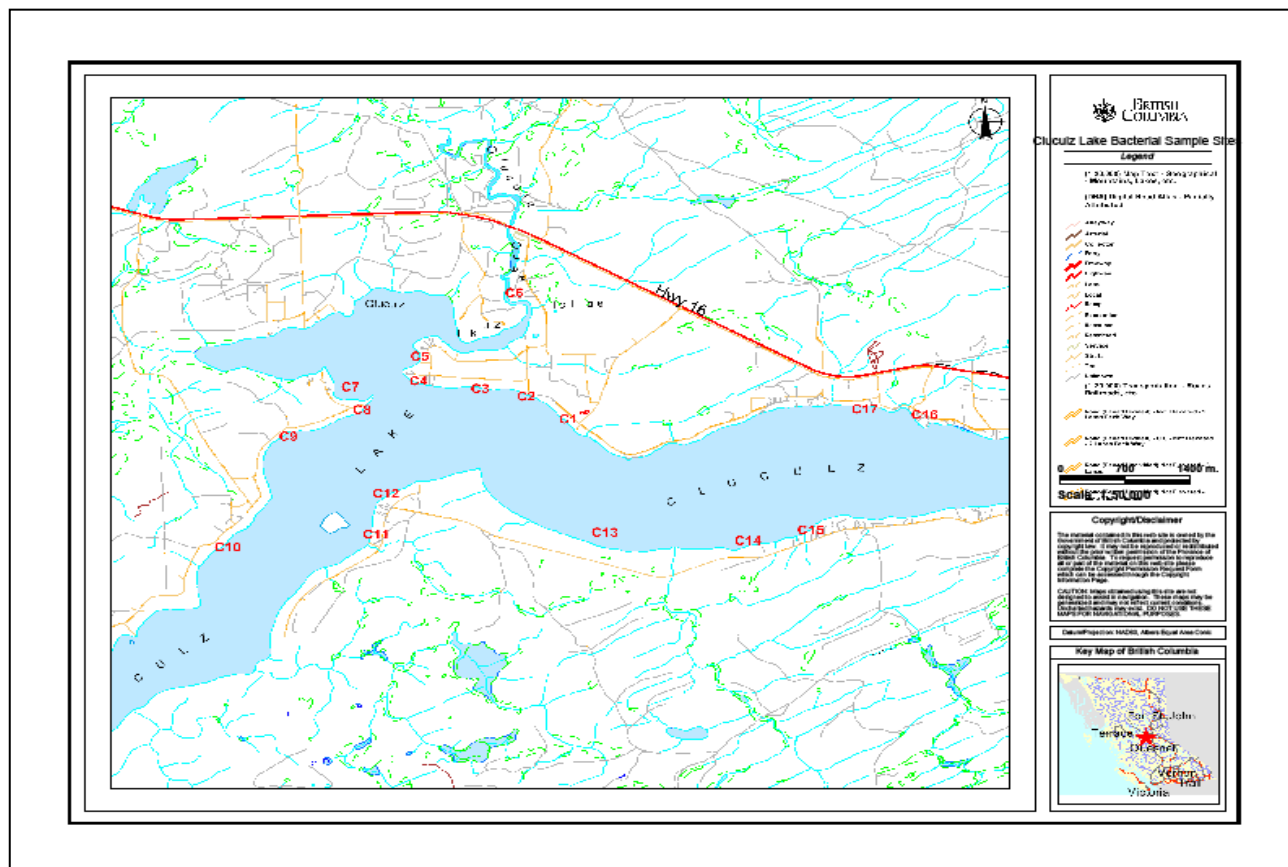


Figure 3. Cluculz Lake sample site map.

High bacterial counts were found in Cluculz Lake when compared to guidelines for drinking water where exceedances occurred in 38% of samples taken in the summer, and in 29% of samples taken in the fall (Appendix A, Tables A1 and A2). The majority of drinking water guideline exceedances were observed at sites C5, C6, C7, C15 and C16 (Figures 4 and 5). The presence of these bacteria, which all originate from the intestines of warm-blooded animals and waterfowl, indicate the feces of wildlife, range animals, domestic animals and/or humans is present in Cluculz Lake. When geometric means were compared to recreational guidelines no exceedances were observed during either sampling event (Appendix A, Tables A3 and A4).

