WHITEMUD RIVER
WINTER 2020 WATER QUALITY ASSESSMENT

Report Prepared for Stantec

By

Jay Toews, R.P.Bio., P. Biol.

March 2021

TOEWS ENVIRONMENTAL LTD.

Consulting and Aquatic Sciences

Toews Environmental Ltd.
Consulting & Aquatic Sciences

Jay Toews, R.P.Bio., P. Biol.
597 Elm Street
Winnipeg, MB
R3M 3N7
204 479 4235
ToewsEnvironmental.ca

March 25, 2021

Stephen Biswanger, P.Eng.
Stantec
500–311 Portage Avenue, Winnipeg, Manitoba R3B 2B9
stephen.biswanger@stantec.com

Re: Final Report: Whitemud River Winter 2020 Water Quality Assessment

Dear Mr. Biswanger,

I am pleased to submit the enclosed final report, *Whitemud River Winter 2020 Water Quality Assessment*. The report provides interpretation of data collected in February 2020 to assess water quality in the Whitemud River between Neepawa and Gladstone, Manitoba, during the ice-cover season. Together with the summer water quality assessment and model report submitted in June 2020, it is intended to support planning and licensing of increased wastewater volumes in the R3 Innovations Inc. (R3II) facility, which treats wastewater from the HyLife hog processing facility in Neepawa.

The findings of the winter assessment support conclusions and recommendations from the summer assessment pertaining to local impairments to water quality in the Whitemud River. The impairments include vulnerability to depressed dissolved oxygen concentrations, as well as high phosphorus concentrations in the river in the Neepawa area, partly reflective of accumulated historical loadings. It is recommended that overall Biochemical Oxygen Demand (BOD) loading to the river not be increased significantly over current (2020) loading and that overall phosphorus releases in the area be reduced to below historical levels, to prevent further accumulation of phosphorus and negative impacts in the river.

In recent years, BOD and phosphorus discharges from the R3II facility have been well below their licensed limits and a minor contributor to the total loads in the river. The proposed increase in wastewater volume in the R3II facility can be accommodated provided the effluent continues to be of superior quality relative to the current licensed limit and provided any related increase in phosphorus loading is balanced by a larger reduction from other sources, to a achieve a net reduction in overall loading to the river.

I understand that the draft of this report was reviewed by Stantec and HyLife. I trust that it, together with the summer water quality assessment and model report submitted previously, will provide valuable guidance for current and future planning on the Whitemud River with respect to wastewater treatment and effluent release.

I thank you for the opportunity to work with you on this meaningful project.

Sincerely,

Jay Toews, R.P.Bio., P. Biol.
Toews Environmental Ltd.
Jay.Toews@ToewsEnvironmental.ca

WHITEMUD RIVER
WINTER 2020 WATER QUALITY ASSESSMENT

EXECUTIVE SUMMARY

Toews Environmental Ltd. was retained by Stantec Consulting Ltd. (Stantec), on behalf of HyLife Foods LP (HyLife), to assess water quality in the Whitemud River under ice-covered winter conditions based on historical data and data produced by Stantec in a field study conducted from February 24 to February 28 2020. The assessment follows a similar assessment for the open-water season, reported on previously, and is intended to support possible application by HyLife to increase the licensed volume of effluent discharge from the R3 Innovations Inc. (R3II) wastewater treatment facility, which treats wastewater from the HyLife hog processing facility just downstream of Neepawa, Manitoba.

The February 2020 study followed heavy precipitation prior to freeze-up in fall 2019, which saturated soils and may have led to higher-than-typical incremental flow along the river channel during the winter. Mass-balance analysis of measured chemical parameters suggested that incremental inflows in the order of 15% of the total river discharge may have occurred in the lower portion of the study reach between Neepawa and Gladstone.

River discharge measured at six sites within the study reach averaged 0.187 m^3/s. As this result was below the 0.2 m^3/s assumed to be a minimum release from Lake Irwin, upstream of the study reach, it supported the recommendation from the summer assessment that a target minimum flow be established for the river.

In historical data collected from 1974 to 2018, dissolved oxygen concentrations were below the Manitoba Water Quality Objective (Instantaneous Minimum of 3 mg/L) in 15% of samples collected during the winter at monitoring stations downstream of Neepawa. The R3II facility began operating in 2009, and all winter measurements collected from 2011 to 2018 were above this Objective. The data suggest that the river generally meets the dissolved oxygen Objective but is vulnerable to depression of oxygen concentrations, which may impair its ability to sustain the sensitive species of aquatic life such as cool-water fish that would be expected to inhabit the river.

During the February 2020 field study, the total loading of Biochemical Oxygen Demand (BOD) to the Whitemud River in the R3II effluent was 1.6% of the maximum permitted by the facility's *Environment Act* Licence 2870 RRR, based on carbonaceous BOD and ammonia Limits stipulated in the Licence. The effluent's low BOD, as well as aeration in the receiving wetland before its outlet to the river, resulted in negligible net oxygen demand to the river. Based on inferential interpretation of nutrients and metals data, extensive anoxia did not occur along the study reach of the river at the time of the study.

Phosphorus data from the February 2020 study corroborate the conclusion from the assessment of summer 2019 conditions that elevated phosphorus concentrations occur in the Whitemud River between Neepawa and Gladstone, likely due to remobilization of phosphorus historically accumulated in

the sediments from excessive loading to the river in the Neepawa area. Therefore, the winter assessment supports the recommendation from the summer assessment that overall phosphorus loading to the river in the Neepawa area be reduced to below historical levels.

Observations in February 2020 of abundant fish within the wetland that receives warm effluent from the R3II facility, and of wildlife indicative of fish presence in the open-water plume in the river, suggest that seasonal entrainment of fish into the thermal plume and wetland may be occurring. It is suggested that a study of this entrainment and its possible effects on the local fish community be conducted unless a means is implemented of cooling the effluent prior to its discharge to the wetland.

Concentrations of carbonaceous BOD, ammonia and phosphorus in the R3II effluent during the February 2020 field study were lower than the background (upstream) concentrations in the Whitemud River. Therefore, as per the summer assessment, the proposed 46% increase in effluent volume would not be expected to result in negative impacts to the river, provided a similar final effluent quality is maintained.

Table of Contents

List of Tables

List of Figures

WHITEMUD RIVER
WINTER 2020 WATER QUALITY ASSESSMENT

1) Introduction and Background

Toews Environmental Ltd. (TEL) was retained by Stantec Consulting Ltd. (Stantec), on behalf of HyLife Foods LP (HyLife), to assess water quality in the Whitemud River with respect to possible effects of treated effluent discharge from the R3 Innovations Inc. (R3II) wastewater treatment facility. The R3II facility receives and treats wastewater from the HyLife hog processing facility in Neepawa, Manitoba, under terms of *Environment Act* Licence 2870 RRR. The assessment will inform an application to increase the Licence's effluent discharge Limit from 1570 m^3/day to 2290 m^3/day, to support expansion of the HyLife facility.

In June 2020, TEL produced a report entitled "*Whitemud River Summer Water Quality Assessment & Model*", which included interpretation of historical data and a water quality model developed from data produced in field studies conducted by Stantec in July and September 2019. That report included a recommendation that total phosphorus loading to the Whitemud River from point sources in the Neepawa area be reduced to below historical levels to reduce, or begin to reverse, accumulating negative impacts to water quality and aquatic habitat in the river.

The summer assessment and model report (Toews 2020) also identified low dissolved oxygen concentrations as an impairment to the river's ability to support sensitive species of aquatic life. The model and data showed that the low dissolved oxygen concentrations were primarily the result of high primary productivity fueled by excessive phosphorus, and that the oxygen and Biochemical Oxygen Demand (BOD) levels in the R3II effluent were protective of water quality in the river at the time of the study.[1] The report noted, however, that an assessment of water quality should be completed in winter, when ice cover would reduce aeration, possibly leading to depressed oxygen levels.

As part of the recommended winter assessment, Stantec conducted a field study in February 2020 and produced a report (Stantec 2020) describing the methods used and data collected. This report by TEL provides additional data analysis, interpretation, and assessment of water quality in the Whitemud River in winter conditions, based on the February 2020 field study and historical data.

[1] The R3II facility's effluent quality in 2019 and previous years was superior to the Limits stipulated in the facility's *Environment Act* Licence.

2) Conditions during the February 2020 Field Study

2.1 Effluent Discharges

The winter field study took place from February 24 to February 28, 2020. At that time, the Town of Neepawa municipal wastewater facility, which normally discharges effluent to the Whitemud River in spring and fall, had not discharged since the end of October.

Based on daily data provided by HyLife, effluent discharge from the R3II facility ranged from 0.019 m^3/s to 0.024 m^3/s and averaged 0.022 m^3/s from two days prior to the sampling period to the end of the sampling period (from February 22 to February 28 2020). Similar to during the summer 2019 field studies, the R3II effluent quality was superior to the Limits stipulated in *Environment Act* Licence 2870 RRR. The concentrations of BOD, ammonia and phosphorus in the R3II effluent, based on measurements collected during the field study (Stantec 2020) and reported by HyLife, were as follows:

- BOD: Less than the analytical reporting limit of 2.0 mg/L in all measurements;
- Total ammonia nitrogen: 0.018 mg/L to 0.12 mg/L;
- Total phosphorus: 0.035 mg/L to 0.04 mg/L.

All of the values listed above were less than the background (upstream) concentrations in the Whitemud River measured at Site 1 during the field study.

As described in the winter data report (Stantec 2020), the R3II facility discharges its effluent via a pipe into a wetland that flows into the Whitemud River approximately 300 m from the discharge pipe. Total phosphorus concentrations measured at the wetland outlet were notably higher than in the R3II effluent (by a factor of 2.7) and in the river at Site 1, upstream of the outlet (by a factor of 1.8). The increase in phosphorus concentrations between the R3II effluent and the wetland outlet may be the result of:

- Exchange of water in the wetland with the river and/or groundwater;
- Attenuated release of phosphorus accumulated in the wetland from brief periods of higher phosphorus discharge from the R3II facility; and/or,
- External sources of nutrients such as waterfowl inhabiting the wetland.

Comparison of the chemistry between the wetland outlet sample and the R3II effluent collected from the discharge pipe suggests that some mixing of effluent and river water had occurred in the wetland outlet sample, possibly due to mixing of the wetland outflow and the river at the location the sample was collected. The following parameters, which had higher concentrations in the R3II effluent than in the upstream (Site 1) river water (by a factor of three or more), decreased by more than 30% between the R3II discharge pipe and the wetland outlet sample:

- Chloride, fluoride, antimony, cesium, chromium, cobalt, molybdenum, nickel, rubidium, vanadium.

Conversely, the following parameters, which had lower concentrations in the R3II effluent than in the upstream (Site 1) river water (by a factor of three or more), increased by more than 30% between the R3II discharge pipe and the wetland outlet sample:

- Arsenic, barium, lithium, strontium, uranium.

Mass-balance analysis of some parameters listed above indicates that although the parameters' concentrations changed between the R3II discharge pipe and the wetland outlet, their loads were conserved between the R3II discharge and Sites 1 and 3 in the river. The mass-balance analysis is described in Section 2.4 with respect to loads of selected parameters along the river.

2.2 Weather

Weather varied during the February 24-28 2020 field study, with daytime highs ranging from -10.0°C to 0.5°C and overnight lows ranging from -17.2°C to -11.0°C at Carberry, approximately 40 km south of the study area (Environment and Climate Change Canada 2020). Reported snow cover at Carberry was 24-25 cm (Environment and Climate Change Canada 2020), and measurements of snow cover on the ice, within approximately 2 m of the centre of the Whitemud River channel, ranged from 3 cm to 20 cm in the field study (Stantec 2020).

The sampling event immediately followed three days in which the daytime high air temperature exceeded 0°C by as much as 2.3 °C, but in no time in December 2019, January 2020 or February 2020 did the daily mean temperature exceed 0°C (Environment and Climate Change Canada 2020). Therefore, atypical surface runoff or melting of the river ice were not confounding factors in the study.

2.3 Whitemud River Flows

Discharges (flows) in the Whitemud River during the fall and winter preceding the winter 2020 field study are presented in Figure 1. Heavy precipitation in September and October 2019 caused extensive surface runoff in the Whitemud River watershed that resulted in record-high river discharge in early to mid-October (Water Survey Canada 2020a,b). River discharge at Keyes, near the mid-point of the study reach between Neepawa and Gladstone, peaked at 6.05 m^3/s on October 19 (Water Survey Canada 2020a). Discharge at Westbourne, downstream of the study reach, peaked at 28.6 m^3/s on October 20 2019 (Water Survey Canada 2020b).

At the seasonally-operated gauge near Keyes, discharge on the last day of measurement (October 31 2019) was 1.17 m^3/s. As mean daily temperatures had begun remaining below zero several days earlier (Environment and Climate Change Canada 2020), the river likely became frozen over at that time.

Continuous discharge measurements collected farther downstream at Westbourne remained high through the winter. During the sampling period, discharge in the river at Westbourne was at approximately the 75th percentile, measured as 1.33 m^3/s on February 27 2020 (Water Survey Canada 2020b).

Discharge measurements collected by Stantec at the six sampling sites between February 24 and February 28 2020 ranged from 0.099 m^3/s at Site 1 to 0.328 m^3/s at Site 3 and did not show an upstream/downstream trend (Stantec 2020). Adding the additional discharge of the R3II effluent (average 0.022 m^3/s as described in Section 2.1) to the Site 1 value gives six discharge measurements averaging 0.187 m^3/s ± 0.077 m^3/s (95% confidence interval) in the study reach during the sampling period.

The average measured discharge of 0.187 m^3/s was less than the assumed minimum release of 0.2 m^3/s from Lake Irwin, upstream of Neepawa. The summer assessment (Toews 2020) identified that establishment of a target minimum flow in the river would aid the assessment of potential impacts from wastewater discharges and protect the ecological integrity of the river.

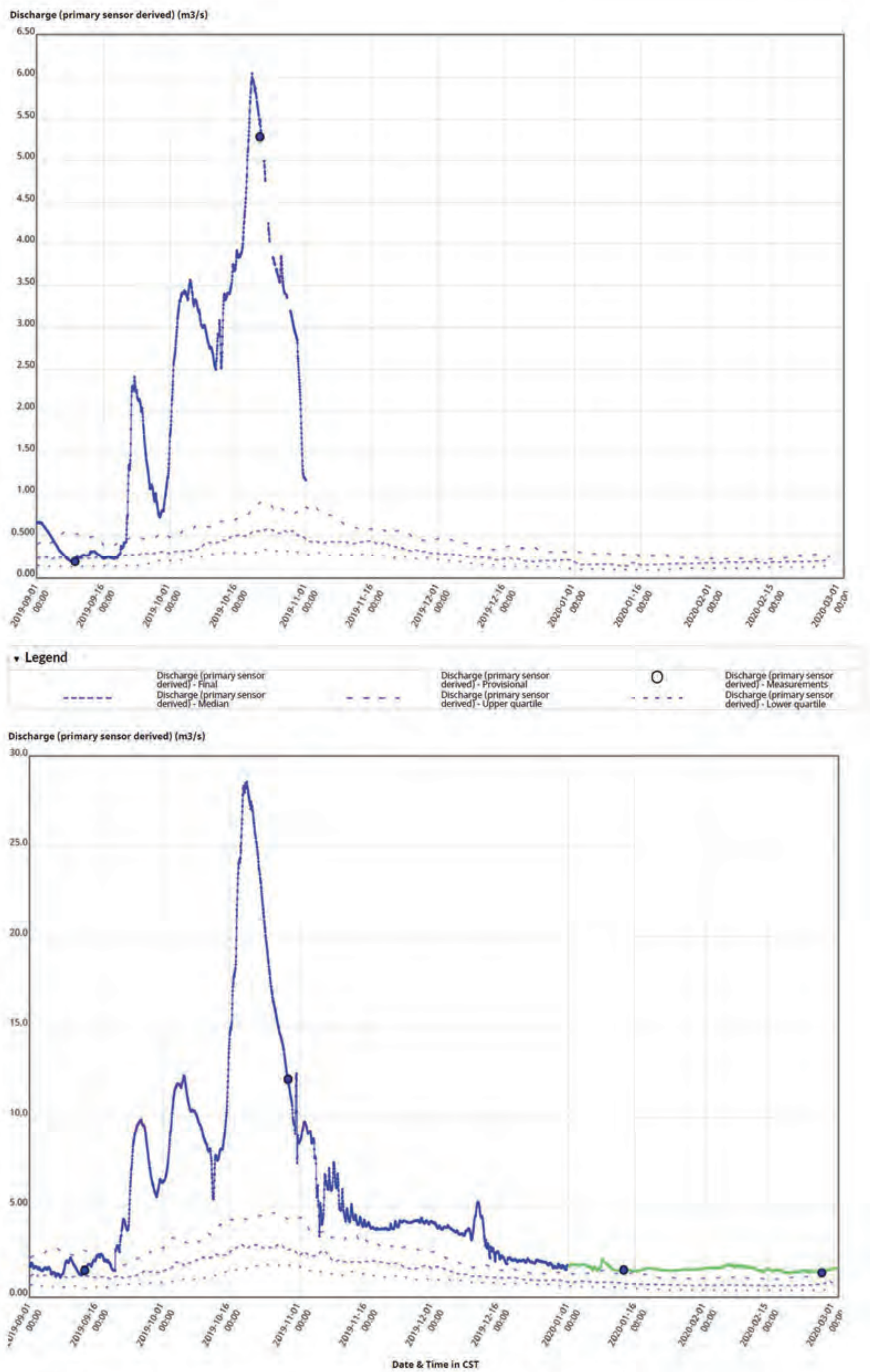


Figure 1. Flows in the Whitemud River from September 1 2019 to March 1 2020 at Water Survey Canada Gauges 05LL005 near Keyes (top) and 05LL002 at Westbourne (bottom). (Water Survey Canada 2020 a,b.)

2.4 Additional Inflows to the River

Tributary flows, groundwater discharge or other inflows that may occur along the Whitemud River may have been unusually high during the winter of 2019/2020 due to the saturation of soils and filling of sloughs that occurred with the heavy precipitation prior to freeze-up. Incremental increases in river discharge were not detected in discharge (flow) measurements collected at the six sampling stations along the river during the field study in February 2020. However, the concentrations of several measured parameters decreased between the upstream and downstream ends of the study reach, suggesting possible dilution by inflows. Mass-balance analysis of dissolved parameters in the river water may provide an indirect means of quantifying the possible inflows that would be responsible for this dilution.

To identify relatively conservative parameters most suitable for mass-balance analysis along the river channel, several parameters were assessed in terms of the proportion of the upstream (Site 1 plus R3II) loads that were measured, or “recovered”, at Site 2. The parameters showing the highest recovery were deemed least influenced by assimilation and best suited for evaluating mass-balance of loads along the river channel further downstream. The four parameters showing the highest recovery of upstream loads at Site 2 were:

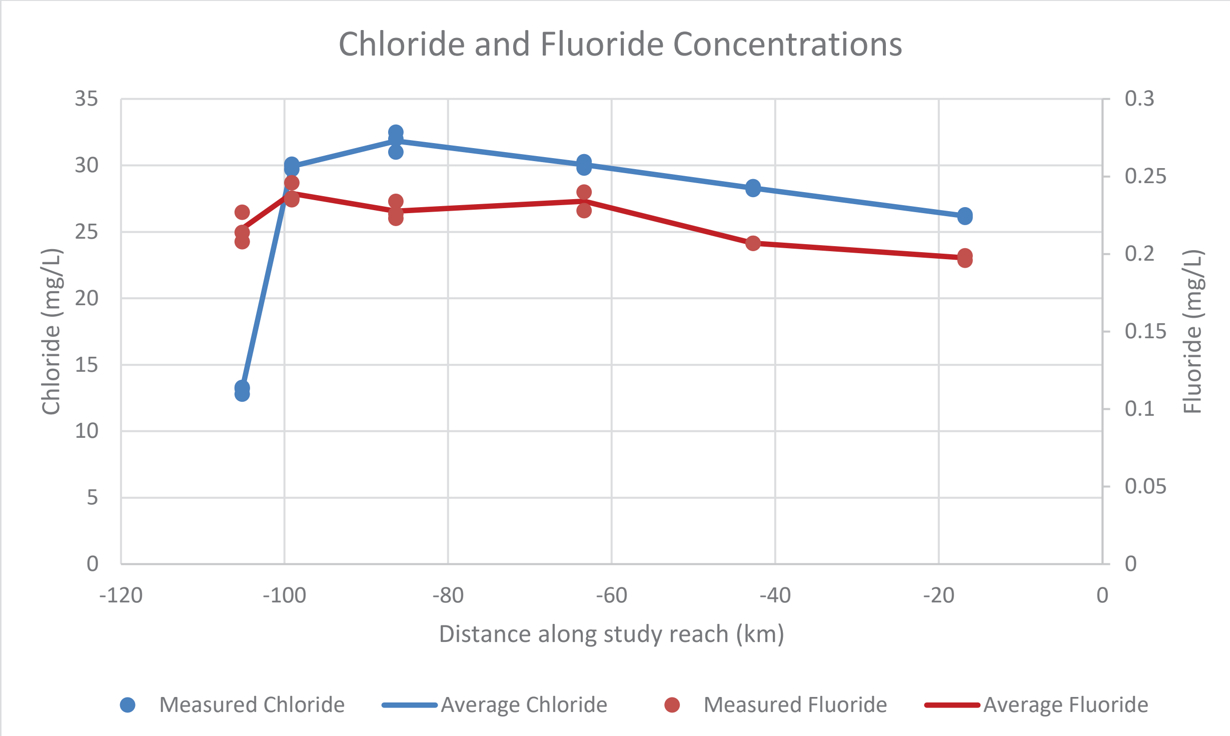
- Cobalt (92.1 % recovery);
- Fluoride (89.4 % recovery);
- Rubidium (49.1 % recovery); and,
- Chloride (47.2 % recovery).[2]

The concentrations of these four parameters decreased between Site 4 and 5 and between Site 5 and 6, as shown in Figure 2. The decreases in concentration could have resulted from:

- Dilution by groundwater or other inflows to the river downstream of Site 4;
- Differences along the river caused by variation in effluent loading from the R3II facility, as the water sampled at Sites 2-6 likely had passed by the R3II facility on different days; and/or,
- Assimilation by sediments and growing vegetation along the channel.

If it is assumed that the decreases were attributable entirely to dilution by inflows, the loads of each parameter, shown in Figure 3, can be used to calculate the inflow. Table 1 summarizes the apparent load reductions (or dilutions) that occurred along the study reach of the river. Based on the average change for cobalt, fluoride and rubidium (excluding chloride, due to its likely prevalence in groundwater), the inflow between Site 4 and Site 6 was approximately 14.6% of the total river flow. At the average measured river discharge of 0.187 m^3/s, this inflow would have been approximately 0.027 m^3/s. However, given the uncertainty associated with the possible assimilation of measured ions along the river channel as described above, administration of a more conservative tracer (e.g. rhodamine B) would be required to discern incremental inflows along the river with greater precision.

[2] Analysis of the September 2019 dataset produced results of 95.5% recovery of fluoride and 73.4% of chloride at Site 2. In both datasets, concentrations of chloride and other ions were higher at Site 3 than at Site 2. The higher salt concentrations at Sites 3 and 4 may reflect attenuated release of accumulated salts in the wetland and river downstream of the effluent outfalls at Neepawa.



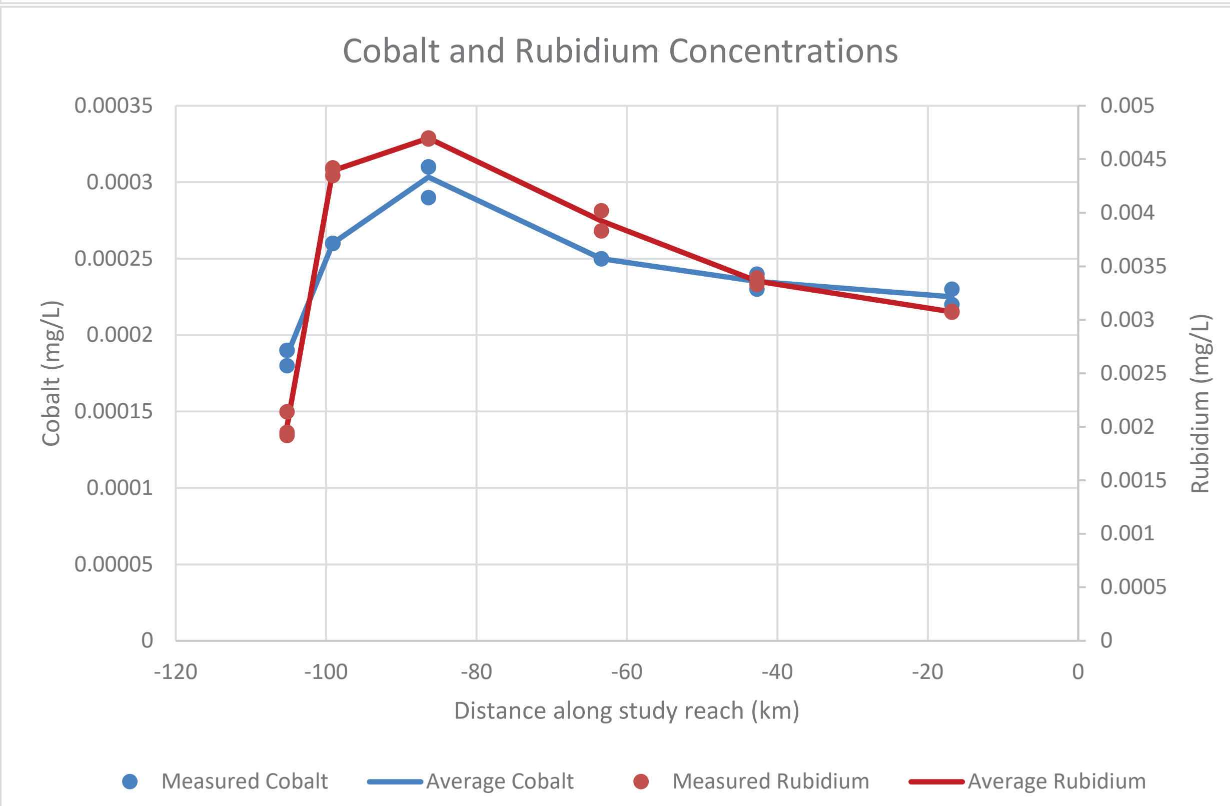


Figure 2. Chloride, fluoride, cobalt and rubidium concentrations in the Whitemud River, February 24-28 2020.

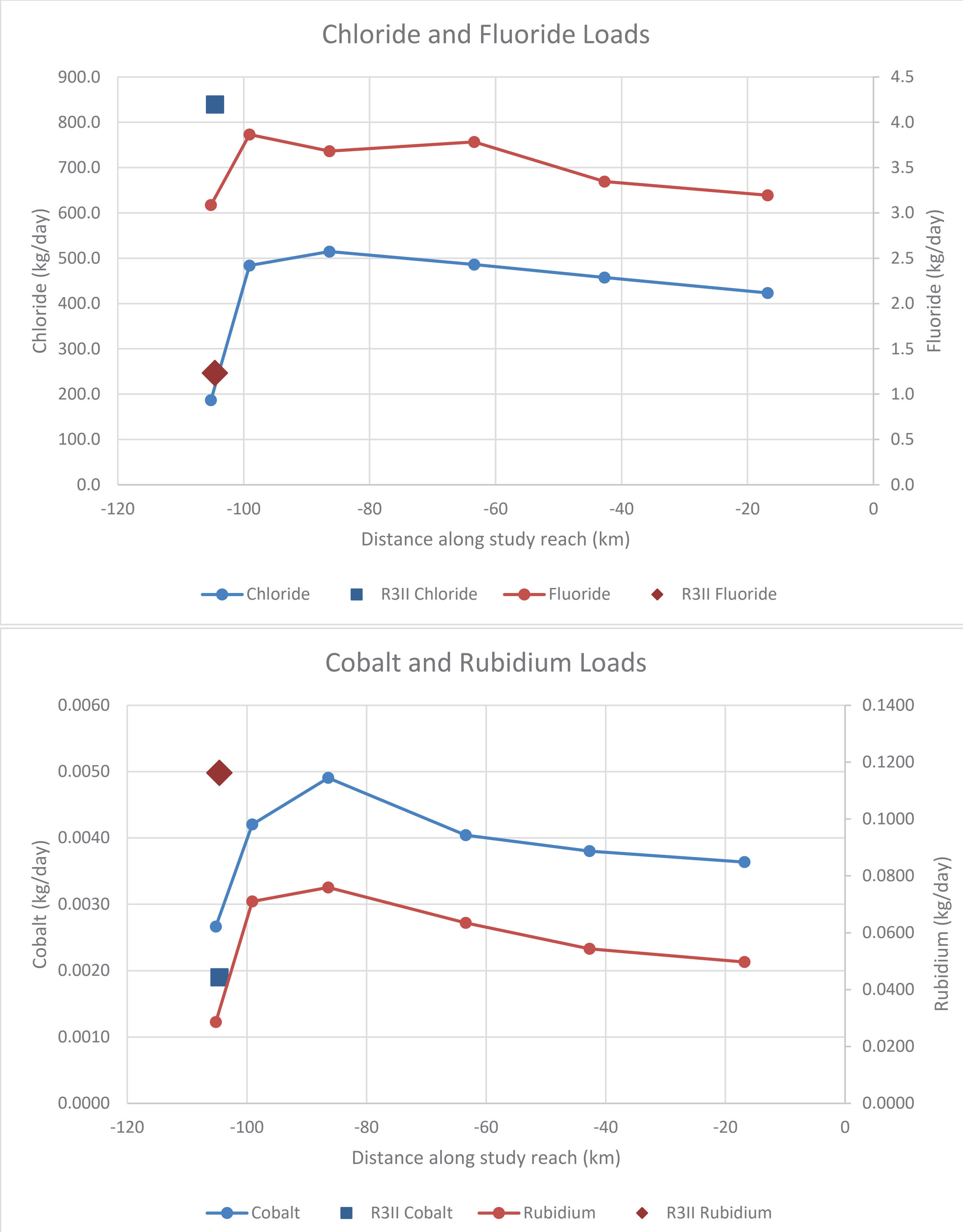


Figure 3. Chloride, fluoride, cobalt and rubidium loads in the Whitemud River, February 24-28 2020, and in the R3II effluent on February 24 2020.

Table 1. Percentage of upstream (Site 1 plus R3II) loads indicated by concentrations of chloride, fluoride, cobalt and rubidium at Sites 2 to 6, assuming a uniform river discharge of 0.187 m^3/s.

	Chloride	Fluoride	Cobalt	Rubidium
Site 2	47.2	89.4	92.1	49.1
Site 3	50.1	85.2	107.5	52.4
Site 4	47.3	87.6	88.6	43.8
Site 5	44.6	77.4	83.3	37.5
Site 6	41.3	73.9	79.7	34.3
% difference between Sites 2-4 (average) and Site 5	3.6	9.9	12.8	10.9
% difference between Site 5 and Site 6	3.3	3.6	3.5	3.2
% difference between Sites 2-4 (average) and Site 6	6.9	13.5	16.3	14.1

3) Results of the Winter 2020 Assessment

The data collected in the February 2020 field study are presented in the "*Winter field data report for water quality study for HyLife Foods facility expansion*" (Stantec 2020). The following sections of this report describe additional analysis and interpretation of those data pertinent to identified impairments to water quality in the Whitemud River and to potential impacts of the R3II effluent.

3.1 Nutrients and Primary Production

Concentrations of the total and bioavailable fractions of major nutrients, shown in Figure 4, showed little variation among the sampling sites along the river except for phosphorus, which was elevated in the middle of the study reach relative to the upstream and downstream ends despite the diluting effect of the R3II effluent. This localized elevation of phosphorus concentration is consistent with the localized phosphorus release from the sediments identified in the summer assessment and model (Toews 2020) and is discussed in Section 3.3.

The bioavailable (total reactive) fraction of phosphorus, presented in Figure 4, showed more variability among sites than the other parameters. However, the apparent spike in reactive phosphorus at Site 3 is likely an anomaly associated with hydrolysis of polyphosphates in the sample (possibly caused during sample handling, as discussed in Section 3.3). The high average value at Site 6 appears to be an erroneous outlier caused by the higher duplicate measurement that neither fits with the other replicate at the site, nor with the ortho-phosphate value for that sample, nor with those measured values at sites further upstream. It is likely that the apparent rise in reactive phosphorus between Site 5 and Site 6 is exaggerated and that the concentrations followed a pattern similar to the bioavailable nitrogen and silica concentrations along the stream.

As would be expected during the winter, primary production by phytoplankton and benthic algae appears to have been low in the Whitemud River during the February 2020 field study. Chlorophyll *a*, an indicator of phytoplankton concentrations, was less than or equal to 3 µg/L at all sampling sites. The uniformity of the concentrations of the major nutrients required by benthic algae (Figure 4) suggests little net growth of benthic algae or vegetation in the river channel. It is possible that primary productivity was lower in February 2020 than in most winters, as the flushing flows that occurred just prior to freeze-up may have scoured benthic algae from the riverbed. Increased growth of benthic algae would be expected later in winter, with increased daylight.

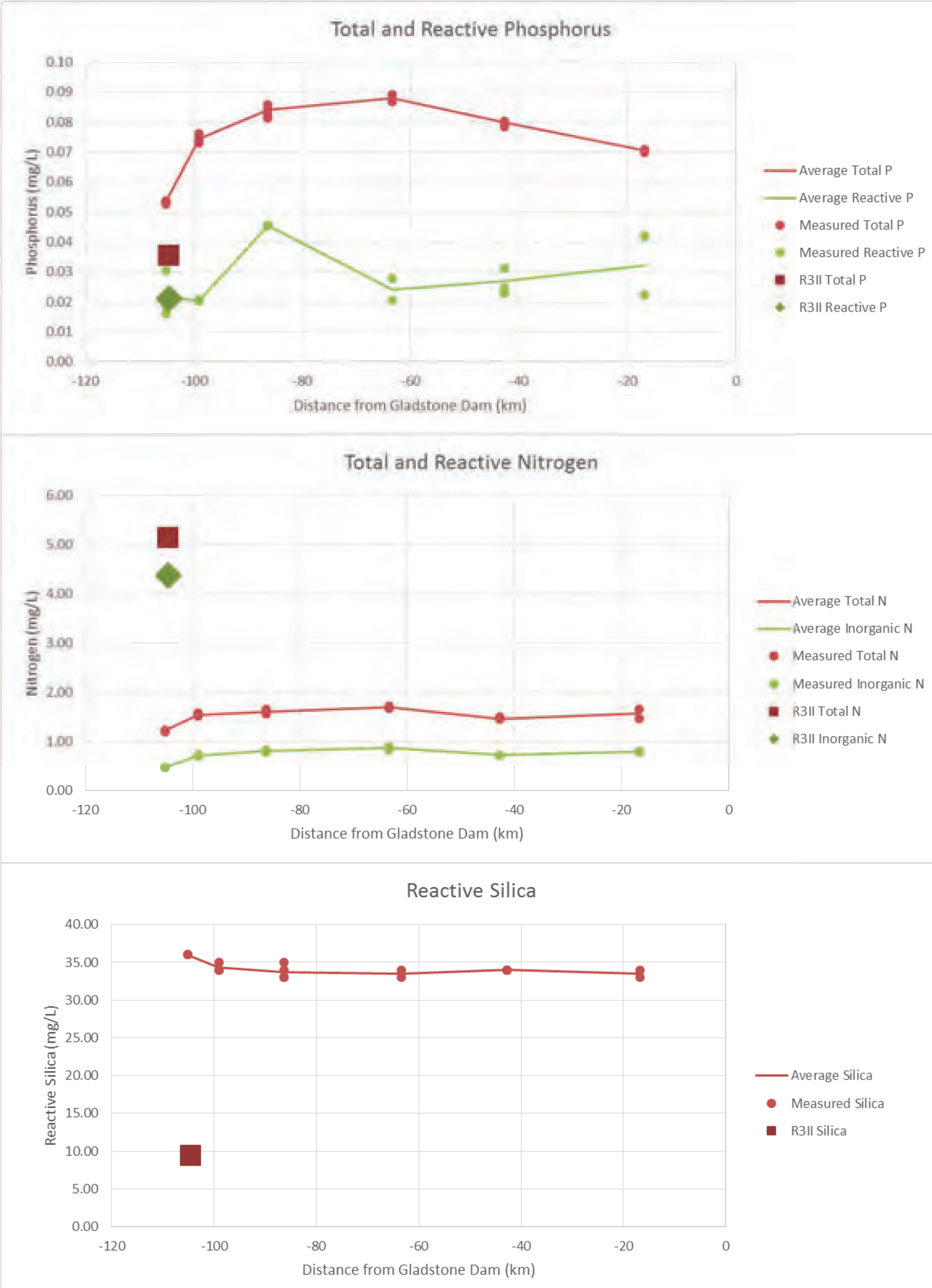


Figure 4. Phosphorus, Nitrogen and Silica concentrations in the Whitemud River and R3II effluent, February 24-28 2020.

3.2 Nitrogen

Total nitrogen concentrations in the Whitemud River, shown in Figure 4, averaged 1.23 mg/L at Site 1, upstream of the R3II effluent outfall, and 1.58 mg/L at the 5 sites downstream of the outfall. In terms of loads, these concentrations suggest some assimilation of nitrogen just downstream of the effluent discharge and little net assimilation along the river downstream of Site 2. (The calculated total nitrogen loads, based on a uniform river discharge of 0.187 m^3/s, were 17.5 kg/day at Site 1, 9.8 kg/day in the R3II effluent, and average of 25.5 kg/day at Sites 2 to 6.)

Figure 5 shows the composition of the inorganic nitrogen fractions (ammonia, nitrate and nitrite) measured in samples collected in the February 2020 field study. Concentrations of nitrite in all samples collected from the river were below the analytical reporting limit of 0.02 mg/L. Nitrite in the sample collected from the R3II outfall was less than the analytical reporting limit of 0.05 mg/L.

The highest ammonia concentration measured was 0.19 mg/L, at Site 2. All ammonia concentrations measured in the river and in the R3II effluent were below the Manitoba Water Quality Objective for protection of cool-water aquatic life (Manitoba Water Stewardship 2011). All nitrate concentrations measured in the river and in the R3II effluent were below the Manitoba Water Quality Guideline of 13 mg/L for protection of freshwater aquatic life (Manitoba Water Stewardship 2011).

The highly-oxidized nitrogen speciation shown in Figure 5 (absence of nitrite and dominance by nitrate) is indicative of well-oxygenated water in the river at the time of sampling. This is discussed further in Section 3.4.

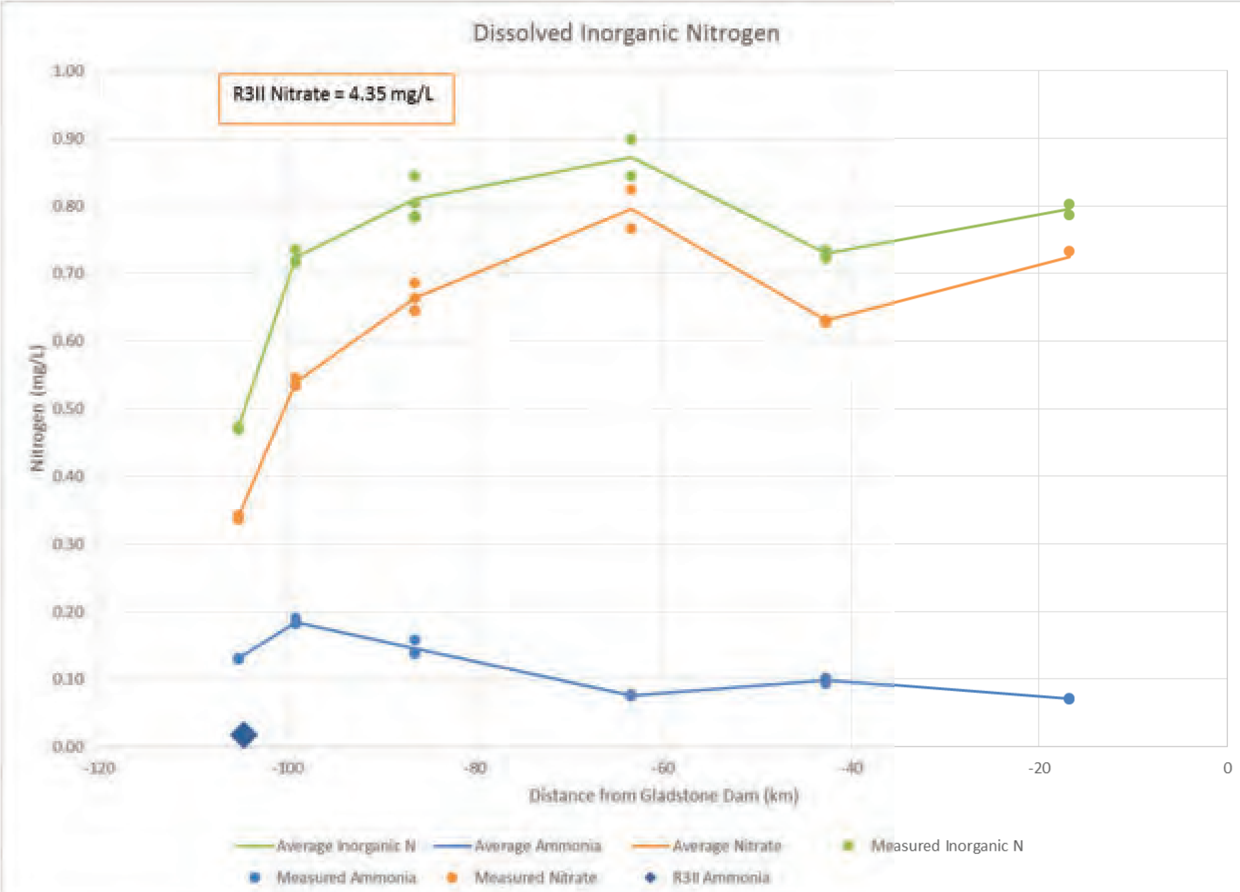


Figure 5. Inorganic nitrogen concentrations in the Whitemud River and R3II effluent, February 24-28 2020.

3.3 Phosphorus

The average total phosphorus concentration in the Whitemud River at Site 1, upstream of the R3II effluent outfall, was 0.053 mg/L, just above the Narrative Manitoba Water Guideline of 0.05 mg/L (Manitoba Water Stewardship 2011). Downstream of Site 1, average total phosphorus concentrations increased to a peak of 0.088 mg/L at Site 4, despite dilution by the R3II effluent, which had a total phosphorus concentration of 0.035 mg/L. Downstream of Site 4, phosphorus concentrations dropped to just below those measured at Site 2 (Figure 6).

