Okanagan Lake Collaborative Monitoring Agreement

2011 Summary Report

BC Ministry of Environment

Environmental Protection Division

Penticton

Table of Contents

List of Tables

List of Figures

Executive Summary

Shared stewardship of water resources has been identified as a priority by local governments and the province of BC. To incrementally further this ambition, a Memorandum of Understanding (MOU) between BC Ministry of Environment, the City of Kelowna, Regional District of Central Okanagan and the District of Summerland, established a framework in 2010, for implementing a cost-shared monitoring program of Okanagan Lake. 2011 was the inaugural year for the Collaborative Monitoring Program for Okanagan Lake. Sampling of Okanagan Lake was carried out on 7 dates, 5 through a contract, and 2 as part of the regular BC Ministry of Environment spring-fall program on all mainstem Okanagan lakes. The data demonstrates that the main body of Okanagan Lake in 2011 met the water quality objectives set for the lake in 2005, with the exception of Secchi depth in the south basin. The data provide important information to a long-term database necessary for guiding Liquid Waste Management Planning within the Okanagan Basin. Contracted sample collection services and laboratory services for 2011, totalled $21,819.25. It is recommended that the MOU be renewed for a 3 year term, with annual review and amendment, to reflect any mutually agreed upon technical or administrative changes.

Introduction

Background and Context:

Living Water Smart, the provinces vision and commitment to ensuring that our water stays healthy and secure for future generations, closely aligns with the guiding principles of the Okanagan Basin Water Boards Okanagan Sustainable Water Strategy. In both, share stewardship is promoted as key to sustainability of significant BC freshwater resources. Okanagan Lake is the single most important freshwater body to the Okanagan economy. Sustainable long-term management of this common resource requires investment in science-based information to support and inform decisions made by local and provincial governments. In particular, timely and integrated water quality information is fundamental to Liquid Waste Management as well as drinking water management within the Okanagan basin. Municipal liquid waste management within the Okanagan has benefited from a long history of investment in advanced waste water treatment. Indeed, utilization of the best available control technology to manage municipal effluents places the Okanagan in a leadership position, within BC and Canada. Water science information supports and confirms the success of these investments. Nevertheless, approximately 18 Mm^3/yr of tertiary effluent is discharged annually to Okanagan Lake, from which approximately 100,000 people obtain some portion of their drinking water. In 2010, the municipal effluent volume was approximately 5% of inflow to Okanagan Lake in a low flow year, and is expected to become a larger proportion as the population grows and climate change potentially provides less effective inflow to the lake. Waste management in the basin has primarily focused on phosphorus (P) removal from municipal effluents in order to prevent eutrophication of the lakes. As the population continues to increase, P loading is again increasing in some lakes. As the volume of effluent grows, there is a responsibility for ensuring sufficient information is gathered to understand how and why Okanagan Lake changes over time. To understand the condition of Okanagan Lake in relation to

conventional and emerging contaminants, proactive, collaborative and integrated monitoring at the basin level is desirable to ensure sustainability.

Local and provincial agencies have monitored Okanagan Lake quality intermittently over many decades. While this information has been useful, this information was not well integrated and could not specifically address the Okanagan Lake water quality objectives prepared in 2005 (http://www.env.gov.bc.ca/wat/wq/objectives/oklakes_update_over/index.html; Nordin, 2005). Furthermore, testing of sediments for changes near wastewater outfalls, as an early indicator of impact, has not been carried out to date. Similarly, testing for various emerging contaminants of concern is not possible with the existing resourcing. Without local government collaboration a comprehensive water quality monitoring and reporting program cannot be accomplished by the Ministry of Environment. To address these issues, a collaborative monitoring and reporting program was established with the City of Kelowna, Regional District of Central Okanagan and the District of Summerland in late-2010.

Purpose of Collaborative Monitoring of Okanagan Lake

The collaborative monitoring program on Okanagan Lake combines resources from 3 local governments and the province, to provide high quality, integrated, and timely water quality information to guide Liquid Waste Management Planning and manage Okanagan Lake into the future. A primary function of the monitoring is to determine attainment of Okanagan Lake water quality objectives (Appendix A). This function has been made possible through this partnership. Over time, and with the support of other local governments, this program may be expanded to address similar issues on other lakes in the basin, or address emerging issues of common concern.

Okanagan Lake Collaborative Monitoring Agreement

The 2010 Memorandum of Understanding (MOU) provided a framework for cost shared collaborative monitoring of Okanagan Lake as developed and signed on October 26, 2010 by the BC Ministry of Environment (MOE), City of Kelowna, Regional District of Central Okanagan and the District of Summerland (Appendix B).

The MOU established an approximate flow proportionate, cost shared budget ($22,000) for the collection of samples and lab charges associated with the monitoring program necessary to check attainment of the water quality objectives for Okanagan Lake

The MOU set a 1 year term to the agreement, ending December 31, 2011. The MOU requires that a Technical Advisory Group meet annually to review the results, determine monitoring priorities, disperse any remaining funds, and if mutually agreed, re-negotiate the MOU for a subsequent term.

Collaborative Monitoring Agreement Implementation - 2011

Sample Collection Contract

An invitation to quote (ITQ) for sample collection services was issued on January 19, 2011, to the following suitably qualified local contractors:

Golder Associates, Kelowna.

Larratt Aquatic Consulting, West Kelowna.

Okanagan Nation Alliance, West Kelowna.

Summit Environmental Consultants, Vernon.

All four submitted comprehensive and competitively priced bids. Okanagan Nation Alliance (ONA) provided the lowest priced bid at $10,183.25. A services contract (CPNEN11058) was awarded to the ONA on February 14, 2011 (Appendix C).

Sampling Program Implementation

The BC MOE staff collected the first and last samples at 4 sites on Okanagan Lake (Figure 1). The ONA collected five monthly samples at the same four sites on Okanagan Lake as per the contract. A BC MOE employee observed sample collection on the first date and at the first site to ensure methods and quality assurance procedures were implemented as per the contract. Samples were shipped on the day of collection to Maxxam Analytics in Burnaby, and data returned to MOE staff in Penticton for collation and quality control checks. All data is stored in the BC MOE database and files and are available upon request.

Figure 1. Map of Okanagan Lake indicating sampling sites in four lake basins. 1 = Armstrong Arm, 2 = Ok Centre (north basin), 3 = Kelowna (central basin), and 4 = Summerland (south basin).

Water Quality Objectives Attainment and Seasonal Trends

Water quality samples for nutrients and general ions, phytoplankton chlorophyll-*a*, water clarity, temperature and dissolved oxygen profiles were collected at 4 sites. This data is summarized in Table 1, and compared against the water quality objectives for Okanagan Lake. All water chemistry data is provided in Appendix D.

Briefly, the water chemistry data demonstrated that Okanagan Lake water quality was good and almost all water quality objectives were met in 2011. On the basis of concentrations of nitrogen, phosphorus, phytoplankton chlorophyll-*a*, and Secchi depth, the main body of Okanagan Lake would be considered oligotrophic, while Armstrong Arm would be considered mesotrophic.

Table 1. Water quality objectives and 2011 attainment for four sites in Okanagan Lake.

Water Quality Objectives

Lake Site	Seasonal (April-Sept) Secchi (m)	Seasonal (April-Sept) Chl-*a* (µg/L)	Spring TP (mg/L)	Spring TN (mg/L)	DO @ bottom (mg/L)
Summerland	≥ 7	≤ 4.0	≤ 0.007	≤ 0.230	-
Kelowna	≥ 6	≤ 4.5	≤ 0.008	≤ 0.230	-
Ok Centre	≥ 6	≤ 4.5	≤ 0.008	≤ 0.230	-
Armstrong Arm	≥ 5	≤ 5.0	≤ 0.010	≤ 0.250	≥ 5

2011 Objectives Attainment

Lake Site	Seasonal (April-Sept) Secchi (m)	Seasonal (April-Sept) Chl-*a* (µg/L)	Spring TP (mg/L)	Spring TN (mg/L)	DO @ bottom (mg/L)
Summerland	6.5	1.4	0.004	0.120	-
Kelowna	6.1	1.5	0.004	0.230	-
Ok Centre	6.6	1.8	0.004	0.210	-
Armstrong Arm	2.7	2.3	0.008	0.210	4.7 (Aug) & 2.4 (Sept)

Key: Objective Not Met | Objective Met

Seasonal changes in water clarity in Okanagan Lake corresponded in part to changes in algal abundance. Generally, over the growing season, as phytoplankton chlorophyll-*a* increased, Secchi depth decreased (Figure 2). Water clarity was high in the early spring and decreased as algal production increased. Following the spring algae bloom, water clarity became progressively clearer into the fall. Continued collection of chlorophyll-*a* samples and Secchi depth measurements is recommended.

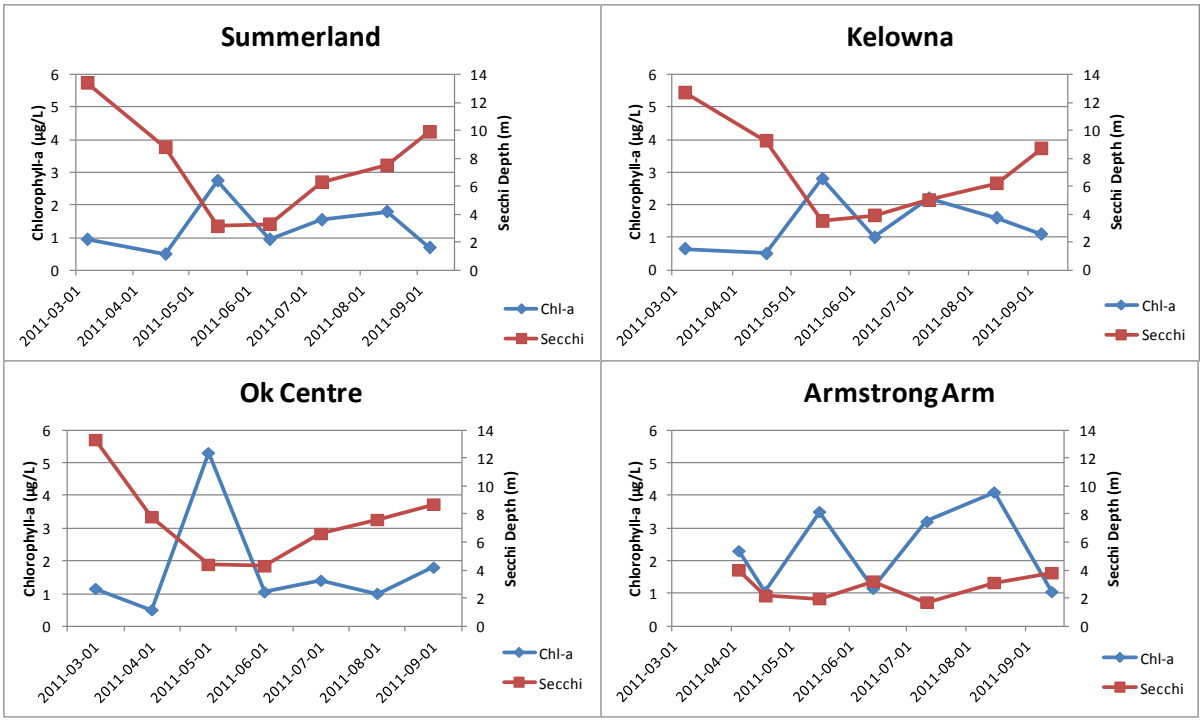


Table 2. Secchi Depth and chlorophyll-*a* concentrations at four sites in Okanagan Lake.

Silica concentrations did not vary widely between sites (mean range = 6.6 – 7.8 mg/L), but exhibited seasonal patterns that were most likely related to diatom algae production. Following algal blooms, concentrations of silica were highest in the early spring, then decreased throughout the summer and increased slightly again in September. (Appendix E). Continued collection of silica samples is of lower priority.

Phosphorus concentrations were generally quite low in Okanagan Lake and exhibited little seasonal variation. The three main lake basins were similarly low, whereas Armstrong Arm phosphorus concentrations were higher, especially in late-summer/early-fall hypolimnetic waters (Appendix F). Total dissolved phosphorus concentrations and variation were similar to total phosphorus. Ortho phosphorus was near or below detection limits except in the fall at Summerland and Armstrong Arm. Continued collection of total phosphorus and total dissolved phosphorus is recommended.

Like phosphorus, nitrogen levels in Okanagan Lake were relatively low. Ammonia and NO_2+NO_3 were low throughout the year, but decreased in the epilimnion following thermal stratification (Appendix G). In the three main basins, total nitrogen was lower in the early-spring and fall, with higher concentrations throughout the summer. Total nitrogen in the hypolimnion differed from this pattern, as it increased throughout the entire growing season. Continued collection of total and NO_2+NO_3 samples is recommended. Other forms of nitrogen could also be added to the program as funds allow.