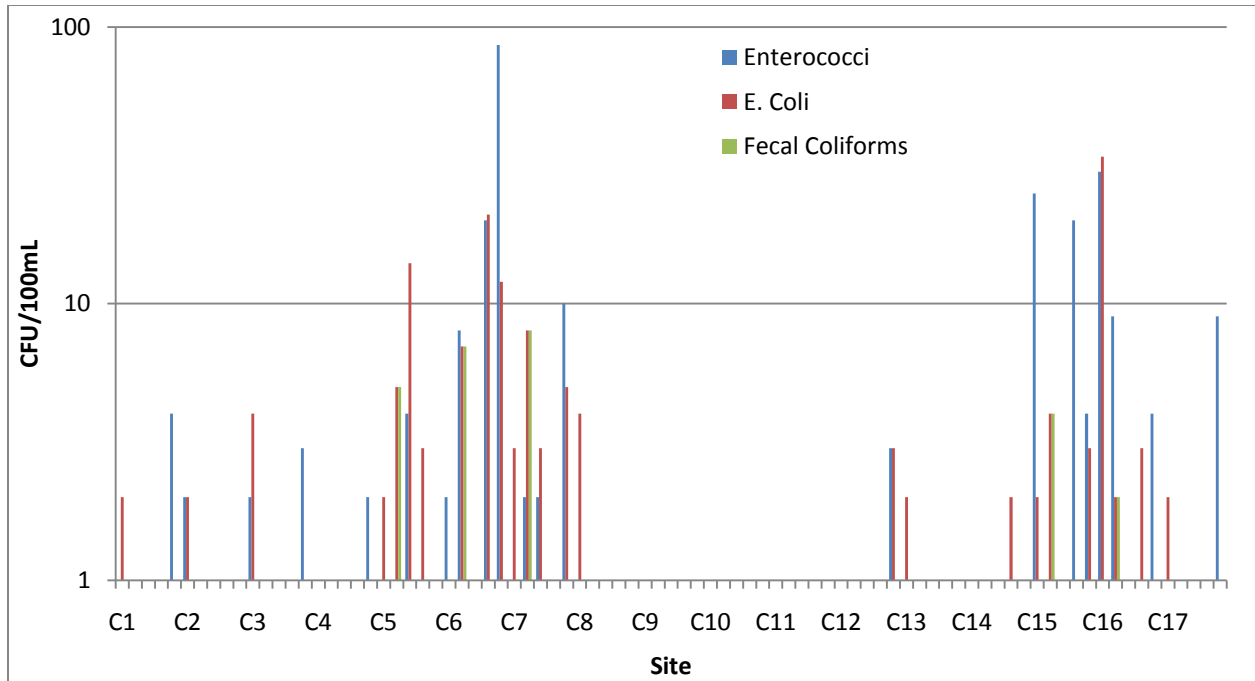


Figure 4. Bacterial densities for all sites on Cluculz Lake for June/July 2007. (Drinking Water Quality Guidelines: 0 CFU/100mL for *E. coli*, *Enterococci* and fecal coliforms. Recreation Water Quality Guidelines:  $\leq 77/100\text{mL}$  geometric mean for *E. Coli*,  $\leq 20/100\text{mL}$  geometric mean for *Enterococci*, and  $\leq 200/100\text{mL}$  geometric mean for fecal coliforms.)

