Coeur d'Alene Lake Monitoring Program

2010 Annual Report

Volume 1: State Waters

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DRAFT 2010 Annual Report

Volume 1: State Waters

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Executive Summary

This report describes a routine monitoring program on Coeur d'Alene Lake conducted by the Idaho Department of Environmental Quality (IDEQ) for 2010. This document reports on limnological conditions in the northern two thirds of Coeur d'Alene Lake which is under state jurisdiction.

In June 2007, IDEQ and the Coeur d'Alene Tribe (Tribe) began a routine monitoring program of Coeur d'Alene Lake. This program is a continuation of baseline monitoring and studies conducted by the U.S. Geological Survey (USGS) and the Tribe from October 2003 through August 2006 (WY04-06, Wood and Beckwith 2008) and an earlier USGS baseline study conducted from January 1991 through December 1992 (CY91-92, Woods and Beckwith 1997). Under agreement by IDEQ and the Tribe, as part of an ongoing effort to jointly develop and implement a Lake Management Plan (LMP) for the lake, a program of continued monitoring at key USGS sites was initiated. The LMP was finalized in March 2009 (IDEQ and Tribe 2009). The goal of routine monitoring is to provide a long-term, annual trend record of key water quality parameters in support of LMP decisions and implementation.

IDEQ and the Tribe jointly prepared a Quality Assurance Project Plan (QAPP) according to EPA guidelines, and submitted the QAPP to EPA for approval. The QAPP was designed to not only address quality assurance/quality control (QA/QC) issues but also to serve as the work plan for the 2010 monitoring season. QA/QC samples prepared by IDEQ and the Tribe entailed equipment and field blanks, sample replicates, replication between IDEQ and Tribe field crews and equipment, and sample replications between two laboratories for nutrient analysis (SVL Analytical for IDEQ, Spokane Tribal Laboratory for the Tribe). QA/QC data are also presented for the metals analysis performed at the EPA Manchester Laboratory.

IDEQ sampled seven primary stations during this study: C1-Tubbs Hill, C2-Wolf Lodge Bay, C3-Driftwood Point, C4-University Point, Kidd Island Bay, Mica Bay, and Rockford Bay. During the 2010 calendar year, there were between 7 and 8 sampling events at each station. Each station is analyzed in detail in this report, and 2010 data are compared to previous data when available. In addition to these primary sites, a secondary site in Kidd Island Bay was analyzed twice. The conditions at this station do not reflect the overall conditions of Kidd Island Bay, and although it is discussed in detail in this document, it is excluded from inter-site comparisons.

Discharge to Coeur d'Alene Lake from the Coeur d'Alene and St. Joe Rivers was much lower than average during the 2010 water year. Analysis of total phosphorus and total nitrogen loads from the Coeur d'Alene River to the lake are lower than in previous years reflecting this lower than average water year. Like in previous years, relatively high flow conditions (e.g., rain-on-snow events and spring runoff) on the Coeur d'Alene River manifest as high metals concentrations in Coeur d'Alene Lake including some of the shallow bays.

On every sampling date at every station, dissolved zinc (DZn) concentrations exceed Idaho water quality standards (WQS) of 36 µg/L at 25 mg/L hardness. Dissolved cadmium (DCd) concentrations exceeded WQS (0.22 – 0.26 µg/L depending on hardness) on two days at station C1,

once at C2, twice at C3, and on five days at station C4. Dissolved lead (DPb) concentrations exceeded WQS (0.54 µg/L at 25 mg/L hardness) on two days at station C4. At sites C1, C3, and C4, DZn, DCd, and DPb were generally lower than in previous years, likely reflecting lower than usual riverine flow conditions.

Nitrogen and phosphorus concentrations were low, and all sites were phosphorus limited based on analysis of total nitrogen to total phosphorus ratios. Total phosphorus concentrations at sites C1, C3, and C4 were higher than 91-92 conditions, but they were generally lower than concentrations since 2005. Chlorophyll *a* concentrations at these sites were higher than in 91-92 and WY2005.

The 2009 Coeur d'Alene Lake Management Plan established water quality "trigger" conditions that serve as an early warning system that the lake is transitioning to undesirable conditions. Overall, undesirable conditions of dissolved oxygen, total phosphorus, chlorophyll *a*, and Secchi depth were not triggered with two exceptions. At station C1, dissolved oxygen fell below 6.0 mg/L in the hypolimnion on September 28, and at Kidd Island Bay, the mean July through October Secchi depth was shallower than the desired Secchi depth of 8.1 m for shallow bays.

A trigger condition was also established for phytoplankton composition (i.e., cyanobacteria (blue-green algae) are a dominant algal group with seasonal blooms). At all stations, there were moderate blooms of phytoplankton with cyanobacteria as a major component in terms of cell counts. However, northern waters of Coeur d'Alene Lake do not exhibit what are typically considered cyanobacteria blooms. A trend of interest in Coeur d'Alene Lake is the presence of the colonial cyanobacteria *Microcystis sp*. Certain species of *Microcystis* are known to produce a class of cyanotoxins labeled microcystins, which can be a hepatotoxin (liver damage). While *Microcystis sp.* can dominate phytoplankton samples in cell counts and biovolume during summer months, the cell counts are well below the guidelines of concern established by the World Health Organization.

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Acronyms and Abbreviations

BEIPC	Coeur d'Alene Basin Environmental Improvement Project Commission (formed in 2002)
BEMP	Basin Environmental Monitoring Program
cfs	cubic feet per second
CCC	Criterion Continuous Concentration (chronic criteria)
CMC	Criterion Maximum Concentration (acute criteria)
CWA	Federal Clean Water Act
CY91-92	calendar years 1991–1992, USGS sampling from January 1991–December 1992
CY07-08	calendar years 2007–2008, IDEQ and Tribe sampling from June 2007–December 2008
CY08	calendar year 2008, IDEQ and Tribe sampling
DOP	Dissolved ortho-phosphate
DTP	Dissolved total phosphorus
IDEQ	Idaho Department of Environmental Quality
EPA	U.S. Environmental Protection Agency
IDAPA	Idaho Administrative Procedures Act
kg	kilogram
2009 LMP	2009 Coeur d'Alene Lake Management Plan
m	meter
mg/L	milligrams per liter
SSC	suspended sediment concentration
QAPP	Quality Assurance Project Plan
TP	Total phosphorus
TN	Total nitrogen
Tribe	Coeur d'Alene Tribe
TSS	total suspended solids
µg/L	micrograms per liter
µm	micron
$\mu m^3/mL$	cubic microns per milliliter

USGS	United States Geological Survey
WQS	water quality standards
WY04-06	water years 2004–2006, USGS sampling from October 2003–August 2006

Section 1: Description of Monitoring Program

1.1 Background

This report describes a routine monitoring program on Coeur d'Alene Lake conducted by the Idaho Department of Environmental Quality (IDEQ) and the Coeur d'Alene Tribe (Tribe), from April through December 2010. Limnological data and analyses for this period are presented. This is the third annual monitoring report; previous reports covered the period of 2007-08 (Tribe and IDEQ 2010) and 2009 (Tribe and IDEQ 2012). For monitoring year 2010, IDEQ and the Tribe are producing separate annual reports (Volumes 1 and 2).

In June 2007, IDEQ and the Tribe began a routine monitoring program in Coeur d'Alene Lake. This program is a continuation of baseline monitoring and studies conducted by the U.S. Geological Survey (USGS) and the Tribe from October 2003 through August 2006 (Wood and Beckwith 2008) and an earlier USGS baseline study conducted from January 1991 through December 1992 (Woods and Beckwith 1997). The 2003–2006 studies (water years 04–06) were funded by an Environmental Protection Agency (EPA) Clean Water Act grant whose funding ended in 2006. Under agreement by IDEQ and the Tribe, as part of an ongoing effort to jointly develop and implement a Lake Management Plan (LMP) for the lake, a program of continued monitoring at key USGS sites was initiated. The goal of routine monitoring is to provide long-term, annual trend records of key water quality parameters in support of LMP decisions and implementation. Under the LMP, Tribal staff shall sample stations in Tribal jurisdiction waters of the southern lake and lower St. Joe River, and IDEQ staff shall sample northern pool waters within State jurisdiction.

Regional EPA staff have participated in the effort for development of a LMP. The EPA staff secured agreements and made arrangements for the EPA Manchester Laboratory (in Port Orchard, WA) to receive and analyze samples for concentrations of trace metals, certain minerals, and chlorophyll a. IDEQ and the Tribe secured laboratory facilities and financing for sample analysis of nutrient concentrations and phytoplankton identification/enumeration. The Tribe selected Spokane Tribal Laboratory for their nutrient analysis, IDEQ selected SVL Analytical (Kellogg, ID), and both selected TG EcoLogic (an LLC arm of TerraGraphics) for phytoplankton samples.

IDEQ and the Tribe jointly prepared a Quality Assurance Project Plan (QAPP) according to EPA guidelines, and submitted the QAPP to EPA for approval. The document was approved in June, 2007 (IDEQ and Tribe 2007). The QAPP was designed to not only address quality assurance/quality control (QA/QC) issues but to serve as the initial work plan for the 2007 monitoring season. In preparation for each subsequent monitoring season, EPA has required an amended QAPP. IDEQ and the Tribe have updated the QAPP each year and submitted the updated document to EPA for approval (IDEQ and Tribe 2010).

The Coeur d'Alene Lake Management Plan was finalized in March of 2009 (IDEQ and Tribe 2009). Discussion and details of a core routine monitoring program are presented in Appendix B of the 2009 LMP.

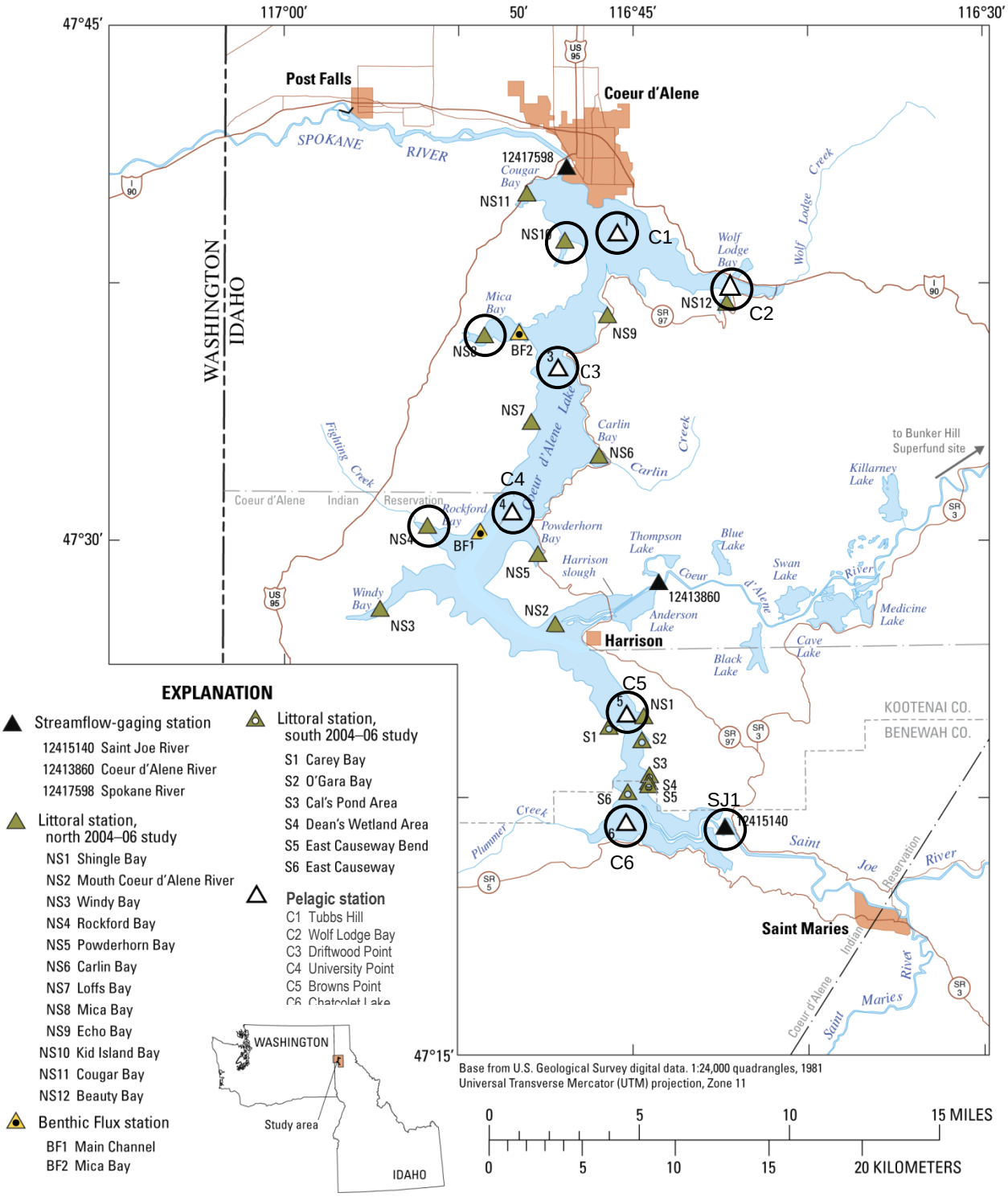

Figure 1. Map of sampling sites for the 2010 Coeur d'Alene Lake Monitoring Program (circled); map provided by USGS for WY04-06 sampling program. *Source*: Wood and Beckwith 2008.

1.2 Sampling Locations and Sampling Frequency

Initially, IDEQ selected two of the USGS reference sites in the deep waters of the northern pool for continued monitoring. These were sampling sites C1-SE of Tubbs Hill, and C4-NE of University Point. In 2010, IDEQ added additional sites at or near previous USGS study locations: two deep stations (C2-Wolf Lodge Bay and C3-NW of Driftwood Point) and three bay stations (Kidd Island, Mica, and Rockford) (Table 1) (Figure 1). The Tribe retained USGS sites C5-mid-lake between Browns Point and north end of Shingle Bay (NE of Blue Point by USGS), and C6-Chatcolet Lake. In 2007, the Tribe added a station on the lower St. Joe River (SJ1).

The schedule of sampling events was established at a maximum of eight sampling visits per calendar year (Table 2). The timing of sampling visits coincides with specific river flow and lake conditions of interest throughout the year. IDEQ and the Tribe coordinate their respective field sampling events so that they are both conducted during the same week. The lake sampling schedule matches fairly closely to the USGS sampling scheme at the mouths of the Coeur d'Alene and St. Joe Rivers under the EPA Coeur d'Alene Basin Environmental Monitoring Plan (BEMP) (USEPA 2004). The BEMP began in October 2003 to evaluate the long-term effects of cleanup actions as part of the remediation process for the Bunker Hill Mining and Metallurgical Complex Superfund facility.

Table 1. Sampling locations of the Coeur d'Alene Lake Monitoring Program.

Site Name	Agency	USGS Site Number and Location	Depth*	Lat/Long
C1	IDEQ	473900116453000 1.3 miles SE of Tubbs Hill near Coeur d'Alene, ID	40 m	47° 39' 00" -116° 45' 30"
C2	IDEQ	473730116410000 Wolf Lodge Bay near Coeur d'Alene, ID	29.5 m	47° 37' 30" -116° 41' 00"
C3	IDEQ	473500116482000 0.8 miles southwest of Driftwood Point near Coeur d'Alene, ID	52 m	47° 35' 00" -116° 48' 20"
C4	IDEQ	473054116500600 1.7 miles northeast of University Point near Harrison, ID	40 m	47° 30' 54" -116° 50' 06"
Kidd Island Bay	IDEQ	Kidd Island Bay	9.8 m	47° 38' 43" -116° 47' 52"
Mica Bay	IDEQ	Mica Bay	11.6 m	47° 36' 15" -116° 51' 00
Rockford Bay	IDEQ	Rockford Bay	15.5 m	47° 30' 18" -116° 53' 18"
C5	Tribe	472500116450000 mid-lake between Browns Point and north end of Shingle Bay near Harrison, ID	17 m	47° 25' 00" -116° 45' 00"
C6	Tribe	472120116451000 Chatcolet Lake: 0.4 miles northwest of Rocky Point near Plummer, ID	11 m	47° 21' 20" -116° 45' 10"
SJ1	Tribe	Lower St. Joe River: ~100 m upstream of USGS gage 12415140 near Chatcolet, ID	18 m	47° 21' 27" 116° 41' 10"

*at full summer pool, lake surface elevation is 2128 feet above sea level (NAD 1927)

Table 2. Annual sampling visits for the Coeur d'Alene Lake Monitoring Program (selection of 8 events).

	Season	Month	Lake Condition
1	winter/early spring	December—March	*Variable schedule*: unstratified; prior to spring peak runoff; potential opportunity to sample during major rain-on-snow lake inflow event.
2	winter/early spring	January—March	*Optional schedule*: unstratified; prior to spring peak runoff; second opportunity to sample during major rain-on-snow lake inflow event, or early spring peak runoff.
3	spring	late March—early June	*Variable schedule*: during spring peak runoff, opportunity to sample strong riverine influences on the lake; spring pulse of diatom growth develops.
4	late spring	mid-June	*Set schedule*: onset of stratification, spring pulse of diatom growth; before the onset of strong thermal stratification.
5	summer	mid-July	*Set schedule*: strong thermal stratification is established; sample the development of a metalimnetic chlorophyll *a* maximum; for some years, the peak of epilimnetic temperatures and thermocline thickness.
6	summer	mid-August	*Set schedule:* for some years, the peak of epilimnetic temperatures and thermocline thickness; declines in dissolved oxygen near bottom may become evident; phytoplankton peaks might start to develop at stations C5 and C6.
7	late summer	mid-September	*Optional—depending on early season sampling*: phytoplankton growth waning in northern pool, and still-strong thermal stratification in northern pool; DO deficit at C5 may be at maximum for season.
8	fall	early October	*Set schedule*: within northern pool, thermocline is deep but stratification still persists, DO deficits near bottom are still evident and often exhibit the peak of DO deficit for the season; waters of C5 and C6 have undergone fall turnover, and phytoplankton growth may still be at its peak.
9	early winter	late November—early December	*Set schedule:* unstratified (lake has undergone fall turnover); water quality data fairly uniform from top to bottom, and not yet affected by a rain-on-snow event (usually).

1.3 Parameters Sampled and Sampling Methods

Details of the routine lake sampling are presented in Part B and Appendix B of the QAPP (IDEQ and Tribe 2010). These details include variables sampled, instrumentation maintenance and calibration, field measurements taken and methods, sample containers and reagents for water

samples, pre-visit cleaning procedures and in-the-field procedures to avoid contamination, methods for water sampling and sample preservation, and quality control samples such as blanks and replicates. The sampling program detailed in the QAPP is summarized below.

1.3.1 Field Measurements Taken

During sampling events IDEQ and the Tribe measure and record a series of physical parameters. The sampling site is first located using a GPS way-point feature, and then the sampling boats are anchored. The actual latitude and longitude of the boat is recorded both before and after all sampling. Station water depth is recorded using a fathometer. Notes are also taken on the current weather conditions.

Using a Hydrolab® DS5X multiprobe with chlorophyll *a* fluorescence sensor, a water column profile is measured. Variables include water temperature, dissolved oxygen (DO) concentration, %DO saturation, pH, specific conductance, chlorophyll *a* fluorescence, and turbidity. As the Hydrolab® reaches the lake bottom, station water depth is confirmed with the depth sensor. The lake bottom is easily felt with the Hydrolab.

A Secchi disc transparency measurement is taken. IDEQ records a Secchi disc depth with and without the aid of an aquatic view tube. The Tribe and IDEQ use radiation measurement instruments to determine the depth where Photosynthetically Active Radiation (PAR) is 1% of the light incident on the water surface. This 1% light level is the theoretical compensation point for photosynthetically driven primary productivity and is labeled as the bottom of the photic zone in this report. Instrumentation includes an on-deck sensor to represent light intensity impinging on the water surface ($\mu mol/s/m^2$) and an underwater PAR sensor to measure light intensity going down the water column. The photic zone depth is determined and recorded when underwater PAR is 1% of the on-deck light reading.

1.3.2 Chemical and Biological Constituents

Water quality variables that are sampled and analyzed are shown in Table 3 along with the laboratory methods and target reporting limits from the three laboratories utilized (and the fourth lab, TG Eco-Logic for phytoplankton identification/enumeration). The Tribe and IDEQ sample multiple zones down the water column, as described below. Not all variables are analyzed within every sampling depth zone.

The four vertical sampling zones are

1. **Photic zone composite:** five equally spaced samples from 1 m below the surface to the depth where underwater PAR is 1% of the light incident on the surface, composited into a churn splitter.

2. **Zone of maximum chlorophyll *a*:** a discrete sample collected at the depth of maximum chlorophyll *a* fluorescence if so determined by the Hydrolab® profile. During summer stratification, on 2-3 of the yearly sampling visits, there has been a pronounced peak of chlorophyll *a* fluorescence within the metalimnion or upper hypolimnion observed in the USGS WY04-06 program and the Tribe/IDEQ program (2007–09).

3. Discrete sampling at mid-column and lower column for northern pool stations: Depending on the depth of the station, the water column is sampled at 20 or 25 m and 30 or 40 m. USGS sampled at these depths, and a trend of interest was that zinc concentrations vary considerably from upper waters to bottom waters from about April through October. Beginning in 2009, if IDEQ sampled at a chlorophyll *a* maximum depth in the summer, this sample substituted for the 20 m sample (chlorophyll *a* summer maxima are typically found at 15–19 m depths).

4. 1 meter above lake bottom: a discrete sample, with sampling depth determined from the Hydrolab® profile.

1.3.3 Sampling Methods

In general, the water sampling program is conducted in accordance to the USGS standard procedures for sample collection, as described in the National Field Manual for the Collection of Water-Quality Data: U.S. Geological Survey TWRI, Book 9, chapters A1-A6 (USGS variously dated). The TWRI manuals describe the procedures for

- Selection of equipment and supplies for surface water sampling (Chapter A2, Lane *et al*. 2003)
- Preparation for water sampling (Chapter A1, Wilde 2005)
- Cleaning of equipment for water sampling (Chapter A3, Wilde 2004)
- Collection of lake water samples (Chapter A4, Wilde *et al*. 1999)
- Field processing of water samples (Chapter A5, Wilde *et al*. 2004)
- Handling and shipping of samples (Chapter A5)

The specific sampling procedures used by the Tribe and IDEQ are detailed in Appendix B of the QAPP (IDEQ and Tribe, 2010). A summary of some of the sampling features is as follows

- Sample bottles used for metals samples are PreCleaned Certified™, 500 ml HDPE bottles for dissolved and total metals analysis. Container preparation includes: non-phosphate detergent washing, multiple tap water and ASTM Type I deionized water rinses, and 1:1 HNO_3 rinses.
- Water samples are obtained with a 2.2 L or 6.2 L non-metallic Kemmerer bottle with sample water composited into a 14 L churn splitter.
- Filters for chlorophyll *a* analysis are Advantec MFS GF-75, 0.3 µm pore size. Filters are placed in a Petri dish, covered with aluminum foil, and kept cold on dry ice while on the boat. Filters are shipped to the EPA Manchester lab in dry ice containers.
- Filtration for dissolved metals and nutrients use Millipore groundwater filter capsules: 0.45 µm pore size, 600 cm^2 filter area.

Table 3. Analytical methods and data quality for analytes of the Coeur d'Alene Lake Monitoring Program

Analyte	Analytical Method	Target Reporting Limit	Precision & Accuracy/ Completeness
Nutrients	***Spokane Lab / SVL Analytical***	***Spokane / SVL***	
ammonia, dissolved[1]	EPA 350.3 / EPA 350.1	10 / 30 µg/L	+/- 25% 95%
nitrite+nitrate, dissolved[1,2]	EPA 353.2	10 / 15 (50) µg/L	
total nitrogen	SVL = SM D-5176	50 µg/L	
total Kjeldahl nitrogen	Spokane = EPA 351.2	50 µg/L	
total phosphorus	EPA 365.3 / SM 4500-P-E	5 µg/L	
total dissolved phosphorus[1]	EPA 365.3 / SM 4500-P-E	5 µg/L	
orthophosphate, dissolved[1]	EPA 365.5 / SM 4500-P-E	2 / 3 µg/L	
Total recoverable metals, unfiltered, digested		***EPA Manchester Lab***	
cadmium	EPA 200.8 – ICP-MS	0.13 µg/L	+/- 25% 95%
lead	EPA 200.8 – ICP-MS	0.13 µg/L	
zinc	EPA 200.7 – ICP-SAS	5.0 µg/L	
arsenic	EPA 200.8 – ICP-MS	0.63 µg/L	
iron	EPA 200.7 – ICP-SAS	5.0 µg/L	
manganese	EPA 200.8 – ICP-MS	0.13 µg/L	
Dissolved metals, filterable, undigested[1]		***EPA Manchester Lab***	
cadmium	EPA 200.8 – ICP-MS	0.10 µg/L	+/- 25% 95%
lead	EPA 200.8 – ICP-MS	0.10 µg/L	
zinc	EPA 200.7 – ICP-SAS	5.0 µg/L	
arsenic	EPA 200.8 – ICP-MS	0.20 µg/L	
iron	EPA 200.7 – ICP-SAS	5.0 µg/L	
manganese	EPA 200.8 – ICP-MS	0.10 µg/L	
Minerals		***EPA Manchester Lab***	
total hardness (as $CaCO_3$)	SM 2340B	0.30 mg/L	+/- 25% 95%
calcium, dissolved	EPA 200.7–ICP-AES-mod. scan	0.03 mg/L	
magnesium, dissolved	EPA 200.7–ICP-AES-mod. scan	0.05 mg/L	
Biological		***EPA Manchester Lab***	
chlorophyll *a*	SM 1002G – fluorometric	1.0 µg/L	+/- 25% 95%
Biological		***TG Eco-Logic***	
phytoplankton	SM 1002 C-F – identification /enumeration with sedimentation and 900x magnification	n/a	n/a

[1]Samples are field filtered through a 0.45 µm pore size capsule filter for dissolved analysis
[2]In December 2010, SVL's MRL for nitrite+nitrate increased to 50 µg/L.

Section 2: Background Limnology

2.1 Lake Stratification

The main body of Coeur d'Alene Lake is monomictic, that is, it circulates freely during the winter months and becomes thermally stratified in the summer. During the summer months, the shallow surface water becomes much warmer than the bottom water as the result of warmer air temperatures. This warm surface water (epilimnion) is less dense than the cold bottom water (hypolimnion), and the two layers are separated by the thermocline, a layer of water whose temperature decreases 1°C/m or greater with depth. Because the epilimnion is unable to mix with the hypolimnion, these layers may develop differing chemical profiles as well. Stratification in Coeur d'Alene Lake persists until lower air temperatures cool the surface water forcing it to sink due to its higher density.

Dissolved oxygen (DO) profiles at northern pool stations, during early summer through late fall stratification, show a hypolimnetic condition of consumed oxygen primarily through bacterial decomposition of organic material. Oxygen consumption is greatest at the sediment-water interface where the accumulation of organic material and bacterial metabolism is greatest. During stratification there is minimal atmospheric DO replenishment of lower waters until fall turnover. The 2009 LMP has established a lower DO target for the summer through fall hypolimnion of northern waters at 6.0 mg/L DO (IDEQ and Tribe 2009).

2.2 Idaho Water Quality Standards: Trace Metals

Initial discussion of trace metals begins with dissolved metals in relation to Idaho Water Quality Standards (WQS) numeric criteria for aquatic life (IDAPA 58.01.02 §210). Dissolved metals in the WQS are functionally free ions within water samples passed through a 0.45 µm filter. WQS establish Criterion Continuous Concentration (CCC), a 4 day average concentration of a toxic substance which ensures adequate protection of sensitive species of aquatic organisms from chronic toxicity. The CCC is not to be exceeded more than once every 3 years. WQS also establish a Criterion Maximum Concentration (CMC), the maximum instantaneous or 1 hour average concentration to protect aquatic organisms from acute toxicity. The CMC is not to be exceeded more than once every 3 years.

Dissolved trace metal results are presented in comparison with the CCC. In the WQS, hardness dependent metals are calculated with equations that use total hardness in mg/L as $CaCO_3$. For hardness dependent metals other than cadmium, the minimum hardness allowed for use in those equations is 25 mg/L. In April 2010, Idaho WQS changed such that the equation to calculate cadmium CCC can use a minimum hardness of 10 mg/L. The cadmium CCC equation is

$$CCC_{Cd} = e^{(0.627 \times ln(Hard) - 3.344)} \times (1.101672 - (ln(Hard) \times 0.041838)$$

where *Hard* is the hardness in mg/L $CaCO_3$. In 2010 the only sites that experienced hardness concentrations above 25 mg/L were C3 (April 12), C4 (March 3 and April 13), Rockford Bay (April 12) and Kidd Island Bay station 2 (August 16). Because hardness in Cd'A Lake is almost always less

than 25 mg/L, CCCs presented for dissolved Zn (36 µg/L) and Pb (0.54 µg/L) use this cap. For cadmium CCCs, actual hardness below 25 mg/L was used in the aforementioned equation. In 2010, the minimum hardness measured was 19.3 mg/L resulting in a calculated cadmium CCC of 0.22 µg/L. On a sampling day, if one of the trace metal concentrations from the set of depth zone samples exceeded the CCC threshold, this was considered a four day average and an exceedance of the CCC.

2.3 Nutrients, Chlorophyll *a*, Water Clarity, and Trophic State

Nutrient limitation is an important concept in the biogeochemistry of aquatic systems. A limiting nutrient in natural waters is an element that is in shortest supply relative to the demands of plants (phytoplankton, macrophytes, and attached algae), and the addition of that nutrient will stimulate plant growth. In lakes, phosphorus is often the limiting nutrient, although in some instances, nitrogen may be limiting or there is co-limitation of phosphorus and nitrogen. To determine whether phosphorus or nitrogen are limiting, the TN:TP molar ratios in samples are compared to the "Redfield Ratio," the idealized ratio of nitrogen:phosphorus in plant material. If TN:TP in a sample is greater than 23, the sample is phosphorus limited; if it is less than 23, it is nitrogen limited (Wetzel 2001).

Limnological investigations typically categorize a lake with a "trophic state" using in-lake indicator conditions of: total phosphorus, chlorophyll *a* (as a measure of phytoplankton biomass), water clarity, and, at times, nitrogen (Table 4). An "oligotrophic" lake is generally low in nutrient concentrations (phosphorus and nitrogen), low in phytoplankton productivity with minor blue-green algae populations, and high in water clarity during summer through fall months. A "eutrophic lake" is generally high in nutrients, high in phytoplankton productivity, often includes blooms of nuisance blue-green algae, and is low in water clarity. The 2009 Lake Management Plan established water quality trigger conditions for stations C1, C4, and the shallow bays in the northern waters (DEQ and Tribe, 2009). These trigger conditions are based on the transition from an oligotrophic system to a meso-oligotrophic system.

Chlorophyll *a* is a photosynthetic pigment found in all algae and cyanobacteria. High concentrations of chlorophyll *a* are a typical response to high nutrient loading and thus high productivity. Conversely, low nutrient loads are associated with low chlorophyll *a* production. In oligotrophic lakes there can be a significant subsurface peak of chlorophyll *a* during summer months. The peak is normally found at the bottom of the thermocline (metalimnion) or just below the thermocline as high water densities slows the sinking rate of non-motile plankton cells. At this peak, called the chlorophyll *a* metalimnion maximum, there may also be increased nutrient availability intensifying productivity. The chlorophyll *a* maximum is commonly observed throughout Cd'A Lake.

Secchi disc transparency depths collected by IDEQ and presented throughout this report are measurements taken with the aid of an aquatic view tube. IDEQ has used this method since 2007. Secchi disc measurements are more accurate and consistent with a view tube because it lessens the effect of wave and sun glare. On windy days, common for Cd'A Lake, Secchi depths can be recorded

at least a meter deeper than readings without the view tube. However, Secchi values represented in (Table 4) and the LMP "trigger condition" tables reference depths taken without a view tube. This is of minor concern since Secchi disc values do not represent a primary determinant of trophic state or a LMP trigger condition.

Table 4. Trophic-state classification based on open-boundary values for four limnological variables. *Source*: Woods and Beckwith 1997

Limnological variable	Oligotrophic	Mesotrophic	Eutrophic
Total phosphorus (µg/L)			
annual geometric mean	8.0	26.7	84.4
± 1 SD	4.8 – 13.3	14.5 - 49.0	48.0 – 189.0
Total nitrogen (µg/L)			
annual geometric mean	661	753	1,875
± 1 SD	371 – 1,180	485 – 1,170	861 – 4,081
Chlorophyll *a* (µg/L)			
annual geometric mean	1.7	4.7	14.3
± 1 SD	0.8 – 3.4	3.0 – 7.4	6.7 – 31.0
Secchi-disc transparency (m)			
annual geometric mean	9.9	4.2	2.4
± 1 SD	5.9 – 16.5	2.4 – 7.4	1.5 – 4.0

2.4 Phytoplankton Enumeration

Phytoplankton are the primary producers in a lake, that is, they are responsible for converting sunlight and nutrients into energy which may be consumed by organisms such as zooplankton, insects, and fish. Phytoplankton in this report are categorized into six different ecological groups: diatoms, green algae (chlorophyceae), chrysophytes (yellow-green flagellates), cryptophytes, dinoflagellates, and cyanobacteria (blue-green algae). Dominant organisms in this report are identified by either the number of samples where cells/mL was highest or cell count was at least 5% of the total group assemblage count; and/or the number of samples where biovolume (μm^3/mL) was highest or biovolume was at least 5% of the total group assemblage biovolume.

Of particular concern are some species of toxin-producing cyanobacteria (e.g., *Microcystis sp.*). Some species of *Microcystis* are known to produce a class of cyanotoxins labeled Microcystins, which can be a hepatotoxin (causes liver damage). The World Health Organization established guidelines of concern for *Microcystis* of >100,000 cells/mL (Chorus and Bartram 1999).

Section 3: Riverine Flow: Hydrodynamics and Incoming Metals, Sediments, and Nutrients

Flow and current patterns within the lake are created by: 1) two major inflow rivers, the Coeur d'Alene and St. Joe, along with tributary streams, and lake outflow via Spokane River regulated by the Post Falls dam, 2) currents generated by wind and cessation of high winds, and 3) thermodynamics. Flow and current patterns are extremely variable and complex in Coeur d'Alene Lake seasonally and annually. The Coeur d'Alene River continues to carry elevated concentrations of both dissolved and particulate forms of potentially toxic metals into the lake particularly during flood events. The St. Joe River delivers background concentrations of trace metal compounds into the southern lake. Both rivers deliver suspended sediment with associated nutrients (phosphorus and nitrogen), along with organic and inorganic nutrient compounds. These sediment/nutrient loads are at their peak during high flow events. Water quality patterns within the lake in part reflect the characteristics of the two inflowing rivers.

Since August 2003, the EPA Basin Environmental Monitoring Program (BEMP) has funded the USGS to monitor flow, sediment, mining-associated contaminants, and nutrient transport at: 1) several sampling sites along the Coeur d'Alene River including the mouth at Harrison, 2) the St. Joe River close to the mouth, and 3) at the lake's outlet to the Spokane River (USEPA, 2004). During periods of high flow, the St. Joe River would overflow its banks in some locations and discharge directly into the lake resulting in periods of inaccurate flow data. To avoid this complication, the USGS moved its gaging station in October of 2009 from river mile 5.4 (Chatcolet) upstream to river mile 7.4 (Ramsdell). The hydrograph from Chatcolet compares well to the hydrograph from Ramsdell making comparisons between the two stations appropriate (Figure 2).

IDEQ and the Tribe obtain annual BEMP data as an important source of water quality information for concentrations of constituents coming into the lake and as a comparison to concentrations measured within the lake. Annual nutrient loads can be estimated from site data near the mouths of the two rivers. Flow and water quality data from BEMP will continue to be integrated into ELCOM-CAEDYM computer modeling efforts. Selected USGS river data for WY10 (October 1, 2009–September 30, 2010) are presented in this report.

During WY10, the Coeur d'Alene River discharged approximately 1.4 million ac-ft, and the St. Joe River at Ramsdell discharged approximately 1.5 million acre feet (Figure 2). This annual flow is much lower than the 50 year norm based on long-term flow records measured on the Coeur d'Alene River at Cataldo. The combined annual discharge into the lake from these two rivers (2.9 million ac-ft) is much lower than the previous two years of LMP monitoring where the combined flow from the two rivers was 4.6 million ac-ft in WY08 and 4.0 million ac-ft in WY09. Unlike in WY09, there was no large rain-on-snow event during WY10, and spring runoff did not peak as high as during the previous two years. During WY08, peak spring runoff was 27,300 cfs on the Coeur d'Alene River and 22,400 cfs on the St. Joe River. Peak spring runoff in WY09 on both the Coeur d'Alene and St. Joe Rivers was 13,200 cfs, and peak runoff on both rivers in WY10 was around 9,000 cfs.

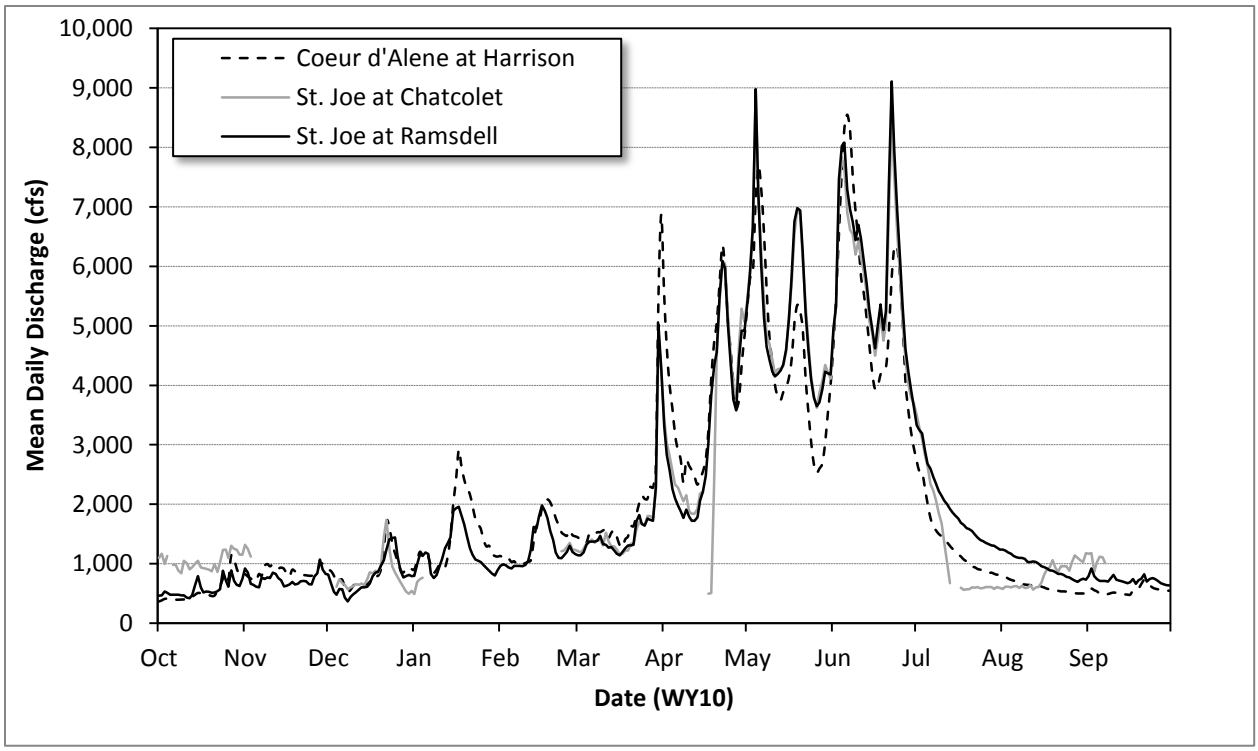

Figure 2. Mean daily discharge for the Coeur d'Alene and St. Joe Rivers for Water Year 2010 (October 1, 2009–September 30, 2010). *Source*: USGS 2011.

3.1 Nutrient Loading into Coeur d'Alene Lake

Lake studies commonly include measurements, estimations, and modeling of phosphorus and nitrogen inflows and outflows to a lake (a nutrient budget). Estimates of annual phosphorus and nitrogen loading are important for nutrient management efforts, where isolated load sources can be identified and cost-effectiveness plans can be made for nutrient-reduction efforts if so warranted. This is one stated goal of the 2009 LMP.

General categories of nutrient sources pertinent to Coeur d'Alene Lake include 1) input from the two major rivers, Coeur d'Alene and St. Joe, 2) input from streams discharging directly into the lake, 3) point discharges from wastewater treatment plants which mainly are discharges into the rivers and streams, 4) atmospheric deposition, both precipitation and dryfall, 5) groundwater seepage influenced by septic system drainfields around the lake, and 6) stormwater runoff, either from outflow drains or dispersed among properties around the perimeter of the lake.

A great deal of seasonal and annual nutrient loading is related to precipitation patterns and river flows. Nutrient load is a product of water discharge and concentration, thus in general, the higher the flow the higher the loading. Also, high flows with rapid velocity have a scouring and erosive affect, increasing particulate nutrient loading.

3.1.1 Previous Nutrient Load Estimates

Nutrient loads for the Coeur d'Alene basin have been assayed by the USGS for calendar years 1991-1992 (Woods and Beckwith, 1997) and water years 2004-2006 (Wood and Beckwith, 2008) (Table 5). These studies illustrated that 1) total annual inflow TP load is very dependent on annual inflow water volume, 2) the mouth of the St. Joe River consistently has the highest proportion of TP annual load to the lake, 3) that there are years when the Coeur d'Alene River has a higher TN load than the St. Joe, 4) TN loads in WY04-06 had declined since CY91-92, and 5) sources other than the St. Joe and Coeur d'Alene Rivers may contribute substantial amounts of nutrients to the lake.

Table 5. Summary of nutrient loading budgets and annual river flow volume for Coeur d'Alene Lake as developed by the USGS for calendar years 1991 and 1992 and Water Years 2004 – 2006. *Source*: modified from Table 4, Wood and Beckwith 2008

Budget component	CY1991	CY1992	WY2004	WY2005	WY2006
River flow volume (acre-feet/yr)					
Total river inflow	4,831,851	2,383,497	2,950,996	3,283,388	4,272,459
Percent St. Joe River	56%	57%	53%	53%	52%
Percent Coeur d'Alene River	44%	43%	47%	47%	48%
Total phosphorus load (pounds/yr)					
Total inflow load	204,624	86,877	167,139	218,295	317,520
Percent St. Joe River	43%	37%	47%	46%	50%
Percent Coeur d'Alene River	36%	28%	34%	38%	38%
Percent Other	21%	35%	19%	16%	12%
Total nitrogen load (pounds/yr)					
Total inflow load	4,652,550	2,101,365	899,640	879,795	1,027,530
Percent St. Joe River	47%	36%	15%	12%	18%
Percent Cd'A River	39%	42%	29%	27%	19%
Percent other	14%	22%	56%	61%	63%

3.1.2 IDEQ Nutrient Load Estimates of the Coeur d'Alene River

Total phosphorus and total nitrogen loads were calculated for the Coeur d'Alene River using USGS BEMP data and the USGS model, LOADEST (Runkel et al. 2004). LOADEST uses historical discharge and concentration data to develop a regression model. This model is then applied to a time series of stream flow measurements to calculate constituent load. Because the calibration input contains censored data, load estimation was defined under the AMLE method incorporated into LOADEST. Load regression statistics are shown in Table 6.

The Coeur d'Alene River was analyzed for total phosphorus and total nitrogen load at five USGS stations. One station is on the North Fork Coeur d'Alene River at Enaville and one station is at the mouth of the river at Harrison. Three stations are located on the South Fork Coeur d'Alene River at

(from upstream to downstream) Elizabeth Park, Smelterville, and Pinehurst. Smelterville discharge data are limited to days when BEMP data were collected. To overcome this limitation, we calculated the correlation between instantaneous discharge at Smelterville and that at Elizabeth Park ($y = 1.0497x + 13.208$; $r^2 = 0.9963$). This calculation was then applied to the time series discharge measurements at Elizabeth Park to derive streamflow at Smelterville. In addition to these stations, contributions from the Page and Smelterville Wastewater Treatment Plants (WWTP) were calculated. Total phosphorus and total nitrogen loads for the Page and Smelterville WWTPs are monthly loads based on discharge monthly reports provided by the treatment plants. Total phosphorus and total nitrogen are once-monthly samples from the WWTP effluent discharge stream. These concentrations are multiplied by the average monthly effluent flow rate to calculate the monthly loads, which are combined to produce total annual loads.

Table 6. LOADEST regression model statistics for WY2010.

	Calibration Points* (Period of Record)	Days with Mean Daily Flow	Mean Load (tons/ day)	95% Confidence Interval (tons/day)		Std. Error Predic-tion (tons/ day)	Std. Error (tons/ day)	R^2 (%)	Select-ed Model
Total Phosphorus									
Elizabeth Park	35 (2003-10)	365	0.007	0.005	0.011	0.002	0.002	93.45	8
Smelterville	42 (2002-10)	365	0.043	0.020	0.082	0.016	0.016	83.06	9
Pinehurst	68 (2001-10)	365	0.051	0.027	0.083	0.016	0.016	79.05	9
Enaville	53 (2001-10)	365	0.041	0.030	0.054	0.006	0.006	96.65	5
Harrison	59 (2001-10)	365	0.11	0.07	0.16	0.02	0.02	96.13	9
Total Nitrogen									
Elizabeth Park	47 (2003-10)	365	0.12	0.10	0.15	0.01	0.01	94.18	8
Smelterville	47 (2003-10)	365	0.15	0.10	0.21	0.03	0.03	91.38	9
Pinehurst	49 (2003-10)	365	0.30	0.15	0.54	0.10	0.10	64.94	8
Enaville	33 (2003-10)	365	0.24	0.19	0.30	0.03	0.02	95.68	6
Harrison	45 (2003-10)	365	0.55	0.48	0.63	0.04	0.04	95.94	6

*Calibration points are days with concentration data.

Total phosphorus load calculations for WY10 are represented in a schematic diagram showing the direction of flow from the North and South Forks through Harrison (Figure 3). In the South Fork, 25,810 lbs of total phosphorus were added to the stream load between Elizabeth Park and Smelterville (6,453 lbs TP/mi over 5.0 river miles). Between Smelterville and Pinehurst, an estimated 5,990 lbs were added (1,619 lbs TP/mi over 3.7 river miles). The total phosphorus load estimates for all of the previous years since WY2004 show that the stretch of river between Smelterville and Pinehurst typically contributes more total phosphorus than the stretch of river between Elizabeth Park and Smelterville (Table 7).

In Appendix B of the LMP, it was notes that historic data has shown an apparent phosphorus contribution spike between Elizabeth Park and Smelterville (IDEQ and Tribe 2009). This spike in phosphorus is suspected to be from the "Smelterville seeps." The nutrient data (and thus loading calculations) collected at Pinehurst should reflect effluent from the Page and Smelterville WWTPs as well as Pine Creek which all discharge into the South Fork prior to the Pinehurst sampling station. However, for WY10, WY04, and WY05 the calculated annual load at Pinehurst is less than the simple addition of the WWTPs to Smelterville, and this does include the unknown Pine Creek contribution. At this point in our analysis, it is uncertain why the modeling estimates are seemingly underestimating the annual load at Pinehurst for certain water years.

For WY10 the relative TN loading between the Smelterville and Pinehurst sampling stations was not anomalous as it was for TP (i.e., there was sufficient increase at Pinehurst to account for TN contributions from the WWTPs and Pine Creek).

For WY09 and WY10, the South Fork contributed more TP and TN loading to the main stem of the Cd'A River (after the confluence) than the North Fork at Enaville (Table 7). This result contrasts to previous calculations from WY04–WY08 where the North Fork contributed more nutrients. The North Fork generally has lower concentrations of TP and TN than the South Fork, but since 1991, the North Fork contributes on average 78% of the water flow at the confluence of the two rivers. This accounts for the normally larger TP and TN load from the North Fork, but this was not the case for WY09 and WY10.

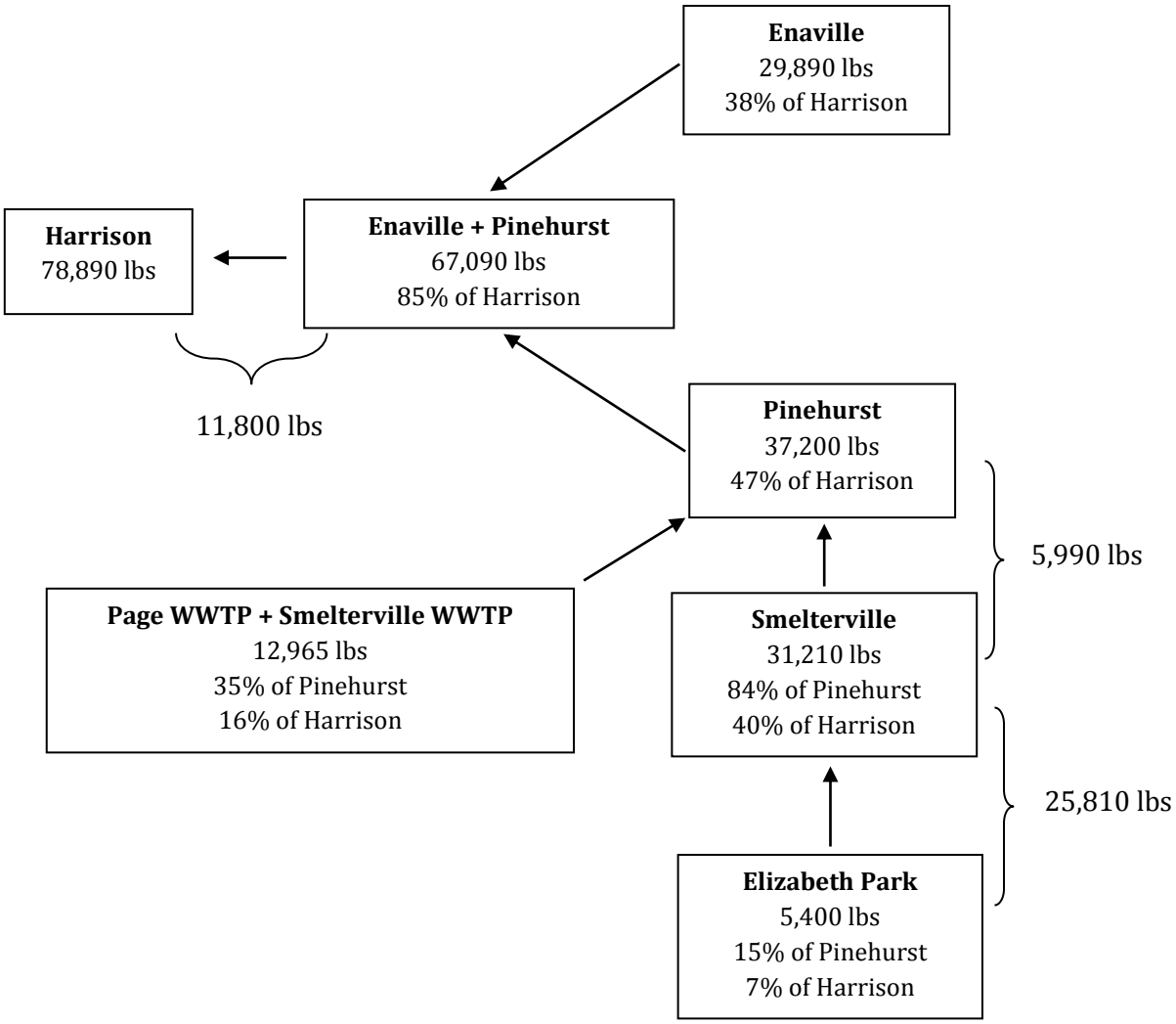

Figure 3. Total phosphorus load during WY10 for the Coeur d'Alene River as estimated using LOADEST.

Table 7. Total phosphorus and total nitrogen loads for various sites along the Coeur d'Alene River as estimated by IDEQ using LOADEST.

	S. Fork Cd'A @ Elizabeth Park USGS 12413210	**S. Fork Cd'A @ Smelter-ville** USGS 12413355	**Page+ Smelter-ville WWTP**	**S. Fork Cd'A @ Pinehurst** USGS 12413470	**N. Fork Cd'A @ Enaville** USGS 12413000	**Add Pinehurst + Enaville**	**Cd'A River @ Harrison** USGS 12413860
			WY2004				
Discharge (ac ft/yr)	186,591	205,454		282,829	1,052,079	1,334,908	ND
TP (lbs/yr)	4,920	12,140	10,345	20,580	26,410	46,990	ND
% of Pinehurst	24%	59%	50%	--	--	--	--
% of Harrison	9%	21%	18%	36%	47%	83%	--
USGS estimate	--	--	--	--	--	--	*56,660*
TN (lbs/yr)	70,840	80,820	ND	104,430	157,520	261,950	ND
% of Pinehurst	68%	77%	ND	--	--	--	--
% of Harrison	27%	31%	ND	48%	61%	102%	--
USGS estimate	--	--	--	--	--	--	*257,940*
			WY2005				
Discharge (ac ft/yr)	190,957	210,016		291,259	1,094,694	1,385,953	1,547,752
TP (lbs/yr)	5,590	13,110	11,370	23,720	32,200	55,920	70,240
% of Pinehurst	24%	55%	48%	--	--	--	--
% of Harrison	3%	19%	16%	34%	46%	80%	--
USGS estimate	--	--	--	--	--	--	*84,215*
TN (lbs/yr)	90,300	99,510	ND	149,840	292,870	442,710	666,350
% of Pinehurst	60%	66%	ND	--	--	--	--
% of Harrison	14%	15%	ND	22%	44%	66%	--
USGS estimate	--	--	--	--	--	--	*235,890*
			WY2006				
Discharge (ac ft/yr)	277,301	300,645	--	426,044	1,476,877	1,902,113	2,069,113
TP (lbs/yr)	13,350	22,980	13,030	39,550	62,890	114,970	119,630
% of Pinehurst	34%	58%	33%	--	--	--	--
% of Harrison	11%	19%	11%	33%	53%	96%	--
USGS estimate	--	--	--	--	--	--	*119,490*
TN (lbs/yr)	142,680	141,040	92,195	240,370	436,200	676,570	860,770
% of Pinehurst	59%	59%	38%	--	--	--	--
% of Harrison	17%	17%	11%	28%	51%	79%	--
USGS estimate	--	--	--	--	--	--	*193,790*
			WY2007				
Discharge (ac ft/yr)	236,828	258,161	--	382,239	1,319,322	1,701,561	1,856,941
TP (lbs/yr)	10,870	19,040	13,900	43,780	66,000	109,780	131,290
% of Pinehurst	25%	43%	32%	--	--	--	--
% of Harrison	8%	15%	11%	33%	50%	84%	--
TN (lbs/yr)	138,860	126,170	98,245	276,650	422,470	699,120	826,840
% of Pinehurst	50%	46%	36%	--	--	--	--
% of Harrison	17%	15%	12%	33%	51%	85%	--
			WY2008				
Discharge (ac ft/yr)	303,539	328,205	--	483,435	1,541,254	1,421,534	2,256,099
TP (lbs/yr)	35,480	49,770	13,975	102,920	210,890	313,810	311,480
% of Pinehurst	25%	48%	14%	--	--	--	--
% of Harrison	11%	16%	4%	33%	68%	101%	--
TN (lbs/yr)	204,520	171,850	98,155	403,710	683,960	1,087,670	855,520
% of Pinehurst	51%	43%	24%	--	--	--	--
% of Harrison	24%	20%	11%	47%	80%	127%	--

Table 7cont. Total phosphorus and total nitrogen loads for various sites along the Coeur d'Alene River as estimated by IDEQ using LOADEST.

