Lake Windermere Recreational Impact and Sediment Quality Assessment

Windermere Lake

Prepared By:
Ecoscape Environmental Consultants Ltd. &
Larratt Aquatic Ltd.
Prepared For:
Lake Windermere Ambassadors

January 31, 2023

LAKE WINDERMERE

RECREATIONAL IMPACTS AND SEDIMENT QUALITY

Prepared For:

Lake Windermere Ambassadors
Windermere Lake

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1.0	January 31, 2023	JS	JS	Issued for Use

EXECUTIVE SUMMARY

This preliminary 2022 study provides an assessment of recreational impacts on sensitive environmental values and sediment quality (or sediment suspension) at Windermere Lake. The purpose of this report is to provide guidance for implementation of the full work program in 2023.

Sediment cores and existing habitat related data were used to help determine potential risks to environmental values and those associated with sediment disruption or contamination resulting from ongoing and active recreational use. Sediment cores showed detectable hydrocarbons at 6 of 9 sites distributed through the lake. The highest recorded hydrocarbon result was 460 mg/kg of EPH 19-32 (extractable petroleum hydrocarbons), measured at the Rockier Sediment site. The field crew noted a hydrocarbon odor when they took sediment cores in marinas, supporting detection of EPH 19-32. Sediment quality guidelines are not set for EPHs because it is a broad category of hydrocarbons. More detailed VOC (volatile organic compounds), BTEX (benzene, toluene, ethylbenzene and xylene), or PAH (Polycyclic aromatic hydrocarbons) analyses panels would be needed for guideline comparison. The results from the first sampling trip indicate there would be value in a more thorough investigation of hydrocarbon contamination in Windermere Lake at a larger scale.

Lake Windermere sediments contained elevated arsenic, copper and lead exceeding the 80% of maximum allowable concentration warning threshold. Of these, only arsenic exceeded the BC sediment quality guideline (<5.9 mg/kg) with 7 of 9 sites exceeding the guideline by as much as double the deep and control sites. The Deep Site had among the highest values for most parameters, a result likely attributed to sediment focusing into the deepest point of the lake every time it becomes resuspended.

Phytoplankton densities were moderate in the southern half of the lake while the northern two sites had very high densities and were dominated by the bloom forming[1] and potentially toxic cyanobacteria *Anacystis sp.* The beach sample contained 21,410 cells/mL of cyanobacteria, a concerning result for a popular swimming area. While this is unlikely to lead to acute cyanotoxicity, chronic low dose exposure cannot be ruled out.

A method assessing boat density on the lake was also created by the team for the first year. Data was collected and revisions and recommendations to a full year of data collection have been provided. The intent of this study is to determine areas with the greatest recreational use. Following that, recommendations for the most appropriate recreational areas will be provided, considering environmental values for the lake and overall sediment quality.

[1] Several cyanobacteria taxa can control their buoyancy, allowing them to float near the surface where light is more abundant. This can lead to thick accumulations of algal biomass, an event known as a bloom.

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1.0 INTRODUCTION

Ecoscape Environmental Consultants Ltd. (Ecoscape) and Larratt Aquatic Consulting Ltd, (LAC) were retained by Lake Windermere Ambassadors (the LWA) to provide an assessment of recreational impacts on sensitive environmental values and sediment quality at Windermere Lake (Figure 1). The purpose of this report is to provide guidance for implementation of the full work program in 2023. This interim report summarizes preliminary results from the 2022 data. This report is bound by the general Terms and Conditions, found in APPENDIX A:.

1.1. Background

Lake Windermere is a shallow lake with an average depth of around 4 to 5 m, formed by a very large widening in the Columbia River. Lake Windermere is part of the Columbia Wetlands, one of the longest intact wetlands in North America.

The current and projected boating use of Lake Windermere has the potential to impact water quality, habitat values and potentially domestic water intakes. Power boating can be so intense on summer weekends that the carrying capacity for safe boating is likely exceeded. Other values, such as habitat, are also likely impacted by recreational activities (e.g., disturbance of nesting waterfowl). Boating styles and behaviors also vary, as do the demand for supporting facilities such as launches and marinas. Large power boats >4.58 m (15 ft.) represent the category most likely to adversely impact Lake Windermere because of their size and associated wakes. For instance, surf boats create turbulence that can reach 8 meters into the water column (Larratt and Self, 2018; Raymond and Galvez-Cloutier 2015). Boat traffic correlates with up to 50% increases in turbidity and accelerated shoreline erosion in many studies (Asplund 2000; Mastran et al. 1994; Schleppe et al. 2017; Mercier-Bliase and Prairie 2014; Raymond and Galvez-Cloutier 2015) Wake turbulence is particularly concerning given the extensive shallow areas (or littoral zone) of Windermere Lake. Fine organic and silty sediments accumulated on these shallows are easily re-suspended with wake turbulence from prop wash, which can be exacerbated when large ballasts are present in boats to create larger wakes.

