Hydraulic Operations Department, Manitoba Hydro
On behalf of: **Wuskwatim Power Limited Partnership**

WATER POWER ACT & ENVIRONMENT ACT LICENCES 2015 ANNUAL WATER LEVELS REPORT FOR WUSKWATIM GENERATING STATION

Original signed by: Mario Duenas

2016 05 30

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W.V. PENNER

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EXECUTIVE SUMMARY

Manitoba Hydro operates the Wuskwatim GS on behalf of Wuskwatim Power Limited Partnership in accordance with the Water Power Act and Environment Act licences issued by the Province of Manitoba. These licences constrain the water level on Wuskwatim Lake, and the rate of change in water level on Birch Tree Lake.

Environment Act Licence No. 2699 for Wuskwatim GS requires an annual water level report for each calendar year. This report addresses all water level constraints imposed by both the Water Power Act and Environment Act licences. The report contains information on data collection, validation, and reporting, as well as a summary of licence limit exceedances during the year.

The monthly reports recorded five Wuskwatim Lake and ten Birch Tree Lake licence limit exceedances during 2015. Investigation into these events concluded that two of the Birch Tree Lake events were not attributable to Wuskwatim operations. The reasons for the occurrence of these events were explained in Section 5.3 and Appendix I.

In summary, water levels deviated outside the licence limits as follows.

Location	Constraint	Variable	Total Number of Exceedances	Total Number of Readings	% Compliance
Wuskwatim Lake	Max Elevation	Mean Daily Water Level	5	365	99.63 %
Wuskwatim Lake	Max Elevation	Hourly Water Level	0	8760	100 %
Birch Tree Lake	Water Level Variation	Mean Daily Water Level	8	365	97.81 %

Refinements to operations continue to reduce the number of future licence limit exceedances on Wuskwatim and Birch Tree lakes.

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APPENDICES

1.0 INTRODUCTION

1.1 Background

Wuskwatim Power Limited Partnership (WPLP) is a legal entity involving Nisichawayasihk Cree Nation (NCN) and Manitoba Hydro, which developed and now owns the Wuskwatim Generating Station (GS). Manitoba Hydro operates the station as part of the Manitoba power grid on behalf of WPLP.

WPLP received licences under *The Water Power Act* and *The Environment Act* for the development of the Wuskwatim GS. The Interim Water Power Act licence stipulates a maximum and minimum allowable water level on Wuskwatim Lake. Environment Act Licence No. 2699 stipulates a maximum and minimum water level on Wuskwatim Lake, a maximum daily change in water level on Birch Tree Lake, as well as monthly and annual reporting requirements. This report fulfills the annual reporting requirement of Environment Act Licence No. 2699.

Manitoba Hydro prepared the Wuskwatim GS Licence Implementation Guide for Water Levels to establish and document the water regime terms specified by the Wuskwatim licences. The guide was reviewed and approved by the Province of Manitoba. The Licence Implementation Guide forms the basis for content of this report, is included as Appendix II, and provides the following details:

- calculation methodology to be used for determining critical levels,
- protocol for reporting to meet licence requirements, and
- manner in which compliance will be defined and assessed

1.2 Objective

The objective of this report is to report on Wuskwatim GS licence compliance by summarizing the Water Power Act and Environment Act licence requirements and providing the relevant water level data for the 2015 reporting period. In the case of any licence limit exceedance, this report provides the reason for the exceedance, actions taken to prevent such an event from occurring in the future, and proof of regulator notification.

1.3 Outline

Section 1.0 contains the introduction to the report, including background information on licence and reporting requirements, objective and outline of the report. Following the introduction is section 2.0, which provides the Wuskwatim GS project location and description. Section 3.0 summarizes the water level data collection process including data transfer, storage and validation. Section 4.0 includes information about data sources, definition of compliance, and compliance reporting. Section 5.0 describes the data analysis used to prepare this report, includes a summary table of deviations from licence constraints during the 2015 calendar year, and provides reasons for any licence deviations. Section 6.0 summarizes major system upgrades or changes during the 2015 calendar year, and finally Section 7.0 provides conclusions and closure to the report.

Appendix I provides copies of relevant correspondence with Manitoba Conservation and Water Stewardship related to licence limit exceedances. Appendix II contains a copy of the Licence Implementation Guide, which contains all required background information related to the definitions of compliance and compliance reporting.

The enclosed CD contains final water level data for Wuskwatim Lake and Birch Tree Lake used in the preparation of this report.

2.0 WUSKWATIM GENERATING STATION

2.1 Project Location

The Wuskwatim Generating Station is located on the Burntwood River, in the Nelson House Resource Management Area, approximately 56 km southwest of Thompson, 35 km southeast of Nelson House, or approximately 830 km north by road from Winnipeg. The geographical location of the station is shown in Figure 1. A photograph of the station is shown in Figure 2. A general arrangement of the site is shown in Figure 3.

2.2 Project Description

The Wuskwatim Generating Station consists of a 3-unit powerhouse with a nameplate capacity of 209 MW, gravity dams and embankment structures, and a 3-bay spillway with heated gates. Tables 1 and 2 summarize the operating parameters and construction specifications of the Wuskwatim Generating Station.

Table 1: Construction Specifications and Operating Parameters of the Wuskwatim Generating Station

Construction Period	2006 to 2012
Licensed Capacity	210 MW
2015 Generation	1,374 million kW-h
Waterfall Drop (head)	21.4 m
Maximum Licence Forebay Elevation	234.0 m
Minimum Licence Forebay Elevation	233.75 m

Table 2: Principal Structures for the Wuskwatim Generating Station

Powerhouse	Number of Units	3
	Length	75 m
	Discharge Capacity (at full gate)	1,100 m^3/s
	Power Production	3 units @ 69.7 MW/unit TOTAL = 209 MW
Spillway	Number of Bays	3

	Total Length	43.0 m
	Discharge Capacity (Wuskwatim L. @ 234.0 m)	2,310 m^3/s
Dams	Material	Impervious fill and granular fill
	Crest Elevation	236.69 – 237.80 m

The reservoir at Wuskwatim Generating Station has a total area of 88.41 km^2 and a fetch length of approximately 1.88 km. There is typically a 0.1 m drop between the reservoir level on Wuskwatim Lake and the forebay level of the station. The reservoir normal maximum water level is 234.0 m while the forebay normal maximum water level is 233.9 m. The incremental flooded area due to the project is 0.37 sq. km allowing the majority of the reservoir and forebay to be contained by natural river banks and minimizing the need for dykes.

Inflow to Wuskwatim is largely dependent on the Churchill River Diversion, as controlled by the Notigi Control Structure. The generating station operates in a daily cycling mode within the allowed 0.25 m water level range on Wuskwatim Lake.

The operators and maintenance personnel of the Wuskwatim Generating Station are located on site. Support and technical services are also located in the nearby city of Thompson.

3.0 DATA COLLECTION

3.1 Water Level Gauges

Beginning in February 2015, Hydraulic Operations staff compiled data from three remote water level gauges located on Wuskwatim Lake, and two remote water level gauges located on Birch Tree Lake to evaluate licence compliance. The number of Wuskwatim Lake gauges was reduced from five to three and Birch Tree Lake gauges from four to two. Approval from Manitoba Conservation and Water Stewardship to reduce the number of gauges to the minimum required by Environment Act Licence No. 2699 is included in Appendix I. The locations of the water level gauges as well as the gauge description sheets are contained in the Licence Implementation Guide appendices. Manitoba Hydro uses the recorded water level data to measure compliance with the licence conditions as they apply to hourly and mean daily water levels (with wind and wave effects eliminated) on Wuskwatim Lake, and daily average water level changes on Birch Tree Lake.

3.2 Data Transmission and Storage

Manitoba Hydro remote gauges on Wuskwatim and Birch Tree lakes use pressure transducers and data loggers to record, store and transmit water level data to satellites operated by the National Oceanic and Atmospheric Administration (NOAA). Manitoba Hydro retrieves the data from internet data sources offered by NOAA and United States Geological Survey as well as directly from the loggers during a site visit. In all cases, Manitoba Hydro uses the OpenDCS Toolkit, an auto-collection

software that decodes and sends the data to two databases: HyDams and HyTime that are accessible to interested parties within Manitoba Hydro.

Water level data is collected and published according to the procedures and Quality Control Assurance processes established by Water Survey of Canada. Near real-time data is available but it is not recognized as official. Final data, or published data is generated through several levels of reviews to verify compliance with applicable standards and includes recognition of the impact of other related environmental and contextual factors.

Figure 4 shows the data transmission and storage process for remote gauge water level data used in the preparation of this report.

4.0 WATER POWER ACT AND ENVIRONMENT ACT DATA REPORTING

4.1 Monitoring & Reporting Process

As required by Clause 33 of Environment Act Licence No. 2699, an annual water level report for each calendar year, must be provided to Manitoba Sustainable Development. This report uses final data only from the required water level gauges based on three levels of internal review. The annual report also contains any compliance reports issued in the 2015 reporting period. Due to the quality assurance processing time, this report is issued by June 1 of the following year.

4.2 Data Sources

The water level data used in preparing this report was obtained from the Manitoba Hydro hydrometric database which contains water level data of various time steps including real-time (5-minute interval), hourly, daily average and mean daily (with wind and wave effects eliminated) data. Hourly water level and flow data from Wuskwatim can be used in determining the operational impact of the project on Birch Tree Lake in case the Birch Tree Lake daily change in water level exceeds the licence limit.

4.3 Compliance

Section 4.2 of the Wuskwatim Interim Water Power Act licence states that:

> *The Licensee shall not raise the headwaters of its development above an elevation of 234.0 metres ASL as measured on Wuskwatim Lake, except as ordered by the Minister under Clause 72(b) of the Water Power Regulation or as fixed by the Minister under Clause 72(c) of the Water Power Regulation.*

Clause 30(a) of Environment Act Licence No. 2699 states that the Licensee shall operate the Development within the following parameters:

Maintain the mean daily water level on Wuskwatim Lake (wind and wave effects eliminated) between 233.75 meters and 234.0 meters Above Sea Level (ASL), as determined by measurements from a minimum of three water level monitoring stations on Wuskwatim Lake.

Clause 30(b) of Environment Act Licence No. 2699 states that the Licensee shall operate the Development within the following parameters:

Maintain mean daily water levels on Birch Tree Lake such that the daily water level variations shall be less than 0.10 meters and 0.15 meters in open water and winter conditions (wind and wave effects eliminated) respectively. Any exceptions to these fluctuations shall be reported within one week to Manitoba Water Stewardship.

4.4 Compliance Reporting

Compliance for Wuskwatim GS has been defined, and agreed upon with Manitoba Sustainable Development using the maximum and minimum water level limits stated by the Water Power Act and Environment Act licences. More precisely the Wuskwatim Lake water level shall be in compliance with the upper limit defined by both licences if:

1. The Wuskwatim Mean Daily Water Level (with wind and wave effects eliminated) does not exceed 234.0 meters, and
2. The Wuskwatim Hourly Water Level does not exceed 234.1 meters more than two times for two consecutive hours each time in any 24 hour period.

Furthermore, the Wuskwatim Lake water level is in compliance with the lower limit defined by both licences if:

1. The Wuskwatim Mean Daily Water Level (with wind and wave effects eliminated) does not recede below 233.75 meters, and
2. The Wuskwatim Hourly Water Level does not recede below 233.65 meters more than two times for two consecutive hours each time in any 24 hour period.

For the purpose of licence compliance at Birch Tree Lake, open water will refer to the period from May 1 to October 31 and winter will refer to the period from November 1 to April 30. The Birch Tree Lake Daily Change in water level is in compliance when:

1. The Birch Tree Lake Daily Change is below these seasonal limits, or
2. The Birch Tree Lake Daily Change is above these seasonal limits but the change attributable to Wuskwatim Generating Station is below these seasonal limits.

In the event that the Wuskwatim Lake or Birch Tree Lake water levels are not in compliance with the licence limits as described above, notification will be made to Manitoba Sustainable Development within one week of the incident. A follow up

compliance report on causes contributing to the event and changes to operations, if any will also be provided.

WPLP publishes monthly and annual compliance reports on its web site at www.wuskwatim.ca.

5.0 SUMMARY OF FINDINGS

5.1 Data Analysis

Water level data was analyzed to prepare charts outlining water conditions at Wuskwatim Lake and Birch Tree Lake during the 2015 reporting period. All readings were evaluated against licence limits to identify violations based on the definition of licence compliance given in Section 4.4.

Wuskwatim Lake Hourly Water Level, Wuskwatim Lake Mean Daily Water Level, and Birch Tree Lake Daily Water Level Change is shown in Figure 5, 6, and 7 respectively, for the 2015 reporting period.

5.2 Licence Exceedances

During the 2015 reporting period, there were 15 recorded instances of water levels outside of the licence limits. The maximum number of possible instances was calculated as the sum of instances pertaining to each licence constraint and was based on the station operating from January 1 to December 31. Each licence constraint yields the following number of possible instances:

- Maximum/Minimum Mean Daily Water Level on Wuskwatim Lake – 365 days of possible instances,
- Maximum/Minimum Hourly Water Level on Wuskwatim Lake – 365 days * 24 hours = 8760 possible instances, and
- Maximum Daily Water Level Change on Birch Tree Lake – 365 days

Table 3 shows a breakdown of licence limit exceedances for Wuskwatim Lake and Birch Tree Lake for the 2015 reporting period. The Hydraulic Operations Department investigated the incidents to determine the reasons for their occurrence. Copies of correspondence notifying Manitoba Conservation and Water Stewardship of these events are included in Appendix I of this report.

Table 3: Wuskwatim Generating Station, Water Power Act and Environment Act Licences: Summary of Events for the reporting period of 2015

Date	Location	Constraint	Variable
January 24-28,2015	Wuskwatim Lake	Max Elevation	Mean Daily Water Level
May 4,6 & 8, 2015	Birch Tree Lake	Water Level Variation	Mean Daily Water Level
June 5 & 6, 2015	Birch Tree Lake	Water Level Variation	Mean Daily Water Level
June 27, 2015	Birch Tree Lake	Water Level Variation	Mean Daily Water Level
July 29, 2015*	Birch Tree Lake	Water Level Variation	Mean Daily Water Level
July 31, 2015	Birch Tree Lake	Water Level Variation	Mean Daily Water Level
September 30, 2015	Birch Tree Lake	Water Level Variation	Mean Daily Water Level
November 20, 2015*	Birch Tree Lake	Water Level Variation	Mean Daily Water Level

**exceedance not attributable to Wuskwatim operation*

5.3 Licence Exceedances Explanation

The table below provides brief explanation of the exceedances at Wuskwatim and Birch Tree lakes. These are further explained in detail in the correspondences included in Appendix I.

Table 4: Summary of Events and Explanation for the reporting period of 2015

Date	Location	Constraint	Explanation
January 24-28,2015	Wuskwatim Lake	Max Elevation	Ice restriction at the outlet of Wuskwatim Lake
May 4,6 & 8, 2015	Birch Tree Lake	Water Level Variation	Multi-day maintenance outages
June 5 & 6, 2015	Birch Tree Lake	Water Level Variation	Maintenance outage of Unit 1
June 27, 2015	Birch Tree Lake	Water Level Variation	Change in cycling due to declining inflows from upstream of Wuskwatim Lake
July 29, 2015*	Birch Tree Lake	Water Level Variation	Increased local inflow due to rainfall event
July 31, 2015	Birch Tree Lake	Water Level Variation	Change in cycling due to increased local inflow from rainfall event
September 30, 2015	Birch Tree Lake	Water Level Variation	Change in cycling due to declining inflows from upstream of Wuskwatim Lake
November 20, 2015*	Birch Tree Lake	Water Level Variation	Ice restriction at Manasan Ice Control Structure and wind event

**exceedance not attributable to Wuskwatim operation*

Manitoba Hydro continues to investigate refinements of the operations to reduce the number of future licence limit exceedances on Wuskwatim and Birch Tree Lakes.

6.0 MAJOR SYSTEM UPGRADES/CHANGES

Maintenance and construction activities that occurred during the 2015 calendar year include:

- No major events to report

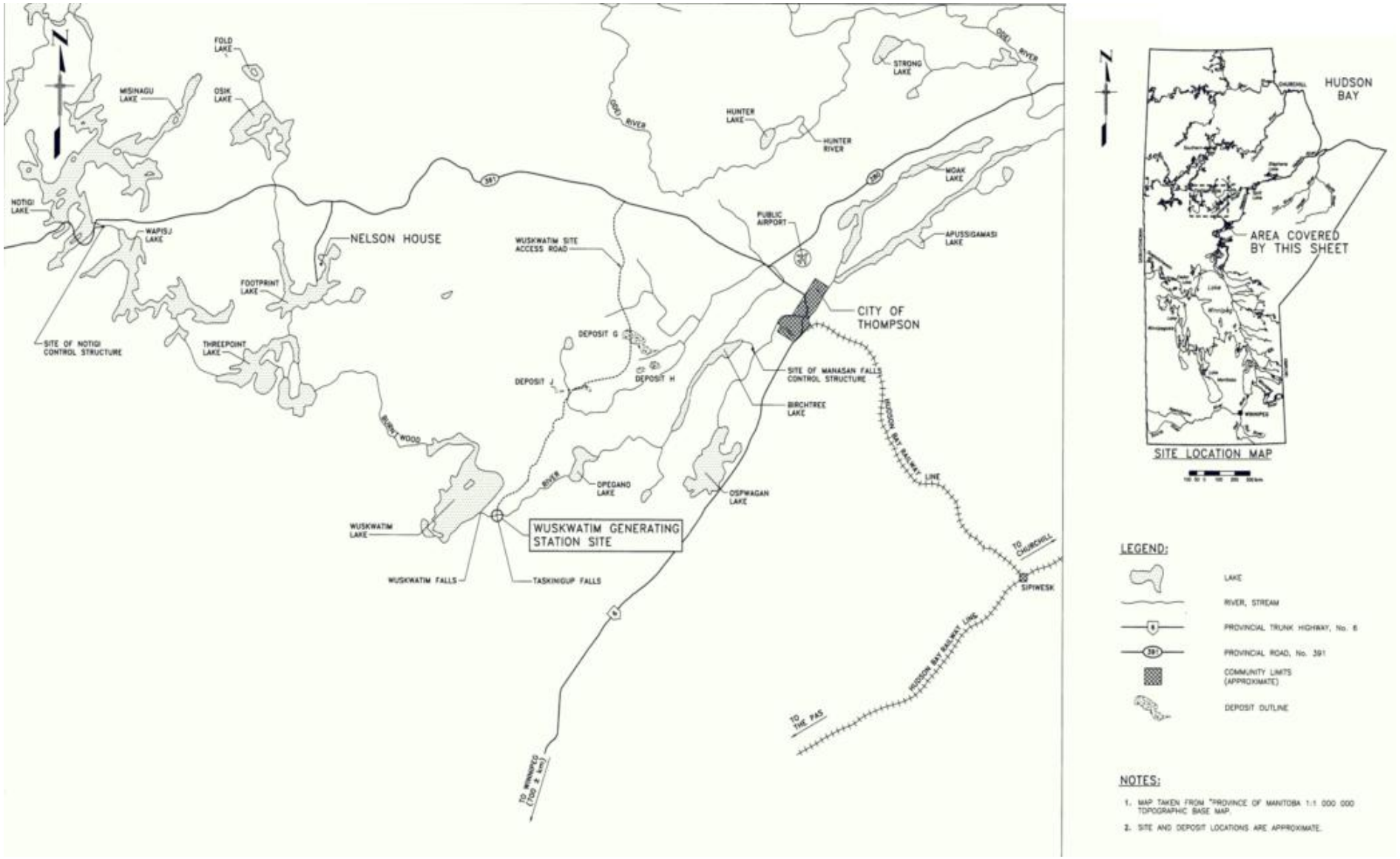
7.0 CONCLUSIONS & CLOSURE

During the January 1 to December 31, 2015 reporting period, there were 15 events when water levels deviated from the Water Power Act and Environment Act licence limits. Water levels were in compliance with the licences as follows:

Location	Constraint	Variable	Total Number of Exceedances	Total Number of Readings	% Compliance
Wuskwatim Lake	Max Elevation	Mean Daily Water Level	5	365	98.63 %
Wuskwatim Lake	Max Elevation	Hourly Water Level	0	8760	100 %
Birch Tree Lake	Water Level Variation	Mean Daily Water Level	8	365	97.81 %

Refinements to operations continue to reduce the number of future licence limit exceedances on Wuskwatim and Birch Tree lakes.

Manitoba Hydro continues to operate the Wuskwatim Generating Station in accordance with the Interim Licence under the Water Power Act for the development of water power at the Wuskwatim Site on the Burntwood River and Environment Act Licence No. 2699.



Manitoba Hydro	MANITOBA HYDRO	
	HYDRAULIC OPERATIONS DEPARTMENT	
	WUSKWATIM GENERATING STATION	
DRAWN BY	LOCATION MAP	
YEAR 2016	PROJECT ANNUAL WATER LEVEL REPORT	FIGURE 1

Manitoba Hydro	MANITOBA HYDRO	
	HYDRAULIC OPERATIONS DEPARTMENT	
	WUSKWATIM GENERATING STATION	
DRAWN BY MJD	PHOTOGRAPH OF GENERATING STATION	
YEAR 2016	PROJECT ANNUAL WATER LEVEL REPORT	FIGURE 2

E SIZE – 671 x 952

SHT.	REV.
0001	02

1-00184-DE-07311-0003

SHT.	REV.
0001	02

1-00184-DE-07311-0003

LEGEND:

- GROUND SURFACE CONTOUR (SEE NOTE 5)
- SHORELINE (SEE NOTE 6)
- COORDINATE GRID MARKER (LOCATED AT 250 METRE INTERVALS)
- TUBULAR TRANSMISSION LINE TOWER
- SQUARE TRANSMISSION LINE TOWER

N

31 750 E

32 000 E

32 250 E

32 500 E

154 750 N

154 500 N

EXCAVATED MATERIALS PLACEMENT AREA

ACCESS ROAD

NORTH DIKE

EL 236.6

FULL SUPPLY LEVEL
EL. 234.0

MAXIMUM FLOOD LEVEL
EL. 235.5

SPILLWAY APPROACH CHANNEL

WALL B

SPILLWAY

WALL C

NON-OVERFLOW DAM

STAGE I UPSTREAM COFFERDAM (REMNANT)

FOREBAY

BEDROCK SURFACE

ACCESS RAMP

INTAKE CHANNEL

SERVICE BAY

WALL F

PARKING LOT
EL. 224.5

SPILLWAY DISCHARGE CHANNEL

STAGE II UPSTREAM COFFERDAM

WALL A

EL 229.3

BEDROCK SURFACE

WALL E

EL 230.0

EL 230.6

EL 224.5

SOUTH TRANSITION STRUCTURE

WALL D

TAILRACE CHANNEL

AXIS OF PRINCIPAL STRUCTURES

INTAKE & POWERHOUSE

MAIN DAM

BURNTWOOD RIVER
FLOW

TAILWATER LEVELS PRE-KEPUCHE

MAXIMUM (PMF)	217.80
NORMAL (WINTER)	213.20
NORMAL (SUMMER)	212.60
MINIMUM (1 UNIT)	209.80

SCALE 1:1000

20 0 20 40 60 80 100 METRES

NOTES:

1. COORDINATE AND ELEVATION VALUES SHOWN ARE IN METRES.
2. COORDINATES SHOWN ON THIS DRAWING ARE BASED ON MANITOBA HYDRO WUSKWATIM G. S. REVISED STATION GRID.
3. ELEVATIONS ARE BASED ON CANADIAN GOVERNMENT VERTICAL DATUM 1928 (GEODETIC SURVEY OF CANADA DATUM QUADRANGLE SHEET No. 55098, REVISION 3, MARCH 1971. ALSO REFERRED TO BY MANITOBA HYDRO AS GEODETIC SURVEY OF CANADA DATUM 1969 LOCAL ADJUSTMENT).
4. TOPOGRAPHY AND SURFACE FEATURES SHOWN WERE TABLE DIGITIZED FROM THE ORIGINAL MYLAR PLANS DRAWING NUMBER 07062-E-00008, WHICH WAS PRODUCED USING PHOTOGRAMMETRIC METHODS BASED ON 1:10,000 SCALE PHOTOGRAPHY DATED JUNE 16, 1986. SEE REFERENCE DRAWINGS BELOW.
5. LOCATIONS OF FOREBAY OUTLINE AND TAILWATER LEVEL BASED ON TOPOGRAPHY AND ARE APPROXIMATE.

