GroupeHemispheres

Pinette Lake Water Regime

HML
Howse Minerals Limited

Technical Report

Our file: PR185-22-15

Your order: HPP-LD-20150604-1

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info@hemis.ca
QUÉBEC : 5731, rue Saint-Louis, suite 201, Lévis (Qc) G6V 4E2 418 903-9678
MONTRÉAL : 1453, rue Beaubien Est, suite 301, Montréal (Qc) H2G 3C6 514 509-6572
www.hemis.ca

PROJECT TEAM

GROUPE HÉMISPHÈRES

Mariana Trindade	Geographer, PhD, Director, Review and Quality Control
Daniel Néron	Geographer, M.Sc., Project Manager, Fieldwork and Drafting
Simon Barrette	Biologist, M.Sc., Fieldwork
Samuel Denault	Biologist, M.Sc., Fieldwork
Elissa Dickoum	Geomatician, M.Sc. in Earth Science and Geography, Mapping
Christian Corbeil	Professional Technologist, Reviewer

Collaborators (Howse Minerals Limited)

Loïc Didillon	Manager – Environment and permitting
Lisa Clancey	Environment Technician
Jean-François Dion	Environment Technician

Cover page photographs
Left: Gauging ruler installed in Pinette Lake
Right: Hydrometric station at the Pinette Lake outflow

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REVISION AND PUBLICATION		
Number	**Date**	**Modification or Publication Data**
00	2015-09-30	Preliminary Technical Report
01	2015-10-22	Final Technical Report

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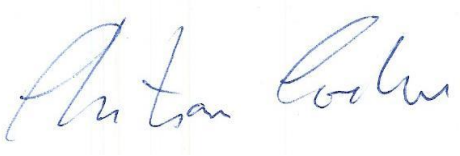
Report prepared by:

Daniel Néron, M.Sc
Geographer, Project Manager

Report revised by:

Mariana Trindade, PhD
Geographer, Project Director



Christian Corbeil,
Professionnal Technologist

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GLOSSARY

Bankfull stage

Stage at which a stream just overflows its natural banks.

Channel

The longitudinal boundary surface consisting of the bed and banks or sides within which water flows with a free surface.

Creek

Natural stream of water, normally smaller than, and often tributary to, a river.

Hydraulic radius

The ratio of the wetted area divided by the wetted perimeter.

Hydrometric station

A station in a water channel where water depth and discharge rate are measured.

Wetted area

Transversal area of a water course where flowing water is visible.

Wetted perimeter

Transversal perimeter of a water course where water flows above it.

Wetland

Area saturated with water or flooded over a sufficiently long period to influence the soil and vegetation components. More closely resembling an aquatic environment during floods and becoming almost terrestrial during droughts, wetlands are colonized by a specialized plant cover that is used as an indicator to delineate them.

1 INTRODUCTION

Howse Minerals Limited (HML) is currently studying the development of the Howse Project in Labrador, located about 25 km north-west of Schefferville, Quebec. In March 2015, Environment Canada raised concerns over the Pinette Lake water regime after the review of the first draft of the Howse EIS. Concern was based on the possible reduction of 25% of Pinette Lake's drainage basin. After optimization to reduce the effect toward this waterbody, the proposed reduction is now only 3%. The layout of the mining project is the one received in August 2015.

Additional information was therefore necessary to better portray the hydrology for Pinette Lake. The main inflow at Pinette Lake has been monitored for several years now for water quality (Groupe Hémisphères, 2014a). Since 2012, HML samples at least four times a year this tributary.

Groupe Hémisphères was mandated by HML to complete the hydrological program for the Howse Project, namely the water regime of Pinette Lake. The program was structured to identify the basic hydrological properties of this water body, enough to calculate a possible stage drawdown, in order to be able to apply for the necessary environmental certificate of authorization.

2 SITE DESCRIPTION

2.1 Physiography

The Howse Project sits on the Labrador geosyncline (or Labrador Trough), which is an arcuate belt of sedimentary, volcanic and intrusive rocks, over 1,200 km long and up to 100 km wide.