	S. Fork Cd'A @ Elizabeth Park USGS 12413210	**S. Fork Cd'A @ Smelter-ville** USGS 12413355	**Page+ Smelter-ville WWTP**	**S. Fork Cd'A @ Pinehurst** USGS 12413470	**N. Fork Cd'A @ Enaville** USGS 12413000	**Add Pinehurst + Enaville**	**Cd'A River @ Harrison** USGS 12413860
			WY2009				
Discharge (ac ft/yr)	233,042	254,192	2,621	376,846	1,044,688	1,421,534	1,809,614
TP (lbs/yr)	11,780	20,570	13,025	87,750	42,330	130,080	191,730
% of Pinehurst	13%	23%	15%	--	--	--	--
% of Harrison	6%	11%	7%	46%	22%	68%	--
TN (lbs/yr)	147,750	113,560	89,595	371,030	173,680	544,710	663,090
% of Pinehurst	40%	31%	24%	--	--	--	--
% of Harrison	22%	17%	14%	56%	26%	82%	--
			WY2010				
Discharge (ac ft/yr)	160,667	178,211	2,245	177,533	967,767	1,145,300	1,414,840
TP (lbs/yr)	5,400	31,210	12,965	37,200	29,890	67,090	78,890
% of Pinehurst	15%	84%	35%	--	--	--	--
% of Harrison	7%	40%	16%	47%	38%	85%	--
TN (lbs/yr)	89,570	107,170	83,405	220,260	175,680	395,940	400,740
% of Pinehurst	41%	49%	38%	--	--	--	--
% of Harrison	22%	27%	21%	55%	44%	99%	--

Section 4: Data Results

A listing of all raw data collected by IDEQ in 2010 is presented in Appendices A–D. This section presents a data analysis summary of the IDEQ results. The first sampling event was on March 3, 2010, and IDEQ conducted a total of 8 sampling events concluding on December 9, 2010.

In addition to the 2010 data, this annual report includes comparisons of IDEQ monitoring from mid-2007 through 2009 with data collected by USGS in Water Years (WY) 2004–2006 (Wood and Beckwith 2008), and in some cases with data collected by USGS in calendar years 1991 and 1992 (Woods and Beckwith 1997). The 2009 Lake Management Plan (IDEQ and Tribe 2009) also includes a rather comprehensive State of Lake Water Quality Assessment which utilized data through 2006 and compared data from the two USGS studies.

4.1 Graphical Presentation of Data

For discussions of lake water quality presented in this Section, box plots are often used for data presentations. A diagram of box plots statistics used in this report as computed by Minitab statistical software is shown in Figure 4. Box plot central tendency is shown as the median, and includes calculation of the geometric mean (geomean).

$$geomean = \sqrt[n]{x_1 x_2 x_3 \dots x_n}$$

The geomean dampens the effect of very high or low values in small sample size data sets compared to calculation of the arithmetic mean. In the CY91-92 data set of limnological variables, USGS used geometric means to assign trophic state to Coeur d'Alene Lake sampling stations (Woods and Beckwith 1997). The measures and milestone tables of the 2009 LMP (Section 5.1) also assigns geometric means to limnological variables for desired and trigger conditions (IDEQ and Tribe 2009).

4.1.1 IDEQ Approach to Data Presentation

An important component of the LMP monitoring program is to establish long-term annual trends in lake water quality. To conduct a comparison with the past USGS data, IDEQ graphic and statistical data should be grouped by either a water year or calendar year. Data comparisons are best made when all seasons are included because of the significant seasonal variability in Coeur d'Alene Lake data. IDEQ has elected to present trends per calendar year. IDEQ box plot data in this section for the period July 2007–October 2008, have been restricted to the CY08 data set (December 2007–October 2008). This CY08 data set includes the December 2007 sampling run because we missed the December 2008 run due to dangerous lake conditions. Sampling data collected in early December are important to include because the late fall season exhibits the most uniformity from top to bottom in chemical concentrations. For all summary statistics presented in this report, one-half the Method Reporting Limit (MRL) was used for data values reported as <MRL (e.g., TP values reported as <MRL of 5 µg/L were given a value of 2.5 µg/L for summary statistics).

DEQ represents temperature, dissolved oxygen concentration, and dissolved oxygen saturation with isopleths (e.g., Figure 5, Figure 6, Figure 7). Isopleths are lines on graphs that show the change in these variables as a function of depth (y-axis) and time (x-axis). The variables are measured at specific depths (shown as points on the graph) and lines of equal value are interpolated between these points using the statistical software MiniTab. Caution must be taken in interpreting isopleth lines where measured data are separated by large depth or time intervals. In the graphs provided in this document, the winter months are not shown because sampling dates were at least three months apart. This period is assumed to be completely mixed, and temperature, dissolved oxygen concentration, and dissolved oxygen saturation do not change substantially with depth (see Section 2.1 for further discussion).

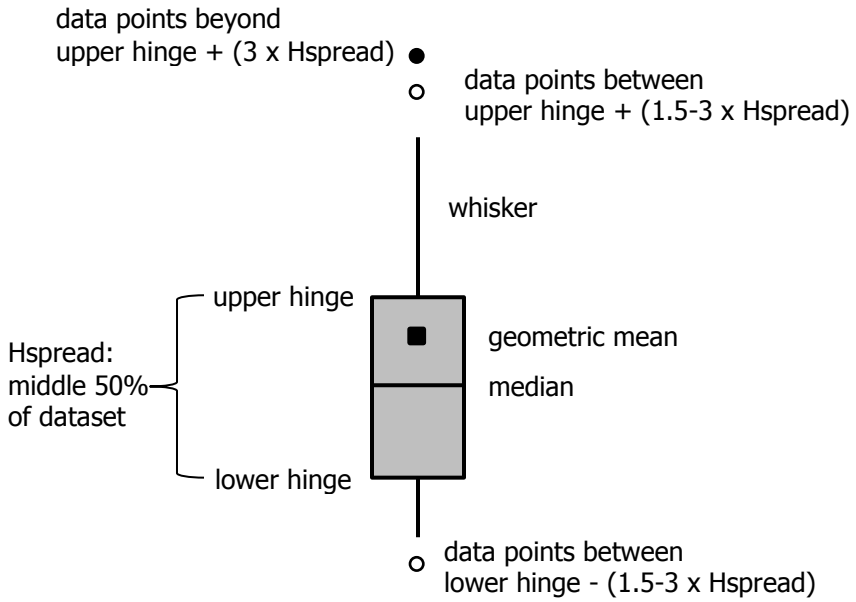

Figure 4. Definitions of box plot statistics used for data presentation within this report.

4.2 Statistical Analysis

To analyze differences between sampling years, the data were analyzed using two methods in the statistical software, MiniTab. For sample sizes greater than 15, analysis was conducted using a two-sample t-test at various confidence levels ($p<0.1$, $p<0.05$, and $p<0.01$). If the sample size was 15 or less, the non-parametric Mann-Whitney test was employed at $p<0.1$, $p<0.05$, and $p<0.01$. Both tests were one-sided and compared the directional difference between CY10 and previous sampling years.

4.3 Lake Water Quality Results

In following sections, separate categories of parameters will be discussed. In Table 8, monitoring data for each variable were combined for all sampling days and all sampling depth zones (see Appendices A-D). For data values reported as <MRL, one-half the MRL was assigned for calculation of summary statistics.

Table 8. Summary of water quality results for 2010. Variables are presented in µg/L except where noted.

Water Quality Variables	C1 Tubbs Hill	C2 Wolf Lodge Bay	C3 Driftwood Point	C4 University Point	Kidd Island Bay	Mica Bay	Rockford Bay
Trace Metals							
Total Zn							
geomean (n)	57.4 (32)	50.7 (21)	63.3 (24)	65.6 (32)	51.2 (7)	48.8 (7)	55.2 (7)
range	44.5-73.8	38.2-75.7	46.3-74.3	45.8-97.2	39.0-62.4	37.2-60.7	39.9-73.3
Dissolved Zn							
geomean (n)	56.4 (32)	49.4 (21)	62.0 (24)	64.0 (32)	49.2 (7)	46.1 (7)	51.9 (7)
range	46.0-74.4	37.8-69.3	47.9-76.3	45.3-85.7	41.0-64.1	39.6-56.2	40.3-66.5
Total Cd							
geomean (n)	0.20 (32)	0.17 (21)	0.23 (24)	0.24 (32)	0.19 (7)	0.19 (7)	0.22 (7)
range	0.15-0.26	0.07-0.22	0.18-0.27	0.19-0.38	0.18-0.21	0.17-0.22	0.18-0.26
Dissolved Cd							
geomean (n)	0.20 (32)	0.17 (21)	0.23 (24)	0.23 (32)	0.19 (7)	0.18 (7)	0.20 (7)
range	0.16-0.28	0.11-0.24	0.18-0.31	0.17-0.32	0.17-0.21	0.15-0.21	0.18-0.23
Total Pb							
geomean (n)	0.48 (32)	0.33 (21)	0.90 (24)	1.4 (32)	0.80 (7)	0.68 (7)	1.3 (7)
range	0.19-1.8	0.14-1.0	0.35-2.9	0.46-4.6	0.57-1.9	0.36-2.0	0.54-2.3
Dissolved Pb							
geomean (n)	<0.10 (32)	<0.10 (21)	0.11 (24)	0.16 (32)	0.10 (7)	<0.10 (7)	0.19 (7)
range	<0.10-0.34	<0.10-0.15	0.10-0.49	<0.10-0.72	<0.10-0.39	<0.10-0.26	<0.10-0.46
Total As							
geomean (n)	<0.63 (32)	<0.63 (21)	<0.63 (24)	<0.63 (32)	<0.63 (7)	<0.63 (7)	<0.63 (7)
range	<0.63	<0.63	<0.63	<0.63-0.66	<0.63	<0.63-84	<0.63
Dissolved As							
geomean (n)	0.39 (32)	0.40 (21)	0.38 (24)	0.40 (32)	0.41 (7)	0.40 (7)	0.41 (7)
range	0.31-0.48	0.33-0.47	0.32-0.48	0.32-0.55	0.37-0.45	0.36-0.50	0.34-0.56
Metals and Hardness							
Total Fe							
geomean (n)	17 (32)	29 (21)	24 (24)	36 (31)	26 (7)	37 (7)	55 (7)
range	7.3-36	13-49	8.6-58	11-156	16-38	15-88	15-132
Dissolved Fe							
geomean (n)	<5.0 (32)	3.6 (21)	<5.0 (24)	5.8 (32)	<5.0 (7)	6.4 (7)	8.6 (7)
range	<5.0-10.0	<5.0-8.6	<5.0-12.0	<5.0-22.0	<5.0-8.9	<5.0-10.0	<5.0-24.0
Total Mn							
geomean (n)	3.7 (32)	5.3 (21)	5.4 (24)	8.1 (32)	3.8 (7)	5.5 (7)	8.0 (7)
range	1.8-11.7	2.0-16.4	2.8-12.5	3.6-31.9	2.8-6.5	3.5-6.9	4.1-15.4
Dissolved Mn							
geomean (n)	0.40 (32)	1.07 (21)	1.93 (24)	0.62 (32)	0.77 (7)	0.99 (7)	1.96 (7)
range	0.17-1.30	0.35-2.90	1.70-2.11	0.14-7.60	0.45-1.40	0.49-2.20	1.30-3.60
Total hardness (mg/L as $CaCO_3$)							
geomean (n)	22 (32)	21 (21)	23 (24)	23 (32)	22 (7)	22 (7)	23 (7)
range	20-24	19-24	20-25	21-27	20-24	20-24	20-25

Table 8 cont. Summary of water quality results for 2010. Variables are presented in µg/L except where noted.

Water Quality Variables	C1 Tubbs Hill	C2 Wolf Lodge Bay	C3 Driftwood Point	C4 University Point	Kidd Island Bay	Mica Bay	Rockford Bay
Nutrients, Chlorophyll *a*, and Phytoplankton							
Total P geomean (n) range	<5 (31) <5-7	<5 (20) <5-8	<5 (22) <5-7	<5 (31) <5-5	<5 (7) <5-7	6 (7) <5-12	6 (7) <5-15
Diss. total P geomean (n) range	<5 (32) <5-6	<5 (21) <5-<5	<5 (24) <5-<5	<5 (32) <5-7	<5 (7) <5	<5 (7) <5	<5 (7) <5-7
Diss. ortho-P geomean (n) range	<3 (7) <3-<3	<3 (5) <3-<3	<3 (7) <3-<3	<3 (7) <3-<3	<3 (6) <3-<3	<3 (6) <3-<3	<3 (6) <3-<3
Total N geomean (n) range	102 (32) 68-158	98 (21) 71-147	115 (21) 65-163	111 (32) 76-161	91 (7) 71-107	100 (7) 81-125	102 (7) <50-138
Diss. NO_2+NO_3 geomean (n) range	18 (32) <15-70	16 (21) <15-77	22 (23) <15-105	22 (32) <15-72	<15 (7) <15-20	<15 (7) <15-15	15 (7) <15-52
Diss. NH_3 geomean (n) range	<30 (32) <30-41	<30 (21) <30-47	<30 (24) <30-37	17 (32) <30-61	<30 (7) <30-<30	<30 (7) <30-33	<30 (7) <30-43
TN:TP (mol:mol) geomean (n) range	62 (31) 28-140	55 (20) 27-130	69 (19) 30-136	51 (31) 24-142	48 (7) 28-95	38 (7) 23-90	35 (7) 17-76
Chlorophyll *a* geomean (n) range	1.43 (8) <1.00-2.30	1.52 (7) <1.00-3.12	1.81 (7) 1.00-3.20	1.80 (8) 1.00-3.08	1.32 (7) <1.00-2.57	1.56 (7) <1.00-5.65	1.69 (7) <1.00-4.86
Phytoplankton (cells/mL) geomean (n) range	5,106 (8) 2,500-9,366	8,610 (1)	5,680 (6) 2,463-8,683	5,922 (8) 2,926-8,244	9,342 (1)	9,218 (2) 6,586-12,903	8,671 (2) 7,135-10,537
Phytoplankton biovolume (μm^3/mL) geomean (n) range	177,115 (8) 102,400-330,500	200,500 (1)	260,123 (6) 136,000-933,200	207,301 (8) 105,600-372,200	216,500 (1)	390,813 (2) 294,400-518,800	344,420 (2) 276,000-429,800

Table 8 cont. Summary of water quality results for 2010. Variables are presented in µg/L except where noted.

Water Quality Variables	C1 Tubbs Hill	C2 Wolf Lodge Bay	C3 Driftwood Point	C4 University Point	Kidd Island Bay	Mica Bay	Rockford Bay
Water Clarity							
Secchi depth w/view tube (m) geomean (n) range	8.4 (7) 6.1-12.2	6.3 (7) 4.0-10.9	7.2 (7) 4.4-12.4	7.0 (8) 4.7-11.0	6.1 (7) 4.5-9.4	5.8 (7) 2.9-11.0	5.2 (7) 2.4-10.0
1% light depth (m) —photic zone geomean (n) range	15.0 (6) 13.0-17.3	13.5 (6) 11.0-16.0	13.4 (7) 10.0-17.0	12.9 (8) 11.0-15.3	--	8.5 (1)	7.0 (1)
(%) Surface light reaching bottom geomean (n) range	--	--	--	--	4.7 (7) 3.0-7.1	2.2 (6) 1.1-3.6	2.9 (6) 1.7-5.5

Section 5: Site Analysis

5.1 C1-Tubbs Hill

5.1.1 Thermal Stratification and Oxygen Depletion

The water column at station C1-Tubbs Hill was thermally mixed from at least March through approximately May and thermally stratified from June through September (Figure 5). Thermocline depth was 8–13 m on July 22 and 7–11 m on August 16. The thermocline had deepened to 15–18 m by September 28. The greatest temperature change with depth was -3.4 °C/m on July 22 between 9–10 m. By the December 7 sampling event, the water at C1 had completely turned over.

Oxygen depletion in the hypolimnion began in June and persisted throughout the summer (Figure 6, Figure 7). DO concentrations were highest during the March sampling when the water was coldest and well mixed. The DO concentration was lowest in the hypolimnion during the September 28 sampling (Figure 6). On this date, the sample at 40.5 m was 5.8 mg/L and was below the 6.0 mg/L target for hypolimnetic oxygen. After fall turnover, the low oxygen hypolimnion mixed with the oxygenated epilimnion resulting in DO concentrations ranging from 9.4–10.0 mg/L during the December sampling.

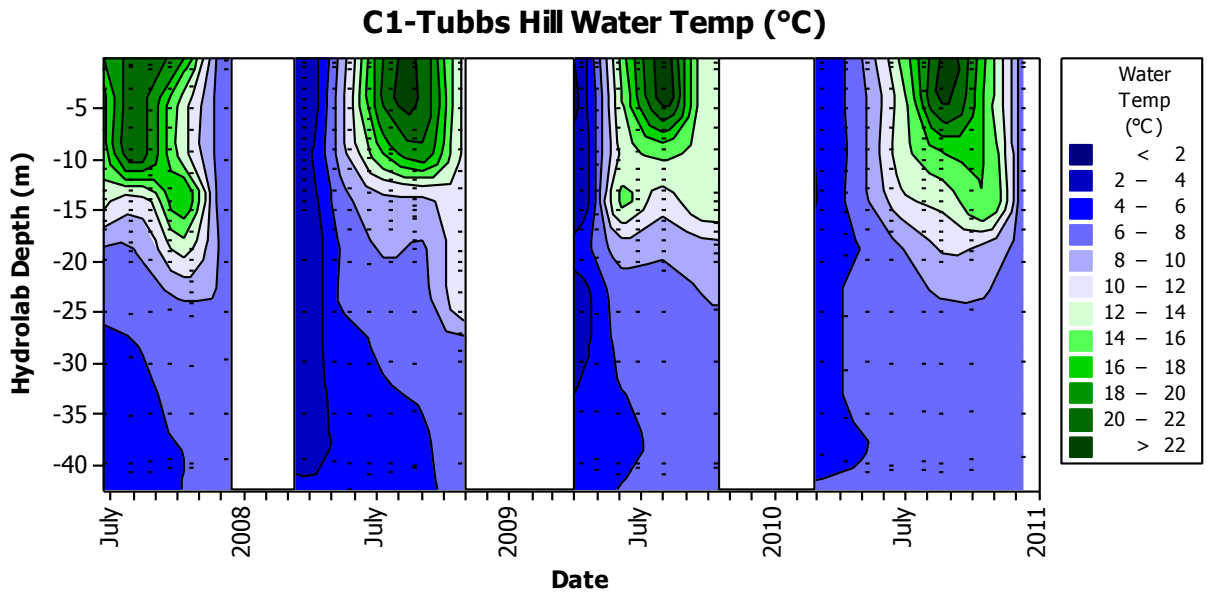

Figure 5. Water temperature profiles at C1-Tubbs Hill. Measured values are represented by points and lines represent values of equal temperature. Ticks on the x-axis are in months.

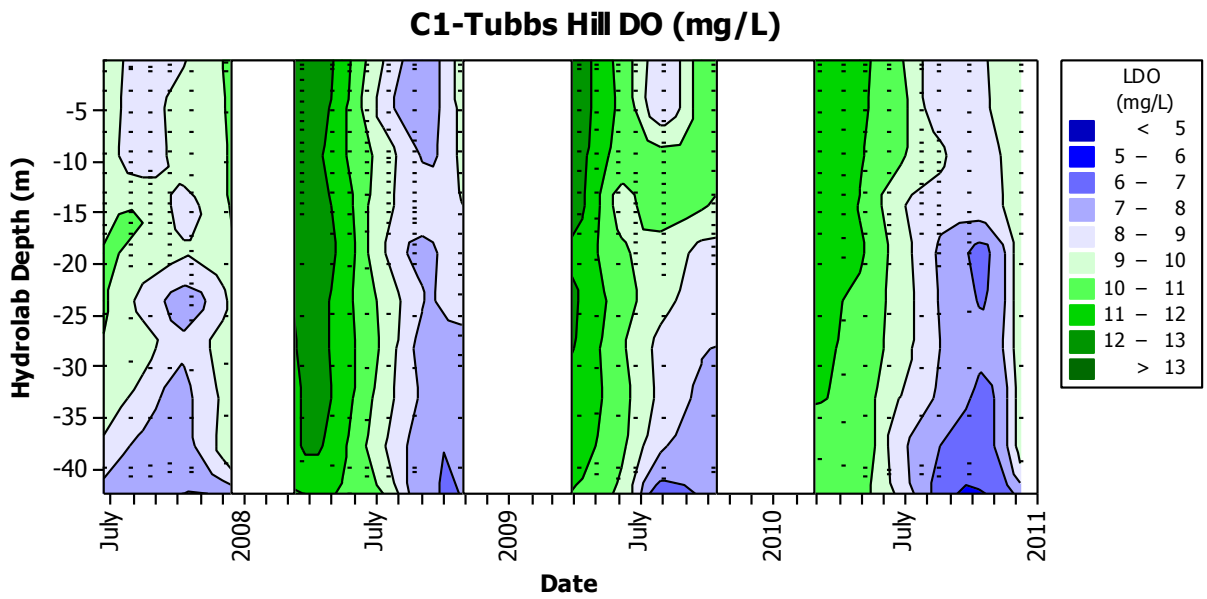

Figure 6. Dissolved oxygen concentrations (mg/L) at C1-Tubbs Hill. Measured values are represented by points and lines represent values of equal DO concentration. Ticks on the x-axis are in months.

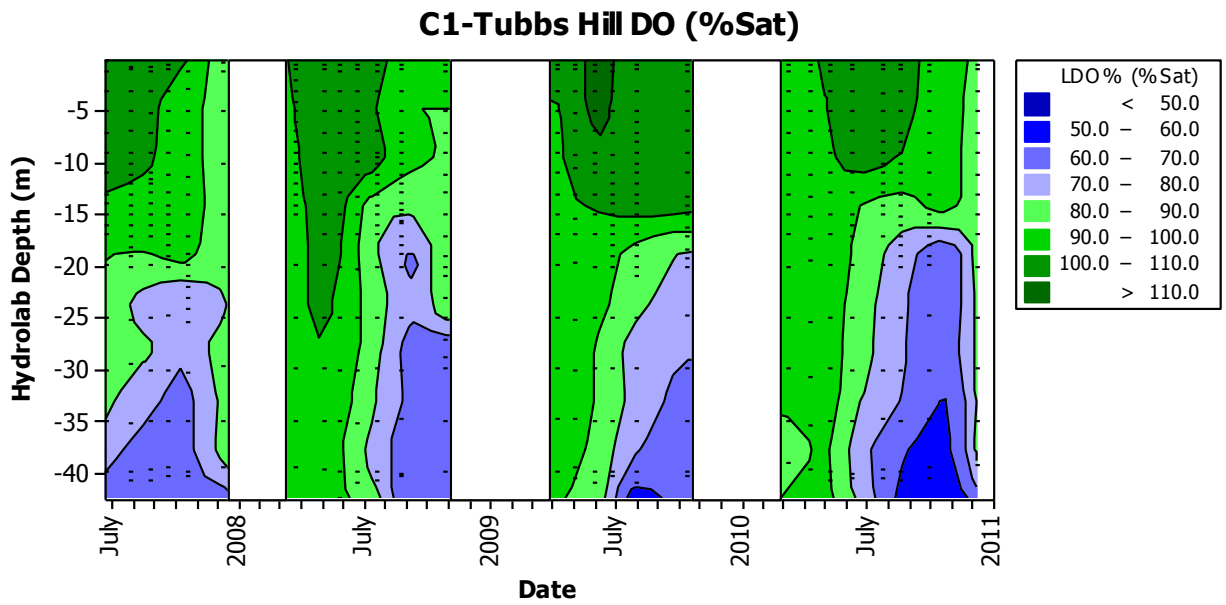

Figure 7. Dissolved oxygen saturation (%Sat) at C1-Tubbs Hill. Measured values are represented by points and lines represent values of equal saturation. Ticks on the x-axis are in months.

5.1.2 Idaho Water Quality Standards

All dissolved zinc samples collected during 2010 at C1-Tubbs Hill violated the Idaho WQS of 36 µg/L at 25 mg/L hardness (CCC and CMC). The mean dissolved zinc concentration collected in 2010 was statistically lower than the mean concentration for WY04 ($p<0.01$), WY05 ($p<0.05$), WY06 ($p<0.05$), and CY08 ($p<0.05$) (Figure 8). The mean dissolved zinc concentration for CY10 was not significantly different than CY09 ($p>0.1$).

The dissolved cadmium criterion (ranging from 0.23–0.24 µg/L) was exceeded on July 22 (20 m), and August 16 (17.5 m at the chlorophyll *a* maximum and 40 m). The mean dissolved cadmium concentration in 2010 was lower than all previous sampling years at C1 ($p<0.01$) (Figure 9).

Dissolved lead showed little variability compared to previous years, and no samples exceeded the CCC of 0.54 µg/L. Most dissolved lead concentrations were below the EPA reporting limit of 0.10 µg/L. It is typical for high total and dissolved lead concentrations to correlate with high river flows (e.g., Tribe and IDEQ 2010 and 2012). The highest concentrations of total and dissolved lead at C1 were on May 5, corresponding to spring runoff on the Cd'A River (Figure 2). The mean dissolved lead concentration was statistically lower in 2010 than in WY06, CY08, and CY09 ($p<0.01$) (Figure 10). The mean dissolved lead concentration for CY10 was not significantly different than WY04 and WY05 ($p>0.1$).

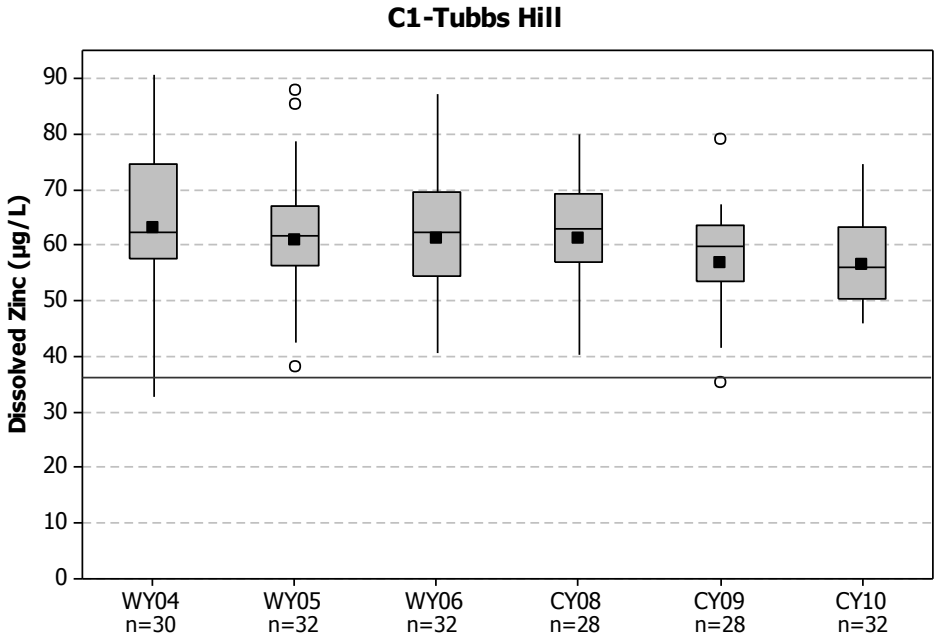

Figure 8. Dissolved zinc concentrations (µg/L) at C1-Tubbs Hill (photic zone, 20 m, 30 m, and near bottom). Horizontal black line represents the IDEQ WQS of 36 µg/L Zn at 25 mg/L total hardness. *Source*: WY04-06 (Wood and Beckwith 2008); CY08 (Tribe and IDEQ 2010); CY09 (Tribe and IDEQ 2012).

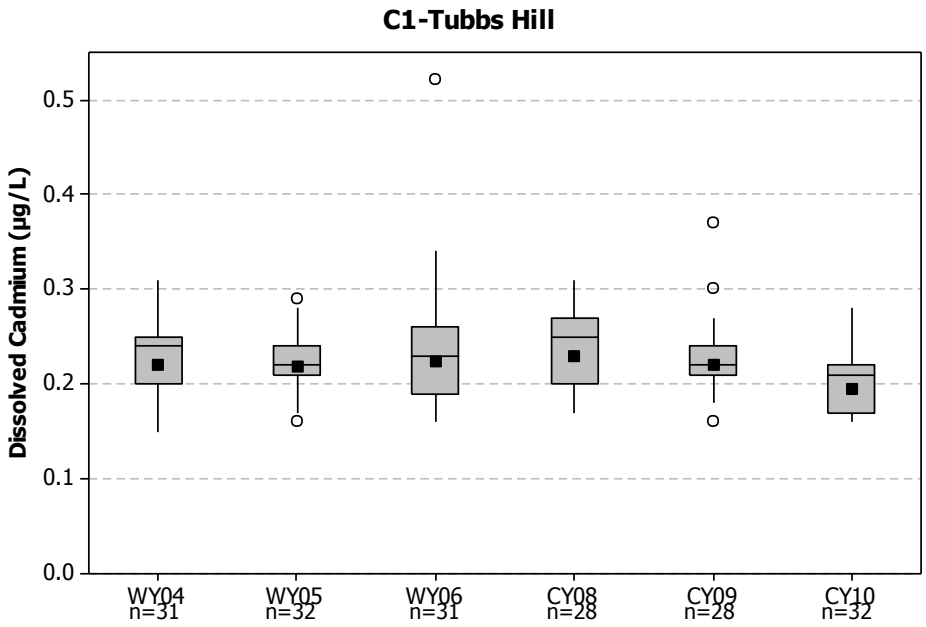

Figure 9. Dissolved cadmium concentrations (µg/L) at C1-Tubbs Hill (photic zone, 20 m, 30 m, and near bottom. *Source*: WY04-06 (Wood and Beckwith 2008); CY08 (Tribe and IDEQ 2010); CY09 (Tribe and IDEQ 2012).

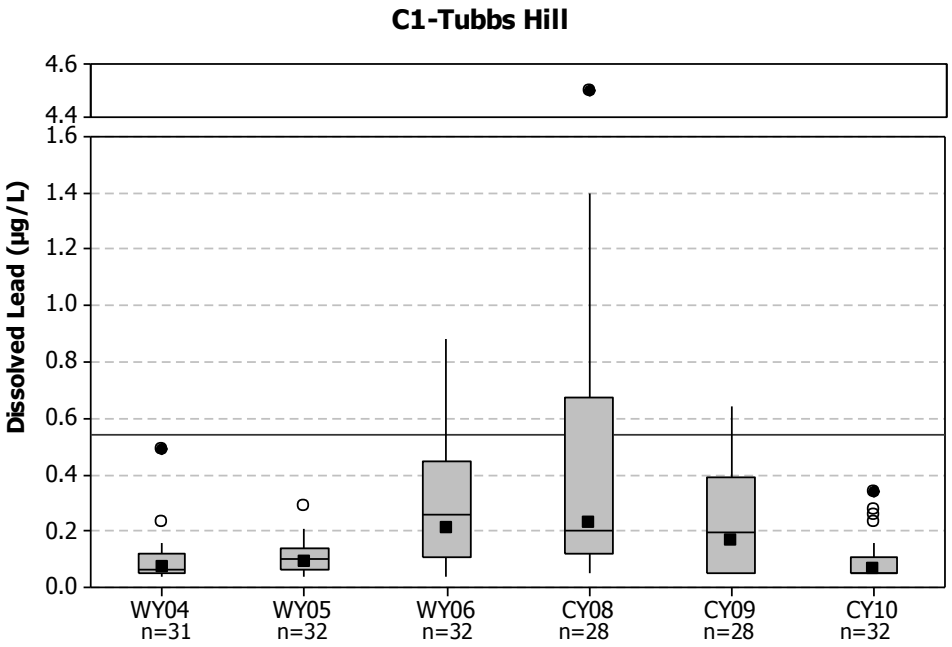

Figure 10. Dissolved lead concentrations (µg/L) at C1-Tubbs Hill (photic zone, 20 m, 30 m, and near bottom). Horizontal black line represents the IDEQ WQS of 0.54 µg/L Pb at 25 mg/L total hardness. *Source*: WY04-06 (Wood and Beckwith 2008); CY08 (Tribe and IDEQ 2010); CY09 (Tribe and IDEQ 2012)

5.1.3 Nutrients, Chlorophyll *a*, Water Clarity, and Trophic State

Total phosphorus concentrations ranged from <5–7 µg/L, and total nitrogen concentrations ranged from 68–158 µg/L (Table 8). All concentrations of dissolved total phosphorus (DTP) except one sample were below the MRL of 5 µg/L, and all dissolved orthophosphate (DOP) results were less than the MRL of 3 µg/L. Maximum dissolved inorganic nitrogen (DIN, ammonia and nitrite+nitrate) was 85 µg/L, and this was a near bottom sample. In 2010, all of the samples at C1 were phosphorus limited (TN:TP ranged from 28–140 mol:mol).

The annual total phosphorus geomean was <5 µg/L, below the LMP trigger condition of 8.0 µg/L (Figure 11). Based on the TP concentration, site C1 was oligotrophic in 2010 (Table 4). The mean TP in 2010 was less than in WY04 ($p<0.1$), WY05 ($p<0.05$) and WY06, CY08, and CY09 ($p<0.01$). Mean TP in CY10 was not significantly different than CY91-92 ($p>0.1$). Comparison of photic zone TP concentrations since 1991, shows that after a peak on April 29, 2009, TP concentrations dropped rapidly and remained low until at least December 7, 2010 (Figure 12).

The annual chlorophyll *a* geomean was 1.43 µg/L, less than the LMP trigger condition of 3.0 µg/L, and no samples exceeded 5.0 µg/L, further indicating that C1 was oligotrophic (Figure 13). Mean chlorophyll *a* in 2010 was higher than the mean Chl *a* in CY91-92 ($p<0.05$). The mean Chl *a* in 2010 was lower than mean Chl *a* in WY06 ($p<0.05$), CY08 ($p<0.01$) and CY09 ($p<0.1$). Mean Chl *a* in CY10 was not significantly different than in WY04 and WY05 ($p>0.1$).

The annual geometric mean Secchi depth (with a view tube) was 8.4 m which would classify site C1 as oligotrophic (Table 4). July-October geomean Secchi depth was 10.6 m, which is better than the desired condition outlined in the LMP of no less than 8.3 m for northern deep waters. Secchi disc depth was the shallowest on June 8 (6.1 m) (Figure 14). In the two previous years, Secchi depth was at its minimum earlier in the spring on 5/22/08 at 2.8 m and on 4/29/09 at 2.0 m, much shallower than in 2010. On September 28, the 1% light depth was 17.3 m and Secchi depth was at its deepest (12.2 m). This event was approximately 1 month later in the year than in 2008 and 2009. Secchi depth and the depth of the photic zone (as measured by the depth at which 1% of the surface light reaches) were less variable in 2010 than in the two previous years.

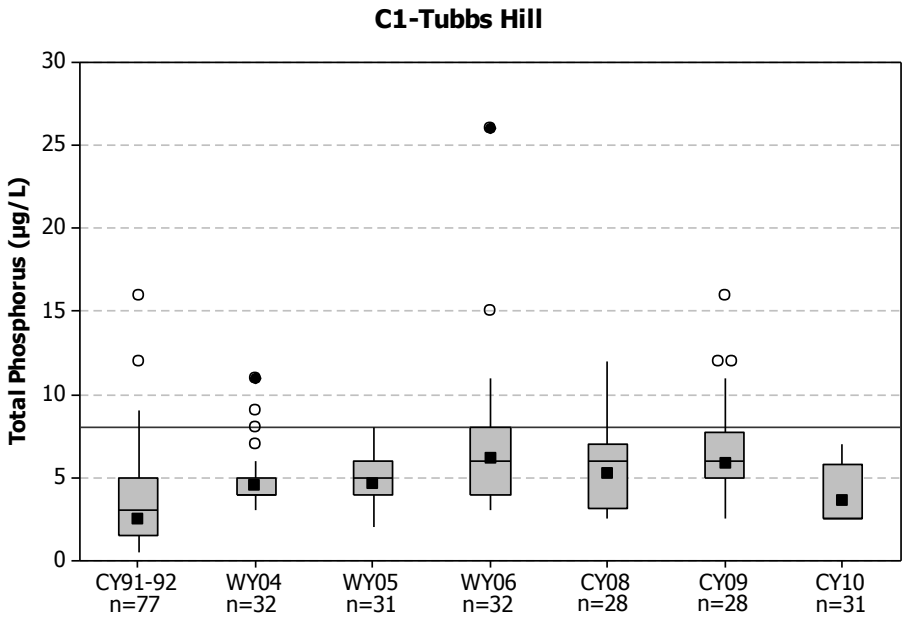

Figure 11. Total phosphorus concentrations (µg/L) at C1-Tubbs Hill (photic zone, 20 m, 30 m, and near bottom samples). Horizontal black line represents the LMP trigger condition of 8 µg/L. *Source*: CY91-92 (Woods and Beckwith 1997); WY04-06 (Wood and Beckwith 2008); CY08 (Tribe and IDEQ 2010); CY09 (Tribe and IDEQ 2012).

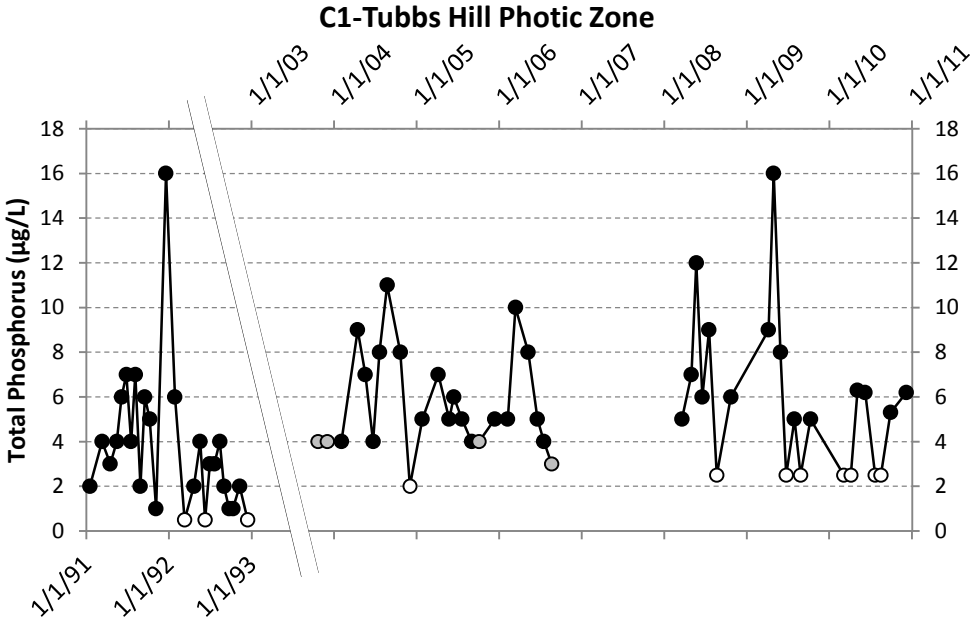

Figure 12. Total phosphorus concentration (µg/L) in the photic zone of C1-Tubbs Hill. Open circles are 1/2 of the MRL. Gray dots are estimates. *Source*: CY91-92 (Woods and Beckwith 1997); WY04-06 (Wood and Beckwith 2008); CY08 (Tribe and IDEQ 2010); CY09 (Tribe and IDEQ 2012).

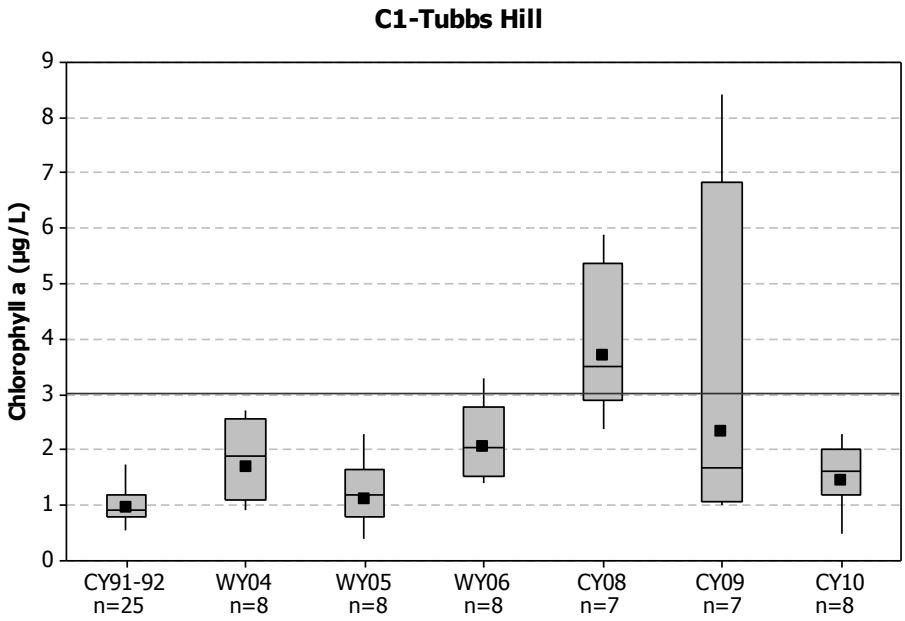

Figure 13. Chlorophyll *a* concentrations (µg/L) at C1-Tubbs Hill (photic zone). Horizontal black line represents the LMP trigger condition of 3 µg/L. *Source*: CY91-92 (Woods and Beckwith 1997); WY04-06 (Wood and Beckwith 2008); CY08 (Tribe and IDEQ 2010); CY09 (Tribe and IDEQ 2012).

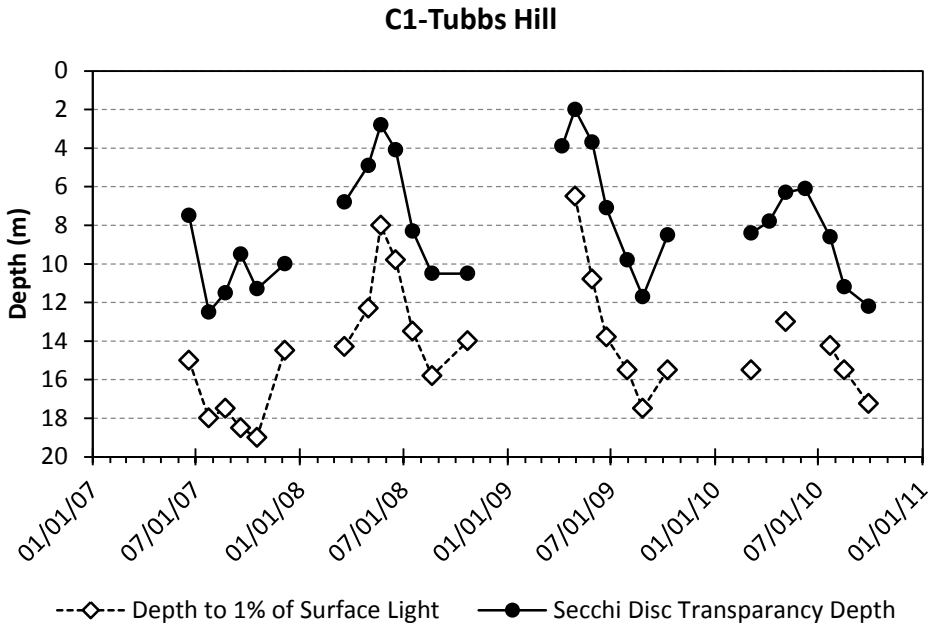

Figure 14. Secchi disc transparency depths (with view tube) and depth to 1% of the incident surface light at station C1-Tubbs Hill for July 2007–December 2010.

5.1.4 Phytoplankton Enumeration

Phytoplankton cell counts at C1 were typically dominated by diatoms, chrysophytes, and cyanobacteria (blue-green algae) (Figure 15). The sampling date with the highest cell count was 6/8/2010 coinciding with the shallowest Secchi-depth and the highest chlorophyll a concentration of the year (Figure 14, Appendices A, B, and D). The timing of this peak is similar to the highest cell counts in previous years. In early spring, phytoplankton cells were dominated by diatoms and chrysophytes. In the late spring, cyanobacteria increased and diatom cell counts diminished. Throughout the remainder of the year, chrysophytes and cyanobacteria co-dominated.

Phytoplankton trends by biovolume show diatoms dominating the sample throughout most of the year and peaking on 5/5/2010, also the day of highest total biovolume (Figure 16). After a decline of diatoms through summer months, green algae became the dominant group in biovolume. An early peak of diatoms followed by a peak in greens is similar to the pattern seen at C1 in 2009. Maximum total biovolume in 2010 was considerably less than in 2008 and 2009.

Seventeen genus/species have been recorded each year since 2007 (Table 9). In the 8 photic zone samples collected in 2010, 14 genus/species occurred in 6 or more of the samples. *Asterionella formosa* was the most dominant diatom (cell count and biovolume), and *Aulacoseira italica* (biovolume), *Fragilaria capucina* (biovolume), and *Fragilaria crotonensis* (primarily biovolume) were also dominant. *Coelastrum sp.* were dominant green algae (cell count and biovolume). *Ochromonas sp*. (biovolume) and small, taxonomically unidentified microflagellates (commonly cell count and occasionally biovolume) were dominant chrysophytes. *Cryptomonas sp*. (biovolume) and *Komma sp*. (biovolume) were dominant cryptophytes. *Gymnodinium sp.* (biovolume) were dominant dinoflagellates. *Microcystis sp*. (cell count) and coccoid and rod *Synechococcus sp.* (commonly cell count and occasionally biovolume) were dominant cyanobacteria.

Microcystis was present in 3 of the samples collected at C1, and cell counts were never above 100,000 cells/mL (Appendix D). Unlike in previous years, no phytoplankton samples were taken from the chlorophyll *a* maximum at station C1.

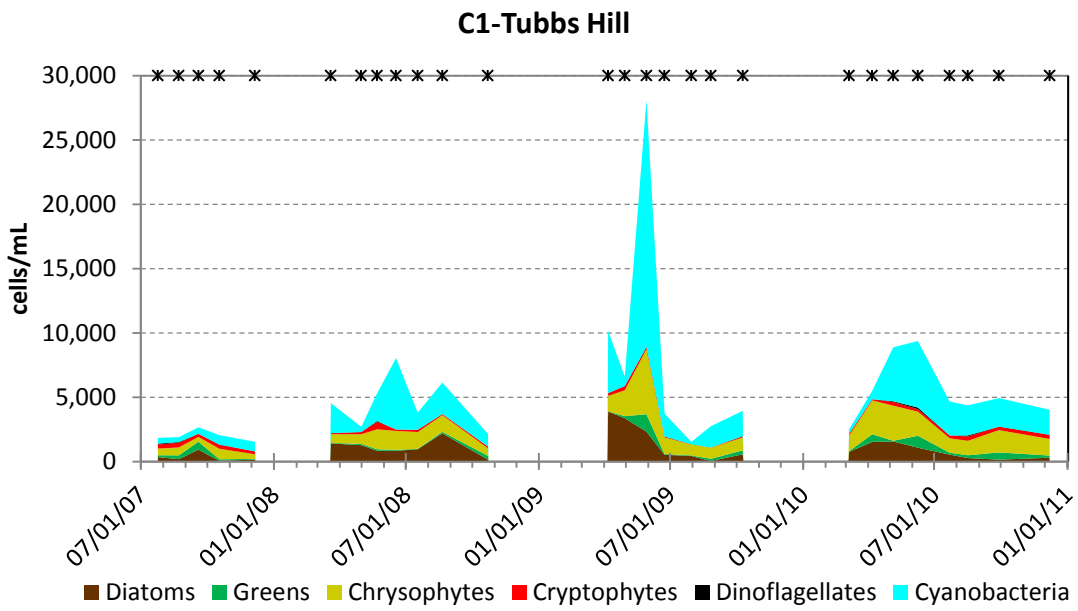

Figure 15. Phytoplankton cell counts (cells/mL) at C1-Tubbs Hill (photic zone samples). *sampling dates.

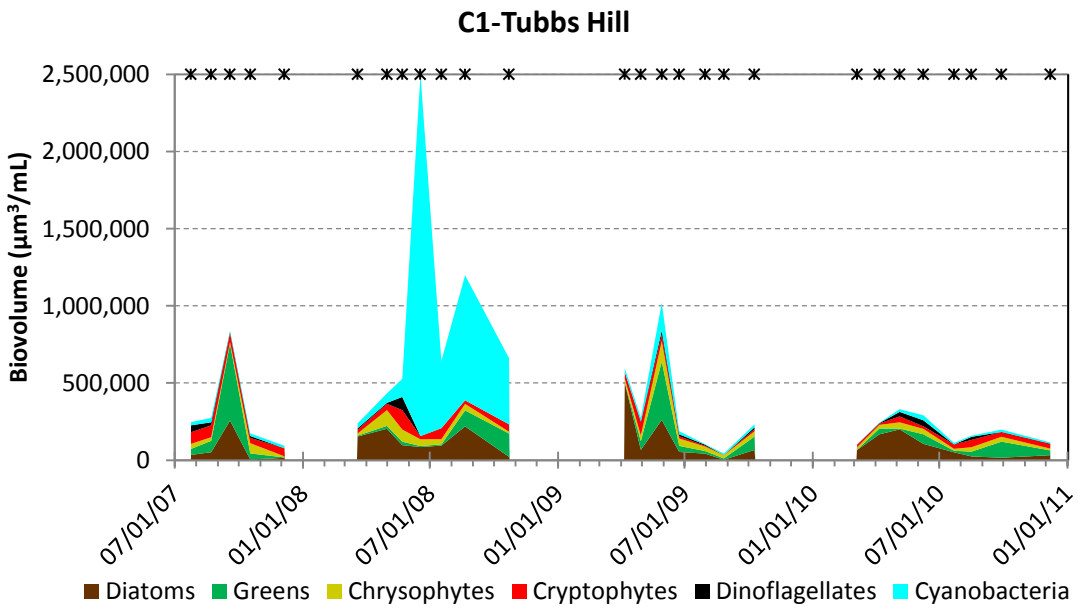

Figure 16. Phytoplankton biovolume (µm³/mL) at C1-Tubbs Hill (photic zone samples). *sampling dates.

Table 9. Phytoplankton species presence at station C1-Tubbs Hill for calendar years 2007–10.

Genus/Species	Presence 2007-2010				Number of times genus/ species was present in 8 photic zone samples in 2010	Number of samples within dominant group (cells or colonies/ mL)[a]	Number of samples within dominant group (biovolume)[b]
Bacillariophyceae (diatoms)							
Achnanthidium sp.	07	08	09		--		
Asterionella formosa var1	07	08	09	10	8	6	7
Aulacoseira granulata		08	09		--		
Aulacoseira italica			09	10	4		2
Cyclotella comta	07		09		--		
Cyclotella glomerata	07	08	09		--		
Cyclotella stelligera	07		09		--		
Diatoma sp.			09		--		
Fragilaria acus		08			--		
Fragilaria capucina	07	08	09	10	7		3
Fragilaria crotonensis		08	09	10	3	1	2
Fragilaria intermedia			09	10	1		
Fragilaria ulna		08			--		
Navicula sp.		08	09	10	1		1
Rhizoselenia sp.		08	09	10	6		
Stephanodiscus sp.		08			--		
Synedra acus var. angustissima		08	09		--		
Synedra nana			09		--		
Tabellaria fenestrata	07			10	2		1
Tabellaria flocculosa			09		--		
Chlorophyceae (coccoid greens, desmids, etc.)							
Acanthosphaera sp.	07		09		--		
Ankistrodesmus sp.	07	08	09	10	1		
Botryococcus sp. (cells)				10	1		
Chlorella	07	08	09		--		
Clamydocapsa sp.		08		10	1		1
Clamydomonas				10	1		
Coelastrum sp.	07		09	10	2	2	2
Cosmarium sp.	07			10	1		1
Crucigenia sp.	07				--		
Dichtyosphaerium			09		--		
Elakatothrix sp3	07	08	09	10	1		
Gleotila sp.			09		--		
Gloeococcus				10	1		
Golenkinia sp.	07	08	09	10	2		
Langerheimia			09		--		

Table 9 cont. Phytoplankton species presence at station C1-Tubbs Hill for calendar years 2007–10.

Genus/Species	Presence 2007-2010				Number of times genus/ species was present in 8 photic zone samples in 2010	Number of samples within dominant group (cells or colonies/ mL)[a]	Number of samples within dominant group (biovolume)[b]
Chlorophyceae (coccoid greens, desmids, etc.) – continued							
Micractinium pusillum	07				--		
Monoraphidium		08	09		--		
Nephroselmis			09	10	5		1
Oocystis sp.	07	08	09	10	1		
Pediastrum sp.				10	1		1
Phacus		08	09	10	1		
Planctonema sp.		08			--		
Planctosphaeria sp. (rod)	07	08	09		--		
Polytoma sp.			09		--		
Pseudosphaerocystis sp.			09		--		
Scenedesmus sp.	07	08		10	1		
Scourfieldia			09	10	3		
Spondylosium sp.				10	1	1	1
Staurastrum sp.	07				--		
Stichococcus minutissimus			09		--		
Tetraedron	07			10	1		
Willea sp.	07				--		
Chrysophyceae (yellow-green flagellates)							
Bitrichia sp.	07	08		10	1		
Chromulina sp1	07	08	09	10	5		
Chrysochromulina sp.	07	08	09	10	4		
Chrysococcus			09	10	8		
Chrysolykos sp.				10	1		
Chrysosphaerella sp.			09	10	1		
Dinobryon sp.	07	08	09	10	5		
Kephyrion sp.	07	08	09	10	2		
Mallomonas sp2		08			--		
Ochromonas sp.		08	09	10	6		2
Pseudokephrion sp.		08			--		
Small microflagellates	07	08	09	10	8	8	3
Sphaleromantis sp.			09		--		
Spiniferomonas				10	1		
Synura		08			--		
Trachelomonas sp.			09		--		
Uroglena sp. (cells)			09		--		

Table 9 cont. Phytoplankton species presence at station C1-Tubbs Hill for calendar years 2007–10.

Genus/Species	Presence 2007-2010				Number of times genus/species was present in 8 photic zone samples in 2010	Number of samples within dominant group (cells or colonies/mL)[a]	Number of samples within dominant group (biovolume)[b]
Cryptophyta (flagellates)							
Chilomonas sp.				10	2		1
Chroomonas acuta				10	6		1
Cryptomonas sp. (sm, med, lrg)	07	08	09	10	8		5
Komma sp.	07	08	09	10	8		3
Dinophyceae (dinoflagellates)							
Gloeodinium sp.			09		--		
Gymnodinium sp. (sm, med, lrg)	07	08	09	10	4		3
Peridinium sp1	07	08			--		
Cyanophyta (cyanobacteria or blue-greens)							
Anabaena circinalis	07				--		
Aphanothecae sp.	07				--		
Chroococcus sp. (cells)	07	08	09	10	2		
Coelosphaeria sp.		08	09		--		
Gomphosphaeria sp. (cells)	07				--		
Microcystis sp. (cells)		08	09	10	3	3	
Oscillatoria agardhii		08			--		
Synechococcus sp. (coccoid)	07	08	09	10	7	6	
Synechococcus sp. (rod)	07	08	09	10	8	8	
Synechococcus sp. (coccoid+rod)					--	--	3
Synechocystis			09	10	6		

a = The group of genus/species where the count of cells (or colonies)/mL, as a percentage of the total assemblage count, was 5% or greater in 8 photic zone samples.

b = The group of genus/species where the biovolume (um^3/mL) of cells (or colonies), as a percentage of the total assemblage biovolume, was 5% or greater in 8 photic zone samples.

5.2 C2-Wolf Lodge Bay

5.2.1 Thermal Stratification and Oxygen Depletion

The water column at station C2-Wolf Lodge Bay was thermally mixed from at least March through approximately May and thermally stratified from July through at least September (Figure 17). Thermocline depth was 10–13 m on July 23 and 10–16 m on August 19. The thermocline had deepened to 13–16 m by September 28. The greatest temperature change with depth was -2.2 °C/m on August 19 between 13-14 m. C2 was not sampled in December; therefore, complete turnover is not shown.