Based on our experience in Windermere Lake during Foreshore Inventory Mapping (FIM) conducted by Ecoscape during 2020, we forecast the following power boating risks:

- To water quality: spills and sediment disturbance, particularly in shallow areas
- To habitat values: longshore current disruption, onshore wake erosion and spills/discharges from marina/docks
- To drinking water intakes: turbid plumes that include contaminants can travel from disturbed areas to intakes

1.2. Work Plan Objectives

Key concerns identified on Windermere Lake include:

- Identifying areas of Windermere Lake that are most suitable for different types of recreational activities, based upon the environmental concerns associated with the activities (e.g., power versus paddle craft and preferred areas for recreation that minimize impacts to Windermere Lake).
- Identifying potential power craft related impacts from boat wake, sediment disruption and water quality, shoreline erosion, and invasive species establishment.
- Trying to provide support to help identify the "carrying capacity" of Windermere Lake, considering water quality and environmental values.

The aim of this project is to investigate the long-term threats from boating activity to lake water source protection and habitat values on Lake Windermere. We plan to focus on most at-risk areas for water quality, habitat values and domestic intakes.

The specific objectives include:

- Establish the theoretical boat capacity of the lake using metrics/modelling developed for Kalamalka and Wood lakes and compare against current use patterns (Schleppe et al. 2017).
- Determine wake impacts including sediment disturbance, shoreline erosion, destruction of aquatic plants, and their significant potential to move invasive mussel larvae in ballast tanks
- Determine the likelihood of sediment resuspension causing damage to water quality and releasing nutrients that lead to accelerated algae growth and algae blooms
- Identify potential boat wake related impacts to wetlands connected to Windermere Lake
- Develop recommendations on steps moving forward including where to boat and ranges of boat carrying capacity

1.3. 2022 Work Plan Overview

The following provides a brief summary of works conducted during 2022.

- Ecoscape prepared a proposed method for collecting and tracking boat utilization of the lake. This was completed to help ensure data collected by the LWA was consistent, efficient, and could be incorporated into any data models for boat utilization.
- LAC collected sediment cores for sediment quality analyses, including hydrocarbons and metals
- Collection of periphyton algal samples to understand alga communities and densities

- Deployment of sediment traps to document sediment accumulation rates, originating from either sediment resuspension or from natural deposition processes

2.0 SUMMARY OF PRELIMINARY METHODS AND RESULTS

2.1. Boat Data Collection Summary

Boat data requires the data collected as a "snapshot" in time. Each data collection event must identify the following key information, in order to be useful for the boat density modelling:

- Date and time of the sampling event
- Location on the lake
- Activity occurring (e.g., sitting still, pulling a water skier, creating wake for a wake boarder, paddling, etc.)

On Windermere Lake, boat densities and utilization of the lake vary depending upon many factors, such as time of day or time of year (e.g., a long weekend). To ensure sampling is not biased, sampling events must occur throughout the day (i.e., numerous sampling events during the morning, midday, afternoon, and evening) and must also sample peak and low density use periods over the summer period.

2.1.1 Field Methods

2.1.1.1. Field Prep and Gear

The following are necessary pieces of equipment to collect the data:

- Binoculars
- A good understanding of different boat types, and methods of recreating
- Laptop
- Safe access to a viewpoint of the lake or safe access on a boat
- Attention to detail to ensure data collected is as accurately portrayed on maps as possible. This data will be digitized to support the study and data must be provided such that it can be easily implemented into the analysis
- Any other common piece of field equipment or personal protective gear necessary
- A printed copy of the GIS map sets, several coloured markers (e.g., Sharpie), small stickers to label the Sample ID on maps, and a hard surface to work from. *A new printed map should be used for each sample day.*

2.1.1.2. Field Sampling

Each sampling event should:

- Be completed in the shortest period possible
- Enter data into the laptop during collection, if possible

- Ensure that the Sample ID for each boat is clearly labelled on the maps. *Any data that cannot be interpreted will not be entered.*
- You may wish to laminate a few data collection sheets because the are more water resistant. For next year, if iPads are used, they will avoid or reduce water related data collection problems.
- Review all data collected the day of collection. Correct any observed errors.
- Back up each day of data by emailing the data to Jason Schleppe at jschleppe@ecoscapeltd.com
- Follow all other standard field data collection techniques and be as accurate as possible.

2.1.2 Field Data Collected

The database setup used during 2022 included the following data fields:

- Sample ID: Sample ID is the unique identifier for each boat counted. This field is extremely important because it is used to relate the boat counted in the survey to the real world spatially. For each sample day, use labels 1-1, 1-2 for sample day 1, and 2-1,2-2, for sample day three. *Stickers may be useful to stick to the map grid, with pre labelled Sample IDs for efficiency.*
- Date – Sample date
- Time – 24 hour clock time the boat was counted. *It is preferred to sample the entire lake in a short period of time (i.e., 1 to 2 hours) to reduce the potential for counting a vessel more than once.*
- Sample Crew – The initial of each field assessor. *It is assumed that field notes with full names will be provided for reporting purposes.*
- Boat Type – A boat type is used to describe the vessel type
    - Power Boat - This is a vessel that does not produce a large wake but is capable of high speeds. These vessels often have larger outboard motors on them. *All larger vessels capable of high speeds will default to a Power Boat if the boat type is not known*.
    - Wake Boat – A wake boat or a wake surf boat is a vessel that usually contains a ballast used to produce a large wake. There are many specific brands of this vessel type. *A boat should only be counted if the assessor is confident of the boat type*.
    - Fishing Boat – A fishing boat is a smaller vessel, typically under 18 feet. They may have motors that range from 10 to 15 horsepower and generally do not produce a large wake. Typically, these boats do not have a steering system, which is done using the motor and a tiller.
    - Paddle Craft – A paddle craft is any boat that is powered manually. These can be canoes or kayaks.
    - Other – Other craft that may be counted could be stand up paddle boards, belly boat / float tubes, or unique floating vessels (e.g., a foot peddle powered toy). *It is not necessary to count these. These data may or may*

