Appendix G5

2017 Habitat Compensation Monitoring Report

MEADOWBANK GOLD MINE

2017 HABITAT COMPENSATION MONITORING REPORT

In Accordance with

DFO Fisheries Authorizations NU-03-0191.2, NU-03-0191.3, NU-03-0191.4 and 14-HCAA-01046

Prepared by:
Agnico Eagle Mines Limited – Meadowbank Division

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EXECUTIVE SUMMARY

According to Fisheries and Oceans Canada (DFO) Authorizations NU-03-0191.2, NU-03-0191.3, NU-03-0191.4 and 14-HCAA-01046, Agnico Eagle maintains a Habitat Compensation Monitoring Plan (HCMP; February, 2017) to ensure that fish habitat compensation features at the Meadowbank site are constructed and functioning as intended. Based on the schedule described in the HCMP, monitoring of compensation features generally occurs every 2 years.

In 2017, monitoring was conducted for the constructed spawning pad, located at stream crossing R02 along the all-weather access road (AWAR) to Baker Lake, as well as for several onsite habitat compensation features (East Dike, Bay-Goose Dike, Dogleg Ponds). As described in the HCMP, the AWAR study included a visual assessment of stability, as well biological monitoring to confirm use by Arctic grayling. The onsite monitoring included an assessment of interstitial water quality, periphyton growth, and fish use.

The constructed spawning pads at stream crossing R02 along the AWAR were visually confirmed to be stable as designed. Generally, condition factors of adult fish, population size distributions and timing of migration were within the range of values seen in previous years, confirming continued use of this area by Arctic grayling. Larval drift rates of collection continue to exceed those observed prior to construction of the spawning pad, but were lower than recent years, likely due to significantly lower water levels and warmer water temperatures.

Onsite, interstitial water quality within the dike faces met CCME guidelines for aquatic life with the exception of TSS in one sample, and healthy periphyton community growth with increasing biomass was observed. Angling and underwater motion camera monitoring demonstrated continued fish use of the dikes as habitat. A total of 120 fish were caught through angling and there were no mortalities. A total of 36 fish sightings were captured on camera during the underwater motion camera program. Fish use of NP-1 was confirmed through underwater motion camera surveys (though only 1 fish was observed). Angling also indicated presence of Arctic char in Dogleg Pond, suggesting this system may now be accessible from Second Portage Lake. Bathymetric surveys were completed for two of the three Dogleg ponds, but a further analysis of results is required to understand reductions in pond areas compared to baseline surveys, as many factors suggest this is an artifact of different mapping methods.

Overall, the constructed spawning pads at R02 have increased the quantity of high-value habitat, and larval drift data continues to provide evidence of Arctic grayling spawning in this reach since construction occurred. Angling and underwater camera methods demonstrated that fish appear to be using habitat created by dikes and diversion channels around the mine site. Once the minimum monitoring period as described in the HCMP (2017) is reached for each compensation features, a weight-of-evidence approach incorporating all data

collected to date will be used to determine whether specific criteria for success have been met. This will occur first for the East and Bay-Goose Dike in 2021.

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SECTION 1 • INTRODUCTION

1.1 BACKGROUND

In accordance with Fisheries and Oceans Canada (DFO) Authorizations NU-03-0191.2, NU-03-0191.3, NU-03-0191.4, and 14-HCAA-01046, Agnico Eagle maintains a Habitat Compensation Monitoring Plan (HCMP; February, 2017) to ensure that fish habitat compensation described in Meadowbank's No Net Loss Plans (Cumberland, 2008; AEM, 2012) is constructed and functioning as intended. This program is carried out as a targeted monitoring plan under the Meadowbank Aquatic Effects Monitoring Program (AEMP).

1.2 SUMMARY OF COMPENSATION FEATURES

Habitat compensation features have been implemented or are planned to be constructed in three general areas: along the All Weather Access Road to Baker Lake (NU-0191.2), in the Portage (main minesite) area (NU-03-0191.3), and in the Vault area (NU-03-0191.4, 14-HCAA-01046). A brief description of habitat compensation features in each area is provided below. Further details are available in the most recent Habitat Compensation Monitoring Plan (Version 4, February, 2017).

1.2.1 AWAR Compensation

Construction of the 110 km All Weather Access Road (AWAR) between the Hamlet of Baker Lake and the Meadowbank Mine was completed in the spring of 2008, under DFO Authorization NU-03-0190.2. Four AWAR crossings were found to impact fish-bearing streams, so habitat compensation was required by DFO to account for any potential reductions in productivity.

In 2009, a habitat compensation project consisting of four gravel spawning pads was constructed at crossing R02 according to design specifications that met biological criteria aimed at enhancing Arctic grayling productivity. The construction focused on creating high value spawning and nursery habitat to compensate for the loss of the low and medium value habitat affected by bridge abutment construction at the four crossings.

Per Condition 5 of Fisheries Act Authorization NU-03-0190.2, monitoring studies have been conducted to evaluate fish migrations at the four AWAR crossings where "harmful alteration, disruption or destruction" (HADD) of fish habitat occurred (R02, R06, R09, and R15), and where compensation was implemented (R02). The details of this program are described in the original HCMP (Azimuth, 2007). In 2013, Agnico Eagle and DFO reviewed the information collected to date, and determined that conditions of the Authorization pertaining to monitoring of HADD sites were fulfilled, and that further monitoring would focus on the habitat compensation features. Updates to the scheduled monitoring activities at R02 were made in 2013 (AEM, 2014a).

1.2.2 Portage Area Compensation

Fish habitat losses in the Portage area are largely due to the dewatering of the northwest arm of Second Portage Lake for the mine's tailings storage facility (TSF), and the Bay-Goose Basin of Third Portage Lake for construction of the Portage and Goose Island pits. These areas were impounded from the rest of their lakes using dewatering dikes constructed from material quarried onsite. Compensation consists largely of re-flooding the de-watered basins, and gains from land-to-lake conversion. Minor gains are achieved through surface water diversion channels which increase the flooded area of the nearby Dogleg Ponds.

1.2.2.1 Bay-Goose Basin Re-Flooding

While the TSF area will be a permanent loss of fish habitat, the Bay-Goose dike will be breached post-closure and the impounded pit areas will be gradually re-flooded to re-gain the temporarily lost habitat.

Prior to re-flooding, a number of habitat improvement measures will be implemented to increase the productive capacity of this area. Construction of a boulder garden feature along the west side of the soft-sediment Bay-Goose Basin will increase habitat suitability in this area. This feature will consist of at least 2.97 ha of heterogeneous, coarse substrate habitat in the <4 m depth zone, just west of the Goose Pit. Construction of mine-related features (pit caps, roads and dikes) from coarse rock material throughout the basin will create shoals and reefs after re-flooding. In addition, approximately 30% of the area of Portage Pit will be partially backfilled reducing the amount of ultra-deep water areas, and increasing habitat suitability in this area.

1.2.2.2 Dogleg Pond Enhancements

Dogleg Pond and the "North Portage" ponds, Dogleg North Pond (also called NP-1) and NP-2, were isolated ponds located near the waste rock area, just north of Second Portage Lake. Since drainage of NP-2 into Second Portage Lake became blocked by the waste rock pile on the northern edge of the TSF, a connecting channel was excavated to direct flow from NP-2 to Dogleg North Pond, effectively increasing the drainage area of Dogleg and Dogleg North Pond. The accompanying increase in wetted area was estimated at 5% for Dogleg Pond, 15% for Dogleg North Pond (NP-1), and 5% for NP-2. Through construction of a diversion channel, connectivity between the ponds has been improved, and previously inaccessible habitat in Dogleg North Pond has become available for use by lake trout, Arctic char and round whitefish currently inhabiting Dogleg Pond.

1.2.2.3 Finger Dikes

In keeping with the original NNLP, finger dikes will also be constructed on the Bay-Goose Dike extending into Third Portage Lake. These features will provide additional "shoreline" habitat that is used by most species for spawning, and will have a total area of 1 ha at their base.

1.2.3 Vault Area Compensation

Vault Lake and Phaser Lake, located north of the Portage area, drain into the adjacent Wally Lake, but the connection is not passable to fish. To allow construction of the Vault and Phaser pits, Vault Lake has been separated from Wally Lake with a dike and both lakes have been dewatered.

1.2.3.1 Vault and Phaser Lake Re-Flooding

Post-closure, Vault Lake will connect to Phaser Lake through the Phaser Pit. Both areas will be re-flooded and the connection to Wally Lake re-established with a deeper channel to permit better fish passage. These lakes will be expanded by construction of the Vault and Phaser pits, a portion of which is in a terrestrial zone. Alterations of the basin area outside the pit will improve habitat through the development of shoals and mixed substrate areas.

1.3 OBJECTIVES

The following sections describe the monitoring objectives for compensation features by location. These objectives are fulfilled according to the methods and schedule described in detail in Section 2, below, and in the HCMP.

1.3.1 AWAR Monitoring Objectives

Based on Condition 5.2 of DFO Authorization NU-03-0190.2, the objectives of the AWAR monitoring program are as follows:

- Assess the stability and successful utilization of all compensation features during the spawning and nursery period for Arctic grayling (Condition 5.2.1)

Additional Conditions pertaining to monitoring of HADD sites were no longer required as per the HCMP (that was designed in consultation with DFO) and as part of the DFO authorization amendment process.

1.3.2 Portage and Vault Area Monitoring Objectives

Based on Condition 6 of DFO Authorizations NU-03-0190.3, NU-03-0191.4, and 14-HCAA-01046, the objectives of the Portage area monitoring program are as follows:

- Assess the stability and successful utilization of all fish habitat compensation features according to the methodology and schedule detailed in the Habitat Compensation Monitoring Plan

- Provide a photographic record before, during and after construction, during decommissioning and post-restoration to indicate that all works and undertakings have been completed according to the conditions of the Authorization and the NNLP

1.4 SCHEDULE OF MONITORING

Please refer to the schedule of monitoring events from the HCMP (February, 2017). Monitoring activities conducted in 2017 followed the schedule therein.

SECTION 2 • CURRENT-YEAR MONITORING METHODOLOGY

As per the schedule of monitoring events, monitoring was conducted in 2017 for the AWAR compensation feature (Fisheries Act Authorization NU-0191.2; Condition 5.2.1) and for the Portage area compensation features (Fisheries Act Authorizations NU-0191.3 and NU-0191.4; Condition 6).

A description of the methods used to monitor each habitat compensation feature according to the objectives of DFO Fisheries Act Authorizations is provided in the HCMP. Specific details (e.g. dates, locations) and any adjustments to standard methods in the reporting year's monitoring events are described below.

2.1 AWAR MONITORING

2.1.1 Stability

The compensation features were visually assessed to determine general stability in comparison to previous years. In particular, signs of any significant movement of the coarse substrate material used to construct the berms were noted. Significant movement would be identified as any changes prohibiting the berms from functioning as intended to reduce water flow rates and improve spawning habitat in this area.

2.1.2 Larval Drift Traps

In total, 11 larval drift traps (DT) were set at R02 from June 10 through July 2, 2017 (UTM coordinates provided in Table 1; locations shown in Figure 1). Four traps (DT A1 to A4) were upstream of the R02 habitat compensation area. Four traps (DT B1 – B4) were immediately downstream of the R02 habitat compensation, and four traps (DT C1 – C3) were set slightly upstream of the bridge in locations identical to previous monitoring events. Six of the larval drift traps consisted of a square sided cone with a ridged frame that funnelled into a 0.5 mm nitex mesh bag. Attached at the back of the nitex bag was a Nalgene®-type container where the drift was collected. Four traps consisted of a ~60cm x 30cm square frame which has a 0.5 mm nitex mesh bag, attached to a hard plastic container where the drift was collected. One was similarly constructed, with a size of 47 x 30 cm. The frame was submerged at least halfway under water and secured by poles on each side. Drift traps were checked at least every three days, but most commonly every day. Larval drift was identified in the field and preserved in vials of diluted formalin.

Table 1. UTM coordinates for drift traps at R02, 2017. All traps were set from June 10 – July 2, 2017.

Drift Trap ID	GPS Coordinates
A1	14W 0643438
	UTM 7143416
A2	14W 0643452
	UTM 7143426
A3	14W 0643444
	UTM 7143432
A4	14W 0643449
	UTM 7143430
B1	14W 0643682
	UTM 7143529
B2	14W 0643699
	UTM 7143520
B3	14W 0643716
	UTM 7143574
B4	14W 0643728
	UTM 7143540
C1	14W 0643762
	UTM 7143400
C2	14W 0643770
	UTM 7143406
C3	14W 0643778
	UTM 7143412

2.1.3 Hoopnets

Hoopnets were set upstream of HADD crossing R02 to monitor the passage of fish and evaluate population structure. Nets consisted of either a 4 ft (1.22 m) or 3 ft (0.9 m) diameter front hoop, with interior hoops and traps that prevent fish from escaping but provide enough space for fish to survive. Wings were attached to the front hoop to direct fish into the net. The captured fish were gently removed by field technicians, placed in large tubs filled on location with stream water for biological processing and then placed in a recovery tub. The fish were released up or downstream of the hoopnets, depending on the fish's migration direction. The Animal Use Protocol Report for this work is provided in Appendix A.

Biological processing included:

- measurement of fork length

- measurement of weight using a Pesola field scale (+/-2 to 5 g)
- classification of maturity by gently palpitating the abdomen and visually identifying distinguishable male or female features

Hoopnets were first deployed on June 10, 2017 and were removed on July 7, 2017. Without jeopardizing the safety of the field personnel, the nets were placed in the thalweg of the streams depending on ice-flow conditions and stream velocities, to ensure the maximum effort to capture migrating fish.

Hoopnet locations (Table 2) were selected upstream (R02A) and downstream (R02B) of the constructed spawning pads as in previous years to provide evidence of use of this compensation feature.

Table 2. Approximate hoopnet locations, net orientation (upstream-moving fish, US; downstream-moving fish, DS), dates of deployment and approximate stream coverage at crossings R02 in 2017.

Location	GPS Coordinates	Dates	# Nets		% Coverage
			US	DS	
R02A	14W 0643511	June 10 - 11	1	0	20
	UTM 7143458	June 12 - 27	2	0	20
		June 27 - July 10	2	2	80
R02B	14W 0643745	June 10 - 11	2	1	20
	UTM 7143596	June 12 - July 10	2	2	25

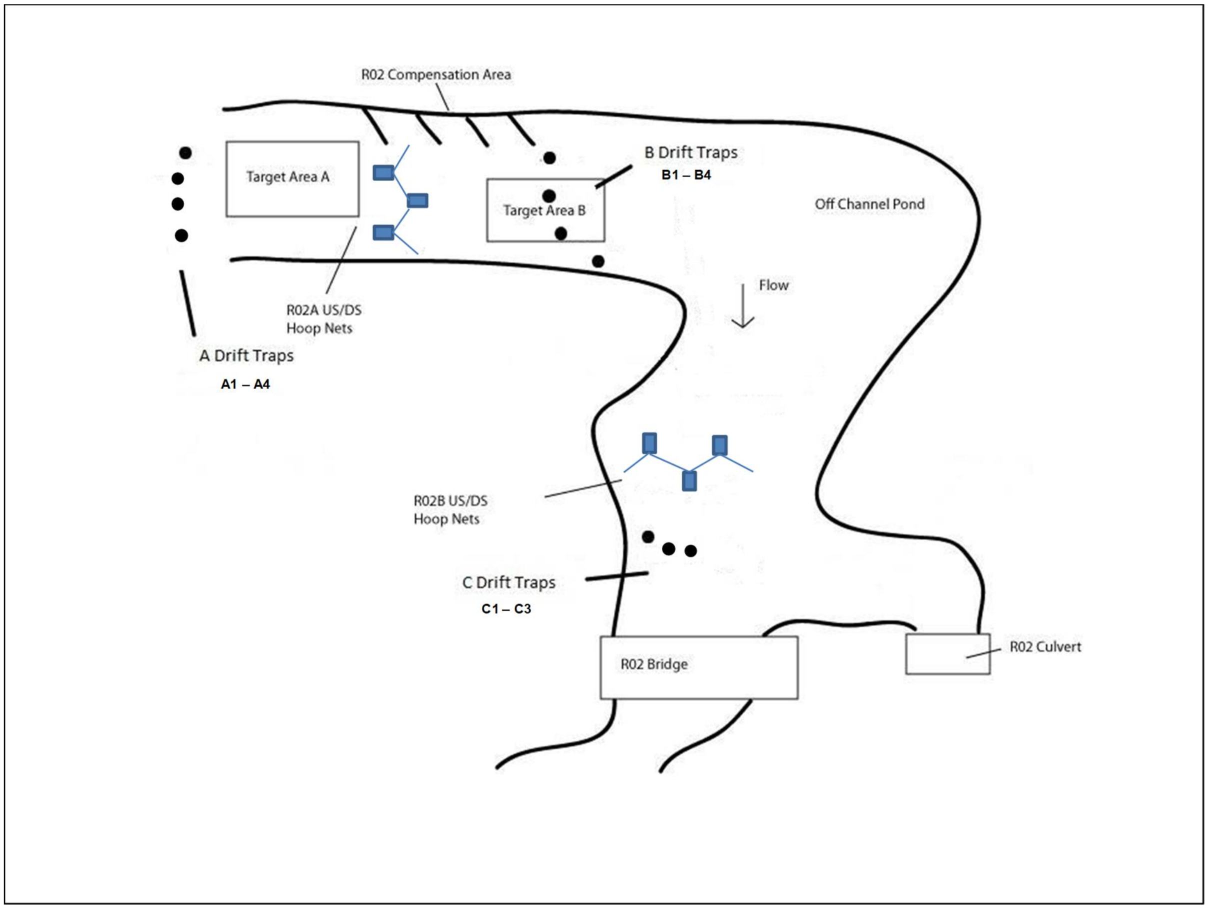


Figure 1. Locations of hoopnets and larval drift traps in 2017 with respect to the R02 habitat compensation feature.

2.1.4 Angling

No angling was conducted in 2017 since this monitoring tool has been minimally effective in past years.

2.1.5 Underwater Video

In addition to the use of hoopnets and angling, underwater camera video was taken in attempts to directly identify use of the berms by spawning Arctic grayling. The focus areas for the underwater video cameras were the R02 compensation berms, Target Area A, and Target Area B. Cameras were set between June 16 – June 28, and 10 hours of footage were recorded.

The cameras were deployed in the deeper slow moving water (>2 ft deep) within the spawning berms. The cameras were mounted on a ½” x 12” L shaped piece of rebar which was welded to a 4” x 12” steel “C” beam. The “C” beam acted as a base for the camera mount. A rope with a buoy at one end was attached to the rebar and lowered into the water. The buoy was used a locater once the camera was deployed under water.

2.1.6 Water Temperature

Water temperature measurements were recorded using a standard mercury thermometer. Although these are not a component of compensation monitoring, they help to provide a record of the environmental setting under which migrations are occurring.

2.2 PORTAGE AREA MONITORING

2.2.1 Interstitial Water Quality

Modeling during the EIA process indicated that metals leaching from quarried rock used in dike construction would not significantly impact the aquatic environment. Nevertheless, interstitial water quality of constructed habitat compensation features is assessed through the HCMP to verify predictions.

In order to collect a representative sample from the bioactive zone between the rocks, an electric diaphragm pump with food-grade silicon tubing was used. Samples were taken at depths between 1 and 2 m at previously established locations (Table 3), and analyzed at ALS laboratory for total suspended solids, phosphate, hardness, and total and dissolved metals. Results are compared to background (reference station) concentrations and CCME guidelines where available.

Samples were collected in two locations along the East Dike exterior, and three locations along the Bay-Goose Dike exterior. Sampling locations are shown in Figure 2 and GPS coordinates are provided in Table 3.

Table 3. UTM coordinates for interstitial water sampling locations (approximate locations of underwater video monitoring and angling).

Location	Station ID	UTM Coordinates	Depth
East Dike	ED-PW-2*	14W 0639382 7214257	1.8 m
	ED-PW-4	14W 0639381 7213846	1.5 m
Bay Goose Dike	BG-PW-2	14W 0638993 7212783	1.9 m
	BG-PW-4	14W 0639001 7212509	1.6 m
	BG-PW-6	14W 0638592 7211820	1.7 m
Third Portage Lake Reference Station	TPL-REF	14W 0639289 7210860	1.9 m
Second Portage Lake Reference Station	SP-REF	14W 0640510 7213187	1.7 m

**Note that in the 2015 report, this location was misidentified as PW-1, but coordinates are the same.*

QA/QC procedures were followed to ensure that the data collected are representative of the material sampled. Data quality is assured throughout the collection and analysis of samples using standard procedures, certified laboratories and by staffing of trained technicians. A target of 10% field duplicates or at least one sample per event are to be submitted for QA/QC analysis to assess the variability and sample homogeneity for this monitoring program (one duplicate sample was therefore collected for water quality in 2017). Field QA/QC duplicate results were assessed using the relative percent difference (RPD) between measurements: The equation used to calculate a RPD is:

$$RPD= [(A-B)/((A+B)/2)] \times 100$$

As outlined in AEM (2014a) RPDs were considered unacceptable when the RPD value of 50% for concentrations that were greater than 10x the Method Detection Limits (MDL) were exceeded.

2.2.2 Periphyton Growth

Periphyton monitoring was conducted by Agnico Eagle technicians with the assistance of Azimuth Consulting Group. Methods and detailed results for this component are provided in Appendix B.

2.2.3 Fish Use

Angling and underwater motion camera monitoring was performed by Agnico Eagle technicians between August 5 and September 27, 2017. Ice fishing was performed between November 24 and December 31, 2017 for the Dogleg and Second Portage Lake locations. Both the angling and underwater motion camera monitoring took place in and around the interstitial water sampling locations, as shown on Figure 1. The Animal Use Protocol Report for this work is provided in Appendix A.

A total angling effort of 53.5 h was completed. This included 17 h at locations along the East Dike and the Second Portage Lake reference station, 20.75 h at locations along the Bay-Goose Dike and the Third Portage Lake reference station, 13.75 h in Dogleg Pond, and 2 h in Dogleg North Pond (NP-1). All fish were caught using a jigging method with a small jigging spoon with barbless hooks. All fish caught by angling were recorded, and the majority were weighed, measured, tagged, and released. A total of 12 fish were not tagged due to a mechanical issue with the tagging gun. To minimize stress, each fish was processed quickly and then released, by holding underwater until it was able to swim away on its own.

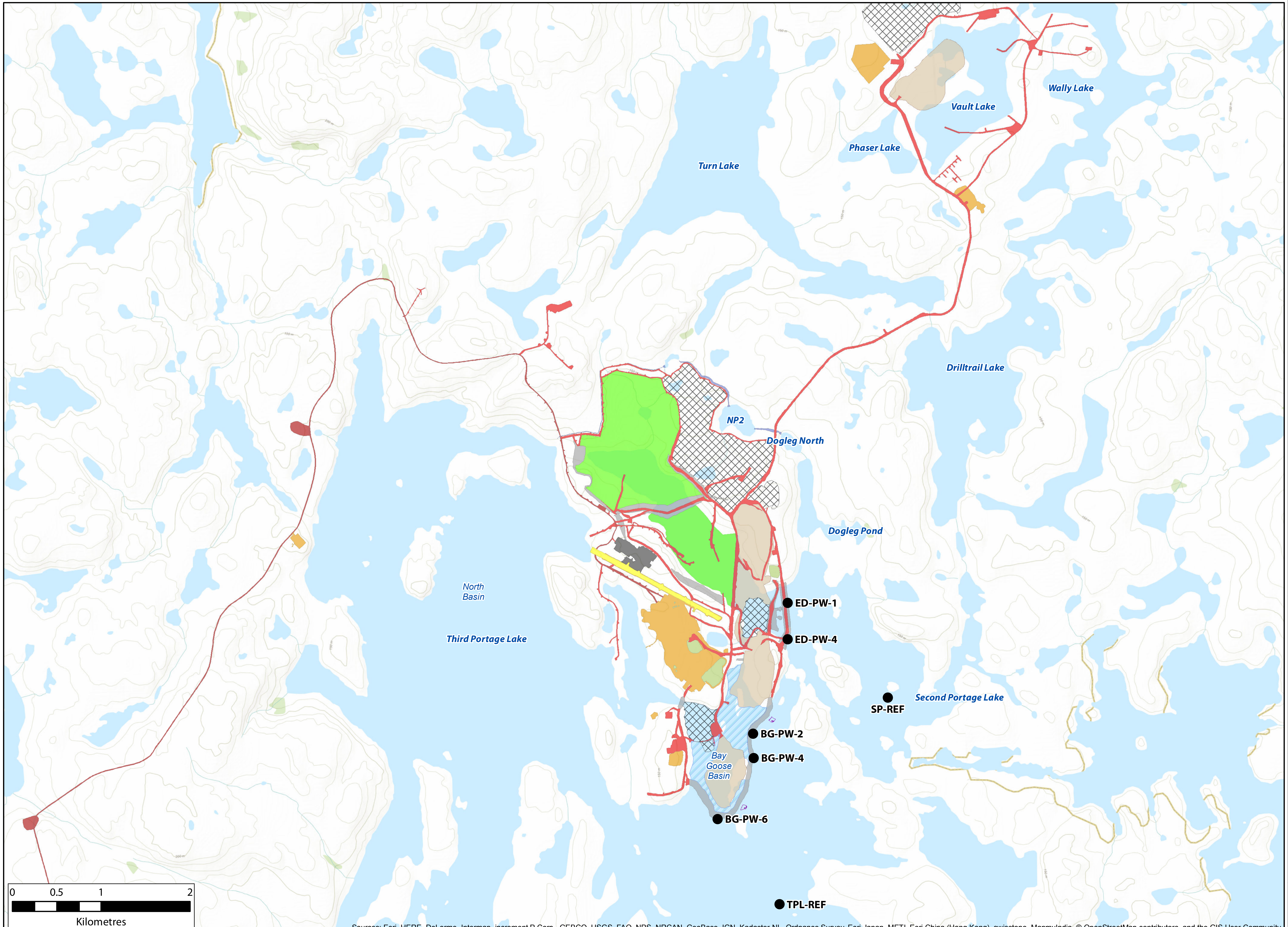
This was the second year of underwater motion camera monitoring, and a total effort of 34.6 h of video footage was collected. This included 11.2 h in Second Portage Lake (including East Dike stations and reference), 9.4 h in Third Portage Lake (including the Bay-Goose Dike stations and reference), 9.5 h in Dogleg Pond and 4.5 h in NP-1. Cameras were attached to custom-made heavy metal stands and lowered by rope along the face of the dikes and reference areas. Cameras were collected approximately 2 – 4 h later. Due to the cold water temperatures, the battery life on the underwater motion cameras was restricted to 2 h.

2.2.4 Structure

Design intent of the East and Bay-Goose Dikes was incorporated into the 2012 NNLP and no additional monitoring is planned in the HCMP.

Design intent of the access improvements for the Dogleg system were planned to be monitored beginning in 2015 to confirm whether construction of the diversion channel from NP-2 to Dogleg North Pond (NP-1) is increasing the wetted area of these ponds as assumed, and to confirm the potential for fish movement, especially between Dogleg Pond and Dogleg North Pond (NP-1).

Planned monitoring included bathymetric surveys to determine the water depth or area of each pond, and an assessment of water depth in connecting channels. These surveys could not be completed in 2015 and were conducted in 2017.



Legend

- Habitat Monitoring Location

Mine Plan (2015)

- Quarry
- AWPAR Quarry
- Dewatered Lake
- Tailings Storage Facility
- Roads
- AWPAR
- Dikes
- Diversion Ditch
- Stockpiles
- Pits
- Facility
- Airstrip
- Waste Dump
- Potential Finger Dike

Habitat Compensation Monitoring Locations

DOUGAN & ASSOCIATES
ECOLOGICAL CONSULTING & DESIGN
77 Wyndham Street South • Guelph ON N1E 5R3
T 519.822.1609 • F 519.822.5389 • www.dougan.ca

PROJECT: DA11-062-06

CLIENT: Agnico-Eagle Mines Ltd., Meadowbank Div.

N / W / E / S
UTM Zone 14 NAD83

DATE: MARCH 2016

SCALE: 1:40,000

DRAWN BY: LC

CHECKED BY:

FIGURE:

2

The information displayed on this map has been compiled from various sources. While every effort has been made to accurately depict the information, this map should not be relied on as being a precise indicator of locations, features, or roads, nor as a guide to navigation. MNR data provided by Queen's Printer of Ontario. Use of the data in any derivative product does not constitute an endorsement by the MNR or the Ontario Government of such products.

SECTION 3 • RESULTS

3.1 AWAR MONITORING

3.1.1 Stability

Visual observations indicated little to no movement of the spawning berm material. The berms appear to be functioning as intended to reduce water flow rates and depths. Gravel substrate on the downstream side of each berm is intact.

3.1.2 Larval Drift Traps

In 2017, 636 Arctic grayling larvae (young of the year) were collected in the R02 reach studied. Of these, 152 larvae were collected in traps A1 – A4, which were placed upstream of the compensation area and downstream of natural spawning habitat (Table 4). In total, 224 Arctic grayling larvae were collected in traps B1 – B4, which were located just downstream of the habitat compensation area. Drift traps C1 – C3 were placed further downstream, and collected a total of 260 larvae. Maximum collection in one day occurred at drift trap C2 (146 larvae).

Table 4. Total, daily average and daily maximum catch of Arctic grayling larvae at R02 in 2017.

Drift Trap ID	Total	Average	Max
A1	33	3.3	12
A2	25	2.5	8
A3	35	3.5	14
A4	59	5.9	34
Total	152	3.8	34
B1	63	6.3	22
B2	38	3.8	17
B3	108	10.8	38
B4	15	7.5	15
Total	224	7.1	38
C1	10	1	3
C2	230	23	146
C3	20	2	10
Total	260	8.7	146

Arctic grayling are spring spawners that migrate from lakes and large rivers to smaller streams to spawn over gravel or rocky bottoms (Evans et al. 2002). The literature suggests that spawning occurs between 7 and 10°C (Evans et al. 2002, McPhail and Lindsey, 1970, &

Scott and Crossman, 1973). Young are thought to hatch within 16-18 days at water temperatures of 9°C or within 8 to 32 days of water temperature of 15.5°C (McPhail and Lindsey, 1970 and Krueger, 1981). At R02, the peak larval drift catch occurred around June 13 in 2017, when the water temperature was approximately 4.5°C (Figure 3). This is earlier than 2015 and 2013, when peak catch occurred on June 24 and 22, respectively, with water temperatures around 4-6°C. As was found in previous studies at R02, and contrary to the cited literature, the primary Arctic grayling spawning run may be occurring at temperatures less than 5°C, below the ice or immediately at ice off since larvae are always caught immediately upon study initiation.

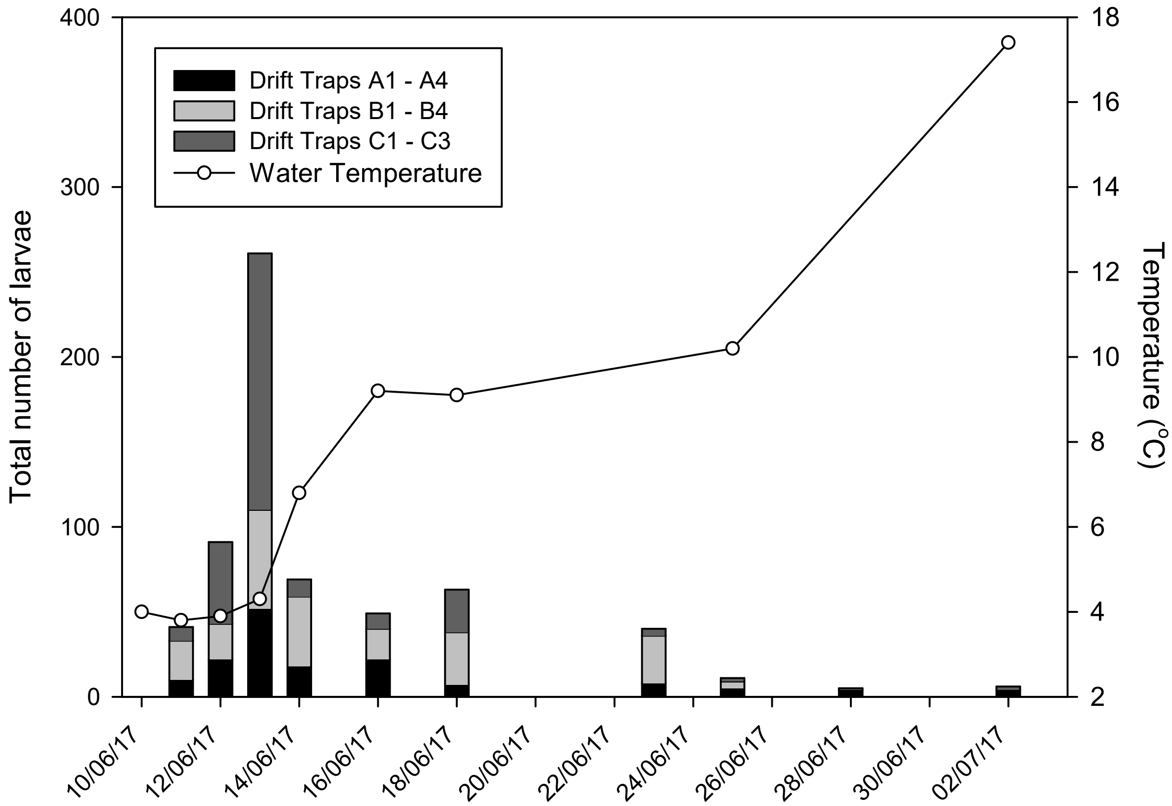


Figure 3. Water temperature and total number of Arctic grayling larvae collected at drift trap areas A, B and C from June 10 – July 2, 2017.