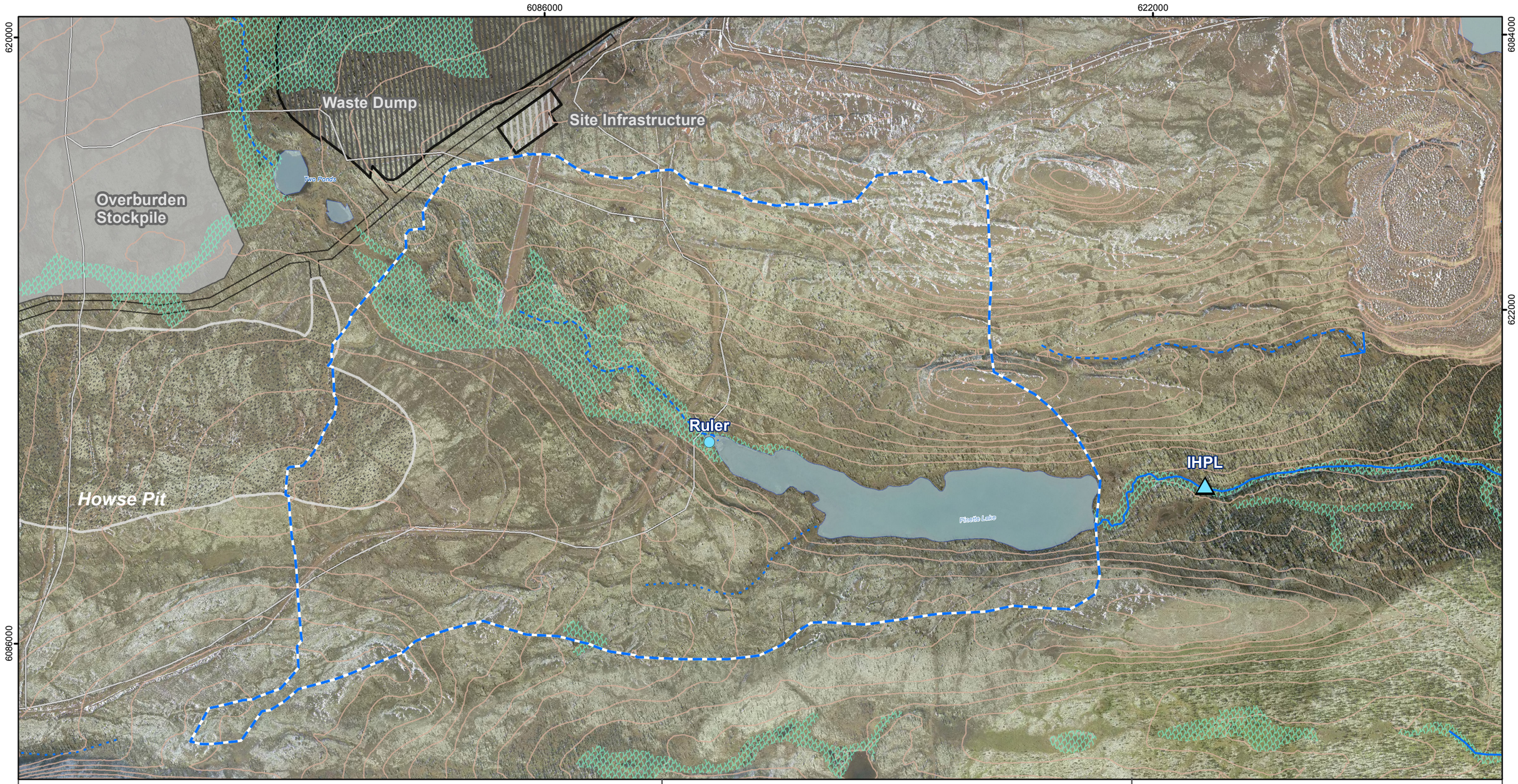
Two distinct ecoregions are present: areas below about 680 m asl are part of the Mid Subarctic Forest ecoregion dominated by forested ecosystems; and areas above 680 m asl are classified as High Subarctic Tundra ecoregions (Groupe Hémisphères, May 2010). Most of the Howse sector is located in the High Subarctic Tundra. Although punctuated by isolated bedrock outcrops, till has by far the greatest areal coverage of any landform within the area. Some streams, which tend to follow the roughly northwest-southeast oriented bedrock fractures and fold axis, exist within the Timmins sector (Groupe Hémisphères, May 2010).

2.2 Hydrography

Knowledge about the surface flow pattern in the area was updated through field observations and an interpretation of 2008 aerial photographs taken by New Millennium Limited (NML) at a scale of 1:10,000.

The Pinette Lake is a headwater lake of 15 ha fed by two tributaries. The main one is PIN1, a very small creek coming from the north and mostly intermittent over time. The second one has no name and is a torrent in the west and never observed flowing.

Pinette Lake does have an outlet, unofficially named Pinette Creek, which discharges into Elross Creek. At the outlet, his drainage basin covers 229 ha, waterbody included. Figure 1 presents the Pinette Lake Hydrology and Hydrography.



LEGEND

Survey

- Hydrometric Station
- Ruler

Infrastructure and Mining Components

- Proposed Howse Pit
- Proposed Topsoil/ Overburden Stockpile
- Proposed Site Infrastructure
- Proposed In-Pit Dump /Waste Dump

Basemap

- Permanent Watercourse
- Intermittent Watercourse
- Storm Runoff
- Disappearing Stream
- Artesian Spring
- Water Body
- Contour Line (16 ft)
- Provincial Border
- Existing Road
- Main Access Road
- Wetland
- Watershed Boundary

*Hydronyms are oriented along the direction of water flow

FILE, PROJECT, DATE, AUTHOR:
GH-0660 , PR185-22-14, 2015-10-22, edickoum

N

0 500
Meters

UTM 19N NAD 83

SCALE: 1:10 000

SOURCES:
Basemap
Government of Canada, NTDB, 1:50,000, 1979
Government of NL and Government of Quebec, Boundary used for claims
Groupe Hémisphères, Hydrology, 2013.

