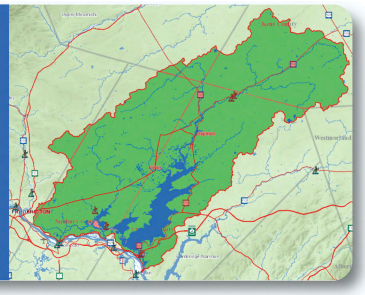
Jemseg Grand Lake Watershed Association
Water Monitoring Program Report – 2021

by
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March 1, 2022

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Jemseg Grand Lake Watershed Association



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Jemseg Grand Lake Watershed Association
Water Monitoring Program Report – 2021

1.0 Introduction

The Jemseg Grand Lake Watershed Association (JGLWA) was formed in the fall of 2019 by committed volunteers to initiate activities to build public interest and to work together for the benefit of our environment and the watershed area. In 2020 the JGLWA initiated a water quality monitoring program and reported in through the New Brunswick Environmental Trust program. We continued our monitoring program in 2021, building on the program that we initiated the year before, and including a few additional monitoring components to allow us to better assess the water quality of Grand Lake.

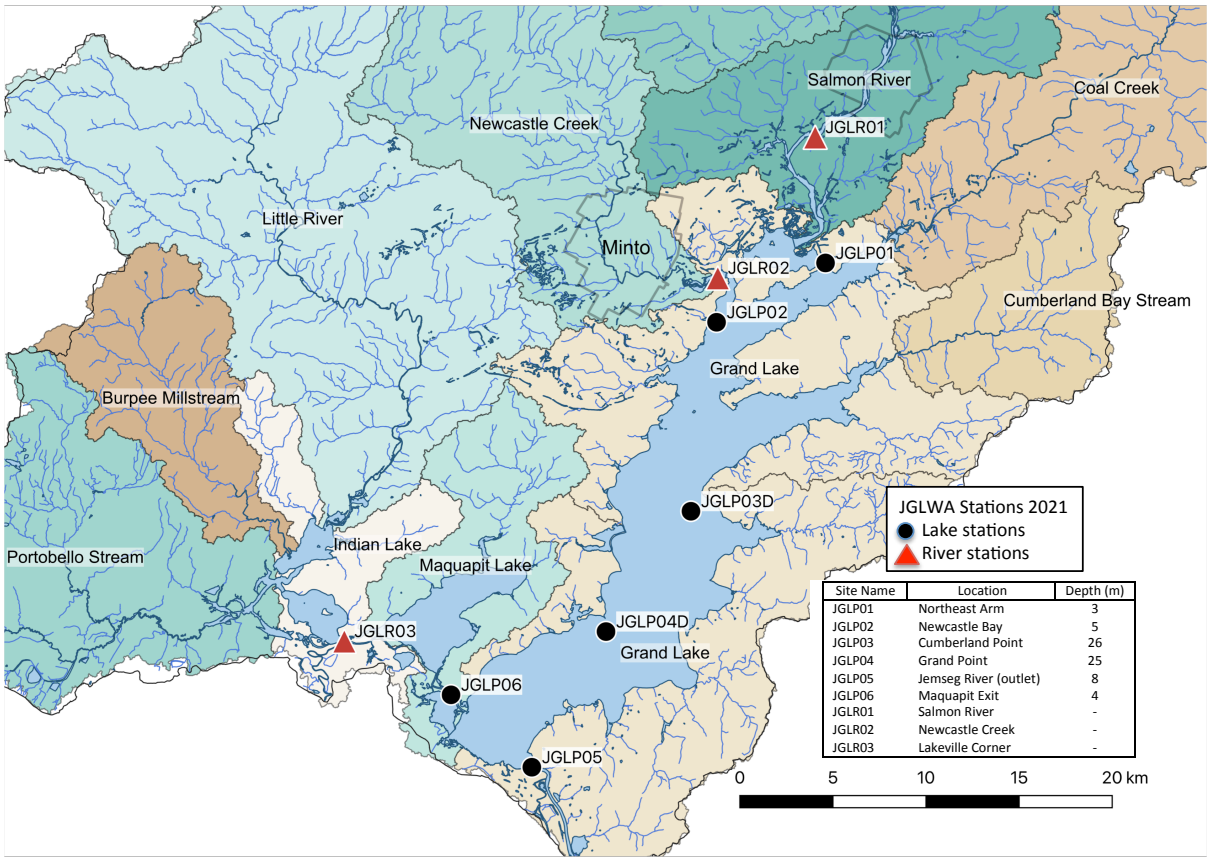
Our program was initially designed to examine the water quality of Grand Lake, its main inflows as well as the outflow (Jemseg River). With feedback from year one, we made modifications to improve and enhance the program. Our volunteer program included monthly sampling of our core 6 stations within Grand Lake from June until September 2021. Volunteers were engaged to measure biophysical parameters at surface and at depth and to collect water samples to measure major ions, nutrients, trace metals and chlorophyll *a* (*chl a*). In addition, we collected water samples from below the thermocline at our two deep stations to detect potential changes. During 2020 sampling, some of the water chemistry parameters were highest near sections of Grand Lake close to river inflows. We added three river stations to the program, sampling the same parameters as for our core lakes stations to determine quality of waters inflowing to the lake. Our *Escherichia coli* (*E. coli*) sampling program was revised to include shoreline areas along the perimeter of Grand Lake in areas of cottages and the potential for non point source sewage effluent seepage. Finally, we collected phytoplankton and zooplankton in the early fall to describe the plankton community in the lake.

2.0 Methods

Grand Lake is the largest lake in New Brunswick and is fed by three main inflows: Salmon River, New Castle Creek, and the Maquapit Thoroughfare Exit (Maquapit Exit). Outflow is through the Jemseg River to the Saint John River. Our sampling locations were designed to obtain water quality data from locations on Grand Lake close to these inflow sources and the outflow, as well as from two mid-lake, deep basin locations. A total of six water quality sampling sites were established (Figure 1). We also added three river sites to better describe inflowing water, they are located at Salmon River, Newcastle Creek, and Lakeville Corner (Figure 1). In addition, in partnership with Atlantic Coastal Action Plan Saint John (ACAP Saint John), we established two cyanobacteria monitoring stations (Jemseg River, Grand Lake) and deployed solid phase adsorption toxin tracking (SPATT) collectors and temperature loggers at these stations. ACAP Saint John will report data collected from these two stations

separately. An additional temperature logger was deployed near Cumberland Point logging surface water temperature every 30 minutes.

Water quality sampling was conducted by two volunteer teams, with one team sampling the three southwest sampling stations and the other team sampling the three northeast stations. Stations were sampled four times during the summer of 2021 (June 20-22, July 17-19, August 22-26, September 17 and 28). Stations were accessed using a boat and positioned using a Garmin GPS/depthsounder. At each station pH, conductivity, temperature and oxygen were measured at 1 m intervals using a YSI multimeter. Secchi disk depth was taken at each site. Surface water samples were collected for general water chemistry, nutrients, metals, chl *a* and *E. coli*. At our two Grand Lake deep water stations (JGLP03 and JGLP04), we took samples at 20 m using a 2L Niskin water sampler to determine whether water chemistry was different below the thermocline. Surface water samples and measurements were taken at the three river sites, with similar methods to those used at the lake stations. River sites were accessed by road. Water samples were kept cold and transported to the Research and Productivity Council Laboratories (RPC) within 24 hours of collection for analysis. A surface water phytoplankton sample was collected using a 500 ml container and a zooplankton sample using a 8 inch diameter, 63 micron mesh net sample towed behind a kayak was taken off Cumberland Point to determine a baseline plankton community. Samples were preserved in Ethanol, and shipped to Biolimno Consulting for taxonomic analysis.



Site Name	Location	Depth (m)
JGLP01	Northeast Arm	3
JGLP02	Newcastle Bay	5
JGLP03	Cumberland Point	26
JGLP04	Grand Point	25
JGLP05	Jemseg River (outlet)	8
JGLP06	Maquapit Exit	4
JGLR01	Salmon River	-
JGLR02	Newcastle Creek	-
JGLR03	Lakeville Corner	-

Figure 1. Jemseg Grand Lake Watershed sampling stations. Legend indicates station site name, location and depth at site. Subwatersheds are colour shaded.

Conductivity, pH, oxygen and temperature date results are presented in graphs by depth to show vertical profiles at the two deep mid lake sampling sites. Water chemistry results were used to generate a water quality index for each individual station, as well as to compile an overall water quality index for the whole lake using the Canadian Council of Ministers of the Environment (CCME) approach (CCME, 2001). The CCME water quality index (WQI) provides a method to summarize water quality data to facilitate communication about water quality to a general audience. The WQI incorporates three elements: *scope* - the number of variables not meeting water quality objectives; *frequency* - the number of times these objectives are not met; and *amplitude* - the amount by which the objectives are not met. The WQI produces a score between 0 (worst water quality) and 100 (best water quality). These scores are divided into five descriptive categories to simplify presentation (CCME, 2001). We used parameters similar to those used by the New Brunswick Department of Environment and Local Government (NBDELG) for their watershed "Report Cards", which incorporate information about levels of ammonia, arsenic, chloride, copper, dissolved oxygen, iron, nitrate, pH, phosphorus, turbidity, zinc in water. To determine trophic status of the lake, we adapted a trophic state index (TSI) equation originally developed by Carlson and Simpson (1996) and commonly used for lake management, using nitrogen, phosphorus and chl *a*. TSI provides an estimate of relative biological productivity of the aquatic ecosystem.

3.0 Results

3.1 Surface temperature

Temperature data collected from the Grand Lake and Jemseg loggers was compiled, and summarized in Table 1. For Grand Lake, overall average temperature was 22 ºC for the period of deployment (July 1 to September 19) in 2021, similar to the average temperature for 2020 (21ºC), with August having the warmest average temperatures of 23 ºC for both years (Table 1). In 2021, maximum temperature (27 ºC) was reached in mid August, and coolest temperature of 17 ºC. Daily temperature fluctuation was approximately 2 ºC. In 2021, there was a total of 33 days with temperatures reaching above 23 ºC, 25 of these in August. Jemseg River had a greater range of temperature then in Grand Lake, however, overall average was within 1 degree for each month, and overall. Jemseg also had more days above 23 ºC then did Grand Lake.

Table 1. Lake surface temperature summary statistics from Grand Lake (Cumberland Point JGLP03) and Jemseg (JGLP05).

Month	Max Temp (ºC)			Min Temp (ºC)			Average (ºC)			No. days >23ºC		
	Grand Lake		Jemseg	Grand Lake		Jemseg	Grand Lake		Jemseg	Grand Lake		Jemseg
	2020	2021	2021	2020	2021	2021	2020	2021	2021	2020	2021	2021
July	27	26	25	18	17	14	23	22	21	20	7	17
August	29	27	29	18	20	16	23	23	24	24	25	26
September	23	24	27	14	17	13	19	20	19	0	1	1
Overall	29	27	29	8	17	13	21	22	21	46	33	44

3.2 Grand Lake Surface Water Biophysical Characteristics

Biophysical characteristics of Grand Lake surface water taken during our four monthly sampling sessions are provided in Table 2 and summarized in the following bullet points.

Grand Lake sites

- Average dissolved oxygen percentage ranged from 78% at Northeast Arm to 92% at Jemseg.
- Warmest average temperatures were at Maquapit Exit and Newcastle Creek, with temperatures of 21.7 °C and 22.0 °C respectively.
- Average pH for most stations was around neutral, from 6.7 to 7.2, maximum was 7.5 at Grand Pt. Bar, and minimum of 6.9 at Maquapit Exit.
- Average conductivity was lowest at Maquapit (38.4 µS/cm) and highest at Northeast Arm (78.9 µS/cm). This shows the variation in the lake inflow from the Salmon River into Northeast Arm, and the very dark/boggy water of the Maquapit Lake region.
- Secchi disk readings for the lake are naturally low due to the background colour of the water. Readings averaged between 0.7 and 2.9 m, with highest averages from Cumberland Point.

River Sites

- Average percentage of dissolved oxygen ranged from 69% at Salmon River and Lakeville Corner to 76.3% at Newcastle Creek.
- Warmest average temperatures was at Lakeville Corner, with temperatures of 23.3 °C and lowest at 20.3 °C at Newcastle Creek.
- Average pH was slightly more acidic then the lake stations, ranging from 6.2 to 6.5, maximum and minimum was at Salmon River, with 7.2 and 5.4 respectively.
- Average conductivity ranged from 40.6 (Lakeville Corner) to 85.9 microS/cm (Newcastle Creek). This was a greater range than at the lake sites.

Table 2. Summary statistics of Jemseg Grand Lake Watershed Surface Water Biophysical Characteristics

Sampling stn	Dissolved Oxygen mg/L			Dissolved Oxygen %			Water Temp ° C			pH			Conductivity microS/cm			Secchi (m)		
	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min
Northeast Arm JGLP01	6.9	8.1	6.0	78.0	89.0	69.0	21.4	24.9	17.8	6.8	7.0	6.6	78.9	97.0	61.6	0.8	1.0	0.8
Newcaste Bay JGLP02	7.5	8.5	6.6	84.5	91.0	80.0	21.5	25.1	18.8	7.1	7.2	6.9	78.4	87.8	69.4	1.4	2.0	1.0
Cumberland Pt JGLP03	8.3	9.1	7.3	92.0	96.0	86.0	20.4	23.3	17.6	7.2	7.3	7.0	68.4	73.6	59.4	2.9	3.5	2.0
Grand Pt. Bar JGLP04	8.3	9.2	7.4	90.3	95.0	81.0	20.6	23.9	18.8	7.1	7.5	6.8	65.1	70.3	61.0	1.9	2.7	1.5
Jemseg River JGLP05	8.1	9.2	6.4	86.0	95.0	77.0	20.8	24.6	18.3	7.1	7.4	7.0	69.4	76.5	61.0	2.1	2.4	1.8
Maquapit Exit JGLP06	7.3	8.2	6.0	79.0	84.0	73.0	21.7	24.5	18.7	6.7	6.9	6.5	38.4	42.5	35.7	0.7	0.8	0.5
Salmon River JGLR01	6.1	7.5	3.9	69.0	87.0	50.0	22.2	27.7	16.4	6.3	7.2	5.4	46.3	71.1	33.7			
Newcastle Cr JGLR02	6.9	7.7	5.4	76.3	87.0	66.0	20.3	25.3	14.6	6.2	6.6	5.6	85.9	109.3	59.3			
Lakeville Corner JGLR03	5.9	7.2	4.4	69.0	85.0	56.0	23.3	27.8	18.5	6.5	6.6	6.4	40.6	41.7	39.9			

3.3 Vertical Profiles

For the inflow and outflow stations (Northeast Arm, Newcastle Bay, Maquapit Exit and Jemseg River), water depth was not deep enough at these sites to establish thermoclines. At the mid-lake deep stations (>25 m at Cumberland Point and Grand Point), thermal stratification was set in June, and continued into August. Oxygen concentrations did decrease with depth, especially in August. At depths below 20 m at Cumberland Pt and Grand Bar Pt, oxygen concentrations decreased to below the critical 5.5 mg/L concentration in August. In September, the thermocline (the depth at which there is a sudden change in temperature) was less obvious, and while sampling in September, the thermocline was completely gone, and temperature and oxygen concentrations were similar from surface to bottom.

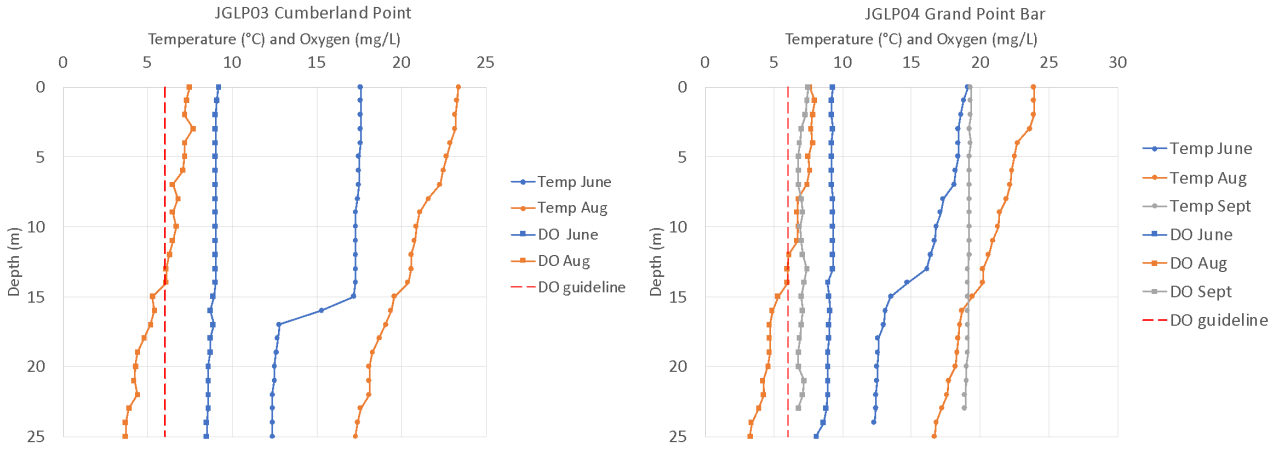


Figure 2**.** Vertical profiles of temperature and oxygen concentrations versus depth at Cumberland Point and Grand Bar Point for June, August and September, 2021. Red dashed line indicates critical oxygen concentration of 5.5 mg/L.

3.4 Water Quality

Water quality sampling results for key parameters used to score the WQI are summarized in Table 3. For a complete set of analytical results, refer to Appendix A. Results were compared with CCME Canadian Water Quality Guidelines for the Protection of Aquatic Life (Freshwater)(CWQG; CCME, 1999), and for nutrients, compared with proposed total nitrogen and total phosphorus guidelines for the Saint John River Watershed (Culp et. al. 2005).

Only two parameters had exceedances of the CWQG, including total phosphorus and iron at two lake sites, and three river sites. Interestingly, the parameters of exceedance at Salmon River and Lakeville corner were the same exceedances as to their corresponding lake sites, indicating that the river inflow is the likely source. There were no exceedances at the two mid-lake stations, or at the Jemseg River site. Iron is a parameter that frequently exceeds the CWQG in freshwater bodies across Canada, and since the concentrations were just above the CWQG, they are currently not a big concern; iron is more of an aesthetic concern and less of a concern to the health of aquatic life. The exceedances for

phosphorus are a concern as they can lead to eutrophic conditions in the lake. More information on this is described under the TSI section.

