FINAL REPORT

NEIWPCC Job Code:	0100-334-002
Project Code:	L-2022-055
Contractor:	Organisme bassin versant baie Missisquoi (OBVBM)
Prepared By:	Johanne Bérubé, François Boilard, OBVBM
	Andrzej Barwicz, President APLP
Project Period:	May 4, 2022 – June 30, 2023
Date Submitted:	May 24, 2023
Date Approved:	June 6, 2023

LE PORTRAIT ENVIRONNEMENTAL DU BASSIN VERSANT DU LAC PARKER EN 2022 : BATHYMÉTRIE, SÉDIMENTOLOGIE, PHYSICOCHIMIE

CONTACT INFORMATION :

- ADMINISTRATIVE CONTACT: JOHANNE BERUBÉ-OBVBM
- TECHNICAL CONTACT: ANDRZEJ BARWICZ – APLP

Organisme du bassin versant de la bai Missiauoi (OBVBM)

110 rue de la Rivière, Bedford, Qc, Canada J0J 1A0,

450 248-0100, Johanne.berube@obvbm.org

This is a Organisme bassin versant baie Missisquoi LCBP funded project.

This project was funded by an agreement awarded by the Great Lakes Fishery Commission to NEIWPCC in partnership with the Lake Champlain Basin Program.

EXECUTIVE SUMMARY

The Lake Parker watershed is the head watershed of the North Missisquoi River in the Missisquoi bay sub watershed. In the past, the forest industry used Lake Parker to float logs, leaving behind a large volume of wood debris. More recently, housing development has increase the pressure on the lake and contributed to accelerate the eutrophication process. A proliferation of invasive aquatic plants during the last twenty years has been documented. The regional project "Restoration of Lake Parker Watershed" started in 2010 in collaboration between APLP, the Municipality of Eastman and OBVBM, with the objective to restore the lake's "self-healing" processes, enabling the restoration of its water quality. Currently, corrective management actions in the watershed are being completed to address historic sources of erosion. Thus, while the sedimentation has to be stopped at the source, the preparation of the detailed action plan for the lake revitalization is the priority. The planning process unavoidably requires the recent "Environmental portrait of the lake Parker watershed: 2022: bathymetry sedimentology and physicochemistry". This is the project granted by LCBP, executed in collaboration between OBVBM end APLP and Synergis, and described in this report.

Location: the project is located in the municipality of Eastman, in the MRC of Memphrémagog, Lake Parker is the head lake of the Missisquoi Nord River located at 45°19'49.2"N 72°18'40.8"W The land occupation around the lake is mainly forested and residential.

Objectives: the main objective of the project is to obtain an updated and completed environmental portrait of the lake Parker in 2022. It is an unavoidable step in planning the revitalization process of the lake Parker watershed providing the information necessary to the elaboration of a technically viable and legally acceptable action plan.

Actions: the main substantial tasks of this project focused on:

- Bathymetry – to determine, in particular, the quantity and distribution of the accumulated sedimentation on the bottom of the Lake Parker
- Sedimentology - Characterization and analysis of the sediments, in order to better understand the nature and composition of the accumulated materials, essentially due to both: natural erosion process and, very important in this case, contribution of the human activities in the watershed
- Physicochemistry - to determine in particular, the quantity of oxygen diluted in the water, REDOX, Ph., etc.
- Recommendations for the next step: Action plan for Lake Parker revitalization.

Timeframe:

- Bathymetry - June 2022
- Sedimentology - July 2022
- Recommendations - October 2022 to January 2023 (along with the analysis and interpretation of the acquired data)

Results:

- Bathymetry
  - Bathymetric chart for the lake Parker in 2022 obtained by the precise GPS based measurement: measurement grid

  - Higher resolution on the 3 most sedimentation-charged areas of the lake

- Sedimentology
  - Results of the measurement of the accumulated sedimentation thickness, in the 23 points of the lake.
  - Results of the laboratory analysis of the sedimentation samples, providing information on the nature and the composition of the accumulated sedimentation.
  - Results, of the estimation of the quantity of the accumulated sedimentation in the three most sedimentation-charged areas, *(through the combination of the sediments-thickness measurement with the results of the bathymetry).*

- Physicochemistry: the results of the measurements of the quantity of the oxygen diluted in the water, and other parameters: REDOX, Ph., etc.