Infrastructure and Mining Components
New Millennium Capital Corp., Mining sites and roads
TATA Steel Minerals Canada Limited/ MET-CHEM, Howse Deposit Design for General Layout, 2013

LAKE PINETTE WATER REGIME - TECHNICAL REPORT

Pinette Lake Hydrology

Howse Minerals Limited

GroupeHemispheres
5731, rue Saint-Louis, Bureau 201, Lévis (QC) Canada, G6V 4E2
1453, rue Beaubien est, Bureau 301, Montréal (QC) Canada, H2G 3C6

Figure 1

3 METHODOLOGY

3.1 Field Program Chronology

Field logistics were managed by Groupe Hémisphères in collaboration with Loïc Didillon (HML). The first fieldwork was conducted in April 19, 2015 by Daniel Néron in order to assess the feasibility of the project.

The second field campaign was conducted in May 16 by Simon Barrette, with the help of Lisa Clancey for some installations and gauging. A third visit, conducted in June 25 by Samuel Denault, with the help of Jean-François Dion, completed the installation while allowing another gauging of the hydrometric station. The same team returned in July 15 for gauging and a first download. A second download was achieved by Jean-François Dion in August 20. At last, Simon Barrette and Samuel Denault completed the measurements needed at the outlet and at the hydrometric station in September 1.

3.2 Water Regime

To be able to estimate the drawdown of Pinette Lake from any change in the water supply, a relation stage/discharge needs to be known. To do so, stage measurements in conjunction with outflow measurements has to be repeated in order to establish the rating curve. Last, the stage/volume relationship for the lake needs to be established.

3.3 Stage Measurements and Monitoring of the Waterbody

A standard enameled gauging ruler was installed in Pinette Lake and was equipped with a hydrostatic pressure probe, brand Heron Instruments® model DipperLog. This automatic water-level data logger was programmed to take stage measurements at 15-minutes intervals. For convenience, this ruler is based near the main inflow were an access road passes nearby. One of the photographs of the cover shows the ruler. As an arbitrary reference, the invert of the nearby culvert stands at 176 cm with respect to the ruler.

3.3.1 Pressure Monitoring

An automatic air pressure data logger already installed near the mine site, a Heron Instruments® model BaroLog, was used. The barometric pressure variations are used to compensate water level readings recorded by the water level monitoring probe.

3.3.2 Water Level Monitoring

To obtain the water head (H), the raw data obtained from the probe loggers were corrected for barometric pressure variations using the following equation:

$$H = \text{Water level recorded (m)} - \text{Barometric pressure (m)} \pm \text{Altitude correction (m)} \quad (1)$$

An altitude correction was also applied to the barometric data for hydrometric stations that stand at a significantly different elevation.

3.4 Outflows Measurements

3.4.1 Hydrometric Station

The station IHPL was installed in a straight and uniform section of the stream with a D50 of 120 mm and a bankfull width and height of 1.90 m and 0.70 m respectively. This station was installed at the outlet of Pinette Lake, at a point where the velocity is appropriate for the apparatus (>0.01 m/s) and the flow is substantially laminar. The relationship between water depth and velocity was established by repeatedly

measuring the speed of the water going through the stream section under various flow conditions using a velocimeter (see next section for details).

3.4.2 Instant Flow

All flows are calculated using the relationship between the average water velocity and the wetted area, according to the following formula:

$$Q = VA \quad (2)$$

Where Q = flow (m^3/s)
V = average velocity (m/s)
A = wetted area (m^2)

The average water velocity was measured by dividing the wet area in several columns. At the center of each column, the average value was measured by slowly moving the velocimeter up and down for 20 seconds. A velocimeter brand Swoffer® model 2100 was used. The flow was obtained by multiplying the wetted area by the weighted average velocity of the water.

The flow was then measured several times in order to establish the rating curve, a relationship with the water depth. The rating curve takes the following exponential form:

$$Q = aH^b \quad (3)$$

Where Q = flow rate (m^3/s)
H = water head over the probe (m)
a and ^{b} = proportionality constants

3.4.3 Average Flood Flow

At the hydrometric station, a geodesic field survey was carried out in order to obtain a detailed cross-sectional profile of the area along with the longitudinal slope (S) of the section. On the basis of the high water mark obtained from the field observation of physical criteria, the maximum wetted area (A) and perimeter (P) was determined for a channel at least 30 m long.

The average flood flow is estimated using formula (4) and Manning's equation to estimate the velocity:

$$V = 1/n\ R^{2/3}\ S^{1/2} \quad (4)$$

Where V = velocity (m/s)
n = Manning's roughness coefficient
R = hydraulic radius (m)
S = stream gradient (m/m)

The hydraulic radius (R) is the ratio of the wetted area (A) divided by the wetted perimeter (P). Manning's roughness coefficient represents the resistances for water to flow in open flow stream channels. This value is selected by taking the local stream bed and flood plain composition into account.