Oxygen depletion in the hypolimnion began in June and persisted throughout the summer (Figure 18, Figure 19). DO concentrations were highest in March and April before stratification. The DO concentration was lowest in the hypolimnion during the September 28 sampling (Figure 18), but the hypolimnion was never below the 6 mg/L LMP target condition.

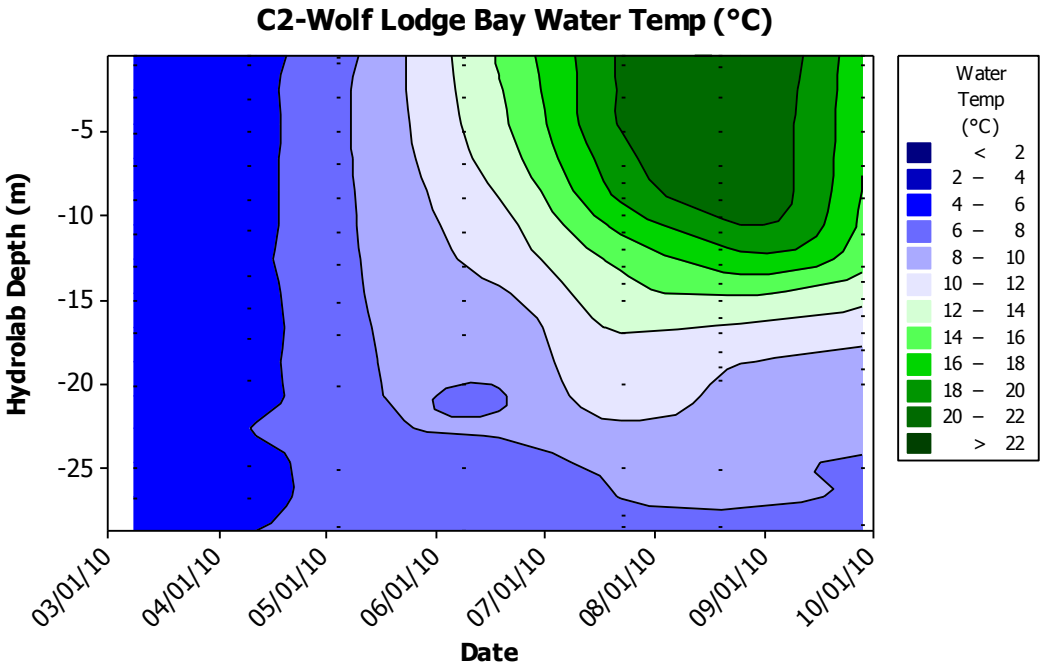

Figure 17. Water temperature profiles at C2-Wolf Lodge Bay. Measured values are represented by points and lines represent values of equal temperature.

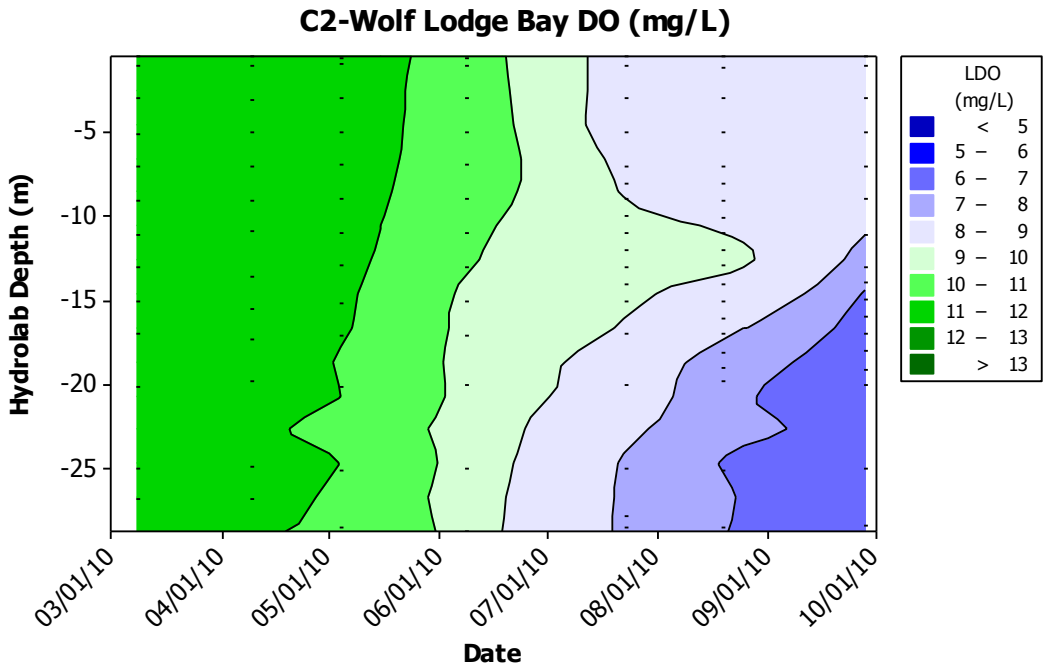

Figure 18. Dissolved oxygen concentrations (mg/L) at C2-Wolf Lodge Bay. Measured values are represented by points and lines represent values of equal DO concentration.

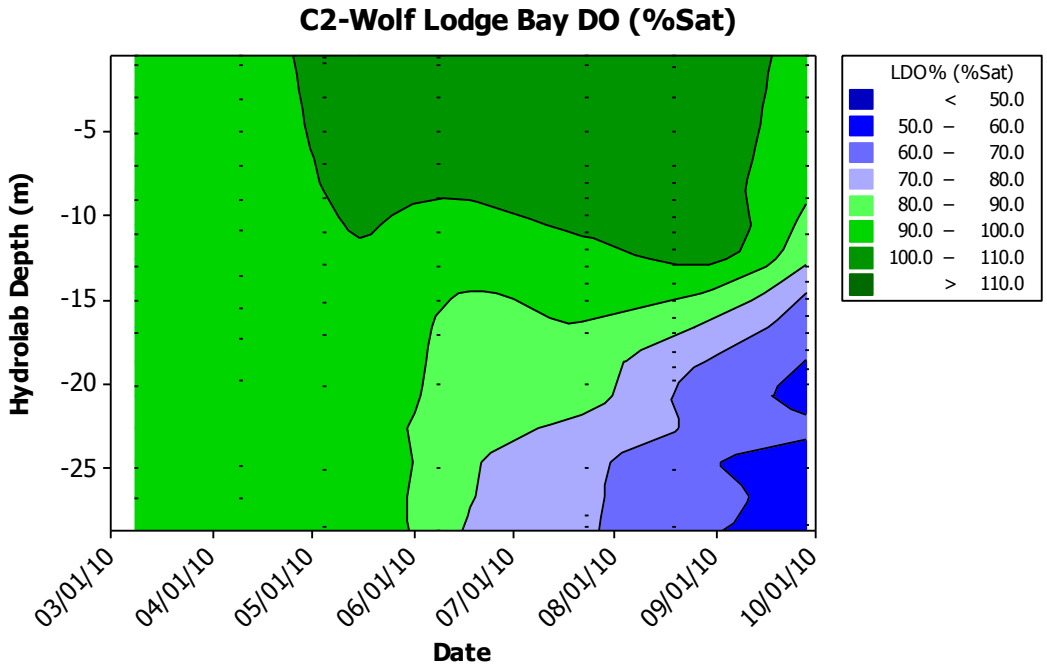

Figure 19. Dissolved oxygen saturation (%Sat) at C2-Wolf Lodge Bay. Measured values are represented by points and lines represent values of equal saturation.

5.2.2 Idaho Water Quality Standards

All dissolved zinc samples collected during 2010 at C2-Wolf Lodge Bay violated the Idaho WQS of 36 µg/L at 25 mg/L hardness (CCC and CMC). Only one dissolved Cd sample violated the WQS (August 19 at 20 m). No dissolved Pb samples violated the WQS. Only 3 out of 21 dissolved Pb samples were above the MRL of 10 µg/L (May 4 at 20 m and 27.5 m, and June 8 in the photic zone).

5.2.3 Nutrients, Chlorophyll *a*, Water Clarity, and Trophic State

Total phosphorus concentrations ranged from <5–8 µg/L, and total nitrogen concentrations ranged from 71–147 µg/L (Table 8). All concentrations of DTP were below 5 µg/L (MRL), and all DOP results were less than 3 µg/L (MRL). Maximum DIN was 92 µg/L (photic zone on August 19). In 2010, all of the samples at C2 were phosphorus limited (TN:TP ranged from 27–130 mol:mol).

The annual total phosphorus geomean was <5 µg/L, below the LMP trigger condition of 8.0 µg/L (Table 8). Based on the TP concentrations, site C2 was oligotrophic in 2010 (Table 4). The annual chlorophyll *a* geomean was 1.52 µg/L, less than the LMP trigger condition of 3.0 µg/L, and no samples exceeded 5.0 µg/L, further indicating that C2 was oligotrophic (Table 8). The annual geometric mean Secchi depth (with a view tube) was 6.3 m, which would classify site C2 as meso-oligotrophic (Table 4). July–October geomean Secchi depth was 9.5 m, which is better than the desired condition outlined in the LMP of no less than 8.3 m for northern lake deep waters. On May 4, the 1% light depth was 11.0 m, and Secchi depth was at its shallowest (4.0 m). On August 19, Secchi depth was at its deepest (10.9 m), and the 1% light depth was 16.0 m (Figure 20).

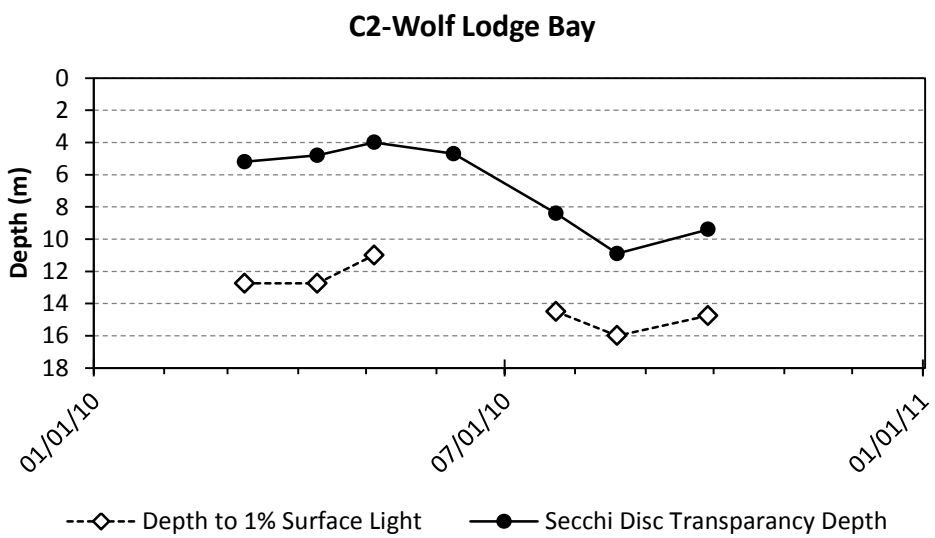

Figure 20. Secchi disc depths (with a view tube) and depth to 1% of the incident surface light at station C2-Wolf Lodge Bay for 2010.

5.2.4 Phytoplankton Enumeration

A phytoplankton enumeration and biovolume sample was collected from the photic zone (1–11.0 m) on May 4, 2010. Phytoplankton cell counts were dominated by cyanobacteria and chrysophytes, and diatoms were also common (Figure 21). Diatoms dominated the sample in biovolume (Figure 22).

Dominant organisms in the sample included: *Synechococcus sp*. (coccoid) (cell count and biovolume), small microflagellates (cell count and biovolume), *Asterionella formosa* (biovolume), *Ochromonas sp.* (biovolume), and *Synechococcus sp*. (rod) (cell count) (Appendix D). *Microcystis* was not present in the phytoplankton samples collected at C2.

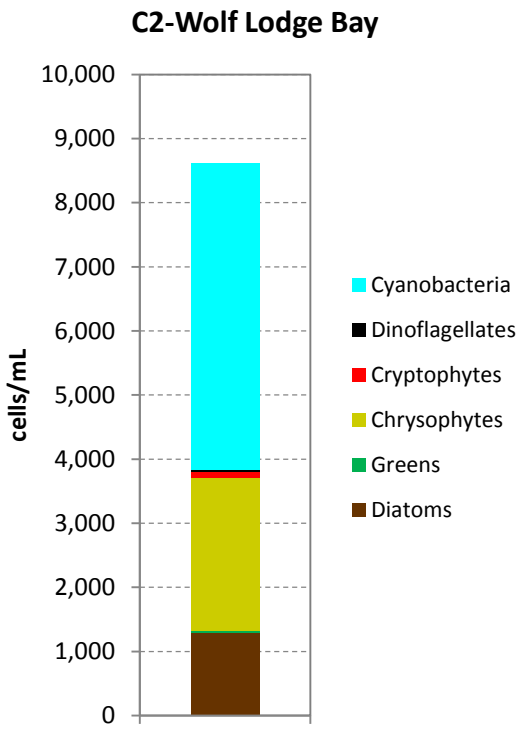

Figure 21. Phytoplankton cell counts (cells/mL) at C2-Wolf Lodge Bay (photic zone).

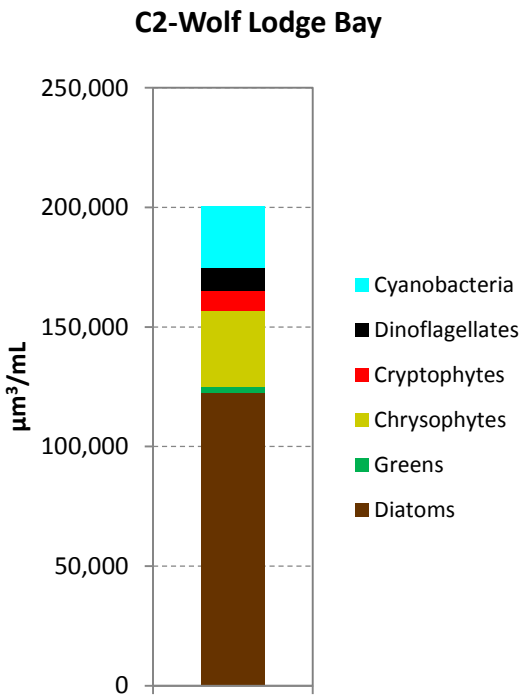

Figure 22. Phytoplankton biovolume (μm^3/mL) at C2-Wolf Lodge Bay (photic zone).

5.3 C3-Driftwood Point

5.3.1 Thermal Stratification and Oxygen Depletion

The water column at station C3-Driftwood Point was thermally mixed from at least March through approximately April. Thermal stratification began in June and the thermocline was well developed from July through September (Figure 23). Thermocline depth was 6-9 m on July 21 and 10–14 m on August 19. The thermocline had deepened to 14–18 m by September 29. The greatest temperature change with depth was -6.0 °C/m from 10–11 m on August 29.

DO concentrations were highest during the March sampling when C3 was cold and well mixed. Oxygen concentrations at C3 were almost always higher in the surface waters than at depth (Figure 24). Oxygen depletion in the hypolimnion began in June and persisted throughout the summer (Figure 25). The DO concentration was lowest in the hypolimnion during the September 29 sampling at 19.0 m (6.5 mg/L) (Figure 24). The dissolved oxygen concentrations never fell below the 6 mg/L LMP trigger condition.

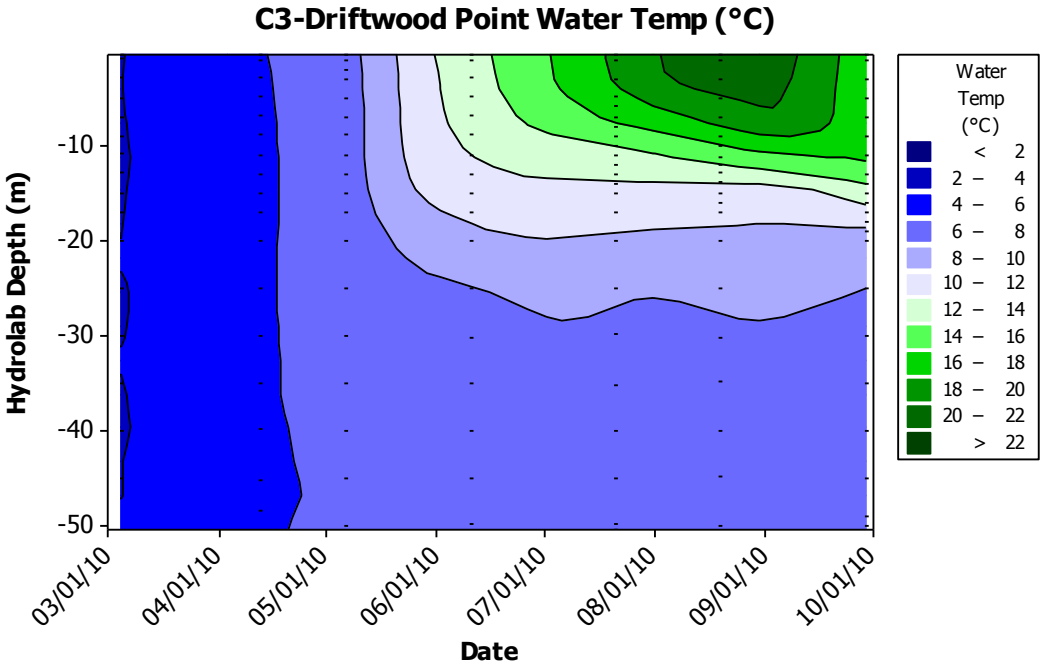

Figure 23. Water temperature profiles at C3-Driftwood Point. Measured values are represented by points and lines represent values of equal temperature.

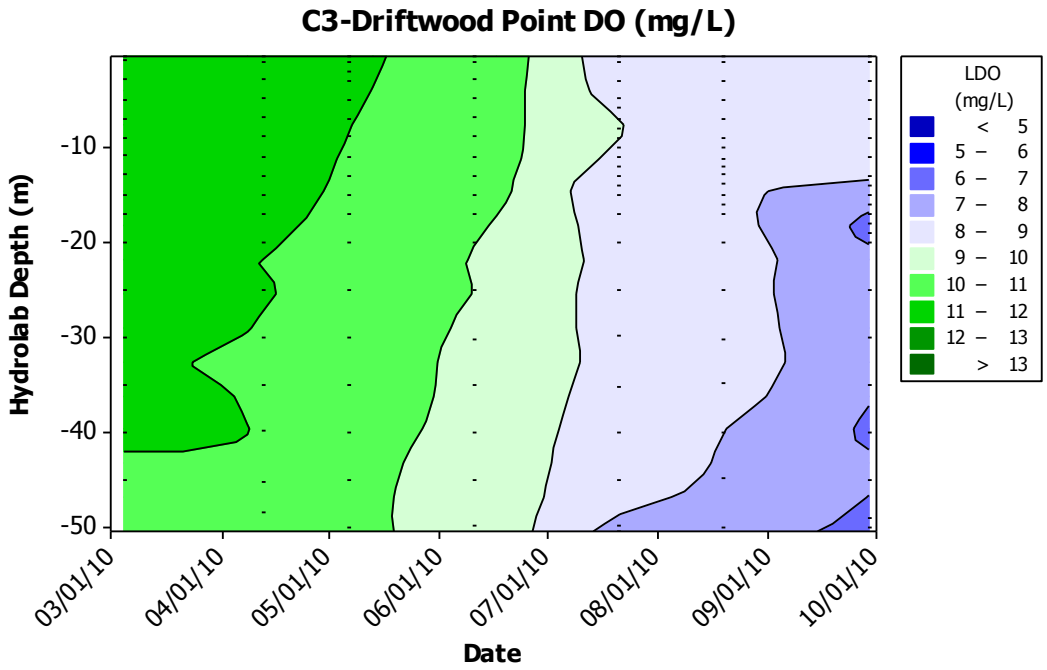

Figure 24. Dissolved oxygen concentrations (mg/L) at C3-Driftwood Point. Measured values are represented by points and lines represent values of equal DO concentration.

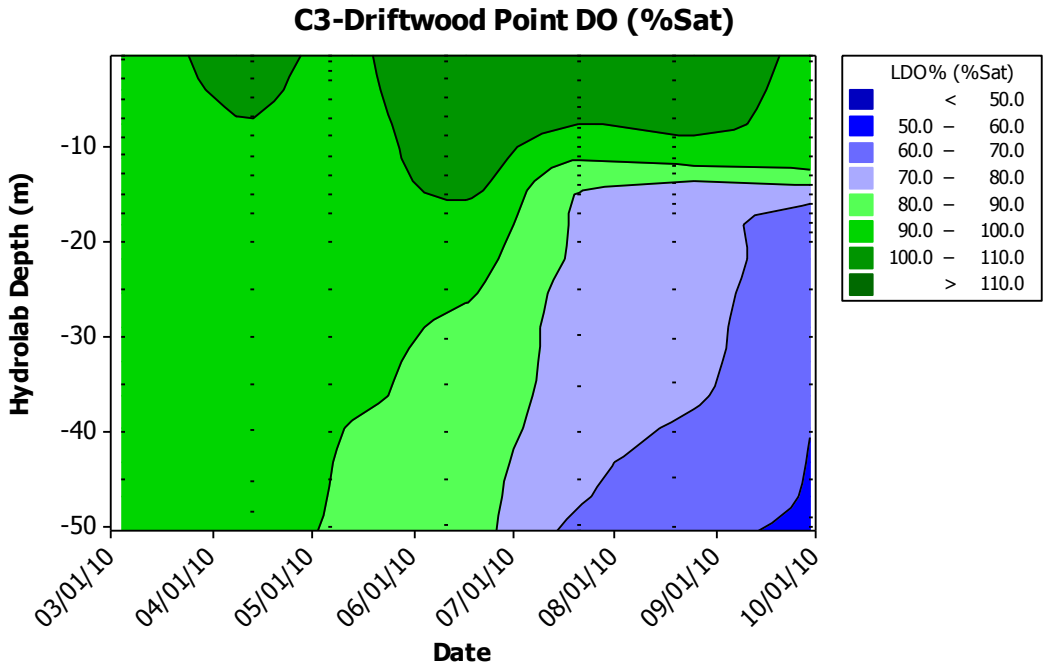

Figure 25. Dissolved oxygen saturation (%Sat) at C3-Driftwood Point. Measured values are represented by points and lines represent values of equal saturation.

5.3.2 Idaho Water Quality Standards

All dissolved zinc samples collected during 2010 at C3-Drfitwood Point violated the Idaho WQS of 36 µg/L at 25 mg/L hardness (CCC and CMC) (Figure 26). The mean dissolved zinc concentrations collected in 2010 were statistically less than the mean dissolved Zn in WY04 ($p<0.05$) but not significantly different than WY05 or WY06 ($p>0.1$).

Dissolved cadmium showed less variability than in previous years (Figure 27). The dissolved cadmium criterion (ranging from 0.22–0.25 µg/L) was exceeded on June 10 in the photic zone and at 25 m and on August 19 in the photic zone and at 49.5 m. The mean dissolved cadmium at C3 in 2010 was statistically lower than in WY04 ($p<0.01$), WY05 ($p<0.05$), and WY06 ($p<0.05$).

No dissolved lead samples exceeded the CCC of 0.54 µg/L (Figure 28). It is typical for high total and dissolved lead concentrations to correlate with high river flows (e.g. Tribe and IDEQ, 2010 and 2012). The highest concentrations were on May 6, corresponding spring runoff on the Cd'A River (Figure 2). The mean dissolved lead concentration was statistically lower in 2010 than in WY05 ($p<0.05$) and WY06 ($p<0.01$), but CY10 was not significantly different than WY04 ($p>0.1$).

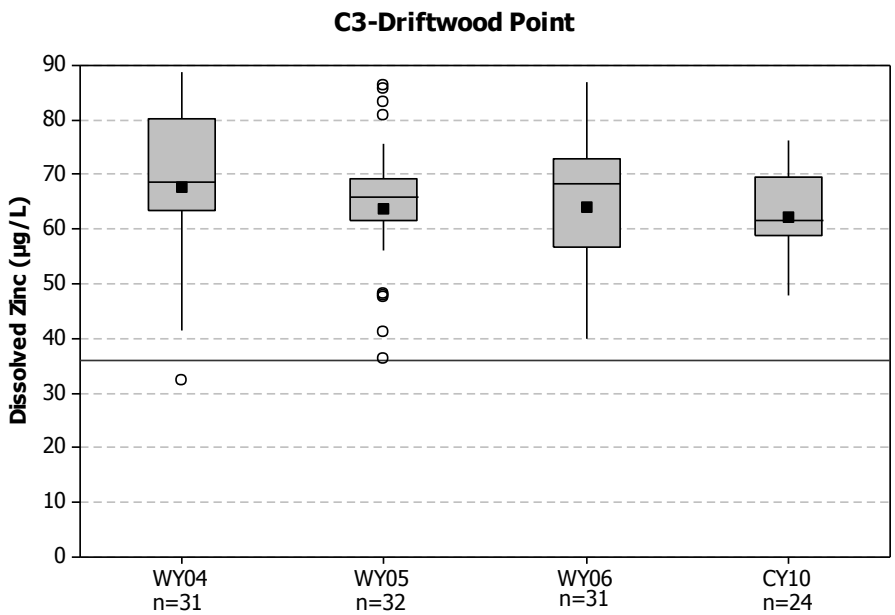

Figure 26. Dissolved zinc concentrations (µg/L) at C3-Driftwood Point (photic zone, 25 m, 40 m, and near bottom). Horizontal black line represents the IDEQ WQS of 36 µg/L Zn at 25 mg/L total hardness. *Source*: WY04-06 (Wood and Beckwith 2008)

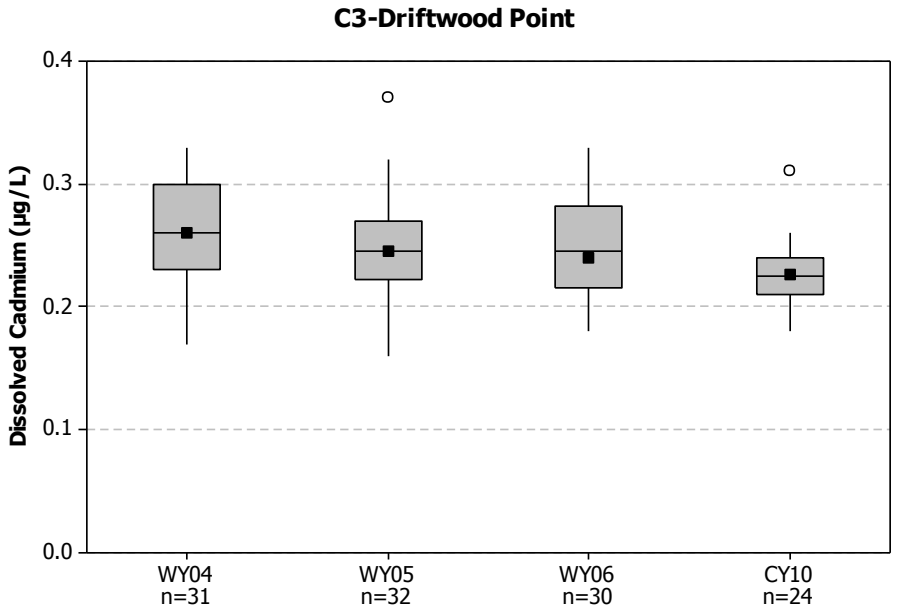

Figure 27. Dissolved cadmium concentrations (µg/L) at C3-Driftwood Point (photic zone, 25 m, 40 m, and near bottom). *Source:* WY04-06 (Wood and Beckwith 2008).

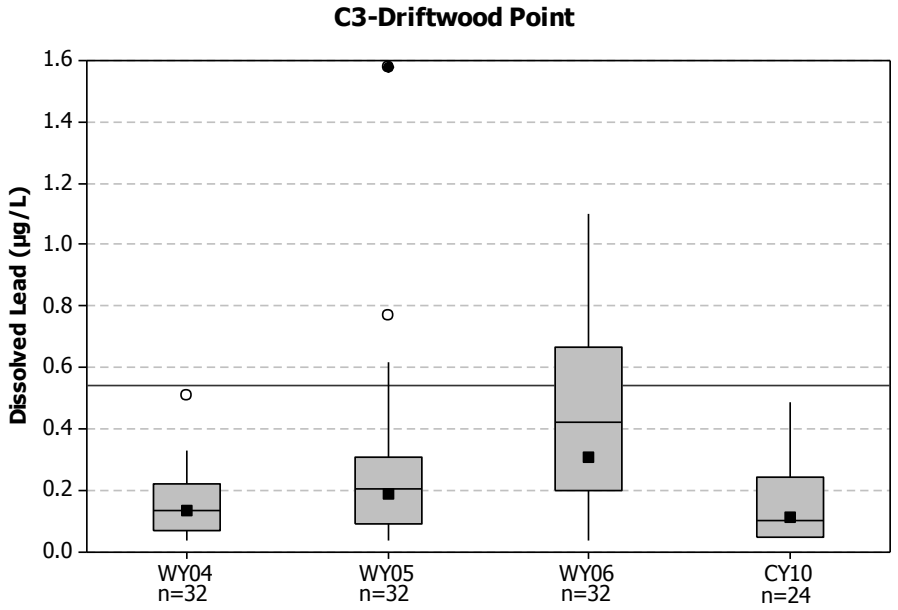

Figure 28. Dissolved lead concentrations (µg/L) at C3-Driftwood Point (photic zone, 25 m, 40 m, and near bottom). Horizontal black line represents the IDEQ WQS of 0.54 µg/L Zn at 25 mg/L total hardness. *Source*: WY04-06 (Wood and Beckwith 2008).

5.3.3 Nutrients, Chlorophyll *a*, Water Clarity, and Trophic State

Total phosphorus concentrations ranged from <5–7 µg/L and total nitrogen concentrations ranged from 65–163 µg/L (Table 8). All concentrations of DTP were below 5 µg/L (MRL), and all DOP results were less than 3µg/L (MRL). Maximum DIN was 120 µg/L (40 m on September 29). In 2010, all of the samples at C3 were phosphorus limited (TN:TP ranged from 30–136 mol:mol).

The annual total phosphorus geomean was <5 µg/L, below the LMP trigger condition of 8.0 µg/L (Figure 29). Based on the TP concentrations site C3 was oligotrophic in 2010 (Table 4). The mean TP in 2010 was greater than the mean TP in 91-92 ($p<0.01$) and less than the mean TP in WY05 ($p<0.05$) and WY06 ($p<0.01$). The mean TP concentration in CY10 was not significantly different than that in WY04 ($p>0.1$).

The annual chlorophyll *a* geomean in the photic zone was 1.81 µg/L (less than the LMP trigger condition of 3.0 µg/L), and no samples exceeded 5.0 µg/L further indicating that C3 was oligotrophic (Figure 30). Mean chlorophyll *a* in 2010 was higher than the mean Chl *a* in 91-92 ($p<0.01$) and WY05 ($p<0.05$), but it was not significantly different than WY04 or WY06 ($p>0.1$).

The annual geometric mean Secchi depth (with a view tube) was 7.2 m, which would classify site C3 as oligotrophic (Table 4). July–October geomean Secchi depth was 10.8 m, which is better than the desired condition outlined in the LMP of no less than 8.3 m for northern lake deep waters. Secchi disc depth was the shallowest on June 8 (6.1 m), and the 1% light penetration depth was 10.0 m (Figure 31). On August 19, the 1% light depth was 17.0 m and Secchi depth was at its deepest (12.4 m).

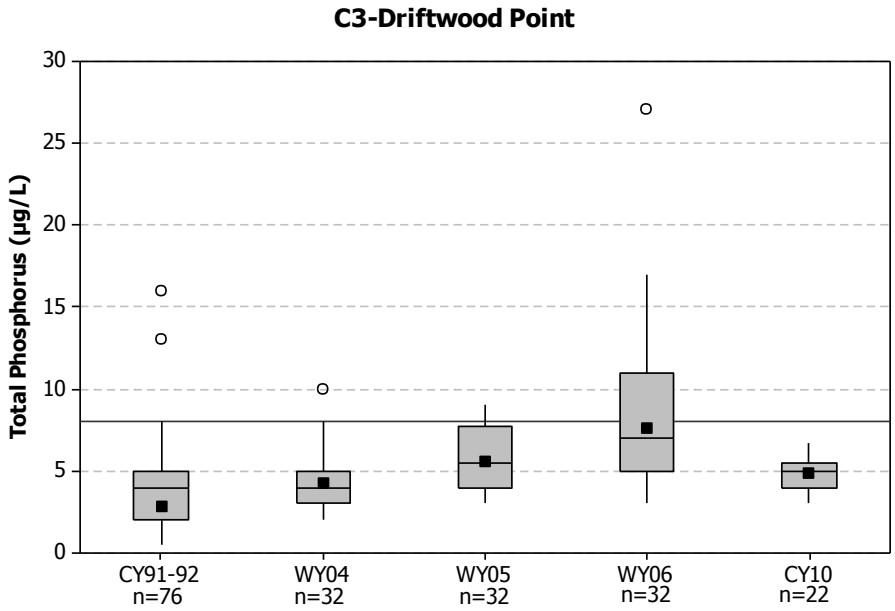

Figure 29. Total phosphorus concentrations (µg/L) at C3-Driftwood Point (photic zone, 25 m, 40 m, and near bottom). Horizontal black line represents the LMP trigger condition of 8 µg/L. *Source:* CY91-92 (Woods and Beckwith 1997); WY04-06 (Wood and Beckwith 2008)

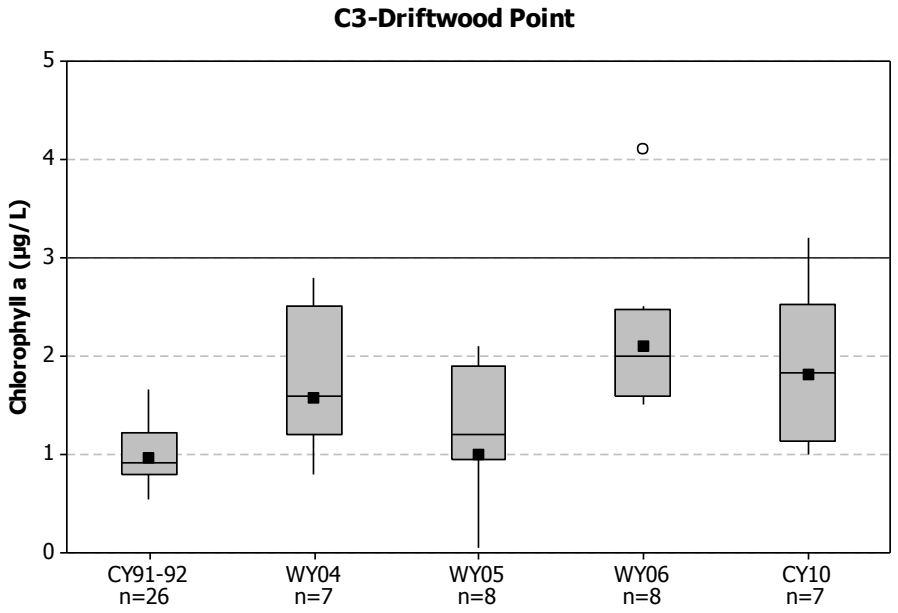

Figure 30. Chlorophyll a concentrations (µg/L) at C3-Driftwood Point (photic zone). Horizontal black line represents the LMP trigger condition of 3 µg/L. *Source:* CY91-92 (Woods and Beckwith 1997); WY04-06 (Wood and Beckwith 2008)

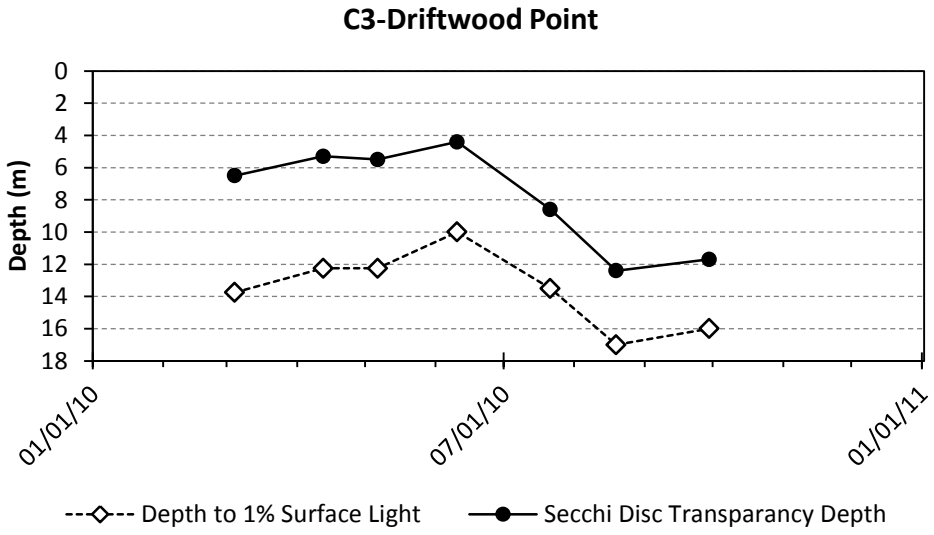

Figure 31. Secchi disc depths (with a view tube) and depth to 1% of the incident surface light at station C3-Driftwood Point for 2010.

5.3.4 Phytoplankton Enumeration

Phytoplankton samples were obtained 6 times at site C3, from April 12 to September 29. Phytoplankton cell counts at C3 were typically dominated by diatoms, chrysophytes, and cyanobacteria (Figure 32). The sampling dates with the highest cell counts were April 12 and June 10. The former coincided with the highest chlorophyll *a* concentration, and the later coincided with the shallowest Secchi-depth of the year (Figure 31, Appendices A, B, and D). In early spring, phytoplankton cells were dominated by diatoms and chrysophytes. Throughout the summer, diatoms diminished and cyanobacteria cell count increased.

Phytoplankton biovolume shows a diatom bloom on April 12 (with *Tabellaria fenestrata* and *Aulacoseira italica* dominant). This date had the highest biovolume and chlorophyll *a* concentration of all C3 samples (Figure 33). After a diatom decline, greens, chrysophytes, cryptophytes, and cyanobacteria had similar biovolumes with some variation throughout the year.

Asterionella formosa, *Chromulina sp., Chrysococcus*, small microflagellates, *Komma sp.,* and *Synechoccus sp*. (rod) were present in all the samples collected at C3 (Appendix D). Small microflagellates were the most frequent dominant species by cells/mL (4 days), and they were within the dominant cell count group for all six samples. Synechococcus sp. (rod & coccoid) and *Asterionella formosa* were also common in the dominant cells/mL group. *Asterionella formosa* was the most frequent dominant species by biovolume (2 days), and it was within the dominant biovolume group for 4 days. *Aulacoseira italica* was also common within the dominant biovolume group. *Microcystis* was present in 1 sample (July 21), and cell counts were well below 100,000 cells/mL (Appendix D).

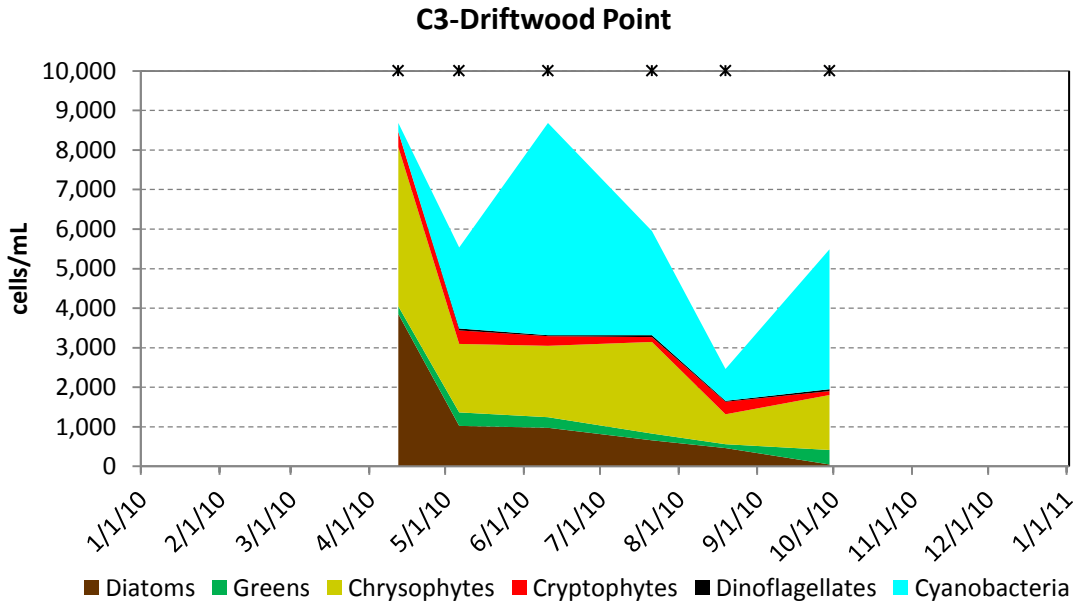

Figure 32. Phytoplankton cell counts (cells/mL) at C3-Drfitwood Point (photic zone). *sampling dates.

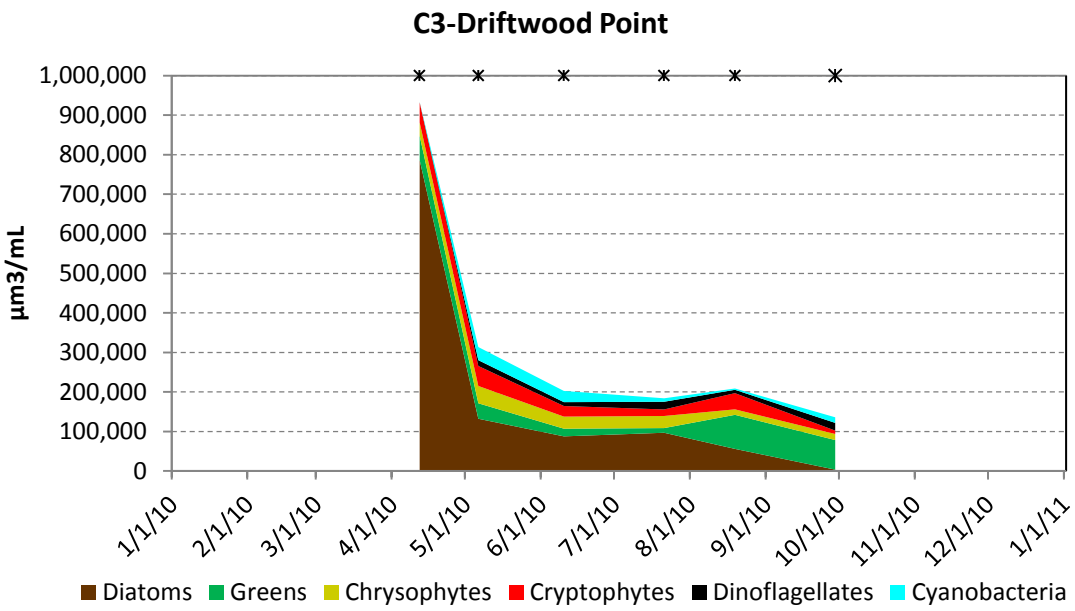

Figure 33. Phytoplankton biovolume (µm³/mL) at C3-Driftwood Point (photic zone). *sampling dates.

5.4 C4-Univeristy Point

5.4.1 Thermal Stratification and Oxygen Depletion

The water column at station C4-University Point was thermally mixed from at least March through approximately May. Thermal stratification began in June and the thermocline was well developed from July through September (Figure 34). Thermocline depth was 7–12 m on July 20 and 8–15 m on August 18. The thermocline had deepened to 15–17 m by September 30. The greatest temperature change with depth was -2.9 °C/m on August 18 between 8–9 m. By the December 9 sampling event, the water at C4 had completely turned over.

Oxygen depletion in the hypolimnion began in June and intensified through the summer (Figure 35, Figure 36). DO concentrations were highest during the March sampling when the water was coldest and well mixed. The DO concentration was lowest in the hypolimnion during the September 30 sampling (Figure 35). On this date, there was also an oxygen sag at 0.2 m off the bottom, but the water column remained above the 6.0 mg/L LMP trigger condition. After fall turnover, the low oxygen hypolimnion mixed with the oxygenated epilimnion resulting in DO concentrations ranging from 9.8-10.2 mg/L during the December sampling.

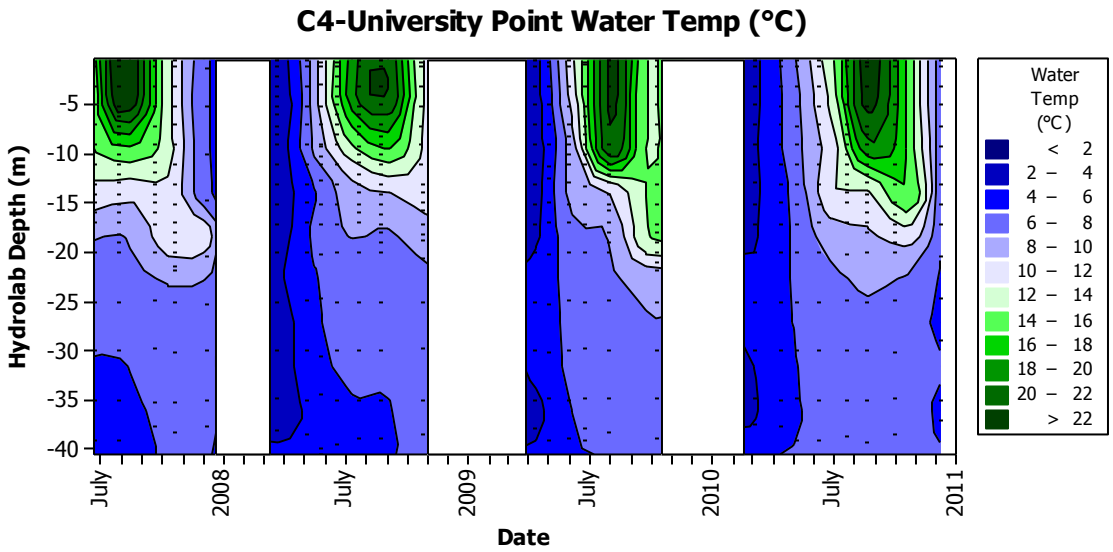

Figure 34. Water temperature profiles at C4-University Point. Measured values are represented by points and lines represent values of equal temperature. Ticks on the x-axis are in months.

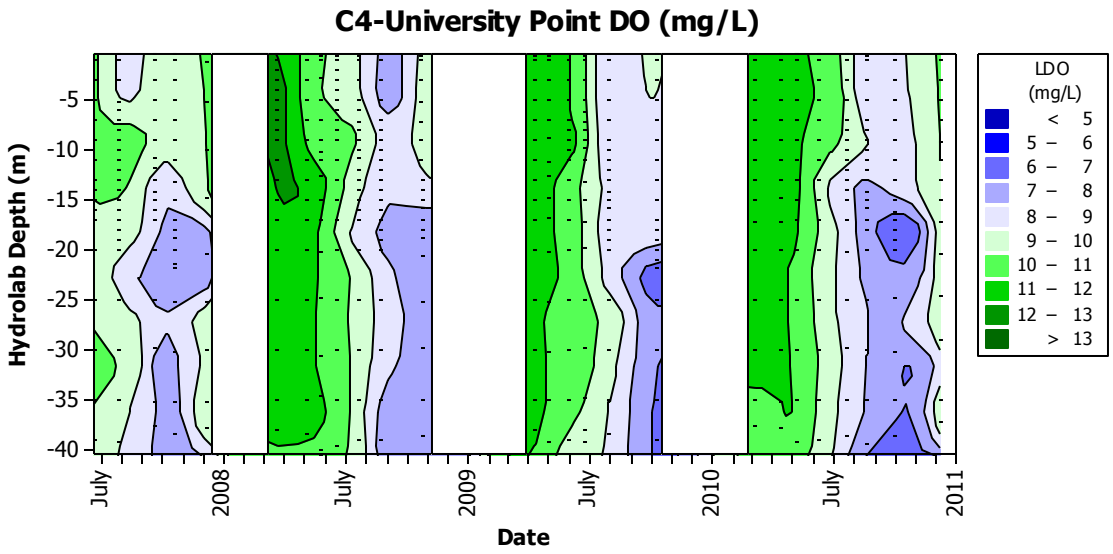

Figure 35. Dissolved oxygen concentrations (mg/L) at C4-Univeristy Point. Measured values are represented by points and lines represent values of equal DO concentration. Ticks on the x-axis are in months.

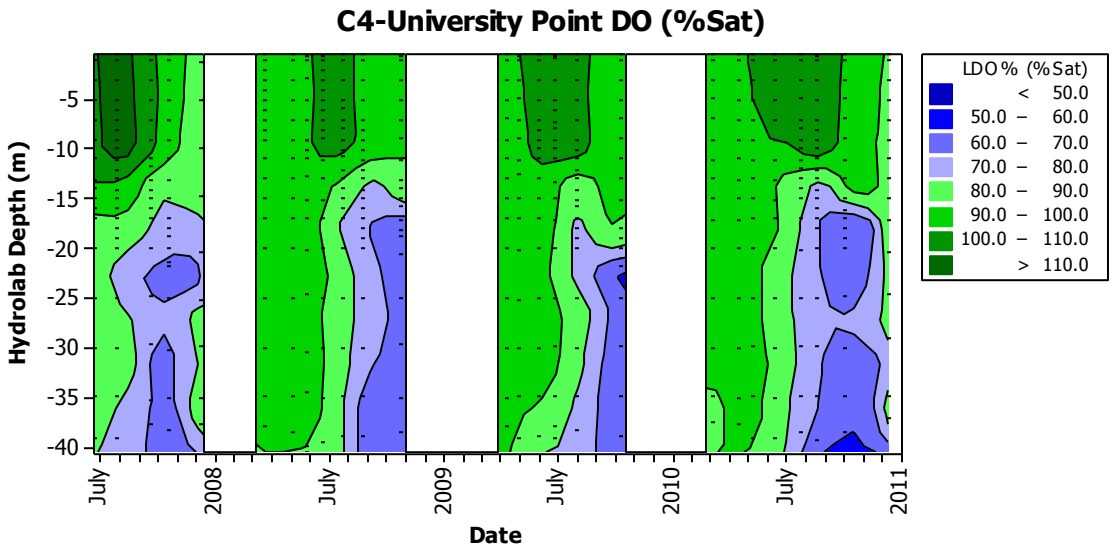

Figure 36. Dissolved oxygen saturation (%Sat) at C4-University Point. Measured values are represented by points and lines represent values of equal saturation. Ticks on the x-axis are in months.

5.4.2 Idaho Water Quality Standards

All dissolved zinc samples collected during 2010 at C4-University Point violated the Idaho WQS of 36 µg/L at 25 mg/L hardness (CCC and CMC). The mean dissolved zinc concentration collected in 2010 was less than the mean dissolved Zn in WY04 ($p<0.01$), WY06 ($p<0.1$), and CY08 ($p<0.05$) (Figure 37). The mean dissolved zinc concentration in 2010 was not significantly different than the mean dissolved zinc concentration in WY05 and CY09 ($p>0.1$).

The dissolved cadmium criterion (ranging from 0.23–0.26 µg/L) was exceeded on the following dates at these depths: March 3 at 36.5 m, June 9 in the photic zone, July 20 at 30.0 m, August 18 at 20, 30 and 38.5 m, and December 9 at 20.0 m. The mean dissolved cadmium concentration in 2010 was lower than WY04, WY05, WY06, CY08, and CY09 ($p<0.01$) (Figure 38).

Dissolved lead concentrations exceeded the CCC of 0.54 µg/L on April 13 (photic zone, 20.0 m, and 37.0 m) and on May 7 (photic zone). It is typical for high total and dissolved lead concentrations to correlate with high river flows (e.g., Tribe and IDEQ, 2010 and 2012). The highest concentrations were on April 13, which may be a response to a peak in the Coeur d'Alene River hydrograph on March 31 (Figure 2). The mean dissolved lead concentration was statistically lower in 2010 than in WY05 ($p<0.05$), WY06 ($p<0.01$), CY08 ($p<0.01$), and CY09 ($p<0.01$) (Figure 39). The mean dissolved lead concentration in 2010 was not significantly different than the mean dissolved lead concentration in WY04 ($p>0.1$).

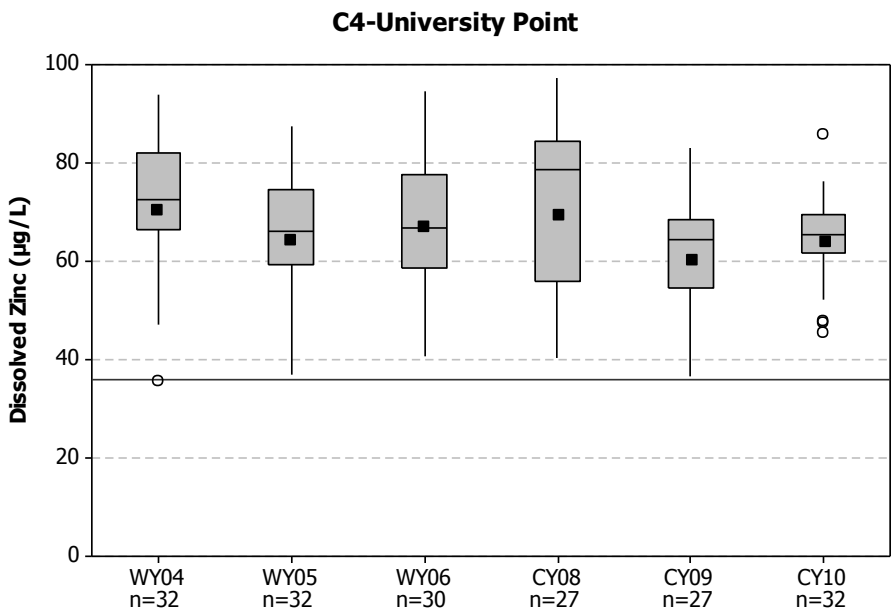

Figure 37. Dissolved zinc concentrations (µg/L) at C4-University Point (photic zone, 20 m, 30 m, and near bottom). Horizontal black line represents the IDEQ WQS of 36 µg/L Zn at 25 mg/L total hardness. *Source*: WY04-06 (Wood and Beckwith 2008); CY08 (Tribe and IDEQ 2010); CY09 (Tribe and IDEQ 2012).

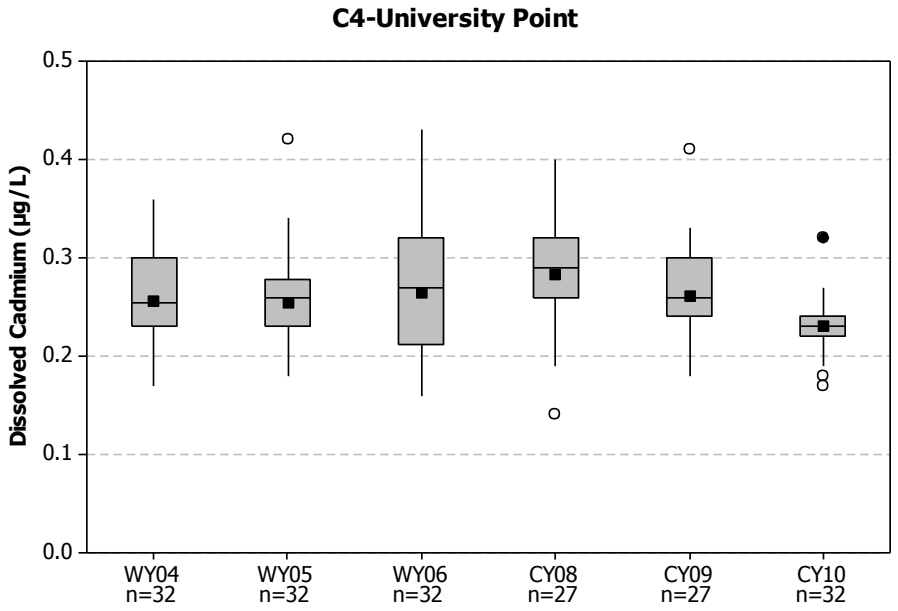

Figure 38. Dissolved cadmium concentrations (µg/L) at C4-University Point (photic zone, 20 m, 30 m, and near bottom). *Source*: WY04-06 (Wood and Beckwith 2008); CY08 (Tribe and IDEQ 2010); CY09 (Tribe and IDEQ 2012).