- Recommendations: based on the obtained results, including in particular, the accumulations of the sedimentation exceeding 5 meters (15 feet) in many areas, and the lack of the oxygen diluted in the water deeper than 3.5 m (10 feet), the recommendations for the elaboration of the detailed action plan for revitalization have been formulated, including the analyses of pros and cons resulting from the series of the pilot projects completed in Quebec in the years 2000 – 2020.

CONTENTS

1. PROJECT SYNOPSIS

The need for the project work.

The lake Parker watershed is the head watershed of the North Missisquoi River watershed, located in the municipality of Eastman, in the MRC of Memphrémagog, a part of the territory of action of OBVBM. Lake Parker, located at 45°19'49.2"N 72°18'40.8"W, is surrounded by mainly forested and residential lands.

In the past, the forest industry used Lake Parker to float logs, leaving behind a large volume of wood chips. More recently, housing development has increased the pressure on the lake and contributed to accelerating the eutrophication process. A proliferation of invasive aquatic plants during the last twenty years has been documented.

The regional project “Restoration of Lake Parker Watershed” started in 2010 in collaboration between APLP, the Municipality of Eastman and OBVBM, with the objective to restore the lake’s “self-healing” processes, enabling the restoration of its water quality.

Currently, the corrective management actions in the watershed are being completed to address historic sources of erosion. Thus, while the sedimentation has to be stopped at the source, the preparation of the detailed action plan for the lake’s revitalisation has become the priority.

The purpose of the project:

As the planning process unavoidably requires the recent information about the state of the lake, the project providing an “Environmental portrait of the lake Parker watershed: 2022: bathymetry, sedimentology and physicochemistry” was proposed.

The project objective:

The main objective of the project was to obtain an updated and completed environmental portrait of the lake Parker in 2022 as well as obtaining the information necessary to the elaboration of a technically viable and legally acceptable action plan.

The role of partnering organizations:

The project was proposed and executed in the collaboration between

- OBVBM (**Or**ganisme du **B**asin **V**ersant de la **B**ai **M**issisquoi),
- APLP (**A**ssociation pour la **P**rotection du **B**asin **V**ersant du **L**ac **P**arker) - being a member of the OBVBM, as the association protecting the head watershed of the Missisquoi North River.
- Synergis - an expert company in the field of such a kind of environmental projects.

The action in the lake were carried out in close collaboration between Synergis and APLP teams at the personal and material levels.

Approaches and timetable

In order to obtain the updated and completed environmental portrait of the lake Parker, in the context of the accomplished studies and corrective works carried out in the frame of the regional project “Revitalization of the lake Parker watershed”, the main substantial tasks of this project were focused on;

Bathymetry: to determine, in particular, the quantity and destruction of the accumulated sedimentation on the bottom of the Lake Parker. This work was executed in June 2022.

Sedimentology: Characterization and analysis of the sediments, in order to better understand the nature and composition of the accumulated materials, essentially due to both: natural erosion process and, very important in this case, contribution of the human activities in the watershed. This work was executed in July 2022.

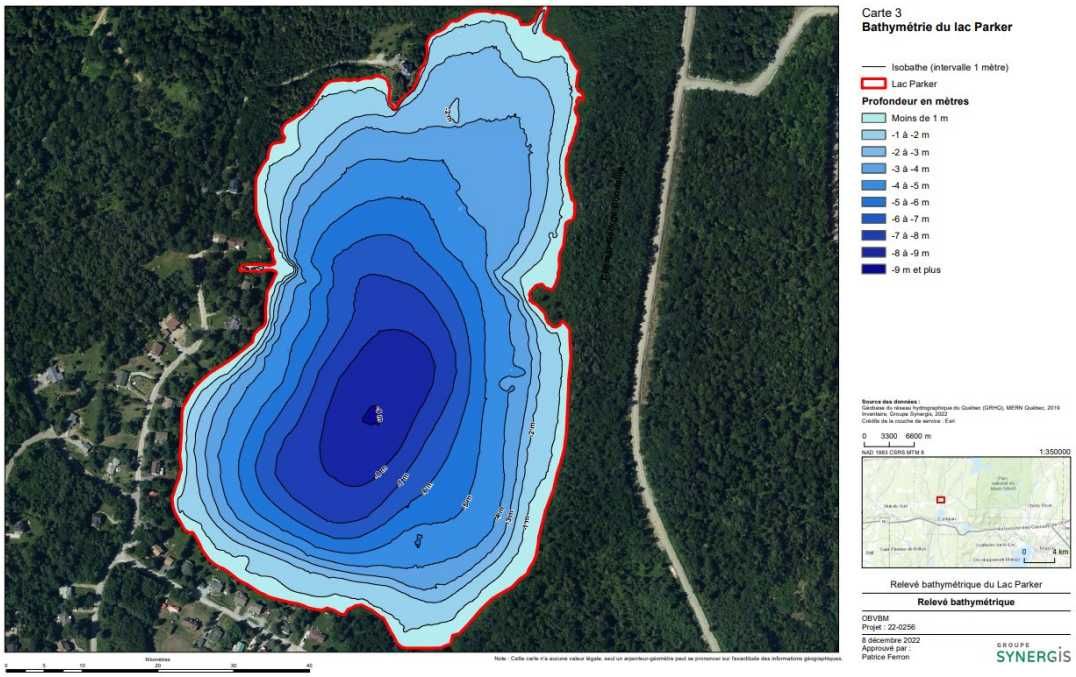
Physicochemistry: to determine, in particular, the quantity of oxygen diluted in the water, REDOX, Ph., etc. This work was executed in September 2022.