Since 2005, the number of drift traps and dates of monitoring have varied at R02 (Table 5). Therefore, the larval drift observed in annual monitoring programs is best compared if values are standardized to the number of traps and number of days monitored. The trapping period in 2017 was average, with traps set for approximately 23 days from mid-June to early

July. This is similar to 2006, 2008, 2011, and 2015 when the monitoring period was about 24 days, although traps were set at least 4 days earlier in 2017 than any other year. In 2007, 2009 and 2010, the trapping period was extended to late July or early August, and was 37 – 45 days long. In late July of each year, larval drift was essentially reduced to nil, and including these days in the total relative count distorts values in 2007, 2009 and 2010 compared to other years. In order to make a more appropriate comparison, the first 24 days of each monitoring period are examined (for 2017, only 23 days are available). In 2005, no Arctic grayling larvae were collected at R02, likely because only one drift trap was set and trapping began at least 5 days later than other years. This is not considered to be a representative sample, so is excluded from the comparison.

Table 5. Summary of larval drift trap sets at R02 from 2005 to 2017.

Drift Traps	2005	2006	2007	2008	2009	2010	2011	2013	2015	2017
Date in	Jun 29	Jun 24	Jun 23	Jun 21	Jun 24	Jun 24	Jun 22	Jun 14	Jun 18	Jun 10
Date out	Jul 17	Jul 19	Jul 29	Jul 16	Aug 07	Aug 01	Jul 17	Jun 29	Jul 17	Jul 2
Max # traps	1	2	7	8	9	12	12	9	12	11
# trap days	19	46	259	160	405	468	288	117	348	253

Total catch per trap day was relatively low in 2017 compared to previous post-construction years, but was similar to values observed in 2009 (Figure 4). This was likely due to low water levels overall, and warmer water temperatures occurring earlier in the season than recent years. For example, in 2015, temperatures of 8-10°C (when larval drift typically tails off) were not reached until July 1+, whereas temperatures in that range occurred as early as June 15 in 2017 (Figure 3). Larval catch per trap day was similar between stations A, B and C.

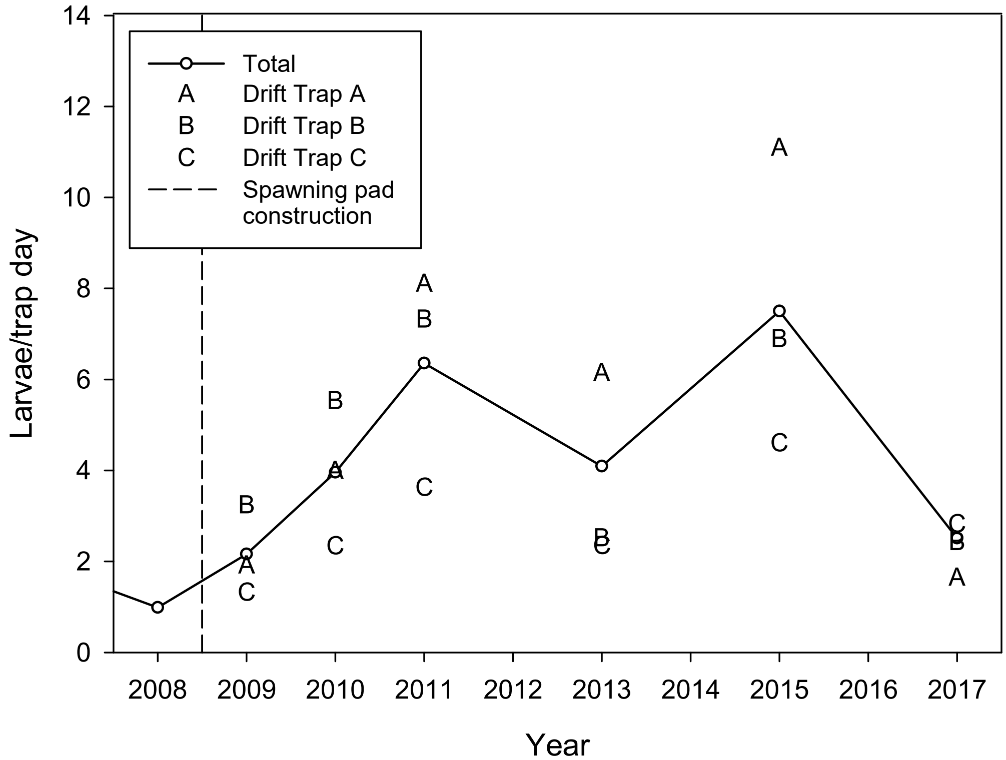


Figure 4. Total relative larval drift count (# larvae/trap day for the first 24 study days), and relative larval drift count upstream and downstream of the constructed spawning pad area at R02 from 2006 to 2017.

3.1.3 Hoopnets and Angling

3.1.3.1 Total Catch

All records of hoopnet and angling catch are provided in Appendix C. As in the past, the predominant species of adult fish collected in 2017 along the AWAR were Arctic grayling (*Thymallus arcticus*) (147 fish). Six round whitefish (*Prosopium cylindraceum)* and one lake trout (*Salvelinus namaycush)* were also caught. A summary of the total number of adult fish collected is provided in Table 5. Since Arctic grayling are the primary species of concern in this study, the majority of the data analysis includes only individuals of that species (as indicated).

Table 6. Total number of fish collected by species.

Species	Total Catch
Arctic Grayling	147
Lake Trout	1
Round Whitefish	6
Burbot	0
Total	154

By standardizing the catch to the number of nets or % stream coverage and number of days fished, a cursory comparison of inter-annual trends can be performed. It should be noted, however, that longer study periods involve a greater proportion of days on which fewer fish are migrating. If the study continues beyond the actual migration period, the total number of fish per unit effort is reduced when compared with shorter studies conducted only while migration is occurring. This potentially confounding factor is not taken into account here.

Study effort in 2017 was similar to 2009, 2010, 2011, and 2015 with up to 8 nets deployed over the near one-month study period resulting in 212 net-days (Table 7). Catch per unit effort based on % stream coverage in 2017 was slightly lower than 2015 (Figure 5). As indicated above, this metric describes the overall catch per unit effort, or the catch efficiency, and is not necessarily an accurate description of the total migrating population. Since Arctic grayling migrate during a certain time frame, it is expected that fish caught per unit of stream coverage will decrease if timing of maximum effort does not coincide with peak migration. In 2015 and 2017, maximum effort (up to 10 nets and 90% stream coverage) occurred towards early to mid-July, which is considered to be the tail of the migration, whereas in previous years, coverage was substantially higher earlier in the study period (e.g. up to 75% in June 2011 and 2013, compared to 20-60% in 2015 at R02A) when fish are generally considered most active due to lower water temperatures. The peak efficiency observed in 2013 was likely a result of a high proportion of coverage and a short study timeline.

Another factor affecting total catch and catch per unit effort in 2017 was significantly warmer water temperatures and lower water levels than observed previously, as discussed in Section 3.1.2. By the end of the study period, hoopnets were not able to be submerged to their full width, reducing catch efficiency.

Although studies are always initiated immediately once ice conditions are safe for work, these trends will continue to be monitored in subsequent years in order to assist in timing the study to maximize efficiency.

Table 7. Summary of dates and number of nets (upstream and downstream) used at R02 from 2005 to 2017.

Hoop Nets	2005	2006	2007	2008	2009	2010	2011	2013	2015	2017
Date in	Jun 29	Jun 24	Jun 24	Jun 17	Jun 26	Jun 25	Jun 24	Jun 14	Jun 17	Jun 10
Date out	Jul 18	Jul 19	Jul 20	Jul 16	Aug 02	Aug 01	Jul 19	Jun 29	Jul 17	Jul 7
Max # nets	2	2	5	4	9	7	9	10	10	8
# net days	42	50	132	124	234	227	219	122	237	212

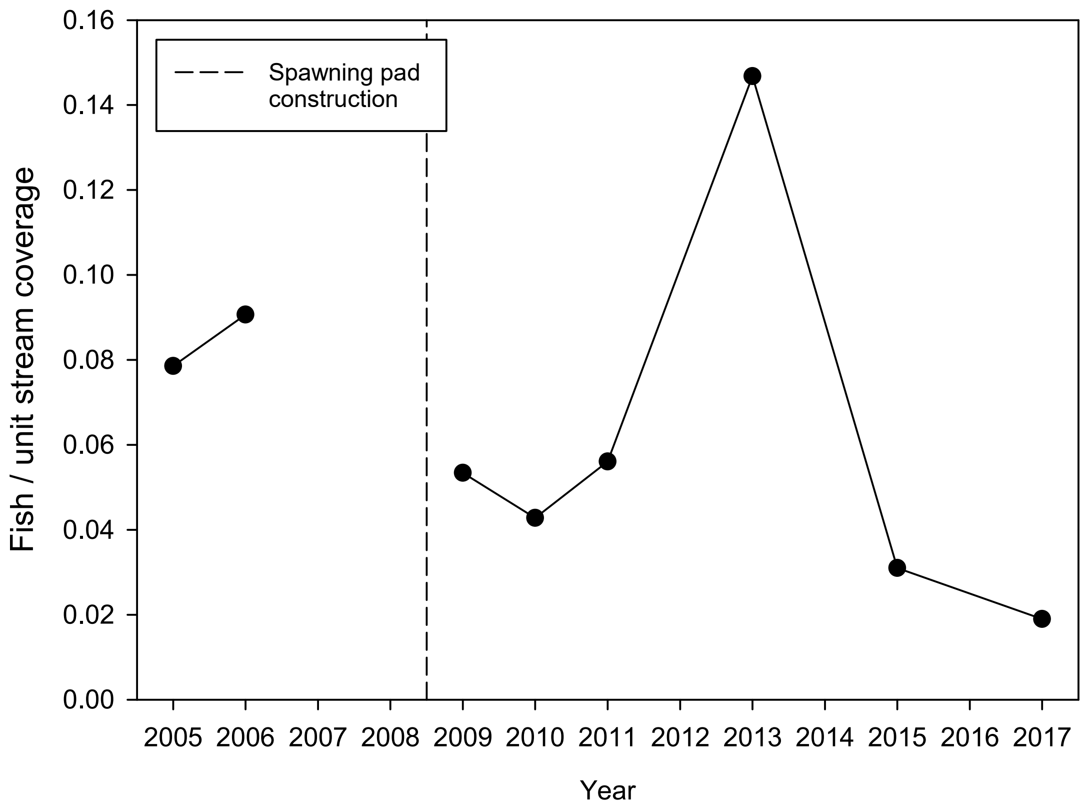


Figure 5. Number of fish captured per unit of stream coverage (% coverage x days) at R02 from 2005 to 2017.

3.1.3.2 Movements

A total of 140 Arctic grayling were captured moving upstream and 7 moving downstream. Fish were caught on the first sampling day (June 11), when temperatures were 3.8°C. This was the lowest water temperature observed during the monitoring event, but was 2.8°C higher than observed in 2015 (June 17), even though monitoring began 7 d earlier in 2017. Similar to 2015, the bi-modal distribution of captures over time observed in previous years was not as distinct in 2017 (Figure 6), and the overall percentage of fish moving downstream was lower.

Peak larval drift (June 13; Section 3.1.2) occurred just prior to the observed peak adult migration (June 12), indicating that although large mature fish were still moving upstream during the collection period, migration and spawning also occurred prior to the study initiation (likely under the ice or immediately at ice-off).

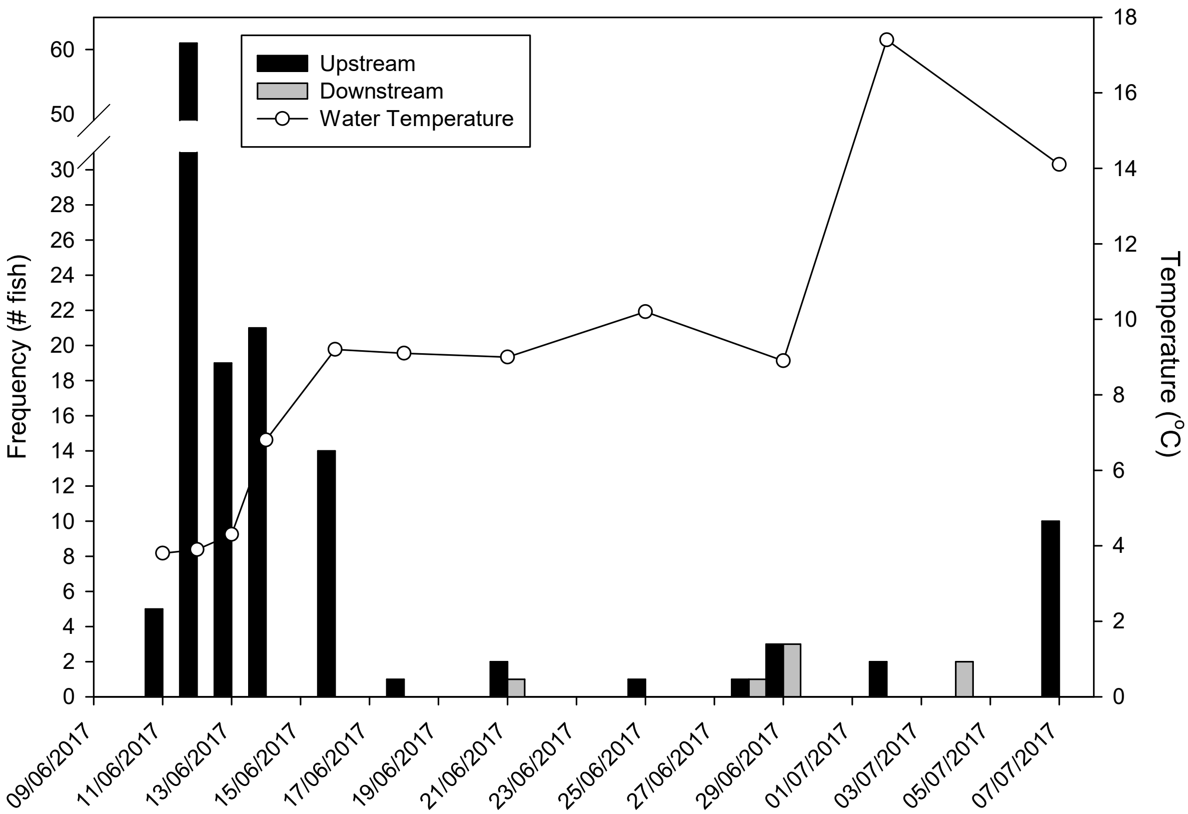


Figure 6. Upstream and downstream movements of Arctic grayling at R02 in 2017.

The R02 nets were set in two locations - just upstream (R02A) and downstream of the habitat compensation area (R02B). In 2017, many more fish (144) were collected at R02A than R02B (3) (see Table 8), likely due to the higher proportion of stream coverage at this location (80 vs 20%; Section 2.1.3) and very low water levels at R02B.

Table 8. Upstream and downstream movements of Arctic grayling by net location since 2010.

R02 Hoopnet ID	Fish Movement	2010	2011	2013	2015	2017
A	US	61	175	81	19	138
	DS	58	13	41	32	6
B	US	103	25	33	8	2
	DS	8	16	5	14	1
C	US	3	1	-	-	-
	DS	11	25	-	-	-
Total	US	167	201	114	27	140
	DS	77	54	46	46	7

3.1.3.3 Condition Factor

Table 8 provides a summary of the average, maximum and minimum length and weight, and the average condition factor of Arctic grayling collected. Lengths and weights are similar to previous years. The average condition factor (K) was greater than 1.00, which demonstrates a healthy population.**Error! Reference source not found.** Five fish were lost in transfer prior to recording length or weight data, resulting in a sample size of 142 fish.

Table 9. Average, maximum and minimum Arctic grayling length, weight and average condition factor (K).

	Length (mm)			Weight (g)			K*
n	Avg	Max	Min	Avg	Max	Min	Avg
142	293	394	172	303	600	80	1.17

* K = (weight/((length/10)^3)) x 100

Condition factors for years 2006 – 2017 are shown in Figure 7. Condition factor and variability are similar to previous years.

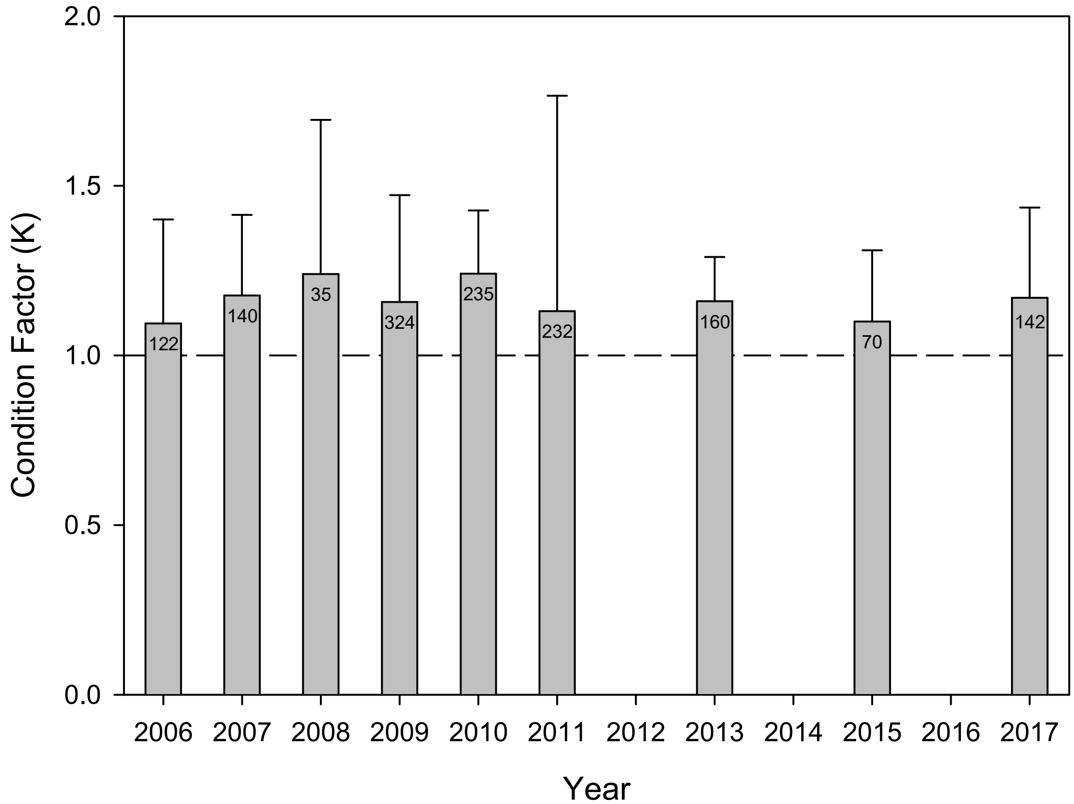


Figure 7. Average condition factor of Arctic grayling captured at R02. Error bars indicate standard deviation. Values indicate total number of fish.

3.1.3.4 Size Distribution and Maturity

As in the past, the length-frequency distribution (Figure 8) of fish collected at R02 is approximately normally distributed with the largest number of fish collected in the 300-320 mm size class (34 fish). This data demonstrates that recruitment is occurring as would be expected.

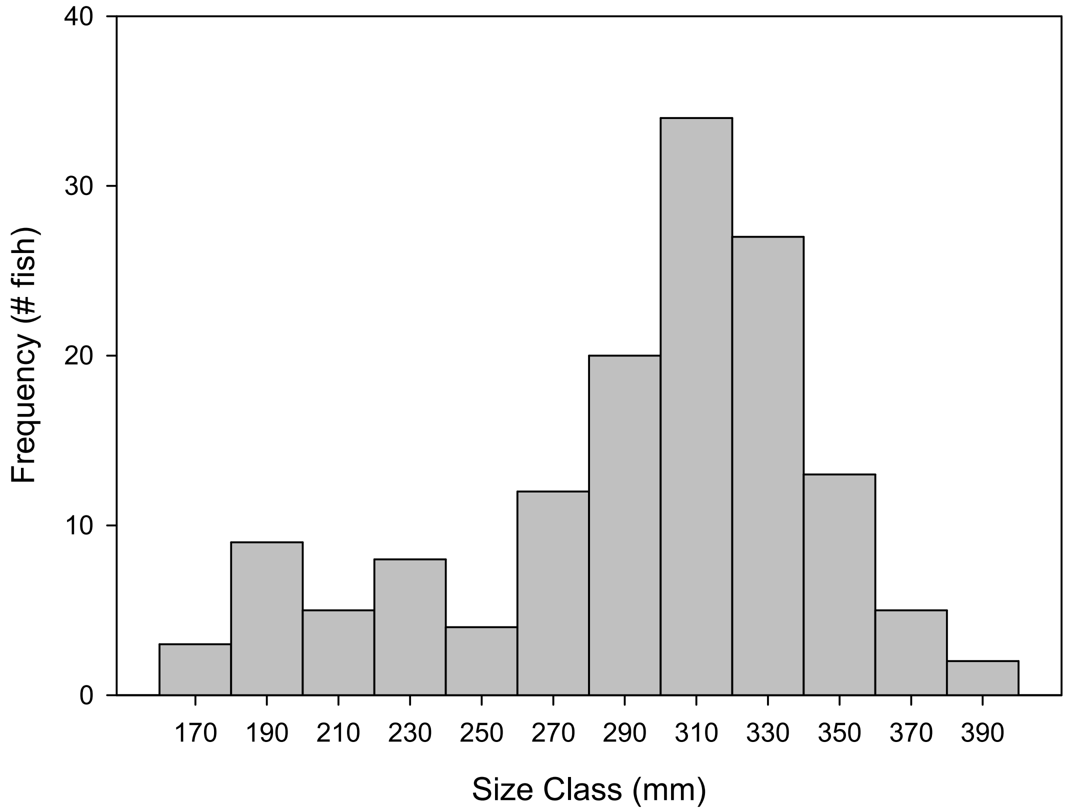


Figure 8. Length-frequency distribution of Arctic grayling captured at R02 in 2017.

The total numbers of male and female fish captured by spawning classification are shown in Table 10. Numbers of male and female fish were approximately equal.

Table 10. Number of fish by spawning classification caught at R02 in 2017.

Classification	Catch
Female	*Total = 61*
Immature	11
Ready	23
Waiting	22
Spent	1
Unknown	4
Male	*Total = 69*
Immature	4
Ready	56
Waiting	6
Spent	1
Unknown	2

3.1.3.5 Current Year Recaptures

Floy tags are commonly used to provide population density measurements, but they are also very useful in tracking the activities of migrating fish. Table 11 provides the results of the current year tagging program, or "recaptures" at each crossing. In 2017, 5 fish were re-captured at R02 (all Arctic grayling).

Table 11. Arctic grayling captured and re-captured in the current year at R02.

Fish	Date Collected	Net	US/DS	Tag #	Length	Weight	Sex	Maturity
1	6/12/17	R02A	US	407	380	326	M7	Ready
	6/13/17	R02A	US	407	397	328	M7	Ready
2	6/12/17	R02A	US	373	280	281	M8	Ripe
	6/13/17	R02A	US	373	270	300	F3	Ripe
3	6/12/17	R02A	US	362	350	302	M7	Ready
	6/13/17	R02A	US	362	320	307	M7	Ready
4	6/12/17	R02A	US	369	310	306	M7	Ready
	6/14/17	R02A	US	369	310	310	M7	Ready
5	6/14/17	R02A	US	629	280	240	M7	Ready
	6/16/17	R02A	US	629	150	235	M7	Ready

3.1.3.6 Previous Year Recaptures

In 2017, one fish caught at R02 was a previous year recapture (Table 12). This fish was previously captured at R02 on June 13, 2013. It has gained approximately 90 mm in length and 45 g in weight.

Table 12. Arctic grayling captured in 2017 that were captured in previous years.

Fish	Date	US/DS	Tag #	Length	Weight	Sex	Maturity
1	6/11/17	US	101280	330	319	Male	Ripe

3.1.4 Underwater Video

Of the 10 hrs of footage recorded, surface disturbance, sunlight, and a poor camera angle obscured footage for 4 hrs. However, unlike the first year of underwater video footage in 2015, numerous fish were captured on camera. Specifically, there were were numerous observations of fish surfacing in the deep pool of water between Target area A and Target area B. In total, 100 observations of fish were captured on video in this general area. One 35 min clip revealed 43 fish observations suggesting that a shoal of fish was using this area to feed and perhaps spawn. The videos showed a number of fish surfacing for food.

Fish were mainly observed in areas of small pebble/rocky areas, instead of areas where the section of the river bed was composed of small or medium size boulders.

The majority of the fish were impossible to identify because of the video quality, but a few came close enough to the camera to be confirmed as Arctic grayling.

3.2 PORTAGE AREA MONITORING

3.2.1 Interstitial Water Quality

3.2.1.1 Results

Analytical results of the interstitial water quality sampling are provided in Appendix D with CCME Water Quality Guidelines for the Protection of Aquatic Life (2007). During sampling, care was taken not to disturb sediment, but TSS was elevated (8 mg/L) compared to the CCME guideline (6 mg/L) at Bay-Goose Station 6, suggesting sediment may have become suspended during sampling. TSS at all other stations was below detection limits (1 mg/L) except for the Bay-Goose duplicate (1.1 mg/L) and Second Portage Lake reference site (2.0 mg/L).

No other values exceeded the CCME guidelines, and overall results for dike stations were similar to reference stations. These results indicate that the water quality in the interstitial spaces along the East Dike and Bay-Goose Dike continues to be suitable for egg incubation and periphyton growth.

3.2.1.2 QA/QC

All laboratory analyses were completed by ALS Laboratories: Vancouver, B.C. which is an accredited laboratory by the Canadian Association for Laboratories Accreditation (CALA) Inc. The results met laboratory QA/QC internal data quality objectives for precision and completeness. During the interstitial water quality sampling, one duplicate sample was taken at BG-PW-6. The QA/QC results are summarized in Appendix E. The results of this evaluation indicate a high level of consistency between the original field sample and the field duplicate sample. None of the samples exceeded an RPD of 50% for concentrations that were greater than 10x the Method Detection Limits (MDL).

3.2.2 Periphyton Growth

Full results for this monitoring component are provided in Appendix B. The results indicate that periphyton community succession has progressed from diatom-dominated early-stage communities to a more heterogeneous mix of cyanobacteria, diatoms and to a lesser extent, chlorophyte taxa in these mid-stage communities (>5 years post construction). Overall, the progress at the Bay-Goose dike towards a heterogenous periphyton community has been slower than that seen for SP-ED; however, some progress was made at each area (i.e., higher diversity at TPE-BGN and higher biomass at TPE-BGS) in 2017. At the East Dike HCF, taxa richness and Simpson's Diversity values are nearly identical to the reference area in Second Portage Lake indicating the presence of a community similar to background conditions.

Biomass has also steadily increased on the dike faces in the post-construction phase, but total biomass is still lower compared to the reference areas (particularly at the Bay-Goose Dike HCFs). It is apparent that 5-7 years post-construction is not a sufficient amount of time for full colonization of new barren rock surfaces to background levels of biomass. The presence of a structurally similar periphyton community at each of the HCFs relative to their respective reference areas indicates a healthy periphyton community. Biomass growth is expected to continue as periphyton community succession progresses.

3.2.3 Fish Use

As in the last monitoring year (2015), analysis of fish use of the habitat compensation features (dike faces and Dogleg Ponds) was assessed through the minimally invasive techniques of angling and underwater motion video prescribed in the 2017 HCMP. This proved to be a successful non-lethal program which demonstrated continued fish presence in and around the study areas.

3.2.3.1 Angling

A total of 120 fish were caught through angling and there were no mortalities. This includes 40 fish in Dogleg Pond, 38 fish in Second Portage Lake, and 42 fish in Third Portage Lake. Twelve fish were lost in transfer before they could be fully tagged, weighed, or measured.

Fishing stations were only recorded for Second Portage Lake in 2017, and angling durations were not recorded for each station, so the full assessment of differences between reference sites and dikes sites could not be carried out. In 2015, catch per unit effort (CPUE) was similar in all cases, or slightly higher at dike stations compared to reference stations, indicating that fish use of dike face habitat was not reduced compared to reference stations, which was also observed in 2011. This trend will be re-assessed in 2019, and again in 2021 prior to integrating all results into a weight-of-evidence assessment of success of the habitat compensation features. No specific criteria for success are associated with fish use of the dike faces (see Habitat Compensation Monitoring Plan, February, 2017), so the reduced data availability for 2017 is not expected to significantly affect the overall assessment.

Table 13. Angling time, # fish caught and catch per unit effort (CPUE; fish/hr) per station.

Lake	Station	# Fish	Time (line hours)	CPUE
Third Portage Lake	BG-2	-	-	-
	BG-4	-	-	-
	BG-6	-	-	-
	TPL-REF	-	-	-
	Sub-total	42	20.75	2.0
Second Portage Lake	ED-2	15	-	-
	ED-4	12	-	-
	SP-REF	11	-	-
	Sub-total	38	17	2.2
Dogleg Pond		41	13.75	3.0

A summary of the data recorded for each fish is provided in Tables 14 - 16.

Table 14. Summary of fish caught through angling at HCMP stations along the Bay-Goose Dike.

Date	Station	Species	Fish #	Tag #	Fork Length (mm)	Weight (g)
9/01/17	-	LT	1	654	420	1360
	-	LT	2	-	-	-
	-	LT	3	655	570	2267
	-	LT	4	656	580	2494
	-	LT	5	36	450	1020
	-	LT	6	657	580	2494
9/04/17	-	LT	7	658	510	1588
	-	LT	8	659	550	1950
9/06/17	-	LT	9	660	500	1542
	-	LT	10	661	470	1088
	-	LT	11	662	520	1542
	-	LT	12	663	600	2086
	-	LT	13	664	470	1225
	-	LT	14	665	580	1996
	-	LT	15	666	520	1814
	-	LT	16	-	-	-
	-	LT	17	-	-	-
	-	LT	18	667	530	1542
	-	LT	19	668	530	1814
	-	LT	20	669	570	1950

Date	Station	Species	Fish #	Tag #	Fork Length (mm)	Weight (g)
	-	LT	21	670	530	1814
	-	LT	22	-	-	-
	-	LT	23	672	54	1542
	-	LT	24	-	-	-
9/13/17	-	LT	25	673	330	454
	-	LT	26	674	600	2381
	-	LT	27	675	530	1588
	-	LT	28	-	-	-
	-	LT	29	827	600	2177
	-	LT	30	828	520	1814
	-	LT	31	829	500	1814
	-	LT	32	830	530	1588
	-	LT	33	-	-	-
9/16/17	-	LT	34	834	460	907
	-	LT	35	-	-	-
	-	LT	36	828	520	1814
	-	LT	37	835	760	1814
9/18/17	-	LT	38	836	540	1361
	-	LT	39	-	-	-
	-	LT	40	837	650	2948
	-	LT	41	838	610	2041
	-	LT	42	839	460	1134

Table 15. Summary of fish caught through angling at HCMP stations along the East Dike and Second Portage Lake reference station.

Date	Station	Species	Fish #	Tag #	Fork Length (mm)	Weight (g)
8/30/17	-	LT	1	563	620	3401
8/30/17	-	LT	2	562	390	771
8/30/17	-	LT	3	561	430	1315
8/30/17	-	LT	4	-	-	-
8/30/17	-	LT	5	560	340	725
8/30/17	-	LT	6	558	430	907
8/30/17	-	LT	7	557	395	793
8/30/17	-	LT	8	556	440	1474
8/31/17	-	LT	9	555	550	1973
8/31/17	-	LT	10	554	420	793
8/31/17	-	LT	11	553	402	907
8/31/17	-	LT	12	552	360	793
8/31/17	-	LT	13	338	390	793
8/31/17	-	LT	14	652	810	5896
8/31/17	-	LT	15	653	420	907
9/14/17	-	LT	16	831	830	5670
9/14/17	-	LT	17	832	670	3401
9/24/17	-	LT	18	812	650	3400
9/24/17	-	AC	19	813	500	1200
9/24/17	-	AC	20	814	545	1400

Date	Station	Species	Fish #	Tag #	Fork Length (mm)	Weight (g)
9/24/17	-	AC	21	815	505	1350
9/24/17	-	LT	22	816	550	1550
9/26/17	-	LT	23	817	424	850
9/26/17	-	LT	24	818	425	950
9/26/17	-	LT	25	819	775	5350
9/27/17	-	LT	26	857	397	625
9/27/17	-	LT	27	858	682	2950
9/27/17	-	AC	28	859	515	1200
9/27/17	-	LT	29	860	362	400
9/27/17	-	LT	30	863	462	1100
11/25/17	-	LT	31	-	490	-
11/26/17	-	LT	32	867	340	362
11/26/17	-	LT	33	868	388	453
11/26/17	-	LT	34	869	465	907
11/26/17	-	LT	35	-	190	230
12/04/17	-	LT	36	870	370	453
12/04/17	-	LT	37	871	290	226
12/31/17	-	LT	38	873	260	272

Length-frequency distributions were developed for Second Portage Lake stations only, since no distinction was available between dike and reference stations for Third Portage Lake. These data indicate that a greater proportion of larger fish were captured along the dike face compared to the reference station. However, the small number of fish captured in one year prohibits robust statistical comparison.