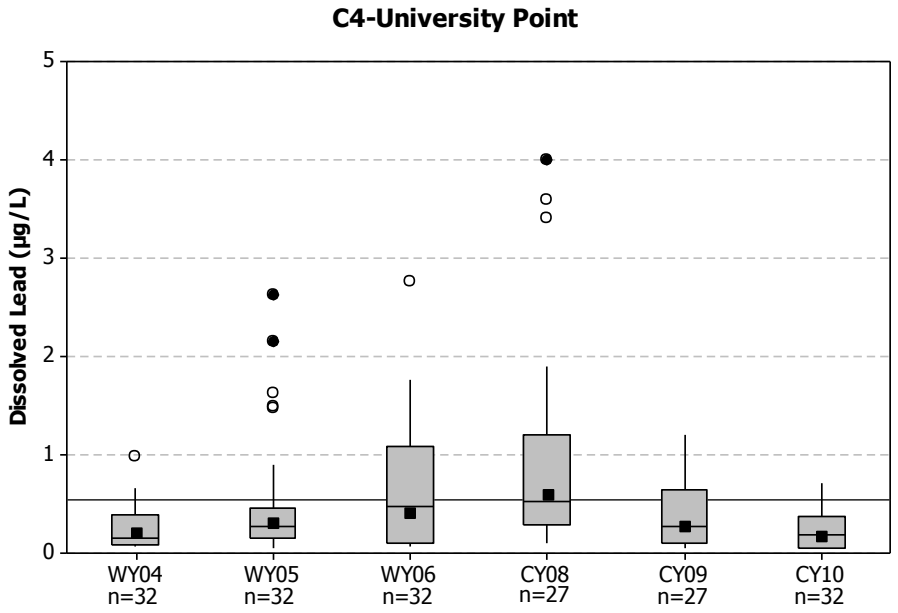

Figure 39. Dissolved lead concentrations (µg/L) at C4-University Point (photic zone, 20 m, 30 m, and near bottom). Horizontal black line represents the IDEQ WQS of 0.54 µg/L Pb at 25 mg/L total hardness. *Source*: WY04-06 (Wood and Beckwith 2008); CY08 (Tribe and IDEQ 2010); CY09 (Tribe and IDEQ 2012).

5.4.3 Nutrients, Chlorophyll *a*, Water Clarity, and Trophic State

Total phosphorus concentrations ranged from <5–11 µg/L, and total nitrogen concentrations ranged from 76–161 µg/L (Table 8). All concentrations of DTP except for two were below 5 µg/L (MRL), and all DOP results were less than 3µg/L (MRL). Maximum DIN was 87 µg/L (at 37.8 m on September 30). In 2010, all of the samples at C4 were phosphorus limited (TN:TP ranged from 24–142 mol:mol).

The annual total phosphorus geomean was <5 µg/L, below the LMP trigger condition of 8.0 µg/L (Figure 40). Based on the TP concentration, site C4 was oligotrophic in 2010 (Table 4). The mean TP in 2010 was less than WY05, WY06, CY08, and CY09 ($p<0.01$), but it was not significantly different than the mean concentrations in CY91-92 and WY04 ($p>0.1$). Comparison of photic zone TP concentrations since 1991 shows that after a peak on April 28, 2009, TP concentrations dropped rapidly and remained low until at least December 9, 2010 (Figure 41).

The annual chlorophyll *a* geomean was 1.80 µg/L, less than the LMP trigger condition of 3.0 µg/L, and no samples exceeded 5.0 µg/L further indicating that C4 was oligotrophic. Mean chlorophyll *a* in 2010 was higher than mean Chl *a* in CY91-92 ($p<0.01$) and WY05 ($p<0.1$) and lower than the mean concentration in CY08 ($p<0.05$) (Figure 42). It was not significantly different than the mean chlorophyll *a* concentrations in WY04, WY06, or CY09 ($p>0.1$).

The annual geometric mean Secchi depth (with a view tube) was 7.0 m, which would classify site C4 as oligotrophic (Table 4). July-October geomean Secchi depth was 9.3 m, which is better than the desired condition outlined in the LMP of no less than 7.7 m for mid-lake deep waters. Secchi disc depth was the shallowest on June 9 (4.7 m), and the 1% light penetration depth was 11.0 m (Figure 43). In the two previous years, Secchi depth was at its minimum earlier in the spring on 5/23/08 at 0.4 m and on 4/28/09 at 1.8 m (much shallower than in 2010). On August 18, the 1% light depth was 15.3 m and Secchi depth was at its deepest (11.0 m), similar to 2008 and 2009. Secchi depth and the depth of the photic zone were less variable in 2010 than in the two previous years.

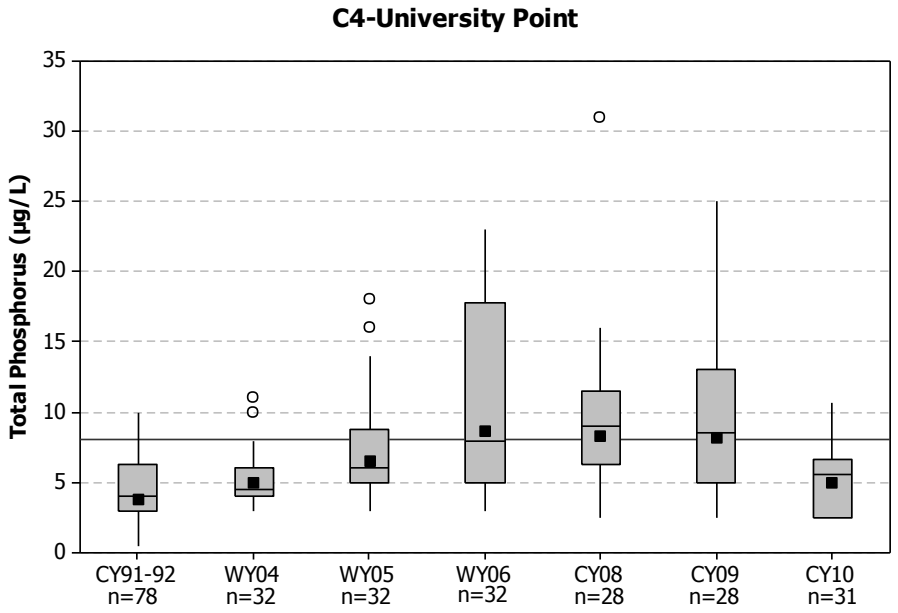

Figure 40. Total phosphorus concentrations (µg/L) at C4-University Point (photic zone, 20 m, 30 m, and near bottom). Horizontal black line represents the LMP trigger condition of 8 µg/L. *Source*: CY91-92 (Woods and Beckwith 1997); WY04-06 (Wood and Beckwith 2008); CY08 (Tribe and IDEQ 2010); CY09 (Tribe and IDEQ 2012).

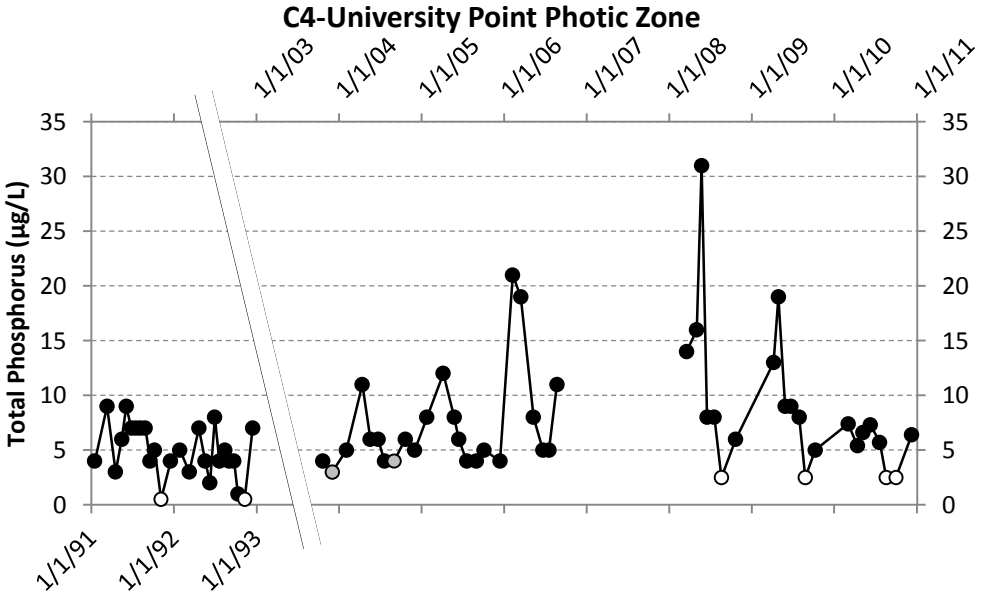

Figure 41. Total phosphorus concentration (µg/L) in the photic zone of C4-University Point. Open circles are 1/2 of the MRL. Gray dots are estimates. *Source*: CY91-92 (Woods and Beckwith 1997); WY04-06 (Wood and Beckwith 2008); CY08 (Tribe and IDEQ 2010); CY09 (Tribe and IDEQ 2012).

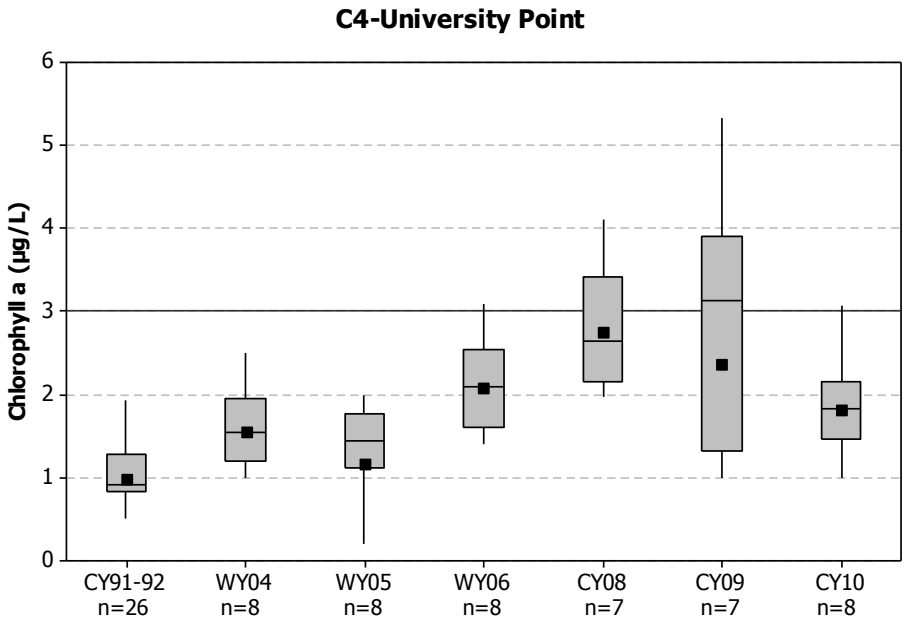

Figure 42. Chlorophyll *a* concentrations (µg/L) at C4-University Point (photic zone). Horizontal black line represents the LMP trigger condition of 3 µg/L. *Source*: CY91-92 (Woods and Beckwith 1997); WY04-06 (Wood and Beckwith 2008); CY08 (Tribe and IDEQ 2010); CY09 (Tribe and IDEQ 2012).

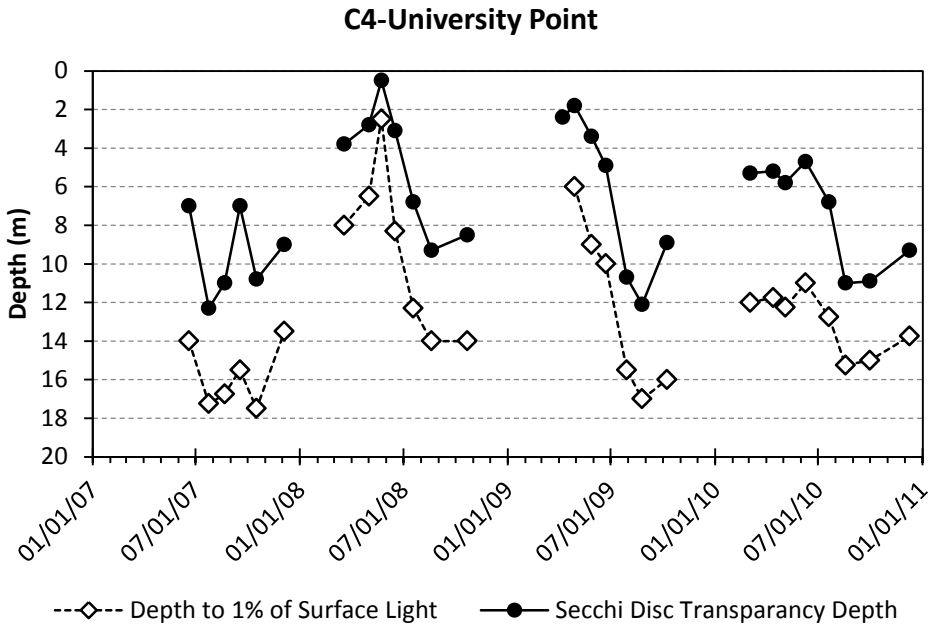

Figure 43. Secchi disc depths (with a view tube) and depth to 1% of the incident surface light at station C4-University Point for since June 19, 2007.

5.4.4 Phytoplankton Enumeration

Phytoplankton cell counts at C4 were typically dominated by diatoms, chrysophytes, and cyanobacteria (Figure 44). The sampling date with the highest cell count was 6/9/2010 coinciding with the shallowest Secchi depth of the year (Figure 43). The timing of this spring peak is similar to the highest cell counts 2009. August 18 also had a peak in cell counts primarily due to an increase in cyanobacteria cells.

Phytoplankton biovolume shows diatoms dominating the sample throughout most of the year and peaking on 4/13/2010, also the day of highest biovolume (Figure 45). During dieback of the first diatom bloom, there was a peak in cryptophytes in June and a peak in greens in July. Phytoplankton biovolume was generally lower and showed less variability than in previous years.

Fifteen genus/species have been recorded each year from 2007– 2010 (Table 10). In the 8 photic zone samples collected in 2010, 11 genus/species occurred in 6 or more of the samples. A*sterionella formosa* was the most dominant diatom (cell count and biovolume), and *Aulacoseira granulata* (biovolume), *Aulacoseira italica* (cell count and biovolume)*, Fragilaria capucina* (biovolume), and *Tabellaria fenestrata* (biovolume) were also dominant diatoms. The green alga *Nephroselmis* was dominant by biovolume. Small, taxonomixally unidentified flagellates were the most dominant chrysophytes by cell count. These unidentified flagellates were also dominant by biovolume as were *Chrysococcus*. The cryptophytes *Chilomonas sp., Cryptomonas sp*., and *Komma sp*. were all dominant by biovolume. *Microcystis sp*. (cell count) and coccoid and rod *Synechococcus sp.* (commonly cell count and occasionally biovolume) were dominant cyanobacteria.

Microcystis sp. was present on March 3, June 9, and July 20, and cell counts were never above 100,000 cells/mL (Appendix D). Unlike in previous years, no phytoplankton samples were taken from the chlorophyll *a* maximum at station C4.

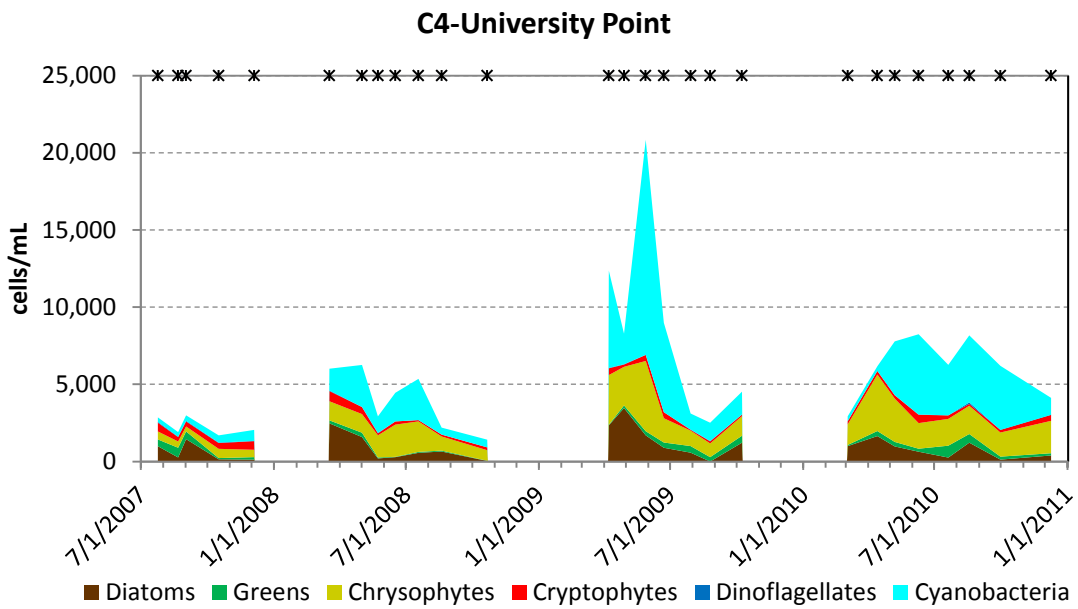

Figure 44. Phytoplankton cell counts (cells/mL) at C4-Univeristy Point(photic zone). *sampling date.

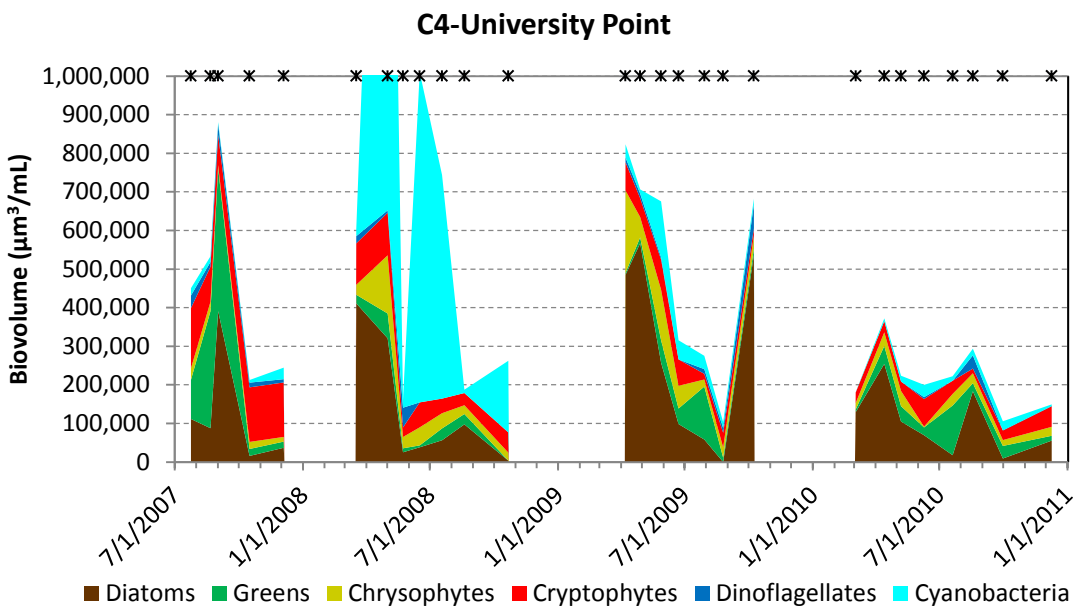

Figure 45. Phytoplankton biovolume (µm³/mL) at C4-University Point (photic zone). Biovolume on 5/01/08 was 2,749,100 µm³/mL, and on 6/16/08, it was 1,009,800 µm³/mL. *sampling date.

Table 10. Phytoplankton species presence at station C4-University Point for CY07-10.

Genus/Species	Presence 2007-2010				Number of times genus/ species was present in 8 photic zone samples in 2010	Number of samples within dominant group (cells or colonies/ mL)	Number of samples within dominant group (biovolume)
Bacillariophyceae (diatoms)							
Achnanthidium sp.		08	09	10	1		
Asterionella formosa var1	07	08	09	10	7	4	6
Aulacoseira distans		08			--		
Aulacoseira granulata	07	08		10	3		2
Aulacoseira italica		08	09	10	4	2	3
Cyclotella comta	07		09	10	2		
Cyclotella glomerata	07	08	09		--		
Cyclotella stelligera		08			--		
Fragilaria acus	07	08			--		
Fragilaria capucina	07	08	09	10	7		2
Fragilaria crotonensis	07	08	09	10	1		1
Fragilaria intermedia			09	10	1		
Navicula sp.		08	09	10	1		1
Pinnularia sp.	07				--		
Rhizoselenia sp.		08	09	10	4		
Synedra acus var. angustissima	07	08			--		
Synedra nana		08			--		
Tabellaria fenestrata	07			10	3		3
Tabellaria flocculosa			09		--		
Chlorophyceae (coccoid greens, desmids, etc.)							
Acanthosphaera sp.	07				--		
Actinastrum hantschii			09		--		
Ankistrodesmus sp.	07	08	09	10	2		
Botryococcus sp. (cells)	07				--		
Chlorella	07	08	09		--		
Clamydocapsa sp.		08		10	1	1	1
Clamydomonas				10	3	1	
Coccomyxa sp.	07				--		
Coelastrum sp.	07		09		--		
Cosmarium sp.	07			10	1		1
Crucigenia sp.	07				--		
Elakatothrix sp3	07	08	09	10	2		
Gleotila sp.	07				--		
Gloeococcus			09	10	1		
Golenkinia sp.	07	08	09		--		
Langerheimia				10	1		
Monomastix sp.				10	1		

Table 10 cont. Phytoplankton species presence at station C4-University Point for CY07-10.

Genus/Species	Presence 2007-2010				Number of times genus/ species was present in 8 photic zone samples in 2010	Number of samples within dominant group (cells or colonies/ mL)	Number of samples within dominant group (biovolume)
Chlorophyceae (coccoid greens, desmids, etc.) cont.							
Monoraphidium		08	09	10	3		
Nephroselmis			09	10	8		2
Oocystis sp.	07	08	09		--		
Pediastrum sp.			09		--		
Phacus		08	09	10	1		
Planctonema sp.	07				--		
Planctosphaeria sp. (rod)	07				--		
Polytoma sp.			09		--		
Pseudosphaerocystis sp.			09		--		
Scourfieldia			09	10	4		
Sphaerocystis sp.			09		--		
Spondylosium sp.	07			10	1		1
Staurastrum sp.	07				--		
Tetraedron	07				--		
Willea sp.	07				--		
Chrysophyceae (yellow-green flagellates)							
Bitrichia sp.			09	10	1		
Chromulina sp1	07	08	09	10	5		
Chrysochromulina sp.	07	08	09	10	3		
Chrysococcus			09	10	7		2
Dinobryon sp.	07	08	09	10	3		
Kephyrion sp.	07	08	09	10	2		
Mallomonas sp2	07	08	09		--		
Ochromonas sp.		08	09	10	7		
Pseudokephrion sp.		08			--		
Small microflagellates	07	08	09	10	8	8	3
Sphaleromantis sp.			09		--		
Synura		08	09		--		
Trachelomonas sp.			09		--		
Cryptophyta (flagellates)							
Chilomonas sp.				10	3		2
Chroomonas acuta				10	6		1
Cryptomonas sp. (sm, med, lrg)	07	08	09	10	8	1	5
Komma sp.	07	08	09	10	7		2
Dinophyceae (dinoflagellates)							
Gymnodinium sp. (sm, med, lrg)	07	08		10	2		1
Peridinium sp1	07	08			--		

Table 10 cont. Phytoplankton species presence at station C4-University Point for CY07-10.

Genus/Species	Presence 2007-2010				Number of times genus/ species was present in 8 photic zone samples in 2010	Number of samples within dominant group (cells or colonies/ mL)	Number of samples within dominant group (biovolume)
Cyanophyta (cyanobacteria or blue-greens)							
Anabaena circinalis	07	08			--		
Chroococcus sp. (cells)		08	09	10	2		1
Gomphosphaeria sp. (cells)	07			10	1	1	1
Lyngbya sp.	07				--		
Merismopedia sp.			09		--		
Microcystis sp. (cells)	07	08	09	10	3	3	
Oscillatoria agardhii		08			--		
Synechococcus sp. (coccoid)	07	08	09	10	7	5	1
Synechococcus sp. (rod)	07	08	09	10	8	6	2
Synechococcus sp. (coccoid+rod)					--		2
Synechocystis				10	5		

a = The group of genus/species where the count of cells (or colonies)/mL, as a percentage of the total assemblage count, was 5% or greater in 8 photic zone samples.

b = The group of genus/species where the biovolume (um^3/mL) of cells (or colonies), as a percentage of the total assemblage biovolume, was 5% or greater in 8 photic zone samples.

5.5 Kidd Island Bay

5.5.1 Thermal Stratification and Oxygen Depletion

Kidd Island Bay is one of the more shallow bays in the lake, and to obtain a sampling site of at least 9 m depth the site location was placed on the outer edge of the bay (at approximately 9.5 m depth, Figure 1). For 2010 it was decided to have relative deep sites to determine if the bays developed a thermocline. In retrospect, the sampling site was too close to the open waters and not sufficiently within the interior of the bay.

The water column at the Kidd Island Bay station was thermally mixed from at least March through approximately May. A deep thermocline existed on July 22 (8 m to bottom) and moved up the water column on August 16 (5–8 m). By the end of September, the water had become thermally mixed again (Figure 46). The greatest temperature change with depth was -2.8 °C/m on August 16 between 7-8 m.

Oxygen concentrations decreased as the water became warmer, but there was no hypolimnetic oxygen depletion as seen in deeper stations (Figure 47, Figure 48). Oxygen concentrations were always above the 6 mg/L LMP trigger condition for northern waters.

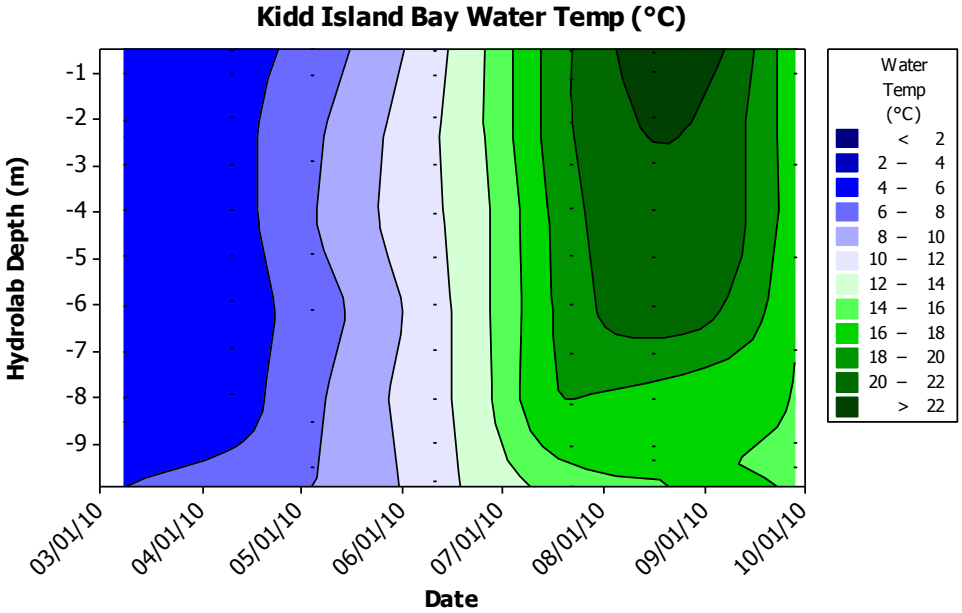

Figure 46. Water temperature profiles at Kidd Island Bay. Measured values are represented by points and lines represent values of equal temperature.

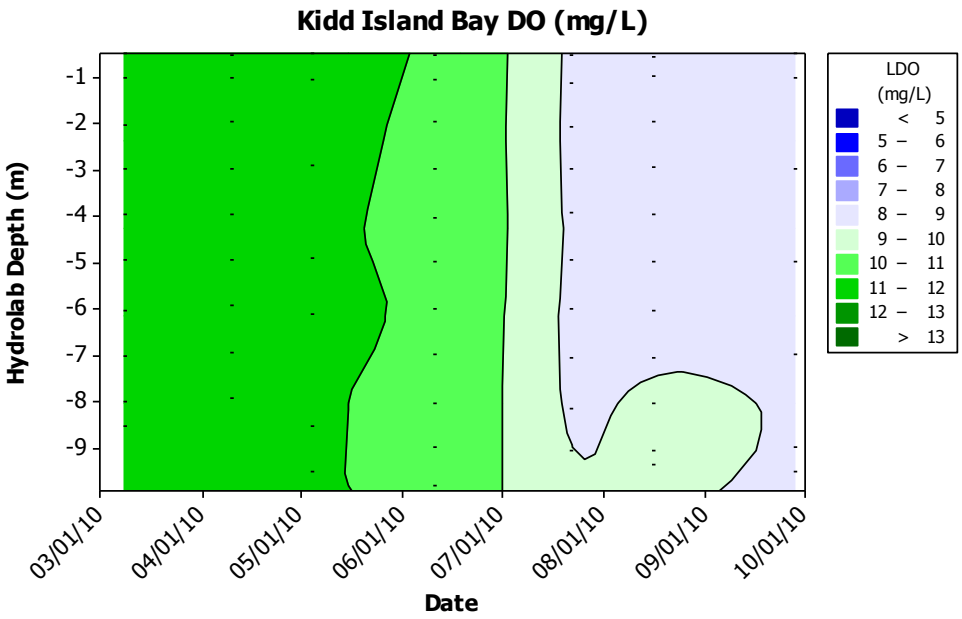

Figure 47. Dissolved oxygen concentrations (mg/L) at Kidd Island Bay. Measured values are represented by points and lines represent values of equal DO concentration.

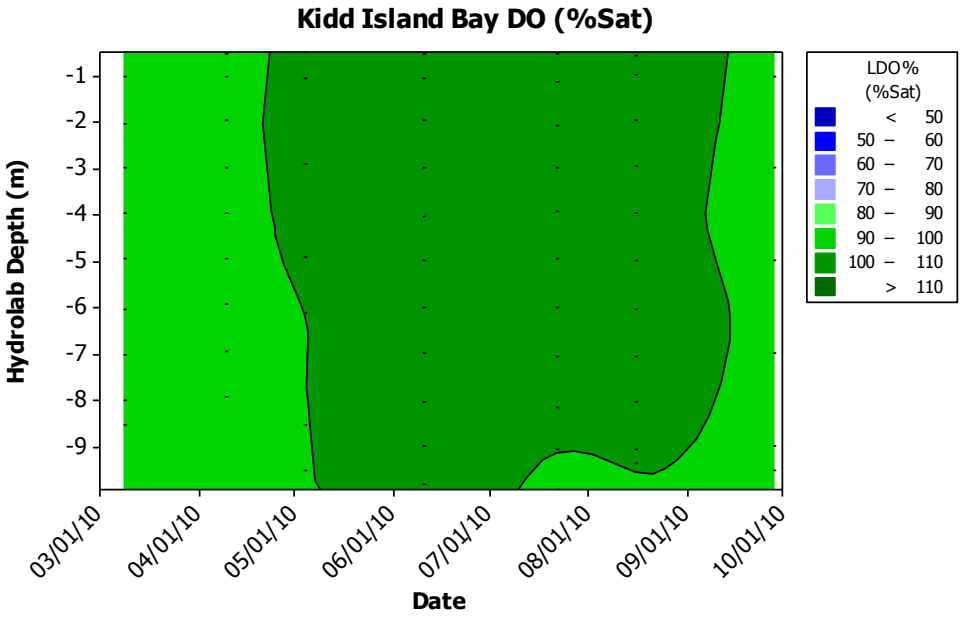

Figure 48. Dissolved oxygen saturation (%Sat) at Kidd Island Bay. Measured values are represented by points and lines represent values of equal saturation.

5.5.2 Idaho Water Quality Standards

All dissolved zinc samples collected during 2010 at Kidd Island Bay violated the Idaho WQS of 36 µg/L at 25 mg/L hardness (CCC and CMC). No dissolved Cd or Pb samples violated Idaho WQS. The highest total and dissolved lead concentrations were collected on May 4, which coincided with the spring runoff peak in the Cd'A River hydrograph (Figure 2).

5.5.3 Nutrients, Chlorophyll *a*, Water Clarity, and Trophic State

Total phosphorus concentrations ranged from <5–7 µg/L, and total nitrogen concentrations ranged from 71-107 µg/L (Table 8). All concentrations of DTP were below 5 µg/L (MRL), and all DOP results were less than 3µg/L (MRL). Maximum DIN was 35 µg/L (photic zone on March 8). In 2010, all of the samples at Kidd Island Bay were phosphorus limited (TN:TP ranged from 29–95 mol:mol).

The annual total phosphorus geomean was <5 µg/L, which is below the nearshore LMP trigger condition of 9.0 µg/L (Table 8). Based on the TP concentration Kidd Island Bay was oligotrophic in 2010 (Table 4).

The annual chlorophyll *a* geomean was 1.32 µg/L, which is less than the LMP trigger condition of 3.0 µg/L. No samples exceeded 5.0 µg/L further indicating that Kidd Island Bay was oligotrophic.

The annual geometric mean Secchi depth (with a view tube) was 6.1 m, which would classify Kidd Island Bay as meso-oligotrophic (Table 4). July-October geomean Secchi depth was 7.8 m, which is less than the desired condition outlined in the LMP of no less than 8.1 m for northern lake bays. Secchi depth was the shallowest on April 9 (4.5 m) and deepest on August 16 (9.4 m) (Figure 49). Throughout the water column, more than 1% of incident surface light was transmitted.

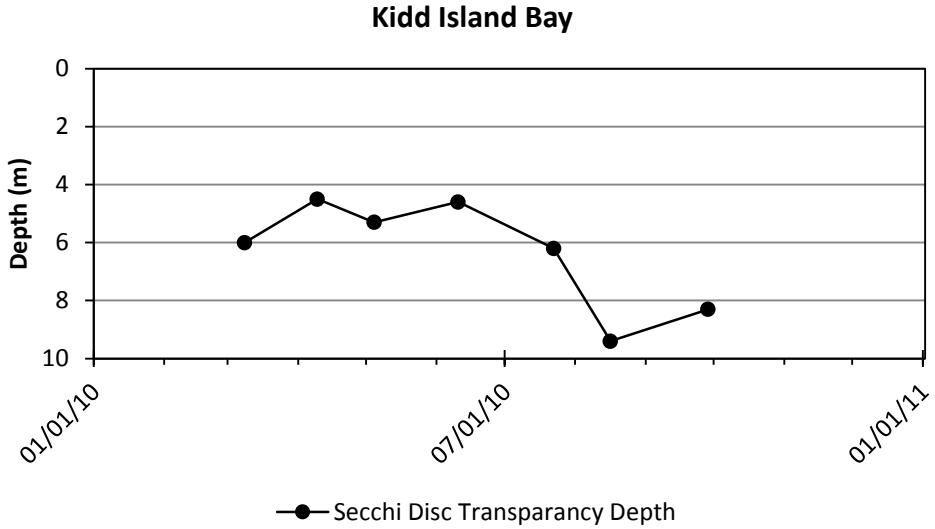

Figure 49. Secchi disc transparency depths at Kidd Island Bay for 2010.

5.5.4 Phytoplankton Enumeration

A phytoplankton enumeration and biovolume sample was collected on May 10, 2010. Phytoplankton cell counts were dominated by cyanobacteria , and to a lesser extent chrysophytes and diatoms (Figure 50). Dominant organisms by cell count were *Synechoccus sp*. (rod), small microflagellates, *Synechoccus sp*. (coccoid), and *Asterionella formosa* (Appendix D). *Microcystis* was not present in the phytoplankton sample.

Phytoplankton biovolume shows diatoms dominating the sample (Figure 51). Dominant organisms by biovolume included *Asterionella formosa*, *Synechoccus sp*. (rod), and *Chryptomonas sp.*

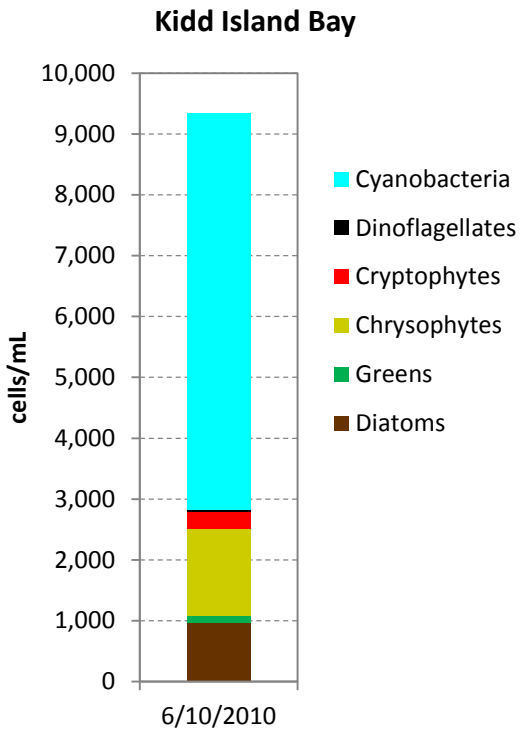

Figure 50. Phytoplankton cell counts (cells/mL) at Kidd Island Bay (photic zone).

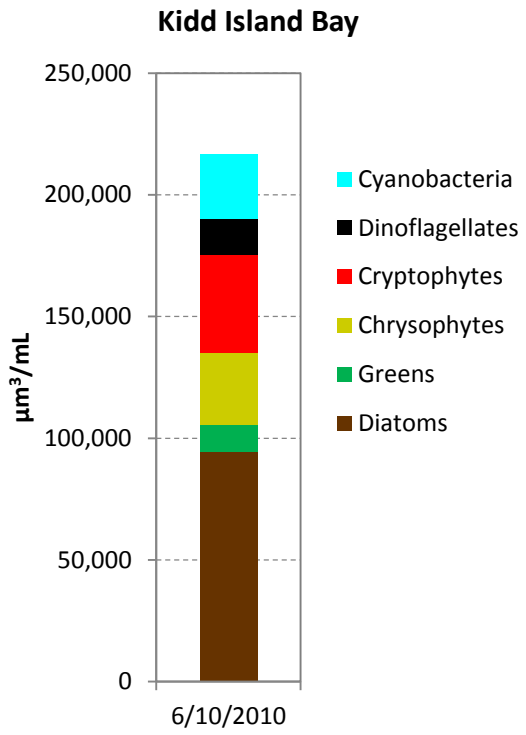

Figure 51. Phytoplankton biovolume (μm^3/mL) at Kidd Island Bay (photic zone).

5.6 Kidd Island Bay Station 2

5.6.1 Thermal Stratification and Oxygen Depletion

On August 16 and September 28, two samples were collected from a very shallow site in Kidd Island Bay (Kidd Island Bay Station 2 at 47°38'19.2", -116°48'02.5"). The depth at this site was approximately 1 m, too shallow for a thermocline to form and oxygen depletion to take place.

5.6.2 Idaho Water Quality Standards

On August 16, the dissolved lead concentration (0.90 µg/L) exceeded Idaho WQS, and total lead concentration was high at 4.0 µg/L. Lead is preferentially bound to particulates and may also be contained in porewater. The high lead concentrations may have been due to observed water skiing which was disturbing lake bed sediments in the bay (as indicated by turbidity measurements of more than 14 NTU and a dissolved iron concentration of 151 µg/L). There was also an above normal total arsenic concentration (1.6 µg/L). During both sampling dates, dissolved zinc and dissolved cadmium were quite low and below WQS, which may be due to Kidd Creek diluting the zinc and cadmium concentrations from the main lake body.

5.6.3 Nutrients, Chlorophyll *a*, and Water Clarity

Total phosphorus and total nitrogen concentrations were higher than the Kidd Island Bay station closer to the main body of the lake, further indicating that the chemistry at Kidd Station 2 was not being strongly influenced by the main body of the lake. On August 16, the chlorophyll *a* concentration was unusually high (10.8 µg/L), and Secchi depth was very low (0.8 m), probably due to the ski boat pulverizing macrophytes and suspending sediment.

5.6.4 Phytoplankton Enumeration

A phytoplankton enumeration and biovolume sample was collected on August 16, 2010. Based on the genus/species list (Appendix D) it appears that the sample was contaminated with epiphyton associated with macrophyte leaves and sediment attached periphyton. This is also supported by the much higher cell counts and biovolume in the Kidd Station 2 sample compared to all other samples collected in 2010. Phytoplankton cell counts were dominated cyanobacteria and to a lesser extent chrysophytes (Figure 52). Phytoplankton biovolume shows diatoms and cyanobacteria dominating the sample (Figure 53).

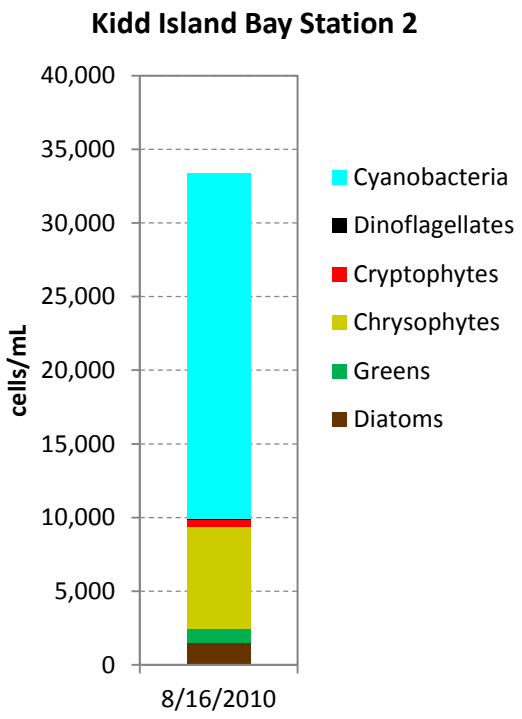

Figure 52. Phytoplankton cell counts (cells/mL) at Kidd Island Bay Station 2.

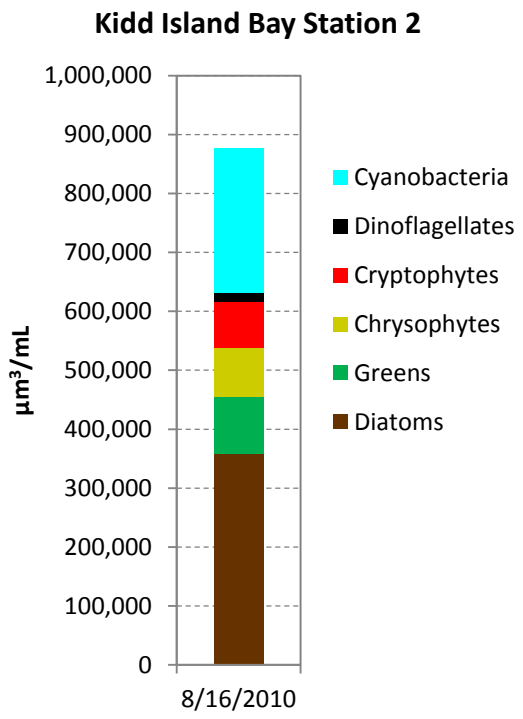

Figure 53. Phytoplankton biovolume (μm^3/mL) at Kidd Island Bay Station 2.

5.7 Mica Bay

5.7.1 Thermal Stratification and Oxygen Depletion

The water column at the Mica Bay station (approximately 11.2 m depth) was thermally mixed from at least March through approximately May. A deep thermocline existed on July 21 (9–11 m), and a thermocline existed on August 19 (8–11 m). By the end of September, the water had become thermally mixed again (Figure 54). The greatest temperature change with depth was -3.5 °C/m on July 21 between 9–10 m.

Oxygen concentrations decreased as the water became warmer, and there was a small depression of oxygen depletion in the hypolimnion (Figure 55, Figure 56). Oxygen concentrations were always above the 6 mg/L LMP trigger condition for northern waters.

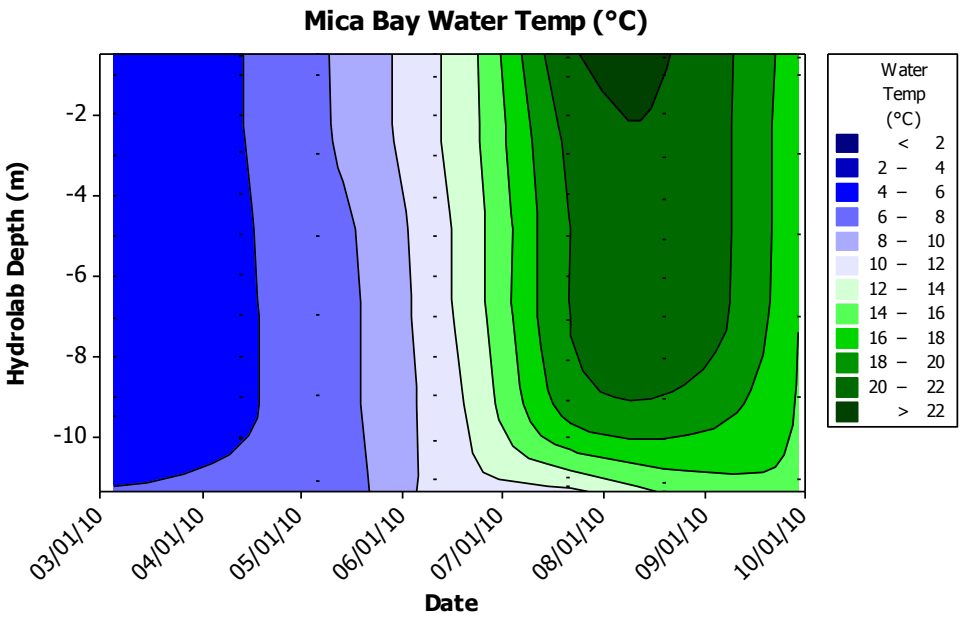

Figure 54. Water temperature profiles at Mica Bay. Measured values are represented by points and lines represent values of equal temperature.

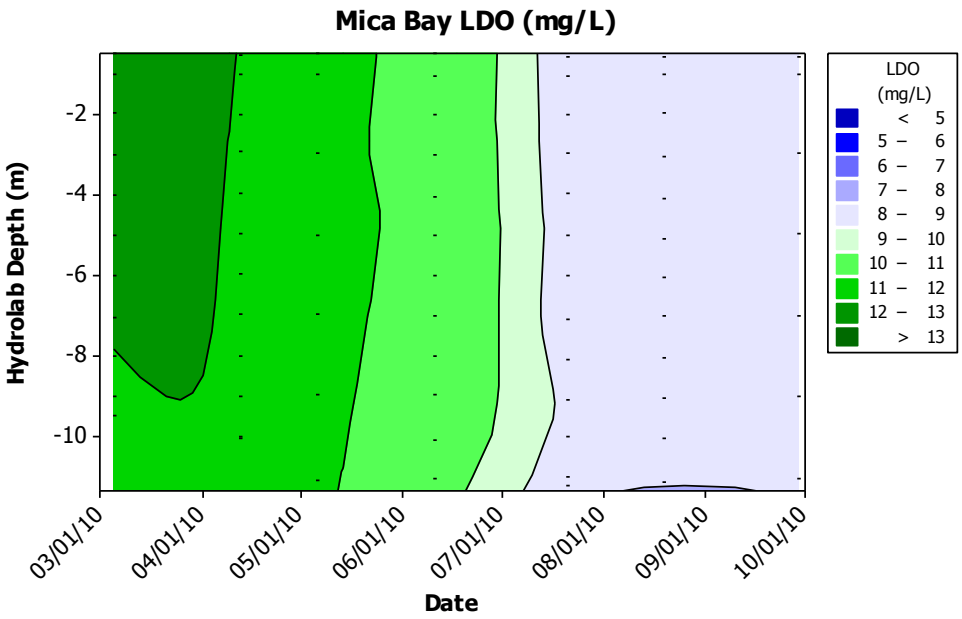

Figure 55. Dissolved oxygen concentrations (mg/L) at Mica Bay. Measured values are represented by points and lines represent values of equal DO concentration.

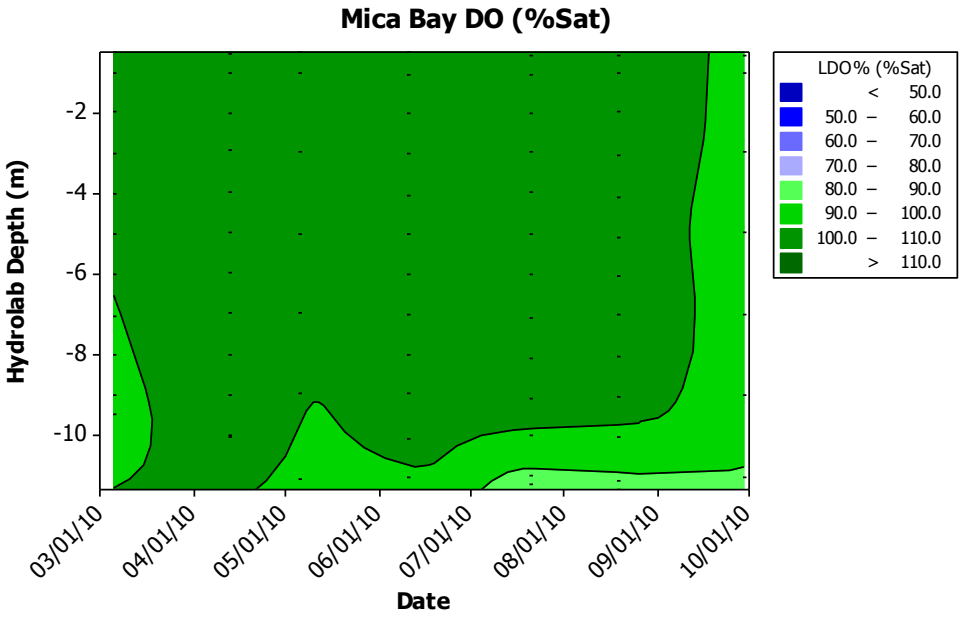

Figure 56. Dissolved oxygen saturation (%Sat) at Mica Bay. Measured values are represented by points and lines represent values of equal saturation.

5.7.2 Idaho Water Quality Standards

All dissolved zinc samples collected during 2010 at Mica Bay violated the Idaho WQS of 36 µg/L at 25 mg/L hardness (CCC and CMC). No dissolved Cd or Pb samples violated Idaho WQS. The highest total and dissolved lead concentrations were collected on May 5, coinciding with the spring runoff peak from the Cd'A River (Figure 2).

5.7.3 Nutrients, Chlorophyll *a*, Water Clarity, and Trophic State

Total phosphorus concentrations ranged from <5-12 µg/L, and total nitrogen concentrations ranged from 81-125 µg/L (Table 8). All concentrations of DTP were below 5 µg/L (MRL), and all DOP results were less than 3µg/L (MRL). Maximum DIN was 41 µg/L (photic zone on March 5). In 2010, all of the samples at Mica Bay were phosphorus limited (TN:TP ranged from 23–90 mol:mol).

The annual total phosphorus geomean was 6 µg/L, which is below the nearshore LMP trigger condition of 9.0 µg/L (Table 8). Based on the TP concentration Mica Bay was oligotrophic in 2010 (Table 4).

The annual chlorophyll *a* geomean was 1.56 µg/L, which is less than the LMP trigger condition of 3.0 µg/L. Two samples exceeded 5.0 µg/L (March 5 and April 12), but the Chl *a* concentrations decreased throughout the remainder of the year indicating that Mica Bay is oligotrophic.

The annual geometric mean Secchi depth (with a view tube) was 5.8 m, which would classify Mica Bay as meso-oligotrophic (Table 4). July-October geomean Secchi depth was 9.7 m, which is better than the desired condition outlined in the LMP no less than 8.1 m for northern lake bays. Secchi disc depth was the shallowest on March 5 (2.9 m) and deepest on August 19 (11.0 m) (Figure 57). Throughout the water column, more than 1% of incident surface light was transmitted.

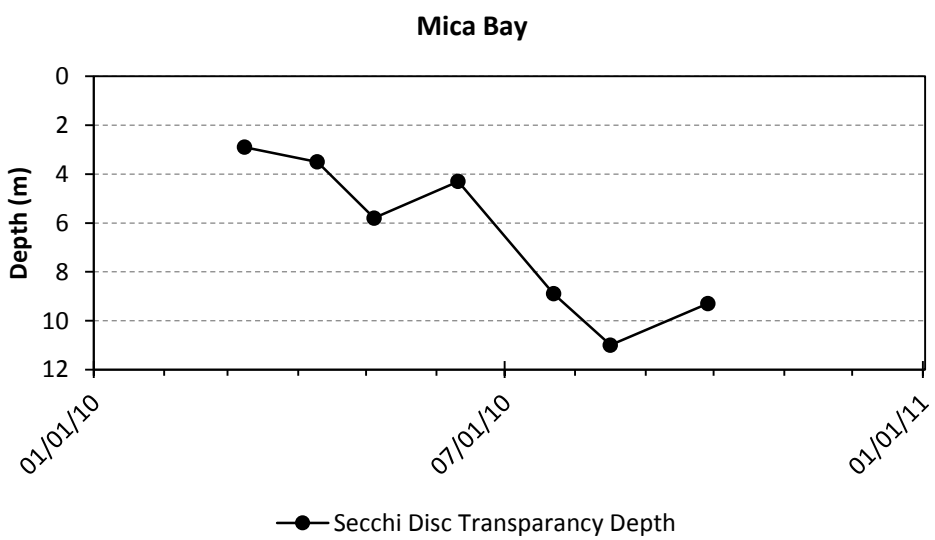

Figure 57. Secchi disc transparency depths at Mica Bay for 2010.

5.7.4 Phytoplankton Enumeration

Two phytoplankton enumeration and biovolume samples were collected on March 5 and June 10. Phytoplankton cell counts were dominated by diatoms in March and cyanobacteria in June. Chrysophytes were also present in substantial amounts (Figure 58). Phytoplankton biovolume shows diatoms dominating both samples (Figure 59).

On March 5, *Asterionella formosa* and small microflagellates were dominant by cell count, and *Asterionella formosa* was dominant by biovolume (Appendix D). On June 10, *Synechoccus sp*. (rod and coccoid), small microflagellates, and *Asterionella formosa* were dominant by cell count, and *Asterionella formosa*, *Dinobryon sp.,* and *Synechoccus sp*. (rod) were dominant by biovolume. *Microcystis* was present (488 cells/mL) in the June 10 sample (Appendix D).

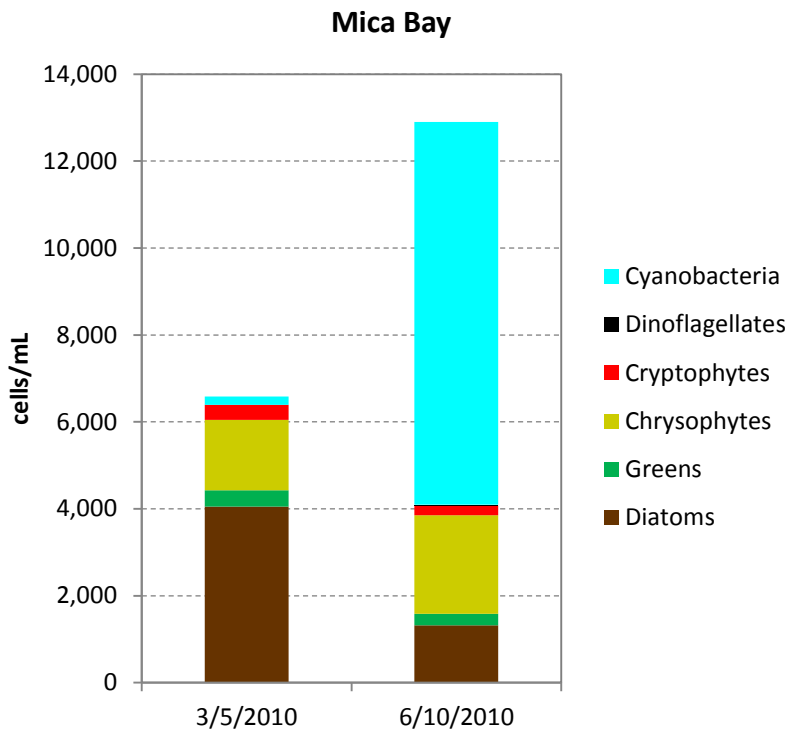

Figure 58. Phytoplankton cell counts (cells/mL) at Mica Bay (photic zone).