Water quality samples taken at 20 m at the two midlake sites (identified as JGLP03D, JGLP04D) had 6 of the 11WQI parameters similar to concentrations from samples taken at the corresponding surface sample. Three of the parameters, nitrate, turbidity and zinc had increased concentrations compared to the surface, while pH and oxygen had decreased values. Except for oxygen, none of the other changed parameters triggered an exceedance of the CWQG.

Table 3. Average water quality results from Grand Lake surface water samples collected between June – September 2021. RL = recording limits of a parameter, CWQG = Canadian Water Quality Guidelines for the Protection of Aquatic Life (CWQG; CCME, 1999), and for nutrients, compared with proposed total nitrogen and total phosphorus guidelines for the Saint John River Watershed (Culp et. al. 2005), shaded values are those that had average exceedances that were above CCME guideline.

Analytes	Units	RL	CWQG	Grand Lake Sampling Sites								Inflow Sampling Sites		
				JGLP01	JGLP02	JGLPO3	JGLP03D	JGLP04	JGLP04D	JGLP05	JGLP06	JGLR01	JGLR02	JGLR03
Chloride	mg/L	0.5	120	3.85	4.10	4.68	4.70	4.63	4.70	4.88	3.18	3.93	5.50	3.28
Ammonia (as N)	mg/L	0.05	1.54	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Nitrate (as N)	mg/L	0.05	13	< 0.05	0.17	0.06	0.12	<0.05	0.10	0.06	< 0.05	< 0.05	< 0.05	< 0.05
Phosphorus – Tot	mg/L	0.002	0.03	0.03	0.02	0.01	0.01	0.01	0.01	0.01	0.03	0.03	0.03	0.03
pH	units	-	6.5-9	7.30	7.35	7.40	7.00	7.45	6.90	7.43	7.18	6.98	6.78	6.90
Turbidity	NTU	0.1	10	3.08	1.98	0.65	1.05	0.65	0.90	0.73	3.08	2.78	2.08	2.90
Arsenic	mg/L	0.001	0.005	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Copper	mg/L	0.001	0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Iron	mg/L	0.02	0.3	0.53	0.27	0.09	0.08	0.09	0.08	0.11	0.40	0.66	0.75	0.59
Zinc	mg/L	0.001	0.03	0.0128	0.0075	0.0080	0.0150	0.0097	0.0155	0.0070	0.0103	0.0045	0.0060	0.0035
Dissolved oxygen	mg/L		5.5	6.9	7.5	8.3	5.2	8.3	5.9	8.1	7.3	6.1	6.9	5.9

3.5 Historical Nutrient Data

Historical water quality data from Grand Lake was obtained from New Brunswick's Department of Environment. Historical (1975, 1979 and 1993) data for total nitrogen, total phosphorus and *chl a* was compared to the same parameters for samples collected in 2020 and 2021 from four locations on Grand Lake (Figure 3). For consistency, July samples were used for comparison. For total nitrogen, highest concentrations were obtained in 1975, with a slight decrease since that time. Unfortunately there were no measurements for total phosphorus in 1975 and 1979, therefore there is only one year for comparison, 1993. Phosphorus concentrations were similar in 1993 and 2021, with slightly higher values in 2020. *Chl a* measurements were low in the 1970s, but then peaked in 1993, and decreased again for 2021. No *chl a* was collected in 2020.

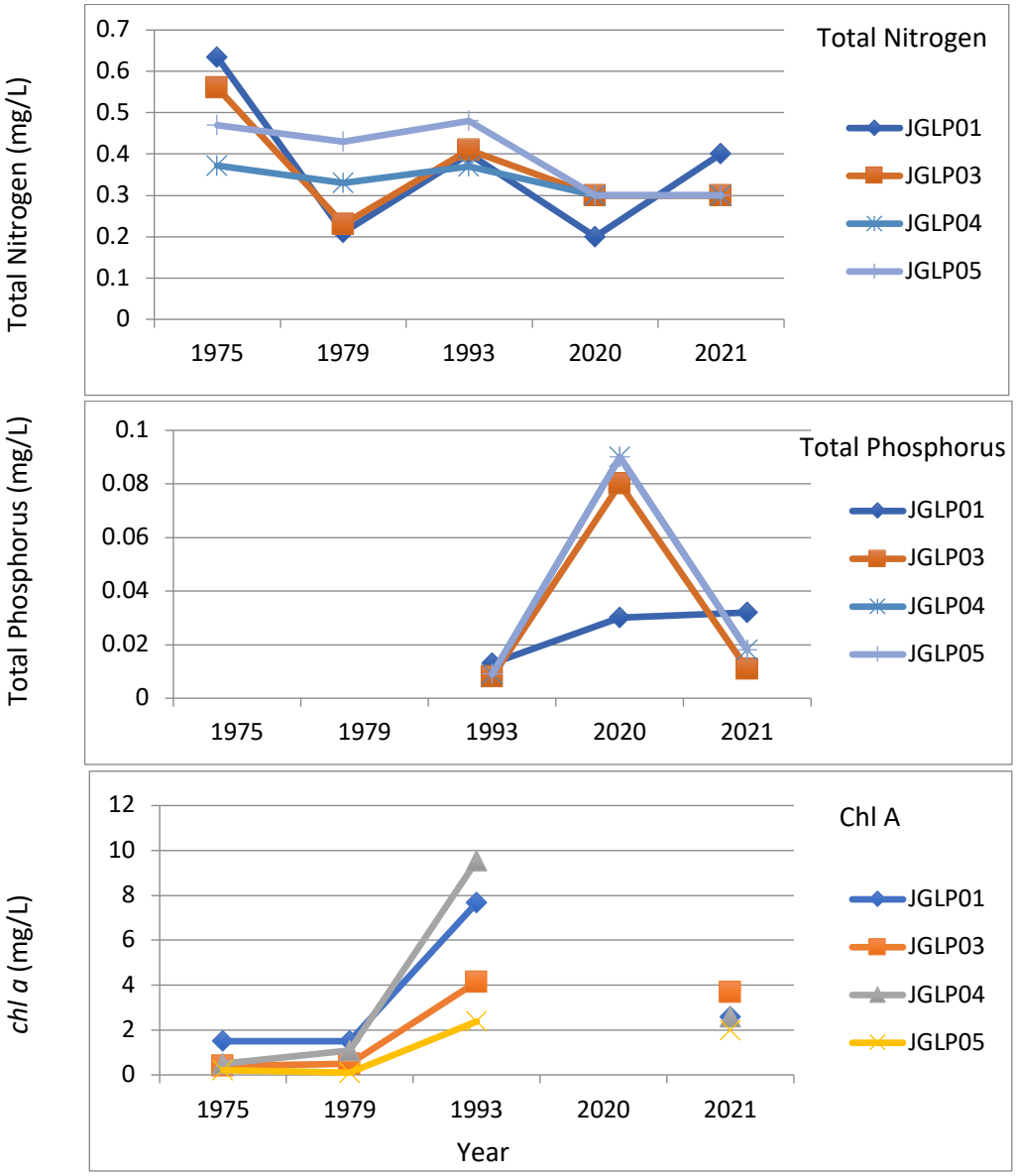


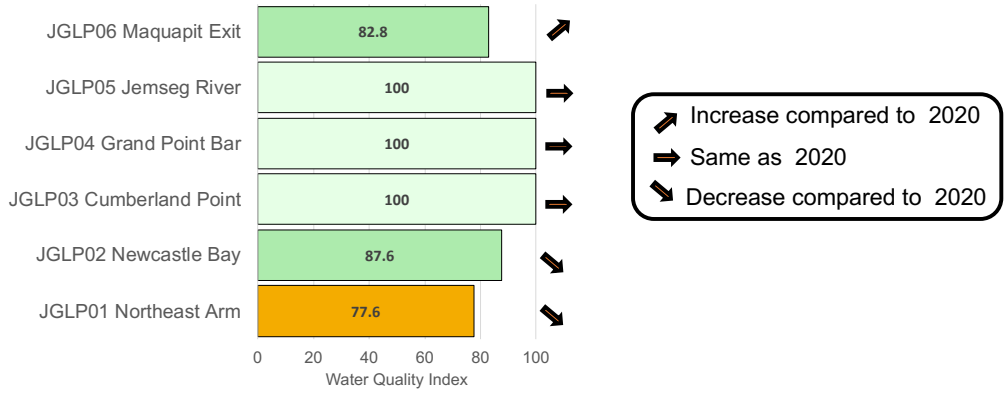
Figure 3. Historical comparisons of Grand Lake water total nitrogen (mg/L), total phosphorus (mg/L) and *chl a* (ug/L). Scaling of X axis data points is not in temporal proportion.

3.5 Water quality Index

Using the CCME Water quality index (WQI) manual (CCME, 2001), the WQI of the six sampling sites was calculated using the following parameters: arsenic, ammonia, chloride, dissolved oxygen (surface measurement), iron, nitrate, pH, total phosphorus, turbidity, and zinc. The WQI score for each station is provided in Table 4 and identified on the watershed map (Figure 4).

The overall average water quality index for 2021 was calculated to be 91.3, slightly lower than last year but still in the ”Excellent” category.

Table 4**.** Water quality index determined from the six Grand Lake sampling sites for four sampling periods, monthly from June to September 2021. Score colour can be compared to legend.



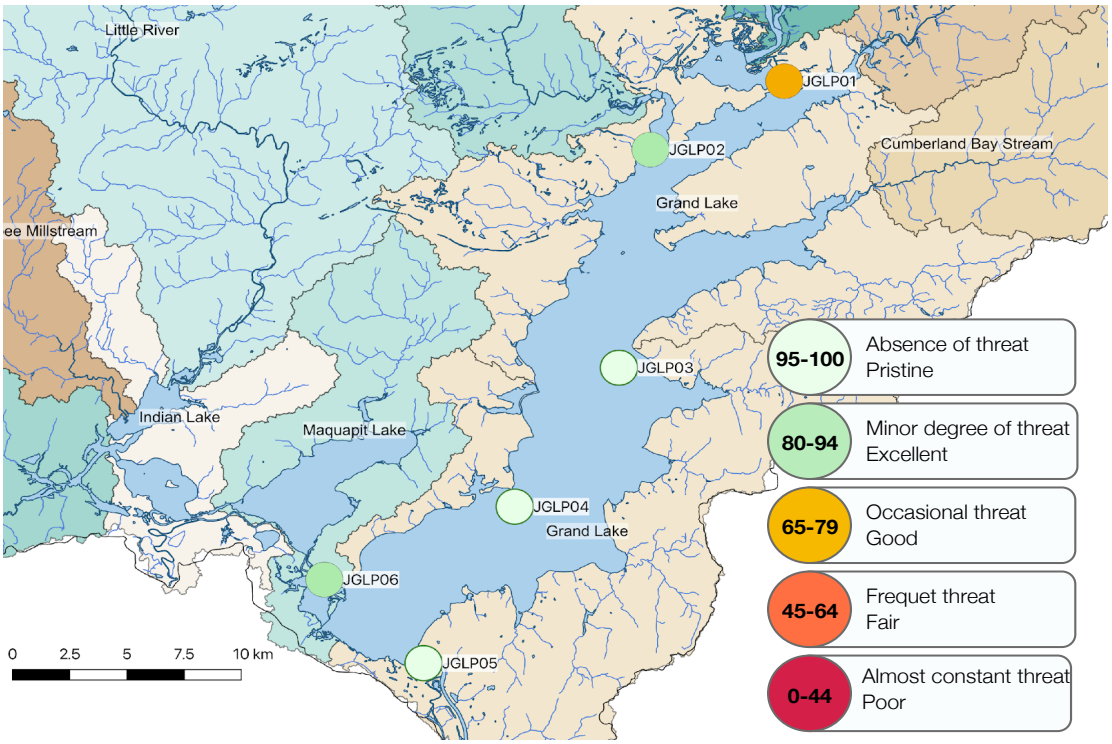


Figure 4. Water quality index colour score indicated inside circle for the six sampling locations on Grand Lake. Score ranking is found in legend of Table 4.

3.6 Trophic Status Index

The TSI score is intended to reflect the biological productivity of a lake. Each trophic class supports different aquatic ecosystems, including fish and other organisms. We determined the TSI score for each station using total phosphorus, and chl *a* measurements.

Hypertrophic lakes (TSI >70) Nutrient polluted with low visibility, algal blooms and periodically low oxygen levels.

Eutrophic lakes (TSI 50-70) have a high level biological productivity. Due to excessive nutrients, especially nitrogen and phosphorus, these water bodies can support an abundance of aquatic plants.

Mesotrophic lakes (TSI 40-50) have a moderate level of productivity and fair water quality. Attributes include clear water with increasing probability of low oxygen levels (anoxia) during the summer.

Oligotrophic lakes (TSI <40) have low primary productivity due to low nutrients. They generally have good water quality.

For Grand Lake, Cumberland Point and Jemseg River had scores indicating oligotrophic conditions (Table 5, Figure 5). Grand Point Bar and the inflow sites (Northeast Arm, Newcastle Bay and Maquapit Exit) all had scores indicating mesotrophic conditions.

Table 5**.** Trophic Status Index (TSI) scores for the six Grand Lake sampling stations. Score is based on total nitrogen, total phosphorus, and chl *a* measurements. TSI scores fall into three categories: Eutrophic lakes (TSI 50-70). Mesotrophic lakes (TSI 40-50) Oligotrophic lakes (TSI <40)

Site	**TSI**	**Status**
Northeast Arm (JGP01)	46	Mesotrophic
Newcastle Bay (JGLP02)	44	Mesotrophic
Cumberland Point (JGLP03)	34	Oligotrophic
Grand Point Bar (JGLP04)	41	Mesotrophic
Jemseg River (JGLP05)	37	Oligotrophic
Maquapit Exit (JGLP06)	46	Mesotrophic
Overall	**41.0**	**Mesotrophic**

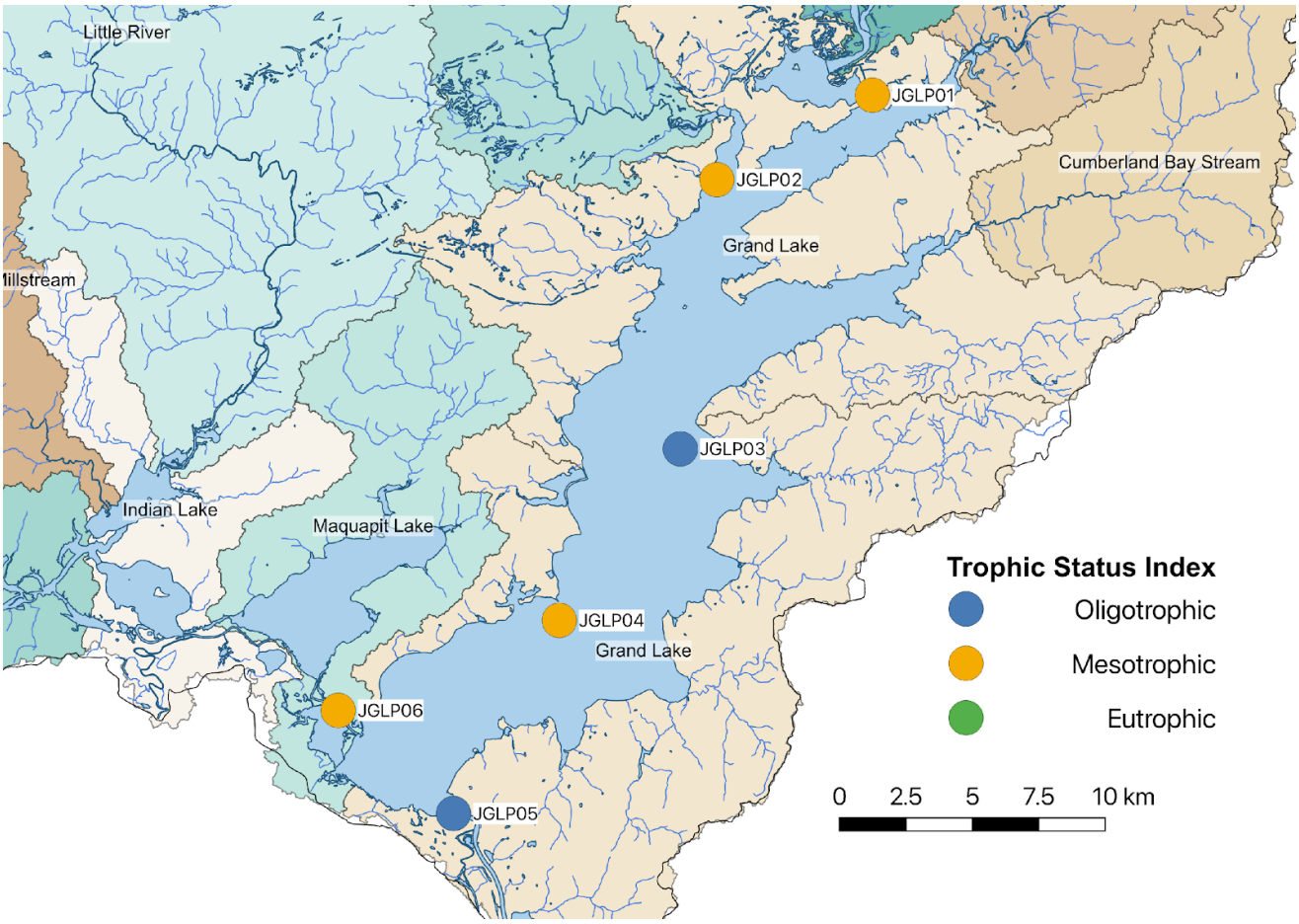


Figure 5**.** Trophic Status Index colour score for the six sampling locations on Grand Lake. Score ranking is found in legend of Table 5.

3.7 E. coli sampling

To test freshwater for faecal material from sewage discharge, stormwater, or agricultural runoff, water samples were collected from 14 sites around the perimeter of Grand Lake and analyzed for *E. coli*. Elevated levels of *E. coli* do not necessarily cause health issues in humans, however it is used as an indicator of faecal contamination and signals the potential presence of pathogenic microrganisms. (CCME, 1999). The recreational water quality guideline for *E. coli* established by CCME is $\leq$ 400 MPN/100 ml.

E. coli concentrations were all below the CCME guideline for Canadian recreational water quality of less than 400 per 100 ml of sample. Of the 14 samples, the highest concentrations of 140 MPN/100 ml was found at Douglas Harbour (JGLE07), with the second highest of 45 MPN/100 ml at Whites Cove (JGLE04).

E. coli concentrations vary substantially over time. The JGLWA will attempt to monitor areas of concern several times during the summer season to better delineate the zone of influence.