Recommendations: for the next step being the elaboration of an "Action plan for the Lake Parker revitalization", have been formulated along with the analysis and interpretation of the acquired data, in the period October 2022 to January 2023.

2. TASKS COMPLETED

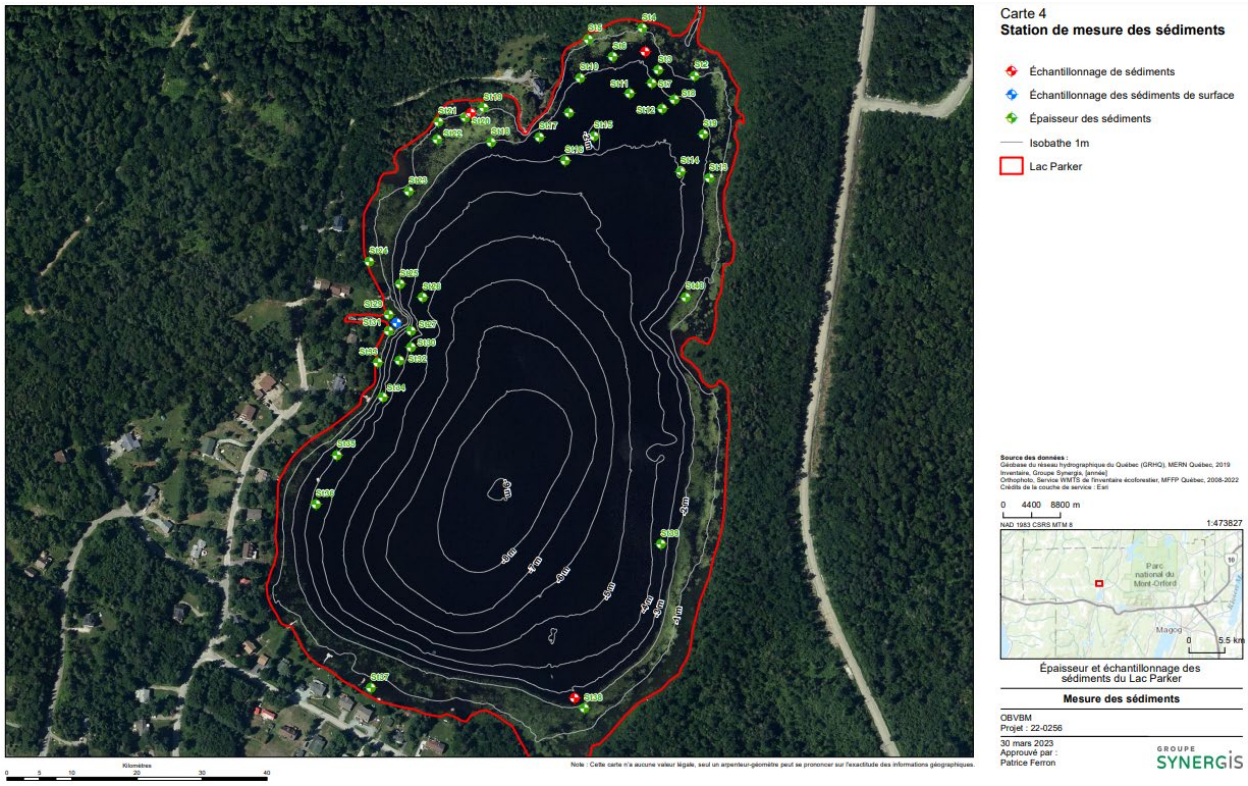
Tasks completed to achieve the goal(s) of the project, include the "project task table" and an additional task devoted to the physiochemistry, according to the excellent suggestion of the reviewers, during the work plan acceptance process, to measure also the oxygen diluted in water.