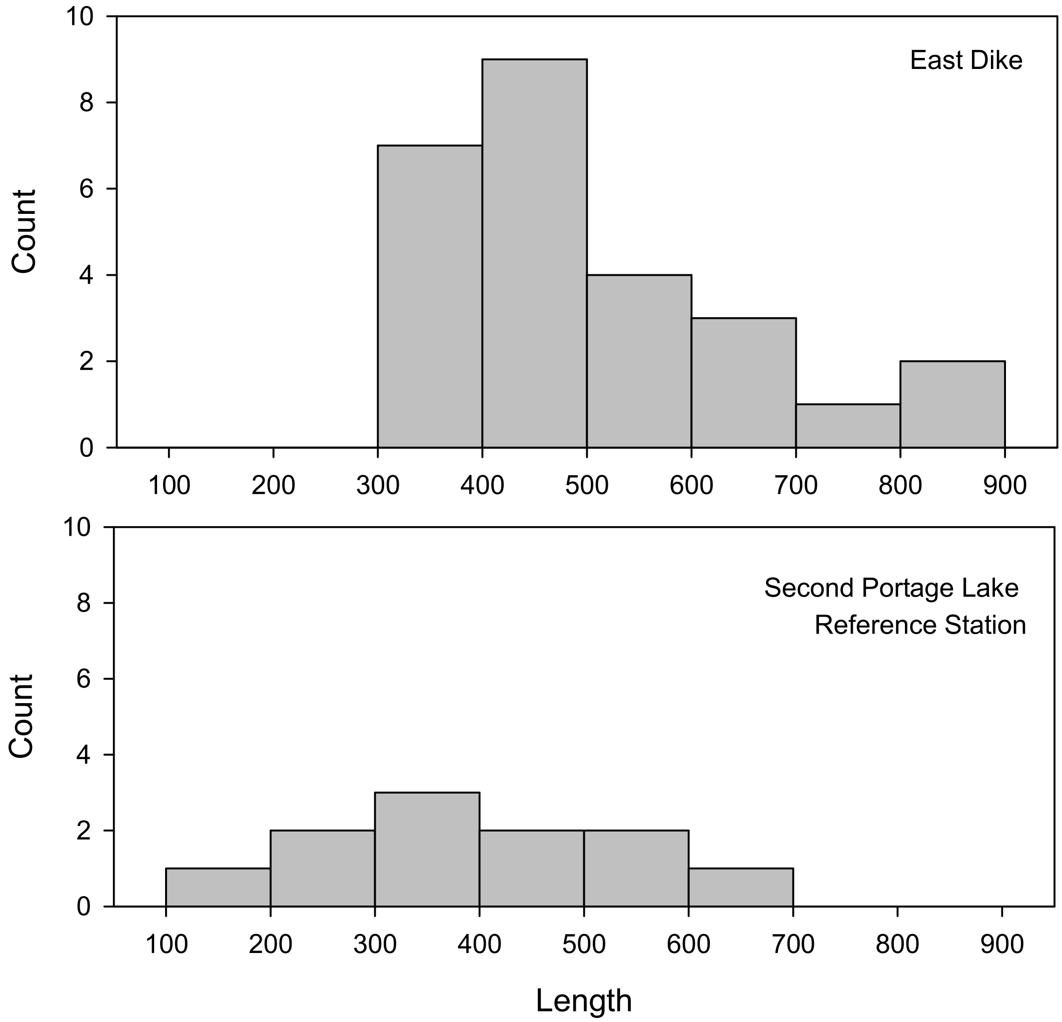


Figure 9. Length-frequency distribution of lake trout captured through angling in Second Portage Lakes in 2017. Fishing efforts are not assumed to be equal between sites.

With 13.75 h of effort, 40 fish were caught in Dogleg Pond (Table 16). This included 6 Arctic char, which were not identified in this pond prior to 2015. Access for that species was conservatively excluded from habitat compensation calculations in 2012. However, it was suggested that Arctic char may eventually access this area from Second Portage Lake due to changes in water levels as a result of construction of the channel from NP-2. Since Arctic char were captured in Dogleg Pond during the past two monitoring events, the channel connecting Dogleg Pond to Second Portage Lake will be observed to determine whether fish passage is now possible and Arctic char are accessing the Dogleg system via this route.

With 6 line-hours of effort, no fish were caught in NP-1, which was previously determined to be fishless (see 2012 NNLP). Although fish were identified as being caught in this pond in 2015, there was an error in communications, and no fishing was conducted in that area. The fish reported as caught in Dogleg North (NP-1) were from the northern section of Dogleg Pond. However, one fish was captured on underwater video in 2017 (see Section 3.2.3.2).

Access to NP-1 habitat for lake trout and round whitefish was identified as part of the onsite habitat compensation through construction of the diversion channel from NP-2 Pond, which occurred in 2013.

Table 16. Summary of fish caught through angling in Dogleg Pond in 2017.

Date	Species	Fish #	Fork Length (mm)	Weight (g)
8/05/17	Lake Trout	1	331	380
8/05/17	Lake Trout	2	381	610
8/05/17	Lake Trout	3	330	370
8/05/17	Lake Trout	4	322	380
8/05/17	Lake Trout	5	380	560
8/19/17	Lake Trout	6	337	310
8/19/17	Lake Trout	7	565	280
8/19/17	Lake Trout	8	564	410
9/22/17	Lake Trout	9	840	408
9/22/17	Lake Trout	10	841	377
9/22/17	Lake Trout	11	842	400
9/22/17	A. Char	12	843	479
9/22/17	A. Char	13	844	450
9/22/17	Lake Trout	14	845	365
9/22/17	A. Char	15	846	470
9/22/17	Lake Trout	16	847	377
9/22/17	Lake Trout	17	848	400
9/22/17	Lake Trout	18	849	925
9/22/17	Lake Trout	19	850	451
9/23/17	Lake Trout	20	801	389
9/23/17	Lake Trout	21	802	350
9/23/17	Lake Trout	22	803	348
9/23/17	Lake Trout	23	804	295
9/23/17	A. Char	24	805	351
9/23/17	Lake Trout	25	806	551
9/23/17	Lake Trout	26	807	682
9/23/17	Lake Trout	27	808	486
9/23/17	Lake Trout	28	809	403
9/23/17	Lake Trout	29	810	379
9/23/17	Lake Trout	30	811	355
9/26/17	Lake Trout	31	50	385
9/26/17	Lake Trout	32	49	396
9/26/17	Lake Trout	33	851	344
9/26/17	Lake Trout	34	852	392
9/26/17	Lake Trout	35	853	337
9/26/17	Lake Trout	36	854	403

9/26/17	Lake Trout	37	855	547
9/26/17	Lake Trout	38	856	357
11/30/17	Arctic char	39	339	490
11/30/17	Arctic char	40	341	400

3.2.3.2 Underwater Camera

A total of 36 fish sightings were captured on camera during the underwater motion camera monitoring program. This included 11 fish at ED-2, 5 fish at ED-4, 2 fish at BG-2, 1 fish at BG-4, 16 fish in Dogleg Pond, and 1 fish in NP-1. This is the first evidence of fish use in NP-1, which was identified as a habitat compensation area in the 2012 NNLP, as access enhancements were expected to make it available to fish. Species on video were not identified. The current software program did not allow determination of weight, length or sex. The number of fish observed in each location are provided in Table 17. Underwater camera monitoring was not conducted at the reference locations (SP-REF or TPL-REF). Fish use of NP-1 in particular will continue to be monitored as part of the regular HCMP program to confirm use of this newly available habitat.

Table 17. Dates and # fish captured on underwater camera at Portage area monitoring stations.

Station	Date	# of Fish Captured on Camera
ED-2	8/30/17	7
	9/08/17	11
ED-4	8/30/17	5
SP-REF	-	-
BG-2	9/06/17	2
BG-4	9/06/17	1
BG-6	9/06/17	-
TPL-REF	-	-

3.2.4 Structure

In 2017, a bathymetric survey was conducted to confirm whether construction of the diversion channel from NP-2 to Dogleg North (NP-1) is increasing the wetted area of these ponds as assumed, and to confirm the potential for fish movement, especially between Dogleg Pond and NP-1 (which was previously determined to be fishless).

The NNLP for the Meadowbank site (2012) identified the projected increase in wetted area as 5% for Dogleg Pond, 15% for Dogleg North Pond (NP-1), and 5% for NP-2. The area used in baseline calculations and projected increase in area for each pond is described in Table 18. Baseline areas were initially determined from bathymetric surveys conducted by

Agnico technicians in August 2010 and 2011, and used in conjunction with air photos (unknown date) by a GIS consultant (Dougan & Associates) to map baseline pond areas.

Updated bathymetric surveys were conducted by Agnico survey technicians for Dogleg Pond and NP-1 on September 17, 2017. NP-2 was not surveyed.

The results of the 2017 survey indicate that total areas of Dogleg Pond and NP-1 are about 30% lower than those reported in the 2012 NNLP. Although some inter-annual variability would be expected, and 2017 was a very low water level year in this area (see Section 3.1.2), visual assessment by Agnico Environment Department technicians indicated that it is very unlikely pond area has actually decreased 30% over the past 6 years. Further, since estimated maximum depths for each pond did not change or even increased in 2017 compared to baseline data, and reported shoreline elevations for NP-1 increased, the differences in area are likely an artifact of differences in mapping techniques between GIS methods used by Dougan and Associates for baseline data, and total area calculated by survey technicians in 2017.

Baseline mapping by Dougan utilized both bathymetric surveys conducted at a relatively coarse scale, along with air photos (unknown date) to interpret the total area of the Dogleg Ponds, whereas areas calculated by Agnico survey technicians in 2017 were based on surveys only. A close-up of the baseline 2011 mapping along with survey data is provided in Figure 10, showing how a larger total pond area may have been calculated using that method.

Since the Dogleg Ponds are planned to be monitored until at least 2025 prior to determination of habitat compensation success, a further in-depth review of differences in habitat mapping and potentially, further surveys, will be conducted and included in the next monitoring report (2019).

Table 18. Area and shoreline elevations used in baseline calculations, projected increase in area, and measured area/shoreline elevation for the Dogleg Ponds. *2012 NNLP, Figure 4-7.

Project Phase	Metric	Dogleg Pond	NP-1 (Dogleg North Pond)	NP-2
Baseline	Baseline Area (ha)	21.2	3.2	8.7
	Baseline Max. Depth (m)	11	3.8	5
	Baseline Shoreline Elevation (m)	-	133.17*	143.50*
Projected Change	% Increase in Area	5%	15%	5%
	Post-compensation Area – 2025+ (ha)	22.2	3.7	9.1

Post-construction 2017	Measured Area 2017 (ha)	13.6	2.5	-
	Measured Max. Depth (ha)	12+	4	-
	Measured Shoreline Elevation (m)	-	135.25	-

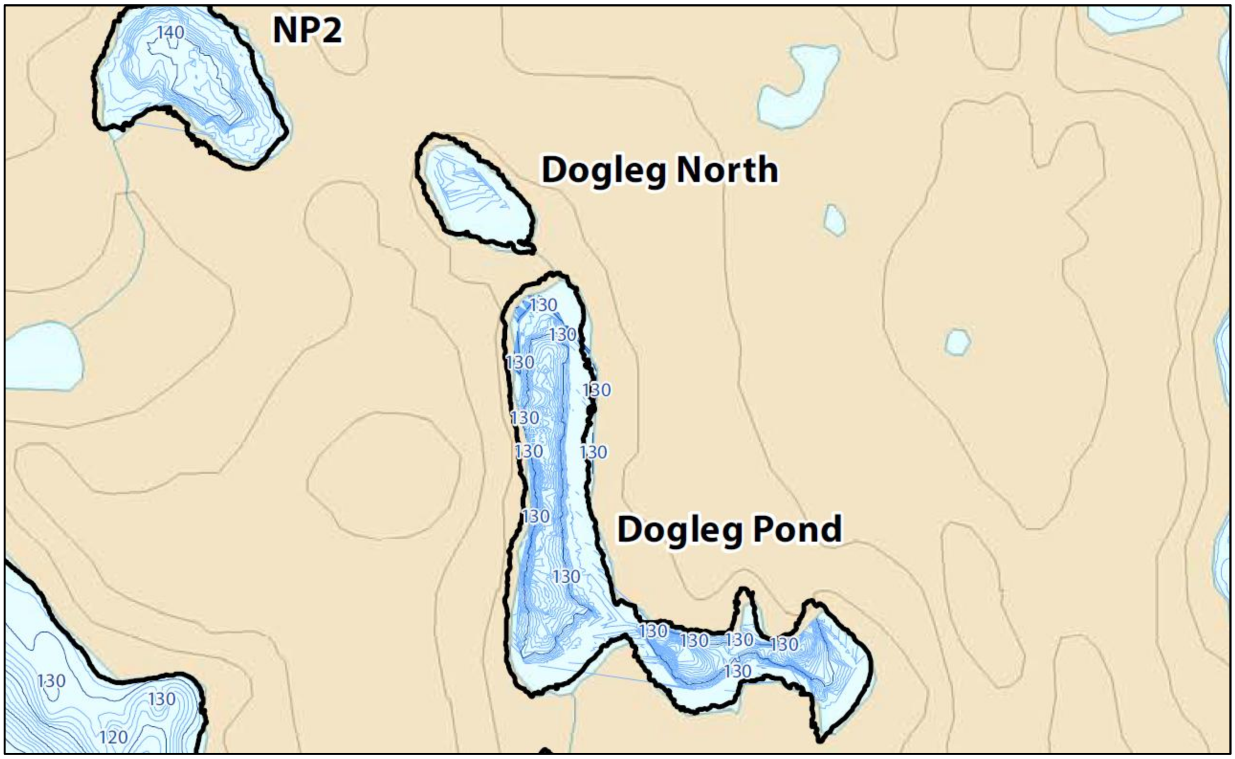


Figure 10. Close-up showing bathymetric contours (blue lines) and final mapped lake area based on air photos (black line) for the Dogleg System in baseline mapping (2012 NNLP, Figure 1-3). Note the difference in area that could arise from each method. The pond marked at "Dogleg North" is also referred to as NP-1.

SECTION 4 • SUMMARY

4.1 AWAR MONITORING

The intention of the constructed spawning pad feature was to decrease flow rates and water depths, and provide suitable substrate for Arctic grayling spawning. Stability of the feature was visually confirmed, with minor shifting of material as anticipated at construction.

Data collected in 2017 indicate that fish migrating at R02 continue to have a well distributed population structure (greatest number of fish in the middle size class) and are generally a good body weight (K > 1). The number of fish caught per unit effort (% stream coverage) was slightly lower than 2015 catch, likely as a result of comparably very low water levels and warmer temperatures. Overall however, these data confirm continued use of the R02 reach by Arctic grayling.

In the HCMP, no specific criteria are established for determining success of the spawning pads constructed at R02 based on fish use metrics (hoopnet catch, larval drift). Although the successful utilization of the spawning pads is difficult to quantify, the larval drift data collected in 2017 continues to provide evidence of Arctic grayling spawning in this reach since construction occurred. Comparing equal catch per unit effort, the number of larvae caught throughout the R02 reach has increased at least slightly since 2009, despite catch being impacted by low water levels and warm temperatures in 2017. Since monitoring will be ongoing until road decommissioning, overall success of the compensation feature will be assessed at that time taking into account the weight of evidence of all data collected throughout the monitoring program.

4.2 PORTAGE AREA MONITORING

As described in Meadowbank's 2012 NNLP, outer faces of the dewatering dikes (Bay Goose and East Dike) are assumed to provide simulated reef habitat for fish in Second and Third Portage Lakes. Monitoring goals for these features as described in the HCMP include assessment of interstitial water quality, periphyton growth and fish use every two years, initially. In 2017, interstitial water quality met CCME guidelines with the exception of TSS at one location (likely due to disturbance during sampling). Periphyton coverage continues to develop compared to values observed initially after construction, indicating healthy periphyton community growth with increasing biomass. Fish use of habitat in and around the dike faces was confirmed through angling and underwater motion cameras.

Construction of a diversion channel between NP-2 and NP-1 was planned to result in slightly increased water levels, provide improved connectivity between these ponds, and especially to open previously inaccessible habitat in Dogleg North Pond (NP-1) for use by lake trout and round whitefish which naturally occupied Dogleg Pond and NP-2. It was noted that eventually these ponds may be seasonally accessible from Second Portage Lake, theoretically providing access for Arctic char. However, access for char was conservatively excluded from habitat gain calculations. Fish use of NP-1 was confirmed in 2017 through underwater motion camera surveys (though only 1 fish was observed). Angling also indicated presence of Arctic char in Dogleg Pond, suggesting this system may now be accessible from Second Portage Lake. Bathymetric surveys were completed, but a further analysis of results is required to understand differences from baseline surveys, which appear to be an artifact of different mapping methods. Water levels and connectivity will be confirmed during the next monitoring event.

SECTION 5 • ACTIONS

5.1 AWAR MONITORING

The following actions were planned for 2017. Agnico's responses are indicated below each action.

- To reduce the amount of poor quality video footage, a low profile mount will be built for each camera.
  - A low profile mount was tried but proved to bring more instability of camera. Further engineering options will be investigated to develop improved methods for obtaining video footage in streams.

Other than possible improvements for obtaining video footage, no specific actions are recommended for AWAR monitoring in 2019.

5.2 PORTAGE AREA MONITORING

The following actions were recommended in 2015 for subsequent Portage area monitoring events, and Agnico's response to each is provided:

- Revise underwater motion camera methods to improve proportion of usable footage.
  - It was decided that the existing mount would be used after basic modifications on ensuring stability and by focusing effort on maximising installation effectiveness in the field. For example, remote control bracelets were used to ensure quality of image, when possible, and more time was allocated in setting the equipment underwater. These measures provided sufficiently high quality video footage.
- Investigate software to facilitate video processing and potentially allow a more precise identification of fish species.
  - Software assessed did not bring added value. And thus status quo was maintained on images collected and analysed.
- Conduct surveys of water levels in the Dogleg system to determine any increase in wetted area.
  - Completed, but differences as compared to baseline mapping need to be further investigated. Survey of NP-2 remains to be conducted.

- Assess flow in connecting channels within the Dogleg system to confirm potential for improved fish passage.
  - Will be conducted in 2019.
- Record angling effort specifically by monitoring station to facilitate catch-per-unit effort calculations.
  - A more detailed approach still needs to be integrated with the methodology and efforts will be maintained in 2019.

The following actions are recommended for Portage area monitoring in 2019:

- Further investigate software to facilitate video processing and potentially allow a more precise identification of fish species.
- Compare differences in baseline mapping and 2017 bathymetry for Dogleg System.
- Complete bathymetric survey of NP-2.
- Assess flow in connecting channels within the Dogleg system to confirm potential for improved fish passage (including channels between NP-2 and NP-1, NP-1 and Dogleg Pond, and Dogleg Pond to Second Portage Lake).
- Record angling effort specifically by monitoring station to facilitate catch-per-unit effort calculations.

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APPENDIX A

Animal Use Protocol Report

Pêches et Océans Canada | Fisheries and Oceans Canada

Freshwater Institute Animal Care Committee
Animal Use Protocol Report Form

AUP #:	**FWI-ACC-2017 -15**
Project Title:	Meadowbank Mine: Fisheries Habitat Compensation Monitoring - All-Weather Access Road (AWAR) and Mine Site Authorization Monitoring
Was this project new or a renewal?	Renewal
Last Year's AUP # (if applicable):	**FWI-ACC-2015-021**
Project Lead: **Phone** **E-mail**	Tom Thomson 819-759-3555 ext. 6906 Tom.thomson@agnicoeagle.com
Contact Person: **Phone** **E-mail**	Robin Allard 819-759-3555 ext. 6744 Robin.allard@agnicoeagle.com
Project end date:	2017-12-31

1. **Did the project deviate from the approved AUP? If yes, please describe.**
   No, the project did not deviate from the approved AUP.

2. **Fill the chart out below, per species**

	Numbers Approved in AUP		**Actual Numbers**		
Species	**Live sampled and released**	**Dead sampled**	**Live sampled and released, AUP approved**	**Dead sampled, AUP approved**	**Euthanized due to injury from capture**
Arctic Grayling	200	20	147	0	0
Lake Trout	200	50	103	0	0
Arctic Char			10	0	0
Round Whitefish			6	0	0
Larval		400	0	400	0

3. If you did not euthanize any animals or have any mortalities, skip to question 4.

a. Describe how the animal died during capture?

A total of 6 mortalities occurred during the programs. The Arctic Grayling mortalities were small (year 1-2) fish that were a result of incidental injury in an attempt to escape through the hoop net mesh.

b. What were the causes?

The Arctic Grayling were caught in the fine mesh and did not survive.

c. Where these mortalities expected?

Attempts to ensure near zero mortality occur during the programs. However, in previous years, a number of smaller grayling have been caught in the hoop net mesh.

d. What methods could be changed to decrease death to animals?

All hoop net sets are checked within a 24hr period. It is possible to reduce the duration between sets. Ensuring that all hoop nets placed by field staff are not deployed in areas where fast moving water is present or in shallow sections of the stream.

e. Were any post mortems done on the animal(s)?

Zero post mortems were completed during the 2017 programs.

f. What was done with the carcasses?

4. Where there any injuries to animals? If no, skip to question 5.

a. How many animals were injured?

5 Arctic Grayling and 1 Round Whitefish were caught in the 1" mesh of the hoop nets.

b. What injuries occurred?

The injured fish were very fatigued and had small abrasions were they were caught in the net.

c. Were any treatments given to the injured animals?

The injured fish were placed in a recovery bin. The fish remained the containment bin until they were strong enough to be released. The injured fish were not tagged.

d. What methods could be changed to decrease injury to animals?

Ensuring that all hoop nets placed by field staff are not deployed in areas where fast moving water is present or in shallow sections of the stream.

5. Were any non-target species captured? If no, skip to questions 6.

a. what species were captured?

b. what was done with the non-target species?

c. what methods could be changed to decrease the capture of non-target species?

6. Were there any incidents? If no, skip to question 7.
Field incidents include; weather issues, equipment issues, field staff, and methods.

a. Describe what happened.
During peak freshet, chunks of ice will flow downstream and upset the hoop nets. High winds caused weather delays or disrupted field work on the Portage Lake system. Video footage on the underwater cameras was limited due to poor battery life and improper placement by field staff. Video footage & angling effort per lake were not equal.

b. Can anything be done to mitigate these incidents for future projects?
It is possible to commit to an earlier start date when weather tends to be more cooperative. Large ice auger flutes have been ordered so efforts can continue until the end of license. The larger auger flutes will also allow us to collect video footage under the ice.

Camera techniques such as trolling with the camera mounted to the transom of boat were not completed this year due to equipment issues. This will be addressed in the future and will be used in addition to the stationary cameras.

7. How could your methods be changed to reduce pain, injury and suffering of animals? (3 R's and endpoints)

The nature of this project requires AEM to capture fish in order to determine presence/absence in the environment. Fish cannot be replaced by a non-animal alternative.

AEM, to reduce the number of fish being used during the monitoring studies, is and will continue to increase the use of underwater cameras to verify presence/absence of fish habitat usage in the environment.

AEM, to minimize pain and/or distress to fish will continue to use best management practices. Smaller hoops with smaller mesh size will be used in future programs along the AWAR. This should optimize net deployment and contribute to a lower number of small fish getting caught in the nets. Also, AEM will continue to ensure that all hoop nets placed by field staff are not deployed in shallow sections of the stream or in areas where fast moving water is present.

Tom Thomson	2018-01-11
Project Lead	**Date**

APPENDIX B

2017 HCM Periphyton Report

Technical Memorandum

Date: March 26th, 2018

To: Robin Allard, Martin Archambault (Agnico Eagle)

From: Marianna DiMauro, Gary Mann, Eric Franz

RE: Habitat Compensation Monitoring Program 2017: East Dike and Bay-Goose Dike Periphyton

OVERVIEW

Under terms of the Department of Fisheries and Oceans Canada *Fisheries Act* Authorization (NU-03-0191), long-term monitoring following the Habitat Compensation Monitoring Program (HCMP) is designed to document the functionality of habitat compensation features (HCFs) constructed to offset habitat losses associated with development of the Meadowbank Mine. The monitoring strategy of the HCMP (Azimuth, 2008) describes both the physical and ecological monitoring requirements and presents the schedule for monitoring implementation and decision criteria for evaluating the success of HCF functionality. The monitoring strategy for ecological components follows a tiered framework consisting of both quantitative and qualitative tools (**Figure 1**). The first tier focuses on identifying constraints to HCF functionality (e.g., metals release); higher tiers involve more specialized tools that are only triggered if the success criteria specified in the HCMP are not met.

In 2017, tier 1 quantitative and qualitative ecological components were monitored for both the East Dike HCF (year C+9) and for the Bay-Goose Dike HCF (year C+7). Note that C denotes year of construction completion; 2008 for the East Dike and 2010 for the Bay-Goose Dike. Azimuth was contracted to support Agnico Eagle with reporting on the periphyton component of the program (i.e., qualitative periphyton community monitoring in shallow [rock sampling] zones only); the results of which are documented herein.

OBJECTIVES

Periphyton species composition and biomass are indirect indicators of lake productivity, reflecting nutrient concentrations in the lake, and are sometimes indicators of the presence of contaminants. This community serves as the base of the hard-bottom benthic food chain, which ultimately leads up to fish. As described in the HCMP (Azimuth, 2008), success criteria for periphyton monitoring focus on the capability of HCFs to function as fish habitat. The HCFs are expected to provide good substrate for periphyton to colonize. The intent of this component is to document periphyton community colonization and development on the dike face HCFs. This technical memorandum focuses on the 2017 and historical results related to periphyton monitoring of shallow habitat (0 – 1 m) along the dike faces. Periphyton community was directly sampled (i.e., scraped off the rocks) and analyzed for density (cells/cm^2) and biomass (µg/cm^2); a greater emphasis is placed on the latter as it is more ecologically relevant and is derived from the density counts (see methods). The results are compared to the baseline community data and reference sites to determine whether there are any gross differences in composition.

METHODS

Periphyton Community Sampling – Shallow Zone

Periphyton community sampling was completed by Agnico Eagle staff between September 1st and 6th. Periphyton samples were collected in the following areas in relation to each dike HCF (sampling locations are shown in **Figure 2**):

- East Dike HCF (Second Portage Lake)
  - East Dike (SP-ED)
  - Drilltrail Arm reference area (SP-DT)
- Bay-Goose Dike HCF (Third Portage Lake – East basin)
  - Bay-Goose Dike – North section (TPE-BGN)
  - Bay-Goose Dike – South section (TPE-BGS)
  - Reference area (TPE-G)

Five replicate samples were collected from each area and analyzed independently. UTM coordinates for each replicate sample are presented in **Table 1**. Sampling locations were chosen according to the following criteria: a sufficient number of large, flat rocks from a water depth of approximately 0.5 m with a flat surface facing upwards as much as possible, and with uniform algal coverage, not particularly dense or sparse. Periphyton growth is naturally variable due to differences in wave action, aspect to sun, water depth and clarity, nutrient availability, rock type, water temperature and other factors.

Periphyton samples were collected using a specially-designed algae 'scrubber'. The procedures for collecting the samples are outlined in detail in the standard operating procedure (SOP) for Periphyton Sampling (**Appendix A**). In general, the scrubbers were used to remove and retain periphyton from a 20 cm^2 area on each rock; three rocks were composited for each replicate sample (i.e., each of the 5 replicates at a sampling area consisted of 3 rocks). Periphyton samples were preserved in the field with a small amount of Lugol's solution and sent to Plankton R Us Inc. (Winnipeg, MB) for taxonomic identification and biomass (µg/cm^2) estimation.

In the laboratory, each periphyton sample was well mixed and 2 mL sub-samples of suspension were sonicated for 10 to 20 seconds using a Sonifer Cell Disruptor (model w140) and gravity settled for 24 h in an Ütermohl chamber (Findlay et al., 1999). Counts were performed on an inverted microscope at magnifications of 125X, 400X, and 1200X with phase contrast illumination. Cells were identified, counted and measured from random fields until 100 cells of the dominant species were found. Cell counts were converted to wet weight biomass by approximating cell volume. Estimates of cell volume for each species were obtained by measurements of up to 50 cells of an individual species and applying the geometric formula best fitted to the shape of the cell (Vollenweider, 1968; Rott, 1981). For comparison between stations and among years, the individual species density (cells/cm^2) and biomass (µg/cm^2) data were summarized at the level of major taxa group (cyanobacteria, chlorophytes, chrysophytes, diatoms, and dinoflagellates). The laboratory data are included in **Appendix B**.

Simpson's diversity index was calculated for each replicate sample to quantify periphyton species diversity among areas and replicates (Washington, 1984). Simpson's diversity index takes into account both the abundance patterns and taxonomic richness of the community. It measures the probability that two individuals randomly selected from a sample will belong to the same species. This is calculated by determining, for each taxonomic group at a site, the proportion of individuals that it contributes to the total at the site. This diversity index can range from 0 to 1, with a value of 1 representing the highest diversity. Simpson's diversity (D) is calculated as follows:

$$\mathrm{D} = 1 - \sum \frac{n_i(n_i - 1)}{N(N - 1)}$$

where:
N is the total number of organisms/replicate sample;
n_i is the total number of organisms of the i^{th} taxa/replicate sample.

The number of species occurring per replicate sample was calculated to measure the species richness among replicates, areas and sampling events.

Quality Assurance / Quality Control

One field duplicate was collected and field replicates (5 per area) were collected for periphyton to test consistency in field methods and to determine natural variability and spatial heterogeneity within and among areas. When collection of each replicate sample was completed, the 'scrubber' was rinsed in lake water to ensure that no debris remained in the bristles. A relative percent difference (RPD) of 50% is targeted for total density and total biomass while acknowledging small-scale spatial variability in the periphyton community may result in RPDs outside this range. As a measure of laboratory QA/QC on the enumeration method, replicate counts were performed on 10% of the samples. Laboratory replicate samples were chosen at random and processed at different times from the original analysis to reduce biases. The laboratory replicate is a new aliquot (10 ml) from the sample jar and is counted from the start in the same manner as the original aliquot (10 ml) taken from the jar. An RPD of 25% for total density and total biomass concentrations is considered acceptable.

RESULTS

Quality Assurance/Quality Control

Periphyton samples collected from prescribed areas of rock surface were quantified by density (cells/cm^2) and biomass (µg/cm^2). RPDs for total density met the data quality objectives (DQO's) for both field and laboratory duplicates. However, the total biomass did not meet the DQOs for the field duplicate and one of the laboratory duplicate samples (**Table 2**). The highest RPD (54%) was observed in the total biomass estimate for the field duplicate sample collected at TPE-G replicate station 3. A difference in species richness was observed in the field duplicate sample and minor differences were observed in two of the laboratory duplicates. Lastly, the Simpson's diversity calculations between the original samples and their duplicates show little variability (less than 10%). Overall, the variability in density, richness, and Simpson's diversity is considered minor and within the range of acceptability whereas the variability in biomass exceeded the DQOs in two cases.

East Dike HCF

Periphyton samples were collected from rock surfaces at 5 locations each along the East Dike face (SP-ED) and at the reference location (SP-DT). Total cell density and biomass were lower at SP-ED compared to SP-DT in 2017 (**Table 3**). Density and biomass were both highly variable within each location in 2017, but mean estimates of cell density and biomass were both approximately 2-fold lower at the SP-ED area compared to SP-DT (**Table 3**, **Figure 3, Figure 4**). Relative to the 2015 survey, the 2017 results show increases in mean cell density of 100% (from 235,000 to 469,000 cells/cm^2) and in mean biomass of 92% (from 79 to 152 µg/cm^2) along the East Dike.

Despite absolute differences in cell density between the East Dike and the reference areas, the proportion of cell densities by major taxa group was similar between SP-ED and SP-DT in 2017 (**Figure 3**). Cyanobacteria and diatoms accounted for 98% of the cell density at SP-ED and nearly 100% at SP-DT. At SP-ED, cyanobacteria comprised 48% of the periphyton community compared with 64% at SP-DT (**Table 3**). Diatoms were the next most abundant major taxon, accounting for 50% of the cell density at SP-ED compared with 36% at SP-DT. In contrast to cell density, the species composition for periphyton biomass was different between SP-ED and SP-DT. Similar to 2015, diatoms were the dominant major taxon in terms of biomass along the East Dike (77%), while the biomass at the reference was comprised almost equally of cyanobacteria (52%) and diatoms (43%). Biomass differences between the East Dike and reference areas are primarily due to the presence of larger (i.e., higher cell volumes) cyanobacteria species at SP-DT (e.g., *Petalonema alatum* Berk (see **Appendix C** for information on the species cell volumes and presence/absence by replicate area). The shift in community composition at SP-ED includes a lower proportion of cyanobacteria and higher proportion of diatoms compared to 2015. Differences in species composition within major taxa groups (i.e., cyanobacteria) suggest community succession at SP-ED is likely still on-going.

Community diversity indices (Simpson's Diversity and taxa richness) were similar at all sampling areas (**Table 3**). Taxa richness in 2017 was between 15 and 20 at SP-ED and between 15 and 18 at SP-DT, consistent with the number of taxa observed in 2015 (Azimuth, 2016). Simpson's Diversity was also similar between the two areas: 0.77 at SP-ED and 0.73 at SP-DT.

Bay-Goose Dike HCF

Periphyton samples were collected from rock surfaces at 5 locations each along the north and south sections of the Bay-Goose Dike face (TPE-BGN; TPE-BGS) and at the reference location TPE-G (**Table 4**, **Figure 5, Figure 6**)**.** The 2017 event was the third cycle of habitat compensation monitoring along the Bay-Goose Dike, with the first and second conducted in 2011 and 2015, respectively. Periphyton cell density at TPE-BGN and TPE-BGS was approximately 86,000 cells/cm^2 and 74,000 cell/cm^2, respectively, in 2017. These results are higher than the reported cell densities in the 2015 survey (Azimuth, 2015). Furthermore, both Bay-Goose Dike locations were approximately 10-fold lower in cell density compared to the reference area (TPE-G) in 2017, consistent with the ratio that was observed in the 2015 survey. Despite overall similar periphyton cell densities between 2015 and 2017, mean total biomass decreased by 23% at TPE-BGN (from 22.7 in 2015 to 17 µg/cm^2 in 2017) and increased by 30% at TPE-BGS (from 43.7 in 2015 to 57 µg/cm^2 in 2017) in 2017 relative to 2015 (**Figure 5, Figure 6**).

The periphyton community composition at TPE-BGN and TPE-BGS was composed mainly of diatoms in 2017 (64% and 68% by cell density, respectively), whereas the community at TPE-G were composed primarily of cyanobacteria (69%) and diatoms (26%) (**Table 4**). Biomass by major taxa group was higher for diatoms than cyanobacteria, and lower within-station variability was observed compared to 2015 (**Table 4**). On average, the percent distribution of biomass by major taxa group was similar between the Bay-Goose Dike locations compared to the reference location TPE-G.

Compared to the 2015 results, the 2017 periphyton community data along the Bay-Goose Dike had similar proportions of cyanobacteria and diatoms in terms of cell density. However, in terms of biomass, the proportion of cyanobacteria decreased by 23% whereas the proportion of diatom increased slightly (4%) in 2017. The biggest change in biomass in 2017 was the increase in chlorophytes seen at TPE-BGS (nearly 66% of total biomass) compared to 2015 (1.3% to total biomass).