not be used but have been added to address things that don't fit any of the categories above, but may be considered "a boat".

- Boat Activity – A boat activity is what the boat is doing at the time of sampling
  - Wake / Surf – A boat that is actively towing or facilitating wake boarding or wake surfing (or arguably similar wake type activity behind a Wake Boat
  - Fishing - A vessel that is actively fishing, with rods deployed. *A stationary vessel that is casting is considered fishing.*
  - Slow Travel – A vessel that is under power but not moving fast. These boats would not be generating much, if any wake. These speeds would be similar to what you would view in a marina for example.
  - Towing (Tube/Skier) – Boats that are towing a tube(s), or skier(s) or other similar activities.
  - Paddle – A boat that is being actively paddled around the lake
  - Stationary Single – A boat that is not under power, is generally stationary, and is not moored or tethered to another vessel.
  - Stationary Multiple – A group of vessels that are stationary, not under power, and tethered together. If desired, the number of tethered boats could also be counted.
- Under Power – This will document whether the boat is moving or stationary (Yes /No)
- Lake Area – If sampling from a vessel, it may not be possible to sample the entire lake from one location. The maps have broken the lake down into three sectors, where it has been assumed that the sample can sample the entire sector. The total sample area (North, South, Middle, South Middle, etc.) should be documented. If the area sampled is different than what is shown on the maps, a sharpie should be used to identify the area sampled. *It is ok to move around a bit to fully sample. For instance, you may stop, count one area, quickly move to another vantage to count another area, and this would be considered one sampling event. As noted above, one sampling event should be kept as short as possible to get a snapshot in time, but care should be taken to avoid duplicating or counting a vessel twice.*
- Observed Wake – Identify whether a wake was observed or not
- Within 30 m of Shore – If possible, identify whether the vessel is within 30 m from shore. 30 m from shore is a specific distance referenced in legislation. *If you cannot decide, do not indicate yes in this field.*
- Observed Sediment – It is unknown if this data can be collected. However, if an observable sediment plume is noticed, it should be tracked. However, if it is unknown or hard to tell, please indicate No.
- Comments – The comments field can be used to put in any specific comments about the sample point. For instance, if the number of tethered boats is counted, it could be added here. *Please note, this database can be adapted. If new fields*

are deemed important to track about an boat, these data can be added as new fields in the Excel table.

2.1.2.1. Data Entry and Recording

An Excel sheet was provided. Each sample day was entered onto a new tab at the bottom of the Excel and labelled with the date. This will act to avoid duplication of the Sample ID and act as a QA/QC for the data collected.

The following are general instructions

- The Database tab contains the data fields that will be collected. Please cut and paste the data field into each day on the first entry. From that point, the data field should self populate after you start typing.
- *Do not change the database into a different short form. These data must all be entered the exact same between days because the software used for analysis is case and character sensitive (i.e., one or two spaces with the space bar are different to the software).*

2.1.2.2. Comparison of Digital to Paper Records

Throughout the 2022 work season, discussion with LWA staff and the project team identified opportunities to use a digital mapping versus the paper method established above. The following summarizes the differences between the two methods and will facilitate discussion for the best ways to collect and manage boat density data in 2023.

- Paper Method (Presented above) – Using this method, data is entered into an Excel spreadsheet, and the unique SampleID is placed onto a printed paper map. This data is then digitized in GIS (digital mapping) for use in models. This method had the advantage of being quick to setup, but was found to be slow during field entry. Entering data as a snapshot is important because it will help avoid duplication of datapoints accidentally (e.g., to sample the whole lake, a boat may move during the count, and be counted twice).
- Digital Method – Using a digital method, an IPad device would be used. This data would be entered in real time to the GIS database and would reduce the need to have both Excel and a paper map copy. Further, this method reduces the number of times data must be transcribed, reducing the potential for human induced error. This method is also more time efficient for data entry, and saves time for digitization of boat count data from the paper maps. However, this method requires at least 1, preferably 2 IPads, with appropriate software and licensing.

Ecoscape has attempted to compare these two methods, by benchmarking data entry times to compare the expenses associated with software to collect data entirely digitally. At this time, the costs are likely similar in nature, but are dependent upon number of expected sampling events. To enter data from the paper maps, it takes up to 5 minutes to enter each data point, with an average of 2 to 3 minutes. This equated to a data entry time of 3 hours of actual data entry time for about 130 data points between the 6

sampling events. The time for data entry likely exceeds the costs associated with digital entry due to the expected quantity of data points .