Figure 6 shows that the increase in phosphorus concentrations in the middle of the study reach was attributable to increased concentrations of the acid-hydrolyzable fraction of inorganic phosphorus.[3]

[3] The apparent switch in dominance between ortho-phosphate and acid-hydrolyzable phosphorus at Site 2, seen in Figure 6, appears to be an anomaly without probable cause in the river. It is likely that the samples from Site 2 were unintentionally acidified prior to analysis, which would have converted a portion of the acid-hydrolyzable phosphorus to ortho-phosphate.

This elevation of acid-hydrolyzable phosphorus concentrations, highest between Site 2 and Site 5, is consistent with the finding in the summer 2019 assessment that substantial inorganic phosphorus release from the sediments occurs in this reach of the river. As discussed in the summer assessment report (Toews 2020), this localized sediment phosphorus release may be caused by accumulated historical phosphorus loading in the Neepawa area.

The release of inorganic phosphorus from the riverbed sediments would occur either as reductive dissolution of ferric and manganese compounds under anaerobic conditions, or as release of mineralized phosphorus from organic matter on the riverbed. Figure 7 shows that the pattern of total iron and manganese concentrations in the river did not match that of inorganic phosphorus. Therefore, the phosphorus release from the sediments during the February 2020 sampling program was likely more reflective of remineralization of phosphorus in the benthic biofilm (predominantly, the previous year’s benthic algae and associated bacterial assemblage). While anoxia likely occurred in the sediments in at least some areas, the phosphorus and metals data do not indicate that it was extensive along the river. Conditions in the river pertaining to oxygen are discussed more in Section 3.4.

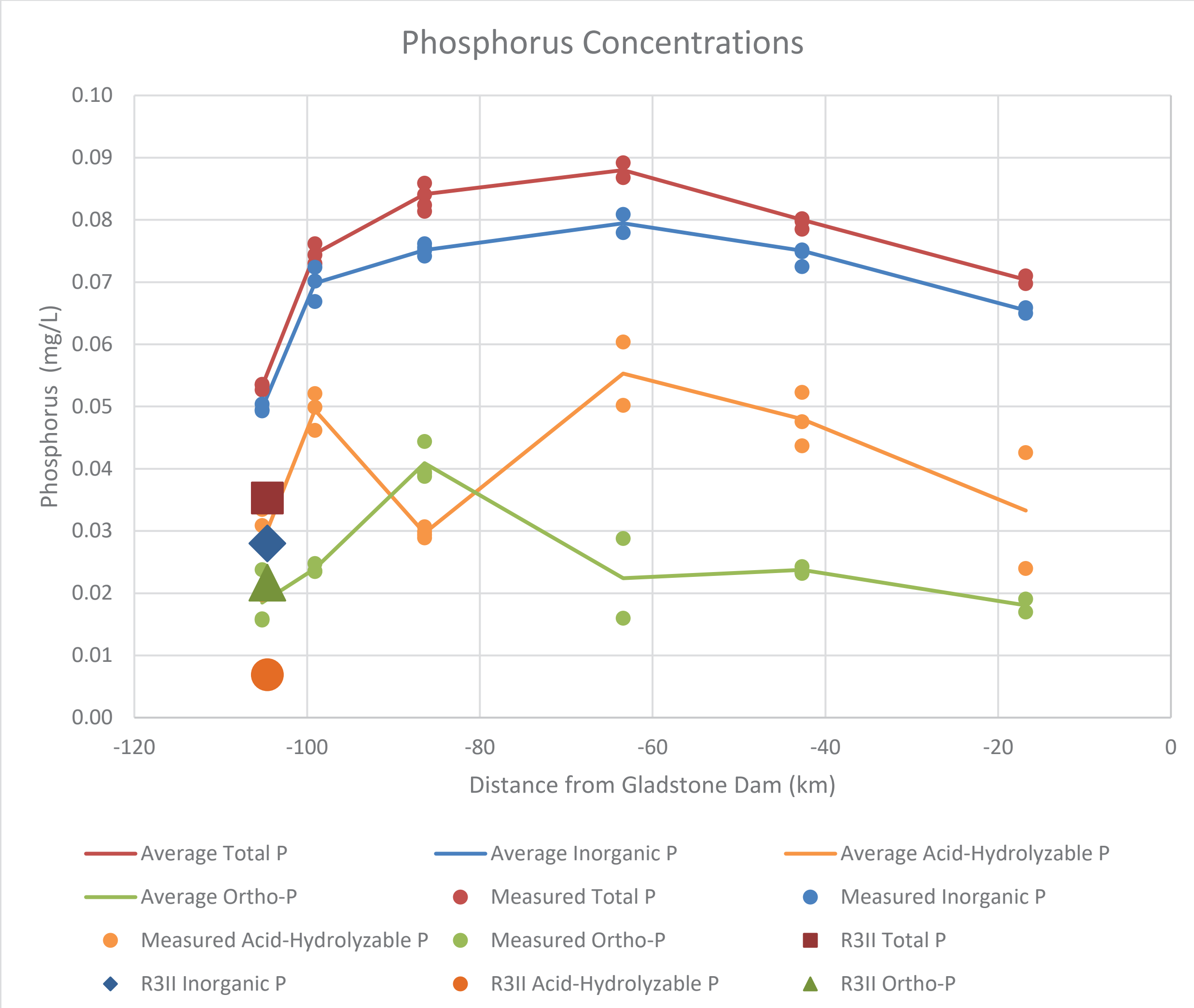


Figure 6. Total and inorganic phosphorus concentrations in the Whitemud River and R3II effluent, February 24-28 2020.

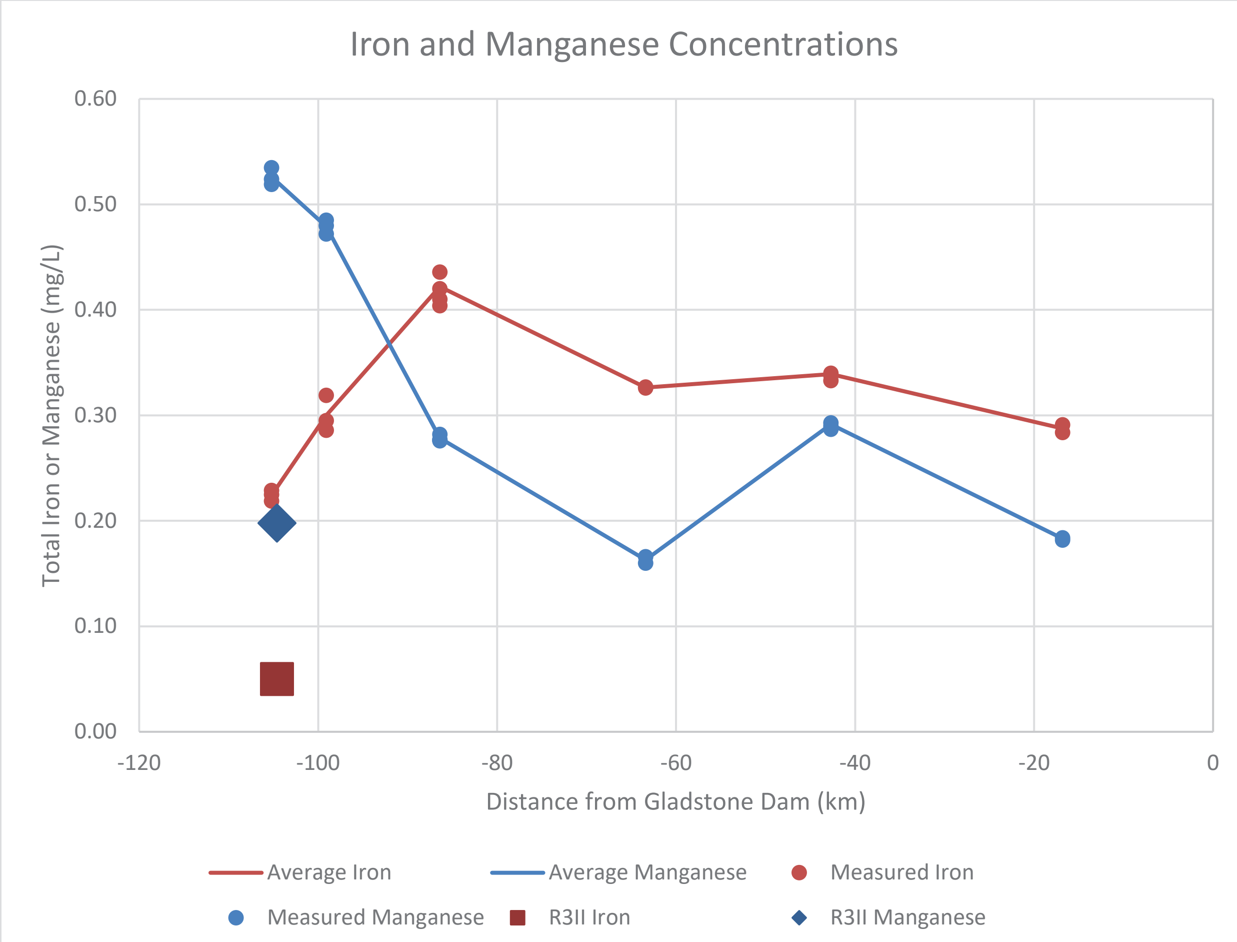


Figure 7. Total iron and manganese concentrations in the Whitemud River and R3II effluent, February 24-28 2020.

3.4 Dissolved Oxygen

3.4.1 February 2020 Field Study

Dissolved oxygen data were not obtained in the February 2020 sampling event (Stantec 2020), but indirect indication of oxygen levels in the river can be inferred from the nutrients and related data described in the preceding sections of this report. Most notably:

- The nitrogen speciation was strongly dominated by nitrate, nitrite was undetectable, and ammonia did not increase along the study reach (Section 3.2). These observations suggest that the water column was not anoxic.
- Based on instream iron and manganese concentrations, the apparent release of mineralized phosphorus from the riverbed sediments was associated primarily with desorption from organic matter (Section 3.3). Therefore, while some anoxia in the riverbed sediments would be

expected and was likely, the available data do not suggest that extensive anoxia occurred along the study reach.

Based on the above considerations, some anoxia likely occurred in the riverbed sediments but it was not strong enough to cause extensive anoxia in the overlying water column. While dissolved oxygen concentrations in the water cannot be estimated with precision, they may have been high enough in February 2020 to support sensitive species of aquatic life such as cool-water sport fish.

3.4.2 Historical Data

The provincial water quality database includes dissolved oxygen data for the period 1974-2018 at long-term monitoring stations at Westbourne (downstream of the 2019-2020 study reach) and on Boggy Creek (also known as the Whitemud River) upstream of its confluence with Stony Creek at Neepawa. Additional data exist for prior to 1993 for two stations within the study reach including at Gladstone (Station MB05LS003, just downstream of Site 6 but upstream of the Gladstone Dam), as well as additional stations upstream and downstream of the study reach.

The complete dataset for the winter season, defined as December 1 to March 15 inclusive, is presented in Figure 8. The figure shows that dissolved oxygen measurements collected during the winter varied widely from year to year at all stations. However, all measurements at the upstream stations were above the Manitoba Water Quality Objective of 3.0 mg/L for protection of cool-water aquatic life (Manitoba Water Stewardship 2011). At stations within and downstream of the Neepawa-Gladstone reach of the river, 15% of measurements were below this Objective, both before and after the R3II facility began operation in 2009, but not since 2010.

These data indicate that the Whitemud River downstream of Neepawa is generally above the Objective but vulnerable to severe depression of oxygen concentrations (below 3 mg/L) during the winter, which may impair its ability to sustain the sensitive species of aquatic life such as cool-water fish that would be expected to inhabit the river.

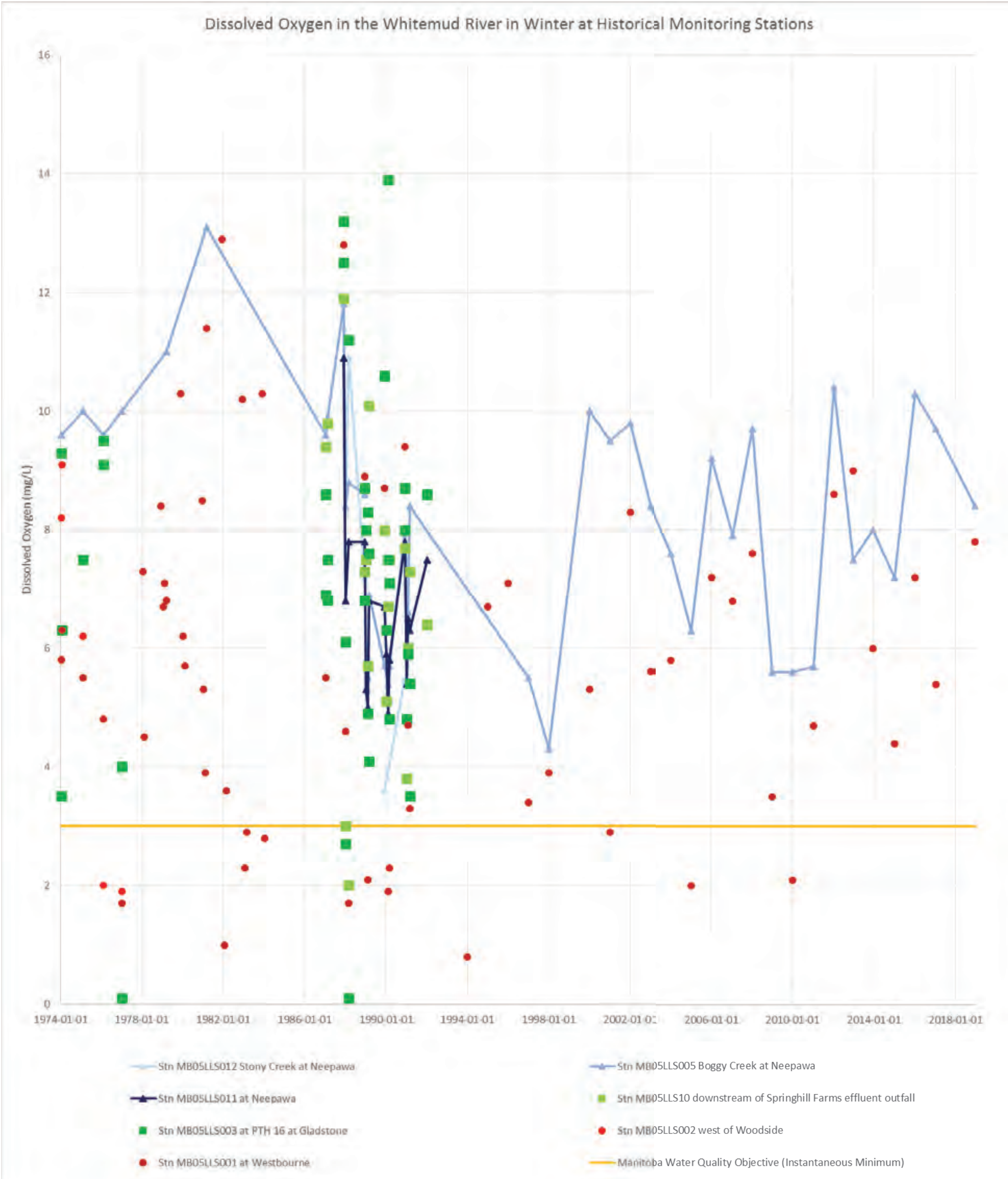


Figure 8. Dissolved oxygen in the Whitemud River at historical monitoring stations upstream (3 stations – blue lines), within (two stations – green squares), and downstream (two stations – red circles) of the 2019-2020 study reach. Data provided by Manitoba Agriculture and Resource Development (2020).

3.4.3 Effect of R3II Effluent on Dissolved Oxygen

During the February 2020 field study, the R3II effluent had carbonaceous BOD and ammonia concentrations of <2 mg/L and 0.018 mg/L, respectively, at the point where it was discharged into the receiving wetland. The 1.13 ha (2.8 acre) surface of the wetland was ice-free, resulting in aeration of the effluent before it entered the Whitemud River. Due to the very low carbonaceous and nitrogenous oxygen demand in the effluent, and to its aeration in the wetland, the effluent will have had a negligible impact on total BOD loads and no significant direct negative effect on dissolved oxygen in the river during the February 2020 sampling event.

Due to its small water volume under ice cover and low flows, the Whitemud River would have little capacity for additional oxygen demand during the winter. Importantly, BOD and ammonia in the R3II effluent during sampling and throughout the winter of 2019/2020 were well below the facility's licensed discharge Limits of 25 mg/L carbonaceous BOD and 12.14 mg/L ammonia nitrogen (at measured pH of 7.8). The carbonaceous BOD and ammonia concentrations measured in the field study were approximately 4% and 0.15% of these Licence limits, respectively, or 1.6% of the total licensed BOD load to the river. Furthermore, the Town of Neepawa municipal wastewater treatment facility had not discharged since the end of October but is planning to initiate year-round discharge under terms of Licence 3270, which stipulates limits of 25 mg/L carbonaceous BOD and daily ammonia loads up to 74 kg/day in winter. It is possible that discharge of effluents from the R3II and Town of Neepawa municipal wastewater facilities may overwhelm the Whitemud River's assimilative capacity for oxygen demand, particularly if one or both facilities approach their Licence Limits.

3.5 Heat

As described in the "*Winter field data report for water quality study for HyLife Foods facility expansion*" (Stantec 2020), the R3II effluent during the February 2020 field study was discharged into the receiving wetland at a temperature of approximately 28°C. At the point of mixing with the Whitemud River, the water temperature was 3.6°C, and an open-water plume, approximately 1-2 m wide, extended approximately 110 m downstream along the riverbank (Stantec 2020).

Thermal effluents can cause mortality in fish and other aquatic biota through several mechanisms, including elevation of activity and metabolic state during seasons with inadequate food supply, as well as stimulation of temperature-dependent hormonal responses and associated behaviour, such as spawning, in inappropriate seasons. Where a thermal effluent plume extends some distance in a river, it can attract and thereby entrain fish into the warm water, leading to high densities of fish within the plume. In areas of temperate climate such as Manitoba, this effect can be pronounced in the fall season of dropping temperatures, when fish actively seek out the warmer water and then remain entrapped in the plume until spring.

Field observations in the February 2020 study included abundant small fish in the wetland below the R3II effluent discharge and River Otters in the open-water plume in the Whitemud River. It is recommended that the extent of fish entrainment within the plume and wetland be studied to determine its possible impact on the local fish community.

4) Synthesis and Recommendations

To complement an assessment of water quality in the Whitemud River conducted in summer 2019, a study under ice-covered conditions was conducted in February 2020. The study took place following heavy precipitation in fall 2019, which may have increased the incremental flows attributable to tributaries and groundwater along the river channel in the study reach between Neepawa and Gladstone. However, measured river discharge at the time of the study was 0.187 m^3/s, less than the assumed minimum release from Lake Irwin (0.2 m^3/s). This supports the conclusion determined in the summer assessment that lower flows are common in the river, as well as the recommendation that a target minimum flow be established.

Concentrations of carbonaceous BOD, ammonia and phosphorus in the R3II effluent during the February field study were less than the background (upstream) concentrations in the Whitemud River. Therefore, as per the summer assessment, the proposed 46% increase in effluent loading would not be expected to result in negative impacts to the river, provided a similar final effluent quality is maintained.

Total carbonaceous and nitrogenous BOD loading to the river in the R3II effluent was approximately 1.6% of that permitted under the facility's *Environment Act* Licence 2870 RRR. Based on inferential interpretation of nutrients and metals data, the river was not anoxic in the study reach. Historical data, however, show a 15% incidence of depression of dissolved oxygen to below the Manitoba Water Quality Objective (Instantaneous Minimum of 3 mg/L) downstream of the wastewater effluent discharges at Neepawa during the winter. It is recommended that additional study of dissolved oxygen in the river under ice-covered conditions be conducted if BOD loading is to increase during the winter in effluent discharges or other sources in the Neepawa area.

Phosphorus data from the February 2020 study corroborate the conclusion from the summer 2019 assessment that elevated phosphorus concentrations occur in the Whitemud River between Neepawa and Gladstone, possibly due to release of phosphorus historically accumulated from excessive loading to the river in the Neepawa area. Therefore, the winter assessment supports the recommendation that overall phosphorus loading to the river in the Neepawa area be reduced to below historical levels.

Observations in February 2020 of abundant fish within the wetland that receives thermal effluent from the R3II facility, and of wildlife indicative of fish presence in the open-water plume in the river, suggest that seasonal entrainment of fish into the thermal plume may be occurring. It is recommended that a study of this entrainment and its possible effect on the local fish community be conducted unless a means is implemented to cool the effluent prior to its discharge to the receiving wetland.

5) References

Environment and Climate Change Canada. 2020. Daily data report for February 2020, Station 5010547 at Carberry CS. https://climate.weather.gc.ca/climate_data/daily_data_e.html?StationID=27741&timeframe=2&StartYear=1840&EndYear=2020&Day=23&Year=2020&Month=2 accessed July 24 2020.

Manitoba Agriculture and Resource Development. 2020. Whitemud Watershed water quality data. February 13 2020. Water Quality Management Section, Manitoba Agriculture and Resource Development, 200 Saulteaux Crescent, Winnipeg MB R3J 3W3.

Manitoba Water Stewardship. 2011. Manitoba Water Quality Standards, Objectives and Guidelines. Water Science and Management Branch. Manitoba Water Stewardship Report 2011-01.

Stantec. 2020. Winter field data report for water quality study for HyLife Foods facility expansion. Draft report, April 30 2020.

Toews, J. 2020. Whitemud River Summer Water Quality Assessment & Model. Report prepared for Stantec by Toews Environmental Ltd. June 2020. vii + 39 pp. + 1 appendix (28 pp.).

Water Survey Canada. 2020a. Real-time discharge data for Gauging Station 05LL002 at Westbourne. https://wateroffice.ec.gc.ca/report/real_time_e.html?stn=05LL002&mode=Graph&startDate=2019-09-01&endDate=2020-03-01&prm1=47&y1Max=&y1Min=&median1=1&upper1=1&lower1=1&prm2=-1&y2Max=&y2Min= accessed July 25 2020.

Water Survey Canada. 2020b. Real-time discharge data for Gauging Station 05LL005 near Keyes. https://wateroffice.ec.gc.ca/report/real_time_e.html?stn=05LL005&mode=Graph&startDate=2019-09-01&endDate=2020-03-01&prm1=47&y1Max=&y1Min=&median1=1&upper1=1&lower1=1&prm2=-1&y2Max=&y2Min= accessed July 25 14 2020.

6) Closure

The information and recommendations provided in this report reflect the professional judgement of the author. They rely upon data and information including those provided by accredited laboratories, those obtained from cited reports previously released by other consultants, those provided by Manitoba Agriculture and Resource Development, and those provided directly by the client. Those data and information have not been verified by Toews Environmental; therefore, no warranty is made pertaining to the data, information or recommendations developed from them beyond the professional diligence of the author.

Contents of this report have undergone review by Stantec and HyLife Foods LP.

This report has been prepared exclusively for Stantec and HyLife. Any use by third parties without the written consent of Stantec and Toews Environmental Ltd. is prohibited.

Report prepared by:

____

Jay Toews, R.P.Bio., P. Biol.

Toews Environmental Consulting and Aquatic Sciences

Field Data Report for Water Quality Study for Hylife Foods Facility Expansion

Final Report

October 20, 2021

Prepared for:

Hylife Foods LP

Prepared by:

Stantec Consulting Ltd.
500-311 Portage Avenue
Winnipeg, MB R3B 0B9

111440368

Sign-off Sheet

This document entitled FIELD DATA REPORT FOR WATER QUALITY STUDY FOR HYLIFE FOODS FACILITY EXPANSION was prepared by Stantec Consulting Ltd. ("Stantec") for the account of Hylife Foods LP (the "Client"). Any reliance on this document by any third party is strictly prohibited. The material in it reflects Stantec's professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party. Such third party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party as a result of decisions made or actions taken based on this document.

Prepared by ______________________________

(signature)

Johanna Theroux, M.Sc.

(signature)

Stephen Biswanger, P.Eng.

Approved by ____________ ____________________

(signature)

Dave Morgan, Ph.D., P.Eng.

Table of Contents

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

Abbreviations

AFDW	Ash Free Dry Weight
BOD	Biochemical Oxygen Demand
DO	Dissolved Oxygen
NTU	Nephelometric Turbidity Unit
PAR	Photosynthetically Active Radiation
PTH	Provincial Trunk Highway
TDS	Total Dissolved Solids
TKN	Total Kjeldahl Nitrogen
TN	Total Nitrogen
TP	Total Phosphorus
TSS	Total Suspended Solids
WSC	Water Survey of Canada

1.0 BACKGROUND

The planned expansion of the Hylife Foods LP (Hylife) pork processing facility in Neepawa, Manitoba to process up to 9,000 hogs/day via an expansion in hog production, and the addition of a 1,000 sow/day sow processing facility will increase wastewater to be treated by the associated R3 Innovations Inc. wastewater treatment facility (R3 Innovations). R3 Innovations has been in operation since it was licensed in 2009. The processing increase will result in a need for R3 Innovations to treat and discharge up to an additional 720 m^3/day of effluent (totaling 2,290 m^3/day) to the Whitemud River, a 46% increase over the existing licensed effluent volume of 1,570 m^3/day. In addition, the Town of Neepawa currently operates a wastewater treatment lagoon system, which discharges seasonally into the Whitemud River upstream of the R3 Innovations discharge point. The Town of Neepawa is currently upgrading their lagoon system with a new outfall structure and a continuous discharge and is scheduled to be operational in late 2020.

A review of the available information on the Whitemud River identified relatively little current hydrological and water quality information to describe the Whitemud River. Previous assessments of the Whitemud River by Earth Tech (2008) for the initial development and licensing of R3 Innovations included water quality data from the Province of Manitoba from 1990-1992 and hydrological data from the Water Survey of Canada (WSC) gauging stations 05LL011 and 05LL009 from 1961-1992.

A water quality study is underway to develop a comprehensive understanding of the Whitemud River in its present state, and to better understand and define the required R3 Innovations treatment upgrade(s) to accommodate the planned increase in wastewater production. The study will include consideration of the combined effects of increased effluent discharge from R3 Innovations and the Town of Neepawa's upgraded lagoon wastewater treatment system on the Whitemud River.

The water quality assessment includes development of an open-water water quality model supported by data collected in 2019 and 2020. This report summarizes the data collected in the summer and fall of 2019 representing open water conditions; data collected under ice-covered conditions in 2020 is reported separately.

2.0 WATER QUALITY PROGRAM

The field program was developed by Stantec with consideration of the previous Earth Tech program and knowledge of current conditions, and sampling locations were selected in conjunction with the Town of Neepawa. Stantec carried out the field program with access provided/facilitated by the Town of Neepawa, consenting private land owners, and public roads. Six sites were selected for the water quality program encompassing approximately 75 km of the Whitemud River from the Town of Neepawa downstream to near the Town of Gladstone, Manitoba (**Appendix A; Figure 1-1**).

2.1 TIMING OF EVENTS

The open water field program was completed over a total of eight days from July 22-25, 2019, and September 9-12, 2019. The collected data will be combined with other available data to characterize the receiving conditions in the Whitemud River during open water conditions. The July 2019 dataset includes the effect of the summertime seasonal release of the Town of Neepawa's wastewater lagoon, as Cell 3 was actively being discharged from July 9-28, 2019, influencing the entire duration of the July sampling.

2.2 SAMPLING SITES

Six sampling sites on the Whitemud River were identified based on ease of access, ability to characterize baseline data (upstream site) and ability to characterize potential effluent effects (downstream sites). The sites are located along a section of the Whitemud River that is approximately 75 kilometers in length from the Town of Neepawa, downstream to the Town of Gladstone (**Appendix A; Figure 1-1**) (**Appendix B; Photolog**). The sites were chosen to be representative of the Whitemud River, selected considering avoidance of potential anomalies, including major upstream tributary inflows and uncharacteristic land use activities, in order to characterize typical open water stream conditions. Water samples were also collected directly from both the Town of Neepawa's lagoon effluent discharge (July release) and R3 Innovations wastewater discharge to characterize the direct wastewater inputs to the Whitemud River.

Site 1 is located within the Neepawa Golf and Country Club course, 304 meters upstream of the Town of Neepawa's lagoon Cell 3 effluent discharge point and approximately 565 meters upstream of the point where the R3 Innovations discharge meets the Whitemud River. This site represents the background water quality in the Whitemud River. Site 1 is located in the previously studied "Model Reach 2" (Earth Tech 2008).

The R3 Innovations discharge is located south of the Whitemud River where the outfall structure discharges into a low-lying wetland area, which then flows northeastwardly and discharges into the river approximately 245 m downstream. The Town of Neepawa lagoon discharge is located at GPS location 14 U 5565064N 468854E, approximately 270 m upstream of the point where the R3 Innovations discharge meets the Whitemud River.

Site 2 is located approximately 5.4 km downstream of the point where the R3 Innovations discharge meets the Whitemud River. The site was accessed with permission via private property known locally as

Watson's Yard. The property includes an active cattle pasture and watering area where cattle frequently cross the river and shoreline areas to drink. Site 2 is located in the previously studied "Model Reach 3" (Earth Tech 2008).

Site 3 is located approximately 17.7 km downstream of the point where the R3 Innovations discharge meets the Whitemud River. The site is located immediately upstream of a 3600 mm culvert road crossing, adjacent to pasture land. Riparian vegetation was present; however, evidence of livestock access to the riverbank was observed approximately 100 meters upstream of the site. Site 3 is located in previously studied "Model Reach 5" (Earth Tech 2008).

Site 4 is located approximately 38.7 km downstream of the point where the R3 Innovations discharge meets the Whitemud River. Site 4 is located adjacent to paved highway 352, north of Provincial Trunk Highway (PTH) 16 approximately 15 m upstream of the bridge. The site included grass and shrub vegetation with steep banks and evidence of soil erosion due to bank failure and large amounts of deadfall were present under the bridge, which had a flow restricting effect. Site 4 is located in previously studied "Model Reach 8" (Earth Tech 2008).

Site 5 is located 58.6 kilometers downstream of the point where the R3 Innovations discharge meets the Whitemud River. The riparian areas are well vegetated with emergent vegetation, upland grasses, broadleaved plants, and deciduous trees and shrubs. The site is located upstream of a concrete bridge with proximate land use being agricultural cropland. A residence is located approximately 43 m upstream of the sampling location. Site 5 is located in previously studied "Model Reach 16" (Earth Tech 2008).

Site 6 is located 82.8 km downstream of the point where the R3 Innovations discharge meets the Whitemud River. The site is located immediately upstream of a 4 x 1200 mm low level culvert crossing. The riparian area is well vegetated with emergent vegetation, upland grasses, broadleaved plants, deciduous trees and shrubs. Evidence of erosion was observed on the left channel bank (north side), with approximately 1 m of horizontal undercutting apparent directly upstream of the crossing. Deadfall and debris were observed at this site, creating a flow restriction. The sampling transect was located immediately upstream of the debris. Site 6 is located in previously studied "Model Reach 17" (Earth Tech 2008).

Table 2-1 below presents the river distance from each site to the Gladstone Dam, to correspond to the previous modelling work (Earth Tech, 2008).

Table 2-1 Distance of Selected Sites to Gladstone Dam to Correspond to Previous Model (Earth Tech 2008)

Location	UTM Coordinates	Distance to Gladstone dam (km)	Model Reach # (Earth Tech 2008)
Site 1	14U 5564864N 468867E	98.08	2
Neepawa Lagoon effluent discharge	14U 5565064N 468854E	97.87	2
R3 Innovations discharge	14 U 5565001N 468997E	97.52	2
Site 2	14U 5566524N 469989E	92.68	3
Site 3	14U 5567495N 474751E	80.38	5
Site 4	14U 5564498N 482789E	59.38	8
Site 5	14 U 5558016N 488794E	39.45	16
Site 6	14U 5560433N 500249E	15.27	17

2.3 PARAMETERS

2.3.1 *In-Situ* Water Monitoring

In-situ water quality data was collected at all six sites as part of the July and September sampling events, with monitoring conducted at surface (approximately 10 cm below the water surface) and bottom (approximately 10 cm above the bottom of the channel bed). The *in-situ* parameters measured included:

- Water temperature (°C)
- Dissolved oxygen (DO) (mg/L)
- Specific Conductivity (µS/cm)
- pH
- Oxidation Reduction Potential (ORP) (mV)
- Turbidity (NTU)
- Total dissolved solids (TDS)(g/L)
- Photosynthetically Active Radiation (PAR) Profile (µmol)
- Depth (m)– 1 m intervals across the channel width
- Velocity (m/s)– 1 m intervals across the channel width
- Approximately 12-hour (overnight) dissolved oxygen (DO) (mg/L) – select locations

2.3.2 Water and Periphyton Sampling

Water samples were collected at all six sites, the Town of Neepawa's lagoon effluent discharge (July only), and the R3 Innovations effluent discharge for analysis of the following parameters by an accredited laboratory (ALS Laboratories):

- Alkalinity- HCO_3, CO_3, OH (mg/L)
- Biochemical Oxygen Demand- Nitrogenous and Carbonaceous (mg/L)
- Silica- Reactive Soluble (mg/L)
- Total Metals (µg/L)
- Ammonia (mg/L)
- Carbon- Total Inorganic, Organic and Dissolved (mg/L)
- Total Nitrogen (mg/L)
- Chlorophyll a (mg/L)
- Phosphorus- Soluble Reactive, Dissolved and Particulate (mg/L)
- Fecal Coliforms (#/100 mL)
- *E.coli* (*Escherichia coli*) (#/100 mL)
- Nitrate and Nitrite (mg/L)
- Total and Volatile Suspended Solids (mg/L)
- Phytoplankton– taxonomy
- Periphyton– Ash Free Dry Weight (total g)
- Periphyton– Chlorophyll-a (µg/cm^2)

The analyte parameters were selected based on the required parameters for water quality modeling using the Qual2K water quality model, and to provide additional context for the water quality assessment.

2.3.3 Visual Characterization

A general, visual characterization was conducted at the 6 sites in both the July and September sampling events. The visual assessment included general observations and photographs of aquatic and riparian vegetation species, observed substrate and streambank characteristics, and notable site features (Table 4-1; **Appendix B**).

3.0 METHODS

3.1 SITE SELECTION AND ACCESSIBILITY

All sites were selected based on accessibility and ability to characterize representative conditions in the Whitemud River. Sites were accessed by vehicle on service, municipal, or private road and traversing riverbanks to the water's edge. Water sampling and *in-situ* monitoring was conducted by wading into and across the channel, except for Site 3 that required the use of a small 1.5 m inflatable watercraft due to depth of the water, flow, and substrate characteristics. To maintain the inflatable boat in a stable location during the sampling, a rope was secured to the fence line on either side of the channel, running across the width of the channel, and was used as a pulley system to maintain the watercraft in-place.

3.2 WATER QUALITY MONITORING

Water quality monitoring (*in-situ)* was conducted at all 6 sites at 3 approximately equally spaced subsampling locations (left, middle, right, facing downstream) (Figure 3-1). Surface (approximately 10 cm from surface) and bottom (approximately 10 cm from bottom) measurements were collected at each subsampling location, denoted with suffix "S" for surface and "B" for bottom, respectively. A summary of the *in-situ* water monitoring program, including sites and associated parameters, is presented in Table 3-1.

Water quality and flow data were also collected in the receiving waterbody directly downstream of the Hylife effluent outfall pipe during the September sampling event. No in-situ water quality monitoring was conducted during the July sampling event at the Neepawa or Hylife effluent outfalls as effluent discharge data were collected and provided by Hylife and the Town of Neepawa (further described in Section 4.2).

Table 3-1 Summary of the *In-Situ* Water Monitoring Program

July 2019	Parameters	Location
Water Quality	• Water temperature (°C) • Dissolved oxygen (DO) (mg/L) • Specific Conductivity (µS/cm) • pH • Oxidation Reduction Potential (ORP) (mV) • Turbidity (NTU) • Total dissolved solids (TDS)(g/L)	Sites 1-6 • left, middle, right, facing downstream; • surface and bottom
	• 12-hour (overnight) dissolved oxygen (DO) (mg/L)	Sites 1, 3, and 4 at approximately 0.6 m depth
Hydrology	• Depth (m) • Velocity (m/s)	Sites 1-6 • 1 m intervals across channel width
PAR Profiles	• µmol/m^2/s at approximately 20 cm depth intervals	Sites 1-6

Table 3-1 Summary of the *In-Situ* Water Monitoring Program

July 2019	Parameters	Location
		• 3 profiles: left, middle, and right; facing downstream
September 2019	**Parameters**	**Location**
Water Quality	• Water temperature (°C) • Dissolved oxygen (DO) (mg/L) • Specific Conductivity (µS/cm) • pH • Oxidation Reduction Potential (ORP) (mV) • Turbidity (NTU) • Total dissolved solids (TDS)(g/L)	Sites 1-5 • left, middle, and right; facing downstream; • surface and bottom Site 6 • 4 in-culvert measurements R3 Innovations discharge • 1 mid-stream point in receiving body below outfall pipe
	• 12-hour (overnight) DO readings (mg/L)	Sites 1, 2, and 4 at approximately 0.6 m depth
Hydrology	• Depth (m) • Velocity (m/s)	Sites 1-6 • 1 m intervals across channel width
	• In-culvert velocity, culvert width, and water depth measurement	• R3 Innovations discharge • Site 3 (1 culvert) • Site 6 (4 culverts)
PAR Profiles	• µmol/m^2/s at approximately 10 cm depth intervals	Sites1-6 • 1 profile (mid-stream)

In-situ water quality parameters were measured using a handheld multiparameter Horiba U-52, rented and calibrated from Maxim Environmental and Safety Inc. Two measurements were taken at each subsampling point approximately 10 cm below the water surface (denoted surface reading) and 10 cm above channel bottom (denoted bottom reading). The Horiba U-52 can take single measurements or interval measurements and was deployed overnight at three sites in both the July and September sampling events to collect overnight multiparameter readings (including DO). Interval measurements were collected by securing the probe to a cinder block anchor and anchoring it on the river's substrate approximately 20 cm off the bottom and approximately 2-4 m from the shoreline. The handheld unit was inserted into a plastic bag and bin, and the bin secured to the shore, locked to a tree/fencepost. In the September sampling event, *in-situ* measurements were also taken in the R3 Innovations effluent discharge at a mid-stream point directly downstream (approximately 0.5 m) from the effluent outfall structure in the receiving water body.

Channel velocity and effluent discharge data were collected to estimate effluent loading and streamflow characteristics for the Qual2K model. Hydrological data was collected to profile stream flow characteristics and channel morphology at each of the 6 sites in the Whitemud River. At each site, the channel width was measured from wetted edge to wetted edge across the width of the channel. Depth (m) and velocity (m/s) were then measured across the width of the channel at 1 m intervals using a handheld flow probe with attached measuring stick (Global Water StreamFlow Probe FP111) in July. Velocity measurements in September were conducted using a more precise instrument due to the relatively low flow characteristics of the Whitemud River encountered, an electromagnetic flow probe (Hach Flo-Mate FH-950/MF Pro with wading rod) in September. In the September sampling event, velocity and depth were also measured in the R3 Innovations effluent discharge by placing the flow probe vertically into the outfall pipe, measuring the effluent velocity as it was discharged to the wetland area. Discharge data for the Town of Neepawa wastewater lagoon was obtained from the Town of Neepawa for the July discharge event (the lagoon was not discharging during the September event). Additional data from the R3 Innovations discharge and the Town of Neepawa wastewater lagoon discharge is described further in Section 4.2.

Photosynthentically Active Radition (PAR) profiles were measured at all six sites during the July and September sampling events. All PAR profiles consisted of an average reading over 15 seconds collected at depth increments of 10-20 cm, from surface to bottom. Each PAR profile was collected with consideration for shadows, consistency of cloud cover, or other sources of light extinction which can affect PAR readings. The measurement describes how light is extinguished through the water column due to turbidity, suspended particles and phytoplankton. In July, three profiles per site were conducted including left, middle, and right; facing downstream (Figure 3-1) except for Site 4, where only two profiles were measured (left and right bank) due to decreasing light conditions at the time of measurement. The September 2019 field program was modified to collect only 1 PAR profile per site, at the approximate deepest point, generally in the mid-stream.

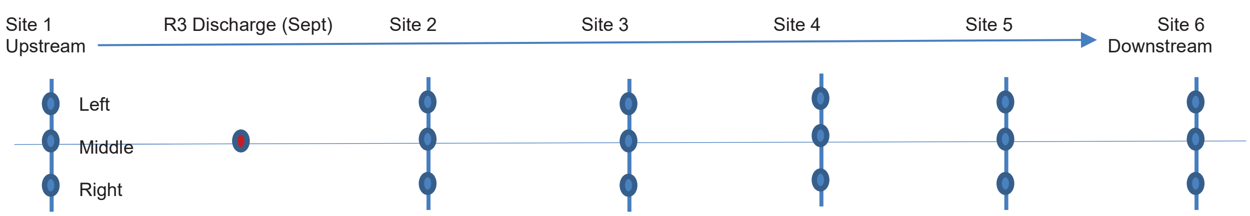


Figure 3-1 Conceptual Representation of *in-situ* Water Monitoring Design

3.3 WATER QUALITY SAMPLING

Water quality sampling (*ex-situ*) was conducted at all six sites with two to three approximately equally spaced subsampling points (left, middle, right, facing downstream) (Figure 3-2). Samples were collected at approximately 20-40 cm below surface, representing the mid-stream.

Water samples were also collected directly from the outfall pipes of the R3 Innovations discharge (in both July and September sampling event) and the Town of Neepawa lagoon discharge (July sampling event). The Town of Neepawa operates a seasonal discharge for their wastewater lagoon which was actively being discharged from July 9-28, 2019 corresponding to the July sampling event; while the R3 Innovations operates a continuous discharge.