The periphyton community at the Bay-Goose Dike was less diverse than the reference area as indicated by lower Simpson's Diversity scores and fewer taxa (**Table 4**). Mean taxa counts at TPE-BGN (12 taxa) and TPE-BGS (10 taxa) were lower than those at TPE-G (15 taxa). While the taxa richness at TPE-BGN improved in 2017, the taxa richness at TPE-BGS was noticeably lower compared to 2015; however the latter trend was also observed at the reference area. This pattern is interesting considering the opposite trend in biomass was observed (see above). Simpson's Diversity scores were lower at both TPE-BGN and TPE-BGS in 2017 than in 2015. At TPE-BGN, richness was 12 in 2017 compared to 10 in 2015, and Simpson's Diversity was 0.55 in 2017 compared to 0.57 in 2015. Overall, TPE-BGN had lower Simpson's diversity and biomass but slightly higher species richness and cell density, compared to TPE-BGS in 2017.

Relative to SP-ED, the patterns of colonization and succession seen at TPE-BGN and TPE-BGS have been generally slower and more variable. The 2017 results, while different from those seen in 2015, do not clearly show progress towards a heterogeneous periphyton community comprised of cyanobacteria and diatom species (e.g., similar to the reference area). That said, temporal changes at the reference area (TPE-G) relative to 2015 show increased biomass but decreased taxa richness, which is similar to TPE-BGS. TPE-BGN, however, decreased slightly in biomass but had higher taxa richness relative to 2015. A full list of periphyton species with a presence/absence matrix for the Third Portage sampling locations in 2017 is presented in **Appendix C**.

OVERALL DISCUSSION AND CONCLUSIONS

Cell density and biomass in early stage periphyton communities at the East Dike HCF (in 2009) and Bay-Goose Dike HCF (in 2011) were predictably low in the year after construction. Periphyton community development is dependent on a number of factors, including nutrient availability (Bonilla et al., 2005), light (Kiffney et al., 2003) and the capacity of different taxa to colonize, grow, compete, tolerate stress, and resist loss processes (Cox, 1990). Analysis of the early-stage periphyton communities at the East Dike and Bay-Goose Dike HCFs showed diatoms were the predominant taxa group responsible for early colonization of the HCFs. In general, periphyton community succession has progressed from diatom-dominated early-stage communities to a more heterogeneous mix of cyanobacteria, diatoms, and to a lesser extent, chlorophyte taxa in the mid-stage communities (≥ 5 years post construction).

The shift from a diatom-dominated to heterogeneous periphyton community on the HCFs is characterized by increased species diversity measures (i.e., increased taxa richness and Simpson's Diversity). While species diversity measures increased from 2011 to 2015, there was little increase and in some cases a decrease from 2015 to 2017. While there was an increase in community diversity (i.e., greater proportion of cyanobacteria) observed at the TPE-BGN site, a decreased community diversity was observed at the TPE-BGS site in the Bay-Goose Dike HCFs in 2017 relative to 2015 (although a similar pattern was seen at the reference area (TPE-G). Overall, the progress at the Bay-Goose dike towards a heterogenous periphyton community has been slower than that seen for SP-ED; however, some progress was made at each area (i.e., higher diversity at TPE-BGN and higher biomass at TPE-BGS) in 2017. Similarly, decreased community diversity was observed at the East Dike sites in 2017 relative to 2015. At the East Dike HCF, taxa richness and Simpson's Diversity values are nearly identical to the reference area in Second Portage Lake indicating the presence of a community similar to background conditions.

Biomass has also steadily increased on the HCFs in Second Portage and Third Portage Lakes in the post-dike construction phase, but total biomass is still lower compared to the reference areas (particularly at the Bay-Goose Dike HCFs). It is apparent that 5-7 years post-construction is not a sufficient amount of time for full colonization of new barren rock surfaces to background levels of biomass. The presence of a structurally similar periphyton community at each of the HCFs relative to their respective reference areas indicates a healthy periphyton community. Biomass growth is expected to continue as periphyton community succession progresses.

It's unclear what factors/variables have contributed to a more abundant (biomass and density) and diverse (taxa richness and Simpson's Diversity) periphyton community at the southern extent of Bay-Goose Dike compared to the northern portion of the Dike. One possibility is that the southern aspect at TPE-BGS provides better growing conditions (i.e., exposure to sunlight) than the eastern aspect at TPE-BGN. While less important at the reference areas due to the lower profile natural shorelines, aspect might be more important with the steeper and higher dike faces at the HCF stations. That said, the temporal biomass trajectory seen at the SP-ED (eastern aspect) is more similar to that seen at TPE-BGS (southern aspect) (**Table 5**). Interestingly, while TPE-BGN's mean abundance and diversity metrics were lower than TPE-BGS's, some of the results for individual replicates were actually higher, highlighting the influence of high natural variability in periphyton data.

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Table 1. Periphyton rock sampling locations, 2017.

HCF	Sampling Area ID	Date	Replicate #	UTM Coordinates	
				Easting	Northing
East Dike HCF	SP-ED	1-Sep-17	1	14W 639371	7214359
			2	14W 639380	7214257
			3	14W 639400	7214057
			4	14W 639413	7213948
			5	14W 639378	7213846
	SP-DT	1-Sep-17	1	15W 358698	7213919
			2	15W 358703	7213958
			3	15W 358731	7214014
			4	14W 641326	7213862
			5	14W 641305	7213774
Bay-Goose Dike HCF	TPE-BGN	4-Sep-17	1	14W 639195	7213027
			2	14W 639110	7212917
			3	14W 639012	7212819
			4	14W 638983	7212679
			5	14W 639004	7212522
	TPE-BGS	4-Sep-17	1	14W 638945	7212166
			2	14W 638845	7211968
			3	14W 638529	7211831
			4	14W 638453	7211967
			5	14W 638361	7212098
	TPE-G	6-Sep-17	1	14W 637940	7210751
			2	14W 637947	7210747
			3	14W 637960	7210745
			4	14W 637967	7210740
			5	14W 637975	7210732

Table 2. QA/QC results for the field and laboratory duplicate periphyton samples.

	Field Duplicate		
	TPE-G-3 06-Sep-17	**Field Duplicate**	**RPD (%)**
Total Density	810057	789549	2.6
Total Biomass	156.3	271.5	-53.9
# Taxa	13	21	-47.1
Simpsons Diversity	0.82	0.81	1.7

	Laboratory Duplicates								
	TPE-G-1 06-Sep-17	**Lab Duplicate**	**RPD (%)**	**TPE-BGS-2 04-Sep-17**	**Lab Duplicate**	**RPD (%)**	**SP-ED-5 01-Sep-17**	**Lab Duplicate**	**RPD (%)**
Total Density	606517	610106	-0.6	38042	33735	12.0	506029	477318	5.8
Total Biomass	152	177	-15.6	7.9	5.6	33.5	208	227	-8.4
# Taxa	16	14	13.3	7	7	0.0	16	17	-6.1
Simpsons Diversity	0.76	0.77	-0.9	0.62	0.61	1.4	0.80	0.76	5.1

Notes:
RPD = Relative Percent Difference (%) = ((original - duplicate) / (original + duplicate)/2) x 100.
Shaded RPDs exceed 50% (field duplicates) or 25% (lab duplicates).
NA = Not Applicable for rare species.

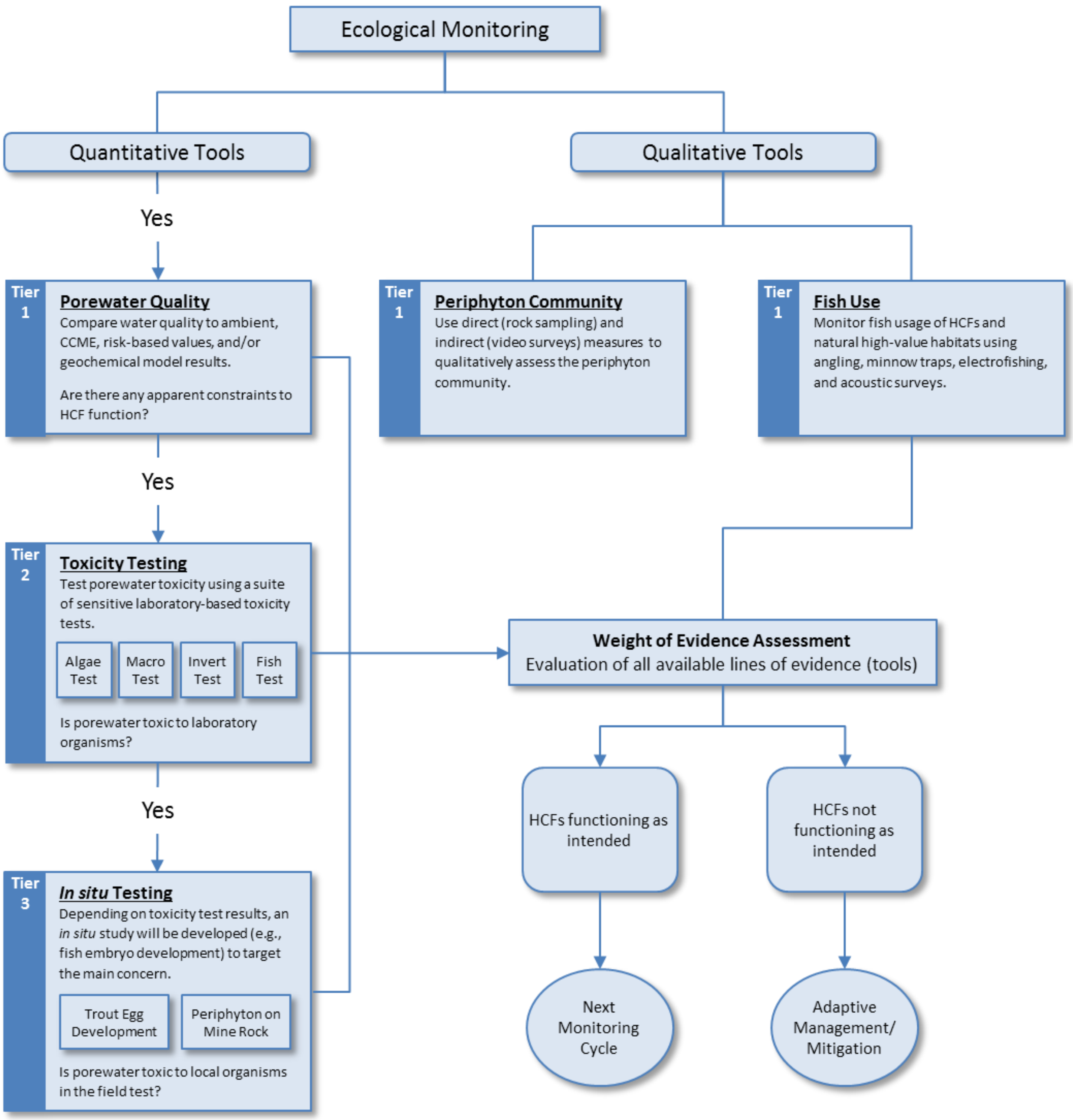
Table 3. Density (cells/cm^2), biomass (µg/cm^2) and diversity of major periphyton taxa groups for East Dike HCF sampling areas.

Area-Replicate ID	Date	Cyanobacteria	Chlorophyte	Chrysophyte	Diatom	Dinoflagellate	Total	# Taxa	Simpson's Diversity
Periphyton Density (cells/cm^2)									
SP-ED-1	01-Sep-17	270959	0	12561	138171	0	421691	17	0.70
SP-ED-2	01-Sep-17	282623	17944	0	263183	0	563750	19	0.80
SP-ED-3	01-Sep-17	122849	0	1380	329899	0	454129	15	0.76
SP-ED-4	01-Sep-17	169781	0	0	227755	0	397535	20	0.80
SP-ED-5	01-Sep-17	285314	0	10767	209948	0	506029	16	0.80
	station mean	***226305***	***3589***	***4942***	***233791***	***0***	***468627***	***17***	***0.77***
	as %	***48%***	***0.77%***	***1.1%***	***50%***	***0%***			
SP-DT-1	01-Sep-17	846971	0	0	416308	0	1263279	17	0.76
SP-DT-2	01-Sep-17	624462	0	0	276342	0	900804	17	0.65
SP-DT-3	01-Sep-17	502440	17944	0	167480	0	687865	16	0.71
SP-DT-4	01-Sep-17	640013	2991	0	427673	0	1070677	18	0.79
SP-DT-5	01-Sep-17	379821	0	0	388793	0	768614	15	0.74
	station mean	***598742***	***4187***	***0***	***335319***	***0***	***938248***	***17***	***0.73***
	as %	***64%***	***0.4%***	***0%***	***36%***	***0%***			
Periphyton Biomass (µg/cm^2)									
SP-ED-1	01-Sep-17	33	0.0	2.8	55	0	91		
SP-ED-2	01-Sep-17	17	86	0.0	122	0	224		
SP-ED-3	01-Sep-17	5.4	0.0	0.3	141	0	146		
SP-ED-4	01-Sep-17	13.2	0.0	0.0	76	0	89		
SP-ED-5	01-Sep-17	16.9	0.0	2.4	189	0	208		
	station mean	***17.0***	***17.2***	***1.1***	***117***	***0***	***152***		
	as %	***11%***	***11.3%***	***0.7%***	***77%***	***0%***			
SP-DT-1	01-Sep-17	343	0.0	0.0	142	0	485		
SP-DT-2	01-Sep-17	245	0.0	0.0	216	0	460		
SP-DT-3	01-Sep-17	207	80.3	0.0	228	0	515		
SP-DT-4	01-Sep-17	92	12.2	0.0	203	0	307		
SP-DT-5	01-Sep-17	184	0.0	0.0	89	0	273		
	station mean	***214***	***18.5***	***0***	***176***	***0***	***408***		
	as %	***52%***	***4.5%***	***0%***	***43%***	***0%***			

Table 4. Density (cells/cm^2), biomass (µg/cm^2) and diversity of major periphyton taxa groups for Bay-Goose Dike HCF sampling areas.

Area-Replicate ID	Date	Cyanobacteria	Chlorophyte	Chrysophyte	Diatom	Dinoflagellate	Total	# Taxa	Simpson's Diversity
Periphyton Density (cells/cm^2)									
TPE-BGN-1	04-Sep-17	26916	0	3230	132429	0	162575	12	0.48
TPE-BGN-2	04-Sep-17	5383	2153	1436	41631	0	50603	12	0.47
TPE-BGN-3	04-Sep-17	39119	0	2871	27275	0	69265	11	0.65
TPE-BGN-4	04-Sep-17	48091	3589	2153	22969	0	76802	12	0.61
TPE-BGN-5	04-Sep-17	19739	0	1436	50603	0	71777	11	0.53
	station mean	***27850***	***1148***	***2225***	***54981***	***0***	***86204***	***12***	***0.55***
	as %	***32%***	***1.3%***	***2.6%***	***64%***	***0.0%***			
TPE-BGS-1	04-Sep-17	2871	0	0	48808	0	51680	9	0.46
TPE-BGS-2	04-Sep-17	12202	0	3589	22251	0	38042	7	0.62
TPE-BGS-3	04-Sep-17	10408	0	3589	49526	0	63523	11	0.55
TPE-BGS-4	04-Sep-17	13638	1436	0	50962	0	66035	12	0.55
TPE-BGS-5	04-Sep-17	21533	46057	4187	80151	0	151928	11	0.71
	station mean	***12130***	***9499***	***2273***	***50340***	***0***	***74242***	***10***	***0.58***
	as %	***16%***	***12.8%***	***3.1%***	***68%***	***0.0%***			
TPE-G-1	06-Sep-17	421691	7178	0	177649	0	606517	16	0.76
TPE-G-2	06-Sep-17	763915	17944	0	207641	0	989500	16	0.76
TPE-G-3	06-Sep-17	469115	0	2563	338378	0	810057	13	0.82
TPE-G-4	06-Sep-17	667528	10767	0	229687	0	907982	12	0.80
TPE-G-5	06-Sep-17	721361	150732	3589	193798	0	1069480	17	0.81
	station mean	***608722***	***37324***	***1230***	***229431***	***0***	***876707***	***15***	***0.79***
	as %	***69%***	***4.3%***	***0.1%***	***26%***	***0.00%***			
Periphyton Biomass (µg/cm^2)									
TPE-BGN-1	04-Sep-17	4.2	0.0	0.7	27.2	0.0	32.1		
TPE-BGN-2	04-Sep-17	2.0	1.1	0.3	6.0	0.0	9.4		
TPE-BGN-3	04-Sep-17	3.5	0.0	0.6	9.9	0.0	14.1		
TPE-BGN-4	04-Sep-17	6.0	7.0	0.5	9.5	0.0	22.9		
TPE-BGN-5	04-Sep-17	1.4	0.0	0.3	5.1	0.0	6.8		
	station mean	***3.4***	***1.6***	***0.5***	***11.5***	***0.0***	***17.1***		
	as %	***20%***	***9.5%***	***2.9%***	***68%***	***0.0%***			
TPE-BGS-1	04-Sep-17	0.2	0.0	0.0	15.6	0.0	15.9		
TPE-BGS-2	04-Sep-17	5.4	0.0	0.8	1.7	0.0	7.9		
TPE-BGS-3	04-Sep-17	2.6	0.0	0.8	16.8	0.0	20.2		
TPE-BGS-4	04-Sep-17	13.3	5.0	0.0	9.8	0.0	28.1		
TPE-BGS-5	04-Sep-17	11.3	183	0.9	19.4	0.0	215		
	station mean	***6.6***	***37.6***	***0.5***	***12.7***	***0.0***	***57***		
	as %	***11%***	***65.6%***	***0.9%***	***22%***	***0.0%***			
TPE-G-1	06-Sep-17	71	24.8	0.0	55	0.0	152		
TPE-G-2	06-Sep-17	184	29.9	0.0	126	0.0	340		
TPE-G-3	06-Sep-17	56	0.0	0.6	100	0.0	156		
TPE-G-4	06-Sep-17	376	38.5	0.0	135	0.0	549		
TPE-G-5	06-Sep-17	256	351	0.8	44.3	0.0	652		
	station mean	***189***	***89***	***0.3***	***92***	***0.0***	***370***		
	as %	***51%***	***24%***	***0.1%***	***25%***	***0.0%***			

Figure 1. Ecological monitoring strategy for habitat compensation features (HCFs), Meadowbank Mine (adapted from Azimuth, 2008).



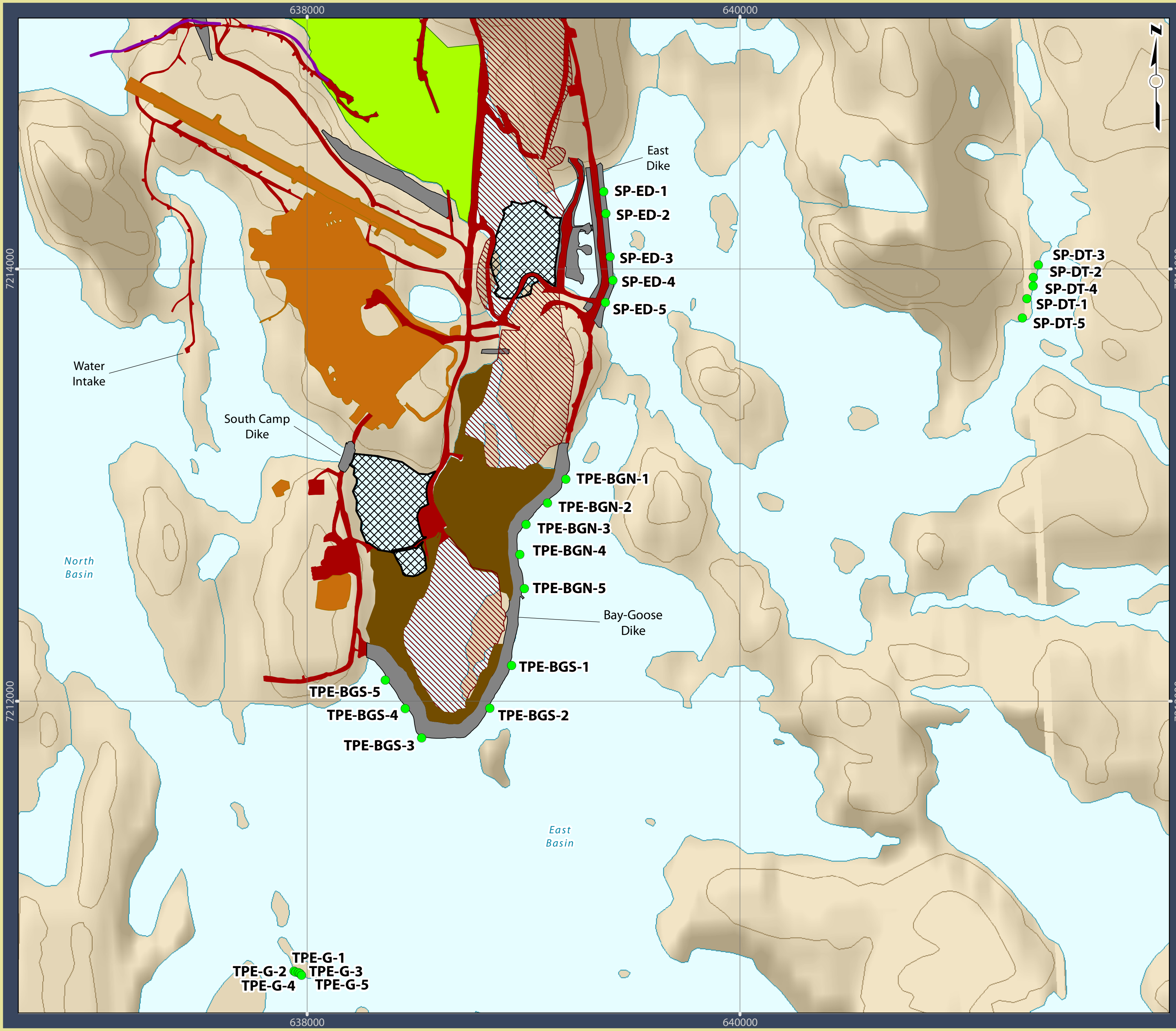


Figure 2: Periphyton Rock Sampling Locations for the 2017 Survey

Legend

- Periphyton Sampling Location
- All Weather Access Road

Mine Features

- Dewatering Pipe Discharge
- Facilities
- Road
- Dike
- Diversion Ditch
- Waste Dump
- Pit
- Dewatered Lake
- Portage Attenuation Facility
- Tailings Storage Facility

Prepared for:

By:

0 200 400 600

Metres

Projection: UTM Zone 14 NAD83

Data Sources:
Natural Resources Canada, GeoBase®
National Topographic Database
Agnico-Eagle Mines Limited.
Azimuth Consulting Group Inc.

Meadowbank Gold Project

AGNICO EAGLE

CASLYS CONSULTING

Figure 3. Mean and relative periphyton biomass (μg/cm²) for major taxa groups at East Dike HCF sampling areas.

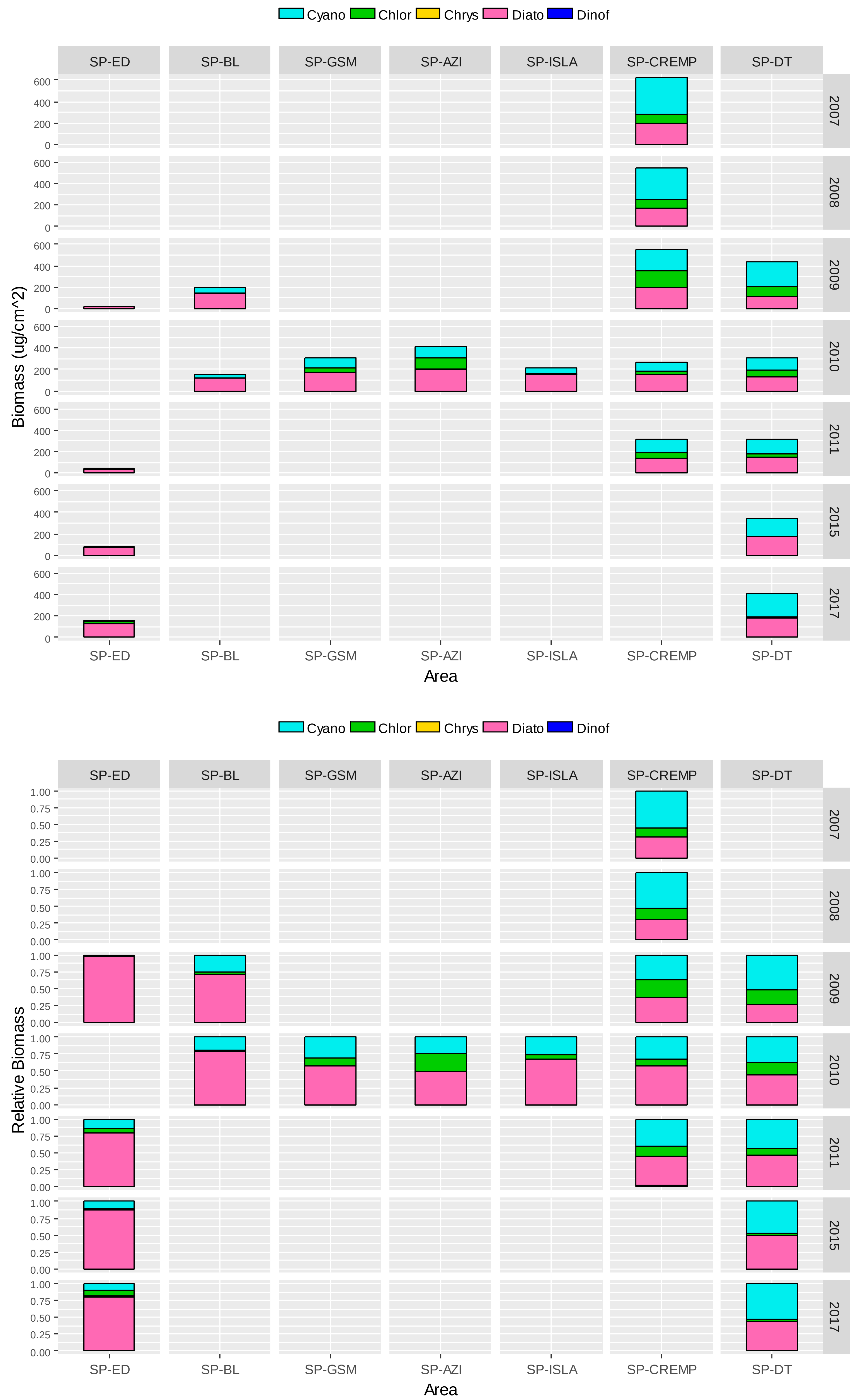
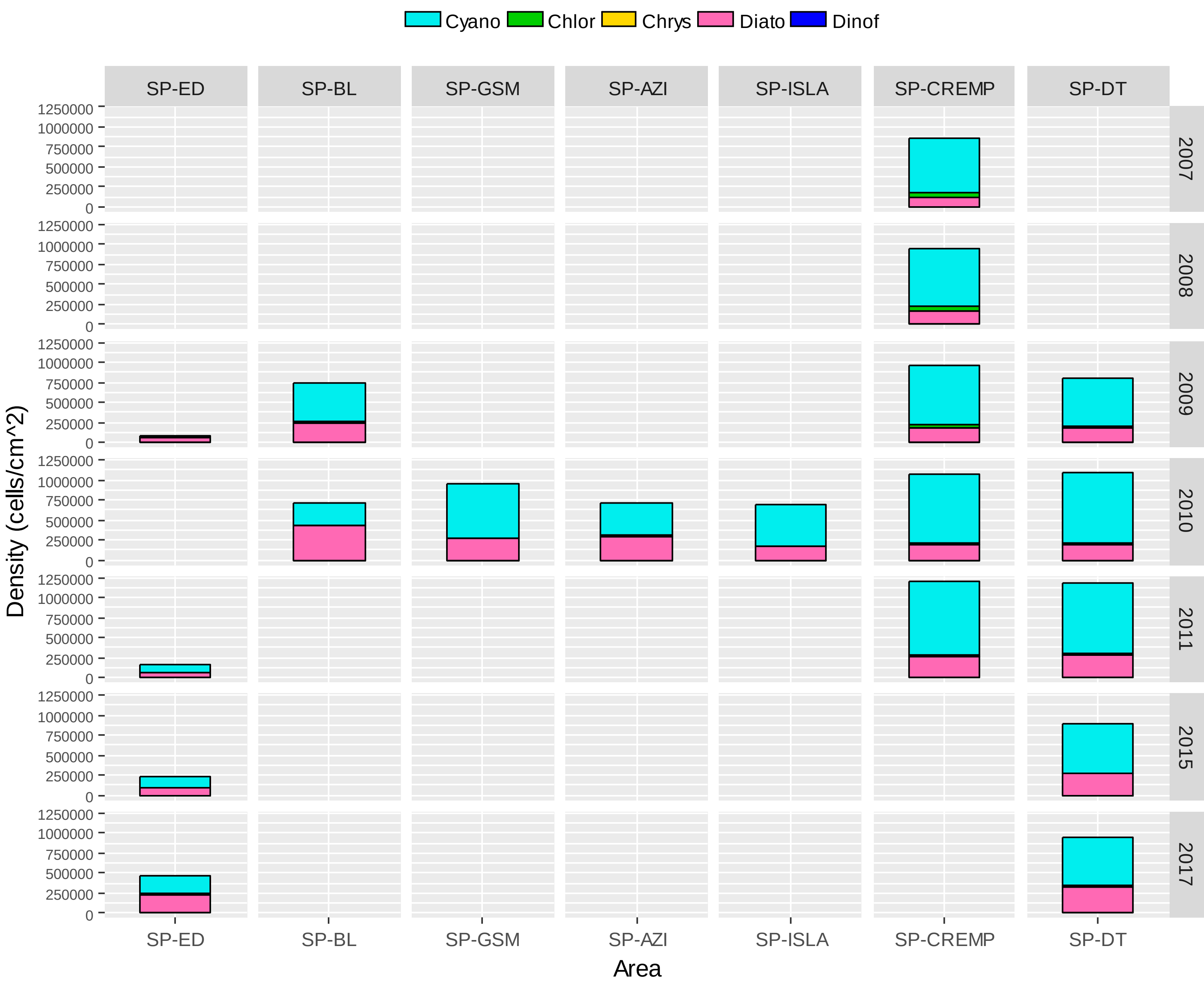


Figure 4. Mean and relative periphyton density (cells/cm²) for major taxa groups at East Dike HCF sampling areas.