FOR MICROFILM USE ONLY

Manitoba Hydro

MANITOBA HYDRO

HYDRAULIC OPERATIONS DEPARTMENT

WUSKWATIM GENERATING STATION

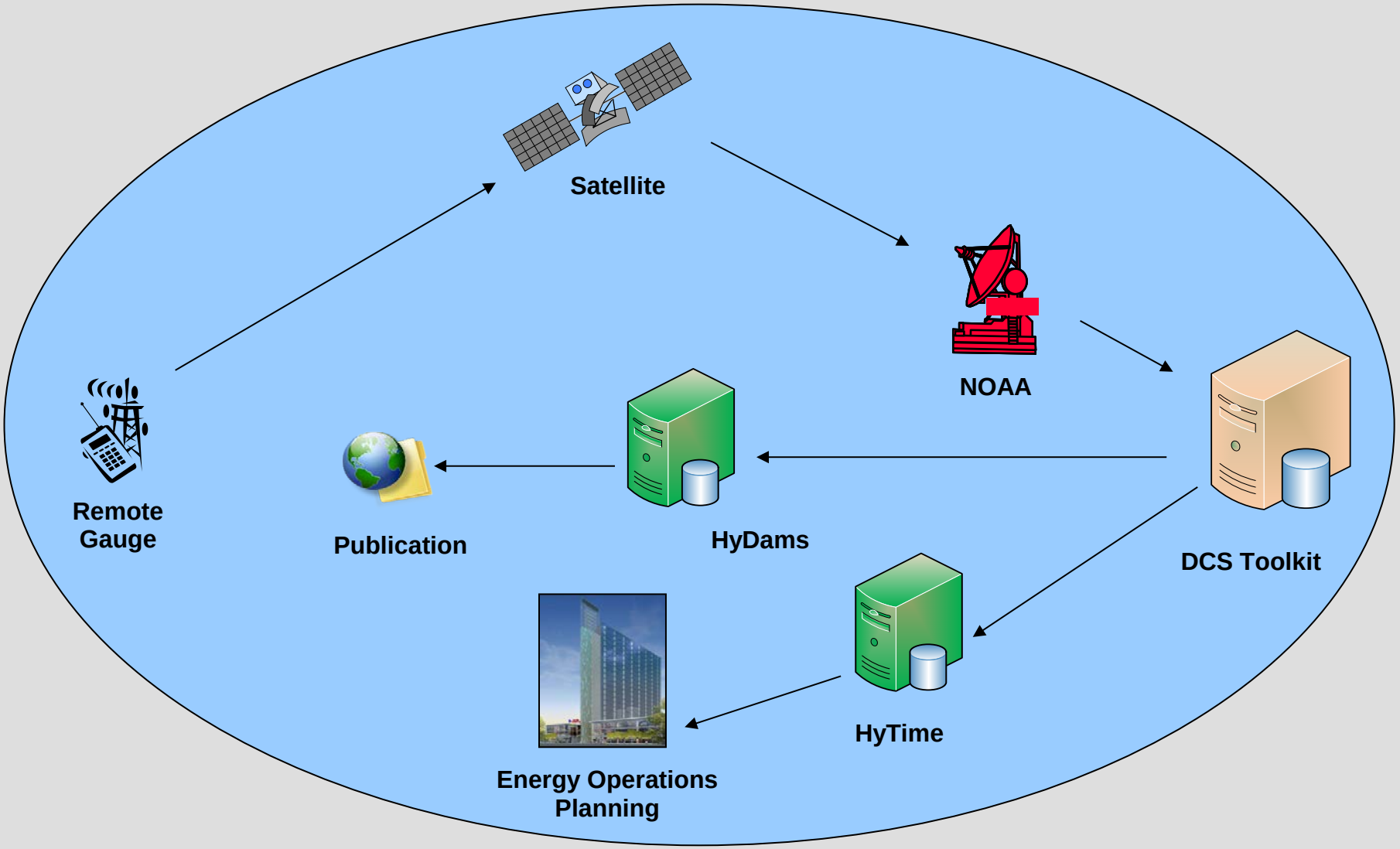
DRAWN BY

GENERAL ARRANGEMENT

YEAR
2016

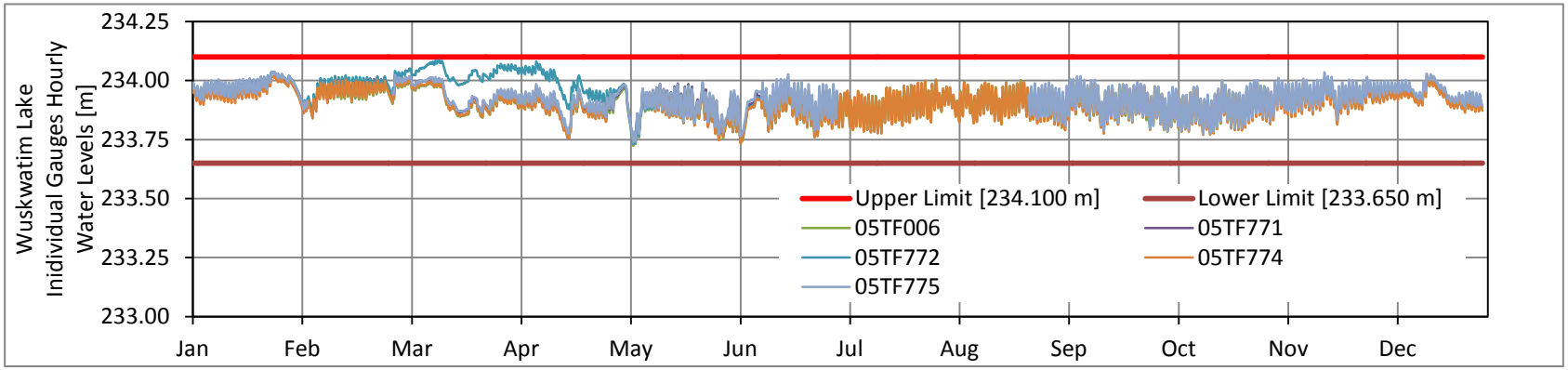
PROJECT
ANNUAL WATER LEVEL REPORT

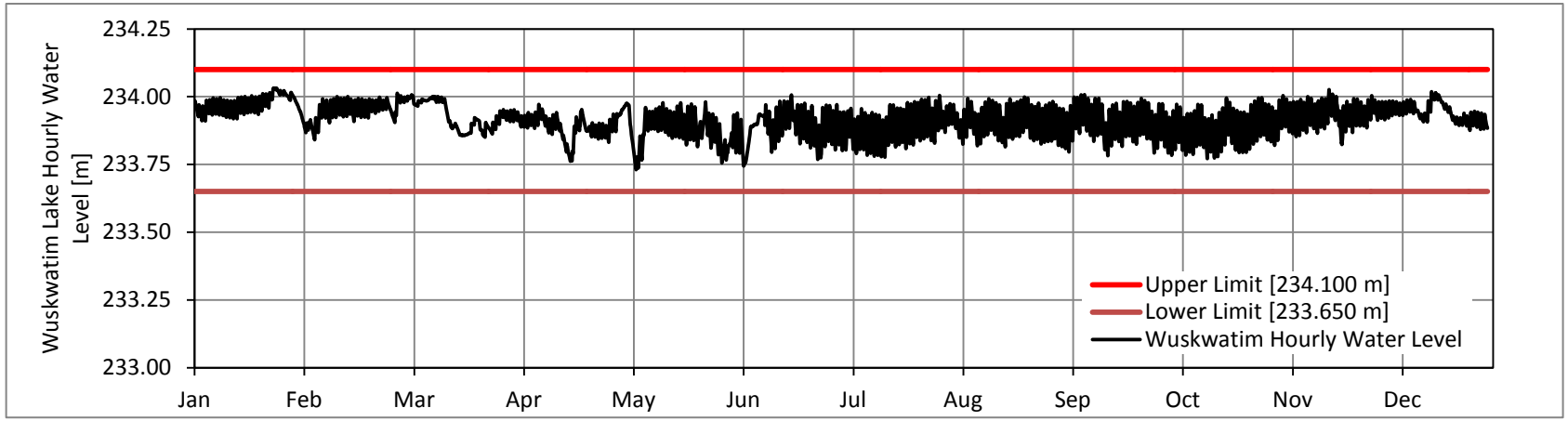
FIGURE 3



Manitoba Hydro	MANITOBA HYDRO	
	HYDRAULIC OPERATIONS DEPARTMENT	
	HYDROLOGIC DATA ACQUISITION AND MANAGEMENT SYSTEM	
	REMOTE DATA PROCESS MAP	
YEAR 2016	PROJECT ANNUAL WATER LEVEL REPORT	FIGURE 4

Wuskwatim Generating Station - Wuskwatim Lake Hourly Water Levels Compliance Report for 2015

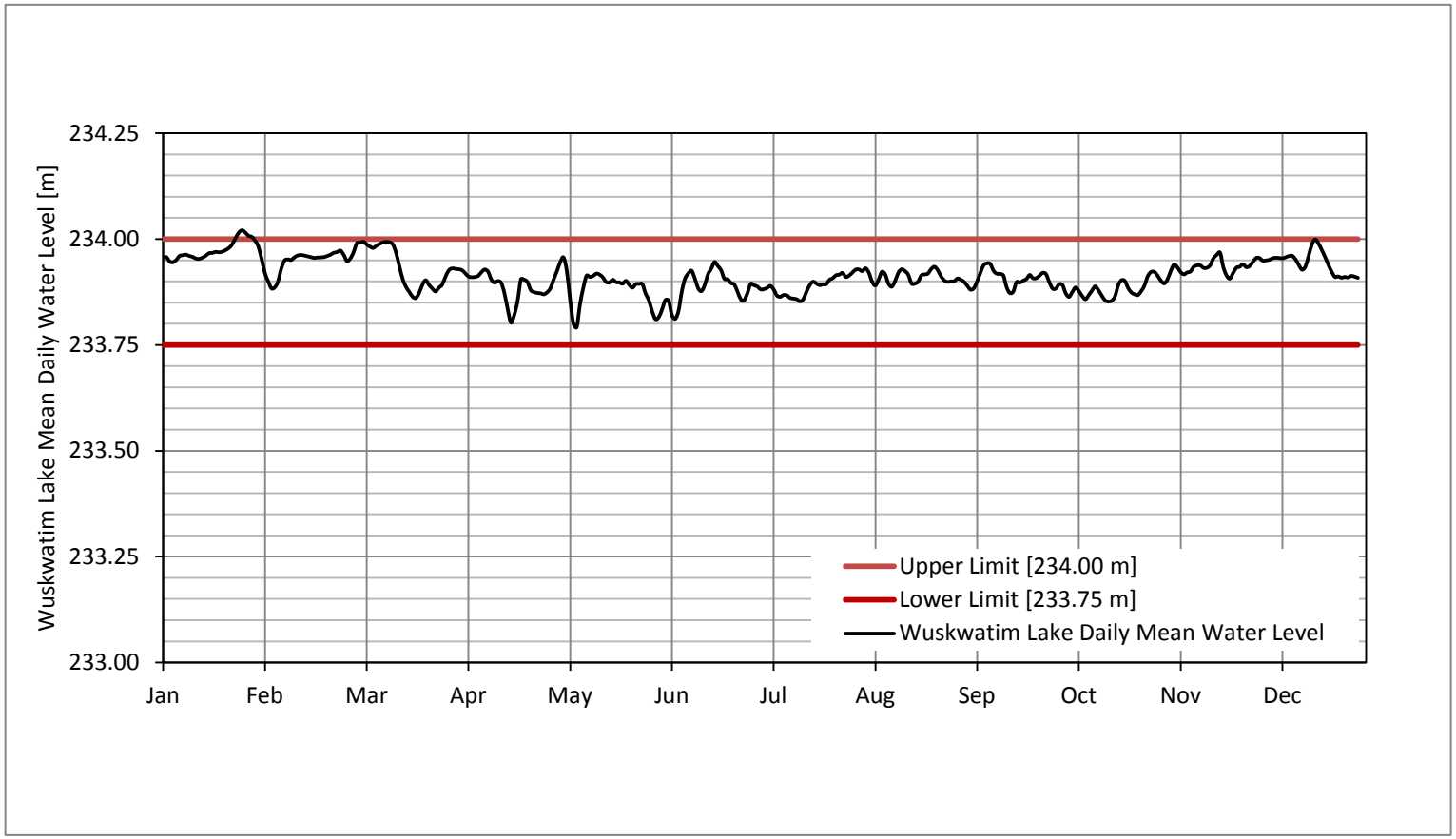




Note:
Wuskwatim Hourly Water Level is calculated using Wuskwatim Lake gauges 05TF006, 05TF771, 05TF772, 05TF774, & 05TF775 until February 1, 2015 and 05TF006, 05TF774 & 05TF775 for the rest of the year.

Manitoba Hydro	MANITOBA HYDRO	
	HYDRAULIC OPERATIONS DEPT.	
	WUSKWATIM GENERATING STATION	
DRAWN BY MJD	WUSKWATIM LAKE HOURLY WL (2015)	
YEAR 2016	PROJECT ANNUAL WATER LEVEL REPORT	FIGURE 5

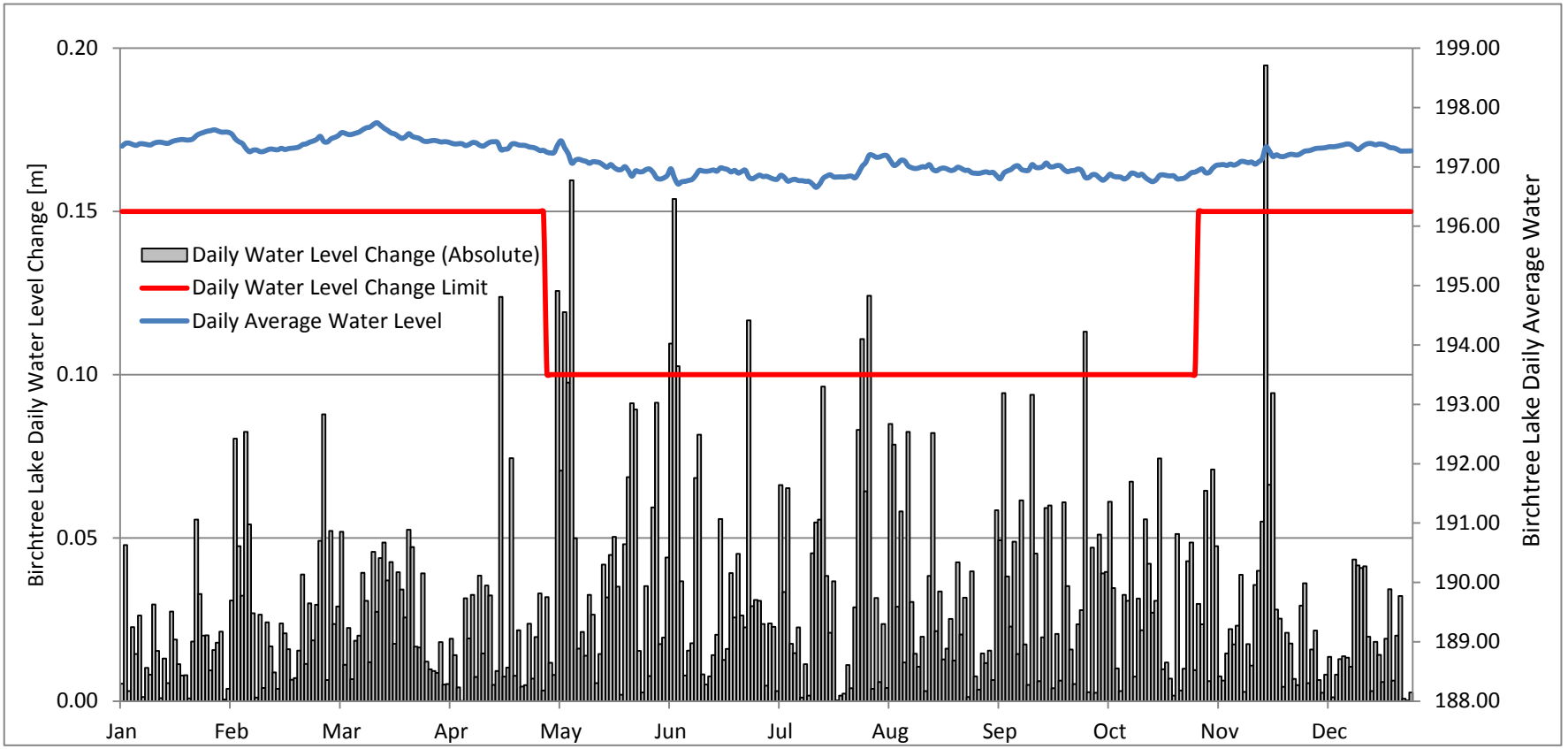
Wuskwatim Generating Station - Wuskwatim Lake Mean Daily Water Level Compliance Report for 2015



Note:
Wuskwatim Lake Mean Daily Water Level is calculated using Wuskwatim Lake gauges 05TF006, 05TF771, 05TF772, 05TF774, & 05TF775 until February 1, 2015 and 05TF006, 05TF774 & 05TF775 for the rest of the year.

Manitoba Hydro	MANITOBA HYDRO	
	HYDRAULIC OPERATIONS DEPT.	
	WUSKWATIM GENERATING STATION	
DRAWN BY MJD	WUSKWATIM LAKE MEAN DAILY WL (2015)	
YEAR 2016	PROJECT ANNUAL WATER LEVEL REPORT	FIGURE 6

Wuskwatim Generating Station - Birchtree Lake Daily Water Level Change Compliance Report for 2015



Note:
The Birchtree Lake Daily Water Level Change is calculated using Birchtree Lake gauges 05TG701, 05TG707, 05TG746, & 05TG747 until February 1, 2015 and gauges 05TG701 & 05TG746 for the rest of the year.
The daily water level change limit is equal to 0.1 m in open water conditions (May 1 to October 31) and 0.15 m in winter conditions

Manitoba Hydro	MANITOBA HYDRO	
	HYDRAULIC OPERATIONS DEPT.	
	WUSKWATIM GENERATING STATION	
DRAWN BY MJD	BIRCHTREE LAKE DAILY WL CHANGE (2015)	
YEAR 2016	PROJECT ANNUAL WATER LEVEL REPORT	FIGURE 7

APPENDIX I

CORRESPONDENCE WITH MANITOBA CONSERVATION AND WATER STEWARDSHIP

Manitoba
Conservation and Water Stewardship

Environmental Stewardship Division
Environmental Approvals Branch
123 Main Street, Suite 160, Winnipeg Manitoba R3C 1A5
T 204 945-8321 **F** 204-945-5229
www.gov.mb.ca/conservation/eal

January 21, 2014

File No.: 53.1.5

W. V. Penner, P. Eng.
Manager
Hydraulic Operations Department
Manitoba Hydro
P.O. Box 815
Winnipeg MB R3C 2P4

Dear Mr. Penner:

This letter is in response to your letter correspondence dated December 17, 2013 from W. Penner to R. Matthews regarding gauge recommendations for licence compliance (Environment Act Licence No. 2699) for the Wuskwatim Generating Station. Clause 30(a) and (c) of Environment Act Licence No. 2699 states that a minimum of three gauges will be used to determine the water level on Wuskwatim Lake and a minimum of two gauges on Birchtree Lake. Currently, there are five gauges operating on Wuskwatim Lake and four gauges on Birchtree Lake.

The Province of Manitoba approves the following gauges as provided in the tables below:

Wuskwatim Lake

Gauge	Location
05TF006	West shore of Wuskwatim Lake (near Thompson)
05TF774	North shore of Wuskwatim Lake
05TF775	East shore of Wuskwatim Lake

Birchtree Lake

Gauge	Location
05TG701	Burntwood River above Manasan Falls
05TG746	Birchtree Lake

The Province of Manitoba also approves the averaging techniques and reporting protocols, as described by your correspondence dated December 17, 2013, regarding water level determinations on Wuskwatim Lake and Birchtree Lake.

Please contact Puru Singh at 204-945-3613 if you have questions about this matter. Thank you.

Yours truly,

Tracey Braun, M.Sc.
Director

Cc: Puru Singh, Rob Matthews, Scott Nachtigall, Bruce Webb

Manitoba Hydro

360 Portage Ave (16) • Winnipeg Manitoba Canada • R3C 0G8
Telephone / *N° de téléphone :* 204-360-3018 • Fax / *N° de télécopieur :* 204-360-6136
wpenner@hydro.mb.ca

2015 02 09

Mr. R. Matthews, P. Geo.
Manager, Water Use Licensing
Manitoba Conservation & Water Stewardship
Box 16 - 200 Saulteaux Crescent
Winnipeg MB R3J 3W3

Dear Mr. Matthews:

WUSKWATIM GENERATING STATION - WATER POWER & ENVIRONMENT ACT LICENSES - DAILY AVERAGE LEVLE ABOVE LICENCE LIMIT

During the last week of January 2015, the mean daily water level variation on Wuskwatim Lake was above the licence limit specified in Article 4 of the Wuskwatim Water Power Act Licence and clause 30 of *The Environment Act* Licence No. 2699.

The Wuskwatim Lake mean daily water level exceeded the upper licence limit of 234.0 metres by a maximum of 0.02 metres from January 24 to 28, 2015. Hydraulic Operations Department is investigating the incident and we will advise you of the outcome.

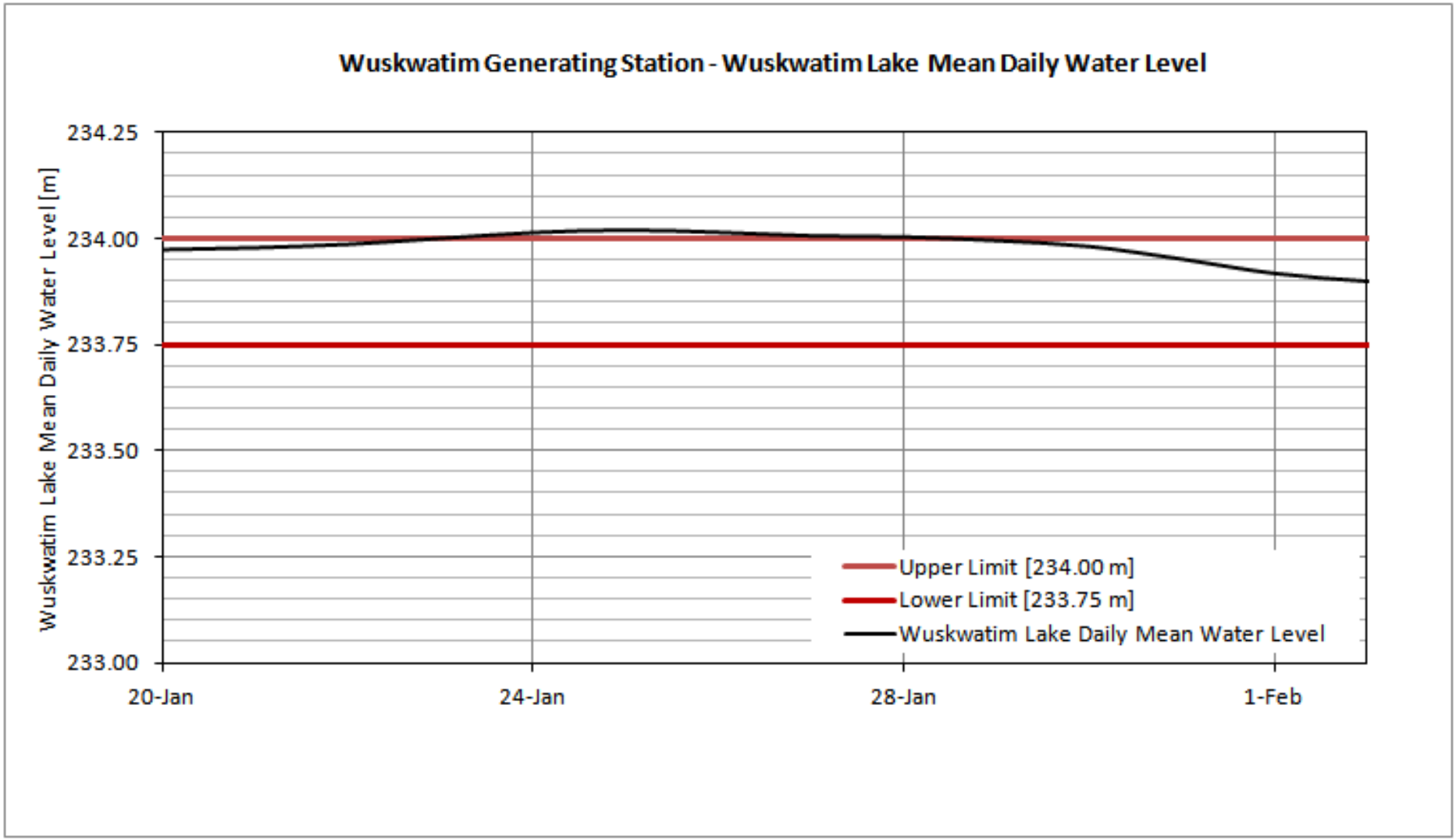
If you have any questions about this matter, please call me at (204) 360-3018.

Yours truly,

Original signed by, *Wesley Penner*

W.V. Penner, P. Eng.
Manager
Hydraulic Operations Department

MJD/sl/ 00184-07311-0032_00
Att.


Wuskwatim Generating Station - Wuskwatim Lake Mean Daily Water Level
Wuskwatim Lake Mean Daily Water Level [m]
234.25
234.00
233.75
233.50
233.25
233.00
20-Jan
24-Jan
28-Jan
1-Feb
Upper Limit [234.00 m]
Lower Limit [233.75 m]
Wuskwatim Lake Daily Mean Water Level

Manitoba Hydro

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wpenner@hydro.mb.ca

2015 03 11

Mr. R. Matthews, P.Geo.
Manager, Water Use Licensing
Manitoba Conservation & Water Stewardship
Box 16 - 200 Saulteaux Crescent
Winnipeg MANITOBA R3J 3W3

Dear Mr. Matthews:

WUSKWATIM GENERATING STATION- WATER POWER AND ENVIRONMENT ACT LICENCES - DAILY AVERAGE LAKE LEVEL ABOVE LICENCE LIMIT

The following is an explanation of the event that caused the level of Wuskwatim Lake to rise above the licence limit specified in Article 4 of the Wuskwatim Water Power Act Licence and clause 30 of Environment Act Licence No. 2699 during the last week of January 2015. This letter supplements our February 9, 2015 report regarding this incident.

There was an increase in inflow to Wuskwatim Lake from January 24 to 28 because of a warm weather period that caused the mean daily water level to exceed the upper licence limit of 234.0 metres (m) by a maximum of 0.02 m (Figure 1). The warm weather was enough to release water from storage upstream of the many sets of rapids between Wuskwatim Lake and Nelson House but not enough to reduce outlet ice restrictions at Wapisu, Threepoint or Footprint Lakes. This additional inflow without easing of lake outlet restriction caused Wuskwatim Lake to rise without changing the ice-affected relationship between Wuskwatim Lake level and forebay level. Since the forebay level is used to regulate the lake, staff were not immediately aware of the exceedance. Manitoba Hydro is taking steps to remedy this situation.

If you have any questions about this matter, please call me at (204) 360-3018.

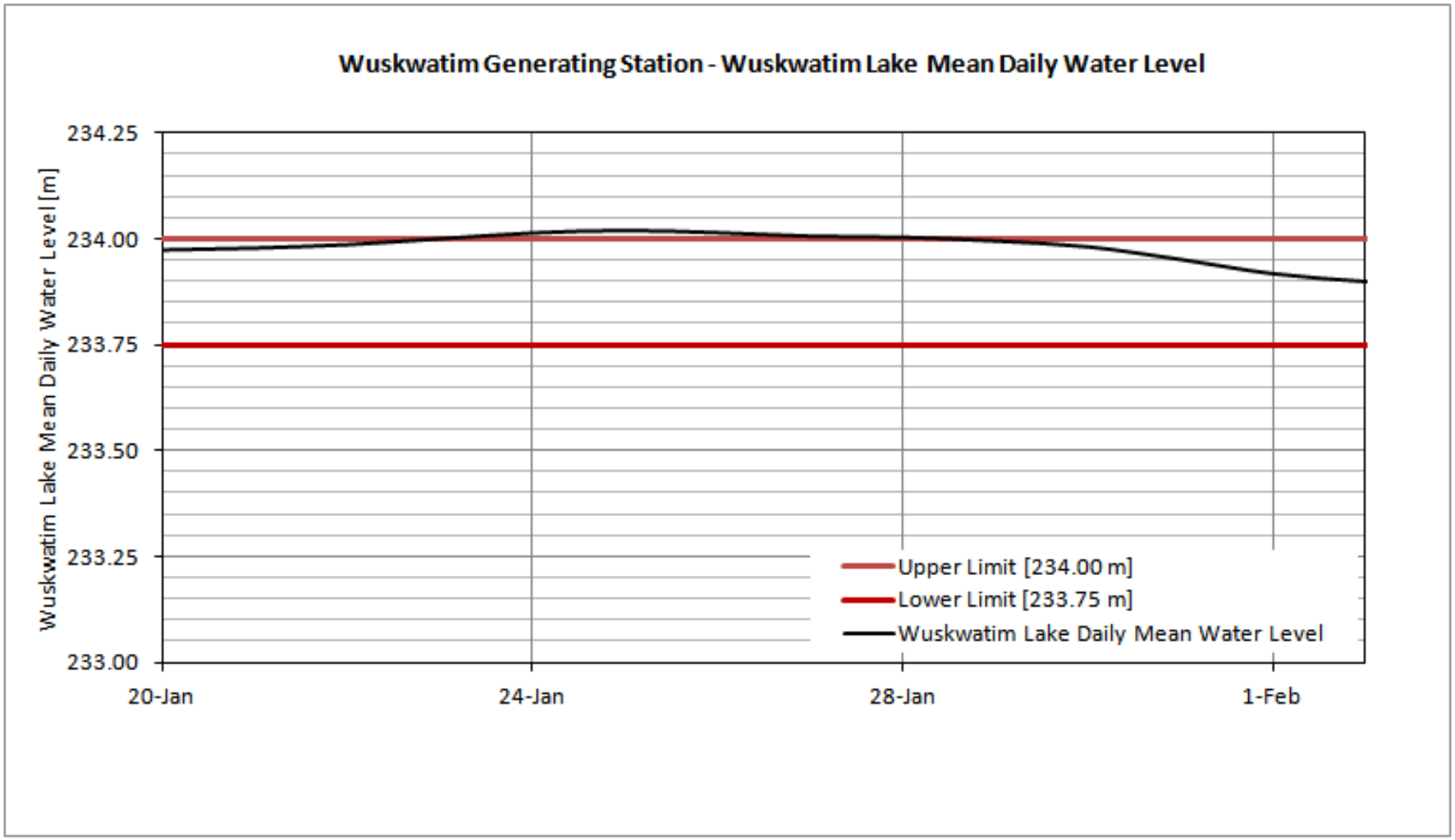
Yours truly,

Original signed by; *Wesley Penner*

W.V. Penner, P. Eng.
Manager
Hydraulic Operations Department

MJD/sl/ 00184-07311-0033_00
Att.