Temperature profiles were similar at all four sites and the seasonal progression exhibited is typical of north temperate lakes. In the spring, the lake was cold and well mixed, and temperatures did not vary much with depth. As the season progressed and air temperatures rose, the lake became thermally stratified with warm water in the epilimnion (upper ~10 m) and relatively cold water in the hypolimnion (below ~20m).

Dissolved oxygen (DO) profiles followed similar seasonal patterns in the south, central and north basins. These basins exhibited orthograde profiles, with high DO concentrations in the spring and decreasing concentrations in the epilimnion as temperatures gradually increased throughout the summer (Figure 2). Conversely, Armstrong Arm is more eutrophic than the other basins and exhibited a clinograde profile. During spring turnover, Armstrong Arm had high DO concentrations and a subsequent depletion of oxygen in the hypolimnion occurred in the summer with increased biological oxidation of organic matter (Figure 2). Continued collection of temperature and dissolved oxygen profiles is recommended.

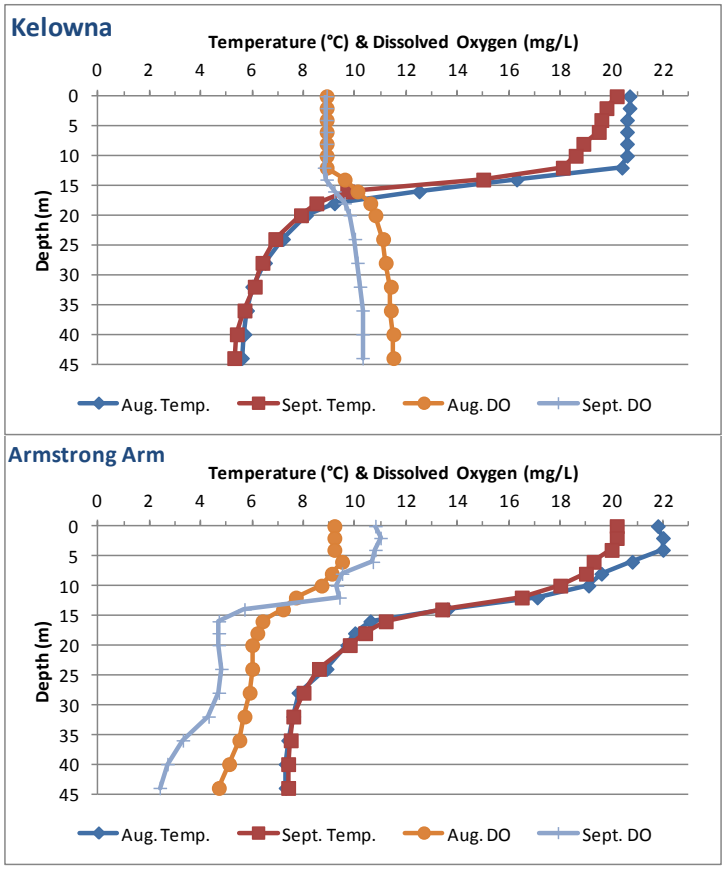


Figure 2. Water column temperature and dissolved oxygen in two Okanagan Lake basins exhibiting orthograde (Kelowna) and clinograde (Armstrong Arm) profiles.

Samples for phytoplankton and zooplankton abundance and taxonomic composition were collected at the central and southern sites (Appendix H). Phytoplankton communities were very diverse with many species present, however, there were only a few species that were most dominant. These communities were quite similar at both sites, with minor seasonal differences in various species abundances.

Generally, a successional pattern began with a spring peak of diatoms and flagellates followed by a summer assemblage dominated by cyanophytes which persisted into the fall when diatoms and flagellates typically regained dominance. Phytoplankton objectives for Okanagan Lake indicate that less than 5% of the phytoplankton biomass (growing season [April to September] mean should be composed of nitrogen-fixing cyanobacteria species (i.e., species with heterocysts). Both central and south sites were slightly above level this with 6.4% and 6.6%, respectively.

Zooplankton diversity was much lower than phytoplankton, but is comparable to other large lakes in BC. Similar zooplankton species were found at both the central and south sites, and were dominated by copepods throughout the year, with cladocerans emerging in late summer and fall. There were differences in abundances throughout the year, as the central site had higher zooplankton abundances in the spring, while the south site had higher populations in the late-summer and fall. Another difference between sites is that on average, there were more cladocerans in the south site compared to the central site. Zooplankton objectives for Okanagan Lake indicate that there should be a minimum of 5% by numbers of cladocerans (averaged over the growing season) in the zooplankton community. The south site achieved this with 8.7%, while the central site did not, with 4.2%. The objectives also note that there should be no significant change in dominant species. The dominant species that were present in Okanagan Lake (and have been over the past 30 years) are used as indicators of biological change; these include the calanoid copepod *Leptodiapomus ashlandi*, the cyclopoid copepod *Diacyclops bicuspidatus thomasii* and the cladocerans *Daphnia galeata mendotae*, *Diaphanasoma* and *Bosmina*. These dominant species were found at both sampling sites in 2011, and there appears to be no significant changes.

Summary of Program Costs

Sample Collection Contract

- ONA sample collection charges were delivered on budget at: $10,183.25. Refer to Appendix I for copies of individual invoices.

Laboratory Analysis Costs

- Maxxam analytical costs for water chemistry and chlorophyll-*a* analyses totalled: $4,112. A final Year End statement is attached in Appendix J.
- Fraser Environmental costs for phytoplankton and zooplankton analytical costs totalled: $7,512.96. A final Year End statement is attached as Appendix K.

Summary of Program Costs 2011

- A balance of $180.75 is expected once all invoices are paid. See Table 3 for the Statement of Accounts summary. A forecast surplus of 3-4 % is suggested for subsequent years to provide a small contingency fund.

Table 3. Summary statement of accounts for Okanagan collaborative monitoring agreement, 2011.

Statement of Accounts for Okanagan Collaborative Monitoring Agreement 2011

Component	Supplier	March	April	May	June	July	August	September	totals
Water chemistry	Maxxam Analytics Burnaby	MOE	640	796	640	796	640	600	4112
Plankton taxonomy	Fraser Environmental Burnaby		1254	1254	1254	1254	1254	1254	7524
Sample collection	ONA West Kelowna	MOE	2037	2037	2037	2037	2037	MOE	10183
								Grand total	21819
								Budget	22000
								Balance	180.8

MOE In-kind and direct costs

- In 2011 the MOE contributed approximately 70 hours for development of the MOU, contract tendering, contract monitoring, and sample collection in spring and fall. Approximately $500 was spent on laboratory costs.

Recommendations

- The Technical Advisory Group met on December 5, 2011 to review the parameters, sites, frequency and protocols of the 2011 sampling program, and ensured the program goals of long term data quality and comparability, and fiscal accountability were met.
- Renewal of the agreement for a 3-year term was agreed upon and addresses the Ministry's need to ensure continuity and effective program management, and accommodate local governments budgetary time lines. A draft 3-year MOU is provided in Appendix L and an estimated cost breakdown in Appendix M. As laboratory prices will not be known until spring 2012, a 2% increase to lab pricing (Appendix M) was allowed. Removal of silica, ammonia nitrogen, total dissolved nitrogen, and ortho P from the parameter list are options, if required, to stay within budget and provide a small contingency fund. The parameter list will be reviewed once 2012 sampler contract and lab prices are finalized.
- Partners to the MOU are encouraged to post the final version of this report on their web sites and refer to the web site address in their respective annual reports required under appropriate Environmental Management Act authorizations.

Appendix A: Okanagan Lake Water Quality Objectives (Nordin, 2005)

	North Basin	Central Basin	South Basin	Armstrong Arm
Secchi disc Transparency (m) (growing season average)	6	6	7	5
Dissolved Oxygen	-	-	-	5 mg/L min in bottom waters
Total Phosphorus (µg/L) (at spring overturn)	8	8	7	10
Chlorophyll-a (µg/L) (growing season average)	4.5	4.5	4	5
Total Nitrogen (µg/L) (maximum)	230	230	230	250
N:P ratio (spring .weight ratio)	>25:1	>25:1	>25:1	>25:1
Phytoplankton Structure (heterocystous cyanobacteria by numbers)	<5%	<5%	<5%	<5%
Phytoplankton growing season average biomass	<0.75 g/m3	<0.75 g/m3	<0.75 g/m3	<0.75 g/m3
Zooplankton designated species mix minimum biomass	50 ug/m3	50 ug/m3	50 ug/m3	50 ug/m3
Zooplankton Structure (minimum of cladocerar by numbers)	5%	5%	5%	5%
Contaminants in fish tissue and *Mysis* tissue	Below human consumption and wildlife protection guidelines	Below human consumption and wildlife protection guidelines	Below human consumption and wildlife protection guidelines	Below human consumption and wildlife protection guidelines

Nordin, R.N. 2005. Water quality objectives for Okanagan Lake, a first update. Prepared for the BC Ministry of Water Land and Air Protection, Penticton, BC. 44p.

Appendix B: Memorandum of Understanding 2011

MEMORANDUM OF UNDERSTANDING

BETWEEN

MINISTRY OF ENVIRONMENT
GOVERNMENT OF THE PROVINCE OF
BRITISH COLUMBIA

AND

THE CITY OF KELOWNA

AND

THE REGIONAL DISTRICT OF CENTRAL OKANAGAN

AND

THE DISTRICT OF SUMMERLAND

RESPECTING

THE *Okanagan Lake Collaborative Monitoring Agreement* for **2011**

BETWEEN:

Government of the Province of British Columbia
As Represented by
Vic Jensen, Senior Impact Assessment Biologist of the
Environmental Protection and Assurance Division
Ministry of Environment

(hereinafter referred to as the "MOE")

AND

City of Kelowna
As Represented by
Mike Gosselin, Supervisor Wastewater Treatment Operations

Regional District of Central Okanagan
As Represented by
Angela Lambrecht, Water and Wastewater Process Technologist

District of Summerland
As Represented by
Kevin McLuskey, Supervisor Wastewater Treatment Operation

(hereinafter referred to as the "local governments")

WHEREAS:

A. This Memorandum of Understanding (MOU) serves to enable collaboration of the MOE and the local governments to provide high quality, integrated and timely water quality information to enable sustainable environmental management of Okanagan Lake, and guide Liquid Waste Management Planning at the basin level.

B. The local governments will reimburse the Ministry for costs incurred as described in Section 3 and Appendix 1.

SECTION 3.0 SUBJECT MATTER

3.1 Collaborative Monitoring and Reporting Program

3.1.1 A collaborative monitoring and reporting program is to replace receiving environment monitoring and environmental impact assessment programs required under existing Municipal Sewage Regulation Operational Certificates or permits.

3.1.2 Monthly sampling and associated field measurement collection from March through September, and analysis of water chemistry for 4 sites and plankton taxonomy for 2 sites on Okanagan Lake as per Appendix 1.

3.1.3 Annual reporting of Okanagan Lake Trophic Status, trends, and attainment of water quality objectives through the MOE or other suitable web sites.

3.2 Operational Certificates and Lake Monitoring

3.2.1 Lake monitoring requirements under the Operational Certificates ME 12211, PE 11652 and ME 13627 for the City of Kelowna, Regional District of Central Okanagan, and District of Summerland respectively, are waived while the named local governments participate in this Collaborative Monitoring MOU. The MOE will provide written confirmation following MOU sign-off.

3.2.2 Effluent monitoring requirements and compliance with all other terms and conditions of the Operational Certificates will remain in effect.

3.3 Cost Estimates of Program:

3.3.1 Costs of this program include laboratory and sample collection costs.

3.3.2 Laboratory expenses are as per Appendix 1: $12,000 (full program 2 sites + 2 sites chemistry only: Okanagan Centre, Armstrong Arm)

3.3.3 Sample collection contract: $10,000

3.3.4 Total projected annual costs: $22,000 (costs based on 18M m3 effluent discharged per year = $0.0013/m3).

3.4 Roles and Responsibilities

3.4.1 The Ministry will contribute program coordination and contract management for sample collection and reporting of results.

3.4.2 The local governments agree to provide the Ministry with funds sufficient to cover costs as described in Section 5.0 and detailed in Appendix 1.

6.3 Surplus funds at the end of the sampling season will be reviewed by the Technical Advisory Group and will be returned to local governments or reallocated through renewal of this MOU for the following year.

SECTION 7.0 LIABILITY

7.1 Each participant and personnel by association, waives all claims against the other participants in respect of damage caused to its personnel and/or its property by personnel or agents (excluding contractors) of that other participant arising out of, or in connection with the implementation of this MOU.

7.2 The provisions of sections 7.1 will survive the termination of this MOU for any reason whatsoever.

SECTION 8.0 DISPUTE RESOLUTION

8.1 Any new issue, matter of general concern or dispute arising from this MOU will be dealt with by Technical Advisory Group or their delegates.