Bathymetry : the bathymetric chart of Lake Parker in 2022 has been obtained. It enables, in particular, users to see the distribution and to estimate the volume of the sedimentation accumulated on the bottom of the Lake Parker.



All the results are presented in the section 3.1 of the Chapter 3 (Results and interpretations) of the appended Synergis technical report.

Sedimentology: the thickness of the layer of the sedimentation accumulated on the bottom of the lake was measured at the representative points shown on the chart below.



The measurement results are in the table below. The table can be found at page 22 of the appended Synergis technical report.

Tableau 4. Mesures directes de l'épaisseur des sédiments lacustres à l'aide de la perche de sondage, delta du ruisseau Khartoum, lac Parker, mesures effectuées le 7 juillet 2022

Station de mesure	Mesure - surface des sédiments (m)	Mesure - perche enfoncée dans les sédiments (m)	Épaisseur des sédiments estimée (m)
ST1	nd	nd	nd
ST2	0,9	5	4,1
ST3	1,5	4,9	3,4
ST4	0,7	4	3,3
ST5	0,7	4,17	3,47
ST6	1,6	3,3	1,7
ST7	2,1	4,9	2,8
ST8	2,15	4,9	2,75
ST9	2,2	4,9	2,7
ST10	1,9	4,9	3
ST11	2,4	4,9	2,5
ST12	2,5	4,9	2,4
ST13	1,7	3,2	1,5
ST14	2,89	4,9	2,01
ST15	nd	nd	nd
ST16	3,13	4,9	1,77
ST17	2,25	4,37	2,12
Moyenne	-	-	2,63 (± 0,4) *
Écart-type	-	-	0,74
Minimum	-	-	1,5
Maximum	-	-	4,1
Nombre de mesures	-	-	15

* La précision des mesures d'épaisseur des sédiments (± 0,4 m ou 15 % d'incertitude de la moyenne) a été obtenue pour les 15 mesures à partir de l'écart-type et de la valeur *t* de Student (niveau de confiance à 95 %).

Characterization and analysis of the sediments, in order to better understand the nature and composition of the accumulated materials, essentially due to both: natural erosion process and contribution of the human activities in the watershed, which is very important in this case. This work was executed in July 2022. The picture shown below is an example of the granulometric results. The other granulometric results can be found in the section 3.2.2 (Sediment Coring Sampling Results –Thickness, nature and composition of sediments (history sedimentary) of the appended Synergis technical report.