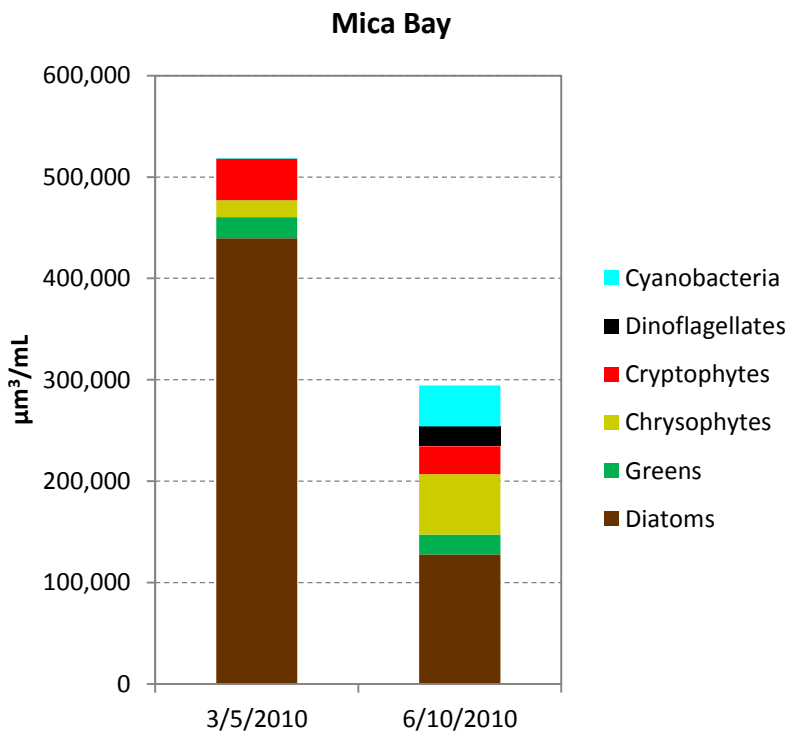

Figure 59. Phytoplankton biovolume (µm³/mL) at Mica Bay (photic zone).

5.8 Rockford Bay

5.8.1 Thermal Stratification and Oxygen Depletion

The Rockford Bay station (approximately 10.2 m depth) did not develop a thermocline during the 2010 sampling (Figure 60). The greatest temperature change with depth occurred on June 9 between 0.5-1 m (-2.2 °C/m) which was likely due to solar heating of the surface water.

Oxygen concentrations decreased as the water became warmer, and the water was always over 90% saturation (Figure 61, Figure 62). Oxygen concentrations were always above the 6 mg/L LMP trigger condition for northern waters.

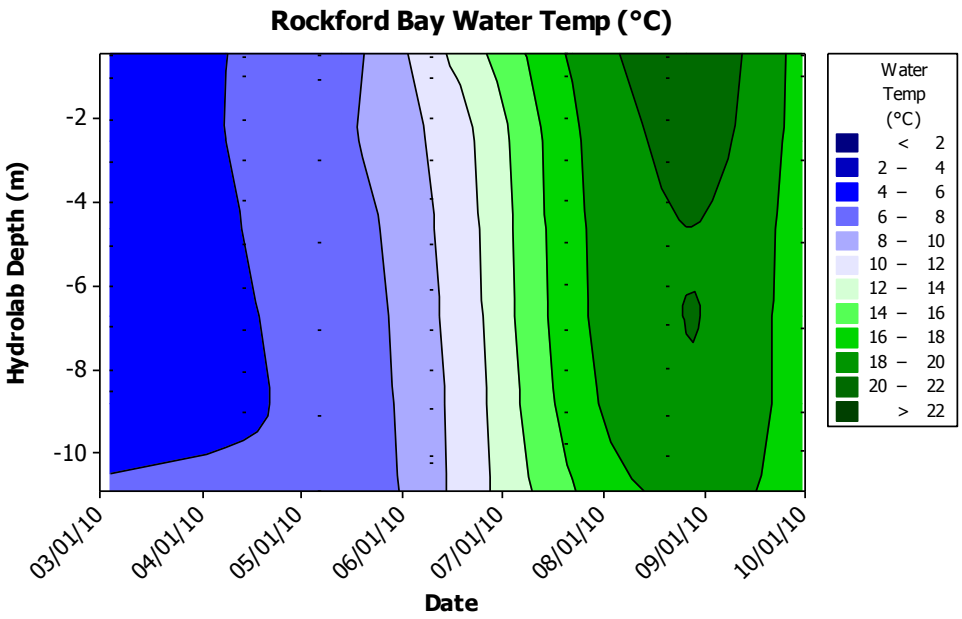

Figure 60. Water temperature profiles at Rockford Bay. Measured values are represented by points and lines represent values of equal temperature.

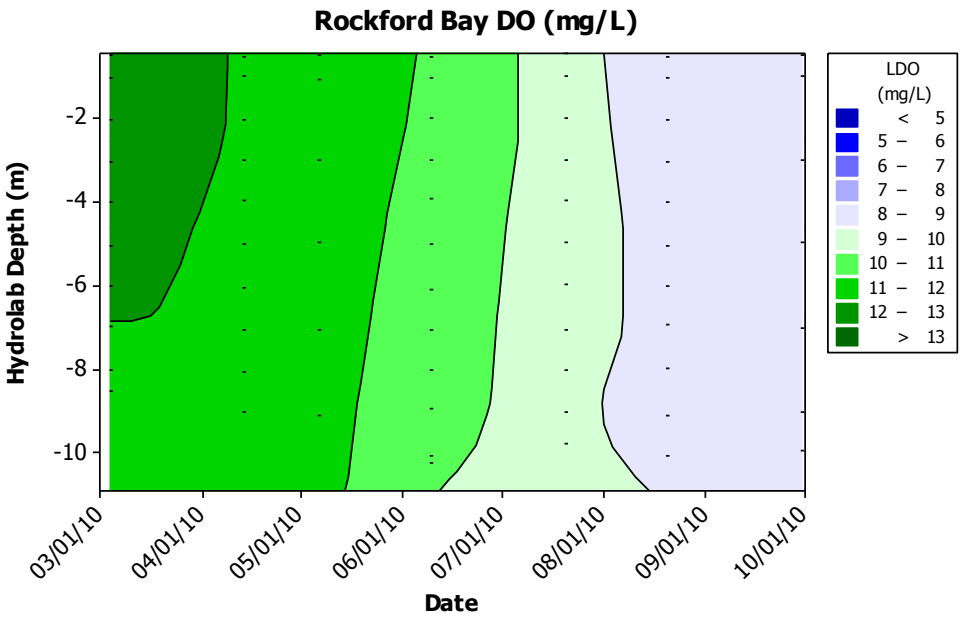

Figure 61. Dissolved oxygen concentrations (mg/L) at Rockford Bay. Measured values are represented by points and lines represent values of equal DO concentration.

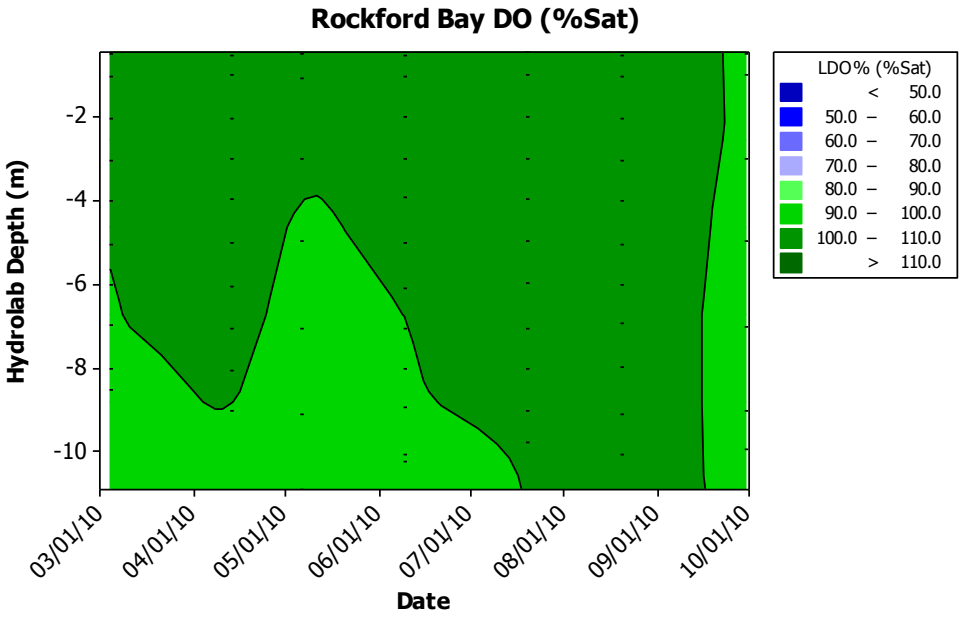

Figure 62. Dissolved oxygen saturation (%Sat) at Rockford Bay. Measured values are represented by points and lines represent values of equal saturation.

5.8.2 Idaho Water Quality Standards

All dissolved zinc samples collected during 2010 in Rockford Bay violated the Idaho WQS of 36 µg/L at 25 mg/L hardness (CCC and CMC). No dissolved Cd or Pb samples violated Idaho WQS. The highest total and dissolved lead concentrations were on June 9, coinciding with the spring runoff peak from the Cd'A River (Figure 2).

5.8.3 Nutrients, Chlorophyll *a*, Water Clarity, and Trophic State

Total phosphorus concentrations ranged from <5-15 µg/L, and total nitrogen concentrations ranged from 60-138 µg/L (Table 8). All concentrations of DTP except one (7 µg/L on June 9) were below 5 µg/L (MRL), and all DOP results were less than 3µg/L (MRL). Maximum DIN was 67 µg/L (photic zone on March 4). In 2010, all of the samples at Rockford Bay were phosphorus limited (TN:TP ranged from 17–76 mol:mol). The sample with the lowest TN:TP was on June 9, the day with the highest TP, TDP, total Fe, and Chl *a* concentrations.

The annual total phosphorus geomean was 6 µg/L, which is below the nearshore LMP trigger condition of 9.0 µg/L. Based on the TP concentration Rockford Bay was oligotrophic in 2010 (Table 4).

The annual chlorophyll *a* geomean was 1.69 µg/L, which is less than the LMP trigger condition of 3.0 µg/L. No samples exceeded 5.0 µg/L further indicating that Rockford Bay is oligotrophic (Table 4).

The annual geometric mean Secchi depth (with a view tube) was 5.2 m, which would classify Rockford Bay as meso-oligotrophic (Table 4). July-October geomean Secchi depth was 8.7 m, higher than the desired condition outlined in the LMP of no less than 7.7 m for mid-lake waters. Secchi disc depth was the shallowest on June 9 (2.4 m) and deepest on August 20 and September 30 (10.0 m) (Figure 57). Throughout the water column, more than 1% of incident surface light was transmitted.

5.8.4 Phytoplankton Enumeration

Two phytoplankton enumeration and biovolume samples were collected on April 13 and June 9. Phytoplankton cell counts were dominated by chrysophytes in April and cyanobacteria in June (Figure 64). Phytoplankton biovolume shows diatoms dominating both samples (Figure 65).

On April 3, small microflagellates and *Aulacoseira italica* were dominant by cell count, and *Aulacoseira italic*, *Tabellaria fenestrata*, and *Asterionella formosa* were dominant by biovolume (Appendix D). On June 9, *Synechoccus sp*. (rod and coccoid), small microflagellates, and *Asterionella formosa* were dominant by cells/mL, and *Asterionella formosa*, *Fraginaria capunica*, and *Chryptomonas* were dominant by biovolume. *Microcystis sp*. was present (488 cells/mL) in the June 9 sample (Appendix D).

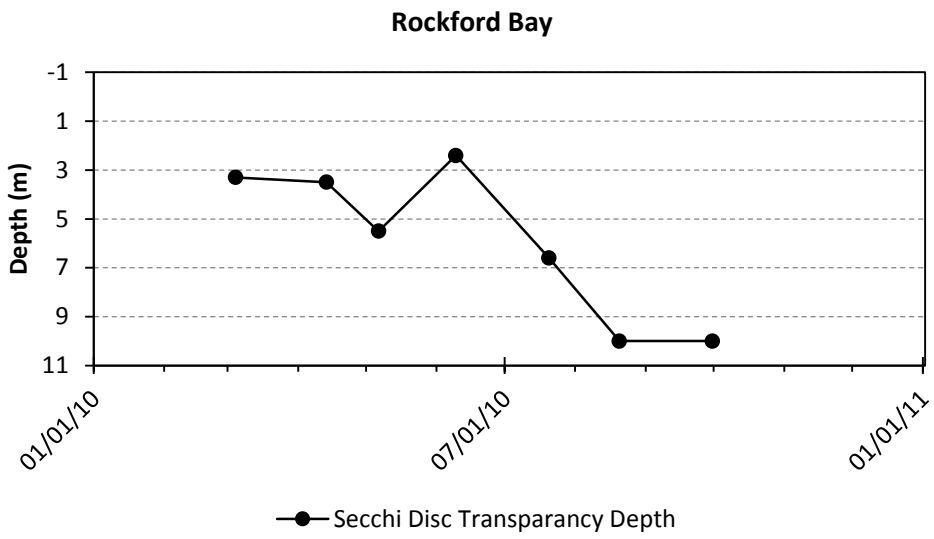

Figure 63. Secchi disc transparency depths at Rockford Bay for 2010.

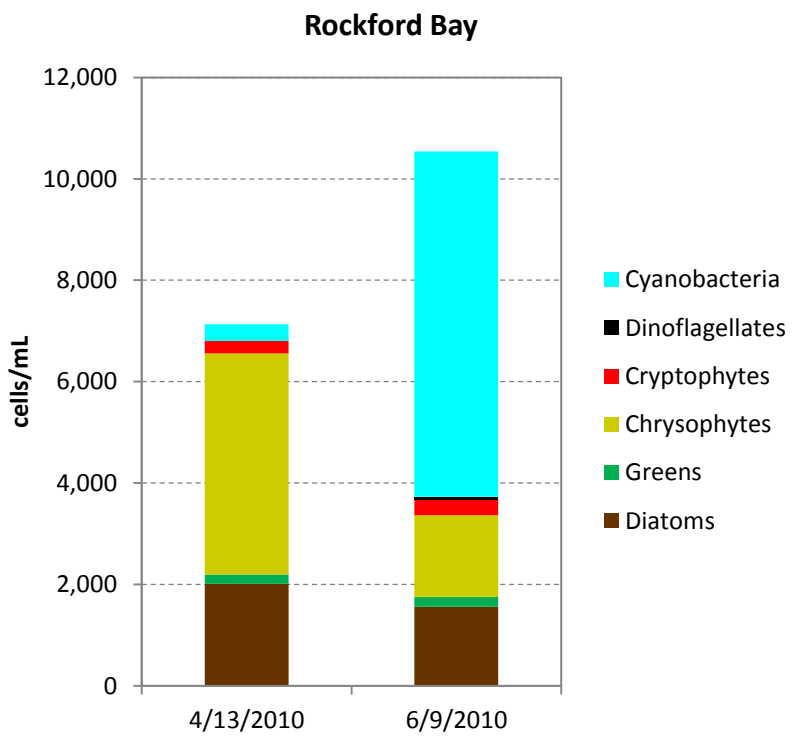

Figure 64. Phytoplankton cell counts (cells/mL) at Rockford Bay (photic zone).

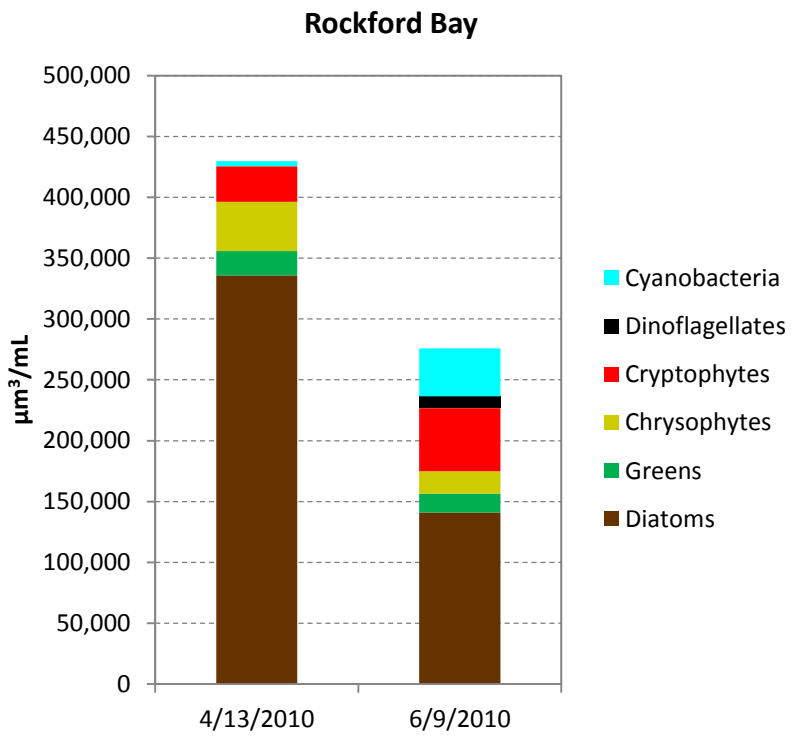

Figure 65. Phytoplankton biovolume (µm³/mL) at Rockford Bay (photic zone).

Section 6: Conclusions

Previous work on Coeur d'Alene Lake in the 1970s indicated that the northern two-thirds of the lake ranged from oligotrophic to mesotrophic (see Woods and Beckwith 1997 for discussion). Data from 1991-1992 indicated stations C1, C2, C3, and C4 were oligotrophic based on total phosphorus, total nitrogen, and chlorophyll *a* concentrations (Woods and Beckwith 1997). Annual geometric means of total phosphorus and total nitrogen at northern deep stations have been consistently within oligotrophic concentration ranges for WY04-06 and CY08-09 (Wood and Beckwith 2008; Tribe and IDEQ 2010, 2012). Chlorophyll *a* concentrations during this time period also point to the lake being oligotrophic with the exception of CY08 when chlorophyll *a* was elevated to concentrations reflecting a meso-oligotrophic status. It should be noted that WY08 had higher than average flows, but it is not clear if the elevated chlorophyll *a* concentrations were a direct result of increased stream discharge to the lake as nutrient concentrations were not substantially elevated. The trophic state of the northern lake (including bays) in CY10 was oligotrophic based on total phosphorus, total nitrogen, and photic zone chlorophyll *a* geometric mean concentrations (Table 11).

Table 11. Trophic state of the sites sampled in CY10 based on total phosphorus, total nitrogen, and photic zone chlorophyll *a*.

	Total P (µg/L)		Total N (µg/L)		Photic Chlorophyll *a* (µg/L)	
Site	**geomean**	**TS**	**geomean**	**TS**	**geomean**	**TS**
C1: Tubbs Hill	<5	O	102	O	1.43	O
C2: Wolf Lodge Bay	<5	O	98	O	1.52	O
C3: Driftwood Point	<5	O	115	O	1.81	O
C4: University Point	<5	O	111	O	1.80	O
Kidd Island Bay	<5	O	91	O	1.32	O
Mica Bay	6	O	100	O	1.56	O
Rockford Bay	6	O	102	O	1.69	O

O = oligotrophic

The median discharge from the Cd'A River was 1.84 million ac-ft/yr (WY05–WY10); this is much higher than the annual discharge in WY10 of 1.42 million ac-ft/yr (USGS 2011). The St. Joe River also discharged much less in WY10 (1.46 million ac-ft/yr) compared to the median discharge (2.20 million ac-ft/yr from WY04-WY10) (USGS 2011). As a result of this low-flow year, Cd'A lake received relatively lower inputs of nutrients and metals from the two major rivers. This can be seen in the mean concentrations of dissolved zinc, dissolved cadmium, dissolved lead, and total phosphorus at the deep stations which were mostly statistically lower than previous years (Table 12). Mean chlorophyll *a* concentrations in WY10 did not show a correlation with the low water

year and lower total phosphorus concentrations despite evidence that Cd'A Lake was phosphorus limited.

Table 12. Summary of statistical differences between the mean concentration in CY2010 and previous years. Means for metals and total phosphorus are from all sample depths at all locations. Chlorophyll *a* means are from the photic zone at all locations.

	Site	CY91-92	WY04	WY05	WY06	CY08	CY09
Dissolved Zn	C1	nd	–	–	–	–	*
	C3	nd	–	*	*	nd	nd
	C4	nd	–	*	–	–	*
Dissolved Cd	C1	nd	–	–	–	–	–
	C3	nd	–	–	–	nd	nd
	C4	nd	–	–	–	–	–
Dissolved Pb	C1	nd	*	*	–	–	–
	C3	nd	*	–	–	nd	nd
	C4	nd	*	–	–	–	–
Total P	C1	*	–	–	–	–	–
	C3	+	*	–	–	nd	nd
	C4	*	*	–	–	–	–
Chl *a*	C1	+	*	*	–	–	–
	C3	+	*	+	*	nd	nd
	C4	+	*	+	*	–	*

+	Mean concentration in CY10 was statistically higher (p<0.1).
–	Mean concentration in CY10 was statistically lower (p<0.1).
*	Mean concentration in CY10 was not statistically different (p>0.1).
nd	No data

Spatial analysis of the 2010 lake data indicates that total lead (TPb) concentrations generally decrease from south to north through the main channel of the lake. Two sample t-tests among the deep stations show that mean TPb concentrations for all depths are such that C4>C3>C1>C2 ($p<0.05$). Comparison between the TPb concentrations in the bays and the photic zone of the nearest deep station shows a more complex relationship. Paired t-tests indicate that TPb in Kidd Island Bay is higher than at C1 and lower in Mica Bay than at C3 ($p<0.05$). There was no significant difference between Rockford Bay and C4 ($p>0.1$). When the same statistical tests are applied to dissolved zinc (DZn), there is no significant difference between C4 and C3 or Kidd Island Bay and C1 ($p>0.1$). There are significant differences between the other deep stations: C3>C1>C2 ($p<0.05$). DZn in Mica Bay is less than C3, and Rockford Bay has lower DZn concentrations than C4.

Because many of the total phosphorus samples were below the method reporting limit (5 µg/L), a robust statistical analysis of TP spatial trends cannot be applied. There is no significant difference in photic zone chlorophyll *a* concentrations among stations (deep and bays) based on paired t-tests ($p>0.1$).

Section 7: Quality Assurance/Quality Control

The QA/QC (quality assurance/quality control) program and parameters for Coeur d'Alene Lake monitoring are detailed in the 2010 QAPP Addendum (IDEQ and Tribe 2010), and were also detailed in the initial annual monitoring report (for 2007-08, Tribe and IDEQ 2010). The following section presents a summary of QA/QC results collected during 2010 monitoring.

QC samples are controlled samples introduced into the analysis stream whose results are used to review data quality and to calculate the accuracy and precision of the chemical analysis program. Collection and analysis frequency for field QC samples are generally recommended to consist of approximately 10% of the water quality samples taken. For QC results that are unsatisfactory, methods in the field or laboratory need to be examined for modifications that will bring the results within the precision/accuracy guidelines of the QAPP (Table 3).

7.1 Method Reporting Limits (MRLs)

MRLs for metals, minerals, and chlorophyll *a* are established by the EPA Manchester Lab. For nutrient analysis, MRLs were provided by Spokane Tribal Lab (STL) and SVL Analytical (Table 3).

For analysis of total phosphorus (TP) and dissolved total phosphorus (DTP), SVL has modified their Standard Operating Procedure (SOP) for method SM 4500-P-E to provide for a low level phosphorus analysis to meet the needs of the Coeur d'Alene Lake sampling program. For the modified 2010 SOP, MRLs for TP and DTP were 5 µg/L, and Method Detection Limits (MDLs) were 0.7 µg/L.

7.2 Field and Office Blanks

Field and office blanks follow the same sample preparation chain as do field-collected samples. The blanks consist of constituent-free inorganic blank water (IBW) poured into a Kemmerer sampling device, which is then poured into a churn splitter. The blanks are then taken from the churn splitter and filtered and/or preserved as appropriate. Most office and field blanks were below the MRL (Table 13). One field blank from June 10 had total and dissolved zinc concentrations higher than the MRL (15.0 and 7.7 µg/L, respectively). On March 2, the office blank had a dissolved lead concentration of 0.12 µg/L.

7.3 Replicates to Assess Precision

Precision is defined as the degree of agreement between independent, similar, or repeated measures. Precision is expressed in terms of analytical variability. For this project, analytical variability is measured as the relative percent difference (RPD), or coefficient of variability, between analytical field and laboratory replicates, and between the MSD and LCSD analysis (see Section 7.4.1). Field replicates prepared by IDEQ are conducted to identify environmental, monitoring equipment, sample handling, and laboratory environment/measurement variability.

The two laboratories also perform and report duplicate analysis of selected field samples submitted, and these replicates isolate laboratory analytical variability.

For laboratory replicates, the two laboratories have a ± 20% RPD requirement. For SVL nutrient analysis, there is no control limit for the %RPD if the concentration in the samples is less than five (5) times the MRL. For field prepared replicates the level of acceptance is ±25% RPD (Table 3). Replicate data results were calculated as absolute differences between pairs, so limit requirements are %RPD (Table 13). For either the laboratory or field replicates, if both results of a replicate set for any variable were <MRL, a %RPD was not calculated, and thus not included in the mean %RPD statistics.

7.3.1 Laboratory Replicates

Laboratory replicates are samples that are collected in the field and analyzed twice in the laboratory (2nd data column of Table 13). All mean %RPD for metals and minerals were below the 20% lab requirement. For lab replicates of nutrients, results for total nitrogen, total phosphorus, and total dissolved phosphorus were satisfactory. The results for dissolved ammonia and dissolved nitrite+nitrate were above 20% RPD. SVL labeled these results as not applicable for the control limit since concentrations were less than 5 times MRL (code R3 on the footnotes of Table 13).

7.3.2 Sample Replicates

Replicate sets of samples are withdrawn from the same volume of water in the churn splitter. They are processed and analyzed separately to assess any variability in sample handling, bottles, shipping, or laboratory analytical precision (3rd data column of Table 13). For the 2010 sampling, IDEQ took seven sample replicates at various depth zones. All results for nutrients, metals and minerals were satisfactory (<25% RPD).

7.3.3 Field Replicates

A field replicate is defined as a second sample from the same location and sample depth zone, collected in immediate succession, using identical techniques (5th data column Table 13). A field replicate provides estimates of the total sampling and analytical precision, and potential heterogeneity in the sampled medium. For nutrient field replicates, all variables with a calculated mean %RPD were greater than sample replicates except for dissolved ammonia. Dissolved nitrite+nitrate was the only nutrient field replicate that had a mean RPD >25%.

For metals, minerals, and chlorophyll *a*, all mean %RPDs were below 25% with the exception of dissolved iron. Field replicates with %RPDs greater than laboratory and sample replicates were total and dissolved lead, iron, and manganese. Lead, iron, and manganese are often associated with particulates including colloidal material such as oxyhydroxides. The higher %RPD in these analytes may be due the heterogeneity of fine particulates in the water column and/or the ability for some colloids to pass through the 0.45 µm filter capsule. The presence and composition of colloids and their interactions with metals in Coeur d'Alene Lake is pertinent to the LMP and further investigation is warranted.

Table 13. QA/QC results: blanks and replicates for 2010 (see footnotes continued on next page).

Analyte	Field & office blanks # <MRL[a]/ # of samples	Lab replicates Mean %RPD[b] (n)	Sample replicates Mean %RPD (n)[c]	Mean absolute difference between replicate pairs µg/L[c]	Field replicates Mean %RPD (n)[cd]	Side-by-side field replicates Mean %RPD (n)[c]
Nutrients—SVL						
dissolved ammonia[e]	*3/4	*37.4 (2)[R3]	12.3 (1)	8	9.5 (1)	6.8 (1)[f]
dissolved nitrite+nitrate[e]	4/4	*25.4 (8)[R3]	18.8 (5)[f]	9.7	*40.9 (4)	38.7 (2)[f]
total nitrogen	4/4	7.1 (17)	5.8 (7)	6	9.2 (9)	53.9 (3)[g]
total phosphorus	4/4	3.8 (18)	8.1 (4)[f]	0.5	15.1 (5)	13.4 (3)
dissolved total phosphorus[e]	4/4	10.7 (2)	<MRL (7)	<MRL	<MRL (9)	<MRL (3)
dissolved ortho-phosphate	4/4	--	--	--	<MRL (7)	69.7 (1)[f]
Total recoverable metals, unfiltered, digested—EPA Manchester						
cadmium	4/4	3.9 (12)	3.1 (7)	0.01	3.8 (9)	1.8 (3)
lead	4/4	3.1 (15)	1.3 (7)	0.01	4.9 (9)	13.0 (3)
zinc	*3/4	2.5 (14)	2.5 (7)	1.6	2.8 (9)	4.7 (3)
arsenic	4/4	3.8 (2)[f]	<MRL (7)	<MRL	<MRL (9)	12.1 (1)
iron	4/4	6.6 (15)	5.7 (7)	1.4	16.0 (8)	4.8 (3)
manganese	4/4	1.1 (15)	0.6 (7)	0.0	5.3 (9)	23.7 (3)
Dissolved metals, filtered, undigested [e]—EPA Manchester						
cadmium	4/4	8.3 (12)[f]	5.3 (7)	0.01	5.0 (9)	10.2 (3)
lead	*3/4	13.9 (11)[f]	11.1 (5)	0.01	22.4 (5)[f]	38.6 (3)
zinc	*3/4	3.2 (14)	3.5 (7)	2.1	1.3 (9)	7.7 (3)
arsenic	4/4	4.2 (15)	2.2 (7)	0.01	2.5 (9)	7.4 (3)
iron	4/4	5.3 (10)	12.5 (2)[f]	0.7	*28.2 (5)[f]	13.5 (2)
manganese	4/4	1.6 (15)	3.6 (7)	0.02	19.0 (9)	30.2 (3)
Minerals—EPA Manchester						
total hardness (as $CaCO_3$)	4/4	1.4 (15)	1.2 (7)	0.3	1.2 (9)	2.3 (3)
calcium, dissolved	4/4	1.6 (15)	2.3 (7)	0.14	1.1 (9)	3.0 (3)
magnesium, dissolved	4/4	0.8 (15)	1.3 (7)	0.02	1.0 (9)	1.5 (3)
Biological—EPA Manchester						
chlorophyll *a*	3/3	--	--	--	17.3 (6)	66.2 (2)[f]

a = <MRL—less than method reporting limit.
b = %RPD—relative percent difference.
c = n = sample size. Calculations of mean % RPD and mean absolute difference can be based on fewer replicate pairs when both values of a set were <MRL (not included in the calculations).
d = Field replicates were either photic zone composites or at discrete depths.
e = Samples are field filtered through a 0.45 µm pore size capsule filter for dissolved analysis.
f = At least one replicate pair had results where one concentration was below the MRL and one concentration was above the MRL. In these instances, %RPD is calculated to be at least the number reported.
g = Total nitrogen results from SVL are compared to TKN+NO_2+NO_3 results from STL.

* = QA/QC results that do not meet (exceed) established or required limits (does not apply to field side-by-side replicates).
R3= For SVL lab replicates, if constituent concentrations are less than 5 times the MRL, %RPD does not apply (as in the case for ammonia and nitrite+nitrate).

7.3.4 Field Staff Replicates

Once a year, in August, IDEQ and the Tribe have sampled southern station C5 (Figure 1), side-by-side. The two monitoring boats are anchored close together, and then at the same time field staff independently conducts all field measurements and water sample collections for submittal to the laboratories. This sampling incorporates numerous possibilities for sampling error, including environmental heterogeneity from collecting five discrete samples within the photic zone and compositing within a churn splitter. An added level of variability is that IDEQ nutrient samples are analyzed by SVL Analytical, while Tribe samples are analyzed by the Spokane Tribal Laboratory (STL). In 2010, three water zones were sampled by both staff: the photic zone (1.0–13.5 m), 9 m, and near bottom (17.0 m). IDEQ and the Tribe do not establish a required %RPD limit for field staff replicates (6th data column in Table 13).

Similar to data from 2007 through 2009, the 2010 side-by-side results for nutrient analysis were generally poorer than desired. The %RPD for ammonia appeared to be satisfactory, but given the difference in MRLs for SVL (30 µg/L) and STL (10 µg/L), it is difficult to compare the results that were below the MRLs. Compared to 2009 results, the side-by-side replicates were greatly improved for total phosphorus (74.6% RPD in 2009), but like in 2009, the TP results from SVL were consistently higher than those reported from STL. The side-by-side results from the EPA Manchester Lab for metals and minerals were acceptable with all mean %RPDs less than 25% except for dissolved lead and dissolved manganese. For the two sets of chlorophyll *a* the mean %RPD was higher than desired at 66%. Both chlorophyll *a* results for IDEQ were approximately 2 µg/L, while Tribe chlorophyll *a* results were less than 1.0 µg/L MRL.

7.3.5 Lab Sample Splits

Beginning in 2008, IDEQ and the Tribe initiated an annual sampling where nutrient sample replicates between SVL and STL (lab-sample split) are compared. IDEQ prepares a sample replicate set from one of the depth zones sampled (same churn splitter), and submits one set to SVL and the other to STL (Table 14). The Tribe does likewise. In 2010 the laboratory sample spilt was conducted on April 6: C1 (photic zone) for IDEQ samples and C5 (photic zone) for Tribe samples.

For TP and DOP, the IDEQ samples were below the MRL at SVL and above the MRL at STL. This resulted in %RPDs greater than 25%. Results from the Tribe samples were satisfactory. For DTP both sample sets were satisfactory. Because dissolved ammonia results from SVL were below the MRL (30 µg/L) but above the MRL for STL (10 µg/L) for the IDEQ sample set, it is not possible to precisely determine the %RPD (≤90.0%). For nitrite+nitrate, the %RPD of IDEQ samples was 29.4%. The Tribe sample set was satisfactory. The TN analytical methods differ between SVL and STL. TN from SVL was compared to total Kjeldahl nitrogen + nitrite+nitrate from STL. IDEQ samples were satisfactory, but the Tribe sample set produced a high %RPD (79%).

Table 14. Results of laboratory splits between SVL Analytical and Spokane Tribal Lab for IDEQ and Tribe samples taken April 6, 2010.

Constituent	SVL results (µg/L)	STL results (µg/L)	Absolute difference (µg/L)	%RPD
Total phosphorus (TP)				
DEQ samples	<5	8	3.1[a]	*48.1[a]
Tribe samples	13	16	3	23.8
Dissolved total phosphorus (DTP)				
DEQ samples	<5	<5	<MRL	<MRL
Tribe samples	<5	5	0.1[a]	9.7[a]
Dissolved ortho-phosphorus (DOP)				
DEQ samples	<3	4	1.1[a]	*31.9[a]
Tribe samples	<3	3	0.1[a]	3.4[a]
Dissolved ammonia (NH_3)				
DEQ samples	<30	11	18[b]	90.0[b]
Tribe samples	<30	<10	<MRL	<MRL
Dissolved nitrite + nitrate (NO_2 + NO_3)				
DEQ samples	42	31	11	*29.4
Tribe samples	<15	16	1.1[a]	7.1[a]
Total nitrogen (TN)—IDEQ	130		--	--
Total Kjeldahl nitrogen (TKN) —Tribe		120	--	--
TN vs. TKN+NO_2+NO_3				
DEQ samples	130	151	21	14.9
Tribe samples	98	226	128	*79.0

a = A replicate pair had results where one concentration was below the MRL and one concentration was above the MRL. In these instances, %RPD is calculated to be at least the number reported.
b = For ammonia, the MRL is greater for SVL, and %RPD is the highest or at most value.
* QA/QC results exceed established limits

7.4 Matrix Spikes and Lab Control Samples to Assess Accuracy

Accuracy is the amount of agreement between a measured value and the true value. For the Coeur d'Alene Lake Monitoring Program, accuracy assessments were exclusively prepared and measured in the two laboratories as the percent recovery of matrix spikes, matrix spike duplicates, standard laboratory control samples, and laboratory control sample duplicates.

7.4.1 Matrix Spike/Matrix Spike Duplicates (MS/MSDs)

MS/MSDs are sample analyses performed to provide information about the effect of the sample matrix on analyte recovery and measurement of the project samples. To create the MS/MSD, known concentrations of analytes are added to the environmental samples prior to digestion or preparation. The samples are then processed through the entire analytical procedure, and the percent recovery of known analytes is calculated (%Rec). The laboratory recovery requirements are 75–125 %Rec. The EPA lab analyzes MS duplicates, and the MS %Rec pairs can be matched to calculate a %RPD for precision. For nutrients, SVL does not perform matrix spike duplicates.

Results for matrix spikes are shown in Table 15. For metals and chlorophyll *a,* these are combined results from IDEQ and Tribe submittals to the EPA lab. Mean MS %Rec for all analytes are well within the acceptable limit (1st data column). The range of %Rec (2nd column) depicts whether accuracy was both less and greater than 100% recovery, or if the recovery is consistently under or over the known spike concentration. For nearly all analyses the range was on both sides of 100%. The exceptions to this were dissolved cadmium and dissolved arsenic, both of which were consistently greater than 100%. For mean %RPD of matrix spike duplicate pairs (3rd data column Table 15), all results are well within acceptable limits.

7.4.2 Laboratory Control Samples (LCS) and LCS Duplicates (LCSD)

LCS is a clean matrix spiked with known quantities of analytes. The LCS is processed with field samples through every step of preparation and analysis. Measuring percent recovery of each analyte in the LCS provides a measure of accuracy for the analyte in the project samples. The EPA lab conducts LCS duplicates, and the LCS %Rec pairs can be matched to calculate a %RPD precision. For nutrients, SVL does not perform LCS duplicates.

Results for LCS are shown in the 4th and 5th data columns in Table 15. For metals and chlorophyll *a* these are combined results from IDEQ and Tribe submittals to the EPA lab. All mean %Rec results are within the acceptable limit, and nearly all ranges of %Rec were on both sides of 100%. The exceptions included dissolved iron which was consistently higher than 100% and chlorophyll *a* which was at or below 100%. All LCSD results were within acceptable limits (6th data column of Table 15).

7.4.3 Laboratory Blind Samples for Total Phosphorus Analysis

IDEQ purchased a series of standards of known total phosphorus concentration (ranging from 5 – 50 µg/L) and submitted them to SVL to be analyzed in the same manner as field collected samples. These standards are termed "laboratory blind" samples because the concentrations are unknown to the analyst at SVL. The objective of this blind study was to assess the operational performance of the laboratory in terms of accuracy over a range of total phosphorus concentrations.

The four results from 10–50 µg/L were within ±15% of the actual concentration (Table 14). The SVL result for the 5 µg/L TP standard was <5 ug/L (the MRL), so an accurate difference cannot be obtained. With the exception of one sample (10 µg/L standard), the laboratory under-reported the actual concentrations.

Table 15. QA/QC results: Matrix Spikes and Lab Control Samples for 2010.

Analyte	MS mean %Rec[ab] (n)[c]	MS range %Rec[b]	MSD mean %RPD of %Rec (n)[d]	LCS mean %Rec[b] (n)[c]	LCS range of %Rec[b]	LCSD mean %RPD of %Rec[d]
Nutrients—SVL						
dissolved ammonia[e]	103 (20)	97-114	--	102 (15)	96-106	--
dissolved nitrite+nitrate[e]	100 (29)	92-105	--	99 (19)	98-106	--
total nitrogen	98 (18)	88-117	--	100 (19)	93-113	--
total phosphorus	101 (17)	92-106	1.6 (1)	98 (17)	87-108	--
dissolved total phosphorus[e]	99 (17)	96-104	--	97 (17)	88-109	--
dissolved ortho-phosphate	101 (17)	91-108	1.3 (17)	98 (18)	83-108	--
Total recoverable metals, unfiltered, digested—EPA Manchester						
cadmium	98	94-101	1.2	100	97-103	0.9
lead	98	93-104	0.7	101	97-107	0.6
zinc	100	91-107	2.7	100	90-107	1.8
arsenic	99	95-103	0.7	98	96-104	0.9
iron	103	96-109	2.0	103	95-106	1.4
manganese	97	92-100	1.0	100	97-103	0.7
Dissolved metals, filtered, undigested [e]—EPA Manchester						
cadmium	106	103-109	0.6	101	99-103	0.5
lead	99	93-105	1.1	101	96-106	0.9
zinc	103	94-110	1.7	103	98-113	1.9
arsenic	105	103-108	0.6	100	98-102	0.8
iron	105	97-108	0.8	106	101-110	1.1
manganese	99	96-104	0.7	102	99-106	0.7
Minerals—EPA Manchester						
total hardness (as $CaCO_3$)	101	98-104	1.2	103	98-106	0.8
calcium, dissolved [e]	101	91-108	2.1	102	98-107	1.7
magnesium, dissolved [e]	103	99-107	1.1	103	99-105	0.7
Biological—EPA Manchester						
chlorophyll *a*	--	--	--	94 (n=15)	83-100	3.1

a = %Rec—percent recovery.
b = includes duplicates if available
c = n=30 unless otherwise noted
d = n=15 unless otherwise noted.
e = Samples are field filtered through a 0.45 µm pore size capsule filter for dissolved analysis

Table 16. Laboratory blind sample results for total phosphorus.

Analysis date	TP standard concentration (µg/L)	Laboratory result (µg/L)	Difference (µg/L)	%Rec
07/23/10	5.0	<5	--	<MRL
07/21/10	10.0	10.5	-0.5	105.0
07/22/10	25.0	21.7	3.3	86.8
08/19/10	25.0	23.4	1.6	93.6
07/20/10	50.0	45.3	4.7	90.6

7.5 Presence of Particulates in Filtered Samples

During periods of high suspended material within the lake, in particular during high river inflows, both IDEQ and the Tribe have experienced fine colloidal materials passing through the 0.45 µm capsule filters and presenting a visual appearance of particulates floating within the filtered samples. This occurred during 2008 sampling (Tribe and IDEQ, 2010), and again occurred during sampling on April 7, 2009 (one sample set for IDEQ, and three sample sets for the Tribe).

When the turbidity of a filtered sample exceeds 1 NTU, the EPA lab SOP calls for the sample to be acid digested before going through spectrophotometric analysis. This acid digestion may release metal ions that were adsorbed or incorporated in the fine colloidal material, thereby giving an inaccurate high bias of free dissolved metal ions in the filtered sampled. To overcome this, IDEQ and the Tribe implemented a policy of post-filtering 0.45 µm filtered samples if particulates were visible. This post-filtering procedure involves passing a 0.45 µm filtered sample through an additional 0.2 µm membrane filter and comparing the results. No samples collected during the 2010 field season had visible particulates, thus no samples underwent the post filtering procedure. However, this procedure will remain in place for future sampling events.

7.6 Completeness and QA/QC Conclusions

Completeness is defined as the percentage of usable data obtained from the total amount of data generated. Completeness was not 100% for the sampling data of 2010 for the following reasons: 1) Under oxic conditions, most natural waters have low dissolved ammonia concentrations, and Coeur d'Alene Lake is no exception. With low concentrations and various potentials for field and laboratory ammonia contamination, the QA/QC results have occasionally been well outside the range of acceptance limits. 2) Dissolved NO_2+NO_3 often had poor reproducibility which appears to be a result of laboratory methods as shown by the high %RPD of laboratory replicates. Additionally, on September 9, the dissolved NO_2+NO_3 concentration in the photic zone at C3 was abnormally high and exceeded the total nitrogen concentration. To obtain a lower MRL and greater consistency with Tribe data for dissolved inorganic nitrogen, IDEQ will be using Spokane Tribal Lab for dissolved NH_3 and NO_2+NO_3 analysis for the 2011 field season.

Based on the total array of replicate phosphorus samples (sample, field, field-crew, and lab-split replicates), total phosphorus QA/QC results have improved since 2009. Based on the results of the

blind samples submitted to SVL, it appears the lab is slightly under-reporting total phosphorus concentrations (Table 16). This may account for some of the discrepancy between the laboratory splits for total phosphorus (Table 14).

The results for metals analysis are good. In earlier reports, DEQ noted questionable total and dissolved manganese results. During the 2010 season, no manganese concentrations were questioned, however we found that total and dissolved lead, iron, and manganese showed more variability in field replicates than in sample and laboratory replicates. Although most of the results were within the acceptable range, these results suggest that these metals may be interacting with fine particulates.

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Appendix A:
2010 Physical Parameters

Table A1. Physical parameters for 2010 sampling

Date	Time	Depth to bottom (m)	Air tempera-ture (°C)	Surface light intensity 400 – 700 nm (µmol/s/ m^2)	Depth to 1% of surface light (m)	Secchi disc trans-parency w/view tube (m)	% of surface light 1 m off bottom (%)
C1 Tubbs Hill							
5-Mar	13:25	39.4	9.1	1138	15.5	8.4	--
6-Apr	9:30	39.8	12.4	--	--	7.8	--
5-May	10:00	41.0	11.9	1540	13.0	6.3	--
8-Jun	13:15	40.9	15.7	--	--	6.1	--
22-Jul	9:30	40.9	18.8	1766	14.25	8.6	--
16-Aug	11:15	41.0	21.9	1525	15.5	11.2	--
28-Sep	12:20	40.8	19.5	1359	17.25	12.2	--
7-Dec	10:50	40.9	18.8	427	16.75	11.4	--
C2 Wolf Lodge Bay							
8-Mar	13:15	27.0	7.5	317	12.75	5.2	--
9-Apr	10:10	27.5	7.8	390	12.75	4.8	--
4-May	9:45	28.7	9.5	1389	11.0	4.0	--
8-Jun	9:30	29.3	13.7	--	--	4.7	--
23-Jul	9:00	28.7	16.4	1481	14.5	8.4	--
19-Aug	14:45	28.7	16.4	1376	16.0	10.9	--
28-Sep	9:45	28.5	16.9	1142	14.0	9.4	--
C3 Driftwood Point							
4-Mar	13:45	45.0	9.1	372	13.75	6.5	--
12-Apr	13:15	48.6	13.5	533	12.25	5.3	--
6-May	9:45	50.4	--	985	12.25	5.5	--
10-Jun	9:30	50.3	10.8	400	10.0	4.4	--
21-Jul	9:45	50.7	20.8	1578	13.5	8.6	--
19-Aug	11:45	50.4	18.4	1494	17.0	12.4	--
29-Sep	10:00	50.2	14.7	1198	16.0	11.7	--
C4 University Point							
3-Mar	10:40	37.7	11.7	322	12.0	5.3	--
13-Apr	11:45	38.0	8.5	212	11.75	5.2	--
4-May	9:45	39.5	7.9	1368	12.25	5.8	--
9-Jun	11:45	39.3	13.5	1797	11.0	4.7	--
20-Jul	12:55	38.9	20.8	1833	12.75	6.8	--
18-Aug	13:30	39.6	23.4	999	15.25	11.0	--
30-Sep	10:45	38.7	15.0	1433	15.0	10.9	--
9-Dec	11:15	37.9	7.0	690	13.75	9.3	--

Table A1 continued

Date	Time	Depth to bottom (m)	Air tempera-ture (°C)	Surface light intensity 400 – 700 nm (µmol/s/ m^2)	Depth to 1% of surface light (m)	Secchi disc trans-parency w/view tube (m)	% of surface light 1 m off bottom (%)
Kidd Island Bay							
8-Mar	11:15	8.7	9.1	545	>7.5	6.0	7.1
9-Apr	15:00	8.4	7.1	495	>7.25	4.5	5.8
4-May	14:15	9.5	10.1	1049	>9.0	5.3	4.1
10-Jun	15:15	9.9	13.5	554	>9.0	4.6	3.0
22-Jul	14:20	10.5	21.5	624	>9.0	6.2	4.5
16-Aug	14:45	9.6	24.0	1591	>9.0	9.4	6.3
28-Sep	16:00	9.7	25.0	1059	>9.0	8.3	3.7
Kidd Island Bay Station 2							
16-Aug	16:00	1.25	26.4	1072	>1.25	0.7	17.4
Mica Bay							
5-Mar	10:50	9.75	9.4	1018	8.5	2.9	--
12-Apr	10:15	10.1	13.8	1266	>9.0	3.5	1.5
5-May	14:30	11.1	10.8	1077	>10.0	5.8	2.0
10-Jun	13:30	11.2	12.5	377	>10.0	4.3	1.1
21-Jul	13:45	11.5	23.4	1616	>11.0	8.9	3.4
19-Aug	9:55	11.5	16.3	1263	>11.0	11.0	3.6
29-Sep	13:45	11.3	19.5	1350	>11.0	9.3	2.8
Rockford Bay							
4-Mar	10:30	8.6	8.1	674	>7.5	3.3	1.7
13-Apr	9:15	9.1	7.7	137	>8.0	3.5	1.9
6-May	14:15	11.0	9.9	1744	>10.0	5.5	2.0
9-Jun	10:00	10.5	13.4	362	7.0	2.4	--
20-Jul	9:20	9.9	18.9	1485	>9.0	6.6	3.0
20-Aug	10:45	10.2	17.7	1427	>10.0	10.0	5.5
30-Sep	14:15	10.2	19.0	1121	>10.0	10.0	5.2

Appendix B:
2010 Chemical Parameters: Trace Metals, Metals and Hardness, and Nutrients and Chlorophyll *a*

Table B1. Chemistry at C1 Tubbs Hill

C1 Tubbs Hill: Trace Metals

Date	Time	Sample Depth (m)	Total As (µg/L)	Total Cd (µg/L)	Total Pb (µg/L)	Total Zn (µg/L)	Diss. As (µg/L)	Diss. Cd (µg/L)	Diss. Pb (µg/L)	Diss. Zn (µg/L)
March										
5	13:45	1-15.5	<0.63	0.16	0.2	56.1	0.42	0.17	0.15	52.7
5	14:45	20	<0.63	0.16	0.2	52.7	0.40	0.18	<0.10	49.9
5	15:15	30	<0.63	0.15	0.2	52.2	0.41	0.17	<0.10	51.3
5	16:00	38.5	<0.63	0.16	0.2	53.8	0.39	0.16	<0.10	52.4
April										
6	11:00	1-15.0	<0.63	0.18	0.3	52.1	0.45	0.18	<0.10	46.0
6	13:00	20	<0.63	0.18	0.4	51.3	0.45	0.17	<0.10	47.6
6	13:55	30	<0.63	0.18	0.3	52.9	0.44	0.16	<0.10	46.5
6	14:45	38.75	<0.63	0.17	0.3	52.4	0.44	0.18	<0.10	48.4
May										
5	10:30	1-13.0	<0.63	0.21	1.7	58.2	0.41	0.21	0.26	60.1
5	12:00	20	<0.63	0.21	1.8	59.2	0.41	0.21	0.23	56.8
5	12:30	30	<0.63	0.21	1.8	58.1	0.40	0.21	0.34	56.5
5	13:00	40.0	<0.63	0.20	1.7	63.2	0.37	0.21	0.28	58.6
June										
8	15:45	1-12.25	<0.63	0.22	1.1	56.7	0.38	0.22	0.16	51.4
8	13:45	20	<0.63	0.21	1.0	61.2	0.39	0.22	0.11	58.0
8	14:45	30	<0.63	0.21	1.1	63.7	0.39	0.24	0.10	62.1
8	15:15	40.0	<0.63	0.21	1.1	64.4	0.36	0.22	<0.10	55.9
July										
22	11:00	1-14.5	<0.63	0.2	0.55	44.5	0.38	0.2	<0.10	48.7
22	11:30	20	<0.63	0.26	0.62	55.2	0.34	0.24	<0.10	64.2
22	12:00	30	<0.63	0.22	0.45	57.2	0.35	0.22	<0.10	68.5
22	13:00	40.0	<0.63	0.23	0.53	64.7	0.37	0.22	<0.10	68.9
August										
16	13:15	1-15.5	<0.63	0.22	0.48	48.8	0.38	0.20	<0.10	49.1
16	12:30	17.5	<0.63	0.23	0.59	60.7	0.31	0.25	<0.10	61.5
16	12:15	30	<0.63	0.23	0.41	64.9	0.34	0.23	<0.10	63.4
16	11:45	40.0	<0.63	0.24	0.53	73.8	0.42	0.28	0.13	74.4
September										
28	14:30	1-17.25	<0.63	0.20	0.28	46.9	0.43	0.19	<0.10	46.8
28	14:00	20	<0.63	0.24	0.41	64.8	0.34	0.22	<0.10	64.0
28	13:30	30	<0.63	0.23	0.32	66.9	0.34	0.22	<0.10	67.9
28	13:00	39.75	<0.63	0.24	0.34	70.9	0.36	0.21	<0.10	68.7
December										
7	12:00	1-16.75	<0.63	0.20	0.27	54.4	0.48	0.17	<0.10	53.6
7	12:15	20	<0.63	0.19	0.29	55.9	0.45	0.17	<0.10	56.0
7	12:45	30	<0.63	0.18	0.31	56.2	0.43	0.17	<0.10	55.2
7	13:00	38.75	<0.63	0.19	0.30	54.2	0.46	0.16	<0.10	55.3

Table B1 continued.

C1 Tubbs Hill: Metals and Hardness

Date	Time	Sample Depth (m)	Total Fe (µg/L)	Total Mn (µg/L)	Diss. Fe (µg/L)	Diss. Mn (µg/L)	Diss. Ca (mg/L)	Diss. Mg (mg/L)	T. Hard (mg/L $CaCO_3$)
March									
5	13:45	1-15.5	e 8	1.8	<5.0	0.43	5.75	1.81	22.6
5	14:45	20	e 10	1.8	<5.0	0.17	5.69	1.77	21.9
5	15:15	30	e 8	1.8	<5.0	0.24	5.85	1.81	21.9
5	16:00	38.5	9.3	2.0	<5.0	0.21	5.96	1.80	22.2
April									
6	11:00	1-15.0	14	2.2	<5.0	0.38	5.48	1.87	21.9
6	13:00	20	17	2.1	<5.0	0.30	5.54	1.86	21.8
6	13:55	30	12	2.1	<5.0	0.23	5.43	1.86	22.1
6	14:45	38.75	27	2.4	<5.0	0.25	5.65	1.86	21.9
May									
5	10:30	1-13.0	32	5.9	7.6	0.42	6.20	1.96	23.3
5	12:00	20	31	6.0	6.1	0.36	6.06	1.93	23.6
5	12:30	30	31	5.9	8.8	0.58	6.00	1.94	23.3
5	13:00	40.0	35	5.9	7.0	0.28	6.17	1.96	23.9
June									
8	15:45	1-12.25	36	6.8	7.8	0.82	6.08	1.87	21.9
8	13:45	20	30	5.5	5.2	0.50	6.30	1.92	22.8
8	14:45	30	23	5.0	<5.0	0.26	6.49	1.99	23.0
8	15:15	40.0	26	5.8	<5.0	0.36	6.10	1.94	22.4
July									
22	11:00	1-14.5	25	3.1	5.2	0.37	5.63	1.80	20.2
22	11:30	20	28	3.2	5.5	0.25	5.84	1.92	20.3
22	12:00	30	16	3.1	<5.0	0.18	6.41	2.01	21.9
22	13:00	40.0	20	6.9	<5.0	0.76	6.3	2.01	22.3
August									
16	13:15	1-15.5	20	3.2	<5.0	1.30	5.63	1.72	20.7
16	12:30	17.5	22	2.4	<5.0	0.60	5.72	1.78	21.0
16	12:15	30	21	2.7	<5.0	0.25	5.96	1.88	22.6
16	11:45	40.0	26	10.7	<5.0	1.30	6.21	1.93	22.9
September									
28	14:30	1-17.25	7.3	2.4	<5.0	0.80	5.94	1.82	21.8
28	14:00	20	9.1	3.7	<5.0	0.29	6.08	1.88	22.4
28	13:30	30	9.3	5.1	<5.0	0.41	6.17	1.95	22.7
28	13:00	39.75	13	11.7	<5.0	1.10	6.19	1.96	23.4
December									
7	12:00	1-16.75	12	3.3	6.4	1.10	6.16	1.92	22.7
7	12:15	20	25	3.3	10.0	0.58	6.15	1.93	22.4
7	12:45	30	13	3.3	<5.0	0.20	6.13	1.93	22.7
7	13:00	38.75	9.3	3.1	5.6	0.20	6.17	1.94	22.2

Table B1 continued.