8.2 The dispute or disagreement will not be submitted to a third party for resolution.

SECTION 9.0 TERM OF AGREEMENT

9.1 This MOU will begin January 1, 2011 and end December 31, 2011.

9.2 This MOU may be amended by mutual written agreement by the Participants to this MOU.

9.3 Prior to the termination of this MOU, it may be renewed for an additional period on terms agreed to by participants to this MOU.

9.4 Any of the participants to this MOU may terminate participation in this agreement upon provision of sixty (60) days written notice to the other participants of their intention to terminate participation in this MOU.

9.5 On the date of termination of this MOU or termination of participation in this agreement, the lake monitoring requirements under local government operational certificates or permits as noted above, are reinstated. Regardless of the reason for termination or the participant who gives

Signed on behalf of the MOE:

Vic Jensen
Ministry of Environment
Province of British Columbia

Oct 26/2010
Date

Signed on behalf of local governments:

Mike Gosselin
City of Kelowna

Oct 26/2010
Date

Angela Lambrecht
Regional District of Central Okanagan

Oct 26, 2010
Date

Kevin McLuskey
District of Summerland

Oct 28, 2010
Date

Appendix C: Services Contract (CPNEN11058)

Received

MAR 2 8 2011

Received

102 Industrial Place
Penticton, BC V2A 7C8

MAR 1 8 2011

GENERAL SERVICE AGREEMENT

102 Industrial Place
Penticton, BC V2A 7C8

BRITISH COLUMBIA
The Best Place on Earth

For Administrative Purposes Only	
Ministry Contract No.: CPNEN11058 *Requisition No.:* _____ *Solicitation No.(if applicable):* _____ *Commodity Code:* _____ ***Contractor Information*** *Supplier Name:* _____ *Supplier No.:* _____ *Telephone No.:* _____ *E-mail Address:* _____ *Website:* _____	***Financial Information*** *Client:* 048 *Responsibility Centre:* 294K1 *Service Line:* 30595 *STOB:* 6001 *Project:* 2930563 ***Template version:*** *October 21, 2010*

Governing law

13.21 This Agreement is governed by, and is to be interpreted and construed in accordance with, the laws applicable in British Columbia.

14 INTERPRETATION

14.1 In this Agreement:

(a) "includes" and "including" are not intended to be limiting;

(b) unless the context otherwise requires, references to sections by number are to sections of this Agreement;

(c) the Contractor and the Province are referred to as "the parties" and each of them as a "party";

(d) "attached" means attached to this Agreement when used in relation to a schedule;

(e) unless otherwise specified, a reference to a statute by name means the statute of British Columbia by that name, as amended or replaced from time to time;

(f) the headings have been inserted for convenience of reference only and are not intended to describe, enlarge or restrict the scope or meaning of this Agreement or any provision of it;

(g) "person" includes an individual, partnership, corporation or legal entity of any nature; and

(h) unless the context otherwise requires, words expressed in the singular include the plural and *vice versa*.

15 EXECUTION AND DELIVERY OF AGREEMENT

15.1 This Agreement may be entered into by a separate copy of this Agreement being executed by, or on behalf of, each party and that executed copy being delivered to the other party by a method provided for in section 13.1 or any other method agreed to by the parties.

The parties have executed this Agreement as follows:

SIGNED on the ____ day of _____, 20__ by the Contractor (or, if not an individual, on its behalf by its authorized signatory or signatories):	SIGNED on the 23 day of March, 2011 on behalf of the Province by its duly authorized representative:
Signature(s)	Signature
Pauline TerBasket Print Name(s)	J ROBYN ROOME Print Name
EXECUTIVE DIRECTOR Print Title(s)	Regional Manager Print Title Environmental Protection Division

Appendix D: 2011 Okanagan Lake water chemistry and phytoplankton chlorophyll *a* data, 2011.

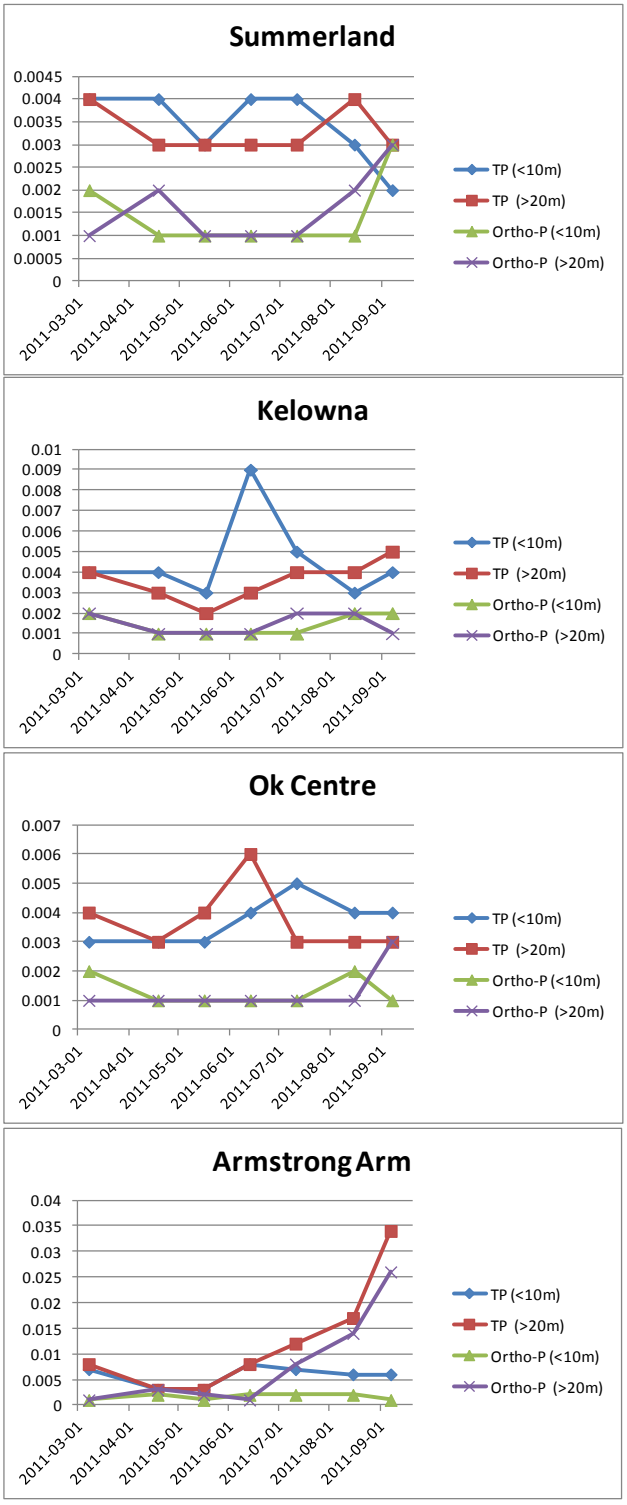
			µg/L	mg/L	°C	m	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Site	**EMS #**	**Sampling Date**	**Chl-a**	**DO**	**Temp**	**Secchi**	**Silica (<10m)**	**Silica (>20m)**	**Ortho-P (<10m)**	**Ortho-P (>20m)**	**TKN (<10m)**	**TKN (>20m)**	**Total Org N (<10m)**	**Total Org N (>20m)**
Summerland	0500454	2011-03-07	0.95	13	3.3	13.4	7.6	7.5	0.002	0.001	0.06	*0.02*		
Summerland	0500454	2011-04-18	0.5	16	4.4	8.8	7.3	7.4	0.001	0.002	0.19	0.22	0.18	0.21
Summerland	0500454	2011-05-16	2.75	11	9	3.15	6.9	6.9	0.001	0.001	0.21	0.23	0.21	0.22
Summerland	0500454	2011-06-13	0.95	11	14	3.3	7	7.1	0.001	0.001	0.19	0.23	0.18	0.22
Summerland	0500454	2011-07-11	1.55	11	18.7	6.3	6.8	7	0.001	0.001	0.2	0.21	0.19	0.19
Summerland	0500454	2011-08-15	1.8	8.7	21.3	7.5	6.4	6.7	0.001	0.002	0.19	*0.02*	0.17	*0.02*
Summerland	0500454	2011-09-07	0.7	9	20.7	9.9	6.9	7.2	0.003	0.003	0.23	0.07		
Kelowna	0500235	2011-03-07	0.65	13	2.4	12.7	7.5	7.5	0.002	0.002	0.16	0.13		
Kelowna	0500236	2011-04-18	*0.5*	16	5.1	9.25	7.4	7.4	0.001	0.001	0.18	0.19	0.15	0.13
Kelowna	0500236	2011-05-17	2.8	12	9.4	3.5	7.5	7.4	*0.001*	*0.001*	0.27	0.22	0.26	0.21
Kelowna	0500236	2011-06-13	1	10	15.1	3.9	6.7	6.9	0.001	0.001	0.21	0.18	0.21	0.17
Kelowna	0500236	2011-07-11	2.2	11	17.3	5	6.5	6.9	0.001	0.002	0.18	0.19	0.16	0.18
Kelowna	0500236	2011-08-15	1.6	8.9	20.7	6.2	6.5	7.1	0.002	0.002	0.2	0.2	0.19	0.18
Kelowna	0500236	2011-09-07	1.1	8.9	20.2	8.7	6.8	7.3	0.002	0.001	0.13	0.14		
Ok Centre	0500730	2011-03-10	1.15	11.6	3.6	13.3	7.2	7.4	0.002	0.001	0.14	0.12		
Ok Centre	0500730	2011-04-18	0.5	15	6.3	7.8	7.2	7.3	0.001	0.001	0.17	0.16	0.16	0.16
Ok Centre	0500730	2011-05-16	5.3	13	9.3	4.4	6.3	6.7	0.001	0.001	0.25	0.26	0.24	0.24
Ok Centre	0500730	2011-06-13	1.05	11	15.6	4.3	6.4	6.7	0.001	0.001	0.24	0.31	0.23	0.3
Ok Centre	0500730	2011-07-11	1.4	12	18	6.6	6.2	6.7	0.001	0.001	0.18	0.2	0.17	0.18
Ok Centre	0500730	2011-08-15	1	8.8	21.5	7.6	6.2	6.6	0.002	0.001	0.21	0.18	0.21	0.17
Ok Centre	0500730	2011-09-14	1.8	10.5	20.6	8.7	6.7	7	*0.001*	0.003	0.19	0.2		
Armstrong Arm	0500239	2011-04-04	2.3	11.4	4.8	4	7.3	7.4	0.001	0.001	0.21	0.21		
Armstrong Arm	0500239	2011-04-18	1.05	15	7.4	2.15	6.9	7.2	0.002	0.003	0.25	0.21	0.23	0.16
Armstrong Arm	0500239	2011-05-16	3.5	11	13.7	1.95	6.2	7.1	0.001	0.002	0.26	0.22	0.26	0.2
Armstrong Arm	0500239	2011-06-13	1.15	9.9	19.2	3.2	6.4	7.4	0.002	0.001	0.21	0.21	0.21	0.19
Armstrong Arm	0500239	2011-07-11	3.2	12	20.7	1.7	6.4	7.8	0.002	0.008	0.22	0.21	0.21	0.2
Armstrong Arm	0500239	2011-08-15	4.1	9.2	21.8	3.1	6.3	8.1	0.002	0.014	0.22	0.22	0.21	0.21
Armstrong Arm	0500239	2011-09-14	1.05	10.8	20.2	3.8	7	9.7	0.001	0.026	0.21	0.25		

mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
DP (<10m)	**DP (>20m)**	**Ammonia (<10m)**	**Ammonia (>20m)**	**NO2+NO3 (<10m)**	**NO2+NO3 (>20m)**	**TN (<10m)**	**TN (>20m)**	**TP (<10m)**	**TP (>20m)**
0.002	0.002			0.067	0.067	0.12	0.08	0.004	0.004
0.003	0.003	0.012	0.008	0.052	0.052	0.24	0.27	0.004	0.003
0.003	0.002	*0.005*	0.006	0.035	0.05	0.25	0.28	0.003	0.003
0.003	0.003	0.006	0.013	0.004	0.043	0.19	0.27	0.004	0.003
0.003	0.002	0.009	0.015	0.003	0.049	0.2	0.26	0.004	0.003
0.003	0.002	0.019	0.013	0.002	0.051	0.19	0.03	0.003	0.004
0.003	0.003			0.002	0.056	0.23	0.13	0.002	0.003
0.003	0.003			0.068	0.068	0.23	0.19	0.004	0.004
0.003	0.003	0.023	0.059	0.051	0.046	0.23	0.24	0.004	0.003
0.002	*0.002*	0.006	0.006	0.028	0.043	0.29	0.26	0.003	0.002
0.006	0.003	*0.005*	0.013	*0.002*	0.036	0.21	0.22	0.009	0.003
0.002	0.003	0.013	0.011	*0.002*	0.061	0.18	0.25	0.005	0.004
0.003	0.003	0.008	0.015	*0.002*	0.061	0.2	0.26	0.003	0.004
0.004	0.003			*0.002*	0.078	0.13	0.22	0.004	0.005
0.002	0.003			0.065	0.065	0.21	0.19	0.003	0.004
0.002	0.002	0.009	0.008	0.034	0.042	0.2	0.21	0.003	0.003
0.002	0.003	0.007	0.018	0.003	0.038	0.25	0.3	0.003	0.004
0.003	0.004	0.006	0.017	*0.002*	0.026	0.24	0.34	0.004	0.006
0.003	0.002	0.007	0.014	*0.002*	0.033	0.18	0.23	0.005	0.003
0.003	0.003	0.007	0.009	*0.002*	0.044	0.21	0.23	0.004	0.003
0.004	*0.002*			0.2	0.24	0.2	0.24	0.004	0.003
0.002	0.003			0.003	*0.002*	0.21	0.21	0.007	0.008
0.002	0.002	0.016	0.047	*0.002*	*0.002*	0.25	0.21	0.003	0.003
0.002	0.002	*0.005*	0.014	*0.002*	*0.002*	0.26	0.22	0.003	0.003
0.003	0.007	0.006	0.016	0.002	0.011	0.21	0.22	0.008	0.008
0.003	0.01	0.011	0.011	*0.002*	0.052	0.22	0.26	0.007	0.012
0.003	0.014	0.01	0.015	*0.002*	0.082	0.22	0.31	0.006	0.017
0.005	0.032			*0.002*	0.123	0.21	0.37	0.006	0.034