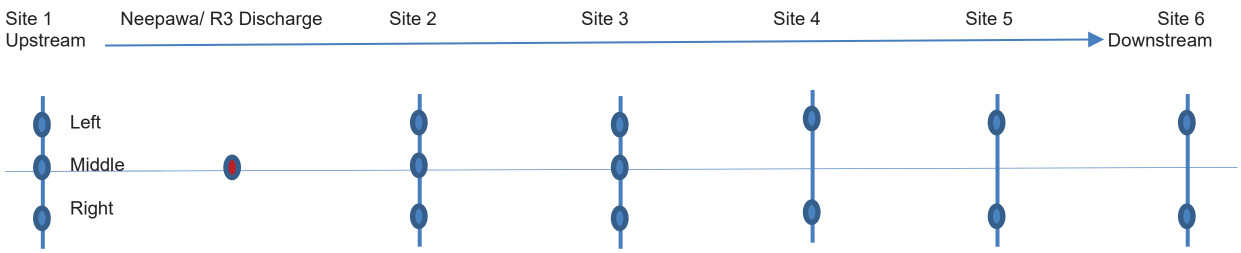


Figure 3-2 Visual Representation of *ex-situ* Water Sampling Design

All water samples from were collected using a telescopic pole grab sampler, with attached 1 L sample collection bottle. At Sites 1-6, the telescopic pole was used to collect the sample from upstream of the wading area, to avoid capturing disturbances associated with wading into the water. The 1 L collection bottle was rinsed three times with river water (deposited downstream) prior to collecting the sample. In July and September, two and three field duplicates, respectively were incorporated into the sampling program for quality assurance and quality control. Samples were preserved (if required) with laboratory prepared reagents, labelled, and stored on ice. Samples were delivered by courier to ALS Laboratory in Winnipeg, Manitoba, within approximately 48 hours of sample collection.

Phytoplankton sampling was collected by slowly lowering the water collection bottle into the water down the profile of the euphotic zone in order to collect a representative sample. Phytoplankton samples were preserved with Luguols solution and stored/shipped at room temperature to avoid damage to phytoplankton cellular structure.

Periphyton samples were collected at all six sites, with three subsamples each. Samples from Sites 1, 3, 4, 5, and 6 were collected by selecting 3 rocks near the Site location. Rocks were collected from approximately 30 cm depth. Samples from Site 2 included periphyton scrapings from pieces of woody debris, as no rocky substrate was present at the site. A plastic cutting board stencil with a 5 cm x 5 cm square hole was placed on the rock, and putty knifes were used to scrape the area within the square, placing all periphyton tissue into a 50 mL vial (Figure 3-3). A toothbrush was used to scrape any additional fine material from within the stencil area. All instruments were washed with deionized water that was captured and submitted into the sample vile. In the July sampling event, 1 subsample was analyzed for Chlorophyll-a (Chl-a) and the remaining 2 subsamples were analyzed for ash-free dry weight (AFDW) for sites 1,2,3, and 6. For sites 4 and 5, two additional subsamples were collected (labelled with suffix "B"), providing a duplicate for the Chl-a analysis, and a triplicate for the AFDW analysis at these sites. In the September 2019 sampling event, each of the three subsamples (rocks) were scraped with two squares each, capturing triplicate subsamples for AFDW and Chl-a analyses, respectively.

Figure 3-3 Periphyton Sampling using 5 cm x 5 cm Periphyton Templates, Rock after Periphyton Removed with Knife, and Woody Debris with Periphyton Growth at Site 2 (left to right)

4.0 FIELD PROGRAM RESULTS

4.1 VISUAL CHARACTERIZATIONS

Substrate and vegetative communities were characterized using a basic, general, visual observation at each of the six sites and effluent discharge locations. The results of the visual characterizations are presented in Table 4-1 with representative photos in Figure 4-1, Figure 4-2, Figure 4-3, Figure 4-4, and in **Appendix B**.

Table 4-1 Summary of General Visual Observations of Vegetation and Substrate Present at Sites 1-6 and at the Effluent Discharge Locations

		Vegetative Communities		
Site	**Substrate**	**Emergent**	**Submergent**	**Riparian**
1	cobble, with small rocks and gravel sized particles	Common great Bulrush (*Scirpus validus*), Common duckweed (*Lemna minor L.*), Arum leaved arrowhead (*Peltandra virginica*)	Periphyton on rocks, Narrow Leaf Pond Weed (*Potamogeton strictifolius*)	Yellow and white sweet clover (*Melilotus albus*), Narrow leaved reed grass (*Calamagrostis stricta*), Crowfoot (*Anemone canadensis*), Giant ragweed (*Ambrosia trifida*), Smooth brome (*Bromus inermis*), various grasses, sedges and shrubs
2	silty sand mixed with clay along the shorelines, and gravel sized particles in-stream	Arum leaved arrowhead (*Peltandra virginica*), Common duckweed (*Lemna minor L.*)	Periphyton on wood debris	Raspberries (*Rubus idaeus*), Green Ash (*Fraxinus pennsylvanica*), Cottonwood (*P.deltoides*), White sweet clover (*Melilotus albus*), Perennial sow thistle (*Sonchus arvensis*), various grasses
3	clay and sand which was sticky, very fine, and mucky	Arum leaved arrowhead (*Peltandra virginica*), Narrow-leaved cattail (*Typha angustifolia*), Bulrush (*Scirpus lacustris*)	Periphyton on rocks	Narrow leaved reed grass (*Calamagrostis stricta*), Smooth brome (*Bromus inermis*), Bur oak (*Quercus macropcarpa*), willows, Stinging Nettle (*Urtica dioica*), Canada Thistle (*Cirsium arvense*) various grasses, sedges and sbrubs
4	rocks, gravel, some clay sized particles and several large boulders (>30 cm diameter) were along the left bank (facing downstream)	Narrow-leaved cattail (*Typha angustifolia*), Arum leaved arrowhead (*Peltandra virginica*), Common duckweed (*Lemna minor L.*), Common great bulrush (*Scirpus validus*), grasses along gravel shoreline	Periphyton on rocks, Narrow Leaf Pond Weed (*Potamogeton strictifolius*), filamentous algae	Willows, Cocklebur (*Xanthium strumarium*), Dandelion (*Araxacum officinale*) various grasses, sedges and shrubs
5	Boulder rocks on the left channel bank (>30 cm diameter), gravel and sand sized particles	Grasses along gravel shoreline	Periphyton on rocks	Bur Oak (*Quercus macropcarpa*), Elm (*L. Ulmus*), Smooth Brome (*Bromus inermis*), various grasses, sedges, shrubs
6	Rocky, gravel, substrate with undercutting of bank on north side causing	None observed	Periphyton on rocks	Elm (*L. Ulmus*), Yarrow (*Achillea millefolium*), Bur oak (*Quercus macropcarpa*), Giant

Table 4-1 Summary of General Visual Observations of Vegetation and Substrate Present at Sites 1-6 and at the Effluent Discharge Locations

		Vegetative Communities		
Site	**Substrate**	**Emergent**	**Submergent**	**Riparian**
	deposit of clay/silt sized particles			Ragweed (*Ambrosia trifida*), various grasses, sedges, shrubs
R3 Innovations Discharge	Not Assessed	Various wetland plants, Common great bulrush (*Scirpus validus*), Common duckweed (*Lemna minor L.*), Narrow-leaved cattail (*Typha angustifolia*)	Not assessed	Timothy (*Phleum pretense*), Stinging Nettle (*Urtica dioica*), Canada Thistle (*Cirsium arvense*), Brown-eyed Susan (*Rudbeckia triloba*), various tall grasses
Neepawa Lagoon Discharge	Not Assessed	Various wetland plants, Common great bulrush (*Scirpus validus*), Common duckweed (*Lemna minor L.*), Narrow-leaved cattail (*Typha angustifolia*)	Not assessed	Stinging Nettle (*Urtica dioica*), Canada Thistle (*Cirsium arvense*), Phragmites (*Phragmites australis*), various tall grasses

Figure 4-1 Substrate at Sites 1, 2, and 4 (left to right)

Figure 4-2 Substrate at Site 6 and Site 5 (left to right)

Figure 4-3 Riparian Vegetation Observed at Sites 1 (left bank), 2 (right bank) and 3 (upstream)

Figure 4-4 Riparian Vegetation Observed at Sites 4 (left bank), 5 (right bank) and 6 (upstream)

4.2 WATER QUALITY RESULTS

4.2.1 *In-Situ* Water Quality

In-situ water quality results for Sites 1-6 for all parameters are tabulated in **Appendix C**.

4.2.1.1 Dissolved Oxygen

Dissolved oxygen (DO) concentrations at all sites and depths measured at approximately mid-day ranged from 7.51 to 13.27 mg/L in July and from 6.7 to 12.14 mg/L in September. When measured overnight, dissolved oxygen showed a minimum concentration of 1.84 mg/L at Site 3 in July (4:32 AM) and 3.39 mg/L at Site 2 in September (5:16 AM).

In general, dissolved oxygen measurements in the Whitemud River during *in-situ* monitoring were similar when measured at surface and at bottom (Figure 4-5; Figure 4-6). This result was anticipated and is characteristic of the relatively shallow nature of the river. As expected, the fluctuation in DO was more pronounced in July than in September. This observation is characteristic of the increased water temperatures and consequently, the lower solubility of oxygen overnight in July, combined with greater daytime production of DO. The DO in July was observed to range from a minimum of 1.84 mg/L (Site 4 overnight) to a maximum of 12.5 mg/L (Site 4 left bank, surface) (Figure 4-5). In September, the DO concentrations ranged from 3.39 mg/L (Site 2 overnight) to a maximum of 12.14 mg/L (Site 1 middle, bottom) (Figure 4-6).

The HORIBA U-52 was deployed overnight at three of the six sites in both the July and September 2019 sampling events to monitor DO at 1-minute intervals for approximately 12 hours. This monitoring was performed to determine how DO is depleted in the Whitemud River when photosynthesis decreases during overnight conditions. In July, the upstream location (Site 1) experienced a reduction in DO to 4.44 mg/L, while DO in the two downstream locations (Site 3 and 4) was reduced to 2.1 and 1.84 mg/L respectively (Figure 4-8; Figure 4-9; Figure 4-9). In September, the upstream location (Site 1) experienced a reduction in DO to 4.0 mg/L while the DO concentrations at the two downstream locations (Site 2 and 4) were reduced to 3.39 and 3.84 mg/L respectively (Figure 4-10; Figure 4-11; Figure 4-12).

Figure 4-5 July Daytime DO Concentrations

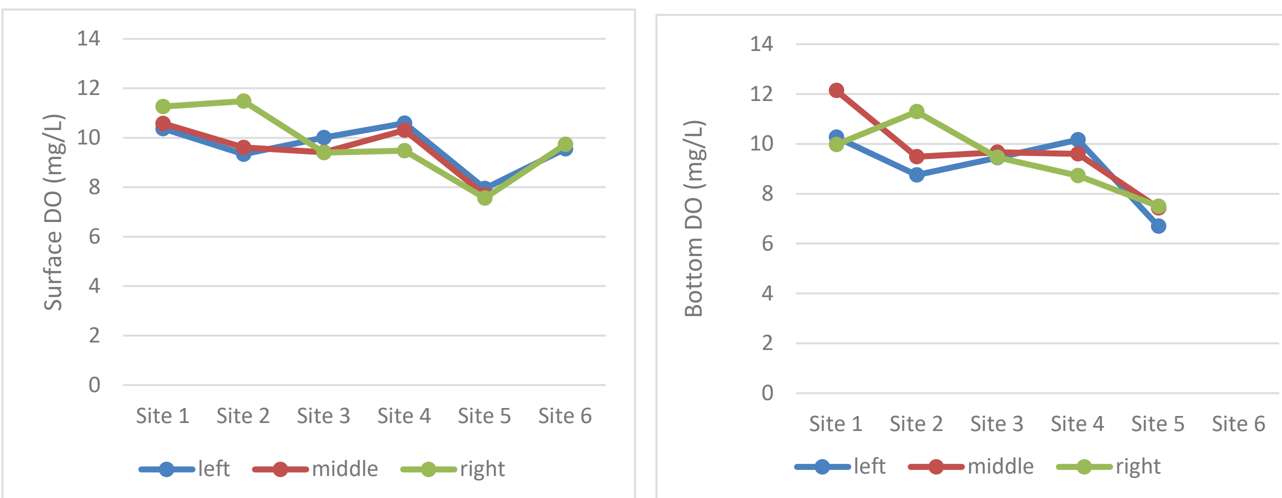


Figure 4-6 September Daytime DO Concentrations

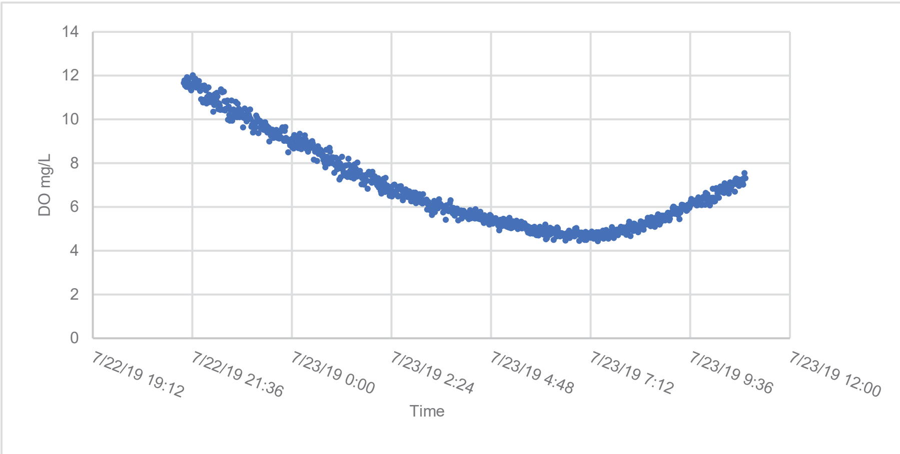


Figure 4-7 July 12-hour Overnight DO at Site 1

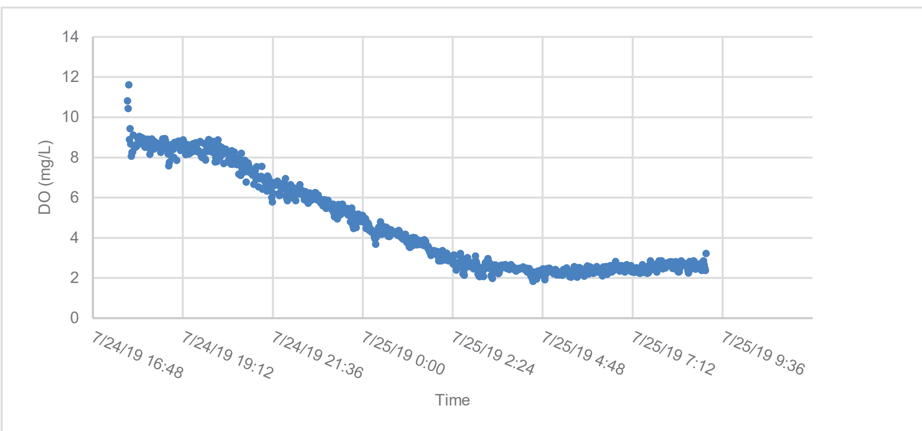


Figure 4-8 July 12-hour Overnight DO at Site 3

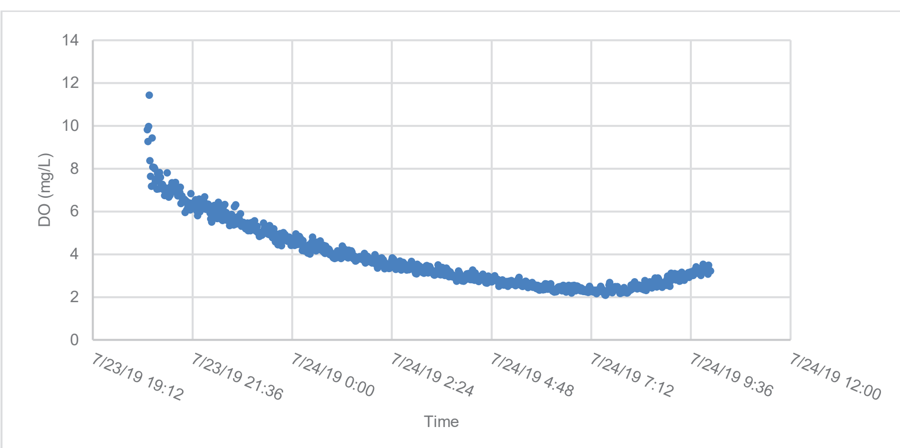


Figure 4-9 July 12-hour Overnight DO at Site 4

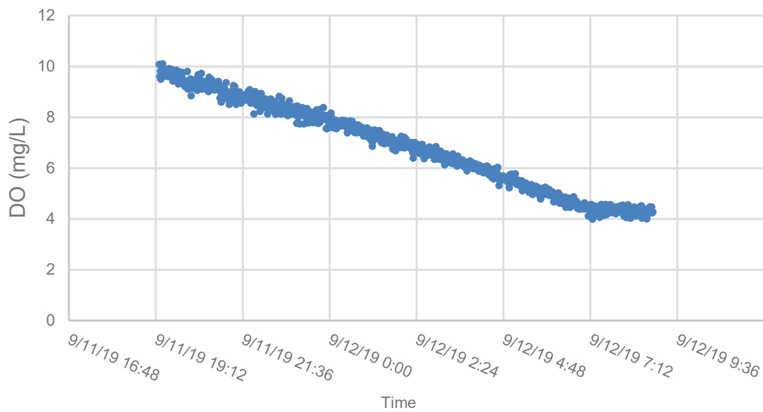


Figure 4-10 September 12-hour Overnight DO at Site 1

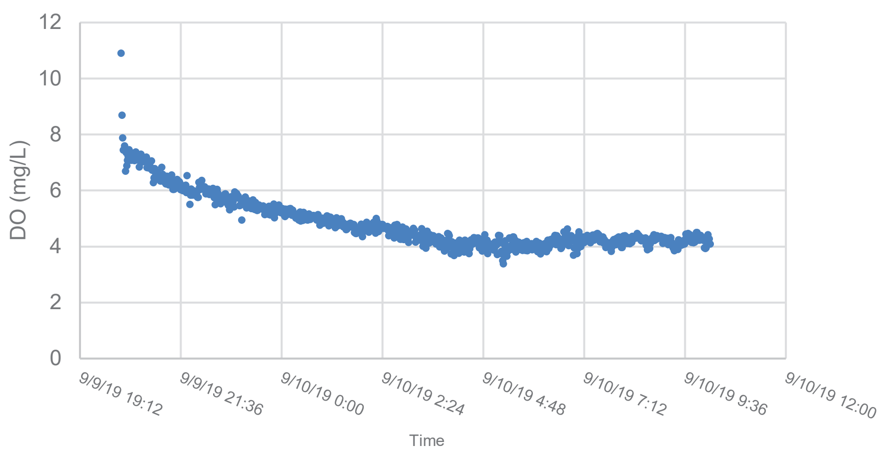


Figure 4-11 September 12-hour DO at Site 2

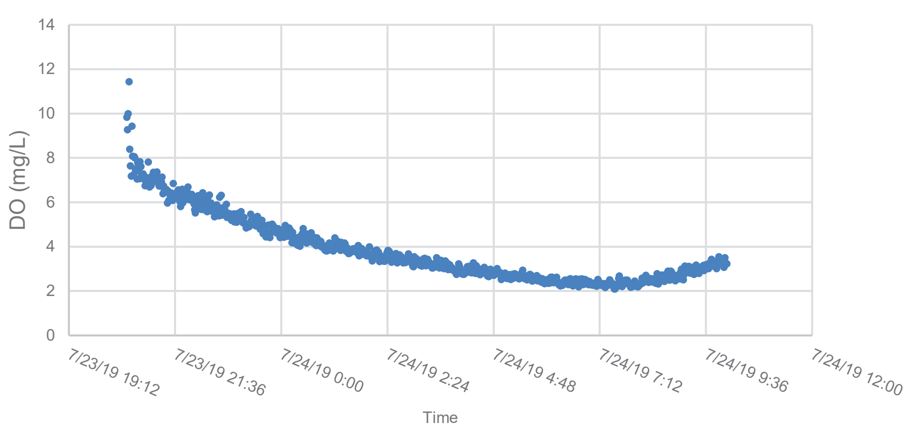


Figure 4-12 September 12-hour DO at Site 4

Turbidity

Turbidity measurements varied across the sites in both sampling events. In the July sampling event, Sites 1 and 2 recorded the lowest levels of turbidity with values ranging from 17.5 NTU to 27.6 NTU. Turbidity increased at Site 3 with values ranging from 65.1 NTU to 99.1 NTU and then varied at Sites 4, 5, and 6, with values ranging from 34.6 NTU (Site 4) to 67.0 NTU (Site 6). In July, surface turbidity ranged from 17.5 NTU (Site 2, right bank) to 74.1 NTU (Site 3, right bank) and bottom turbidity ranged from 18.9 NTU (Site 2, middle) to 99.1 NTU (Site 3, right bank).

In the September sampling event, the overall range in turbidity decreased relative to July with surface turbidity ranging from 12.1 NTU (Site 3, right bank) to 31.2 NTU (Site 5, left bank) and bottom turbidity ranging from 12.6 NTU (Site 3, right bank) to 27 NTU (Site 5, left bank).

Photosynthetically Active Radiation

In the July sampling event, photosynthetically active radiation (PAR) at the water surface ranged from 69.14 µmol/m^2/s (Site 4) to 2225 µmol/m^2/s (Site 1) and in September from 32.04 µmol/m^2/s (Site 2) to 382.2 µmol/m^2/s at (Site 3). The surface PAR represents the amount of light entering the water column and is influenced by current weather conditions (cloud cover), shading (canopy cover), and time of day. Low surface PAR values in this study were largely influenced by time of day and weather conditions, with predominantly cloudy conditions in September represented in the relatively lower surface PAR values. As expected, PAR values showed a decreasing trend with depth, representing light attenuation along the water profile due to water characteristics such as turbidity, suspended particles, and phytoplankton. Mid-stream PAR profiles for each site are presented in Figure 4-13 below.

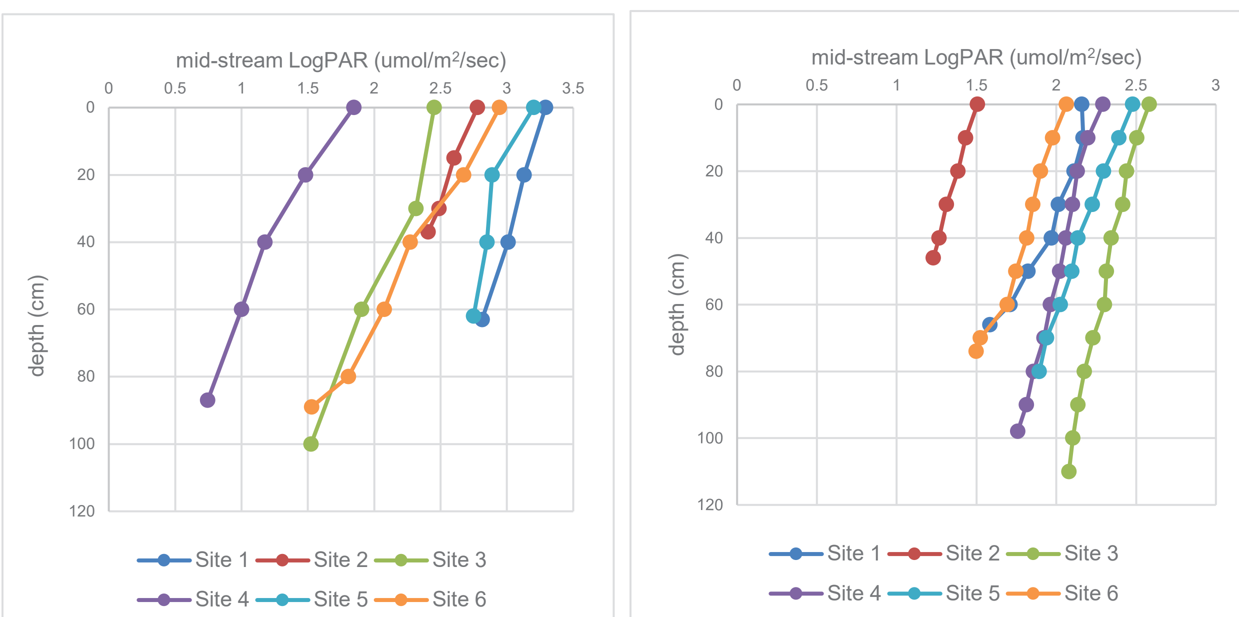


Figure 4-13 Mid-stream PAR Profiles in July (left) and September (right)

Hydrology

In general, the channel at each site was approximately trapezoidal in shape, with the deepest portion of the channel near the middle of the stream width. Stream widths at each site varied from 8 m to 12 m and the maximum depth at sites varied from 0.46 m (Site 2) to 1.28 m (Site 3).

Culvert flow was also measured (see **Appendix D**) and used as a comparison to the calculated channel flow at Site 3 and 6 for reference. A summary of the calculated flow at each site is presented in Table 4-2. Discrepancies between culvert flow and channel flow at Site 6 are likely due to driftwood and debris obstructing the culvert flow as shown in Figure 4-14. Flow data from the WSC station 05LL005 (Whitemud River at Keyes) (ECCC 2019) near the study Site 5 was referenced (daily average on July 24, 2019 and September 11, 2019) to correspond with the Site 5 data.

Figure 4-14 Site 6 Showing Debris Obstructions to Culvert Flow

Table 4-2 Calculated Flow Rates

Site	1	Neepawa Lagoon Discharge	R3 Innovations Discharge	2	3	3 culvert flow	4	5	6	6 culvert flow	WSC station 05LL005
July flow (m^3/s)	0.292	0.0356*	0.017**	0.158	0.666	n/a	0.541	0.300	0.513	n/a	0.254
September flow (m^3/s)	0.342	n/a	0.017	0.139	0.344	0.356	0.333	0.344	0.400	0.159	0.264

*Average flow calculated based on data provided by Town of Neepawa

**Average flow calculated using daily discharge data provided by Hylife, from July 21-24, 2019

4.2.2 Laboratory Results

Laboratory results for all sampling locations are tabulated in **Appendix C**. For water chemistry, field duplicate samples were generally within quality limits (relative percent difference <25% if over 5x detection limit, and <100% if under 5x detection limit) with the exceptions in July of: orthophosphate and total reactive phosphorus (Site 4, right bank) and September of: cadmium, *E.coli* (Site 5, left bank), and Chl-a (Site 6, left bank). *E.coli* may have been affected as many samples were near the 30-hour limit for holding time upon analysis, due to the limitations of local courier services.

Parameters commonly used to characterize the effect of municipal and industrial wastewater discharges include BOD, coliforms, *E.coli*, DO, and nutrients. Concentrations of several parameters including nutrients such as nitrogen and phosphorus (total and dissolved), and total ammonia-N across Sites 1-6 are displayed in Figure 4-15 and Figure 4-16, while DO concentrations are displayed in Figure 4-5 and Figure 4-6. Phytoplankton taxonomy in July showed that the most prevalent genus across Sites 1-3 was Aulacoseira (Class Coscinodiscophyceae) and across Sites 4-6 was Merismopedia (Class Cyanophyceae). In September, the most prevalent genus was unidentified (Class Cryptophycaea, Crysophycaea, and Chlorophycaea) across Sites 3-6 and Planktothrix (Class Cyanophycaea) across Sites 1-2 (**Appendix C**).

The laboratory results show that *E.coli* concentrations varied across all sites; however, relatively elevated levels were seen in both sampling events at Site 3. In July, *E.coli* ranged from a minimum concentration of 30 N/100 ML (Site 2) to a maximum concentration of 150 N/100 mL (Site 3). In September, *E.coli* concentrations were relatively elevated compared to July ranging from 93 N/100 mL (Site 2 and 6) to 548 N/100 mL (Site 3). Biochemical oxygen demand (BOD) varied across all sites, ranging from <2.0 mg/L to 5.5 mg/L. BOD appeared to be relatively elevated at Sites 4 and 5 in the July sampling event.

In July, elevated concentrations of nutrients were generally observed at Site 3. Across all sites, total nitrogen concentrations ranged from 0.87 mg/L (Site 5) to 1.76 mg/L (Site 3) and total phosphorus concentrations ranged from 0.312 mg/L (Site 1) to 0.28 mg/L (Site 3). For ammonia-N, the lowest concentrations were observed at the downstream end of the Whitemud River (Sites 5 and 6) with values ranging from 0.012 mg/L-0.02 mg/L and the most elevated concentrations observed at Site 3 (0.055 mg/L – 0.063 mg/L (Figure 4-15). TSS concentrations were highest at Site 3 (38.3 mg/L – 44.4 mg/L), approximately double the background (Site 1) range of 17.7 mg/L to 20.5 mg/L.

In September, nutrients generally decreased from upstream to downstream (Figure 4-16). Total nitrogen concentrations ranged from 0.73 mg/L (Site 6) to 1.52 mg/L (Site 1) and total phosphorus concentrations ranged from 0.08 mg/L (Site 6) to 0.154 (Site 1). Total ammonia-N varied across all sites with the most elevated concentration observed at Site 4 with a value of 0.056 mg/L. TSS also varied across sites with the highest concentrations observed at Site 5 with values ranging from 10.1 mg/L to 11.6 mg/L, approximately 4 x lower concentrations than those recorded in the July sampling event.

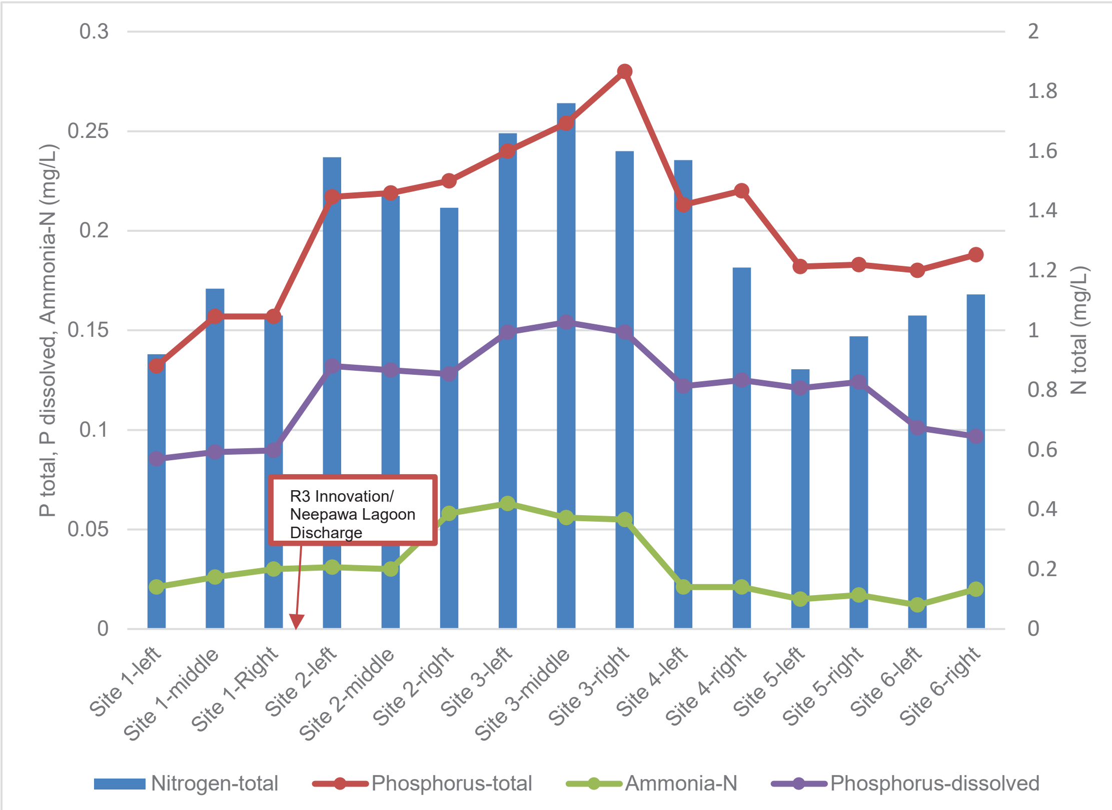


Figure 4-15 Nutrient Concentrations Observed in July along the Whitemud River

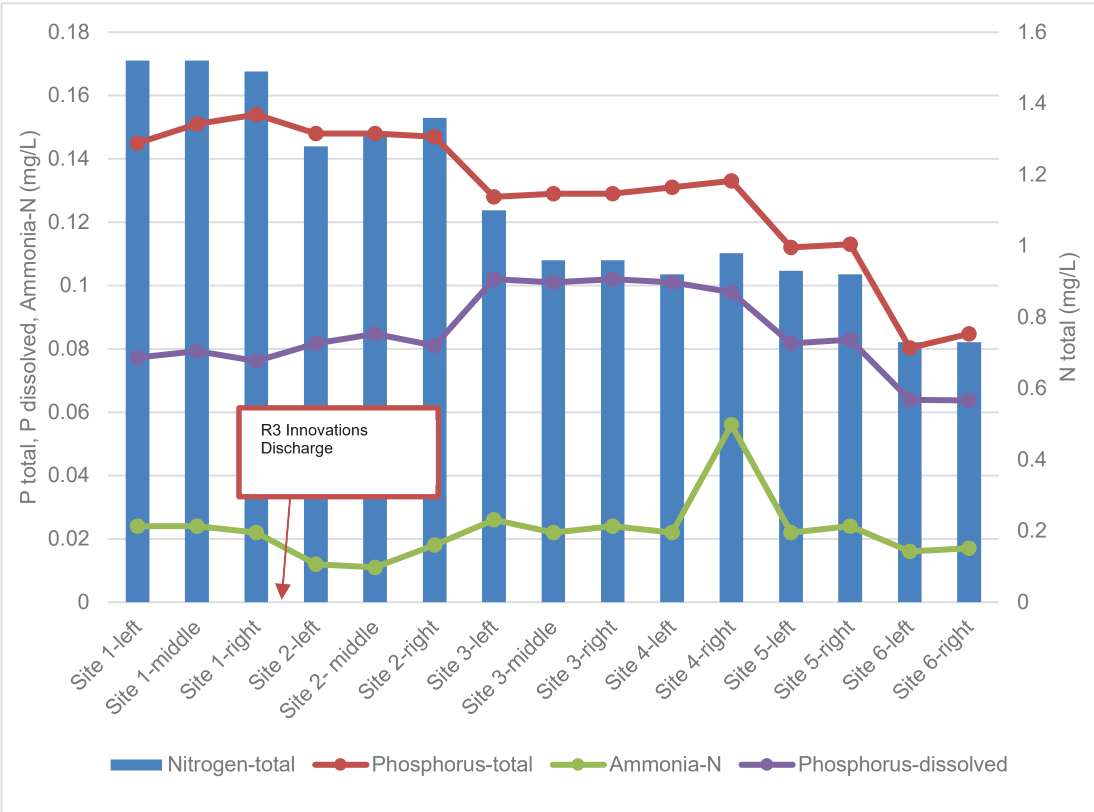


Figure 4-16 Nutrient Concentrations Observed in September along the Whitemud River

Periphyton communities can rapidly and predictably respond to changes in environmental conditions and therefore, can provide a bio-indicator for nutrient effects from wastewater discharges. Periphyton biomass was collected in both the July and September sampling events. The results of the periphyton analyses indicated that periphyton biomass measured as AFDW and Chl-a per unit area varied across all sampling locations.

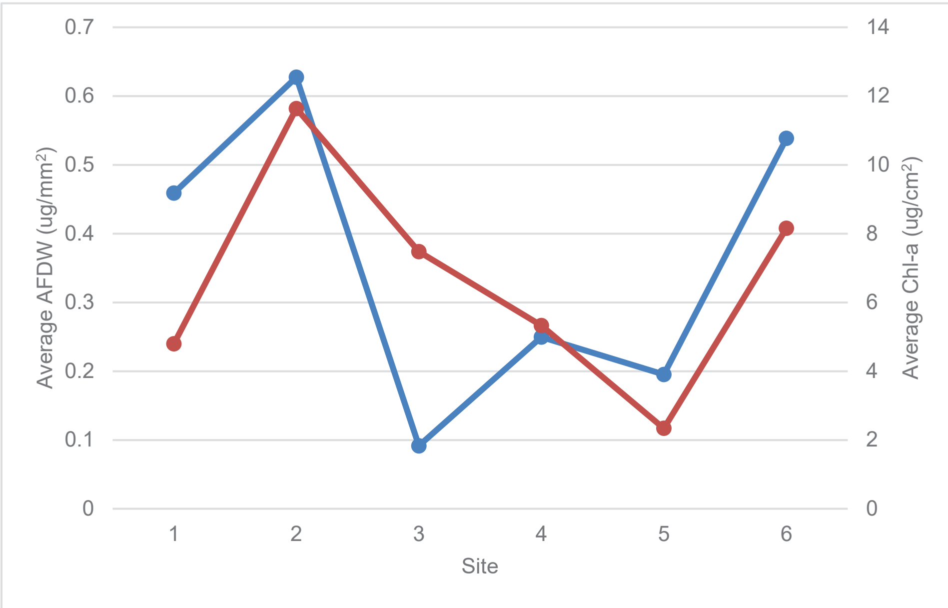


Figure 4-17 Periphyton Biomass Observed in July along the Whitemud River

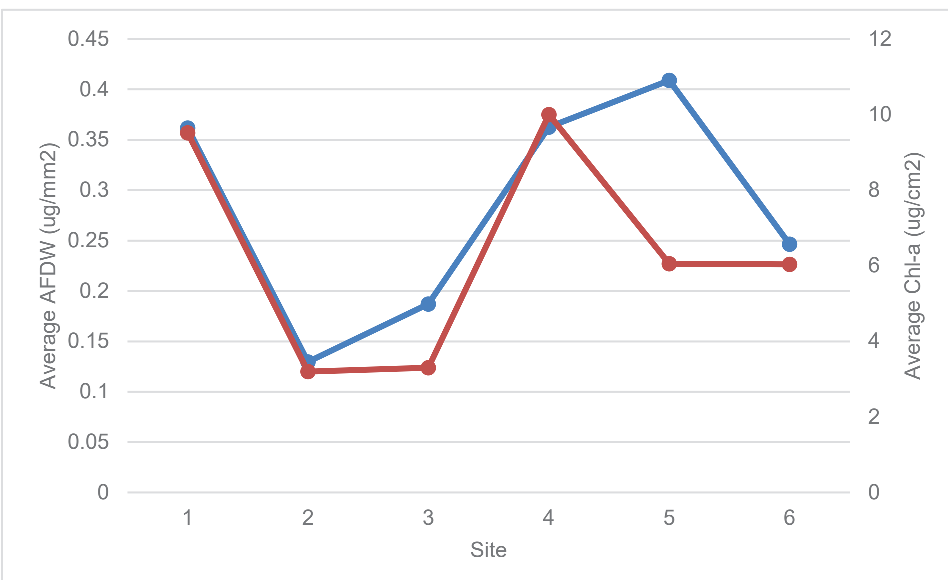


Figure 4-18 Periphyton Biomass Observed in September along the Whitemud River

4.2.3 Effluent Characterization

Laboratory analyses characterizing the R3 Innovations and Neepawa lagoon effluent discharges are tabulated in **Appendix C**. The R3 Innovations discharge was also monitored in the September 2019 sampling event. Results of the *in-situ* monitoring are presented in Table 4-3. Temperature results indicated the R3 Innovations effluent was approximately 30 ˚C, 15˚C above September background water temperatures and 7°C above July water temperatures in the Whitemud River.

Table 4-3 *In-Situ* Monitoring Results for the R3 Innovations Effluent

Parameter	Reading
Date	9/11/2019
Time	18:46
Temperature (°C)	29.22
DO (mg/L)	6.98
Conductivity (µS/cm)	1.66
pH	8
ORP (mV)	129
Turbidity (NTU)	45.9
TDS (g/L)	1.06

The Town of Neepawa lagoon Environment Act License No. 762 VO and subsequent regulator correspondence on January 8, 2016 specifies the following requirements for the Town of Neepawa lagoon effluent discharge:

- BOD (5-day) <30 mg/L
- Total Phosphorus <1.0 mg/L

Based on the July sampling analyses, the Neepawa lagoon effluent had elevated levels of total phosphorus relative to background levels and exceeded the 1.0 mg/L limit with a total phosphorus concentration of 1.74 mg/L. Concentrations of BOD were within the licence limits.

The R3 Innovations Environment Act License No. 2870 RRR specifies the following requirements for the effluent discharge:

- CBOD (5-day) <25 mg/L in any composite sample
- TSS <25 mg/L in any composite sample
- *E. coli* <200/100 mL as determined by the monthly geometric mean of 1 grab sample, 3 consecutive days/week

- Fecal coliforms <200/100 mL as determined by the monthly geometric mean of 1 grab sample, 3 consecutive days/week
- Total nitrogen <15 mg/L as determined by the 30-day rolling average
- Total phosphorus <1.0 mg/L as determined by the 30-day rolling average

Based on the July and September sampling analyses, the R3 Innovations effluent was within licensed limits for all listed parameters.

5.0 SUMMARY

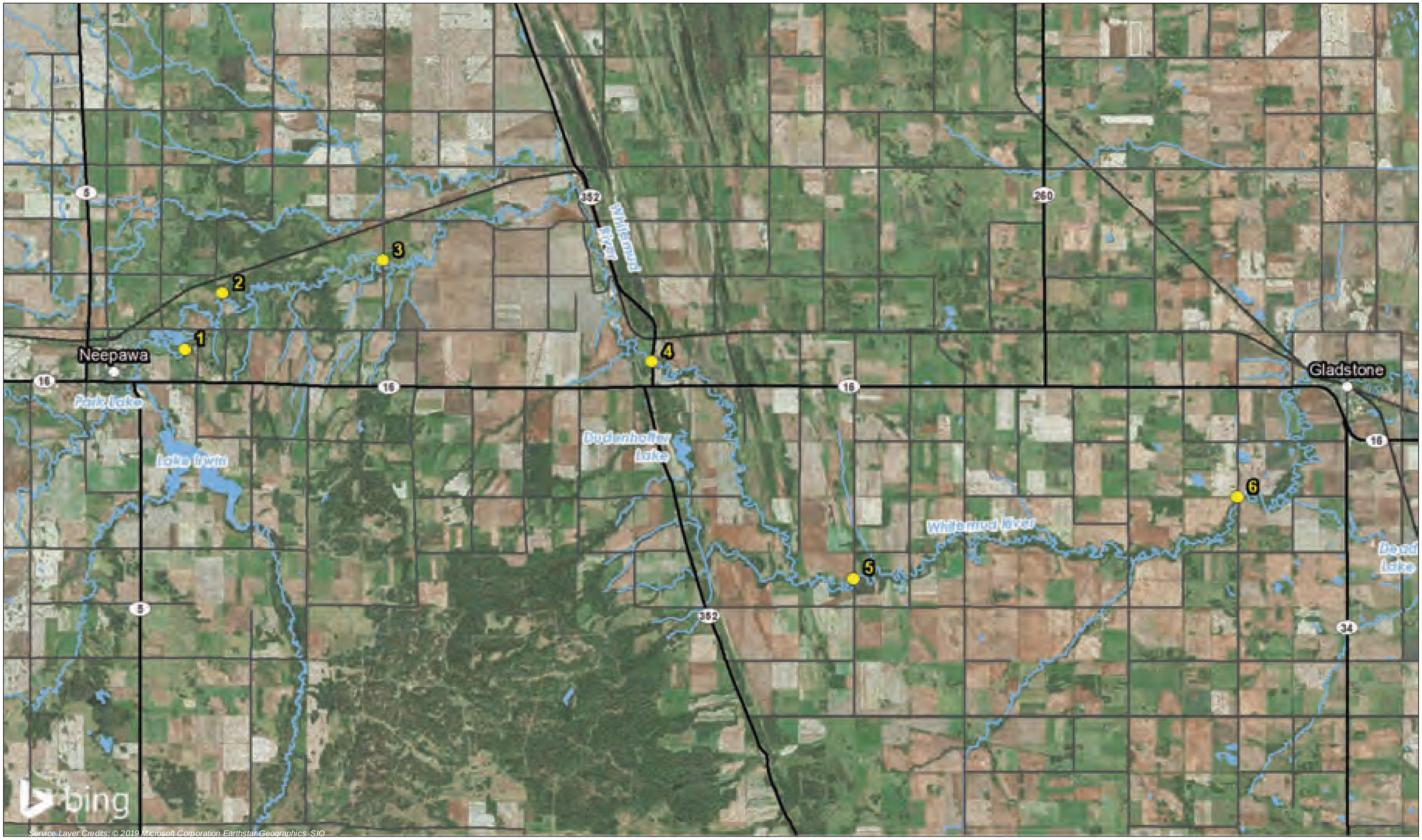
The results of the 2019 open water field program appear to indicate that anoxic conditions can develop in the Whitemud River during typical summer conditions (July/September) as indicated by overnight DO concentrations below 4 mg/L at Site 1 upstream of the effluent inputs, likely due to oxygen consumption by algae and periphyton. However, daytime data shows that DO is replenished through photosynthesis and persistent anoxic conditions do not currently exist. Anoxic conditions overnight appear to be more pronounced at downstream locations with DO concentrations below 2 mg/L. The effects do not appear to be pronounced immediately downstream of the existing effluent discharge (Site 2).