C1 Tubbs Hill: Nutrients and Chlorophyll *a*

Date	Time	Sample Depth (m)	Total P (µg/L)	Diss. Total P (µg/L)	Diss. Ortho-P (µg/L)	Total N (µg/L)	Diss. NO_2+NO_3 (µg/L)	Diss. NH_3 (µg/L)	Chl *a* (µg/L)
March									
5	13:45	1-15.5	<5	<5	--	101	40	<30	1.75
5	14:45	20	<5	<5	--	98	31	34	--
5	15:15	30	<5	<5	--	99	16	<30	--
5	16:00	38.5	<5	<5	--	96	17	<30	--
April									
6	11:00	1-15.0	<5	<5	<3	130	42	<30	1.51
6	13:00	20	<5	<5	--	108	21	<30	--
6	13:55	30	<5	<5	--	106	22	<30	--
6	14:45	38.75	<5	<5	--	102	25	<30	--
May									
5	10:30	1-13.0	6	<5	<3	114	<15	<30	2.07
5	12:00	20	7	<5	--	100	<15	<30	--
5	12:30	30	7	<5	--	107	<15	<30	--
5	13:00	40.0	7	<5	--	92	<15	<30	--
June									
8	15:45	1-12.25	6	<5	<3	90	<15	<30	2.30
8	13:45	20	6	<5	--	113	<15	<30	--
8	14:45	30	5	<5	--	130	24	<30	--
8	15:15	40.0	6	<5	--	106	<15	<30	--
July									
22	11:00	1-14.5	<5	<5	<3	80	15	<30	1.31
22	11:30	20	<5	<5	--	95	<15	<30	--
22	12:00	30	<5	<5	--	113	19	<30	--
22	13:00	40.0	--	<5	--	151	49	<30	--
August									
16	13:15	1-15.5	<5	<5	<3	85	18	<30	1.90
16	12:30	17.5	<5	<5	--	84	<15	<30	2.94
16	12:15	30	<5	<5	--	96	34	<30	--
16	11:45	40.0	<5	<5	--	132	70	<30	--
September									
28	14:30	1-17.25	5	<5	<3	99	<15	<30	<1.00
28	14:00	20	<5	<5	--	87	45	<30	--
28	13:30	30	<5	<5	--	134	41	<30	--
28	13:00	39.75	<5	<5	--	158	60	<30	--
December									
7	12:00	1-16.75	6	6	<3	87	<50	<30	1.14
7	12:15	20	6	<5	--	77	<50	41	--
7	12:45	30	5	<5	--	77	<50	34	--
7	13:00	38.75	5	<5	--	68	<50	37	--

Table B2. Chemistry at C2 Wolf Lodge Bay

C2 Wolf Lodge Bay: Trace Metals

Date	Time	Sample Depth (m)	Total As (µg/L)	Total Cd (µg/L)	Total Pb (µg/L)	Total Zn (µg/L)	Diss. As (µg/L)	Diss. Cd (µg/L)	Diss. Pb (µg/L)	Diss. Zn (µg/L)
March										
8	14:00	1-12.75	<0.63	0.13	0.2	42.9	0.41	0.11	<0.10	40.4
8	14:45	20	<0.63	<0.13	0.2	41.8	0.41	0.11	<0.10	40.7
8	15:15	26	<0.63	0.13	0.1	42.3	0.41	0.12	<0.10	41.4
April										
9	11:45	1-12.75	<0.63	0.13	0.2	46.6	0.44	0.14	<0.10	40.4
9	12:30	20	<0.63	0.14	0.2	45.6	0.46	0.13	<0.10	40.6
9	13:15	26.5	<0.63	0.14	0.2	44.3	0.46	0.13	<0.10	37.8
May										
4	11:15	1-11.0	<0.63	0.17	0.8	48.3	0.40	0.16	<0.10	48.0
4	12:15	20	<0.63	0.17	0.8	50.2	0.43	0.17	0.11	50.2
4	13:00	27.5	<0.63	0.18	0.9	50.2	0.39	0.17	0.15	51.3
June										
8	10:30	1-9.5	<0.63	0.17	0.6	47.0	0.45	0.19	0.10	40.6
8	11:45	20	<0.63	0.19	0.9	62.2	0.39	0.18	<0.10	56.5
8	12:00	28.25	<0.63	0.22	1.0	68.4	0.47	0.19	<0.10	68.3
July										
23	10:30	1-14.5	<0.63	0.2	0.34	38.2	0.42	0.17	<0.10	41.8
23	11:30	20	<0.63	0.2	0.34	51.7	0.38	0.2	<0.10	58.3
23	12:00	27.75	<0.63	0.21	0.33	75.7	0.34	0.19	<0.10	63.1
August										
19	16:15	1-16.0	<0.63	0.18	0.19	41.9	0.40	0.20	<0.10	43.1
19	15:45	20	<0.63	0.21	0.29	56.7	0.37	0.24	<0.10	61.2
19	15:30	27.75	<0.63	0.20	0.31	60.1	0.33	0.20	<0.10	64.4
September										
28	10:45	1-14.75	<0.63	0.18	0.21	42.5	0.44	0.17	<0.10	42.2
28	11:00	20	<0.63	0.22	0.32	61.9	0.35	0.20	<0.10	62.8
28	11:15	27.5	<0.63	0.21	0.31	65.7	0.35	0.19	<0.10	66.1

Table B2 continued.

C2 Wolf Lodge Bay: Metals and Hardness

Date	Time	Sample Depth (m)	Total Fe (µg/L)	Total Mn (µg/L)	Diss. Fe (µg/L)	Diss. Mn (µg/L)	Diss. Ca (mg/L)	Diss. Mg (mg/L)	T. Hard (mg/L $CaCO_3$)
March									
8	14:00	1-12.75	36	3.9	7.4	1.20	5.33	1.73	20.5
8	14:45	20	40	4.3	<5.0	0.76	5.52	1.67	20.6
8	15:15	26	38	4.4	<5.0	0.92	5.48	1.70	20.5
April									
9	11:45	1-12.75	32	3.5	<5.0	0.94	5.24	1.74	21.1
9	12:30	20	33	3.6	6.0	1.10	5.31	1.75	20.8
9	13:15	26.5	35	3.6	5.6	1.00	5.01	1.75	20.3
May									
4	11:15	1-11.0	49	4.7	<5.0	1.1	5.72	1.79	21.6
4	12:15	20	41	5.5	<5.0	1.7	5.84	1.87	22.0
4	13:00	27.5	41	5.6	<5.0	1.8	5.92	1.86	21.7
June									
8	10:30	1-9.5	48	4.1	8.6	0.68	5.62	1.81	21.1
8	11:45	20	41	12.9	8.6	0.92	6.23	1.99	22.8
8	12:00	28.25	30	12.1	<5.0	0.54	6.51	2.00	24.1
July									
23	10:30	1-14.5	22	2.6	5.7	0.35	5.46	1.75	19.3
23	11:30	20	27	2.8	6.8	0.43	6.06	1.83	19.8
23	12:00	27.75	24	8.5	5.9	1.8	6.18	1.96	21.7
August									
19	16:15	1-16.0	13	2.0	<5.0	0.81	5.68	1.72	20.4
19	15:45	20	22	5.8	<5.0	1.50	6.04	1.9	21.6
19	15:30	27.75	22	11.7	<5.0	2.20	6.33	1.98	22.2
September									
28	10:45	1-14.75	13	2.8	<5.0	0.73	5.76	1.79	21.3
28	11:00	20	22	11.2	<5.0	2.9	6.02	1.91	22.3
28	11:15	27.5	16	16.4	<5.0	2.8	6.26	1.97	22.8

Table B2 continued.

C2 Wolf Lodge Bay: Nutrients and Chlorophyll *a*

Date	Time	Sample Depth (m)	Total P (µg/L)	Diss. Total P (µg/L)	Diss. Ortho-P (µg/L)	Total N (µg/L)	Diss. NO_2+NO_3 (µg/L)	Diss. NH_3 (µg/L)	Chl *a* (µg/L)
March									
8	14:00	1-12.75	5	<5	<3	83	57	<30	2.52
8	14:45	20	7	<5	--	91	<15	<30	--
8	15:15	26	6	<5	--	96	<15	<30	--
April									
9	11:45	1-12.75	<5	<5	--	94	20	<30	2.09
9	12:30	20	<5	<5	--	99	<15	<30	--
9	13:15	26.5	<5	<5	--	95	<15	<30	--
May									
4	11:15	1-11.0	7	<5	<3	125	<15	<30	3.12
4	12:15	20	7	<5	--	96	<15	<30	--
4	13:00	27.5	8	<5	--	99	<15	<30	--
June									
8	10:30	1-9.5	8	<5	<3	100	28	<30	1.60
8	11:45	20	6	<5	--	120	29	<30	--
8	12:00	28.25	7	<5	--	129	27	47	--
July									
23	10:30	1-14.5	<5	<5	--	85	<15	<30	1.28
23	11:30	20	<5	<5	--	85	<15	<30	--
23	12:00	27.75	--	<5	--	127	24	<30	--
August									
19	16:15	1-16.0	<5	<5	<3	72	77	<30	<1.00
19	15:45	20	<5	<5	--	71	<15	<30	--
19	15:30	27.75	<5	<5	--	99	37	<30	--
September									
28	10:45	1-14.75	<5	<5	<3	87	20	<30	1.10
28	11:00	20	<5	<5	--	101	30	<30	--
28	11:15	27.5	<5	<5	--	147	45	<30	--

Table B3. Chemistry at C3 Driftwood Point

C3 Driftwood Point: Trace Metals

Date	Time	Sample Depth (m)	Total As (µg/L)	Total Cd (µg/L)	Total Pb (µg/L)	Total Zn (µg/L)	Diss. As (µg/L)	Diss. Cd (µg/L)	Diss. Pb (µg/L)	Diss. Zn (µg/L)
March										
4	14:00	1-13.75	<0.63	0.19	0.8	65.2	0.42	0.20	<0.10	61.1
4	15:00	20	<0.63	0.20	0.7	63.5	0.42	0.18	<0.10	60.7
April										
12	14:15	1-12.25	<0.63	0.24	1.5	67.8	0.40	0.22	0.23	63.0
12	16:00	47.5	<0.63	0.22	1.5	68.9	0.40	0.21	0.25	60.1
May										
6	10:45	1-12.25	<0.63	0.23	2.6	60.1	0.36	0.22	0.49	58.9
6	11:30	25	<0.63	0.23	2.9	64.8	0.35	0.20	0.32	59.4
6	12:15	40	<0.63	0.23	2.5	64.3	0.36	0.21	0.36	60.4
6	13:00	49.5	<0.63	0.23	2.4	64.7	0.38	0.22	0.29	60.1
June										
10	12:15	1-10.0	<0.63	0.27	2.7	59.7	0.34	0.26	0.27	48.6
10	10:30	25	<0.63	0.24	1.3	65.9	0.44	0.31	0.14	58.7
10	11:15	40	<0.63	0.25	1.2	70.2	0.38	0.24	<0.10	61.9
10	12:00	49.25	<0.63	0.22	1.2	74.3	0.38	0.23	0.18	71.5
July										
21	13:00	1-13.5	<0.63	0.21	0.94	46.3	0.37	0.21	0.14	47.9
21	12:15	25	<0.63	0.24	0.59	60.9	0.32	0.23	<0.10	64.7
21	11:30	40	<0.63	0.24	0.58	62.1	0.35	0.24	<0.10	71.6
21	11:00	49.75	<0.63	0.25	0.62	67.8	0.37	0.24	<0.10	75.2
August										
19	12:30	1-13.5	<0.63	0.22	0.46	46.8	0.44	0.24	0.11	48.9
19	12:45	25	<0.63	0.23	0.54	63.5	0.35	0.24	0.10	69.3
19	13:15	40	<0.63	0.22	0.51	66.6	0.35	0.24	<0.10	71.1
19	13:30	49.5	<0.63	0.24	0.61	71.9	0.37	0.26	0.11	76.3
September										
29	12:30	1-16.0	<0.63	0.18	0.36	48.0	0.48	0.19	<0.10	48.0
29	12:15	25	<0.63	0.24	0.41	66.8	0.35	0.23	<0.10	66.4
29	11:30	40	<0.63	0.22	0.35	70.4	0.36	0.22	<0.10	68.9
29	11:00	49.0	<0.63	0.23	0.38	69.6	0.34	0.21	<0.10	69.5

Table B3 continued.

C3 Driftwood Point: Metals and Hardness

Date	Time	Sample Depth (m)	Total Fe (µg/L)	Total Mn (µg/L)	Diss. Fe (µg/L)	Diss. Mn (µg/L)	Diss. Ca (mg/L)	Diss. Mg (mg/L)	T. Hard (mg/L $CaCO_3$)
March									
4	14:00	1-13.75	24	3.5	<5.0	0.25	6.23	1.86	23.5
4	15:00	20	24	3.5	<5.0	0.22	6.18	1.91	23.3
April									
12	14:15	1-12.25	40	6.2	7.9	0.27	6.42	2.11	24.3
12	16:00	47.5	42	6.6	6.5	0.34	6.20	2.11	24.6
May									
6	10:45	1-12.25	42	7.6	12.0	0.68	6.02	1.93	23.5
6	11:30	25	52	9.1	9.0	0.41	6.12	1.93	24.3
6	12:15	40	43	7.7	7.0	0.56	6.14	1.94	24.1
6	13:00	49.5	42	7.8	7.4	0.70	6.08	1.96	24.2
June									
10	12:15	1-10.0	58	12.5	9.3	1.4	5.52	1.70	20.1
10	10:30	25	30	6.1	5.5	0.25	6.22	1.96	22.6
10	11:15	40	29	7.0	5.6	0.15	6.33	1.98	23.5
10	12:00	49.25	24	8.3	5.8	1.2	6.41	2.02	23.5
July									
21	13:00	1-13.5	32	4.2	8.1	1.1	5.51	1.81	20.3
21	12:15	25	21	3.2	<5.0	0.23	5.98	1.98	22.2
21	11:30	40	18	3.8	<5.0	0.26	6.46	1.98	22
21	11:00	49.75	20	6.2	6.3	0.95	6.38	2.01	22.3
August									
19	12:30	1-13.5	13	2.8	<5.0	0.77	5.99	1.85	21.6
19	12:45	25	20	2.8	<5.0	0.50	6.17	1.91	22.0
19	13:15	40	17	3.8	<5.0	0.22	6.29	1.95	22.4
19	13:30	49.5	21	5.9	<5.0	1.10	6.22	1.95	22.3
September									
29	12:30	1-16.0	8.6	3.4	<5.0	0.76	6.12	1.86	22.3
29	12:15	25	11	4.8	<5.0	0.31	6.05	1.89	22.8
29	11:30	40	10	6.2	<5.0	0.72	6.25	1.90	23.2
29	11:00	49.0	11	7.04	<5.0	0.64	6.15	1.92	22.8

Table B3 continued.

C3 Driftwood Point: Nutrients and Chlorophyll *a*

Date	Time	Sample Depth (m)	Total P (µg/L)	Diss. Total P (µg/L)	Diss. Ortho-P (µg/L)	Total N (µg/L)	Diss. NO_2+NO_3 (µg/L)	Diss. NH_3 (µg/L)	Chl *a* (µg/L)
March									
4	14:00	1-13.75	6	<5	<3	113	23	<30	2.16
4	15:00	20	<5	<5	--	109	23	<30	--
April									
12	14:15	1-12.25	<5	<5	<3	124	20	33	3.20
12	16:00	47.5	5	<5	--	117	21	37	--
May									
6	10:45	1-12.25	6	<5	<3	104	<15	<30	2.52
6	11:30	25	5	<5	--	--	<15	<30	--
6	12:15	40	5	<5	--	--	<15	<30	--
6	13:00	49.5	6	<5	--	--	<15	<30	--
June									
10	12:15	1-10.0	7	<5	<3	92	<15	<30	1.83
10	10:30	25	6	<5	--	122	16	<30	--
10	11:15	40	<5	<5	--	134	18	<30	--
10	12:00	49.25	5	<5	--	137	20	<30	--
July									
21	13:00	1-13.5	5	<5	<3	98	<15	<30	1.78
21	12:15	25	<5	<5	--	115	24	<30	--
21	11:30	40	--	<5	--	163	44	<30	--
21	11:00	49.75	<5	<5	--	127	56	<30	--
August									
19	12:30	1-13.5	<5	<5	<3	65	<15	<30	1.14
19	12:45	25	<5	<5	--	90	33	<30	--
19	13:15	40	--	<5	--	115	55	<30	--
19	13:30	49.5	5	<5	--	132	74	<30	--
September									
29	12:30	1-16.0	6	<5	<3	90	q 208	<30	1.00
29	12:15	25	<5	<5	--	121	55	<30	--
29	11:30	40	<5	<5	--	146	105	<30	--
29	11:00	49.0	<5	<5	--	154	85	<30	--

q=Questionable result. Dissolved NO_2+NO_3 concentration was higher than the TP concentration.

Table B4. Chemistry at C4 University Point

C4 University Point: Trace Metals

Date	Time	Sample Depth (m)	Total As (µg/L)	Total Cd (µg/L)	Total Pb (µg/L)	Total Zn (µg/L)	Diss. As (µg/L)	Diss. Cd (µg/L)	Diss. Pb (µg/L)	Diss. Zn (µg/L)
March										
3	11:30	1-12.0	<0.63	0.24	1.6	67.9	0.39	0.20	0.15	66.3
3	12:45	20.0	<0.63	0.24	2.0	71.4	0.38	0.22	0.19	69.2
3	13:30	30.0	<0.63	0.27	2.5	75.1	0.39	0.23	0.25	71.4
3	14:10	36.5	<0.63	0.38	4.6	97.2	0.34	0.32	0.44	85.7
April										
13	13:00	1-11.5	<0.63	0.25	2.8	72.1	0.41	0.25	0.72	65.2
13	14:00	20.0	<0.63	0.25	2.6	74.6	0.39	0.24	0.68	62.4
13	14:30	30.0	<0.63	0.25	2.3	69.6	0.39	0.23	0.50	65.4
13	15:15	37.0	<0.63	0.26	2.3	69.8	0.40	0.23	0.59	62.1
May										
7	10:45	1-12.25	<0.63	0.23	2.9	62.7	0.34	0.22	0.59	60.8
7	11:30	20.0	<0.63	0.22	2.2	62.1	0.34	0.22	0.27	61.8
7	12:30	30.0	<0.63	0.21	2.0	63.4	0.38	0.23	0.23	63.9
7	13:45	38.5	<0.63	0.24	2.0	66.1	0.35	0.23	0.20	61.9
June										
9	12:30	1-11.0	<0.63	0.28	2.0	60.8	0.35	0.24	0.18	52.3
9	13:15	20.0	<0.63	0.22	1.5	64.0	0.35	0.23	<0.10	61.1
9	14:00	30.0	<0.63	0.23	1.3	71.1	0.37	0.23	<0.10	60.2
9	14:30	38.25	<0.63	0.24	1.3	72.4	0.38	0.24	0.11	68.4
July										
20	14:00	1-12.75	<0.63	0.23	1.5	47.6	0.42	0.21	0.20	47.8
20	14:15	20.0	<0.63	0.28	0.96	58.3	0.36	0.23	<0.10	66.7
20	14:45	30.0	<0.63	0.24	0.68	61.3	0.38	0.27	<0.10	70.1
20	15:15	38.0	<0.63	0.25	0.67	62.1	0.40	0.24	<0.10	71.2
August										
18	15:00	1-15.25	<0.63	0.21	0.74	45.8	0.46	0.22	0.12	47.6
18	14:30	20.0	<0.63	0.25	0.89	60.1	0.32	0.25	0.12	65.0
18	14:15	30.0	<0.63	0.22	0.70	63.7	0.34	0.25	<0.10	67.6
18	14:00	38.5	<0.63	0.28	0.75	72.1	0.37	0.26	0.12	76.4
September										
30	13:00	1-15.0	<0.63	0.19	0.53	48.6	0.55	0.18	<0.10	45.3
30	12:15	20.0	<0.63	0.20	1.00	66.0	0.48	0.17	<0.10	62.6
30	11:45	30.0	<0.63	0.25	0.46	67.8	0.37	0.23	<0.10	69.7
30	11:15	37.75	<0.63	0.25	0.48	71.8	0.37	0.24	<0.10	70.6
December										
9	12:00	1-13.75	<0.63	0.20	1.0	63.0	0.49	0.19	0.21	63.2
9	12:30	20.0	0.66	0.24	1.5	66.7	0.55	0.27	0.19	66.5
9	12:45	30.0	<0.63	0.26	3.2	71.6	0.50	0.21	0.40	67.2
9	13:00	37.0	<0.63	0.25	4.5	72.6	0.50	0.22	0.44	70.5

Table B4 continued.

C4 University Point: Metals and Hardness

Date	Time	Sample Depth (m)	Total Fe (µg/L)	Total Mn (µg/L)	Diss. Fe (µg/L)	Diss. Mn (µg/L)	Diss. Ca (mg/L)	Diss. Mg (mg/L)	T. Hard (mg/L $CaCO_3$)
March									
3	11:30	1-12.0	52	8.0	6.0	0.57	6.36	2.05	23.8
3	12:45	20.0	65	10.5	7.5	0.41	6.46	2.07	24.2
3	13:30	30.0	87	14.9	10.0	1.00	6.65	2.07	24.3
3	14:10	36.5	156	31.9	19.0	7.60	6.90	2.24	26.5
April									
13	13:00	1-11.5	61	9.0	22.0	0.69	6.36	2.18	24.8
13	14:00	20.0	58	8.6	17.0	1.10	6.20	2.15	25.4
13	14:30	30.0	52	8.0	18.0	0.32	6.41	2.15	24.5
13	15:15	37.0	52	8.1	16.0	0.27	6.21	2.12	24.4
May									
7	10:45	1-12.25	53	9.3	16.0	2.3	6.14	1.89	23.5
7	11:30	20.0	40	7.4	7.6	0.54	6.15	1.96	23.5
7	12:30	30.0	40	6.7	<5.0	0.47	6.26	1.99	23.8
7	13:45	38.5	40	6.6	6.1	0.51	6.12	1.97	24.4
June									
9	12:30	1-11.0	52	10.8	9.1	1.0	5.75	1.73	21.2
9	13:15	20.0	37	8.0	<5.0	0.15	6.40	1.91	22.4
9	14:00	30.0	33	7.5	<5.0	0.14	6.29	1.94	23.5
9	14:30	38.25	30	8.6	<5.0	0.5	6.68	2.02	23.8
July									
20	14:00	1-12.75	44	7.3	9.1	0.67	5.99	1.82	20.9
20	14:15	20.0	34	7.0	7.5	0.41	6.12	1.92	20.8
20	14:45	30.0	21	4.4	5.3	0.18	6.3	2.01	21.8
20	15:15	38.0	21	4.9	<5.0	0.31	6.29	2.00	21.9
August									
18	15:00	1-15.25	15	4.3	<5.0	1.1	6.12	1.83	21.6
18	14:30	20.0	24	3.9	<5.0	0.73	5.98	1.83	21.1
18	14:15	30.0	19	3.6	<5.0	0.28	6.2	1.92	22.2
18	14:00	38.5	32	9.08	<5.0	1.2	6.35	1.94	22.5
September									
30	13:00	1-15.0	18	4.2	<5.0	0.55	6.19	1.90	23.2
30	12:15	20.0	20	14.0	<5.0	0.86	6.12	1.88	22.6
30	11:45	30.0	11	5.9	<5.0	0.18	6.23	1.94	22.7
30	11:15	37.75	13	8.2	<5.0	0.28	6.18	1.93	23.2
December									
9	12:00	1-13.75	21	7.0	8.7	1.40	6.41	2.04	23.7
9	12:30	20.0	q 80	8.7	8.0	0.55	6.51	2.07	22.6
9	12:45	30.0	53	14.8	11.0	2.10	6.49	2.09	24.2
9	13:00	37.0	62	19.9	11.0	3.50	6.67	2.15	24.4

Table B4 continued.

C4 University Point: Nutrients and Chlorophyll *a*

Date	Time	Sample Depth (m)	Total P (µg/L)	Diss. Total P (µg/L)	Diss. Ortho-P (µg/L)	Total N (µg/L)	Diss. NO_2+NO_3 (µg/L)	Diss. NH_3 (µg/L)	Chl *a* (µg/L)
March									
3	11:30	1-12.0	7	6	<3	140	35	<30	3.08
3	12:45	20.0	8	<5	--	131	38	<30	--
3	13:30	30.0	9	<5	--	135	48	<30	--
3	14:10	36.5	11	<5	--	138	58	<30	--
April									
13	13:00	1-11.5	5	<5	<3	116	21	<30	2.17
13	14:00	20.0	5	<5	--	123	21	58	--
13	14:30	30.0	<5	<5	--	116	28	36	--
13	15:15	37.0	5	<5	--	119	23	46	--
May									
7	10:45	1-12.25	7	<5	--	101	<15	<30	1.88
7	11:30	20.0	6	<5	--	112	<15	<30	--
7	12:30	30.0	6	<5	--	112	<15	<30	--
7	13:45	38.5	5	<5	--	118	<15	<30	--
June									
9	12:30	1-11.0	7	<5	<3	81	<15	<30	2.13
9	13:15	20.0	7	<5	--	124	<15	<30	--
9	14:00	30.0	6	<5	--	120	24	<30	--
9	14:30	38.25	6	<5	--	135	25	61	--
July									
20	14:00	1-12.75	6	<5	<3	85	<15	<30	1.79
20	14:15	20.0	<5	<5	--	101	<15	<30	--
20	14:45	30.0	--	<5	--	114	28	<30	--
20	15:15	38.0	4	<5	--	114	38	<30	--
August									
18	15:00	1-15.25	<5	<5	<3	78	<15	<30	1.65
18	14:30	20.0	5	<5	--	76	<15	<30	--
18	14:15	30.0	<5	<5	--	98	35	<30	--
18	14:00	38.5	<5	<5	--	122	61	<30	--
September									
30	13:00	1-15.0	<5	<5	<3	105	20	<30	1.00
30	12:15	20.0	<5	<5	--	128	37	<30	--
30	11:45	30.0	<5	<5	--	130	56	<30	--
30	11:15	37.75	<5	<5	--	161	72	<30	--
December									
9	12:00	1-13.75	6	<5	<3	103	<50	<30	1.40
9	12:30	20.0	9	7	--	95	<50	<30	--
9	12:45	30.0	6	<5	--	90	<50	<30	--
9	13:00	37.0	6	<5	--	91	<50	<30	--

Table B5. Chemistry at Kidd Island Bay

Kidd Island Bay: Trace Metals

Date	Time	Sample Depth (m)	Total As (µg/L)	Total Cd (µg/L)	Total Pb (µg/L)	Total Zn (µg/L)	Diss. As (µg/L)	Diss. Cd (µg/L)	Diss. Pb (µg/L)	Diss. Zn (µg/L)
March										
8	11:45	1-7.5	<0.63	0.20	0.7	62.0	0.45	0.19	0.10	64.1
April										
9	15:45	1-7.25	<0.63	0.18	0.6	60.8	0.43	0.18	<0.10	54.7
May										
4	15:00	1-8.5	<0.63	0.21	1.9	62.4	0.41	0.19	0.39	57.5
June										
10	16:00	1-9.0	<0.63	0.20	1.0	57.2	0.37	0.21	<0.10	49.2
July										
22	14:30	1-9.0	<0.63	0.2	0.66	39	0.39	0.19	<0.10	41
August										
16	15:15	1-8.5	<0.63	0.18	0.57	41.4	0.41	0.18	0.15	41.5
September										
28	16:30	1-8.75	<0.63	0.19	0.74	42.7	0.45	0.17	0.13	41.5

Kidd Island Bay: Metals and Hardness

Date	Time	Sample Depth (m)	Total Fe (µg/L)	Total Mn (µg/L)	Diss. Fe (µg/L)	Diss. Mn (µg/L)	Diss. Ca (mg/L)	Diss. Mg (mg/L)	T. Hard (mg/L $CaCO_3$)
March									
8	11:45	1-7.5	22	3.3	<5.0	0.78	6.05	1.88	23.1
April									
9	15:45	1-7.25	31	3.3	<5.0	0.70	5.97	1.97	23.0
May									
4	15:00	1-8.5	38	6.5	8.9	0.98	6.05	1.95	24.0
June									
10	16:00	1-9.0	38	5.7	<5.0	0.45	6.18	1.87	22.3
July									
22	14:30	1-9.0	28	3.3	7.1	0.56	5.6	1.75	19.7
August									
16	15:15	1-8.5	18	2.8	<5.0	1.4	5.61	1.7	20.2
September									
28	16:30	1-8.75	16	3.0	<5.0	0.85	5.81	1.79	21.6

Table B5 continued.

Kidd Island Bay: Nutrients and Chlorophyll *a*

Date	Time	Sample Depth (m)	Total P (µg/L)	Diss. Total P (µg/L)	Diss. Ortho-P (µg/L)	Total N (µg/L)	Diss. NO_2+NO_3 (µg/L)	Diss. NH_3 (µg/L)	Chl *a* (µg/L)
March									
8	11:45	1-7.5	5	<5	<3	101	20	<30	2.30
April									
9	15:45	1-7.25	<5	<5	--	107	<15	<30	2.57
May									
4	15:00	1-8.5	6	<5	<3	107	<15	<30	1.08
June									
10	16:00	1-9.0	7	<5	<3	91	<15	<30	1.50
July									
22	14:30	1-9.0	<5	<5	<3	77	<15	<30	<1.00
August									
16	15:15	1-8.5	4	<5	<3	71	<15	<30	1.22
September									
28	16:30	1-8.75	4	<5	<3	90	<15	<30	1.20

Kidd Island Bay Station 2: Trace Metals

Date	Time	Sample Depth (m)	Total As (µg/L)	Total Cd (µg/L)	Total Pb (µg/L)	Total Zn (µg/L)	Diss. As (µg/L)	Diss. Cd (µg/L)	Diss. Pb (µg/L)	Diss. Zn (µg/L)
August										
16	16:45	0.75	1.6	0.19	4.0	25.9	1.4	<0.10	0.90	<5
September										
28	17:00	0.5	<0.63	<0.13	1.0	15.0	0.59	<0.10	0.29	5.4

Kidd Island Bay Station 2: Metals and Hardness

Date	Time	Sample Depth (m)	Total Fe (µg/L)	Total Mn (µg/L)	Diss. Fe (µg/L)	Diss. Mn (µg/L)	Diss. Ca (mg/L)	Diss. Mg (mg/L)	T. Hard (mg/L $CaCO_3$)
August									
16	16:45	0.75	631	26.7	151	6.65	6.89	2.22	26.2
September									
28	17:00	0.5	141	6.71	49	1.3	6.05	1.92	22.4

Table B5 continued.

Kidd Island Bay Station 2: Nutrients and Chlorophyll *a*

Date	Time	Sample Depth (m)	Total P (µg/L)	Diss. Total P (µg/L)	Diss. Ortho-P (µg/L)	Total N (µg/L)	Diss. NO_2+NO_3 (µg/L)	Diss. NH_3 (µg/L)	Chl *a* (µg/L)
August									
16	16:45	0.75	48.0	11.0	--	297	<15	36	10.8
September									
28	17:00	0.5	15.7	8.0	4	148	<15	<30	1.50

Table B6. Chemistry at Mica Bay

Mica Bay: Trace Metals

Date	Time	Sample Depth (m)	Total As (µg/L)	Total Cd (µg/L)	Total Pb (µg/L)	Total Zn (µg/L)	Diss. As (µg/L)	Diss. Cd (µg/L)	Diss. Pb (µg/L)	Diss. Zn (µg/L)
March										
5	11:15	1-8.5	0.84	0.18	0.7	58.5	0.41	0.16	0.11	52.2
April										
12	11:30	1-9.0	<0.63	0.20	0.6	60.7	0.39	0.18	0.13	50.3
May										
5	15:00	1-10.0	<0.63	0.20	2.0	58.7	0.36	0.21	0.26	56.2
June										
10	14:00	1-10.0	<0.63	0.22	1.0	53.9	0.36	0.21	<0.10	46.8
July										
21	14:30	1-10.5	<0.63	0.19	0.54	37.2	0.38	0.18	<0.10	40.2
August										
19	10:30	1-10.5	<0.63	0.17	0.36	37.3	0.43	0.17	<0.10	39.6
September										
29	14:30	1-10.25	0.63	0.19	0.41	42.2	0.5	0.15	0.1	40.2

Mica Bay: Metals and Hardness

Date	Time	Sample Depth (m)	Total Fe (µg/L)	Total Mn (µg/L)	Diss. Fe (µg/L)	Diss. Mn (µg/L)	Diss. Ca (mg/L)	Diss. Mg (mg/L)	T. Hard (mg/L $CaCO_3$)
March									
5	11:15	1-8.5	88	6.9	10.0	2.20	6.08	1.87	23.0
April									
12	11:30	1-9.0	63	5.3	7.0	1.50	5.85	1.99	23.4
May									
5	15:00	1-10.0	48	6.7	8.2	0.86	6.06	1.91	23.5
June									
10	14:00	1-10.0	47	6.8	8.4	0.49	5.90	1.82	21.3
July									
21	14:30	1-10.5	26	3.5	7.3	0.64	5.62	1.79	19.5
August									
19	10:30	1-10.5	15	3.8	<5.0	1.5	5.85	1.73	20.2
September									
29	14:30	1-10.25	19	6.67	5.0	0.7	5.98	1.8	21.8

Table B6 continued.

Mica Bay: Nutrients and Chlorophyll *a*

Date	Time	Sample Depth (m)	Total P (µg/L)	Diss. Total P (µg/L)	Diss. Ortho-P (µg/L)	Total N (µg/L)	Diss. NO_2+NO_3 (µg/L)	Diss. NH_3 (µg/L)	Chl *a* (µg/L)
March									
5	11:15	1-8.5	12	<5	--	125	<15	33	5.65
April									
12	11:30	1-9.0	7	<5	<3	118	<15	<30	5.12
May									
5	15:00	1-10.0	8	<5	<3	98	<15	<30	2.17
June									
10	14:00	1-10.0	9	<5	<3	102	<15	<30	2.91
July									
21	14:30	1-10.5	6	<5	<3	81	<15	<30	<1.00
August									
19	10:30	1-10.5	<5	<5	<3	82	<15	<30	<1.00
September									
29	14:30	1-10.25	<5	<5	<3	102	<15	31	<1.00

Table B7. Chemistry at Rockford Bay

Rockford Bay: Trace Metals

Date	Time	Sample Depth (m)	Total As (µg/L)	Total Cd (µg/L)	Total Pb (µg/L)	Total Zn (µg/L)	Diss. As (µg/L)	Diss. Cd (µg/L)	Diss. Pb (µg/L)	Diss. Zn (µg/L)
March										
4	11:00	1-7.5	<0.63	0.26	2.3	73.3	0.37	0.21	0.23	66.5
April										
13	10:30	1-8.0	<0.63	0.23	2.1	67.8	0.38	0.22	0.39	59.4
May										
6	14:45	1-10.0	<0.63	0.21	1.3	63.7	0.34	0.19	0.15	61.9
June										
9	10:45	1-7.0	<0.63	0.25	2.3	62.1	0.39	0.23	0.46	49.6
July										
10	11:00	1-9.0	<0.63	0.23	1.0	42.1	0.42	0.20	0.17	45.2
August										
20	11:15	1-9.25	<0.63	0.19	0.54	39.9	0.48	0.19	0.15	40.3
September										
30	14:45	1-9.25	<0.63	0.18	0.64	47.2	0.56	0.18	<0.1	45.7

Rockford Bay: Metals and Hardness

Date	Time	Sample Depth (m)	Total Fe (µg/L)	Total Mn (µg/L)	Diss. Fe (µg/L)	Diss. Mn (µg/L)	Diss. Ca (mg/L)	Diss. Mg (mg/L)	T. Hard (mg/L $CaCO_3$)
March									
4	11:00	1-7.5	124	15.4	13.0	3.60	6.61	2.13	24.9
April									
13	10:30	1-8.0	107	10.8	20.0	2.00	6.37	2.21	25.2
May									
6	14:45	1-10.0	57	6.0	<5.0	1.3	6.35	2.00	24.8
June									
9	10:45	1-7.0	132	13.8	24.0	3.4	5.84	1.85	22.2
July									
10	11:00	1-9.0	53	7.2	15.0	1.8	5.87	1.77	20.2
August									
20	11:15	1-9.25	20	4.1	5.9	1.5	6.07	1.84	21.8
September									
30	14:45	1-9.25	15	5.0	<5.0	1.3	6.35	1.93	23.4

Table B7 continued.

Rockford Bay: Nutrients and Chlorophyll *a*

Date	Time	Sample Depth (m)	Total P (µg/L)	Diss. Total P (µg/L)	Diss. Ortho-P (µg/L)	Total N (µg/L)	Diss. NO_2+NO_3 (µg/L)	Diss. NH_3 (µg/L)	Chl *a* (µg/L)
March									
4	11:00	1-7.5	10	<5	<3	138	52	<30	4.18
April									
13	10:30	1-8.0	7	<5	<3	119	20	43	2.26
May									
6	14:45	1-10.0	8	<5	<3	108	<15	<30	1.59
June									
9	10:45	1-7.0	15	7	<3	115	<15	<30	4.86
July									
10	11:00	1-9.0	8	<5	<3	107	<15	<30	1.10
August									
20	11:15	1-9.25	<5	<5	--	60	20	<30	<1.00
September									
30	14:45	1-9.25	<5	<5	<3	86	23	<30	1.00

Appendix C:
2010 Water Column Profiles

Table C1. Water column profiles at C1 Tubbs Hill

C1 Tubbs Hill: Water Column Profile

Time	Depth (m)	Water Temp (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%Sat)	pH	Specific Conductance (µS/cm)	Chl *a* (Volts)	Turbidity (NTU)
5-Mar								
12:54	0.5	4.9	11.6	97.1	7.6	50	0.035	2.0
12:55	1.0	4.6	11.7	96.9	7.6	47	0.035	1.6
12:56	3.1	4.5	11.6	96.0	7.6	50	0.038	0.4
12:56	5.1	4.4	11.6	95.6	7.5	50	0.039	1.0
12:57	7.1	4.4	11.5	95.1	7.5	51	0.047	1.1
12:58	9.0	4.3	11.5	94.8	7.5	49	0.059	1.2
12:59	11.1	4.3	11.5	94.5	7.5	50	0.066	1.2
13:00	13.1	4.3	11.4	94.1	7.5	50	0.070	1.0
13:01	15.0	4.3	11.4	93.8	7.5	50	0.068	0.9
13:01	17.0	4.3	11.3	93.4	7.5	50	0.070	1.0
13:02	20.0	4.3	11.3	93.1	7.5	50	0.068	1.0
13:03	25.1	4.3	11.2	92.5	7.4	50	0.068	1.0
13:04	30.0	4.3	11.2	91.9	7.4	50	0.071	1.1
13:05	35.0	4.3	11.1	90.9	7.4	50	0.072	1.3
13:11	39.1	4.3	10.4	85.2	7.4	--	--	--
6-Apr								
9:31	0.5	5.3	11.7	98.8	6.9	47	0.037	0.9
9:32	1.0	5.3	11.7	98.7	7.1	47	0.039	0.8
9:32	3.0	5.3	11.6	98.3	7.2	47	0.044	1.0
9:33	4.9	5.3	11.6	98.3	7.2	48	0.057	0.8
9:34	6.9	5.3	11.6	97.9	7.3	47	0.062	1.1
9:35	9.1	5.3	11.5	97.6	7.3	47	0.070	0.8
9:35	11.2	5.3	11.5	97.2	7.3	47	0.070	1.0
9:36	13.3	5.3	11.5	97.0	7.3	47	0.069	1.1
9:37	15.1	5.3	11.4	96.6	7.4	47	0.071	1.0
9:38	17.4	5.3	11.4	96.5	7.4	48	0.072	1.0
9:38	19.5	5.3	11.4	96.1	7.4	48	0.069	1.0
9:40	25.5	5.3	11.3	95.4	7.4	48	0.071	1.1
9:40	30.8	5.2	11.2	94.9	7.4	48	0.073	1.1
9:41	35.5	5.2	11.1	94.1	7.4	48	0.075	1.1
9:43	39.8	5.2	11.1	93.4	7.4	48	--	--

Table C1 continued.

C1 Tubbs Hill: Water Column Profile

Time	Depth (m)	Water Temp (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%Sat)	pH	Specific Conductance (µS/cm)	Chl *a* (Volts)	Turbidity (NTU)
5-May								
9:30	0.5	7.8	11.2	100.9	7.4	55	0.010	0.0
9:31	1.1	7.7	11.2	100.6	7.4	55	0.010	0.0
9:32	3.0	7.6	11.2	100.1	7.5	54	0.013	0.0
9:33	5.0	7.6	11.1	99.7	7.5	55	0.021	0.0
9:33	7.0	7.6	11.1	99.3	7.5	55	0.038	0.0
9:34	8.9	7.6	11.1	99.0	7.5	55	0.038	0.0
9:35	11.0	7.6	11.0	98.5	7.6	55	0.040	0.0
9:37	12.9	7.6	11.0	98.2	7.6	55	0.039	0.0
9:38	15.0	7.6	10.9	97.8	7.6	54	0.039	0.0
9:38	17.0	7.5	10.9	97.8	7.6	55	0.038	0.0
9:39	20.0	7.5	10.9	97.2	7.6	55	0.038	0.0
9:40	25.1	7.5	10.8	96.4	7.6	55	0.039	0.0
9:42	30.0	7.5	10.7	95.7	7.6	55	0.038	0.0
9:43	35.0	7.5	10.6	95.0	7.6	55	0.039	0.0
9:45	40.0	7.5	10.5	94.3	7.6	55	0.043	0.0
9:47	40.9	7.5	10.5	94.0	7.6	55	0.040	0.0
8-Jun								
13:17	0.5	14.2	10.2	106.3	7.7	42	0.010	0.0
13:18	1.0	13.8	10.3	106.4	7.7	42	0.010	0.0
13:19	3.0	13.0	10.4	105.4	7.7	41	0.014	0.0
13:20	5.0	12.8	10.3	104.6	7.7	42	0.021	0.0
13:21	7.0	12.8	10.3	104.1	7.7	42	0.025	0.0
13:22	9.0	12.7	10.2	103.3	7.6	42	0.029	0.0
13:22	11.0	12.6	10.2	102.7	7.6	42	0.031	0.0
13:23	13.0	12.2	10.2	102.0	7.6	41	0.031	0.0
13:24	15.1	10.5	10.0	96.0	7.4	43	0.031	0.0
13:26	16.1	10.1	9.9	94.1	7.3	43	0.027	0.0
13:25	17.1	8.2	9.9	90.1	7.2	44	0.017	0.0
13:27	20.0	7.4	9.9	88.0	7.1	44	0.016	0.0
13:28	25.0	6.8	9.7	85.5	7.0	45	0.015	0.0
13:29	30.1	6.6	9.7	84.7	7.0	45	0.013	0.0
13:30	35.1	6.5	9.5	82.8	7.0	45	0.011	0.0
13:32	40.2	6.5	9.2	79.8	7.0	45	0.012	0.0
13:34	40.7	6.5	9.2	79.6	7.0	45	0.012	0.7

Table C1 continued.

C1 Tubbs Hill: Water Column Profile

Time	Depth (m)	Water Temp (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%Sat)	pH	Specific Conductance (µS/cm)	Chl *a* (Volts)	Turbidity (NTU)
22-Jul								
9:43	0.5	20.5	8.6	103.4	7.7	34	0.010	0.0
9:44	1.0	20.5	8.6	103.5	7.7	35	0.011	0.0
9:45	3.2	20.5	8.6	103.4	7.7	35	0.012	0.0
9:46	5.0	20.4	8.6	102.9	7.7	35	0.013	0.0
9:47	6.9	20.4	8.6	102.6	7.7	35	0.013	0.0
9:49	8.0	20.3	8.6	102.6	7.7	35	0.014	0.0
9:50	8.9	18.6	8.9	103.4	7.7	35	0.019	0.0
9:51	10.0	15.2	9.3	100.4	7.5	35	0.023	0.0
9:52	10.9	13.7	9.2	95.4	7.3	35	0.026	0.0
9:53	12.1	12.8	9.0	92.0	7.2	35	0.031	0.0
9:54	13.0	11.7	8.8	87.4	7.1	35	0.033	0.0
9:55	14.1	11.6	8.7	86.7	7.0	35	0.034	0.0
9:56	15.1	11.0	8.6	84.1	7.0	36	0.033	0.0
9:57	17.0	10.2	8.5	82.0	6.9	36	0.030	0.0
9:58	20.0	9.1	8.5	79.7	6.9	37	0.021	0.0
10:00	25.0	7.6	8.7	78.6	6.9	38	0.014	0.0
10:03	30.2	7.1	8.6	76.6	6.8	39	0.012	0.0
10:04	34.9	6.8	8.4	74.2	6.8	39	0.010	0.0
10:06	39.7	6.7	7.6	66.8	6.7	39	0.011	0.0
10:08	40.6	6.7	7.5	66.1	6.8	39	0.012	0.0

Table C1 continued.

C1 Tubbs Hill: Water Column Profile

Time	Depth (m)	Water Temp (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%Sat)	pH	Specific Conductance (µS/cm)	Chl *a* (Volts)	Turbidity (NTU)
16-Aug								
10:46	0.5	22.2	8.3	102.6	7.8	36	0.008	0.0
10:46	1.0	22.0	8.3	102.3	7.9	36	0.009	0.0
10:47	3.0	21.9	8.3	102.1	7.9	36	0.010	0.0
10:49	4.9	21.8	8.3	101.9	7.9	36	0.012	0.0
10:51	7.0	21.2	8.6	104.2	7.9	36	0.015	0.0
10:52	7.9	18.0	9.1	103.7	7.8	36	0.021	0.0
10:53	9.0	16.0	9.1	99.3	7.5	35	0.029	0.2
10:54	10.1	15.6	9.2	98.8	7.5	35	0.029	0.1
10:54	11.0	14.6	8.9	94.3	7.4	35	0.036	0.3
10:55	12.0	14.0	8.9	93.0	7.3	35	0.032	0.2
10:56	13.0	13.4	8.8	90.6	7.2	36	0.033	0.1
10:57	14.2	12.6	8.6	86.4	7.1	36	0.034	0.1
10:58	15.2	11.9	8.4	83.0	7.0	36	0.042	0.1
10:59	16.1	11.0	8.1	79.3	7.0	36	0.041	0.0
11:00	17.1	10.7	7.9	76.7	6.9	36	0.040	0.0
11:01	18.1	10.5	7.9	75.6	6.9	36	0.043	0.0
11:02	19.0	10.2	7.9	74.9	6.9	37	0.037	0.0
11:02	20.2	9.8	7.8	73.8	6.9	37	0.035	0.0
11:04	25.0	8.1	7.9	71.7	6.8	38	0.019	0.0
11:04	30.1	7.5	7.9	70.9	6.8	39	0.014	0.0
11:05	35.0	7.1	7.9	69.9	6.8	39	0.009	0.0
11:07	40.0	6.9	6.6	58.1	6.7	40	0.009	0.0
11:09	40.8	6.8	6.3	55.8	6.7	40	0.010	0.4

Table C1 continued.

C1 Tubbs Hill: Water Column Profile

Time	Depth (m)	Water Temp (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%Sat)	pH	Specific Conductance (µS/cm)	Chl *a* (Volts)	Turbidity (NTU)
28-Sep								
12:23	0.5	16.8	8.8	96.9	7.3	52	0.009	0.3
12:24	1.0	16.7	8.8	96.9	7.4	52	0.010	0.1
12:25	3.1	16.5	8.8	96.3	7.4	52	0.011	0.2
12:26	5.1	16.4	8.7	95.7	7.4	51	0.012	0.3
12:26	7.0	16.3	8.7	95.2	7.4	52	0.014	0.5
12:27	9.1	16.1	8.7	94.4	7.4	52	0.018	0.5
12:28	11.0	16.1	8.6	93.2	7.3	52	0.017	0.6
12:28	13.0	16.0	8.5	92.7	7.3	52	0.017	0.6
12:29	15.0	16.0	8.5	91.9	7.3	52	0.016	0.7
12:31	15.9	14.8	7.6	80.4	7.0	52	0.015	0.8
12:32	17.1	11.6	7.0	68.5	6.6	52	0.021	0.8
12:33	18.0	10.3	6.8	64.8	6.6	52	0.018	0.7
12:34	19.0	9.6	6.8	64.0	6.5	53	0.017	0.7
12:34	20.0	9.3	6.8	63.7	6.5	53	0.015	0.7
12:35	24.8	8.0	6.9	62.9	6.5	54	0.013	0.6
12:37	30.2	7.4	6.8	60.5	6.5	55	0.011	0.6
12:37	34.8	7.3	6.6	58.9	6.4	55	0.009	0.7
12:38	39.6	7.2	6.0	53.4	6.4	55	0.009	0.9
12:41	40.5	7.2	5.8	51.2	6.4	55	0.010	1.2
7-Dec								
10:49	0.5	7.1	10.0	87.4	6.8	46	0.012	0.0
10:49	1.0	7.1	9.9	86.8	6.8	46	0.012	0.0
10:52	3.0	7.1	9.9	86.7	6.9	46	0.018	0.0
10:53	5.1	7.1	9.8	86.0	6.9	46	0.018	0.0
10:54	7.0	7.1	9.8	85.7	6.9	46	0.017	0.0
10:54	9.1	7.1	9.8	85.4	6.9	46	0.016	0.0
10:55	11.1	7.1	9.7	85.1	6.9	46	0.019	0.0
10:56	13.1	7.1	9.7	84.9	6.9	46	0.018	0.0
10:57	15.1	7.1	9.7	84.6	6.9	46	0.019	0.0
10:57	17.0	7.1	9.6	84.3	6.9	46	0.019	0.0
10:58	20.1	7.0	9.6	84.0	6.9	46	0.018	0.0
10:59	25.1	7.0	9.6	83.4	6.9	46	0.017	0.0
11:00	30.0	6.9	9.5	82.9	6.9	46	0.019	0.0
11:01	35.1	6.9	9.5	82.6	6.9	46	0.018	0.0
11:02	39.4	6.9	9.4	81.9	6.9	46	0.017	0.0

Table C2. Water column profiles at C2 Wolf Lodge Bay

C2 Wolf Lodge Bay: Water Column Profile

Time	Depth (m)	Water Temp (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%Sat)	pH	Specific Conductance (µS/cm)	Chl *a* (Volts)	Turbidity (NTU)
8-Mar								
13:19	0.5	4.7	11.8	98.9	7.6	50	0.043	1.4
13:20	1.0	4.7	11.8	99.1	7.5	49	0.047	1.3
13:21	3.0	4.6	11.8	98.7	7.5	50	0.066	1.2
13:21	5.1	4.7	11.7	98.5	7.5	50	0.077	1.3
13:22	7.0	4.6	11.7	98.2	7.5	49	0.089	1.4
13:23	9.1	4.6	11.7	97.7	7.5	49	0.093	1.4
13:23	11.1	4.6	11.6	97.2	7.5	50	0.096	1.5
13:24	13.1	4.6	11.6	96.9	7.5	50	0.108	1.4
13:25	15.0	4.5	11.5	96.6	7.5	49	0.101	1.5
13:26	17.0	4.5	11.5	96.3	7.5	49	0.097	1.5
13:27	20.1	4.5	11.5	95.7	7.5	50	0.090	1.9
13:27	25.0	4.4	11.3	94.6	7.4	49	0.095	1.7
13:29	26.8	4.4	11.3	93.8	7.4	50	0.115	1.9
9-Apr								
10:23	0.5	5.4	11.6	98.1	6.4	46	0.044	1.9
10:24	1.1	5.4	11.6	98.2	7.0	46	0.043	1.6
10:26	3.1	5.4	11.6	97.6	7.2	46	0.064	1.7
10:27	5.0	5.4	11.5	97.5	7.3	46	0.073	1.7
10:27	7.0	5.4	11.5	97.2	7.3	46	0.070	1.7
10:28	9.1	5.4	11.5	96.8	7.3	46	0.075	1.8
10:29	10.9	5.4	11.4	96.6	7.3	46	0.073	1.8
10:30	13.6	5.4	11.4	96.2	7.3	46	0.076	1.9
10:31	15.5	5.4	11.4	96.0	7.3	46	0.078	2.0
10:32	17.3	5.4	11.3	95.7	7.4	46	0.077	2.0
10:32	19.8	5.4	11.3	95.5	7.4	46	0.074	2.2
10:33	24.9	5.4	11.2	94.7	7.4	46	0.077	2.1
10:37	26.7	5.4	11.2	94.3	7.4	46	0.076	2.5

Table C2 continued.

C2 Wolf Lodge Bay: Water Column Profile

Time	Depth (m)	Water Temp (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%Sat)	pH	Specific Conductance (µS/cm)	Chl *a* (Volts)	Turbidity (NTU)
4-May								
10:13	0.6	8.1	11.5	103.4	7.5	52	0.015	1.0
10:14	1.0	8.1	11.4	103.3	7.6	53	0.014	1.1
10:14	3.0	8.0	11.4	102.7	7.6	52	0.026	1.0
10:15	5.0	8.1	11.4	102.6	7.6	52	0.039	1.3
10:16	7.0	8.0	11.3	102.1	7.6	52	0.043	1.3
10:16	9.0	8.0	11.3	101.8	7.5	52	0.043	1.1
10:17	11.0	8.0	11.3	101.4	7.5	52	0.046	0.9
10:18	12.9	8.0	11.2	101.1	7.5	52	0.045	0.8
10:19	15.1	8.0	11.2	100.7	7.5	52	0.046	0.9
10:20	17.1	8.0	11.2	100.4	7.5	52	0.043	0.9
10:21	20.2	8.0	11.1	99.8	7.5	53	0.044	0.7
10:21	25.0	8.0	11.0	99.3	7.5	53	0.049	0.6
10:23	28.5	7.9	11.0	98.6	7.5	53	0.044	0.9
8-Jun								
9:28	0.6	14.2	10.1	105.0	6.8	40	0.011	3.5
9:29	1.1	14.2	10.1	105.0	7.0	40	0.012	1.8
9:30	3.0	13.5	10.2	104.6	7.3	41	0.015	1.3
9:31	5.0	13.3	10.3	104.8	7.4	41	0.025	1.2
9:32	6.9	12.6	10.4	104.4	7.4	42	0.031	1.0
9:34	9.0	11.3	10.3	100.9	7.3	42	0.040	1.3
9:35	11.0	10.7	10.0	96.3	7.2	42	0.033	1.6
9:36	13.0	10.4	9.9	94.6	7.1	43	0.037	1.2
9:39	15.0	8.9	9.4	86.7	6.9	44	0.020	0.8
9:42	17.1	7.7	9.3	83.1	6.8	45	0.014	0.8
9:43	20.1	7.3	9.3	82.2	6.8	45	0.013	0.6
9:45	25.0	6.8	9.1	80.2	6.8	45	0.013	0.5
9:47	28.7	6.7	9.0	78.8	6.8	45	0.012	0.5

Table C2 continued.