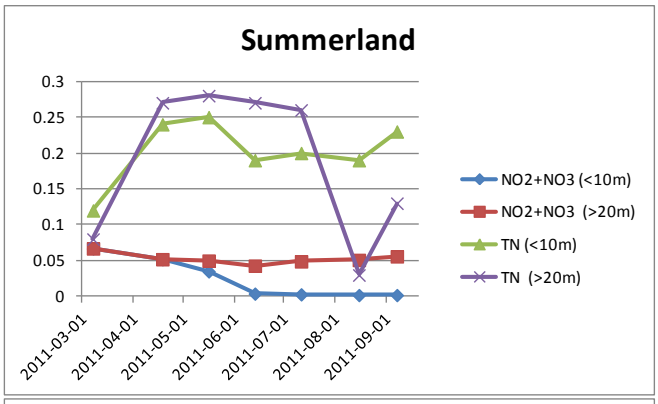
Appendix E: Okanagan Lake seasonal data for dissolved silica data, 2001-2011

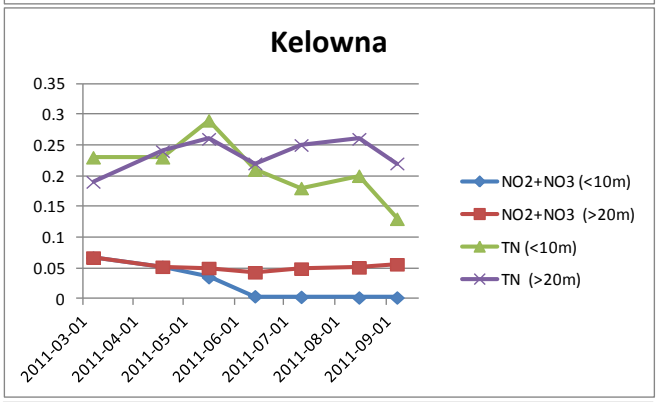
	Summerland		Kelowna		Ok Centre		Armstrong Arm	
	Silica (<10m)	**Silica (>20m)**	**Silica (<10m)**	**Silica (>20m)**	**Silica (<10m)**	**Silica (>20m)**	**Silica (<10m)**	**Silica (>20m)**
	7.6	7.5	7.5	7.5	7.2	7.4	7.3	7.4
	7.3	7.4	7.4	7.4	7.2	7.3	6.9	7.2
	6.9	6.9	7.5	7.4	6.3	6.7	6.2	7.1
	7	7.1	6.7	6.9	6.4	6.7	6.4	7.4
	6.8	7	6.5	6.9	6.2	6.7	6.4	7.8
	6.4	6.7	6.5	7.1	6.2	6.6	6.3	8.1
	6.9	7.2	6.8	7.3	6.7	7	7	9.7
Mean	7.0	7.1	7.0	7.2	6.6	6.9	6.6	7.8
Min	6.4	6.7	6.5	6.9	6.2	6.6	6.2	7.1
Max	7.6	7.5	7.5	7.5	7.2	7.4	7.3	9.7

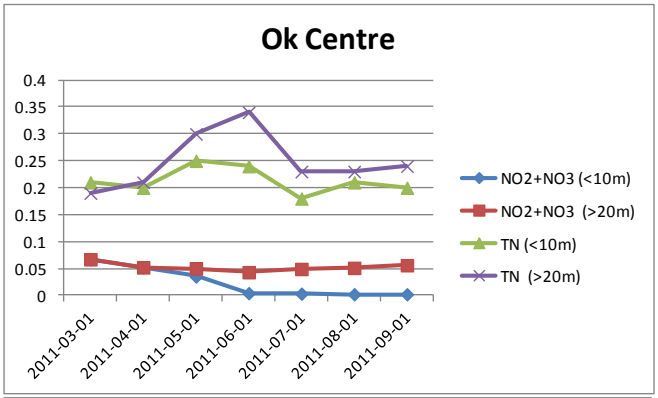
Appendix F: Okanagan Lake total and ortho phosphorus seasonal data, 2011.

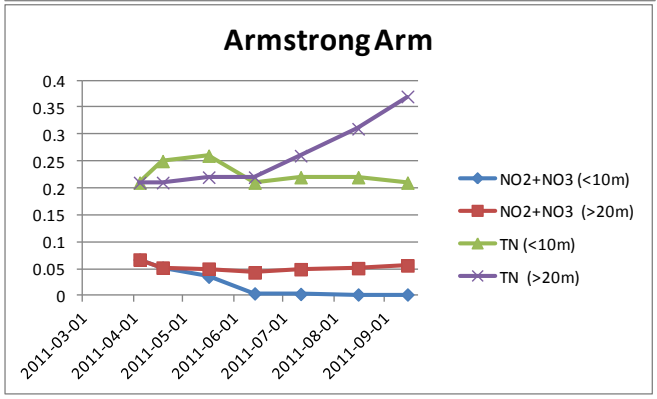


Appendix G: Okanagan Lake total nitrogen and nitrate+nitrite nitrogen seasonal data, 2011.









Appendix H: Okanagan Lake phytoplankton and zooplankton data, 2011.

PHYTOPLANKTON	Okanagan Lk	Okanagan Lk	Okanagan Lk	Okanagan Lk	Okanagan Lk	Okanagan Lk
Site Name	D/S Kelowna STP (deep)	D/S Kelowna STP (deep)	D/S Kelowna STP (deep)	D/S Kelowna STP (deep)	D/S Kelowna STP (deep)	D/S Kelowna STP (deep)
Site Number	0500236	0500236	0500236	0500236	0500236	0500236
Sampling Date(s)	2011-04-18	2011-05-17	2011-06-13	2011-07-11	2011-08-15	2011-09-07
Depth (m)	1-10	1-10	1-10	1-10	1-10	1-10
units	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL
Order : Centrales						
Cyclotella cf bodanica	1.0		8.4	2.8	11.2	2.8
Cyclotella glomerata	5.6	341.6	470.4	145.6	25.2	1.0
Cyclotella spp.	1.0	1.0	11.2	2.8	1.0	5.6
Melosira italica	70.0	53.2	28.0	16.8	5.6	11.2
Melosira sp.			1.0			
Rhizosolenia eriensis / longiseta		11.2	2.8		1.0	
Stephanodiscus cf astrea	1.0	1.0	5.6			2.8
Stephanodiscus Niagarae		1.0	1.0	1.0	1.0	
UID						
Order : Chaetophorales						
Stigeoclonium sp.		1.0				
Order : Chlorococcales						
Actinastrum sp.		1.0				
Ankistrodesmus falcatus	1.0	5.6	1.0	1.0	1.0	1.0
Ankistrodesmus spp.	2.8		1.0			
Botryococcus braunii	1.0	1.0		1.0	1.0	1.0
Closteriopsis cf longissima		1.0	1.0	1.0	2.8	1.0
Closteriopsis sp.	1.0					
Coelastrum cf microporum					1.0	
Crucigenia quadrata	1.0	1.0	33.6	1.0	11.2	1.0
Crucigenia cf rectangularis						1.0
Crucigenia tetrapedia						1.0
Elakatothrix gelatinosa	1.0	11.2	11.2	22.4	16.8	16.8
Nephrocytium sp. ?	1.0	1.0		1.0		1.0
Oocystis cf lacustris			1.0		1.0	
Oocystis spp.	1.0			1.0	1.0	
Quadrigula closterioides						1.0
Quadrigula sp.						1.0
Schroederia sp.?	1.0					
Selenastrum minutum			1.0	1.0	5.6	8.4
Sphaerocystis schroeteri	1.0	1.0			1.0	1.0
Tetraedron minimum					1.0	1.0
Order : Chroococcales						
Anacystis elachista	1.0	1.0	1.0	1.0	1.0	364.0
Anacystis cf limneticus						1.0
Anacystis sp.				1.0		1.0
Gomphosphaeria aponina				1.0		1.0
Gomphosphaeria pallidum						1.0

Gomphosphaeria spp.				1.0		
Order : Cryptomonadales						
Chroomonas acuta	70.0	14.0	28.0	103.6	22.4	50.4
Cryptomonas ovata / erosa		1.0	30.8	11.2	2.8	1.0
Cryptomonas sp.	1.0	1.0	1.0	5.6	1.0	1.0
Order: Dinokontae						
Ceratium hirundinella			1.0			
Peridinium cf inconspicuum			1.0		1.0	
Peridinium / Glenodinium		1.0	1.0	1.0		
Gymnodinium sp. ?			1.0	1.0	1.0	
Order : Nostocales						
Anabaena cf affinis					1.0	
Anabaena cf circinalis			1.0	1.0	1.0	154.0
Anabaena spp.				22.4	30.8	16.8
Anabaena spp ?			1.0			
Aphanizomenon ?					1.0	140.0
Order : Ochromonadales						
Dinobryon cf bavaricum		117.6	42.0	201.6	1.0	5.6
Dinobryon divergens		11.2	1.0	8.4	5.6	
Dinobryon cf sertularia	1.0	39.2				
Dinobryon spp.	1.0	81.2	25.2	30.8	33.6	8.4
Kephyrion/Pseudokephyrion				1.0		1.0
UID cyst		89.6				
UID					1.0	
Order : Oedogoniales						
Oedogonium sp.		1.0				
Order : Oscillatoriales						
Lyngbya cf limnetica	588.0	56.0	1,260.0	722.4	571.2	1,744.4
Lyngbya sp.					1.0	
Oscillatoria cf tenuis	257.6	1.0	392.0	226.8	70.0	168.0
Oscillatoria sp.			1.0			
Oscillatoria sp. ?				1.0		
Order : Pennales						
Achnanthes minutissima		1.0	1.0	1.0	1.0	5.6
Achnanthes sp.	1.0			1.0		
Amphipleura pellucida		1.0				
Amphiprora = Entomoneis sp.		1.0	1.0			
Amphora ovalis	1.0	2.8		1.0	1.0	
Amphora sp.	5.6		1.0	1.0	1.0	1.0
Asterionella formosa			78.4		11.2	1.0
*Asterionella formosa **	19.6	86.8		190.4		
Campylodiscus sp.	1.0					
Ceratoneis arcus		1.0	1.0			
Ceratoneis sp.			1.0			
Cocconeis placentula		1.0		1.0		1.0
Cocconeis sp.	2.8	1.0			1.0	
Cymatopleura cf solea		1.0				
Cymbella affinis		1.0	1.0			1.0
Cymbella cf minuta	1.0	16.8	1.0		2.8	2.8

Cymbella spp.	1.0	8.4	2.8		1.0	1.0
Diatoma elongatum	1.0	5.6			1.0	
Diatoma hiemale		1.0		1.0		
Diatoma vulgare		1.0				
Diatoma spp.	2.8	1.0	1.0			
Diploneis sp.				1.0		
Epithemia turgida	1.0		1.0		1.0	1.0
Epithemia sp.		1.0	1.0			
Eunotia spp.			1.0	1.0		1.0
Fragilaria crotonensis		92.4	103.6	14.0	28.0	1.0
*Fragilaria crotonensis **	2.8					
Fragilaria spp.	1.0	1.0	1.0	1.0	1.0	16.8
Frustulia rhomboides					1.0	
Gomphonema constrictum	1.0	1.0				
Gomphonema geminata		1.0				
Gomphonema olivaceum	1.0		1.0	1.0		1.0
Gomphonema spp.		1.0	1.0	5.6	1.0	2.8
Meridion circulare		1.0				
Navicula radiosa				1.0		
Navicula spp.	1.0	5.6	1.0	1.0	1.0	
Nitzschia spp.	2.8					
Pinnularia cf gibba					1.0	1.0
Pinnularia sp.				1.0		
Pleurosigma/Gyrosigma sp.		1.0		1.0		1.0
Stauroneis sp.						1.0
Surirella sp.						1.0
Synedra actinastroides			1.0			
Synedra acus		2.8	33.6	5.6	1.0	1.0
Synedra capitata			1.0			
Synedra ulna		1.0	1.0	1.0		
Synedra spp.	1.0	1.0	1.0	1.0	1.0	
Tabellaria fenestrata		19.6	67.2	44.8	1.0	5.6
*Tabellaria fenestrata **	42.0					
Tabellaria flocculosa	1.0	1.0				
UID	1.0	1.0	2.8	1.0	1.0	2.8
Order : Rhizochrysidales						
Diceras phaseolus				1.0	1.0	2.8
Order : Tetrasporales						
Gloeocystis ampla	1.0				1.0	11.2
Order : Ulothricales						
Ulothrix sp. ?			19.6	5.6	1.0	2.8
Order : Volvocales						
Chlamydomonas sp.				1.0		
UID			1.0	1.0		
Order : Zygnematales						
Arthrodesmus sp.		1.0		1.0	1.0	1.0
Closterium sp.			1.0			
Cosmarium spp.	1.0	1.0	1.0	1.0	1.0	
Euastrum sp.					1.0	

Mougeotia sp. ?		1.0	1.0	2.8	5.6	5.6
Spondylosium planum			2.8	11.2	2.8	5.6
Staurastrum cf paradoxum		1.0	1.0	1.0	1.0	1.0
UID colonial algae		1.0	1.0			
UID unicellular algae				1.0	1.0	
UID filamentous algae			1.0			
* Note : some frustules are bent						
UID flagellates observed but not counted.						
UID = unidentified due to lack of size and/or missing morphological characters.						