3.4.4 Precipitation

Precipitation data was obtained from Environment Canada (Station no 7117823 - Schefferville A) to visualize flow fluctuations with precipitations.

3.5 Water Level Prediction

The last activity consists of fluctuating inflow and outflow lake levels iteratively. The routing model is used and takes into account the lake stage/volume and the stage/discharge relationship. Evaporation was not considered since the goal was not to reproduce a certain event but to discriminate a possible reduction of 4% of the drainage basin, and therefore will not change between scenarios. The natural flow and modified flow that enter the model come from the Water Management Plan developed by SNC-Lavalin (August 2015). Table 1 show the monthly variation of the estimated outlet flow between scenarios.

Table 1. Pinette Lake Estimated Outlet Natural (237 ha) and Modified Flow (228 ha)

MONTH	NATURAL FLOW (L/s)	MODIFIED FLOW (L/s)
Jan	0.0	0.0
Feb	0.1	0.1
Mar	0.3	0.3
Apr	4.4	4.2
May	340.1	327.9
Jun	0.0	0.0
Jul	5.5	5.3
Aug	12.3	11.9
Sep	18.4	17.7
Oct	25.1	24.2
Nov	2.4	2.3
Dec	0.1	0.1

Source: SNC-Lavalin (August 2015)

4 RESULTS AND DISCUSSIONS

4.1 Observed Water Level Variation

Figure 2 shows the water level fluctuations of Pinette Lake during the study period. Little water-level variation was observed during this period. The stage over this two month period is shown along with precipitation. Daily precipitation from the Schefferville A weather station can be found in Appendix I. Between maximum level (53 cm) and minimum level (43 cm), a difference of only 10 cm was recorded between June 25 and August 20, 2015. Even in the spring, when a gage ruler was installed on May 16, the water level was as low as 54 cm.

The water level of this water body showed a rapid increase to 53 cm on July 8 following two days of precipitation totaling 41.4 mm of rain. The same phenomena appears July 15 after 25.9 mm of rain. A gradual decline in the levels between those peaks were then observed.

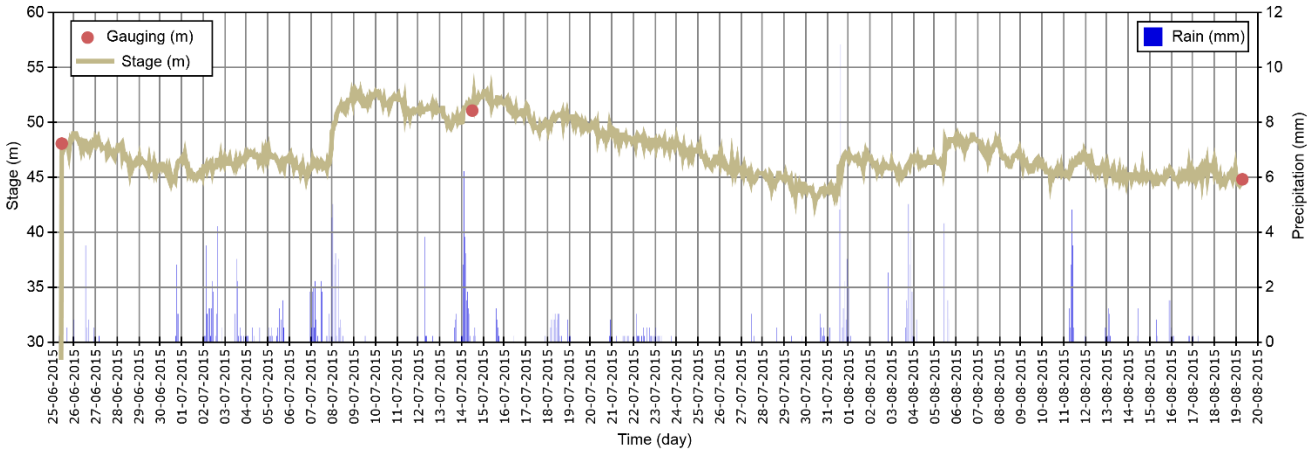


Figure 2. Water Level of Pinette Lake – June 25 to August 20, 2015

4.2 Surface Flow Measurements and Relation to Morphometry

4.2.1 Hydrometric Station IHPL

The IHPL hydrometric station was installed on May 16, 2015. Given its location and geology, the flow channel theoretically offers a good level of variation. For example, the April reconnaissance visit of this stream yielded a dry bed, and therefore a stream classification of intermittent.