6.0 REFERENCES

Earth Tech. 2008. Request for Alteration to the Town of Neepawa's Industrial Wastewater Treatment Facility, Neepawa, Manitoba. Earth Tech Canada Inc. Winnipeg, Manitoba.

ECCC 2019. Environment and Climate Change Canada. Water Survey of Canada. Real-Time Hydrometric Data for Whitemud River Near Keyes (05LL005). Available from: https://wateroffice.ec.gc.ca/report/real_time_e.html?stn=05LL005. Retrieved Dec 17, 2019.

Appendix A FIGURES



Legend

- Proposed Water Quality Site
- Major Road
- Minor Road
- Railway
- Watercourse
- Waterbody

N

0 2 4 Kilometres
(At original document size of 8.5x11)
1:175,000

Notes
1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base Data Sources: Government of Manitoba
3. Microsoft product sceen shot reprinted with permission from Microsoft Corporation

Stantec

Project Location
Whitemud River, Manitoba

Prepared by ACampigotto on 2019-08-26
Reviewed by JTheroux on 2019-08-26

Client/Project
Hylife Foods LP
Water Quality Study

111440368

Figure No.
1-1

Title
Site Location Map

G:_GIS_Project_Folder\111440368_HylifeFoods\ArcMaps\Proposed_WaterQualitySites_20190826.mxd Revised: 2019-08-26 By: ACampigotto

Appendix B PHOTOGRAPHS

Client:	**Hylife**	**Project:**	**111440368**
Site Name:	**Whitemud River**	**Site Location:**	**Neepawa, Manitoba**

Photograph ID: 1

Photo Location:
Site 1

Direction:
Upstream

Survey Date:
7/22/2019

Comments:
GPS 14 U 5564864N
468867E

Photograph ID: 2

Photo Location:
Site 1

Direction:
Downstream

Survey Date:
7/22/2019

Comments:
GPS 14 U 5564864N
468867E

Client:	**Hylife**	**Project:**	**111440368**
Site Name:	**Whitemud River**	**Site Location:**	**Neepawa, Manitoba**

Photograph ID: 3

Photo Location:
Site 1

Direction:
Water column

Survey Date:
7/22/2019

Comments:
GPS 14 U 5564864N
468867E

Photograph ID: 4

Photo Location:
Site 1

Direction:
Periphyton scrapings on rock

Survey Date:
9/9/2019

Comments:
GPS 14 U 5564864N
468867E

Stantec **Photographic Log**

Client:	**Hylife**	**Project:**	**111440368**
Site Name:	**Whitemud River**	**Site Location:**	**Neepawa, Manitoba**

Photograph ID: 5

Photo Location:
Neepawa Lagoon Effluent Outfall

Direction:
Downstream

Survey Date:
7/22/2019

Comments:
GPS 14 U 5565064N 468854E

Photograph ID: 6

Photo Location:
Neepawa Lagoon Effluent Outfall

Direction:
Upstream in-pipe

Survey Date:
7/22/2019

Comments:
GPS 14 U 5565064N 468854E

Client:	**Hylife**	**Project:**	**111440368**
Site Name:	**Whitemud River**	**Site Location:**	**Neepawa, Manitoba**

Photograph ID: 7

Photo Location:
Neepawa Lagoon Effluent Outfall

Direction:
Right bank

Survey Date:
9/9/2019

Comments:
GPS 14 U 5565064N 468854E

Photograph ID: 8

Photo Location:
R3 Innovations Effluent Outfall

Direction:
Upstream in-pipe

Survey Date:
7/22/2019

Comments:
GPS 14 U 5565001N 468997E

Stantec **Photographic Log**

Client:	**Hylife**	**Project:**	**111440368**
Site Name:	**Whitemud River**	**Site Location:**	**Neepawa, Manitoba**

Photograph ID: 9

Photo Location:
R3 Innovations Effluent Outfall

Direction:
Downstream

Survey Date:
7/22/2019

Comments:
GPS 14 U 5565001N 468997E

Photograph ID: 10

Photo Location:
Site 2

Direction:
Right bank

Survey Date:
7/22/2019

Comments:
GPS 14 U 5566524N 469989E

Client:	Hylife	Project:	111440368
Site Name:	Whitemud River	Site Location:	Neepawa, Manitoba

Photograph ID: 11

Photo Location:
Site 2

Direction:
Downstream

Survey Date:
7/22/2019

Comments:
GPS 14 U 5566524N 469989E

Photograph ID: 12

Photo Location:
Site 2

Direction:
Left bank

Survey Date:
7/22/2019

Comments:
GPS 14 U 5566524N 469989E

Client:	Hylife	Project:	111440368
Site Name:	Whitemud River	Site Location:	Neepawa, Manitoba

Photograph ID: 13

Photo Location:
Site 2

Direction:
Periphyton on woody debris

Survey Date:
7/22/2019

Comments:
GPS 14 U 5566524N 469989E

Photograph ID: 14

Photo Location:
Site 2

Direction:
Upstream

Survey Date:
9/9/2019

Comments:
GPS 14 U 5566524N 469989E

Client:	**Hylife**	**Project:**	**111440368**
Site Name:	**Whitemud River**	**Site Location:**	**Neepawa, Manitoba**

Photograph ID: 15

Photo Location:
Site 3

Direction:
Downstream (left bank)

Survey Date:
7/23/2019

Comments:
GPS 14 U 5567495N 474751E

Photograph ID: 16

Photo Location:
Site 3

Direction:
Left bank

Survey Date:
7/23/2019

Comments:
GPS 14 U 5567495N 474751E

Stantec **Photographic Log**

Client:	**Hylife**	**Project:**	**111440368**
Site Name:	**Whitemud River**	**Site Location:**	**Neepawa, Manitoba**

Photograph ID: 17

Photo Location:
Site 3

Direction:
Dowstream of culvert

Survey Date:
9/10/2019

Comments:
GPS 14 U 5567495N
474751E

Photograph ID: 18

Photo Location:
Site 3

Direction:
Left bank

Survey Date:
9/10/2019

Comments:
GPS 14 U 5567495N
474751E

Client:	Hylife	Project:	111440368
Site Name:	Whitemud River	Site Location:	Neepawa, Manitoba

Photograph ID: 19

Photo Location:
Site 3

Direction:
Periphyton scraping on rock

Survey Date:
9/10/2019

Comments:
GPS 14 U 5567495N 474751E

Photograph ID: 20

Photo Location:
Site 3

Direction:
Upstream of culvert

Survey Date:
7/15/2019

Comments:
GPS 14 U 5567495N 474751E

Photographic Log

Client:	Hylife	Project:	111440368
Site Name:	Whitemud River	Site Location:	Neepawa, Manitoba

Photograph ID: 21

Photo Location:
Site 4

Direction:
Downstream, algae and debris

Survey Date:
9/10/2019

Comments:
GPS 14 U 5564498N 482789E

Photograph ID: 22

Photo Location:
Site 4

Direction:
Water column

Survey Date:
9/10/2019

Comments:
GPS 14 U 5564498N 482789E

Client:	Hylife	Project:	111440368
Site Name:	**Whitemud River**	**Site Location:**	**Neepawa, Manitoba**

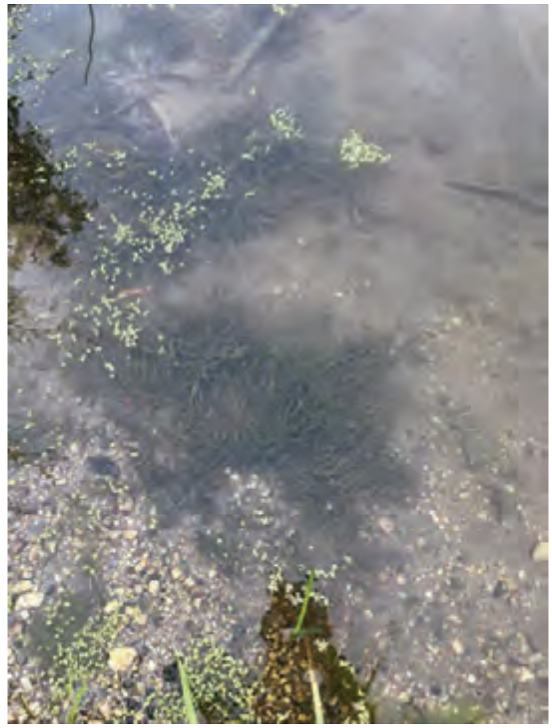
Photograph ID: 23

Photo Location:
Site 4

Direction:
Water column, substrate

Survey Date:
9/10/2019

Comments:
GPS 14 U 5564498N 482789E



Photograph ID: 24

Photo Location:
Site 4

Direction:
Periphyton scraping on rock

Survey Date:
9/10/2019

Comments:
GPS 14 U 5564498N 482789E

Photographic Log

Client:	**Hylife**	**Project:**	**111440368**
Site Name:	**Whitemud River**	**Site Location:**	**Neepawa, Manitoba**

Photograph ID: 25

Photo Location:
Site 4

Direction:
Right bank

Survey Date:
7/23/2019

Comments:
GPS 14 U 5564498N
482789E

Photograph ID: 26

Photo Location:
Site 4

Direction:
Downstream, substrate

Survey Date:
7/23/2019

Comments:
GPS 14 U 5564498N
482789E

Stantec

Photographic Log

Client:	Hylife	Project:	111440368
Site Name:	Whitemud River	Site Location:	Neepawa, Manitoba

Photograph ID: 27

Photo Location:
Site 4

Direction:
Water column, periphyton on boulders

Survey Date:
7/23/2019

Comments:
GPS 14 U 5564498N 482789E

Photograph ID: 28

Photo Location:
Site 4

Direction:
left bank

Survey Date:
7/23/2019

Comments:
GPS 14 U 5564498N 482789E

Stantec

Photographic Log

Client:	Hylife	Project:	111440368
Site Name:	Whitemud River	Site Location:	Neepawa, Manitoba

Photograph ID: 29

Photo Location:
Site 4

Direction:
Upstream

Survey Date:
7/23/2019

Comments:
GPS 14 U 5564498N
482789E

Photograph ID: 30

Photo Location:
Site 5

Direction:
Downstream

Survey Date:
7/24/2019

Comments:
GPS 14 U 5558016N
488794E

Client:	Hylife	Project:	111440368
Site Name:	Whitemud River	Site Location:	Neepawa, Manitoba

Photograph ID: 31 **Photo Location:** Site 5 **Direction:** Upstream **Survey Date:** 7/24/2019 **Comments:** GPS 14 U 5558016N 488794E	
Photograph ID: 32 **Photo Location:** Site 5 **Direction:** Right bank **Survey Date:** 7/24/2019 **Comments:** GPS 14 U 5558016N 488794E	

Client:	**Hylife**	**Project:**	**111440368**
Site Name:	**Whitemud River**	**Site Location:**	**Neepawa, Manitoba**

Photograph ID: 33

Photo Location:
Site 5

Direction:
Water column, periphyton on boulders

Survey Date:
7/24/2019

Comments:
GPS 14 U 5558016N 488794E

Photograph ID: 34

Photo Location:
Site 5

Direction:
Downstream, bridge

Survey Date:
7/24/2019

Comments:
GPS 14 U 5558016N 488794E

Client:	**Hylife**	**Project:**	**111440368**
Site Name:	**Whitemud River**	**Site Location:**	**Neepawa, Manitoba**

Photograph ID: 35

Photo Location:
Site 5

Direction:
Periphyton scrapings on rock

Survey Date:
9/11/2019

Comments:
GPS 14 U 5558016N 488794E

Photograph ID: 36

Photo Location:
Site 5

Direction:
Left bank

Survey Date:
9/11/2019

Comments:
GPS 14 U 5558016N 488794E

Stantec **Photographic Log**

Client:	**Hylife**	**Project:**	**111440368**
Site Name:	**Whitemud River**	**Site Location:**	**Neepawa, Manitoba**

Photograph ID: 37

Photo Location:
Site 6

Direction:
Upstream

Survey Date:
9/11/2019

Comments:
GPS 14 U 5560433
500249E

Photograph ID: 38

Photo Location:
Site 6

Direction:
Water column, substrate

Survey Date:
9/11/2019

Comments:
GPS 14 U 5560433
500249E

Client:	Hylife	Project:	111440368
Site Name:	Whitemud River	Site Location:	Neepawa, Manitoba

Photograph ID: 39 **Photo Location:** Site 6 **Direction:** Downstream **Survey Date:** 9/11/2019 **Comments:** GPS 14 U 5560433 500249E	
Photograph ID: 40 **Photo Location:** Site 6 **Direction:** Periphyton scrapings on rock **Survey Date:** 9/11/2019 **Comments:** GPS 14 U 5560433 500249E	

Client:	Hylife	Project:	111440368
Site Name:	Whitemud River	Site Location:	Neepawa, Manitoba

Photograph ID: 41

Photo Location:
Site 6

Direction:
Upstream end of bridge, facing downstream

Survey Date:
9/11/2019

Comments:
GPS 14 U 5560433 500249E

Photograph ID: 42

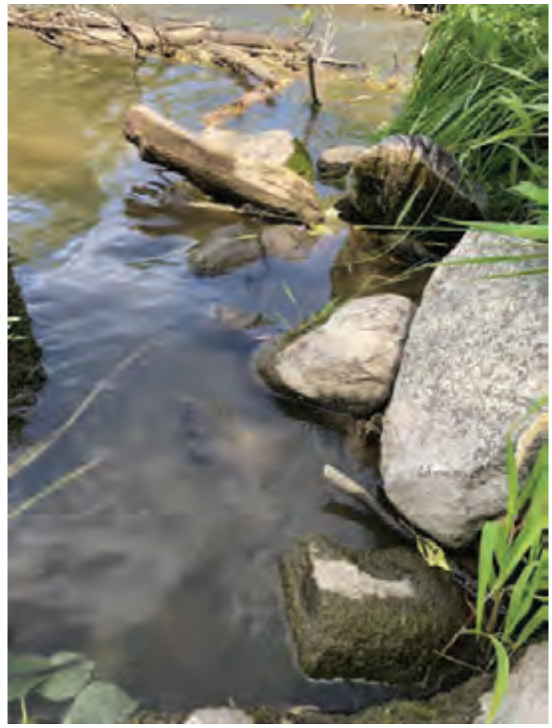
Photo Location:
Site 6

Direction:
Left bank

Survey Date:
7/24/2019

Comments:
GPS 14 U 5560433 500249E

Client:	**Hylife**	**Project:**	**111440368**
Site Name:	**Whitemud River**	**Site Location:**	**Neepawa, Manitoba**

Photograph ID: 43	
Photo Location: Site 6	
Direction: Water column, periphyton and substrate	
Survey Date: 7/24/2019	
Comments: GPS 14 U 5560433 500249E	

Appendix C IN-SITU AND LABORATORY DATA

Table C-1 Raw Periphyton Data

	Site 1			Site 2			Site 3			Site 4					Site 5					Site 6		
Periphyton	Rep 1	Rep 2	Rep 3	Rep 1	Rep 2	Rep 3	Rep 1	Rep 2	Rep 3	Rep 1	Rep 2	Rep 3	4B-ChA	4B-AFDW	Rep 1	Rep 2	Rep 3	5B-AFDW	5B-ChA	Rep 1	Rep 2	Rep 3
ID	L2315847-17	L2315847-18	L2315847-19	L2315847-14	L2315847-15	L2315847-16	L2316756-16	L2316756-17	L2316756-18	L2316756-13	L2316756-14	L2316756-15	L2317170-26	L2317170-26	L2317170-28	L2317170-29	L2317170-30	L2317170-27	L2317170-27	L2317170-31	L2317170-32	L2317170-33
Date	7/22/2019 2:00:00 PM	7/22/2019 2:00:00 PM	7/22/2019 2:00:00 PM	7/22/2019 7:36:00 PM	7/22/2019 7:36:00 PM	7/22/2019 7:44:00 PM	7/23/2019 6:09:00 PM	7/23/2019 6:09:00 PM	7/23/2019 6:09:00 PM	7/23/2019 8:48:00 PM	7/23/2019 8:48:00 PM	7/23/2019 8:48:00 PM	7/25/2019 10:00:00 AM	7/25/2019 10:00:00 AM	7/24/2019 12:30:00 PM	7/24/2019 12:30:00 PM	7/24/2019 12:30:00 PM	7/25/2019 11:00:00 AM	7/25/2019 11:00:00 AM	7/24/2019 3:32:00 PM	7/24/2019 3:32:00 PM	7/24/2019 3:32:00 PM
Chlorophyll a (ug)	120	-	-	291	-	-	187	-	-	81	-	-	555	-	-	41	-	-	76	-	204	-
Dry Weight (g)	-	0.327	1.060	-	0.285	0.716	-	0.173	0.230	-	0.409	0.476	-	0.821	0.369	-	0.204	2.060	-	1.530	-	1.220
Ash Free Dry Weight (g)	-	0.081	0.148	-	0.192	0.122	-	0.020	0.026	-	0.080	0.076	-	0.155	0.046	-	0.020	0.243	-	0.138	-	0.131
Chlorophyll a/unit area (ug/cm$^{2)}$	4.80	-	-	11.64	-	-	7.48	-	-	3.26	-	-	7.40	-	-	1.65	-	-	3.02	-	8.16	-
Ash Free Dry Weight/unit area (ug/cm$^{2)}$	-	0.0033	0.0059	-	0.0077	0.0049	-	0.0008	0.0010	-	0.0032	0.0030	-	0.0012	0.0018	-	0.0008	0.0032	-	0.0055	-	0.0052

Table C-2 July Analytical Data

ALS			Site 1			Site 2				Site 3			Site 4			Site 5		Site 6			
		Sample ID	JL1	JM1	JR1	JL2	JM2	JR2	JR2 DUP	JL3	JM3	JL3	JL4	JR4	JR4 DUP	JL5	JR5	JL6	JR6	HYLIFE EFFLUENT	LAGOON
		ALS ID	L2315847-7	L2315847-5	L2315847-6	L2315847-4	L2315847-1	L2315847-2	L2315847-3	L2316756-6	L2316756-5	L2316756-4	L2316756-3	L2316756-1	L2316756-2	L2317170-1	L2317170-2	L2317170-3	L2317170-4	L2315847-8	L2315847-9
Multiple Work Orders		Date Sampled	7/22/2019 1:15:00 PM	7/22/2019 1:45:00 PM	7/22/2019 2:00:00 PM	7/22/2019 6:36:00 PM	7/22/2019 6:45:00 PM	7/22/2019 6:53:00 PM	7/22/2019 7:00:00 PM	7/23/2019 5:20:00 PM	7/23/2019 5:30:00 PM	7/23/2019 5:45:00 PM	7/23/2019 7:31:00 PM	7/23/2019 8:00:00 PM	7/23/2019 7:51:00 PM	7/24/2019 11:55:00 AM	7/24/2019 11:45:00 AM	7/24/2019 2:30:00 PM	7/24/2019 2:41:00 PM	7/22/2019 3:24:00 PM	7/22/2019 3:43:00 PM
Analyte	Units	LOR	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
Volatile Suspended Solids	mg/L	2	5.1	6.4	5.3	5.9	5.1	4.5	4.9	9.3	7.2	7.1	7.9	7.6	8.7	3.6	5.1	6.4	7.2	<2.0	4.4
Total Suspended Solids	mg/L	2	17.7	20.5	19.1	20.4	21.2	17.6	19.7	44.4	38.3	41.6	20.8	20	21.9	17.7	22.1	24.9	27.6	<2.0	7.3
Alkalinity, Total (as CaCO3)	mg/L	1	170	169	171	192	191	195	192	202	203	199	207	207	208	239	236	237	239	136	275
Ammonia, Total (as N)	mg/L	0.01	0.021	0.026	0.03	0.031	0.03	0.058	0.028	0.063	0.056	0.055	0.021	0.021	0.02	0.015	0.017	0.012	0.02	0.164	15.7
Bicarbonate (HCO3)	mg/L	1.2	200	199	201	220	221	226	219	238	240	234	227	227	229	275	274	270	274	166	335
Carbonate (CO3)	mg/L	0.6	3.84	3.24	3.6	6.72	6.12	6	7.32	4.2	3.96	4.56	12.4	12.6	11.8	8.28	6.96	9.12	8.76	<0.60	<0.60
Hydroxide (OH)	mg/L	0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34
Nitrate and Nitrite as N	mg/L	0.07	<0.070	<0.070	<0.070	0.334	0.341	0.319	0.34	0.24	0.245	0.247	<0.070	<0.070	<0.070	<0.070	<0.070	<0.070	<0.070	7.32	0.076
Nitrate (as N)	mg/L	0.02	0.035	0.037	0.038	0.253	0.258	0.24	0.258	0.214	0.217	0.22	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	7.25	0.045
Nitrite (as N)	mg/L	0.01	0.016	0.017	0.016	0.082	0.083	0.079	0.082	0.027	0.028	0.027	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.073	0.03
Total Kjeldahl Nitrogen	mg/L	0.2	0.92	1.14	1.05	1.25	1.11	1.09	1.24	1.42	1.52	1.36	1.57	1.21	1.37	0.87	0.98	1.05	1.12	0.96	18.4
Total Nitrogen	mg/L	0.2	0.92	1.14	1.05	1.58	1.45	1.41	1.58	1.66	1.76	1.6	1.57	1.21	1.37	0.87	0.98	1.05	1.12	8.28	18.5
Orthophosphate-Dissolved (as P)	mg/L	0.003	0.0319	0.0373	0.0487	0.0617	0.0592	0.0511	0.0567	0.0593	0.0486	0.0887	0.0309	0.0376	0.0496	0.0759	0.0411	0.0367	0.0353	0.0129	1.08
Phosphorus (P)-Total Dissolved	mg/L	0.003	0.0854	0.0888	0.0897	0.132	0.13	0.128	0.131	0.149	0.154	0.149	0.122	0.125	0.123	0.121	0.124	0.101	0.0967	0.0228	1.55
Phosphorus (P)-Total Reactive	mg/L	0.003	0.0419	0.0458	0.046	0.0628	0.0754	0.0628	0.0769	0.102	0.0911	0.108	0.0309	0.0367	0.061	0.0787	0.0754	0.0346	0.0376	0.0201	1.21
Phosphorus (P)-Total	mg/L	0.003	0.132	0.157	0.157	0.217	0.219	0.225	0.223	0.24	0.254	0.28	0.213	0.22	0.217	0.182	0.183	0.18	0.188	0.0366	1.74
Phosphorus (P)-Total Particulate	mg/L	0.0042	0.0465	0.0685	0.067	0.0853	0.0893	0.0963	0.0923	0.0912	0.101	0.131	0.0912	0.0958	0.0945	0.0607	0.0585	0.0793	0.0912	0.0138	0.193
Silica, Reactive (as SiO2)	mg/L	1	6.4	6.1	6.2	6.4	6.2	6.1	6.6	8.2	8.1	8.1	5.2	5.1	5.1	13.8	14	14.1	14	9.3	21.2
Dissolved Organic Carbon	mg/L	0.5	8.5	8.29	8.43	8.65	8.57	8.59	9.02	9.66	9.7	10.1	10.8	10.6	10.5	9.73	9.78	10.3	10.2	8.5	5.02
Total Inorganic Carbon	mg/L	0.5	33.1	33.2	32.6	37.4	37.2	37.5	38.6	40.9	40.5	40	41.1	40.3	41	46.8	47.4	48.7	47.2	33.1	25.9
Total Organic Carbon	mg/L	0.5	8.5	8.61	8.68	8.67	9.07	8.44	8.71	9.18	9.19	8.62	9.82	11	10.7	9.91	9.94	10.4	10.2	8.5	4.54
Escherichia Coli	MPN/100mL	1	111	130	115	30	35	41	49	96	118	150	36	67	63	49	60	84	79	5	2
Fecal Coliforms	MPN/100mL	1	57 *	46 *	26 *	16 *	38 *	45 *	45 *	75 *	88 *	81 *	79 *	87 *	77 *	65	64	51	49	2 *	9 *
Phytoplankton	taxonomy	n/a	IP	IP	IP	IP	IP	IP	IP	IP	IP	IP	IP	IP	IP	IP	IP	IP	IP	IP	IP
Aluminum (Al)-Total	mg/L	0.003	0.0923	0.108	0.109	0.104	0.0916	0.0978	0.0985	0.285	0.25	0.224	0.0778	0.0866	0.0734	0.156	0.172	0.223	0.233	0.0923	<0.0030
Antimony (Sb)-Total	mg/L	0.0001	0.00013	0.0001	0.0001	0.00013	0.00013	0.00013	0.00012	0.0002	0.00017	0.00016	0.0002	0.00021	0.00019	0.00018	0.00017	0.00016	0.00016	0.00013	0.00024
Arsenic (As)-Total	mg/L	0.0001	0.0225	0.0229	0.023	0.0178	0.0174	0.0174	0.0176	0.0165	0.0166	0.0164	0.0205	0.0207	0.0204	0.0165	0.0168	0.0157	0.0154	0.0225	0.00026
Barium (Ba)-Total	mg/L	0.0001	0.101	0.101	0.102	0.111	0.107	0.108	0.111	0.116	0.115	0.116	0.0995	0.0999	0.0987	0.12	0.125	0.132	0.128	0.101	0.0178
Beryllium (Be)-Total	mg/L	0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)-Total	mg/L	0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Total	mg/L	0.01	0.047	0.049	0.049	0.07	0.072	0.071	0.071	0.082	0.082	0.083	0.11	0.108	0.107	0.127	0.129	0.119	0.118	0.047	0.073
Cadmium (Cd)-Total	mg/L	0.000005	0.0000093	0.0000067	0.0000124	0.0000112	0.000011	0.0000097	0.0000081	0.0000243	0.0000252	0.0000223	0.0000104	0.0000137	0.0000087	0.0000074	0.0000101	0.000021	0.0000144	0.0000093	0.0000064
Calcium (Ca)-Total	mg/L	0.05	33.1	32.6	33.7	40.7	40.1	39.5	40.2	46.2	45.6	44.7	47.5	46.3	45.8	49.4	50.9	52.1	51.7	33.1	22.5
Cesium (Cs)-Total	mg/L	0.00001	0.000021	0.00002	0.000021	0.00002	0.000016	0.000017	0.000018	0.000039	0.000035	0.000033	0.000012	0.000016	0.000012	0.000025	0.000027	0.000036	0.00004	0.000021	0.000097
Chromium (Cr)-Total	mg/L	0.0001	0.00021	0.00022	0.0003	0.00024	0.00033	0.0002	0.00022	0.00051	0.00045	0.00044	0.00022	0.00023	0.00017	0.00031	0.00038	0.00042	0.00047	0.00021	0.00019
Cobalt (Co)-Total	mg/L	0.0001	0.00022	0.00024	0.00025	0.00033	0.00032	0.00033	0.00032	0.00055	0.00051	0.00051	0.0005	0.00051	0.00049	0.00044	0.00047	0.00047	0.00046	0.00022	0.00077
Copper (Cu)-Total	mg/L	0.0005	0.00081	0.00088	0.00092	0.0009	0.0009	0.00091	0.00085	0.00136	0.0013	0.00131	0.00121	0.00125	0.00123	0.00111	0.00115	0.0014	0.00131	0.00081	0.00424
Iron (Fe)-Total	mg/L	0.01	0.302	0.333	0.349	0.355	0.306	0.343	0.327	0.769	0.707	0.667	0.216	0.242	0.21	0.368	0.407	0.451	0.491	0.302	0.282
Lead (Pb)-Total	mg/L	0.00005	0.000213	0.000238	0.000252	0.000238	0.000211	0.000212	0.000212	0.000506	0.000481	0.00047	0.000226	0.000236	0.000211	0.000229	0.000249	0.000402	0.000349	0.000213	<0.000050
Lithium (Li)-Total	mg/L	0.001	0.0255	0.0252	0.0255	0.0271	0.0274	0.0272	0.027	0.0303	0.03	0.0301	0.0322	0.032	0.0317	0.0303	0.0308	0.03	0.0291	0.0255	0.0129
Magnesium (Mg)-Total	mg/L	0.005	26.5	26.7	26.8	30.3	29.7	30	30.2	32.1	32.2	32.6	31	31.7	31.2	30.3	31	29.5	29.6	26.5	65.3
Manganese (Mn)-Total	mg/L	0.0001	0.151	0.183	0.182	0.156	0.144	0.147	0.147	0.25	0.244	0.241	0.266	0.276	0.262	0.127	0.136	0.171	0.168	0.151	0.0352
Molybdenum (Mo)-Total	mg/L	0.00005	0.00173	0.00171	0.00171	0.00194	0.00193	0.00198	0.00191	0.00205	0.00204	0.00203	0.00224	0.00216	0.0022	0.00186	0.00184	0.00184	0.00183	0.00173	0.00362
Nickel (Ni)-Total	mg/L	0.0005	0.00133	0.00136	0.00137	0.00201	0.002	0.002	0.00197	0.00298	0.00296	0.00298	0.00295	0.00295	0.00306	0.00265	0.00279	0.00289	0.00287	0.00133	0.01
Phosphorus (P)-Total	mg/L	0.03	0.149	0.137	0.152	0.221	0.213	0.2	0.224	0.274	0.275	0.263	0.221	0.24	0.231	0.157	0.164	0.165	0.162	0.149	0.043
Potassium (K)-Total	mg/L	0.05	6.45	6.57	6.44	8.32	8.15	8.18	8.4	9.23	9.34	9.15	9.41	9.49	9.43	8.02	8.19	6.92	6.75	6.45	42.9
Rubidium (Rb)-Total	mg/L	0.0002	0.00189	0.00199	0.00199	0.00433	0.00414	0.00433	0.00426	0.00473	0.00478	0.00461	0.00382	0.00382	0.00374	0.00321	0.00329	0.0028	0.00277	0.00189	0.0665
Selenium (Se)-Total	mg/L	0.00005	0.000177	0.000176	0.000158	0.000198	0.000212	0.000202	0.000165	0.000238	0.000215	0.000229	0.00029	0.000295	0.000276	0.000218	0.000204	0.000231	0.000226	0.000177	0.000098
Silicon (Si)-Total	mg/L	0.1	3.8	3.78	3.86	4.28	4.09	4.13	4.14	5.38	5.22	5.08	3.04	3.05	2.96	6.34	6.29	6.7	6.85	3.8	4.99
Silver (Ag)-Total	mg/L	0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Total	mg/L	0.05	9.65	9.51	9.38	17.5	17.6	17.3	17.9	20.4	20.6	20.6	25.2	25.7	25.1	25	25.5	21.2	21	9.65	115
Strontium (Sr)-Total	mg/L	0.0002	0.18	0.182	0.181	0.205	0.197	0.197	0.196	0.208	0.203	0.204	0.204	0.204	0.202	0.21	0.214	0.225	0.222	0.18	0.0834
Sulfur (S)-Total	mg/L	0.5	13.5	13.2	13.5	14.1	13.5	13.6	13.4	12.6	13.1	13.1	12.8	12.7	12.6	11.4	11.3	10	10.1	13.5	5.64
Tellurium (Te)-Total	mg/L	0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Thallium (Tl)-Total	mg/L	0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Thorium (Th)-Total	mg/L	0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Tin (Sn)-Total	mg/L	0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Total	mg/L	0.0003	0.0029	0.0029	0.00326	0.00314	0.00242	0.00309	0.00307	0.00829	0.00761	0.00661	0.00248	0.00275	0.00242	0.00502	0.00558	0.00728	0.00792	0.0029	<0.00030
Tungsten (W)-Total	mg/L	0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Uranium (U)-Total	mg/L	0.00001	0.00159	0.00152	0.00157	0.00167	0.00163	0.00161	0.00163	0.00167	0.00164	0.0016	0.00176	0.00176	0.00175	0.00153	0.00152	0.00135	0.00134	0.00159	0.000029
Vanadium (V)-Total	mg/L	0.0005	0.00147	0.00147	0.00154	0.00186	0.00179	0.00183	0.00184	0.00306	0.00298	0.00292	0.0028	0.00292	0.00281	0.00258	0.00263	0.00293	0.00294	0.00147	<0.00050
Zinc (Zn)-Total	mg/L	0.003	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0032	0.0033	0.0031	<0.0030	0.003	<0.0030	<0.0030	<0.0030	0.0051	<0.0030	<0.0030	0.0208
Zirconium (Zr)-Total	mg/L	0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	0.00032	0.00029	0.00029	<0.00020	<0.00020	0.00027	0.00023	0.00026	0.00043	0.00032	<0.00020	<0.00020
BOD	mg/L	2	2.3	2.4	2.4	2.7	3	2.4	2.7	2.9	2.2	2.7	4.5	4.9	4.8	5.5	<2.0	2.7	3.4	<2.0	2.9
BOD Carbonaceous	mg/L	2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.9	3.5	3.3	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Chlorophyll a	ug/L	0.1	24.8	26.3	23.6	33.4	34.1	33.4	31.5	27.5	23.9	37.2	18.3	20.3	22.5	7.86	12.2	19	18.6	<0.10	12.7
Phaeophytin a	ug/L	0.1	13.8	13.8	12.8	19.4	19.5	18.2	17.6	13.1	12.5	16	17.9	20.8	21	6.29	11.3	9.87	10.3	<0.10	7.24

Table C-3 September Water Quality Analytical Results

ALS			Site 1			Site 2			Site 3				Site 4		Site 5			Site 6			
		Sample ID	SL1	SM1	SR1	SL2	SM2	SR2	SL3	SM3	SR3	SL3-dup	SL4	SR4	SL5	SL5-dup	SR5	SL6	SL6 - DUP	SR6	HYLIFE EFFLUENT
		ALS ID	L2344845-10	L2344845-11	L2344845-12	L2344845-4	L2344845-5	L2344845-6	L2345846-4	L2345846-5	L2345846-6	L2345846-7	L2345846-12	L2345846-11	L2345823-7	L2345823-8	L2345823-9	L2345823-1	L2345823-2	L2345823-3	L2344845-13
Multiple Work Orders		Date Sampled	9/9/2019 4:49:00 PM	9/9/2019 4:35:00 PM	9/9/2019 4:21:00 PM	9/9/2019 7:30:00 PM	9/9/2019 7:20:00 PM	9/9/2019 7:10:00 PM	9/10/2019 1:20:00 PM	9/10/2019 1:10:00 PM	9/10/2019 12:58:00 PM	9/10/2019 1:25:00 PM	9/10/2019 4:30:00 PM	9/10/2019 4:21:00 PM	9/11/2019 10:05:00 AM	9/11/2019 10:05:00 AM	9/11/2019 10:36:00 AM	9/11/2019 3:39:00 PM	9/11/2019 3:58:00 PM	9/11/2019 3:25:00 PM	9/9/2019 4:45:00 PM
Analyte	Units	LOR	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
Volatile Suspended Solids	mg/L	2	5.5	6.1	6.8	4.8	5.9	4.7	2.9	3.3	2.4	3.7	2.1	2.8	3.3	2.4	3.7	<2.0	2.1	2.5	<2.0
Total Suspended Solids	mg/L	2	9.3	9.6	9.2	8	8.9	7.6	8.5	7.7	6.9	9.3	7.7	6.5	10.3	10.1	11.6	7.2	8	6.1	<2.0
Alkalinity, Total (as CaCO3)	mg/L	1	174	173	175	175	174	180	189	187	187	188	185	188	216	213	216	206	207	206	173
Ammonia, Total (as N)	mg/L	0.01	0.024	0.024	0.022	0.012	0.011	0.018	0.026	0.022	0.024	0.027	0.022	0.056	0.022	0.015	0.024	0.016	0.016	0.017	0.02
Bicarbonate (HCO3)	mg/L	1.2	213	211	213	210	207	220	221	224	223	224	219	222	250	245	248	235	238	238	211
Carbonate (CO3)	mg/L	0.6	<0.60	<0.60	<0.60	1.2	2.28	<0.60	4.68	2.16	2.64	2.64	3.48	3.6	6.6	7.32	7.44	8.04	6.96	6.84	<0.60
Chloride	mg/L	0.5	4.91	4.8	5.04	26.4	26.2	26.6	33.2	31.5	31.8	33.5	28.4	28.2	26.9	26.5	26.5	27.5	27.6	27.4	415
Fluoride	mg/L	0.02	0.19	0.188	0.189	0.213	0.21	0.209	0.237	0.233	0.232	0.238	0.223	0.22	0.205	0.204	0.203	0.199	0.199	0.197	0.61
Hydroxide (OH)	mg/L	0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34
Nitrate and Nitrite as N	mg/L	0.07	0.091	0.098	0.092	<0.070	<0.070	<0.070	<0.070	<0.070	<0.070	<0.070	<0.070	<0.070	<0.070	<0.070	<0.070	<0.070	<0.070	<0.070	5.63
Nitrate (as N)	mg/L	0.02	0.091	0.098	0.092	0.049	0.048	0.044	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	5.63
Nitrite (as N)	mg/L	0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.050 *
Total Kjeldahl Nitrogen	mg/L	0.2	1.43	1.42	1.39	1.28	1.31	1.36	1.1	0.96	0.96	1	0.92	0.98	0.93	0.91	0.92	0.73	0.78	0.73	0.69
Total Nitrogen	mg/L	0.2	1.52	1.52	1.49	1.28	1.31	1.36	1.1	0.96	0.96	1	0.92	0.98	0.93	0.91	0.92	0.73	0.78	0.73	6.32
Orthophosphate-Dissolved (as P)	mg/L	0.003	0.0424	0.0422	0.0417	0.0492	0.0495	0.05	0.0654	0.0639	0.0614	0.0646	0.0624	0.0626	0.0501	0.0486	0.0508	0.0357	0.0388	0.0278	0.0125
Phosphorus (P)-Total Dissolved	mg/L	0.003	0.0773	0.0793	0.0761	0.0817	0.0847	0.081	0.102	0.101	0.102	0.103	0.101	0.0979	0.0817	0.0813	0.0829	0.0639	0.0646	0.0637	0.0214
Phosphorus (P)-Total Reactive	mg/L	0.003	0.0382	0.0444	0.0459	0.0506	0.0488	0.0484	0.064	0.068	0.0647	0.0652	0.0641	0.0656	0.0554	0.052	0.0501	0.041	0.0394	0.0278	0.0128
Phosphorus (P)-Total	mg/L	0.003	0.145	0.151	0.154	0.148	0.148	0.147	0.128	0.129	0.129	0.125	0.131	0.133	0.112	0.11	0.113	0.0803	0.0821	0.0847	0.022
Phosphorus (P)-Total Particulate	mg/L	0.0042	0.068	0.0718	0.0784	0.066	0.063	0.066	0.0267	0.0281	0.0267	0.022	0.0307	0.0352	0.0303	0.0292	0.0304	0.0164	0.0174	0.021	<0.0042
Silica, Reactive (as SiO2)	mg/L	1	19.9	21	20.5	19.5	19.2	19	18.5	18	17.5	17.8	16.1	16.4	13.3	12.7	12.8	7.7	7.5	7.6	7
Dissolved Organic Carbon	mg/L	0.5	9.5	9.46	9.48	9.38	9.41	9.65	8.91	9.06	9.28	9.09	8.79	8.72	9.27	9.39	9.26	8.02	8	7.97	3.39
Total Inorganic Carbon	mg/L	0.5	37.7	36.6	35.8	33.1	36	36.3	39.3	39.3	38.6	38.3	38.8	39	45.2	45	44.8	43.2	43	42.9	36.8
Total Organic Carbon	mg/L	0.5	9.81	9.65	9.93	9.61	9.54	9.83	9.02	8.97	8.87	8.44	8.63	8.75	9.36	9.19	9.3	7.86	8.28	7.82	3.3
Escherichia Coli	MPN/ 100mL	1	99	150	104	116	131	93	488	228	345	548	145	166	326	435	272	93	96	96	<1
Fecal Coliforms	MPN/ 100mL	1	147	108	102	127	112	70	272 *	248 *	248 *	365 *	152 *	225 *	133	138	105	66	75	81	<1
Phytoplankton taxonomy	-	n/a	IP	IP	IP	IP	IP	IP	IP	IP	IP	IP	IP	IP	IP	IP	IP	IP	IP	IP	IP
Aluminum (Al)-Total	mg/L	0.003	-	0.0402	-	-	0.0385	-	-	0.0833	-	-	-	0.0726	0.117	0.107	-	-	-	0.0771	<0.0030
Antimony (Sb)-Total	mg/L	0.0001	-	<0.00010	-	-	<0.00010	-	-	0.00012	-	-	-	0.00011	0.00016	0.00014	-	-	-	0.00014	0.00017
Arsenic (As)-Total	mg/L	0.0001	-	0.0136	-	-	0.0158	-	-	0.0153	-	-	-	0.0133	0.0122	0.0119	-	-	-	0.00866	0.00027
Barium (Ba)-Total	mg/L	0.0001	-	0.133	-	-	0.119	-	-	0.108	-	-	-	0.0975	0.114	0.114	-	-	-	0.106	0.0152
Beryllium (Be)-Total	mg/L	0.0001	-	<0.00010	-	-	<0.00010	-	-	<0.00010	-	-	-	<0.00010	<0.00010	<0.00010	-	-	-	<0.00010	<0.00010
Bismuth (Bi)-Total	mg/L	0.00005	-	<0.000050	-	-	<0.000050	-	-	<0.000050	-	-	-	<0.000050	<0.000050	<0.000050	-	-	-	<0.000050	<0.000050
Boron (B)-Total	mg/L	0.01	-	0.063	-	-	0.067	-	-	0.063	-	-	-	0.061	0.066	0.067	-	-	-	0.064	0.083
Cadmium (Cd)-Total	mg/L	0.000005	-	0.0000073	-	-	0.0000089	-	-	0.0000104	-	-	-	0.0000064	0.0000258	0.0000338	-	-	-	0.0000128	0.0000141
Calcium (Ca)-Total	mg/L	0.05	-	31.6	-	-	33.4	-	-	36.5	-	-	-	36.5	41.1	43	-	-	-	42.7	26.3
Cesium (Cs)-Total	mg/L	0.00001	-	<0.000010	-	-	<0.000010	-	-	0.000013	-	-	-	0.000011	0.000018	0.000017	-	-	-	0.000014	0.000078
Chromium (Cr)-Total	mg/L	0.0001	-	0.00013	-	-	0.00012	-	-	0.00017	-	-	-	0.00016	0.00039	0.00025	-	-	-	0.00017	0.00015
Cobalt (Co)-Total	mg/L	0.0001	-	0.00016	-	-	0.00021	-	-	0.00028	-	-	-	0.00025	0.0003	0.0003	-	-	-	0.00024	0.00099
Copper (Cu)-Total	mg/L	0.0005	-	0.0006	-	-	0.00092	-	-	0.00084	-	-	-	0.001	0.00116	0.00111	-	-	-	0.00117	0.00378
Iron (Fe)-Total	mg/L	0.01	-	0.28	-	-	0.239	-	-	0.34	-	-	-	0.226	0.365	0.35	-	-	-	0.25	0.061
Lead (Pb)-Total	mg/L	0.00005	-	0.000143	-	-	0.000144	-	-	0.000186	-	-	-	0.000161	0.000189	0.000173	-	-	-	0.000144	<0.000050
Lithium (Li)-Total	mg/L	0.001	-	0.0271	-	-	0.0266	-	-	0.0256	-	-	-	0.0251	0.0282	0.0286	-	-	-	0.0276	0.0136
Magnesium (Mg)-Total	mg/L	0.005	-	28.5	-	-	32.7	-	-	32.5	-	-	-	30.7	32.9	32.2	-	-	-	31.2	114
Manganese (Mn)-Total	mg/L	0.0001	-	0.16	-	-	0.0915	-	-	0.0972	-	-	-	0.0778	0.0903	0.087	-	-	-	0.0494	0.246
Molybdenum (Mo)-Total	mg/L	0.00005	-	0.00149	-	-	0.00161	-	-	0.00175	-	-	-	0.0016	0.00163	0.00162	-	-	-	0.00162	0.00494
Nickel (Ni)-Total	mg/L	0.0005	-	0.00115	-	-	0.00176	-	-	0.00204	-	-	-	0.00226	0.00248	0.00243	-	-	-	0.0023	0.00903
Phosphorus (P)-Total	mg/L	0.03	-	0.155	-	-	0.141	-	-	0.133	-	-	-	0.119	0.121	0.126	-	-	-	0.08	0.038
Potassium (K)-Total	mg/L	0.05	-	6.72	-	-	8.86	-	-	8.69	-	-	-	8.43	7.79	7.7	-	-	-	8.13	40.8
Rubidium (Rb)-Total	mg/L	0.0002	-	0.00168	-	-	0.00436	-	-	0.00438	-	-	-	0.00341	0.003	0.00289	-	-	-	0.00274	0.0556
Selenium (Se)-Total	mg/L	0.00005	-	0.000118	-	-	0.000126	-	-	0.000142	-	-	-	0.000219	0.000207	0.000183	-	-	-	0.000164	<0.000050
Silicon (Si)-Total	mg/L	0.1	-	10.4	-	-	9.62	-	-	8.67	-	-	-	7.82	6.51	6.49	-	-	-	3.93	3.66
Silver (Ag)-Total	mg/L	0.00001	-	<0.000010	-	-	<0.000010	-	-	<0.000010	-	-	-	<0.000010	<0.000010	<0.000010	-	-	-	0.000017	<0.000010
Sodium (Na)-Total	mg/L	0.05	-	9.72	-	-	15.4	-	-	15.9	-	-	-	14.9	17	16.3	-	-	-	16.1	122
Strontium (Sr)-Total	mg/L	0.0002	-	0.172	-	-	0.174	-	-	0.171	-	-	-	0.168	0.197	0.199	-	-	-	0.194	0.092
Sulfur (S)-Total	mg/L	0.5	-	11	-	-	10.5	-	-	8.94	-	-	-	8.25	7.87	8.12	-	-	-	9.2	3.76
Tellurium (Te)-Total	mg/L	0.0002	-	<0.00020	-	-	<0.00020	-	-	<0.00020	-	-	-	<0.00020	<0.00020	<0.00020	-	-	-	<0.00020	<0.00020
Thallium (Tl)-Total	mg/L	0.00001	-	<0.000010	-	-	<0.000010	-	-	<0.000010	-	-	-	<0.000010	<0.000010	<0.000010	-	-	-	<0.000010	<0.000010
Thorium (Th)-Total	mg/L	0.0001	-	<0.00010	-	-	<0.00010	-	-	<0.00010	-	-	-	<0.00010	<0.00010	<0.00010	-	-	-	<0.00010	<0.00010
Tin (Sn)-Total	mg/L	0.0001	-	<0.00010	-	-	<0.00010	-	-	<0.00010	-	-	-	<0.00010	<0.00010	<0.00010	-	-	-	<0.00010	<0.00010
Titanium (Ti)-Total	mg/L	0.0003	-	0.0012	-	-	0.00108	-	-	0.00228	-	-	-	0.0022	0.0034	0.00319	-	-	-	0.00228	<0.00030
Tungsten (W)-Total	mg/L	0.0001	-	<0.00010	-	-	<0.00010	-	-	<0.00010	-	-	-	<0.00010	<0.00010	<0.00010	-	-	-	<0.00010	<0.00010
Uranium (U)-Total	mg/L	0.00001	-	0.00125	-	-	0.00105	-	-	0.00127	-	-	-	0.00123	0.00124	0.00124	-	-	-	0.00113	0.000027