PHYTOPLANKTON						
Site Name	Okanagan L S Prairie C-	Okanagan L S Prairie C-	Okanagan L S Prairie C-	Okanagan L S Prairie C-	Okanagan L S Prairie C-	Okanagan L S Prairie C-
Site Number	0500454	0500454	0500454	0500454	0500454	0500454
Sampling Date(s)	2011-04-18	2011-05-16	2011-06-13	2011-07-11	2011-08-15	2011-09-07
Depth (m)	1-10	1-10	1-10	1-10	1-10	1-10
units	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL
Order : Centrales						
Cyclotella bodanica		1.0	1.0	2.8	2.8	11.2
Cyclotella glomerata		5.6	478.8	142.8	30.8	5.6
Cyclotella spp.	2.8	8.4	28.0	2.8	2.8	1.0
Melosira italica	106.4	22.4	19.6	5.6	1.0	5.6
Melosira sp.		1.0		1.0	1.0	
Rhizosolenia eriensis / longiseta			8.4	8.4	1.0	
Stephanodiscus Niagarae	1.0		1.0	1.0	1.0	1.0
Stephanodiscus cf astrea	1.0	1.0	1.0	8.4	1.0	1.0
Order : Chlorococcales						
Ankistrodesmus falcatus	1.0	14.0	2.8	2.8	1.0	
Ankistrodesmus spp.	1.0	1.0	1.0			
Botryococcus braunii	1.0	1.0	1.0	1.0	1.0	1.0
Closteriopsis cf longissima	2.8	1.0	1.0	1.0	1.0	
Crucigenia quadrata	1.0	1.0	1.0	1.0		67.2
Crucigenia cf rectangularis						1.0
Dictyosphaerium pulchellum						1.0
Elakatothrix gelatinosa	1.0	8.4	16.8	11.2	16.8	5.6
Nephrocytium cf ecdysiscepanum						1.0
Nephrocytium sp. ?					1.0	
Oocystis cf lacustris	1.0				11.2	1.0
Oocystis spp.			1.0	1.0	1.0	11.2
Quadrigula closterioides						1.0
Selenastrum minutum				5.6	11.2	1.0
Selenastrum sp.					1.0	1.0
Sphaerocystis schroeteri					1.0	1.0
Tetraedron minimum				1.0	2.8	8.4
Order : Chroococcales						

Anacystis elachista			1.0		280.0	392.0
Anacystis cf limneticus	1.0					44.8
Anacystis sp.						1.0
Gomphosphaeria aponina				1.0		1.0
Gomphosphaeria pallidum			1.0		1.0	1.0
Order : Cryptomonadales						
Chroomonas acuta	25.2	16.8	25.2	19.6	44.8	33.6
Cryptomonas ovata / erosa	2.8	5.6	11.2	8.4	2.8	2.8
Cryptomonas sp.	8.4	2.8	11.2	14.0	2.8	1.0
Order: Dinokontae						
Ceratium hirundinella			1.0	1.0		
Peridinium cf inconspicuum				2.8		
Peridinium / Glenodinium			1.0	1.0		
Gymnodinium sp. ?			1.0	1.0		1.0
Order : Nostocales						
Anabaena cf affinis					1.0	1.0
Anabaena cf circinalis					1.0	56.0
Anabaena cf flos-aquae					1.0	
Anabaena cf spiroides						1.0
Anabaena spp.					168.0	1.0
Aphanizomenon ?					1.0	1.0
Order : Ochromonadales						
Dinobryon cf bavaricum		8.4	11.2	78.4	1.0	1.0
Dinobryon divergens		1.0	2.8		1.0	
Dinobryon elegantissimum						1.0
Dinobryon cf sertularia	1.0	25.2	1.0			
Dinobryon spp.		2.8	16.8	145.6	140.0	5.6
Kephyrion/Pseudokephyrion			5.6	5.6	1.0	11.2
UID Cyst			1.0	1.0		
UID					1.0	
Order : Oscillatoriales						
Lyngbya cf contorta			1.0			
Lyngbya cf limnetica	772.8	392.0	677.6	764.4	137.2	322.0
Oscillatoria cf tenuis	140.0	308.0	266.0	168.0	1.0	196.0
Oscillatoria sp.				84.0		
Oscillatoria sp. ?			1.0		1.0	1.0
UID		1.0				
Order : Pennales						
Achnanthes flexella				1.0	1.0	
Achnanthes minutissima			1.0	2.8	8.4	2.8
Achnanthes sp.			1.0	1.0		
Amphiprora = Entomoneis sp.	1.0	1.0	1.0			
Amphora ovalis	1.0	1.0	1.0	1.0	2.8	2.8
Amphora sp.				1.0	1.0	1.0
Asterionella formosa			123.2	72.8	2.8	1.0
*Asterionella formosa **	5.6	19.6				
Ceratoneis sp.			1.0			
Cocconeis placentula	1.0			1.0	1.0	1.0
Cocconeis sp.	1.0				1.0	

Cymatopleura sp.	1.0		1.0			
Cymbella affinis			1.0	1.0		
Cymbella cf minuta	1.0	1.0	1.0	1.0	2.8	
Cymbella spp.	1.0	1.0	1.0	1.0	1.0	1.0
Diatoma elongatum			2.8	2.8		
Diatoma spp.		1.0	1.0		1.0	1.0
Diploneis sp.			1.0			
Epithemia turgida				1.0		
Epithemia sp.				1.0		
Eunotia spp.				1.0	1.0	
Fragilaria crotonensis		5.6	42.0	19.6	8.4	8.4
*Fragilaria crotonensis **	1.0					
Fragilaria spp.	1.0		14.0	1.0	1.0	1.0
Frustulia spp.						1.0
Gomphonema constrictum			1.0		1.0	
Gomphonema olivaceum		1.0		1.0	1.0	1.0
Gomphonema spp.			1.0	1.0	1.0	
Mastogloia sp.			1.0			
Navicula radiosa			1.0	1.0	1.0	
Navicula spp.		1.0	1.0	2.8	2.8	1.0
Nedium sp.				1.0		
Nitzschia spp.	1.0	8.4				1.0
Pinnularia cf gibba				1.0		
Pleurosigma/Gyrosigma sp.	1.0		1.0		1.0	1.0
Stauroneis sp.					1.0	
Synedra acus		2.8	16.8	28.0	1.0	1.0
Synedra ulna		1.0	1.0	1.0	1.0	
Synedra spp.	1.0	1.0	2.8	1.0	1.0	
Tabellaria fenestrata			50.4	75.6	5.6	
*Tabellaria fenestrata **	22.4	16.8				
UID	1.0	1.0	1.0	1.0	2.8	1.0
Order : Rhizochrysidales						
Diceras phaseolus				1.0	2.8	
Order : Tetrasporales						
Gloeocystis ampla						22.4
Order : Ulothricales						
Ulothrix sp. ?			8.4	5.6	1.0	1.0
Order : Zygnematales						
Arthrodesmus sp.			1.0	1.0	1.0	1.0
Cosmarium spp.		1.0	1.0	1.0	1.0	
Mougeotia sp. ?	1.0	1.0	1.0	1.0	1.0	1.0
Spondylosium planum		1.0	2.8	1.0	2.8	5.6
Staurastrum cf paradoxum			1.0	1.0	1.0	1.0
Staurastrum sp.					1.0	
Zygnema sp.			1.0			
UID						1.0
UID unicellular algae	1.0			1.0	1.0	1.0
UID colonial algae					1.0	

UID filamentous algae				1.0		
* Note : some frustules are bent						
UID flagellates observed but not counted.						
UID = unidentified due to lack of size and/or missing morphological characters.						

ZOOPLANKTON		Okanagan Lk	Okanagan Lk	Okanagan Lk	Okanagan Lk	Okanagan Lk	Okanagan Lk
Site Name		D/S Kelowna STP (deep)	D/S Kelowna STP (deep)	D/S Kelowna STP (deep)	D/S Kelowna STP (deep)	D/S Kelowna STP (deep)	D/S Kelowna STP (deep)
Site Number		0500236	0500236	0500236	0500236	0500236	0500236
FES Sample Number		**110687**	**110688**	**110689**	**110690**	**110691**	**110692**
Sampling Date(s)		2011-04-18	2011-05-17	2011-06-13	2011-07-11	2011-08-15	2011-09-07
Depth (m)		0-45	0-45	0-45	0-45	0-45	0-45
units = total organisms / sample	stage						
Sub-class : Copepoda							
Order : Cyclopoida							
Diacyclops thomasi	adult	3,300	2,600	950	820	600	100
UID	copepodid		100	48,000	68,000	24,000	38,000
Order : Calanoida							
Family : Diaptomidae	copepodid						
Leptodiaptomus ashlandi	adult	15,300	23,000	1,320	3,600	3,200	1,400
Leptodiaptomus ashlandi	copepodid	160,000	98,600	6,300	8,700	19,200	34,000
Epischura nevadensis	adult			2	51	600	890
Epischura nevadensis	copepodid	2		1		3,300	5,900
UID Calanoida / Cyclopoida	nauplii	26,000	1,300	17,000	7,000	9,000	700
Order : Cladocera							
Bosmina longirostris	adult	30		190	7,000	1,200	3,300
Chydorus sphaericus	adult	10					
Daphnia thorata	adult	30		20	160	1,200	2,300
Daphnia sp.	juvenile			20	290	2,700	1,900
Diaphanosoma brachyurum	adult				50	900	1,100
Leptodora kindtii	adult				1	5	14
Family : Sididae	juvenile			50	1,300	2,600	1,200
Phylum : Rotifera							
Conochilus	colony			170	100	2,000	1,600
Kellicottia longispina		32,000	1,800	18,000	6,000	2,100	18,000
Keratella cochlearis		100	100	4,000	3,000	400	6,000
Keratella quadrata		1,400		25,000	14,000	400	
Plautius		3,800	2,200	900			
Polyarthra				1,000			100
Testudinella							100
UID Rotifera		2,000	2,100	1,800			
Order : Mysidacea							
Mysis relicta			5				

TOTAL		243,972	131,805	124,723	120,072	73,405	116,604
UID = unidentified due to lack of size and/or missing morphological characters.							