Given the above, we are recommending that data collection in 2023 proceed in exclusively digital format. To accomplish this, the following would have to occur:

- LWA would have to provide Ecoscape with IPads they wish to use for data collection. *Ecoscape does not have a sufficient supply of IPads to use for this and would have to purchase them for this project.*
- LWA would ship the IPads to Ecoscape, who would load software for data collection
- Ecoscape would ship the IPads back to LWA, and provide a brief training event for how to use them
- Ecoscape would provide trouble shooting support as required, acknowledging that we have assumed users are familiar with the IPads and only require training and mentorship on the specific software used and how to enter data correctly.

2.2. Sediment Cores and Traps

As part of the broader boat capacity study, sediment cores were collected from nine sites throughout Windermere Lake (Figure 1). These cores were analyzed for extractable hydrocarbons (EPHs) as well as total metals. At the same time, sediment traps for measuring sediment accumulation rates were deployed at six sites. Shortly after it was deployed, the trap at Marina 1 was removed and returned to LWA. Plans were made to deploy traps at a seventh site but the aquatic macrophyte beds at the Creek Trap site were too dense.

Sediment cores showed detectable hydrocarbons at 6 of 9 sites distributed through the lake (Figure 2). The highest recorded hydrocarbon result was 460 mg/kg of EPH 19-32, measured at the Rockier Sediment site. The LAC field crew noted a hydrocarbon odor when they took sediment cores in marinas.

Sediment quality guidelines are not set for EPHs because it is a broad category. More detailed VOC, BTEX, or PAH analyses panels would be needed for guideline comparison. The results from the first sampling trip indicate there would be value in a more thorough investigation of hydrocarbon contamination in Windermere Lake.

In addition to the elevated hydrocarbon concentrations, arsenic, copper, and lead were also elevated in the Windermere Lake sediments, exceeding the 80% of maximum allowable concentration warning threshold[2] (Figure 2). Of these, only arsenic exceeded

[2] Screening samples against a warning value of 80% of the maximum allowable concentration is a common analysis technique used to flag samples that do not currently exceed guidelines but may warrant further investigation because of relatively high concentrations for a given parameter.

the BC sediment quality guideline (<5.9 mg/kg) with 7 of 9 sites exceeding the guideline by as much as double at the deep and control sites.

The Deep Site had among the highest values for most parameters, a result likely attributed to sediment focusing towards the deepest point of the lake every time it becomes resuspended.