Figure 1:


Wuskwatim Generating Station - Wuskwatim Lake Mean Daily Water Level
Wuskwatim Lake Mean Daily Water Level [m]
234.25
234.00
233.75
233.50
233.25
233.00
20-Jan
24-Jan
28-Jan
1-Feb
Upper Limit [234.00 m]
Lower Limit [233.75 m]
Wuskwatim Lake Daily Mean Water Level

Manitoba Hydro

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wpenner@hydro.mb.ca

2015 05 11

Mr. R. Matthews, P.Geo.
Manager, Water Use Licensing
Manitoba Conservation & Water Stewardship
Box 16 - 200 Saulteaux Crescent
Winnipeg MB R3C 3W3

Dear Mr. Matthews:

WUSKWATIM GENERATION STATION - BIRCH TREE LAKE ENVIRONMENT ACT LICENCE - MEAN DALILY WATER LEVEL VARIATION ABOVE LEVEL VARIATION ABOVE LICENCE LIMIT

On May 04, 06 and 08, 2015, the mean daily water level variations on Birch Tree Lake were above the licence limit specified in clause 30 (b) of *The Environment Act* Licence No. 2699.

The Birch Tree Lake daily water level changes were 0.126, 0.119 and 0.160 metres on May 04, 06 and 08, 2015 respectively (Figure 1). Clause 30(b) of *The Environment Act* Licence No. 2699 limits mean daily water level variations on Birch Tree Lake to 0.10 metres under open water conditions. Hydraulic Operations Department is investigating the incidents and we will advise you of the outcome.

If you have any questions about this matter, please call me at (204) 360-3018.

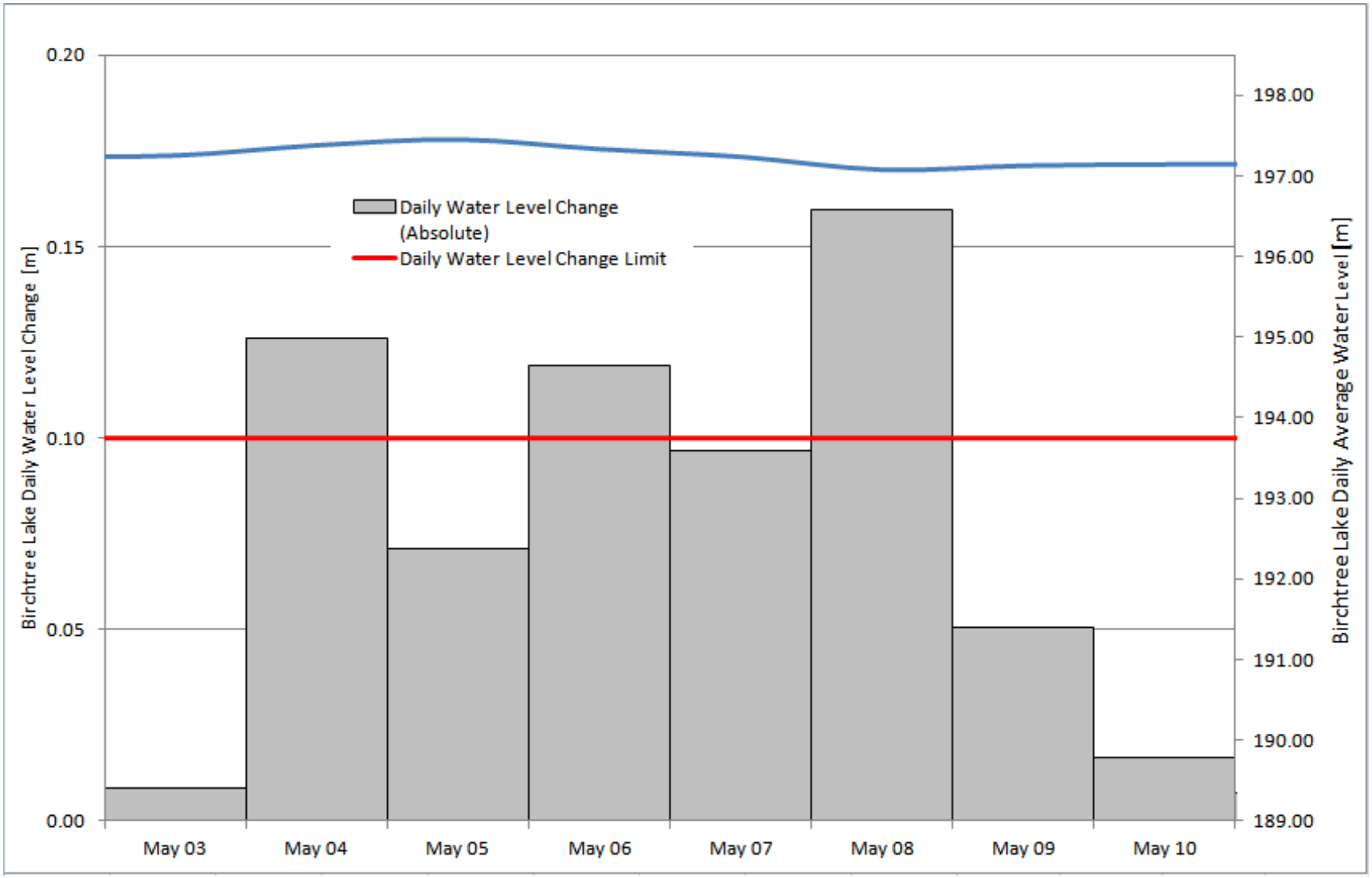
Yours truly,

Original signed by; *p.p. Brian Giesbrecht*
Wesley Penner

W.V. Penner, P. Eng.
Manager
Hydraulic Operations Department

MJD/sl/ 00184-07311-0038_00
Att.

Figure 1:


0.20
0.15
0.10
0.05
0.00
198.00
197.00
196.00
195.00
194.00
193.00
192.00
191.00
190.00
189.00
Daily Water Level Change (Absolute)
Daily Water Level Change Limit
Birchtree Lake Daily Water Level Change [m]
Birchtree Lake Daily Average Water Level [m]
May 03
May 04
May 05
May 06
May 07
May 08
May 09
May 10

Manitoba Hydro

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wpenner@hydro.mb.ca

2015 10 01

Mr. R. Matthews, P.Geo.
Manager, Water Use Licensing
Manitoba Conservation & Water Stewardship
Box 16 - 200 Saulteaux
Winnipeg MB R3C 3W3

Dear Mr. Matthews:

WUSKWATIM GENERATING STATION - ENVIRONMENT ACT LICENCE - BIRCH TREE LAKE MEAN DAILY WATER LEVEL ABOVE LICENCE LIMIT

Mean daily water level variations on Birch Tree Lake were above the licence limit specified in clause 30 (b) of *The Environment Act* Licence No. 2699 as described below. This letter supplements our May 11, 2015 report regarding these incidents.

The Birch Tree Lake daily water level changes were 0.13, 0.12 and 0.16 metres (m) on May 4, 6 and 8, 2015 respectively (Figure 1). The licence limits mean daily water level variations on Birch Tree Lake to 0.10 metres under open water conditions. These exceedances were all caused by unusual operation of Wuskwatim Generating Station to accommodate planned maintenance outages on three transmission lines (G9F, F27P and P19W). Manitoba Hydro limits the daily average change in Wuskwatim outflow to 100 cubic meters per second (cms) to avoid exceeding the Birch Tree licence limit. However, this limit was not effective during these three occasions. Manitoba Hydro continues to refine the cycling patterns in order to stay within the Birch Tree licence limit.

During the multi-day maintenance outage of transmission line G9F, Wuskwatim generation was reduced and the forebay allowed to pond-up to near the licence limit of 234.0 m. The outage limited the amount of generation that could be transferred from Wuskwatim to the main Manitoba Hydro grid. Starting on May 3rd, generation was increased as G9F was put back on service which elevated the Birch Tree level and exceeded the mean daily water level variation on May 4th by 0.03 m.

In anticipation of upcoming outages to transmission lines F27P and P19W from May 6 to 8, Wuskwatim outflow remained consistently high from May 4 to 5. This operation drew down the Wuskwatim forebay, creating room to store water during the maintenance outages rather than spill it. The prolonged periods of high and low flow around the time of these outages caused the mean daily water level variation at Birch Tree Lake on May 6th and 8th to exceed

the licence limit by 0.02 and 0.06 m respectively.

Wuskwatim Lake mean daily water level was maintained within the licence limit during this period (Figure 2).

If you have any questions about this matter, please call me at 204-360-3018.

Yours truly,

Original signed by: *Wesley Penner*

W.V. Penner, P. Eng.
Manager
Hydraulic Operations Department

MJD/sl/00184-07311-0042_00
Att.

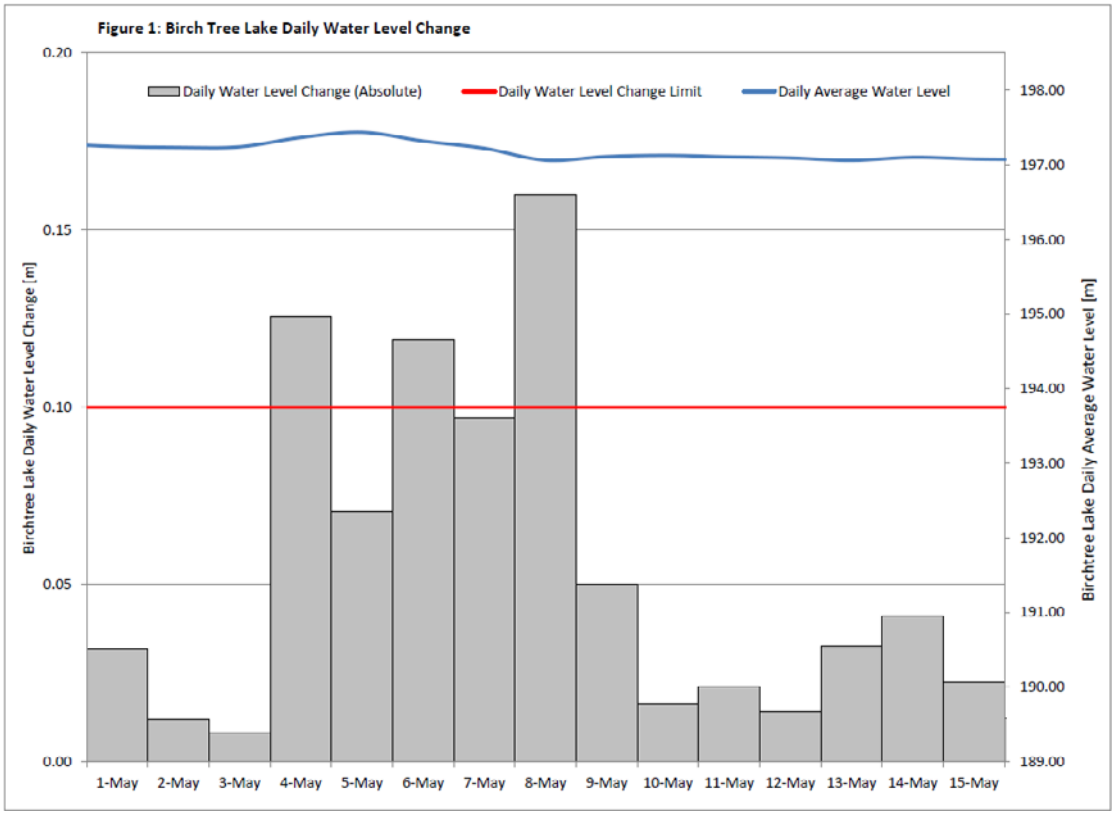
Figure 1: Birch Tree Lake Daily Water Level Change
Daily Water Level Change (Absolute)
Daily Water Level Change Limit
Daily Average Water Level
Birchtree Lake Daily Water Level Change [m]
Birchtree Lake Daily Average Water Level [m]
0.20
0.15
0.10
0.05
0.00
198.00
197.00
196.00
195.00
194.00
193.00
192.00
191.00
190.00
189.00
1-May
2-May
3-May
4-May
5-May
6-May
7-May
8-May
9-May
10-May
11-May
12-May
13-May
14-May
15-May

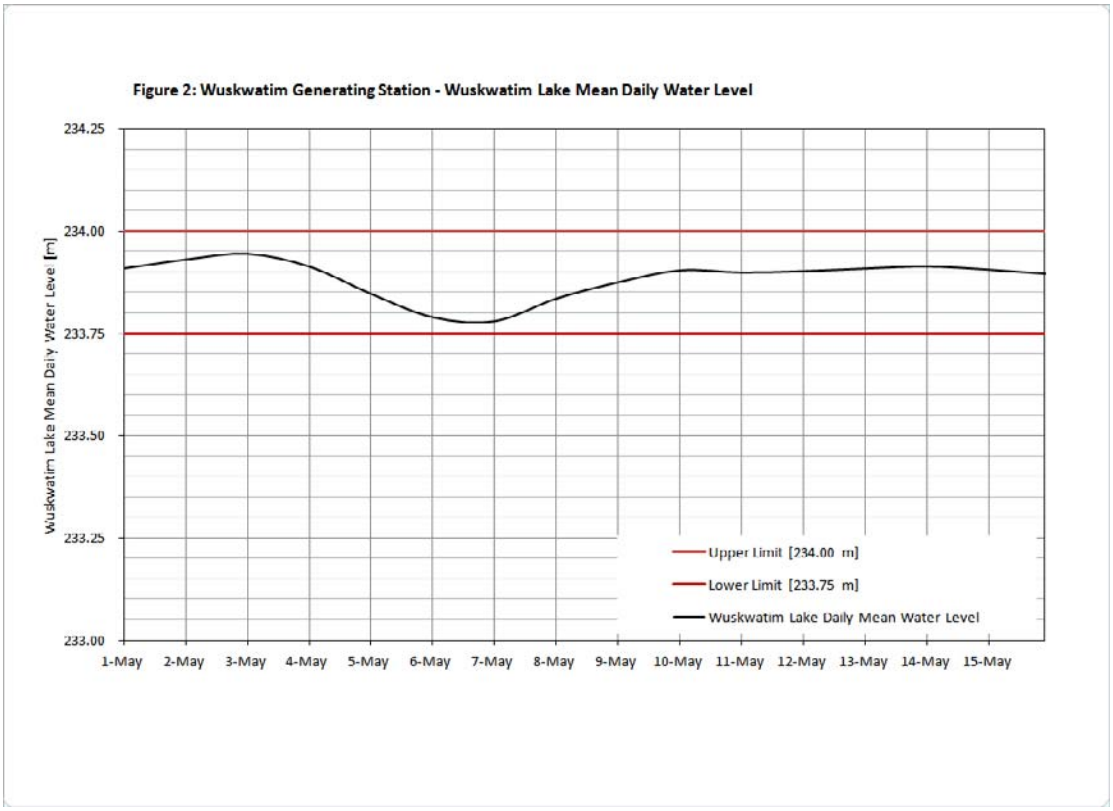
Figure 2: Wuskwatim Generating Station - Wuskwatim Lake Mean Daily Water Level
Wuskwatim Lake Mean Daily Water Level [m]
234.25
234.00
233.75
233.50
233.25
233.00
Upper Limit [234.00 m]
Lower Limit [233.75 m]
Wuskwatim Lake Daily Mean Water Level
1-May
2-May
3-May
4-May
5-May
6-May
7-May
8-May
9-May
10-May
11-May
12-May
13-May
14-May
15-May

Manitoba Hydro

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wpenner@hydro.mb.ca

2015 06 12

Mr. R. Matthews
Manager, Water Use Licence
Manitoba Conservation and Water Stewardship
Box 16 - 200 Saulteaux Crescent
Winnipeg MB R3J 3W3

Dear Mr. Matthews:

WUSKWATIM GENERATING STATION - BIRCH TREE LAKE ENVIRONMENT ACT LICENCE - MEAN DAILY WATER LEVEL VARIATION ABOVE LICENCE LIMIT

On June 05 and 06, 2015, the mean daily water level variations on Birch Tree Lake were above the licence limit specified in clause 30 (b) of *The Environment Act* Licence No. 2699.

The Birch Tree Lake daily water level changes were 0.11 and 0.15 metres on June 05 and 06, 2015 respectively (Figure 1). Clause 30(b) of *The Environment Act* Licence No. 2699 limits mean daily water level variations on Birch Tree Lake to 0.10 metres under open water conditions. Hydraulic Operations Department is investigating the incidents and we will advise you of the outcome.

If you have any questions about this matter, please call me at (204) 360-3018.

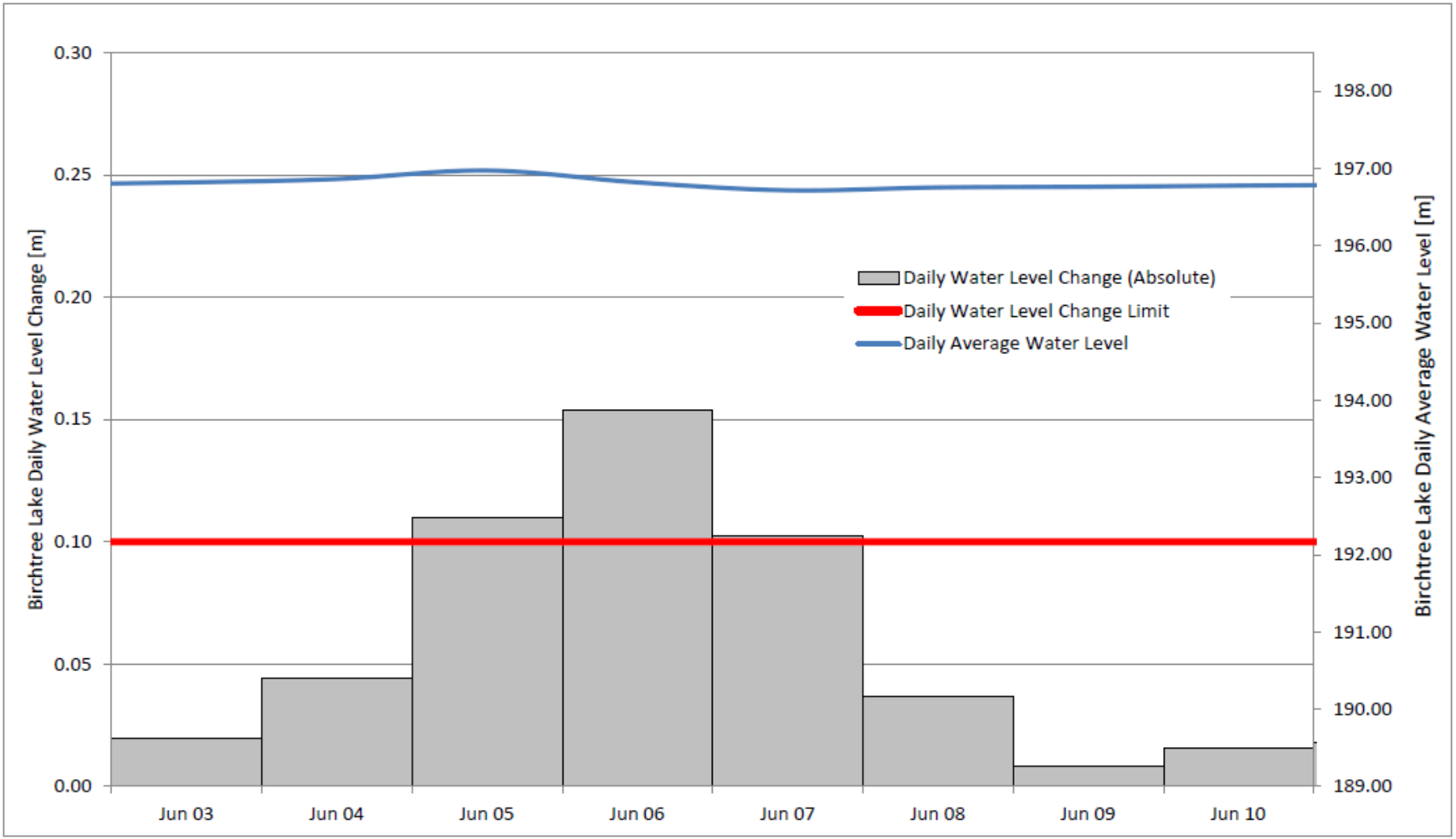
Yours truly,

Original signed by: *Wesley Penner*

W.V. Penner, P. Eng.
Manager
Hydraulic Operations Department

MJD/sl/00184-07311-0039_00
Att.

Figure 1:


0.30
0.25
0.20
0.15
0.10
0.05
0.00
Birchtree Lake Daily Water Level Change [m]
198.00
197.00
196.00
195.00
194.00
193.00
192.00
191.00
190.00
189.00
Birchtree Lake Daily Average Water Level [m]
Daily Water Level Change (Absolute)
Daily Water Level Change Limit
Daily Average Water Level
Jun 03
Jun 04
Jun 05
Jun 06
Jun 07
Jun 08
Jun 09
Jun 10

Manitoba Hydro

360 Portage Ave (16) • Winnipeg Manitoba Canada • R3C 0G8
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wpenner@hydro.mb.ca

2015 10 28

Mr. R. Matthews, P.Geo.
Manager, Water Use Licensing
Manitoba Conservation and Water Stewardship
Box 16 - 200 Saulteaux Crescent
Winnipeg MB R3J 3W3

Dear Mr. Matthews:

WUSKWATIM GENERATING STATION - ENVIRONMENT ACT LICENCE - BIRCH TREE LAKE MEAN WATER LEVEL VARIATION ABOVE LICENCE LIMIT

Mean daily water level variations on Birch Tree Lake were above the licence limit specified in clause 30 (b) of *The Environment Act* Licence No. 2699 as described below. This letter supplements our June 12, 2015 report regarding these incidents.

The Birch Tree Lake daily water level changes were 0.11 and 0.15 metres (m) on June 05 and 06, 2015 respectively (Figure 1). The licence limits mean daily water level variations on Birch Tree Lake to 0.10 metres under open water conditions. Manitoba Hydro continues to refine cycling mode transitions in order to avoid future licence exceedances.

On June 05, 2015, there was a scheduled maintenance outage of Wuskwatim Unit 1. Wuskwatim Generating Station operation changed from a cycling mode of three units operating on-peak and one unit off-peak to two units producing a sustained outflow from the station. The two-unit sustained outflow at night (off-peak) instead of the usual one unit operation elevated the Birch Tree Lake level and caused the mean daily water level variation to exceed the licence limit by 0.01 m.

On June 06, 2015, because the outflow from the station was two units during the day instead of the usual three unit operation, the inflows and water level at Birch Tree Lake dropped and caused the mean daily water level variation to exceed the licence limit by 0.05 m.

The mean daily water level variation on June 07, 2015 was exactly 0.10 m. Station operators were able to return to a cycling mode of operation on June 11 and remain below the licence limit on Birch Tree Lake.

If you have any questions about this matter, please call me at 204-360-3018.