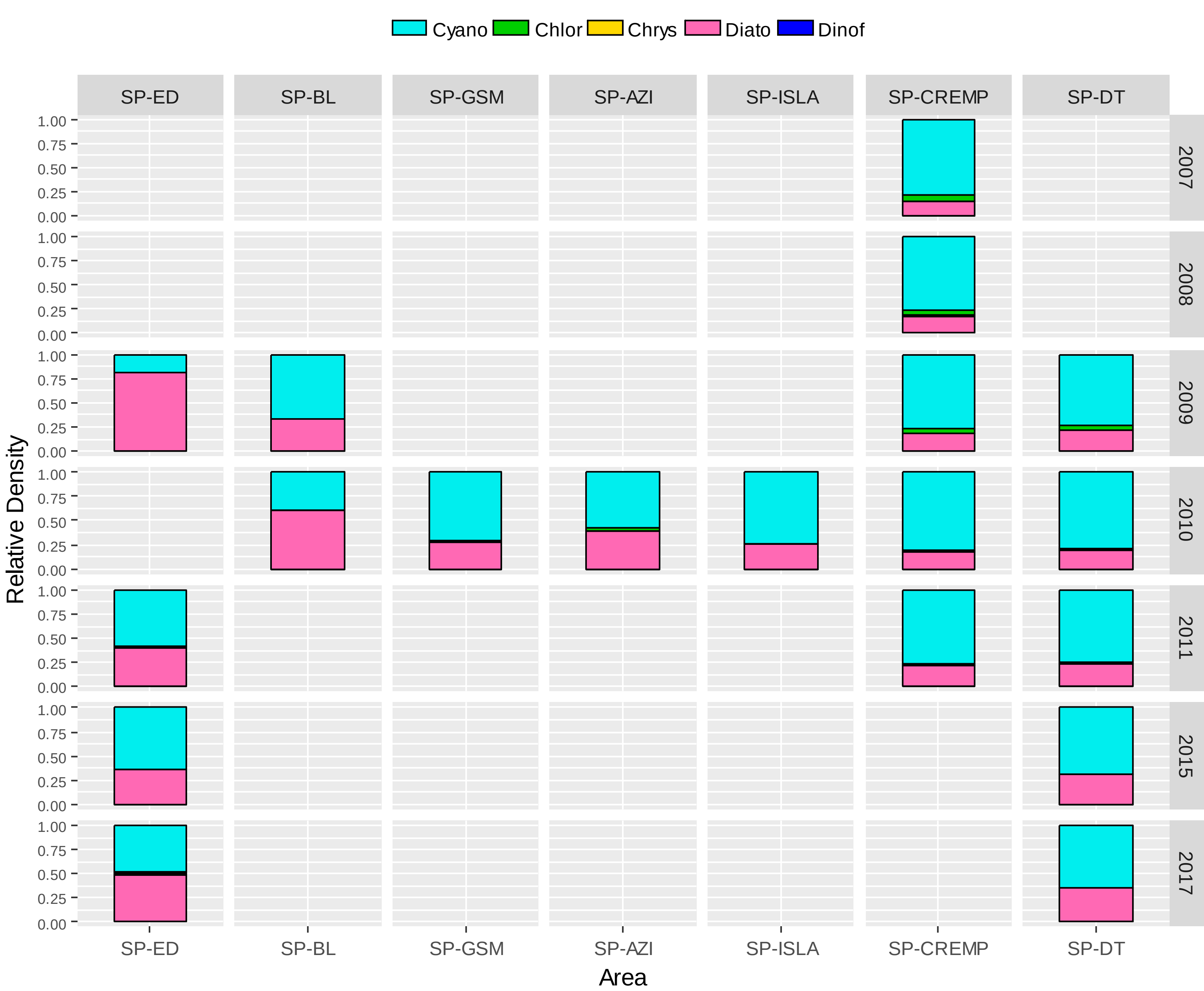
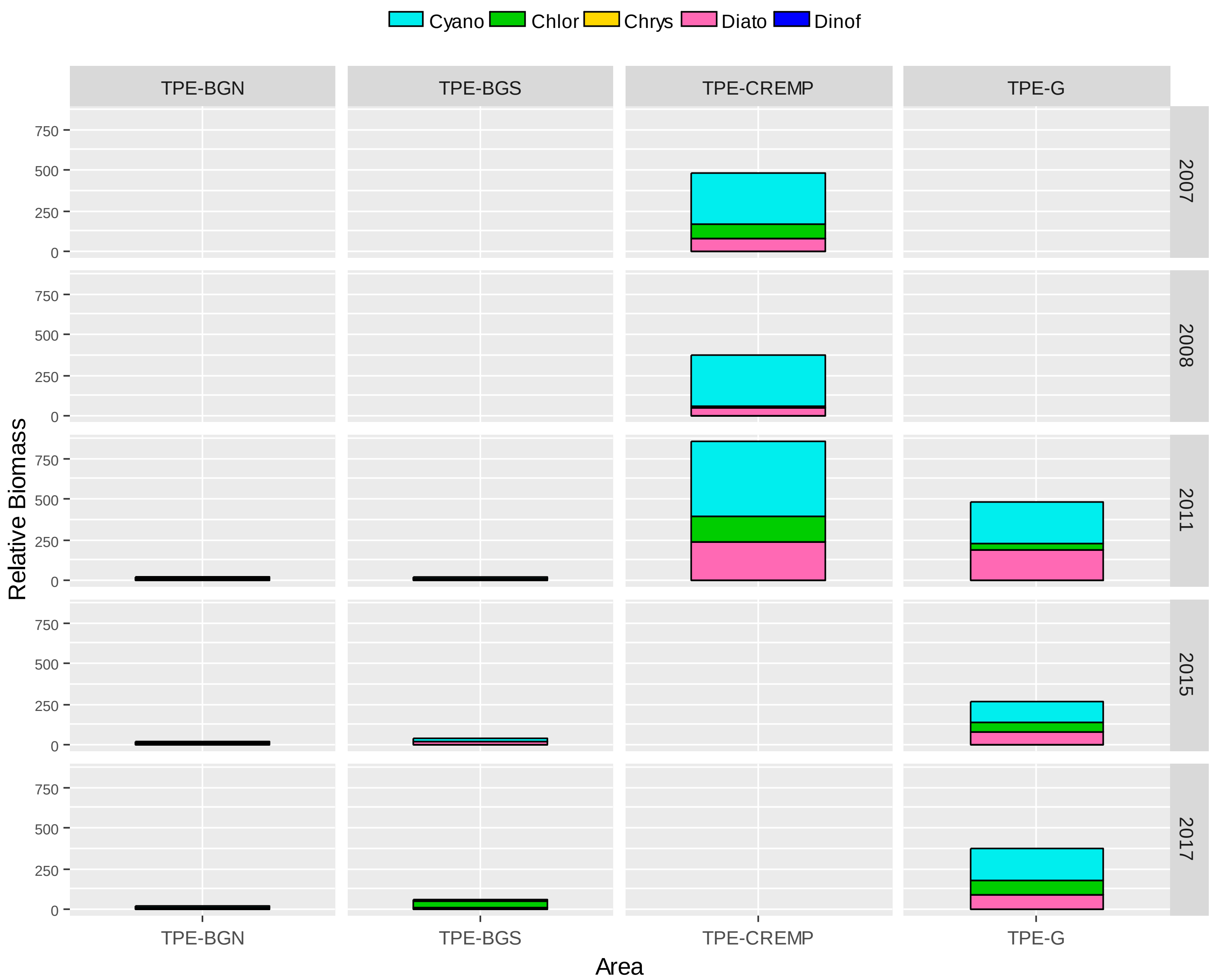


Figure 5. Mean and relative periphyton biomass (μg/cm²) for major taxa groups at Bay-Goose Dike HCF sampling areas.



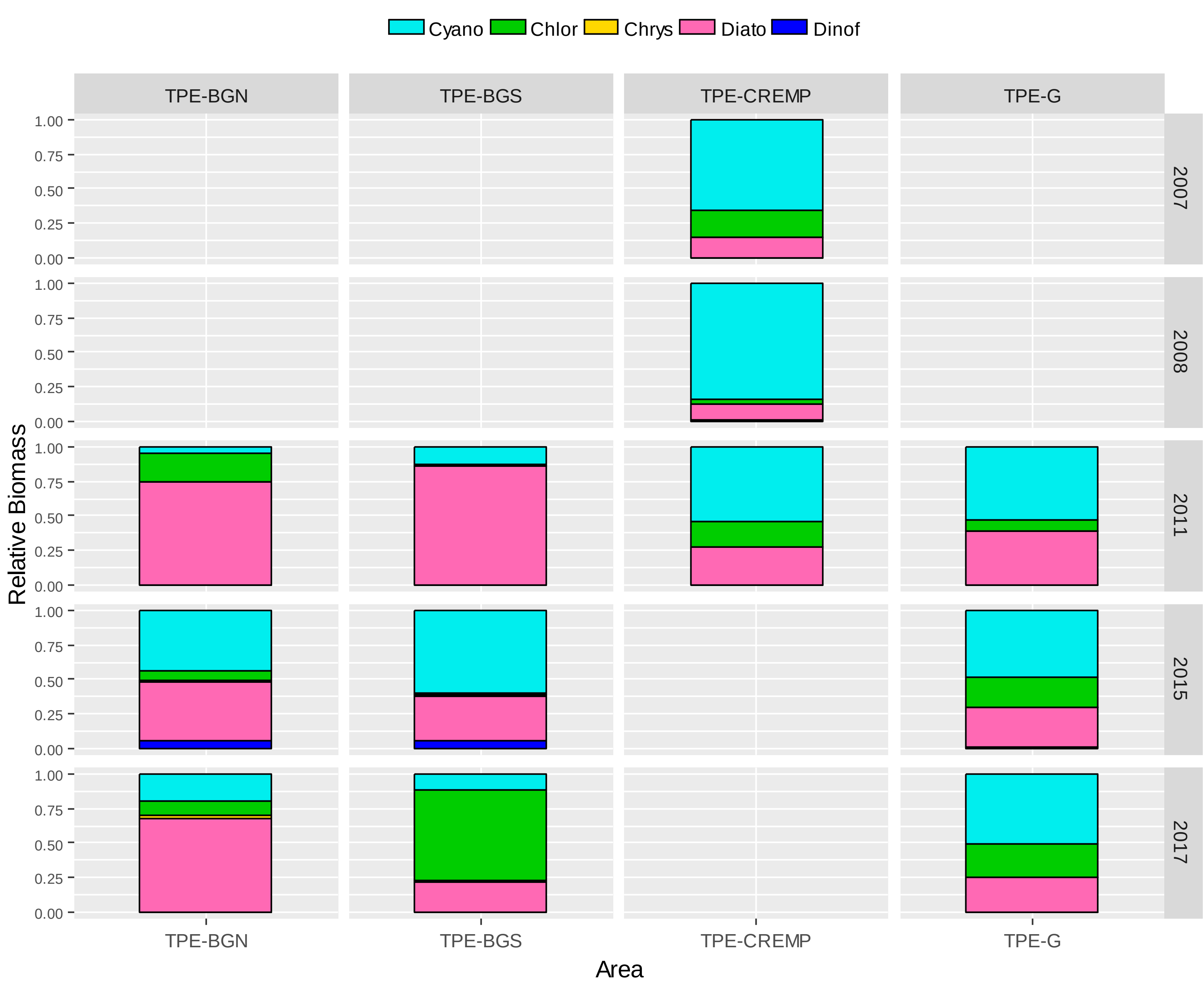
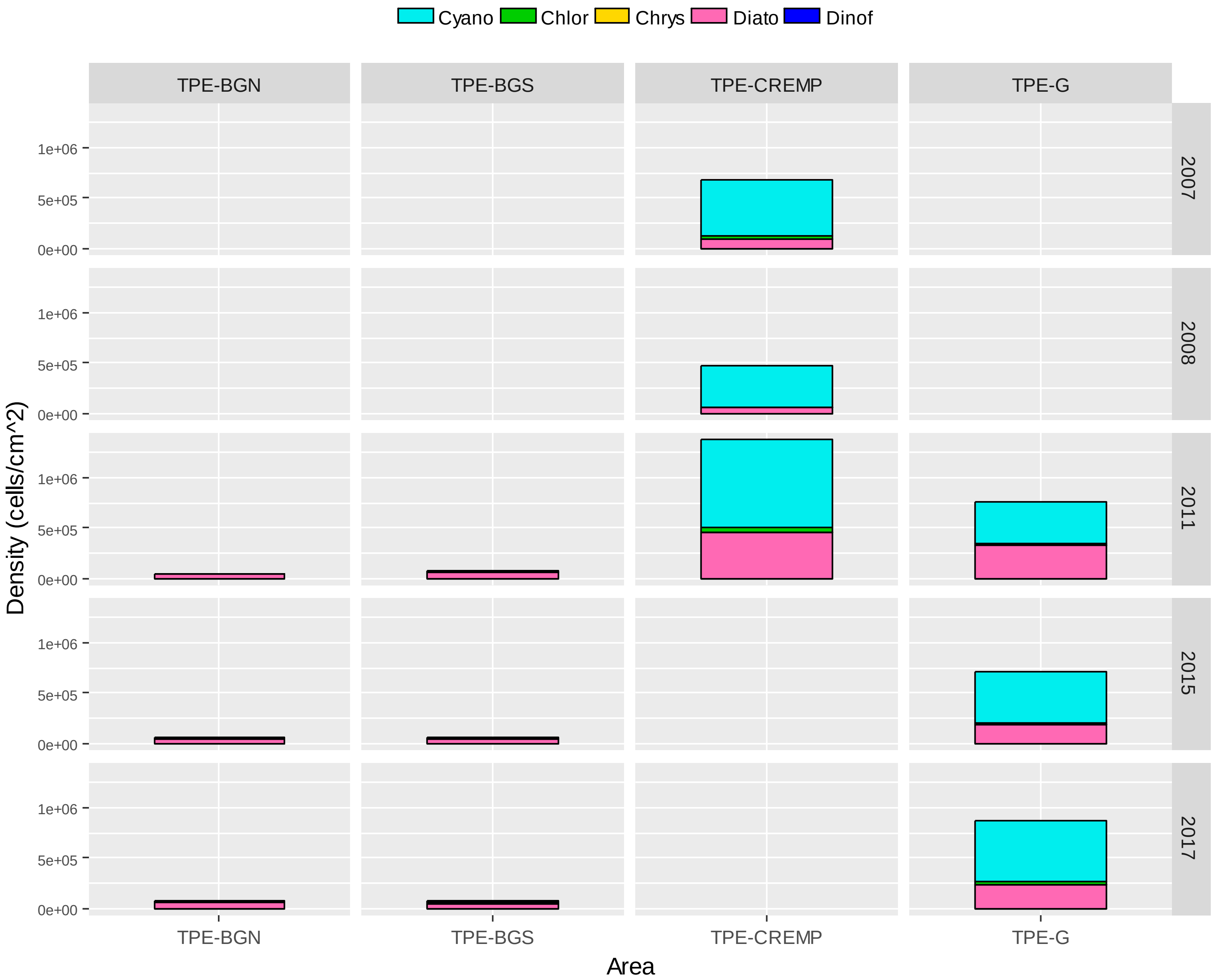
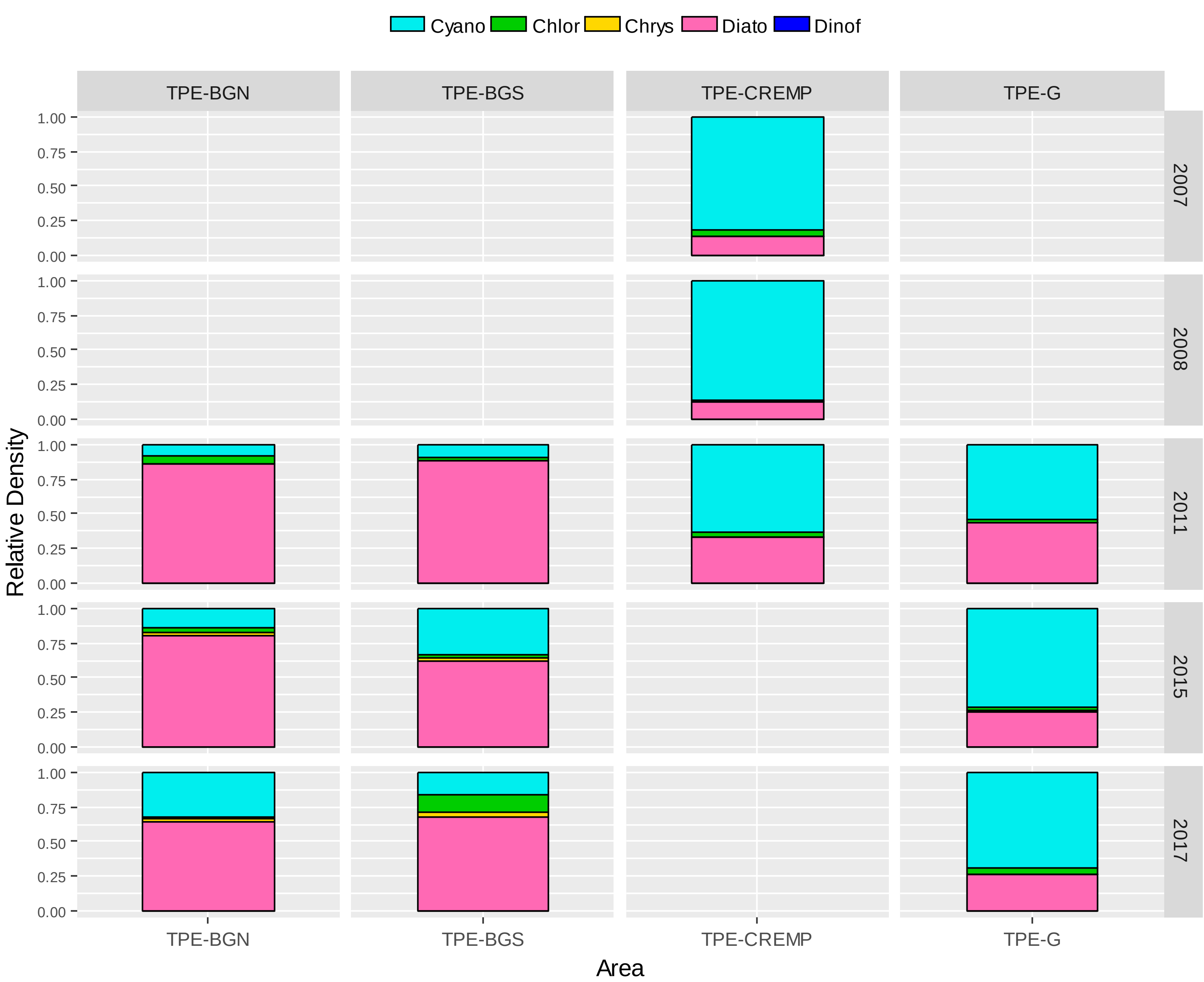


Figure 6. Mean and relative periphyton density (cells/cm^2) for major taxa groups at Bay-Goose Dike HCF sampling areas.





LIST OF APPENDICES

APPENDIX A

Standard Operating Procedure - HCMP Periphyton Sampling

Standard Operating Procedure

Meadowbank Project Lakes

HCM Periphyton Sampling

Equipment:

- Field collection data forms, pencils, waterproof markers & clipboard
- GPS unit, batteries
- Periphyton sampler, syringes & plastic tubes
- Binder clips (to pinch tubes on periphyton sampler)
- Shoulder gloves (with 5 cm increments marked from fingertip to shoulder)
- Large tote
- Field sample bottles & preservative (per replicate):
    - 1 – 500 mL plastic jar
    - 1 syringe & Lugol's solution
- Cooler(s) or action packer(s) (for storing and shipping samples)
- Address labels for cooler(s)/action packer(s)
- Chain-of-custody forms
- Large Ziploc bag (for sending chain-of-custody form in cooler)
- Packing tape (for sealing cooler)

General Procedures:

- Before going into the field, **label** all **sampling containers**. Using a permanent waterproof marker, print the following information directly onto both the jar and jar lid:
    - Azimuth company name
    - Station abbreviation (e.g. SP-CREMP) and replicate number (e.g. SP-CREMP -1, TPE-CREMP-2)
    - Date of sample collection

- Before and during sampling fill in the requested information on the **field data form**. Forms are made of waterproof paper; **print** all information on the form using a **lead pencil** or write-in-the-rain pen.

- Access to the area may be by boat or foot; in either event, ensure the sampling area is not impacted by boat (launch) or other anthropogenic activities. Record the **UTM coordinates** for each sampling station, measured using a GPS unit in NAD 83, on the field data form. In future sampling events, sample periphyton from the same locations.

- **Select a rock** with a **flat surface**, no more than 0.5 meter below the water surface, with the following criteria:

    - Facing up as much as possible; if not, with a small slope
    - Uniform algal coverage, not uniformly dense or sparse

- The periphyton sampler is a specially designed **scrubber**, consisting of a plexiglass tube with a plunger that fits snugly inside and a distal wire brush that is in direct contact with the rock surface. Press the tube against the rock to form a tight seal. To **detach** the **periphyton colonies**, depress the plunger and twist for approximately 30 half turns. The periphyton mixture is suspended (i.e. by opening the plunger approximately ¼ of the device volume) and drawn into a syringe that is attached to the tube (pinch intake tube closed when drawing suspension into syringe). Empty the syringe (pinch output tube closed prior to detaching the syringe) into the pre-labeled replicate 1 sampling container (i.e. TPE-CREMP-1). Continue scraping and syringing (approximately 2 times: another 20 half turns of the sampler, then 10 half turns, then a final rinse of sampler) until all visible periphyton are completely removed from the rock surface. This procedure works well with two people; one to scrub the rocks and clamp the intake tube, the other to operate the syringe and clamp the output tube. The number of turns in this SOP errs on the side of caution and may be too many for the average sampling site. Use discretion and examine each sampled rock to ensure it has been fully cleaned where the scrubber was used.

- **Repeat** rock selection and scrubbing steps **two more times**, selecting undisturbed flat rocks in less than 0.5 meter of water. Put the collected periphyton samples from each rock into the same pre-labeled replicate 1 sampling container (i.e. TPE-1) as above. These <u>3 rocks are composited</u> into one replicate sample; approximately 500 mL of water/periphyton are collected in total.

- **Repeat** above steps for each replicate required at the station. For every 125 mL of periphyton mixture in each sampling container, **add 1 mL of Lugol's solution** to preserve the sample (the sample should look the colour of weak tea). Seal the sampling containers and store in a cooler at **room temperature**.

- Fill out a **chain-of-custody** form completely and place into a sealed Ziploc plastic bag inside the shipping container. If using digital COC form, print 2 copies of the document in the field (one for the laboratory, one for Azimuth). Questions about COCs can be directed to Eric Franz.

HCM Periphyton Scrubbing

- Collect periphyton scrubbing samples from **5 stations** within SP and TPE
- Stations in SP that will be revisited are: SP-DT and SP-ED
- Stations in TPE will include: TPE-BGN, TPE-BGS and TPE-G (reference site)
- Each station consists of 5 replicate samples (these are close together for 4 stations but spread out for the 2 dike stations)
- Each replicate will consist of scrubbings from 3 rocks and will be placed in 1 x 500mL jar and preserved with Lugol's solution
- Ship samples and COC to David Findlay at Plankton R Us

David Findlay
Plankton R Us Inc.
39 Alburg Drive
Winnipeg, MB
R2N 1M1
Tel: 204-254-7952

NOTE: Along the dike face it may be necessary to set up a tote to receive the rock. If the aspect of the dike face is too steep to safely or properly sample in-situ place the rock in the tote in the boat. It must hold enough water to cover the sampled rock so that the plunger works properly. Make sure the tote is clean after each sample.

APPENDIX B

Periphyton Laboratory Data

Appendix B
Periphyton Laboratory Data
Plankton R Us, Winnipeg, MB

Epilithic (El) algal species data for CREMP (Project HCMP) 2017 (for Azimuth consulting group)

**** 1st number in species code = group 1=cyanobacteria 2=chlorophyte 5=diatoms 7=Dinoflagellates**

**** total daily biomass is sum of all species on a given date**

***********R specifies a replicate count for QA/QC**

Location	Station	Date	Species code	Speceis name	density cells/cm^2	biomass µg/cm^2	length µ	width µ	cell volume µ^3
DUP	1	06-Sep-17	1057	Leptolyngbya lemnetica (Anaga.) Anagnostid	5127	0.72	124.00	1.20	140.20
DUP	1	06-Sep-17	1077	Pseudoanabaena sp.	25635	0.28	2.40	2.40	10.90
DUP	1	06-Sep-17	1084	Gloeocapsa punctata	130737	4.38	4.00	4.00	33.50
DUP	1	06-Sep-17	1102	Gloeothece sp.	48706	0.23	2.10	2.10	4.80
DUP	1	06-Sep-17	1131	Heteroleibeinia profunda Komarek	297363	23.91	25.60	2.00	80.40
DUP	1	06-Sep-17	1220	Rivularia dura Roth	15381	75.73	91.00	8.30	4923.70
DUP	1	06-Sep-17	1223	Chamaesiphon incrustans Smith	17944	0.48	5.70	3.00	26.90
DUP	1	06-Sep-17	2205	Mougeotia sp.	2563	2.90	40.00	6.00	1131.00
DUP	1	06-Sep-17	2954	Stigeoclonium sp.	10254	11.28	14.00	10.00	1099.60
DUP	1	06-Sep-17	5513	Tabellaria fenestrata (Lyngbye) Kutzing	15381	20.87	81.00	8.00	1357.20
DUP	1	06-Sep-17	5514	Tabellaria flocculsa (Roth) Kutzing	48706	64.98	26.00	14.00	1334.10
DUP	1	06-Sep-17	5547	Frustulia rhomboides (Ehrenberg) de Toni	2563	6.95	69.00	10.00	2709.60
DUP	1	06-Sep-17	5702	Achnanthes minutissima Kutzing	92285	6.80	17.60	4.00	73.70
DUP	1	06-Sep-17	5726	Eucocconeis sp.	2563	11.01	41.00	20.00	4293.50
DUP	1	06-Sep-17	5767	Nitzschia fonticola Grunow	5127	0.21	10.00	4.00	41.90
DUP	1	06-Sep-17	5836	Encyonema silesiacum (Bleisch) D.G. Mann	10254	12.08	30.00	10.00	1178.10
DUP	1	06-Sep-17	5857	Nitzschia filiformis (W. Smith) Hustedt	17944	2.39	53.00	3.10	133.30
DUP	1	06-Sep-17	5873	Gomphonema minutum	10254	4.30	25.00	8.00	418.90
DUP	1	06-Sep-17	5875	Cocconies disculus Schum.	10254	16.31	31.00	14.00	1590.70
DUP	1	06-Sep-17	5882	Anomoenies vitrea Ross	10254	3.29	34.00	6.00	320.40
DUP	1	06-Sep-17	5901	Denticula sp	10254	2.42	25.00	6.00	235.60
SP-DT	1	01-Sep-17	1014	Chroococcus limneticus Lemmermann	86133	2.10	3.60	3.60	24.40
SP-DT	1	01-Sep-17	1057	Leptolyngbya lemnetica (Anaga.) Anagnostid	50244	21.47	136.00	2.00	427.30
SP-DT	1	01-Sep-17	1077	Pseudoanabaena sp.	129199	1.61	3.00	2.30	12.50
SP-DT	1	01-Sep-17	1124	Petalonema alatum Berk	93310	290.21	110.00	6.00	3110.20
SP-DT	1	01-Sep-17	1136	Lyngbya mucicola Lemmermann	488085	27.58	72.00	1.00	56.50
SP-DT	1	01-Sep-17	5311	Cymbella minuta Kutzing	7178	2.34	15.60	7.30	326.50
SP-DT	1	01-Sep-17	5509	Cyclotella ocellata Pant.	7178	3.17	10.40	10.40	441.70
SP-DT	1	01-Sep-17	5514	Tabellaria flocculsa (Roth) Kutzing	7178	9.06	24.60	14.00	1262.30
SP-DT	1	01-Sep-17	5519	Synedra acus v. radians (Kutzing) Hustedt	3589	0.20	53.00	2.00	55.50
SP-DT	1	01-Sep-17	5702	Achnanthes minutissima Kutzing	319409	26.22	19.60	4.00	82.10
SP-DT	1	01-Sep-17	5726	Eucocconeis sp.	7178	30.82	41.00	20.00	4293.50
SP-DT	1	01-Sep-17	5820	Eunotia arcus Ehrenberg	7178	8.64	46.00	10.00	1204.30
SP-DT	1	01-Sep-17	5836	Encyonema silesiacum (Bleisch) D.G. Mann	35889	42.28	30.00	10.00	1178.10
SP-DT	1	01-Sep-17	5874	Nitzschia palea (Kutzing) W. Smith	3589	2.83	47.00	8.00	787.50
SP-DT	1	01-Sep-17	5875	Cocconies disculus Schum.	7178	9.58	26.00	14.00	1334.10
SP-DT	1	01-Sep-17	5876	Aulacoseira islandica v. helvetica Muller	3589	4.69	26.00	8.00	1306.90
SP-DT	1	01-Sep-17	5882	Anomoenies vitrea Ross	7178	2.23	33.00	6.00	311.00
SP-DT	2	01-Sep-17	1057	Leptolyngbya lemnetica (Anaga.) Anagnostid	14355	6.58	146.00	2.00	458.70
SP-DT	2	01-Sep-17	1124	Petalonema alatum Berk	68188	200.62	86.00	6.60	2942.20
SP-DT	2	01-Sep-17	1131	Heteroleibeinia profunda Komarek	35889	2.17	19.30	2.00	60.60
SP-DT	2	01-Sep-17	1136	Lyngbya mucicola Lemmermann	506029	35.37	89.00	1.00	69.90
SP-DT	2	01-Sep-17	5311	Cymbella minuta Kutzing	3589	1.30	16.00	7.60	362.90
SP-DT	2	01-Sep-17	5514	Tabellaria flocculsa (Roth) Kutzing	7178	9.58	26.00	14.00	1334.10
SP-DT	2	01-Sep-17	5519	Synedra acus v. radians (Kutzing) Hustedt	7178	0.42	56.00	2.00	58.60
SP-DT	2	01-Sep-17	5702	Achnanthes minutissima Kutzing	136377	11.20	19.60	4.00	82.10
SP-DT	2	01-Sep-17	5726	Eucocconeis sp.	10767	45.10	40.00	20.00	4188.80
SP-DT	2	01-Sep-17	5820	Eunotia arcus Ehrenberg	7178	27.48	65.00	15.00	3828.80
SP-DT	2	01-Sep-17	5836	Encyonema silesiacum (Bleisch) D.G. Mann	10767	12.68	30.00	10.00	1178.10
SP-DT	2	01-Sep-17	5865	Cymbella prostrata (Berkeley) Cleve	3589	65.48	96.00	22.00	18246.40
SP-DT	2	01-Sep-17	5874	Nitzschia palea (Kutzing) W. Smith	7178	4.87	72.00	6.00	678.60
SP-DT	2	01-Sep-17	5875	Cocconies disculus Schum.	3589	5.52	30.00	14.00	1539.40
SP-DT	2	01-Sep-17	5882	Anomoenies vitrea Ross	46655	13.63	31.00	6.00	292.20
SP-DT	2	01-Sep-17	5901	Denticula sp	3589	2.41	40.00	8.00	670.20
SP-DT	2	01-Sep-17	5910	Navicula exigua (Greg.) Muller	28711	15.87	33.00	8.00	552.90
SP-DT	3	01-Sep-17	1014	Chroococcus limneticus Lemmermann	29907	0.73	3.60	3.60	24.40
SP-DT	3	01-Sep-17	1057	Leptolyngbya lemnetica (Anaga.) Anagnostid	77759	31.76	130.00	2.00	408.40
SP-DT	3	01-Sep-17	1124	Petalonema alatum Berk	47851	148.98	91.00	6.60	3113.30
SP-DT	3	01-Sep-17	1136	Lyngbya mucicola Lemmermann	346923	25.33	93.00	1.00	73.00
SP-DT	3	01-Sep-17	2205	Mougeotia sp.	17944	80.33	57.00	10.00	4476.80
SP-DT	3	01-Sep-17	5306	Navicula minima Grunow	5981	0.35	11.00	4.50	58.30
SP-DT	3	01-Sep-17	5514	Tabellaria flocculsa (Roth) Kutzing	17944	23.94	26.00	14.00	1334.10
SP-DT	3	01-Sep-17	5702	Achnanthes minutissima Kutzing	77759	6.19	19.00	4.00	79.60
SP-DT	3	01-Sep-17	5726	Eucocconeis sp.	2991	12.53	40.00	20.00	4188.80
SP-DT	3	01-Sep-17	5781	Eunotia sp.	2991	5.09	65.00	10.00	1701.70

Epilithic (EI) algal species data for CREMP (Project HCMP) 2017 (for Azimuth consulting group)

**** 1st number in species code = group 1=cyanobacteria 2=chlorophyte 5=diatoms 7=Dinoflagellates**

**** total daily biomass is sum of all species on a given date**

************R specifies a replicate count for QA/QC**

Location	Station	Date	Species code	Speceis name	density cells/cm^2	biomass µg/cm^2	length µ	width µ	cell volume µ^3
SP-DT	3	01-Sep-17	5836	Encyonema silesiacum (Bleisch) D.G. Mann	2991	3.05	26.00	10.00	1021.00
SP-DT	3	01-Sep-17	5865	Cymbella prostrata (Berkeley) Cleve	8972	149.16	96.00	21.00	16625.30
SP-DT	3	01-Sep-17	5870	Navicula radiosa Kutzing	2991	5.09	65.00	10.00	1701.70
SP-DT	3	01-Sep-17	5875	Cocconies disculus Schum.	5981	9.21	30.00	14.00	1539.40
SP-DT	3	01-Sep-17	5882	Anomoenies vitrea Ross	20935	6.51	33.00	6.00	311.00
SP-DT	3	01-Sep-17	5910	Navicula exigua (Greg.) Muller	17944	6.93	41.00	6.00	386.40
SP-DT	4	01-Sep-17	1057	Leptolyngbya lemnetica (Anaga.) Anagnostid	23926	12.25	163.00	2.00	512.10
SP-DT	4	01-Sep-17	1084	Gloeocapsa punctata	203369	6.81	4.00	4.00	33.50
SP-DT	4	01-Sep-17	1124	Petalonema alatum Berk	17944	46.66	76.00	6.60	2600.10
SP-DT	4	01-Sep-17	1131	Heteroleibeinia profunda Komarek	62805	4.15	21.00	2.00	66.00
SP-DT	4	01-Sep-17	1136	Lyngbya mucicola Lemmermann	331970	22.41	86.00	1.00	67.50
SP-DT	4	01-Sep-17	2193	Staurodesmus paradoxum Meyen	2991	12.21	30.00	26.00	4084.10
SP-DT	4	01-Sep-17	5306	Navicula minima Grunow	8972	0.65	11.00	5.00	72.00
SP-DT	4	01-Sep-17	5513	Tabellaria fenestrata (Lyngbye) Kutzing	5981	16.13	103.00	10.00	2696.50
SP-DT	4	01-Sep-17	5514	Tabellaria flocculsa (Roth) Kutzing	5981	7.98	26.00	14.00	1334.10
SP-DT	4	01-Sep-17	5702	Achnanthes minutissima Kutzing	293090	23.33	19.00	4.00	79.60
SP-DT	4	01-Sep-17	5726	Eucocconeis sp.	17944	75.17	40.00	20.00	4188.80
SP-DT	4	01-Sep-17	5728	Epithemia argus Kutzing	5981	32.07	80.00	16.00	5361.70
SP-DT	4	01-Sep-17	5836	Encyonema silesiacum (Bleisch) D.G. Mann	2991	3.52	30.00	10.00	1178.10
SP-DT	4	01-Sep-17	5870	Navicula radiosa Kutzing	2991	5.32	68.00	10.00	1780.20
SP-DT	4	01-Sep-17	5873	Gomphonema minutum	23926	10.42	26.00	8.00	435.60
SP-DT	4	01-Sep-17	5874	Nitzschia palea (Kutzing) W. Smith	2991	2.46	49.00	8.00	821.00
SP-DT	4	01-Sep-17	5882	Anomoenies vitrea Ross	35889	11.16	33.00	6.00	311.00
SP-DT	4	01-Sep-17	5910	Navicula exigua (Greg.) Muller	20935	14.38	41.00	8.00	687.00
SP-DT	5	01-Sep-17	1057	Leptolyngbya lemnetica (Anaga.) Anagnostid	14954	5.92	126.00	2.00	395.80
SP-DT	5	01-Sep-17	1084	Gloeocapsa punctata	71777	2.40	4.00	4.00	33.50
SP-DT	5	01-Sep-17	1124	Petalonema alatum Berk	17944	52.80	86.00	6.60	2942.20
SP-DT	5	01-Sep-17	1131	Heteroleibeinia profunda Komarek	35889	1.81	16.00	2.00	50.30
SP-DT	5	01-Sep-17	1136	Lyngbya mucicola Lemmermann	218322	15.26	89.00	1.00	69.90
SP-DT	5	01-Sep-17	1220	Rivularia dura Roth	20935	105.58	91.00	8.40	5043.00
SP-DT	5	01-Sep-17	5311	Cymbella minuta Kutzing	5981	2.35	15.60	8.00	392.10
SP-DT	5	01-Sep-17	5514	Tabellaria flocculsa (Roth) Kutzing	17944	23.94	26.00	14.00	1334.10
SP-DT	5	01-Sep-17	5702	Achnanthes minutissima Kutzing	308044	24.52	19.00	4.00	79.60
SP-DT	5	01-Sep-17	5836	Encyonema silesiacum (Bleisch) D.G. Mann	8972	10.57	30.00	10.00	1178.10
SP-DT	5	01-Sep-17	5870	Navicula radiosa Kutzing	2991	5.40	69.00	10.00	1806.40
SP-DT	5	01-Sep-17	5873	Gomphonema minutum	5981	2.71	27.00	8.00	452.40
SP-DT	5	01-Sep-17	5882	Anomoenies vitrea Ross	20935	6.71	34.00	6.00	320.40
SP-DT	5	01-Sep-17	5884	Gomphonema angustum Agardh	5981	6.89	44.00	10.00	1151.90
SP-DT	5	01-Sep-17	5910	Navicula exigua (Greg.) Muller	2991	1.16	41.00	6.00	386.40
SP-DT	5	01-Sep-17	5910	Navicula exigua (Greg.) Muller	8972	5.12	50.00	6.60	570.20
SP-ED	1	01-Sep-17	1057	Leptolyngbya lemnetica (Anaga.) Anagnostid	17944	6.54	116.00	2.00	364.40
SP-ED	1	01-Sep-17	1077	Pseudoanabaena sp.	17944	0.28	2.70	2.70	15.50
SP-ED	1	01-Sep-17	1122	Phormidium autumnale Agardh	1794	4.77	94.00	6.00	2657.80
SP-ED	1	01-Sep-17	1124	Petalonema alatum Berk	3589	10.80	103.00	6.10	3010.10
SP-ED	1	01-Sep-17	1131	Heteroleibeinia profunda Komarek	19739	1.49	24.10	2.00	75.70
SP-ED	1	01-Sep-17	1136	Lyngbya mucicola Lemmermann	209948	9.24	56.00	1.00	44.00
SP-ED	1	01-Sep-17	4388	Dinobryon sertularia Ehrenberg	12561	2.84	12.00	6.00	226.20
SP-ED	1	01-Sep-17	5306	Navicula minima Grunow	1794	0.12	12.00	4.60	66.50
SP-ED	1	01-Sep-17	5514	Tabellaria flocculsa (Roth) Kutzing	19739	25.83	25.50	14.00	1308.50
SP-ED	1	01-Sep-17	5702	Achnanthes minutissima Kutzing	87927	7.00	19.00	4.00	79.60
SP-ED	1	01-Sep-17	5726	Eucocconeis sp.	1794	7.70	41.00	20.00	4293.50
SP-ED	1	01-Sep-17	5873	Gomphonema minutum	7178	3.17	26.40	8.00	442.30
SP-ED	1	01-Sep-17	5874	Nitzschia palea (Kutzing) W. Smith	5383	3.09	61.00	6.00	574.90
SP-ED	1	01-Sep-17	5875	Cocconies disculus Schum.	1794	2.85	31.00	14.00	1590.70
SP-ED	1	01-Sep-17	5882	Anomoenies vitrea Ross	5383	1.83	36.00	6.00	339.30
SP-ED	1	01-Sep-17	5884	Gomphonema angustum Agardh	1794	1.93	41.00	10.00	1073.40
SP-ED	1	01-Sep-17	5910	Navicula exigua (Greg.) Muller	5383	1.93	38.00	6.00	358.10
SP-ED	2	01-Sep-17	1057	Leptolyngbya lemnetica (Anaga.) Anagnostid	37384	13.62	116.00	2.00	364.40
SP-ED	2	01-Sep-17	1102	Gloeothece sp.	195892	0.94	2.10	2.10	4.80
SP-ED	2	01-Sep-17	1136	Lyngbya mucicola Lemmermann	49347	2.13	55.00	1.00	43.20
SP-ED	2	01-Sep-17	2205	Mougeotia sp.	17944	85.97	61.00	10.00	4790.90
SP-ED	2	01-Sep-17	5306	Navicula minima Grunow	2991	0.12	9.60	4.00	40.20
SP-ED	2	01-Sep-17	5311	Cymbella minuta Kutzing	5981	1.90	14.00	7.60	317.60
SP-ED	2	01-Sep-17	5509	Cyclotella ocellata Pant.	1495	0.59	10.00	10.00	392.70
SP-ED	2	01-Sep-17	5514	Tabellaria flocculsa (Roth) Kutzing	46356	61.84	26.00	14.00	1334.10