Details of the cross-section surveying can be found in Figure 3. At the time of installation in May, water level were well under the high water mark (HWM). From the morphometry of the bed for the HWM condition, the wet area covers 0.730 m³ while the wet perimeter is 4.90 m, with a slope of 1.5% (measured as the difference in elevation 15 m downstream and upstream). Considering that the bed is mainly composed of cobbles and boulders, a Manning's roughness coefficient of 0.055 is associated with that channel.

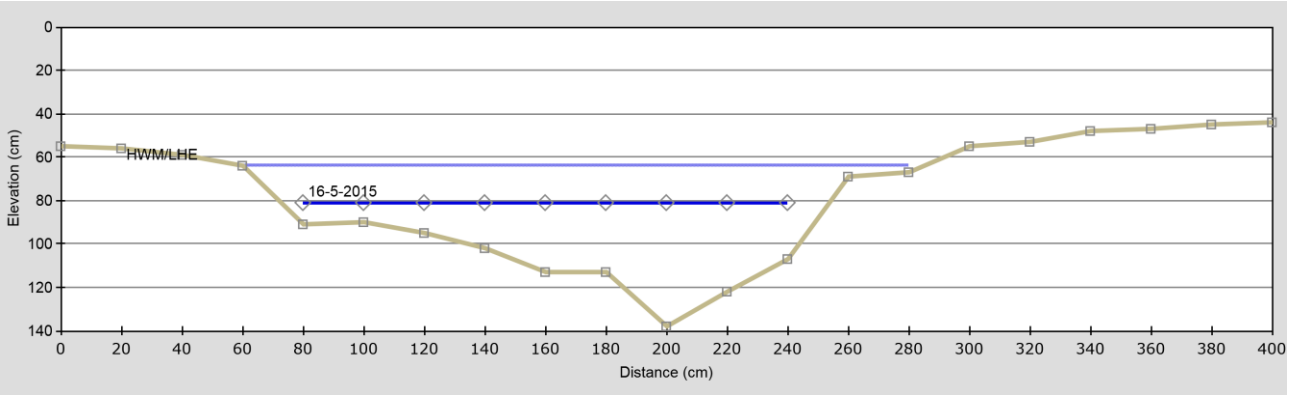
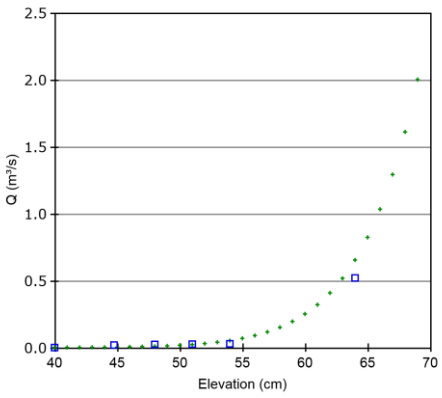


Figure 3. Cross-Section Drawing of Station IHPL

4.2.2 Stage-Discharge Relationship

The stage-discharge calibration curve was obtained from 3 gauging events in 2015 and 2 theoretical events which enable the interpolation of the outflow of Pinette Lake from any given water level. The visit in September at the outlet of the lake allows to estimate the zero discharge level at 32 cm and a normal flood level at 64 cm. At this location that largely control the lake level, the outlet is 36 m large and have a rectangular notch 0.5 m depth, 0.2 m wide.

Because of the peculiarity of spring 2015 (few precipitation and lot of sublimation), the freshet was weak and we were unable to observed and measure the flow at bankfull or normal flood. For this reason, this high flow was evaluated using the Manning's equation. Figure 4 show this relationship that have a strong goodness of fit.



Formula

$Q = 9.23782E\text{-}28\ Stage^{14.8656}$

Goodness of fit

$R^2 = 0.9881$

Figure 4. Stage-discharge relationship of Pinette Lake

4.2.3 Stage-Volume relationship

The bathymetric maps from Groupe Hémisphères (2014b) give the area of each isobath. Using the Simpson equation, the cumulative volume can be evaluated. Figure 5 shows the stage-volume relationship for Pinette Lake. It takes the form of polynomial trend line and have a strong goodness of fit.