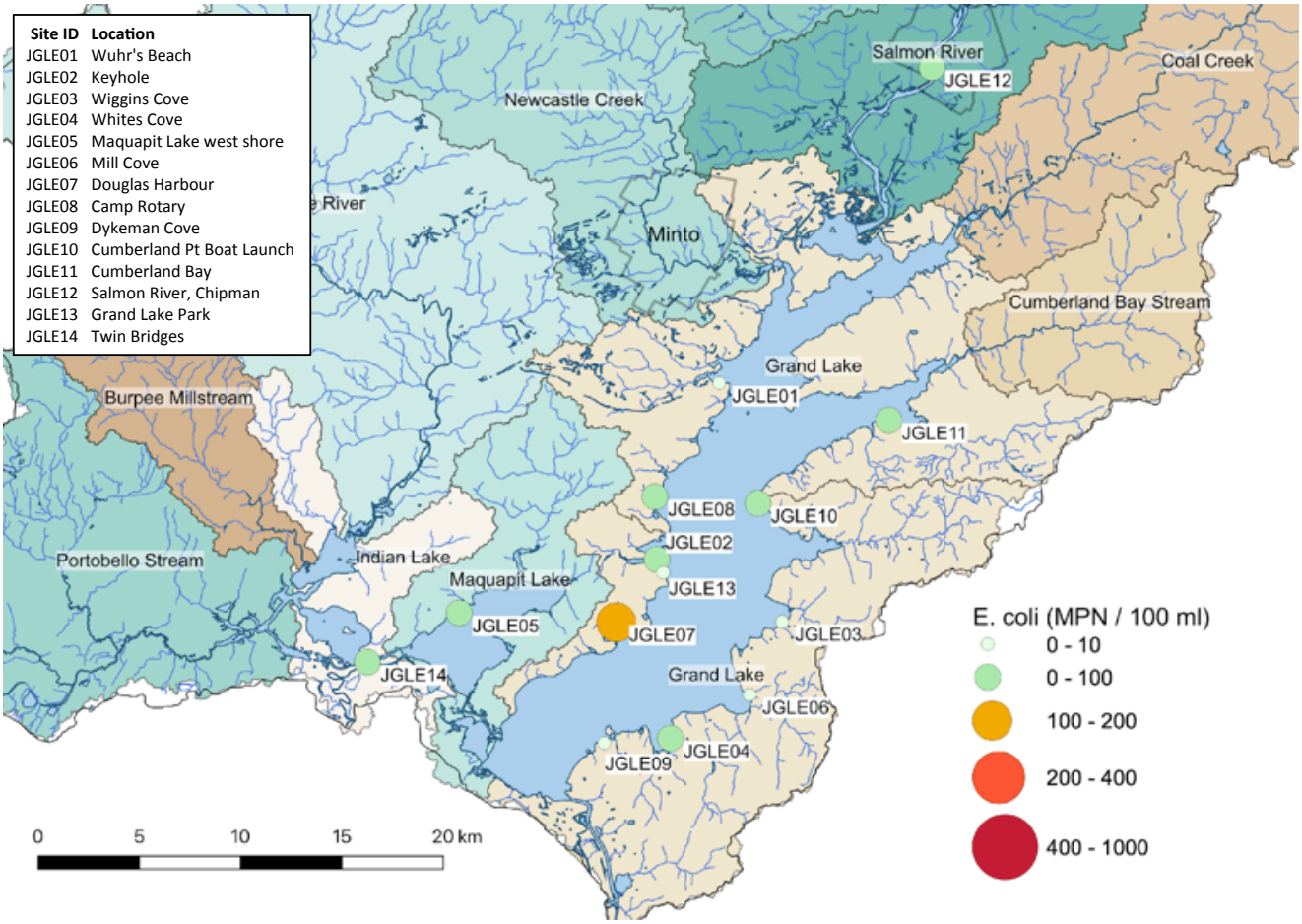


Figure 6. *E. coli* concentrations from 14 near shore locations around the perimeter of Grand Lake.

3.8 Plankton

Plankton samples were collected in Grand Lake in October 11, 2021. This was a fall collection, and results indicate that the community is heading towards winter, and is experiencing a fall turnover period. There are also some indications that that the lake is moderately nutrient rich and that there may be a dominance of planktivorous fish in the lake, preying on zooplankton. A better assessment of the internal structure and function of the lake ecosystem can be done with a late summer sample, which is planned for 2022.

The *phytoplankton* community (algae) is quantitatively dominated by diatoms (Fig 7.) This is a typical situation during fall turnover. Diatoms require silica to make their signature hard cases that surround their cells. Over the course of summer stratification, the epilimnion where primary production is possible is depleted of silica as diatoms die and settle out of that zone. During fall turnover, silica rich water from the bottom of the lake gets transported up and mixed throughout the lake creating good growth conditions. Diatoms are divided into two general groups: centric and

pennate. Centric diatoms do better in lower Si:P (more nutrients) therefore more common in nutrient enriched environments. In Grand Lake roughly 60 % of the diatoms were centric indicating that the lake is moderately nutrient rich. Diatoms can be very good bioindicators, but for this purpose the typical approach is to use diatoms attached to plants, rocks, or sediments near shore.

Chlorophytes, green algae, are a very diverse group that can be found in most types of lakes. Many of the green algae in Grand Lake were small, fast-growing species that can dominate in nutrient rich environments but, then again, are also found in a wide range of lake types. Chrysophytes, golden algae, were a minute part of the phytoplankton community. Golden algae can indicate oligotrophic and/or humic waters.

Cyanobacteria were not found in the sample. This is likely due to Cyanobacteria's preference for warm water, and that their population had significantly declined during the October sample.

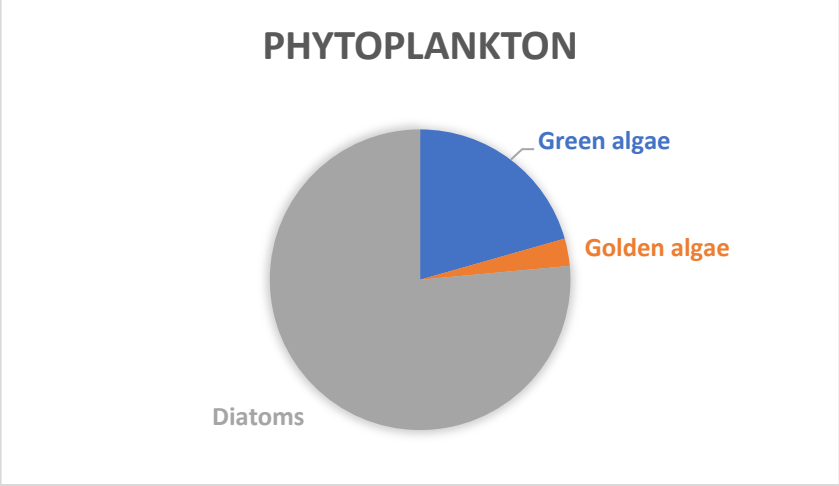


Figure 7. Fall Phytoplankton Community of Grand Lake

The zooplankton community (small invertebrate animals) was dominated by small, herbivorous species, primarily copepods and rotifers. Some species are more often found in cold-water lakes or conditions (*Cyclops scutifer, Daphnia longiremis,* and a couple of the rotifers). The community is a mix of species that prefer oligotrophic or mesotrophic conditions, and many that are indifferent to nutrient status.

Grand Lake had few *Daphnia* and what was there were smaller species. *Daphnia* sp. are a key genus in lakes because they are extremely good at filtering out phytoplankton and controlling algal blooms. They are however very sensitive to fish predators and are typically replaced by smaller species like *Bosmina* & *Ceriodaphnia* spp in lakes with large populations of planktivores.

The relative abundance of cyclopoids and calanoids can indicate nutrient status of lakes, with cyclopoids being less numerous in oligotrophic conditions. Our Grand Lake data was entered into a Calanoid/Cyclopoid ratio index (Ejsmont-Karabin & Karabin 2013), which resulted in a "mesotrophic" nutrient status. This lines up well with available chemistry and chlorophyll data.

Some aspects of the structure of the zooplankton community that are used to assess the structure and function of the lake ecosystem, such as the general size distribution, the percentage of Daphnia in the

Cladocera and the relation between cyclopoid and calanoid copepods rely on biomass estimates rather than abundance. Therefore, published weight estimates for species were used to make biomass estimates. In terms of biomass copepods and small cladocerans (mainly *Bosmina*) dominate the zooplankton community. The main difference in the relative dominance when looking at biomass compared to abundance, is that the small-bodied rotifers make up a much smaller part of the community and that small cladocerans make up a bigger part. Copepods retain a similar proportion.

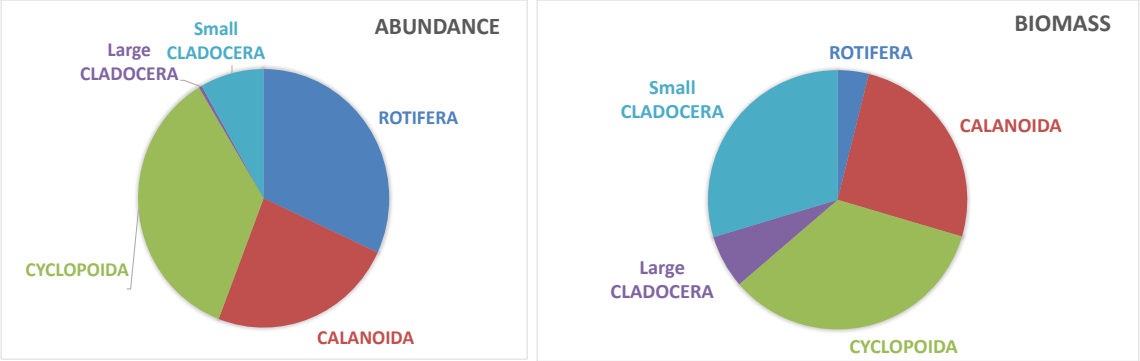


Figure 8. The relative contribution of major zooplankton groups by abundance (left) and biomass (right).

4.0 Discussion

Results from the second year of the Grand Lake watershed water quality monitoring program confirmed our data from 2020, and indicate that the lake has reasonably good water quality with only a couple of parameters that indicate potential for concern.

The mid-lake water sampling stations had excellent WQI scores, indicating that there were no exceedances of parameters that have CCME guidelines. TSI scores at Cumberland Pt. indicated oligotrophic waters, which suggest that biological productivity is limited by the nutrient concentrations in the water. The TSI score at Grand Point Bar was reduced to “mesotrophic”. During the summer, thermoclines were established at the two mid lake stations, which is a natural occurrence that is expected for deep lakes like Grand Lake. Oxygen concentrations in 2020 and 2021 declined below the thermocline and approached 5 mg/L for July and below 5 mg/L in August, which is below the CWQG for warm water biota of 5.5 mgL, indicating a potential hazard to fish.

Using the WQI parameters for comparison, the deep water (20 m) samples taken at the two midlake sites showed increases in nitrate, turbidity and zinc and decreases in pH and oxygen compared to the surface samples. Except for oxygen, these did not create exceedances of CWQG. We will continue to sample deep water at these sites in 2022, and investigate further these changes, and determine whether there is a concern for the benthic ecosystem in these locations.

The sampling stations near lake inflows had greater variability in surface water chemistry then the mid-lake channels and were the only stations with CWQG exceedances. To further improve our

understanding of the water chemistry at the inflow sources, we added 3 river stations. The same parameters that were in exceedance at Northeast Arm were also in exceedance at the Salmon River site, and similarly for the Maquapit Exit, and Lakeville Corner sites. This suggests that the water quality at these lake locations is influenced by the inflow sources. We will continue to monitor these river sites in 2022.

The sampling station draining the Maquapit lake subwatershed continued to have a different water chemistry profile than other stations. It had the lowest average pH, lowest conductivity, lowest Secchi disk depth, and highest colour readings. This profile reflects the slow moving, high organic dark water, characteristics of bog/wetland systems. This station also had the highest phosphorus concentrations from our sampling program. Water samples taken from Lakeville Corners, the outlet of French Lake, and inlet for Maquapit Lake, had very similar chemistry. The outlet station at Jemseg River continued to mirror water quality from the main body of the lake. There were no CWQG exceedances.

The *E. coli* program was redesigned for 2021, with focus on collecting samples from bays and areas of cottage development, where potential for *E. coli* contamination is greatest. Of the 14 sites sampled, all were below the CWQG for recreational activity. Douglas Harbour had the highest concentrations, however they were still less then half the guideline. Douglas Harbour is a fairly enclosed bay, with lots of boat traffic and other human activities. Our sampling program for 2022 will increase our temporal and spatial sampling in the bay to determine the source of the contamination, and whether it poses any human health concerns.

In 2022 we collected both phyto and zoo plankton samples to get a baseline of the biodiversity of the plankton community in Grand Lake. The sample was collected in October, which presented a community in transition from summer to winter. Phytoplankton was dominated by diatoms, followed by Chlorophytes (green algae). Cyanobacteria was not detected in our fall sample. Cyanobacteria prefer warm water, and would have greatest populations during the summer months. Summer sampling in 2022 will provide a better assessment of the Cyanobacteria community. The zooplankton community was dominated by copepods and rotifers. Daphnia were few in the collected sample. Daphnia, are a common zooplankton found in lake communities, but are sensitive to fish populations. Further plankton sampling in 2022 will allow us to describe in more depth the lake plankton community, and assess the potential to use this information as a bioindicator of the status of the Grand Lake aquatic ecosystem.

Overall water quality in Grand Lake is good, and sampling in the inflow rivers provided additional information to allow for better assessment. Addition of plankton samples provides information on the aquatic ecosystem of the lake. Nutrients are currently at acceptable concentrations in the main body of the lake, with TSI scores at mesotrophic levels for 4 of the 6 lake sites. However, there were exceedances at two of the sites near inflows, as well as their corresponding river sites, and indications for the plankton community make nutrients the main concern in the lake. Future focus of our sampling program will be delineating the source of the nutrients, and how these nutrients affect the lake aquatic community.

5.0 Acknowledgements

The authors would like to thank the New Brunswick Environmental Trust Fund, ACAP Saint John and the New Brunswick Alliance of Lake Associations for supporting this program. Special thanks to Joy Thomas, Robert Thomas, Jennifer McPhail, John Hughes, Hazen Hughes, Mike Kelly, and Mary Murdoch for being part of the sampling program.

6.0 References

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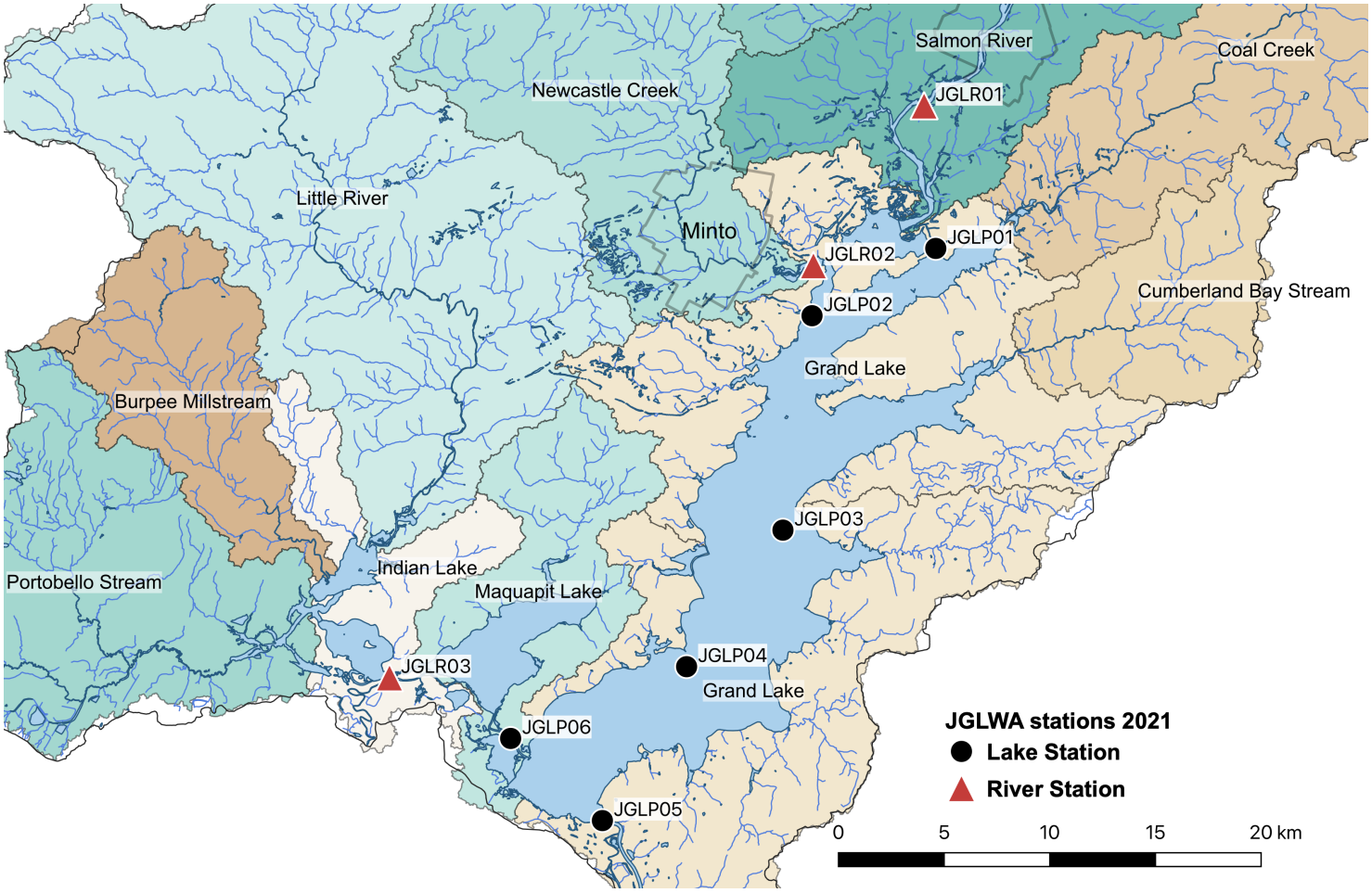
Appendix 1 – 2021 Water and Plankton Analysis Results for the Jemseg Grand Lake Watershed Association

Appendix – 2021 Water and Plankton Analysis Results for the Jemseg Grand Lake Watershed Association

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Report ID: 400811-IAS
Report Date: 05-Jul-21
Date Received: 21-Jun-21

CERTIFICATE OF ANALYSIS

for
Jemseg Grand Lake Watershed Association
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Attention: Eric Luiker
Project #: 210119
Location: Grand Lake

Analysis of Surface Water

RPC Sample ID:			400811-1	400811-2	400811-3
Client Sample ID:			JGLP01 17/21/19002	JGLP02 17/21/19001	JGLP03 17/21/19000
Date Sampled:			20-Jun-21	20-Jun-21	20-Jun-21
Analytes	**Units**	**RL**			
Sodium	mg/L	0.05	6.12	4.36	4.01
Potassium	mg/L	0.02	0.43	0.38	0.38
Calcium	mg/L	0.05	9.30	7.51	6.67
Magnesium	mg/L	0.01	1.50	1.33	1.12
Alkalinity (as $CaCO_3$)	mg/L	2	17	12	10
Chloride	mg/L	0.5	3.8	3.7	4.6
Fluoride	mg/L	0.05	0.20	0.11	0.13
Sulfate	mg/L	1	20	17	12
Bromine	mg/L	0.01	< 0.01	< 0.01	< 0.01
Ammonia (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Un-ionized @ 20ºC	mg/L	-	< 0.001	< 0.001	< 0.001
Nitrate + Nitrite (as N)	mg/L	0.05	< 0.05	0.05	0.06
Nitrite (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Nitrate (as N)	mg/L	0.05	< 0.05	0.05	0.06
Nitrogen - Total	mg/L	0.2	0.6	0.4	0.3
Phosphorus - Total	mg/L	0.002	0.028	0.028	0.011
Carbon - Total Organic	mg/L	0.5	10.7	9.1	7.5
Colour	TCU	5	124	83	57
Conductivity	µS/cm	1	97	80	71
pH	units	-	7.5	7.4	7.4
Turbidity	NTU	0.1	4.0	2.2	0.7
Chlorophyll-a	µg/L	0.5	3.5	2.5	< 0.5
Calculated Parameters					
Bicarbonate (as $CaCO_3$)	mg/L	-	16.9	12.0	10.0
Carbonate (as $CaCO_3$)	mg/L	-	0.050	0.028	0.024
Hardness (as $CaCO_3$)	mg/L	0.2	29.4	24.2	21.3
TDS (calc)	mg/L	-	52	42	35
Saturation pH (20°C)	units	-	9.1	9.4	9.5
Langelier Index (20°C)	-	-	-1.62	-1.96	-2.08

This report relates only to the sample(s) and information provided to the laboratory.