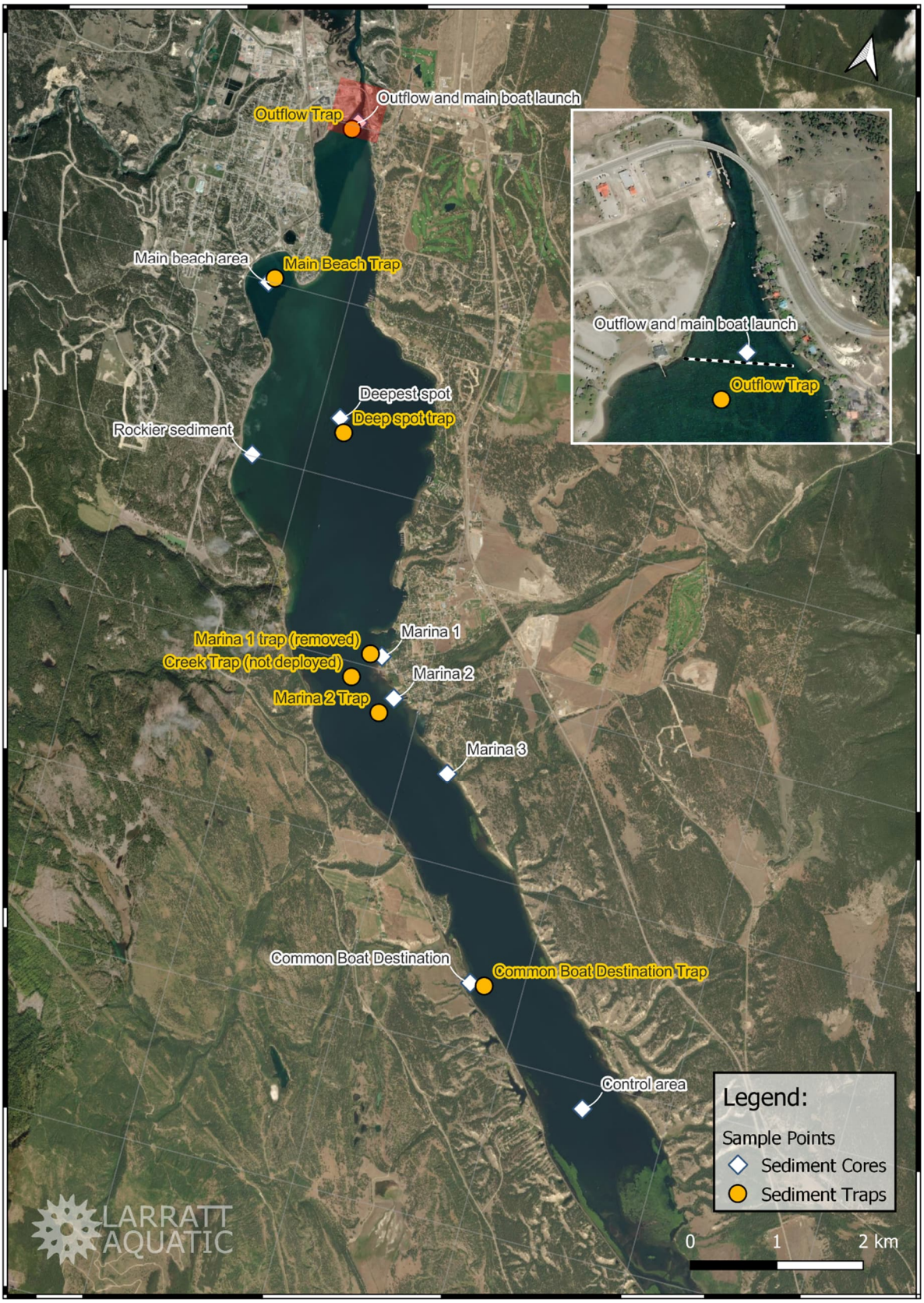

Figure 1. Sediment Sampling Sites

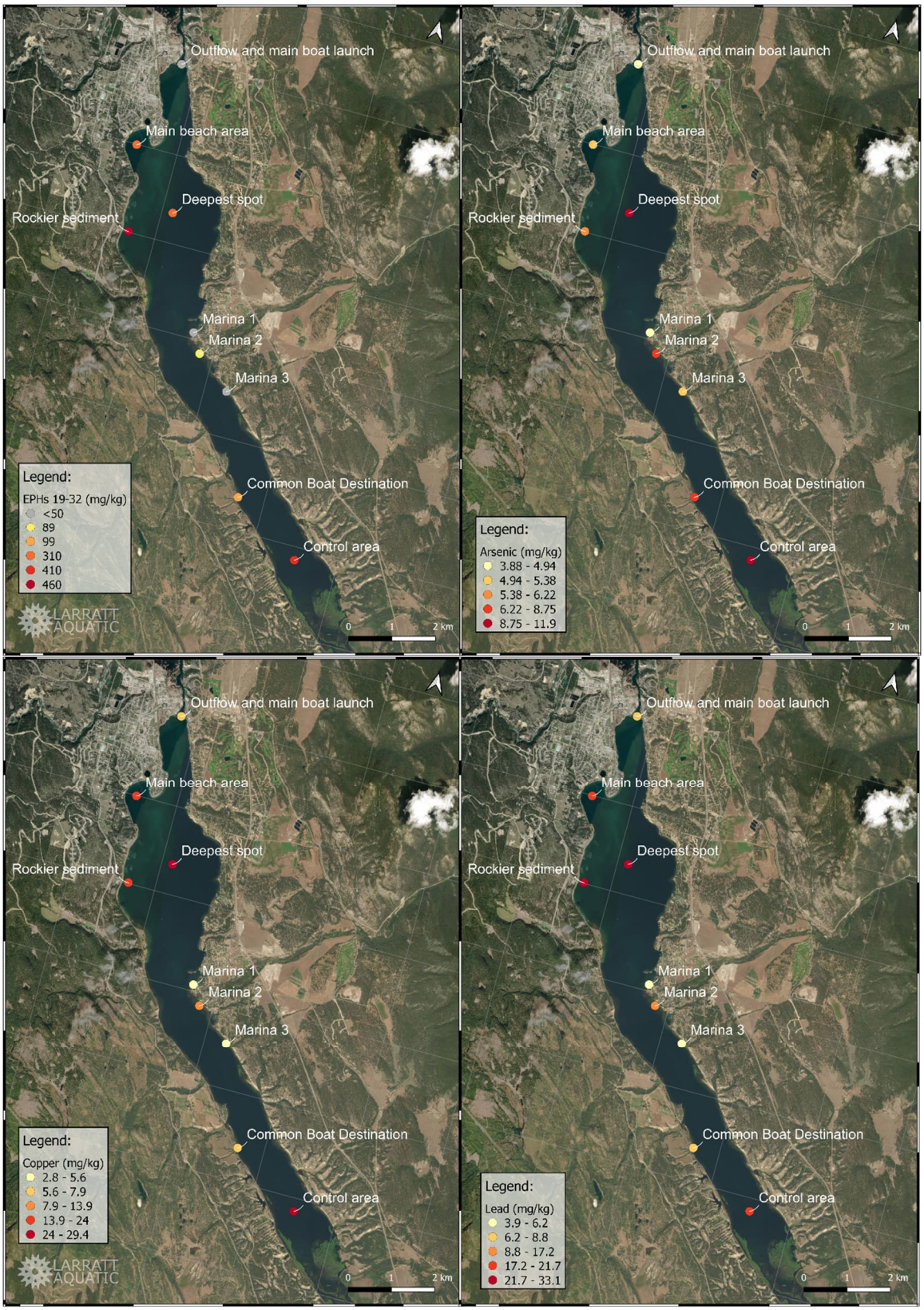

Figure 2. Map of sediment chemistry concentrations for EPH19-32, arsenic, copper, and lead

Note: Sample sites colourized based on relative concentrations between the sites

2.2.1 Phytoplankton

Phytoplankton (free-floating algae) densities were measured at four sites on the September 2022 field trip using surface grab samples (Figure 4). Phytoplankton densities were moderate in the southern half of the lake while the northern two sites had very high densities and were dominated by the bloom forming[3] and potentially toxic cyanobacteria *Anacystis sp.* (Figure 3). The beach sample contained 21,410 cells/mL of cyanobacteria, a concerning result for a popular swimming area. While this is unlikely to lead to acute cyanotoxicity, chronic low dose exposure cannot be ruled out.