Table C-3 September Water Quality Analytical Results

ALS			Site 1			Site 2			Site 3				Site 4		Site 5			Site 6			
		Sample ID	SL1	SM1	SR1	SL2	SM2	SR2	SL3	SM3	SR3	SL3-dup	SL4	SR4	SL5	SL5-dup	SR5	SL6	SL6 - DUP	SR6	HYLIFE EFFLUENT
		ALS ID	L2344845-10	L2344845-11	L2344845-12	L2344845-4	L2344845-5	L2344845-6	L2345846-4	L2345846-5	L2345846-6	L2345846-7	L2345846-12	L2345846-11	L2345823-7	L2345823-8	L2345823-9	L2345823-1	L2345823-2	L2345823-3	L2344845-13
Multiple Work Orders		Date Sampled	9/9/2019 4:49:00 PM	9/9/2019 4:35:00 PM	9/9/2019 4:21:00 PM	9/9/2019 7:30:00 PM	9/9/2019 7:20:00 PM	9/9/2019 7:10:00 PM	9/10/2019 1:20:00 PM	9/10/2019 1:10:00 PM	9/10/2019 12:58:00 PM	9/10/2019 1:25:00 PM	9/10/2019 4:30:00 PM	9/10/2019 4:21:00 PM	9/11/2019 10:05:00 AM	9/11/2019 10:05:00 AM	9/11/2019 10:36:00 AM	9/11/2019 3:39:00 PM	9/11/2019 3:58:00 PM	9/11/2019 3:25:00 PM	9/9/2019 4:45:00 PM
Analyte	Units	LOR	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
Vanadium (V)-Total	mg/L	0.0005	-	0.00111	-	-	0.0013	-	-	0.00136	-	-	-	0.00159	0.00169	0.00164	-	-	-	0.00143	<0.00050
Zinc (Zn)-Total	mg/L	0.003	-	<0.0030	-	-	<0.0030	-	-	<0.0030	-	-	-	<0.0030	<0.0030	<0.0030	-	-	-	<0.0030	0.0122
Zirconium (Zr)-Total	mg/L	0.0002	-	<0.00020	-	-	<0.00020	-	-	<0.00020	-	-	-	<0.00020	<0.00020	<0.00020	-	-	-	<0.00020	<0.00020
Biochemical Oxygen Demand	mg/L	2	2.5	2.7	2.4	2.6	2.7	2.3	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.5	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0 *
BOD Carbonaceous	mg/L	2	-	2.1	-	-	<2.0	-	-	<2.0	-	-	-	<2.0	<2.0	<2.0	-	-	-	<2.0	<2.0
Chlorophyll a	ug/L	0.1	17.2	16.6	19.2	16	16.8	15.6	6.59	6.57	5.99	6.17	9.12	9.04	9.62	8.94	9.49	3.52	2.73	4.08	<0.10
Phaeophytin a	ug/L	0.1	8.57	9.1	9.46	9.92	9.75	9.91	6.66	6.77	6.62	6.49	8.31	7.7	7.46	7.2	7.58	3.64	2.88	3.74	<0.10

Table C-4 September Periphyton Analytical Results

		Site 1			Site 2			Site 3			Site 4			Site 5			Site 6		
Periphyton		Rep 1	Rep 2	Rep 3	Rep 1	Rep 2	Rep 3	Rep 1	Rep 2	Rep 3	Rep 1	Rep 2	Rep 3	Rep 1	Rep 2	Rep 3	Rep 1	Rep 2	Rep 3
ID		L2344845-7	L2344845-8	L2344845-9	L2344845-1	L2344845-2	L2344845-3	L2345846-1	L2345846-2	L2345846-3	L2345846-8	L2345846-9	L2345846-10	L2345823-10	L2345823-11	L2345823-12	L2345823-4	L2345823-5	L2345823-6
Date		9/9/2019 4:00:00 PM	9/9/2019 4:00:00 PM	9/9/2019 4:08:00 PM	9/9/2019 7:58:00 PM	9/9/2019 7:55:00 PM	9/9/2019 7:58:00 PM	9/10/2019 2:40:00 PM	9/10/2019 2:45:00 PM	9/10/2019 2:50:00 PM	9/10/2019 5:15:00 PM	9/10/2019 5:18:00 PM	9/10/2019 5:25:00 PM	9/11/2019 12:30:00 PM	9/11/2019 12:30:00 PM	9/11/2019 12:30:00 PM	9/11/2019 5:20:00 PM	9/11/2019 5:00:00 PM	9/11/2019 5:10:00 PM
Chlorophyll a	ug	194	416	104	125	13.9	101	107	56.5	84.4	143	239	368	142	141	171	84.9	225	143
Dry Weight	g	0.107	1.2	0.377	0.418	0.0223	0.657	0.164	0.537	0.402	0.691	0.504	0.45	0.578	0.685	0.802	0.633	0.252	1.19
AFDW	g	0.0222	0.1555	0.0935	0.0506	0.009	0.0376	0.0209	0.0534	0.0659	0.1019	0.0896	0.0804	0.0792	0.1036	0.1239	0.066	0.0345	0.0844
Chlorophyll a/unit area	ug/cm^2	7.76	16.64	4.16	5	0.556	4.04	4.28	2.26	3.376	5.72	9.56	14.72	5.68	5.64	6.84	3.396	9	5.72
AFDW/unit area	ug/cm^2	0.000888	0.00622	0.00374	0.002024	0.00036	0.001504	0.000836	0.002136	0.002636	0.004076	0.003584	0.003216	0.003168	0.004144	0.004956	0.00264	0.00138	0.003376

Table 4a July *In-Situ* Water Quality Monitoring Measurements

	Site 1						Site 2						Site 3					
Site ID	JL1-s	JL1-b	JM1-s	JM1-b	JR1-s	JR1-b	JL2-s	JL2-b	JM2-s	JM2-b	JR2-s	JR2-b	JL3-s	JL3-b	JM3-s	JM3-b	JR3-s	JR3-b
Date	22/07/19	22/07/19	22/07/19	22/07/19	22/07/19	22/07/19	22/07/19	22/07/19	22/07/19	22/07/19	22/07/19	22/07/19	23/07/19	23/07/19	23/07/19	23/07/19	23/07/19	23/07/19
Time	12:58	13:04	13:06	13:10	13:12	13:15	18:22	18:22	18:25	18:29	18:31	18:33	16:30	16:40	16:43	16:46	16:18	16:22
Temperature (°C)	23.95	23.78	23.31	23.39	23.31	23.37	27.03	27.03	26.67	26.71	26.50	26.52	26.09	26.03	26.08	25.94	26.28	25.82
DO (mg/L)	11.61	10.55	11.06	10.62	11	10.8	10.93	10.93	13.27	12.96	10.2	10.95	9.59	8.65	9.11	9.19	10.26	8.91
Conductivity (uS/cm)	0.407	0.400	0.394	0.394	0.394	0.394	0.490	0.490	0.491	0.491	0.493	0.493	0.521	0.521	0.523	0.524	0.521	0.523
pH	8.63	8.51	8.45	8.41	8.54	8.5	8.75	8.75	8.66	8.59	8.63	8.75	8.39	8.33	8.39	8.34	8.42	8.25
ORP (mV)	55	77	86	91	87	91	66	66	82	91	93	92	216	215	218	226	202	225
Turbidity (NTU)	27.6	25.0	24.5	23.5	24.2	23.0	19.7	19.7	19.5	18.9	17.5	20.5	73.3	69.2	65.1	70.4	74.1	99.1
TDS (g/L)	0.263	0.260	0.256	0.256	0.256	0.256	0.318	0.318	0.320	0.319	0.321	0.321	0.333	0.333	0.334	0.335	0.334	0.335

	Site 4						Site 5						Site 6					
Site ID	JL4-s	JL4-b	JM4-s	JM4-b	JR4-s	JR4-b	JL5-s	JL5-b	JM5-s	JM5-b	JR5-s	JR5-b	JL6-s	JL6-b	JM6-s	JM6-b	JR6-s	JR6-b
Date	23/07/19	23/07/19	23/07/19	23/07/19	23/07/19	23/07/19	24/07/19	24/07/19	24/07/19	24/07/19	24/07/19	24/07/19	24/07/19	24/07/19	24/07/19	24/07/19	24/07/19	24/07/19
Time	19:17	19:20	19:24	19:26	19:28	19:29	11:26	11:28	11:30	11:32	11:33	11:35	14:17	14:19	14:20	14:22	14:25	14:27
Temperature (°C)	27.15	27.18	26.84	26.95	26.81	26.79	24.28	24.30	24.13	24.11	24.18	24.15	25.61	25.09	25.27	25.14	25.16	25.13
DO (mg/L)	12.5	11.15	10.29	10.75	12.45	12.82	8.43	7.9	10.19	10.32	8.43	8.11	10.08	8.63	8.77	7.99	8.01	7.51
Conductivity (uS/cm)	0.530	0.529	0.532	0.531	0.533	0.533	0.573	0.578	0.579	0.579	0.578	0.579	0.552	0.550	0.553	0.553	0.553	0.552
pH	8.85	8.83	8.95	8.82	8.96	8.91	8.46	8.39	8.43	8.39	8.44	8.37	8.53	8.33	8.48	8.32	8.52	8.46
ORP (mV)	107	112	115	124	119	124	214	229	236	243	246	255	217	235	232	247	244	255
Turbidity (NTU)	35.4	37.8	36.4	36.1	34.6	36.3	38.9	39.7	38.7	38.7	38.3	39.3	56.2	67.0	55.2	57.5	57.0	58.0
TDS (g/L)	0.340	0.338	0.341	0.340	0.341	0.341	0.370	0.370	0.370	0.370	0.370	0.370	0.353	0.352	0.354	0.354	0.354	0.353

Table 4b September *In-Situ* Water Quality Monitoring Measurements

	Site 1						Site 2						Site 3					
Site ID	SL1-s	SL1-b	SM1-s	SM1-b	SR1-s	SR1-b	SL2-s	SL2-b	SM2-s	SM2-b	SR2-s	SR2-b	SL3-s	SL3-b	SM3-s	SM3-b	SR3-s	SR3-b
Date	9/9/19	9/9/19	9/9/19	9/9/19	9/9/19	9/9/19	9/9/19	9/9/19	9/9/19	9/9/19	9/9/19	9/9/19	10/9/19	10/9/19	10/9/19	10/9/19	10/9/19	10/9/19
Time	14:49	14:52	14:35	14:40	14:21	14:28	18:50	18:52	18:45	18:48	18:40	18:42	13:44	13:48	13:50	13:52	13:55	14:00
Temperature (°C)	15.08	15.09	15.35	15.17	15.56	15.49	15.69	15.71	15.72	15.73	15.74	15.75	15.09	14.96	14.98	14.95	14.95	14.93
DO (mg/L)	10.37	10.27	10.58	12.14	11.26	9.97	9.33	8.75	9.61	9.48	11.48	11.29	10.01	9.44	9.42	9.66	9.4	9.46
Conductivity (uS/cm)	0.37	0.37	0.367	0.37	0.373	0.37	0.439	0.439	0.439	0.439	0.438	0.438	0.459	0.459	0.459	0.459	0.459	0.458
pH	8.32	8.29	8.33	8.31	8.35	8.34	8.41	8.41	8.41	8.41	8.43	8.42	8.35	8.37	8.35	8.34	8.36	8.34
ORP (mV)	76	79	69	74	46	0.27	82	83	79	80	80	82	108	103	104	105	104	106
Turbidity (NTU)	21.5	22.4	23.9	22.9	21.1	19.9	18.3	19.6	15.9	20.6	18.8	18.6	14.2	25.8	13.5	13.2	12.1	12.6
TDS (g/L)	0.24	0.24	0.236	0.24	0.242	0.24	0.285	0.286	0.285	0.285	0.284	0.284	0.299	0.298	0.299	0.298	0.298	0.298

	Site 4						Site 5						Site 6		R3 Innovations
Site ID	SL4-s	SL4-b	SM4-s	SM4-b	SR4-s	SR4-b	SL5-s	SL5-b	SM5-s	SM5-b	SR5-s	SR5-b	SL6-s	SR6-s	Mid-Stream
Date	10/9/19	10/9/19	10/9/19	10/9/19	10/9/19	10/9/19	11/9/19	11/9/19	11/9/19	11/9/19	11/9/19	11/9/19	11/9/19	11/9/19	11/9/19
Time	16:35	16:38	16:40	16:41	16:43	16:45	10:45	10:50	10:58	11:02	11:05	11:07	17:35	17:30	18:46
Temperature (°C)	15.18	15.13	15.08	15.1	15.13	15.15	14.47	14.43	14.42	14.32	14.34	14.35	14.61	14.7	29.22
DO (mg/L)	10.59	10.16	10.31	9.6	9.48	8.73	7.95	6.7	7.69	7.43	7.56	7.5	9.55	9.74	6.98
Conductivity (uS/cm)	0.441	0.442	0.442	0.442	0.442	0.442	0.477	0.478	0.478	0.478	0.477	0.477	0.46	0.465	1.66
pH	8.46	8.45	8.45	8.43	8.46	8.44	8.35	8.33	8.37	8.37	8.38	8.38	8.51	8.47	8
ORP (mV)	95	96	95	97	97	98	142	141	140	140	130	130	130	132	129
Turbidity (NTU)	14.8	16.4	16.6	16.4	14.9	14.9	31.2	27	24.4	24.8	23.8	23.5	13.2	13.1	45.9
TDS (g/L)	0.287	0.287	0.287	0.287	0.287	0.287	0.31	0.311	0.311	0.311	0.31	0.31	0.299	0.302	1.06

Table 5a July *In-Situ* PAR Measurements

Site 1						Site 2						Site 3					
JR1		JM1		JL1		JR2		JM2		JL2		JR3		JM3		JL3	
Date	22-Jul-19	Date	22-Jul-19	Date	22-Jul-19	Date	22-Jul-19	Date	22-Jul-19	Date	22-Jul-19	Date	23-Jul-19	Date	23-Jul-19	Date	23-Jul-19
Time	14:32	Time	14:28	Time	14:20	Time	19:14	Time	19:18	Time	19:21	Time	16:51	Time	16:54	Time	16:57
Weather sunny with light cloud cover						Weather dusk, no wind, 24C						Weather mostly sunny, 30C, no wind					
Depth (cm)	Reading (umol)	Depth (cm)	Reading (umol)	Depth (cm)	Reading (umol)	Depth (cm)	Reading (umol)	Depth (cm)	Reading (umol)	Depth (cm)	Reading (umol)	Depth (cm)	Reading (umol)	Depth (cm)	Reading (umol)	Depth (cm)	Reading (umol)
Surface	2225	surface	1954.9	surface	2141	surface	460.2	surface	600.5	surface	525.2	surface	841.4	surface	283.1	surface	779
20	1413.5	20	1351.3	20	1526.2	15	333	15	400.2	bottom (20)	361.2	30	255.3	30	206.4	30	87.23
bottom (43)	1091.6	40	1020	40	1252.3	30	263.4	30	308.3			60	149.47	60	80.1	60	70.48
		bottom (63)	649.8	bottom (44)	1208	45	228.8	bottom (37)	254.6			bottom (91)	111.45	bottom (100)	33.44	bottom (77)	19.02
						60	173.07										
						bottom (70)	142.58										

Site 4				Site 5						Site 6					
JR4		JL4		JR5		JM5		JL5		JR6		JM6		JL6	
Date	23-Jul-19	Date	23-Jul-19	Date	24-Jul-19	Date	24-Jul-19	Date	24-Jul-19	Date	24-Jul-19	Date	24-Jul-19	Date	24-Jul-19
Time	20:43	Time	20:43	Time	12:05	Time	12:08	Time	12:12	Time	15:20	Time	15:15	Time	15:10
Weather dusk, clear, light wind				Weather sunny, 26C, light wind						Weather lightly shaded by tree cover; light cloud cover					
Depth (cm)	Reading (umol)	Depth (cm)	Reading (umol)	Depth (cm)	Reading (umol)	Depth (cm)	Reading (umol)	Depth (cm)	Reading (umol)	Depth (cm)	Reading (umol)	Depth (cm)	Reading (umol)	Depth (cm)	Reading (umol)
surface	69.14	surface	70.17	surface	1758.8	surface	1594.5	surface	1558.3	surface	840.6	surface	879.7	surface	1557.1
20	34.8	20	30.36	15	1152.2	20	775.1	15	1197.6	20	484.7	20	470.8	20	561.4
bottom (25)	20.03	40	14.98	30	857.9	40	709.2	30	777	40	255.7	40	186.5	40	346
		60	10.01	bottom (34)	729.9	bottom (62)	561.4	45	664.6	bottom (52)	95.83	60	119.23	60	223.8
		bottom (87)	5.57					bottom (54)	554.2			80	64.01	80	160.79
												bottom (89)	33.71	100	107.46
														bottom (107)	52.26

Table 5b September *In-Situ* PAR Measurements

Site 1		Site 2		Site 3		Site 4		Site 5		Site 6	
Date:	9-Sep-19	Date:	9-Sep-19	Date:	10-Sep-19	Date:	10-Sep-19	Date:	11-Sep-19	Date:	11-Sep-19
Time:	15:11	Time:	18:30	Time:	13:34	Time:	16:16	Time:	11:17	Time:	16:18
Weather:	cloudy, 15C, light wind	Weather:	cloudy, light wind, 12C	Weather:	overcast, 12C, light wind	Weather:	overcast, 15C, light wind	Weather:	cloudy, 15C, light wind	Weather:	cloudy, windy 10km/hr, 15C
Approx depth (cm)	PAR Reading (umol)	Approx depth (cm)	PAR Reading (umol)	Approx depth (cm)	PAR Reading (umol)	Approx depth (cm)	PAR Reading (umol)	Approx depth (cm)	PAR Reading (umol)	Approx depth (cm)	PAR Reading (umol)
surface	144.33	surface	32.04	surface	382.2	surface	196.33	surface	301.7	surface	115.75
10	147.57	10	27.03	10	319.5	10	157.92	10	246.6	10	95.16
20	129.27	20	24.26	20	276.4	20	135.38	20	198.23	20	79.79
30	103.31	30	20.48	30	260.7	30	126.46	30	168.41	30	71.34
40	93.07	40	18.48	40	221.2	40	114.77	40	136.53	40	65.33
50	66.66	bottom (46)	16.97	50	206.4	50	104.9	50	125.09	50	55.92
60	51.43			60	200.4	60	91.9	60	106.09	60	49.36
bottom (66)	38.46			70	169.75	70	83.84	70	87.18	70	33.41
				80	149.99	80	72.12	bottom (80)	78.38	bottom (74)	31.55
				90	136.86	90	65.18				
				100	126.88	bottom (98)	57.29				
				bottom (110)	120						

Table 6a July *In-Situ* Flow Measurements

Site 1					
Date	7/22/2019				
Width (m)	8.6				
Interval (m)	Depth (m)	Flow (m/s)	area (m^2)	flow rate (m^3/s)	L/s
0.8	0.21	0.1	0.2	0.0168	16.8
1.6	0.43	0.1	0.3	0.0344	34.4
2.4	0.56	0.1	0.4	0.0448	44.8
3.2	0.63	0.1	0.5	0.0504	50.4
4.0	0.52	0.2	0.4	0.0832	83.2
4.8	0.44	0.1	0.4	0.0352	35.2
5.6	0.35	0.1	0.3	0.0280	28.0
6.4	0.32	nr	0.3		0.0
7.2	0.25	nr	0.2		0.0
8.6	0	nr	0.0		0.0
Flow Rate	292.8				
Flow Rate (m^3/s)	0.293				

Site 2				
Date	7/22/2019			
Width (m)	12			
Interval (m)	Depth (m)	Flow (m/s)	flow rate (m^3/s)	L/s
1	0.47	0.0	0.000	0.0
2	0.60	0.0	0.000	0.0
3	0.70	0.0	0.000	0.0
4	0.61	0.1	0.061	61.0
5	0.53	0.0	0.000	0.0
6	0.60	0.1	0.060	60.0
7	0.37	0.1	0.037	37.0
8	0.31	0.0	0.000	0.0
9	0.27	0.0	0.000	0.0
10	0.25	0.0	0.000	0.0
11	0.20	0.0	0.000	0.0
12	0.16	0.0	0.000	0.0
				158
				0.158

Site 3				
Date	7/23/2019			
Width (m)	8			
Interval (m)	Depth (m)	Flow (m/s)	flow rate (m^3/s)	L/s
1	0.85	0.0	0.000	0.0
2	0.91	0.1	0.091	91.0
3	1.20	0.1	0.120	120.0
4	1.10	0.1	0.110	110.0
5	1.20	0.1	0.120	120.0
6	1.00	0.1	0.100	100.0
7	0.77	0.1	0.077	77.0
8	0.48	0.1	0.048	48.0
				666
				0.666

Site 4				
Date	7/23/2019			
Width (m)	10			
Interval (m)	Depth (m)	Flow (m/s)	flow rate (m^3/s)	L/s
1	0.12	0.1	0.012	12.0
2	0.25	0.1	0.025	25.0
3	0.43	0.1	0.043	43.0
4	0.52	0.1	0.052	52.0
5	0.68	0.1	0.068	68.0
6	0.71	0.1	0.071	71.0
7	0.17	0.1	0.017	17.0
8	0.98	0.1	0.098	98.0
9	0.87	0.1	0.087	87.0
10	0.68	0.1	0.068	68.0
				541
				0.541

Site 5				
Date	7/24/2019			
Width (m)	11			
Interval (m)	Depth (m)	Flow (m/s)	flow rate (m^3/s)	L/s
1.0	0.22	0.1	0.02	22.0
2.0	0.28	0.1	0.03	28.0
3.0	0.34	0.1	0.03	34.0
4.0	0.43	0.1	0.04	43.0
5.0	0.53	0.1	0.05	53.0
6.0	0.62	0.1	0.06	62.0
7.0	0.58	0.1	0.06	58.0
8.0	0.56	0.0	0.00	0.0
9.0	0.54	0.0	0.00	0.0
10.0	0.45	0.0	0.00	0.0
				300
				0.300

Site 6				
Date	7/24/2019			
Width (m)	8			
Interval (m)	Depth (m)	Flow (m/s)	flow rate (m^3/s)	L/s
1.0	0.93	0.1	0.093	93
2.0	1.07	0.0	0	0
3.0	1.00	0.1	0.1	100
4.0	0.89	0.1	0.089	89
5.0	0.79	0.1	0.079	79
6.0	0.69	0.1	0.069	69
7.0	0.52	0.1	0.052	52
8.0	0.31	0.1	0.031	31
				513
				0.513

Hylife effluent					
date	Flow (L/s)	date	flow (L/s)	date	Flow (L/s)
7/22/2019	18.1	7/23/2019	22	7/24/2019	12.1
average					17.4
					17.4
					0.017

Table 6b September *In-Situ* Flow Measurements

Site 1 — Date: 9/9/2019; Width (m): 8.70

point	depth (m)	flow (m/s)	flow rate (m^3/s)
1	0.24	-0.032	-0.008
2	0.38	0.093	0.035
3	0.50	0.063	0.032
4	0.60	0.014	0.008
5	0.66	0.097	0.064
6	0.55	0.117	0.064
7	0.44	0.091	0.040
8	0.40	0.238	0.095
9	0.34	0.014	0.003
Total flow (m3/s)			0.342

Hylife Effluent — Date: 9/9/2019; Width (m): 0.20

Rep	depth (m)	diameter	flow (m/s)	area (m2)	flow rate (m3/s)
1	0.08	0.20	1.494	0.01	0.017
2	0.09	0.20	1.117	0.01	0.015
3	0.09	0.20	1.474	0.01	0.020
average					0.018
Total flow (m3/s)					0.018

Site 2 — Date: 9/9/2019; Width (m): 11.70

point	depth (m)	flow (m/s)	flow rate (m^3/s)
1	0.15	0.019	0.003
2	0.46	0.033	0.015
3	0.40	0.049	0.020
4	0.36	0.059	0.021
5	0.40	0.051	0.020
6	0.38	0.054	0.021
7	0.32	0.040	0.013
8	0.22	0.031	0.007
9	0.22	0.030	0.007
10	0.26	0.046	0.012
11	0.30	0.002	0.001
Total flow (m3/s)			0.139

Site 3 — Date: 9/10/2019; Width (m): 9.80

point	depth (m)	flow (m/s)	flow rate (m^3/s)
1	0.60	-0.016	-0.010
2	1.00	0.013	0.013
3	1.28	0.056	0.072
4	1.14	0.055	0.063
5	1.12	0.061	0.068
6	1.10	0.050	0.055
7	1.00	0.042	0.042
8	0.88	0.028	0.025
9	0.62	0.010	0.006
10	0.38	-0.008	-0.003
Total flow (m3/s)			0.344

Site 3-culverts — Date: 9/10/2019; Width (m): 3.60

depth (m)	diameter	area	flow (m/s)	flow rate (m3/s)
0.28	3.60	0.37	0.972	0.356
Total flow (m3/s)				0.356

Site 4 — Date: 9/10/2019; Width (m): 11.40

point	depth (m)	flow (m/s)	flow rate (m^3/s)
1	0.20	0.054	0.011
2	0.38	0.056	0.021
3	0.48	0.058	0.028
4	0.56	0.049	0.027
5	0.76	0.047	0.036
6	0.94	0.041	0.039
7	0.98	0.022	0.022
8	1.20	0.050	0.060
9	0.88	0.060	0.053
10	0.80	0.042	0.034
11	0.70	0.005	0.004
Total flow (m3/s)			0.333

Site 5 — Date: 9/12/2019; Width (m): 13.50

point	depth (m)	flow (m/s)	flow rate (m^3/s)
1	0.52	0.036	0.019
2	0.60	0.022	0.013
3	0.66	0.041	0.027
4	0.70	0.028	0.020
5	0.78	0.031	0.024
6	0.86	0.038	0.033
7	0.88	0.039	0.034
8	0.90	0.040	0.036
9	0.88	0.044	0.039
10	0.86	0.029	0.025
11	0.84	0.029	0.024
12	0.82	0.032	0.026
13	0.78	0.009	0.007
14	0.80	0.022	0.018
Total flow (m3/s)			0.345

Site 6 — Date: 9/12/2019; Width (m): 11.70

point	depth (m)	flow (m/s)	flow rate (m^3/s)
1	0.20	-0.060	-0.012
2	0.30	-0.080	-0.024
3	0.24	-0.048	-0.012
4	0.30	0.037	0.011
5	0.86	0.287	0.247
6	0.52	0.207	0.108
7	0.60	0.058	0.035
8	0.66	-0.033	-0.022
Total flow (m3/s)			0.400

Site 6-culverts — Date: 9/12/2019; Width (m): 1.20

culvert (L-R)	diameter (m)	depth (m)	flow (m/s)	area (m2)	flow rate (m3/s)
1	1.20	0.42	0.056	0.35	0.020
2	1.20	0.25	0.552	0.17	0.094
3	1.20	0.22	0.075	0.14	0.011
4	1.20	0.26	0.189	0.18	0.034
Total flow (m3/s)					0.159

Table C-5 Phytoplankton Taxonomy

DateSamp	LabNum	Source	Class	Genus	Species	CellperLitre	Unit
9/10/2019	L2351034-1	SL3	Bacillariophyceae	Aulacoseira	sp.	1000	Filament
9/10/2019	L2351034-1	SL3	Cryptophyceae	Cryptomonas	sp.	50000	Single Cell
9/10/2019	L2351034-1	SL3	Chlorophyceae	Monoraphidium	sp.	43000	Single Cell
9/10/2019	L2351034-1	SL3	Cyanophyceae	Pseudanabaena	sp.	12000	Filament
9/10/2019	L2351034-1	SL3	Cyanophyceae	Planktolyngbya	sp.	12000	Filament
9/10/2019	L2351034-1	SL3	Cryptophyceae	Unidentified		396000	Single Cell
9/10/2019	L2351034-1	SL3	Cyanophyceae	Microcystis	sp.	6000	Colony
9/10/2019	L2351034-1	SL3	Euglenophyceae	Trachelomonas	sp.	2000	Single Cell
9/10/2019	L2351034-1	SL3	Euglenophyceae	Euglena	sp.	1000	Single Cell
9/10/2019	L2351034-1	SL3	Bacillariophyceae	Nitzschia	sp.	93000	Single Cell
9/10/2019	L2351034-1	SL3	Cyanophyceae	Aphanocapsa	sp.	19000	Colony
9/10/2019	L2351034-1	SL3	Chlorophyceae	Unidentified		81000	Single Cell
9/10/2019	L2351034-1	SL3	Cyanophyceae	Planktothrix	sp.	19000	Filament
9/10/2019	L2351034-1	SL3	Chlorophyceae	Scenedesmus	sp.	50000	Colony
9/10/2019	L2351034-1	SL3	Bacillariophyceae	Navicula	sp.	6000	Single Cell
9/10/2019	L2351034-1	SL3	Chlorophyceae	Unidentified		37000	Colony
9/10/2019	L2351034-1	SL3	Bacillariophyceae	Cyclotella	sp.	31000	Single Cell
9/10/2019	L2351034-2	SM3	Cyanophyceae	Planktolyngbya	sp.	6000	Filament
9/10/2019	L2351034-2	SM3	Euglenophyceae	Phacus	sp.	6000	Single Cell
9/10/2019	L2351034-2	SM3	Bacillariophyceae	Cocconeis	sp.	6000	Single Cell
9/10/2019	L2351034-2	SM3	Cyanophyceae	Pseudanabaena	sp.	6000	Filament
9/10/2019	L2351034-2	SM3	Chlorophyceae	Monoraphidium	sp.	19000	Single Cell
9/10/2019	L2351034-2	SM3	Cryptophyceae	Cryptomonas	sp.	37000	Single Cell
9/10/2019	L2351034-2	SM3	Chlorophyceae	Pediastrum	Boryanum	1000	Colony
9/10/2019	L2351034-2	SM3	Chlorophyceae	Scenedesmus	arcuatus	1000	Colony
9/10/2019	L2351034-2	SM3	Chrysophyceae	Mallomonas	sp.	12000	Single Cell
9/10/2019	L2351034-2	SM3	Chlorophyceae	Scenedesmus	quadricauda	6000	Colony
9/10/2019	L2351034-2	SM3	Bacillariophyceae	Nitzschia	sp.	112000	Single Cell
9/10/2019	L2351034-2	SM3	Chlorophyceae	Scenedesmus	acuminatus	6000	Colony
9/10/2019	L2351034-2	SM3	Bacillariophyceae	Navicula	sp.	6000	Single Cell
9/10/2019	L2351034-2	SM3	Chlorophyceae	Scenedesmus	sp.	31000	Colony
9/10/2019	L2351034-2	SM3	Bacillariophyceae	Cyclotella	sp.	43000	Single Cell
9/10/2019	L2351034-2	SM3	Chrysophyceae	small chrysophytes		99000	Single Cell
9/10/2019	L2351034-2	SM3	Chlorophyceae	Unidentified		99000	Single Cell

Table C-5 Phytoplankton Taxonomy

DateSamp	LabNum	Source	Class	Genus	Species	CellperLitre	Unit
9/10/2019	L2351034-2	SM3	Chlorophyceae	Scenedesmus	spinosus	12000	Colony
9/10/2019	L2351034-2	SM3	Chlorophyceae	Elakatothrix	sp.	50000	Single Cell
9/10/2019	L2351034-2	SM3	Cyanophyceae	Aphanocapsa	sp.	19000	Colony
9/10/2019	L2351034-2	SM3	Chlorophyceae	Unidentified		43000	Colony
9/10/2019	L2351034-2	SM3	Cyanophyceae	Microcystis	sp.	25000	Colony
9/10/2019	L2351034-2	SM3	Cyanophyceae	Planktothrix	sp.	15000	Filament
9/10/2019	L2351034-2	SM3	Cryptophyceae	Unidentified		297000	Single Cell
9/10/2019	L2351034-3	SR3	Chlorophyceae	Scenedesmus	arcuatus	1000	Colony
9/10/2019	L2351034-3	SR3	Cryptophyceae	Unidentified		594000	Single Cell
9/10/2019	L2351034-3	SR3	Chlorophyceae	Scenedesmus	quadricauda	19000	Colony
9/10/2019	L2351034-3	SR3	Bacillariophyceae	Nitzschia	sp.	99000	Single Cell
9/10/2019	L2351034-3	SR3	Chlorophyceae	Tetraedron	minimum	6000	Single Cell
9/10/2019	L2351034-3	SR3	Chlorophyceae	Scenedesmus	spinosus	6000	Colony
9/10/2019	L2351034-3	SR3	Chlorophyceae	Unidentified		99000	Single Cell
9/10/2019	L2351034-3	SR3	Chlorophyceae	Oocystis	sp.	6000	Colony
9/10/2019	L2351034-3	SR3	Bacillariophyceae	Navicula	sp.	6000	Single Cell
9/10/2019	L2351034-3	SR3	Chlorophyceae	Unidentified		81000	Colony
9/10/2019	L2351034-3	SR3	Chlorophyceae	Scenedesmus	sp.	50000	Colony
9/10/2019	L2351034-3	SR3	Chlorophyceae	Elakatothrix	sp.	37000	Single Cell
9/10/2019	L2351034-3	SR3	Bacillariophyceae	Aulacoseira	sp.	1000	Filament
9/10/2019	L2351034-3	SR3	Cyanophyceae	Merismopedia	sp.	180000	Single Cell
9/10/2019	L2351034-3	SR3	Cyanophyceae	Microcystis	sp.	37000	Colony
9/10/2019	L2351034-3	SR3	Bacillariophyceae	Caloneis	sp.	1000	Single Cell
9/10/2019	L2351034-3	SR3	Cyanophyceae	Pseudanabaena	sp.	12000	Filament
9/10/2019	L2351034-3	SR3	Bacillariophyceae	Cyclotella	sp.	31000	Single Cell
9/10/2019	L2351034-3	SR3	Euglenophyceae	Trachelomonas	sp.	19000	Single Cell
9/10/2019	L2351034-3	SR3	Cyanophyceae	Planktothrix	sp.	15000	Filament
9/10/2019	L2351034-3	SR3	Euglenophyceae	Phacus	sp.	1000	Single Cell
9/10/2019	L2351034-3	SR3	Euglenophyceae	Euglena	sp.	25000	Single Cell
9/10/2019	L2351034-3	SR3	Bacillariophyceae	Rhoicosphenia	sp.	1000	Single Cell
9/10/2019	L2351034-3	SR3	Cyanophyceae	Aphanocapsa	sp.	6000	Colony
9/10/2019	L2351034-3	SR3	Chlorophyceae	Monoraphidium	sp.	62000	Single Cell
9/10/2019	L2351034-3	SR3	Cryptophyceae	Cryptomonas	sp.	99000	Single Cell
9/10/2019	L2351034-4	SL3-DUP	Cyanophyceae	Aphanocapsa	sp.	6000	Colony

