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

WATER POWER ACT & ENVIRONMENT ACT LICENCES 2019 ANNUAL WATER LEVEL COMPLIANCE REPORT FOR WUSKWATIM GENERATING STATION

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DATE: 2020-05-07

REPORT NO: WP&O 20/04

ENGINEERS GEOSCIENTISTS MANITOBA
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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.

During the 2019 calendar year, there were no events where water levels deviated from the licence limits. A summary of Wuskwatim compliance is provided below.

Location	Constraint	Variable	Exceedances Attributed to Wuskwatim Operations	Number of Readings	% Compliance
Wuskwatim Lake	Max/Min Elevation	Mean Daily Water Level	0	365	100 %
Wuskwatim Lake	Max/Min Elevation	Hourly Water Level	0	8760	100 %
Birch Tree Lake	Water Level Variation	Mean Daily Water Level	0	365	100 %

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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 and is available at:

https://www.gov.mb.ca/sd/waterstewardship/licensing/pdf/licence_implementation_guide_later_levels_2016.PDF

The Licence Implementation Guide forms the basis for content of this report 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

This report documents Wuskwatim GS licence compliance by summarizing the Water Power Act and Environment Act licence requirements and providing the relevant water level data for the 2019 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 of deviations from licence constraints during the 2019 calendar year, and provides reasons for any licence deviations. Section 6.0 summarizes major system upgrades or changes during the 2019 calendar year, and Section 7.0 summarizes 2019 dam safety activities. Finally, Section 8.0 provides conclusions and closure to the report.

Appendix I provides a list of dam safety activities completed in 2019.

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
2019 Generation	1,649 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 located in the nearby city of Thompson.

3.0 DATA COLLECTION

3.1 Water Level Gauges

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 for the 2019 reporting period. The locations of the water level gauges as well as the gauge description sheets are contained in Appendix A of the Licence Implementation Guide which is available at:

https://www.gov.mb.ca/sd/waterstewardship/licensing/pdf/licence_implementation_guide_later_levels_2016.PDF

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 to record water levels and data loggers with transmitters to store and send this information through GOES satellites to ground based receivers both of which are operated by the National Oceanic and Atmospheric Administration (NOAA). Manitoba Hydro then retrieves the data via satellite rebroadcast from NOAA (with backup data sources being via internet data sources offered by NOAA and United States Geological Survey) as well as directly from the loggers during a site visit. Manitoba Hydro uses software applications that retrieve, decode and send the data to the HyDams database that is 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 Conservation and Climate. This report uses final data from the required water level gauges based on three levels of internal review. It also contains any compliance reports issued in the 2019 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 near 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 Sustainable Development.*

4.4 Compliance Reporting

Compliance for Wuskwatim GS has been defined and agreed upon with Manitoba Conservation and Climate 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 Conservation and Climate 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

Manitoba Hydro analyzed water level data to prepare charts outlining water conditions at Wuskwatim Lake and Birch Tree Lake during the 2019 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 2019 reporting period.

5.2 Licence Exceedances

During the 2019 reporting period, there were no 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

6.0 MAJOR SYSTEM UPGRADES/CHANGES

Maintenance and construction activities that occurred during the 2019 calendar year include:

- Sewer and water utilidor upgrade
- Substation decommissioning complete
- SST4 and SST5 transformer replaced
- Completed grouting on south transition structure to seal the leak

7.0 DAM SAFETY

Manitoba Hydro operates and maintains the generating station and associated structures at Wuskwatim based on the Canadian Dam Association Dam Safety Guidelines. A summary of dam safety activities for 2019 is provided in Appendix I.