RL = Reporting Limit

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Inorganic Analytical Chemistry

Matthew Norman
Senior Chemist
Inorganic Analytical Chemistry

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Attention: Eric Luiker
Project #: 210119
Location: Grand Lake

Analysis of Surface Water

RPC Sample ID:			400811-4	400811-5	400811-6
Client Sample ID:			JGLR01 17/21/19003	JGLR02 17/21/19004	JGLR03 17/21/19008
Date Sampled:			21-Jun-21	21-Jun-21	21-Jun-21
Analytes	**Units**	**RL**			
Sodium	mg/L	0.05	4.12	5.11	2.32
Potassium	mg/L	0.02	0.36	0.48	0.30
Calcium	mg/L	0.05	5.86	11.8	3.67
Magnesium	mg/L	0.01	0.95	2.09	0.58
Alkalinity (as $CaCO_3$)	mg/L	2	15	15	5
Chloride	mg/L	0.5	4.0	5.8	3.3
Fluoride	mg/L	0.05	0.13	0.20	0.14
Sulfate	mg/L	1	6	27	7
Bromine	mg/L	0.01	0.01	0.01	< 0.01
Ammonia (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Un-ionized @ 20ºC	mg/L	-	< 0.001	< 0.001	< 0.001
Nitrate + Nitrite (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Nitrite (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Nitrate (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Nitrogen - Total	mg/L	0.2	0.3	0.3	0.4
Phosphorus - Total	mg/L	0.002	0.030	0.022	0.030
Carbon - Total Organic	mg/L	0.5	7.2	7.9	10.5
Colour	TCU	5	75	82	114
Conductivity	µS/cm	1	61	119	40
pH	units	-	7.3	7.3	7.2
Turbidity	NTU	0.1	2.1	2.2	3.4
Chlorophyll-a	µg/L	0.5	13.5	2.3	4.4
Calculated Parameters					
Bicarbonate (as $CaCO_3$)	mg/L	-	15.0	15.0	5.0
Carbonate (as $CaCO_3$)	mg/L	-	0.028	0.028	0.007
Hardness (as $CaCO_3$)	mg/L	0.2	18.5	38.1	11.6
TDS (calc)	mg/L	-	31	62	21
Saturation pH (20°C)	units	-	9.4	9.1	10.0
Langelier Index (20°C)	-	-	-2.06	-1.78	-2.82

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Client Sample ID:			JGLP01 17/21/19002	JGLP02 17/21/19001	JGLP03 17/21/19000
Date Sampled:			20-Jun-21	20-Jun-21	20-Jun-21
Analytes	**Units**	**RL**			
Aluminum	mg/L	0.001	0.167	0.129	0.089
Antimony	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Arsenic	mg/L	0.001	< 0.001	< 0.001	< 0.001
Barium	mg/L	0.001	0.034	0.025	0.019
Beryllium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Bismuth	mg/L	0.001	< 0.001	< 0.001	< 0.001
Boron	mg/L	0.001	0.005	0.004	0.003
Cadmium	mg/L	0.00001	0.00001	0.00001	< 0.00001
Calcium	mg/L	0.05	9.30	7.51	6.67
Chromium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Cobalt	mg/L	0.0001	0.0002	< 0.0001	< 0.0001
Copper	mg/L	0.001	< 0.001	< 0.001	< 0.001
Iron	mg/L	0.02	0.54	0.25	0.11
Lead	mg/L	0.0001	0.0003	0.0001	< 0.0001
Lithium	mg/L	0.0001	0.0012	0.0010	0.0007
Magnesium	mg/L	0.01	1.50	1.33	1.12
Manganese	mg/L	0.001	0.179	0.066	0.016
Molybdenum	mg/L	0.0001	0.0001	0.0001	< 0.0001
Nickel	mg/L	0.001	< 0.001	< 0.001	< 0.001
Potassium	mg/L	0.02	0.43	0.38	0.38
Rubidium	mg/L	0.0001	0.0012	0.0008	0.0006
Selenium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Silver	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Sodium	mg/L	0.05	6.12	4.36	4.01
Strontium	mg/L	0.001	0.144	0.109	0.082
Tellurium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Thallium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Tin	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Uranium	mg/L	0.0001	0.0002	0.0001	< 0.0001
Vanadium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Zinc	mg/L	0.001	0.033	0.011	0.006

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Attention: Eric Luiker
Project #: 210119
Location: Grand Lake

Analysis of Surface Water

RPC Sample ID:			400811-4	400811-5	400811-6
Client Sample ID:			JGLR01 17/21/19003	JGLR02 17/21/19004	JGLR03 17/21/19008
Date Sampled:			21-Jun-21	21-Jun-21	21-Jun-21
Analytes	**Units**	**RL**			
Aluminum	mg/L	0.001	0.085	0.129	0.173
Antimony	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Arsenic	mg/L	0.001	< 0.001	< 0.001	< 0.001
Barium	mg/L	0.001	0.034	0.022	0.016
Beryllium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Bismuth	mg/L	0.001	< 0.001	< 0.001	< 0.001
Boron	mg/L	0.001	0.003	0.005	0.003
Cadmium	mg/L	0.00001	0.00006	0.00001	0.00002
Calcium	mg/L	0.05	5.86	11.8	3.67
Chromium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Cobalt	mg/L	0.0001	0.0001	0.0002	0.0001
Copper	mg/L	0.001	< 0.001	< 0.001	< 0.001
Iron	mg/L	0.02	0.47	0.48	0.55
Lead	mg/L	0.0001	0.0002	0.0001	0.0004
Lithium	mg/L	0.0001	0.0012	0.0021	0.0009
Magnesium	mg/L	0.01	0.95	2.09	0.58
Manganese	mg/L	0.001	0.071	0.122	0.083
Molybdenum	mg/L	0.0001	< 0.0001	0.0002	< 0.0001
Nickel	mg/L	0.001	< 0.001	< 0.001	< 0.001
Potassium	mg/L	0.02	0.36	0.48	0.30
Rubidium	mg/L	0.0001	0.0009	0.0011	0.0009
Selenium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Silver	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Sodium	mg/L	0.05	4.12	5.11	2.32
Strontium	mg/L	0.001	0.051	0.242	0.046
Tellurium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Thallium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Tin	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Uranium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Vanadium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Zinc	mg/L	0.001	0.002	0.005	0.003

Report ID: 400811-IAS
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Methods

Analyte	RPC SOP #	Method Reference	Method Principle
Ammonia	4.M47	APHA 4500-NH_3 G	Phenate Colourimetry
pH	4.M03	APHA 4500-H^+ B	pH Electrode - Electrometric
Alkalinity (as $CaCO_3$)	4.M43	EPA 310.2	Methyl Orange Colourimetry
Chloride	4.M44	APHA 4500-CL E	Ferricyanide Colourimetry
Fluoride	4.M30	APHA 4500-F- D	SPADNS Colourimetry
Sulfate	4.M45	APHA 4500-SO_4 E	Turbidimetry
Nitrate + Nitrite (as N)	4.M48	APHA 4500-NO_3 H	Hydrazine Red., Derivitization, Colourimetry
Nitrite (as N)	4.M49	APHA 4500-NO2- B	Ferrous Ammonium Sulfate Colourimetry
Nitrogen - Total	IAS-M57.01	ASTM D8083-16	Combustion/Chemiluminescence
Phosphorus - Total	4.M17	APHA 4500-P E	Digestion, Manual Colourimetry
Carbon - Total Organic	4.M38	APHA 5310 C	UV-Persulfate Digestion, NDIR Detection
Turbidity	4.M06	APHA 2130 B	Nephelometry
Colour	4.M55	APHA 2120 Color (A,C)	Single Wavelength Spectrophotometry
Conductivity	4.M04	APHA 2510 B	Conductivity Meter - Electrode
Trace Metals	4.M01/4.M29	EPA 200.8/EPA 200.7	ICP-MS/ICP-ES

Report ID: 400977-IAS
Report Date: 05-Jul-21
Date Received: 22-Jun-21

CERTIFICATE OF ANALYSIS

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Attention: Eric Luiker
Project #: 210119
Location: Grand Lake

Analysis of Surface Water

RPC Sample ID:			400977-1	400977-2	400977-3
Client Sample ID:			JGLP04 17/21/19005	JGLP05 17/21/19007	JGLP06 17/21/19006
Date Sampled:			21-Jun-21	21-Jun-21	21-Jun-21
Analytes	**Units**	**RL**			
Sodium	mg/L	0.05	4.72	3.78	2.39
Potassium	mg/L	0.02	0.47	0.38	0.34
Calcium	mg/L	0.05	6.66	6.40	3.83
Magnesium	mg/L	0.01	1.16	1.07	0.65
Alkalinity (as $CaCO_3$)	mg/L	2	12	12	10
Chloride	mg/L	0.5	4.6	4.6	3.3
Fluoride	mg/L	0.05	0.11	0.12	0.11
Sulfate	mg/L	1	11	12	3
Bromine	mg/L	0.01	< 0.01	< 0.01	< 0.01
Ammonia (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Un-ionized @ 20ºC	mg/L	-	< 0.001	< 0.001	< 0.001
Nitrate + Nitrite (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Nitrite (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Nitrate (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Nitrogen - Total	mg/L	0.2	0.3	0.4	0.4
Phosphorus - Total	mg/L	0.002	0.010	0.015	0.035
Carbon - Total Organic	mg/L	0.5	7.2	8.1	8.9
Colour	TCU	5	52	50	78
Conductivity	µS/cm	1	72	70	41
pH	units	-	7.8	7.6	7.4
Turbidity	NTU	0.1	0.6	0.7	4.3
Chlorophyll-a	µg/L	0.5	3.4	< 0.5	4.1
Calculated Parameters					
Bicarbonate (as $CaCO_3$)	mg/L	-	11.9	11.9	10.0
Carbonate (as $CaCO_3$)	mg/L	-	0.071	0.045	0.024
Hardness (as $CaCO_3$)	mg/L	0.2	21.4	20.4	12.2
TDS (calc)	mg/L	-	36	36	20
Saturation pH (20°C)	units	-	9.4	9.4	9.7
Langelier Index (20°C)	-	-	-1.61	-1.82	-2.30

This report relates only to the sample(s) and information provided to the laboratory.

RL = Reporting Limit

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Report Date: 05-Jul-21
Date Received: 22-Jun-21

CERTIFICATE OF ANALYSIS

for
Jemseg Grand Lake Watershed Association
35 Pinecone Lane
Waterborough, NB E3C 0A5

rpc
921 College Hill Rd
Fredericton NB
Canada E3B 6Z9
Tel: 506.452.1212
Fax: 506.452.0594
www.rpc.ca

Attention: Eric Luiker
Project #: 210119
Location: Grand Lake

Analysis of Surface Water

RPC Sample ID:			400977-1	400977-2	400977-3
Client Sample ID:			JGLP04 17/21/19005	JGLP05 17/21/19007	JGLP06 17/21/19006
Date Sampled:			21-Jun-21	21-Jun-21	21-Jun-21
Analytes	**Units**	**RL**			
Aluminum	mg/L	0.001	0.091	0.086	0.143
Antimony	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Arsenic	mg/L	0.001	< 0.001	< 0.001	< 0.001
Barium	mg/L	0.001	0.021	0.018	0.014
Beryllium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Bismuth	mg/L	0.001	< 0.001	< 0.001	< 0.001
Boron	mg/L	0.001	0.004	0.003	0.003
Cadmium	mg/L	0.00001	0.00003	< 0.00001	0.00001
Calcium	mg/L	0.05	6.66	6.40	3.83
Chromium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Cobalt	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Copper	mg/L	0.001	0.001	< 0.001	< 0.001
Iron	mg/L	0.02	0.10	0.12	0.39
Lead	mg/L	0.0001	0.0012	0.0002	0.0004
Lithium	mg/L	0.0001	0.0007	0.0007	0.0006
Magnesium	mg/L	0.01	1.16	1.07	0.65
Manganese	mg/L	0.001	0.012	0.014	0.044
Molybdenum	mg/L	0.0001	0.0001	< 0.0001	< 0.0001
Nickel	mg/L	0.001	< 0.001	< 0.001	< 0.001
Potassium	mg/L	0.02	0.47	0.38	0.34
Rubidium	mg/L	0.0001	0.0007	0.0007	0.0008
Selenium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Silver	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Sodium	mg/L	0.05	4.72	3.78	2.39
Strontium	mg/L	0.001	0.082	0.080	0.043
Tellurium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Thallium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Tin	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Uranium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Vanadium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Zinc	mg/L	0.001	0.016	0.010	0.009

Report ID: 400977-IAS
Report Date: 05-Jul-21
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for
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Methods

Analyte	RPC SOP #	Method Reference	Method Principle
Ammonia	4.M47	APHA 4500-NH_3 G	Phenate Colourimetry
pH	4.M03	APHA 4500-H^+ B	pH Electrode - Electrometric
Alkalinity (as $CaCO_3$)	4.M43	EPA 310.2	Methyl Orange Colourimetry
Chloride	4.M44	APHA 4500-CL E	Ferricyanide Colourimetry
Fluoride	4.M30	APHA 4500-F- D	SPADNS Colourimetry
Sulfate	4.M45	APHA 4500-SO_4 E	Turbidimetry
Nitrate + Nitrite (as N)	4.M48	APHA 4500-NO_3 H	Hydrazine Red., Derivitization, Colourimetry
Nitrite (as N)	4.M49	APHA 4500-NO2- B	Ferrous Ammonium Sulfate Colourimetry
Nitrogen - Total	IAS-M57.01	ASTM D8083-16	Combustion/Chemiluminescence
Phosphorus - Total	4.M17	APHA 4500-P E	Digestion, Manual Colourimetry
Carbon - Total Organic	4.M38	APHA 5310 C	UV-Persulfate Digestion, NDIR Detection
Turbidity	4.M06	APHA 2130 B	Nephelometry
Colour	4.M55	APHA 2120 Color (A,C)	Single Wavelength Spectrophotometry
Conductivity	4.M04	APHA 2510 B	Conductivity Meter - Electrode
Trace Metals	4.M01/4.M29	EPA 200.8/EPA 200.7	ICP-MS/ICP-ES

Report ID: 404658-IAS
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Date Received: 19-Jul-21

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for
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Attention: Eric Luiker
Project #: 210119
Location: Grand Lake

Analysis of Surface Water

RPC Sample ID:			404658-1	404658-2	404658-3
Client Sample ID:			JGLP01 17/21 19012	JGLP02 17/21 19011	JGLP03 17/21 19010
Date Sampled:			18-Jul-21	18-Jul-21	18-Jul-21
Analytes	**Units**	**RL**			
Sodium	mg/L	0.05	4.94	4.98	4.02
Potassium	mg/L	0.02	0.39	0.44	0.40
Calcium	mg/L	0.05	8.85	10.1	8.02
Magnesium	mg/L	0.01	1.24	1.50	1.16
Alkalinity (as $CaCO_3$)	mg/L	2	15	13	12
Chloride	mg/L	0.5	3.3	4.1	4.5
Fluoride	mg/L	0.05	0.35	0.22	0.17
Sulfate	mg/L	1	14	19	13
Bromine	mg/L	0.01	0.01	< 0.01	< 0.01
Ammonia (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Un-ionized @ 20ºC	mg/L	-	< 0.001	< 0.001	< 0.001
Nitrate + Nitrite (as N)	mg/L	0.05	< 0.05	0.28	0.07
Nitrite (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Nitrate (as N)	mg/L	0.05	< 0.05	0.28	0.07
Nitrogen - Total	mg/L	0.2	0.4	0.3	0.3
Phosphorus - Total	mg/L	0.002	0.032	0.019	0.011
Carbon - Total Organic	mg/L	0.5	16.5	8.8	7.8
Colour	TCU	5	158	65	47
Conductivity	µS/cm	1	75	88	72
pH	units	-	7.0	7.2	7.3
Turbidity	NTU	0.1	2.5	1.6	1.0
Calculated Parameters					
Bicarbonate (as $CaCO_3$)	mg/L	-	15.0	13.0	12.0
Carbonate (as $CaCO_3$)	mg/L	-	0.014	0.019	0.023
Hardness (as $CaCO_3$)	mg/L	0.2	27.2	31.4	24.8
TDS (calc)	mg/L	-	59	59	47
Saturation pH (20°C)	units	-	9.2	9.2	9.3
Langelier Index (20°C)	-	-	-2.19	-2.00	-2.03

This report relates only to the sample(s) and information provided to the laboratory.