Appendix B

Periphyton Laboratory Data

Plankton R Us, Winnipeg, MB

Epilithic (EI) algal species data for CREMP (Project HCMP) 2017 (for Azimuth consulting group)

**** 1st number in species code = group 1=cyanobacteria 2=chlorophyte 5=diatoms 7=Dinoflagellates**

**** total daily biomass is sum of all species on a given date**

**********R specifies a replicate count for QA/QC**

Location	Station	Date	Species code	Speceis name	density cells/cm^2	biomass µg/cm^2	length µ	width µ	cell volume µ^3
SP-ED	2	01-Sep-17	5546	Gyrosigma sp	1495	2.47	86.00	7.00	1654.80
SP-ED	2	01-Sep-17	5551	Cyclotella michiganiana Skvortzow	2991	0.15	5.00	5.00	49.10
SP-ED	2	01-Sep-17	5702	Achnanthes minutissima Kutzing	139068	12.82	22.00	4.00	92.20
SP-ED	2	01-Sep-17	5726	Eucocconeis sp.	2991	12.84	41.00	20.00	4293.50
SP-ED	2	01-Sep-17	5768	Nitzschia linearis W. Smith	2991	2.61	52.00	8.00	871.30
SP-ED	2	01-Sep-17	5836	Encyonema silesiacum (Bleisch) D.G. Mann	2991	3.52	30.00	10.00	1178.10
SP-ED	2	01-Sep-17	5873	Gomphonema minutum	4486	2.03	27.00	8.00	452.40
SP-ED	2	01-Sep-17	5874	Nitzschia palea (Kutzing) W. Smith	5981	3.89	69.00	6.00	650.30
SP-ED	2	01-Sep-17	5882	Anomoenies vitrea Ross	23926	8.57	38.00	6.00	358.10
SP-ED	2	01-Sep-17	5884	Gomphonema angustum Agardh	2991	3.21	41.00	10.00	1073.40
SP-ED	2	01-Sep-17	5910	Navicula exigua (Greg.) Muller	16449	5.27	34.00	6.00	320.40
SP-ED	3	01-Sep-17	1057	Leptolyngbya lemnetica (Anaga.) Anagnostid	13803	4.16	96.00	2.00	301.60
SP-ED	3	01-Sep-17	1102	Gloeothece sp.	88341	0.37	2.00	2.00	4.20
SP-ED	3	01-Sep-17	1136	Lyngbya mucicola Lemmermann	20705	0.83	51.00	1.00	40.10
SP-ED	3	01-Sep-17	4388	Dinobryon sertularia Ehrenberg	1380	0.31	12.00	6.00	226.20
SP-ED	3	01-Sep-17	5306	Navicula minima Grunow	22085	1.59	11.00	5.00	72.00
SP-ED	3	01-Sep-17	5514	Tabellaria flocculsa (Roth) Kutzing	48312	64.45	26.00	14.00	1334.10
SP-ED	3	01-Sep-17	5546	Gyrosigma sp	1380	1.91	81.00	6.60	1385.60
SP-ED	3	01-Sep-17	5702	Achnanthes minutissima Kutzing	191866	17.77	22.10	4.00	92.60
SP-ED	3	01-Sep-17	5726	Eucocconeis sp.	6902	28.91	40.00	20.00	4188.80
SP-ED	3	01-Sep-17	5768	Nitzschia linearis W. Smith	1380	2.49	69.00	10.00	1806.40
SP-ED	3	01-Sep-17	5836	Encyonema silesiacum (Bleisch) D.G. Mann	1380	1.63	30.00	10.00	1178.10
SP-ED	3	01-Sep-17	5873	Gomphonema minutum	1380	0.62	27.00	8.00	452.40
SP-ED	3	01-Sep-17	5874	Nitzschia palea (Kutzing) W. Smith	13803	7.94	61.00	6.00	574.90
SP-ED	3	01-Sep-17	5882	Anomoenies vitrea Ross	5521	1.87	36.00	6.00	339.30
SP-ED	3	01-Sep-17	5910	Navicula exigua (Greg.) Muller	35889	11.50	34.00	6.00	320.40
SP-ED	4	01-Sep-17	1015	Chroococcus turgidus (Kutzing) Nageli	11043	4.07	11.00	8.00	368.60
SP-ED	4	01-Sep-17	1057	Leptolyngbya lemnetica (Anaga.) Anagnostid	16564	5.26	101.00	2.00	317.30
SP-ED	4	01-Sep-17	1084	Gloeocapsa punctata	31748	1.06	4.00	4.00	33.50
SP-ED	4	01-Sep-17	1102	Gloeothece sp.	63495	0.27	2.00	2.00	4.20
SP-ED	4	01-Sep-17	1131	Heteroleibeinia profunda Komarek	27607	1.71	19.69	2.00	61.90
SP-ED	4	01-Sep-17	1136	Lyngbya mucicola Lemmermann	19325	0.80	53.00	1.00	41.60
SP-ED	4	01-Sep-17	5306	Navicula minima Grunow	4141	0.19	11.00	4.00	46.10
SP-ED	4	01-Sep-17	5311	Cymbella minuta Kutzing	1380	0.41	15.60	7.00	300.20
SP-ED	4	01-Sep-17	5507	Cyclotella stelligera Cleve and Grunow	1380	6.26	22.60	22.60	4533.00
SP-ED	4	01-Sep-17	5514	Tabellaria flocculsa (Roth) Kutzing	6902	9.21	26.00	14.00	1334.10
SP-ED	4	01-Sep-17	5547	Frustulia rhomboides (Ehrenberg) de Toni	1380	3.52	65.00	10.00	2552.50
SP-ED	4	01-Sep-17	5551	Cyclotella michiganiana Skvortzow	5521	0.27	5.00	5.00	49.10
SP-ED	4	01-Sep-17	5702	Achnanthes minutissima Kutzing	157358	14.51	22.00	4.00	92.20
SP-ED	4	01-Sep-17	5726	Eucocconeis sp.	1380	5.78	40.00	20.00	4188.80
SP-ED	4	01-Sep-17	5768	Nitzschia linearis W. Smith	4141	9.32	86.00	10.00	2251.50
SP-ED	4	01-Sep-17	5836	Encyonema silesiacum (Bleisch) D.G. Mann	2761	3.36	31.00	10.00	1217.40
SP-ED	4	01-Sep-17	5874	Nitzschia palea (Kutzing) W. Smith	5521	3.17	61.00	6.00	574.90
SP-ED	4	01-Sep-17	5882	Anomoenies vitrea Ross	16564	5.31	34.00	6.00	320.40
SP-ED	4	01-Sep-17	5884	Gomphonema angustum Agardh	11043	12.14	42.00	10.00	1099.60
SP-ED	4	01-Sep-17	5910	Navicula exigua (Greg.) Muller	8282	2.42	31.00	6.00	292.20
SP-ED	5	01-Sep-17	1057	Leptolyngbya lemnetica (Anaga.) Anagnostid	28711	9.11	101.00	2.00	317.30
SP-ED	5	01-Sep-17	1084	Gloeocapsa punctata	181237	6.07	4.00	4.00	33.50
SP-ED	5	01-Sep-17	1117	Merismopedia punctata Meyen	57422	0.90	3.10	3.10	15.60
SP-ED	5	01-Sep-17	1136	Lyngbya mucicola Lemmermann	17944	0.79	56.00	1.00	44.00
SP-ED	5	01-Sep-17	4388	Dinobryon sertularia Ehrenberg	10767	2.44	12.00	6.00	226.20
SP-ED	5	01-Sep-17	5509	Cyclotella ocellata Pant.	1794	0.70	10.00	10.00	392.70
SP-ED	5	01-Sep-17	5514	Tabellaria flocculsa (Roth) Kutzing	100488	123.75	24.00	14.00	1231.50
SP-ED	5	01-Sep-17	5519	Synedra acus v. radians (Kutzing) Hustedt	7178	0.38	51.00	2.00	53.40
SP-ED	5	01-Sep-17	5546	Gyrosigma sp	1794	1.67	66.00	6.00	933.10
SP-ED	5	01-Sep-17	5702	Achnanthes minutissima Kutzing	61011	4.83	18.90	4.00	79.20
SP-ED	5	01-Sep-17	5726	Eucocconeis sp.	10767	45.10	40.00	20.00	4188.80
SP-ED	5	01-Sep-17	5767	Nitzschia fonticola Grunow	1794	0.28	24.00	5.00	157.10
SP-ED	5	01-Sep-17	5836	Encyonema silesiacum (Bleisch) D.G. Mann	3589	4.23	30.00	10.00	1178.10
SP-ED	5	01-Sep-17	5873	Gomphonema minutum	7178	3.13	26.00	8.00	435.60
SP-ED	5	01-Sep-17	5882	Anomoenies vitrea Ross	10767	3.55	35.00	6.00	329.90
SP-ED	5	01-Sep-17	5910	Navicula exigua (Greg.) Muller	3589	1.32	39.00	6.00	367.60
SP-ED	5R	01-Sep-17	1057	Leptolyngbya lemnetica (Anaga.) Anagnostid	26916	8.54	101.00	2.00	317.30
SP-ED	5R	01-Sep-17	1084	Gloeocapsa punctata	199182	6.67	4.00	4.00	33.50
SP-ED	5R	01-Sep-17	1136	Lyngbya mucicola Lemmermann	10767	0.47	56.00	1.00	44.00

Epilithic (El) algal species data for CREMP (Project HCMP) 2017 (for Azimuth consulting group)

**** 1st number in species code = group 1=cyanobacteria 2=chlorophyte 5=diatoms 7=Dinoflagellates**

**** total daily biomass is sum of all species on a given date**

*********R specifies a replicate count for QA/QC**

Location	Station	Date	Species code	Speceis name	density cells/cm^2	biomass µg/cm^2	length µ	width µ	cell volume µ^3
SP-ED	5R	01-Sep-17	4388	Dinobryon sertularia Ehrenberg	16150	3.65	12.00	6.00	226.20
SP-ED	5R	01-Sep-17	5507	Cyclotella stelligera Cleve and Grunow	3589	8.13	11.30	22.60	2266.50
SP-ED	5R	01-Sep-17	5509	Cyclotella ocellata Pant.	3589	1.41	10.00	10.00	392.70
SP-ED	5R	01-Sep-17	5513	Tabellaria fenestrata (Lyngbye) Kutzing	3589	8.55	91.00	10.00	2382.40
SP-ED	5R	01-Sep-17	5514	Tabellaria flocculsa (Roth) Kutzing	96899	119.33	24.00	14.00	1231.50
SP-ED	5R	01-Sep-17	5519	Synedra acus v. radians (Kutzing) Hustedt	3589	0.19	51.00	2.00	53.40
SP-ED	5R	01-Sep-17	5702	Achnanthes minutissima Kutzing	64599	5.12	18.90	4.00	79.20
SP-ED	5R	01-Sep-17	5726	Eucocconeis sp.	8972	37.58	40.00	20.00	4188.80
SP-ED	5R	01-Sep-17	5767	Nitzschia fonticola Grunow	1794	0.28	24.00	5.00	157.10
SP-ED	5R	01-Sep-17	5836	Encyonema silesiacum (Bleisch) D.G. Mann	5383	6.34	30.00	10.00	1178.10
SP-ED	5R	01-Sep-17	5873	Gomphonema minutum	3589	1.56	26.00	8.00	435.60
SP-ED	5R	01-Sep-17	5882	Anomoenies vitrea Ross	16150	5.33	35.00	6.00	329.90
SP-ED	5R	01-Sep-17	5884	Gomphonema angustum Agardh	10767	12.68	45.00	10.00	1178.10
SP-ED	5R	01-Sep-17	5910	Navicula exigua (Greg.) Muller	1794	0.66	39.00	6.00	367.60
TPE-G	1	06-Sep-17	1057	Leptolyngbya lemnetica (Anaga.) Anagnostid	8972	2.19	216.00	1.20	244.30
TPE-G	1	06-Sep-17	1102	Gloeothece sp.	159704	0.77	2.10	2.10	4.80
TPE-G	1	06-Sep-17	1131	Heteroleibeinia profunda Komarek	213537	14.50	21.60	2.00	67.90
TPE-G	1	06-Sep-17	1220	Rivularia dura Roth	10767	53.01	91.00	8.30	4923.70
TPE-G	1	06-Sep-17	1223	Chamaesiphon incrustans Smith	28711	0.87	6.40	3.00	30.20
TPE-G	1	06-Sep-17	2205	Mougeotia sp.	7178	24.80	44.00	10.00	3455.80
TPE-G	1	06-Sep-17	5509	Cyclotella ocellata Pant.	1794	0.45	8.60	8.60	249.80
TPE-G	1	06-Sep-17	5514	Tabellaria flocculsa (Roth) Kutzing	10767	14.36	26.00	14.00	1334.10
TPE-G	1	06-Sep-17	5547	Frustulia rhomboides (Ehrenberg) de Toni	1794	4.37	62.00	10.00	2434.70
TPE-G	1	06-Sep-17	5702	Achnanthes minutissima Kutzing	122021	9.71	19.00	4.00	79.60
TPE-G	1	06-Sep-17	5726	Eucocconeis sp.	1794	7.70	41.00	20.00	4293.50
TPE-G	1	06-Sep-17	5769	Nitzschia sigmoidea (Ehenberg) W. Smith	1794	1.06	52.00	6.60	593.00
TPE-G	1	06-Sep-17	5836	Encyonema silesiacum (Bleisch) D.G. Mann	5383	6.34	30.00	10.00	1178.10
TPE-G	1	06-Sep-17	5857	Nitzschia filiformis (W. Smith) Hustedt	1794	0.22	51.00	3.00	120.20
TPE-G	1	06-Sep-17	5873	Gomphonema minutum	8972	3.91	26.00	8.00	435.60
TPE-G	1	06-Sep-17	5882	Anomoenies vitrea Ross	21533	7.31	36.00	6.00	339.30
TPE-G	1R	06-Sep-17	1057	Leptolyngbya lemnetica (Anaga.) Anagnostid	12561	2.76	194.00	1.20	219.40
TPE-G	1R	06-Sep-17	1102	Gloeothece sp.	181237	0.87	2.10	2.10	4.80
TPE-G	1R	06-Sep-17	1131	Heteroleibeinia profunda Komarek	195593	13.28	21.60	2.00	67.90
TPE-G	1R	06-Sep-17	1220	Rivularia dura Roth	17944	88.35	91.00	8.30	4923.70
TPE-G	1R	06-Sep-17	1223	Chamaesiphon incrustans Smith	46655	1.41	6.40	3.00	30.20
TPE-G	1R	06-Sep-17	2205	Mougeotia sp.	7178	24.80	44.00	10.00	3455.80
TPE-G	1R	06-Sep-17	5509	Cyclotella ocellata Pant.	1794	0.45	8.60	8.60	249.80
TPE-G	1R	06-Sep-17	5514	Tabellaria flocculsa (Roth) Kutzing	7178	9.58	26.00	14.00	1334.10
TPE-G	1R	06-Sep-17	5702	Achnanthes minutissima Kutzing	109460	8.71	19.00	4.00	79.60
TPE-G	1R	06-Sep-17	5726	Eucocconeis sp.	1794	7.70	41.00	20.00	4293.50
TPE-G	1R	06-Sep-17	5836	Encyonema silesiacum (Bleisch) D.G. Mann	5383	6.34	30.00	10.00	1178.10
TPE-G	1R	06-Sep-17	5870	Navicula radiosa Kutzing	3589	5.83	62.00	10.00	1623.20
TPE-G	1R	06-Sep-17	5873	Gomphonema minutum	5383	2.34	26.00	8.00	435.60
TPE-G	1R	06-Sep-17	5882	Anomoenies vitrea Ross	14355	4.87	36.00	6.00	339.30
TPE-G	2	06-Sep-17	1057	Leptolyngbya lemnetica (Anaga.) Anagnostid	41016	6.96	150.00	1.20	169.60
TPE-G	2	06-Sep-17	1102	Gloeothece sp.	297363	1.43	2.10	2.10	4.80
TPE-G	2	06-Sep-17	1131	Heteroleibeinia profunda Komarek	358886	27.06	24.00	2.00	75.40
TPE-G	2	06-Sep-17	1220	Rivularia dura Roth	25635	147.02	106.00	8.30	5735.20
TPE-G	2	06-Sep-17	1223	Chamaesiphon incrustans Smith	41016	1.10	5.70	3.00	26.90
TPE-G	2	06-Sep-17	2178	Cosmarium sp.	2563	12.08	30.00	30.00	4712.40
TPE-G	2	06-Sep-17	2205	Mougeotia sp.	15381	17.83	41.00	6.00	1159.20
TPE-G	2	06-Sep-17	5513	Tabellaria fenestrata (Lyngbye) Kutzing	5127	6.96	81.00	8.00	1357.20
TPE-G	2	06-Sep-17	5514	Tabellaria flocculsa (Roth) Kutzing	51269	68.40	26.00	14.00	1334.10
TPE-G	2	06-Sep-17	5547	Frustulia rhomboides (Ehrenberg) de Toni	2563	6.95	69.00	10.00	2709.60
TPE-G	2	06-Sep-17	5702	Achnanthes minutissima Kutzing	99975	7.37	17.60	4.00	73.70
TPE-G	2	06-Sep-17	5726	Eucocconeis sp.	2563	11.01	41.00	20.00	4293.50
TPE-G	2	06-Sep-17	5836	Encyonema silesiacum (Bleisch) D.G. Mann	12817	15.10	30.00	10.00	1178.10
TPE-G	2	06-Sep-17	5857	Nitzschia filiformis (W. Smith) Hustedt	2563	0.33	51.00	3.10	128.30
TPE-G	2	06-Sep-17	5873	Gomphonema minutum	5127	2.15	25.00	8.00	418.90
TPE-G	2	06-Sep-17	5882	Anomoenies vitrea Ross	25635	8.21	34.00	6.00	320.40
TPE-G	3	06-Sep-17	1057	Leptolyngbya lemnetica (Anaga.) Anagnostid	57422	10.13	156.00	1.20	176.40
TPE-G	3	06-Sep-17	1077	Pseudoanabaena sp.	64087	0.70	2.40	2.40	10.90
TPE-G	3	06-Sep-17	1084	Gloeocapsa punctata	28711	0.96	4.00	4.00	33.50
TPE-G	3	06-Sep-17	1102	Gloeothece sp.	92285	0.44	2.10	2.10	4.80
TPE-G	3	06-Sep-17	1102	Gloeothece sp.	93310	0.45	2.10	2.10	4.80

Epilithic (El) algal species data for CREMP (Project HCMP) 2017 (for Azimuth consulting group)

**** 1st number in species code = group 1=cyanobacteria 2=chlorophyte 5=diatoms 7=Dinoflagellates**

**** total daily biomass is sum of all species on a given date**

**********R specifies a replicate count for QA/QC**

Location	Station	Date	Species code	Speceis name	density cells/cm^2	biomass μg/cm^2	length μ	width μ	cell volume μ^3
TPE-G	3	06-Sep-17	1122	Phormidium autumnale Agardh	2563	6.60	91.00	6.00	2573.00
TPE-G	3	06-Sep-17	1131	Heteroleibeinia profunda Komarek	279418	22.47	25.60	2.00	80.40
TPE-G	3	06-Sep-17	1131	Heteroleibeinia profunda Komarek	358886	27.06	24.00	2.00	75.40
TPE-G	3	06-Sep-17	1220	Rivularia dura Roth	5127	25.24	91.00	8.30	4923.70
TPE-G	3	06-Sep-17	1220	Rivularia dura Roth	93310	336.19	91.00	7.10	3602.90
TPE-G	3	06-Sep-17	1223	Chamaesiphon incrustans Smith	25635	0.71	5.90	3.00	27.80
TPE-G	3	06-Sep-17	1223	Chamaesiphon incrustans Smith	35889	1.00	5.90	3.00	27.80
TPE-G	3	06-Sep-17	2178	Cosmarium sp.	3589	9.79	25.00	25.00	2727.10
TPE-G	3	06-Sep-17	2205	Mougeotia sp.	7178	28.75	51.00	10.00	4005.50
TPE-G	3	06-Sep-17	4388	Dinobryon sertularia Ehrenberg	2563	0.58	12.00	6.00	226.20
TPE-G	3	06-Sep-17	5507	Cyclotella stelligera Cleve and Grunow	2563	8.05	20.00	20.00	3141.60
TPE-G	3	06-Sep-17	5509	Cyclotella ocellata Pant.	2563	0.54	8.10	8.10	208.70
TPE-G	3	06-Sep-17	5509	Cyclotella ocellata Pant.	3589	0.99	8.90	8.90	276.80
TPE-G	3	06-Sep-17	5513	Tabellaria fenestrata (Lyngbye) Kutzing	5127	6.96	81.00	8.00	1357.20
TPE-G	3	06-Sep-17	5514	Tabellaria flocculsa (Roth) Kutzing	25635	34.20	26.00	14.00	1334.10
TPE-G	3	06-Sep-17	5514	Tabellaria flocculsa (Roth) Kutzing	75366	100.55	26.00	14.00	1334.10
TPE-G	3	06-Sep-17	5702	Achnanthes minutissima Kutzing	215332	15.87	17.60	4.00	73.70
TPE-G	3	06-Sep-17	5702	Achnanthes minutissima Kutzing	78955	6.28	19.00	4.00	79.60
TPE-G	3	06-Sep-17	5726	Eucocconeis sp.	2563	11.01	41.00	20.00	4293.50
TPE-G	3	06-Sep-17	5767	Nitzschia fonticola Grunow	10254	0.43	10.00	4.00	41.90
TPE-G	3	06-Sep-17	5767	Nitzschia fonticola Grunow	21533	1.08	12.00	4.00	50.30
TPE-G	3	06-Sep-17	5769	Nitzschia sigmoidea (Ehenberg) W. Smith	3589	3.69	96.00	6.40	1029.40
TPE-G	3	06-Sep-17	5836	Encyonema silesiacum (Bleisch) D.G. Mann	14355	16.91	30.00	10.00	1178.10
TPE-G	3	06-Sep-17	5857	Nitzschia filiformis (W. Smith) Hustedt	25635	3.42	53.00	3.10	133.30
TPE-G	3	06-Sep-17	5857	Nitzschia filiformis (W. Smith) Hustedt	21533	2.71	50.00	3.10	125.80
TPE-G	3	06-Sep-17	5873	Gomphonema minutum	10254	4.30	25.00	8.00	418.90
TPE-G	3	06-Sep-17	5873	Gomphonema minutum	3589	0.81	24.00	6.00	226.20
TPE-G	3	06-Sep-17	5875	Cocconies disculus Schum.	2563	3.95	30.00	14.00	1539.40
TPE-G	3	06-Sep-17	5882	Anomoenies vitrea Ross	28198	9.03	34.00	6.00	320.40
TPE-G	3	06-Sep-17	5882	Anomoenies vitrea Ross	7178	2.10	31.00	6.00	292.20
TPE-G	3	06-Sep-17	5901	Denticula sp	7690	1.81	25.00	6.00	235.60
TPE-G	5	06-Sep-17	1014	Chroococcus limneticus Lemmermann	57422	1.08	3.30	3.30	18.80
TPE-G	5	06-Sep-17	1057	Leptolyngbya lemnetica (Anaga.) Anagnostid	21533	4.87	200.00	1.20	226.20
TPE-G	5	06-Sep-17	1102	Gloeothece sp.	165088	0.79	2.10	2.10	4.80
TPE-G	5	06-Sep-17	1131	Heteroleibeinia profunda Komarek	384008	27.26	22.60	2.00	71.00
TPE-G	5	06-Sep-17	1220	Rivularia dura Roth	57422	221.16	103.00	6.90	3851.50
TPE-G	5	06-Sep-17	1223	Chamaesiphon incrustans Smith	35889	1.02	6.00	3.00	28.30
TPE-G	5	06-Sep-17	2205	Mougeotia sp.	129199	298.73	46.00	8.00	2312.20
TPE-G	5	06-Sep-17	2216	Zygnema sp.	21533	52.43	31.00	10.00	2434.70
TPE-G	5	06-Sep-17	4388	Dinobryon sertularia Ehrenberg	3589	0.81	12.00	6.00	226.20
TPE-G	5	06-Sep-17	5509	Cyclotella ocellata Pant.	3589	0.52	4.30	9.30	146.00
TPE-G	5	06-Sep-17	5514	Tabellaria flocculsa (Roth) Kutzing	14355	20.63	28.00	14.00	1436.80
TPE-G	5	06-Sep-17	5519	Synedra acus v. radians (Kutzing) Hustedt	14355	0.92	61.00	2.00	63.90
TPE-G	5	06-Sep-17	5551	Cyclotella michiganiana Skvortzow	3589	0.18	5.00	5.00	49.10
TPE-G	5	06-Sep-17	5702	Achnanthes minutissima Kutzing	114844	8.46	17.60	4.00	73.70
TPE-G	5	06-Sep-17	5857	Nitzschia filiformis (W. Smith) Hustedt	7178	0.85	50.00	3.00	117.80
TPE-G	5	06-Sep-17	5873	Gomphonema minutum	14355	6.01	25.00	8.00	418.90
TPE-G	5	06-Sep-17	5882	Anomoenies vitrea Ross	21533	6.70	33.00	6.00	311.00
TPE-BGN	1	04-Sep-17	1122	Phormidium autumnale Agardh	1077	2.77	91.00	6.00	2573.00
TPE-BGN	1	04-Sep-17	1131	Heteroleibeinia profunda Komarek	25840	1.44	17.70	2.00	55.60
TPE-BGN	1	04-Sep-17	4383	Dinobryon bavaricum Imhof	3230	0.73	12.00	6.00	226.20
TPE-BGN	1	04-Sep-17	5507	Cyclotella stelligera Cleve and Grunow	1077	3.92	21.00	21.00	3636.80
TPE-BGN	1	04-Sep-17	5514	Tabellaria flocculsa (Roth) Kutzing	5383	7.73	28.00	14.00	1436.80
TPE-BGN	1	04-Sep-17	5519	Synedra acus v. radians (Kutzing) Hustedt	2153	0.15	61.00	2.10	70.40
TPE-BGN	1	04-Sep-17	5702	Achnanthes minutissima Kutzing	114126	8.13	17.00	4.00	71.20
TPE-BGN	1	04-Sep-17	5836	Encyonema silesiacum (Bleisch) D.G. Mann	3230	3.81	30.00	10.00	1178.10
TPE-BGN	1	04-Sep-17	5857	Nitzschia filiformis (W. Smith) Hustedt	1077	0.13	51.00	3.00	120.20
TPE-BGN	1	04-Sep-17	5873	Gomphonema minutum	1077	0.47	26.00	8.00	435.60
TPE-BGN	1	04-Sep-17	5874	Nitzschia palea (Kutzing) W. Smith	1077	1.80	64.00	10.00	1675.50
TPE-BGN	1	04-Sep-17	5882	Anomoenies vitrea Ross	3230	1.07	35.00	6.00	329.90
TPE-BGN	2	04-Sep-17	1122	Phormidium autumnale Agardh	718	1.70	84.00	6.00	2375.00
TPE-BGN	2	04-Sep-17	1131	Heteroleibeinia profunda Komarek	4666	0.28	19.00	2.00	59.70
TPE-BGN	2	04-Sep-17	2954	Stigeoclonium sp.	2153	1.10	18.00	6.00	508.90
TPE-BGN	2	04-Sep-17	4383	Dinobryon bavaricum Imhof	718	0.16	12.00	6.00	226.20
TPE-BGN	2	04-Sep-17	4388	Dinobryon sertularia Ehrenberg	718	0.16	12.00	6.00	226.20

Appendix B
Periphyton Laboratory Data
Plankton R Us, Winnipeg, MB

Epilithic (El) algal species data for CREMP (Project HCMP) 2017 (for Azimuth consulting group)