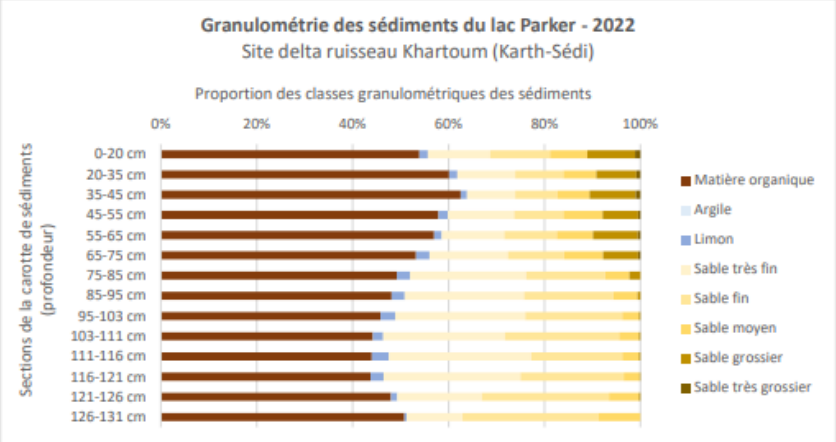
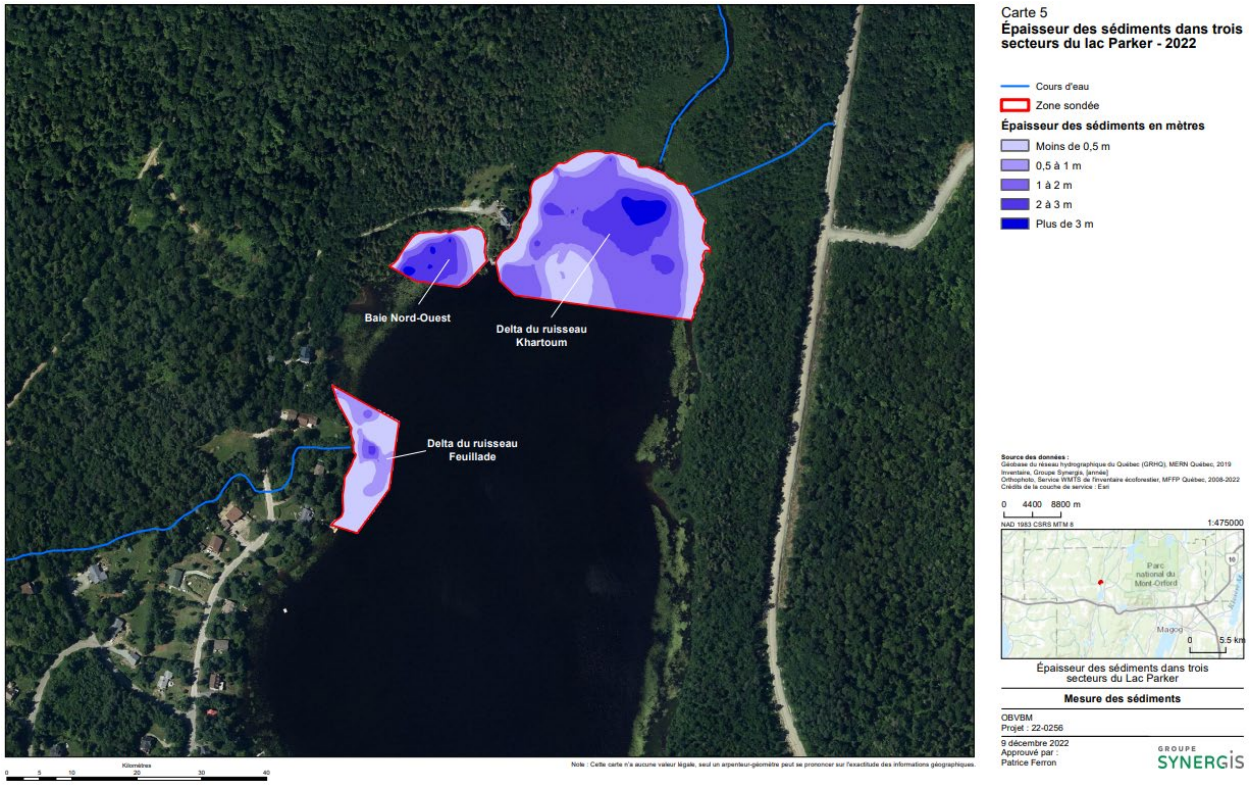


Figure 4. Granulométrie des sédiments du delta du ruisseau Khartoum au lac Parker obtenue à partir de l'analyse d'une carotte de sédiments prélevée le 7 juillet 2022

The section of the sediments sample (“the core”) still confirms the presence of the wood chips residue *(despite the actions of oxygenation by “windmills”)*

Photo 6. Section de la carotte de sédiments (coupée en deux longitudinalement) prélevée le 7 juillet 2022 dans le delta du ruisseau Khartoum, lac Parker.

The next image highlights the areas with the biggest sediment charges:



A combination of the results of the bathymetry and of the measurement of the thickness of the sediment enabled an estimation of the volume of the sedimentation accumulated on the bottom of the lake at the three areas shown above.

- At the mouth of the Kahrtoum stream it is ~ 30030m³ on the surface of 25 105 m²
- At the mouth of the North-West bay it is ~ 5935m³ on the surface of 4095 m²
- At the mouth of the Feuillade stream it is ~ 1805m³ on the surface of 5 295 m²

All the results are presented in the section 3.2 and 3.3 of the Chapter 3 (Results and interpretations) of the appended Synergis technical report.

Physicochemistry: to determine in particular, the quantity of oxygen diluted in the water, REDOX, Ph., etc. This work was executed in September 2022.