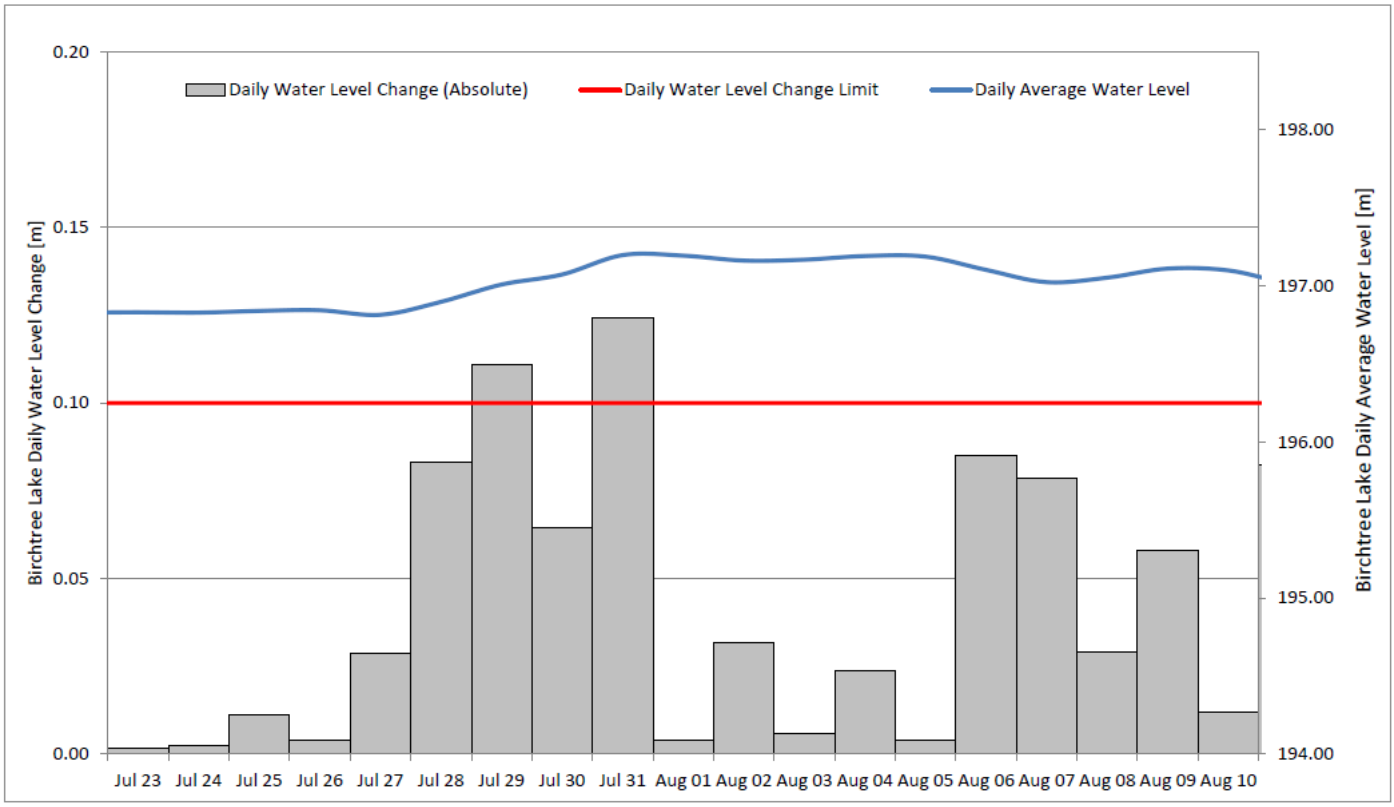
Yours truly,

Original signed by; *Wesley Penner*

W.V. Penner, P. Eng.
Manager
Hydraulic Operations Department

MJD/sl/00184-07311-0045_00

Figure 1: Wuskwatim Generating Station - Birchtree Lake Daily Water Level Change



Note: The Birchtree Lake Daily Water Level Change is calculated using Birchtree Lake gauges 05TG701 & 05TG746
The daily water level change limit is equal to 0.1 m in open water conditions (May 1 to October 31) and 0.15 m in winter conditions (November 1 to April 30)

Manitoba Hydro

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wpenner@hydro.mb.ca

2015 07 07

Mr. R. Matthews, P.Geo.
Manager, Water Use Licensing
Manitoba Conservation & Water Stewardship
Box 16, 200 Saulteaux Crescent
Winnipeg MB R3J 3W3

Dear Mr. Matthews:

WUSKWATIM GENERATING STATION - BIRCH TREE LAKE ENVIRONMENT ACT LICENCE - MEAN DAILY WATER LEVEL ABOVE LICENCE LIMIT

On June 27, 2015, the mean daily water level variations on Birch Tree Lake were above the licence limit specified in clause 30 (b) of *The Environment Act* Licence No. 2699.

The Birch Tree Lake daily water level change was 0.12 metres on June 27, 2015 (Figure 1). Clause 30(b) of *The Environment Act* Licence No. 2699 limits mean daily water level variations on Birch Tree Lake to 0.10 metres under open water conditions. Hydraulic Operations Department is investigating the incident and we will advise you of the outcome.

If you have any questions about this matter, please call me at (204) 360-3018.

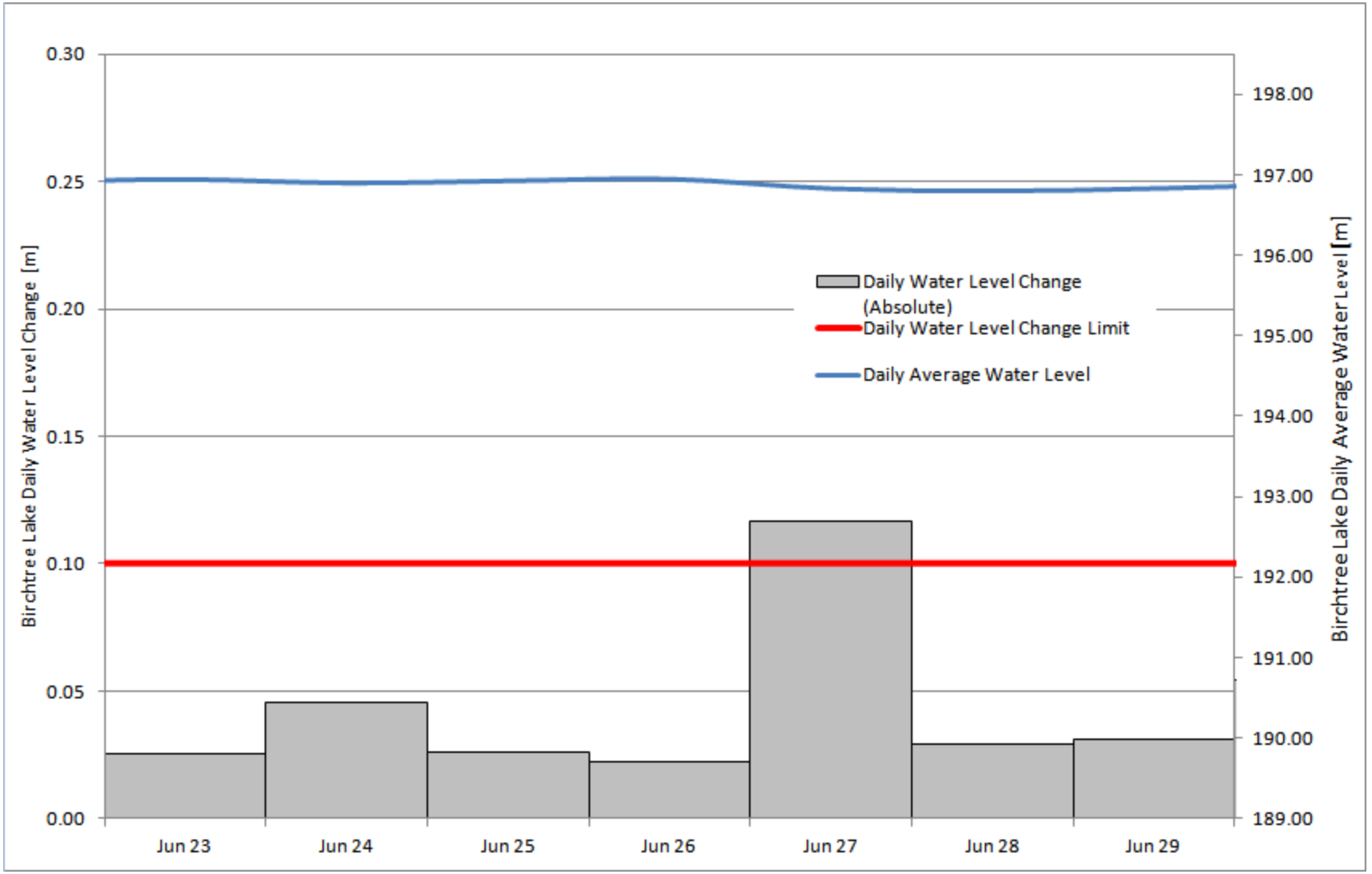
Yours truly,

Original signed by, *Wesley Penner*

W.V. Penner, P. Eng.
Manager
Hydraulic Operations Department

MJD/sl/00184-07311-0040_00

Figure 1:


0.30
0.25
0.20
0.15
0.10
0.05
0.00
Birchtree Lake Daily Water Level Change [m]
198.00
197.00
196.00
195.00
194.00
193.00
192.00
191.00
190.00
189.00
Birchtree Lake Daily Average Water Level [m]
Daily Water Level Change (Absolute)
Daily Water Level Change Limit
Daily Average Water Level
Jun 23
Jun 24
Jun 25
Jun 26
Jun 27
Jun 28
Jun 29

Manitoba Hydro

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wpenner@hydro.mb.ca

2016 03 07

Mr. R. Matthews, P.Geo.
Manager, Water Use Licensing
Manitoba Conservation & Water Stewardship
Box 16, 200 Saulteaux Crescent
Winnipeg MB R3J 3W3

Dear Mr. Matthews:

WUSKWATIM GENERATING STATION - ENVIRONMENT ACT LICENCE - BIRCH TREE LAKE MEAN WATER LEVEL VARIATION ABOVE LICENCE LIMIT

The mean daily water level variation on Birchtree Lake was above the licence limit specified in clause 30 (b) of *The Environment Act* Licence No. 2699 as described below. Manitoba Hydro has determined that Wuskwatim operations caused this exceedance. This letter supplements our July 07, 2015 report regarding this incident.

The Birch Tree Lake daily water level change was 0.12 metres (m) on June 27, 2015 (Figure 1). The licence limits mean daily water level variations on Birch Tree Lake to 0.10 m under open water conditions.

Declining inflows from upstream caused the forebay level to drop during cycling operations at Wuskwatim Generating Station (shown circled in Figure 2). On June 26, to prevent the forebay level from going below the licence limit, the cycling pattern during the day was shortened by about 4 hours from the previous day and the flow at night was about 57 cubic meter per second less to reduce overall outflow. This operation returned the forebay to normal cycling levels (Figure 2). However, this operation caused the Birch Tree lake level to drop and exceeded the mean daily water level variation by 0.02 m on June 27.

If you have any questions about this matter, please call me at 204-360-3018.

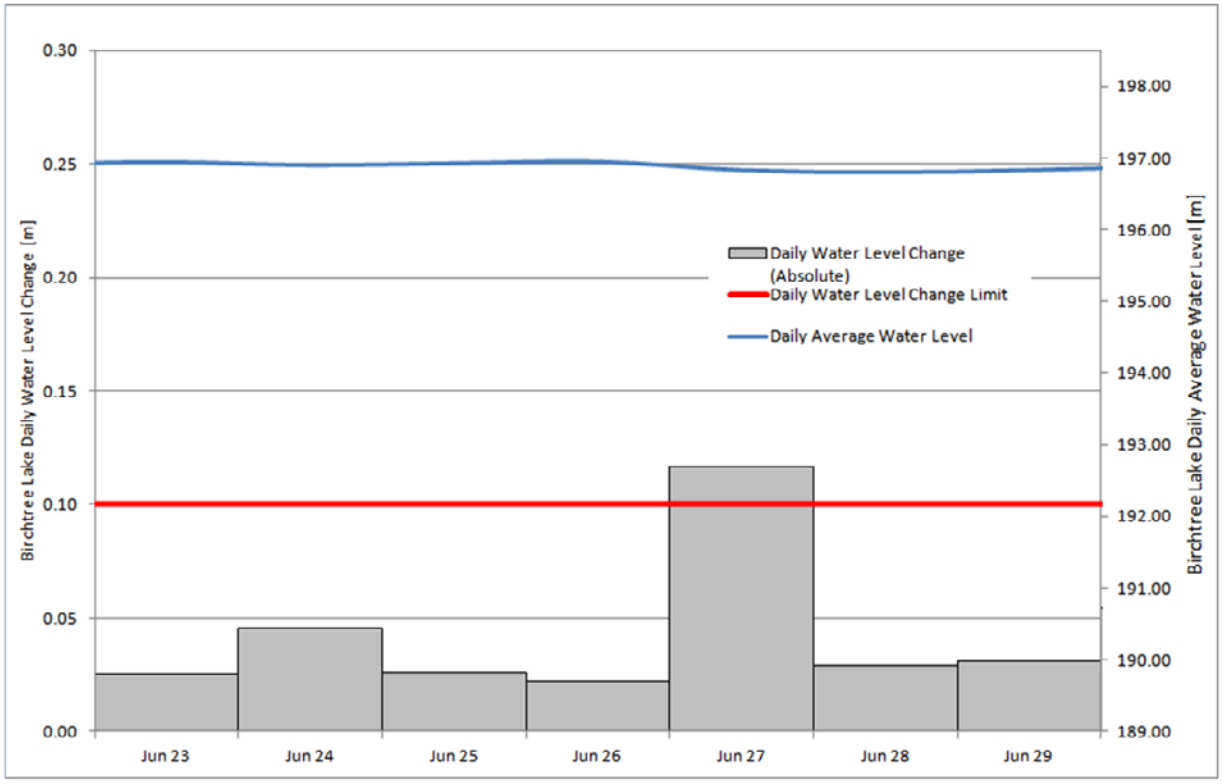
Yours truly,

Original signed by, Wesley Penner

W.V. Penner, P. Eng.
Manager
Hydraulic Operations Department

MJD/sl00184-07311-0049_00
Att.

Figure 1:


0.30
0.25
0.20
0.15
0.10
0.05
0.00
198.00
197.00
196.00
195.00
194.00
193.00
192.00
191.00
190.00
189.00
Birchtree Lake Daily Water Level Change [m]
Birchtree Lake Daily Average Water Level [m]
Daily Water Level Change (Absolute)
Daily Water Level Change Limit
Daily Average Water Level
Jun 23
Jun 24
Jun 25
Jun 26
Jun 27
Jun 28
Jun 29

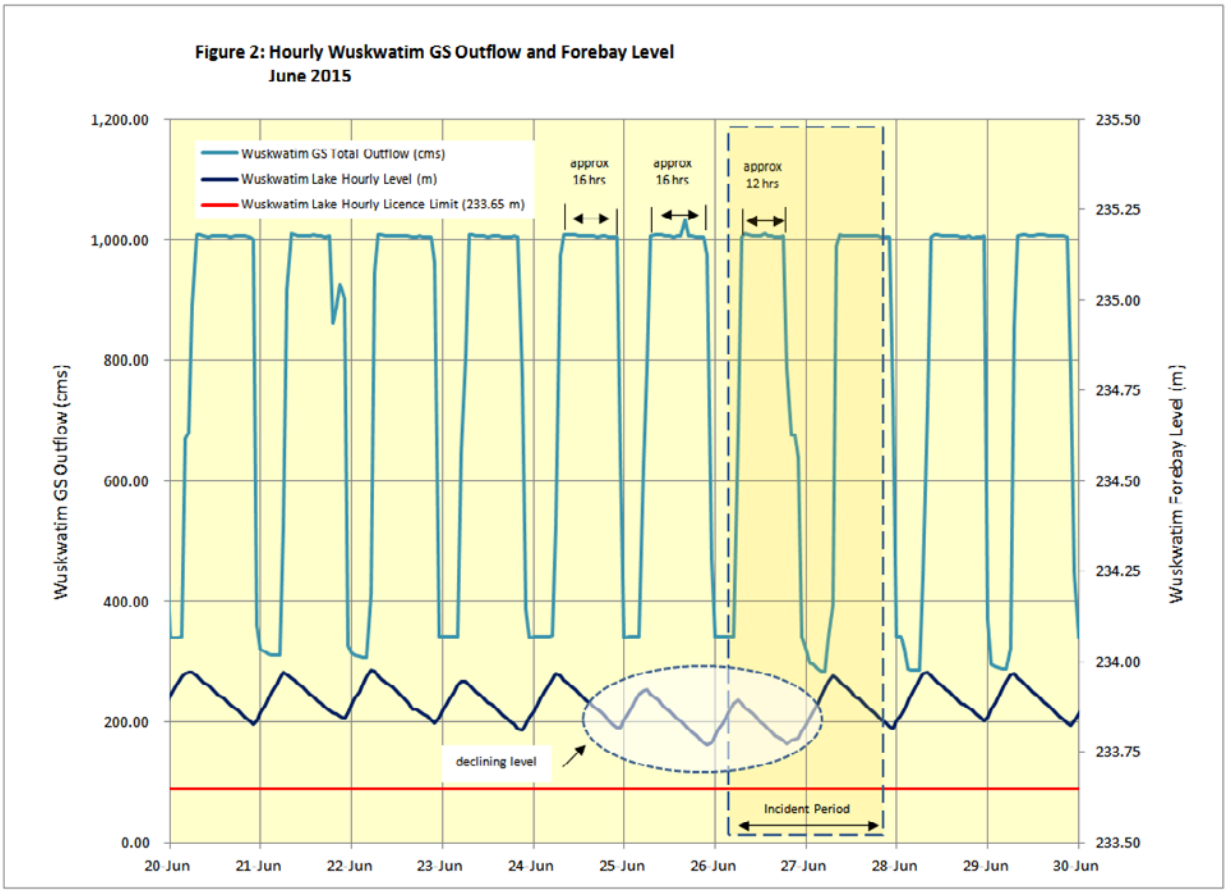


Figure 2: Hourly Wuskwatim GS Outflow and Forebay Level
June 2015
1,200.00
1,000.00
800.00
600.00
400.00
200.00
0.00
235.50
235.25
235.00
234.75
234.50
234.25
234.00
233.75
233.50
Wuskwatim GS Outflow (cms)
Wuskwatim Forebay Level (m)
Wuskwatim GS Total Outflow (cms)
Wuskwatim Lake Hourly Level (m)
Wuskwatim Lake Hourly Licence Limit (233.65 m)
approx 16 hrs
approx 16 hrs
approx 12 hrs
declining level
Incident Period
20 Jun
21 Jun
22 Jun
23 Jun
24 Jun
25 Jun
26 Jun
27 Jun
28 Jun
29 Jun
30 Jun

Manitoba Hydro

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wpenner@hydro.mb.ca

2015 08 10

Mr. R. Matthews, P.Geo.
Manager, Water Use Licensing
Manitoba Conservation & Water Stewardship
Box 16, 200 Saulteaux Crescent
Winnipeg MB R3J 3W3

Dear Mr. Matthews:

WUSKWATIM GENERATING STATION - BIRCH TREE LAKE ENVIRONMENT ACT LICENCE - MEAN DAILY WATER LEVEL ABOVE LICENCE LIMIT

On July 29 and 31, 2015, the mean daily water level variations on Birch Tree Lake were above the licence limit specified in clause 30 (b) of *The Environment Act* Licence No. 2699.

The Birch Tree Lake daily water level changes were 0.111 and 0.124 metres on July 29 and 31, 2015 respectively (Figure 1). Clause 30(b) of *The Environment Act* Licence No. 2699 limits mean daily water level variations on Birch Tree Lake to 0.10 metres under open water conditions. Hydraulic Operations Department is investigating the incidents and we will advise you of the outcome.

If you have any questions about this matter, please call me at (204) 360-3018.

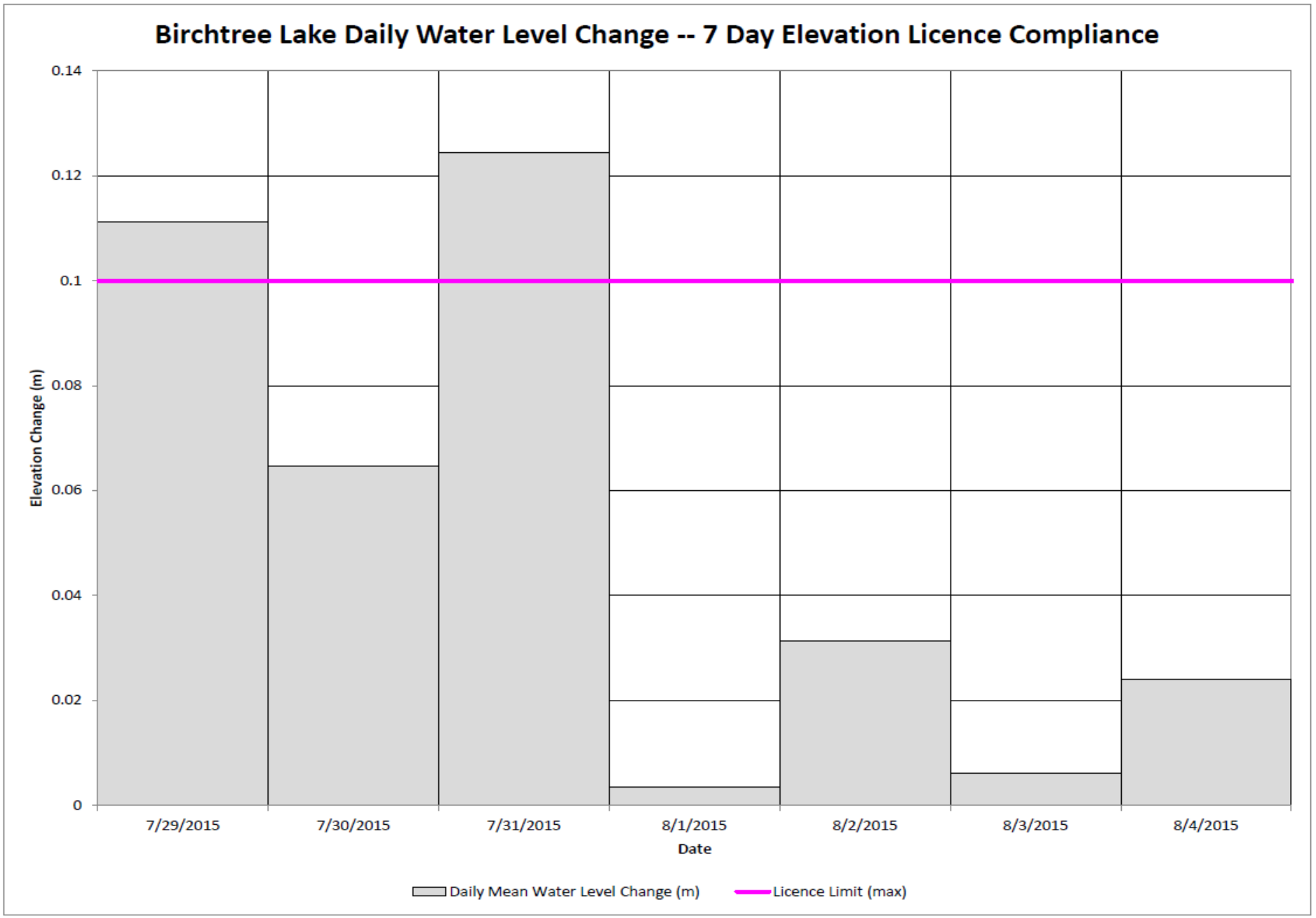
Yours truly,

Original signed by; *Wesley Penner*

W.V. Penner, P. Eng.
Manager
Hydraulic Operations Department

MJD/sl/00184-07311-0041_00
Att.

Figure 1:


Birchtree Lake Daily Water Level Change -- 7 Day Elevation Licence Compliance
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Elevation Change (m)
7/29/2015
7/30/2015
7/31/2015
8/1/2015
8/2/2015
8/3/2015
8/4/2015
Date
Daily Mean Water Level Change (m)
Licence Limit (max)

Manitoba Hydro

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wpenner@hydro.mb.ca

2015 10 14

Mr. R. Matthews, P. Geo.
Manager, Water Use Licensing
Manitoba Conservation & Water Stewardship
Box 16 - 200 Saulteaux Crescent
Winnipeg MB R3J 3W3

Dear Mr. Matthews:

WUSKWATIM GENERATION STATION - ENVIRONMENT ACT LICENCE - BIRCH TREE LAKE MEAN WATER LEVEL VARIATION ABOVE LICENCE LIMIT

On July 29 and 31, 2015, the mean daily water level variation on Birch Tree Lake was above the licence limit specified in clause 30 (b) of *The Environment Act* Licence No. 2699 (Licence). This letter supplements our August 5, 2015 report regarding these incidents.

The Birch Tree Lake daily water level changes were 0.11 and 0.12 metres (m) on July 29 and 31, 2015 respectively (Figure 1). The licence limits mean daily water level variations on Birch Tree Lake to 0.10 m under open water conditions. The July 29 incident occurred during a significant regional rainfall event and the July 31 incident was partly a result of the operation of the Wuskwatim Generating Station in response to this rainfall event.

A total of about 70 mm of rainfall from July 28 to 29 increased the local inflow and elevated the Birch Tree Lake water level. Hydraulic modeling determined that Wuskwatim Generating Station operations would have caused a Birch Tree Lake daily change of 0.072 m. For this reason, the July 29 incident is not considered a licence violation.

On July 31, Wuskwatim Generating Station changed cycling patterns to deal with increased local inflow from the recent rainfall event. The increased local inflow in the vicinity of Birch Tree Lake from the rainfall event in combination with Wuskwatim Generating Station change in cycling pattern caused Birch Tree Lake to exceed the mean daily water level variation by 0.02 m.

If you have any questions about this matter, please call me at 204-360-3018.

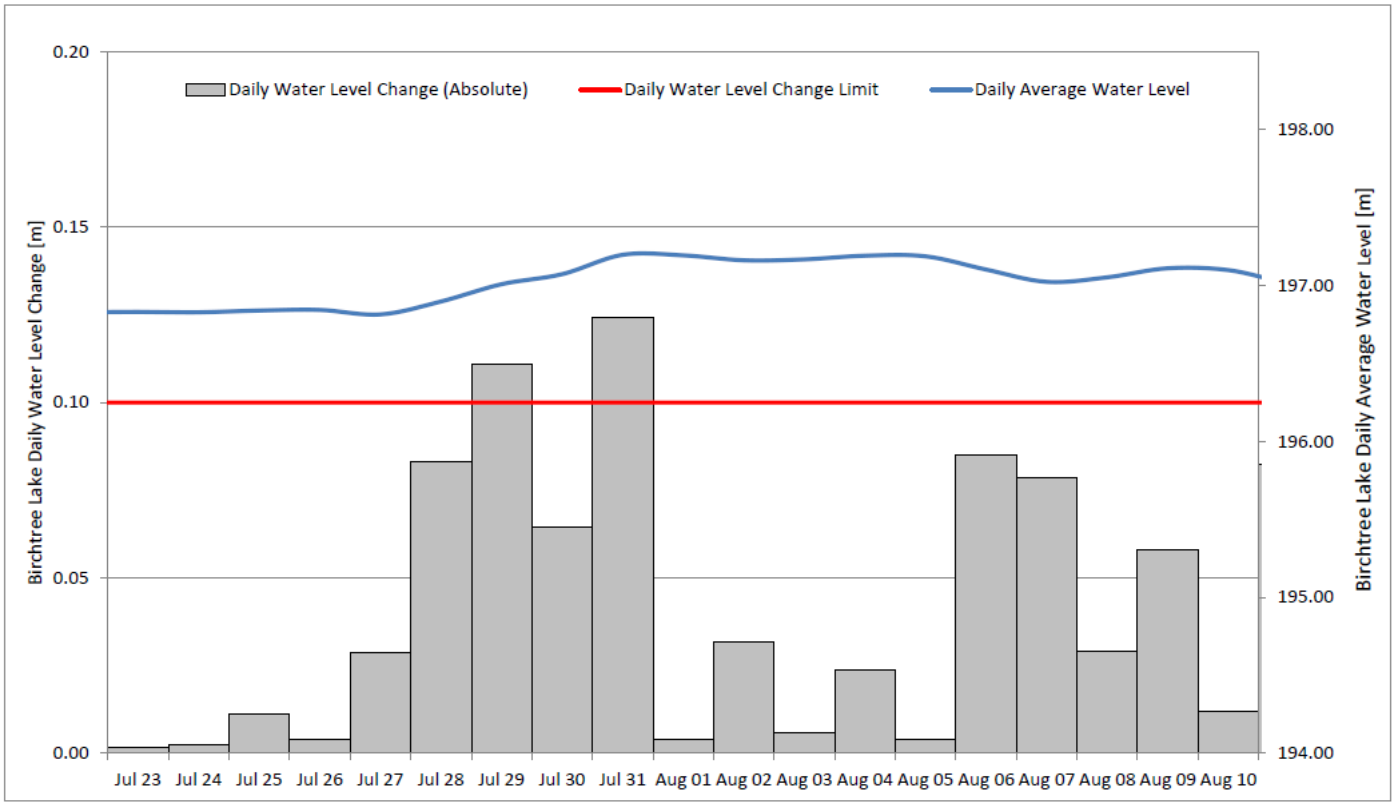
Yours truly,

Original signed by; *Wesley Penner*

W.V. Penner, P. Eng.
Manager
Hydraulic Operations Department

MJD/sl/ 00184-07311-0044_00

Figure 1: Wuskwatim Generating Station - Birchtree Lake Daily Water Level Change



Note: The Birchtree Lake Daily Water Level Change is calculated using Birchtree Lake gauges 05TG701 & 05TG746
The daily water level change limit is equal to 0.1 m in open water conditions (May 1 to October 31) and 0.15 m in winter conditions (November 1 to April 30)

Manitoba Hydro

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wpenner@hydro.mb.ca

2015 10 01

Mr. R. Matthews, P.Geo.
Manager, Water Use Licensing
Manitoba Conservation & Water Stewardship
Box 16- 200 Saulteaux Crescent
Winnipeg MB R3J 3W3

Dear Mr. Matthews:

WUSKWATIM GENERATING STATION - BIRCH TREE LAKE ENVIRONMENT ACT LICENCE - MEAN DAILY WATER LEVEL VARIATION ABOVE LICENCE LIMIT

On September 30, 2015, the mean daily water level variation on Birch Tree Lake was above the licence limit specified in clause 30 (b) of *The Environment Act* Licence No. 2699.