ZOOPLANKTON							
Site Name		Okanagan Lk/S Prairie C-	Okanagan Lk/S Prairie C-	Okanagan Lk/S Prairie C-	Okanagan Lk/S Prairie C-	Okanagan Lk/S Prairie C-	Okanagan Lk/S Prairie C-
Site Number		0500454	0500454	0500454	0500454	0500454	0500454
Sampling Date(s)		2011-04-18	2011-05-16	2011-06-13	2011-07-11	2011-08-15	2011-09-07
Sampling Time(s)							
Depth (m)		0-45	0-45	0-45	0-45	0-45	0-45
units = total organisms / sample	stage						
Sub-class : Copepoda							
Order : Cyclopoida							
Diacyclops thomasi	adult	2,400	1,190	1,900	700	1,700	800
UID	copepodid	300		21,000	41,000	69,000	80,000
Order : Calanoida							
Family : Diaptomidae	copepodid						
Leptodiaptomus ashlandi	adult	3,300	3,860	1,900	2,500	2,400	1,800
Leptodiaptomus ashlandi	copepodid	79,400	7,900	6,300	8,200	19,800	67,000
Epischura nevadensis	adult	1			7	660	1,600
Epischura nevadensis	copepodid	100			130	2,590	7,400
UID Calanoida / Cyclopoida	nauplii	8,000	1,500	11,000	8,000	17,000	800
Order : Cladocera							
Bosmina longirostris	adult		20		13,000	11,000	2,900
Daphnia thorata	adult			3	17	800	1,400
Daphnia sp.	juvenile				5	2,700	4,200
Diaphanosoma brachyurum	adult				60	1,300	800
Leptodora kindtii	adult					2	
Family : Sididae	juvenile				400	2,100	2,100
Sida crystallina						2	
Phylum : Rotifera							
Conochilus	colony	1,200			2,600	700	1,600
Kellicottia longispina		10,000	300	11,000	32,000	12,000	14,000
Keratella cochlearis		4,000	100	7,000	14,000	14,000	13,000
Keratella quadrata			400	1,300	10,000	4,000	1,000
Plautius		9,000	1,700	13,000		200	
Polyarthra spp.				100			1,000
Testudinella						200	
UID Rotifera		6,000	100	1,200	1,600		
TOTAL		123,701	17,070	75,803	134,219	162,154	201,400
UID = unidentified due to lack of size and/or missing morphological characters.							

Phytoplankton Biovolumes for Okanagan Lake			
cell #		**Average**	
Units = micrometres (µ)	**Length**	**Width**	**Depth**
Order : Centrales			
Cyclotella cf bodanica		31.9	16.2
Cyclotella glomerata		10.1	5.0
Cyclotella spp.		28.3	14.6
Melosira italica	17.8	11.0	5.5
Melosira sp.	21.5	4.7	2.4
Rhizosolenia eriensis / longiseta	65.0	12.0	6.0
Stephanodiscus cf astrea		31.3	16.5
Stephanodiscus Niagarae	60.0	42.9	19.2
Order : Chaetophorales			
Stigeoclonium sp.	20.0	5.0	2.5
Order : Chlorococcales			
Actinastrum sp.	6.0	2.0	1.0
Ankistrodesmus falcatus	50.0	0.5	0.5
Ankistrodesmus spp.	30.0	0.5	0.6
Botryococcus braunii	4.3	27.4	4.0
Closteriopsis cf longissima	380.0	3.8	1.9
Closteriopsis sp.	193.3	4.3	2.2
Coelastrum cf microporum	6.0	4.0	2.0
Crucigenia quadrata	2.5	3.5	1.8
Crucigenia cf rectangularis	20.0	5.0	2.5
Crucigenia tetrapedia	3.5	8.5	
Dictyosphaerium pulchellum		6.5	3.3
Elakatothrix gelatinosa	25.0	3.6	1.8
Kirchneriella sp.	10.0	3.5	1.8
Nephrocytium cf ecdysiscepanum	30.0	15.0	7.5
Nephrocytium sp. ?	8.5	4.5	2.3
Oocystis cf lacustris	15.0	8.0	4.0
Oocystis spp.	9.7	5.0	2.5
Quadrigula closterioides	19.0	2.0	1.0
Quadrigula sp.	20.0	3.0	1.5
Scenedesmus spp.	10.0	2.5	1.3
Schroederia sp.?	60.0	4.0	2.0
Selenastrum minutum	7.5	2.0	1.0
Selenastrum sp.	15.0	3.0	1.5
Sphaerocystis schroeteri	6.0	4.0	2.0
Tetraedron minimum	10.0	10.0	5.0
Order : Chroococcales			
Anacystis elachista	2.0	1.9	
Anacystis cf limneticus	6.0	6.0	
Anacystis sp.		2.0	
Gomphosphaeria aponina	6.0	4.0	
Gomphosphaeria pallidum	2.5	2.0	
Gomphosphaeria sp.?	2.5	2.0	
Gomphosphaeria spp.		2.3	
Order : Cryptomonadales			
Chroomonas acuta	14.0	7.2	3.6

Cryptomonas ovata / erosa	26.0	12.0	6.0
Cryptomonas sp.	24.0	20.0	10.0
Order: Dinokontae			
Ceratium hirundinella	175.0	50.3	25.2
Peridinium cf inconspicuum	19.0	17.5	8.8
Peridinium / Glenodinium	58.3	46.8	23.4
Gymnodinium sp. ?	19.5	16.5	8.3
Order : Nostocales			
Anabaena cf circinalis		6.0	3.0
Anabaena cf flos-aquae	7.0	10.5	2.8
Anabaena cf spiroides		11.6	5.8
Anabaena spp.	5.5	6.1	3.1
Aphanizomenon ?	4.3	2.3	1.2
Order : Ochromonadales			
Dinobryon cf bavaricum	50.0	8.8	4.4
Dinobryon divergens	37.5	7.0	3.5
Dinobryon elegantissimum	27.5	7.5	3.8
Dinobryon cf sertularia	35.0	10.0	5.0
Dinobryon spp.	50.0	10.0	5.0
Kephyrion/Pseudokephyrion	6.6	4.8	2.4
UID Cyst	18.0	8.8	6.9
Order : Oedogoniales			
Oedogonium sp.	30.0	5.0	2.5
Order : Oscillatoriales			
Lyngbya cf contorta	5.0	1.5	0.8
Lyngbya cf limnetica	3.1	1.4	0.7
Lyngbya sp.	4.5	2.5	1.3
Oscillatoria cf tenuis	8.9	3.8	1.9
Oscillatoria sp.		2.5	1.3
Order : Pennales			
Achnanthes flexella	25.0	15.0	7.5
Achnanthes minutissima	12.5	2.5	1.3
Achnanthes sp.	15.0	10.0	5.0
Amphipleura pellucida	77.5	7.5	3.8
Amphiprora = Entomoneis sp.	75.0	54.0	27.0
Amphora ovalis	36.8	17.8	8.9
Amphora sp.	36.0	13.0	6.5
Asterionella formosa	62.5	2.0	1.0
Campylodiscus sp.	62.5	50.0	25.0
Ceratoneis arcus	100.0	5.0	2.5
Ceratoneis sp.	30.0	4.0	2.0
Cocconeis placentula	35.0	20.0	10.0
Cocconeis sp.	20.0	14.0	7.0
Cymatopleura cf solea	70.0	20.0	10.0
Cymatopleura sp.	125.0	40.0	20.0
Cymbella affinis	81.3	31.5	15.8
Cymbella cf minuta	25.3	5.0	3.8
Cymbella spp.	77.5	25.5	14.4
Diatoma elongatum	39.0	4.3	2.2
Diatoma hiemale	20.0	7.5	3.8

Diatoma vulgare	50.0	10.0	5.0
Diatoma spp.	60.0	11.3	5.7
Diploneis sp.	32.5	17.5	8.8
Epithemia turgida	75.0	15.0	7.5
Epithemia sp.	25.0	6.0	3.0
Eunotia spp.	45.8	7.5	3.8
Fragilaria crotonensis	62.5	2.5	1.3
Fragilaria spp.	36.9	4.4	2.2
Frustulia rhomboides	50.0	10.0	5.0
Frustulia spp.	75.0	17.5	8.8
Gomphonema constrictum	57.0	16.8	8.4
Gomphonema geminata	108.0	27.5	13.8
Gomphonema olivaceum	29.8	4.3	2.2
Gomphonema spp.	20.0	6.0	3.0
Meridion circulare	50.0	7.5	3.8
Navicula radiosa	56.8	11.1	5.6
Navicula spp.	35.4	12.3	6.2
Neidium sp.	25.0	17.5	8.8
Nitzschia spp.	37.5	4.5	2.3
Pinnularia cf gibba	240.0	23.8	11.9
Pinnularia sp.	240.0	23.8	11.9
Pleurosigma/Gyrosigma sp.	135.2	20.8	10.4
Stauroneis sp.	100.0	7.5	3.8
Surirella sp.	100.0	40.0	20.0
Synedra actinastroides	65.0	1.5	0.8
Synedra acus	300.0	3.2	1.6
Synedra capitata	300.0	9.0	4.5
Synedra ulna	470.0	6.8	3.4
Synedra spp.	175.0	5.0	2.5
Tabellaria fenestrata	65.8	2.4	1.3
Tabellaria flocculosa	35.0	3.5	1.8
UID	60.0	12.0	6.0
Order : Rhizochrysidales			
Diceras phaseolus	37.5	10.0	5.0
Order : Tetrasporales			
Gloeocystis ampla	12.5	5.5	2.8
Order : Ulothricales			
Ulothrix sp. ?	27.5	4.9	2.4
Order : Volvocales			
Chlamydomonas sp.	24.0	20.0	10.0
Order : Zygnematales			
Arthrodesmus sp.	25.0	12.5	6.3
Closterium sp.	135.0	12.0	6.0
Cosmarium spp.	50.0	25.0	12.5
Euastrum sp.	50.0	25.0	12.5
Mougeotia sp. ?	65.0	4.0	2.0
Mougeotia sp.	42.5	3.5	1.8
Spondylosium planum	17.5	12.5	6.3
Staurastrum cf paradoxum	37.5	20.0	10.0
Staurastrum sp.	37.5	20.0	10.0

Zygnema sp.	50.0	7.5	3.8

Zooplankton Biovolumes for Okanagan Lake				
cell #			**Average**	
Units = micrometres (µ)	stage	**Length**	**Width**	**Depth**
Sub-class : Copepoda				
Order : Cyclopoida				
Diacyclops thomasi	adult	1,573	417	274
Diacyclops thomasi	copepodid	681	190	106
UID	copepodid	738	216	148
Order : Calanoida				
Family : Diaptomidae	copepodid			
Leptodiaptomus ashlandi	adult	2,134	534	482
Leptodiaptomus ashlandi	copepodid	3,188	780	780
Epischura nevadensis	adult	3,194	1,120	988
Epischura nevadensis	copepodid	5,371	1,314	1,256
UID Calanoida / Cyclopoida	nauplii	269	108	99
Order : Cladocera				
Bosmina longirostris	adult	392	293	154
Chydorus sphaericus	adult	360	300	220
Daphnia thorata	adult	2,098	877	462
Daphnia sp.	juvenile	846	266	154
Diaphanosoma brachyurum	adult	1,588	708	608
Leptodora kindtii	adult	5,980	1,380	570
Family : Sididae	juvenile	862	332	298
Sida crystallina		2,120	960	720
Phylum : Rotifera				
Conochilus	colony	382	386	386
Filinia		240	100	100
Kellicottia longispina		140	102	68
Keratella cochlearis		100	60	20
Keratella quadrata		161	88	57
Plautius		219	150	60
Polyarthra spp.		172	104	100
Testudinella		520	227	227
UID Rotifera		212	141	138
Order : Mysidacea				
Mysis relicta		7,310	1,010	1,010

Appendix I: 2011 ONA Invoices

OKANAGAN NATION ALLIANCE
#106 - 3500 Carrington Road, Westbank, BC V4T 3C1
Phone 250-707-0095 Toll Free 1-866-662-9609 Fax 250-707-0166 www.syilx.org

INVOICE

PROJECT: Okanagan Lake Sampling
INVOICE NO: 636-001
INVOICE DATE: April 30, 2011
DATE SENT: July 8, 2011

TO:

Vic Jensen
Ministry of Environment
102 Industrial Place
Penticton, BC V2A 7C8

Contract #: 2930563
Email: vic.jensen@gov.bc.ca
Phone: 250-490-8258

For professional services provided for April 2011

OK Lake Sampling

Professional Fees:	**SUB-TOTAL**
Program Delivery April	$ *2,036.65*
Per Contract: 1 of 5 sessions	
Total Due (CAD)	**$ 2,036.65**

Please make all cheques payable to: **Okanagan Nation Alliance.**
If you have any questions concerning this invoice please call Judith Monroe at (250) 707-0095

Capital Goods Received
Received DD/MM/YY 11 / 7 / 2011
Signature: _____ Date: July 11/2011
Qualified Receiver
Printed name: Vic Jensen
Is this a capital Asset? Yes ___ No X
(If yes - enter stob 2000 in A/E)
294KI 30595 / 2930563
Client/Resp/Service Line/Stob/Project
Invoice (if not on invoice) #
WIP #
P.O. or Contract #
Prices, extensions checked: (initial)
Expense Authority
Printed Name:
If required,
Signature:

OKANAGAN NATION ALLIANCE

#106 - 3500 Carrington Road, Westbank, BC V4T 3C1
Phone 250-707-0095 Toll Free 1-866-662-9609 Fax 250-707-0166 www.syilx.org

INVOICE

PROJECT: Okanagan Lake Sampling
INVOICE NO: 636-002
INVOICE DATE: May 31, 2011
DATE SENT: July 13, 2011

TO:

Vic Jensen
Ministry of Environment
102 Industrial Place
Penticton, BC V2A 7C8

Contract #: 2930563
Email: vic.jensen@gov.bc.ca
cc: mike.sokal@gov.bc.ca
Phone: 250-490-8258