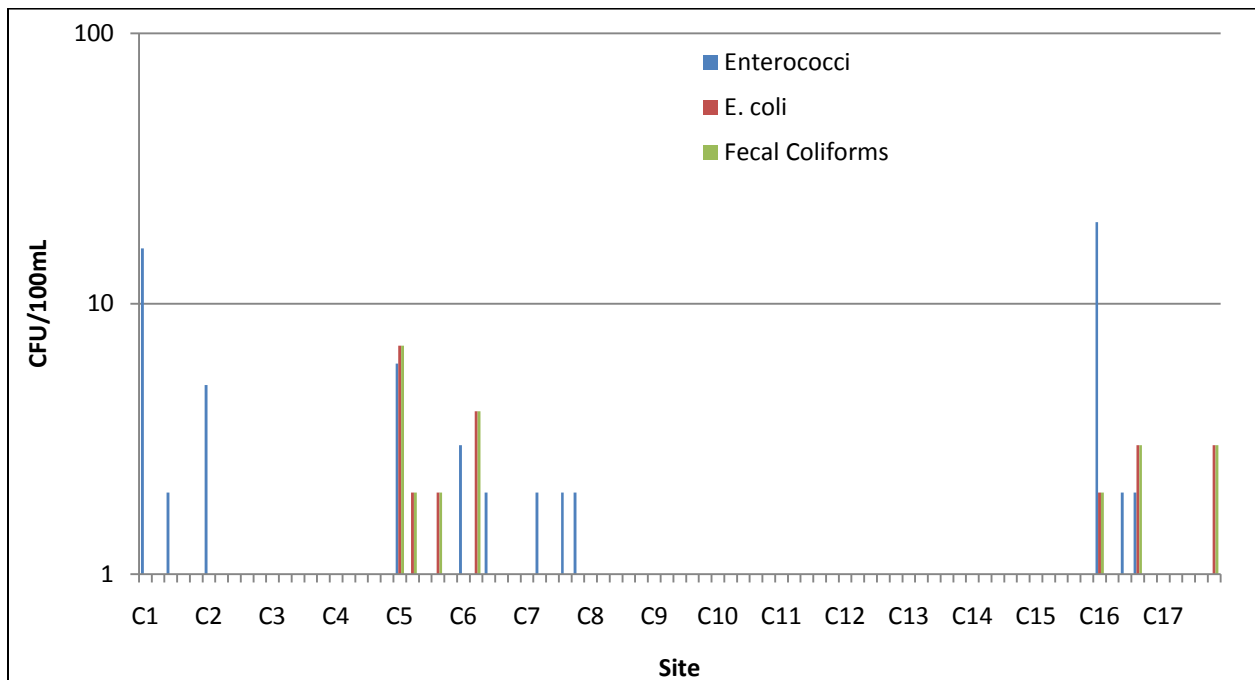


Figure 5. Bacterial densities for all sites on Cluculz Lake for October 2007. (Drinking Water Quality Guidelines: 0 CFU/100mL for *E. coli*, *Enterococci* and fecal coliforms. Recreation Water Quality Guidelines:  $\leq 77/100\text{mL}$  geometric mean for *E. Coli*,  $\leq 20/100\text{mL}$  geometric mean for *Enterococci*, and  $\leq 200/100\text{mL}$  geometric mean for fecal coliforms.)

## Conclusions and Recommendations

Review of the Cluculz Lake data show no exceedances of recreational water quality guidelines during this program. However, the results indicate a raw water quality unsuitable for human consumption without prior treatment. This suggestion agrees with the Ministry of Health recommendation for treatment of all surface drinking water supplies (B.C. Healthfile #49a, 2000). *Enterococci* and *E. coli* were detected on most parts of the lake (primarily sites C5, C6, C7, C15 and C16) at concentrations exceeding the recommended drinking water guideline for source water that undergoes no treatment. This suggests that runoff/seepage from mammal/waterfowl waste is impacting the potability of the lake. The detection of these indicator bacteria suggests that contamination has occurred and that pathogenic organisms may be present (RIC, 1998). High numbers of bacteria may indicate leaking septic systems or the runoff of animal manure (Rosen, 2000). Although wildlife may be the source of some of these organisms, there are numerous septic systems, pit privies and domestic animals around the lake that are possible sources. However, no method of bacterial source tracking has been used in this study, so identifying the source of contamination at this time is not possible.

It is recommended, based on the results of this study, that a shoreline nutrient sampling program be undertaken, combined with lakeshore fluorometry and possible system dye testing, which may help identify shoreline sources of contamination (i.e. leaking septic systems). Furthermore, additional bacterial samples, including bacterial source tracking, should be collected during mid-summer when concentrations appear to be highest. This may help to identify fecal sources.