**** 1st number in species code = group 1=cyanobacteria 2=chlorophyte 5=diatoms 7=Dinoflagellates**

**** total daily biomass is sum of all species on a given date**

**********R specifies a replicate count for QA/QC**

Location	Station	Date	Species code	Speceis name	density cells/cm^2	biomass µg/cm^2	length µ	width µ	cell volume µ^3
TPE-BGN	2	04-Sep-17	5509	Cyclotella ocellata Pant.	359	0.08	8.30	8.30	224.50
TPE-BGN	2	04-Sep-17	5514	Tabellaria flocculsa (Roth) Kutzing	1077	1.44	26.00	14.00	1334.10
TPE-BGN	2	04-Sep-17	5702	Achnanthes minutissima Kutzing	36247	2.73	18.00	4.00	75.40
TPE-BGN	2	04-Sep-17	5836	Encyonema silesiacum (Bleisch) D.G. Mann	718	0.85	30.00	10.00	1178.10
TPE-BGN	2	04-Sep-17	5857	Nitzschia filiformis (W. Smith) Hustedt	1077	0.14	51.00	3.10	128.30
TPE-BGN	2	04-Sep-17	5873	Gomphonema minutum	718	0.31	26.00	8.00	435.60
TPE-BGN	2	04-Sep-17	5882	Anomoenies vitrea Ross	1436	0.49	36.00	6.00	339.30
TPE-BGN	3	04-Sep-17	1057	Leptolyngbya lemnetica (Anaga.) Anagnostid	2871	1.32	146.00	2.00	458.70
TPE-BGN	3	04-Sep-17	1131	Heteroleibeinia profunda Komarek	36247	2.16	19.00	2.00	59.70
TPE-BGN	3	04-Sep-17	4383	Dinobryon bavaricum Imhof	1794	0.41	12.00	6.00	226.20
TPE-BGN	3	04-Sep-17	4388	Dinobryon sertularia Ehrenberg	1077	0.24	12.00	6.00	226.20
TPE-BGN	3	04-Sep-17	5514	Tabellaria flocculsa (Roth) Kutzing	4307	6.19	28.00	14.00	1436.80
TPE-BGN	3	04-Sep-17	5551	Cyclotella michiganiana Skvortzow	1794	0.09	5.00	5.00	49.10
TPE-BGN	3	04-Sep-17	5702	Achnanthes minutissima Kutzing	17944	1.35	18.00	4.00	75.40
TPE-BGN	3	04-Sep-17	5726	Eucocconeis sp.	359	1.50	40.00	20.00	4188.80
TPE-BGN	3	04-Sep-17	5857	Nitzschia filiformis (W. Smith) Hustedt	1077	0.14	50.00	3.10	125.80
TPE-BGN	3	04-Sep-17	5873	Gomphonema minutum	718	0.30	25.00	8.00	418.90
TPE-BGN	3	04-Sep-17	5882	Anomoenies vitrea Ross	1077	0.36	35.00	6.00	329.90
TPE-BGN	4	04-Sep-17	1057	Leptolyngbya lemnetica (Anaga.) Anagnostid	1794	0.56	100.00	2.00	314.20
TPE-BGN	4	04-Sep-17	1122	Phormidium autumnale Agardh	359	0.87	86.00	6.00	2431.60
TPE-BGN	4	04-Sep-17	1131	Heteroleibeinia profunda Komarek	45220	2.84	20.00	2.00	62.80
TPE-BGN	4	04-Sep-17	1220	Rivularia dura Roth	718	1.68	80.00	6.10	2338.00
TPE-BGN	4	04-Sep-17	2205	Mougeotia sp.	3589	7.00	69.00	6.00	1950.90
TPE-BGN	4	04-Sep-17	4388	Dinobryon sertularia Ehrenberg	2153	0.49	12.00	6.00	226.20
TPE-BGN	4	04-Sep-17	5509	Cyclotella ocellata Pant.	718	0.20	8.90	8.90	276.80
TPE-BGN	4	04-Sep-17	5514	Tabellaria flocculsa (Roth) Kutzing	5742	7.66	26.00	14.00	1334.10
TPE-BGN	4	04-Sep-17	5551	Cyclotella michiganiana Skvortzow	1077	0.05	5.00	5.00	49.10
TPE-BGN	4	04-Sep-17	5702	Achnanthes minutissima Kutzing	13638	1.01	17.60	4.00	73.70
TPE-BGN	4	04-Sep-17	5873	Gomphonema minutum	359	0.16	26.00	8.00	435.60
TPE-BGN	4	04-Sep-17	5882	Anomoenies vitrea Ross	1436	0.42	31.00	6.00	292.20
TPE-BGN	5	04-Sep-17	1057	Leptolyngbya lemnetica (Anaga.) Anagnostid	1436	0.61	136.00	2.00	427.30
TPE-BGN	5	04-Sep-17	1077	Pseudoanabaena sp.	4307	0.03	2.10	2.10	7.30
TPE-BGN	5	04-Sep-17	1131	Heteroleibeinia profunda Komarek	13997	0.77	17.50	2.00	55.00
TPE-BGN	5	04-Sep-17	4388	Dinobryon sertularia Ehrenberg	1436	0.32	12.00	6.00	226.20
TPE-BGN	5	04-Sep-17	5311	Cymbella minuta Kutzing	359	0.13	14.30	8.00	359.40
TPE-BGN	5	04-Sep-17	5518	Synedra acus Kutzing	718	0.08	110.00	2.00	115.20
TPE-BGN	5	04-Sep-17	5547	Frustulia rhomboides (Ehrenberg) de Toni	359	1.07	76.00	10.00	2984.50
TPE-BGN	5	04-Sep-17	5551	Cyclotella michiganiana Skvortzow	1436	0.07	5.00	5.00	49.10
TPE-BGN	5	04-Sep-17	5702	Achnanthes minutissima Kutzing	47014	3.46	17.60	4.00	73.70
TPE-BGN	5	04-Sep-17	5873	Gomphonema minutum	359	0.16	27.00	8.00	452.40
TPE-BGN	5	04-Sep-17	5882	Anomoenies vitrea Ross	359	0.11	32.00	6.00	301.60
TPE-BGNS	1	04-Sep-17	1057	Leptolyngbya lemnetica (Anaga.) Anagnostid	718	0.09	116.00	1.20	131.20
TPE-BGNS	1	04-Sep-17	1131	Heteroleibeinia profunda Komarek	2153	0.13	19.21	2.00	60.30
TPE-BGNS	1	04-Sep-17	5514	Tabellaria flocculsa (Roth) Kutzing	7537	10.05	26.00	14.00	1334.10
TPE-BGNS	1	04-Sep-17	5519	Synedra acus v. radians (Kutzing) Hustedt	718	0.05	61.00	2.00	63.90
TPE-BGNS	1	04-Sep-17	5702	Achnanthes minutissima Kutzing	36965	3.10	20.00	4.00	83.80
TPE-BGNS	1	04-Sep-17	5726	Eucocconeis sp.	359	1.50	40.00	20.00	4188.80
TPE-BGNS	1	04-Sep-17	5860	Diatoma vulgare Bory	1436	0.38	28.20	6.00	265.80
TPE-BGNS	1	04-Sep-17	5882	Anomoenies vitrea Ross	359	0.11	34.00	6.00	320.40
TPE-BGNS	1	04-Sep-17	5910	Navicula exigua (Greg.) Muller	1436	0.44	27.00	6.60	307.90
TPE-BGNS	2	04-Sep-17	1057	Leptolyngbya lemnetica (Anaga.) Anagnostid	5024	1.83	116.00	2.00	364.40
TPE-BGNS	2	04-Sep-17	1085	Rivularia sp.	359	0.72	59.00	6.60	2018.50
TPE-BGNS	2	04-Sep-17	1124	Petalonema alatum Berk	1077	2.50	82.00	6.00	2318.50
TPE-BGNS	2	04-Sep-17	1131	Heteroleibeinia profunda Komarek	5742	0.32	17.60	2.00	55.30
TPE-BGNS	2	04-Sep-17	4388	Dinobryon sertularia Ehrenberg	3589	0.81	12.00	6.00	226.20
TPE-BGNS	2	04-Sep-17	5702	Achnanthes minutissima Kutzing	21892	1.65	18.00	4.00	75.40
TPE-BGNS	2	04-Sep-17	5873	Gomphonema minutum	359	0.09	26.00	6.00	245.00
TPE-BGNS	2R	04-Sep-17	1057	Leptolyngbya lemnetica (Anaga.) Anagnostid	4307	1.57	116.00	2.00	364.40
TPE-BGNS	2R	04-Sep-17	1124	Petalonema alatum Berk	718	1.66	82.00	6.00	2318.50
TPE-BGNS	2R	04-Sep-17	1131	Heteroleibeinia profunda Komarek	5383	0.30	17.60	2.00	55.30
TPE-BGNS	2R	04-Sep-17	4388	Dinobryon sertularia Ehrenberg	2153	0.49	12.00	6.00	226.20
TPE-BGNS	2R	04-Sep-17	5551	Cyclotella michiganiana Skvortzow	1077	0.05	5.00	5.00	49.10
TPE-BGNS	2R	04-Sep-17	5702	Achnanthes minutissima Kutzing	19739	1.49	18.00	4.00	75.40
TPE-BGNS	2R	04-Sep-17	5873	Gomphonema minutum	359	0.09	26.00	6.00	245.00
TPE-BGNS	3	04-Sep-17	1057	Leptolyngbya lemnetica (Anaga.) Anagnostid	1077	0.48	141.00	2.00	443.00

Epilithic (El) algal species data for CREMP (Project HCMP) 2017 (for Azimuth consulting group)

**** 1st number in species code = group 1=cyanobacteria 2=chlorophyte 5=diatoms 7=Dinoflagellates**

**** total daily biomass is sum of all species on a given date**

*********R specifies a replicate count for QA/QC**

Location	Station	Date	Species code	Speceis name	density cells/cm^2	biomass µg/cm^2	length µ	width µ	cell volume µ^3
TPE-BGNS	3	04-Sep-17	1085	Rivularia sp.	359	0.66	54.00	6.60	1847.40
TPE-BGNS	3	04-Sep-17	1131	Heteroleibeinia profunda Komarek	7537	0.44	18.60	2.00	58.40
TPE-BGNS	3	04-Sep-17	1239	Homoeothrix varians Komarek & Kalina	1436	0.99	86.00	3.20	691.70
TPE-BGNS	3	04-Sep-17	4383	Dinobryon bavaricum Imhof	2153	0.49	12.00	6.00	226.20
TPE-BGNS	3	04-Sep-17	4388	Dinobryon sertularia Ehrenberg	1436	0.32	12.00	6.00	226.20
TPE-BGNS	3	04-Sep-17	5514	Tabellaria flocculsa (Roth) Kutzing	5383	7.18	26.00	14.00	1334.10
TPE-BGNS	3	04-Sep-17	5702	Achnanthes minutissima Kutzing	41631	3.66	21.00	4.00	88.00
TPE-BGNS	3	04-Sep-17	5726	Eucocconeis sp.	1077	4.85	43.00	20.00	4502.90
TPE-BGNS	3	04-Sep-17	5875	Cocconies disculus Schum.	359	0.55	30.00	14.00	1539.40
TPE-BGNS	3	04-Sep-17	5910	Navicula exigua (Greg.) Muller	1077	0.52	29.00	8.00	485.90
TPE-BGNS	4	04-Sep-17	1057	Leptolyngbya lemnetica (Anaga.) Anagnostid	2153	1.04	154.00	2.00	483.80
TPE-BGNS	4	04-Sep-17	1122	Phormidium autumnale Agardh	2153	7.37	121.00	6.00	3421.20
TPE-BGNS	4	04-Sep-17	1124	Petalonema alatum Berk	1794	4.41	87.00	6.00	2459.90
TPE-BGNS	4	04-Sep-17	1131	Heteroleibeinia profunda Komarek	7537	0.51	21.60	2.00	67.90
TPE-BGNS	4	04-Sep-17	2205	Mougeotia sp.	1436	4.96	44.00	10.00	3455.80
TPE-BGNS	4	04-Sep-17	5306	Navicula minima Grunow	359	0.02	10.00	4.60	55.40
TPE-BGNS	4	04-Sep-17	5514	Tabellaria flocculsa (Roth) Kutzing	3948	5.27	26.00	14.00	1334.10
TPE-BGNS	4	04-Sep-17	5519	Synedra acus v. radians (Kutzing) Hustedt	718	0.05	60.00	2.00	62.80
TPE-BGNS	4	04-Sep-17	5551	Cyclotella michiganiana Skvortzow	1436	0.07	5.00	5.00	49.10
TPE-BGNS	4	04-Sep-17	5702	Achnanthes minutissima Kutzing	43425	3.82	21.00	4.00	88.00
TPE-BGNS	4	04-Sep-17	5874	Nitzschia palea (Kutzing) W. Smith	359	0.35	59.00	8.00	988.60
TPE-BGNS	4	04-Sep-17	5882	Anomoenies vitrea Ross	718	0.24	36.00	6.00	339.30
TPE-BGNS	5	04-Sep-17	1057	Leptolyngbya lemnetica (Anaga.) Anagnostid	2393	1.10	146.00	2.00	458.70
TPE-BGNS	5	04-Sep-17	1124	Petalonema alatum Berk	3589	9.21	75.00	6.60	2565.90
TPE-BGNS	5	04-Sep-17	1131	Heteroleibeinia profunda Komarek	15552	0.97	19.80	2.00	62.20
TPE-BGNS	5	04-Sep-17	2205	Mougeotia sp.	40076	166.82	53.00	10.00	4162.60
TPE-BGNS	5	04-Sep-17	2216	Zygnema sp.	5981	16.24	24.00	12.00	2714.30
TPE-BGNS	5	04-Sep-17	4383	Dinobryon bavaricum Imhof	4187	0.95	12.00	6.00	226.20
TPE-BGNS	5	04-Sep-17	5509	Cyclotella ocellata Pant.	598	0.23	10.00	10.00	392.70
TPE-BGNS	5	04-Sep-17	5514	Tabellaria flocculsa (Roth) Kutzing	9570	12.28	25.00	14.00	1282.80
TPE-BGNS	5	04-Sep-17	5702	Achnanthes minutissima Kutzing	68188	6.03	21.10	4.00	88.40
TPE-BGNS	5	04-Sep-17	5882	Anomoenies vitrea Ross	598	0.19	34.00	6.00	320.40
TPE-BGNS	5	04-Sep-17	5910	Navicula exigua (Greg.) Muller	1196	0.62	31.00	8.00	519.40

APPENDIX C

Presence (+) / Absence (-) Matrix of Periphyton Species

Appendix C. Presence (+) / absence (-) matrix of periphyton species 2017.

Taxon Code	Taxon Name	Cell Measurements length (μ)	width (μ)	volume (μ^3)	Second Portage Lake Drilltrail Arm (Reference Area) SP-DT 1	2	3	4	5
	Cyanobacteria								
1014	*Chroococcus limneticus Lemmermann*	3.5	3.5	22.5	+	-	+	-	-
1015	*Chroococcus turgidus (Kutzing) Nageli*	11.0	8.0	368.6	-	-	-	-	-
1057	*Leptolyngbya lemnetica (Anaga.)*	136.3	1.8	338.7	+	+	+	+	+
1077	*Pseudoanabaena sp.*	2.5	2.4	11.4	+	-	-	-	-
1084	*Gloeocapsa punctata*	4.0	4.0	33.5	-	-	-	+	+
1085	*Rivularia sp.*	56.5	6.6	1933.0	-	-	-	-	-
1102	*Gloeothece sp.*	2.1	2.1	4.7	-	-	-	-	-
1117	*Merismopedia punctata Meyen*	3.1	3.1	15.6	-	-	-	-	-
1122	*Phormidium autumnale Agardh*	94.5	6.0	2671.9	-	-	-	-	-
1124	*Petalonema alatum Berk*	87.8	6.3	2738.1	+	+	+	+	+
1131	*Heteroleibeinia profunda Komarek*	20.6	2.0	64.6	-	+	-	+	+
1136	*Lyngbya mucicola Lemmermann*	68.7	1.0	54.0	+	+	+	+	+
1220	*Rivularia dura Roth*	92.8	7.8	4473.9	-	-	-	-	+
1223	*Chamaesiphon incrustans Smith*	6.0	3.0	28.3	-	-	-	-	-
1239	*Homoeothrix varians Komarek & Kalina*	86.0	3.2	691.7	-	-	-	-	-
	Chlorophyte								
2178	*Cosmarium sp.*	27.5	27.5	3719.8	-	-	-	-	-
2193	*Staurodesmus paradoxum Meyen*	30.0	26.0	4084.1	-	-	-	+	-
2205	*Mougeotia sp.*	50.0	8.7	3123.3	-	-	+	-	-
2216	*Zygnema sp.*	27.5	11.0	2574.5	-	-	-	-	-
2954	*Stigeoclonium sp.*	16.0	8.0	804.3	-	-	-	-	-
	Chrysophyte								
4383	*Dinobryon bavaricum Imhof*	12.0	6.0	226.2	-	-	-	-	-
4388	*Dinobryon sertularia Ehrenberg*	12.0	6.0	226.2	-	-	-	-	-
	Diatom								
5306	*Navicula minima Grunow*	10.8	4.5	58.6	-	-	+	+	-
5311	*Cymbella minuta Kutzing*	15.2	7.6	343.1	+	+	-	-	+
5507	*Cyclotella stelligera Cleve and Grunow*	18.7	21.6	3394.5	-	-	-	-	-
5509	*Cyclotella ocellata Pant.*	8.8	9.3	303.7	+	-	-	-	-
5513	*Tabellaria fenestrata (Lyngbye) Kutzing*	87.4	8.8	1830.1	-	-	-	+	-
5514	*Tabellaria flocculsa (Roth) Kutzing*	26.0	14.0	1332.3	+	+	+	+	+
5518	*Synedra acus Kutzing*	110.0	2.0	115.2	-	-	-	-	-
5519	*Synedra acus v. radians (Kutzing) Hustedt*	56.8	2.0	60.2	+	+	-	-	-
5546	*Gyrosigma sp*	77.7	6.5	1324.5	-	-	-	-	-
5547	*Frustulia rhomboides (Ehrenberg) de Toni*	68.2	10.0	2678.2	-	-	-	-	-
5551	*Cyclotella michiganiana Skvortzow*	5.0	5.0	49.1	-	-	-	-	-
5702	*Achnanthes minutissima Kutzing*	19.1	4.0	80.0	+	+	+	+	+
5726	*Eucocconeis sp.*	40.6	20.0	4252.8	+	+	+	+	-
5728	*Epithemia argus Kutzing*	80.0	16.0	5361.7	-	-	-	+	-
5767	*Nitzschia fonticola Grunow*	16.0	4.4	89.7	-	-	-	-	-
5768	*Nitzschia linearis W. Smith*	69.0	9.3	1643.1	-	-	-	-	-
5769	*Nitzschia sigmoidea (Ehenberg) W. Smith*	74.0	6.5	811.2	-	-	-	-	-
5781	*Eunotia sp.*	65.0	10.0	1701.7	-	-	+	-	-
5820	*Eunotia arcus Ehrenberg*	55.5	12.5	2516.6	+	+	-	-	-
5836	*Encyonema silesiacum (Bleisch) D.G. Mann*	29.8	10.0	1171.2	+	+	+	+	+
5857	*Nitzschia filiformis (W. Smith) Hustedt*	51.1	3.1	125.9	-	-	-	-	-
5860	*Diatoma vulgare Bory*	28.2	6.0	265.8	-	-	-	-	-
5865	*Cymbella prostrata (Berkeley) Cleve*	96.0	21.5	17435.9	-	+	+	-	-
5870	*Navicula radiosa Kutzing*	66.0	10.0	1727.9	-	-	+	+	+
5873	*Gomphonema minutum*	25.9	7.7	407.0	-	-	-	+	+
5874	*Nitzschia palea (Kutzing) W. Smith*	60.3	7.1	814.0	+	+	-	+	-
5875	*Cocconies disculus Schum.*	29.7	14.0	1524.7	+	+	+	-	-
5876	*Aulacoseira islandica v. helvetica Muller*	26.0	8.0	1306.9	+	-	-	-	-
5882	*Anomoenies vitrea Ross*	34.2	6.0	322.3	+	+	+	+	+
5884	*Gomphonema angustum Agardh*	42.6	10.0	1115.3	-	-	-	-	+
5901	*Denticula sp*	30.0	6.7	380.5	-	+	-	-	-
5910	*Navicula exigua (Greg.) Muller*	36.3	6.7	423.0	-	+	+	+	-
	Total Richness				**17**	**17**	**16**	**18**	**14**

Appendix C. Presence (+) / absence (-) matrix of periphyton species 2017.

Taxon Code	Taxon Name	Cell Measurements length (μ)	width (μ)	volume (μ^3)	Second Portage Lake East Dike SP-ED 1	2	3	4	5
	Cyanobacteria								
1014	*Chroococcus limneticus Lemmermann*	3.5	3.5	22.5	-	-	-	-	-
1015	*Chroococcus turgidus (Kutzing) Nageli*	11.0	8.0	368.6	-	-	-	+	-
1057	*Leptolyngbya lemnetica (Anaga.)*	136.3	1.8	338.7	+	+	+	+	+
1077	*Pseudoanabaena sp.*	2.5	2.4	11.4	+	-	-	-	-
1084	*Gloeocapsa punctata*	4.0	4.0	33.5	-	-	-	+	+
1085	*Rivularia sp.*	56.5	6.6	1933.0	-	-	-	-	-
1102	*Gloeothece sp.*	2.1	2.1	4.7	-	+	+	+	-
1117	*Merismopedia punctata Meyen*	3.1	3.1	15.6	-	-	-	-	+
1122	*Phormidium autumnale Agardh*	94.5	6.0	2671.9	+	-	-	-	-
1124	*Petalonema alatum Berk*	87.8	6.3	2738.1	+	-	-	-	-
1131	*Heteroleibeinia profunda Komarek*	20.6	2.0	64.6	+	-	-	+	-
1136	*Lyngbya mucicola Lemmermann*	68.7	1.0	54.0	+	+	+	+	+
1220	*Rivularia dura Roth*	92.8	7.8	4473.9	-	-	-	-	-
1223	*Chamaesiphon incrustans Smith*	6.0	3.0	28.3	-	-	-	-	-
1239	*Homoeothrix varians Komarek & Kalina*	86.0	3.2	691.7	-	-	-	-	-
	Chlorophyte								
2178	*Cosmarium sp.*	27.5	27.5	3719.8	-	-	-	-	-
2193	*Staurodesmus paradoxum Meyen*	30.0	26.0	4084.1	-	-	-	-	-
2205	*Mougeotia sp.*	50.0	8.7	3123.3	-	+	-	-	-
2216	*Zygnema sp.*	27.5	11.0	2574.5	-	-	-	-	-
2954	*Stigeoclonium sp.*	16.0	8.0	804.3	-	-	-	-	-
	Chrysophyte								
4383	*Dinobryon bavaricum Imhof*	12.0	6.0	226.2	-	-	-	-	-
4388	*Dinobryon sertularia Ehrenberg*	12.0	6.0	226.2	+	-	+	-	+
	Diatom								
5306	*Navicula minima Grunow*	10.8	4.5	58.6	+	+	+	+	-
5311	*Cymbella minuta Kutzing*	15.2	7.6	343.1	-	+	-	+	-
5507	*Cyclotella stelligera Cleve and Grunow*	18.7	21.6	3394.5	-	-	-	+	-
5509	*Cyclotella ocellata Pant.*	8.8	9.3	303.7	-	+	-	-	+
5513	*Tabellaria fenestrata (Lyngbye) Kutzing*	87.4	8.8	1830.1	-	-	-	-	-
5514	*Tabellaria flocculsa (Roth) Kutzing*	26.0	14.0	1332.3	+	+	+	+	+
5518	*Synedra acus Kutzing*	110.0	2.0	115.2	-	-	-	-	-
5519	*Synedra acus v. radians (Kutzing) Hustedt*	56.8	2.0	60.2	-	-	-	-	+
5546	*Gyrosigma sp*	77.7	6.5	1324.5	-	+	+	-	+
5547	*Frustulia rhomboides (Ehrenberg) de Toni*	68.2	10.0	2678.2	-	-	-	+	-
5551	*Cyclotella michiganiana Skvortzow*	5.0	5.0	49.1	-	+	-	+	-
5702	*Achnanthes minutissima Kutzing*	19.1	4.0	80.0	+	+	+	+	+
5726	*Eucocconeis sp.*	40.6	20.0	4252.8	+	+	+	+	+
5728	*Epithemia argus Kutzing*	80.0	16.0	5361.7	-	-	-	-	-
5767	*Nitzschia fonticola Grunow*	16.0	4.4	89.7	-	-	-	-	+
5768	*Nitzschia linearis W. Smith*	69.0	9.3	1643.1	-	+	+	+	-
5769	*Nitzschia sigmoidea (Ehenberg) W. Smith*	74.0	6.5	811.2	-	-	-	-	-
5781	*Eunotia sp.*	65.0	10.0	1701.7	-	-	-	-	-
5820	*Eunotia arcus Ehrenberg*	55.5	12.5	2516.6	-	-	-	-	-
5836	*Encyonema silesiacum (Bleisch) D.G. Mann*	29.8	10.0	1171.2	-	+	+	+	+
5857	*Nitzschia filiformis (W. Smith) Hustedt*	51.1	3.1	125.9	-	-	-	-	-
5860	*Diatoma vulgare Bory*	28.2	6.0	265.8	-	-	-	-	-
5865	*Cymbella prostrata (Berkeley) Cleve*	96.0	21.5	17435.9	-	-	-	-	-
5870	*Navicula radiosa Kutzing*	66.0	10.0	1727.9	-	-	-	-	-
5873	*Gomphonema minutum*	25.9	7.7	407.0	+	+	+	-	+
5874	*Nitzschia palea (Kutzing) W. Smith*	60.3	7.1	814.0	+	+	+	+	-
5875	*Cocconies disculus Schum.*	29.7	14.0	1524.7	+	-	-	-	-
5876	*Aulacoseira islandica v. helvetica Muller*	26.0	8.0	1306.9	-	-	-	-	-
5882	*Anomoenies vitrea Ross*	34.2	6.0	322.3	+	+	+	+	+
5884	*Gomphonema angustum Agardh*	42.6	10.0	1115.3	+	+	-	+	-
5901	*Denticula sp*	30.0	6.7	380.5	-	-	-	-	-
5910	*Navicula exigua (Greg.) Muller*	36.3	6.7	423.0	+	+	+	+	+
	Total Richness				**17**	**19**	**15**	**20**	**16**

Appendix C. Presence (+) / absence (-) matrix of periphyton species 2017.

Taxon Code	Taxon Name	Cell Measurements length (μ)	width (μ)	volume (μ³)	Third Portage Lake - East Basin Bay-Goose Dike - North Section TPE-BGN 1	2	3	4	5
	Cyanobacteria								
1014	*Chroococcus limneticus Lemmermann*	3.5	3.5	22.5	-	-	-	-	-
1015	*Chroococcus turgidus (Kutzing) Nageli*	11.0	8.0	368.6	-	-	-	-	-
1057	*Leptolyngbya lemnetica (Anaga.)*	136.3	1.8	338.7	-	-	+	+	+
1077	*Pseudoanabaena sp.*	2.5	2.4	11.4	-	-	-	-	+
1084	*Gloeocapsa punctata*	4.0	4.0	33.5	-	-	-	-	-
1085	*Rivularia sp.*	56.5	6.6	1933.0	-	-	-	-	-
1102	*Gloeothece sp.*	2.1	2.1	4.7	-	-	-	-	-
1117	*Merismopedia punctata Meyen*	3.1	3.1	15.6	-	-	-	-	-
1122	*Phormidium autumnale Agardh*	94.5	6.0	2671.9	+	+	-	+	-
1124	*Petalonema alatum Berk*	87.8	6.3	2738.1	-	-	-	-	-
1131	*Heteroleibeinia profunda Komarek*	20.6	2.0	64.6	+	+	+	+	+
1136	*Lyngbya mucicola Lemmermann*	68.7	1.0	54.0	-	-	-	-	-
1220	*Rivularia dura Roth*	92.8	7.8	4473.9	-	-	-	+	-
1223	*Chamaesiphon incrustans Smith*	6.0	3.0	28.3	-	-	-	-	-
1239	*Homoeothrix varians Komarek & Kalina*	86.0	3.2	691.7	-	-	-	-	-
	Chlorophyte								
2178	*Cosmarium sp.*	27.5	27.5	3719.8	-	-	-	-	-
2193	*Staurodesmus paradoxum Meyen*	30.0	26.0	4084.1	-	-	-	-	-
2205	*Mougeotia sp.*	50.0	8.7	3123.3	-	-	-	+	-
2216	*Zygnema sp.*	27.5	11.0	2574.5	-	-	-	-	-
2954	*Stigeoclonium sp.*	16.0	8.0	804.3	-	+	-	-	-
	Chrysophyte								
4383	*Dinobryon bavaricum Imhof*	12.0	6.0	226.2	+	+	+	-	-
4388	*Dinobryon sertularia Ehrenberg*	12.0	6.0	226.2	-	+	+	+	+
	Diatom								
5306	*Navicula minima Grunow*	10.8	4.5	58.6	-	-	-	-	-
5311	*Cymbella minuta Kutzing*	15.2	7.6	343.1	-	-	-	-	+
5507	*Cyclotella stelligera Cleve and Grunow*	18.7	21.6	3394.5	+	-	-	-	-
5509	*Cyclotella ocellata Pant.*	8.8	9.3	303.7	-	+	-	+	-
5513	*Tabellaria fenestrata (Lyngbye) Kutzing*	87.4	8.8	1830.1	-	-	-	-	-
5514	*Tabellaria flocculsa (Roth) Kutzing*	26.0	14.0	1332.3	+	+	+	+	-
5518	*Synedra acus Kutzing*	110.0	2.0	115.2	-	-	-	-	+
5519	*Synedra acus v. radians (Kutzing) Hustedt*	56.8	2.0	60.2	+	-	-	-	-
5546	*Gyrosigma sp*	77.7	6.5	1324.5	-	-	-	-	-
5547	*Frustulia rhomboides (Ehrenberg) de Toni*	68.2	10.0	2678.2	-	-	-	-	+
5551	*Cyclotella michiganiana Skvortzow*	5.0	5.0	49.1	-	-	+	+	+
5702	*Achnanthes minutissima Kutzing*	19.1	4.0	80.0	+	+	+	+	+
5726	*Eucocconeis sp.*	40.6	20.0	4252.8	-	-	+	-	-
5728	*Epithemia argus Kutzing*	80.0	16.0	5361.7	-	-	-	-	-
5767	*Nitzschia fonticola Grunow*	16.0	4.4	89.7	-	-	-	-	-
5768	*Nitzschia linearis W. Smith*	69.0	9.3	1643.1	-	-	-	-	-
5769	*Nitzschia sigmoidea (Ehenberg) W. Smith*	74.0	6.5	811.2	-	-	-	-	-
5781	*Eunotia sp.*	65.0	10.0	1701.7	-	-	-	-	-
5820	*Eunotia arcus Ehrenberg*	55.5	12.5	2516.6	-	-	-	-	-
5836	*Encyonema silesiacum (Bleisch) D.G. Mann*	29.8	10.0	1171.2	+	+	-	-	-
5857	*Nitzschia filiformis (W. Smith) Hustedt*	51.1	3.1	125.9	+	+	+	-	-
5860	*Diatoma vulgare Bory*	28.2	6.0	265.8	-	-	-	-	-
5865	*Cymbella prostrata (Berkeley) Cleve*	96.0	21.5	17435.9	-	-	-	-	-
5870	*Navicula radiosa Kutzing*	66.0	10.0	1727.9	-	-	-	-	-
5873	*Gomphonema minutum*	25.9	7.7	407.0	+	+	+	+	+
5874	*Nitzschia palea (Kutzing) W. Smith*	60.3	7.1	814.0	+	-	-	-	-
5875	*Cocconies disculus Schum.*	29.7	14.0	1524.7	-	-	-	-	-
5876	*Aulacoseira islandica v. helvetica Muller*	26.0	8.0	1306.9	-	-	-	-	-
5882	*Anomoenies vitrea Ross*	34.2	6.0	322.3	+	+	+	+	+
5884	*Gomphonema angustum Agardh*	42.6	10.0	1115.3	-	-	-	-	-
5901	*Denticula sp*	30.0	6.7	380.5	-	-	-	-	-
5910	*Navicula exigua (Greg.) Muller*	36.3	6.7	423.0	-	-	-	-	-
	Total Richness				**12**	**12**	**11**	**12**	**11**

Appendix C. Presence (+) / absence (-) matrix of periphyton species 2017.

Taxon Code	Taxon Name	Cell Measurements length (µ)	width (µ)	volume (μ^3)	Third Portage Lake - East Basin Reference Area TPE-G 1	2	3	4	5
	Cyanobacteria								
1014	*Chroococcus limneticus Lemmermann*	3.5	3.5	22.5	-	-	-	-	+
1015	*Chroococcus turgidus (Kutzing) Nageli*	11.0	8.0	368.6	-	-	-	-	-
1057	*Leptolyngbya lemnetica (Anaga.)*	136.3	1.8	338.7	+	+	+	-	+
1077	*Pseudoanabaena sp.*	2.5	2.4	11.4	-	-	+	-	-
1084	*Gloeocapsa punctata*	4.0	4.0	33.5	-	-	+	-	-
1085	*Rivularia sp.*	56.5	6.6	1933.0	-	-	-	-	-
1102	*Gloeothece sp.*	2.1	2.1	4.7	+	+	-	-	+
1117	*Merismopedia punctata Meyen*	3.1	3.1	15.6	-	-	-	-	-
1122	*Phormidium autumnale Agardh*	94.5	6.0	2671.9	-	-	+	-	-
1124	*Petalonema alatum Berk*	87.8	6.3	2738.1	-	-	-	-	-
1131	*Heteroleibeinia profunda Komarek*	20.6	2.0	64.6	+	+	-	-	+
1136	*Lyngbya mucicola Lemmermann*	68.7	1.0	54.0	-	-	-	-	-
1220	*Rivularia dura Roth*	92.8	7.8	4473.9	+	+	-	-	+
1223	*Chamaesiphon incrustans Smith*	6.0	3.0	28.3	+	+	-	-	+
1239	*Homoeothrix varians Komarek & Kalina*	86.0	3.2	691.7	-	-	-	-	-
	Chlorophyte								
2178	*Cosmarium sp.*	27.5	27.5	3719.8	-	+	+	-	-
2193	*Staurodesmus paradoxum Meyen*	30.0	26.0	4084.1	-	-	-	-	-
2205	*Mougeotia sp.*	50.0	8.7	3123.3	+	+	+	-	+
2216	*Zygnema sp.*	27.5	11.0	2574.5	-	-	-	-	+
2954	*Stigeoclonium sp.*	16.0	8.0	804.3	-	-	-	-	-
	Chrysophyte								
4383	*Dinobryon bavaricum Imhof*	12.0	6.0	226.2	-	-	-	-	-
4388	*Dinobryon sertularia Ehrenberg*	12.0	6.0	226.2	-	-	+	-	+
	Diatom								
5306	*Navicula minima Grunow*	10.8	4.5	58.6	-	-	-	-	-
5311	*Cymbella minuta Kutzing*	15.2	7.6	343.1	-	-	-	-	-
5507	*Cyclotella stelligera Cleve and Grunow*	18.7	21.6	3394.5	-	-	+	-	-
5509	*Cyclotella ocellata Pant.*	8.8	9.3	303.7	+	-	-	-	+
5513	*Tabellaria fenestrata (Lyngbye) Kutzing*	87.4	8.8	1830.1	-	+	-	+	-
5514	*Tabellaria flocculsa (Roth) Kutzing*	26.0	14.0	1332.3	+	+	-	-	+
5518	*Synedra acus Kutzing*	110.0	2.0	115.2	-	-	-	-	-
5519	*Synedra acus v. radians (Kutzing) Hustedt*	56.8	2.0	60.2	-	-	-	-	+
5546	*Gyrosigma sp*	77.7	6.5	1324.5	-	-	-	-	-
5547	*Frustulia rhomboides (Ehrenberg) de Toni*	68.2	10.0	2678.2	+	+	-	-	-
5551	*Cyclotella michiganiana Skvortzow*	5.0	5.0	49.1	-	-	-	-	+
5702	*Achnanthes minutissima Kutzing*	19.1	4.0	80.0	+	+	-	-	+
5726	*Eucocconeis sp.*	40.6	20.0	4252.8	+	+	-	+	-
5728	*Epithemia argus Kutzing*	80.0	16.0	5361.7	-	-	-	-	-
5767	*Nitzschia fonticola Grunow*	16.0	4.4	89.7	-	-	-	-	-
5768	*Nitzschia linearis W. Smith*	69.0	9.3	1643.1	-	-	-	-	-
5769	*Nitzschia sigmoidea (Ehenberg) W. Smith*	74.0	6.5	811.2	+	-	-	+	-
5781	*Eunotia sp.*	65.0	10.0	1701.7	-	-	-	-	-
5820	*Eunotia arcus Ehrenberg*	55.5	12.5	2516.6	-	-	-	-	-
5836	*Encyonema silesiacum (Bleisch) D.G. Mann*	29.8	10.0	1171.2	+	+	-	+	-
5857	*Nitzschia filiformis (W. Smith) Hustedt*	51.1	3.1	125.9	+	+	-	-	+
5860	*Diatoma vulgare Bory*	28.2	6.0	265.8	-	-	-	-	-
5865	*Cymbella prostrata (Berkeley) Cleve*	96.0	21.5	17435.9	-	-	-	-	-
5870	*Navicula radiosa Kutzing*	66.0	10.0	1727.9	-	-	-	-	-
5873	*Gomphonema minutum*	25.9	7.7	407.0	+	+	-	-	+
5874	*Nitzschia palea (Kutzing) W. Smith*	60.3	7.1	814.0	-	-	-	-	-
5875	*Cocconies disculus Schum.*	29.7	14.0	1524.7	-	-	-	+	-
5876	*Aulacoseira islandica v. helvetica Muller*	26.0	8.0	1306.9	-	-	-	-	-
5882	*Anomoenies vitrea Ross*	34.2	6.0	322.3	+	+	-	-	+
5884	*Gomphonema angustum Agardh*	42.6	10.0	1115.3	-	-	-	-	-
5901	*Denticula sp*	30.0	6.7	380.5	-	-	-	+	-
5910	*Navicula exigua (Greg.) Muller*	36.3	6.7	423.0	-	-	-	-	-
	Total Richness				**16**	**16**	**8**	**6**	**17**

Appendix C. Presence (+) / absence (-) matrix of periphyton species 2017.