For professional services provided for May 2011

OK Lake Sampling

Professional Fees:	**SUB-TOTAL**
Program Delivery April	$ *2,036.65*
Per Contract: 2 of 5 sessions	
Total Due (CAD)	**$ 2,036.65**

Please make all cheques payable to: **Okanagan Nation Alliance.**
If you have any questions concerning this invoice please call Peggy Nowosad at (250) 707-0095

Goods Services Received
Rec'd ODMMYY: 13 / 7 / 2011
Signature: July 13/2011
Printed name: VIC Jensen
Is this a capital Asset? X
(If yes - enter item number in A/P)
294K1 30595 2930563.
Client/Resp/Service Line/Stob
Invoice # (if not on invoice)
WIP #
P.O. or Contract #:
Prices, extensions checked. (initial)
Expense Authority
Printed Name:
Signature:

OKANAGAN NATION ALLIANCE

#106 - 3500 Carrington Road, Westbank, BC V4T 3C1
Phone 250-707-0095 Toll Free 1-866-662-9609 Fax 250-707-0166 www.syilx.org

INVOICE

PROJECT: Okanagan Lake Sampling
INVOICE NO: 636-003
INVOICE DATE: June 30, 2011
DATE SENT: August 11, 2011

TO:

Vic Jensen
Ministry of Environment
102 Industrial Place
Penticton, BC V2A 7C8

Contract #: 2930563
Email: vic.jensen@gov.bc.ca
cc: mike.sokal@gov.bc.ca
Phone: 250-490-8258

For professional services provided for June 2011

OK Lake Sampling

	SUB-TOTAL
Professional Fees:	
Program Delivery April	$ 2,036.65
Per Contract: 3 of 5 sessions	
Total Due (CAD)	**$ 2,036.65**

Aug 15/2011
Vic Jensen X
2941.30595 29 30563

Please make all cheques payable to: **Okanagan Nation Alliance.**
If you have any questions concerning this invoice please call Peggy Nowosad at (250) 707-0095

OKANAGAN NATION ALLIANCE

#106 - 3500 Carrington Road, Westbank, BC V4T 3C1
Phone 250-707-0095 Toll Free 1-866-662-9609 Fax 250-707-0166 www.syilx.org

INVOICE

PROJECT: Okanagan Lake Sampling
INVOICE NO: 636-004
INVOICE DATE: July 31, 2011
DATE SENT: Sept 12, 2011

TO:

Vic Jensen
Ministry of Environment
102 Industrial Place
Penticton, BC V2A 7C8

Contract #: 2930563
Email: vic.jensen@gov.bc.ca
cc: mike.sokal@gov.bc.ca
Phone: 250-490-8258

For professional services provided for July 2011

OK Lake Sampling

Professional Fees:

	SUB-TOTAL
Program Delivery April Per Contract: 4 of 5 sessions	$ 2,036.65
Total Due (CAD)	**$ 2,036.65**

12 09 11
Sept 12/11
Vic Jensen
X
294 KI 30595 2930563

Please make all cheques payable to: **Okanagan Nation Alliance.**
If you have any questions concerning this invoice please call Peggy Nowosad at (250) 707-0095

OKANAGAN NATION ALLIANCE

#106 - 3500 Carrington Road, Westbank, BC V4T 3C1
Phone 250-707-0095 Toll Free 1-866-662-9609 Fax 250-707-0166 www.syilx.org

INVOICE

PROJECT: Okanagan Lake Sampling
INVOICE NO: 636-005
INVOICE DATE: August 31, 2011
DATE SENT: Sept 12, 2011

TO:

Vic Jensen
Ministry of Environment
102 Industrial Place
Penticton, BC V2A 7C8

Contract #: 2930563
Email: vic.jensen@gov.bc.ca
cc: mike.sokal@gov.bc.ca
Phone: 250-490-8258

For professional services provided for August 2011

OK Lake Sampling

Professional Fees:	**SUB-TOTAL**
Program Delivery April Per Contract: 4 of 5 sessions	$ 2,036.65
	Total Due (CAD) $ 2,036.65

12 . 09 . 2011 Sept 12/11
Vic Jensen
294K1 30595 2930563

Please make all cheques payable to: **Okanagan Nation Alliance.**
If you have any questions concerning this invoice please call Peggy Nowosad at (250) 707-0095

Appendix J: Maxxam Analytics invoice records, 2011

Maxxam

Success Through Science®

Maxxam
4606 Canada Way
Burnaby British Columbia
Canada V5G 1K5
Tel (604) 734 7276
Fax (604) 731 2386

Invoice : Reference Only

Invoice Date: 07 Nov 11
Page 21 of 28

To: MINISTRY OF ENVIRONMENT

#401-333 Victoria Street
Nelson, BC
V1L 4K3
Att:Linda Reid

Account # : 151023

Client Code 4818 continued

Client Code	Invoice Number	Invoice Date	Job Number	Project#(Name)	Requisition Id	Invoice Amount
	509804	2011/04/20	B126928	S030122OLK	50180445	103.00
	510069	2011/04/21	B130015	S030122OLK	50180588	42.00
	510234	2011/04/25	B130005	S030122OLK	50180590	150.00
	510237	2011/04/25	B130012	S030122OLK	50180589	150.00
	514330	2011/05/09	B134297	S030122OLK	50180591	32.00
	515401	2011/05/12	B134276	S030122OLK	50180592	150.00
	520254	2011/05/31	B141170	S030122OLK	50182368	150.00
	523207	2011/06/13	B141151	S030122OLK	50182367	150.00
	526116	2011/06/24	B151921	S030122OLK	50182956	150.00
	526117	2011/06/24	B151927	S030122OLK	50182957	150.00
	538674	2011/08/03	A954755	S030122OLK	50167241	0.00
				Project S030122OLK SubTotal :		3,419.50
				Project S030122OLK HST Total :		410.34
				Project S030122OLK YTD SubTotal :		11,778.00
				Project S030122OLK HST YTD Total :		1,413.36
	538698	2011/08/03	B020734	S030122OLK	50171451	0.00
				Project S030122OLK SubTotal :		0.00
				Project S030122OLK HST Total :		0.00
				Project S030122OLK YTD SubTotal :		11,778.00
				Project S030122OLK HST YTD Total :		1,413.36
	538838	2011/08/04	B165112	S030122OLK	50183508	150.00
	538840	2011/08/04	B165115	S030122OLK	50183507	150.00
	543787	2011/08/25	B176433	S030122OLK	50184520	30.00
	543796	2011/08/25	B176436	S030122OLK	50184523	30.00
	543798	2011/08/25	B176443	S030122OLK	50184521	30.00
	543800	2011/08/25	B176450	S030122OLK	50184519	30.00
	543802	2011/08/25	B176451	S030122OLK	50184447	30.00
	543803	2011/08/25	B176453	S030122OLK	50184522	30.00
	546202	2011/08/31	B176425	S030122OLK	50184147	150.00
	548060	2011/09/02	B176423	S030122OLK	50184148	150.00
	551131	2011/09/20	B184344	S030122OLK	50184905	150.00

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Fax (604) 731 2386

Invoice : Reference Only

Invoice Date: 07 Nov 11

To: MINISTRY OF ENVIRONMENT

#401-333 Victoria Street
Nelson, BC
V1L 4K3
Att:Linda Reid

Account # : 151023

Client Code 4818 continued

Client Code	Invoice Number	Invoice Date	Job Number	Project#(Name)	Requisition Id	Invoice Amount
	551154	2011/09/20	B184356	S030122OLK	50184904	150.00
	551190	2011/09/20	B185045	S030122OLK	50184903	150.00
	551199	2011/09/20	B185047	S030122OLK	50184901	150.00
	552161	2011/09/22	B185048	S030122OLK	50184902	150.00
	552871	2011/09/26	B182111	S030122OLK	50184896	150.00
	552971	2011/09/26	B187115	S030122OLK	50184929	141.00
	553401	2011/09/27	B186802	S030122OLK	50184910	150.00
				Project S030122OLK SubTotal :		1,971.00
				Project S030122OLK HST Total :		236.52
				Project S030122OLK YTD SubTotal :		11,778.00
				Project S030122OLK HST YTD Total :		1,413.36
	553402	2011/09/27	B186805	S030122OLK	50184912	150.00
				Project S030122OLK SubTotal :		150.00
				Project S030122OLK HST Total :		18.00
				Project S030122OLK YTD SubTotal :		11,778.00
				Project S030122OLK HST YTD Total :		1,413.36
	553403	2011/09/27	B186812	S030122OLK	50184906	150.00
	553406	2011/09/27	B187106	S030122OLK	50184914	150.00
	553407	2011/09/27	B187112	S030122OLK	50184913	150.00
	553520	2011/09/28	B187758	S030122OLK	50184918	150.00
	553523	2011/09/28	B187760	S030122OLK	50184917	150.00
	553524	2011/09/28	B187762	S030122OLK	50184916	150.00
	553525	2011/09/28	B187766	S030122OLK	50184915	150.00
	553866	2011/09/28	B186809	S030122OLK	50184911	150.00
	557498	2011/10/04	B189819	S030122OLK	50184919	150.00
	557499	2011/10/04	B189831	S030122OLK	50184920	150.00
	557945	2011/10/06	B190319	S030122OLK	50184922	150.00
	557946	2011/10/06	B190337	S030122OLK	50184923	103.00
	558193	2011/10/07	B190328	S030122OLK	50184921	103.00
	558538	2011/10/12	B196182	S030122OLK	50186214	22.50
	558540	2011/10/12	B196186	S030122OLK	50186215	22.50

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Invoice Date: 07 Nov 11

To: MINISTRY OF ENVIRONMENT

#401-333 Victoria Street
Nelson, BC
V1L 4K3
Att:Linda Reid

Account # : 151023

Client Code 4818 continued

Client Code	Invoice Number	Invoice Date	Job Number	Project#(Name)	Requisition Id	Invoice Amount
	564293	2011/10/31	B198475	LSSS	50184085	119.00
				Project LSSS SubTotal :		4,480.00
				Project LSSS HST Total :		537.60
				Project LSSS YTD SubTotal :		9,033.50
				Project LSSS HST YTD Total :		1,084.02
	520240	2011/05/31	B140051	OKCOLAB11	50181105	160.00
				Project OKCOLAB11 SubTotal :		160.00
				Project OKCOLAB11 HST Total :		19.20
				Project OKCOLAB11 YTD SubTotal :		160.00
				Project OKCOLAB11 HST YTD Total :		19.20
	512312	2011/04/29	B131535	OKLCOLAB11	50181099	160.00
	512316	2011/04/29	B131546	OKLCOLAB11	50181087	160.00
	512319	2011/04/29	B131554	OKLCOLAB11	50181104	160.00
	514989	2011/05/11	B131551	OKLCOLAB11	50181094	160.00
	520241	2011/05/31	B140057	OKLCOLAB11	50181109	156.00
	520247	2011/05/31	B140640	OKLCOLAB11	50181095	160.00
	520236	2011/05/31	B140026	OKLCOLAB11	50181100	160.00
	520239	2011/05/31	B140045	OKLCOLAB11	50181089	160.00
	524360	2011/06/17	B150728	OKLCOLAB11	50181106	160.00
	524364	2011/06/17	B150730	OKLCOLAB11	50181096	160.00
	524367	2011/06/17	B150734	OKLCOLAB11	50181090	160.00
	525997	2011/06/23	B150731	OKLCOLAB11	50181101	160.00
	533882	2011/07/22	B161811	OKLCOLAB11	50181110	156.00
	533883	2011/07/22	B161820	OKLCOLAB11	50181102	160.00
	535849	2011/07/28	B161813	OKLCOLAB11	50181097	160.00
	535852	2011/07/28	B161817	OKLCOLAB11	50181092	160.00
	535855	2011/07/28	B161823	OKLCOLAB11	50181107	160.00
	543623	2011/08/24	B175509	OKLCOLAB11	50181108	160.00
	543624	2011/08/24	B175527	OKLCOLAB11	50181103	160.00
	543625	2011/08/24	B175537	OKLCOLAB11	50181098	160.00
	545511	2011/08/30	B175532	OKLCOLAB11	50181093	160.00