C2 Wolf Lodge Bay: Water Column Profile

Time	Depth (m)	Water Temp (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%Sat)	pH	Specific Conductance (µS/cm)	Chl *a* (Volts)	Turbidity (NTU)
23-Jul								
9:16	0.5	20.3	8.7	102.5	7.6	35	0.010	0.0
9:17	1.0	20.2	8.7	103.1	7.7	34	0.010	0.0
9:18	3.0	20.2	8.6	102.3	7.7	35	0.011	0.0
9:19	5.0	20.2	8.6	102.1	7.7	35	0.014	0.0
9:19	7.0	19.4	8.8	102.9	7.7	35	0.017	0.0
9:20	8.0	18.7	8.9	102.7	7.7	35	0.019	0.0
9:22	9.0	18.5	9.0	102.7	7.7	34	0.019	0.0
9:23	10.0	17.8	9.1	102.5	7.6	35	0.021	0.0
9:24	11.0	16.1	9.3	100.9	7.5	35	0.025	0.0
9:26	12.0	15.3	9.3	99.5	7.4	35	0.024	0.0
9:27	13.0	14.1	9.2	95.7	7.3	35	0.032	0.0
9:28	14.1	13.6	9.1	94.2	7.3	35	0.028	0.0
9:29	15.0	13.2	9.1	93.2	7.2	35	0.027	0.0
9:30	17.0	12.1	9.0	89.2	7.1	36	0.031	0.0
9:31	20.0	11.0	8.6	83.9	7.0	36	0.037	0.0
9:32	25.0	8.4	8.0	72.6	6.8	39	0.028	0.0
9:37	27.8	7.9	7.9	71.3	6.8	39	0.020	0.0
9:37	28.5	7.8	7.9	71.3	6.8	39	0.022	0.0

Table C2 continued.

C2 Wolf Lodge Bay: Water Column Profile

Time	Depth (m)	Water Temp (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%Sat)	pH	Specific Conductance (µS/cm)	Chl *a* (Volts)	Turbidity (NTU)
19-Aug								
14:48	0.5	22.0	8.5	104.9	8.0	36	0.010	0.0
14:49	1.1	21.9	8.5	104.8	8.0	36	0.011	0.0
14:50	3.0	21.9	8.5	104.2	7.9	36	0.012	0.0
14:51	5.0	21.8	8.4	103.8	7.9	36	0.013	0.0
14:51	7.1	21.8	8.4	103.6	7.9	36	0.016	0.0
14:52	8.0	21.7	8.4	103.5	8.0	36	0.018	0.0
14:53	9.1	21.5	8.5	103.8	8.0	36	0.018	0.0
14:54	10.1	21.0	8.7	105.4	8.0	36	0.020	0.0
14:55	11.0	19.8	9.0	106.8	7.9	35	0.022	0.0
14:55	12.0	18.7	9.2	106.4	7.8	36	0.024	0.0
14:56	13.0	17.0	9.1	101.9	7.6	35	0.026	0.0
14:57	14.0	14.8	8.8	94.2	7.4	35	0.029	0.0
14:58	15.0	13.7	8.5	88.7	7.2	36	0.030	0.1
14:59	16.1	11.9	8.1	81.4	7.0	36	0.026	0.1
15:00	17.0	11.3	7.9	78.3	7.0	37	0.028	0.0
15:01	18.1	10.4	7.5	72.5	6.9	37	0.029	0.0
15:02	19.0	9.6	7.3	69.2	6.9	38	0.028	0.1
15:03	19.8	9.1	6.9	64.2	6.8	38	0.025	0.0
15:04	25.1	8.2	6.7	61.2	6.8	39	0.018	0.0
15:05	28.5	7.5	6.8	61.5	6.8	39	0.016	0.3

Table C2 continued.

C2 Wolf Lodge Bay: Water Column Profile

Time	Depth (m)	Water Temp (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%Sat)	pH	Specific Conductance (µS/cm)	Chl *a* (Volts)	Turbidity (NTU)
28-Sep								
9:47	0.5	16.3	8.8	96.2	7.2	51	0.010	0.7
9:48	1.1	16.3	8.8	96.0	7.3	51	0.011	0.7
9:48	3.0	16.3	8.8	95.7	7.3	51	0.015	0.5
9:49	5.0	16.2	8.7	95.3	7.3	51	0.017	0.5
9:50	7.0	16.1	8.6	94.0	7.3	51	0.019	0.6
9:51	9.0	15.9	8.4	91.2	7.2	51	0.018	0.8
9:53	11.1	15.6	8.1	87.1	7.0	51	0.024	0.8
9:53	13.0	14.9	7.7	81.3	6.9	51	0.019	0.8
9:54	14.0	13.9	7.0	72.9	6.7	52	0.020	0.8
9:55	15.0	12.4	6.9	69.2	6.6	52	0.021	0.8
9:56	16.0	11.3	6.6	64.8	6.5	52	0.022	0.8
9:57	17.0	10.9	6.6	63.5	6.5	52	0.019	0.9
9:58	18.0	9.8	6.6	62.2	6.5	53	0.018	0.9
9:59	19.1	9.2	6.3	58.5	6.4	54	0.012	0.9
9:59	20.0	8.9	6.2	57.4	6.4	54	0.013	0.9
10:00	25.0	7.8	6.1	55.0	6.4	55	0.013	0.9
10:02	28.3	7.5	6.3	56.2	6.4	55	0.012	1.0

Table C3. Water column profiles at C3 Driftwood Point

C3 Driftwood Point: Water Column Profile

Time	Depth (m)	Water Temp (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%Sat)	pH	Specific Conductance (µS/cm)	Chl *a* (Volts)	Turbidity (NTU)
4-Mar								
13:06	0.5	3.9	11.8	96.9	7.8	53	0.041	5.3
13:07	0.9	4.0	11.8	96.8	7.8	52	0.040	0.8
13:07	2.9	4.0	11.8	96.8	7.7	53	0.041	0.7
13:08	5.0	3.9	11.8	96.5	7.7	53	0.048	0.6
13:10	7.0	3.9	11.7	95.8	7.6	53	0.060	0.7
13:11	9.0	3.9	11.7	95.7	7.6	54	0.077	0.7
13:12	11.0	3.9	11.6	95.1	7.6	53	0.078	0.9
13:13	13.0	3.9	11.6	94.8	7.6	53	0.073	0.9
13:14	15.0	3.9	11.5	94.6	7.6	53	0.074	1.0
13:15	17.0	3.9	11.5	94.6	7.6	53	0.078	0.9
13:17	20.0	3.9	11.5	93.9	7.6	53	0.081	1.2
13:18	25.0	3.9	11.4	93.4	7.5	53	0.084	1.3
13:19	30.0	3.9	11.3	92.8	7.5	53	0.081	1.1
13:21	35.0	3.9	11.2	92.1	7.5	53	0.079	1.0
13:22	40.0	3.9	11.2	91.4	7.5	53	0.077	1.1
13:23	45.0	3.9	11.1	90.8	7.5	53	0.084	1.3
12-Apr								
13:23	0.5	5.4	11.8	101.3	7.6	51	0.040	1.2
13:24	1.0	5.3	11.8	101.1	7.6	52	0.042	1.1
13:24	3.0	5.3	11.8	100.7	7.5	52	0.049	0.7
13:25	5.0	5.2	11.8	100.8	7.5	52	0.064	1.5
13:26	7.0	5.2	11.7	100.1	7.5	52	0.086	1.3
13:27	8.9	5.1	11.7	99.5	7.5	52	0.088	2.0
13:27	11.0	5.1	11.6	99.0	7.5	53	0.094	1.7
13:29	13.0	5.1	11.6	98.8	7.5	52	0.097	2.1
13:30	15.0	5.1	11.5	98.3	7.5	52	0.098	2.2
13:30	17.0	5.1	11.5	98.2	7.5	54	0.099	1.9
13:33	20.1	5.1	11.5	97.7	7.5	53	0.104	1.9
13:34	25.0	5.1	11.4	96.9	7.5	52	0.097	1.8
13:34	30.0	5.1	11.3	96.3	7.5	52	0.098	2.1
13:35	35.0	5.1	11.2	95.8	7.5	52	0.100	1.9
13:37	39.9	5.1	11.2	95.3	7.5	52	0.100	2.1
13:38	45.2	5.1	11.1	94.5	7.5	53	0.095	2.0
13:39	48.5	5.1	11.0	94.1	7.5	52	0.103	2.2

Table C3 continued.

C3 Driftwood Point: Water Column Profile

Time	Depth (m)	Water Temp (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%Sat)	pH	Specific Conductance (µS/cm)	Chl *a* (Volts)	Turbidity (NTU)
6-May								
9:49	0.5	7.1	11.3	99.0	7.4	54	0.015	7.4
9:50	1.1	7.1	11.3	99.1	7.5	55	0.014	0.0
9:50	2.0	7.0	11.3	99.0	7.6	54	0.015	0.0
9:51	3.1	7.0	11.2	98.3	7.6	54	0.016	0.0
9:52	5.0	7.0	11.2	98.0	7.6	55	0.029	0.0
9:53	7.0	7.0	11.1	97.5	7.6	55	0.031	0.0
9:54	9.0	7.0	11.1	97.0	7.6	54	0.031	0.0
9:54	11.0	6.9	11.0	96.6	7.6	54	0.035	0.0
9:55	13.1	6.9	11.0	96.4	7.6	54	0.032	0.0
9:56	15.1	6.9	11.0	96.0	7.6	54	0.036	0.0
9:57	17.0	6.9	10.9	95.3	7.6	54	0.034	0.0
9:57	20.0	6.9	10.8	94.3	7.6	54	0.033	0.0
9:58	25.0	6.8	10.7	93.2	7.6	54	0.030	0.0
10:00	30.1	6.7	10.6	92.3	7.6	54	0.032	0.2
10:01	35.1	6.7	10.5	91.5	7.5	55	0.034	0.2
10:02	40.0	6.5	10.3	89.7	7.5	55	0.031	0.0
10:03	44.9	6.4	10.3	89.2	7.5	55	0.037	0.0
10:05	50.1	6.4	10.2	88.5	7.6	55	0.034	0.5
10-Jun								
9:36	0.5	12.7	10.7	108.1	7.3	38	0.021	0.4
9:37	1.1	12.7	10.7	108.1	7.5	38	0.023	0.3
9:38	2.9	12.6	10.6	107.8	7.6	38	0.026	0.4
9:39	4.9	12.5	10.6	106.9	7.6	38	0.027	0.4
9:40	6.9	12.4	10.5	106.4	7.6	38	0.030	0.5
9:40	9.0	12.3	10.6	106.1	7.6	38	0.028	0.5
9:41	11.0	12.0	10.6	105.6	7.6	39	0.030	0.7
9:42	13.1	11.4	10.6	104.2	7.6	40	0.036	0.4
9:42	15.1	11.1	10.5	102.4	7.6	40	0.038	0.4
9:43	17.2	10.0	10.2	97.2	7.4	42	0.031	0.2
9:44	20.1	8.8	10.1	93.8	7.3	43	0.023	0.0
9:46	25.1	7.4	10.1	90.8	7.3	44	0.020	0.0
9:49	30.3	7.1	10.0	88.8	7.2	45	0.016	0.0
9:50	35.0	6.9	9.9	87.9	7.2	45	0.014	0.0
9:51	40.0	6.7	9.8	86.6	7.2	45	0.013	0.0
9:52	45.0	6.5	9.6	84.2	7.2	45	0.011	0.0
9:55	49.8	6.5	9.5	83.4	7.2	45	0.012	0.0

Table C3 continued.

C3 Driftwood Point: Water Column Profile

Time	Depth (m)	Water Temp (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%Sat)	pH	Specific Conductance (µS/cm)	Chl *a* (Volts)	Turbidity (NTU)
21-Jul								
9:45	0.5	20.3	8.6	102.1	7.7	35	0.008	0.0
9:46	1.1	20.2	8.6	101.9	7.7	35	0.008	0.0
9:47	3.0	20.0	8.6	101.7	7.7	35	0.010	0.0
9:48	4.8	19.7	8.6	101.4	7.7	35	0.014	0.0
9:51	6.0	19.5	8.7	101.9	7.7	35	0.016	0.0
9:49	7.0	18.2	8.9	101.7	7.7	35	0.020	0.0
9:53	8.0	16.2	9.1	99.7	7.5	35	0.023	0.0
9:54	9.0	14.4	9.1	95.6	7.3	35	0.026	0.0
9:55	10.1	13.7	9.0	93.1	7.3	35	0.028	0.0
9:56	11.0	13.2	8.8	90.8	7.2	35	0.030	0.0
9:56	12.0	12.5	8.7	87.4	7.1	35	0.033	0.0
9:57	13.1	11.7	8.5	84.5	7.0	35	0.032	0.0
9:59	14.0	11.2	8.4	82.6	7.0	35	0.032	0.0
9:59	15.0	10.5	8.3	79.9	6.9	36	0.025	0.0
10:02	17.1	9.7	8.3	78.4	6.9	36	0.022	0.0
10:03	20.0	8.7	8.4	77.7	6.9	37	0.018	0.0
10:04	25.0	7.5	8.5	76.3	6.8	38	0.014	0.0
10:05	29.9	7.2	8.5	75.5	6.8	39	0.014	0.0
10:07	35.2	7.0	8.4	74.6	6.8	39	0.011	0.0
10:08	40.0	6.9	8.3	73.2	6.8	39	0.010	0.0
10:09	45.0	6.8	8.1	71.0	6.8	39	0.009	0.0
10:10	49.9	6.7	7.8	68.2	6.8	39	0.009	0.0
10:11	50.4	6.7	7.7	67.8	6.8	39	0.010	0.0

Table C3 continued.

C3 Driftwood Point: Water Column Profile

Time	Depth (m)	Water Temp (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%Sat)	pH	Specific Conductance (µS/cm)	Chl *a* (Volts)	Turbidity (NTU)
19-Aug								
11:25	0.5	22.0	8.5	105.1	8.1	38	0.009	0.0
11:26	1.0	22.0	8.5	104.9	8.0	38	0.009	0.0
11:27	3.1	22.0	8.5	104.4	8.1	37	0.011	0.0
11:27	5.0	21.9	8.4	104.2	8.1	38	0.012	0.0
11:28	7.0	21.7	8.5	104.1	8.1	37	0.014	0.0
11:29	9.0	21.7	8.4	103.6	8.1	37	0.015	0.0
11:31	10.1	21.5	8.4	102.9	8.0	37	0.016	0.0
11:32	11.2	15.5	9.0	96.8	7.4	36	0.032	0.0
11:33	12.1	13.6	8.7	90.2	7.2	35	0.034	0.0
11:33	13.0	11.6	8.1	80.4	7.0	36	0.032	0.0
11:34	13.9	10.2	7.7	74.0	6.9	36	0.033	0.0
11:35	15.1	9.8	7.7	73.6	6.9	37	0.031	0.0
11:36	16.1	9.0	7.8	72.7	6.9	37	0.024	0.0
11:36	17.2	8.7	7.8	72.5	6.9	38	0.022	0.0
11:37	20.0	8.3	7.9	72.5	6.8	38	0.016	0.0
11:37	25.0	7.7	8.0	72.5	6.8	38	0.012	0.0
11:38	30.2	7.3	8.0	72.0	6.8	39	0.010	0.0
11:40	34.9	7.1	8.0	71.1	6.8	39	0.009	0.0
11:41	40.0	7.0	7.7	68.1	6.7	39	0.009	0.0
11:43	44.8	6.9	7.5	66.5	6.8	39	0.008	0.0
11:44	50.0	6.9	7.0	62.0	6.7	39	0.008	0.0

Table C3 continued.

C3 Driftwood Point: Water Column Profile*

Time	Depth (m)	Water Temp (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%Sat)	pH	Specific Conductance (µS/cm)	Chl *a* (Volts)	Turbidity (NTU)
29-Sep								
	0.5	16.3	8.9	97.2	6.9	53	0.001	0.0
	1.0	16.3	8.9	97.1	7.2	53	0.009	0.0
	3.0	16.3	8.9	96.7	7.4	53	0.012	0.0
	5.0	16.2	8.8	96.1	7.4	54	0.015	0.0
	7.0	16.2	8.8	95.6	7.5	52	0.016	0.0
	9.0	16.2	8.7	94.8	7.4	52	0.017	0.0
	11.0	16.1	8.7	94.0	7.4	52	0.016	0.0
	13.0	15.9	8.6	92.7	7.4	52	0.017	0.0
	14.0	15.8	8.3	89.5	7.3	52	0.017	0.0
	15.0	13.4	7.5	76.0	6.9	52	0.015	0.0
	16.0	11.9	6.7	66.2	6.7	52	0.018	0.0
	17.0	11.2	6.7	65.5	6.7	52	0.018	0.0
	18.0	10.2	6.7	63.1	6.6	52	0.016	0.1
	19.0	9.8	6.5	61.6	6.6	52	0.015	0.0
	20.0	9.4	6.6	62.0	6.6	52	0.015	0.0
	25.0	7.9	7.0	62.9	6.6	53	0.012	0.0
	30.0	7.5	6.9	61.6	6.5	54	0.010	0.0
	35.0	7.5	6.8	60.8	6.5	55	0.009	0.0
	40.0	7.4	6.8	60.1	6.5	54	0.009	0.1
	45.0	7.4	6.7	59.3	6.5	55	0.009	0.1
10:19	49.0	7.4	6.6	58.6	6.5	54	0.009	0.1
	50.0	7.3	6.6	58.3	6.5	55	0.009	0.2

* The water column data file was corrupt, so the data from Sept. 29, 2010 was retrieved from a hard copy field form. The only time recorded on the field form was at 10:19 am at a depth of 49.0 m.

Table C4. Water column profiles at C4 University Point

C4 University Point: Water Column Profile

Time	Depth (m)	Water Temp (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%Sat)	pH	Specific Conductance (µS/cm)	Chl *a* (Volts)	Turbidity (NTU)
3-Mar								
9:53	0.5	3.8	11.8	97.0	7.4	54	0.045	0.0
9:54	1.1	3.8	11.8	96.9	7.4	55	0.046	2.7
9:55	3.0	3.8	11.7	96.7	7.3	56	0.066	1.4
9:56	5.0	3.8	11.7	96.3	7.4	56	0.083	1.2
9:58	7.0	3.8	11.6	95.8	7.4	55	0.082	1.2
9:59	9.0	3.8	11.6	95.7	7.4	55	0.084	1.5
9:59	11.1	3.8	11.6	95.4	7.4	55	0.076	1.3
10:01	13.0	3.8	11.6	95.2	7.2	55	0.077	1.4
10:02	15.0	3.8	11.5	94.8	7.3	55	0.077	1.5
10:03	17.1	3.8	11.5	94.5	7.3	56	0.081	1.7
10:04	20.0	3.8	11.4	93.7	7.3	56	0.076	1.6
10:05	25.1	3.8	11.3	93.5	7.3	56	0.077	1.6
10:07	30.1	3.8	11.2	92.5	7.3	56	0.087	1.7
10:09	34.9	3.7	10.5	86.5	7.2	61	0.069	2.5
10:13	37.6	3.7	10.4	85.2	7.2	62	0.091	2.8
13-Apr								
11:57	0.5	5.5	12.0	102.9	7.5	52	0.051	2.0
11:58	1.0	5.5	12.0	102.9	7.5	54	0.052	2.4
11:58	3.0	5.5	11.9	102.4	7.5	54	0.069	2.2
11:59	5.1	5.5	11.9	102.2	7.5	54	0.078	1.9
12:00	7.0	5.5	11.8	101.7	7.5	54	0.074	2.3
12:01	9.1	5.5	11.8	101.4	7.5	54	0.084	2.0
12:01	11.0	5.4	11.8	101.0	7.5	53	0.084	1.7
12:02	13.1	5.4	11.8	100.8	7.5	53	0.084	2.0
12:03	14.9	5.4	11.7	100.4	7.5	53	0.082	2.1
12:03	17.1	5.4	11.7	100.2	7.5	53	0.080	2.1
12:04	20.0	5.4	11.6	99.8	7.5	53	0.082	2.1
12:05	25.1	5.4	11.6	99.1	7.5	53	0.088	2.2
12:06	30.1	5.2	11.5	98.1	7.5	53	0.084	2.4
12:07	35.1	5.2	11.4	97.6	7.5	53	0.090	2.4
12:09	37.8	5.2	11.4	96.9	7.5	53	0.098	2.3

Table C4 continued.

C4 University Point: Water Column Profile

Time	Depth (m)	Water Temp (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%Sat)	pH	Specific Conductance (µS/cm)	Chl *a* (Volts)	Turbidity (NTU)
7-May								
9:47	0.5	7.6	11.3	100.3	7.7	52	0.012	0.0
9:49	1.0	7.5	11.2	99.8	7.7	52	0.013	0.0
9:50	3.0	7.2	11.3	99.6	7.7	54	0.015	0.0
9:50	5.0	7.2	11.3	99.5	7.7	54	0.020	0.0
9:51	7.1	7.2	11.2	98.9	7.7	55	0.025	0.0
9:52	9.0	7.1	11.2	98.6	7.7	55	0.028	0.0
9:52	11.1	7.1	11.1	97.9	7.7	54	0.028	0.0
9:53	13.0	6.8	11.1	96.7	7.7	54	0.033	0.0
9:54	15.0	6.6	11.0	95.8	7.6	55	0.037	0.0
9:54	17.1	6.5	11.0	95.0	7.6	55	0.037	0.0
9:55	20.1	6.4	10.9	94.1	7.6	55	0.034	0.0
9:56	25.0	6.3	10.8	92.8	7.6	55	0.030	0.1
9:57	30.0	6.3	10.7	91.8	7.6	55	0.028	0.0
9:58	35.0	6.2	10.6	91.2	7.6	55	0.030	0.0
10:01	39.2	6.1	10.5	89.9	7.5	56	0.033	0.0
9-Jun								
11:54	0.5	12.7	10.6	108.3	7.7	39	0.011	0.0
11:56	1.1	12.6	10.7	108.9	7.7	39	0.013	0.0
11:57	3.0	12.4	10.6	107.8	7.7	39	0.023	0.0
11:58	5.1	11.5	10.9	108.2	7.8	40	0.035	0.0
11:58	7.0	11.1	10.8	106.2	7.7	41	0.044	0.1
11:59	9.1	10.2	10.3	99.8	7.5	40	0.041	0.3
12:00	11.1	9.7	10.1	96.8	7.4	41	0.033	0.3
12:01	13.1	9.3	10.1	95.7	7.3	42	0.029	0.0
12:02	15.1	9.1	10.1	95.0	7.3	42	0.028	0.1
12:03	17.0	8.5	10.2	94.1	7.3	43	0.024	0.1
12:04	20.0	8.0	10.0	91.9	7.2	43	0.020	0.0
12:06	25.0	7.4	9.8	87.9	7.1	43	0.018	0.0
12:07	30.0	6.9	9.9	87.8	7.1	44	0.015	0.0
12:08	35.1	6.6	9.7	85.3	7.1	45	0.015	0.0
12:10	39.1	6.5	9.4	82.6	7.1	45	0.015	0.3

Table C4 continued.

C4 University Point: Water Column Profile

Time	Depth (m)	Water Temp (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%Sat)	pH	Specific Conductance (µS/cm)	Chl *a* (Volts)	Turbidity (NTU)
20-Jul								
12:57	0.5	21.4	8.7	105.2	7.7	37	0.007	0
12:57	1.1	21.3	8.7	105.1	7.7	37	0.008	0
12:58	3.1	20.1	8.9	104.9	7.7	36	0.010	0
12:59	4.9	19.6	9.0	105.1	7.8	36	0.015	0
13:00	7.0	18.8	9.1	104.6	7.8	35	0.021	0
13:01	8.0	17.0	9.2	102.2	7.6	35	0.026	0
13:03	9.0	15.7	9.3	99.9	7.4	35	0.026	0
13:04	10.0	14.9	9.3	98.3	7.4	34	0.037	0
13:04	11.1	14.4	9.2	96.1	7.3	35	0.035	0
13:06	12.0	13.3	8.8	90.1	7.1	35	0.037	0
13:07	13.0	12.6	8.6	86.2	7.0	35	0.032	0
13:08	14.0	12.1	8.5	84.9	7.0	35	0.029	0
13:08	15.0	11.6	8.4	82.6	6.9	35	0.030	0
13:11	17.0	10.2	8.3	79.5	6.9	36	0.022	0
13:12	20.1	8.9	8.2	75.5	6.8	37	0.018	0
13:14	25.0	7.8	8.4	75.7	6.8	38	0.014	0
13:15	29.9	6.9	8.4	74.2	6.7	39	0.012	0
13:16	35.0	6.8	8.3	72.6	6.7	39	0.010	0
13:18	38.7	6.8	8.0	70.4	6.7	39	0.010	0

Table C4 continued.

C4 University Point: Water Column Profile

Time	Depth (m)	Water Temp (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%Sat)	pH	Specific Conductance (µS/cm)	Chl *a* (Volts)	Turbidity (NTU)
18-Aug								
13:09	0.6	22.8	8.4	104.9	8.0	39	0.009	0.0
13:10	1.1	22.7	8.4	105.3	8.0	39	0.009	0.0
13:10	3.1	22.7	8.4	104.9	8.0	39	0.011	0.0
13:11	5.1	22.4	8.4	104.9	8.1	38	0.013	0.0
13:12	7.1	22.1	8.5	104.8	8.1	38	0.015	0.0
13:13	8.0	22.0	8.5	104.6	8.0	38	0.016	0.0
13:14	9.0	19.1	9.0	105.0	7.7	36	0.024	0.0
13:14	10.0	17.8	8.9	101.5	7.5	36	0.032	0.0
13:15	11.0	15.8	8.7	94.8	7.3	35	0.035	0.0
13:16	12.0	14.2	8.7	91.4	7.2	35	0.037	0.0
13:17	12.9	13.1	8.2	84.6	7.1	35	0.035	0.0
13:18	14.2	11.9	7.8	78.2	6.9	35	0.034	0.0
13:19	15.0	10.9	7.6	73.7	6.8	36	0.038	0.0
13:19	15.9	10.4	7.4	71.6	6.8	36	0.033	0.0
13:20	17.0	9.9	7.7	73.0	6.8	36	0.037	0.0
13:21	18.0	9.7	7.4	70.4	6.8	36	0.034	0.0
13:21	20.1	9.0	7.6	71.1	6.8	37	0.024	0.0
13:22	25.0	7.9	7.9	72.2	6.8	38	0.013	0.0
13:23	29.9	7.3	8.2	72.9	6.8	39	0.012	0.0
13:26	35.0	7.0	7.9	69.8	6.8	39	0.009	0.0
13:27	39.3	6.9	7.0	61.6	6.7	39	0.009	0.0

Table C4 continued.

C4 University Point: Water Column Profile

Time	Depth (m)	Water Temp (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%Sat)	pH	Specific Conductance (µS/cm)	Chl *a* (Volts)	Turbidity (NTU)
30-Sep								
10:27	0.5	16.4	8.9	97.6	7.5	55	0.009	0.0
10:27	1.0	16.4	8.9	97.5	7.5	55	0.010	0.0
10:28	3.0	16.4	8.9	97.2	7.5	55	0.011	0.0
10:29	5.0	16.4	8.8	96.8	7.5	54	0.015	0.0
10:30	7.0	16.3	8.8	96.2	7.5	55	0.016	0.0
10:30	9.0	16.3	8.8	95.9	7.5	55	0.018	0.0
10:31	11.0	16.0	8.7	94.1	7.4	54	0.018	0.0
10:32	13.0	16.0	8.6	93.0	7.4	54	0.017	0.0
10:33	15.0	15.3	8.0	86.1	7.2	53	0.017	0.0
10:34	16.2	13.6	7.5	77.1	6.9	53	0.017	0.0
10:35	17.1	11.7	6.4	62.9	6.7	53	0.019	0.0
10:36	18.0	10.9	6.2	60.5	6.6	53	0.014	0.0
10:37	18.9	10.0	6.2	59.1	6.6	53	0.014	0.0
10:38	20.1	9.4	6.3	59.0	6.6	53	0.013	0.0
10:39	24.8	8.3	6.6	60.5	6.6	54	0.011	0.0
10:41	30.2	7.7	7.0	62.5	6.6	54	0.011	0.0
10:42	34.9	7.5	6.8	61.0	6.6	54	0.010	0.0
10:43	38.6	7.3	6.2	55.5	6.5	55	0.010	0.4
9-Dec								
10:59	0.5	6.2	10.2	89.0	6.6	48	0.017	0.2
11:00	1.1	6.2	10.2	88.4	6.8	48	0.017	0.0
11:01	3.1	6.2	10.1	88.1	6.8	48	0.025	0.0
11:01	5.0	6.2	10.1	87.9	6.8	48	0.020	0.0
11:02	7.1	6.2	10.0	87.4	6.8	48	0.020	0.0
11:03	9.1	6.2	10.0	87.4	6.9	48	0.018	0.0
11:04	11.0	6.2	10.0	86.8	6.9	48	0.022	0.0
11:04	13.0	6.2	9.9	86.4	6.9	48	0.019	0.0
11:06	15.0	6.2	9.9	86.2	6.9	48	0.021	0.0
11:06	17.2	6.2	9.9	85.9	6.9	48	0.022	0.0
11:07	20.3	6.0	9.8	85.0	6.9	48	0.029	0.0
11:08	24.6	5.7	9.8	84.2	6.9	48	0.021	0.0
11:10	29.0	5.4	9.9	84.0	6.9	49	0.021	0.0
11:11	35.0	5.3	9.8	83.4	6.9	49	0.020	0.1
11:14	37.2	5.1	9.9	83.3	6.9	49	0.018	0.6

Table C5. Water column profiles at Kidd Island Bay

Kidd Island Bay: Water Column Profile

Time	Depth (m)	Water Temp (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%Sat)	pH	Specific Conductance (µS/cm)	Chl *a* (Volts)	Turbidity (NTU)
8-Mar								
10:49	0.5	4.4	11.6	96.6	6.7	52	0.043	0.3
10:50	1.0	4.4	11.6	96.8	6.9	51	0.048	1.6
10:51	2.0	4.4	11.6	96.6	6.8	46	0.052	1.5
10:52	3.0	4.4	11.5	96.1	6.9	52	0.059	1.3
10:52	4.0	4.3	11.6	96.2	7.0	52	0.066	0.8
10:54	5.0	4.4	11.5	96.0	7.1	52	0.073	0.9
10:54	6.0	4.3	11.5	95.7	7.1	52	0.074	1.3
10:55	7.0	4.3	11.5	95.5	7.1	52	0.073	1.2
10:56	8.0	4.3	11.4	95.3	7.1	53	0.074	1.2
10:57	8.5	4.3	11.4	95.1	7.2	53	0.073	1.5
9-Apr								
15:08	0.5	5.2	11.8	99.1	7.5	50	0.048	1.6
15:08	1.0	5.2	11.8	99.3	7.6	50	0.048	1.5
15:09	2.0	5.2	11.8	99.1	7.6	50	0.057	1.4
15:10	3.0	5.2	11.8	98.9	7.5	49	0.064	1.6
15:10	4.0	5.2	11.8	98.7	7.5	50	0.074	1.5
15:11	5.0	5.2	11.8	98.7	7.6	49	0.085	1.5
15:11	5.9	5.1	11.7	98.4	7.6	50	0.082	1.5
15:12	7.0	5.1	11.7	98.2	7.6	50	0.084	1.6
15:12	7.9	5.1	11.7	97.8	7.6	50	0.087	1.6
4-May								
14:20	0.5	7.3	11.4	101.1	7.6	55	0.013	0.0
14:21	1.0	7.3	11.4	100.8	7.6	55	0.013	0.0
14:22	2.9	7.3	11.4	100.6	7.5	55	0.019	0.0
14:23	4.9	7.3	11.3	100.2	7.6	55	0.023	0.0
14:24	6.1	7.3	11.3	99.8	7.5	55	0.029	0.0
14:25	8.5	7.3	11.2	99.4	7.6	55	0.032	0.0
14:27	9.5	7.3	11.2	98.8	7.5	55	0.030	0.0

Table C5 continued.

Kidd Island Bay: Water Column Profile

Time	Depth (m)	Water Temp (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%Sat)	pH	Specific Conductance (µS/cm)	Chl *a* (Volts)	Turbidity (NTU)
10-Jun								
15:14	0.5	12.4	10.8	108.5	7.9	42	0.018	0.0
15:15	1.1	12.4	10.8	109.0	7.9	42	0.023	0.0
15:16	2.0	12.3	10.8	108.7	7.9	42	0.028	0.0
15:17	3.0	12.3	10.8	108.4	7.8	42	0.030	0.0
15:18	4.1	12.2	10.8	108.2	7.9	42	0.031	0.0
15:18	5.0	12.2	10.7	107.8	7.8	42	0.033	0.0
15:19	6.0	12.2	10.7	107.7	7.9	42	0.034	0.2
15:20	7.0	12.2	10.7	107.3	7.9	42	0.034	0.3
15:21	8.0	12.1	10.6	106.7	7.9	42	0.035	0.8
15:22	9.0	12.0	10.6	105.6	7.8	42	0.041	0.6
15:23	9.8	11.9	10.6	105.4	7.8	42	0.041	0.8
22-Jul								
14:26	0.5	20.0	8.9	105.5	7.8	35	0.009	0.0
14:27	1.2	20.0	8.9	105.7	7.8	35	0.010	0.0
14:28	2.1	20.0	8.8	105.1	7.8	35	0.012	0.0
14:29	3.0	20.0	8.9	105.3	7.8	35	0.011	0.0
14:30	3.9	19.4	8.9	104.4	7.7	34	0.015	0.0
14:30	4.9	19.2	8.9	104.1	7.7	35	0.016	0.0
14:31	6.0	19.0	8.9	103.6	7.7	35	0.016	0.0
14:32	7.1	18.7	8.9	102.9	7.6	35	0.018	0.0
14:33	8.1	18.0	8.9	102.2	7.6	35	0.019	0.0
14:34	9.1	16.2	9.0	98.8	7.4	35	0.019	0.0
14:35	9.9	15.0	9.1	97.5	7.3	35	0.020	0.0
16-Aug								
14:32	0.6	23.6	8.2	104.0	7.8	36	0.008	0.0
14:34	1.0	23.6	8.2	103.6	7.9	36	0.008	0.0
14:35	2.0	22.8	8.2	102.4	7.9	36	0.008	0.0
14:36	3.0	22.6	8.2	101.5	7.9	36	0.009	0.0
14:37	4.0	22.6	8.2	101.5	7.9	36	0.010	0.0
14:37	5.0	22.4	8.2	101.8	7.9	36	0.011	0.0
14:38	6.0	21.3	8.6	103.6	7.9	35	0.014	0.0
14:40	7.1	19.8	8.9	104.5	7.8	35	0.016	0.0
14:41	8.0	17.0	9.2	102.3	7.6	35	0.024	0.1
14:42	9.1	16.3	9.2	100.5	7.5	35	0.028	0.1
14:43	9.4	16.1	9.1	99.1	7.5	35	0.031	1.1

Table C5 continued.

Kidd Island Bay: Water Column Profile

Time	Depth (m)	Water Temp (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%Sat)	pH	Specific Conductance (µS/cm)	Chl *a* (Volts)	Turbidity (NTU)
28-Sep								
16:32	0.5	16.2	8.8	95.9	7.5	52	0.010	0.0
16:32	1.0	16.2	8.9	96.5	7.5	52	0.010	0.0
16:32	3.0	16.0	8.8	95.3	7.4	52	0.014	0.0
16:32	5.0	16.0	8.7	94.6	7.4	52	0.016	0.1
16:32	7.0	15.1	8.7	94.3	7.4	52	0.018	0.4
16:32	9.0	15.9	8.7	93.8	7.4	52	0.018	0.5
16:32	9.5	15.9	8.6	93.6	7.4	52	0.020	1.2

Kidd Island Bay Station 2: Water Column Profile

Time	Depth (m)	Water Temp (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%Sat)	pH	Specific Conductance (µS/cm)	Chl *a* (Volts)	Turbidity (NTU)
16-Aug								
	0.5	24.3	8.9	114.3	9.1	48	0.035	14.7
13:30	1.0	23.4	9.1	114.8	9.2	51	0.057	14.9

Table C6. Water column profiles at Mica Bay

Mica Bay: Water Column Profile

Time	Depth (m)	Water Temp (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%Sat)	pH	Specific Conductance (µS/cm)	Chl *a* (Volts)	Turbidity (NTU)
5-Mar								
10:32	0.5	4.6	12.4	102.8	7.6	53	0.047	2.0
10:33	1.0	4.6	12.4	102.7	7.6	49	0.049	1.8
10:34	2.0	4.4	12.4	102.5	7.6	53	0.059	2.2
10:35	3.0	4.4	12.4	102.0	7.6	52	0.091	2.1
10:35	4.0	4.4	12.3	101.7	7.6	54	0.137	2.1
10:36	5.0	4.4	12.3	101.2	7.6	54	0.171	2.0
10:37	6.0	4.4	12.2	100.4	7.6	53	0.204	2.0
10:38	7.0	4.3	12.1	99.6	7.6	51	0.230	2.4
10:38	8.0	4.3	12.0	98.7	7.6	53	0.233	2.6
10:39	9.0	4.3	11.9	97.9	7.6	53	0.234	2.9
10:41	9.5	4.3	11.6	95.8	7.6	52	0.217	3.9
12-Apr								
10:28	0.5	5.7	12.1	104.5	7.4	49	0.044	2.2
10:29	1.0	5.7	12.1	104.5	7.5	51	0.045	3.9
10:30	2.0	5.7	12.0	103.9	7.5	48	0.069	2.2
10:31	2.9	5.7	12.0	104.0	7.5	50	0.087	2.2
10:31	4.0	5.6	12.0	103.6	7.5	51	0.120	1.8
10:32	5.0	5.6	12.0	103.4	7.4	50	0.128	2.3
10:33	6.0	5.6	11.9	103.0	7.5	51	0.130	2.6
10:34	7.0	5.6	11.9	103.1	7.5	49	0.130	2.4
10:35	8.0	5.6	11.9	102.9	7.6	51	0.125	2.1
10:36	9.0	5.6	11.9	102.6	7.6	51	0.134	1.9
10:36	10.0	5.5	11.9	102.7	7.6	50	0.126	2.4
10:38	10.1	5.5	11.9	102.4	7.6	51	0.137	2.2
5-May								
14:25	0.5	8.2	11.2	101.6	7.7	55	0.009	0.0
14:26	1.0	8.1	11.2	101.4	7.7	54	0.010	0.0
14:27	3.0	7.8	11.2	100.3	7.7	54	0.017	0.0
14:28	5.0	7.3	11.2	99.4	7.7	55	0.034	0.0
14:28	7.0	7.2	11.1	98.7	7.6	55	0.033	0.0
14:29	9.0	7.2	11.1	98.2	7.7	54	0.034	0.0
14:31	11.1	7.1	11.0	97.5	7.6	55	0.042	0.0

Table C6 continued.

Mica Bay: Water Column Profile

Time	Depth (m)	Water Temp (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%Sat)	pH	Specific Conductance (µS/cm)	Chl *a* (Volts)	Turbidity (NTU)
10-Jun								
13:29	0.5	12.6	10.7	108.7	7.9	41	0.016	0.0
13:29	1.1	12.6	10.8	108.9	7.9	41	0.019	0.0
13:30	2.0	12.5	10.7	108.5	7.9	41	0.027	0.0
13:31	3.0	12.3	10.8	108.5	7.9	41	0.037	0.0
13:31	4.1	12.1	10.8	108.0	7.9	41	0.044	0.0
13:32	5.0	12.0	10.8	108.0	7.8	41	0.044	0.0
13:32	6.0	12.0	10.8	108.1	7.8	41	0.041	0.0
13:33	7.0	12.0	10.8	108.0	7.8	41	0.040	0.0
13:34	8.0	11.8	10.6	105.3	7.8	41	0.047	0.2
13:35	9.0	11.5	10.7	105.6	7.7	41	0.047	0.4
13:36	10.1	11.3	10.4	102.2	7.6	41	0.060	0.6
13:37	11.0	11.2	10.2	99.6	7.6	41	0.058	0.7
21-Jul								
13:50	0.6	21.7	8.5	104.4	7.7	35	0.007	0
13:51	1.1	21.6	8.5	103.9	7.7	35	0.008	0
13:52	2.0	20.7	8.6	103.1	7.7	35	0.009	0
13:52	3.0	20.6	8.6	102.4	7.7	35	0.010	0
13:53	4.0	20.2	8.6	102.7	7.8	35	0.012	0
13:54	5.0	20.1	8.7	102.6	7.8	34	0.013	0
13:54	6.0	20.1	8.7	102.5	7.8	34	0.014	0
13:55	7.1	20.0	8.7	102.5	7.8	35	0.014	0
13:56	8.1	19.7	8.7	102.6	7.8	35	0.017	0
13:57	9.1	18.8	8.9	102.7	7.8	34	0.021	0
13:58	10.0	15.3	8.6	92.6	7.3	35	0.025	0
13:59	11.0	12.3	8.3	83.2	7.1	35	0.045	0
14:00	11.2	11.6	8.3	82.2	6.9	36	0.041	0.4

Table C6 continued.

Mica Bay: Water Column Profile

Time	Depth (m)	Water Temp (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%Sat)	pH	Specific Conductance (µS/cm)	Chl *a* (Volts)	Turbidity (NTU)
19-Aug								
9:44	0.6	21.8	8.5	104.0	8.0	36	0.009	0.0
9:44	1.0	21.8	8.4	103.9	8.0	36	0.009	0.0
9:45	2.0	21.8	8.4	103.7	7.9	36	0.010	0.0
9:45	3.0	21.7	8.4	103.5	7.9	36	0.011	0.0
9:46	4.1	21.7	8.4	103.3	7.9	36	0.012	0.0
9:46	5.1	21.7	8.4	102.9	7.9	36	0.012	0.0
9:47	6.1	21.6	8.4	103.0	8.0	36	0.014	0.0
9:48	7.0	21.4	8.6	104.8	8.0	37	0.017	0.0
9:49	8.0	20.8	8.7	104.5	7.9	36	0.017	0.0
9:49	9.0	19.6	8.9	104.8	7.8	36	0.019	0.0
9:50	10.1	17.6	8.5	96.5	7.5	35	0.023	0.0
9:51	11.1	14.7	8.0	84.7	7.2	36	0.032	0.4
9:52	11.3	14.6	7.8	83.0	7.1	36	0.028	1.2
29-Sep								
13:48	0.6	16.6	8.9	97.4	7.5	52	0.008	0.0
13:49	1.0	16.6	8.8	96.8	7.5	52	0.008	0.1
13:50	3.0	16.3	8.8	95.9	7.5	52	0.010	0.2
13:50	5.0	16.1	8.8	95.0	7.5	52	0.014	0.3
13:51	7.0	16.0	8.7	94.6	7.4	52	0.017	0.4
13:52	9.0	15.8	8.5	92.0	7.3	52	0.020	0.5
13:53	11.0	15.6	8.2	87.6	7.2	52	0.018	0.7

Table C7. Water column profiles at Rockford Bay

Rockford Bay: Water Column Profile

Time	Depth (m)	Water Temp (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%Sat)	pH	Specific Conductance (µS/cm)	Chl *a* (Volts)	Turbidity (NTU)
4-Mar								
10:11	0.5	4.3	12.2	101.0	8.1	59	0.061	2.6
10:12	1.0	4.3	12.2	100.9	8.0	59	0.072	2.1
10:13	2.0	4.2	12.2	100.4	7.9	58	0.081	2.4
10:14	3.0	4.2	12.1	100.2	7.8	58	0.097	2.1
10:15	4.0	4.2	12.1	100.3	7.7	58	0.108	2.7
10:16	5.1	4.3	12.1	100.2	7.7	59	0.132	2.5
10:17	6.0	4.2	12.1	99.9	7.7	61	0.120	3.1
10:18	7.0	4.2	12.0	99.4	7.7	60	0.127	3.1
10:18	8.0	4.2	11.9	98.1	7.6	60	0.128	3.3
10:20	8.5	4.2	11.3	93.1	7.6	63	0.116	6.5
13-Apr								
9:37	0.5	6.0	12.0	104.4	7.3	56	0.077	2.9
9:37	1.0	6.0	12.1	105.1	7.4	56	0.078	3.2
9:38	2.0	5.9	12.0	104.4	7.4	55	0.092	3.0
9:39	3.0	5.9	12.1	104.5	7.4	55	0.096	2.5
9:40	4.0	5.9	12.0	104.1	7.4	56	0.095	2.8
9:40	5.0	5.7	11.9	102.8	7.4	55	0.109	2.7
9:41	6.1	5.6	11.9	102.5	7.4	56	0.117	2.9
9:42	7.1	5.5	11.9	102.0	7.4	56	0.110	3.4
9:42	8.1	5.5	11.8	101.4	7.4	56	0.110	3.6
9:43	9.0	5.5	11.7	100.2	7.4	56	0.150	3.7
6-May								
14:03	0.5	7.2	11.4	100.6	7.7	57	0.010	0.0
14:04	1.1	7.1	11.4	100.4	7.7	57	0.011	0.0
14:05	3.0	7.1	11.3	99.6	7.7	56	0.012	0.0
14:06	5.0	6.7	11.3	98.7	7.6	57	0.023	0.0
14:07	7.1	6.4	11.3	97.6	7.7	57	0.030	0.0
14:08	9.1	6.4	11.2	96.5	7.6	57	0.030	0.0
14:09	10.9	6.3	11.0	95.2	7.6	58	0.036	0.8

Table C7 continued.

Rockford Bay: Water Column Profile

Time	Depth (m)	Water Temp (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%Sat)	pH	Specific Conductance (µS/cm)	Chl *a* (Volts)	Turbidity (NTU)
9-Jun								
10:00	0.5	12.7	10.8	110.2	7.1	45	0.019	5.1
10:01	1.0	11.5	10.9	108.5	7.2	43	0.028	1.9
10:02	2.0	10.8	10.9	107.1	7.2	40	0.042	1.5
10:03	3.0	10.6	10.8	104.9	7.3	40	0.051	1.8
10:04	3.9	10.5	10.7	103.7	7.3	40	0.057	2.4
10:05	5.0	10.4	10.5	101.9	7.3	41	0.048	2.5
10:06	6.1	10.3	10.4	100.4	7.3	40	0.052	1.9
10:07	7.1	10.3	10.4	100.5	7.3	40	0.054	1.6
10:07	8.0	10.2	10.4	100.1	7.3	40	0.052	1.4
10:08	9.0	10.2	10.4	99.9	7.3	40	0.054	1.8
10:09	10.1	10.1	10.2	97.7	7.3	40	0.059	1.8
10:10	10.3	10.0	9.6	92.3	7.2	40	0.081	2.6
20-Jul								
10:00	0.5	18.3	9.3	105.4	7.5	34	0.010	0.2
10:01	1.0	18.2	9.3	105.4	7.6	35	0.009	0.0
10:03	2.0	17.7	9.3	104.9	7.6	35	0.014	0.1
10:04	3.0	17.6	9.3	104.2	7.6	35	0.015	0.3
10:04	4.0	17.5	9.3	104.5	7.6	35	0.016	0.2
10:06	5.0	17.4	9.4	104.6	7.6	35	0.018	0.3
10:06	6.0	17.4	9.3	104.1	7.7	35	0.019	0.3
10:07	7.0	17.3	9.4	104.5	7.6	35	0.021	0.2
10:08	8.0	17.2	9.3	103.9	7.6	35	0.020	0.3
10:09	9.0	16.9	9.2	101.6	7.5	35	0.025	0.7
10:10	9.8	16.7	9.1	100.3	7.4	35	0.025	0.7
20-Aug								
10:27	0.5	21.0	8.7	104.9	8.1	38	0.009	0.0
10:27	1.1	21.0	8.7	104.8	8.1	38	0.010	0.0
10:28	2.0	21.0	8.6	104.5	8.1	38	0.010	0.0
10:29	3.0	20.9	8.6	104.1	8.1	38	0.011	0.0
10:29	4.0	20.6	8.7	103.9	8.0	38	0.012	0.0
10:30	5.1	20.3	8.7	103.9	8.0	37	0.015	0.0
10:31	6.0	20.3	8.7	103.7	8.0	38	0.015	0.0
10:31	7.0	20.2	8.7	103.6	8.0	37	0.015	0.0
10:32	8.0	20.2	8.6	103.0	8.0	37	0.016	0.0
10:33	9.1	20.1	8.7	103.1	8.0	37	0.016	0.0
10:35	10.1	19.8	8.7	103.4	7.9	37	0.020	0.2

Table C7 continued.

Rockford Bay: Water Column Profile

Time	Depth (m)	Water Temp (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%Sat)	pH	Specific Conductance (µS/cm)	Chl *a* (Volts)	Turbidity (NTU)
30-Sep								
14:10	0.5	17.1	8.8	98.0	7.5	55	0.008	0.7
14:11	1.0	17.0	8.8	98.0	7.5	55	0.009	0.0
14:12	3.0	16.9	8.8	97.8	7.6	55	0.011	0.0
14:13	5.0	16.6	8.8	96.8	7.5	55	0.013	0.0
14:14	7.0	16.4	8.7	95.8	7.5	55	0.014	0.0
14:15	9.0	16.4	8.7	95.3	7.5	55	0.014	0.1
14:16	10.0	16.2	8.8	95.8	7.5	54	0.016	0.9

Appendix D:
2010 Phytoplankton

Table D1. Phytoplankton enumeration for C1 Tubbs Hill

C1-TUBBS 03/05/10 1-15.5 m	Natural counting units/mL	% of total	Rank	Biovolume $\mu m^3/mL$	% of total	Rank
Bacillariophyceae (diatoms)						
Asterionella formosa	451	18.0	2	45,100	44.0	1
Fragilaria capucina	98	3.9		7,300	7.1	4
Fragilaria crotonensis	183	7.3	4	12,800	12.5	2
Fragilaria intermedia	12	0.5		600	0.6	
Rhizoselenia sp.	12	0.5		600	0.6	
group total	756	30.2		66,400	64.8	
Chlorophyceae (coccoid greens, desmids, etc.)						
Clamydomonas	49	2.0		1,300	1.3	
group total	49	2.0		1,300	1.3	
Chrysophyceae (yellow-green flagellates)						
Chromulina sp.	12	0.5		200	0.2	
Chrysochromulina sp.	37	1.5		2,700	2.6	
Chrysococcus	12	0.5		900	0.9	
Dinobryon sp. (medium)	12	0.5		1,500	1.5	
Kephyrion sp.	12	0.5		600	0.6	
Ochromonas sp.	37	1.5		5,500	5.4	6
Small microflagellates	1,085	43.4	1	5,400	5.3	6
group total	1,207	48.3		16,800	16.4	
Cryptophyta (flagellates)						
Chryptomonas sp. (medium)	24	1.0		4,300	4.2	
Chryptomonas sp. (small)	24	1.0		2,400	2.3	
crypt. subtotal	49	2.0		6,700	6.5	5
Komma sp.	98	3.9		9,800	9.6	3
group total	146	5.9		16,500	16.1	
Dinophyceae (dinoflagellates)						
group total	0	0.0		0	0.0	
Cyanophyta (blue-greens)						
Synechococcus sp. (rod)	341	13.7	3	1,400	1.4	
group total	341	13.7		1,400	1.4	
GRAND TOTAL	**2,500**			**102,400**		

Table D1 continued.

C1-TUBBS 04/06/10 1-15.0 m	Natural counting units/mL	% of total	Rank	Biovolume µm³/mL	% of total	Rank
Bacillariophyceae (diatoms)						
Asterionella formosa	939	17.0	2	93,900	38.7	1
Aulacoseira italica	146	2.7		22,000	9.1	3
Fragilaria capucina	256	4.6		19,200	7.9	4
Fragilaria crotonensis	73	1.3		5,100	2.1	
Rhizoselenia sp.	37	0.7		1,800	0.7	
Tabellaria fenestrata	73	1.3		25,600	10.5	2
group total	1,524	27.7		167,600	69.0	
Chlorophyceae (coccoid greens, desmids, etc.)						
Coelastrum sp. (cells)	488	8.9	3	24,400	10.0	2
Nephroselmis	96	1.7		10,100	4.2	
Phacus (small)	12	0.2		3,000	1.2	
group total	596	10.8		37,500	15.4	
Chrysophyceae (yellow-green flagellates)						
Chrysococcus	49	0.9		3,700	1.5	
Dinobryon sp. (medium)	12	0.2		1,500	0.6	
Ochromonas sp.	37	0.7		5,500	2.3	
Small microflagellates	2,537	46.0	1	12,700	5.2	5
group total	2,634	47.8		23,400	9.6	
Cryptophyta (flagellates)						
Chryptomonas sp. (medium)	24	0.4		4,300	1.8	
crypt. subtotal	24	0.4		4,300	1.8	
Komma sp.	49	0.9		4,900	2.0	
group total	73	1.3		9,200	3.8	
Dinophyceae (dinoflagellates)						
Gymnodinium sp. (small)	12	0.2		2,400	1.0	
group total	12	0.2		2,400	1.0	
Cyanophyta (blue-greens)						
Synechococcus sp. (coccoid)	24	0.4		100	0.0	
Synechococcus sp. (rod)	646	11.7		2,600	1.1	
group total	671	12.2		2,700	1.1	
GRAND TOTAL	**5,510**			**242,800**		

Table D1 continued.

C1-TUBBS 05/05/10 1-13.0 m	Natural counting units/mL	% of total	Rank	Biovolume µm³/mL	% of total	Rank
Bacillariophyceae (diatoms)						
Asterionella formosa	756	8.5	3	75,600	22.9	1
Fragilaria capucina	73	0.8		5,500	1.7	
Fragilaria crotonensis	439	4.9		30,700	9.3	3
Navicula sp. (medium)	49	0.5		24,400	7.4	5
Rhizoselenia sp.	73	0.8		3,700	1.1	
Tabellaria fenestrata	171	1.9		59,800	18.1	2
group total	1,561	17.6		199,700	60.4	
Chlorophyceae (coccoid greens, desmids, etc.)						
Nephroselmis	49	0.5		5,100	1.5	
group total	49	0.5		5,100	1.5	
Chrysophyceae (yellow-green flagellates)						
Bitrichia sp.	24	0.3		3,000	0.9	
Chromulina sp.	146	1.6		2,900	0.9	
Chrysochromulina sp.	24	0.3		1,800	0.5	
Chrysococcus	146	1.6		11,000	3.3	
Dinobryon sp. (medium)	24	0.3		2,900	0.9	
Ochromonas sp.	49	0.5		7,300	2.2	
Small microflagellates	2,317	26.1	2	11,600	3.5	
group total	2,732	30.8		40,500	12.3	
Cryptophyta (flagellates)						
Chryptomonas sp. (large)	24	0.3		8,500	2.6	
Chryptomonas sp. (medium)	73	0.8		12,800	3.9	
crypt. subtotal	98	1.1		21,300	6.4	6
Chroomonas acuta	49	0.5		2,400	0.7	
Komma sp.	146	1.6		14,600	4.4	
group total	293	3.3		38,300	11.6	
Dinophyceae (dinoflagellates)						
Gymnodinium sp. (large)	24	0.3		19,500	5.9	
Gymnodinium sp. (medium)	24	0.3		9,800	3.0	
group total	49	0.5		29,300	8.9	4
Cyanophyta (blue-greens)						
Synechococcus sp. (coccoid)	3,366	37.9	1	13,500	4.1	
Synechococcus sp. (rod)	634	7.1	4	2,500	0.8	
Synechocystis	195	2.2		1,600	0.5	
group total	4,195	47.3		17,600	5.3	
GRAND TOTAL	**8,878**			**330,500**		

Table D1 continued.