Table C-5 Phytoplankton Taxonomy

DateSamp	LabNum	Source	Class	Genus	Species	CellperLitre	Unit
9/10/2019	L2351034-4	SL3-DUP	Cyanophyceae	Microcystis	sp.	25000	Colony
9/10/2019	L2351034-4	SL3-DUP	Cyanophyceae	Aphanizomenon	sp.	1000	Filament
9/10/2019	L2351034-4	SL3-DUP	Chlorophyceae	Unidentified		68000	Colony
9/10/2019	L2351034-4	SL3-DUP	Chlorophyceae	Monoraphidium	sp.	19000	Single Cell
9/10/2019	L2351034-4	SL3-DUP	Chlorophyceae	Scenedesmus	sp.	43000	Colony
9/10/2019	L2351034-4	SL3-DUP	Chlorophyceae	Tetraedron	minimum	6000	Single Cell
9/10/2019	L2351034-4	SL3-DUP	Cyanophyceae	Pseudanabaena	sp.	12000	Filament
9/10/2019	L2351034-4	SL3-DUP	Chlorophyceae	Scenedesmus	quadricauda	6000	Colony
9/10/2019	L2351034-4	SL3-DUP	Bacillariophyceae	Cocconeis	sp.	6000	Single Cell
9/10/2019	L2351034-4	SL3-DUP	Dinophyceae	Gymnodinium	sp.	6000	Single Cell
9/10/2019	L2351034-4	SL3-DUP	Cryptophyceae	Unidentified		396000	Single Cell
9/10/2019	L2351034-4	SL3-DUP	Euglenophyceae	Euglena	sp.	19000	Single Cell
9/10/2019	L2351034-4	SL3-DUP	Chlorophyceae	Scenedesmus	spinosus	12000	Colony
9/10/2019	L2351034-4	SL3-DUP	Bacillariophyceae	Nitzschia	sp.	105000	Single Cell
9/10/2019	L2351034-4	SL3-DUP	Cryptophyceae	Cryptomonas	sp.	62000	Single Cell
9/10/2019	L2351034-4	SL3-DUP	Bacillariophyceae	Navicula	sp.	6000	Single Cell
9/10/2019	L2351034-4	SL3-DUP	Chlorophyceae	Elakatothrix	sp.	74000	Single Cell
9/10/2019	L2351034-4	SL3-DUP	Cyanophyceae	Planktothrix	sp.	13000	Filament
9/10/2019	L2351034-4	SL3-DUP	Bacillariophyceae	Cyclotella	sp.	37000	Single Cell
9/10/2019	L2351034-4	SL3-DUP	Chlorophyceae	Unidentified		56000	Single Cell
9/10/2019	L2351034-5	SR4	Bacillariophyceae	Cyclotella	sp.	50000	Single Cell
9/10/2019	L2351034-5	SR4	Chlorophyceae	Treubaria	sp.	6000	Single Cell
9/10/2019	L2351034-5	SR4	Chlorophyceae	Tetrastrum	staurogeniaeforme	19000	Colony
9/10/2019	L2351034-5	SR4	Chlorophyceae	Kirchneriella	sp.	6000	Colony
9/10/2019	L2351034-5	SR4	Chlorophyceae	Tetraedron	caudatum	6000	Single Cell
9/10/2019	L2351034-5	SR4	Chlorophyceae	Scenedesmus	spinosus	19000	Colony
9/10/2019	L2351034-5	SR4	Bacillariophyceae	Rhoicosphenia	sp.	6000	Single Cell
9/10/2019	L2351034-5	SR4	Cyanophyceae	Aphanocapsa	sp.	31000	Colony
9/10/2019	L2351034-5	SR4	Dinophyceae	Gymnodinium	sp.	6000	Single Cell
9/10/2019	L2351034-5	SR4	Cyanophyceae	Planktothrix	sp.	69000	Filament
9/10/2019	L2351034-5	SR4	Cyanophyceae	Phormidium	sp.	1000	Filament
9/10/2019	L2351034-5	SR4	Bacillariophyceae	Cocconeis	sp.	68000	Single Cell
9/10/2019	L2351034-5	SR4	Chlorophyceae	Actinastrum	sp.	6000	Colony
9/10/2019	L2351034-5	SR4	Bacillariophyceae	Nitzschia	sp.	229000	Single Cell

Table C-5 Phytoplankton Taxonomy

DateSamp	LabNum	Source	Class	Genus	Species	CellperLitre	Unit
9/10/2019	L2351034-5	SR4	Bacillariophyceae	Amphora	sp.	6000	Single Cell
9/10/2019	L2351034-5	SR4	Bacillariophyceae	Achnanthes	sp.	6000	Single Cell
9/10/2019	L2351034-5	SR4	Chlorophyceae	Unidentified		223000	Single Cell
9/10/2019	L2351034-5	SR4	Chlorophyceae	Scenedesmus	sp.	50000	Colony
9/10/2019	L2351034-5	SR4	Chlorophyceae	Scenedesmus	acuminatus	1000	Colony
9/10/2019	L2351034-5	SR4	Bacillariophyceae	Navicula	sp.	43000	Single Cell
9/10/2019	L2351034-5	SR4	Cryptophyceae	Cryptomonas	sp.	43000	Single Cell
9/10/2019	L2351034-5	SR4	Chlorophyceae	Unidentified		279000	Colony
9/10/2019	L2351034-5	SR4	Chlorophyceae	Monoraphidium	sp.	186000	Single Cell
9/10/2019	L2351034-5	SR4	Chlorophyceae	Scenedesmus	arcuatus	1000	Colony
9/10/2019	L2351034-5	SR4	Chrysophyceae	small chrysophytes		12000	Single Cell
9/10/2019	L2351034-5	SR4	Chlorophyceae	Oocystis	sp.	12000	Colony
9/10/2019	L2351034-5	SR4	Cryptophyceae	Unidentified		594000	Single Cell
9/10/2019	L2351034-6	SL4	Bacillariophyceae	Rhoicosphenia	sp.	12000	Single Cell
9/10/2019	L2351034-6	SL4	Euglenophyceae	Strombomonas	sp.	6000	Single Cell
9/10/2019	L2351034-6	SL4	Cryptophyceae	Unidentified		1290000	Single Cell
9/10/2019	L2351034-6	SL4	Cyanophyceae	Planktothrix	sp.	53000	Filament
9/10/2019	L2351034-6	SL4	Chlorophyceae	Scenedesmus	spinosus	6000	Colony
9/10/2019	L2351034-6	SL4	Chlorophyceae	Unidentified		211000	Single Cell
9/10/2019	L2351034-6	SL4	Bacillariophyceae	Aulacoseira	sp.	1000	Filament
9/10/2019	L2351034-6	SL4	Cyanophyceae	Aphanocapsa	sp.	31000	Colony
9/10/2019	L2351034-6	SL4	Chlorophyceae	Unidentified		229000	Colony
9/10/2019	L2351034-6	SL4	Cryptophyceae	Cryptomonas	sp.	19000	Single Cell
9/10/2019	L2351034-6	SL4	Chlorophyceae	Lagerheimia	sp.	12000	Colony
9/10/2019	L2351034-6	SL4	Chlorophyceae	Scenedesmus	sp.	93000	Colony
9/10/2019	L2351034-6	SL4	Bacillariophyceae	Cyclotella	sp.	81000	Single Cell
9/10/2019	L2351034-6	SL4	Bacillariophyceae	Navicula	sp.	25000	Single Cell
9/10/2019	L2351034-6	SL4	Chlorophyceae	Scenedesmus	arcuatus	1000	Colony
9/10/2019	L2351034-6	SL4	Bacillariophyceae	Nitzschia	sp.	273000	Single Cell
9/10/2019	L2351034-6	SL4	Chrysophyceae	Mallomonas	sp.	6000	Single Cell
9/10/2019	L2351034-6	SL4	Cyanophyceae	Pseudanabaena	sp.	2000	Filament
9/10/2019	L2351034-6	SL4	Chlorophyceae	Monoraphidium	sp.	192000	Single Cell
9/10/2019	L2351034-6	SL4	Cyanophyceae	Merismopedia	sp.	25000	Single Cell
9/10/2019	L2351034-6	SL4	Chlorophyceae	Kirchneriella	sp.	12000	Colony

Table C-5 Phytoplankton Taxonomy

DateSamp	LabNum	Source	Class	Genus	Species	CellperLitre	Unit
9/10/2019	L2351034-6	SL4	Chlorophyceae	Closterium	sp.	1000	Single Cell
9/10/2019	L2351034-6	SL4	Chlorophyceae	Actinastrum	sp.	6000	Colony
9/10/2019	L2351034-6	SL4	Bacillariophyceae	Amphora	sp.	6000	Single Cell
9/10/2019	L2351034-6	SL4	Euglenophyceae	Trachelomonas	sp.	12000	Single Cell
9/10/2019	L2351034-6	SL4	Dinophyceae	Gymnodinium	sp.	25000	Single Cell
9/10/2019	L2351034-6	SL4	Cyanophyceae	Microcystis	sp.	12000	Colony
9/10/2019	L2351034-6	SL4	Bacillariophyceae	Cocconeis	sp.	93000	Single Cell
9/10/2019	L2351034-6	SL4	Chrysophyceae	small chrysophytes		198000	Single Cell
9/11/2019	L2351037-1	SL6	Bacillariophyceae	Amphora	sp.	6000	Single Cell
9/11/2019	L2351037-1	SL6	Cryptophyceae	Cryptomonas	sp.	6000	Single Cell
9/11/2019	L2351037-1	SL6	Bacillariophyceae	Cymatopleura	solea	1000	Single Cell
9/11/2019	L2351037-1	SL6	Chrysophyceae	small chrysophytes		495000	Single Cell
9/11/2019	L2351037-1	SL6	Bacillariophyceae	Surirella	sp.	2000	Single Cell
9/11/2019	L2351037-1	SL6	Chlorophyceae	Unidentified		25000	Colony
9/11/2019	L2351037-1	SL6	Bacillariophyceae	Navicula	sp.	19000	Single Cell
9/11/2019	L2351037-1	SL6	Bacillariophyceae	Cyclotella	sp.	12000	Single Cell
9/11/2019	L2351037-1	SL6	Chlorophyceae	Scenedesmus	spinosus	37000	Colony
9/11/2019	L2351037-1	SL6	Bacillariophyceae	Nitzschia	sp.	124000	Single Cell
9/11/2019	L2351037-1	SL6	Chlorophyceae	Tetraedron	sp.	6000	Single Cell
9/11/2019	L2351037-1	SL6	Chlorophyceae	Scenedesmus	sp.	19000	Colony
9/11/2019	L2351037-1	SL6	Chlorophyceae	Unidentified		31000	Single Cell
9/11/2019	L2351037-1	SL6	Chlorophyceae	Scenedesmus	quadricauda	1000	Colony
9/11/2019	L2351037-1	SL6	Chlorophyceae	Monoraphidium	sp.	37000	Single Cell
9/11/2019	L2351037-1	SL6	Chlorophyceae	Closterium	sp.	2000	Single Cell
9/11/2019	L2351037-1	SL6	Cyanophyceae	Merismopedia	sp.	99000	Single Cell
9/11/2019	L2351037-1	SL6	Cryptophyceae	Unidentified		594000	Single Cell
9/11/2019	L2351037-1	SL6	Cyanophyceae	Pseudanabaena	sp.	6000	Filament
9/11/2019	L2351037-2	SL6-DUP	Cryptophyceae	Cryptomonas	sp.	19000	Single Cell
9/11/2019	L2351037-2	SL6-DUP	Chlorophyceae	Unidentified		19000	Colony
9/11/2019	L2351037-2	SL6-DUP	Chlorophyceae	Tetraedron	caudatum	6000	Single Cell
9/11/2019	L2351037-2	SL6-DUP	Chrysophyceae	small chrysophytes		297000	Single Cell
9/11/2019	L2351037-2	SL6-DUP	Bacillariophyceae	Surirella	sp.	1000	Single Cell
9/11/2019	L2351037-2	SL6-DUP	Bacillariophyceae	Amphora	sp.	1000	Single Cell
9/11/2019	L2351037-2	SL6-DUP	Bacillariophyceae	Navicula	sp.	12000	Single Cell

Table C-5 Phytoplankton Taxonomy

DateSamp	LabNum	Source	Class	Genus	Species	CellperLitre	Unit
9/11/2019	L2351037-2	SL6-DUP	Cyanophyceae	Unidentified		6000	Filament
9/11/2019	L2351037-2	SL6-DUP	Bacillariophyceae	Cyclotella	sp.	43000	Single Cell
9/11/2019	L2351037-2	SL6-DUP	Euglenophyceae	Euglena	sp.	1000	Single Cell
9/11/2019	L2351037-2	SL6-DUP	Chlorophyceae	Monoraphidium	sp.	50000	Single Cell
9/11/2019	L2351037-2	SL6-DUP	Chlorophyceae	Scenedesmus	sp.	25000	Colony
9/11/2019	L2351037-2	SL6-DUP	Bacillariophyceae	Nitzschia	sp.	118000	Single Cell
9/11/2019	L2351037-2	SL6-DUP	Chlorophyceae	Unidentified		62000	Single Cell
9/11/2019	L2351037-2	SL6-DUP	Chlorophyceae	Tetrastrum	sp.	6000	Colony
9/11/2019	L2351037-2	SL6-DUP	Dinophyceae	Gymnodinium	sp.	12000	Single Cell
9/11/2019	L2351037-2	SL6-DUP	Chlorophyceae	Scenedesmus	spinosus	37000	Colony
9/11/2019	L2351037-2	SL6-DUP	Cryptophyceae	Unidentified		594000	Single Cell
9/11/2019	L2351037-2	SL6-DUP	Chlorophyceae	Tetrastrum	staurogeniaeforme	6000	Colony
9/11/2019	L2351037-3	SR6	Chlorophyceae	Pediastrum	Boryanum	1000	Colony
9/11/2019	L2351037-3	SR6	Bacillariophyceae	Cyclotella	sp.	31000	Single Cell
9/11/2019	L2351037-3	SR6	Chrysophyceae	Mallomonas	sp.	6000	Single Cell
9/11/2019	L2351037-3	SR6	Chlorophyceae	Scenedesmus	sp.	25000	Colony
9/11/2019	L2351037-3	SR6	Bacillariophyceae	Surirella	sp.	1000	Single Cell
9/11/2019	L2351037-3	SR6	Chrysophyceae	small chrysophytes		495000	Single Cell
9/11/2019	L2351037-3	SR6	Chlorophyceae	Scenedesmus	spinosus	12000	Colony
9/11/2019	L2351037-3	SR6	Bacillariophyceae	Caloneis	sp.	1000	Single Cell
9/11/2019	L2351037-3	SR6	Bacillariophyceae	Nitzschia	sp.	50000	Single Cell
9/11/2019	L2351037-3	SR6	Bacillariophyceae	Navicula	sp.	25000	Single Cell
9/11/2019	L2351037-3	SR6	Chlorophyceae	Tetrastrum	staurogeniaeforme	6000	Colony
9/11/2019	L2351037-3	SR6	Euglenophyceae	Euglena	sp.	19000	Single Cell
9/11/2019	L2351037-3	SR6	Chlorophyceae	Monoraphidium	sp.	37000	Single Cell
9/11/2019	L2351037-3	SR6	Cryptophyceae	Unidentified		990000	Single Cell
9/11/2019	L2351037-3	SR6	Chlorophyceae	Unidentified		1000	Colony
9/11/2019	L2351037-3	SR6	Chlorophyceae	Crucigenia	sp.	6000	Colony
9/11/2019	L2351037-3	SR6	Cryptophyceae	Cryptomonas	sp.	12000	Single Cell
9/11/2019	L2351037-3	SR6	Chlorophyceae	Unidentified		12000	Single Cell
9/11/2019	L2351037-4	SL5	Bacillariophyceae	Gomphonema	sp.	1000	Single Cell
9/11/2019	L2351037-4	SL5	Chlorophyceae	Unidentified		6000	Colony
9/11/2019	L2351037-4	SL5	Bacillariophyceae	Epithemia	sp.	6000	Single Cell
9/11/2019	L2351037-4	SL5	Chlorophyceae	Unidentified		874000	Single Cell

Table C-5 Phytoplankton Taxonomy

DateSamp	LabNum	Source	Class	Genus	Species	CellperLitre	Unit
9/11/2019	L2351037-4	SL5	Bacillariophyceae	Cyclotella	sp.	43000	Single Cell
9/11/2019	L2351037-4	SL5	Cyanophyceae	Aphanocapsa	sp.	6000	Colony
9/11/2019	L2351037-4	SL5	Chlorophyceae	Tetrastrum	sp.	12000	Colony
9/11/2019	L2351037-4	SL5	Cyanophyceae	Gomphosphaeria	sp.	12000	Colony
9/11/2019	L2351037-4	SL5	Chlorophyceae	Scenedesmus	quadricauda	6000	Colony
9/11/2019	L2351037-4	SL5	Cyanophyceae	Oscillatoria	sp.	1000	Filament
9/11/2019	L2351037-4	SL5	Chlorophyceae	Monoraphidium	sp.	99000	Single Cell
9/11/2019	L2351037-4	SL5	Cyanophyceae	Pseudanabaena	sp.	6000	Filament
9/11/2019	L2351037-4	SL5	Cyanophyceae	Unidentified		1000	Filament
9/11/2019	L2351037-4	SL5	Chlorophyceae	Scenedesmus	spinosus	25000	Colony
9/11/2019	L2351037-4	SL5	Chlorophyceae	Scenedesmus	sp.	25000	Colony
9/11/2019	L2351037-4	SL5	Bacillariophyceae	Melosira	sp.	2000	Filament
9/11/2019	L2351037-4	SL5	Cryptophyceae	Unidentified		396000	Single Cell
9/11/2019	L2351037-4	SL5	Chlorophyceae	Lagerheimia	sp.	6000	Colony
9/11/2019	L2351037-4	SL5	Dinophyceae	Gymnodinium	sp.	6000	Single Cell
9/11/2019	L2351037-4	SL5	Chrysophyceae	Dinobryon	sp.	6000	Single Cell
9/11/2019	L2351037-4	SL5	Euglenophyceae	Euglena	sp.	6000	Single Cell
9/11/2019	L2351037-4	SL5	Bacillariophyceae	Nitzschia	sp.	112000	Single Cell
9/11/2019	L2351037-4	SL5	Bacillariophyceae	Cocconeis	sp.	6000	Single Cell
9/11/2019	L2351037-4	SL5	Chlorophyceae	Tetrastrum	staurogeniaeforme	6000	Colony
9/11/2019	L2351037-4	SL5	Euglenophyceae	Trachelomonas	sp.	12000	Single Cell
9/11/2019	L2351037-4	SL5	Cryptophyceae	Cryptomonas	sp.	50000	Single Cell
9/11/2019	L2351037-4	SL5	Chrysophyceae	small chrysophytes		693000	Single Cell
9/11/2019	L2351037-4	SL5	Bacillariophyceae	Navicula	sp.	6000	Single Cell
9/11/2019	L2351037-5	SL5-DUP	Bacillariophyceae	Melosira	sp.	2000	Filament
9/11/2019	L2351037-5	SL5-DUP	Bacillariophyceae	Cyclotella	sp.	68000	Single Cell
9/11/2019	L2351037-5	SL5-DUP	Chlorophyceae	Oocystis	sp.	6000	Colony
9/11/2019	L2351037-5	SL5-DUP	Euglenophyceae	Euglena	sp.	12000	Single Cell
9/11/2019	L2351037-5	SL5-DUP	Chlorophyceae	Scenedesmus	spinosus	12000	Colony
9/11/2019	L2351037-5	SL5-DUP	Cryptophyceae	Cryptomonas	sp.	43000	Single Cell
9/11/2019	L2351037-5	SL5-DUP	Cryptophyceae	Unidentified		693000	Single Cell
9/11/2019	L2351037-5	SL5-DUP	Chrysophyceae	small chrysophytes		693000	Single Cell
9/11/2019	L2351037-5	SL5-DUP	Chlorophyceae	Scenedesmus	acuminatus	12000	Colony
9/11/2019	L2351037-5	SL5-DUP	Chlorophyceae	Monoraphidium	sp.	217000	Single Cell

Table C-5 Phytoplankton Taxonomy

DateSamp	LabNum	Source	Class	Genus	Species	CellperLitre	Unit
9/11/2019	L2351037-5	SL5-DUP	Bacillariophyceae	Synedra	ulna	2000	Single Cell
9/11/2019	L2351037-5	SL5-DUP	Chlorophyceae	Scenedesmus	sp.	43000	Colony
9/11/2019	L2351037-5	SL5-DUP	Chlorophyceae	Lagerheimia	sp.	6000	Colony
9/11/2019	L2351037-5	SL5-DUP	Chlorophyceae	Mougeotia	sp.	1000	Filament
9/11/2019	L2351037-5	SL5-DUP	Bacillariophyceae	Nitzschia	sp.	43000	Single Cell
9/11/2019	L2351037-5	SL5-DUP	Xanthophyceae	Ophiocytium	sp.	1000	Single Cell
9/11/2019	L2351037-5	SL5-DUP	Chlorophyceae	Tetrastrum	staurogeniaeforme	19000	Colony
9/11/2019	L2351037-5	SL5-DUP	Bacillariophyceae	Navicula	sp.	12000	Single Cell
9/11/2019	L2351037-5	SL5-DUP	Chlorophyceae	Unidentified		25000	Colony
9/11/2019	L2351037-5	SL5-DUP	Euglenophyceae	Trachelomonas	sp.	2000	Single Cell
9/11/2019	L2351037-5	SL5-DUP	Dinophyceae	Gymnodinium	sp.	6000	Single Cell
9/11/2019	L2351037-5	SL5-DUP	Chlorophyceae	Unidentified		763000	Single Cell
9/11/2019	L2351037-6	SR5	Cryptophyceae	Unidentified		594000	Single Cell
9/11/2019	L2351037-6	SR5	Cryptophyceae	Cryptomonas	sp.	81000	Single Cell
9/11/2019	L2351037-6	SR5	Chlorophyceae	Tetraedron	caudatum	6000	Single Cell
9/11/2019	L2351037-6	SR5	Chlorophyceae	Tetraedron	minimum	6000	Single Cell
9/11/2019	L2351037-6	SR5	Chlorophyceae	Unidentified		50000	Colony
9/11/2019	L2351037-6	SR5	Euglenophyceae	Trachelomonas	sp.	5000	Single Cell
9/11/2019	L2351037-6	SR5	Euglenophyceae	Euglena	sp.	12000	Single Cell
9/11/2019	L2351037-6	SR5	Chlorophyceae	Scenedesmus	sp.	56000	Colony
9/11/2019	L2351037-6	SR5	Bacillariophyceae	Melosira	sp.	1000	Filament
9/11/2019	L2351037-6	SR5	Chlorophyceae	Tetrastrum	staurogeniaeforme	12000	Colony
9/11/2019	L2351037-6	SR5	Bacillariophyceae	Epithemia	sp.	1000	Single Cell
9/11/2019	L2351037-6	SR5	Bacillariophyceae	Cyclotella	sp.	93000	Single Cell
9/11/2019	L2351037-6	SR5	Bacillariophyceae	Navicula	sp.	31000	Single Cell
9/11/2019	L2351037-6	SR5	Chlorophyceae	Unidentified		1090000	Single Cell
9/11/2019	L2351037-6	SR5	Chlorophyceae	Oocystis	sp.	19000	Colony
9/11/2019	L2351037-6	SR5	Chlorophyceae	Tetraedron	sp.	6000	Single Cell
9/11/2019	L2351037-6	SR5	Dinophyceae	Gymnodinium	sp.	25000	Single Cell
9/11/2019	L2351037-6	SR5	Bacillariophyceae	Synedra	sp.	2000	Single Cell
9/11/2019	L2351037-6	SR5	Chlorophyceae	Scenedesmus	spinosus	12000	Colony
9/11/2019	L2351037-6	SR5	Chlorophyceae	Scenedesmus	acuminatus	1000	Colony
9/11/2019	L2351037-6	SR5	Chrysophyceae	Dinobryon	sp.	14000	Single Cell
9/11/2019	L2351037-6	SR5	Bacillariophyceae	Cocconeis	sp.	6000	Single Cell

Table C-5 Phytoplankton Taxonomy

DateSamp	LabNum	Source	Class	Genus	Species	CellperLitre	Unit
9/11/2019	L2351037-6	SR5	Chlorophyceae	Monoraphidium	sp.	161000	Single Cell
9/11/2019	L2351037-6	SR5	Chrysophyceae	small chrysophytes		594000	Single Cell
9/11/2019	L2351037-6	SR5	Bacillariophyceae	Nitzschia	sp.	81000	Single Cell
9/9/2019	L2351042-1	SL2	Euglenophyceae	Euglena	sp.	12000	Single Cell
9/9/2019	L2351042-1	SL2	Cyanophyceae	Microcystis	sp.	99000	Colony
9/9/2019	L2351042-1	SL2	Chlorophyceae	Tetrastrum	sp.	6000	Colony
9/9/2019	L2351042-1	SL2	Chlorophyceae	Scenedesmus	spinosus	19000	Colony
9/9/2019	L2351042-1	SL2	Chlorophyceae	Pediastrum	tetras	1000	Colony
9/9/2019	L2351042-1	SL2	Chlorophyceae	Scenedesmus	sp.	68000	Colony
9/9/2019	L2351042-1	SL2	Chlorophyceae	Closterium	sp.	3000	Single Cell
9/9/2019	L2351042-1	SL2	Cryptophyceae	Cryptomonas	sp.	217000	Single Cell
9/9/2019	L2351042-1	SL2	Cryptophyceae	Unidentified		594000	Single Cell
9/9/2019	L2351042-1	SL2	Chlorophyceae	Coelastrum	sp.	19000	Colony
9/9/2019	L2351042-1	SL2	Bacillariophyceae	Amphora	sp.	6000	Single Cell
9/9/2019	L2351042-1	SL2	Chlorophyceae	Kirchneriella	sp.	25000	Colony
9/9/2019	L2351042-1	SL2	Cyanophyceae	Planktothrix	sp.	1140000	Filament
9/9/2019	L2351042-1	SL2	Chlorophyceae	Scenedesmus	quadricauda	74000	Colony
9/9/2019	L2351042-1	SL2	Chlorophyceae	Monoraphidium	sp.	297000	Single Cell
9/9/2019	L2351042-1	SL2	Euglenophyceae	Trachelomonas	sp.	6000	Single Cell
9/9/2019	L2351042-1	SL2	Bacillariophyceae	Cocconeis	sp.	19000	Single Cell
9/9/2019	L2351042-1	SL2	Chlorophyceae	Oocystis	sp.	50000	Colony
9/9/2019	L2351042-1	SL2	Bacillariophyceae	Rhoicosphenia	sp.	6000	Single Cell
9/9/2019	L2351042-1	SL2	Bacillariophyceae	Synedra	sp.	6000	Single Cell
9/9/2019	L2351042-1	SL2	Bacillariophyceae	Nitzschia	sp.	87000	Single Cell
9/9/2019	L2351042-1	SL2	Bacillariophyceae	Cyclotella	sp.	19000	Single Cell
9/9/2019	L2351042-1	SL2	Chlorophyceae	Unidentified		99000	Single Cell
9/9/2019	L2351042-1	SL2	Bacillariophyceae	Aulacoseira	sp.	25000	Filament
9/9/2019	L2351042-1	SL2	Bacillariophyceae	Cymbella	sp.	1000	Single Cell
9/9/2019	L2351042-1	SL2	Chlorophyceae	Planktosphaeria	sp.	12000	Colony
9/9/2019	L2351042-1	SL2	Cyanophyceae	Aphanocapsa	sp.	56000	Colony
9/9/2019	L2351042-1	SL2	Chrysophyceae	Mallomonas	sp.	6000	Single Cell
9/9/2019	L2351042-1	SL2	Cyanophyceae	Gomphosphaeria	sp.	2000	Colony
9/9/2019	L2351042-1	SL2	Chlorophyceae	Unidentified		186000	Colony
9/9/2019	L2351042-1	SL2	Bacillariophyceae	Navicula	sp.	37000	Single Cell

Table C-5 Phytoplankton Taxonomy

DateSamp	LabNum	Source	Class	Genus	Species	CellperLitre	Unit
9/9/2019	L2351042-1	SL2	Chlorophyceae	Elakatothrix	sp.	25000	Single Cell
9/9/2019	L2351042-2	SM2	Dinophyceae	Gymnodinium	sp.	6000	Single Cell
9/9/2019	L2351042-2	SM2	Chlorophyceae	Scenedesmus	quadricauda	68000	Colony
9/9/2019	L2351042-2	SM2	Chlorophyceae	Scenedesmus	arcuatus	2000	Colony
9/9/2019	L2351042-2	SM2	Bacillariophyceae	Synedra	ulna	3000	Single Cell
9/9/2019	L2351042-2	SM2	Euglenophyceae	Trachelomonas	sp.	6000	Single Cell
9/9/2019	L2351042-2	SM2	Bacillariophyceae	Navicula	sp.	12000	Single Cell
9/9/2019	L2351042-2	SM2	Euglenophyceae	Phacus	sp.	6000	Single Cell
9/9/2019	L2351042-2	SM2	Bacillariophyceae	Amphora	sp.	19000	Single Cell
9/9/2019	L2351042-2	SM2	Chlorophyceae	Scenedesmus	acuminatus	6000	Colony
9/9/2019	L2351042-2	SM2	Chlorophyceae	Scenedesmus	sp.	149000	Colony
9/9/2019	L2351042-2	SM2	Euglenophyceae	Euglena	sp.	12000	Single Cell
9/9/2019	L2351042-2	SM2	Bacillariophyceae	Cymbella	sp.	1000	Single Cell
9/9/2019	L2351042-2	SM2	Cryptophyceae	Cryptomonas	sp.	161000	Single Cell
9/9/2019	L2351042-2	SM2	Chlorophyceae	Unidentified		267000	Colony
9/9/2019	L2351042-2	SM2	Chrysophyceae	small chrysophytes		6000	Single Cell
9/9/2019	L2351042-2	SM2	Bacillariophyceae	Synedra	sp.	2000	Single Cell
9/9/2019	L2351042-2	SM2	Cryptophyceae	Unidentified		594000	Single Cell
9/9/2019	L2351042-2	SM2	Bacillariophyceae	Aulacoseira	sp.	9000	Filament
9/9/2019	L2351042-2	SM2	Chlorophyceae	Elakatothrix	sp.	43000	Single Cell
9/9/2019	L2351042-2	SM2	Cyanophyceae	Aphanocapsa	sp.	50000	Colony
9/9/2019	L2351042-2	SM2	Chlorophyceae	Unidentified		74000	Single Cell
9/9/2019	L2351042-2	SM2	Cyanophyceae	Microcystis	sp.	37000	Colony
9/9/2019	L2351042-2	SM2	Cyanophyceae	Phormidium	sp.	2000	Filament
9/9/2019	L2351042-2	SM2	Cyanophyceae	Planktothrix	sp.	1040000	Filament
9/9/2019	L2351042-2	SM2	Chlorophyceae	Closterium	sp.	11000	Single Cell
9/9/2019	L2351042-2	SM2	Chlorophyceae	Pediastrum	Boryanum	1000	Colony
9/9/2019	L2351042-2	SM2	Chlorophyceae	Coelastrum	sp.	6000	Colony
9/9/2019	L2351042-2	SM2	Chlorophyceae	Scenedesmus	spinosus	6000	Colony
9/9/2019	L2351042-2	SM2	Bacillariophyceae	Cyclotella	sp.	19000	Single Cell
9/9/2019	L2351042-2	SM2	Chlorophyceae	Kirchneriella	sp.	19000	Colony
9/9/2019	L2351042-2	SM2	Bacillariophyceae	Rhoicosphenia	sp.	6000	Single Cell
9/9/2019	L2351042-2	SM2	Chlorophyceae	Monoraphidium	sp.	304000	Single Cell
9/9/2019	L2351042-2	SM2	Bacillariophyceae	Nitzschia	sp.	62000	Single Cell

Table C-5 Phytoplankton Taxonomy

DateSamp	LabNum	Source	Class	Genus	Species	CellperLitre	Unit
9/9/2019	L2351042-2	SM2	Chlorophyceae	Oocystis	sp.	62000	Colony
9/9/2019	L2351042-3	SR2	Chlorophyceae	Unidentified		242000	Colony
9/9/2019	L2351042-3	SR2	Bacillariophyceae	Navicula	sp.	62000	Single Cell
9/9/2019	L2351042-3	SR2	Chlorophyceae	Oocystis	sp.	37000	Colony
9/9/2019	L2351042-3	SR2	Bacillariophyceae	Aulacoseira	sp.	31000	Filament
9/9/2019	L2351042-3	SR2	Chlorophyceae	Tetraedron	caudatum	6000	Single Cell
9/9/2019	L2351042-3	SR2	Cyanophyceae	Aphanocapsa	sp.	43000	Colony
9/9/2019	L2351042-3	SR2	Cyanophyceae	Gomphosphaeria	sp.	6000	Colony
9/9/2019	L2351042-3	SR2	Chlorophyceae	Closterium	sp.	1000	Single Cell
9/9/2019	L2351042-3	SR2	Cyanophyceae	Microcystis	sp.	81000	Colony
9/9/2019	L2351042-3	SR2	Chlorophyceae	Scenedesmus	acuminatus	6000	Colony
9/9/2019	L2351042-3	SR2	Bacillariophyceae	Cyclotella	sp.	50000	Single Cell
9/9/2019	L2351042-3	SR2	Chlorophyceae	Scenedesmus	quadricauda	93000	Colony
9/9/2019	L2351042-3	SR2	Cyanophyceae	Pseudanabaena	sp.	19000	Filament
9/9/2019	L2351042-3	SR2	Chlorophyceae	Monoraphidium	sp.	155000	Single Cell
9/9/2019	L2351042-3	SR2	Chlorophyceae	Scenedesmus	sp.	112000	Colony
9/9/2019	L2351042-3	SR2	Chlorophyceae	Kirchneriella	sp.	6000	Colony
9/9/2019	L2351042-3	SR2	Chlorophyceae	Coelastrum	sp.	1000	Colony
9/9/2019	L2351042-3	SR2	Chlorophyceae	Scenedesmus	arcuatus	1000	Colony
9/9/2019	L2351042-3	SR2	Cyanophyceae	Planktothrix	sp.	1270000	Filament
9/9/2019	L2351042-3	SR2	Euglenophyceae	Trachelomonas	sp.	2000	Single Cell
9/9/2019	L2351042-3	SR2	Chlorophyceae	Unidentified		192000	Single Cell
9/9/2019	L2351042-3	SR2	Bacillariophyceae	Cocconeis	sp.	12000	Single Cell
9/9/2019	L2351042-3	SR2	Cryptophyceae	Cryptomonas	sp.	149000	Single Cell
9/9/2019	L2351042-3	SR2	Cryptophyceae	Unidentified		198000	Single Cell
9/9/2019	L2351042-3	SR2	Chrysophyceae	small chrysophytes		12000	Single Cell
9/9/2019	L2351042-3	SR2	Bacillariophyceae	Synedra	sp.	6000	Single Cell
9/9/2019	L2351042-3	SR2	Bacillariophyceae	Synedra	ulna	1000	Single Cell
9/9/2019	L2351042-3	SR2	Chlorophyceae	Schroederia	sp.	6000	Single Cell
9/9/2019	L2351042-3	SR2	Chlorophyceae	Scenedesmus	spinosus	6000	Colony
9/9/2019	L2351042-3	SR2	Bacillariophyceae	Nitzschia	sp.	19000	Single Cell
9/9/2019	L2351042-3	SR2	Chlorophyceae	Elakatothrix	sp.	118000	Single Cell
9/9/2019	L2351042-4	SL1	Cyanophyceae	Pseudanabaena	sp.	25000	Filament
9/9/2019	L2351042-4	SL1	Chlorophyceae	Coelastrum	sp.	1000	Colony

Table C-5 Phytoplankton Taxonomy

DateSamp	LabNum	Source	Class	Genus	Species	CellperLitre	Unit
9/9/2019	L2351042-4	SL1	Chlorophyceae	Scenedesmus	quadricauda	43000	Colony
9/9/2019	L2351042-4	SL1	Bacillariophyceae	Rhoicosphenia	sp.	12000	Single Cell
9/9/2019	L2351042-4	SL1	Euglenophyceae	Trachelomonas	sp.	25000	Single Cell
9/9/2019	L2351042-4	SL1	Cyanophyceae	Phormidium	sp.	6000	Filament
9/9/2019	L2351042-4	SL1	Chlorophyceae	Scenedesmus	arcuatus	6000	Colony
9/9/2019	L2351042-4	SL1	Chlorophyceae	Kirchneriella	sp.	12000	Colony
9/9/2019	L2351042-4	SL1	Bacillariophyceae	Cocconeis	sp.	12000	Single Cell
9/9/2019	L2351042-4	SL1	Chlorophyceae	Pediastrum	Boryanum	2000	Colony
9/9/2019	L2351042-4	SL1	Bacillariophyceae	Cyclotella	sp.	25000	Single Cell
9/9/2019	L2351042-4	SL1	Chlorophyceae	Oocystis	sp.	37000	Colony
9/9/2019	L2351042-4	SL1	Cyanophyceae	Microcystis	sp.	56000	Colony
9/9/2019	L2351042-4	SL1	Chlorophyceae	Scenedesmus	acuminatus	19000	Colony
9/9/2019	L2351042-4	SL1	Cyanophyceae	Planktothrix	sp.	1440000	Filament
9/9/2019	L2351042-4	SL1	Chlorophyceae	Closterium	sp.	11000	Single Cell
9/9/2019	L2351042-4	SL1	Chlorophyceae	Monoraphidium	sp.	366000	Single Cell
9/9/2019	L2351042-4	SL1	Chlorophyceae	Scenedesmus	spinosus	12000	Colony
9/9/2019	L2351042-4	SL1	Cryptophyceae	Unidentified		1390000	Single Cell
9/9/2019	L2351042-4	SL1	Bacillariophyceae	Navicula	sp.	62000	Single Cell
9/9/2019	L2351042-4	SL1	Chrysophyceae	Dinobryon	sp.	6000	Single Cell
9/9/2019	L2351042-4	SL1	Bacillariophyceae	Cymbella	sp.	1000	Single Cell
9/9/2019	L2351042-4	SL1	Cyanophyceae	Anabaena	sp.	1000	Filament
9/9/2019	L2351042-4	SL1	Bacillariophyceae	Aulacoseira	sp.	19000	Filament
9/9/2019	L2351042-4	SL1	Cryptophyceae	Cryptomonas	sp.	298000	Single Cell
9/9/2019	L2351042-4	SL1	Chlorophyceae	Elakatothrix	sp.	124000	Single Cell
9/9/2019	L2351042-4	SL1	Cyanophyceae	Aphanocapsa	sp.	81000	Colony
9/9/2019	L2351042-4	SL1	Chlorophyceae	Unidentified		155000	Single Cell
9/9/2019	L2351042-4	SL1	Chlorophyceae	Scenedesmus	sp.	143000	Colony
9/9/2019	L2351042-4	SL1	Euglenophyceae	Euglena	sp.	19000	Single Cell
9/9/2019	L2351042-4	SL1	Chlorophyceae	Unidentified		285000	Colony
9/9/2019	L2351042-4	SL1	Chlorophyceae	Schroederia	sp.	6000	Single Cell
9/9/2019	L2351042-4	SL1	Bacillariophyceae	Nitzschia	sp.	93000	Single Cell
9/9/2019	L2351042-4	SL1	Chrysophyceae	Unidentified		19000	Single Cell
9/9/2019	L2351042-5	SM1	Cyanophyceae	Pseudanabaena	sp.	37000	Filament
9/9/2019	L2351042-5	SM1	Chlorophyceae	Unidentified		149000	Colony

Table C-5 Phytoplankton Taxonomy

DateSamp	LabNum	Source	Class	Genus	Species	CellperLitre	Unit
9/9/2019	L2351042-5	SM1	Chlorophyceae	Scenedesmus	spinosus	25000	Colony
9/9/2019	L2351042-5	SM1	Bacillariophyceae	Aulacoseira	sp.	12000	Filament
9/9/2019	L2351042-5	SM1	Chlorophyceae	Closterium	sp.	10000	Single Cell
9/9/2019	L2351042-5	SM1	Chlorophyceae	Elakatothrix	sp.	19000	Single Cell
9/9/2019	L2351042-5	SM1	Chlorophyceae	Tetraedron	minimum	6000	Single Cell
9/9/2019	L2351042-5	SM1	Cyanophyceae	Microcystis	sp.	74000	Colony
9/9/2019	L2351042-5	SM1	Cyanophyceae	Spirulina	sp.	6000	Filament
9/9/2019	L2351042-5	SM1	Chlorophyceae	Botryococcus	sp.	1000	Colony
9/9/2019	L2351042-5	SM1	Cyanophyceae	Anabaena	sp.	12000	Filament
9/9/2019	L2351042-5	SM1	Chlorophyceae	Unidentified		87000	Single Cell
9/9/2019	L2351042-5	SM1	Cyanophyceae	Phormidium	sp.	7000	Filament
9/9/2019	L2351042-5	SM1	Cyanophyceae	Aphanocapsa	sp.	93000	Colony
9/9/2019	L2351042-5	SM1	Cryptophyceae	Unidentified		1290000	Single Cell
9/9/2019	L2351042-5	SM1	Cyanophyceae	Oscillatoria	sp.	1000	Filament
9/9/2019	L2351042-5	SM1	Chrysophyceae	Unidentified		56000	Single Cell
9/9/2019	L2351042-5	SM1	Chlorophyceae	Coelastrum	sp.	2000	Colony
9/9/2019	L2351042-5	SM1	Chlorophyceae	Tetraedron	caudatum	6000	Single Cell
9/9/2019	L2351042-5	SM1	Euglenophyceae	Euglena	sp.	25000	Single Cell
9/9/2019	L2351042-5	SM1	Bacillariophyceae	Nitzschia	sp.	112000	Single Cell
9/9/2019	L2351042-5	SM1	Bacillariophyceae	Navicula	sp.	155000	Single Cell
9/9/2019	L2351042-5	SM1	Bacillariophyceae	Gomphonema	sp.	12000	Single Cell
9/9/2019	L2351042-5	SM1	Bacillariophyceae	Epithemia	sp.	1000	Single Cell
9/9/2019	L2351042-5	SM1	Bacillariophyceae	Cyclotella	sp.	43000	Single Cell
9/9/2019	L2351042-5	SM1	Chrysophyceae	small chrysophytes		25000	Single Cell
9/9/2019	L2351042-5	SM1	Bacillariophyceae	Amphora	sp.	25000	Single Cell
9/9/2019	L2351042-5	SM1	Cryptophyceae	Cryptomonas	sp.	254000	Single Cell
9/9/2019	L2351042-5	SM1	Chlorophyceae	Scenedesmus	sp.	112000	Colony
9/9/2019	L2351042-5	SM1	Chlorophyceae	Scenedesmus	acuminatus	12000	Colony
9/9/2019	L2351042-5	SM1	Chlorophyceae	Scenedesmus	quadricauda	87000	Colony
9/9/2019	L2351042-5	SM1	Euglenophyceae	Trachelomonas	sp.	19000	Single Cell
9/9/2019	L2351042-5	SM1	Bacillariophyceae	Cocconeis	sp.	31000	Single Cell
9/9/2019	L2351042-5	SM1	Bacillariophyceae	Rhoicosphenia	sp.	12000	Single Cell
9/9/2019	L2351042-5	SM1	Cyanophyceae	Planktothrix	sp.	1460000	Filament
9/9/2019	L2351042-5	SM1	Chlorophyceae	Kirchneriella	sp.	6000	Colony