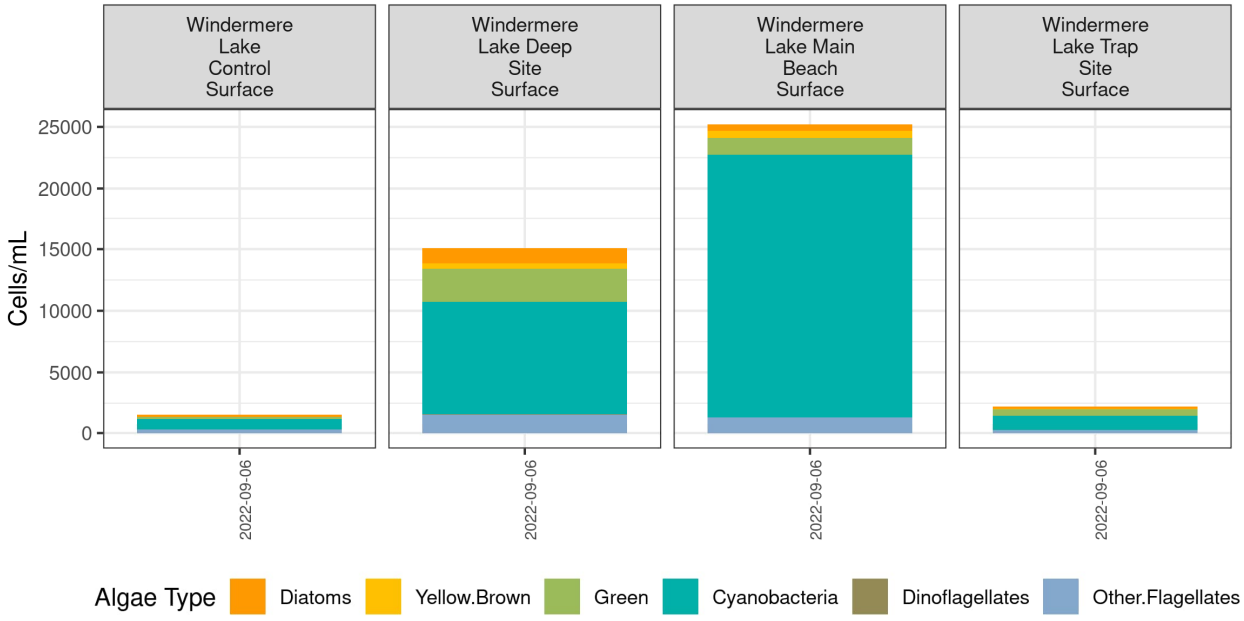

Figure 3. Phytoplankton densities in Windermere Lake sample sites, Sep 6 2022

[3] Several cyanobacteria taxa are able to control their buoyancy, allowing them to float near the surface where light is more abundant. This can lead to thick accumulations of algal biomass, an event known as a bloom.