RL = Reporting Limit

Peter Crowhurst, B.Sc., C.Chem.
Director
Inorganic Analytical Chemistry

Brannen Burhoe
Supervisor
Inorganic Analytical Services

Report ID: 404658-IAS
Report Date: 27-Jul-21
Date Received: 19-Jul-21

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for
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Tel: 506.452.1212
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www.rpc.ca

Attention: Eric Luiker
Project #: 210119
Location: Grand Lake

Analysis of Surface Water

RPC Sample ID:			404658-4	404658-5	404658-6
Client Sample ID:			JGLP04 17/21 19015	JGLP05 17/21 19017	JGLP06 17/21 19016
Date Sampled:			17-Jul-21	17-Jul-21	17-Jul-21
Analytes	**Units**	**RL**			
Sodium	mg/L	0.05	3.91	3.90	2.39
Potassium	mg/L	0.02	0.40	0.39	0.34
Calcium	mg/L	0.05	8.03	8.41	4.46
Magnesium	mg/L	0.01	1.16	1.18	0.62
Alkalinity (as $CaCO_3$)	mg/L	2	12	15	7
Chloride	mg/L	0.5	4.4	4.5	2.9
Fluoride	mg/L	0.05	0.16	0.17	0.15
Sulfate	mg/L	1	12	12	6
Bromine	mg/L	0.01	< 0.01	< 0.01	< 0.01
Ammonia (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Un-ionized @ 20ºC	mg/L	-	< 0.001	< 0.001	< 0.001
Nitrate + Nitrite (as N)	mg/L	0.05	< 0.05	0.05	< 0.05
Nitrite (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Nitrate (as N)	mg/L	0.05	< 0.05	0.05	< 0.05
Nitrogen - Total	mg/L	0.2	0.3	0.3	0.3
Phosphorus - Total	mg/L	0.002	0.018	0.018	0.028
Carbon - Total Organic	mg/L	0.5	7.1	6.8	8.3
Colour	TCU	5	45	47	66
Conductivity	µS/cm	1	70	72	40
pH	units	-	7.2	7.2	6.9
Turbidity	NTU	0.1	1.2	0.9	2.2
Calculated Parameters					
Bicarbonate (as $CaCO_3$)	mg/L	-	12.0	15.0	7.0
Carbonate (as $CaCO_3$)	mg/L	-	0.018	0.022	0.005
Hardness (as $CaCO_3$)	mg/L	0.2	24.8	25.9	13.7
TDS (calc)	mg/L	-	45	47	30
Saturation pH (20°C)	units	-	9.3	9.2	9.8
Langelier Index (20°C)	-	-	-2.12	-2.01	-2.90

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www.rpc.ca

Attention: Eric Luiker
Project #: 210119
Location: Grand Lake

Analysis of Surface Water

RPC Sample ID:			404658-7	404658-8
Client Sample ID:			JGLP03D 17/21 19010	JGLP04D 17/21 19015
Date Sampled:			18-Jul-21	17-Jul-21
Analytes	**Units**	**RL**		
Sodium	mg/L	0.05	4.07	3.98
Potassium	mg/L	0.02	0.41	0.41
Calcium	mg/L	0.05	8.13	8.06
Magnesium	mg/L	0.01	1.19	1.15
Alkalinity (as $CaCO_3$)	mg/L	2	12	12
Chloride	mg/L	0.5	4.6	4.5
Fluoride	mg/L	0.05	0.18	0.16
Sulfate	mg/L	1	13	13
Bromine	mg/L	0.01	0.01	0.01
Ammonia (as N)	mg/L	0.05	< 0.05	< 0.05
Un-ionized @ 20ºC	mg/L	-	< 0.001	< 0.001
Nitrate + Nitrite (as N)	mg/L	0.05	0.11	0.10
Nitrite (as N)	mg/L	0.05	< 0.05	< 0.05
Nitrate (as N)	mg/L	0.05	0.11	0.10
Nitrogen - Total	mg/L	0.2	0.3	0.3
Phosphorus - Total	mg/L	0.002	0.020	0.014
Carbon - Total Organic	mg/L	0.5	7.2	7.3
Colour	TCU	5	44	46
Conductivity	µS/cm	1	73	73
pH	units	-	6.8	6.8
Turbidity	NTU	0.1	1.1	1.1
Calculated Parameters				
Bicarbonate (as $CaCO_3$)	mg/L	-	12.0	12.0
Carbonate (as $CaCO_3$)	mg/L	-	0.007	0.007
Hardness (as $CaCO_3$)	mg/L	0.2	25.2	24.9
TDS (calc)	mg/L	-	47	46
Saturation pH (20°C)	units	-	9.3	9.3
Langelier Index (20°C)	-	-	-2.52	-2.52

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Attention: Eric Luiker
Project #: 210119
Location: Grand Lake

Analysis of Surface Water

RPC Sample ID:			404658-1	404658-2	404658-3
Client Sample ID:			JGLP01 17/21 19012	JGLP02 17/21 19011	JGLP03 17/21 19010
Date Sampled:			18-Jul-21	18-Jul-21	18-Jul-21
Analytes	**Units**	**RL**			
Aluminum	mg/L	0.001	0.193	0.035	0.061
Antimony	mg/L	0.0001	< 0.0001	0.0001	< 0.0001
Arsenic	mg/L	0.001	< 0.001	< 0.001	< 0.001
Barium	mg/L	0.001	0.033	0.022	0.018
Beryllium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Bismuth	mg/L	0.001	< 0.001	< 0.001	< 0.001
Boron	mg/L	0.001	0.004	0.004	0.003
Cadmium	mg/L	0.00001	0.00002	< 0.00001	< 0.00001
Calcium	mg/L	0.05	8.85	10.1	8.02
Chromium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Cobalt	mg/L	0.0001	0.0001	< 0.0001	< 0.0001
Copper	mg/L	0.001	< 0.001	< 0.001	< 0.001
Iron	mg/L	0.02	0.44	0.24	0.08
Lead	mg/L	0.0001	0.0002	0.0001	< 0.0001
Lithium	mg/L	0.0001	0.0011	0.0011	0.0007
Magnesium	mg/L	0.01	1.24	1.50	1.16
Manganese	mg/L	0.001	0.088	0.034	0.007
Molybdenum	mg/L	0.0001	0.0001	0.0002	0.0001
Nickel	mg/L	0.001	< 0.001	< 0.001	< 0.001
Potassium	mg/L	0.02	0.39	0.44	0.40
Rubidium	mg/L	0.0001	0.0009	0.0009	0.0007
Selenium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Silver	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Sodium	mg/L	0.05	4.94	4.98	4.02
Strontium	mg/L	0.001	0.107	0.129	0.083
Tellurium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Thallium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Tin	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Uranium	mg/L	0.0001	0.0001	0.0001	< 0.0001
Vanadium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Zinc	mg/L	0.001	0.009	0.011	0.006

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Attention: Eric Luiker
Project #: 210119
Location: Grand Lake

Analysis of Surface Water

RPC Sample ID:			404658-4	404658-5	404658-6
Client Sample ID:			JGLP04 17/21 19015	JGLP05 17/21 19017	JGLP06 17/21 19016
Date Sampled:			17-Jul-21	17-Jul-21	17-Jul-21
Analytes	**Units**	**RL**			
Aluminum	mg/L	0.001	0.067	0.057	0.103
Antimony	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Arsenic	mg/L	0.001	< 0.001	< 0.001	< 0.001
Barium	mg/L	0.001	0.017	0.017	0.013
Beryllium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Bismuth	mg/L	0.001	< 0.001	< 0.001	< 0.001
Boron	mg/L	0.001	0.003	0.003	0.003
Cadmium	mg/L	0.00001	< 0.00001	< 0.00001	< 0.00001
Calcium	mg/L	0.05	8.03	8.41	4.46
Chromium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Cobalt	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Copper	mg/L	0.001	< 0.001	< 0.001	< 0.001
Iron	mg/L	0.02	0.10	0.09	0.31
Lead	mg/L	0.0001	< 0.0001	< 0.0001	0.0002
Lithium	mg/L	0.0001	0.0007	0.0007	0.0006
Magnesium	mg/L	0.01	1.16	1.18	0.62
Manganese	mg/L	0.001	0.012	0.011	0.023
Molybdenum	mg/L	0.0001	< 0.0001	0.0001	< 0.0001
Nickel	mg/L	0.001	< 0.001	< 0.001	< 0.001
Potassium	mg/L	0.02	0.40	0.39	0.34
Rubidium	mg/L	0.0001	0.0007	0.0007	0.0008
Selenium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Silver	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Sodium	mg/L	0.05	3.91	3.90	2.39
Strontium	mg/L	0.001	0.081	0.082	0.041
Tellurium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Thallium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Tin	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Uranium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Vanadium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Zinc	mg/L	0.001	0.006	0.005	0.015

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Attention: Eric Luiker
Project #: 210119
Location: Grand Lake

Analysis of Surface Water

RPC Sample ID:			404658-7	404658-8
Client Sample ID:			JGLP03D 17/21 19010	JGLP04D 17/21 19015
Date Sampled:			18-Jul-21	17-Jul-21
Analytes	**Units**	**RL**		
Aluminum	mg/L	0.001	0.069	0.067
Antimony	mg/L	0.0001	< 0.0001	< 0.0001
Arsenic	mg/L	0.001	< 0.001	< 0.001
Barium	mg/L	0.001	0.018	0.018
Beryllium	mg/L	0.0001	< 0.0001	< 0.0001
Bismuth	mg/L	0.001	< 0.001	< 0.001
Boron	mg/L	0.001	0.003	0.003
Cadmium	mg/L	0.00001	< 0.00001	< 0.00001
Calcium	mg/L	0.05	8.13	8.06
Chromium	mg/L	0.001	< 0.001	< 0.001
Cobalt	mg/L	0.0001	< 0.0001	< 0.0001
Copper	mg/L	0.001	< 0.001	< 0.001
Iron	mg/L	0.02	0.10	0.09
Lead	mg/L	0.0001	< 0.0001	< 0.0001
Lithium	mg/L	0.0001	0.0007	0.0007
Magnesium	mg/L	0.01	1.19	1.15
Manganese	mg/L	0.001	0.035	0.031
Molybdenum	mg/L	0.0001	0.0002	0.0001
Nickel	mg/L	0.001	< 0.001	< 0.001
Potassium	mg/L	0.02	0.41	0.41
Rubidium	mg/L	0.0001	0.0007	0.0007
Selenium	mg/L	0.001	< 0.001	< 0.001
Silver	mg/L	0.0001	< 0.0001	< 0.0001
Sodium	mg/L	0.05	4.07	3.98
Strontium	mg/L	0.001	0.086	0.084
Tellurium	mg/L	0.0001	< 0.0001	< 0.0001
Thallium	mg/L	0.0001	< 0.0001	< 0.0001
Tin	mg/L	0.0001	< 0.0001	< 0.0001
Uranium	mg/L	0.0001	< 0.0001	< 0.0001
Vanadium	mg/L	0.001	< 0.001	< 0.001
Zinc	mg/L	0.001	0.012	0.016

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Attention: Eric Luiker
Project #: 210119
Location: Grand Lake

Analysis of Water

RPC Sample ID:			404658-1	404658-2	404658-3
Client Sample ID:			JGLP01 17/21 19012	JGLP02 17/21 19011	JGLP03 17/21 19010
Date Sampled:			18-Jul-21	18-Jul-21	18-Jul-21
Analytes	**Units**	**RL**			
Chlorophyll-a	µg/L	0.5	2.6	3.3	3.7

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Attention: Eric Luiker
Project #: 210119
Location: Grand Lake

Analysis of Water

RPC Sample ID:			404658-4	404658-5	404658-6
Client Sample ID:			JGLP04 17/21 19015	JGLP05 17/21 19017	JGLP06 17/21 19016
Date Sampled:			17-Jul-21	17-Jul-21	17-Jul-21
Analytes	**Units**	**RL**			
Chlorophyll-a	µg/L	0.5	2.6	2.0	1.4

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Attention: Eric Luiker
Project #: 210119
Location: Grand Lake

Analysis of Water

RPC Sample ID:			404658-7	404658-8
Client Sample ID:			JGLP03D 17/21 19010	JGLP04D 17/21 19015
Date Sampled:			18-Jul-21	17-Jul-21
Analytes	**Units**	**RL**		
Chlorophyll-a	µg/L	0.5	0.6	0.6

Report ID: 404658-IAS
Report Date: 27-Jul-21
Date Received: 19-Jul-21

CERTIFICATE OF ANALYSIS
for
Jemseg Grand Lake Watershed Association
35 Pinecone Lane
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Tel: 506.452.1212
Fax: 506.452.0594
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Methods

Analyte	RPC SOP #	Method Reference	Method Principle
Ammonia	4.M47	APHA 4500-NH_3 G	Phenate Colourimetry
pH	4.M03	APHA 4500-H^+ B	pH Electrode - Electrometric
Alkalinity (as $CaCO_3$)	4.M43	EPA 310.2	Methyl Orange Colourimetry
Chloride	4.M44	APHA 4500-CL E	Ferricyanide Colourimetry
Fluoride	4.M30	APHA 4500-F- D	SPADNS Colourimetry
Sulfate	4.M45	APHA 4500-SO_4 E	Turbidimetry
Nitrate + Nitrite (as N)	4.M48	APHA 4500-NO_3 H	Hydrazine Red., Derivitization, Colourimetry
Nitrite (as N)	4.M49	APHA 4500-NO2- B	Ferrous Ammonium Sulfate Colourimetry
Nitrogen - Total	IAS-M57.01	ASTM D8083-16	Combustion/Chemiluminescence
Phosphorus - Total	4.M17	APHA 4500-P E	Digestion, Manual Colourimetry
Carbon - Total Organic	4.M38	APHA 5310 C	UV-Persulfate Digestion, NDIR Detection
Turbidity	4.M06	APHA 2130 B	Nephelometry
Colour	4.M55	APHA 2120 Color (A,C)	Single Wavelength Spectrophotometry
Conductivity	4.M04	APHA 2510 B	Conductivity Meter - Electrode
Trace Metals	4.M01/4.M29	EPA 200.8/EPA 200.7	ICP-MS/ICP-ES

Report ID: 406107-IAS
Report Date: 10-Aug-21
Date Received: 28-Jul-21

CERTIFICATE OF ANALYSIS

for
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Tel: 506.452.1212
Fax: 506.452.0594
www.rpc.ca

Attention: Eric Luiker
Project #: 210119

Analysis of Surface Water

RPC Sample ID:			406107-1	406107-2	406107-3
Client Sample ID:			JGLR01 17/21/19014	JGLR02 17/21/19013	JGLR03 17/21/19018
Date Sampled:			27-Jul-21	27-Jul-21	27-Jul-21
Analytes	**Units**	**RL**			
Sodium	mg/L	0.05	2.11	3.42	2.11
Potassium	mg/L	0.02	0.21	0.35	0.25
Calcium	mg/L	0.05	4.12	9.91	4.29
Magnesium	mg/L	0.01	0.62	1.54	0.64
Alkalinity (as $CaCO_3$)	mg/L	2	10	14	9
Chloride	mg/L	0.5	3.1	5.1	3.1
Fluoride	mg/L	0.05	0.46	0.41	0.30
Sulfate	mg/L	1	2	21	6
Bromine	mg/L	0.01	0.01	0.01	0.01
Ammonia (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Un-ionized @ 20ºC	mg/L	-	< 0.001	< 0.001	< 0.001
Nitrate + Nitrite (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Nitrite (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Nitrate (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Nitrogen - Total	mg/L	0.2	0.6	0.4	0.4
Phosphorus - Total	mg/L	0.002	0.038	0.025	0.027
Carbon - Total Organic	mg/L	0.5	23	16.4	13.7
Colour	TCU	5	241	206	126
Conductivity	µS/cm	1	33	89	42
pH	units	-	6.8	6.7	6.9
Turbidity	NTU	0.1	3.5	2.0	1.7
Calculated Parameters					
Bicarbonate (as $CaCO_3$)	mg/L	-	10.0	14.0	9.0
Carbonate (as $CaCO_3$)	mg/L	-	0.006	0.007	0.007
Hardness (as $CaCO_3$)	mg/L	0.2	12.8	31.1	13.3
TDS (calc)	mg/L	-	43	68	36
Saturation pH (20°C)	units	-	9.7	9.2	9.7
Langelier Index (20°C)	-	-	-2.87	-2.48	-2.80

This report relates only to the sample(s) and information provided to the laboratory.