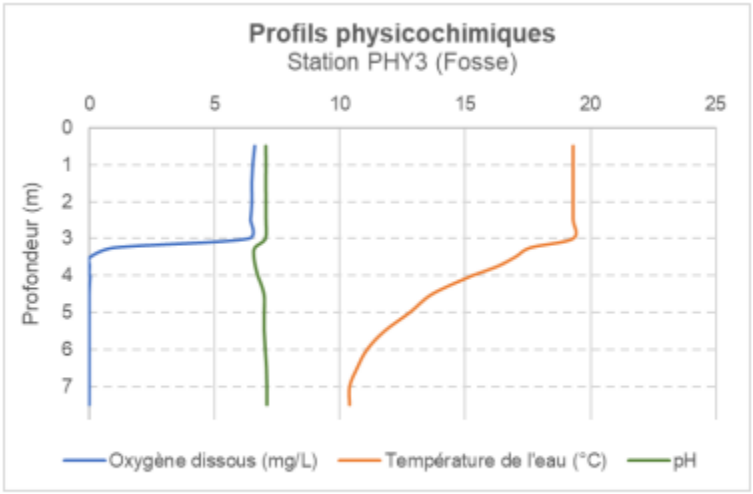


Figure 12. Profils physicochimiques (Température, Oxygène dissous et pH) au-dessus de la fosse du lac Parker, le 15 septembre 2022

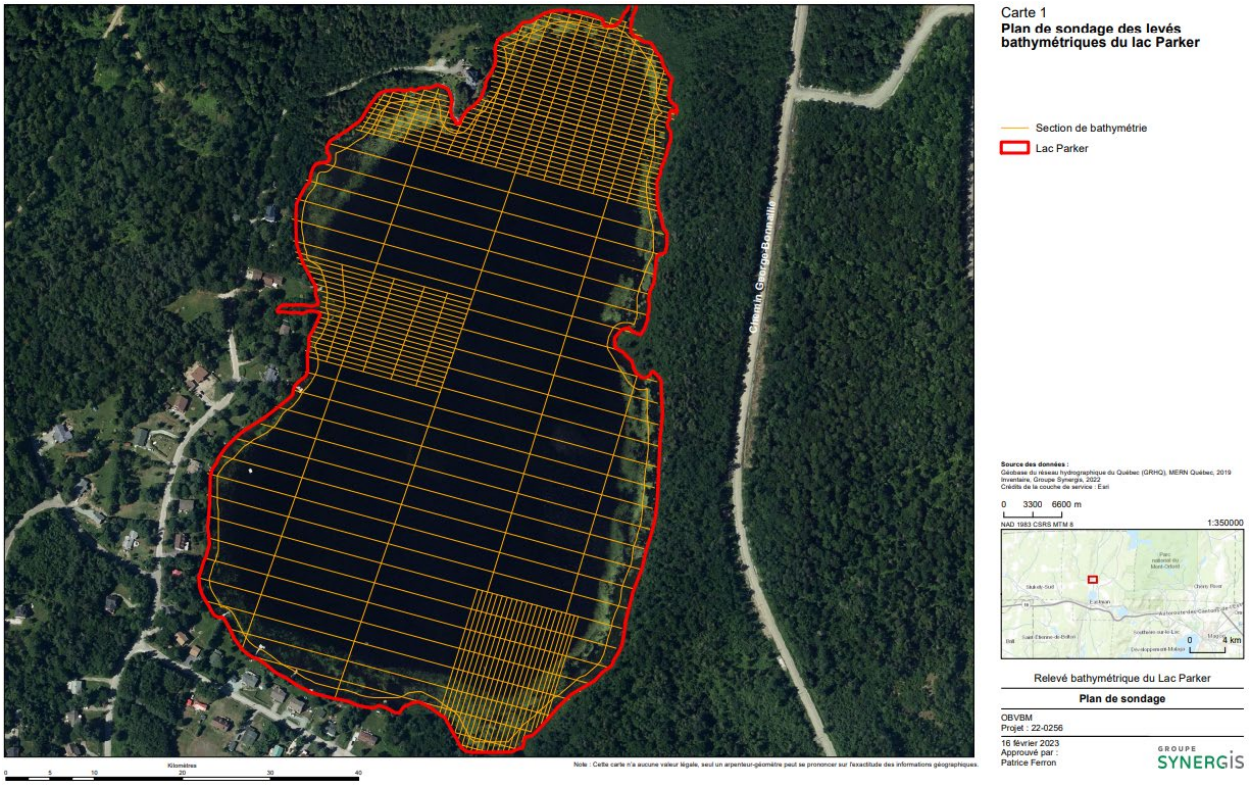
All the results are presented in the section 3.4 of the Chapter 3 (Results and interpretations) of the appended Synergis technical report.