The results of this study suggest a bacterial problem may exist (i.e. levels detected in this program exceed recommended drinking water guidelines for a source water with no treatment). Lakeshore residents who do not currently use any form of water treatment should

be particularly cautious, and boil/treat all drinking water as well as contact their local health authority for additional information regarding the consumption of untreated lake water.

All statements involving water treatment and health issues in this report have been reviewed and approved by NH.

### Contact Information

For more information regarding either this short report, watershed protection (MOE) and/or drinking water/health related issues (NH), please contact the Ministry of Environment (Contact: James Jacklin, 250-565-7103 and Kirsten Heslop, 250-565-6445) or Northern Health (Contact: Greg Tone, 250-567-6153).

### Acknowledgements

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# Appendix A: Bacterial Data Summary

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Table A1: Summarized Cluculz Lake bacterial data collected in June/July 2007. Exceedances of drinking water quality guidelines are highlighted in gold.

Site	Date	Enterococci (CFU)	E.coli (CFU)	Fecal Coliforms (CFU)
Provincial Guidelines	Potability	0 CFU/100mL	0 CFU/100mL	0 CFU/100mL
C1	06/21/07	<1	2	
	07/04/07	<1	<1	<1
	07/11/07	<1	<1	
	07/12/07	<10	<1	
	07/19/07	4	<1	
C2	06/21/07	2	2	
	07/04/07	<1	<1	<1
	07/11/07	<1	1	
	07/12/07	<10	<1	
	07/19/07	<1	<1	
C3	06/21/07	2	4	
	07/04/07	1	<1	<1
	07/11/07	<1	<1	
	07/12/07	<10	<1	
	07/19/07	3	<1	
C4	06/21/07	<1	1	
	07/04/07	<1	<1	<1
	07/11/07	1	<1	
	07/12/07	<10	<1	
	07/19/07	2	<1	
C5	06/21/07	1	2	
	07/04/07	<1	5	5
	07/11/07	4	14	
	07/12/07	<10	3	
	07/19/07	15; 5	4; 5	
C6	06/21/07	2	1	
	07/04/07	8	7	7
	07/11/07	1	1	
	07/12/07	20	21	
	07/19/07	86	12	
C7	06/21/07	1	3	
	07/04/07	2	8	8
	07/11/07	2	3	
	07/12/07	<10; <10	3; 1	
	07/19/07	10	5	
C8	06/21/07	1	4	
	07/04/07	<1	1	1
	07/11/07	<1	<1	
	07/12/07	<10	<1	
	07/19/07	1	<1	
C9	06/21/07	<1	1	
	07/04/07	<1	<1	<1
	07/11/07	<1	<1	
	07/12/07	<10	<1	
	07/19/07	1	<1	

Site	Date	Enterococci (CFU)	E.coli (CFU)	Fecal Coliforms (CFU)
Provincial Guidelines	Potability	0 CFU/100mL	0 CFU/100mL	0 CFU/100mL
C10	06/21/07	<1	<1	
	07/04/07	1	<1	<1
	07/11/07	<1; <1	1; <1	
	07/12/07	<10	<1	
	07/19/07	<1	<1	
C11	06/21/07	1	<1	
	07/04/07	<1	<1	<1
	07/11/07	<1	1	
	07/12/07	<10	1	
	07/19/07	1	<1	
C12	06/21/07	<1	<1	
	07/04/07	<1; <1	<1; <1	<1; <1
	07/11/07	<1	<1	
	07/12/07	<10	1	
	07/19/07	3	3	
C13	06/21/07	<1	2	
	07/04/07	<1	<1	<1
	07/11/07	<1	<1	
	07/12/07	<10	<1	
	07/19/07	<1	1	
C14	06/21/07	1; <1	<1; <1	
	07/04/07	<1	<1	<1
	07/11/07	<1	<1	
	07/12/07	<10	2	
	07/19/07	<1	<1	
C15	06/21/07	25	2	
	07/04/07	1	4	4
	07/11/07	<1	1	
	07/12/07	20	1	
	07/19/07	4	3	
C16	06/21/07	30	34	
	07/04/07	9	2	2
	07/11/07	1	<1	
	07/12/07	<10	3	
	07/19/07	4	1	
C17	06/21/07	1	2	
	07/04/07	<1	<1	<1
	07/11/07	<1	<1	
	07/12/07	<10	<1	
	07/19/07	9	1	
Blind Blanks (C18)	06/21/07	<1	<1	
	07/04/07	<1	<1	<1
	07/11/07	<1	<1	
	07/12/07			
	07/19/07	<1	<1	