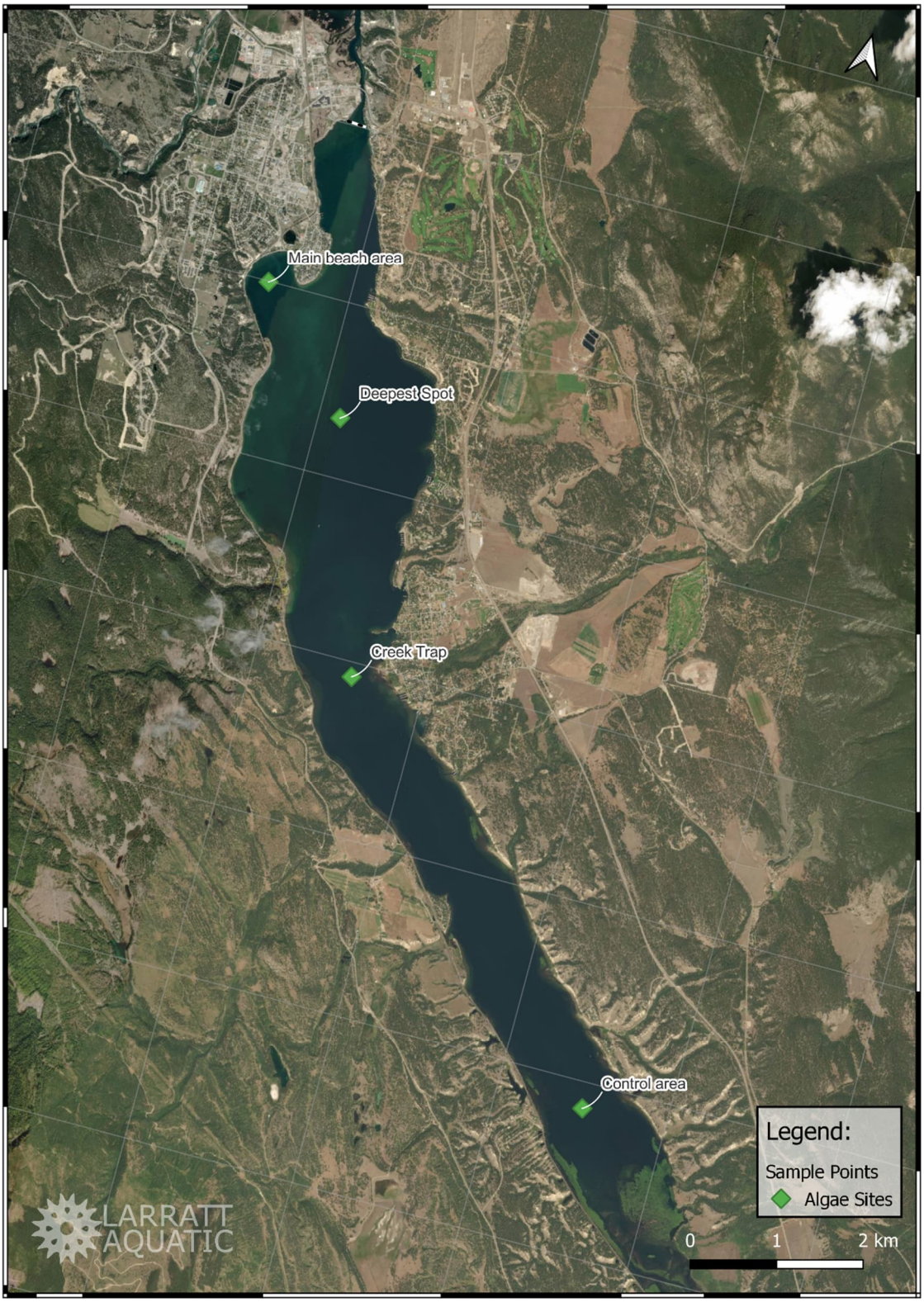

Figure 4. Algae sample sites

3.0 RECOMMENDATIONS

- Enhanced hydrocarbon analyses: Given the number and size of hydrocarbon detections in the Lake Windermere sediments, Ecoscape and LAC recommend further sampling be considered to evaluate the risk to aquatic health. This could be done by increasing the number of sample sites to increase statistical strength, and by using contaminant-specific hydrocarbon analyses such as BTEX/VH/VOC ($179 per sample), LEPH/EPH/PAHs ($239.50 per sample). We will ask the lab to ensure their methods remove organic signatures that are derived from decaying organic matter.
- Continue to monitor cyanobacteria blooms because they can accelerate using nutrients released during sediment disturbance.
- Conduct a thorough statistical analysis of the total Phosphorus data and Total Nitrogen data collected by the Lake Windermere Ambassadors over the past 7 years, including calculating N:P ratios.

4.0 LIMITATIONS

This report has been prepared by Ecoscape and is intended for the sole and exclusive use of Lake Windermere Ambassadors, for the purposes set out in this report. Ecoscape has prepared this report with the understanding that all available information on the past, present, and proposed conditions of the subject property have been disclosed. Ecoscape has relied upon personal communications with Lake Windermere Ambassadors and other information sources to corroborate the documents and other records available for the subject property. Lake Windermere Ambassadors has also acknowledged that in order for Ecoscape to properly provide the professional service, Ecoscape is relying upon full disclosure and accuracy of this information.

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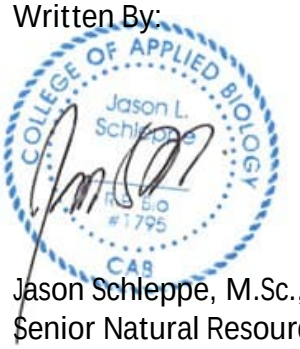
5.0 CLOSURE

We trust that this report satisfies the present requirements. Should you have any questions or comments, please contact the undersigned at your convenience.

Respectfully Submitted
Ecoscape Environmental Consultants Ltd.,

Written By:



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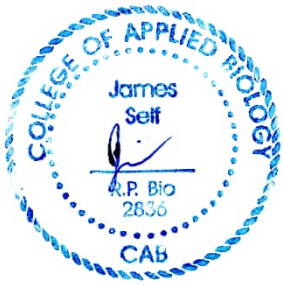

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REFERENCES

Asplund, T. R. (2000). The Effects of Motorized Watercraft on Aquatic Ecosystems. *Report Watercraft*, 1–21. https://doi.org/PUBL-SS-948-00

Brown, K. W., Wolf, H. W., Donnelly, K., C. Slowey, J. F. 1979. The Movement of Fecal Coliforms and Coliphages Below Onsite Lines. Journal of Environmental Quality 8: 121–125.