Table C-5 Phytoplankton Taxonomy

DateSamp	LabNum	Source	Class	Genus	Species	CellperLitre	Unit
9/9/2019	L2351042-5	SM1	Chlorophyceae	Monoraphidium	sp.	403000	Single Cell
9/9/2019	L2351042-5	SM1	Chlorophyceae	Oocystis	sp.	105000	Colony
9/9/2019	L2351042-6	SR1	Bacillariophyceae	Cyclotella	sp.	50000	Single Cell
9/9/2019	L2351042-6	SR1	Chlorophyceae	Closterium	sp.	7000	Single Cell
9/9/2019	L2351042-6	SR1	Chlorophyceae	Unidentified		130000	Single Cell
9/9/2019	L2351042-6	SR1	Bacillariophyceae	Amphora	sp.	6000	Single Cell
9/9/2019	L2351042-6	SR1	Chrysophyceae	small chrysophytes		6000	Single Cell
9/9/2019	L2351042-6	SR1	Chlorophyceae	Coelastrum	sp.	31000	Colony
9/9/2019	L2351042-6	SR1	Bacillariophyceae	Aulacoseira	sp.	12000	Filament
9/9/2019	L2351042-6	SR1	Cyanophyceae	Planktothrix	sp.	1610000	Filament
9/9/2019	L2351042-6	SR1	Chlorophyceae	Unidentified		248000	Colony
9/9/2019	L2351042-6	SR1	Chlorophyceae	Scenedesmus	acuminatus	1000	Colony
9/9/2019	L2351042-6	SR1	Bacillariophyceae	Navicula	sp.	124000	Single Cell
9/9/2019	L2351042-6	SR1	Chlorophyceae	Dictyosphaerium	sp.	12000	Colony
9/9/2019	L2351042-6	SR1	Bacillariophyceae	Gomphonema	sp.	6000	Single Cell
9/9/2019	L2351042-6	SR1	Chlorophyceae	Elakatothrix	sp.	68000	Single Cell
9/9/2019	L2351042-6	SR1	Bacillariophyceae	Nitzschia	sp.	93000	Single Cell
9/9/2019	L2351042-6	SR1	Chlorophyceae	Schroederia	sp.	6000	Single Cell
9/9/2019	L2351042-6	SR1	Euglenophyceae	Euglena	sp.	19000	Single Cell
9/9/2019	L2351042-6	SR1	Bacillariophyceae	Cocconeis	sp.	6000	Single Cell
9/9/2019	L2351042-6	SR1	Cyanophyceae	Pseudanabaena	sp.	6000	Filament
9/9/2019	L2351042-6	SR1	Cyanophyceae	Phormidium	sp.	5000	Filament
9/9/2019	L2351042-6	SR1	Euglenophyceae	Trachelomonas	sp.	12000	Single Cell
9/9/2019	L2351042-6	SR1	Chlorophyceae	Tetrastrum	staurogeniaeforme	12000	Colony
9/9/2019	L2351042-6	SR1	Chlorophyceae	Scenedesmus	quadricauda	74000	Colony
9/9/2019	L2351042-6	SR1	Cryptophyceae	Unidentified		693000	Single Cell
9/9/2019	L2351042-6	SR1	Chlorophyceae	Scenedesmus	sp.	50000	Colony
9/9/2019	L2351042-6	SR1	Cyanophyceae	Microcystis	sp.	74000	Colony
9/9/2019	L2351042-6	SR1	Cyanophyceae	Aphanocapsa	sp.	81000	Colony
9/9/2019	L2351042-6	SR1	Bacillariophyceae	Rhoicosphenia	sp.	6000	Single Cell
9/9/2019	L2351042-6	SR1	Chlorophyceae	Scenedesmus	spinosus	50000	Colony
9/9/2019	L2351042-6	SR1	Chlorophyceae	Kirchneriella	sp.	25000	Colony
9/9/2019	L2351042-6	SR1	Chrysophyceae	Unidentified		62000	Single Cell
9/9/2019	L2351042-6	SR1	Cyanophyceae	Gomphosphaeria	sp.	1000	Colony

Table C-5 Phytoplankton Taxonomy

DateSamp	LabNum	Source	Class	Genus	Species	CellperLitre	Unit
9/9/2019	L2351042-6	SR1	Cryptophyceae	Cryptomonas	sp.	304000	Single Cell
9/9/2019	L2351042-6	SR1	Chlorophyceae	Monoraphidium	sp.	329000	Single Cell
9/9/2019	L2351042-6	SR1	Chlorophyceae	Oocystis	sp.	37000	Colony
9/9/2019	L2351042-7	HYLIFE EFFLUENT	Cyanophyceae	Microcystis	sp.	200	Colony
7/24/2019	L2351049-1	JM1	Cyanophyceae	Microcystis	sp.	1000	Colony
7/24/2019	L2351049-1	JM1	Cyanophyceae	Anabaena	sp.	217000	Filament
7/24/2019	L2351049-1	JM1	Euglenophyceae	Phacus	sp.	6000	Single Cell
7/24/2019	L2351049-1	JM1	Chlorophyceae	Tetrastrum	staurogeniaeforme	25000	Colony
7/24/2019	L2351049-1	JM1	Chlorophyceae	Pediastrum	tetras	1000	Colony
7/24/2019	L2351049-1	JM1	Cyanophyceae	Spirulina	sp.	6000	Filament
7/24/2019	L2351049-1	JM1	Chlorophyceae	Unidentified		396000	Single Cell
7/24/2019	L2351049-1	JM1	Chlorophyceae	Scenedesmus	acuminatus	19000	Colony
7/24/2019	L2351049-1	JM1	Chlorophyceae	Scenedesmus	sp.	192000	Colony
7/24/2019	L2351049-1	JM1	Cyanophyceae	Aphanizomenon	sp.	1166000	Filament
7/24/2019	L2351049-1	JM1	Cryptophyceae	Cryptomonas	sp.	74000	Single Cell
7/24/2019	L2351049-1	JM1	Chlorophyceae	Elakatothrix	sp.	31000	Single Cell
7/24/2019	L2351049-1	JM1	Cyanophyceae	Pseudanabaena	sp.	19000	Filament
7/24/2019	L2351049-1	JM1	Euglenophyceae	Euglena	sp.	19000	Single Cell
7/24/2019	L2351049-1	JM1	Chlorophyceae	Lagerheimia	sp.	12000	Colony
7/24/2019	L2351049-1	JM1	Bacillariophyceae	Aulacoseira	sp.	3564000	Filament
7/24/2019	L2351049-1	JM1	Chlorophyceae	Unidentified		43000	Colony
7/24/2019	L2351049-1	JM1	Chlorophyceae	Scenedesmus	spinosus	81000	Colony
7/24/2019	L2351049-1	JM1	Bacillariophyceae	Nitzschia	sp.	99000	Single Cell
7/24/2019	L2351049-1	JM1	Bacillariophyceae	Caloneis	sp.	1000	Single Cell
7/24/2019	L2351049-1	JM1	Chlorophyceae	Tetraedron	minimum	12000	Single Cell
7/24/2019	L2351049-1	JM1	Bacillariophyceae	Gomphonema	sp.	6000	Single Cell
7/24/2019	L2351049-1	JM1	Cyanophyceae	Merismopedia	sp.	99000	Single Cell
7/24/2019	L2351049-1	JM1	Bacillariophyceae	Navicula	sp.	6000	Single Cell
7/24/2019	L2351049-1	JM1	Cryptophyceae	Unidentified		891000	Single Cell
7/24/2019	L2351049-1	JM1	Chlorophyceae	Pediastrum	Boryanum	19000	Colony
7/24/2019	L2351049-1	JM1	Euglenophyceae	Trachelomonas	sp.	6000	Single Cell
7/24/2019	L2351049-1	JM1	Chlorophyceae	Coelastrum	sp.	6000	Colony
7/24/2019	L2351049-1	JM1	Chlorophyceae	Schroederia	sp.	43000	Single Cell
7/24/2019	L2351049-1	JM1	Chlorophyceae	Oocystis	sp.	37000	Colony

Table C-5 Phytoplankton Taxonomy

DateSamp	LabNum	Source	Class	Genus	Species	CellperLitre	Unit
7/24/2019	L2351049-1	JM1	Dinophyceae	Gymnodinium	sp.	6000	Single Cell
7/24/2019	L2351049-1	JM1	Chlorophyceae	Monoraphidium	sp.	130000	Single Cell
7/24/2019	L2351049-10	JR2 DUP	Cyanophyceae	Aphanocapsa	sp.	19000	Colony
7/24/2019	L2351049-10	JR2 DUP	Cryptophyceae	Unidentified		396000	Single Cell
7/24/2019	L2351049-10	JR2 DUP	Cyanophyceae	Pseudanabaena	sp.	6000	Filament
7/24/2019	L2351049-10	JR2 DUP	Chlorophyceae	Oocystis	sp.	31000	Colony
7/24/2019	L2351049-10	JR2 DUP	Cyanophyceae	Aphanizomenon	sp.	93000	Filament
7/24/2019	L2351049-10	JR2 DUP	Chlorophyceae	Scenedesmus	spinosus	87000	Colony
7/24/2019	L2351049-10	JR2 DUP	Chlorophyceae	Monoraphidium	sp.	316000	Single Cell
7/24/2019	L2351049-10	JR2 DUP	Chlorophyceae	Tetrastrum	staurogeniaeforme	25000	Colony
7/24/2019	L2351049-10	JR2 DUP	Bacillariophyceae	Nitzschia	sp.	118000	Single Cell
7/24/2019	L2351049-10	JR2 DUP	Chlorophyceae	Scenedesmus	sp.	205000	Colony
7/24/2019	L2351049-10	JR2 DUP	Bacillariophyceae	Amphora	sp.	19000	Single Cell
7/24/2019	L2351049-10	JR2 DUP	Dinophyceae	Gymnodinium	sp.	12000	Single Cell
7/24/2019	L2351049-10	JR2 DUP	Bacillariophyceae	Cyclotella	sp.	19000	Single Cell
7/24/2019	L2351049-10	JR2 DUP	Chlorophyceae	Schroederia	sp.	37000	Single Cell
7/24/2019	L2351049-10	JR2 DUP	Bacillariophyceae	Cymbella	sp.	12000	Single Cell
7/24/2019	L2351049-10	JR2 DUP	Bacillariophyceae	Navicula	sp.	25000	Single Cell
7/24/2019	L2351049-10	JR2 DUP	Chlorophyceae	Dictyosphaerium	sp.	12000	Colony
7/24/2019	L2351049-10	JR2 DUP	Chlorophyceae	Treubaria	sp.	37000	Single Cell
7/24/2019	L2351049-10	JR2 DUP	Chlorophyceae	Crucigenia	sp.	6000	Colony
7/24/2019	L2351049-10	JR2 DUP	Bacillariophyceae	Aulacoseira	sp.	2970000	Filament
7/24/2019	L2351049-10	JR2 DUP	Chlorophyceae	Tetrastrum	sp.	12000	Colony
7/24/2019	L2351049-10	JR2 DUP	Cyanophyceae	Anabaena	sp.	56000	Filament
7/24/2019	L2351049-10	JR2 DUP	Chlorophyceae	Closterium	sp.	5000	Single Cell
7/24/2019	L2351049-10	JR2 DUP	Chlorophyceae	Pediastrum	Boryanum	2000	Colony
7/24/2019	L2351049-10	JR2 DUP	Bacillariophyceae	Cocconeis	sp.	37000	Single Cell
7/24/2019	L2351049-10	JR2 DUP	Chlorophyceae	Tetraedron	caudatum	19000	Single Cell
7/24/2019	L2351049-10	JR2 DUP	Chlorophyceae	Pediastrum	duplex	5000	Colony
7/24/2019	L2351049-10	JR2 DUP	Chlorophyceae	Unidentified		693000	Single Cell
7/24/2019	L2351049-10	JR2 DUP	Euglenophyceae	Euglena	sp.	6000	Single Cell
7/24/2019	L2351049-10	JR2 DUP	Chlorophyceae	Unidentified		99000	Colony
7/24/2019	L2351049-10	JR2 DUP	Chlorophyceae	Scenedesmus	acuminatus	25000	Colony
7/24/2019	L2351049-10	JR2 DUP	Xanthophyceae	Ophiocytium	sp.	19000	Single Cell

Table C-5 Phytoplankton Taxonomy

DateSamp	LabNum	Source	Class	Genus	Species	CellperLitre	Unit
7/24/2019	L2351049-10	JR2 DUP	Chlorophyceae	Elakatothrix	sp.	62000	Single Cell
7/24/2019	L2351049-10	JR2 DUP	Chlorophyceae	Scenedesmus	quadricauda	161000	Colony
7/24/2019	L2351049-10	JR2 DUP	Cryptophyceae	Cryptomonas	sp.	43000	Single Cell
7/24/2019	L2351049-10	JR2 DUP	Chlorophyceae	Lagerheimia	sp.	12000	Colony
7/24/2019	L2351049-10	JR2 DUP	Bacillariophyceae	Gomphonema	sp.	6000	Single Cell
7/24/2019	L2351049-11	LAGOON	Cryptophyceae	Unidentified		304000	Single Cell
7/24/2019	L2351049-11	LAGOON	Cyanophyceae	Pseudanabaena	sp.	12000	Filament
7/24/2019	L2351049-11	LAGOON	Chlorophyceae	Schroederia	sp.	6000	Single Cell
7/24/2019	L2351049-11	LAGOON	Chlorophyceae	Oocystis	sp.	1000	Colony
7/24/2019	L2351049-11	LAGOON	Bacillariophyceae	Navicula	sp.	1000	Single Cell
7/24/2019	L2351049-11	LAGOON	Chlorophyceae	Pediastrum	duplex	2000	Colony
7/24/2019	L2351049-11	LAGOON	Chlorophyceae	Unidentified		105000	Single Cell
7/24/2019	L2351049-11	LAGOON	Euglenophyceae	Euglena	sp.	19000	Single Cell
7/24/2019	L2351049-11	LAGOON	Chlorophyceae	Closterium	sp.	171000	Single Cell
7/24/2019	L2351049-11	LAGOON	Chlorophyceae	Scenedesmus	sp.	43000	Colony
7/24/2019	L2351049-11	LAGOON	Chlorophyceae	Scenedesmus	quadricauda	6000	Colony
7/24/2019	L2351049-11	LAGOON	Euglenophyceae	Trachelomonas	sp.	6000	Single Cell
7/24/2019	L2351049-12	HYLIFE EFFLUENT	Euglenophyceae	Euglena	sp.	200	Single Cell
7/24/2019	L2351049-13	JL4	Euglenophyceae	Trachelomonas	sp.	12000	Single Cell
7/24/2019	L2351049-13	JL4	Dinophyceae	Gymnodinium	sp.	81000	Single Cell
7/24/2019	L2351049-13	JL4	Euglenophyceae	Phacus	sp.	6000	Single Cell
7/24/2019	L2351049-13	JL4	Cyanophyceae	Aphanocapsa	sp.	87000	Colony
7/24/2019	L2351049-13	JL4	Chlorophyceae	Tetrastrum	staurogeniaeforme	273000	Colony
7/24/2019	L2351049-13	JL4	Euglenophyceae	Euglena	sp.	31000	Single Cell
7/24/2019	L2351049-13	JL4	Cyanophyceae	Anabaena	sp.	1000	Filament
7/24/2019	L2351049-13	JL4	Chlorophyceae	Tetrastrum	sp.	25000	Colony
7/24/2019	L2351049-13	JL4	Chrysophyceae	Mallomonas	sp.	6000	Single Cell
7/24/2019	L2351049-13	JL4	Chlorophyceae	Tetraedron	caudatum	25000	Single Cell
7/24/2019	L2351049-13	JL4	Bacillariophyceae	Navicula	sp.	56000	Single Cell
7/24/2019	L2351049-13	JL4	Chlorophyceae	Crucigenia	sp.	37000	Colony
7/24/2019	L2351049-13	JL4	Cryptophyceae	Cryptomonas	sp.	74000	Single Cell
7/24/2019	L2351049-13	JL4	Chrysophyceae	small chrysophytes		6000	Single Cell
7/24/2019	L2351049-13	JL4	Chlorophyceae	Tetraedron	minimum	6000	Single Cell
7/24/2019	L2351049-13	JL4	Chlorophyceae	Pediastrum	Boryanum	11000	Colony

Table C-5 Phytoplankton Taxonomy

DateSamp	LabNum	Source	Class	Genus	Species	CellperLitre	Unit
7/24/2019	L2351049-13	JL4	Chlorophyceae	Staurastrum	sp.	2000	Single Cell
7/24/2019	L2351049-13	JL4	Chlorophyceae	Scenedesmus	sp.	725000	Colony
7/24/2019	L2351049-13	JL4	Bacillariophyceae	Gomphonema	sp.	1000	Single Cell
7/24/2019	L2351049-13	JL4	Cryptophyceae	Unidentified		693000	Single Cell
7/24/2019	L2351049-13	JL4	Chlorophyceae	Scenedesmus	quadricauda	12000	Colony
7/24/2019	L2351049-13	JL4	Euglenophyceae	Strombomonas	sp.	19000	Single Cell
7/24/2019	L2351049-13	JL4	Chlorophyceae	Pediastrum	duplex	3000	Colony
7/24/2019	L2351049-13	JL4	Chlorophyceae	Tetraedron	sp.	19000	Single Cell
7/24/2019	L2351049-13	JL4	Chlorophyceae	Actinastrum	sp.	19000	Colony
7/24/2019	L2351049-13	JL4	Chlorophyceae	Scenedesmus	acuminatus	1000	Colony
7/24/2019	L2351049-13	JL4	Chlorophyceae	Closterium	sp.	1000	Single Cell
7/24/2019	L2351049-13	JL4	Chlorophyceae	Unidentified		74000	Colony
7/24/2019	L2351049-13	JL4	Chlorophyceae	Elakatothrix	sp.	12000	Single Cell
7/24/2019	L2351049-13	JL4	Chlorophyceae	Oocystis	sp.	43000	Colony
7/24/2019	L2351049-13	JL4	Chlorophyceae	Coelastrum	sp.	6000	Colony
7/24/2019	L2351049-13	JL4	Chlorophyceae	Monoraphidium	sp.	310000	Single Cell
7/24/2019	L2351049-13	JL4	Chlorophyceae	Dictyosphaerium	sp.	6000	Colony
7/24/2019	L2351049-13	JL4	Chlorophyceae	Unidentified		396000	Single Cell
7/24/2019	L2351049-13	JL4	Chlorophyceae	Treubaria	sp.	43000	Single Cell
7/24/2019	L2351049-13	JL4	Chlorophyceae	Scenedesmus	spinosus	149000	Colony
7/24/2019	L2351049-13	JL4	Cyanophyceae	Pseudanabaena	sp.	3000	Filament
7/24/2019	L2351049-13	JL4	Bacillariophyceae	Aulacoseira	sp.	396000	Filament
7/24/2019	L2351049-13	JL4	Bacillariophyceae	Cyclotella	sp.	37000	Single Cell
7/24/2019	L2351049-13	JL4	Bacillariophyceae	Amphora	sp.	12000	Single Cell
7/24/2019	L2351049-13	JL4	Bacillariophyceae	Nitzschia	sp.	360000	Single Cell
7/24/2019	L2351049-13	JL4	Chlorophyceae	Lagerheimia	sp.	112000	Colony
7/24/2019	L2351049-13	JL4	Cyanophyceae	Merismopedia	sp.	1128000	Single Cell
7/24/2019	L2351049-13	JL4	Bacillariophyceae	Cymbella	sp.	1000	Single Cell
7/24/2019	L2351049-14	JR4	Chlorophyceae	Oocystis	sp.	19000	Colony
7/24/2019	L2351049-14	JR4	Bacillariophyceae	Cyclotella	sp.	99000	Single Cell
7/24/2019	L2351049-14	JR4	Euglenophyceae	Phacus	sp.	6000	Single Cell
7/24/2019	L2351049-14	JR4	Bacillariophyceae	Amphora	sp.	19000	Single Cell
7/24/2019	L2351049-14	JR4	Chlorophyceae	Monoraphidium	sp.	366000	Single Cell
7/24/2019	L2351049-14	JR4	Bacillariophyceae	Navicula	sp.	6000	Single Cell

Table C-5 Phytoplankton Taxonomy

DateSamp	LabNum	Source	Class	Genus	Species	CellperLitre	Unit
7/24/2019	L2351049-14	JR4	Euglenophyceae	Trachelomonas	sp.	6000	Single Cell
7/24/2019	L2351049-14	JR4	Cyanophyceae	Aphanocapsa	sp.	74000	Colony
7/24/2019	L2351049-14	JR4	Chlorophyceae	Tetraedron	caudatum	12000	Single Cell
7/24/2019	L2351049-14	JR4	Chlorophyceae	Crucigenia	sp.	12000	Colony
7/24/2019	L2351049-14	JR4	Bacillariophyceae	Cymbella	sp.	1000	Single Cell
7/24/2019	L2351049-14	JR4	Chlorophyceae	Pediastrum	Boryanum	5000	Colony
7/24/2019	L2351049-14	JR4	Chlorophyceae	Actinastrum	sp.	19000	Colony
7/24/2019	L2351049-14	JR4	Chlorophyceae	Tetraedron	sp.	37000	Single Cell
7/24/2019	L2351049-14	JR4	Chlorophyceae	Pediastrum	duplex	2000	Colony
7/24/2019	L2351049-14	JR4	Cyanophyceae	Merismopedia	sp.	1786000	Single Cell
7/24/2019	L2351049-14	JR4	Dinophyceae	Gymnodinium	sp.	37000	Single Cell
7/24/2019	L2351049-14	JR4	Cryptophyceae	Cryptomonas	sp.	99000	Single Cell
7/24/2019	L2351049-14	JR4	Chlorophyceae	Scenedesmus	quadricauda	25000	Colony
7/24/2019	L2351049-14	JR4	Chlorophyceae	Lagerheimia	sp.	155000	Colony
7/24/2019	L2351049-14	JR4	Chlorophyceae	Scenedesmus	acuminatus	6000	Colony
7/24/2019	L2351049-14	JR4	Cyanophyceae	Anabaena	sp.	1000	Filament
7/24/2019	L2351049-14	JR4	Bacillariophyceae	Nitzschia	sp.	341000	Single Cell
7/24/2019	L2351049-14	JR4	Chlorophyceae	Scenedesmus	sp.	614000	Colony
7/24/2019	L2351049-14	JR4	Chrysophyceae	small chrysophytes		6000	Single Cell
7/24/2019	L2351049-14	JR4	Euglenophyceae	Euglena	sp.	19000	Single Cell
7/24/2019	L2351049-14	JR4	Bacillariophyceae	Aulacoseira	sp.	594000	Filament
7/24/2019	L2351049-14	JR4	Chlorophyceae	Unidentified		105000	Colony
7/24/2019	L2351049-14	JR4	Chlorophyceae	Tetraedron	minimum	6000	Single Cell
7/24/2019	L2351049-14	JR4	Chlorophyceae	Schroederia	sp.	6000	Single Cell
7/24/2019	L2351049-14	JR4	Bacillariophyceae	Cocconeis	sp.	6000	Single Cell
7/24/2019	L2351049-14	JR4	Cryptophyceae	Unidentified		693000	Single Cell
7/24/2019	L2351049-14	JR4	Chlorophyceae	Scenedesmus	spinosus	124000	Colony
7/24/2019	L2351049-14	JR4	Chlorophyceae	Tetrastrum	sp.	6000	Colony
7/24/2019	L2351049-14	JR4	Chlorophyceae	Unidentified		198000	Single Cell
7/24/2019	L2351049-14	JR4	Chlorophyceae	Treubaria	sp.	62000	Single Cell
7/24/2019	L2351049-14	JR4	Chlorophyceae	Tetrastrum	staurogeniaeforme	384000	Colony
7/24/2019	L2351049-15	JR4 DUP	Chlorophyceae	Unidentified		297000	Single Cell
7/24/2019	L2351049-15	JR4 DUP	Chlorophyceae	Tetrastrum	staurogeniaeforme	310000	Colony
7/24/2019	L2351049-15	JR4 DUP	Chlorophyceae	Pediastrum	duplex	5000	Colony

Table C-5 Phytoplankton Taxonomy

DateSamp	LabNum	Source	Class	Genus	Species	CellperLitre	Unit
7/24/2019	L2351049-15	JR4 DUP	Cryptophyceae	Cryptomonas	sp.	25000	Single Cell
7/24/2019	L2351049-15	JR4 DUP	Chlorophyceae	Scenedesmus	quadricauda	37000	Colony
7/24/2019	L2351049-15	JR4 DUP	Chlorophyceae	Pediastrum	Boryanum	6000	Colony
7/24/2019	L2351049-15	JR4 DUP	Chrysophyceae	Mallomonas	sp.	6000	Single Cell
7/24/2019	L2351049-15	JR4 DUP	Cyanophyceae	Pseudanabaena	sp.	37000	Filament
7/24/2019	L2351049-15	JR4 DUP	Chlorophyceae	Unidentified		93000	Colony
7/24/2019	L2351049-15	JR4 DUP	Cryptophyceae	Unidentified		495000	Single Cell
7/24/2019	L2351049-15	JR4 DUP	Chlorophyceae	Oocystis	sp.	25000	Colony
7/24/2019	L2351049-15	JR4 DUP	Chrysophyceae	small chrysophytes		6000	Single Cell
7/24/2019	L2351049-15	JR4 DUP	Bacillariophyceae	Aulacoseira	sp.	198000	Filament
7/24/2019	L2351049-15	JR4 DUP	Bacillariophyceae	Cyclotella	sp.	50000	Single Cell
7/24/2019	L2351049-15	JR4 DUP	Bacillariophyceae	Amphora	sp.	19000	Single Cell
7/24/2019	L2351049-15	JR4 DUP	Cyanophyceae	Merismopedia	sp.	818000	Single Cell
7/24/2019	L2351049-15	JR4 DUP	Chlorophyceae	Golenkinia	sp.	12000	Single Cell
7/24/2019	L2351049-15	JR4 DUP	Dinophyceae	Gymnodinium	sp.	56000	Single Cell
7/24/2019	L2351049-15	JR4 DUP	Chlorophyceae	Treubaria	sp.	62000	Single Cell
7/24/2019	L2351049-15	JR4 DUP	Chlorophyceae	Scenedesmus	acuminatus	6000	Colony
7/24/2019	L2351049-15	JR4 DUP	Chlorophyceae	Lagerheimia	sp.	155000	Colony
7/24/2019	L2351049-15	JR4 DUP	Xanthophyceae	Ophiocytium	sp.	19000	Single Cell
7/24/2019	L2351049-15	JR4 DUP	Cyanophyceae	Aphanocapsa	sp.	50000	Colony
7/24/2019	L2351049-15	JR4 DUP	Chlorophyceae	Tetraedron	sp.	19000	Single Cell
7/24/2019	L2351049-15	JR4 DUP	Chlorophyceae	Scenedesmus	spinosus	112000	Colony
7/24/2019	L2351049-15	JR4 DUP	Bacillariophyceae	Navicula	sp.	37000	Single Cell
7/24/2019	L2351049-15	JR4 DUP	Chlorophyceae	Scenedesmus	sp.	744000	Colony
7/24/2019	L2351049-15	JR4 DUP	Chlorophyceae	Tetrastrum	sp.	31000	Colony
7/24/2019	L2351049-15	JR4 DUP	Bacillariophyceae	Nitzschia	sp.	322000	Single Cell
7/24/2019	L2351049-15	JR4 DUP	Chlorophyceae	Monoraphidium	sp.	341000	Single Cell
7/24/2019	L2351049-15	JR4 DUP	Bacillariophyceae	Cocconeis	sp.	12000	Single Cell
7/24/2019	L2351049-15	JR4 DUP	Chlorophyceae	Crucigenia	sp.	62000	Colony
7/24/2019	L2351049-15	JR4 DUP	Chlorophyceae	Tetraedron	caudatum	19000	Single Cell
7/24/2019	L2351049-15	JR4 DUP	Chlorophyceae	Dictyosphaerium	sp.	6000	Colony
7/24/2019	L2351049-15	JR4 DUP	Euglenophyceae	Euglena	sp.	31000	Single Cell
7/24/2019	L2351049-15	JR4 DUP	Euglenophyceae	Trachelomonas	sp.	31000	Single Cell
7/24/2019	L2351049-15	JR4 DUP	Euglenophyceae	Phacus	sp.	6000	Single Cell

Table C-5 Phytoplankton Taxonomy

DateSamp	LabNum	Source	Class	Genus	Species	CellperLitre	Unit
7/24/2019	L2351049-15	JR4 DUP	Chlorophyceae	Schroederia	sp.	6000	Single Cell
7/24/2019	L2351049-15	JR4 DUP	Chlorophyceae	Coelastrum	sp.	6000	Colony
7/24/2019	L2351049-16	JL5	Bacillariophyceae	Synedra	ulna	4000	Single Cell
7/24/2019	L2351049-16	JL5	Chlorophyceae	Scenedesmus	sp.	1271000	Colony
7/24/2019	L2351049-16	JL5	Chlorophyceae	Crucigenia	tetrapedia	6000	Colony
7/24/2019	L2351049-16	JL5	Chlorophyceae	Crucigenia	sp.	198000	Colony
7/24/2019	L2351049-16	JL5	Bacillariophyceae	Nitzschia	sp.	81000	Single Cell
7/24/2019	L2351049-16	JL5	Xanthophyceae	Ophiocytium	sp.	25000	Single Cell
7/24/2019	L2351049-16	JL5	Bacillariophyceae	Rhoicosphenia	sp.	6000	Single Cell
7/24/2019	L2351049-16	JL5	Chlorophyceae	Kirchneriella	sp.	6000	Colony
7/24/2019	L2351049-16	JL5	Chlorophyceae	Scenedesmus	acuminatus	6000	Colony
7/24/2019	L2351049-16	JL5	Cryptophyceae	Unidentified		297000	Single Cell
7/24/2019	L2351049-16	JL5	Chlorophyceae	Scenedesmus	quadricauda	25000	Colony
7/24/2019	L2351049-16	JL5	Chlorophyceae	Dictyosphaerium	sp.	37000	Colony
7/24/2019	L2351049-16	JL5	Chlorophyceae	Tetrastrum	sp.	43000	Colony
7/24/2019	L2351049-16	JL5	Chlorophyceae	Tetraedron	caudatum	25000	Single Cell
7/24/2019	L2351049-16	JL5	Bacillariophyceae	Cymbella	sp.	1000	Single Cell
7/24/2019	L2351049-16	JL5	Bacillariophyceae	Navicula	sp.	105000	Single Cell
7/24/2019	L2351049-16	JL5	Chlorophyceae	Scenedesmus	spinosus	180000	Colony
7/24/2019	L2351049-16	JL5	Euglenophyceae	Trachelomonas	sp.	12000	Single Cell
7/24/2019	L2351049-16	JL5	Cyanophyceae	Aphanocapsa	sp.	37000	Colony
7/24/2019	L2351049-16	JL5	Chlorophyceae	Tetraedron	sp.	56000	Single Cell
7/24/2019	L2351049-16	JL5	Cyanophyceae	Merismopedia	sp.	1345000	Single Cell
7/24/2019	L2351049-16	JL5	Chlorophyceae	Lagerheimia	sp.	62000	Colony
7/24/2019	L2351049-16	JL5	Chlorophyceae	Treubaria	sp.	12000	Single Cell
7/24/2019	L2351049-16	JL5	Chlorophyceae	Unidentified		198000	Single Cell
7/24/2019	L2351049-16	JL5	Chlorophyceae	Pediastrum	Boryanum	3000	Colony
7/24/2019	L2351049-16	JL5	Chrysophyceae	small chrysophytes		19000	Single Cell
7/24/2019	L2351049-16	JL5	Euglenophyceae	Euglena	sp.	12000	Single Cell
7/24/2019	L2351049-16	JL5	Bacillariophyceae	Cyclotella	sp.	6000	Single Cell
7/24/2019	L2351049-16	JL5	Dinophyceae	Gymnodinium	sp.	211000	Single Cell
7/24/2019	L2351049-16	JL5	Chlorophyceae	Unidentified		217000	Colony
7/24/2019	L2351049-16	JL5	Bacillariophyceae	Amphora	sp.	6000	Single Cell
7/24/2019	L2351049-16	JL5	Chlorophyceae	Monoraphidium	sp.	112000	Single Cell

Table C-5 Phytoplankton Taxonomy

DateSamp	LabNum	Source	Class	Genus	Species	CellperLitre	Unit
7/24/2019	L2351049-16	JL5	Chlorophyceae	Tetrastrum	staurogeniaeforme	161000	Colony
7/24/2019	L2351049-16	JL5	Chlorophyceae	Oocystis	sp.	25000	Colony
7/24/2019	L2351049-16	JL5	Cryptophyceae	Cryptomonas	sp.	31000	Single Cell
7/24/2019	L2351049-16	JL5	Bacillariophyceae	Cocconeis	sp.	12000	Single Cell
7/24/2019	L2351049-16	JL5	Chlorophyceae	Elakatothrix	sp.	4000	Single Cell
7/24/2019	L2351049-17	JR5	Bacillariophyceae	Gomphonema	sp.	12000	Single Cell
7/24/2019	L2351049-17	JR5	Chlorophyceae	Elakatothrix	sp.	19000	Single Cell
7/24/2019	L2351049-17	JR5	Bacillariophyceae	Navicula	sp.	112000	Single Cell
7/24/2019	L2351049-17	JR5	Bacillariophyceae	Cymatopleura	solea	2000	Single Cell
7/24/2019	L2351049-17	JR5	Cyanophyceae	Merismopedia	sp.	2232000	Single Cell
7/24/2019	L2351049-17	JR5	Chlorophyceae	Crucigenia	sp.	273000	Colony
7/24/2019	L2351049-17	JR5	Chlorophyceae	Tetrastrum	sp.	12000	Colony
7/24/2019	L2351049-17	JR5	Euglenophyceae	Trachelomonas	sp.	12000	Single Cell
7/24/2019	L2351049-17	JR5	Chlorophyceae	Tetraedron	caudatum	25000	Single Cell
7/24/2019	L2351049-17	JR5	Cyanophyceae	Aphanocapsa	sp.	6000	Colony
7/24/2019	L2351049-17	JR5	Bacillariophyceae	Gyrosigma	sp.	1000	Single Cell
7/24/2019	L2351049-17	JR5	Bacillariophyceae	Amphora	sp.	37000	Single Cell
7/24/2019	L2351049-17	JR5	Bacillariophyceae	Caloneis	sp.	1000	Single Cell
7/24/2019	L2351049-17	JR5	Chlorophyceae	Oocystis	sp.	12000	Colony
7/24/2019	L2351049-17	JR5	Chlorophyceae	Pediastrum	Boryanum	3000	Colony
7/24/2019	L2351049-17	JR5	Bacillariophyceae	Cymbella	sp.	6000	Single Cell
7/24/2019	L2351049-17	JR5	Chlorophyceae	Tetraedron	sp.	56000	Single Cell
7/24/2019	L2351049-17	JR5	Bacillariophyceae	Cocconeis	sp.	6000	Single Cell
7/24/2019	L2351049-17	JR5	Chlorophyceae	Scenedesmus	spinosus	124000	Colony
7/24/2019	L2351049-17	JR5	Chlorophyceae	Scenedesmus	acuminatus	12000	Colony
7/24/2019	L2351049-17	JR5	Chrysophyceae	small chrysophytes		6000	Single Cell
7/24/2019	L2351049-17	JR5	Dinophyceae	Gymnodinium	sp.	211000	Single Cell
7/24/2019	L2351049-17	JR5	Chlorophyceae	Lagerheimia	sp.	19000	Colony
7/24/2019	L2351049-17	JR5	Chlorophyceae	Coelastrum	sp.	6000	Colony
7/24/2019	L2351049-17	JR5	Chlorophyceae	Crucigenia	tetrapedia	12000	Colony
7/24/2019	L2351049-17	JR5	Chlorophyceae	Tetrastrum	staurogeniaeforme	180000	Colony
7/24/2019	L2351049-17	JR5	Chlorophyceae	Scenedesmus	quadricauda	19000	Colony
7/24/2019	L2351049-17	JR5	Cryptophyceae	Unidentified		43000	Single Cell
7/24/2019	L2351049-17	JR5	Bacillariophyceae	Synedra	ulna	4000	Single Cell

Table C-5 Phytoplankton Taxonomy

DateSamp	LabNum	Source	Class	Genus	Species	CellperLitre	Unit
7/24/2019	L2351049-17	JR5	Chlorophyceae	Scenedesmus	sp.	1265000	Colony
7/24/2019	L2351049-17	JR5	Euglenophyceae	Phacus	sp.	1000	Single Cell
7/24/2019	L2351049-17	JR5	Cryptophyceae	Cryptomonas	sp.	68000	Single Cell
7/24/2019	L2351049-17	JR5	Chlorophyceae	Cosmarium	sp.	1000	Single Cell
7/24/2019	L2351049-17	JR5	Chlorophyceae	Kirchneriella	sp.	12000	Colony
7/24/2019	L2351049-17	JR5	Bacillariophyceae	Nitzschia	sp.	118000	Single Cell
7/24/2019	L2351049-17	JR5	Chlorophyceae	Unidentified		198000	Single Cell
7/24/2019	L2351049-17	JR5	Chlorophyceae	Monoraphidium	sp.	149000	Single Cell
7/24/2019	L2351049-17	JR5	Chlorophyceae	Tetraedron	minimum	12000	Single Cell
7/24/2019	L2351049-17	JR5	Chlorophyceae	Treubaria	sp.	12000	Single Cell
7/24/2019	L2351049-17	JR5	Bacillariophyceae	Cyclotella	sp.	19000	Single Cell
7/24/2019	L2351049-17	JR5	Xanthophyceae	Ophiocytium	sp.	31000	Single Cell
7/24/2019	L2351049-17	JR5	Chlorophyceae	Dictyosphaerium	sp.	37000	Colony
7/24/2019	L2351049-17	JR5	Euglenophyceae	Euglena	sp.	19000	Single Cell
7/24/2019	L2351049-17	JR5	Bacillariophyceae	Surirella	sp.	1000	Single Cell
7/24/2019	L2351049-17	JR5	Chlorophyceae	Unidentified		180000	Colony
7/24/2019	L2351049-18	JL6	Chlorophyceae	Lagerheimia	sp.	186000	Colony
7/24/2019	L2351049-18	JL6	Chlorophyceae	Schroederia	sp.	12000	Single Cell
7/24/2019	L2351049-18	JL6	Chlorophyceae	Scenedesmus	quadricauda	25000	Colony
7/24/2019	L2351049-18	JL6	Chlorophyceae	Monoraphidium	sp.	192000	Single Cell
7/24/2019	L2351049-18	JL6	Chlorophyceae	Oocystis	sp.	12000	Colony
7/24/2019	L2351049-18	JL6	Chlorophyceae	Unidentified		1782000	Single Cell
7/24/2019	L2351049-18	JL6	Chlorophyceae	Pediastrum	Boryanum	6000	Colony
7/24/2019	L2351049-18	JL6	Chlorophyceae	Actinastrum	sp.	31000	Colony
7/24/2019	L2351049-18	JL6	Chlorophyceae	Unidentified		186000	Colony
7/24/2019	L2351049-18	JL6	Cyanophyceae	Pseudanabaena	sp.	192000	Filament
7/24/2019	L2351049-18	JL6	Chlorophyceae	Scenedesmus	acuminatus	56000	Colony
7/24/2019	L2351049-18	JL6	Bacillariophyceae	Amphora	sp.	6000	Single Cell
7/24/2019	L2351049-18	JL6	Chlorophyceae	Crucigenia	sp.	174000	Colony
7/24/2019	L2351049-18	JL6	Chlorophyceae	Coelastrum	sp.	12000	Colony
7/24/2019	L2351049-18	JL6	Chlorophyceae	Elakatothrix	sp.	6000	Single Cell
7/24/2019	L2351049-18	JL6	Chlorophyceae	Dictyosphaerium	sp.	161000	Colony
7/24/2019	L2351049-18	JL6	Xanthophyceae	Ophiocytium	sp.	43000	Single Cell
7/24/2019	L2351049-18	JL6	Chlorophyceae	Scenedesmus	sp.	1333000	Colony

Table C-5 Phytoplankton Taxonomy

DateSamp	LabNum	Source	Class	Genus	Species	CellperLitre	Unit
7/24/2019	L2351049-18	JL6	Chlorophyceae	Scenedesmus	spinosus	211000	Colony
7/24/2019	L2351049-18	JL6	Chlorophyceae	Tetraedron	sp.	25000	Single Cell
7/24/2019	L2351049-18	JL6	Cyanophyceae	Merismopedia	sp.	20634000	Single Cell
7/24/2019	L2351049-18	JL6	Cryptophyceae	Unidentified		495000	Single Cell
7/24/2019	L2351049-18	JL6	Chlorophyceae	Tetraedron	caudatum	31000	Single Cell
7/24/2019	L2351049-18	JL6	Chlorophyceae	Tetrastrum	sp.	180000	Colony
7/24/2019	L2351049-18	JL6	Bacillariophyceae	Caloneis	sp.	1000	Single Cell
7/24/2019	L2351049-18	JL6	Euglenophyceae	Euglena	sp.	19000	Single Cell
7/24/2019	L2351049-18	JL6	Bacillariophyceae	Cocconeis	sp.	6000	Single Cell
7/24/2019	L2351049-18	JL6	Bacillariophyceae	Nitzschia	sp.	118000	Single Cell
7/24/2019	L2351049-18	JL6	Bacillariophyceae	Surirella	sp.	1000	Single Cell
7/24/2019	L2351049-18	JL6	Bacillariophyceae	Navicula	sp.	19000	Single Cell
7/24/2019	L2351049-18	JL6	Cyanophyceae	Aphanizomenon	sp.	1000	Filament
7/24/2019	L2351049-18	JL6	Euglenophyceae	Phacus	sp.	6000	Single Cell
7/24/2019	L2351049-18	JL6	Bacillariophyceae	Synedra	ulna	4000	Single Cell
7/24/2019	L2351049-18	JL6	Bacillariophyceae	Cymatopleura	solea	1000	Single Cell
7/24/2019	L2351049-18	JL6	Euglenophyceae	Trachelomonas	sp.	31000	Single Cell
7/24/2019	L2351049-18	JL6	Chlorophyceae	Tetrastrum	staurogeniaeforme	105000	Colony
7/24/2019	L2351049-18	JL6	Cryptophyceae	Cryptomonas	sp.	19000	Single Cell
7/24/2019	L2351049-18	JL6	Bacillariophyceae	Cyclotella	sp.	25000	Single Cell
7/24/2019	L2351049-18	JL6	Cyanophyceae	Aphanocapsa	sp.	248000	Colony
7/24/2019	L2351049-18	JL6	Chlorophyceae	Tetraedron	minimum	6000	Single Cell
7/24/2019	L2351049-18	JL6	Chlorophyceae	Treubaria	sp.	31000	Single Cell
7/24/2019	L2351049-18	JL6	Dinophyceae	Gymnodinium	sp.	68000	Single Cell
7/24/2019	L2351049-19	JR6	Chlorophyceae	Actinastrum	sp.	12000	Colony
7/24/2019	L2351049-19	JR6	Chlorophyceae	Coelastrum	sp.	25000	Colony
7/24/2019	L2351049-19	JR6	Euglenophyceae	Phacus	sp.	6000	Single Cell
7/24/2019	L2351049-19	JR6	Bacillariophyceae	Navicula	sp.	56000	Single Cell
7/24/2019	L2351049-19	JR6	Euglenophyceae	Euglena	sp.	31000	Single Cell
7/24/2019	L2351049-19	JR6	Chlorophyceae	Pediastrum	Boryanum	7000	Colony
7/24/2019	L2351049-19	JR6	Chlorophyceae	Scenedesmus	sp.	1531000	Colony
7/24/2019	L2351049-19	JR6	Chlorophyceae	Scenedesmus	spinosus	118000	Colony
7/24/2019	L2351049-19	JR6	Chlorophyceae	Monoraphidium	sp.	229000	Single Cell
7/24/2019	L2351049-19	JR6	Chlorophyceae	Scenedesmus	acuminatus	43000	Colony