The Birch Tree Lake daily water level change was 0.11 (Figure 1). Clause 30(b) of *The Environment Act* Licence No. 2699 limits mean daily water level variations on Birch Tree Lake to 0.10 metres under open water conditions. Hydraulic Operations Department is investigating the incident and we will advise you of the outcome.

If you have any questions about this matter, please call me at (204) 360-3018.

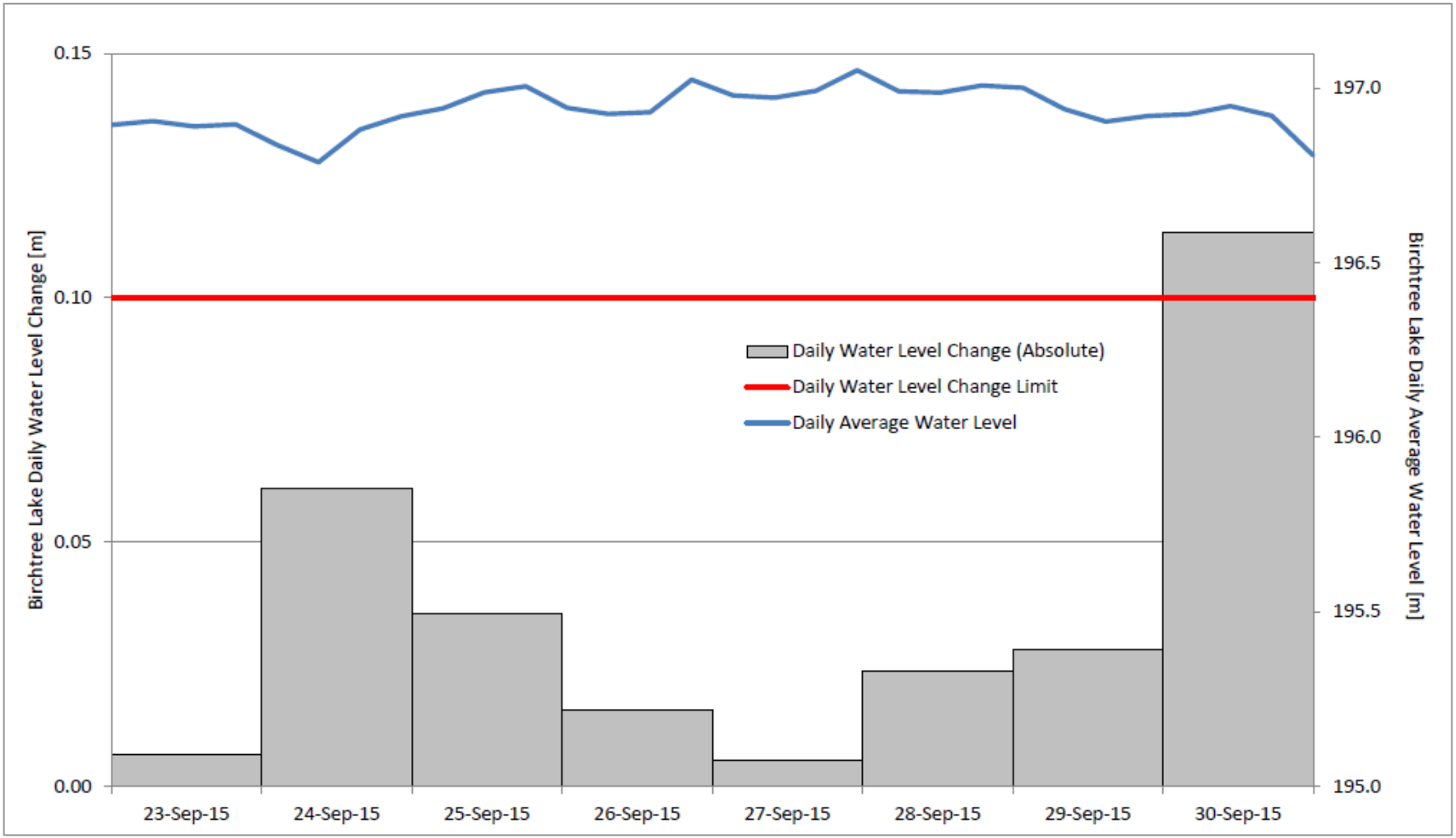
Yours truly,

Original signed by: *Wesley Penner*

W.V. Penner, P. Eng.
Manager
Hydraulic Operations Department

MJD/sl/00184-07311-0043_00
Att.

Figure 1: Wuskwatim Generating Station - Birchtree Lake Daily Water Level Change



Note: The Birchtree Lake Daily Water Level Change is calculated using Birchtree Lake gauges 05TG701, 05TG746
The daily water level change limit is equal to 0.1 m in open water conditions (May 1 to October 31) and 0.15 m in winter conditions (November 1 to April 30)

Manitoba Hydro

360 Portage Ave (16) • Winnipeg Manitoba Canada • R3C 0G8
Telephone / *N° de téléphone :* 204-360-3018 • Fax / *N° de télécopieur :* 204-360-6136
wpenner@hydro.mb.ca

2015 11 10

Mr. R. Matthews, P.Geo.
Manager, Water Use Licensing
Manitoba Conservation & Water Stewardship
Box 16 - 200 Saulteaux Crescent
Winnipeg MB R3J 3W3

Dear Mr. Matthews:

WUSKWATIM GENERATING STATION - ENVIRONMENT ACT LICENCE - BIRCH TREE LAKE MEAN DAILY WATER LEVEL VARIATION ABOVE LICENCE LIMIT

The mean daily water level variation on Birchtree Lake was above the licence limit specified in clause 30 (b) of *The Environment Act* Licence No. 2699 as described below. This letter supplements our October 10, 2015 report regarding this incident.

The Birch Tree Lake daily water level change was 0.11 metres (m) on September 30, 2015 (Figure 1). The licence limits mean daily water level variations on Birch Tree Lake to 0.10 m under open water conditions.

Declining inflows from upstream caused the water level at Wuskwatim Lake to drop (Figure 2). To stop the decline, the cycling pattern was adjusted to reduce overall outflow. This flow reduction caused the Birch Tree lake level to drop and exceeded the mean daily water level variation by 0.01 m on September 30.

If you have any questions about this matter, please call me at 204-360-3018.

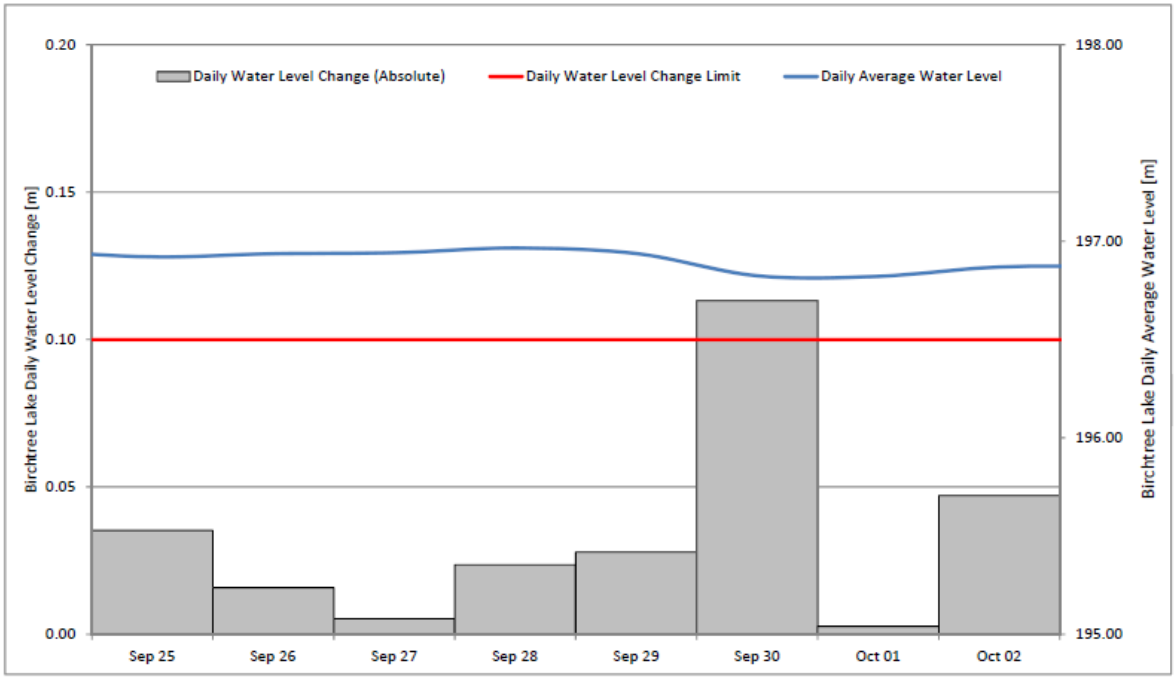
Yours truly,

Original signed by; *Wesley Penner*

W.V. Penner, P. Eng.
Manager
Hydraulic Operations Department

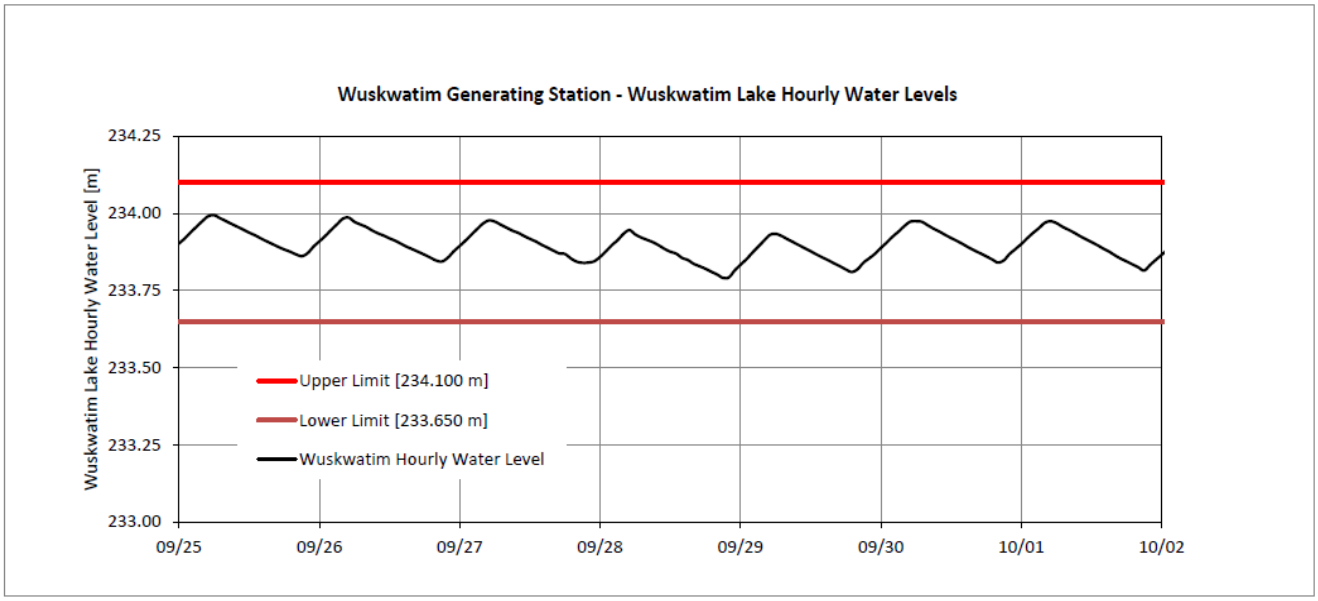
MJD/sl/00184-07311-0046_00

Figure 1:



Note: The Birchtree Lake Daily Water Level Change is calculated using Birchtree Lake gauges 05TG701 & 05TG746
The daily water level change limit is equal to 0.1 m in open water conditions (May 1 to October 31) and 0.15 m in winter conditions (November 1 to April 30)

Figure 2:



Manitoba Hydro

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2015 11 25

Mr. R. Matthews, P.Geo.
Manager, Water Use Licensing
Manitoba Conservation and Water Stewardship
Box 16 - 200 Saulteaux Crescent
Winnipeg MB R3J 3W3

Dear Mr. Matthews:

WUSKWATIM GENERATING STATION - BIRCH TREE LAKE ENVIRONMENT ACT LICENCE - MEAN DAILY WATER LEVEL VARIATION ABOVE LICENCE LIMIT

On November 20, 2015, the mean daily water level variation on Birch Tree Lake was above the licence limit specified in clause 30 (b) of *The Environment Act* Licence No. 2699.

The Birch Tree Lake daily water level change was 0.19 (Figure 1). Clause 30(b) of *The Environment Act* Licence No. 2699 limits mean daily water level variations on Birch Tree Lake to 0.15 metres under winter conditions. Hydraulic Operations Department is investigating the incident and we will advise you of the outcome.

If you have any questions about this matter, please call me at (204) 360-3018.

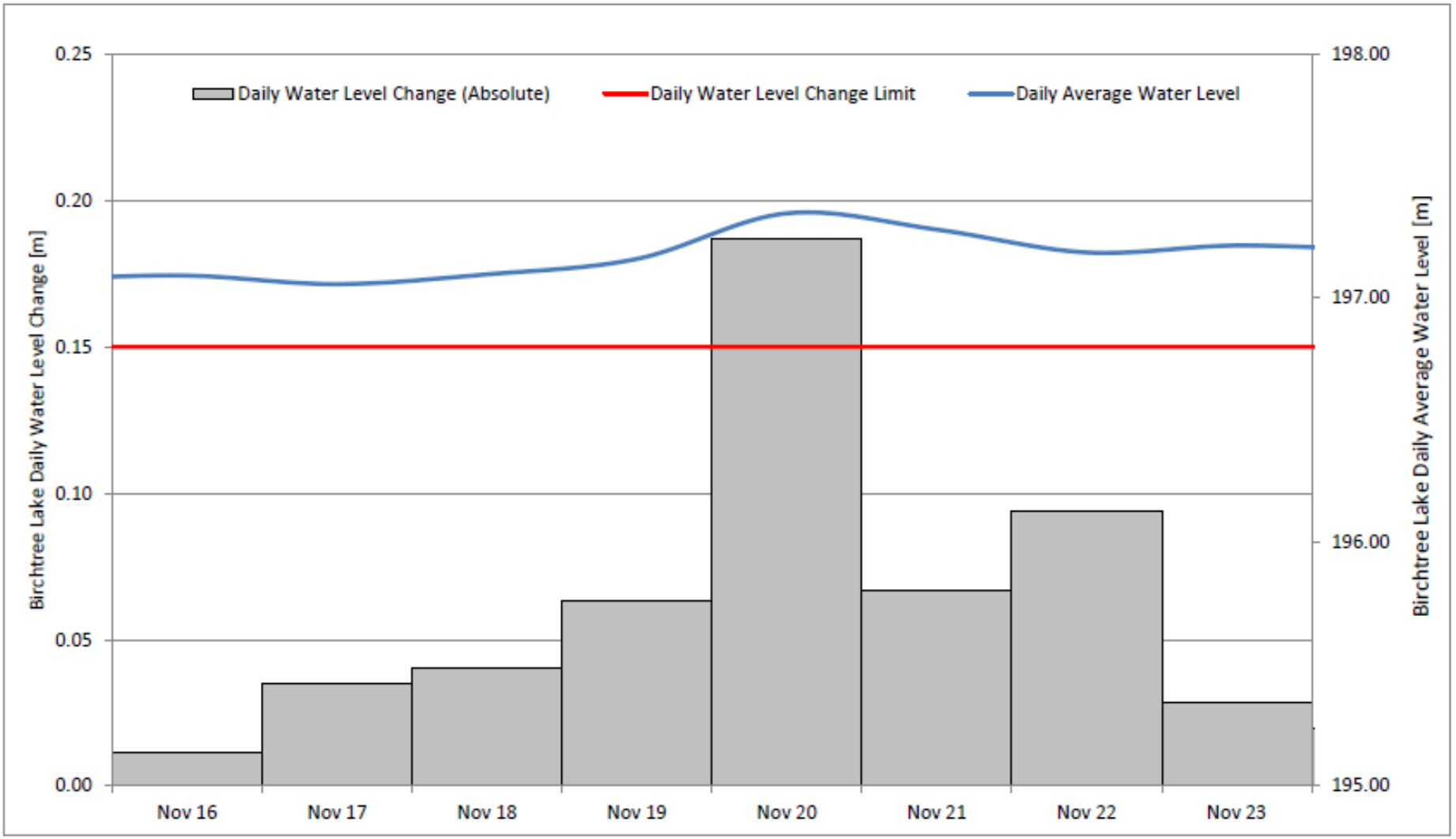
Yours truly,

Original signed by: *Wesley Penner*

W.V. Penner, P. Eng.
Manager
Hydraulic Operations Department

MJD/sl/00184-07311-0047_00
Att.

Figure 1: Wuskwatim Generating Station - Birchtree Lake Daily Water Level Change



Note: The Birchtree Lake Daily Water Level Change is calculated using Birchtree Lake gauges 05TG701 & 05TG746
The daily water level change limit is equal to 0.1 m in open water conditions (May 1 to October 31) and 0.15 m in winter conditions (November 1 to April 30)

Manitoba Hydro

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2016 02 05

Mr. R. Matthews, P.Geo.
Manager, Water Use Licensing
Manitoba Conservation & Water Stewardship
Box 16 - 200 Saulteaux Crescent
Winnipeg MB R3J 3W3

Dear Mr. Matthews:

WUSKWATIM GENERATING STATION - ENVIRONMENT ACT LICENCE - BIRCH TREE LAKE MEAN DAILY WATER LEVEL VARIATION ABOVE LICENCE LIMIT

The mean daily water level variation on Birch Tree Lake was above the licence limit specified in clause 30 (b) of *The Environment Act* Licence No. 2699 as described below. Strong north winds during freeze-up on Birch Tree Lake and at Manasan Ice Control Structure caused the daily water level change on Birch Tree Lake to exceed the licence limit. This licence exceedance is not attributable to Wuskwatim operation. This letter supplements our November 25, 2015 report regarding this incident.

The Birch Tree Lake daily water level change was 0.19 metres (m) on November 20, 2015 (Figure 1). The licence limits mean daily water level variations on Birch Tree Lake to 0.15 m under open winter conditions.

On November 20, ice restriction at Manasan Ice Control Structure during the onset of freeze-up season and strong north winds caused Birch Tree Lake water level to rise. The water level rise caused the daily water level change on Birch Tree to exceed the licence limit by 0.04 m (Figure 1).

Hydraulic modelling results indicate that there was no exceedance on November 20 due to Wuskwatim Generating Station operation. The station total outflow on November 20 was lower than the previous day which should have lowered the Birch Tree Lake water level without the ice restriction and wind event (Figure 2).

If you have any questions about this matter, please call me at 204-360-3018.

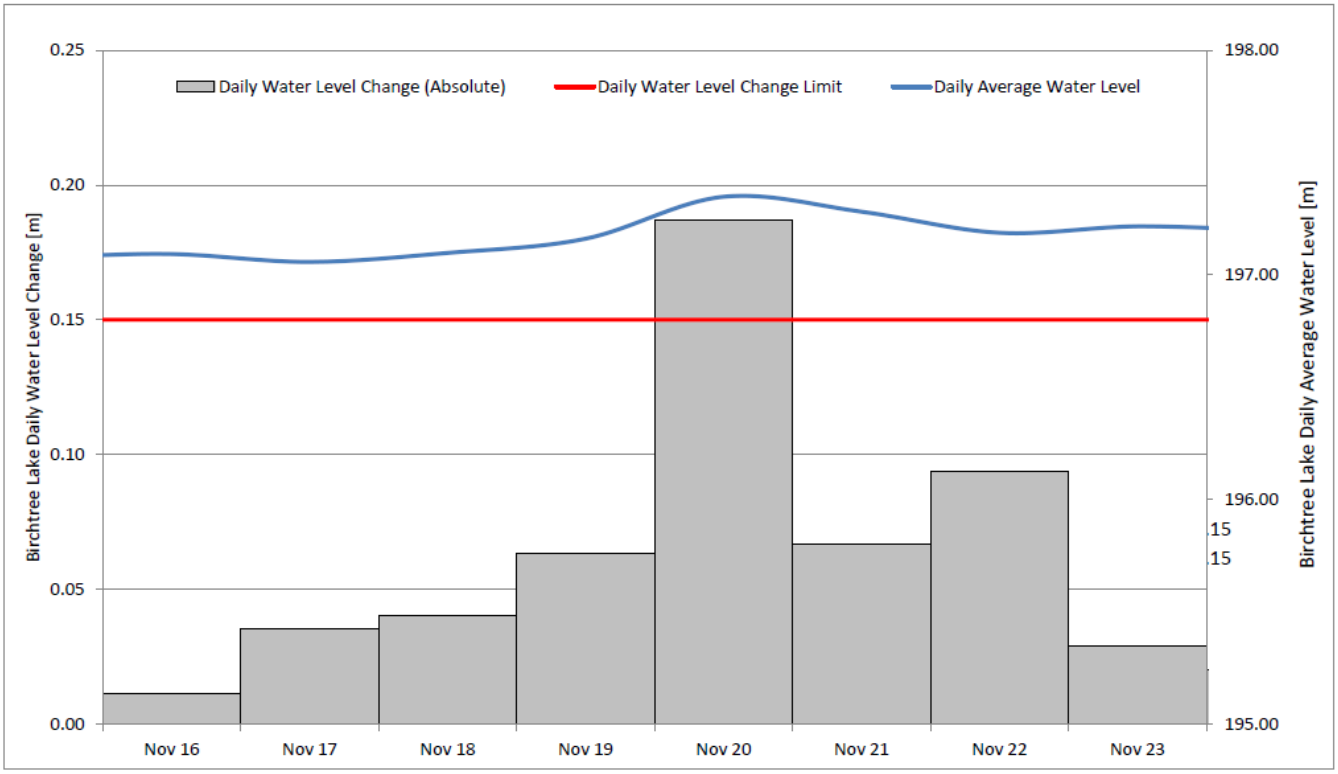
Yours truly,

Original signed by; *Wesley Penner*

W.V. Penner, P. Eng.
Manager
Hydraulic Operations Department

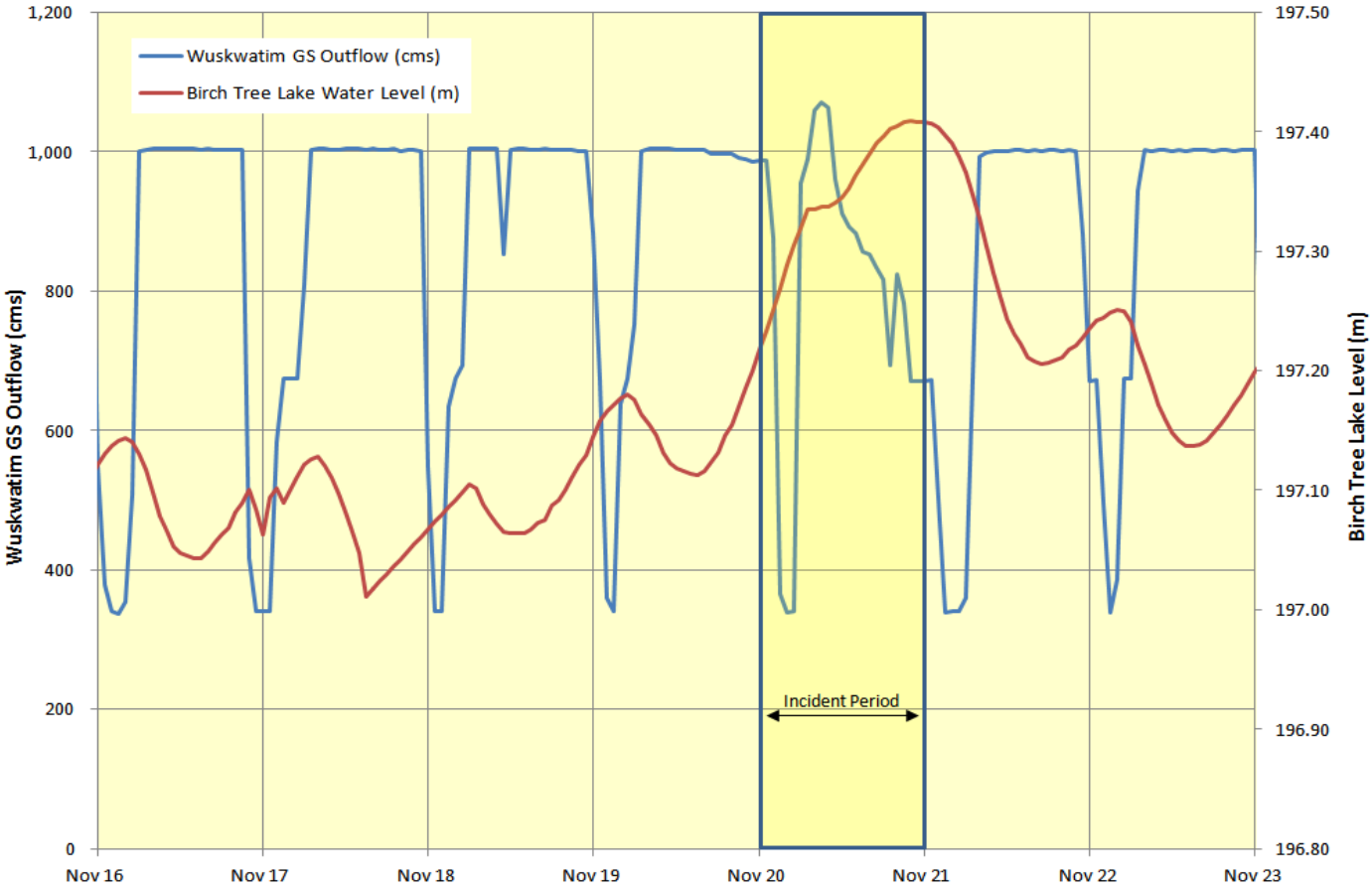
MJD/sl/00184-07311-0048_00
Att.