Recommendations: for the next step being the elaboration of an “Action plan for the Lake Parker revitalization”, have been formulated along with the analysis and interpretation of the acquired data, in the period October 2022 – January 2023. The Chapter 5 (Recommendations) of the appended Synergis technical report address all the recommendations following the analysis of the field work carried out.

3. METHODOLOGY

Bathymetry

The measurement was executed using the single beam echo tracker: Odom -Teledyne, Model: Echotrack CV 1000, operated by the team members from the boat, according to the grill showed below. The details are described in the section 2. 1 of the Chapter 2 (Methodology) of the appended Synergis technical report.



Sedimentology

The following picture represents the Synergis and APLP team members on the lake Parker, on July 7 2022, to take the measurements of the thickness of the sediments layer and the samples of the sediments for analysis.

The next picture is the Synergis equipment, including the heavy sampling frame, and GPS guiding system to find the right measurement position were installed on the APLP member's solid floating platform. The taken "core" was saved for an off-line laboratory analysis within 24 hours.

Photo 4. Installation de la carotteuse à bord du ponton

Photo 5. Aperçu de la section supérieure d'une carotte de sédiments prélevée

This operation was to be carried out mainly in the delta of the Khartoum streams (20 measuring stations) and La Feuillade (14 measuring stations). Other measuring stations (6) randomly distributed on the lake also had to be measured in order to obtain references sediment thickness elsewhere in the lake. The image that follows shows the stations of planned measurements.

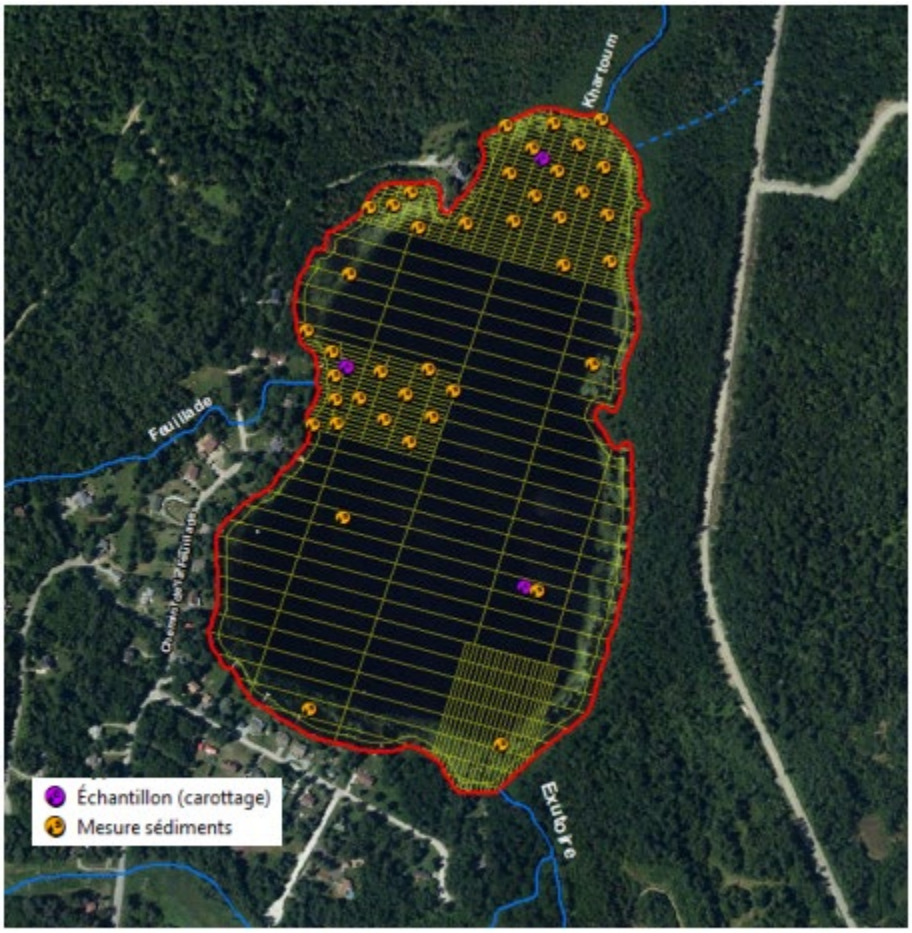


Figure 1. Répartition des stations de mesures des sédiments (mesures *in situ* et carottage)