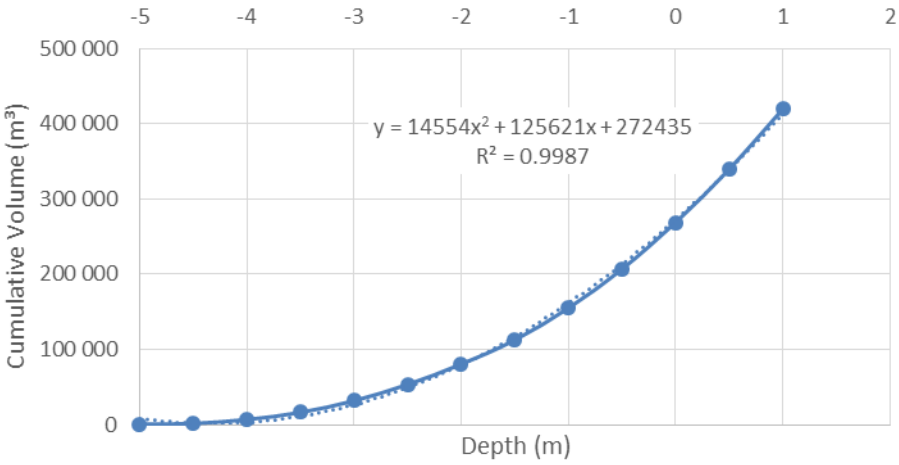


Figure 5. Stage-Volume relationship of Pinette Lake

4.3 Water Level Prediction

The use of the routing model for Pinette Lake give stage with daily variability. The starting level for the first day of January was set to 43 cm. Table 2 shows the mean water level prediction for Pinette Lake between natural and modified flow. It can be seen that the maximum expected difference between those scenarios is a 2 mm drawdown during the spring freshet.

Table 2. Mean Water Level Prediction for Pinette Lake between Natural and Modified Flow

MONTH	NATURAL STAGE (cm)	MODIFIED STAGE (cm)	EXPECTED DIFFERENCE (cm)
Jan	42.3	42.3	0.0
Feb	40.6	40.6	0.0
Mar	39.9	39.9	0.0
Apr	42.5	42.4	-0.1
May	61.3	61.1	-0.2
Jun	41.6	42.6	0.0
Jul	43.7	43.7	0.0
Aug	48.5	48.4	-0.1
Sep	50.2	50.1	-0.1
Oct	51.3	51.2	-0.1
Nov	46.1	46.0	-0.1
Dec	42.8	42.8	0.0

5 CONCLUSIONS

5.1 Observations and Calculations

In mid-May 2015, a ruler was installed on the littoral of Pinette Lake. Since that time, no more than 11 cm in level variations were noted during the three-month period of observation. A hydrostatic pressure probe installed in June subsequently possible to follow in detail the change in lake level. Although precipitation influenced the water level, it need to be substantial and for a duration of several days to do so.

The hydrometric station IHPL was setup in spring 2015 and provided the Stage-Discharge relationship. High flow was evaluated by using the Manning's formula rather than a field observation because spring climatic conditions did not lead to that occurrence. The morphometry of the outlet corroborates the exponential curve used. Nonetheless, a very strong goodness ($R^2 = 0.9881$) allow confidence on this relationship.

Relationship between the stage and the cumulative lake volume demonstrates a very strong goodness of fit using a polynomial curve ($R^2 = 0.9987$).

Together with a routing model, the expected difference between the mean natural flow and the expected modified one is a drawdown of 2 mm during May and no more than 1 mm for summer and autumn. That small difference for a lake is understandable with regard to a reduction in the size of the catchment area not exceeding 4 %.

5.2 Recommendations

The limnimetric ruler installed near a road is a simple tool that offers adequate monitoring. For reliability over time, we suggest that surveyor take ASL altitude of the zero of the ruler and also the invert of the nearby culvert.

6 REFERENCES

Database Consulted

Schefferville A weather station 2015 database. Environment Canada, Meteorological department.

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SNC-Lavalin (August 2015) *Conceptual Engineering for Howse Water Management Plan*. Preliminary Report Number: 622834-4000-40ER-0005_01, 58 p. and 4 appendices

APPENDICES

Appendix I

Meteorological Data

Government of Canada / Gouvernement du Canada

Canada

Climate

Daily Data Report for June 2015

SCHEFFERVILLE A QUEBEC					
Latitude:	54°48'19.000" N	Longitude:	66°48'19.000" W	Elevation:	520.90 m
Climate ID:	7117823	WMO ID:	71921	TC ID:	YKL