C1-TUBBS 06/08/10 1-12.25 m	Natural counting units/mL	% of total	Rank	Biovolume µm³/mL	% of total	Rank
Bacillariophyceae (diatoms)						
Asterionella formosa	756	8.1	4	75,600	26.0	1
Aulacoseira italica	98	1.0		14,600	5.0	4
Fragilaria capucina	195	2.1		14,600	5.0	4
Rhizoselenia sp.	24	0.3		1,200	0.4	
group total	1,073	11.5		106,000	36.5	
Chlorophyceae (coccoid greens, desmids, etc.)						
Ankistrodesmus sp.	49	0.5		3,900	1.3	
Coelastrum sp. (cells)	585	6.3	5	29,300	10.1	3
Elakatothrix sp.	49	0.5		7,300	2.5	
Golenkinia sp.	73	0.8		11,000	3.8	
Nephroselmis	73	0.8		7,600	2.6	
Scourfieldia	98	1.0		2,900	1.0	
group total	927	9.9		62,000	21.3	
Chrysophyceae (yellow-green flagellates)						
Chromulina sp.	73	0.8		1,500	0.5	
Chrysochromulina sp.	24	0.3		1,800	0.6	
Chrysococcus	122	1.3		9,100	3.1	
Chrysolykos sp.	24	0.3		2,400	0.8	
Dinobryon sp. (medium)	73	0.8		8,800	3.0	
Kephyrion sp.	24	0.3		1,200	0.4	
Small microflagellates	1,512	16.1	2	7,600	2.6	
Spiniferomonas	24	0.3		2,400	0.8	
group total	1,878	20.1		34,800	12.0	
Cryptophyta (flagellates)						
Chryptomonas sp. (medium)	24	0.3		4,300	1.5	
crypt. subtotal	24	0.3		4,300	1.5	
Chroomonas acuta	98	1.0		4,900	1.7	
Komma sp.	73	0.8		7,300	2.5	
group total	195	2.1		16,500	5.7	
Dinophyceae (dinoflagellates)						
Gymnodinium sp. (medium)	73	0.8		29,300	10.1	
Gymnodinium sp. (small)	49	0.5		9,800	3.4	
group total	122	1.3		39,100	13.5	2
Cyanophyta (blue-greens)						
Chroococcus sp. (cells)	98	1.0		12,200	4.2	
Microcystis sp.	488	5.2	6	1,000	0.3	
Synechococcus sp. (coccoid)	1,171	12.5	3	4,700	1.6	
Synechococcus sp. (rod)	3,268	34.9	1	13,100	4.5	
Synechocystis	146	1.6		1,200	0.4	
group total	5,171	55.2		32,200	11.1	
GRAND TOTAL	**9,366**			**290,600**		

Table D1 continued.

C1-TUBBS 07/22/10 1-14.5 m	Natural counting units/mL	% of total	Rank	Biovolume µm³/mL	% of total	Rank
Bacillariophyceae (diatoms)						
Asterionella formosa	463	9.9	5	46,300	41.3	1
Fragilaria capucina	49	1.0		3,700	3.3	
Rhizoselenia sp.	24	0.5		1,200	1.1	
group total	537	11.5		51,200	45.7	
Chlorophyceae (coccoid greens, desmids, etc.)						
Nephroselmis	73	1.6		7,600	6.8	3
Scourfieldia	73	1.6		2,200	2.0	
group total	146	3.1		9,800	8.8	
Chrysophyceae (yellow-green flagellates)						
Chrysococcus	49	1.0		3,700	3.3	
Ochromonas sp.	24	0.5		3,700	3.3	
Small microflagellates	1,049	22.5	2	5,200	4.6	
group total	1,122	24.1		12,600	11.3	
Cryptophyta (flagellates)						
Chryptomonas sp. (medium)	122	2.6		21,300	19.0	
crypt. subtotal	122	2.6		21,300	19.0	2
Chroomonas acuta	49	1.0		2,400	2.1	
Komma sp.	49	1.0		4,900	4.4	
group total	220	4.7		28,600	25.5	
Dinophyceae (dinoflagellates)						
group total	0	0.0		0	0.0	
Cyanophyta (blue-greens)						
Microcystis sp.	488	10.5	4	1,000	0.9	
Synechococcus sp. (coccoid)	1,171	25.1	1	4,700	4.2	
Synechococcus sp. (rod)	927	19.9	3	3,700	3.3	
Synechocystis	49	1.0		400	0.4	
group total	2,634	56.5		9,800	8.8	
GRAND TOTAL	**4,659**			**112,000**		

Table D1 continued.

C1-TUBBS 08/16/10 1-15.5 m	Natural counting units/mL	% of total	Rank	Biovolume μm^3/mL	% of total	Rank
Bacillariophyceae (diatoms)						
Asterionella formosa	220	5.0	5	22,000	13.9	1
Rhizoselenia sp.	49	1.1		2,400	1.5	
group total	268	6.1		24,400	15.4	
Chlorophyceae (coccoid greens, desmids, etc.)						
Botryococcus sp. (cells)	24	0.6		100	0.1	
Clamydocapsa sp.	98	2.2		19,500	12.3	2
Golenkinia sp.	24	0.6		3,700	2.3	
Nephroselmis	73	1.7		7,600	4.8	
group total	220	5.0		30,900	19.5	
Chrysophyceae (yellow-green flagellates)						
Chrysococcus	73	1.7		5,500	3.5	
Chrysosphaerella sp.	24	0.6		7,300	4.6	
Ochromonas sp.	73	1.7		11,000	6.9	4
Small microflagellates	951	21.8	2	4,800	3.0	
group total	1,122	25.7		28,600	18.0	
Cryptophyta (flagellates)						
Chryptomonas sp. (medium)	98	2.2		17,100	10.8	
crypt. subtotal	98	2.2		17,100	10.8	3
Chilomonas sp.	49	1.1		12,200	7.7	
Chroomonas acuta	24	0.6		1,200	0.8	
Komma sp.	171	3.9		17,100	10.8	3
group total	341	7.8		47,600	30.0	
Dinophyceae (dinoflagellates)						
Gymnodinium sp. (medium)	24	0.6		9,800	6.2	
Gymnodinium sp. (small)	49	1.1		9,800	6.2	
group total	73	1.7		19,600	12.3	2
Cyanophyta (blue-greens)						
Microcystis sp.	976	22.3	1	2,000	1.3	
Synechococcus sp. (coccoid)	659	15.1	3	2,600	1.6	
Synechococcus sp. (rod)	634	14.5	4	2,500	1.6	
Synechocystis	73	1.7		600	0.4	
group total	2,342	53.6		7,700	4.8	
GRAND TOTAL	**4,366**			**158,800**		

Table D1 continued.

C1-TUBBS 09/28/10 1-17.25 m	Natural counting units/mL	% of total	Rank	Biovolume µm³/mL	% of total	Rank
Bacillariophyceae (diatoms)						
Asterionella formosa	49	1.0		4,900	2.5	
Aulacoseira italica	49	1.0		7,300	3.7	
Fragilaria capucina	49	1.0		3,700	1.9	
group total	146	3.0		15,900	8.0	
Chlorophyceae (coccoid greens, desmids, etc.)						
Oocystis sp. (cells)	24	0.5		3,000	1.5	
Pediastrum sp. (medium)	24	0.5		24,400	12.3	2
Spondylosium sp.	512	10.4	4	76,800	38.8	1
group total	561	11.4		104,200	52.6	
Chrysophyceae (yellow-green flagellates)						
Chromulina sp.	98	2.0		2,000	1.0	
Chrysochromulina sp.	73	1.5		5,500	2.8	
Chrysococcus	49	1.0		3,700	1.9	
Dinobryon sp. (medium)	49	1.0		5,900	3.0	
Ochromonas sp.	49	1.0		7,300	3.7	
Small microflagellates	1,415	28.7	2	7,100	3.6	
group total	1,732	35.1		31,500	15.9	
Cryptophyta (flagellates)						
Chryptomonas sp. (medium)	24	0.5		4,300	2.2	
crypt. subtotal	24	0.5		4,300	2.2	
Chilomonas sp.	49	1.0		12,200	6.2	3
Chroomonas acuta	98	2.0		4,900	2.5	
Komma sp.	98	2.0		9,800	4.9	
group total	268	5.4		31,200	15.7	
Dinophyceae (dinoflagellates)						
group total	0	0.0		0	0.0	
Cyanophyta (blue-greens)						
Chroococcus sp. (cells)	49	1.0		6,100	3.1	
Synechococcus sp. (coccoid)	1,488	30.2	1	6,000	3.0	
Synechococcus sp. (rod)	561	11.4	3	2,200	1.1	
Synechocystis	122	2.5		1,000	0.5	
group total	2,220	45.0		15,300	7.7	
GRAND TOTAL	**4,927**			**198,100**		

Table D1 continued.

C1-TUBBS 12/07/10 1-16.75 m	Natural counting units/mL	% of total	Rank	Biovolume µm^3/mL	% of total	Rank
Bacillariophyceae (diatoms)						
Asterionella formosa	122	3.0		12,200	10.6	4
Aulacoseira italica	98	2.4		14,600	12.7	3
Fragilaria capucina	73	1.8		5,500	4.8	
group total	293	7.3		32,300	28.1	
Chlorophyceae (coccoid greens, desmids, etc.)						
Cosmarium sp.	49	1.2		24,400	21.2	1
Gloeococcus sp.	24	0.6		2,400	2.1	
Scenedesmus sp.	49	1.2		2,900	2.5	
Scourfieldia	24	0.6		700	0.6	
Tetrastrum	24	0.6		500	0.4	
group total	171	4.2		30,900	26.8	
Chrysophyceae (yellow-green flagellates)						
Chromulina sp.	24	0.6		500	0.4	
Chrysococcus	73	1.8		5,500	4.8	
Small microflagellates	1,195	29.7	1	6,000	5.2	6
group total	1,293	32.1		12,000	10.4	
Cryptophyta (flagellates)						
Chryptomonas sp. (medium)	98	2.4		17,100	14.9	
crypt. subtotal	98	2.4		17,100	14.9	2
Chroomonas acuta	146	3.6		7,300	6.3	5
Komma sp.	73	1.8		7,300	6.3	5
group total	317	7.9		31,700	27.5	
Dinophyceae (dinoflagellates)						
group total	0	0.0		0	0.0	
Cyanophyta (blue-greens)						
Synechococcus sp. (coccoid)	976	24.2	2	3,900	3.4	
Synechococcus sp. (rod)	878	21.8	3	3,500	3.0	
Synechocystis	98	2.4		800	0.7	
group total	1,951	48.5		8,200	7.1	
GRAND TOTAL	**4,025**			**115,100**		

Table D2. Phytoplankton enumeration for C2 Wolf Lodge Bay

C2-WOLF 05/04/10 1-11.0 m	Natural counting units/mL	% of total	Rank	Biovolume $\mu m^3/mL$	% of total	Rank
Bacillariophyceae (diatoms)						
Asterionella formosa	1,000	11.6	4	100,000	49.9	1
Aulacoseira italica	49	0.6		7,300	3.6	
Fragilaria capucina	98	1.1		7,300	3.6	
Fragilaria crotonensis	24	0.3		1,700	0.8	
Rhizoselenia sp.	122	1.4		6,100	3.0	
group total	1,293	15.0		122,400	61.0	
Chlorophyceae (coccoid greens, desmids, etc.)						
Nephroselmis	24	0.3		2,500	1.2	
group total	24	0.3		2,500	1.2	
Chrysophyceae (yellow-green flagellates)						
Chromulina sp.	49	0.6		1,000	0.5	
Chrysococcus	122	1.4		9,100	4.5	
Ochromonas sp.	73	0.8		11,000	5.5	3
Small microflagellates	2,146	24.9	2	10,700	5.3	3
group total	2,390	27.8		31,800	15.9	
Cryptophyta (flagellates)						
Chroomonas acuta	24	0.3		1,200	0.6	
Komma sp.	73	0.8		7,300	3.6	
group total	98	1.1		8,500	4.2	
Dinophyceae (dinoflagellates)						
Gymnodinium sp. (medium)	24	0.3		9,800	4.9	
group total	24	0.3		9,800	4.9	
Cyanophyta (blue-greens)						
Chroococcus sp. (cells)	49	0.6		6,100	3.0	
Synechococcus sp. (coccoid)	3,561	41.4	1	14,200	7.1	2
Synechococcus sp. (rod)	1,049	12.2	3	4,200	2.1	
Synechocystis	122	1.4		1,000	0.5	
group total	4,781	55.5		25,500	12.7	
GRAND TOTAL	**8,610**			**200,500**		

Table D3. Phytoplankton enumeration for C3 Driftwood Point

C3-DRIFT 04/12/10 1-12.25 m	Natural counting units/mL	% of total	Rank	Biovolume μm^3/mL	% of total	Rank
Bacillariophyceae (diatoms)						
Asterionella formosa	878	10.1	3	87,800	9.4	3
Aulacoseira italica	1,342	15.4	2	201,200	21.6	2
Cyclotella comta	24	0.3		8,500	0.9	
Fragilaria capucina	244	2.8		18,300	2.0	
Rhizoselenia sp.	24	0.3		1,200	0.1	
Tabellaria fenestrata	1,342	15.4	2	469,500	50.3	1
group total	3,854	44.4		786,500	84.3	
Chlorophyceae (coccoid greens, desmids, etc.)						
Monoraphidium	73	0.8		14,600	1.6	
Nephroselmis	98	1.1		10,100	1.1	
Pandorina sp.	24	0.3		36,600	3.9	
group total	195	2.2		61,300	6.6	
Chrysophyceae (yellow-green flagellates)						
Chromulina sp.	49	0.6		1,000	0.1	
Chrysococcus	146	1.7		11,000	1.2	
Dinobryon sp. (medium)	24	0.3		2,900	0.3	
Small microflagellates	3,805	43.8	1	19,000	2.0	
group total	4,025	46.3		33,900	3.6	
Cryptophyta (flagellates)						
Chryptomonas sp. (large)	24	0.3		8,500	0.9	
Chryptomonas sp. (medium)	73	0.8		12,800	1.4	
crypt. subtotal	98	1.1		21,300	2.3	
Komma sp.	293	3.4		29,300	3.1	
group total	390	4.5		50,600	5.4	
Dinophyceae (dinoflagellates)						
group total	0	0.0		0	0.0	
Cyanophyta (blue-greens)						
Synechococcus sp. (rod)	220	2.5		900	0.1	
group total	220	2.5		900	0.1	
GRAND TOTAL	**8,683**			**933,200**		

Table D3 continued.

C3-DRIFT 05/06/10 1-12.25 m	Natural counting units/mL	% of total	Rank	Biovolume µm³/mL	% of total	Rank
Bacillariophyceae (diatoms)						
Asterionella formosa	561	10.1	2	56,100	17.9	1
Aulacoseira italica	244	4.4		36,600	11.7	2
Fragilaria capucina	24	0.4		1,800	0.6	
Fragilaria crotonensis	122	2.2		8,500	2.7	
Nitzschia sp. (large)	73	1.3		29,300	9.3	3
group total	1,024	18.5		132,300	42.2	
Chlorophyceae (coccoid greens, desmids, etc.)						
Coelastrum sp. (cells)	195	3.5		9,800	3.1	
Monoraphidium	146	2.6		29,300	9.3	3
group total	341	6.2		39,100	12.5	
Chrysophyceae (yellow-green flagellates)						
Chromulina sp.	73	1.3		1,500	0.5	
Chrysococcus	220	4.0		16,500	5.3	6
Dinobryon sp. (medium)	49	0.9		5,900	1.9	
Ochromonas sp.	49	0.9		7,300	2.3	
Small microflagellates	1,293	23.3	1	6,500	2.1	
Mallonomopsis sp.	49	0.9		6,100	1.9	
group total	1,732	31.3		43,800	14.0	
Cryptophyta (flagellates)						
Chryptomonas sp. (large)	24	0.4		8,500	2.7	
Chryptomonas sp. (medium)	73	1.3		12,800	4.1	
crypt. subtotal	98	1.8		21,300	6.8	5
Chilomonas sp.	49	0.9		12,200	3.9	
Chroomonas acuta	49	0.9		2,400	0.8	
Komma sp.	146	2.6		14,600	4.7	
group total	341	6.2		50,500	16.1	
Dinophyceae (dinoflagellates)						
Gymnodinium sp. (medium)	24	0.4		9,800	3.1	
Gymnodinium sp. (small)	24	0.4		4,900	1.6	
group total	49	0.9		14,700	4.7	
Cyanophyta (blue-greens)						
Chroococcus sp. (cells)	195	3.5		24,400	7.8	4
Synechococcus sp. (coccoid)	1,293	23.3	1	5,200	1.7	
Synechococcus sp. (rod)	220	4.0		900	0.3	
Synechocystis	341	6.2	3	2,700	0.9	
group total	2,049	37.0		33,200	10.6	
GRAND TOTAL	**5,537**			**313,600**		

Table D3 continued.

C3-DRIFT 06/10/10 1-10.0 m	Natural counting units/mL	% of total	Rank	Biovolume µm³/mL	% of total	Rank
Bacillariophyceae (diatoms)						
Asterionella formosa	610	7.0	3	61,000	30.1	1
Fragilaria capucina	341	3.9		25,600	12.6	2
Rhizoselenia sp.	24	0.3		1,200	0.6	
group total	976	11.2		87,800	43.3	
Chlorophyceae (coccoid greens, desmids, etc.)						
Ankistrodesmus sp.	49	0.6		3,900	1.9	
Golenkinia sp.	24	0.3		3,700	1.8	
Monoraphidium	24	0.3		4,900	2.4	
Nephroselmis	24	0.3		2,500	1.2	
Scourfieldia	146	1.7		4,400	2.2	
group total	268	3.1		19,400	9.6	
Chrysophyceae (yellow-green flagellates)						
Chromulina sp.	49	0.6		1,000	0.5	
Chrysochromulina sp.	24	0.3		1,800	0.9	
Chrysococcus	49	0.6		3,700	1.8	
Dinobryon sp. (medium)	24	0.3		2,900	1.4	
Kephyrion sp.	49	0.6		2,400	1.2	
Ochromonas sp.	73	0.8		11,000	5.4	4
Small microflagellates	1,537	17.7	2	7,700	3.8	
group total	1,805	20.8		30,500	15.1	
Cryptophyta (flagellates)						
Chryptomonas sp. (medium)	49	0.6		8,500	4.2	
crypt. subtotal	49	0.6		8,500	4.2	
Chilomonas sp.	24	0.3		6,100	3.0	
Chroomonas acuta	98	1.1		4,900	2.4	
Komma sp.	73	0.8		7,300	3.6	
group total	244	2.8		26,800	13.2	
Dinophyceae (dinoflagellates)						
Gymnodinium sp. (medium)	24	0.3		9,800	4.8	
group total	24	0.3		9,800	4.8	
Cyanophyta (blue-greens)						
Chroococcus sp. (cells)	49	0.6		6,100	3.0	
Synechococcus sp. (coccoid)	1,537	17.7	2	6,100	3.0	
Synechococcus sp. (rod)	3,512	40.4	1	14,000	6.9	3
Synechocystis	268	3.1		2,100	1.0	
group total	5,366	61.8		28,300	14.0	
GRAND TOTAL	**8,683**			**202,600**		

Table D3 continued.

C3-DRIFT 07/21/10 1-13.5 m	Natural counting units/mL	% of total	Rank	Biovolume µm³/mL	% of total	Rank
Bacillariophyceae (diatoms)						
Asterionella formosa	122	2.0		12,200	6.6	3
Aulacoseira granulata	366	6.1	5	73,200	39.8	1
Fragilaria capucina	122	2.0		9,100	4.9	
Rhizoselenia sp.	49	0.8		2,400	1.3	
group total	659	11.1		96,900	52.7	
Chlorophyceae (coccoid greens, desmids, etc.)						
Ankistrodesmus sp.	24	0.4		2,000	1.1	
Nephroselmis	73	1.2		7,600	4.1	
Scourfieldia	73	1.2		2,200	1.2	
group total	171	2.9		11,800	6.4	
Chrysophyceae (yellow-green flagellates)						
Chromulina sp.	24	0.4		500	0.3	
Chrysochromulina sp.	24	0.4		1,800	1.0	
Chrysococcus	73	1.2		5,500	3.0	
Kephyrion sp.	24	0.4		1,200	0.7	
Mallomonas sp. (medium)	24	0.4		7,300	4.0	
Ochromonas sp.	24	0.4		3,700	2.0	
Small microflagellates	2,122	35.7	1	10,600	5.8	4
group total	2,317	38.9		30,600	16.6	
Cryptophyta (flagellates)						
Chryptomonas sp. (medium)	24	0.4		4,300	2.3	
crypt. subtotal	24	0.4		4,300	2.3	
Chilomonas sp.	24	0.4		6,100	3.3	
Chroomonas acuta	24	0.4		1,200	0.7	
Komma sp.	49	0.8		4,900	2.7	
group total	122	2.0		16,500	9.0	
Dinophyceae (dinoflagellates)						
Gymnodinium sp. (medium)	49	0.8		19,500	10.6	2
group total	49	0.8		19,500	10.6	
Cyanophyta (blue-greens)						
Microcystis sp.	976	16.4	2	2,000	1.1	
Synechococcus sp. (coccoid)	707	11.9	4	2,800	1.5	
Synechococcus sp. (rod)	927	15.6	3	3,700	2.0	
Synechocystis	24	0.4		200	0.1	
group total	2,634	44.3		8,700	4.7	
GRAND TOTAL	**5,951**			**184,000**		

Table D3 continued.

C3-DRIFT 08/19/10 1-13.5 m	Natural counting units/mL	% of total	Rank	Biovolume µm^3/mL	% of total	Rank
Bacillariophyceae (diatoms)						
Asterionella formosa	220	8.9	4	22,000	10.5	3
Aulacoseira italica	220	8.9	4	32,900	15.8	2
Rhizoselenia sp.	24	1.0		1,200	0.6	
group total	463	18.8		56,100	26.9	
Chlorophyceae (coccoid greens, desmids, etc.)						
Cosmarium sp.	24	1.0		12,200	5.8	6
Euglena sp.	24	1.0		61,000	29.2	1
Phacus (medium)	24	1.0		12,200	5.8	6
Scourfieldia	24	1.0		700	0.3	
group total	98	4.0		86,100	41.2	
Chrysophyceae (yellow-green flagellates)						
Chromulina sp.	24	1.0		500	0.2	
Chrysococcus	73	3.0		5,500	2.6	
Kephyrion sp.	24	1.0		1,200	0.6	
Ochromonas sp.	24	1.0		3,700	1.8	
Small microflagellates	610	24.8	1	3,000	1.4	
group total	756	30.7		13,900	6.7	
Cryptophyta (flagellates)						
Chryptomonas sp. (medium)	24	1.0		4,300	2.1	
crypt. subtotal	24	1.0		4,300	2.1	
Chilomonas sp.	73	3.0		18,300	8.8	4
Chroomonas acuta	73	3.0		3,700	1.8	
Komma sp.	146	5.9	5	14,600	7.0	5
group total	317	12.9		40,900	19.6	
Dinophyceae (dinoflagellates)						
Gloeodinium SP.	24	1.0		8,500	4.1	
group total	24	1.0		8,500	4.1	
Cyanophyta (blue-greens)						
Synechococcus sp. (coccoid)	537	21.8	2	2,100	1.0	
Synechococcus sp. (rod)	244	9.9	3	1,000	0.5	
Synechocystis	24	1.0		200	0.1	
group total	805	32.7		3,300	1.6	
GRAND TOTAL	**2,463**			**208,800**		

Table D3 continued.

C3-DRIFT 09/29/10 1-16.0 m	Natural counting units/mL	% of total	Rank	Biovolume µm^3/mL	% of total	Rank
Bacillariophyceae (diatoms)						
Asterionella formosa	24	0.4		2,400	1.8	
Rhizoselenia sp.	24	0.4		1,200	0.9	
group total	49	0.9		3,600	2.6	
Chlorophyceae (coccoid greens, desmids, etc.)						
Clamydocapsa sp.	24	0.4		4,900	3.6	
Coelastrum sp. (cells)	195	3.6		9,800	7.2	3
Elakatothrix sp.	24	0.4		3,700	2.7	
Nephroselmis	73	1.3		7,600	5.6	5
Pediastrum sp. (medium)	49	0.9		48,800	35.9	1
group total	366	6.7		74,800	55.0	
Chrysophyceae (yellow-green flagellates)						
Bitrichia sp.	24	0.4		3,000	2.2	
Chromulina sp.	73	1.3		1,500	1.1	
Chrysococcus	24	0.4		1,800	1.3	
Dinobryon sp. (medium)	24	0.4		2,900	2.1	
Small microflagellates	1,244	22.7	3	6,200	4.6	
group total	1,390	25.3		15,400	11.3	
Cryptophyta (flagellates)						
Chroomonas acuta	24	0.4		1,200	0.9	
Komma sp.	73	1.3		7,300	5.4	5
group total	98	1.8		8,500	6.3	
Dinophyceae (dinoflagellates)						
Gymnodinium sp. (medium)	49	0.9		19,500	14.3	2
group total	49	0.9		19,500	14.3	
Cyanophyta (blue-greens)						
Synechococcus sp. (coccoid)	2,098	38.2	1	8,400	6.2	4
Synechococcus sp. (rod)	1,439	26.2	2	5,800	4.3	
group total	3,537	64.4		14,200	10.4	
GRAND TOTAL	**5,488**			**136,000**		

Table D4. Phytoplankton enumeration for C4 University Point

C4-UNIV 03/03/10 1-12.0 m	Natural counting units/mL	% of total	Rank	Biovolume $\mu m^3/mL$	% of total	Rank
Bacillariophyceae (diatoms)						
Asterionella formosa	573	19.6	2	57,300	31.7	1
Aulacoseira granulata	49	1.7		9,800	5.4	5
Aulacoseira italica	159	5.4	4	23,800	13.1	3
Fragilaria capucina	73	2.5		5,500	3.0	
Fragilaria intermedia	48	1.6		2,400	1.3	
Rhizoselenia sp.	12	0.4		600	0.3	
Tabellaria fenestrata	85	2.9		29,900	16.5	2
group total	999	34.1		129,300	71.4	
Chlorophyceae (coccoid greens, desmids, etc.)						
Clamydomonas	24	0.8		700	0.4	
Elakatothrix sp.	24	0.8		3,700	2.0	
Nephroselmis	24	0.8		2,500	1.4	
group total	73	2.5		6,900	3.8	
Chrysophyceae (yellow-green flagellates)						
Chrysococcus	12	0.4		900	0.5	
Dinobryon sp. (medium)	12	0.4		1,500	0.8	
Kephyrion sp.	12	0.4		600	0.3	
Ochromonas sp.	49	1.7		7,300	4.0	
Small microflagellates	1,244	42.5	1	6,200	3.4	
group total	1,329	45.4		16,500	9.1	
Cryptophyta (flagellates)						
Chryptomonas sp. (large)	12	0.4		4,300	2.4	
Chryptomonas sp. (medium)	49	1.7		8,500	4.7	
Chryptomonas sp. (small)	49	1.7		4,900	2.7	
crypt. subtotal	110	3.8		17,700	9.8	4
Komma sp.	98	3.3		9,800	5.4	5
group total	207	7.1		27,500	15.2	
Dinophyceae (dinoflagellates)						
group total	0	0.0		0	0.0	
Cyanophyta (blue-greens)						
Microcystis sp.	244	8.3	3	500	0.3	
Synechococcus sp. (coccoid)	24	0.8		100	0.1	
Synechococcus sp. (rod)	49	1.7		200	0.1	
group total	317	10.8		800	0.4	
GRAND TOTAL	**2,926**			**181,000**		

Table D4 continued.

C4-UNIV 04/13/10 1-11.75 m	Natural counting units/mL	% of total	Rank	Biovolume μm^3/mL	% of total	Rank
Bacillariophyceae (diatoms)						
Achnathidium sp.	37	0.6		2,900	0.8	
Asterionella formosa	402	6.5	3	40,200	10.8	3
Aulacoseira granulata	85	1.4		17,100	4.6	
Aulacoseira italica	634	10.3	2	95,100	25.6	1
Cyclotella comta	12	0.2		4,300	1.2	
Fragilaria capucina	207	3.4		15,500	4.2	
Rhizoselenia sp.	49	0.8		2,400	0.6	
Tabellaria fenestrata	220	3.6		76,800	20.6	2
group total	1,646	26.7		254,300	68.3	
Chlorophyceae (coccoid greens, desmids, etc.)						
Monoraphidium	24	0.4		4,900	1.3	
Nephroselmis	281	4.5		29,200	7.8	4
Phacus (medium)	24	0.4		12,200	3.3	
group total	329	5.3		46,300	12.4	
Chrysophyceae (yellow-green flagellates)						
Chromulina sp.	37	0.6		700	0.2	
Chrysococcus	61	1.0		4,600	1.2	
Ochromonas sp.	85	1.4		12,800	3.4	
Small microflagellates	3,476	56.3	1	17,400	4.7	
group total	3,659	59.3		35,500	9.5	
Cryptophyta (flagellates)						
Chryptomonas sp. (large)	12	0.2		4,300	1.2	
Chryptomonas sp. (medium)	37	0.6		6,400	1.7	
Chryptomonas sp. (small)	12	0.2		1,200	0.3	
crypt. subtotal	61	1.0		11,900	3.2	
Komma sp.	171	2.8		17,100	4.6	
group total	232	3.8		29,000	7.8	
Dinophyceae (dinoflagellates)						
group total	0	0.0		0	0.0	
Cyanophyta (blue-greens)						
Chroococcus sp. (cells)	49	0.8		6,100	1.6	
Synechococcus sp. (coccoid)	98	1.6		400	0.1	
Synechococcus sp. (rod)	159	2.6		600	0.2	
group total	305	4.9		7,100	1.9	
GRAND TOTAL	**6,171**			**372,200**		

Table D4 continued.

C4-UNIV 05/07/10 1-12.25 m	Natural counting units/mL	% of total	Rank	Biovolume μm^3/mL	% of total	Rank
Bacillariophyceae (diatoms)						
Asterionella formosa	854	11.0	3	85,400	38.2	1
Aulacoseira italica	49	0.6		7,300	3.3	
Cyclotella comta	24	0.3		8,500	3.8	
Fragilaria capucina	49	0.6		3,700	1.7	
group total	976	12.5		104,900	46.9	
Chlorophyceae (coccoid greens, desmids, etc.)						
Ankistrodesmus sp.	24	0.3		2,000	0.9	
Monoraphidium	122	1.6		24,400	10.9	2
Nephroselmis	122	1.6		12,700	5.7	
Scourfieldia	24	0.3		700	0.3	
group total	293	3.8		39,800	17.8	
Chrysophyceae (yellow-green flagellates)						
Chromulina sp.	73	0.9		1,500	0.7	
Chrysococcus	195	2.5		14,600	6.5	3
Ochromonas sp.	73	0.9		11,000	4.9	
Small microflagellates	2,464	31.7	2	12,300	5.5	4
group total	2,805	36.1		39,400	17.6	
Cryptophyta (flagellates)						
Chryptomonas sp. (large)	24	0.3		8,500	3.8	
crypt. subtotal	24	0.3		8,500	3.8	
Chroomonas acuta	73	0.9		3,700	1.7	
Komma sp.	122	1.6		12,200	5.5	4
group total	220	2.8		24,400	10.9	
Dinophyceae (dinoflagellates)						
group total	0	0.0		0	0.0	
Cyanophyta (blue-greens)						
Synechococcus sp. (coccoid)	2,756	35.4	1	11,000	4.9	
Synechococcus sp. (rod)	439	5.6	4	1,800	0.8	
Synechocystis	293	3.8		2,300	1.0	
group total	3,488	44.8		15,100	6.8	
GRAND TOTAL	**7,781**			**223,600**		

Table D4 continued.

C4-UNIV 06/09/10 1-11.0 m	Natural counting units/mL	% of total	Rank	Biovolume µm^3/mL	% of total	Rank
Bacillariophyceae (diatoms)						
Asterionella formosa	390	4.7		39,000	17.7	1
Aulacoseira granulata	98	1.2		19,500	8.9	3
Fragilaria capucina	146	1.8		11,000	5.0	5
group total	634	7.7		69,500	31.6	
Chlorophyceae (coccoid greens, desmids, etc.)						
Ankistrodesmus sp.	73	0.9		5,900	2.7	
Langerheimia	24	0.3		1,200	0.5	
Monoraphidium	49	0.6		9,800	4.5	
Nephroselmis	24	0.3		2,500	1.1	
Scourfieldia	24	0.3		700	0.3	
group total	195	2.4		20,100	9.1	
Chrysophyceae (yellow-green flagellates)						
Chromulina sp.	98	1.2		2,000	0.9	
Chrysochromulina sp.	24	0.3		1,800	0.8	
Chrysococcus	49	0.6		3,700	1.7	
Ochromonas sp.	49	0.6		7,300	3.3	
Small microflagellates	1,439	17.5	2	7,200	3.3	
group total	1,659	20.1		22,000	10.0	
Cryptophyta (flagellates)						
Chryptomonas sp. (large)	49	0.6		17,100	7.8	
Chryptomonas sp. (medium)	122	1.5		21,300	9.7	
crypt. subtotal	171	2.1		38,400	17.5	2
Chilomonas sp.	49	0.6		12,200	5.6	4
Chroomonas acuta	220	2.7		11,000	5.0	5
Komma sp.	98	1.2		9,800	4.5	
group total	537	6.5		71,400	32.5	
Dinophyceae (dinoflagellates)						
Gymnodinium sp. (small)	24	0.3		4,900	2.2	
group total	24	0.3		4,900	2.2	
Cyanophyta (blue-greens)						
Chroococcus sp. (cells)	98	1.2		12,200	5.6	4
Microcystis sp.	732	8.9	3	1,500	0.7	
Synechococcus sp. (coccoid)	1,439	17.5	2	5,800	2.6	
Synechococcus sp. (rod)	2,756	33.4	1	11,000	5.0	5
Synechocystis	171	2.1		1,400	0.6	
group total	5,195	63.0		31,900	14.5	
GRAND TOTAL	**8,244**			**219,800**		

Table D4 continued.

C4-UNIV 07/20/10 1-12.75 m	Natural counting units/mL	% of total	Rank	Biovolume µm³/mL	% of total	Rank
Bacillariophyceae (diatoms)						
Fragilaria capucina	199	3.2		14,900	6.7	3
Rhizoselenia sp.	57	0.9		2,800	1.3	
group total	256	4.1		17,700	8.0	
Chlorophyceae (coccoid greens, desmids, etc.)						
Clamydocapsa sp.	569	9.1	5	113,800	51.2	1
Elakatothrix sp.	57	0.9		8,500	3.8	
Nephroselmis	28	0.5		3,000	1.3	
Scourfieldia	114	1.8		3,400	1.5	
group total	768	12.3		128,700	57.9	
Chrysophyceae (yellow-green flagellates)						
Chrysococcus	171	2.7		12,800	5.8	4
Kephyrion sp.	28	0.5		1,400	0.6	
Ochromonas sp.	57	0.9		8,500	3.8	
Small microflagellates	1,480	23.6	1	7,400	3.3	
group total	1,736	27.7		30,100	13.5	
Cryptophyta (flagellates)						
Chryptomonas sp. (medium)	114	1.8		19,900	9.0	
crypt. subtotal	114	1.8		19,900	9.0	2
Chilomonas sp.	28	0.5		7,100	3.2	
Chroomonas acuta	28	0.5		1,400	0.6	
Komma sp.	57	0.9		5,700	2.6	
group total	228	3.6		34,100	15.3	
Dinophyceae (dinoflagellates)						
group total	0	0.0		0	0.0	
Cyanophyta (blue-greens)						
Microcystis sp.	854	13.6	4	1,700	0.8	
Synechococcus sp. (coccoid)	1,167	18.6	3	4,700	2.1	
Synechococcus sp. (rod)	1,195	19.1	2	4,800	2.2	
Synechocystis	57	0.9		500	0.2	
group total	3,273	52.3		11,700	5.3	
GRAND TOTAL	**6,260**			**222,300**		

Table D4 continued.

C4-UNIV 08/18/10 1-15.25 m	Natural counting units/mL	% of total	Rank	Biovolume $\mu m^3/mL$	% of total	Rank
Bacillariophyceae (diatoms)						
Asterionella formosa	537	6.6	4	53,700	18.3	2
Fragilaria crotonensis	390	4.8		27,300	9.3	4
Tabellaria fenestrata	293	3.6		102,400	34.9	1
group total	1,220	14.9		183,400	62.4	
Chlorophyceae (coccoid greens, desmids, etc.)						
Clamydomonas	488	6.0	5	13,200	4.5	
Nephroselmis	73	0.9		7,600	2.6	
group total	561	6.9		20,800	7.1	
Chrysophyceae (yellow-green flagellates)						
Chrysochromulina sp.	73	0.9		5,500	1.9	
Chrysococcus	73	0.9		5,500	1.9	
Dinobryon sp. (medium)	24	0.3		2,900	1.0	
Ochromonas sp.	24	0.3		3,700	1.3	
Small microflagellates	1,634	20.0	3	8,200	2.8	
group total	1,829	22.4		25,800	8.8	
Cryptophyta (flagellates)						
Chryptomonas sp. (medium)	49	0.6		8,500	2.9	
crypt. subtotal	49	0.6		8,500	2.9	
Chroomonas acuta	73	0.9		3,700	1.3	
group total	122	1.5		12,200	4.2	
Dinophyceae (dinoflagellates)						
Gymnodinium sp. (medium)	73	0.9		29,300	10.0	
Gymnodinium sp. (small)	24	0.3		4,900	1.7	
group total	98	1.2		34,200	11.6	3
Cyanophyta (blue-greens)						
Synechococcus sp. (coccoid)	1,756	21.5	2	7,000	2.4	
Synechococcus sp. (rod)	2,585	31.6	1	10,300	3.5	
group total	4,342	53.1		17,300	5.9	
GRAND TOTAL	**8,171**			**293,700**		

Table D4 continued.

C4-UNIV 09/30/10 1-15.0 m	Natural counting units/mL	% of total	Rank	Biovolume µm³/mL	% of total	Rank
Bacillariophyceae (diatoms)						
Asterionella formosa	49	0.8		4,900	4.6	
Fragilaria capucina	24	0.4		1,800	1.7	
Rhizoselenia sp.	49	0.8		2,400	2.3	
group total	122	2.0		9,100	8.6	
Chlorophyceae (coccoid greens, desmids, etc.)						
Clamydomonas	24	0.4		700	0.7	
Cosmarium sp.	24	0.4		12,200	11.6	3
Nephroselmis	49	0.8		5,100	4.8	
Spondylosium sp.	98	1.6		14,600	13.8	1
group total	195	3.1		32,600	30.9	
Chrysophyceae (yellow-green flagellates)						
Chromulina sp.	73	1.2		1,500	1.4	
Chrysococcus	49	0.8		3,700	3.5	
Dinobryon sp. (medium)	24	0.4		2,900	2.7	
Small microflagellates	1,415	22.8	3	7,100	6.7	6
group total	1,561	25.2		15,200	14.4	
Cryptophyta (flagellates)						
Chryptomonas sp. (large)	24	0.4		8,500	8.0	5
Chryptomonas sp. (medium)	24	0.4		4,300	4.1	
crypt. subtotal	49	0.8		12,800	12.1	2
Chilomonas sp.	24	0.4		6,100	5.8	
Chroomonas acuta	73	1.2		3,700	3.5	
Komma sp.	24	0.4		2,400	2.3	
group total	171	2.8		25,000	23.7	
Dinophyceae (dinoflagellates)						
group total	0	0.0		0	0.0	
Cyanophyta (blue-greens)						
Gomphosphaeria sp. (cells)	439	7.1	4	8,800	8.3	4
Synechococcus sp. (coccoid)	2,098	33.9	1	8,400	8.0	5
Synechococcus sp. (rod)	1,585	25.6	2	6,300	6.0	7
Synechocystis	24	0.4		200	0.2	
group total	4,147	66.9		23,700	22.4	
GRAND TOTAL	**6,195**			**105,600**		

Table D4 continued.

C4-UNIV 12/09/10 1-13.75 m	Natural counting units/mL	% of total	Rank	Biovolume $\mu m^3/mL$	% of total	Rank
Bacillariophyceae (diatoms)						
Asterionella formosa	195	4.7		19,500	13.1	3
Aulacoseira italica	146	3.6		22,000	14.7	2
Fragilaria capucina	24	0.6		1,800	1.2	
Navicula sp. (medium)	24	0.6		12,200	8.2	4
group total	390	9.5		55,500	37.1	
Chlorophyceae (coccoid greens, desmids, etc.)						
Gloeococcus sp.	24	0.6		2,400	1.6	
Monomastix sp.	49	1.2		6,100	4.1	
Nephroselmis	24	0.6		2,500	1.7	
Scourfieldia	49	1.2		1,500	1.0	
group total	146	3.6		12,500	8.4	
Chrysophyceae (yellow-green flagellates)						
Bitrichia sp.	24	0.6		3,000	2.0	
Chromulina sp.	73	1.8		1,500	1.0	
Chrysochromulina sp.	24	0.6		1,800	1.2	
Ochromonas sp.	49	1.2		7,300	4.9	
Small microflagellates	1,927	46.7	1	9,600	6.4	5
group total	2,098	50.9		23,200	15.5	
Cryptophyta (flagellates)						
Chryptomonas sp. (large)	24	0.6		8,500	5.7	
Chryptomonas sp. (medium)	195	4.7		34,100	22.8	
crypt. subtotal	220	5.3	3	42,600	28.5	1
Chroomonas acuta	122	3.0		6,100	4.1	
Komma sp.	49	1.2		4,900	3.3	
group total	390	9.5		53,600	35.9	
Dinophyceae (dinoflagellates)						
group total	0	0.0		0	0.0	
Cyanophyta (blue-greens)						
Synechococcus sp. (rod)	1,049	25.4	2	4,200	2.8	
Synechocystis	49	1.2		400	0.3	
group total	1,098	26.6		4,600	3.1	
GRAND TOTAL	**4,122**			**149,400**		

Table D5. Phytoplankton enumeration for Kidd Island Bay

KIDD 06/10/10 1-9.0 m	Natural counting units/mL	% of total	Rank	Biovolume μm^3/mL	% of total	Rank
Bacillariophyceae (diatoms)						
Asterionella formosa	878	9.4	4	87,800	40.6	1
Fragilaria capucina	73	0.8		5,500	2.5	
Rhizoselenia sp.	24	0.3		1,200	0.6	
group total	976	10.4		94,500	43.6	
Chlorophyceae (coccoid greens, desmids, etc.)						
Ankistrodesmus sp.	24	0.3		2,000	0.9	
Golenkinia sp.	24	0.3		3,700	1.7	
Nephroselmis	49	0.5		5,100	2.4	
group total	98	1.0		10,800	5.0	
Chrysophyceae (yellow-green flagellates)						
Chrysococcus	73	0.8		5,500	2.5	
Dinobryon sp. (medium)	122	1.3		14,600	6.7	4
Ochromonas sp.	24	0.3		3,700	1.7	
Small microflagellates	1,220	13.1	2	6,100	2.8	
group total	1,439	15.4		29,900	13.8	
Cryptophyta (flagellates)						
Chryptomonas sp. (large)	24	0.3		8,500	3.9	
Chryptomonas sp. (medium)	49	0.5		8,500	3.9	
crypt. subtotal	73	0.8		17,000	7.9	3
Chilomonas sp.	49	0.5		12,200	5.6	5
Chroomonas acuta	73	0.8		3,700	1.7	
Komma sp.	73	0.8		7,300	3.4	
group total	268	2.9		40,200	18.6	
Dinophyceae (dinoflagellates)						
Gymnodinium sp. (medium)	24	0.3		9,800	4.5	
Gymnodinium sp. (small)	24	0.3		4,900	2.3	
group total	49	0.5		14,700	6.8	
Cyanophyta (blue-greens)						
Synechococcus sp. (coccoid)	1,098	11.7	3	4,400	2.0	
Synechococcus sp. (rod)	5,342	57.2	1	21,400	9.9	2
Synechocystis	73	0.8		600	0.3	
group total	6,512	69.7		26,400	12.2	
GRAND TOTAL	**9,342**			**216,500**		

Table D5 continued.

KIDD Station 2 08/16/10 0.75 m	Natural counting units/mL	% of total	Rank	Biovolume μm^3/mL	% of total	Rank
Bacillariophyceae (diatoms)						
Achnathidium sp.	49	0.1		3,900	0.4	
Aulacoseira granulata	122	0.4		24,400	2.8	
Aulacoseira italica	220	0.7		32,900	3.8	
Cyclotella comta	366	1.1		128,100	14.6	2
Cyclotella glomerata	49	0.1		2,400	0.3	
Cymbella sp. (medium)	24	0.1		6,100	0.7	
Epithemia sp.	49	0.1		17,100	2.0	
Eunotia sp. (large)	146	0.4		36,600	4.2	
Fragilaria capucina	24	0.1		1,800	0.2	
Staurosia construens	366	1.1		7,400	0.8	
Gomphonema sp. (medium)	49	0.1		24,400	2.8	
Pinnularia sp. (large)	24	0.1		73,200	8.4	3
group total	1,488	4.5		358,300	40.9	
Chlorophyceae (coccoid greens, desmids, etc.)						
Ankyra	24	0.1		4,500	0.5	
Clamydocapsa sp.	293	0.9		58,500	6.7	5
Clamydomonas	317	0.9		8,600	1.0	
Crucigenia sp.	195	0.6		5,900	0.7	
Monoraphidium	24	0.1		4,900	0.6	
Nephroselmis	73	0.2		7,600	0.9	
Oocystis sp. (cells)	49	0.1		6,100	0.7	
Scenedesmus sp.	24	0.1		1,500	0.2	
group total	1,000	3.0		97,600	11.1	
Chrysophyceae (yellow-green flagellates)						
Bitrichia sp.	24	0.1		3,000	0.3	
Chromulina sp.	73	0.2		1,500	0.2	
Ochromonas sp.	122	0.4		18,300	2.1	
Small microflagellates	6,512	19.5	2	32,600	3.7	
Mallonomopsis sp.	122	0.4		15,200	1.7	
Trachelomonas sp.	73	0.2		11,000	1.3	
group total	6,927	20.7		81,600	9.3	
Cryptophyta (flagellates)						
Chryptomonas sp. (large)	73	0.2		25,600	2.9	
Chryptomonas sp. (medium)	220	0.7		38,400	4.4	
crypt. subtotal	293	0.9		64,000	7.3	4
Komma sp.	146	0.4		14,600	1.7	
group total	439	1.3		78,600	9.0	
Dinophyceae (dinoflagellates)						
Gloeodinium SP.	49	0.1		14,700	1.7	
group total	49	0.1		14,700	1.7	

Table D5 continued.

Cyanophyta (blue-greens)						
Anabaena sp.	683	2.0		34,100	3.9	
Anabaenopsis sp.	5,049	15.1	4	151,500	17.3	1
Microcystis sp.	6,342	19.0	3	12,700	1.4	
Synechococcus sp. (coccoid)	8,635	25.9	1	34,500	3.9	
Synechococcus sp. (rod)	2,415	7.2	5	9,700	1.1	
Synechocystis	366	1.1		2,900	0.3	
group total	23,489	70.3		245,400	28.0	
GRAND TOTAL	**33,392**			**876,200**		

Table D6. Phytoplankton enumeration for Mica Bay

MICA 03/05/10 1-8.5 m	Natural counting units/mL	% of total	Rank	Biovolume μm^3/mL	% of total	Rank
Bacillariophyceae (diatoms)						
Asterionella formosa	3,317	50.4	1	331,700	63.9	1
Aulacoseira granulata	61	0.9		12,200	2.4	
Aulacoseira italica	244	3.7		36,600	7.1	2
Cyclotella comta	12	0.2		4,300	0.8	
Diatoma elongatum	171	2.6		17,100	3.3	
Fragilaria capucina	98	1.5		7,300	1.4	
Fragilaria intermedia	61	0.9		3,000	0.6	
Navicula sp. (small)	12	0.2		1,800	0.3	
Tabellaria fenestrata	73	1.1		25,600	4.9	
group total	4,049	61.5		439,600	84.7	
Chlorophyceae (coccoid greens, desmids, etc.)						
Clamydomonas	37	0.6		1,000	0.2	
Coelastrum sp. (cells)	293	4.4		14,600	2.8	
Gloeococcus sp.	12	0.2		1,200	0.2	
Nephroselmis	24	0.4		2,500	0.5	
Oocystis sp. (cells)	12	0.2		1,500	0.3	
group total	378	5.7		20,800	4.0	
Chrysophyceae (yellow-green flagellates)						
Chrysochromulina sp.	24	0.4		1,800	0.3	
Ochromonas sp.	49	0.7		7,300	1.4	
Small microflagellates	1,549	23.5	2	7,700	1.5	
group total	1,622	24.6		16,800	3.2	
Cryptophyta (flagellates)						
Chryptomonas sp. (large)	12	0.2		4,300	0.8	
Chryptomonas sp. (medium)	49	0.7		8,500	1.6	
Chryptomonas sp. (small)	24	0.4		2,400	0.5	
crypt. subtotal	85	1.3		15,200	2.9	
Komma sp.	256	3.9		25,600	4.9	
group total	341	5.2		40,800	7.9	
Dinophyceae (dinoflagellates)						
group total	0	0.0		0	0.0	
Cyanophyta (blue-greens)						
Synechococcus sp. (coccoid)	24	0.4		100	0.0	
Synechococcus sp. (rod)	171	2.6		700	0.1	
group total	195	3.0		800	0.2	
GRAND TOTAL	**6,586**			**518,800**		

Table D6 continued.

MICA 06/10/10 1-10.0 m	Natural counting units/mL	% of total	Rank	Biovolume µm³/mL	% of total	Rank
Bacillariophyceae (diatoms)						
Asterionella formosa	1,195	9.3	4	119,500	40.6	1
Fragilaria capucina	98	0.8		7,300	2.5	
Rhizoselenia sp.	24	0.2		1,200	0.4	
group total	1,317	10.2		128,000	43.5	
Chlorophyceae (coccoid greens, desmids, etc.)						
Elakatothrix sp.	49	0.4		7,300	2.5	
Nephroselmis	73	0.6		7,600	2.6	
Scourfieldia	146	1.1		4,400	1.5	
group total	268	2.1		19,300	6.6	
Chrysophyceae (yellow-green flagellates)						
Chromulina sp.	73	0.6		1,500	0.5	
Chrysococcus	122	0.9		9,100	3.1	
Dinobryon sp. (medium)	244	1.9		29,300	10.0	2
Mallomonas sp. (medium)	24	0.2		7,300	2.5	
Ochromonas sp.	24	0.2		3,700	1.3	
Small microflagellates	1,781	13.8	2	8,900	3.0	
group total	2,268	17.6		59,800	20.3	
Cryptophyta (flagellates)						
Chryptomonas sp. (medium)	122	0.9		21,300	7.2	
crypt. subtotal	122	0.9		21,300	7.2	4
Chroomonas acuta	73	0.6		3,700	1.3	
Komma sp.	24	0.2		2,400	0.8	
group total	220	1.7		27,400	9.3	
Dinophyceae (dinoflagellates)						
Gymnodinium sp. (large)	24	0.2		19,500	6.6	5
group total	24	0.2		19,500	6.6	
Cyanophyta (blue-greens)						
Chroococcus sp. (cells)	49	0.4		6,100	2.1	
Microcystis sp.	488	3.8		1,000	0.3	
Synechococcus sp. (coccoid)	1,366	10.6	3	5,500	1.9	
Synechococcus sp. (rod)	6,854	53.1	1	27,400	9.3	3
Synechocystis	49	0.4		400	0.1	
group total	8,805	68.2		40,400	13.7	
GRAND TOTAL	**12,903**			**294,400**		

Table D7. Phytoplankton enumeration for Rockford Bay

ROCKFORD 04/03/10 1-8.0 m	Natural counting units/mL	% of total	Rank	Biovolume μm^3/mL	% of total	Rank
Bacillariophyceae (diatoms)						
Achnathidium sp.	12	0.2		1,000	0.2	
Asterionella formosa	378	5.3	3	37,800	8.8	3
Aulacoseira italica	1,110	15.6	2	166,500	38.7	1
Fragilaria capucina	159	2.2		11,900	2.8	
Navicula sp. (medium)	12	0.2		6,100	1.4	
Rhizoselenia sp.	12	0.2		600	0.1	
Synedra nana	12	0.2		900	0.2	
Tabellaria fenestrata	317	4.4		111,000	25.8	2
group total	2,012	28.2		335,800	78.1	
Chlorophyceae (coccoid greens, desmids, etc.)						
Golenkinia sp.	49	0.7		7,300	1.7	
Monoraphidium	12	0.2		2,400	0.6	
Nephroselmis	85	1.2		8,900	2.1	
Scourfieldia	24	0.3		700	0.2	
Tetraedron	12	0.2		600	0.1	
group total	183	2.6		19,900	4.6	
Chrysophyceae (yellow-green flagellates)						
Chromulina sp.	61	0.9		1,200	0.3	
Chrysochromulina sp.	12	0.2		900	0.2	
Chrysococcus	61	0.9		4,600	1.1	
Ochromonas sp.	85	1.2		12,800	3.0	
Small microflagellates	4,122	57.8	1	20,600	4.8	
Uroglena sp. (cells)	24	0.3		500	0.1	
group total	4,366	61.2		40,600	9.4	
Cryptophyta (flagellates)						
Chryptomonas sp. (large)	12	0.2		4,300	1.0	
Chryptomonas sp. (medium)	24	0.3		4,300	1.0	
crypt. subtotal	37	0.5		8,600	2.0	
Komma sp.	207	2.9		20,700	4.8	
group total	244	3.4		29,300	6.8	
Dinophyceae (dinoflagellates)						
group total	0	0.0		0	0.0	
Cyanophyta (blue-greens)						
Chroococcus sp. (cells)	24	0.3		3,000	0.7	
Synechococcus sp. (coccoid)	98	1.4		400	0.1	
Synechococcus sp. (rod)	207	2.9		800	0.2	
group total	329	4.6		4,200	1.0	
GRAND TOTAL	**7,135**			**429,800**		

Table D7 continued.

ROCKFORD 06/09/10 1-7.0 m	Natural counting units/mL	% of total	Rank	Biovolume µm³/mL	% of total	Rank
Bacillariophyceae (diatoms)						
Asterionella formosa	976	9.3	4	97,600	35.4	1
Fragilaria capucina	512	4.9		38,400	13.9	2
Synedra nana	73	0.7		5,100	1.8	
group total	1,561	14.8		141,100	51.1	
Chlorophyceae (coccoid greens, desmids, etc.)						
Ankistrodesmus sp.	73	0.7		5,900	2.1	
Monoraphidium	24	0.2		4,900	1.8	
Nephroselmis	24	0.2		2,500	0.9	
Scourfieldia	73	0.7		2,200	0.8	
group total	195	1.9		15,500	5.6	
Chrysophyceae (yellow-green flagellates)						
Chrysococcus	98	0.9		7,300	2.6	
Ochromonas sp.	24	0.2		3,700	1.3	
Small microflagellates	1,488	14.1	3	7,400	2.7	
group total	1,610	15.3		18,400	6.7	
Cryptophyta (flagellates)						
Chryptomonas sp. (large)	24	0.2		8,500	3.1	
Chryptomonas sp. (medium)	122	1.2		21,300	7.7	
crypt. subtotal	146	1.4		29,800	10.8	3
Chilomonas sp.	49	0.5		12,200	4.4	
Chroomonas acuta	49	0.5		2,400	0.9	
Komma sp.	73	0.7		7,300	2.6	
group total	317	3.0		51,700	18.7	
Dinophyceae (dinoflagellates)						
Gymnodinium sp. (small)	49	0.5		9,800	3.6	
group total	49	0.5		9,800	3.6	
Cyanophyta (blue-greens)						
Chroococcus sp. (cells)	97.6	0.9		12,200	4.4	
Microcystis sp.	487.8	4.6		1,000	0.4	
Synechococcus sp. (coccoid)	2707.4	25.7	2	10,800	3.9	
Synechococcus sp. (rod)	3146.5	29.9	1	12,600	4.6	
Synechocystis	365.9	3.5		2,900	1.1	
group total	6,805	64.6		39,500	14.3	
GRAND TOTAL	**10,537**			**276,000**		