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Invoice : Reference Only

Invoice Date: 07 Nov 11

To: MINISTRY OF ENVIRONMENT

#401-333 Victoria Street
Nelson, BC
V1L 4K3
Att:Linda Reid

3352
160
150
150
150
150 / 4112

Account # : 151023

Client Code 4818 continued

Client Code	Invoice Number	Invoice Date	Job Number	Project#(Name)	Requisition Id	Invoice Amount
				Project OKLCOLAB11 SubTotal :		3,352.00
				Project OKLCOLAB11 HST Total :		402.24
				Project OKLCOLAB11 YTD SubTotal :		3,352.00
				Project OKLCOLAB11 HST YTD Total :		402.24
	538718	2011/08/03	B0A1336	ONA 10	50172888	0.00
				Project ONA 10 SubTotal :		0.00
				Project ONA 10 HST Total :		0.00
				Project ONA 10 YTD SubTotal :		0.00
				Project ONA 10 HST YTD Total :		0.00
	520289	2011/05/31	B142720	ONA11	50181901	28.00
	520291	2011/05/31	B142721	ONA11	50181899	28.00
	520295	2011/05/31	B142740	ONA11	50181898	163.00
	520296	2011/05/31	B142745	ONA11	50181900	163.00
	526516	2011/06/27	B153618	ONA11	50181905	163.00
	526517	2011/06/27	B153621	ONA11	50181903	163.00
	526519	2011/06/27	B153635	ONA11	50181902	28.00
	526520	2011/06/27	B153643	ONA11	50181904	28.00
	527221	2011/06/28	B153633	ONA11	50181935	135.00
	533955	2011/07/22	B164578	ONA11	50181908	163.00
	533957	2011/07/22	B164592	ONA11	50181906	163.00
	533959	2011/07/22	B164607	ONA11	50181907	28.00
	533960	2011/07/22	B164611	ONA11	50181909	28.00
	543780	2011/08/25	B175914	ONA11	50181913	28.00
	543781	2011/08/25	B175916	ONA11	50181911	28.00
	548054	2011/09/02	B175902	ONA11	50181936	135.00
	548057	2011/09/02	B175906	ONA11	50181910	163.00
	548059	2011/09/02	B175912	ONA11	50181912	163.00
	553408	2011/09/27	B187727	ONA11	50181930	28.00
	553409	2011/09/27	B187730	ONA11	50181928	28.00
	558195	2011/10/07	B187732	ONA11	50181927	163.00
	558375	2011/10/11	B187738	ONA11	50181929	163.00

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Appendix K: Fraser Environmental invoice records, 2011

Attention : Robyn Roome
B.C. Ministry of Environment
Cranbrook, Nelson and Penticton, B.C.
Rm. 401-333 Victoria Street
Nelson, B.C.
V1L 4K3
(250) 354-6333
Robyn.Roome@gov.bc.ca

BILLING FOR JANUARY 2012

Payee : Linde Looy
FRASER ENVIRONMENTAL SERVICES
9358 Cinnamon Drive
Surrey, B.C., V3V 1V2
telephone and fax (604) 588-9738

Ministry Contract EQB-11-002-2

INVOICE # 878-TQ

Total for Client Code TQ **$ 7,512.96**

Outstanding Balances

Balance Payable from Previous Month $ 0.00

Appendix L: Draft MOU for Years 2012-14

MEMORANDUM OF UNDERSTANDING

BETWEEN

MINISTRY OF ENVIRONMENT

GOVERNMENT OF THE PROVINCE OF

BRITISH COLUMBIA

AND

THE CITY OF KELOWNA

AND

THE REGIONAL DISTRICT OF CENTRAL OKANAGAN

AND

THE DISTRICT OF SUMMERLAND

RESPECTING

THE *Okanagan Lake Collaborative Monitoring Agreement* for **2012-2014**

BETWEEN:

Government of the Province of British Columbia

As Represented by

Mike Sokal, Impact Assessment Biologist of the

Environmental Protection Division

Ministry of Environment

(hereinafter referred to as the "MOE")

AND

City of Kelowna

As Represented by

Mike Gosselin, Supervisor Wastewater Treatment Operations

Regional District of Central Okanagan

As Represented by

Angela Lambrecht, Water and Wastewater Process Technologist

District of Summerland

As Represented by

Kevin McLuskey, Supervisor Wastewater Treatment Operation

(hereinafter referred to as the "local governments")

THE PARTIES AGREE AS FOLLOWS:

SECTION 1.0 INTERPRETATION

1.1 In this Memorandum of Understanding (MOU) each of the following terms will, unless the context otherwise requires, have the meaning set beside it:

(a) "**Costs,"** means all costs incurred by the Ministry of Environment to deliver the Collaborative Monitoring and Reporting Program set out in Appendix 1.

(b) **"Memorandum of Understanding,"** or **"MOU,"** means this agreement describing the delivery of a collaborative monitoring program on Okanagan Lake.

(c) **"MOE"** means Ministry of Environment, for the Province of British Columbia.

(d) **"local government"** means the City of Kelowna, Regional District of Central Okanagan, and District of Summerland and designates who are signatories to this MOU.

(e) **"Participants"** means representatives of each organization, either MOE or local governments, who are signatories to this MOU.

SECTION 2.0 AGREEMENT AUTHORITY

2.1 This MOU is entered into by the Ministry of Environment under the authority of the *Environment Management Act, Part 2 Section 14 Permits (1)(c)* allowing MOE to require the permittee (here the local governments) to monitor the effects of the introduction of waste into the environment. Where authorizations, permits or operational certificates under the *Environmental Management Act* enable a discharge to surface water, there is an expectation the discharger will provide monitoring information to demonstrate environmental condition.

SECTION 3.0 SUBJECT MATTER

3.1 Three Year Collaborative Monitoring and Reporting Program

3.1.1 A collaborative monitoring and reporting program is to replace receiving environment monitoring and environmental impact assessment programs required under existing Municipal Sewage Regulation Operational Certificates.

3.1.2 Monthly sample and associated field measurement collection from March through September, and analysis of water chemistry for 4 sites and plankton taxonomy for 2 sites on Okanagan Lake as per Appendix 1.

3.1.3 Annual reporting of Okanagan Lake trophic status, trends, and attainment of water quality objectives through the MOE or other suitable web sites.

3.2 Operational Certificates and Lake Monitoring

3.2.1 Lake monitoring requirements under the Operational Certificates ME 12211, PE 11652 and ME 13627 for the City of Kelowna, Regional District of Central Okanagan, and District of Summerland respectively, are waived while the named local governments participate in this Collaborative Monitoring MOU. The MOE will provide written confirmation following MOU sign-off. Other local governments with effluent discharges to Okanagan Lake may become participants under the terms of this MOU.

3.2.2 Effluent monitoring requirements and compliance with all other terms and conditions of the Operational Certificates will remain in effect.

3.3 Cost Estimates of Program:

3.3.1 Costs of this program include laboratory and sample collection costs.

3.3.2 Laboratory expenses are as per Appendix 1: $11,000 (full program 2 sites + 2 sites chemistry only: Okanagan Centre, Armstrong Arm)

3.3.3 Sample collection contract: $11,000

3.3.4 Total projected annual costs: $22,000 (costs based on 18M m3 effluent discharged per year = $0.0013/m3).

3.4 Roles and Responsibilities

3.4.1 The Ministry will contribute in-kind costs of program coordination and contract management for sample collection and reporting of results.

3.4.2 The local governments agree to provide the Ministry with funds sufficient to cover costs as described in Section 5.0 and detailed in Appendix 1.

3.4.3 Representatives of MOE and local governments will form a Technical Advisory Group and will meet annually to review actions carried out under this MOU, and determine renewal of this MOU from year to year.

3.4.4 The Technical Advisory Group may invite input from other agencies or institutions to further the intent of this MOU.

SECTION 4.0 SECURITY AND CONFIDENTIALITY

4.1 All information and documentation provided to, collected by, delivered to or compiled by ministry employees, in the performance of their duties and responsibilities will be dealt with subject to and in accordance with all applicable provisions of Federal, Provincial and Municipal Statutes, particularly

the *Privacy Act,* R.S.C. 1985, c, P-21, and the *Access to Information Act,* R.S.C. 1985**,** c. A-1**,** and the *Freedom of Information and Protection of Privacy Act,* R.S.B.C. 2004, c.165.

SECTION 5.0 BASIS OF PAYMENT

5.1 The local governments will provide the MOE start-up costs for contract services and laboratory services.

5.2 Local government share of costs and maximum estimated annual costs are as follows:

City of Kelowna 50% or $11,000

District of Central Okanagan 32% or $7000

District of Summerland 18% or $4000

5.3 When another municipal effluent discharge routinely occurs to Okanagan Lake, the monitoring requirements and costs will be re-evaluated and re-apportioned.

SECTION 6.0 METHOD OF PAYMENT

6.1 The local governments are responsible for providing maximum costs as per Section 5, before January 31 of years 2012 to 2014, by way of cheque to the **Minister of Finance for British Columbia** *c/o Senior Financial Officer of Corporate Services Division, Ministry of Environment, 4th Floor 333 Victoria Street, Nelson, BCV1L 4K3.*

6.2 The MOE agrees to provide the local governments with a financial statement and an Annual Report.

6.3 Surplus funds at the end of the sampling season will be reviewed by the Technical Advisory Group and will be returned to local governments or reallocated through renewal of this MOU for the following year.

SECTION 7.0 LIABILITY

7.1 Each participant and personnel by association, waives all claims against the other participants in respect of damage caused to its personnel and/or its property by personnel or agents (excluding contractors) of that other participant arising out of, or in connection with the implementation of this MOU.

7.2 The provisions of sections 7.1 will survive the termination of this MOU for any reason whatsoever.

SECTION 8.0 DISPUTE RESOLUTION

8.1 Any new issue, matter of general concern or dispute arising from this MOU will be dealt with by Technical Advisory Group or their delegates.

8.2 The dispute or disagreement will not be submitted to a third party for resolution.

SECTION 9.0 TERM OF AGREEMENT

9.1 This MOU will begin January 31, 2012 and end December 31, 2014.

9.2 This MOU may be reviewed annually and amended by mutual written agreement by the Participants to this MOU.

9.3 Prior to the termination of this MOU, it may be renewed for an additional period on terms agreed to by participants to this MOU.

9.4 Any of the participants to this MOU may terminate participation in this agreement upon provision of sixty (60) days written notice to the other participants of their intention to terminate participation in this MOU.

9.5 On the date of termination of this MOU or termination of participation in this agreement, the lake monitoring requirements under local government operational certificates or permits as noted above, are reinstated. Regardless of the reason for termination or the participant who gives notice of termination, the MOE will not have any obligation to the local governments beyond the reimbursement of funds surplus to costs incurred by MOE to the effective date of termination.

SECTION 10.0 NOTICE

10.1 All official notices and communications pertinent to implementation of this MOU will be in writing and will be mailed or delivered. For the purposes of delivery of Notice, the addresses for delivery are:

For MOE

Ministry of Environment

Attention: Manager, Environmental Protection Division

Suite 401, 333 Victoria Street, Nelson B.C. V1L 4K3

For local governments

City of Kelowna

Attention: Mike Gosselin, Supervisor Wastewater Treatment Operations

951 Raymer Avenue, Kelowna, BC V1Y 4Z7

Regional District of Central Okanagan

Attention: Angela Lambrecht, Water and Wastewater Technologist

1450 K.L.O. Road, Kelowna, BC, V1W 3Z4

District of Summerland

Attention: Kevin McLuskey, Supervisor Wastewater Treatment Operation

13211 Henry Avenue Box 159 Summerland, BC, V0H 1Z0

SECTION 11.0 SAVING PROVISION

11.1 Nothing in this Memorandum of Understanding is in any way intended to replace or amend any obligation that participants are bound to, or required to perform by operation of law, unless otherwise noted in this MOU.

SECTION 12.0 GENERAL

13.1 This MOU reflects the good faith and spirit of cooperation of the participants but is not legally binding on any of the participants.

Signed on behalf of the MOE:

_____ _____

Michael Sokal Date
Ministry of Environment
Province of British Columbia

Signed on behalf of local governments:

_____ _____

Mike Gosselin Date
City of Kelowna

_____ _____

Angela Lambrecht Date
Regional District of Central Okanagan

_____ _____

Kevin McLuskey Date
District of Summerland

Appendix M: Cost estimates for 2012

Parameter	Lab 2011	# tests	parameter cost
Chloro a	$28.00	2	$56.00
Nitrogen: Total	$10.00	2	$20.00
Nitrogen: ammonia-diss	$5.00		$0.00
Nitrite-diss	$5.20		$0.00
NO2 + NO3-diss	$5.00	2	$10.00
Phos-OrthoP diss	$5.00	2	$10.00
Phos-OrthoP diss (LL)	$5.00		$0.00
Phos-Tot Diss	$10.00		$0.00
Phos-Tot	$10.00	2	$20.00
Taxonomy- Phytopl. (Id&Ct/dom-sp,ndom-gen) + biovolume	$347.20	1	$347.20
Taxonomy- Zoopl. (Id&Ct/dom-sp,ndom-gen) + biovolume	$280.00	1	$280.00

Chemistry & Chloro A		Plankton taxonomy	
# tests	cost	# tests	cost
Lab analysis/visit	$116.00	Lab analysis/visit	$627.20
# sites	4	# sites	2
# dates	6	# dates	6
Lab Total	$ 2,784.00	Lab Total	$ 7,526.40
QA 10%	278.40		
Maxxam est	3062.40		
Lab totals + 2%	10800.58		
Contract estimate	$ 11,000.00		
Funding	$ 22,000.00		
Balance	$ 199.42		