	Max Temp °C	Min Temp °C	Mean Temp °C	Heat Deg Days	Cool Deg Days	Total Rain mm	Total Snow cm	Total Precip mm	Snow on Grnd cm	Dir of Max Gust 10's deg	Spd of Max Gust km/h
DAY											
01 ‡	8.3	-1.6	3.4	14.6	0.0	M	M	1.8		24	50
02 ‡	18.0	7.0	12.5	5.5	0.0	M	M	0.0		26	39
03 ‡	19.4	8.5	14.0	4.0	0.0	M	M	0.0		26	67
04 ‡	12.9	0.7	6.8	11.2	0.0	M	M	0.3		28	54
05 ‡	11.1	-1.1	5.0	13.0	0.0	M	M	0.0		33	35
06 ‡	6.8	-0.3	3.3	14.7	0.0	M	M	1.5		32	44
07 ‡	8.9	0.4	4.7	13.3	0.0	M	M	9.8		18	35
08 ‡	19.5	6.3	12.9	5.1	0.0	M	M	0.0		23	32
09 ‡	14.8	5.5	10.2	7.8	0.0	M	M	0.3		11	35
10 ‡	12.7	7.0	9.9	8.1	0.0	M	M	5.8			<31
11 ‡	14.6	7.3	11.0	7.0	0.0	M	M	0.6			<31
12 ‡	9.3	4.9	7.1	10.9	0.0	M	M	7.8			<31
13 ‡	5.7	2.2	4.0	14.0	0.0	M	M	3.8		2	33
14 ‡	14.0	1.1	7.6	10.4	0.0	M	M	0.0		31	33
15 ‡	22.6	1.6	12.1	5.9	0.0	M	M	1.5		26	57
16 ‡	12.3	2.2	7.3	10.7	0.0	M	M	0.8		31	57
17 ‡	10.9	0.7	5.8	12.2	0.0	M	M	0.0		24	56
18 ‡	21.6	1.2	11.4	6.6	0.0	M	M	4.6		24	67
19 ‡	8.7	0.8	4.8	13.2	0.0	M	M	0.8		30	67
20 ‡	16.1	0.7	8.4	9.6	0.0	M	M	5.8		21	61
21 ‡	18.5	2.0	10.3	7.7	0.0	M	M	0.0		27	35
22 ‡	23.7	7.5	15.6	2.4	0.0	M	M	0.0		28	41
23 ‡	25.4	10.3	17.9	0.1	0.0	M	M	0.0		15	57
24 ‡	14.2	8.0	11.1	6.9	0.0	M	M	9.1		14	61
25 ‡	19.4	5.8	12.6	5.4	0.0	M	M	M		7	41
26 ‡	17.4	4.9	11.2	6.8	0.0	M	M	6.1		30	35
27 ‡	21.2	5.5	13.4	4.6	0.0	M	M	0.3		29	50
28 ‡	23.8	5.2	14.5	3.5	0.0	M	M	0.0		33	44
29 ‡	24.2	11.9	18.1	0.0	0.1	M	M	0.0		20	41
30 ‡	23.6	7.4	15.5	2.5	0.0	M	M	5.0		16	39
Sum				237.7	0.1	M	M	65.7^			
Avg	16.0	4.1	10.1								
Xtrm	25.4	-1.6								30	67S

Summary, average and extreme values are based on the data above.

Legend

- A = Accumulated
- C = Precipitation occurred, amount uncertain
- E = Estimated
- F = Accumulated and estimated
- L = Precipitation may or may not have occurred
- M = Missing
- N = Temperature missing but known to be > 0

Government of Canada / Gouvernement du Canada

Canada

Climate

Daily Data Report for July 2015

SCHEFFERVILLE A QUEBEC					
Latitude:	54°48'19.000" N	Longitude:	66°48'19.000" W	Elevation:	520.90 m
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02 ‡	14.4	10.4	12.4	5.6	0.0	M	M	18.8		9	37
03 ‡	17.8	10.0	13.9	4.1	0.0	M	M	8.1			<31
04 ‡	13.9	9.1	11.5	6.5	0.0	M	M	2.9			<31
05 ‡	15.9	10.2	13.1	4.9	0.0	M	M	6.1			<31
06 ‡	22.6	9.2	15.9	2.1	0.0	M	M	0.5		18	43
07 ‡	20.4	14.5	17.5	0.5	0.0	M	M	24.6		20	35
08 ‡	14.5	7.2	10.9	7.1	0.0	M	M	16.8		33	50
09 ‡	22.0	8.3	15.2	2.8	0.0	M	M	0.6		28	54
10 ‡	17.5	8.6	13.1	4.9	0.0	M	M	0.0			<31
11 ‡	18.6	7.8	13.2	4.8	0.0	M	M	0.3			<31
12 ‡	13.3	6.6	10.0	8.0	0.0	M	M	4.6		31	52
13 ‡	M	M	M	M	M	M	M	M		17	37
14 ‡	18.4	8.8	13.6	4.4	0.0	M	M	23.1		26	61
15 ‡	13.0	6.4	9.7	8.3	0.0	M	M	2.8		25	56
16 ‡	11.8	5.7	8.8	9.2	0.0	M	M	0.3		27	44
17 ‡	18.6	3.5	11.1	6.9	0.0	M	M	0.0		13	32
18 ‡	11.7	9.3	10.5	7.5	0.0	M	M	9.6		17	35
19 ‡	14.3	9.0	11.7	6.3	0.0	M	M	0.5		17	37
20 ‡	14.5	9.2	11.9	6.1	0.0	M	M	1.0		16	48
21 ‡	11.6	9.3	10.5	7.5	0.0	M	M	2.1		15	44
22 ‡	12.9	10.3	11.6	6.4	0.0	M	M	4.9		14	39
23 ‡	16.7	10.1	13.4	4.6	0.0	M	M	2.9			<31
24 ‡	17.4	9.2	13.3	4.7	0.0	M	M	0.0			<31
25 ‡	21.3	8.4	14.9	3.1	0.0	M	M	0.0		20	35
26 ‡	21.1	9.3	15.2	2.8	0.0	M	M	0.0		24	43
27 ‡	20.9	12.6	16.8	1.2	0.0	M	M	1.3		23	35
28 ‡	21.9	9.2	15.6	2.4	0.0	M	M	0.5			<31
29 ‡	24.2	8.6	16.4	1.6	0.0	M	M	0.3			<31
30 ‡	27.7	13.4	20.6	0.0	2.6	M	M	2.3		23	48
31 ‡	21.1	13.8	17.5	0.5	0.0	M	M	25.9		17	37
Sum				140.6^	2.6^	M	M	161.1^			
Avg	17.6^	9.1^	13.4^								
Xtrm	27.7^	3.5^								26	61

Summary, average and extreme values are based on the data above.