RL = Reporting Limit

Peter Crowhurst, B.Sc., C.Chem.
Director
Inorganic Analytical Chemistry

Brannen Burhoe
Supervisor
Inorganic Analytical Services

Report ID: 406107-IAS
Report Date: 10-Aug-21
Date Received: 28-Jul-21

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www.rpc.ca

Attention: Eric Luiker
Project #: 210119

Analysis of Surface Water

RPC Sample ID:			406107-1	406107-2	406107-3
Client Sample ID:			JGLR01 17/21/19014	JGLR02 17/21/19013	JGLR03 17/21/19018
Date Sampled:			27-Jul-21	27-Jul-21	27-Jul-21
Analytes	**Units**	**RL**			
Aluminum	mg/L	0.001	0.294	0.198	0.159
Antimony	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Arsenic	mg/L	0.001	< 0.001	< 0.001	< 0.001
Barium	mg/L	0.001	0.038	0.018	0.017
Beryllium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Bismuth	mg/L	0.001	< 0.001	< 0.001	< 0.001
Boron	mg/L	0.001	0.003	0.005	0.004
Cadmium	mg/L	0.00001	0.00002	0.00001	0.00001
Calcium	mg/L	0.05	4.12	9.91	4.29
Chromium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Cobalt	mg/L	0.0001	0.0002	0.0003	< 0.0001
Copper	mg/L	0.001	< 0.001	< 0.001	< 0.001
Iron	mg/L	0.02	0.70	0.73	0.41
Lead	mg/L	0.0001	0.0003	0.0002	0.0002
Lithium	mg/L	0.0001	0.0010	0.0023	0.0009
Magnesium	mg/L	0.01	0.62	1.54	0.64
Manganese	mg/L	0.001	0.082	0.146	0.062
Molybdenum	mg/L	0.0001	0.0001	0.0001	< 0.0001
Nickel	mg/L	0.001	< 0.001	0.001	< 0.001
Potassium	mg/L	0.02	0.21	0.35	0.25
Rubidium	mg/L	0.0001	0.0006	0.0008	0.0009
Selenium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Silver	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Sodium	mg/L	0.05	2.11	3.42	2.11
Strontium	mg/L	0.001	0.034	0.160	0.056
Tellurium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Thallium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Tin	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Uranium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Vanadium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Zinc	mg/L	0.001	0.003	0.004	0.003

Report ID: 406107-IAS
Report Date: 10-Aug-21
Date Received: 28-Jul-21

CERTIFICATE OF ANALYSIS

for

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www.rpc.ca

Attention: Eric Luiker
Project #: 210119

Analysis of Water

RPC Sample ID:			406107-1	406107-2	406107-3
Client Sample ID:			JGLR01 17/21/19014	JGLR02 17/21/19013	JGLR03 17/21/19018
Date Sampled:			27-Jul-21	27-Jul-21	27-Jul-21
Analytes	**Units**	**RL**			
Chlorophyll-a	µg/L	0.5	3.4	1.2	3.6

Report ID: 406107-IAS
Report Date: 10-Aug-21
Date Received: 28-Jul-21

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Methods

Analyte	RPC SOP #	Method Reference	Method Principle
Ammonia	IAS-M47	APHA 4500-NH_3 G	Phenate Colourimetry
pH	IAS-M03	APHA 4500-H^+ B	pH Electrode - Electrometric
Alkalinity (as $CaCO_3$)	IAS-M43	EPA 310.2	Methyl Orange Colourimetry
Chloride	IAS-M44	APHA 4500-CL E	Ferricyanide Colourimetry
Fluoride	IAS-M30	APHA 4500-F- D	SPADNS Colourimetry
Sulfate	IAS-M45	APHA 4500-SO_4 E	Turbidimetry
Nitrate + Nitrite (as N)	IAS-M48	APHA 4500-NO_3 H	Hydrazine Red., Derivitization, Colourimetry
Nitrite (as N)	IAS-M49	APHA 4500-NO2- B	Ferrous Ammonium Sulfate Colourimetry
Nitrogen - Total	IAS-M57	ASTM D8083-16	Combustion/Chemiluminescence
Phosphorus - Total	IAS-M17	APHA 4500-P E	Digestion, Manual Colourimetry
Carbon - Total Organic	IAS-M38	APHA 5310 C	UV-Persulfate Digestion, NDIR Detection
Turbidity	IAS-M06	APHA 2130 B	Nephelometry
Colour	IAS-M55	APHA 2120 Color (A,C)	Single Wavelength Spectrophotometry
Conductivity	IAS-M04	APHA 2510 B	Conductivity Meter - Electrode
Trace Metals	IAS-M01/IAS-M29	EPA 200.8/EPA 200.7	ICP-MS/ICP-ES

Report ID: 409632-IAS
Report Date: 02-Sep-21
Date Received: 23-Aug-21

CERTIFICATE OF ANALYSIS

for
Jemseg Grand Lake Watershed Association
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921 College Hill Rd
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Tel: 506.452.1212
Fax: 506.452.0594
www.rpc.ca

Attention: Eric Luiker
Project #: 210119
Location: Grand Lake

Analysis of Surface Water

RPC Sample ID:			409632-1	409632-2	409632-3
Client Sample ID:			JGLPO1 17/21/19020	JGLPO2 17/21/19021	JGLPO3 17/21/19022
Date Sampled:			22-Aug-21	22-Aug-21	22-Aug-21
Analytes	**Units**	**RL**			
Sodium	mg/L	0.05	6.56	4.56	4.14
Potassium	mg/L	0.02	0.36	0.36	0.39
Calcium	mg/L	0.05	9.39	7.71	7.29
Magnesium	mg/L	0.01	1.63	1.38	1.31
Alkalinity (as $CaCO_3$)	mg/L	2	20	14	13
Chloride	mg/L	0.5	4.1	4.3	5.0
Fluoride	mg/L	0.05	0.32	0.27	0.20
Sulfate	mg/L	1	24	17	14
Bromine	mg/L	0.01	0.01	0.01	< 0.01
Ammonia (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Un-ionized @ 20ºC	mg/L	-	< 0.001	< 0.001	< 0.001
Nitrate + Nitrite (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Nitrite (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Nitrate (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Nitrogen - Total	mg/L	0.2	0.5	0.4	0.3
Phosphorus - Total	mg/L	0.002	0.023	0.015	0.004
Carbon - Total Organic	mg/L	0.5	12.8	10.2	6.8
Colour	TCU	5	130	79	43
Conductivity	µS/cm	1	104	82	73
pH	units	-	7.6	7.6	7.6
Turbidity	NTU	0.1	2.9	1.3	0.4
Calculated Parameters					
Bicarbonate (as $CaCO_3$)	mg/L	-	19.9	13.9	12.9
Carbonate (as $CaCO_3$)	mg/L	-	0.074	0.052	0.048
Hardness (as $CaCO_3$)	mg/L	0.2	30.2	24.9	23.6
TDS (calc)	mg/L	-	59	44	40
Saturation pH (20°C)	units	-	9.1	9.3	9.3
Langelier Index (20°C)	-	-	-1.45	-1.68	-1.74

This report relates only to the sample(s) and information provided to the laboratory.

RL = Reporting Limit

Peter Crowhurst, B.Sc., C.Chem.
Director
Inorganic Analytical Chemistry

Matthew Norman
Senior Chemist
Inorganic Analytical Chemistry

Report ID: 409632-IAS
Report Date: 02-Sep-21
Date Received: 23-Aug-21

CERTIFICATE OF ANALYSIS

for
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Tel: 506.452.1212
Fax: 506.452.0594
www.rpc.ca

Attention: Eric Luiker
Project #: 210119
Location: Grand Lake

Analysis of Surface Water

RPC Sample ID:			409632-4
Client Sample ID:			JGLPO3D 17/21/19022
Date Sampled:			22-Aug-21
Analytes	**Units**	**RL**	
Sodium	mg/L	0.05	4.02
Potassium	mg/L	0.02	0.38
Calcium	mg/L	0.05	7.36
Magnesium	mg/L	0.01	1.29
Alkalinity (as $CaCO_3$)	mg/L	2	14
Chloride	mg/L	0.5	4.8
Fluoride	mg/L	0.05	0.14
Sulfate	mg/L	1	14
Bromine	mg/L	0.01	0.02
Ammonia (as N)	mg/L	0.05	< 0.05
Un-ionized @ 20ºC	mg/L	-	< 0.001
Nitrate + Nitrite (as N)	mg/L	0.05	0.12
Nitrite (as N)	mg/L	0.05	< 0.05
Nitrate (as N)	mg/L	0.05	0.12
Nitrogen - Total	mg/L	0.2	0.5
Phosphorus - Total	mg/L	0.002	0.005
Carbon - Total Organic	mg/L	0.5	6.9
Colour	TCU	5	41
Conductivity	µS/cm	1	76
pH	units	-	7.2
Turbidity	NTU	0.1	1.0
Calculated Parameters			
Bicarbonate (as $CaCO_3$)	mg/L	-	14.0
Carbonate (as $CaCO_3$)	mg/L	-	0.021
Hardness (as $CaCO_3$)	mg/L	0.2	23.7
TDS (calc)	mg/L	-	41
Saturation pH (20°C)	units	-	9.3
Langelier Index (20°C)	-	-	-2.10

Report ID: 409632-IAS
Report Date: 02-Sep-21
Date Received: 23-Aug-21

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Attention: Eric Luiker
Project #: 210119
Location: Grand Lake

Analysis of Surface Water

RPC Sample ID:			409632-1	409632-2	409632-3
Client Sample ID:			JGLPO1 17/21/19020	JGLPO2 17/21/19021	JGLPO3 17/21/19022
Date Sampled:			22-Aug-21	22-Aug-21	22-Aug-21
Analytes	**Units**	**RL**			
Aluminum	mg/L	0.001	0.116	0.090	0.044
Antimony	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Arsenic	mg/L	0.001	< 0.001	< 0.001	< 0.001
Barium	mg/L	0.001	0.035	0.024	0.019
Beryllium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Bismuth	mg/L	0.001	< 0.001	< 0.001	< 0.001
Boron	mg/L	0.001	0.005	0.004	0.003
Cadmium	mg/L	0.00001	< 0.00001	< 0.00001	< 0.00001
Calcium	mg/L	0.05	9.39	7.71	7.29
Chromium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Cobalt	mg/L	0.0001	0.0001	< 0.0001	< 0.0001
Copper	mg/L	0.001	< 0.001	< 0.001	< 0.001
Iron	mg/L	0.02	0.46	0.24	0.07
Lead	mg/L	0.0001	0.0002	< 0.0001	< 0.0001
Lithium	mg/L	0.0001	0.0013	0.0010	0.0007
Magnesium	mg/L	0.01	1.63	1.38	1.31
Manganese	mg/L	0.001	0.117	0.039	0.007
Molybdenum	mg/L	0.0001	0.0002	0.0002	0.0001
Nickel	mg/L	0.001	< 0.001	< 0.001	< 0.001
Potassium	mg/L	0.02	0.36	0.36	0.39
Rubidium	mg/L	0.0001	0.0010	0.0009	0.0007
Selenium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Silver	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Sodium	mg/L	0.05	6.56	4.56	4.14
Strontium	mg/L	0.001	0.150	0.116	0.091
Tellurium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Thallium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Tin	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Uranium	mg/L	0.0001	0.0002	< 0.0001	< 0.0001
Vanadium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Zinc	mg/L	0.001	0.006	0.003	0.014

Report ID: 409632-IAS
Report Date: 02-Sep-21
Date Received: 23-Aug-21

CERTIFICATE OF ANALYSIS

for

Jemseg Grand Lake Watershed Association
35 Pinecone Lane
Waterborough, NB E3C 0A5

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Tel: 506.452.1212
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Attention: Eric Luiker
Project #: 210119
Location: Grand Lake

Analysis of Surface Water

RPC Sample ID:			409632-4
Client Sample ID:			JGLPO3D 17/21/19022
Date Sampled:			22-Aug-21
Analytes	**Units**	**RL**	
Aluminum	mg/L	0.001	0.052
Antimony	mg/L	0.0001	< 0.0001
Arsenic	mg/L	0.001	< 0.001
Barium	mg/L	0.001	0.017
Beryllium	mg/L	0.0001	< 0.0001
Bismuth	mg/L	0.001	< 0.001
Boron	mg/L	0.001	0.003
Cadmium	mg/L	0.00001	< 0.00001
Calcium	mg/L	0.05	7.36
Chromium	mg/L	0.001	< 0.001
Cobalt	mg/L	0.0001	< 0.0001
Copper	mg/L	0.001	< 0.001
Iron	mg/L	0.02	0.06
Lead	mg/L	0.0001	< 0.0001
Lithium	mg/L	0.0001	0.0007
Magnesium	mg/L	0.01	1.29
Manganese	mg/L	0.001	0.056
Molybdenum	mg/L	0.0001	0.0002
Nickel	mg/L	0.001	< 0.001
Potassium	mg/L	0.02	0.38
Rubidium	mg/L	0.0001	0.0008
Selenium	mg/L	0.001	< 0.001
Silver	mg/L	0.0001	< 0.0001
Sodium	mg/L	0.05	4.02
Strontium	mg/L	0.001	0.089
Tellurium	mg/L	0.0001	< 0.0001
Thallium	mg/L	0.0001	< 0.0001
Tin	mg/L	0.0001	< 0.0001
Uranium	mg/L	0.0001	< 0.0001
Vanadium	mg/L	0.001	< 0.001
Zinc	mg/L	0.001	0.018

Report ID: 409632-IAS
Report Date: 02-Sep-21
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Attention: Eric Luiker
Project #: 210119
Location: Grand Lake

Analysis of Water

RPC Sample ID:			409632-1	409632-2	409632-3
Client Sample ID:			JGLPO1 17/21/19020	JGLPO2 17/21/19021	JGLPO3 17/21/19022
Date Sampled:			22-Aug-21	22-Aug-21	22-Aug-21
Analytes	**Units**	**RL**			
Chlorophyll-a	µg/L	0.5	5.6	3.3	4.2

Report ID: 409632-IAS
Report Date: 02-Sep-21
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Attention: Eric Luiker
Project #: 210119
Location: Grand Lake

Analysis of Water

RPC Sample ID:			409632-4
Client Sample ID:			JGLPO3D 17/21/19022
Date Sampled:			22-Aug-21
Analytes	**Units**	**RL**	
Chlorophyll-a	µg/L	0.5	1.1

Report ID: 409632-IAS
Report Date: 02-Sep-21
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Methods

Analyte	RPC SOP #	Method Reference	Method Principle
Ammonia	IAS-M47	APHA 4500-NH_3 G	Phenate Colourimetry
pH	IAS-M03	APHA 4500-H^+ B	pH Electrode - Electrometric
Alkalinity (as $CaCO_3$)	IAS-M43	EPA 310.2	Methyl Orange Colourimetry
Chloride	IAS-M44	APHA 4500-CL E	Ferricyanide Colourimetry
Fluoride	IAS-M30	APHA 4500-F- D	SPADNS Colourimetry
Sulfate	IAS-M45	APHA 4500-SO_4 E	Turbidimetry
Nitrate + Nitrite (as N)	IAS-M48	APHA 4500-NO_3 H	Hydrazine Red., Derivitization, Colourimetry
Nitrite (as N)	IAS-M49	APHA 4500-NO2- B	Ferrous Ammonium Sulfate Colourimetry
Nitrogen - Total	IAS-M57	ASTM D8083-16	Combustion/Chemiluminescence
Phosphorus - Total	IAS-M17	APHA 4500-P E	Digestion, Manual Colourimetry
Carbon - Total Organic	IAS-M38	APHA 5310 C	UV-Persulfate Digestion, NDIR Detection
Turbidity	IAS-M06	APHA 2130 B	Nephelometry
Colour	IAS-M55	APHA 2120 Color (A,C)	Single Wavelength Spectrophotometry
Conductivity	IAS-M04	APHA 2510 B	Conductivity Meter - Electrode
Trace Metals	IAS-M01/IAS-M29	EPA 200.8/EPA 200.7	ICP-MS/ICP-ES

Report ID: 409710-IAS
Report Date: 03-Sep-21
Date Received: 23-Aug-21

CERTIFICATE OF ANALYSIS

for
Jemseg Grand Lake Watershed Association
35 Pinecone Lane
Waterborough, NB E3C 0A5

rpc
921 College Hill Rd
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Canada E3B 6Z9
Tel: 506.452.1212
Fax: 506.452.0594
www.rpc.ca

Attention: Eric Luiker
Project #: 210119
Location: Grand Lake

Analysis of Surface Water

RPC Sample ID:			409710-1	409710-2	409710-3
Client Sample ID:			JGLPO4 17/21/19025	JGLPO5 17/21/19027	JGLPO6 17/21/19026
Date Sampled:			23-Aug-21	23-Aug-21	23-Aug-21
Analytes	**Units**	**RL**			
Sodium	mg/L	0.05	3.72	3.86	2.45
Potassium	mg/L	0.02	0.37	0.36	0.29
Calcium	mg/L	0.05	6.97	8.13	4.31
Magnesium	mg/L	0.01	1.3	1.39	0.72
Alkalinity (as $CaCO_3$)	mg/L	2	13	20	9
Chloride	mg/L	0.5	4.7	5.3	3.3
Fluoride	mg/L	0.05	0.26	0.29	0.28
Sulfate	mg/L	1	14	11	6
Bromine	mg/L	0.01	< 0.01	0.01	0.01
Ammonia (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Un-ionized @ 20ºC	mg/L	-	< 0.001	< 0.001	< 0.001
Nitrate + Nitrite (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Nitrite (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Nitrate (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Nitrogen - Total	mg/L	0.2	0.3	0.3	0.4
Phosphorus - Total	mg/L	0.002	0.010	0.013	0.038
Carbon - Total Organic	mg/L	0.5	6.3	6.6	9.5
Colour	TCU	5	43	43	81
Conductivity	µS/cm	1	74	79	44
pH	units	-	7.2	7.2	7.1
Turbidity	NTU	0.1	0.4	0.8	3.6
Calculated Parameters					
Bicarbonate (as $CaCO_3$)	mg/L	-	13.0	20.0	9.0
Carbonate (as $CaCO_3$)	mg/L	-	0.019	0.030	0.011
Hardness (as $CaCO_3$)	mg/L	0.2	22.8	26.0	13.7
TDS (calc)	mg/L	-	39	43	23
Saturation pH (20°C)	units	-	9.4	9.1	9.7
Langelier Index (20°C)	-	-	-2.15	-1.90	-2.60

This report relates only to the sample(s) and information provided to the laboratory.