Figure 1: Birchtree Lake Daily Water Level Change



Note: The Birchtree Lake Daily Water Level Change is calculated using Birchtree Lake gauges 05TG701 & 05TG746
The daily water level change limit is equal to 0.1 m in open water conditions (May 1 to October 31) and 0.15 m in winter conditions (November 1 to April 30)

Figure 2: Hourly Wuskwatim G.S. Outflow and Birch Tree Water Level
November 2015



APPENDIX II

WUSKWATIM GENERATING STATION LICENCE IMPLEMENTATION GUIDE FOR WATER LEVELS

Wuskwatim Power Limited Partnership
Wuskwatim Generating Station
Licence Implementation Guide for Water Levels

Prepared for:
Manitoba Water Stewardship
200 Saulteaux Crescent
Winnipeg, Manitoba R3J 3W3

Prepared by:
Hydraulic Operations Department
Manitoba Hydro
820 Taylor Avenue
Winnipeg, Manitoba R3C 2P4

On behalf of:
Wuskwatim Power Limited Partnership
820 Taylor Avenue
Winnipeg, Manitoba R3C 2P4

July 2007

Report No. PS&O 07/03

Wuskwatim Power Limited Partnership
Wuskwatim Generating Station
Licence Implementation Guide for Water Levels

PREPARED BY: B.W. GIESBRECHT

REVIEWED BY: W.V. PENNER

NOTED BY: T.M. MILES

DATE: 2007 07 03

REPORT NO: PS&O 07/03

APEGM
Certificate of Authorization
Manitoba Hydro
No. 38 Date: 2007 07 05

Foreword

Wuskwatim Power Limited Partnership (WPLP) has been issued licences under the Environment Act and The Water Power Act for the development of the Wuskwatim Generating Project.

The WPLP is a limited partnership of which 5022649 Manitoba Ltd., a wholly owned subsidiary of Manitoba Hydro, is the general partner and Manitoba Hydro and Taskinigahp Power Corporation, wholly owned by Nisichawayasihk Cree Nation, are limited partners.

The WPLP has entered in contracts with Manitoba Hydro for the management, construction and operation of the Wuskwatim generating station in accordance with the provisions of the applicable agreements as set out in the Project Development Agreement between Nisichawayasihk Cree Nation and Manitoba Hydro. Consistent with responsibilities set out in these agreements, Manitoba Hydro has prepared this report on behalf of the WPLP.

Executive Summary

Introduction
In collaboration with Manitoba Water Stewardship, Manitoba Hydro prepared this guideline to document a common understanding of the water regime terms of the Wuskwatim licences. Environment Act Licence No. 2699 and an Interim Water Power Act licence specify operating limits and reporting requirements that must be met for compliance with the licences. As such, this document sets out the mutually understood and agreed to:

- calculation methodology to be used for determining critical levels,
- protocol for reporting to meet licence requirements, and
- manner in which compliance will be defined and assessed.

Wuskwatim Lake
As required by licence, data from a minimum of three water level gauges will be used to determine the Wuskwatim Lake level. A set of averaging and weighting techniques are employed to remove immediate operational effects and the effects of wind and waves.

Birchtree Lake
As required by licence, data from a minimum of two water level gauges will be used to calculate the daily change on Birchtree Lake. Weighting and averaging techniques are used to remove the effect of wind and waves.

Compliance
Compliance with the licence on Wuskwatim Lake will be measured against both hourly water levels and wind-eliminated water levels. In the event that the Birchtree Lake daily change licence constraint is exceeded, a hydraulic model of the Burntwood River will be

used to determine the change attributable to Wuskwatim operations. Compliance with the Environment Act licence will be measured against the model output.

Monthly and annual reports will be issued to Manitoba Water Stewardship in accordance with the Environment Act licence. Special compliance reports will be issued as necessitated by deviations from licence conditions.

Change Management

Revisions to this Implementation Guide are anticipated to accommodate the change from pre-project monitoring to construction to plant operation. Proposed revisions will be discussed with Manitoba Water Stewardship from time to time. Following review and approval of revisions by Manitoba Water Stewardship, a revised copy of this Implementation Guide will be produced and distributed by Wuskwatim Power Limited Partnership.

A five year window is included in the Environment Act licence to review the appropriateness of the included water level parameters. This review window recognizes that the licence parameters are based on model simulations and that measured data may differ from what was anticipated.

Table of Contents

1. Introduction

1.1 Definitions

For the purposes of this implementation guide, unless the context otherwise requires, the following terms shall have the respective meanings set out below and grammatical variations of such terms shall have corresponding meanings:

ASL means above sea level;

Controlling Benchmarks means:

(a) Manitoba Hydro benchmark BM L20A-1 (85MH2H) for Wuskwatim Lake. This benchmark is a brass cap set in bedrock located along the south shore of Wuskwatim Lake approximately 250 metres northeast of the centre of Wuskwatim Falls. The elevation of this benchmark was established by precise spirit leveling methods from GSC benchmark 69M592 located near Taskinigup Falls. The elevation of benchmark BM L20A-1 is 247.380 metres, GSC CGVD28, 1969 local adjustment

(b) Birchtree Lake benchmarks were established by static GPS methods constrained on GSC benchmarks 69M587 (205.226 metres) located just west of Birchtree Lake at Pipe Lake mine, on 69M575 (208.656 metres) located west of Birchtree Lake along PTH #6 and on Hydro 2 located on the Burntwood River upstream of Opegano Lake. This geodetic control effectively surrounds Birchtree Lake and allows for accurate benchmarks to be established on Birchtree Lake.

Birchtree Lake Gauges means the water level gauges established on Birchtree Lake for the purpose of collecting data used in calculating the **Birchtree Lake Hourly Water Level**;

Birchtree Lake Daily Average Water Level means the arithmetic mean of all hourly water levels recorded at the **Birchtree Lake Gauges** for a calendar day;

Birchtree Lake Daily Change means the difference in the **Birchtree Lake Daily Average Water Level** between one calendar day and the previous calendar day;

Wuskwatim Lake Gauges means the water level gauges established on Wuskwatim Lake for the purpose of collecting data used in calculating the **Wuskwatim Mean Daily Water Level (with wind and wave effects eliminated)**;

Wuskwatim Hourly Water Level means the weighted average of available readings of water levels recorded from the top of one hour to the top of the following hour at the **Wuskwatim Lake Gauges,** calculated as set forth in Section 2.2;

Wuskwatim Daily Average Water Level means the arithmetic mean of all **Wuskwatim Hourly Water Level**s for a calendar day;

Wuskwatim Mean Daily Water Level (with wind and wave effects eliminated) means a three day moving mean of the **Wuskwatim Daily Average Water Level**.

1.2 Datum

In accordance with Clause 30(d) of Environment Act Licence No. 2699 and Section 10.3 of the Wuskwatim Site, Burntwood River Interim Water Power Act licence, water level information for the operation of the Wuskwatim Project is based upon Geodetic Survey of Canada (GS of C), Canadian Government Vertical Datum (CGVD) 1928, 1971 Local Adjustment (also referred to as GS of C CGVD28, 1969 Local Adjustment).

1.3 Water Levels and Water Level Fluctuations

All water levels referenced in this implementation guide are to be inferred as measured in terms of elevations **ASL**, GS of C CGVD28 1971 Local Adjustment. All water levels and water level fluctuations referenced in this implementation guide are to be inferred as measured excluding the effects of wind and waves.

1.4 Quality Control

1.4.1 Benchmarks

Vertical control surveys have been performed to establish appropriate local benchmarks around Wuskwatim Lake and Birchtree Lake at hydrometric gauging stations.

Wuskwatim Lake benchmarks were established by water level transfer from **Controlling Benchmarks** using spirit leveling methods and staff gauge readings. These benchmarks are accurate to ± 10mm.

Vertical control on Birchtree Lake did not meet the required standards for long term water level monitoring. Therefore, elevations for the new benchmarks were established using static GPS methods from **Controlling Benchmarks** in the region. The Birchtree Lake benchmarks are accurate to ± 50 mm, a typical error associated with using GPS survey methods.

1.4.2 Direct water level measurements

Field staff will visit the **Wuskwatim Lake Gauges** and the **Birchtree Lake Gauges** on a two month cycle as a minimum. Additional site visits will be conducted as necessary to maintain gauge performance. Direct water level measurements are taken during these visits and compared to the level indicated by the water level sensor. Direct water level measurements for lakes of this size are typically accurate to within ±5 mm with the instrument error accounting for ±0.8 mm.

1.4.3 Gauge readings

Manitoba Hydro uses pressure transducers to determine water levels at its existing hydrometric gauging stations and at the **Wuskwatim Lake Gauges** and the **Birchtree Lake Gauges**. The error in the reading provided by the pressure transducer is ±0.75 mm given the scale setting that is typically used by Manitoba Hydro. The transducers are temperature corrected, however, if the temperature correction malfunctions, the reading can drift between site visits by up to 0.1 metres, although drift of this magnitude is rare. If the technician visiting the site determines that the transducer reading is more than ±5 mm different from the direct water level measured in accordance with Subsection 1.4.2, the transducer is reset to the direct water level measurement. If the transducer reading is less than ±5 mm different from the direct water level measured in accordance with Subsection 1.4.2, no change is made to the transducer setting.

1.5 Quality assurance procedure for water level data

Water level data exists in three degrees of quality assurance – raw, provisional and final.

Raw data is real-time data that has been transmitted from the field. The only level of quality assurance is that built in to the data collection system, described in Section 1.4. This level of data is used in the daily operation of the Wuskwatim Generating Station. This level of data is also reported monthly in accordance with Subsection 4.3.3 of this guide.

Provisional data is data processed by a qualified data assurance technician who reviews the field data and corrects obvious errors. The data is compared to all available relevant data in the area to verify its accuracy.

Final data has been through two levels of review by qualified technicians and a final review by a professional engineer. This data is considered publishable and has met the quality assurance standards of the National Hydrometric Program. This data will be used for annual reporting described in Subsection 4.3.4 of this guide

2. Wuskwatim Lake

2.1 Gauge location criteria

In accordance with Clause 30(a) of Environment Act Licence 2699, a minimum of three water level gauges will be used in determining the water level of Wuskwatim Lake. Six test locations for the **Wuskwatim Lake Gauges**, shown in Figure 1, have gauges installed temporarily for the purpose of collecting and analyzing water level data. Detailed gauge descriptions are included in Appendix A. From the six test locations, final locations will be selected for the **Wuskwatim Lake Gauges**. Final gauge locations will be in spots that exhibit a minimum variation in water level due to wind speed and direction.

2.2 Wuskwatim Wind-Eliminated Water Level calculation procedure

Clause 30(a) of Environment Act Licence No. 2699 and Section 4.2 of the Interim Water Power Act licence place limits on Wuskwatim Lake water levels. Wuskwatim Lake water levels will be influenced by Wuskwatim operations. Water levels will also be affected by local meteorological events and non-project hydraulic effects. Significant local weather impacts can result from heavy precipitation, the movement of high and low pressure cells and large wind events. Non-project hydraulic impacts may result from upstream storage and release of water caused by changing ice conditions, operation of Notigi Control Structure, rapid spring runoff. To properly evaluate the wind-eliminated water level, averaging techniques are used to remove these effects. Small, short-term weather and hydraulic events can be smoothed out using multiple gauges, gauge weighting and a daily average water level. Larger, long-term events require a longer duration averaging technique. For a lake of this size, a three-day moving mean is appropriate.

In order to ensure that the Licensee's operations remain within the constraints of its licences, compliance will be measured against both the **Wuskwatim Hourly Water Level** and the **Wuskwatim Mean Daily Water Level (with wind and wave effects eliminated)**.

2.2.1 Hourly averaging and weighting

The **Wuskwatim Lake Gauges** will be set to record spot water levels from which the hourly average water level at each gauge location will be calculated. The hourly average water levels from each of the **Wuskwatim Lake Gauges** will be used to determine the **Wuskwatim Hourly Water Level** as shown in Equation 1. The **Wuskwatim Hourly Water Level** is one measure of compliance with Environment Act Licence 2699 and the Interim Water Power Act licence as discussed in Section 4.1, below.

$$HAWL = \sum_{n} \left(W_n G_n \right) \qquad [1]$$

where

$HAWL$ = **Wuskwatim Hourly Water Level**
G_n = hourly average water level for **Wuskwatim Lake Gauge** n
W_n = weighting factor for **Wuskwatim Lake Gauge** n

and

$$\sum_n W_n = 1$$

Weights are assigned in inverse proportion to the standard deviation of each **Wuskwatim Lake Gauge**'s recorded water levels from the **Wuskwatim Mean Daily Water Level (with wind and wave effects eliminated)**. Tables of current weighting factors are included in Appendix B.

Weights will be reviewed regularly and a table of current weights will be included in each annual compliance report.

2.2.2 Three-day moving average

As an intermediate step in determining the **Wuskwatim Mean Daily Water Level (with wind and wave effects eliminated)**, the **Wuskwatim Daily Average Water Level** will be calculated as the arithmetic mean of the **Wuskwatim Hourly Water Level**s as shown in Equation 2.

$$DAWL = \frac{\sum_{i=1}^{n} HAWL_i}{n} \qquad [2]$$

where

$DAWL$ = the **Wuskwatim Daily Average Water Level**
$HAWL_i$ = the **Wuskwatim Hourly Water Level** for hour i
n = the number of available hourly readings for that calendar day

A three-day moving average as shown in Equation 3, will be applied to the **Wuskwatim Daily Average Water Level** data stream to produce the **Wuskwatim Mean Daily Water Level (with wind and wave effects eliminated)**.

$$WEWL_i = \frac{DAWL_{i-2} + DAWL_{i-1} + DAWL_i}{3} \qquad [3]$$

where

$WEWL_i$ = **Wuskwatim Mean Daily Water Level (with wind and wave effects eliminated)** for day i
$DAWL_i$ = **Wuskwatim Daily Average Water Level** for day i

3. Birchtree Lake

3.1 Gauge location criteria

In accordance with Clause 30(c) of Environment Act Licence 2699, a minimum of two water level gauges will be used in determining the **Birchtree Lake Daily Change** for the purpose of licence compliance. In addition to Manitoba Hydro gauge 05TG701 already located on Birchtree Lake, three more test locations for the **Birchtree Lake Gauges**, shown in Figure 2, have gauges installed temporarily for the purpose of collecting and analyzing water level data. Detailed gauge descriptions are located in Appendix A. The final **Birchtree Lake Gauges** will be the ones that exhibit a minimum variation in water level due to wind speed and direction.

3.2 Method to determine magnitude of project impacts on Birchtree Lake Daily Change

Clause 30(b) of Environment Act Licence No. 2699 limits mean daily water level variations on Birchtree Lake to 0.10 metres under open water conditions and 0.15 metres under winter conditions. Water level changes on Birchtree Lake will be affected by Wuskwatim Generating Station operations. Water level changes are also influenced by local meteorological events and by non-project hydraulic effects. The **Birchtree Lake Daily Change** is calculated using the method described in 3.2.1 which attempts to eliminate the effect of wind-driven waves. If the **Birchtree Lake Daily Change** exceeds the limits in Clause 30(b), hydraulic modeling will be completed to estimate the project impact and meteorological and non-project hydraulic impacts will be assessed.

3.2.1 Birchtree Lake Daily Change calculation

Wind and wave effect elimination will be accomplished by calculating a weighted daily average of the water levels recorded by the **Birchtree Lake Gauges** as shown in Equations 4 and 5.

$$BL = \sum_n W_n BG_n \qquad [4]$$

where:

BL = Birchtree Lake hourly water level
W_n = weighting factor for **Birchtree Lake Gauge** n
BG_n = hourly average water level for **Birchtree Lake Gauge** n

and

$$\sum_n W_n = 1$$

$$BLDA = \frac{\sum_{i=1}^{m} BL_i}{m} \qquad [5]$$

where:

BLDA = **Birchtree Lake Daily Average Water Level**
BL_i = Birchtree Lake hourly water level for hour *i*
m = the number of available hourly readings for that calendar day

Weights are assigned in inverse proportion to the standard deviation of each **Birchtree Lake Gauge**'s recorded water levels from the **Birchtree Lake Daily Average Water Level**. Tables of current weighting factors are included in Appendix B.

Weights will be reviewed regularly and a table of current weights will be included in each annual compliance report.

The **Birchtree Lake Daily Change** will be calculated as the absolute difference in **Birchtree Lake Daily Average Water Level** between that calendar day and the previous calendar day as shown in Equation 6.

$$BLDC_j = \left| BLDA_j - BLDA_{j-1} \right| \quad [6]$$

where:

$BLDC_j$ = **Birchtree Lake Daily Change** for calendar day *j*
BLDAj = the **Birchtree Lake Daily Average Water Level** for calendar day *j*

3.2.2 Wuskwatim operational impact determination

As part of the preparation of the Environmental Impact Statement for the Wuskwatim Generating Station, a hydraulic model was developed for the Burntwood River from Wuskwatim Generating Station to First Rapids. In the event that the **Birchtree Lake Daily Change** exceeds 0.10 metres under open water conditions or 0.15 metres under winter conditions, such a model will be used to determine the magnitude of the **Birchtree Lake Daily Change** that is attributable to Wuskwatim Generating Station operations. Actual Wuskwatim outflows preceding such an event will be used as the input hydrograph for the model. The model output will show the impact of Wuskwatim operations on the water level changes recorded on Birchtree Lake.

3.2.3 Meteorological impacts

Local weather can cause an impact on the **Birchtree Lake Daily Change** that is not attributable to Wuskwatim Generating Station operations. Local precipitation can result in a rapid rise of Birchtree Lake water level. The passage of pressure cells can temporarily raise or lower the lake level. Large wind events may produce an effect on water levels that cannot be removed using the weighting technique described in Subsection 3.2.1. Local precipitation data is available from the Environment Canada weather station at Thompson Airport, the Manitoba Hydro weather station at Wuskwatim Generating Station and the Manitoba Hydro weather station at Birchtree Lake. These same weather stations provide atmospheric pressure data and wind speed and direction data. An estimate of the magnitude of the meteorological impact on the **Birchtree Lake**

Daily Change will be made using the model when the **Birchtree Lake Daily Change** exceeds the licence limit.

3.2.4 Non-project hydraulic impacts

Hydraulic impacts caused by factors other than Wuskwatim Generating Station operations can impact the **Birchtree Lake Daily Change**. Such factors include but are not limited to varying upstream storage and release of water caused by ice conditions, varying ice conditions at Manasan Control Structure, operation of the Manasan control structure fuse plug and rapid spring runoff. An estimate of the magnitude of such an impact on the **Birchtree Lake Daily Change** will be made using the model when the **Birchtree Lake Daily Change** exceeds the licence limit.

4. Compliance

4.1 Wuskwatim Lake

Clause 30(a) of Environment Act Licence No. 2699 states that the Licensee shall operate the Development within the following parameters:

> *maintain the mean daily water level on Wuskwatim Lake (wind and wave effects eliminated) between 233.75 meters and 234.0 meters Above Sea Level (ASL), as determined by measurements from a minimum of three water level monitoring stations on Wuskwatim Lake*

Section 4.2 of the Wuskwatim Interim Water Power Act licence states that:

> *The Licensee shall not raise the headwaters of its development above an elevation of 234.0 metres ASL as measured on Wuskwatim Lake, except as ordered by the Minister under Clause 72(b) of the Water Power Regulation or as fixed by the Minister under Clause 72(c) of the Water Power Regulation.*

The forebay level shall be in compliance with the upper limit described above if:

1. The **Wuskwatim Mean Daily Water Level (with wind and wave effects eliminated)** does not exceed 234.0 metres, and
2. The **Wuskwatim Hourly Water Level** does not exceed 234.1 metres more than two times for two consecutive hours each time in any 24 hour period .

The forebay level shall be in compliance with the lower limit described above if:

1. The **Wuskwatim Mean Daily Water Level (with wind and wave effects eliminated)** does not recede below 233.75 metres, and
2. The **Wuskwatim Hourly Water Level** does not recede below 233.65 metres more than two times for two consecutive hours each time in any 24 hour period.

4.2 Birchtree Lake

Clause 30(b) of Environment Act Licence No. 2699 states that the Licensee shall operate the Development within the following parameters:

> *maintain mean daily water levels on Birchtree Lake such that the daily water level variations shall be less than 0.10 meters and 0.15 meters in open water and winter conditions (wind and wave effects eliminated) respectively. Any exceptions to these fluctuations shall be reported within one week to Manitoba Water Stewardship*

For the purposes of licence compliance, open water will refer to the period from May 1 to October 31 and winter will refer to the period from November 1 to April 30. The **Birchtree Lake Daily Change** shall be deemed to be in compliance when:

1. The **Birchtree Lake Daily Change** is below these seasonal limits, or
2. The **Birchtree Lake Daily Change** is above these seasonal limits but the change attributable to Wuskwatim Generating Station is below these seasonal limits.

4.3 Reporting

4.3.1 Compliance Reporting

In the event that the Wuskwatim Generating Station forebay level is not in compliance with the licence limits as described in Section 4.1 above, notification shall be made to Manitoba Water Stewardship within one week of the incident. A follow-up report on causes contributing to the event and changes to operations, if any are needed to prevent such an event in the future, will be provided to Manitoba Water Stewardship.

When the **Birchtree Lake Daily Change** exceeds the open water or winter limit, notification shall be made to Manitoba Water Stewardship within one week of the incident in accordance with Clause 30(b) of Environment Act Licence No. 2699. A follow-up report containing the modeled Wuskwatim-based contribution to the **Birchtree Lake Daily Change** and a discussion of other factors affecting the **Birchtree Lake Daily Change** shall be provided to Manitoba Water Stewardship.

4.3.2 Regular Monthly Reporting

Clause 33 of Environment Act Licence No. 2699 states that:

> *The Licensee shall report, to Manitoba Water Stewardship, on a monthly and annual basis, the water levels monitored pursuant to Clauses 30 (a) and (c) of this Licence including other relevant station and related system operating characteristics. These reports shall also be provided to the Nelson House Resource Management Board, all communities on the Manitoba Hydro Churchill River Diversion Augmented Flow Program notification list and posted on the Manitoba Hydro web site.*

Monthly water level reports will be provided in accordance with Clause 33 of Environment Act Licence No. 2699. These reports will use raw data from the **Wuskwatim Lake Gauges** and the **Birchtree Lake Gauges**. The reports will contain the **Wuskwatim Hourly Water Level** and the **Wuskwatim Mean Daily Water Level (with wind and wave effects eliminated)** calculated in accordance with Section 2.2 and the **Birchtree Lake Daily Change** calculated in accordance with Subsection 3.2.1.

4.3.3 Regular Annual Reporting

An annual water level report for each calendar year will be provided in accordance with Clause 33 of Environment Act Licence No. 2699. This report will use final data from the **Wuskwatim Lake Gauges** and the **Birchtree Lake Gauges.** The report will contain the final **Wuskwatim Hourly Water Level**, the final **Wuskwatim Mean Daily Water Level (with wind and wave effects eliminated)** and the final **Birchtree Lake Daily Change**. The annual report will also contain any compliance reports issued in that year. Due to the quality assurance processing time, this report will be issued by June 1 of the following year.

5. Change Management

5.1 Regular Updates

Revisions to this Implementation Guide are anticipated to accommodate the change from pre-project monitoring to construction to plant operation. Proposed revisions to this Implementation Guide will be reviewed with Manitoba Water Stewardship from time to time. Following review and approval of revisions by Manitoba Water Stewardship, a revised copy of this Implementation Guide will be produced and distributed by Wuskwatim Power Limited Partnership.

5.2 Comprehensive Review

Clause 34 of Environment Act Licence No. 2699 states that:

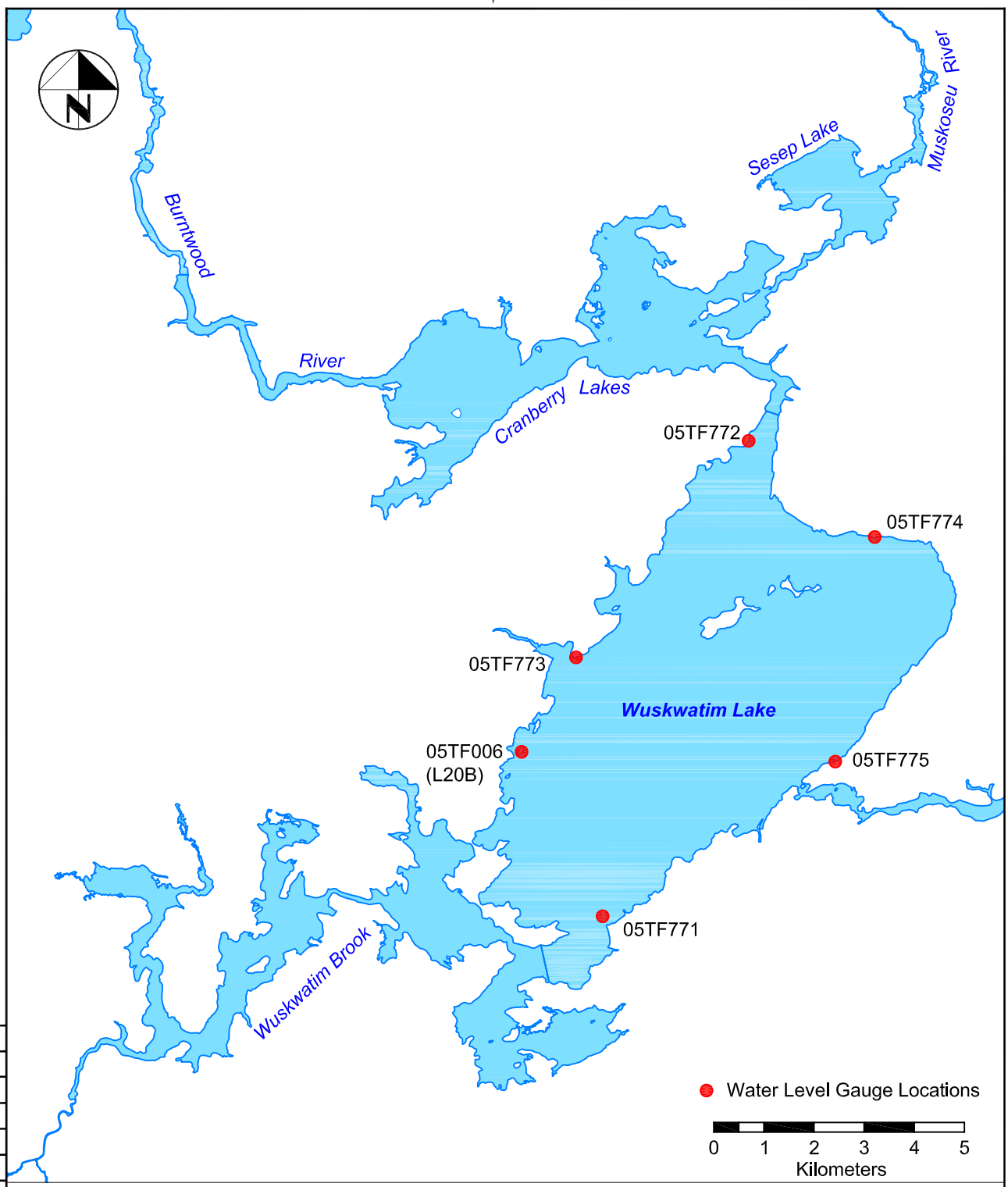
> *The Licensee shall at the commencement of the operation of the Development and for a period of fiver years, unless otherwise directed by the Minister, monitor daily water level variations and the frequency and magnitude of exceedances for the purpose of confirming the appropriateness of the parameters prescribed in Clause 30 of this Licence or the need for adjustments to reflect local hydrological conditions.*

The limits placed on water level and water level fluctuations in Environment Act Licence No. 2699 were based on hydraulic modeling results. This review period provided in Clause 34 was established to corroborate the modeling results with data collected after the generating station becomes operational. At the start of year four of Wuskwatim operation, a licence parameter review process will be initiated by Wuskwatim Power Limited Partnership in collaboration with Manitoba Water Stewardship.