Legend

- A = Accumulated
- C = Precipitation occurred, amount uncertain
- E = Estimated
- F = Accumulated and estimated
- L = Precipitation may or may not have occurred
- M = Missing
- N = Temperature missing but known to be > 0

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Climate

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Daily Data Report for August 2015

SCHEFFERVILLE A QUEBEC					
Latitude:	54°48'19.000" N	**Longitude:**	66°48'19.000" W	**Elevation:**	520.90 m
Climate ID:	7117823	**WMO ID:**	71921	**TC ID:**	YKL

	Max Temp °C	Min Temp °C	Mean Temp °C	Heat Deg Days	Cool Deg Days	Total Rain mm	Total Snow cm	Total Precip mm	Snow on Grnd cm	Dir of Max Gust 10's deg	Spd of Max Gust km/h
DAY											
01 ‡	19.8	9.3	14.6	3.4	0.0	M	M	2.5		25	39
02 ‡	20.3	9.0	14.7	3.3	0.0	M	M	0.0		33	32
03 ‡	20.7	11.5	16.1	1.9	0.0	M	M	17.3		11	44
04 ‡	21.6	12.7	17.2	0.8	0.0	M	M	3.0		14	35
05 ‡	20.5	9.5	15.0	3.0	0.0	M	M	9.6		18	37
06 ‡	14.1	9.0	11.6	6.4	0.0	M	M	0.0			<31
07 ‡	15.3	6.4	10.9	7.1	0.0	M	M	0.0		3	37
08 ‡	21.5	6.2	13.9	4.1	0.0	M	M	0.0		30	41
09 ‡	22.9	6.8	14.9	3.1	0.0	M	M	0.0			<31
10 ‡	24.2	10.1	17.2	0.8	0.0	M	M	0.0			<31
11 ‡	18.1	10.1	14.1	3.9	0.0	M	M	13.3			<31
12 ‡	12.3	8.1	10.2	7.8	0.0	M	M	0.3			<31
13 ‡	16.8	10.9	13.9	4.1	0.0	M	M	3.8		14	32
14 ‡	18.6	12.5	15.6	2.4	0.0	M	M	1.5		21	37
15 ‡	17.4	12.3	14.9	3.1	0.0	M	M	4.0		31	37
16 ‡	17.4	11.6	14.5	3.5	0.0	M	M	4.5		34	35
17 ‡	23.2	6.9	15.1	2.9	0.0	M	M	0.6		24	89
18 ‡	17.6	6.2	11.9	6.1	0.0	M	M	0.0		29	37
19 ‡	20.3	6.5	13.4	4.6	0.0	M	M	0.0			<31
20 ‡	24.0	11.5	17.8	0.2	0.0	M	M	12.6		21	46
21 ‡	22.8	12.9	17.9	0.1	0.0	M	M	0.0		25	61
22 ‡	19.1	11.1	15.1	2.9	0.0	M	M	3.5		25	43
23 ‡	22.1	11.9	17.0	1.0	0.0	M	M	0.0		29	37
24 ‡	25.1	12.8	19.0	0.0	1.0	M	M	0.0			<31
25 ‡	25.3	13.8	19.6	0.0	1.6	M	M	M		15	33
26 ‡	21.9	13.9	17.9	0.1	0.0	M	M	7.3		20	43
27 ‡	19.4	8.5	14.0	4.0	0.0	M	M	3.5		23	35
28 ‡	17.9	6.7	12.3	5.7	0.0	M	M	2.6		23	59
29 ‡	12.8	5.6	9.2	8.8	0.0	M	M	0.5		25	32
30 ‡	13.1	6.0	9.6	8.4	0.0	M	M	2.3			<31
31 ‡	11.3	2.1	6.7	11.3	0.0	M	M	0.0		6	39
Sum				114.8	2.6	M	M	92.7^			
Avg	19.3	9.4	14.4								
Xtrm	25.3	2.1								24	89

Summary, average and extreme values are based on the data above.

Legend

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- F = Accumulated and estimated
- L = Precipitation may or may not have occurred
- M = Missing
- N = Temperature missing but known to be > 0

- S = More than one occurrence
- T = Trace
- Y = Temperature missing but known to be < 0
- [empty] = No data available
- ^ = The value displayed is based on incomplete data
- † = Data for this day has undergone only preliminary quality checking
- ‡ = Partner data that is not subject to review by the National Climate Archives

Date modified: 2015-02-11