RL = Reporting Limit

Peter Crowhurst, B.Sc., C.Chem.
Director
Inorganic Analytical Chemistry

Matthew Norman
Senior Chemist
Inorganic Analytical Chemistry

Report ID: 409710-IAS
Report Date: 03-Sep-21
Date Received: 23-Aug-21

CERTIFICATE OF ANALYSIS

for
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Tel: 506.452.1212
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www.rpc.ca

Attention: Eric Luiker
Project #: 210119
Location: Grand Lake

Analysis of Surface Water

RPC Sample ID:			409710-4
Client Sample ID:			GLPO4D 17/21/19025 Niskin Deep Water @ 20 Meters
Date Sampled:			23-Aug-21
Analytes	**Units**	**RL**	
Sodium	mg/L	0.05	3.78
Potassium	mg/L	0.02	0.39
Calcium	mg/L	0.05	7.11
Magnesium	mg/L	0.01	1.3
Alkalinity (as $CaCO_3$)	mg/L	2	14
Chloride	mg/L	0.5	4.9
Fluoride	mg/L	0.05	0.23
Sulfate	mg/L	1	13
Bromine	mg/L	0.01	0.01
Ammonia (as N)	mg/L	0.05	< 0.05
Un-ionized @ 20ºC	mg/L	-	< 0.001
Nitrate + Nitrite (as N)	mg/L	0.05	0.09
Nitrite (as N)	mg/L	0.05	< 0.05
Nitrate (as N)	mg/L	0.05	0.09
Nitrogen - Total	mg/L	0.2	0.3
Phosphorus - Total	mg/L	0.002	0.009
Carbon - Total Organic	mg/L	0.5	6.0
Colour	TCU	5	40
Conductivity	µS/cm	1	74
pH	units	-	7.0
Turbidity	NTU	0.1	0.7
Calculated Parameters			
Bicarbonate (as $CaCO_3$)	mg/L	-	14.0
Carbonate (as $CaCO_3$)	mg/L	-	0.013
Hardness (as $CaCO_3$)	mg/L	0.2	23.1
TDS (calc)	mg/L	-	40
Saturation pH (20°C)	units	-	9.3
Langelier Index (20°C)	-	-	-2.31

Report ID: 409710-IAS
Report Date: 03-Sep-21
Date Received: 23-Aug-21

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Attention: Eric Luiker
Project #: 210119
Location: Grand Lake

Analysis of Surface Water

RPC Sample ID:			409710-1	409710-2	409710-3
Client Sample ID:			JGLPO4 17/21/19025	JGLPO5 17/21/19027	JGLPO6 17/21/19026
Date Sampled:			23-Aug-21	23-Aug-21	23-Aug-21
Analytes	**Units**	**RL**			
Aluminum	mg/L	0.001	0.047	0.054	0.127
Antimony	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Arsenic	mg/L	0.001	< 0.001	< 0.001	< 0.001
Barium	mg/L	0.001	0.019	0.016	0.014
Beryllium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Bismuth	mg/L	0.001	< 0.001	< 0.001	< 0.001
Boron	mg/L	0.001	0.003	0.004	0.004
Cadmium	mg/L	0.00001	< 0.00001	< 0.00001	< 0.00001
Calcium	mg/L	0.05	6.97	8.13	4.31
Chromium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Cobalt	mg/L	0.0001	< 0.0001	< 0.0001	0.0001
Copper	mg/L	0.001	< 0.001	< 0.001	< 0.001
Iron	mg/L	0.02	0.07	0.14	0.41
Lead	mg/L	0.0001	< 0.0001	< 0.0001	0.0004
Lithium	mg/L	0.0001	0.0007	0.0007	0.0008
Magnesium	mg/L	0.01	1.30	1.39	0.72
Manganese	mg/L	0.001	0.006	0.018	0.076
Molybdenum	mg/L	0.0001	0.0001	0.0002	0.0001
Nickel	mg/L	0.001	< 0.001	< 0.001	< 0.001
Potassium	mg/L	0.02	0.37	0.36	0.29
Rubidium	mg/L	0.0001	0.0007	0.0008	0.0009
Selenium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Silver	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Sodium	mg/L	0.05	3.72	3.86	2.45
Strontium	mg/L	0.001	0.091	0.086	0.052
Tellurium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Thallium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Tin	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Uranium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Vanadium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Zinc	mg/L	0.001	0.007	0.006	0.007

Report ID: 409710-IAS
Report Date: 03-Sep-21
Date Received: 23-Aug-21

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Tel: 506.452.1212
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www.rpc.ca

Attention: Eric Luiker
Project #: 210119
Location: Grand Lake

Analysis of Surface Water

RPC Sample ID:			409710-4
Client Sample ID:			GLPO4D 17/21/19025 Niskin Deep Water @ 20 Meters
Date Sampled:			23-Aug-21
Analytes	**Units**	**RL**	
Aluminum	mg/L	0.001	0.054
Antimony	mg/L	0.0001	< 0.0001
Arsenic	mg/L	0.001	< 0.001
Barium	mg/L	0.001	0.018
Beryllium	mg/L	0.0001	< 0.0001
Bismuth	mg/L	0.001	< 0.001
Boron	mg/L	0.001	0.003
Cadmium	mg/L	0.00001	< 0.00001
Calcium	mg/L	0.05	7.11
Chromium	mg/L	0.001	< 0.001
Cobalt	mg/L	0.0001	< 0.0001
Copper	mg/L	0.001	< 0.001
Iron	mg/L	0.02	0.07
Lead	mg/L	0.0001	< 0.0001
Lithium	mg/L	0.0001	0.0008
Magnesium	mg/L	0.01	1.30
Manganese	mg/L	0.001	0.044
Molybdenum	mg/L	0.0001	0.0002
Nickel	mg/L	0.001	< 0.001
Potassium	mg/L	0.02	0.39
Rubidium	mg/L	0.0001	0.0007
Selenium	mg/L	0.001	< 0.001
Silver	mg/L	0.0001	< 0.0001
Sodium	mg/L	0.05	3.78
Strontium	mg/L	0.001	0.089
Tellurium	mg/L	0.0001	< 0.0001
Thallium	mg/L	0.0001	< 0.0001
Tin	mg/L	0.0001	< 0.0001
Uranium	mg/L	0.0001	< 0.0001
Vanadium	mg/L	0.001	< 0.001
Zinc	mg/L	0.001	0.015

Report ID: 409710-IAS
Report Date: 03-Sep-21
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Attention: Eric Luiker
Project #: 210119
Location: Grand Lake

Analysis of Water

RPC Sample ID:			409710-1	409710-2	409710-3
Client Sample ID:			JGLPO4 17/21/19025	JGLPO5 17/21/19027	JGLPO6 17/21/19026
Date Sampled:			23-Aug-21	23-Aug-21	23-Aug-21
Analytes	**Units**	**RL**			
Chlorophyll-a	µg/L	0.5	3.4	1.2	1.6

Report ID: 409710-IAS
Report Date: 03-Sep-21
Date Received: 23-Aug-21

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Attention: Eric Luiker
Project #: 210119
Location: Grand Lake

Analysis of Water

RPC Sample ID:			409710-4
Client Sample ID:			GLPO4D 17/21/19025 Niskin Deep Water @ 20 Meters
Date Sampled:			23-Aug-21
Analytes	**Units**	**RL**	
Chlorophyll-a	µg/L	0.5	1.2

Report ID: 409710-IAS
Report Date: 03-Sep-21
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Methods

Analyte	RPC SOP #	Method Reference	Method Principle
Ammonia	IAS-M47	APHA 4500-NH_3 G	Phenate Colourimetry
pH	IAS-M03	APHA 4500-H^+ B	pH Electrode - Electrometric
Alkalinity (as $CaCO_3$)	IAS-M43	EPA 310.2	Methyl Orange Colourimetry
Chloride	IAS-M44	APHA 4500-CL E	Ferricyanide Colourimetry
Fluoride	IAS-M30	APHA 4500-F- D	SPADNS Colourimetry
Sulfate	IAS-M45	APHA 4500-SO_4 E	Turbidimetry
Nitrate + Nitrite (as N)	IAS-M48	APHA 4500-NO_3 H	Hydrazine Red., Derivitization, Colourimetry
Nitrite (as N)	IAS-M49	APHA 4500-NO2- B	Ferrous Ammonium Sulfate Colourimetry
Nitrogen - Total	IAS-M57	ASTM D8083-16	Combustion/Chemiluminescence
Phosphorus - Total	IAS-M17	APHA 4500-P E	Digestion, Manual Colourimetry
Carbon - Total Organic	IAS-M38	APHA 5310 C	UV-Persulfate Digestion, NDIR Detection
Turbidity	IAS-M06	APHA 2130 B	Nephelometry
Colour	IAS-M55	APHA 2120 Color (A,C)	Single Wavelength Spectrophotometry
Conductivity	IAS-M04	APHA 2510 B	Conductivity Meter - Electrode
Trace Metals	IAS-M01/IAS-M29	EPA 200.8/EPA 200.7	ICP-MS/ICP-ES

Report ID: 410427-IAS
Report Date: 10-Sep-21
Date Received: 27-Aug-21

CERTIFICATE OF ANALYSIS

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Attention: Eric Luiker
Project #: 210119

Analysis of Surface Water

RPC Sample ID:			410427-1	410427-2	410427-3
Client Sample ID:			JGLRO1 17/21/19024	JGLRO2 17/21/19023	JGLRO3 17/21/19028
Date Sampled:			26-Aug-21	26-Aug-21	26-Aug-21
Analytes	**Units**	**RL**			
Sodium	mg/L	0.05	4.92	4.42	2.3
Potassium	mg/L	0.02	0.45	0.53	0.24
Calcium	mg/L	0.05	6.49	12.6	3.97
Magnesium	mg/L	0.01	1.06	1.98	0.69
Alkalinity (as $CaCO_3$)	mg/L	2	21	19	9
Chloride	mg/L	0.5	5.1	6.0	3.4
Fluoride	mg/L	0.05	0.22	0.40	0.26
Sulfate	mg/L	1	6	22	5
Bromine	mg/L	0.01	0.01	0.01	0.01
Ammonia (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Un-ionized @ 20ºC	mg/L	-	< 0.001	< 0.001	< 0.001
Nitrate + Nitrite (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Nitrite (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Nitrate (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Nitrogen - Total	mg/L	0.2	0.3	0.3	0.4
Phosphorus - Total	mg/L	0.002	0.022	0.038	0.037
Carbon - Total Organic	mg/L	0.5	8.8	15.3	13.9
Colour	TCU	5	76	175	123
Conductivity	µS/cm	1	71	112	42
pH	units	-	7.4	6.9	6.9
Turbidity	NTU	0.1	1.8	2.2	2.8
Calculated Parameters					
Bicarbonate (as $CaCO_3$)	mg/L	-	20.9	19.0	9.0
Carbonate (as $CaCO_3$)	mg/L	-	0.049	0.014	0.007
Hardness (as $CaCO_3$)	mg/L	0.2	20.6	39.6	12.8
TDS (calc)	mg/L	-	38	60	22
Saturation pH (20°C)	units	-	9.2	8.9	9.7
Langelier Index (20°C)	-	-	-1.77	-2.05	-2.83

This report relates only to the sample(s) and information provided to the laboratory.

RL = Reporting Limit

Peter Crowhurst, B.Sc., C.Chem.
Director
Inorganic Analytical Chemistry

Matthew Norman
Senior Chemist
Inorganic Analytical Chemistry

Report ID: 410427-IAS
Report Date: 10-Sep-21
Date Received: 27-Aug-21

CERTIFICATE OF ANALYSIS
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Attention: Eric Luiker
Project #: 210119

Analysis of Surface Water

RPC Sample ID:			410427-1	410427-2	410427-3
Client Sample ID:			JGLRO1 17/21/19024	JGLRO2 17/21/19023	JGLRO3 17/21/19028
Date Sampled:			26-Aug-21	26-Aug-21	26-Aug-21
Analytes	**Units**	**RL**			
Aluminum	mg/L	0.001	0.068	0.151	0.158
Antimony	mg/L	0.0001	0.0001	0.0001	< 0.0001
Arsenic	mg/L	0.001	< 0.001	< 0.001	< 0.001
Barium	mg/L	0.001	0.037	0.019	0.015
Beryllium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Bismuth	mg/L	0.001	< 0.001	< 0.001	< 0.001
Boron	mg/L	0.001	0.004	0.006	0.003
Cadmium	mg/L	0.00001	< 0.00001	< 0.00001	< 0.00001
Calcium	mg/L	0.05	6.49	12.6	3.97
Chromium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Cobalt	mg/L	0.0001	< 0.0001	0.0002	0.0001
Copper	mg/L	0.001	< 0.001	< 0.001	< 0.001
Iron	mg/L	0.02	0.53	0.75	0.67
Lead	mg/L	0.0001	0.0002	0.0002	0.0004
Lithium	mg/L	0.0001	0.0014	0.0026	0.0008
Magnesium	mg/L	0.01	1.06	1.98	0.69
Manganese	mg/L	0.001	0.068	0.169	0.096
Molybdenum	mg/L	0.0001	0.0001	0.0001	< 0.0001
Nickel	mg/L	0.001	< 0.001	< 0.001	< 0.001
Potassium	mg/L	0.02	0.45	0.53	0.24
Rubidium	mg/L	0.0001	0.0011	0.0011	0.0008
Selenium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Silver	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Sodium	mg/L	0.05	4.92	4.42	2.30
Strontium	mg/L	0.001	0.057	0.222	0.051
Tellurium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Thallium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Tin	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Uranium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Vanadium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Zinc	mg/L	0.001	0.009	0.009	0.003

Report ID: 410427-IAS
Report Date: 10-Sep-21
Date Received: 27-Aug-21

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Attention: Eric Luiker
Project #: 210119

Analysis of Water

RPC Sample ID:			410427-1	410427-2	410427-3
Client Sample ID:			JGLRO1 17/21/19024	JGLRO2 17/21/19023	JGLRO3 17/21/19028
Date Sampled:			26-Aug-21	26-Aug-21	26-Aug-21
Analytes	**Units**	**RL**			
Chlorophyll-a	µg/L	0.5	5.8	2.7	4.7

Report ID: 410427-IAS
Report Date: 10-Sep-21
Date Received: 27-Aug-21

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Fax: 506.452.0594
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Methods

Analyte	RPC SOP #	Method Reference	Method Principle
Ammonia	IAS-M47	APHA 4500-NH_3 G	Phenate Colourimetry
pH	IAS-M03	APHA 4500-H^+ B	pH Electrode - Electrometric
Alkalinity (as $CaCO_3$)	IAS-M43	EPA 310.2	Methyl Orange Colourimetry
Chloride	IAS-M44	APHA 4500-CL E	Ferricyanide Colourimetry
Fluoride	IAS-M30	APHA 4500-F- D	SPADNS Colourimetry
Sulfate	IAS-M45	APHA 4500-SO_4 E	Turbidimetry
Nitrate + Nitrite (as N)	IAS-M48	APHA 4500-NO_3 H	Hydrazine Red., Derivitization, Colourimetry
Nitrite (as N)	IAS-M49	APHA 4500-NO2- B	Ferrous Ammonium Sulfate Colourimetry
Nitrogen - Total	IAS-M57	ASTM D8083-16	Combustion/Chemiluminescence
Phosphorus - Total	IAS-M17	APHA 4500-P E	Digestion, Manual Colourimetry
Carbon - Total Organic	IAS-M38	APHA 5310 C	UV-Persulfate Digestion, NDIR Detection
Turbidity	IAS-M06	APHA 2130 B	Nephelometry
Colour	IAS-M55	APHA 2120 Color (A,C)	Single Wavelength Spectrophotometry
Conductivity	IAS-M04	APHA 2510 B	Conductivity Meter - Electrode
Trace Metals	IAS-M01/IAS-M29	EPA 200.8/EPA 200.7	ICP-MS/ICP-ES

Report ID: 410487-ML-W1
Report Date: 30-Aug-21
Date Received: 27-Aug-21

CERTIFICATE OF ANALYSIS

for
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Attention: Eric Luiker / Brad Nickerson / Erin Douthwright / Jemseg Grandlake

Project/Job #: 210119
Client Location: Grand Lake

Microbiological Examination of Water

Analytes:				E. coli
Units:				MPN/100mL
Method ID:				FFA10
Date Analyzed:				27-Aug-21
RPC Sample ID	**Client Sample ID**	**Date Sampled**	**Time Sampled**	
410487-01	JGLE01 17/21/19040	26-Aug-21	2:30:00 PM	1.0
410487-02	JGLE02 17/21/19041	26-Aug-21	3:00:00 PM	26.2
410487-03	JGLE03 17/21/19042	26-Aug-21	3:00:00 PM	1.0
410487-04	JGLE04 17/21/19043	26-Aug-21	10:50:00 AM	45.0
410487-05	JGLE05 17/21/19044	26-Aug-21	3:36:00 PM	31.3
410487-06	JGLE06 17/21/19045	26-Aug-21	3:36:00 PM	2.0
410487-07	JGLE07 17/21/19046	26-Aug-21	3:16:00 PM	139.6
410487-08	JGLE08 17/21/19047	26-Aug-21	2:45:00 PM	28.8
410487-09	JGLE09 17/21/19048	26-Aug-21	2:45:00 PM	5.1
410487-10	JGLE10 17/21/19049	26-Aug-21	10:30:00 AM	22.8
410487-11	JGLE11 17/21/19050	26-Aug-21	12:10:00 PM	10.7
410487-12	JGLE12 17/21/19051	26-Aug-21	1:20:00 PM	36.8
410487-13	JGLE13 17/21/19052	26-Aug-21	3:07:00 PM	8.6
410487-14	JGLE14 17/21/19054	26-Aug-21	4:05:00 PM	18.7

This report relates only to the sample(s) and information provided to the laboratory.

Cathy Hay
Microbiology Supervisor
Food, Fisheries & Aquaculture

Adrienne Fortin
Microbiology Technician
Food, Fisheries & Aquaculture

Report ID: 413436-IAS
Report Date: 30-Sep-21
Date Received: 17-Sep-21

CERTIFICATE OF ANALYSIS

for
Jemseg Grand Lake Watershed Association
35 Pinecone Lane
Waterborough, NB E3C 0A5

rpc
921 College Hill Rd
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Canada E3B 6Z9
Tel: 506.452.1212
Fax: 506.452.0594
www.rpc.ca

Attention: Eric Luiker
Project #: 210119
Location: Grand Lake

Analysis of Surface Water

RPC Sample ID:			413436-1	413436-2	413436-3
Client Sample ID:			JGLPO4 17/21/19035	JGLPO5 17/21/19037	JGLPO6 17/21/19036
Date Sampled:			17-Sep-21	17-Sep-21	17-Sep-21
Analytes	**Units**	**RL**			
Sodium	mg/L	0.05	4.22	4.18	2.54
Potassium	mg/L	0.02	0.38	0.44	0.30
Calcium	mg/L	0.05	7.07	10.1	3.81
Magnesium	mg/L	0.01	1.17	1.35	0.67
Alkalinity (as $CaCO_3$)	mg/L	2	14	25	7
Chloride	mg/L	0.5	4.8	5.1	3.2
Fluoride	mg/L	0.05	0.19	0.19	0.21
Sulfate	mg/L	1	13	10	6
Bromine	mg/L	0.02	< 0.02	< 0.02	< 0.02
Ammonia (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Un-ionized @ 20ºC	mg/L	-	< 0.001	< 0.001	< 0.001
Nitrate + Nitrite (as N)	mg/L	0.05	< 0.05	0.06	< 0.05
Nitrite (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Nitrate (as N)	mg/L	0.05	< 0.05	0.06	< 0.05
Nitrogen - Total	mg/L	0.2	0.3	0.3	0.4
Phosphorus - Total	mg/L	0.002	0.011	0.013	0.034
Carbon - Total Organic	mg/L	0.5	6.4	6.6	10.3
Colour	TCU	5	37	35	80
Conductivity	µS/cm	1	74	88	43
pH	units	-	7.6	7.7	7.3
Turbidity	NTU	0.1	0.4	0.5	2.2
Calculated Parameters					
Bicarbonate (as $CaCO_3$)	mg/L	-	13.9	24.9	7.0
Carbonate (as $CaCO_3$)	mg/L	-	0.052	0.117	0.013
Hardness (as $CaCO_3$)	mg/L	0.2	22.5	30.8	12.3
TDS (calc)	mg/L	-	39	47	22
Saturation pH (20°C)	units	-	9.3	8.9	9.9
Langelier Index (20°C)	-	-	-1.71	-1.21	-2.56

This report relates only to the sample(s) and information provided to the laboratory.