Table A2: Summarized Cluculz Lake bacterial data collected in October 2007. Exceedances of drinking water quality guidelines are highlighted in gold.

Site	Date	Enterococci (CFU)	<i>E.coli</i> (CFU)	Fecal Coliforms (CFU)
Provincial Guidelines	Potability	0 CFU/100mL	0 CFU/100mL	0 CFU/100mL
C1	10/02/07	16	<1	<1
	10/04/07	<1	<1	<1
	10/16/07	2	1	1
	10/29/07	<1	1	1
	10/30/07	<1	1	1
C2	10/02/07	5	<1	<1
	10/04/07	<1	<1	<1
	10/16/07	<1	<1	<1
	10/29/07	1	<1	<1
	10/30/07	<1	1	1
C3	10/02/07	1	<1	<1
	10/04/07	<1	<1	<1
	10/16/07	<1	<1	<1
	10/29/07	<1	<1	<1
	10/30/07	<1	<1	<1
C4	10/02/07	<1	<1	<1
	10/04/07	<1	<1	<1
	10/16/07	<1	<1	<1
	10/29/07	<1	<1	<1
	10/30/07	<1	<1	<1
C5	10/02/07	6	7	7
	10/04/07	1	2	2
	10/16/07	2; 1	1; 2	1; 2
	10/29/07	<1	2	2
	10/30/07	<1	1	1
C6	10/02/07	3	1	1
	10/04/07	<1	4	4
	10/16/07	2	1	1
	10/29/07	<1	1	1
	10/30/07	<1; 2	1; 2	1; 2
C7	10/02/07	<1	1	1
	10/04/07	2	1	1
	10/16/07	1	<1	<1
	10/29/07	2	<1	<1
	10/30/07	2	1	1
C8	10/02/07	<1	<1	<1
	10/04/07	<1	<1	<1
	10/16/07	<1	<1	<1
	10/29/07	<1	<1	<1
	10/30/07	<1	1	1
C9	10/02/07	1	<1	<1
	10/04/07	1	<1	<1
	10/16/07	<1	<1	<1
	10/29/07	<1	<1	<1
	10/30/07	<1	1	1

Site	Date	Enterococci (CFU)	<i>E.coli</i> (CFU)	Fecal Coliforms (CFU)
Provincial Guidelines	Potability	0 CFU/100mL	0 CFU/100mL	0 CFU/100mL
C10	10/02/07	<1; <1	<1; <1	<1; <1
	10/04/07	<1	<1	<1
	10/16/07	<1	<1	<1
	10/29/07	1	<1	<1
	10/30/07	<1	1	1
C11	10/02/07	<1	<1	<1
	10/04/07	<1	<1	<1
	10/16/07	<1	<1	<1
	10/29/07	<1	<1	<1
	10/30/07	<1	<1	<1
C12	10/02/07	<1	<1	<1
	10/04/07	<1	<1	<1
	10/16/07	<1	<1	<1
	10/29/07	<1; 1	<1; <1	<1; <1
	10/30/07	<1	1	1
C13	10/02/07	1	<2	<2
	10/04/07	<1	<1	<1
	10/16/07	<1	<1	<1
	10/29/07	<1	<1	<1
	10/30/07	<1	<1	<1
C14	10/02/07	<1	<1	<1
	10/04/07	<1	<1	<1
	10/16/07	<1	<1	<1
	10/29/07	<1	<1	<1
	10/30/07	<1	<1	<1
C15	10/02/07	<1	<1	<1
	10/04/07	<1	<1	<1
	10/16/07	<1	<1	<1
	10/29/07	<1	<1	<1
	10/30/07	<1	1	1
C16	10/02/07	20	2	2
	10/04/07	<1	1	1
	10/16/07	2	<1	<1
	10/29/07	2	3	3
	10/30/07	1	<1	<1
C17	10/02/07	<1	<1	<1
	10/04/07	<1	<1	<1
	10/16/07	<1	<1	<1
	10/29/07	<1	<1	<1
	10/30/07	<1	3	3
Blind Blanks (C18)	10/02/07			
	10/04/07	<1	<1	<1
	10/16/07			
	10/29/07	<1	<1	<1
	10/30/07			