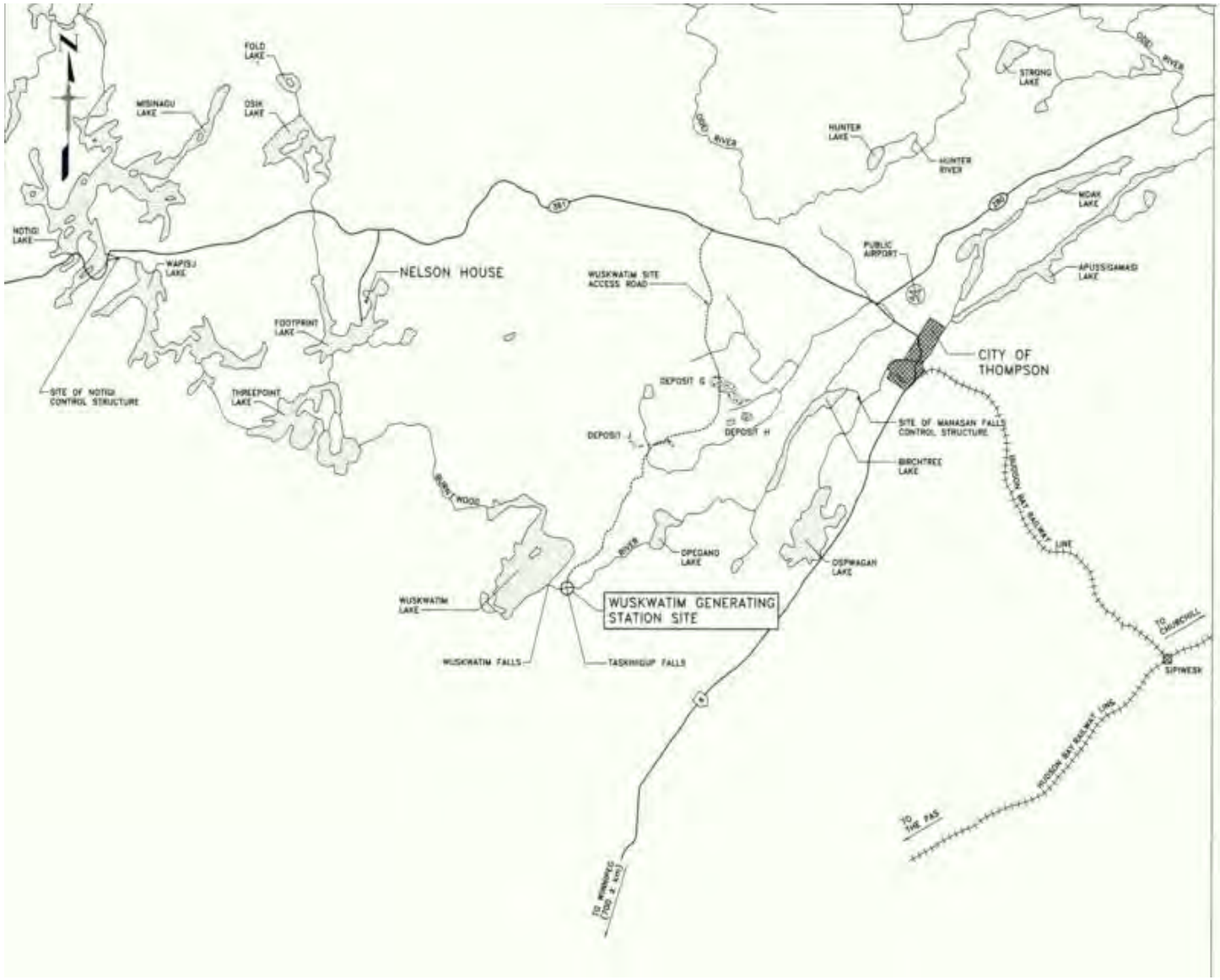
8.0 CONCLUSIONS & CLOSURE

During the January 1 to December 31, 2019 reporting period, there were no events where water levels deviated from the Water Power Act and Environment Act licence limits. Manitoba Hydro operated in compliance with the licences as shown in Table 3.

Table 3: Summary of 2019 Compliance

Location	Constraint	Variable	Exceedances Attributed to Wuskwatim Operations	Number of Readings	% Compliance
Wuskwatim Lake	Max/Min Elevation	Mean Daily Water Level	0	365	100 %
Wuskwatim Lake	Max/Min Elevation	Hourly Water Level	0	8760	100 %
Birch Tree Lake	Water Level Variation	Mean Daily Water Level	0	365	100 %

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.