Mastran, T. A., Dietrich, A. M., Gallagher, D. L., & Grizzard, T. J. (1994). Distribution of polyaromatic hydrocarbons in the water column and sediments of a drinking water reservoir with respect to boating activity. *Water Research*. https://doi.org/10.1016/0043-1354(94)90051-5

Schleppe, J., Larratt, H., & Plewes, R. (2017). Kalamalka and Wood Lake Boat Capacity Study on Water Sources. Retrieved from http://a100.gov.bc.ca/appsdata/acat/documents/r52567/16-1796-BoatCapacityReport-FINAL-Mar.14.2017_1499805760065_9804505186.pdf

Mercier-Blias and Prairer 2014. Project Evaluation of the Impact of Waves Created by Wake Boats on the Shores of the Lakes Memphremagog and Lovering. https://lmcd.org/wp-content/uploads/2022/06/Impact-of-Waves-Created-by-Wake-Boats-Canada.pdf

Raymond, S. and R. Galvez-Cloutier 2015. IMPACT DE LA NAVIGATION EN MILIEU LACUSTRE - ÉTUDE SUR LA REMISE EN SUSPENSION DES SÉDIMENTS : CAS DU LAC MASSON ET DU LAC DES SABLES

APPENDIX A: General Terms and Conditions

General Conditions

This report applies and is subject to these "General Conditions".

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This report concerns a specific site and a specific scope of work and is therefore not applicable to any other sites or any other developments not referred to in the report. Any deviation from the specific site or scope of work would require a supplementary investigation and assessment.

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The client is aware that Ecoscape is not qualified to, nor is it making any recommendations in terms of purchase, sale, investment, or development of the subject property, as such decisions are the sole responsibility of the client.

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The client acknowledges that property containing hazardous wastes and contaminants poses a high risk of claims brought by third parties stemming from the presence of those materials. Accounting for these risks, and in consideration of Ecoscape providing the requested services, the client agrees that Ecoscape's liability to the client, with respect to any issues relating to hazardous wastes or contaminants located on the subject property, shall be limited to the following:

With respect to any claims brought against Ecoscape by the client arising out of the provision or failure to provide services hereunder shall be limited to the amount of fees paid by the client to Ecoscape under this Agreement, whether the action is based on breach of contract or tort;

With respect to claims brought by third parties arising out of the presence of contaminants or hazardous wastes on the subject property, the client agrees to indemnify, defend and hold harmless Ecoscape from and against any and all claim or claims, action or actions, demands, damages, penalties, fines, losses, costs and expenses of every nature and kind whatsoever, including solicitor-client costs, arising or alleged to arise either in whole or part out of services provided by Ecoscape, whether the claim be brought against Ecoscape for breach of contract or tort.

Disclosure of Information by Client

The client agrees to fully cooperate with Ecoscape with respect to the provision of all available information on the past, current, or proposed conditions on the site, including historical information respecting the use of the site. The client acknowledges that in order for Ecoscape to properly provide the service, Ecoscape is relying on full disclosure and accuracy of any such information. Ecoscape does not accept any responsibility for conclusions drawn from erroneous, invalid, or inaccurate data provided to us by another party and used in the preparation of this report.

Standard of Care

Services performed by Ecoscape for this report have been completed in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions in the jurisdiction in which the services are provided. Professional judgement has been applied in developing the conclusions and/or recommendations made in this report.

No warranty or guarantee, express or implied, is made concerning the results, comments, recommendations, or any other portion of this report.

Notification of Authorities

The client acknowledges that in certain instances the discovery of hazardous materials, contaminants or conditions and materials may require that regulatory agencies and other parties be informed and the client agrees that notification to such parties or persons as required may be done by Ecoscape in its reasonably exercised discretion. Further, Ecoscape reserves the right to notify Provincial agencies when rare or endangered flora or fauna are observed, whether the species classifications are identified as such at the local, Provincial, or Federal levels of government.

Ownership of Instruments of Professional Service

The client acknowledges that all reports, plans, and data generated by Ecoscape during the performance of the work and other documents prepared by Ecoscape are considered its professional work product and shall remain the copyright property of Ecoscape.

Alternate Report Format

Where Ecoscape submits both an electronic file and hard copy versions of reports, drawings and other project-related documents and deliverables (collectively termed Ecoscape's instruments of professional service), the client agrees that only the signed and sealed hard copy versions shall be considered final and legally binding. The hard copy versions submitted by Ecoscape shall be the original documents for record and working purposes, and, in the event of a dispute or discrepancies, the hard copy versions shall govern over the electronic versions. Furthermore, the client agrees and waives all future right to dispute that the original hard copy signed version archived by Ecoscape shall be deemed to be the overall original for the Project.

The client agrees that both electronic file and hard copy versions of Ecoscape's instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party other than Ecoscape. The client warrants that Ecoscape's instruments of professional service will be used only and exactly as submitted by Ecoscape.

The client recognizes and agrees that electronic files submitted by Ecoscape have been prepared and submitted using specific software and hardware systems. Ecoscape makes no representation about the compatibility of these files with the client's current or future software and hardware systems.