Table A3. Geometric Mean calculations for *E. coli* and fecal coliforms from samples collected in June and July 2007. No exceedances of recreational water quality guidelines were observed.

Site	Date	<i>E.coli</i> (CFU)	Geometric Mean
Provincial Guidelines	Recreation	≤20 CFU/100mL	
C1	06/21/07	2	
	07/04/07	1	
	07/11/07	1	1.15
	07/12/07	1	
	07/19/07	1	
C2	06/21/07	2	
	07/04/07	1	
	07/11/07	1	1.15
	07/12/07	1	
	07/19/07	1	
C3	06/21/07	4	
	07/04/07	1	
	07/11/07	1	1.32
	07/12/07	1	
	07/19/07	1	
C4	06/21/07	1	
	07/04/07	1	
	07/11/07	1	1.00
	07/12/07	1	
	07/19/07	1	
C5	06/21/07	2	
	07/04/07	5	
	07/11/07	14	4.51
	07/12/07	3	
	07/19/07	4; 5	
C6	06/21/07	1	
	07/04/07	7	
	07/11/07	1	4.46
	07/12/07	21	
	07/19/07	12	
C7	06/21/07	3	
	07/04/07	8	
	07/11/07	3	3.20
	07/12/07	3; 1	
	07/19/07	5	
C8	06/21/07	4	
	07/04/07	1	
	07/11/07	1	1.32
	07/12/07	1	
	07/19/07	1	
C9	06/21/07	1	
	07/04/07	1	
	07/11/07	1	1.00
	07/12/07	1	
	07/19/07	1	

Site	Date	<i>E.coli</i> (CFU)	Geometric Mean
Provincial Guidelines	Recreation	≤20 CFU/100mL	
C10	06/21/07	1	
	07/04/07	1	
	07/11/07	<1; <1	1.00
	07/12/07	1	
	07/19/07	1	
C11	06/21/07	1	
	07/04/07	1	
	07/11/07	1	1.00
	07/12/07	1	
	07/19/07	1	
C12	06/21/07	1	
	07/04/07	<1; <1	
	07/11/07	1	1.20
	07/12/07	1	
	07/19/07	3	
C13	06/21/07	2	
	07/04/07	1	
	07/11/07	1	1.15
	07/12/07	1	
	07/19/07	1	
C14	06/21/07	<1; <1	
	07/04/07	1	
	07/11/07	1	1.12
	07/12/07	2	
	07/19/07	1	
C15	06/21/07	2	
	07/04/07	4	
	07/11/07	1	1.89
	07/12/07	1	
	07/19/07	3	
C16	06/21/07	34	
	07/04/07	2	
	07/11/07	1	2.90
	07/12/07	3	
	07/19/07	1	
C17	06/21/07	2	
	07/04/07	1	
	07/11/07	1	1.15
	07/12/07	1	
	07/19/07	1	
Blind Blanks (C18)	06/21/07	1	
	07/04/07	1	
	07/11/07	1	0.00
	07/12/07		
	07/19/07	1	

Table A4. Geometric Mean calculations for *E. coli* and fecal coliforms from samples collected in October 2007. No exceedances of recreational water quality guidelines were observed.