Figures

Appendix A

Water level gauge description sheets



A SIZE – 184 X 279

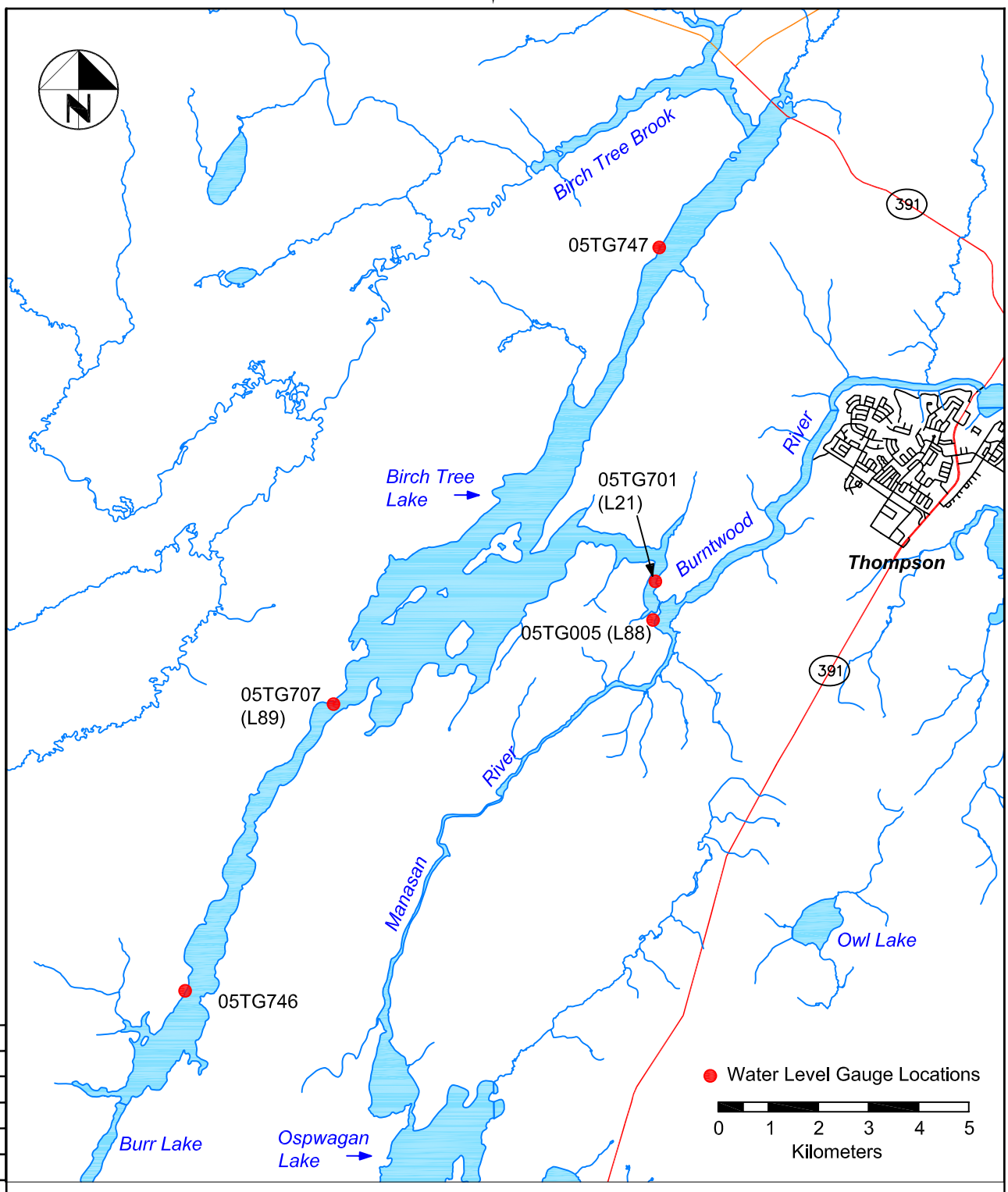
FOR MICROFILMING USE ONLY

NOTED	NO.	DATE	REVISIONS	BY	CKD.	APP.
DESIGN			MANITOBA HYDRO			
TELEPHONE			WUSKWATIM GENERATING STATION			
ELECTRICAL			WATER LEVEL GAUGE TEST LOCATIONS ON WUSKWATIM LAKE			
F.P. ENGINEER						
MECHANICAL	DRAWN	K.R.				
DISTRIBUTION	DESIGN	BG				
PROJECT	DSCALE	AS SHOWN				
CONSTRUCTION	PSCALE	1/8"=1'-0"				
MANAGER	DATE	07/04/02				

SHT. 0001 REV. 00

AUTOCAD ORIGINAL

✳ REDUCED SIZED PLOT



A SIZE - 184 X 279

FOR MICROFILMING USE ONLY

NOTED	NO.	DATE	REVISIONS	BY	CKD.	APP.
DESIGN						
TELEPHONE						
ELECTRICAL						
F.P. ENGINEER						
MECHANICAL						
DISTRIBUTION						
PROJECT						
CONSTRUCTION						
MANAGER						

DRAWN	K.R.
DESIGN	BG
DSCALE	AS SHOWN
PSCALE	1/8"=1'-0"
DATE	07/03/30

MANITOBA HYDRO

WUSKWATIM GENERATING STATION

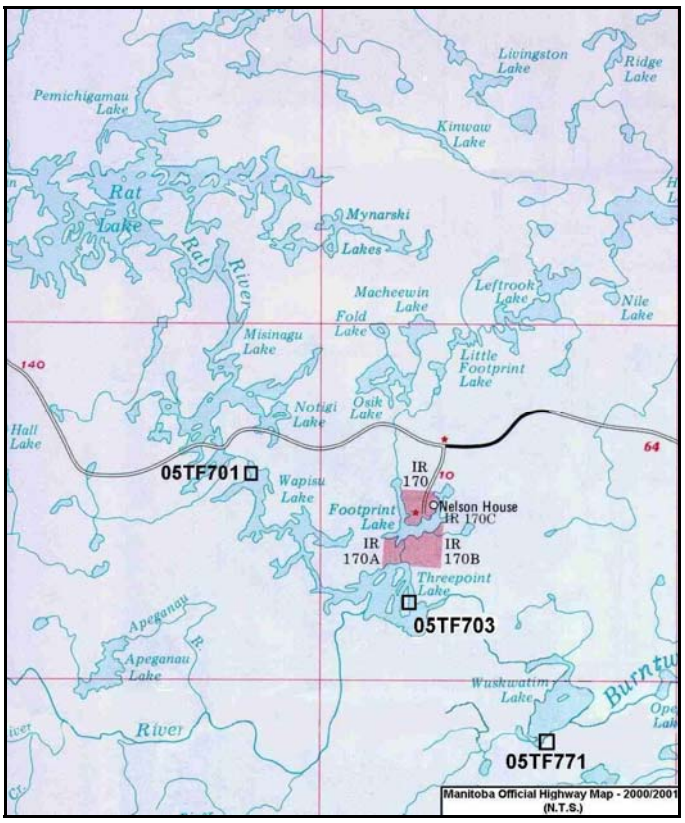
WATER LEVEL GAUGE TEST LOCATIONS ON BIRCHTREE LAKE

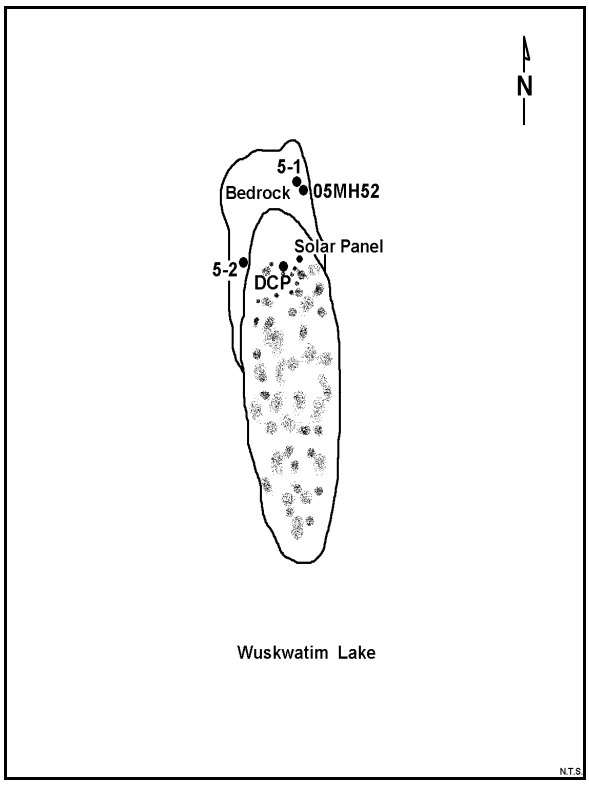
SHT.	REV.
0001	00

AUTOCAD ORIGINAL

✳ REDUCED SIZED PLOT

Wuskwatim Lake Site #5





Number: **05TF771**

Name: **Wuskwatim Lake Site #5**

DCP Id: Drainage Area (km2):

Latitude: 55° 31' 06" Longitude: -98° 34' 42"

Operator: Manitoba Hydro, Thompson

Established: September 2005

Location: On the SE side of Wuskwatim Lake on a small island approx. 3.5 km S of the exit.

Equipment: A Campbell Scientific CR10X data logger, firmware version 1.21, with an SDI-12 Keller pressure transducer in a Campbell Scientific fiberglass enclosure. Solar panel and an external 12 volt gel cell battery in a cooler.

Metering:

Access: Helicopter and boat.

Station Status: Active

Datum: GSC CGVD28 1969 Manitoba Hydro local adjustment

Bench Marks:

05MH52 - Elevation – 234.305 m. A Manitoba Hydro brass cap set in bedrock near water's edge marked with a 3/8" diameter rebar. It is approx. 23.5 m NW of hilti bolt 5-2 and 0.65 m SE of hilti bolt 5-1.

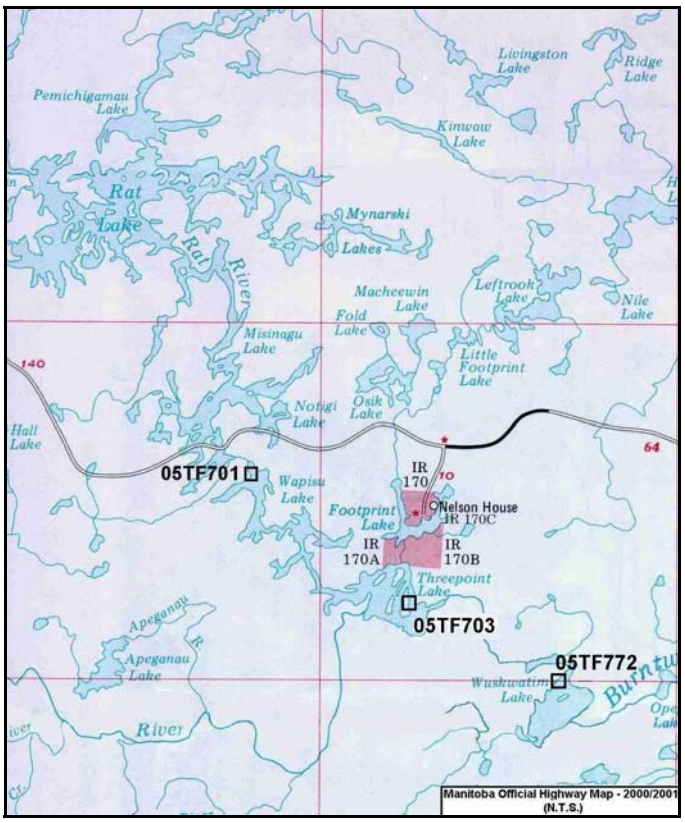
5-2 - Elevation – 234.264 m. A Manitoba Hydro brass cap set in bedrock near water's edge. Brass cap is 11.9 m W from DCP and marked with a 5/8" diameter rebar. Brass cap is 24.1 m SW of hilti bolt 5-1.

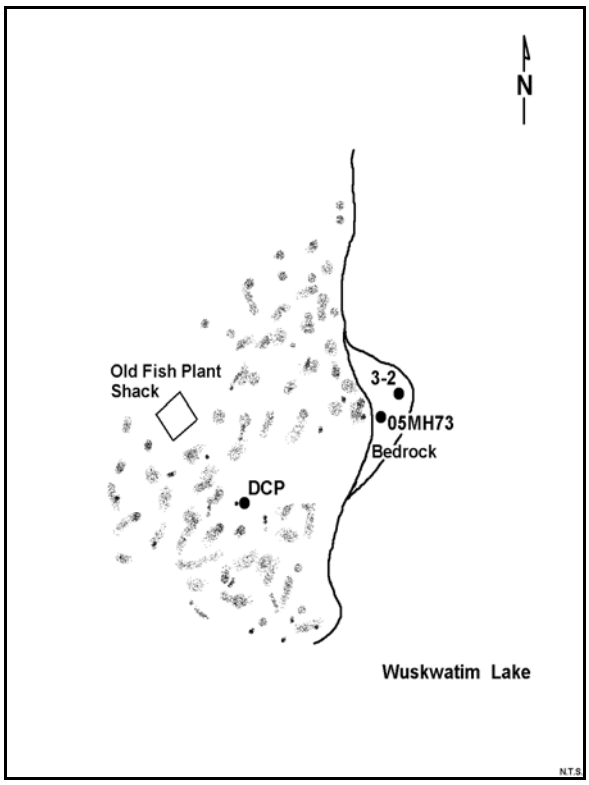
5-1 - Elevation – 234.389 m. A hilti bolt drilled into bedrock near water's edge and marked with a flagged tripod 7.6 m from NE edge of the island and 0.65 m NW of BM 05MH52.

Additional Information:

Source file to PDF: **2007-01-17** Source file last modified: **2007-01-17** Compiled By: A.L. Janier Checked By:

Wuskwatim Lake Site #3





Number: **05TF772**

Name: **Wuskwatim Lake Site #3**

DCP Id: Drainage Area (km2):

Latitude: 55° 36' 12" Longitude: -98° 31' 54"

Operator: Manitoba Hydro, Thompson

Established: September 2005

Location: At the entrance to Wuskwatim Lake on the NW shore at the old fish plant site.

Equipment: A Campbell Scientific CR10X data logger, firmware version 1.21, with an SDI-12 Keller pressure transducer in a Campbell Scientific fiberglass enclosure. Solar panel and an external 12 volt gel cell battery in a cooler.

Metering:

Access: Helicopter and boat.

Station Status: Active

Datum: GSC CGVD28 1969 Manitoba Hydro local adjustment

Bench Marks:

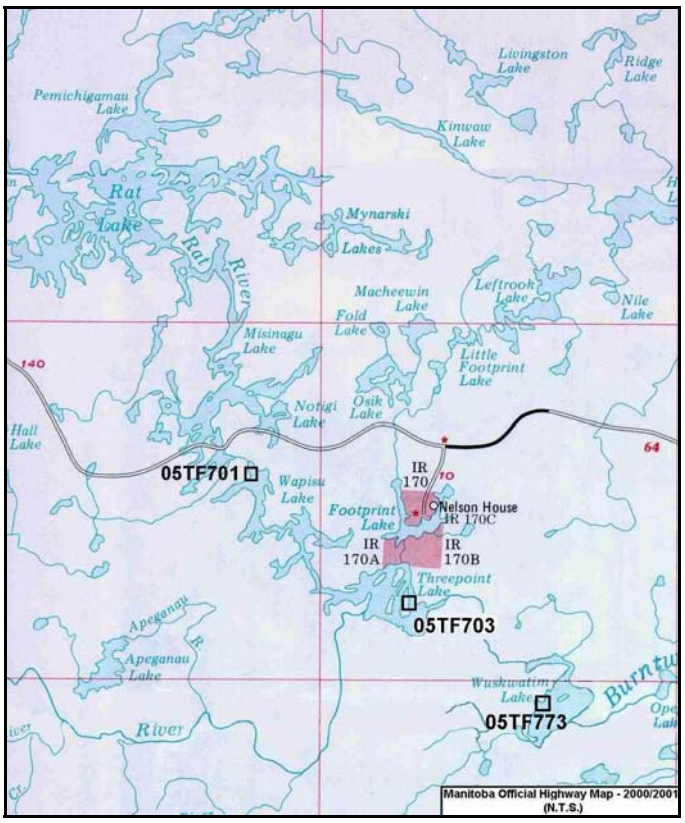
05MH73 – Master - Elevation – 234.183 m. A Manitoba Hydro brass cap stamped 05MH73 set in bedrock near water's edge. Brass cap is 12.2 m NE from DCP and approx. 2 m SW of hilti bolt and marked with a 5/8" diameter rebar.

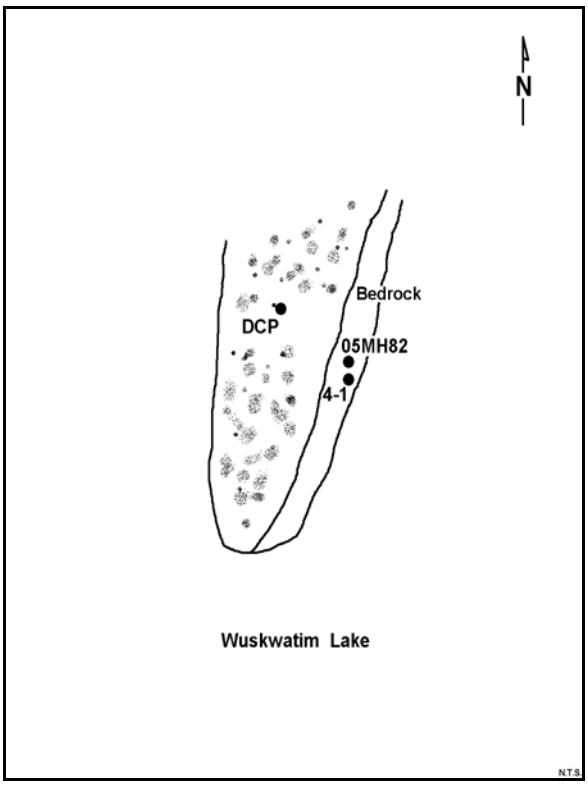
3-2 - Elevation – 233.709 m. A hilti bolt drilled into bedrock near water's edge on the edge of the same rock outcrop as BM 05MH73 and approx. 2 m NE of BM 05MH73.

Additional Information: Shef Codes: TW, HG, ZT, VB

Source file to PDF: **2006-06-15** Source file last modified: **2006-06-15** Compiled By: A.L. Janier Checked By:

Wuskwatim Lake Site #4





Number: **05TF773**

Name: **Wuskwatim Lake Site #4**

DCP Id: Drainage Area (km2):

Latitude: 55° 33' 53" Longitude: -98° 35' 12"

Operator: Manitoba Hydro, Thompson

Established: August 2005

Location: On a point of land on the W shore of Wuskwatim Lake NW of the exit.

Equipment: A Campbell Scientific CR10X data logger, firmware version 1.21, with an SDI-12 Keller pressure transducer in a Campbell Scientific fiberglass enclosure. Solar panel and an external 12 volt gel cell battery in a cooler.

Metering:

Access: Helicopter and boat.

Station Status: Active

Datum: GSC CGVD28 1969 Manitoba Hydro local adjustment

Bench Marks:

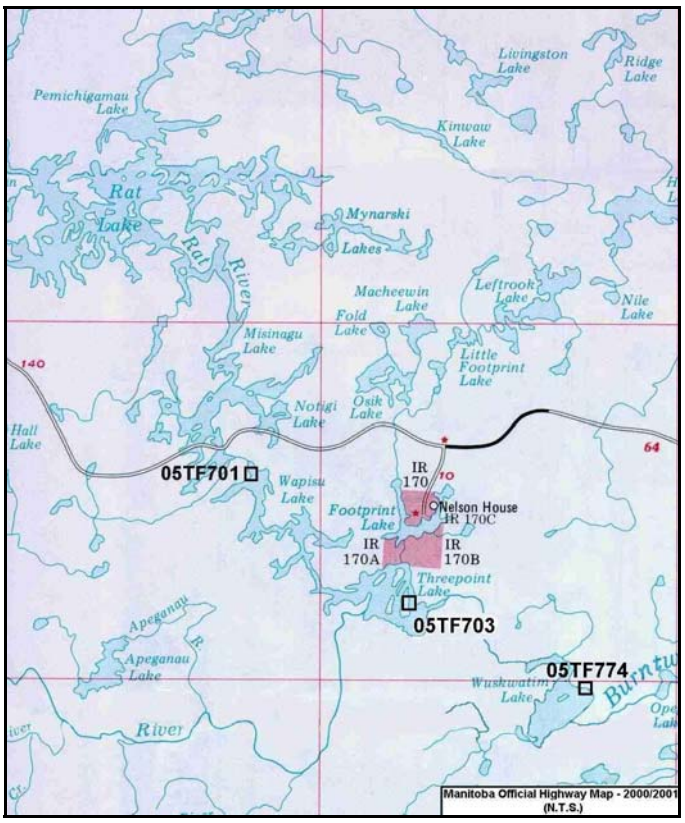
05MH82 (4-2) – Master - Elevation – 234.458 m. A Manitoba Hydro brass cap stamped 05MH82 set in bedrock near water's edge. Brass cap is 11.0 m SE from DCP marked with a 3/8" diameter rebar and is 0.25 m N of hilti bolt 4-1.

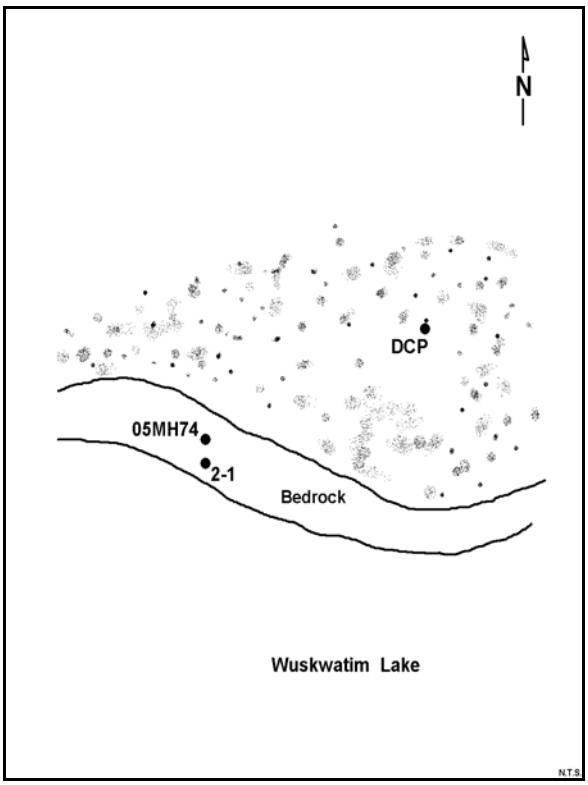
4-1 - Elevation – 234.475 m. A hilti bolt drilled into bedrock near water's edge. Hilti bolt is 11.0 m SE from DCP and marked with a 3/8" diameter rebar 0.25 m S of BM 05MH82.

Additional Information:

Source file to PDF: **2006-04-07** Source file last modified: **2006-04-07** Compiled By: A.L. Janier Checked By:

Wuskwatim Lake Site #2





Number: **05TF774**

Name: **Wuskwatim Lake Site #2**

DCP Id: Drainage Area (km2):

Latitude: 55° 35' 09" Longitude: -98° 29' 31"

Operator: Manitoba Hydro, Thompson

Established: August 2005

Location: On N shore of Wuskwatim Lake approx. 3 km E of the inlet and approx. 3.5 km N of exit .

Equipment: A Campbell Scientific CR10X data logger, firmware version 1.21, with an SDI-12 Keller pressure transducer in a Campbell Scientific fiberglass enclosure. Solar panel and an external 12 volt gel cell battery in a cooler.

Metering:

Access: Helicopter and boat.

Station Status: Active

Datum: GSC CGVD28 1969 Manitoba Hydro local adjustment

Bench Marks:

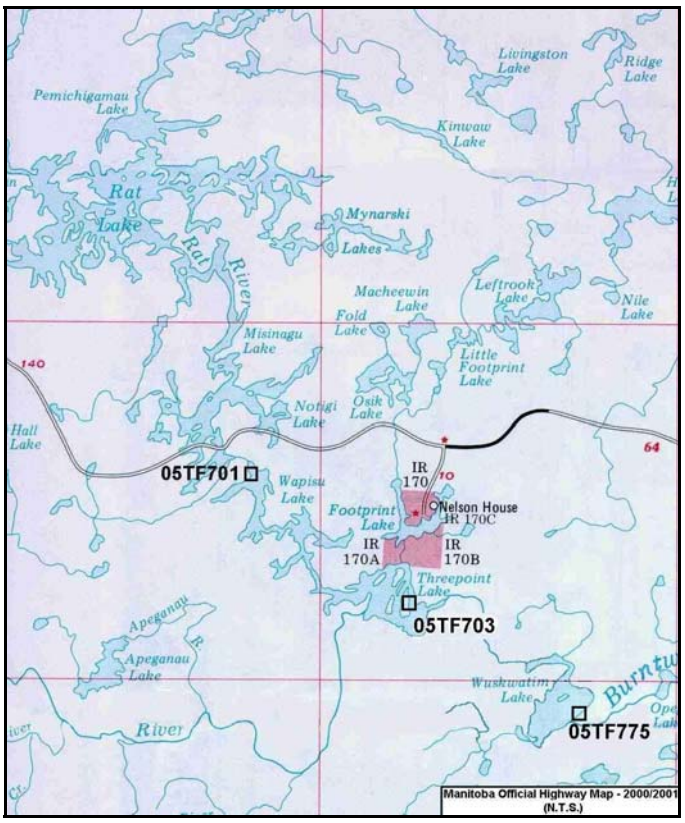
05MH74 – Master - Elevation – 234.374 m. A Manitoba Hydro brass cap set in bedrock near water's edge. Brass cap is 15.2 m SW from the DCP marked with a 5/8" diameter rebar and is 16 cm N of hilti bolt 2-1.