Taxon Code	Taxon Name	Cell Measurements length (μ)	width (μ)	volume (μ^3)	Third Portage Lake - East Basin Bay-Goose Dike - South Section TPE-BGS 1	2	3	4	5
	Cyanobacteria								
1014	*Chroococcus limneticus Lemmermann*	3.5	3.5	22.5	-	-	-	-	-
1015	*Chroococcus turgidus (Kutzing) Nageli*	11.0	8.0	368.6	-	-	-	-	-
1057	*Leptolyngbya lemnetica (Anaga.)*	136.3	1.8	338.7	+	+	+	+	+
1077	*Pseudoanabaena sp.*	2.5	2.4	11.4	-	-	-	-	-
1084	*Gloeocapsa punctata*	4.0	4.0	33.5	-	-	-	-	-
1085	*Rivularia sp.*	56.5	6.6	1933.0	-	+	+	-	-
1102	*Gloeothece sp.*	2.1	2.1	4.7	-	-	-	-	-
1117	*Merismopedia punctata Meyen*	3.1	3.1	15.6	-	-	-	-	-
1122	*Phormidium autumnale Agardh*	94.5	6.0	2671.9	-	-	-	+	-
1124	*Petalonema alatum Berk*	87.8	6.3	2738.1	-	+	-	+	+
1131	*Heteroleibeinia profunda Komarek*	20.6	2.0	64.6	+	+	+	+	+
1136	*Lyngbya mucicola Lemmermann*	68.7	1.0	54.0	-	-	-	-	-
1220	*Rivularia dura Roth*	92.8	7.8	4473.9	-	-	-	-	-
1223	*Chamaesiphon incrustans Smith*	6.0	3.0	28.3	-	-	-	-	-
1239	*Homoeothrix varians Komarek & Kalina*	86.0	3.2	691.7	-	-	+	-	-
	Chlorophyte								
2178	*Cosmarium sp.*	27.5	27.5	3719.8	-	-	-	-	-
2193	*Staurodesmus paradoxum Meyen*	30.0	26.0	4084.1	-	-	-	-	-
2205	*Mougeotia sp.*	50.0	8.7	3123.3	-	-	-	+	+
2216	*Zygnema sp.*	27.5	11.0	2574.5	-	-	-	-	+
2954	*Stigeoclonium sp.*	16.0	8.0	804.3	-	-	-	-	-
	Chrysophyte								
4383	*Dinobryon bavaricum Imhof*	12.0	6.0	226.2	-	-	+	-	+
4388	*Dinobryon sertularia Ehrenberg*	12.0	6.0	226.2	-	+	+	-	-
	Diatom								
5306	*Navicula minima Grunow*	10.8	4.5	58.6	-	-	-	+	-
5311	*Cymbella minuta Kutzing*	15.2	7.6	343.1	-	-	-	-	-
5507	*Cyclotella stelligera Cleve and Grunow*	18.7	21.6	3394.5	-	-	-	-	-
5509	*Cyclotella ocellata Pant.*	8.8	9.3	303.7	-	-	-	-	+
5513	*Tabellaria fenestrata (Lyngbye) Kutzing*	87.4	8.8	1830.1	-	-	-	-	-
5514	*Tabellaria flocculsa (Roth) Kutzing*	26.0	14.0	1332.3	+	-	+	+	+
5518	*Synedra acus Kutzing*	110.0	2.0	115.2	-	-	-	-	-
5519	*Synedra acus v. radians (Kutzing) Hustedt*	56.8	2.0	60.2	+	-	-	+	-
5546	*Gyrosigma sp*	77.7	6.5	1324.5	-	-	-	-	-
5547	*Frustulia rhomboides (Ehrenberg) de Toni*	68.2	10.0	2678.2	-	-	-	-	-
5551	*Cyclotella michiganiana Skvortzow*	5.0	5.0	49.1	-	-	-	+	-
5702	*Achnanthes minutissima Kutzing*	19.1	4.0	80.0	+	+	+	+	+
5726	*Eucocconeis sp.*	40.6	20.0	4252.8	+	-	+	-	-
5728	*Epithemia argus Kutzing*	80.0	16.0	5361.7	-	-	-	-	-
5767	*Nitzschia fonticola Grunow*	16.0	4.4	89.7	-	-	-	-	-
5768	*Nitzschia linearis W. Smith*	69.0	9.3	1643.1	-	-	-	-	-
5769	*Nitzschia sigmoidea (Ehenberg) W. Smith*	74.0	6.5	811.2	-	-	-	-	-
5781	*Eunotia sp.*	65.0	10.0	1701.7	-	-	-	-	-
5820	*Eunotia arcus Ehrenberg*	55.5	12.5	2516.6	-	-	-	-	-
5836	*Encyonema silesiacum (Bleisch) D.G. Mann*	29.8	10.0	1171.2	-	-	-	-	-
5857	*Nitzschia filiformis (W. Smith) Hustedt*	51.1	3.1	125.9	-	-	-	-	-
5860	*Diatoma vulgare Bory*	28.2	6.0	265.8	+	-	-	-	-
5865	*Cymbella prostrata (Berkeley) Cleve*	96.0	21.5	17435.9	-	-	-	-	-
5870	*Navicula radiosa Kutzing*	66.0	10.0	1727.9	-	-	-	-	-
5873	*Gomphonema minutum*	25.9	7.7	407.0	-	+	-	-	-
5874	*Nitzschia palea (Kutzing) W. Smith*	60.3	7.1	814.0	-	-	-	+	-
5875	*Cocconies disculus Schum.*	29.7	14.0	1524.7	-	-	+	-	-
5876	*Aulacoseira islandica v. helvetica Muller*	26.0	8.0	1306.9	-	-	-	-	-
5882	*Anomoenies vitrea Ross*	34.2	6.0	322.3	+	-	-	+	+
5884	*Gomphonema angustum Agardh*	42.6	10.0	1115.3	-	-	-	-	-
5901	*Denticula sp*	30.0	6.7	380.5	-	-	-	-	-
5910	*Navicula exigua (Greg.) Muller*	36.3	6.7	423.0	+	-	+	-	+
	Total Richness				**9**	**7**	**11**	**12**	**11**

APPENDIX C

2017 AWAR Fisheries Data

Apx C - Table 1. Data collected for fish captured through hoopnets at location R02 in 2017. US = upstream; DS = downstream; PYRC = previous year recapture; CYRC = current year recapture; ARGR = Arctic grayling; WTF = round whitefish; LTR = lake trout.

Date/Time	Water Temp	Staff Gauge	Direction (US or DS)	Net ID	Fish #	Tag #	Fork Length (mm)	Weight (g)	Sex/ Maturity	PYRC/ CYRC	Species
6/10/17	4	60	-	-	-	-	-	-	-	-	-
6/11/17	3.8	58	US	R02A	2	101280	319	330	M7	PYRC	ARGR
6/11/17	3.8	58	US	R02A	3	602	345	410	F3	-	ARGR
6/11/17	3.8	58	US	R02A	4	603	328	400	F3	-	ARGR
6/11/17	3.8	58	US	R02A	5	604	328	390	M7	-	ARGR
6/11/17	3.8	58	US	R02A	6	605	315	340	F3	-	ARGR
6/11/17	3.8	58	US	R02A	1	-	290	317	-	-	WTF
6/12/17	3.9	49	US	R02A	7	609	330	410	F2	-	ARGR
6/12/17	3.9	49	US	R02A	8	611	272	230	M8	-	ARGR
6/12/17	3.9	49	US	R02A	9	612	220	350	F2	-	ARGR
6/12/17	3.9	49	US	R02A	11	614	317	340	F2	-	ARGR
6/12/17	3.9	49	US	R02A	12	616	326	480	F2	-	ARGR
6/12/17	3.9	49	US	R02A	13	617	290	300	M7	-	ARGR
6/12/17	3.9	49	US	R02A	14	619	310	380	F3	-	ARGR
6/12/17	3.9	49	US	R02A	15	620	339	400	M7	-	ARGR
6/12/17	3.9	49	US	R02A	16	621	359	470	M7	-	ARGR
6/12/17	3.9	49	US	R02A	17	622	300	310	M7	-	ARGR
6/12/17	3.9	49	US	R02A	18	623	306	350	F3	-	ARGR
6/12/17	3.9	49	US	R02A	19	352	340	480	F2	-	ARGR
6/12/17	3.9	49	US	R02A	20	353	323	330	M7	-	ARGR
6/12/17	3.9	49	US	R02A	21	355	330	420	F3	-	ARGR
6/12/17	3.9	49	US	R02A	22	356	318	350	M7	-	ARGR
6/12/17	3.9	49	US	R02A	23	357	288	280	F1	-	ARGR
6/12/17	3.9	49	US	R02A	24	358	289	290	F3	-	ARGR
6/12/17	3.9	49	US	R02A	25	359	341	430	M7	-	ARGR
6/12/17	3.9	49	US	R02A	26	362	302	350	M7	-	ARGR
6/12/17	3.9	49	US	R02A	27	363	277	250	M8	-	ARGR
6/12/17	3.9	49	US	R02A	28	365	336	410	F3	-	ARGR
6/12/17	3.9	49	US	R02A	29	367	269	240	M8	-	ARGR

Date/Time	Water Temp	Staff Gauge	Direction (US or DS)	Net ID	Fish #	Tag #	Fork Length (mm)	Weight (g)	Sex/ Maturity	PYRC/ CYRC	Species
6/12/17	3.9	49	US	R02A	30	368	308	340	M7	-	ARGR
6/12/17	3.9	49	US	R02A	31	369	306	310	M7	-	ARGR
6/12/17	3.9	49	US	R02A	32	371	323	340	M7	-	ARGR
6/12/17	3.9	49	US	R02A	33	372	316	340	M7	-	ARGR
6/12/17	3.9	49	US	R02A	34	373	281	280	M8	-	ARGR
6/12/17	3.9	49	US	R02A	35	374	292	310	F2	-	ARGR
6/12/17	3.9	49	US	R02A	36	375	296	310	F2	-	ARGR
6/12/17	3.9	49	US	R02A	37	402	345	590	F2	-	ARGR
6/12/17	3.9	49	US	R02A	38	403	310	380	M7	-	ARGR
6/12/17	3.9	49	US	R02A	39	404	319	420	F2	-	ARGR
6/12/17	3.9	49	US	R02A	40	405	331	420	F2	-	ARGR
6/12/17	3.9	49	US	R02A	41	406	365	490	M7	-	ARGR
6/12/17	3.9	49	US	R02A	42	407	326	380	M7	-	ARGR
6/12/17	3.9	49	US	R02A	43	408	325	380	M7	-	ARGR
6/12/17	3.9	49	US	R02A	44	410	349	400	F2	-	ARGR
6/12/17	3.9	49	US	R02A	45	411	344	520	F3	-	ARGR
6/12/17	3.9	49	US	R02A	46	412	320	350	M7	-	ARGR
6/12/17	3.9	49	US	R02A	47	413	285	260	M8	-	ARGR
6/12/17	3.9	49	US	R02A	48	414	380	340	F3	-	ARGR
6/12/17	3.9	49	US	R02A	49	415	333	410	F3	-	ARGR
6/12/17	3.9	49	US	R02A	50	416	336	470	F3	-	ARGR
6/12/17	3.9	49	US	R02A	51	418	364	490	F2	-	ARGR
6/12/17	3.9	49	US	R02A	52	419	308	310	M7	-	ARGR
6/12/17	3.9	49	US	R02A	53	421	348	500	M7	-	ARGR
6/12/17	3.9	49	US	R02A	54	424	337	450	F2	-	ARGR
6/12/17	3.9	49	US	R02A	55	777	258	220	F1	-	ARGR
6/12/17	3.9	49	US	R02A	56	779	394	300	M7	-	ARGR
6/12/17	3.9	49	US	R02A	57	783	308	380	M7	-	ARGR
6/12/17	3.9	49	US	R02A	58	784	283	280	F3	-	ARGR
6/12/17	3.9	49	US	R02A	59	785	278	270	F3	-	ARGR
6/12/17	3.9	49	US	R02A	60	786	292	250	M7	-	ARGR
6/12/17	3.9	49	US	R02A	61	787	280	260	F3	-	ARGR
6/12/17	3.9	49	US	R02A	62	790	336	480	F2	-	ARGR
6/12/17	3.9	49	US	R02A	63	791	307	310	M7	-	ARGR

Date/Time	Water Temp	Staff Gauge	Direction (US or DS)	Net ID	Fish #	Tag #	Fork Length (mm)	Weight (g)	Sex/ Maturity	PYRC/ CYRC	Species
6/12/17	3.9	49	US	R02A	64	792	287	290	M7	-	ARGR
6/12/17	3.9	49	US	R02A	65	793	273	230	M8	-	ARGR
6/12/17	3.9	49	US	R02A	66	794	261	210	F5	-	ARGR
6/12/17	3.9	49	US	R02A	67	-	-	-	-	-	ARGR
6/12/17	3.9	49	US	R02A	68	-	-	-	-	-	ARGR
6/12/17	3.9	49	US	R02A	10	-	301	190	-	-	WTF
6/13/17	4.3	47	US	R02A	69	795	346	390	M7	-	ARGR
6/13/17	4.3	47	US	R02A	70	407	328	397	M7	CYRC	ARGR
6/13/17	4.3	47	US	R02A	71	796	281	240	M7	-	ARGR
6/13/17	4.3	47	US	R02A	72	797	307	310	F3	-	ARGR
6/13/17	4.3	47	US	R02A	73	373	300	270	F3	CYRC	ARGR
6/13/17	4.3	47	US	R02A	74	799	340	440	F2	-	ARGR
6/13/17	4.3	47	US	R02A	75	800	265	200	F3	-	ARGR
6/13/17	4.3	47	US	R02A	76	452	314	350	F2	-	ARGR
6/13/17	4.3	47	US	R02A	77	453	366	490	M7	-	ARGR
6/13/17	4.3	47	US	R02A	78	455	348	480	F2	-	ARGR
6/13/17	4.3	47	US	R02A	79	456	322	380	F3	-	ARGR
6/13/17	4.3	47	US	R02A	80	457	280	304	M7	-	ARGR
6/13/17	4.3	47	US	R02A	81	458	339	470	F2	-	ARGR
6/13/17	4.3	47	US	R02A	82	459	357	410	M7	-	ARGR
6/13/17	4.3	47	US	R02A	83	462	319	380	F2	-	ARGR
6/13/17	4.3	47	US	R02A	84	463	318	340	F2	-	ARGR
6/13/17	4.3	47	US	R02A	85	362	307	320	M7	CYRC	ARGR
6/13/17	4.3	47	US	R02A	86	465	302	290	F2	-	ARGR
6/13/17	4.3	47	US	R02A	87	467	297	260	F2	-	ARGR
6/14/17	6.8	47	US	R02A	88	645	368	510	M7	-	ARGR
6/14/17	6.8	47	US	R02A	89	644	315	360	M7	-	ARGR
6/14/17	6.8	47	US	R02A	90	369	310	310	M7	CYRC	ARGR
6/14/17	6.8	47	US	R02A	91	643	368	600	F2	-	ARGR
6/14/17	6.8	47	US	R02A	92	642	297	280	F5	-	ARGR
6/14/17	6.8	47	US	R02A	93	641	317	330	M7	-	ARGR
6/14/17	6.8	47	US	R02A	94	640	315	320	M7	-	ARGR
6/14/17	6.8	47	US	R02A	95	639	319	350	F3	-	ARGR
6/14/17	6.8	47	US	R02A	96	637	325	390	F3	-	ARGR

Date/Time	Water Temp	Staff Gauge	Direction (US or DS)	Net ID	Fish #	Tag #	Fork Length (mm)	Weight (g)	Sex/ Maturity	PYRC/ CYRC	Species
6/14/17	6.8	47	US	R02A	97	636	282	250	F3	-	ARGR
6/14/17	6.8	47	US	R02A	98	635	287	270	M7	-	ARGR
6/14/17	6.8	47	US	R02A	99	634	315	330	M7	-	ARGR
6/14/17	6.8	47	US	R02A	100	633	309	290	M7	-	ARGR
6/14/17	6.8	47	US	R02A	101	632	323	280	M7	-	ARGR
6/14/17	6.8	47	US	R02A	102	631	326	370	M7	-	ARGR
6/14/17	6.8	47	US	R02A	103	630	220	110	F1	-	ARGR
6/14/17	6.8	47	US	R02A	104	629	240	280	M7	-	ARGR
6/14/17	6.8	47	US	R02A	105	-	230	140	M10	-	ARGR
6/14/17	6.8	47	US	R02A	106	628	268	240	M7	-	ARGR
6/14/17	6.8	47	US	R02A	107	627	255	180	F1	-	ARGR
6/14/17	6.8	47	US	R02A	108	626	257	170	M6	-	ARGR
6/16/17	9.2	43	US	R02A	109	485	293	285	M7	-	ARGR
6/16/17	9.2	43	US	R02A	110	484	328	300	M10	-	ARGR
6/16/17	9.2	43	US	R02A	111	483	300	250	M7	-	ARGR
6/16/17	9.2	43	US	R02A	112	482	348	500	M7	-	ARGR
6/16/17	9.2	43	US	R02A	113	481	319	325	M7	-	ARGR
6/16/17	9.2	43	US	R02A	114	480	333	340	M7	-	ARGR
6/16/17	9.2	43	US	R02A	115	479	320	310	M7	-	ARGR
6/16/17	9.2	43	US	R02A	116	478	270	185	M7	-	ARGR
6/16/17	9.2	43	US	R02A	117	477	315	280	M7	-	ARGR
6/16/17	9.2	43	US	R02A	118	924	335	350	M7	-	ARGR
6/16/17	9.2	43	US	R02A	119	923	270	225	M6	-	ARGR
6/16/17	9.2	43	US	R02A	120	922	286	245	M7	-	ARGR
6/16/17	9.2	43	US	R02A	121	921	228	125	F1	-	ARGR
6/16/17	9.2	43	US	R02A	121	921	228	125	F1	-	ARGR
6/16/17	9.2	43	US	R02A	122	629	235	150	M7	CYRC	ARGR
6/18/17	9.1	40	US	R02A	123	-	213	130	F1	-	ARGR
6/21/17	9	36	US	R02A	125	916	300	250	F4	-	ARGR
6/21/17	9	36	US	R02A	126	-	260	210	-	-	ARGR
6/21/17	9	36	DS	R02B	124	-	200	90	-	-	ARGR
6/25/17	10.2	-	US	R02A	127	897	280	240	M9	-	ARGR
6/28/17	-	-	DS	R02A	130	-	-	-	-	-	ARGR
6/28/17	-	-	US	R02A	128	-	-	-	-	-	ARGR

Date/Time	Water Temp	Staff Gauge	Direction (US or DS)	Net ID	Fish #	Tag #	Fork Length (mm)	Weight (g)	Sex/ Maturity	PYRC/ CYRC	Species
6/28/17	-	-	DS	R02B	129	-	-	-	-	-	WTF
6/29/17	8.9	26.8	DS	R02A	136	329	221	140	M6	-	ARGR
6/29/17	8.9	26.8	DS	R02A	137	330	218	140	F1	-	ARGR
6/29/17	8.9	26.8	DS	R02A	139	-	-	-	-	-	ARGR
6/29/17	8.9	26.8	DS	R02A	138	-	305	280	-	-	WTF
6/29/17	8.9	26.8	US	R02A	134	-	189	110	F1	-	ARGR
6/29/17	8.9	26.8	US	R02A	135	-	230	170	F1	-	ARGR
6/29/17	8.9	26.8	DS	R02B	133	-	244	180	-	-	WTF
6/29/17	8.9	26.8	US	R02B	132	-	200	150	-	-	ARGR
6/29/17	8.9	26.8	US	R02B	131	-	499	550	-	-	LT
7/02/17	17.4	25	US	R02A	140	-	228	160	F5	-	ARGR
7/02/17	17.4	25	US	R02B	141	-	190	100	F1	-	ARGR
7/04/17	-	22	DS	R02A	142	-	202	90	F1	-	ARGR
7/04/17	-	22	DS	R02A	143	-	183	80	M6	-	ARGR
7/07/17	14.1	18	US	R02A	144	-	179	90	-	-	ARGR
7/07/17	14.1	18	US	R02A	145	-	183	80	-	-	ARGR
7/07/17	14.1	18	US	R02A	146	-	190	100	-	-	ARGR
7/07/17	14.1	18	US	R02A	147	-	196	120	-	-	ARGR
7/07/17	14.1	18	US	R02A	148	-	180	90	-	-	ARGR
7/07/17	14.1	18	US	R02A	149	-	192	110	-	-	ARGR
7/07/17	14.1	18	US	R02A	150	-	179	90	-	-	ARGR
7/07/17	14.1	18	US	R02A	151	-	172	80	-	-	ARGR
7/07/17	14.1	18	US	R02A	152	-	189	100	-	-	ARGR
7/07/17	14.1	18	US	R02A	154	-	272	230	F5	-	ARGR
7/07/17	14.1	18	US	R02A	153	-	223	155	-	-	WTF

APPENDIX D

2017 Interstitial Water Quality Results

Apx D - Table 1. Interstitial water quality results for Bay-Goose Dike, East Dike, Second Portage Lake reference station and Third Portage Lake reference station. Results exceeding CCME Water Quality Guidelines for Aquatic Life (2007) are highlighted in grey. All units are mg/L.

Sample ID	Detection Limit	CCME (2007)	BG-PW-6	BG-PW-4	BG-PW-2	BG-PW-DUP	RPD	TPL-REF	ED-PW-1	ED-PW-4	SP-REF
Physical Tests (Water)											
Hardness (as CaCO3)	0.50		10.4	11	10.9	10.5	0.96	10.3	14.1	13.4	14.4
Total Suspended Solids	1.0	6	8.2	<1.0	<1.0	1.1	152	<1.0	<1.0	<1.0	2.0
Anions and Nutrients (Water)											
Phosphorus (P)-Total	0.0020	0.004	<0.0020	0.0029	<0.0020	<0.0020		<0.0020	<0.0020	<0.0020	<0.0020
Total Metals (Water)											
Aluminum (Al)-Total	0.0030	0.1	0.0078	0.0131	0.0072	0.0086	9.76	0.0057	0.0092	0.0060	0.0065
Antimony (Sb)-Total	0.00010		<0.00010	<0.00010	<0.00010	<0.00010		<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)-Total	0.00010	0.005	0.00066	0.00051	0.00054	0.00067	1.50	0.00038	0.00028	0.00029	0.00023
Barium (Ba)-Total	0.000050		0.00279	0.00285	0.00282	0.00278	0.36	0.00281	0.00264	0.00273	0.00263
Beryllium (Be)-Total	0.000020		<0.000020	<0.000020	<0.000020	<0.000020		<0.000020	<0.000020	<0.000020	<0.000020
Bismuth (Bi)-Total	0.000050		<0.000050	<0.000050	<0.000050	<0.000050		<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Total	0.010		<0.010	<0.010	<0.010	<0.010		<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)-Total	0.0000050	0.00017	<0.0000050	<0.0000050	<0.0000050	<0.0000050		<0.0000050	<0.0000050	<0.0000050	<0.0000050
Calcium (Ca)-Total	0.050		2.78	2.73	2.71	2.76	0.72	2.55	3.80	3.62	3.93
Chromium (Cr)-Total	0.00010	0.001	0.00018	0.00025	<0.00010	0.00021	15.3	<0.00010	0.00012	0.00013	0.00010
Cobalt (Co)-Total	0.00010		<0.00010	<0.00010	<0.00010	<0.00010		<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)-Total	0.00050	0.002	<0.00050	<0.00050	<0.00050	<0.00050		<0.00050	<0.00050	0.00061	0.00053
Iron (Fe)-Total	0.010		0.014	0.027	0.010	0.015	6.90	<0.010	0.027	0.022	0.022
Lead (Pb)-Total	0.000050	0.001	<0.000050	0.000097	<0.000050	<0.000050		<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)-Total	0.0010		<0.0010	<0.0010	<0.0010	<0.0010		<0.0010	<0.0010	<0.0010	<0.0010
Magnesium (Mg)-Total	0.10		1.00	1.01	1.01	1.00	0.00	0.96	1.20	1.21	1.23
Manganese (Mn)-Total	0.00010		0.00194	0.00201	0.00110	0.00144	29.5	0.00117	0.00209	0.00202	0.00224
Mercury (Hg)-Total	0.0000050		<0.0000050	<0.0000050	0.0000066	0.0000157		0.0000958	0.0000124	0.0000129	0.0000079
Molybdenum (Mo)-Total	0.000050		0.000183	0.000219	0.000227	0.000174	5.04	0.000165	0.000341	0.000199	0.000218
Nickel (Ni)-Total	0.00050	0.025	0.00056	0.00060	0.00052	0.00055	1.80	<0.00050	<0.00050	0.00058	<0.00050
Phosphorus (P)-Total	0.050		<0.050	<0.050	<0.050	<0.050		<0.050	<0.050	<0.050	<0.050
Potassium (K)-Total	0.10		0.55	0.54	0.54	0.54	1.83	0.53	0.54	0.55	0.55
Selenium (Se)-Total	0.000050	0.001	<0.000050	<0.000050	<0.000050	<0.000050		<0.000050	<0.000050	<0.000050	<0.000050
Silicon (Si)-Total	0.050		<0.10	<0.10	0.10	<0.10		<0.10	0.16	0.15	0.17
Silver (Ag)-Total	0.000010	0.0001	<0.000010	<0.000010	<0.000010	<0.000010		<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Total	0.050		1.09	1.10	1.48	1.07	1.85	1.08	0.898	0.943	0.889
Strontium (Sr)-Total	0.00020		0.0115	0.0114	0.0116	0.0115	0.00	0.0113	0.0171	0.0163	0.0177
Sulfur (S)-Total	0.50		1.56	1.61	1.66	1.64	5.00	1.67	1.56	1.83	1.71
Thallium (Tl)-Total	0.000010	0.0008	<0.000010	<0.000010	<0.000010	<0.000010		<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Total	0.00010		<0.00010	<0.00010	<0.00010	<0.00010		<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Total	0.00030		<0.00030	<0.00030	<0.00030	<0.00030		<0.00030	<0.00030	<0.00030	<0.00030
Uranium (U)-Total	0.000010		0.000048	0.000048	0.000049	0.000049	2.06	0.000044	0.000049	0.000047	0.000047
Vanadium (V)-Total	0.00050		<0.00050	<0.00050	<0.00050	<0.00050		<0.00050	<0.00050	<0.00050	<0.00050

Sample ID	Detection Limit	CCME (2007)	BG-PW-6	BG-PW-4	BG-PW-2	BG-PW-DUP	RPD	TPL-REF	ED-PW-1	ED-PW-4	SP-REF
Zinc (Zn)-Total	0.0030	0.03	<0.0030	<0.0030	<0.0030	<0.0030		<0.0030	<0.0030	<0.0030	<0.0030
Zirconium (Zr)-Total	0.00030		<0.00030	<0.00030	<0.00030	<0.00030		<0.00030	<0.00030	<0.00030	<0.00030
Dissolved Metals (Water)											
Aluminum (Al)-Dissolved	0.0010		0.0023	0.0027	0.0028	0.0030		0.0015	0.0011	0.0012	0.0013
Antimony (Sb)-Dissolved	0.00010		<0.00010	<0.00010	<0.00010	<0.00010		<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)-Dissolved	0.00010		0.00044	0.00044	0.00049	0.00044		0.00037	0.00019	0.00026	0.00021
Barium (Ba)-Dissolved	0.000050		0.00270	0.00304	0.00291	0.00272	26.4	0.00256	0.00254	0.00253	0.00243
Beryllium (Be)-Dissolved	0.000020		<0.000020	<0.000020	<0.000020	<0.000020		<0.000020	<0.000020	<0.000020	<0.000020
Bismuth (Bi)-Dissolved	0.000050		<0.000050	<0.000050	<0.000050	<0.000050	0.00	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Dissolved	0.010		<0.010	<0.010	<0.010	<0.010	0.74	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)-Dissolved	0.0000050		<0.0000050	<0.0000050	<0.0000050	<0.0000050		<0.0000050	<0.0000050	<0.0000050	<0.0000050
Calcium (Ca)-Dissolved	0.050		2.55	2.65	2.63	2.58		2.54	3.71	3.46	3.74
Chromium (Cr)-Dissolved	0.00010		<0.00010	<0.00010	<0.00010	<0.00010		<0.00010	<0.00010	<0.00010	<0.00010
Cobalt (Co)-Dissolved	0.00010		<0.00010	<0.00010	<0.00010	<0.00010		<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)-Dissolved	0.00020		0.00040	0.00040	0.00037	0.00039	1.17	0.00034	0.00055	0.00053	0.00062
Iron (Fe)-Dissolved	0.010		<0.010	<0.010	<0.010	<0.010		<0.010	<0.010	<0.010	<0.010
Lead (Pb)-Dissolved	0.000050		<0.000050	<0.000050	<0.000050	<0.000050		<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)-Dissolved	0.0010		<0.0010	<0.0010	<0.0010	<0.0010	2.53	<0.0010	<0.0010	<0.0010	<0.0010
Magnesium (Mg)-Dissolved	0.10		0.98	1.06	1.06	0.98		0.97	1.18	1.16	1.24
Manganese (Mn)-Dissolved	0.00010		0.00055	0.00050	0.00036	0.00051		0.00035	0.00035	0.00055	0.00031
Mercury (Hg)-Dissolved	0.0000050		<0.0000050	<0.0000050	<0.0000050	<0.0000050		<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Dissolved	0.000050		0.000139	0.000153	0.000156	0.000160	0.00	0.000216	0.000167	0.000176	0.000181
Nickel (Ni)-Dissolved	0.00050		<0.00050	<0.00050	<0.00050	<0.00050	7.55	<0.00050	<0.00050	<0.00050	<0.00050
Phosphorus (P)-Dissolved	0.050		<0.050	<0.050	<0.050	<0.050		<0.050	<0.050	<0.050	<0.050
Potassium (K)-Dissolved	0.10		0.52	0.56	0.54	0.53	14.0	0.51	0.52	0.53	0.53
Selenium (Se)-Dissolved	0.000050		<0.000050	<0.000050	<0.000050	<0.000050		<0.000050	<0.000050	<0.000050	<0.000050
Silicon (Si)-Dissolved	0.050		0.051	0.053	0.054	<0.050		<0.050	0.124	0.100	0.133
Silver (Ag)-Dissolved	0.000010		<0.000010	<0.000010	<0.000010	<0.000010	1.90	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Dissolved	0.050		1.10	1.19	1.16	1.09		1.10	0.892	0.953	0.890
Strontium (Sr)-Dissolved	0.00020		0.0110	0.0119	0.0115	0.0110		0.0116	0.0169	0.0154	0.0168
Sulfur (S)-Dissolved	0.50		1.57	1.87	1.79	1.71		1.59	1.70	1.56	1.69
Thallium (Tl)-Dissolved	0.000010		<0.000010	<0.000010	<0.000010	<0.000010	0.91	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Dissolved	0.00010		<0.00010	<0.00010	<0.00010	<0.00010	0.00	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Dissolved	0.00030		<0.00030	<0.00030	<0.00030	<0.00030	8.54	<0.00030	<0.00030	<0.00030	<0.00030
Uranium (U)-Dissolved	0.000010		0.000044	0.000043	0.000041	0.000046		0.000038	0.000042	0.000038	0.000042
Vanadium (V)-Dissolved	0.00050		<0.00050	<0.00050	<0.00050	<0.00050		<0.00050	<0.00050	<0.00050	<0.00050
Zinc (Zn)-Dissolved	0.0010		<0.0010	<0.0010	<0.0010	<0.0010		<0.0010	<0.0010	<0.0010	<0.0010
Zirconium (Zr)-Dissolved	0.00030		<0.00030	<0.00030	<0.00030	<0.00030	4.44	<0.00030	<0.00030	<0.00030	<0.00030