Site	Date	<i>E.coli</i> (CFU)	Geometric Mean	Fecal Coliforms (CFU)	Geometric Mean
Provincial Guidelines	Recreation	≤20 CFU/100mL		≤200 CFU/100mL	
C1	10/02/07	1		1	
	10/04/07	1		1	
	10/16/07	1	1.00	1	1.00
	10/29/07	1		1	
	10/30/07	1		1	
C2	10/02/07	1		1	
	10/04/07	1		1	
	10/16/07	1	1.00	1	1.00
	10/29/07	1		1	
	10/30/07	1		1	
C3	10/02/07	1		1	
	10/04/07	1		1	
	10/16/07	1	1.00	1	1.00
	10/29/07	1		1	
	10/30/07	1		1	
C4	10/02/07	1		1	
	10/04/07	1		1	
	10/16/07	1	1.00	1	1.00
	10/29/07	1		1	
	10/30/07	1		1	
C5	10/02/07	7		7	
	10/04/07	2		2	
	10/16/07	1; 2	1.96	1; 2	1.96
	10/29/07	2		2	
	10/30/07	1		1	
C6	10/02/07	1		1	
	10/04/07	4		4	
	10/16/07	1	1.41	1	1.41
	10/29/07	1		1	
	10/30/07	1; 2		1; 2	
C7	10/02/07	1		1	
	10/04/07	1		1	
	10/16/07	1	1.00	1	1.00
	10/29/07	1		1	
	10/30/07	1		1	
C8	10/02/07	1		1	
	10/04/07	1		1	
	10/16/07	1	1.00	1	1.00
	10/29/07	1		1	
	10/30/07	1		1	
C9	10/02/07	1		1	
	10/04/07	1		1	
	10/16/07	1	1.00	1	1.00
	10/29/07	1		1	
	10/30/07	1		1	
Provincial Guidelines	Recreation	≤20 CFU/100mL		≤200 CFU/100mL	
C10	10/02/07	<1; <1		<1; <1	
	10/04/07	1		1	
	10/16/07	1	1.00	1	1.00
	10/29/07	1		1	
	10/30/07	1		1	
C11	10/02/07	1		1	
	10/04/07	1		1	
	10/16/07	1	1.00	1	1.00
	10/29/07	1		1	
	10/30/07	1		1	
C12	10/02/07	1		1	
	10/04/07	1		1	
	10/16/07	1	1.00	1	1.00
	10/29/07	<1; <1		<1; <1	
	10/30/07	1		1	
C13	10/02/07	2		2	
	10/04/07	1		1	
	10/16/07	1	1.15	1	1.15
	10/29/07	1		1	
	10/30/07	1		1	
C14	10/02/07	1		1	
	10/04/07	1		1	
	10/16/07	1	1.00	1	1.00
	10/29/07	1		1	
	10/30/07	1		1	
C15	10/02/07	1		1	
	10/04/07	1		1	
	10/16/07	1	1.00	1	1.00
	10/29/07	1		1	
	10/30/07	1		1	
C16	10/02/07	2		2	
	10/04/07	1		1	
	10/16/07	1	1.43	1	1.43
	10/29/07	3		3	
	10/30/07	1		1	
C17	10/02/07	1		1	
	10/04/07	1		1	
	10/16/07	1	1.25	1	1.25
	10/29/07	1		1	
	10/30/07	3		3	
Blind Blanks (C18)	10/02/07				
	10/04/07	1		1	
	10/16/07		0.00		0.00
	10/29/07	1		1	
	10/30/07				

Table A5. Geometric Mean calculations for adjusted *Enterococci* values collected in June/July 2007. No exceedances of recreational water quality guidelines were observed.