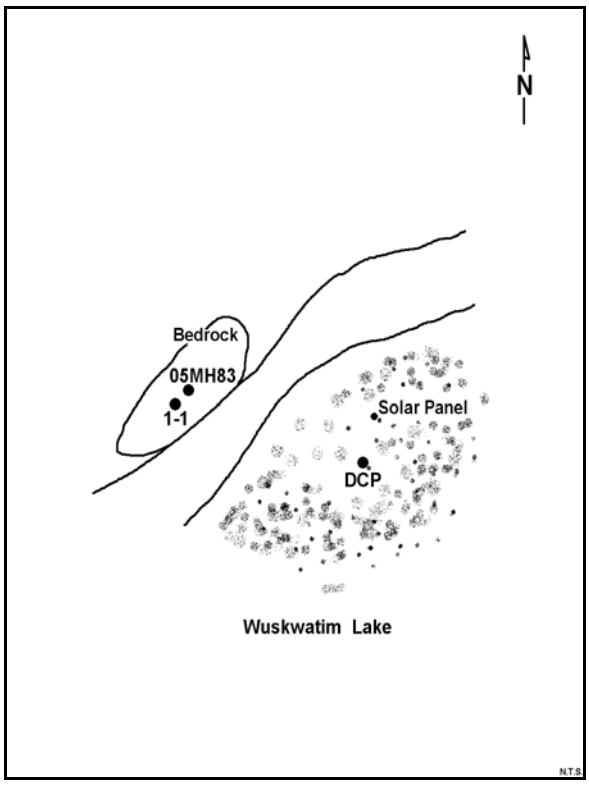
2-1 - Elevation – 234.377 m. A flagged hilti bolt, drilled in to bedrock near water's edge marked with a 0.05 m diameter flagged poplar tree 15.2 m SW of the DCP and 0.16 m S of the BM 05MH74.

Additional Information:

Source file to PDF: **2006-05-25** Source file last modified: **2006-05-25** Compiled By: A.L. Janier Checked By:

Wuskwatim Lake Site #1





Number: **05TF775**

Name: **Wuskwatim Lake Site #1**

DCP Id: Drainage Area (km2):

Latitude: 55° 32' 45" Longitude: -98° 30' 17"

Operator: Manitoba Hydro, Thompson

Established: August 2005

Location: On the SE shore of Wuskwatim Lake approx. 1.5 km NE of Wuskwatim Lake outlet.

Equipment: A Campbell Scientific CR10X data logger, firmware version 1.21, with an SDI-12 Keller pressure transducer in a Campbell Scientific fiberglass enclosure. Solar panel and an external 12 volt gel cell battery in a cooler.

Metering:

Access: Helicopter and boat.

Station Status: Active

Datum: GSC CGVD28 1969 Manitoba Hydro local adjustment

Bench Marks:

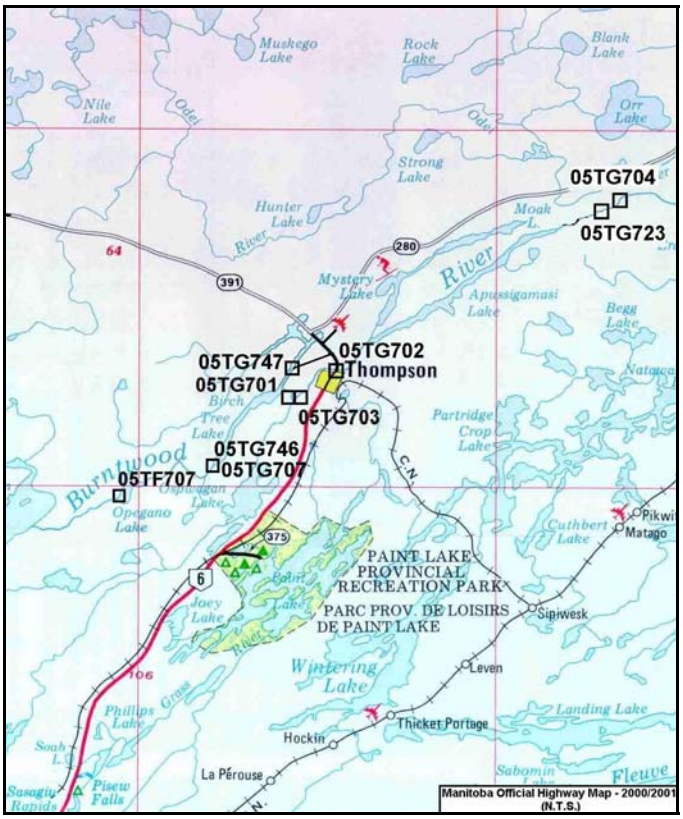
05MH83 – Master - Elevation – 234.736 m. A Manitoba Hydro brass cap set in a bedrock outcrop near water's edge marked with 3/8" diameter rebar and a flagged tripod. The brass cap is 8.2 m W of the DCP 0.2 m NE of the hilti bolt and 2 m W of an eroded bank.

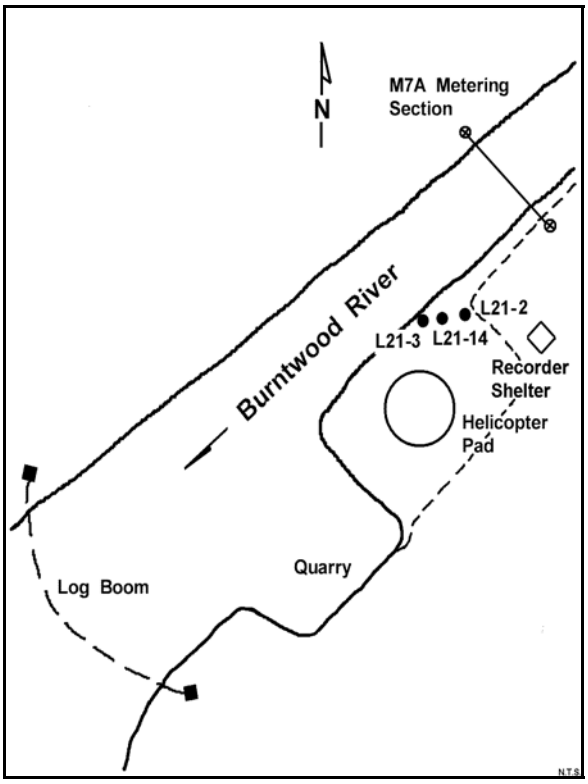
1-1 - Elevation – 234.730 m. A hilti anchor bolt drilled into bedrock near water's edge marked with a flagged tripod. The hilti bolt is 0.2 m SW of BM 05MH83 and 8.2 m WNW of the DCP.

Additional Information:

Source file to PDF: **2006-08-22** Source file last modified: **2006-08-22** Compiled By: A.L. Janier Checked By:

Burntwood River above Manasan Falls





Number: **05TG701**

Name: **Burntwood River above Manasan Falls**

DCP Id: 48225410 Drainage Area (km2):

Latitude: 55° 43' 11" Longitude: 97° 56' 48"

Operator: Manitoba Hydro, Thompson

Established: 1978

Location: On the SE shore 0.5 km above of Manasan Falls.

Equipment: A Valcom EDAS, firmware version 3.09, SDI-12 Sutron pressure transducer in a plywood shelter with an antenna. Real time data is obtained by EDAS unit powered by a 12-volt battery on a 20 watt solar panel.

Metering: M7A discharge section. Discharge measurements are by boat, tagline and ice cover.

Access: Boat or helicopter.

Station Status: Active

Datum: GSC CGVD28 1969 Manitoba Hydro local adjustment

Bench Marks:

L21-2 – Master - Elevation - 199.504 m. Brass cap on high rock outcrop 1.0 m from bank edge and 13.7 m from corner of recorder shack.

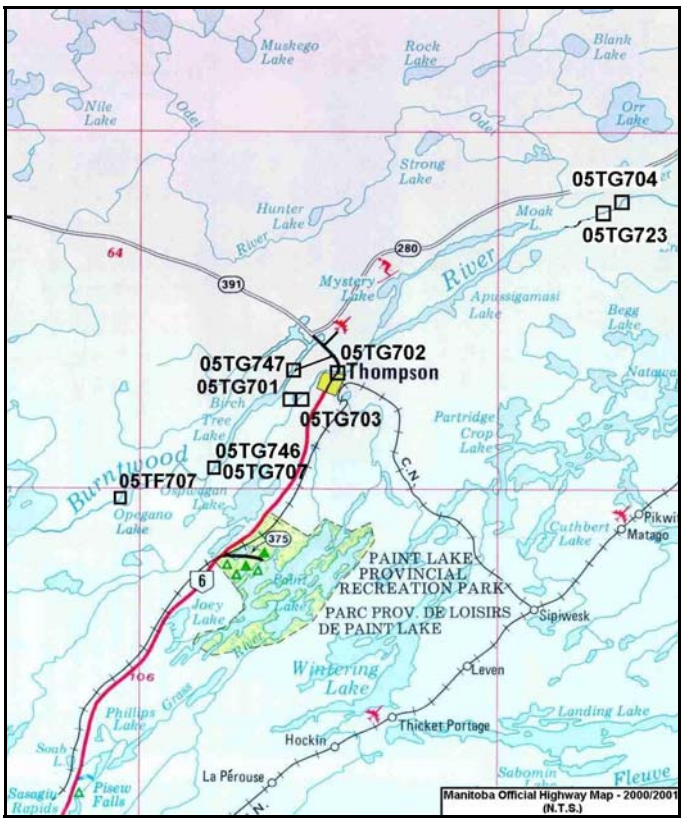
L21-3 - Elevation - 198.320 m. Brass cap on low rock outcrop 1.0 m from bank edge and 5.5 m from L21-2.

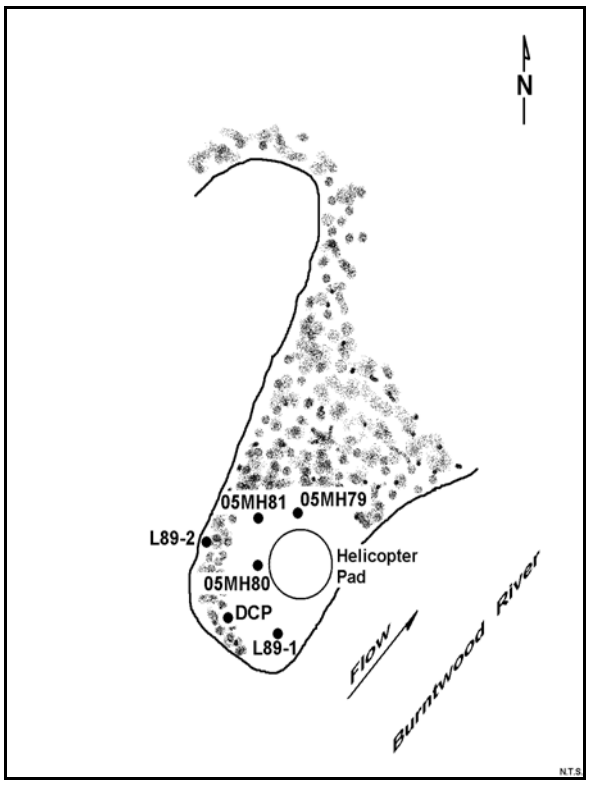
L21-14 - Elevation - 199.309 m. Brass cap in bedrock 1.5 m from the water's edge and 2.2 m E of L21-3.

Additional Information:
Time slot - 00:16, Satellite azimuth - 222.4, Antenna angle - 18.5 degrees.
Shef Codes: HG, TW, VB, ZT, ZD

Source file to PDF: **2006-06-23** Source file last modified: **2006-06-23** Compiled By: A.L. Janier Checked By:

Burntwood River above Birchtree Lake





Number: **05TG707**

Name: **Burntwood River above Birchtree Lake**

DCP Id: Drainage Area (km2):

Latitude: 55° 41' 56.8" Longitude: -98° 02' 57.1"

Operator: Manitoba Hydro, Thompson

Established: September 2005

Location: Left bank of Burntwood River approx. 10 km above Manasan Falls near the entrance to Birchtree Lake at the water level profile site L89.

Equipment: A Campbell Scientific CR10X data logger, firmware version 1.21, with an SDI-12 Keller pressure transducer in a Campbell Scientific fiberglass enclosure. Solar panel and an external 12 volt gel cell battery in a cooler.

Metering:

Access: Helicopter, boat and snowmobile.

Station Status: Active

Datum: GSC CGVD28 1969 Manitoba Hydro local adjustment

Bench Marks:

05MH79 - Elevation – 199.147 m. A Manitoba Hydro brass cap stamped 05MH79 on a ground rod drilled into ground 5.8 m, located approx. 29.5 m NE of the DCP and marked by a steel bar painted green. The most northerly of three brass caps it is 13 m NE of BM 05MH80.

05MH80 – Master - Elevation – 199.068 m. A Manitoba Hydro brass cap stamped 05MH80 on a ground rod drilled into ground 9.1 m, located approx. 16.5 m NE of the DCP and marked by a steel bar painted green. The middle brass cap of three brass caps it is 13 m SW of BM 05MH79.

05MH81 - Elevation – 199.541 m. A Manitoba Hydro brass cap stamped 05MH81 on a ground rod drilled into ground 8.2 m, located 23.4 m NNE of the DCP and marked by a steel bar painted green. The most westerly cap of the three brass caps it is 6.9 m NNE of BM 05MH80. It is farther W than both 05MH80 and 05MH79.

L89-1 - Elevation – 198.767 m. A spike in a 1 m high poplar stump approx. 6.5 m from the river bank.

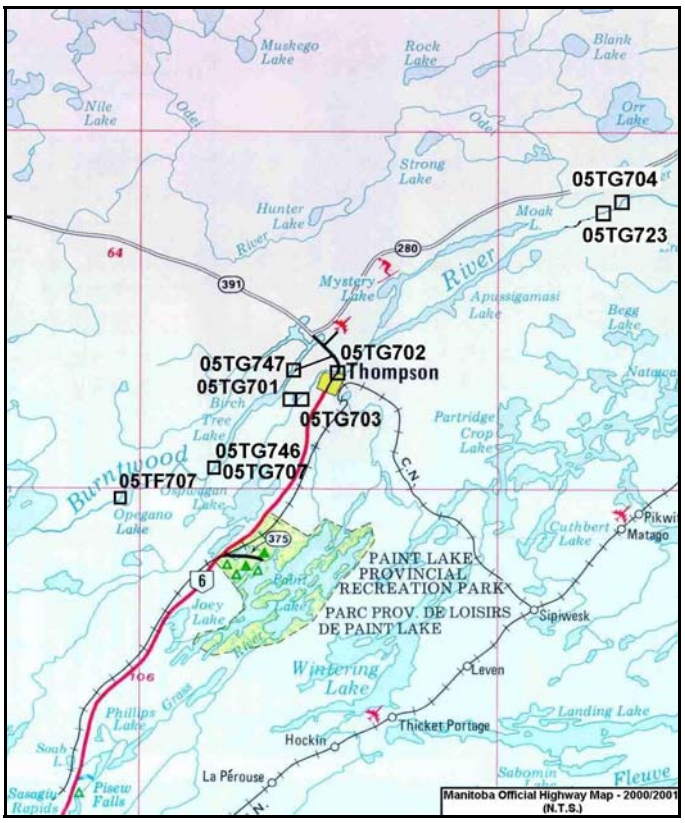
L89-2 - Elevation – 199.498 m. A spike in a 1.5 m high spruce stump at the top of the helicopter pad at entrance to Birchtree Lake. BM is approx. 10.5 km above Manasan Falls on the Burntwood River.

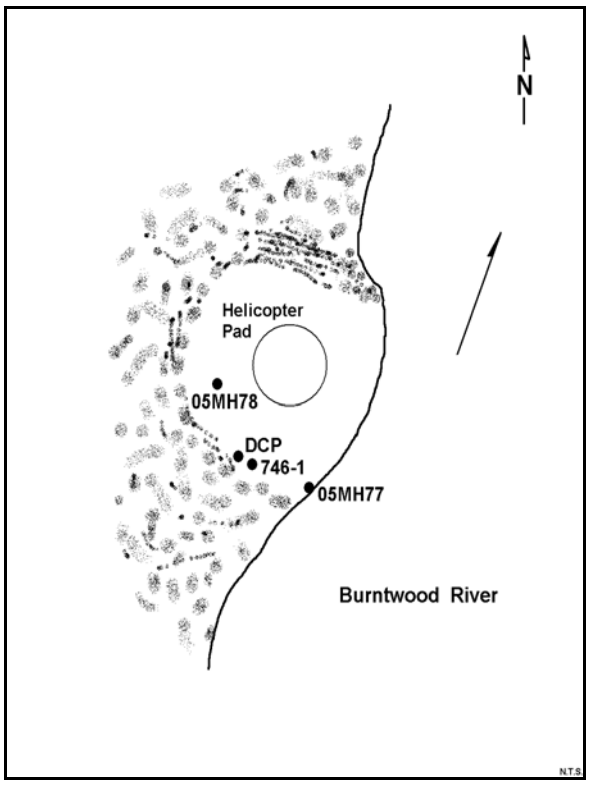
Additional Information:

Source file to PDF: **2006-05-24** Source file last modified: **2006-05-24**

Compiled By: A.L. Janier Checked By:

Birchtree Lake





Number: **05TG746**

Name: **Birchtree Lake**

DCP Id: Drainage Area (km2):

Latitude: 55° 38' 52" Longitude: -98° 05' 49"

Operator: Manitoba Hydro, Thompson

Established: October 2005

Location: Left bank of the Burntwood River above Birchtree Lake approx. 5.0 km below Kepuche Falls.

Equipment: A Campbell Scientific CR10X data logger, firmware version 1.21, with an SDI-12 Keller pressure transducer in a Campbell Scientific fiberglass enclosure. Solar panel and an external 12 volt gel cell battery in a cooler.

Metering:

Access: Helicopter, boat and snowmobile.

Station Status: Active

Datum: GSC CGVD28 1969 Manitoba Hydro local adjustment

Bench Marks:

05MH77 (05-746-1) – Master - Elevation - 197.748 m. A Manitoba Hydro brass cap stamped 05MH77, set in bedrock near water's edge, located approx. 9.3 m SE of the DCP. It is approx. 17 m SE of BM 05MH78 located at the top and W of the helicopter pad.

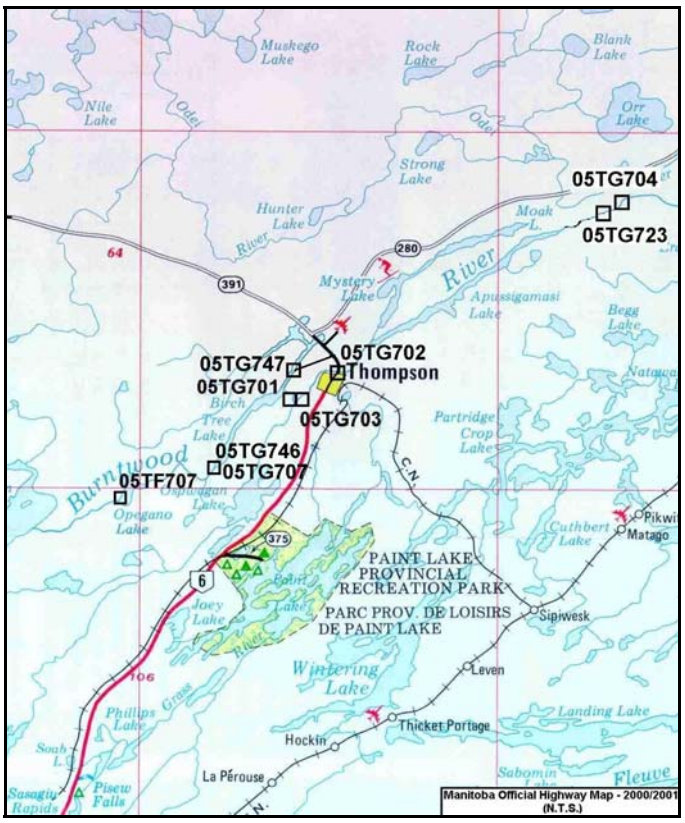
05MH78 (05-746-2) - Elevation – 201.761 m. A Manitoba Hydro brass cap stamped 05MH78, on a ground rod drilled into the ground 4.0 m, marked with a steel rod painted green. It is approx. 8.6 m NNW of the DCP and approx. 17 m NW of BM 05MH77.

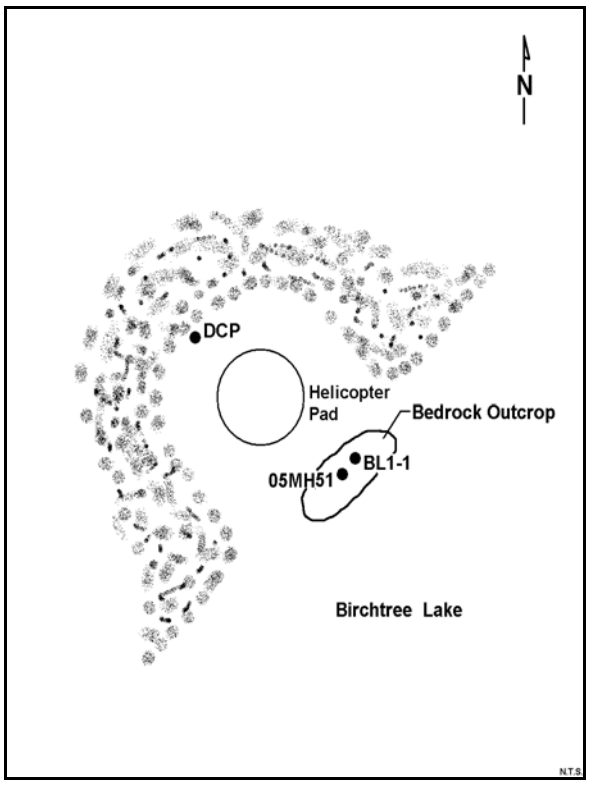
746-1 – Elevation – 202.287 m. Vertical nail in 1.5' high spruce stump SE of and near the DCP on left side of helicopter pad.

Additional Information:

Source file to PDF: **2006-05-24** Source file last modified: **2006-05-24** Compiled By: A.L. Janier Checked By:

Birchtree Lake above Birchtree Brook





Number: **05TG747**

Name: **Birchtree Lake above Birchtree Brook**

DCP Id: Drainage Area (km2):

Latitude: 55° 46' 48" Longitude: -97° 56' 38"

Operator: Manitoba Hydro, Thompson

Established: September 2005

Location: Left bank of Birchtree Lake above Birchtree Brook directly across from a dirt road that extends from the airport runway.

Equipment: A Campbell Scientific CR10X data logger, firmware version 1.21, with an SDI-12 Keller pressure transducer in a Campbell Scientific fiberglass enclosure. Solar panel and an external 12 volt gel cell battery in a cooler.

Metering:

Access: Helicopter, boat and snowmobile.

Station Status: Active

Datum: GSC CGVD28 1969 Manitoba Hydro local adjustment

Bench Marks:

05MH51(05-747-1) – Master - Elevation – 198.115 m. A Manitoba Hydro brass cap set in bedrock, marked with a 5/8 " diameter rebar painted fluorescent orange. It is located approx. 0.190 m SW of a hilti bolt BL1-1 (05-747-2) drilled into the same bedrock outcrop and approx. 22.6 m SE of the DCP near water's edge.

BL1-1 - Elevation – 198.103 m. A hilti bolt drilled into bedrock and marked with a 5/8" diameter rebar painted fluorescent orange. The hilti bolt is 0.19 m NE of brass cap 05MH51 and 22.6 m SE of the DCP in the same bedrock outcrop near water's edge.

Additional Information: Shef Codes: HG, TW, VB, ZT

Source file to PDF: **2006-06-14** Source file last modified: **2006-06-14** Compiled By: A.L. Janier Checked By:

Appendix B

Water Level Gauge Weighting Factors

B.1. Wuskwatim Lake Gauges

Weights are assigned in inverse proportion to the standard deviations of each **Wuskwatim Lake Gauge**'s recorded levels from the **Wuskwatim Lake Mean Daily Water Level (with wind and wave effects eliminated)** based on the individual period of record at each gauge. The weighting factors are determined using the following equations:

$$X\left(\frac{1}{S_1}+\frac{1}{S_2}+\ldots\frac{1}{S_i}\right)=1.0 \qquad \text{[B-1]}$$

$$W_1=\frac{X}{S_1};\quad W_2=\frac{X}{S_2};\quad W_i=\frac{X}{S_i} \qquad \text{[B-2]}$$

where:

X = a computational constant
S_i = standard deviation for **Wuskwatim Lake Gauge** i
W_i = weighting factor for **Wuskwatim Lake Gauge** i

Initial weighting factors have been estimated as 1/n where n is the number of **Wuskwatim Lake Gauge**s.

Gauge	Weighting Factor
05TF006	0.167
05TF771	0.167
05TF772	0.167
05TF773	0.167
05TF774	0.167
05TF775	0.167

Weighting Factors for 6 gauges operating

B.2. Birchtree Lake Gauges

Weights are assigned in inverse proportion to the standard deviations of each **Birchtree Lake Gauge**'s recorded levels from the **Birchtree Lake Daily Average Water Level** based on the individual period of record at each gauge. The weighting factors are determined using the following equations:

$$X\left(\frac{1}{S_1}+\frac{1}{S_2}+\ldots\frac{1}{S_i}\right)=1.0 \qquad \text{[B-1]}$$

$$W_1=\frac{X}{S_1};\quad W_2=\frac{X}{S_2};\quad W_i=\frac{X}{S_i} \qquad \text{[B-2]}$$

where:

X = a computational constant
S_i = standard deviation for **Birchtree Lake Gauge** i
W_i = weighting factor for **Birchtree Lake Gauge** i

Initial weighting factors have been estimated as 1/n where n is the number of **Birchtree Lake Gauge**s.

Gauge	Weighting Factor
05TG701	0.250
05TG707	0.250
05TG746	0.250
05TG747	0.250

Weighting Factors when 4 gauges operating