Table C-5 Phytoplankton Taxonomy

DateSamp	LabNum	Source	Class	Genus	Species	CellperLitre	Unit
7/24/2019	L2351049-19	JR6	Chlorophyceae	Tetraedron	caudatum	31000	Single Cell
7/24/2019	L2351049-19	JR6	Chlorophyceae	Closterium	sp.	2000	Single Cell
7/24/2019	L2351049-19	JR6	Chlorophyceae	Unidentified		1584000	Single Cell
7/24/2019	L2351049-19	JR6	Bacillariophyceae	Nitzschia	sp.	136000	Single Cell
7/24/2019	L2351049-19	JR6	Bacillariophyceae	Surirella	sp.	1000	Single Cell
7/24/2019	L2351049-19	JR6	Cryptophyceae	Cryptomonas	sp.	37000	Single Cell
7/24/2019	L2351049-19	JR6	Chrysophyceae	small chrysophytes		6000	Single Cell
7/24/2019	L2351049-19	JR6	Chlorophyceae	Pediastrum	duplex	1000	Colony
7/24/2019	L2351049-19	JR6	Chlorophyceae	Scenedesmus	quadricauda	31000	Colony
7/24/2019	L2351049-19	JR6	Bacillariophyceae	Synedra	ulna	6000	Single Cell
7/24/2019	L2351049-19	JR6	Chlorophyceae	Unidentified		273000	Colony
7/24/2019	L2351049-19	JR6	Cryptophyceae	Unidentified		792000	Single Cell
7/24/2019	L2351049-19	JR6	Chlorophyceae	Tetrastrum	staurogeniaeforme	112000	Colony
7/24/2019	L2351049-19	JR6	Cyanophyceae	Pseudanabaena	sp.	155000	Filament
7/24/2019	L2351049-19	JR6	Chlorophyceae	Lagerheimia	sp.	130000	Colony
7/24/2019	L2351049-19	JR6	Chlorophyceae	Elakatothrix	sp.	25000	Single Cell
7/24/2019	L2351049-19	JR6	Chlorophyceae	Tetrastrum	sp.	155000	Colony
7/24/2019	L2351049-19	JR6	Chlorophyceae	Dictyosphaerium	sp.	136000	Colony
7/24/2019	L2351049-19	JR6	Bacillariophyceae	Cymatopleura	solea	2000	Single Cell
7/24/2019	L2351049-19	JR6	Cyanophyceae	Merismopedia	sp.	23709000	Single Cell
7/24/2019	L2351049-19	JR6	Chlorophyceae	Cosmarium	sp.	1000	Single Cell
7/24/2019	L2351049-19	JR6	Chlorophyceae	Schroederia	sp.	19000	Single Cell
7/24/2019	L2351049-19	JR6	Bacillariophyceae	Gyrosigma	sp.	2000	Single Cell
7/24/2019	L2351049-19	JR6	Cyanophyceae	Aphanocapsa	sp.	180000	Colony
7/24/2019	L2351049-19	JR6	Bacillariophyceae	Cymbella	sp.	6000	Single Cell
7/24/2019	L2351049-19	JR6	Chlorophyceae	Crucigenia	sp.	174000	Colony
7/24/2019	L2351049-19	JR6	Euglenophyceae	Trachelomonas	sp.	12000	Single Cell
7/24/2019	L2351049-19	JR6	Bacillariophyceae	Cyclotella	sp.	87000	Single Cell
7/24/2019	L2351049-19	JR6	Chlorophyceae	Kirchneriella	sp.	12000	Colony
7/24/2019	L2351049-19	JR6	Chlorophyceae	Treubaria	sp.	19000	Single Cell
7/24/2019	L2351049-19	JR6	Xanthophyceae	Ophiocytium	sp.	81000	Single Cell
7/24/2019	L2351049-19	JR6	Dinophyceae	Gymnodinium	sp.	31000	Single Cell
7/24/2019	L2351049-19	JR6	Bacillariophyceae	Aulacoseira	sp.	12000	Filament
7/24/2019	L2351049-2	JL1	Euglenophyceae	Euglena	sp.	12000	Single Cell

Table C-5 Phytoplankton Taxonomy

DateSamp	LabNum	Source	Class	Genus	Species	CellperLitre	Unit
7/24/2019	L2351049-2	JL1	Chlorophyceae	Pediastrum	Boryanum	3000	Colony
7/24/2019	L2351049-2	JL1	Cyanophyceae	Anabaena	sp.	198000	Filament
7/24/2019	L2351049-2	JL1	Bacillariophyceae	Gomphonema	sp.	6000	Single Cell
7/24/2019	L2351049-2	JL1	Chlorophyceae	Unidentified		31000	Colony
7/24/2019	L2351049-2	JL1	Chlorophyceae	Unidentified		198000	Single Cell
7/24/2019	L2351049-2	JL1	Cyanophyceae	Merismopedia	sp.	56000	Single Cell
7/24/2019	L2351049-2	JL1	Chlorophyceae	Elakatothrix	sp.	62000	Single Cell
7/24/2019	L2351049-2	JL1	Chlorophyceae	Closterium	sp.	3000	Single Cell
7/24/2019	L2351049-2	JL1	Bacillariophyceae	Cymbella	sp.	1000	Single Cell
7/24/2019	L2351049-2	JL1	Chlorophyceae	Tetrastrum	staurogeniaeforme	12000	Colony
7/24/2019	L2351049-2	JL1	Chlorophyceae	Scenedesmus	quadricauda	99000	Colony
7/24/2019	L2351049-2	JL1	Chlorophyceae	Dictyosphaerium	sp.	12000	Colony
7/24/2019	L2351049-2	JL1	Chlorophyceae	Scenedesmus	spinosus	68000	Colony
7/24/2019	L2351049-2	JL1	Cryptophyceae	Cryptomonas	sp.	74000	Single Cell
7/24/2019	L2351049-2	JL1	Chlorophyceae	Tetraedron	caudatum	6000	Single Cell
7/24/2019	L2351049-2	JL1	Dinophyceae	Ceratium	hirundinella	1000	Single Cell
7/24/2019	L2351049-2	JL1	Cyanophyceae	Aphanizomenon	sp.	1122000	Filament
7/24/2019	L2351049-2	JL1	Chlorophyceae	Crucigenia	sp.	12000	Colony
7/24/2019	L2351049-2	JL1	Chlorophyceae	Scenedesmus	sp.	167000	Colony
7/24/2019	L2351049-2	JL1	Chlorophyceae	Spirogyra	sp.	1000	Filament
7/24/2019	L2351049-2	JL1	Chlorophyceae	Monoraphidium	sp.	192000	Single Cell
7/24/2019	L2351049-2	JL1	Bacillariophyceae	Nitzschia	sp.	81000	Single Cell
7/24/2019	L2351049-2	JL1	Cryptophyceae	Unidentified		495000	Single Cell
7/24/2019	L2351049-2	JL1	Cyanophyceae	Planktolyngbya	sp.	6000	Filament
7/24/2019	L2351049-2	JL1	Cyanophyceae	Microcystis	sp.	1000	Colony
7/24/2019	L2351049-2	JL1	Cyanophyceae	Pseudanabaena	sp.	6000	Filament
7/24/2019	L2351049-2	JL1	Bacillariophyceae	Navicula	sp.	12000	Single Cell
7/24/2019	L2351049-2	JL1	Bacillariophyceae	Cocconeis	sp.	12000	Single Cell
7/24/2019	L2351049-2	JL1	Chlorophyceae	Oocystis	sp.	68000	Colony
7/24/2019	L2351049-2	JL1	Chlorophyceae	Lagerheimia	sp.	19000	Colony
7/24/2019	L2351049-2	JL1	Chlorophyceae	Scenedesmus	acuminatus	19000	Colony
7/24/2019	L2351049-2	JL1	Chlorophyceae	Tetraedron	sp.	1000	Single Cell
7/24/2019	L2351049-2	JL1	Bacillariophyceae	Aulacoseira	sp.	4356000	Filament
7/24/2019	L2351049-2	JL1	Chlorophyceae	Schroederia	sp.	37000	Single Cell

Table C-5 Phytoplankton Taxonomy

DateSamp	LabNum	Source	Class	Genus	Species	CellperLitre	Unit
7/24/2019	L2351049-2	JL1	Cyanophyceae	Aphanocapsa	sp.	6000	Colony
7/24/2019	L2351049-3	JR1	Chlorophyceae	Tetrastrum	staurogeniaeforme	19000	Colony
7/24/2019	L2351049-3	JR1	Euglenophyceae	Trachelomonas	sp.	6000	Single Cell
7/24/2019	L2351049-3	JR1	Bacillariophyceae	Cocconeis	sp.	6000	Single Cell
7/24/2019	L2351049-3	JR1	Chlorophyceae	Kirchneriella	sp.	1000	Colony
7/24/2019	L2351049-3	JR1	Chlorophyceae	Schroederia	sp.	68000	Single Cell
7/24/2019	L2351049-3	JR1	Chlorophyceae	Pediastrum	Boryanum	3000	Colony
7/24/2019	L2351049-3	JR1	Chlorophyceae	Monoraphidium	sp.	155000	Single Cell
7/24/2019	L2351049-3	JR1	Chlorophyceae	Unidentified		19000	Colony
7/24/2019	L2351049-3	JR1	Cyanophyceae	Anabaena	sp.	285000	Filament
7/24/2019	L2351049-3	JR1	Chlorophyceae	Oocystis	sp.	74000	Colony
7/24/2019	L2351049-3	JR1	Euglenophyceae	Euglena	sp.	12000	Single Cell
7/24/2019	L2351049-3	JR1	Bacillariophyceae	Aulacoseira	sp.	4059000	Filament
7/24/2019	L2351049-3	JR1	Cyanophyceae	Pseudanabaena	sp.	31000	Filament
7/24/2019	L2351049-3	JR1	Cryptophyceae	Unidentified		198000	Single Cell
7/24/2019	L2351049-3	JR1	Chlorophyceae	Scenedesmus	sp.	149000	Colony
7/24/2019	L2351049-3	JR1	Cyanophyceae	Aphanocapsa	sp.	6000	Colony
7/24/2019	L2351049-3	JR1	Bacillariophyceae	Nitzschia	sp.	136000	Single Cell
7/24/2019	L2351049-3	JR1	Chlorophyceae	Tetraedron	minimum	12000	Single Cell
7/24/2019	L2351049-3	JR1	Cyanophyceae	Microcystis	sp.	2000	Colony
7/24/2019	L2351049-3	JR1	Bacillariophyceae	Navicula	sp.	12000	Single Cell
7/24/2019	L2351049-3	JR1	Chlorophyceae	Scenedesmus	acuminatus	2000	Colony
7/24/2019	L2351049-3	JR1	Chlorophyceae	Pandorina	sp.	1000	Colony
7/24/2019	L2351049-3	JR1	Chlorophyceae	Lagerheimia	sp.	6000	Colony
7/24/2019	L2351049-3	JR1	Bacillariophyceae	Gomphonema	sp.	1000	Single Cell
7/24/2019	L2351049-3	JR1	Bacillariophyceae	Cymbella	sp.	12000	Single Cell
7/24/2019	L2351049-3	JR1	Bacillariophyceae	Cymatopleura	sp.	1000	Single Cell
7/24/2019	L2351049-3	JR1	Chlorophyceae	Unidentified		260000	Single Cell
7/24/2019	L2351049-3	JR1	Cyanophyceae	Aphanizomenon	sp.	1283000	Filament
7/24/2019	L2351049-3	JR1	Bacillariophyceae	Cyclotella	sp.	12000	Single Cell
7/24/2019	L2351049-3	JR1	Chlorophyceae	Scenedesmus	spinosus	68000	Colony
7/24/2019	L2351049-3	JR1	Cyanophyceae	Spirulina	sp.	6000	Filament
7/24/2019	L2351049-3	JR1	Cyanophyceae	Merismopedia	sp.	50000	Single Cell
7/24/2019	L2351049-3	JR1	Cryptophyceae	Cryptomonas	sp.	62000	Single Cell

Table C-5 Phytoplankton Taxonomy

DateSamp	LabNum	Source	Class	Genus	Species	CellperLitre	Unit
7/24/2019	L2351049-3	JR1	Bacillariophyceae	Rhoicosphenia	sp.	6000	Single Cell
7/24/2019	L2351049-3	JR1	Chlorophyceae	Scenedesmus	quadricauda	43000	Colony
7/24/2019	L2351049-4	JL2	Bacillariophyceae	Cocconeis	sp.	19000	Single Cell
7/24/2019	L2351049-4	JL2	Cryptophyceae	Unidentified		198000	Single Cell
7/24/2019	L2351049-4	JL2	Bacillariophyceae	Nitzschia	sp.	105000	Single Cell
7/24/2019	L2351049-4	JL2	Dinophyceae	Gymnodinium	sp.	19000	Single Cell
7/24/2019	L2351049-4	JL2	Chlorophyceae	Monoraphidium	sp.	329000	Single Cell
7/24/2019	L2351049-4	JL2	Chlorophyceae	Tetraedron	sp.	6000	Single Cell
7/24/2019	L2351049-4	JL2	Euglenophyceae	Trachelomonas	sp.	31000	Single Cell
7/24/2019	L2351049-4	JL2	Bacillariophyceae	Navicula	sp.	6000	Single Cell
7/24/2019	L2351049-4	JL2	Chlorophyceae	Crucigenia	sp.	2000	Colony
7/24/2019	L2351049-4	JL2	Chlorophyceae	Treubaria	sp.	31000	Single Cell
7/24/2019	L2351049-4	JL2	Chlorophyceae	Unidentified		105000	Colony
7/24/2019	L2351049-4	JL2	Chlorophyceae	Dictyosphaerium	sp.	19000	Colony
7/24/2019	L2351049-4	JL2	Cyanophyceae	Pseudanabaena	sp.	12000	Filament
7/24/2019	L2351049-4	JL2	Bacillariophyceae	Aulacoseira	sp.	2772000	Filament
7/24/2019	L2351049-4	JL2	Chlorophyceae	Scenedesmus	spinosus	149000	Colony
7/24/2019	L2351049-4	JL2	Bacillariophyceae	Amphora	sp.	19000	Single Cell
7/24/2019	L2351049-4	JL2	Cyanophyceae	Phormidium	sp.	1000	Filament
7/24/2019	L2351049-4	JL2	Chrysophyceae	small chrysophytes		12000	Single Cell
7/24/2019	L2351049-4	JL2	Cryptophyceae	Cryptomonas	sp.	87000	Single Cell
7/24/2019	L2351049-4	JL2	Chlorophyceae	Tetraedron	caudatum	12000	Single Cell
7/24/2019	L2351049-4	JL2	Chlorophyceae	Scenedesmus	quadricauda	81000	Colony
7/24/2019	L2351049-4	JL2	Chlorophyceae	Planktosphaeria	sp.	6000	Colony
7/24/2019	L2351049-4	JL2	Chlorophyceae	Closterium	sp.	1000	Single Cell
7/24/2019	L2351049-4	JL2	Cyanophyceae	Merismopedia	sp.	843000	Single Cell
7/24/2019	L2351049-4	JL2	Chlorophyceae	Elakatothrix	sp.	136000	Single Cell
7/24/2019	L2351049-4	JL2	Chlorophyceae	Pediastrum	Boryanum	2000	Colony
7/24/2019	L2351049-4	JL2	Cyanophyceae	Aphanizomenon	sp.	87000	Filament
7/24/2019	L2351049-4	JL2	Euglenophyceae	Euglena	sp.	6000	Single Cell
7/24/2019	L2351049-4	JL2	Cyanophyceae	Anabaena	sp.	62000	Filament
7/24/2019	L2351049-4	JL2	Chlorophyceae	Tetrastrum	staurogeniaeforme	19000	Colony
7/24/2019	L2351049-4	JL2	Chlorophyceae	Oocystis	sp.	81000	Colony
7/24/2019	L2351049-4	JL2	Chlorophyceae	Schroederia	sp.	12000	Single Cell

Table C-5 Phytoplankton Taxonomy

DateSamp	LabNum	Source	Class	Genus	Species	CellperLitre	Unit
7/24/2019	L2351049-4	JL2	Chlorophyceae	Unidentified		453000	Single Cell
7/24/2019	L2351049-4	JL2	Euglenophyceae	Phacus	sp.	6000	Single Cell
7/24/2019	L2351049-4	JL2	Chlorophyceae	Pediastrum	duplex	2000	Colony
7/24/2019	L2351049-4	JL2	Chlorophyceae	Scenedesmus	sp.	279000	Colony
7/24/2019	L2351049-4	JL2	Cyanophyceae	Aphanocapsa	sp.	6000	Colony
7/24/2019	L2351049-4	JL2	Chlorophyceae	Scenedesmus	acuminatus	19000	Colony
7/24/2019	L2351049-4	JL2	Chlorophyceae	Coelastrum	sp.	6000	Colony
7/24/2019	L2351049-4	JL2	Chlorophyceae	Tetraedron	minimum	6000	Single Cell
7/24/2019	L2351049-4	JL2	Chlorophyceae	Lagerheimia	sp.	25000	Colony
7/24/2019	L2351049-5	JR2	Bacillariophyceae	Aulacoseira	sp.	2277000	Filament
7/24/2019	L2351049-5	JR2	Cyanophyceae	Aphanizomenon	sp.	87000	Filament
7/24/2019	L2351049-5	JR2	Chlorophyceae	Tetraedron	caudatum	6000	Single Cell
7/24/2019	L2351049-5	JR2	Cyanophyceae	Anabaena	sp.	50000	Filament
7/24/2019	L2351049-5	JR2	Cyanophyceae	Pseudanabaena	sp.	12000	Filament
7/24/2019	L2351049-5	JR2	Cyanophyceae	Aphanocapsa	sp.	12000	Colony
7/24/2019	L2351049-5	JR2	Chlorophyceae	Unidentified		68000	Colony
7/24/2019	L2351049-5	JR2	Chlorophyceae	Tetraedron	minimum	19000	Single Cell
7/24/2019	L2351049-5	JR2	Chlorophyceae	Actinastrum	sp.	6000	Colony
7/24/2019	L2351049-5	JR2	Cyanophyceae	Merismopedia	sp.	1265000	Single Cell
7/24/2019	L2351049-5	JR2	Chlorophyceae	Coelastrum	sp.	19000	Colony
7/24/2019	L2351049-5	JR2	Chlorophyceae	Oocystis	sp.	50000	Colony
7/24/2019	L2351049-5	JR2	Chlorophyceae	Dictyosphaerium	sp.	25000	Colony
7/24/2019	L2351049-5	JR2	Chlorophyceae	Pediastrum	duplex	3000	Colony
7/24/2019	L2351049-5	JR2	Chlorophyceae	Elakatothrix	sp.	56000	Single Cell
7/24/2019	L2351049-5	JR2	Chlorophyceae	Tetraedron	sp.	12000	Single Cell
7/24/2019	L2351049-5	JR2	Chlorophyceae	Tetrastrum	sp.	25000	Colony
7/24/2019	L2351049-5	JR2	Chlorophyceae	Scenedesmus	sp.	316000	Colony
7/24/2019	L2351049-5	JR2	Cryptophyceae	Unidentified		297000	Single Cell
7/24/2019	L2351049-5	JR2	Chlorophyceae	Scenedesmus	acuminatus	2000	Colony
7/24/2019	L2351049-5	JR2	Bacillariophyceae	Cocconeis	sp.	25000	Single Cell
7/24/2019	L2351049-5	JR2	Chlorophyceae	Scenedesmus	quadricauda	205000	Colony
7/24/2019	L2351049-5	JR2	Euglenophyceae	Euglena	sp.	25000	Single Cell
7/24/2019	L2351049-5	JR2	Bacillariophyceae	Nitzschia	sp.	93000	Single Cell
7/24/2019	L2351049-5	JR2	Chlorophyceae	Lagerheimia	sp.	6000	Colony

Table C-5 Phytoplankton Taxonomy

DateSamp	LabNum	Source	Class	Genus	Species	CellperLitre	Unit
7/24/2019	L2351049-5	JR2	Bacillariophyceae	Navicula	sp.	19000	Single Cell
7/24/2019	L2351049-5	JR2	Chlorophyceae	Treubaria	sp.	19000	Single Cell
7/24/2019	L2351049-5	JR2	Chlorophyceae	Unidentified		693000	Single Cell
7/24/2019	L2351049-5	JR2	Chlorophyceae	Tetrastrum	staurogeniaeforme	12000	Colony
7/24/2019	L2351049-5	JR2	Chlorophyceae	Monoraphidium	sp.	304000	Single Cell
7/24/2019	L2351049-5	JR2	Chlorophyceae	Pediastrum	Boryanum	7000	Colony
7/24/2019	L2351049-5	JR2	Bacillariophyceae	Cyclotella	sp.	19000	Single Cell
7/24/2019	L2351049-5	JR2	Chlorophyceae	Schroederia	sp.	19000	Single Cell
7/24/2019	L2351049-5	JR2	Cryptophyceae	Cryptomonas	sp.	50000	Single Cell
7/24/2019	L2351049-5	JR2	Chlorophyceae	Kirchneriella	sp.	6000	Colony
7/24/2019	L2351049-6	JM2	Chlorophyceae	Scenedesmus	sp.	254000	Colony
7/24/2019	L2351049-6	JM2	Cryptophyceae	Unidentified		297000	Single Cell
7/24/2019	L2351049-6	JM2	Cyanophyceae	Pseudanabaena	sp.	31000	Filament
7/24/2019	L2351049-6	JM2	Cyanophyceae	Aphanizomenon	sp.	50000	Filament
7/24/2019	L2351049-6	JM2	Chlorophyceae	Lagerheimia	sp.	6000	Colony
7/24/2019	L2351049-6	JM2	Chlorophyceae	Tetraedron	minimum	6000	Single Cell
7/24/2019	L2351049-6	JM2	Chlorophyceae	Tetraedron	sp.	31000	Single Cell
7/24/2019	L2351049-6	JM2	Bacillariophyceae	Nitzschia	sp.	130000	Single Cell
7/24/2019	L2351049-6	JM2	Chlorophyceae	Scenedesmus	spinosus	62000	Colony
7/24/2019	L2351049-6	JM2	Bacillariophyceae	Aulacoseira	sp.	2970000	Filament
7/24/2019	L2351049-6	JM2	Cyanophyceae	Aphanocapsa	sp.	6000	Colony
7/24/2019	L2351049-6	JM2	Bacillariophyceae	Caloneis	sp.	1000	Single Cell
7/24/2019	L2351049-6	JM2	Cyanophyceae	Merismopedia	sp.	595000	Single Cell
7/24/2019	L2351049-6	JM2	Bacillariophyceae	Cyclotella	sp.	6000	Single Cell
7/24/2019	L2351049-6	JM2	Chlorophyceae	Treubaria	sp.	31000	Single Cell
7/24/2019	L2351049-6	JM2	Bacillariophyceae	Gomphonema	sp.	6000	Single Cell
7/24/2019	L2351049-6	JM2	Cyanophyceae	Gomphosphaeria	sp.	6000	Colony
7/24/2019	L2351049-6	JM2	Bacillariophyceae	Synedra	ulna	1000	Single Cell
7/24/2019	L2351049-6	JM2	Chlorophyceae	Tetrastrum	staurogeniaeforme	25000	Colony
7/24/2019	L2351049-6	JM2	Bacillariophyceae	Cocconeis	sp.	6000	Single Cell
7/24/2019	L2351049-6	JM2	Chlorophyceae	Crucigenia	sp.	2000	Colony
7/24/2019	L2351049-6	JM2	Dinophyceae	Gymnodinium	sp.	19000	Single Cell
7/24/2019	L2351049-6	JM2	Chlorophyceae	Schroederia	sp.	31000	Single Cell
7/24/2019	L2351049-6	JM2	Chlorophyceae	Monoraphidium	sp.	254000	Single Cell

Table C-5 Phytoplankton Taxonomy

DateSamp	LabNum	Source	Class	Genus	Species	CellperLitre	Unit
7/24/2019	L2351049-6	JM2	Chlorophyceae	Unidentified		161000	Colony
7/24/2019	L2351049-6	JM2	Chlorophyceae	Tetraedron	caudatum	12000	Single Cell
7/24/2019	L2351049-6	JM2	Chlorophyceae	Scenedesmus	acuminatus	12000	Colony
7/24/2019	L2351049-6	JM2	Chlorophyceae	Oocystis	sp.	130000	Colony
7/24/2019	L2351049-6	JM2	Euglenophyceae	Euglena	sp.	19000	Single Cell
7/24/2019	L2351049-6	JM2	Chlorophyceae	Pediastrum	Boryanum	3000	Colony
7/24/2019	L2351049-6	JM2	Chlorophyceae	Scenedesmus	quadricauda	180000	Colony
7/24/2019	L2351049-6	JM2	Bacillariophyceae	Navicula	sp.	12000	Single Cell
7/24/2019	L2351049-6	JM2	Chlorophyceae	Tetrastrum	sp.	19000	Colony
7/24/2019	L2351049-6	JM2	Chlorophyceae	Unidentified		792000	Single Cell
7/24/2019	L2351049-6	JM2	Chlorophyceae	Coelastrum	sp.	6000	Colony
7/24/2019	L2351049-6	JM2	Cryptophyceae	Cryptomonas	sp.	43000	Single Cell
7/24/2019	L2351049-6	JM2	Cyanophyceae	Anabaena	sp.	68000	Filament
7/24/2019	L2351049-6	JM2	Chlorophyceae	Elakatothrix	sp.	56000	Single Cell
7/24/2019	L2351049-6	JM2	Chlorophyceae	Pediastrum	duplex	4000	Colony
7/24/2019	L2351049-7	JM3	Chrysophyceae	small chrysophytes		31000	Single Cell
7/24/2019	L2351049-7	JM3	Dinophyceae	Gymnodinium	sp.	12000	Single Cell
7/24/2019	L2351049-7	JM3	Bacillariophyceae	Navicula	sp.	50000	Single Cell
7/24/2019	L2351049-7	JM3	Euglenophyceae	Euglena	sp.	68000	Single Cell
7/24/2019	L2351049-7	JM3	Chlorophyceae	Tetraedron	caudatum	6000	Single Cell
7/24/2019	L2351049-7	JM3	Bacillariophyceae	Caloneis	sp.	1000	Single Cell
7/24/2019	L2351049-7	JM3	Chlorophyceae	Tetrastrum	staurogeniaeforme	68000	Colony
7/24/2019	L2351049-7	JM3	Chlorophyceae	Tetraedron	minimum	6000	Single Cell
7/24/2019	L2351049-7	JM3	Bacillariophyceae	Nitzschia	sp.	105000	Single Cell
7/24/2019	L2351049-7	JM3	Cryptophyceae	Cryptomonas	sp.	118000	Single Cell
7/24/2019	L2351049-7	JM3	Chlorophyceae	Tetrastrum	sp.	31000	Colony
7/24/2019	L2351049-7	JM3	Cyanophyceae	Aphanocapsa	sp.	6000	Colony
7/24/2019	L2351049-7	JM3	Euglenophyceae	Trachelomonas	sp.	19000	Single Cell
7/24/2019	L2351049-7	JM3	Chlorophyceae	Scenedesmus	quadricauda	62000	Colony
7/24/2019	L2351049-7	JM3	Chlorophyceae	Crucigenia	sp.	2000	Colony
7/24/2019	L2351049-7	JM3	Chlorophyceae	Dictyosphaerium	sp.	6000	Colony
7/24/2019	L2351049-7	JM3	Chlorophyceae	Schroederia	sp.	6000	Single Cell
7/24/2019	L2351049-7	JM3	Chlorophyceae	Monoraphidium	sp.	155000	Single Cell
7/24/2019	L2351049-7	JM3	Chlorophyceae	Unidentified		143000	Colony

Table C-5 Phytoplankton Taxonomy

DateSamp	LabNum	Source	Class	Genus	Species	CellperLitre	Unit
7/24/2019	L2351049-7	JM3	Chlorophyceae	Oocystis	sp.	43000	Colony
7/24/2019	L2351049-7	JM3	Chlorophyceae	Elakatothrix	sp.	62000	Single Cell
7/24/2019	L2351049-7	JM3	Chlorophyceae	Pediastrum	Boryanum	4000	Colony
7/24/2019	L2351049-7	JM3	Chlorophyceae	Pediastrum	duplex	1000	Colony
7/24/2019	L2351049-7	JM3	Chlorophyceae	Actinastrum	sp.	6000	Colony
7/24/2019	L2351049-7	JM3	Chlorophyceae	Lagerheimia	sp.	31000	Colony
7/24/2019	L2351049-7	JM3	Chlorophyceae	Unidentified		495000	Single Cell
7/24/2019	L2351049-7	JM3	Bacillariophyceae	Gomphonema	sp.	6000	Single Cell
7/24/2019	L2351049-7	JM3	Chlorophyceae	Scenedesmus	spinosus	43000	Colony
7/24/2019	L2351049-7	JM3	Chlorophyceae	Treubaria	sp.	56000	Single Cell
7/24/2019	L2351049-7	JM3	Cyanophyceae	Merismopedia	sp.	645000	Single Cell
7/24/2019	L2351049-7	JM3	Bacillariophyceae	Aulacoseira	sp.	2178000	Filament
7/24/2019	L2351049-7	JM3	Bacillariophyceae	Amphora	sp.	19000	Single Cell
7/24/2019	L2351049-7	JM3	Cyanophyceae	Pseudanabaena	sp.	6000	Filament
7/24/2019	L2351049-7	JM3	Chlorophyceae	Scenedesmus	sp.	99000	Colony
7/24/2019	L2351049-7	JM3	Cyanophyceae	Geitlerinema	sp.	1000	Filament
7/24/2019	L2351049-7	JM3	Cryptophyceae	Unidentified		396000	Single Cell
7/24/2019	L2351049-7	JM3	Cyanophyceae	Phormidium	sp.	1000	Filament
7/24/2019	L2351049-8	JL3	Chlorophyceae	Schroederia	sp.	6000	Single Cell
7/24/2019	L2351049-8	JL3	Chlorophyceae	Tetraedron	caudatum	6000	Single Cell
7/24/2019	L2351049-8	JL3	Cryptophyceae	Unidentified		792000	Single Cell
7/24/2019	L2351049-8	JL3	Xanthophyceae	Ophiocytium	sp.	12000	Single Cell
7/24/2019	L2351049-8	JL3	Chlorophyceae	Treubaria	sp.	31000	Single Cell
7/24/2019	L2351049-8	JL3	Chlorophyceae	Tetrastrum	sp.	56000	Colony
7/24/2019	L2351049-8	JL3	Chlorophyceae	Elakatothrix	sp.	31000	Single Cell
7/24/2019	L2351049-8	JL3	Chlorophyceae	Unidentified		99000	Colony
7/24/2019	L2351049-8	JL3	Euglenophyceae	Strombomonas	sp.	31000	Single Cell
7/24/2019	L2351049-8	JL3	Chlorophyceae	Scenedesmus	spinosus	62000	Colony
7/24/2019	L2351049-8	JL3	Chlorophyceae	Unidentified		594000	Single Cell
7/24/2019	L2351049-8	JL3	Chlorophyceae	Tetrastrum	staurogeniaeforme	118000	Colony
7/24/2019	L2351049-8	JL3	Bacillariophyceae	Aulacoseira	sp.	1980000	Filament
7/24/2019	L2351049-8	JL3	Bacillariophyceae	Navicula	sp.	118000	Single Cell
7/24/2019	L2351049-8	JL3	Cyanophyceae	Pseudanabaena	sp.	19000	Filament
7/24/2019	L2351049-8	JL3	Chlorophyceae	Scenedesmus	sp.	124000	Colony

Table C-5 Phytoplankton Taxonomy

DateSamp	LabNum	Source	Class	Genus	Species	CellperLitre	Unit
7/24/2019	L2351049-8	JL3	Chlorophyceae	Scenedesmus	quadricauda	56000	Colony
7/24/2019	L2351049-8	JL3	Cyanophyceae	Phormidium	sp.	1000	Filament
7/24/2019	L2351049-8	JL3	Chlorophyceae	Lagerheimia	sp.	19000	Colony
7/24/2019	L2351049-8	JL3	Chlorophyceae	Pediastrum	duplex	2000	Colony
7/24/2019	L2351049-8	JL3	Bacillariophyceae	Amphora	sp.	12000	Single Cell
7/24/2019	L2351049-8	JL3	Chlorophyceae	Pediastrum	Boryanum	3000	Colony
7/24/2019	L2351049-8	JL3	Cyanophyceae	Merismopedia	sp.	248000	Single Cell
7/24/2019	L2351049-8	JL3	Bacillariophyceae	Cymatopleura	sp.	1000	Single Cell
7/24/2019	L2351049-8	JL3	Chlorophyceae	Scenedesmus	acuminatus	12000	Colony
7/24/2019	L2351049-8	JL3	Bacillariophyceae	Gomphonema	sp.	6000	Single Cell
7/24/2019	L2351049-8	JL3	Chlorophyceae	Tetraedron	sp.	6000	Single Cell
7/24/2019	L2351049-8	JL3	Chlorophyceae	Oocystis	sp.	25000	Colony
7/24/2019	L2351049-8	JL3	Euglenophyceae	Euglena	sp.	167000	Single Cell
7/24/2019	L2351049-8	JL3	Chlorophyceae	Crucigenia	sp.	50000	Colony
7/24/2019	L2351049-8	JL3	Dinophyceae	Gymnodinium	sp.	205000	Single Cell
7/24/2019	L2351049-8	JL3	Euglenophyceae	Phacus	sp.	12000	Single Cell
7/24/2019	L2351049-8	JL3	Chlorophyceae	Cosmarium	sp.	1000	Single Cell
7/24/2019	L2351049-8	JL3	Chlorophyceae	Monoraphidium	sp.	211000	Single Cell
7/24/2019	L2351049-8	JL3	Cyanophyceae	Aphanocapsa	sp.	6000	Colony
7/24/2019	L2351049-8	JL3	Chlorophyceae	Coelastrum	sp.	6000	Colony
7/24/2019	L2351049-8	JL3	Chrysophyceae	small chrysophytes		31000	Single Cell
7/24/2019	L2351049-8	JL3	Cryptophyceae	Cryptomonas	sp.	155000	Single Cell
7/24/2019	L2351049-8	JL3	Bacillariophyceae	Nitzschia	sp.	192000	Single Cell
7/24/2019	L2351049-9	JR3	Chlorophyceae	Pediastrum	duplex	3000	Colony
7/24/2019	L2351049-9	JR3	Xanthophyceae	Ophiocytium	sp.	6000	Single Cell
7/24/2019	L2351049-9	JR3	Chlorophyceae	Elakatothrix	sp.	74000	Single Cell
7/24/2019	L2351049-9	JR3	Chlorophyceae	Scenedesmus	quadricauda	87000	Colony
7/24/2019	L2351049-9	JR3	Chlorophyceae	Dictyosphaerium	sp.	12000	Colony
7/24/2019	L2351049-9	JR3	Chlorophyceae	Unidentified		792000	Single Cell
7/24/2019	L2351049-9	JR3	Cyanophyceae	Planktolyngbya	sp.	6000	Filament
7/24/2019	L2351049-9	JR3	Chlorophyceae	Oocystis	sp.	6000	Colony
7/24/2019	L2351049-9	JR3	Chlorophyceae	Unidentified		112000	Colony
7/24/2019	L2351049-9	JR3	Chlorophyceae	Pediastrum	Boryanum	3000	Colony
7/24/2019	L2351049-9	JR3	Chlorophyceae	Monoraphidium	sp.	304000	Single Cell

Table C-5 Phytoplankton Taxonomy

DateSamp	LabNum	Source	Class	Genus	Species	CellperLitre	Unit
7/24/2019	L2351049-9	JR3	Chlorophyceae	Coelastrum	sp.	1000	Colony
7/24/2019	L2351049-9	JR3	Euglenophyceae	Strombomonas	sp.	6000	Single Cell
7/24/2019	L2351049-9	JR3	Bacillariophyceae	Cymbella	sp.	1000	Single Cell
7/24/2019	L2351049-9	JR3	Chlorophyceae	Tetraedron	caudatum	12000	Single Cell
7/24/2019	L2351049-9	JR3	Euglenophyceae	Phacus	sp.	19000	Single Cell
7/24/2019	L2351049-9	JR3	Euglenophyceae	Euglena	sp.	50000	Single Cell
7/24/2019	L2351049-9	JR3	Cyanophyceae	Anabaena	sp.	6000	Filament
7/24/2019	L2351049-9	JR3	Cryptophyceae	Cryptomonas	sp.	143000	Single Cell
7/24/2019	L2351049-9	JR3	Chlorophyceae	Tetrastrum	staurogeniaeforme	25000	Colony
7/24/2019	L2351049-9	JR3	Chrysophyceae	small chrysophytes		25000	Single Cell
7/24/2019	L2351049-9	JR3	Cyanophyceae	Aphanocapsa	sp.	31000	Colony
7/24/2019	L2351049-9	JR3	Chlorophyceae	Scenedesmus	spinosus	43000	Colony
7/24/2019	L2351049-9	JR3	Bacillariophyceae	Navicula	sp.	62000	Single Cell
7/24/2019	L2351049-9	JR3	Cryptophyceae	Unidentified		495000	Single Cell
7/24/2019	L2351049-9	JR3	Bacillariophyceae	Aulacoseira	sp.	2079000	Filament
7/24/2019	L2351049-9	JR3	Bacillariophyceae	Amphora	sp.	6000	Single Cell
7/24/2019	L2351049-9	JR3	Chlorophyceae	Lagerheimia	sp.	12000	Colony
7/24/2019	L2351049-9	JR3	Chlorophyceae	Treubaria	sp.	25000	Single Cell
7/24/2019	L2351049-9	JR3	Dinophyceae	Gymnodinium	sp.	105000	Single Cell
7/24/2019	L2351049-9	JR3	Chlorophyceae	Tetraedron	sp.	12000	Single Cell
7/24/2019	L2351049-9	JR3	Bacillariophyceae	Nitzschia	sp.	143000	Single Cell
7/24/2019	L2351049-9	JR3	Chlorophyceae	Staurastrum	sp.	2000	Single Cell
7/24/2019	L2351049-9	JR3	Chlorophyceae	Scenedesmus	sp.	68000	Colony
7/24/2019	L2351049-9	JR3	Chlorophyceae	Tetrastrum	sp.	56000	Colony

Appendix D FLOW CALCULATIONS

FLOW CALCULATIONS

Channel flow was calculated using depth and flow measurements, taken at 1 m intervals across the channel width. Flow was calculated using the following formula:

$$Q = \sum_{i=1}^{n} v \times d$$

Where:

Q= volumetric flow rate at the channel cross section
n = number of 1 m intervals across the channel width
i = distance (in m) of each interval measurement
v = velocity measurement (m/s)
d =depth measurement (m)

Where the measured velocity indicated a negative value (backward turbulence), flow was assumed to be equal to 0 m/s.

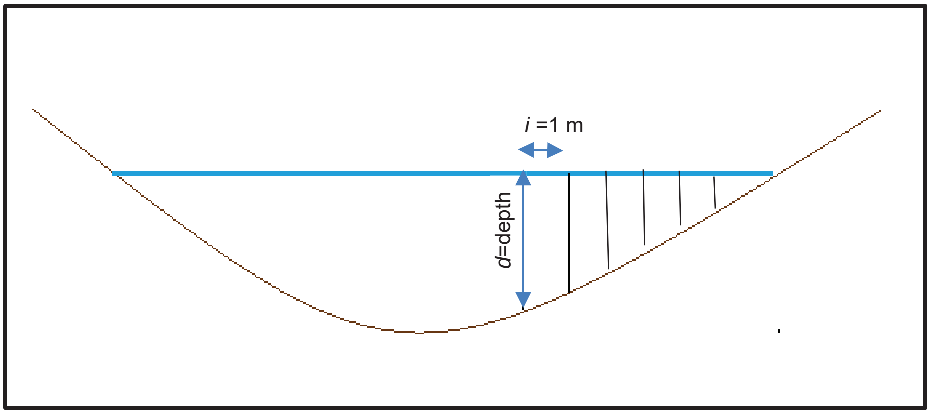


Figure D-1 Graphic Representation of Channel Flow Measurements

Culvert flow at the R3 Innovations discharge outlet and the culvert discharge at Sites 3 and 6 were calculated using depth, velocity, and culvert diameter measurements using https://goodcalculators.com/flow-rate-calculator/. The flow rate is calculated using the following formula:

$$Q = (r^2 \times \theta - \sin(\theta))/2) \times v$$

Where:

Q = volumetric flow rate at the culvert
v = velocity measurement (m/s)
D = diameter of culvert (m)
θ = 2 arccos ((r-h)/r)
where r = radius of the pipe (m)
and h= depth of water (m)

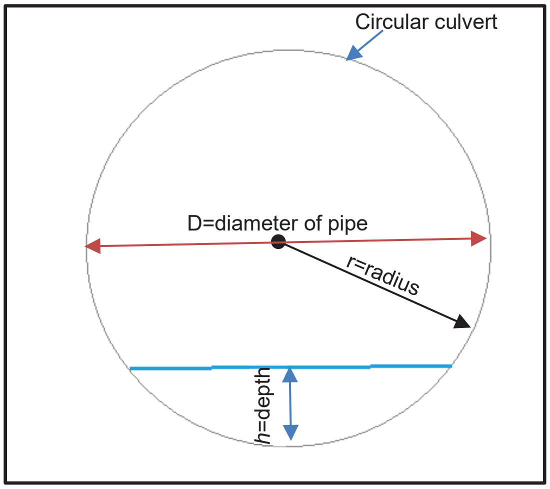


Figure D-2 Graphic Representation of Culvert Flow Measurements

Culvert flow at the Town of Neepawa wastewater effluent lagoon was calculated based on total volume of discharged cell 117,000 m^2, with operator information indicating that half the volume was discharged at full capacity over 19 days (from July 9-28, 2019).

Lagoon discharge was therefore estimated to be:

$$117{,}000\ m^3 \times\ 0.5\ \div 19\ days = 3078\frac{m^3}{day} = 0.0356\ m/s$$