	Date	<10 replaced with 1		<10 replaced with 5		<10 replaced with 10	
		<i>Enterococci</i> adjusted (CFU)	Geometric Mean	<i>Enterococci</i> adjusted (CFU)	Geometric Mean	<i>Enterococci</i> adjusted (CFU)	Geometric Mean
al es	Recreation	≤ 77 CFU/100 mL					
	06/21/07	1		1		1	
	07/04/07	1		1		1	
	07/11/07	1	1.32	1	1.82	1	2.09
	07/12/07	1		5		10	
	07/19/07	4		4		4	
	06/21/07	2		2		2	
	07/04/07	1		1		1	
	07/11/07	1	1.15	1	1.58	1	1.82
	07/12/07	1		5		10	
	07/19/07	1		1		1	
	06/21/07	2		2		2	
	07/04/07	1		1		1	
	07/11/07	1	1.43	1	1.97	1	2.27
	07/12/07	1		5		10	
	07/19/07	3		3		3	
	06/21/07	1		1		1	
	07/04/07	1		1		1	
	07/11/07	1	1.15	1	1.58	1	1.82
	07/12/07	1		5		10	
07/19/07	2		2		2		
06/21/07	1		1		1		
07/04/07	1		1		1		
07/11/07	4	2.09	4	2.89	4	3.31	
07/12/07	1		5		10		
07/19/07	10		10		10		
06/21/07	2		2		2		
07/04/07	8		8		8		
07/11/07	1	7.73	1	7.73	1	7.73	
07/12/07	20		20		20		
07/19/07	86		86		86		

Site	Date	<10 replaced with 1		<10 replaced with 5		<10 replaced with 10	
		<i>Enterococci</i> adjusted (CFU)	Geometric Mean	<i>Enterococci</i> adjusted (CFU)	Geometric Mean	<i>Enterococci</i> adjusted (CFU)	Geometric Mean
Provincial Guidelines	Recreation	≤ 77 CFU/100 mL					
C7	06/21/07	1		1		1	
	07/04/07	2		2		2	
	07/11/07	2	2.09	2	2.89	2	3.31
	07/12/07	1		5		10	
	07/19/07	10		10		10	
C8	06/21/07	1		1		1	
	07/04/07	1		1		1	
	07/11/07	1	1.00	1	1.38	1	1.58
	07/12/07	1		5		10	
	07/19/07	1		1		1	
C9	06/21/07	1		1		1	
	07/04/07	1		1		1	
	07/11/07	1	1.00	1	1.38	1	1.58
	07/12/07	1		5		10	
	07/19/07	1		1		1	
C10	06/21/07	1		1		1	
	07/04/07	1		1		1	
	07/11/07	1	1.00	1	1.38	1	1.58
	07/12/07	1		5		10	
	07/19/07	1		1		1	
C11	06/21/07	1		1		1	
	07/04/07	1		1		1	
	07/11/07	1	1.00	1	1.38	1	1.58
	07/12/07	1		5		10	
	07/19/07	1		1		1	
C12	06/21/07	1		1		1	
	07/04/07	1		1		1	
	07/11/07	1	1.25	1	1.72	1	1.97
	07/12/07	1		5		10	
	07/19/07	3		3		3	

Site	Date	<10 replaced with 1		<10 replaced with 5		<10 replaced with 10		
		<i>Enterococci</i> adjusted (CFU)	Geometric Mean	<i>Enterococci</i> adjusted (CFU)	Geometric Mean	<i>Enterococci</i> adjusted (CFU)	Geometric Mean	
Provincial Guidelines	Recreation	≤ 77 CFU/100 mL						
C13	06/21/07	1		1		1		
	07/04/07	1		1		1		
	07/11/07	1	1.00	1	1.38	1	1.58	
	07/12/07	1		5		10		
	07/19/07	1		1		1		
C14	06/21/07	1		1		1		
	07/04/07	1		1		1		
	07/11/07	1	1.00	1	1.38	1	1.58	
	07/12/07	1		5		10		
	07/19/07	1		1		1		
C15	06/21/07	25		25		25		
	07/04/07	1		1		1		
	07/11/07	1	4.57	1	4.57	1	4.57	
	07/12/07	20		20		20		
	07/19/07	4		4		4		
C16	06/21/07	30		30		30		
	07/04/07	9		9		9		
	07/11/07	1	4.04	1	5.58	1	6.41	
	07/12/07	1		5		10		
	07/19/07	4		4		4		
C17	06/21/07	1		1		1		
	07/04/07	1		1		1		
	07/11/07	1	1.55	1	2.14	1	2.46	
	07/12/07	1		5		10		
	07/19/07	9		9		9		
Blind Blanks (C18)	06/21/07	1		1		1		
	07/04/07	1		1		1		
	07/11/07	1	0.00	1	0.00	1	0.00	
	07/12/07							
	07/19/07	1		1		1		