RL = Reporting Limit

Matthew Norman
Senior Chemist
Inorganic Analytical Chemistry

Brannen Burhoe
Supervisor
Inorganic Analytical Services

Report ID: 413436-IAS
Report Date: 30-Sep-21
Date Received: 17-Sep-21

CERTIFICATE OF ANALYSIS

for
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Tel: 506.452.1212
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www.rpc.ca

Attention: Eric Luiker
Project #: 210119
Location: Grand Lake

Analysis of Surface Water

RPC Sample ID:			413436-1	413436-2	413436-3
Client Sample ID:			JGLPO4 17/21/19035	JGLPO5 17/21/19037	JGLPO6 17/21/19036
Date Sampled:			17-Sep-21	17-Sep-21	17-Sep-21
Analytes	**Units**	**RL**			
Aluminum	mg/L	0.001	0.037	0.034	0.107
Antimony	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Arsenic	mg/L	0.001	< 0.001	< 0.001	< 0.001
Barium	mg/L	0.001	0.018	0.015	0.014
Beryllium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Bismuth	mg/L	0.001	< 0.001	< 0.001	< 0.001
Boron	mg/L	0.001	0.003	0.004	0.003
Cadmium	mg/L	0.00001	< 0.00001	< 0.00001	< 0.00001
Calcium	mg/L	0.05	7.07	10.1	3.81
Chromium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Cobalt	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Copper	mg/L	0.001	< 0.001	< 0.001	< 0.001
Iron	mg/L	0.02	0.07	0.08	0.47
Lead	mg/L	0.0001	< 0.0001	< 0.0001	0.0003
Lithium	mg/L	0.0001	0.0007	0.0006	0.0006
Magnesium	mg/L	0.01	1.17	1.35	0.67
Manganese	mg/L	0.001	0.020	0.013	0.054
Molybdenum	mg/L	0.0001	0.0001	0.0002	< 0.0001
Nickel	mg/L	0.001	< 0.001	< 0.001	< 0.001
Potassium	mg/L	0.02	0.38	0.44	0.30
Rubidium	mg/L	0.0001	0.0007	0.0007	0.0008
Selenium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Silver	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Sodium	mg/L	0.05	4.22	4.18	2.54
Strontium	mg/L	0.001	0.088	0.086	0.050
Tellurium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Thallium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Tin	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Uranium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Vanadium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Zinc	mg/L	0.01	< 0.01	< 0.01	< 0.01

Report ID: 413436-IAS
Report Date: 30-Sep-21
Date Received: 17-Sep-21

CERTIFICATE OF ANALYSIS

for

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35 Pinecone Lane
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www.rpc.ca

Attention: Eric Luiker
Project #: 210119
Location: Grand Lake

Analysis of Water

RPC Sample ID:			413436-1	413436-2	413436-3
Client Sample ID:			JGLPO4 17/21/19035	JGLPO5 17/21/19037	JGLPO6 17/21/19036
Date Sampled:			17-Sep-21	17-Sep-21	17-Sep-21
Analytes	**Units**	**RL**			
Chlorophyll-a	µg/L	0.5	2.9	1.5	1.8

Report ID: 413436-IAS
Report Date: 30-Sep-21
Date Received: 17-Sep-21

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Methods

Analyte	RPC SOP #	Method Reference	Method Principle
Ammonia	IAS-M47	APHA 4500-NH_3 G	Phenate Colourimetry
pH	IAS-M03	APHA 4500-H^+ B	pH Electrode - Electrometric
Alkalinity (as $CaCO_3$)	IAS-M43	EPA 310.2	Methyl Orange Colourimetry
Chloride	IAS-M44	APHA 4500-CL E	Ferricyanide Colourimetry
Fluoride	IAS-M30	APHA 4500-F- D	SPADNS Colourimetry
Sulfate	IAS-M45	APHA 4500-SO_4 E	Turbidimetry
Nitrate + Nitrite (as N)	IAS-M48	APHA 4500-NO_3 H	Hydrazine Red., Derivitization, Colourimetry
Nitrite (as N)	IAS-M49	APHA 4500-NO2- B	Ferrous Ammonium Sulfate Colourimetry
Nitrogen - Total	IAS-M57	ASTM D8083-16	Combustion/Chemiluminescence
Phosphorus - Total	IAS-M17	APHA 4500-P E	Digestion, Manual Colourimetry
Carbon - Total Organic	IAS-M38	APHA 5310 C	UV-Persulfate Digestion, NDIR Detection
Turbidity	IAS-M06	APHA 2130 B	Nephelometry
Colour	IAS-M55	APHA 2120 Color (A,C)	Single Wavelength Spectrophotometry
Conductivity	IAS-M04	APHA 2510 B	Conductivity Meter - Electrode
Trace Metals	IAS-M01/IAS-M29	EPA 200.8/EPA 200.7	ICP-MS/ICP-ES

Report ID: 414878-IAS
Report Date: 13-Oct-21
Date Received: 28-Sep-21

CERTIFICATE OF ANALYSIS

for
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Attention: Eric Luiker
Project #: Not Available

Analysis of Surface Water

RPC Sample ID:			414878-1	414878-2	414878-3
Client Sample ID:			JGL P01	JGL P02	JGL P03
Date Sampled:			28-Sep-21	28-Sep-21	28-Sep-21
Analytes	**Units**	**RL**			
Sodium	mg/L	0.05	4.07	4.67	4.22
Potassium	mg/L	0.02	0.39	0.38	0.36
Calcium	mg/L	0.05	5.57	7.04	6.58
Magnesium	mg/L	0.01	0.97	1.29	1.19
Alkalinity (as $CaCO_3$)	mg/L	2	13	13	13
Chloride	mg/L	0.5	4.2	4.3	4.6
Fluoride	mg/L	0.05	0.30	0.28	0.19
Sulfate	mg/L	1	8	14	13
Bromine	mg/L	0.01	0.01	0.01	< 0.01
Ammonia (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Un-ionized @ 20ºC	mg/L	-	< 0.001	< 0.001	< 0.001
Nitrate + Nitrite (as N)	mg/L	0.05	< 0.05	< 0.05	0.06
Nitrite (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Nitrate (as N)	mg/L	0.05	< 0.05	< 0.05	0.06
Nitrogen - Total	mg/L	0.2	0.5	0.4	0.3
Phosphorus - Total	mg/L	0.002	0.025	0.023	0.007
Carbon - Total Organic	mg/L	0.5	14.3	12.1	7.2
Colour	TCU	5	142	89	37
Conductivity	µS/cm	1	62	77	76
pH	units	-	7.1	7.2	7.3
Turbidity	NTU	0.1	2.9	2.8	0.5
Calculated Parameters					
Bicarbonate (as $CaCO_3$)	mg/L	-	13.0	13.0	13.0
Carbonate (as $CaCO_3$)	mg/L	-	0.015	0.019	0.024
Hardness (as $CaCO_3$)	mg/L	0.2	17.9	22.9	21.3
TDS (calc)	mg/L	-	32	40	38
Saturation pH (20°C)	units	-	9.4	9.3	9.4
Langelier Index (20°C)	-	-	-2.34	-2.15	-2.08

This report relates only to the sample(s) and information provided to the laboratory.

RL = Reporting Limit

Peter Crowhurst, B.Sc., C.Chem.
Director
Inorganic Analytical Chemistry

Brannen Burhoe
Supervisor
Inorganic Analytical Services

Report ID: 414878-IAS
Report Date: 13-Oct-21
Date Received: 28-Sep-21

CERTIFICATE OF ANALYSIS
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Tel: 506.452.1212
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Attention: Eric Luiker
Project #: Not Available

Analysis of Surface Water

RPC Sample ID:			414878-4	414878-5	414878-6
Client Sample ID:			JGL R01	JGL R02	JGL R03
Date Sampled:			28-Sep-21	28-Sep-21	28-Sep-21
Analytes	**Units**	**RL**			
Sodium	mg/L	0.05	1.88	2.93	2.41
Potassium	mg/L	0.02	0.51	0.42	0.28
Calcium	mg/L	0.05	3.52	5.84	3.70
Magnesium	mg/L	0.01	0.72	1.05	0.63
Alkalinity (as $CaCO_3$)	mg/L	2	8	7	7
Chloride	mg/L	0.5	3.5	5.1	3.3
Fluoride	mg/L	0.05	0.50	0.52	0.28
Sulfate	mg/L	1	2	12	6
Bromine	mg/L	0.01	0.01	0.01	0.01
Ammonia (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Un-ionized @ 20ºC	mg/L	-	< 0.001	< 0.001	< 0.001
Nitrate + Nitrite (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Nitrite (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Nitrate (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Nitrogen - Total	mg/L	0.2	0.7	0.5	0.5
Phosphorus - Total	mg/L	0.002	0.038	0.025	0.045
Carbon - Total Organic	mg/L	0.5	25	23	15.8
Colour	TCU	5	228	245	137
Conductivity	µS/cm	1	32	59	40
pH	units	-	6.4	6.2	6.6
Turbidity	NTU	0.1	3.7	1.9	3.7
Calculated Parameters					
Bicarbonate (as $CaCO_3$)	mg/L	-	8.0	7.0	7.0
Carbonate (as $CaCO_3$)	mg/L	-	0.002	0.001	0.003
Hardness (as $CaCO_3$)	mg/L	0.2	11.8	18.9	11.8
TDS (calc)	mg/L	-	19	33	22
Saturation pH (20°C)	units	-	9.8	9.7	9.9
Langelier Index (20°C)	-	-	-3.44	-3.49	-3.27

Report ID: 414878-IAS
Report Date: 13-Oct-21
Date Received: 28-Sep-21

CERTIFICATE OF ANALYSIS
for
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35 Pinecone Lane
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Tel: 506.452.1212
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Attention: Eric Luiker
Project #: Not Available

Analysis of Surface Water

RPC Sample ID:			414878-1	414878-2	414878-3
Client Sample ID:			JGL P01	JGL P02	JGL P03
Date Sampled:			28-Sep-21	28-Sep-21	28-Sep-21
Analytes	**Units**	**RL**			
Aluminum	mg/L	0.001	0.221	0.143	0.038
Antimony	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Arsenic	mg/L	0.001	< 0.001	< 0.001	< 0.001
Barium	mg/L	0.001	0.036	0.025	0.018
Beryllium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Bismuth	mg/L	0.001	< 0.001	< 0.001	< 0.001
Boron	mg/L	0.001	0.003	0.004	0.003
Cadmium	mg/L	0.00001	0.00001	0.00001	< 0.00001
Calcium	mg/L	0.05	5.57	7.04	6.58
Chromium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Cobalt	mg/L	0.0001	0.0002	0.0001	< 0.0001
Copper	mg/L	0.001	< 0.001	< 0.001	< 0.001
Iron	mg/L	0.02	0.67	0.35	0.08
Lead	mg/L	0.0001	0.0002	0.0001	< 0.0001
Lithium	mg/L	0.0001	0.0012	0.0011	0.0007
Magnesium	mg/L	0.01	0.97	1.29	1.19
Manganese	mg/L	0.001	0.097	0.108	0.017
Molybdenum	mg/L	0.0001	< 0.0001	0.0003	0.0002
Nickel	mg/L	0.001	< 0.001	< 0.001	< 0.001
Potassium	mg/L	0.02	0.39	0.38	0.36
Rubidium	mg/L	0.0001	0.0010	0.0008	0.0007
Selenium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Silver	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Sodium	mg/L	0.05	4.07	4.67	4.22
Strontium	mg/L	0.001	0.064	0.100	0.083
Tellurium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Thallium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Tin	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Uranium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Vanadium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Zinc	mg/L	0.001	0.003	0.005	0.006

Report ID: 414878-IAS
Report Date: 13-Oct-21
Date Received: 28-Sep-21

CERTIFICATE OF ANALYSIS
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Tel: 506.452.1212
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Attention: Eric Luiker
Project #: Not Available

Analysis of Surface Water

RPC Sample ID:			414878-4	414878-5	414878-6
Client Sample ID:			JGL R01	JGL R02	JGL R03
Date Sampled:			28-Sep-21	28-Sep-21	28-Sep-21
Analytes	**Units**	**RL**			
Aluminum	mg/L	0.001	0.529	0.342	0.267
Antimony	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Arsenic	mg/L	0.001	< 0.001	< 0.001	< 0.001
Barium	mg/L	0.001	0.052	0.022	0.018
Beryllium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Bismuth	mg/L	0.001	< 0.001	< 0.001	< 0.001
Boron	mg/L	0.001	0.003	0.004	0.003
Cadmium	mg/L	0.00001	0.00002	0.00002	0.00001
Calcium	mg/L	0.05	3.52	5.84	3.70
Chromium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Cobalt	mg/L	0.0001	0.0003	0.0004	0.0002
Copper	mg/L	0.001	< 0.001	< 0.001	< 0.001
Iron	mg/L	0.02	0.95	1.03	0.73
Lead	mg/L	0.0001	0.0003	0.0003	0.0004
Lithium	mg/L	0.0001	0.0010	0.0017	0.0009
Magnesium	mg/L	0.01	0.72	1.05	0.63
Manganese	mg/L	0.001	0.083	0.160	0.122
Molybdenum	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Nickel	mg/L	0.001	< 0.001	0.001	< 0.001
Potassium	mg/L	0.02	0.51	0.42	0.28
Rubidium	mg/L	0.0001	0.0013	0.0010	0.0009
Selenium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Silver	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Sodium	mg/L	0.05	1.88	2.93	2.41
Strontium	mg/L	0.001	0.029	0.103	0.049
Tellurium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Thallium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Tin	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Uranium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Vanadium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Zinc	mg/L	0.001	0.004	0.006	0.005

Report ID: 414878-IAS
Report Date: 13-Oct-21
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Attention: Eric Luiker
Project #: Not Available

Analysis of Water

RPC Sample ID:			414878-1	414878-2	414878-3
Client Sample ID:			JGL P01	JGL P02	JGL P03
Date Sampled:			28-Sep-21	28-Sep-21	28-Sep-21
Analytes	**Units**	**RL**			
Chlorophyll-a	µg/L	0.5	1.4	2.3	1.6

Report ID: 414878-IAS
Report Date: 13-Oct-21
Date Received: 28-Sep-21

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Attention: Eric Luiker
Project #: Not Available

Analysis of Water

RPC Sample ID:			414878-4	414878-5	414878-6
Client Sample ID:			JGL R01	JGL R02	JGL R03
Date Sampled:			28-Sep-21	28-Sep-21	28-Sep-21
Analytes	**Units**	**RL**			
Chlorophyll-a	µg/L	0.5	0.8	1.2	1.5

Report ID: 414878-IAS
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Methods

Analyte	RPC SOP #	Method Reference	Method Principle
Ammonia	IAS-M47	APHA 4500-NH_3 G	Phenate Colourimetry
pH	IAS-M03	APHA 4500-H^+ B	pH Electrode - Electrometric
Alkalinity (as $CaCO_3$)	IAS-M43	EPA 310.2	Methyl Orange Colourimetry
Chloride	IAS-M44	APHA 4500-CL E	Ferricyanide Colourimetry
Fluoride	IAS-M30	APHA 4500-F- D	SPADNS Colourimetry
Sulfate	IAS-M45	APHA 4500-SO_4 E	Turbidimetry
Nitrate + Nitrite (as N)	IAS-M48	APHA 4500-NO_3 H	Hydrazine Red., Derivitization, Colourimetry
Nitrite (as N)	IAS-M49	APHA 4500-NO2- B	Ferrous Ammonium Sulfate Colourimetry
Nitrogen - Total	IAS-M57	ASTM D8083-16	Combustion/Chemiluminescence
Phosphorus - Total	IAS-M17	APHA 4500-P E	Digestion, Manual Colourimetry
Carbon - Total Organic	IAS-M38	APHA 5310 C	UV-Persulfate Digestion, NDIR Detection
Turbidity	IAS-M06	APHA 2130 B	Nephelometry
Colour	IAS-M55	APHA 2120 Color (A,C)	Single Wavelength Spectrophotometry
Conductivity	IAS-M04	APHA 2510 B	Conductivity Meter - Electrode
Trace Metals	IAS-M01/IAS-M29	EPA 200.8/EPA 200.7	ICP-MS/ICP-ES

Zooplankton density (number of organisms/m3) in Grand Lake (October 11, 2021)			
ROTIFERA	Density		
Collotheca mutabilis Harring	6166		
Conochilus unicornis Rousselet	289824		
Gastropus stylifer Imhof	24666		
Kellicotia longispina Kellicott	6166		
Keratella cochlearis Gosse	437819		
Polyathra dolicoptera Idelson	221993		
Polyathra major Burckhardt	98663		
Polyathra vulgaris Carlin	24666		
Synchaeta sp	135662		
Trichocerca longiseta Shrank	141829		
CALANOIDA			
Diaptomus nudus Marsh	60534		
Leptodiaptomus minutus Lilljeborg	13669		
Calanoid copepodid	320245		
Calanoid nauplii	647479		
CYCLOPOIDA			
Cyclops scutifer Sars	9764		
Cyclopoid copepodid	50771		
Cyclopoid (nauplii)	1486118		
CLADOCERA			
Daphnia longiremis Sars	9764		
Ceriodaphnia lacustris Birge	44912		
Bosmina longirostris O.F. Muller	312434		
Holopedium gibberum Zaddach	7811		

Algal density (number of units/L) in Grand Lake, NB (October 11, 2021))	
CHLOROPHYCEAE	
Gloeocystis sp	8168
Monoraphidium braunii Naegeli	4084
Oocystis borgei J.W. Snow	4084
Monoraphidium irregulare (G.M. Smith) Komarkova-Legenerova	4084
Monoraphidium minutum (Nag.) Komarkova-Legenerova	4084
Scenesdesmus ecornis var. *bicellularis* (Ehrenberg) Chodat	4084
CHRYSOPHYCEAE	
Stichogloea doederleinii (Schmidle) Wille	4084
DIATOMS	
Centric Diatom (10 um (Cyclotella/Stephanodiscus sp)	12252
Rhizosolenia eriensis H.L. Smith	4084
Rhizosolenia longiseta Ehrenberg	12252
Stephanodiscus niagarae Ehrenberg	12252
Stephanodiscus sp	8168
Synedra sp	12252
Tabellaria flocculosa (Roth) Kuetzing	12252
Aulacoseira distans (Ehrenberg) Simonsen	16336
Aulacoseira sp *(A. ambigua & A. italica)*	16336
TOTAL	**138856**