Physicochemistry

The physicochemical measurements were performed using a YSI Pro multiparameter probe DSS fitted with a 10-meter-long cable. This probe was previously calibrated the day before field work regarding conductivity, dissolved oxygen and pH. Additionally, the probe was again calibrated at the location of the measurement at the start of the day of use for dissolved oxygen readings, to account for atmospheric pressure and the elevation of the site under study.

The picture below gives an overview of the sampling of physicochemical parameters carried out on September 15, a period during which the thermal stratification of the waters of the lake is at its maximum.

Photo 2. Mesure de la profondeur de Secchi

Photo 3. Mesures des paramètres physicochimiques à l'aide de la sonde YSI

The location of the physical chemistry stations is presented on the map below.

4. QUALITY ASSURANCE TASKS COMPLETED

Quality control measurements were performed in accordance with the QAPP that was approved on July 11th 2022. For example, the boat used for the project was washed down before and after each use to prevent the spread of invasive alien species (IAS) to Lake Parker.

5. DELIVERABLES COMPLETED

According to the work plan:

- Consultant chosen: after analysis of the service in May 2022, the work was entrusted to Groupe Synergis **http://synergis.ca/synergis/index/**. Documentation of the procurement process was provided.

- The QAPP approved in May 2022.

- Data and report, including sedimentation map, as well as the physicichemistry, were available in the preliminary report delivered by Synergis in October 2022.

- Data and report, including management recommendation are specified in the section 5.1 and 5. 2 of the Chapter 5 (Recommendations) in the appended Synergis technical report.

- Revised planning of the watershed of the Lake Parker, is addressed in the Section 5.3 of the Chapter 5 (Recommendations) of the appended Synergis technical report. It takes into account the obtained “Environmental portrait of the Lake Parker in 2022 “, and enables to start the elaboration of the defiled action plan for the lake Parker revitalization . Such a detailed action plan on the ground should, in particular :
  - Taking into account the pros and cons resulting for the revitalization of other lakes in Quebec between 2000 – 2020
  - Analyze the applicability of the existing, known method
  - Select the methods most suitable for the specificity of the lake Parker and complying with the current governmental regulations in this matter

- The final report of the project has been delivered.

6. CONCLUSIONS

The conclusion of the accomplished project included the recommendations for the next step of the regional project “Rehabilitation of the lac Parker watershed”, being the elaboration of the detailed action plan for revitalization of the lake Parker.

In particular, the formulations summarized in the Chapter 5 (Recommendations) of the appended Synergis technical report:

- Are based on the obtained results, including in particular, the accumulations of the sedimentation exceeding 5 meters (15 feet) in many areas, and the lake, and luck of the oxygen diluted in the water deeper than the 3.5 m (10 feet).
- Suggest the analysis:
  - of pros and cons resulting from the series of the pilot projects completed in Quebec in the years 2000 – 2020,
  - of the applicability of popular techniques like dredging and “phoslock’ application or the case of Lake Parker.

7. REFERENCES

Groupe Synergis. 2023. Le portrait environnemental du lac Parker en 2022 : bathymétrie, sédimentologie, physicochimie - Rapport du projet 22-0256. 72 pages + 2 annexes.

8. APPENDICES

Appended Documents:

Appendix1: Groupe Synergis. 2023. Le portrait environnemental du lac Parker en 2022 : bathymétrie,sédimentologie, physicochimie - Rapport du projet 22-0256. 72 pages + 2 annexes.

Photos:

The proper photo credit that NEIWPCC and LCBP can use for future publications is under each photo in the attached report signed by Synergis and accepted by OBVBM and APLP.

Electronic Data:

The electronic version of the attached document: “Groupe Synergis. 2023. Le portrait environnemental du lac Parker en 2022 : bathymétrie, sédimentologie, physicochimie - Rapport du projet 22-0256. 72 pages + 2 annexes ».include electronic datasets generated through your project.