SITE LOCATION MAP

LEGEND:

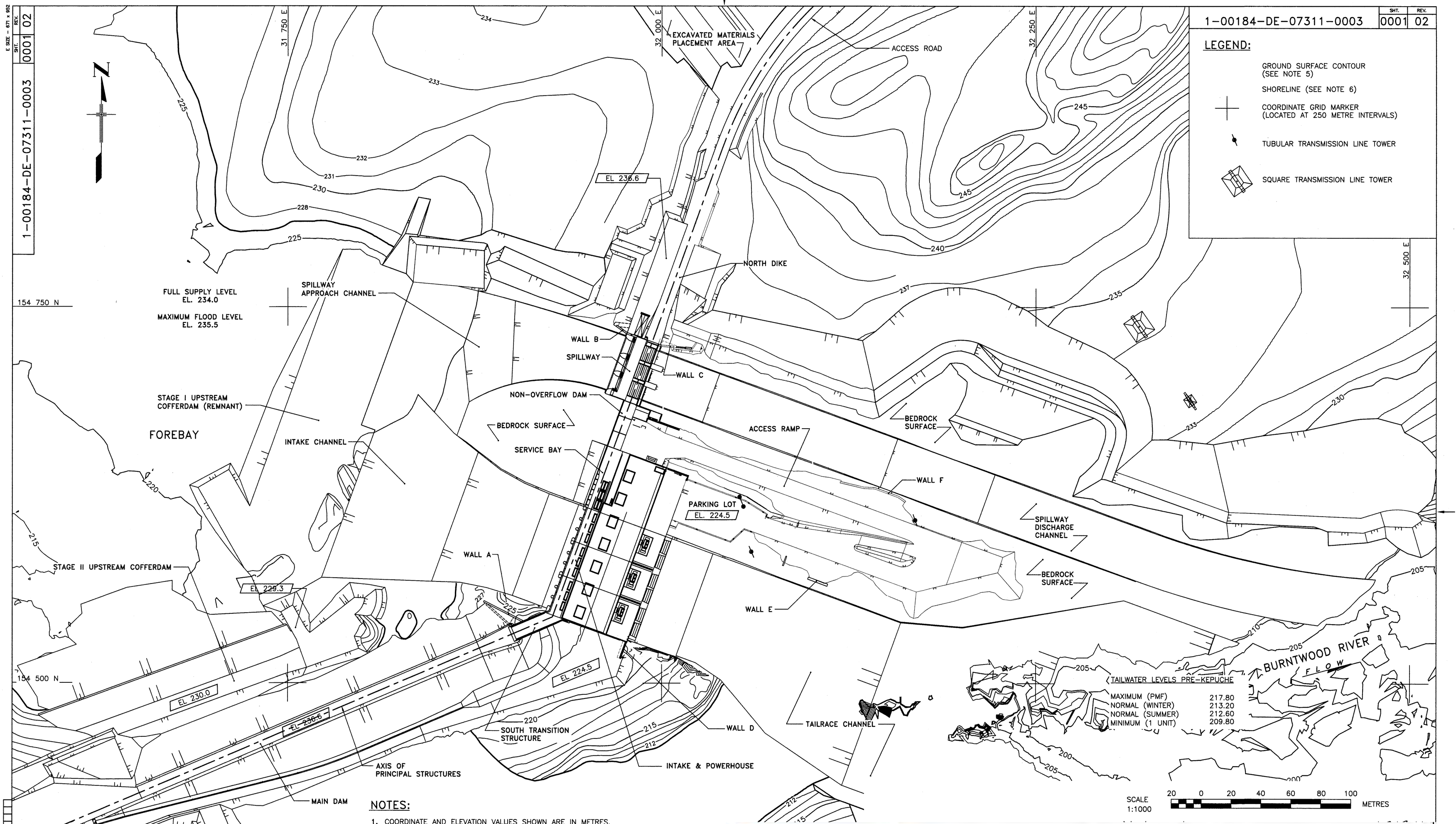
- LAKE
- RIVER, STREAM
- PROVINCIAL TRUNK HIGHWAY, No. 6
- PROVINCIAL ROAD, No. 391
- COMMUNITY LIMITS (APPROXIMATE)
- DEPOSIT OUTLINE

NOTES:

1. MAP TAKEN FROM "PROVINCE OF MANITOBA 1:1 000 000 TOPOGRAPHIC BASE MAP".
2. SITE AND DEPOSIT LOCATIONS ARE APPROXIMATE.

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

Manitoba Hydro	MANITOBA HYDRO	
	HYDRAULIC OPERATIONS DEPARTMENT	
	WUSKWATIM GENERATING STATION	
	PHOTOGRAPH OF GENERATING STATION	
	PROJECT ANNUAL WATER LEVEL REPORT	FIGURE 2



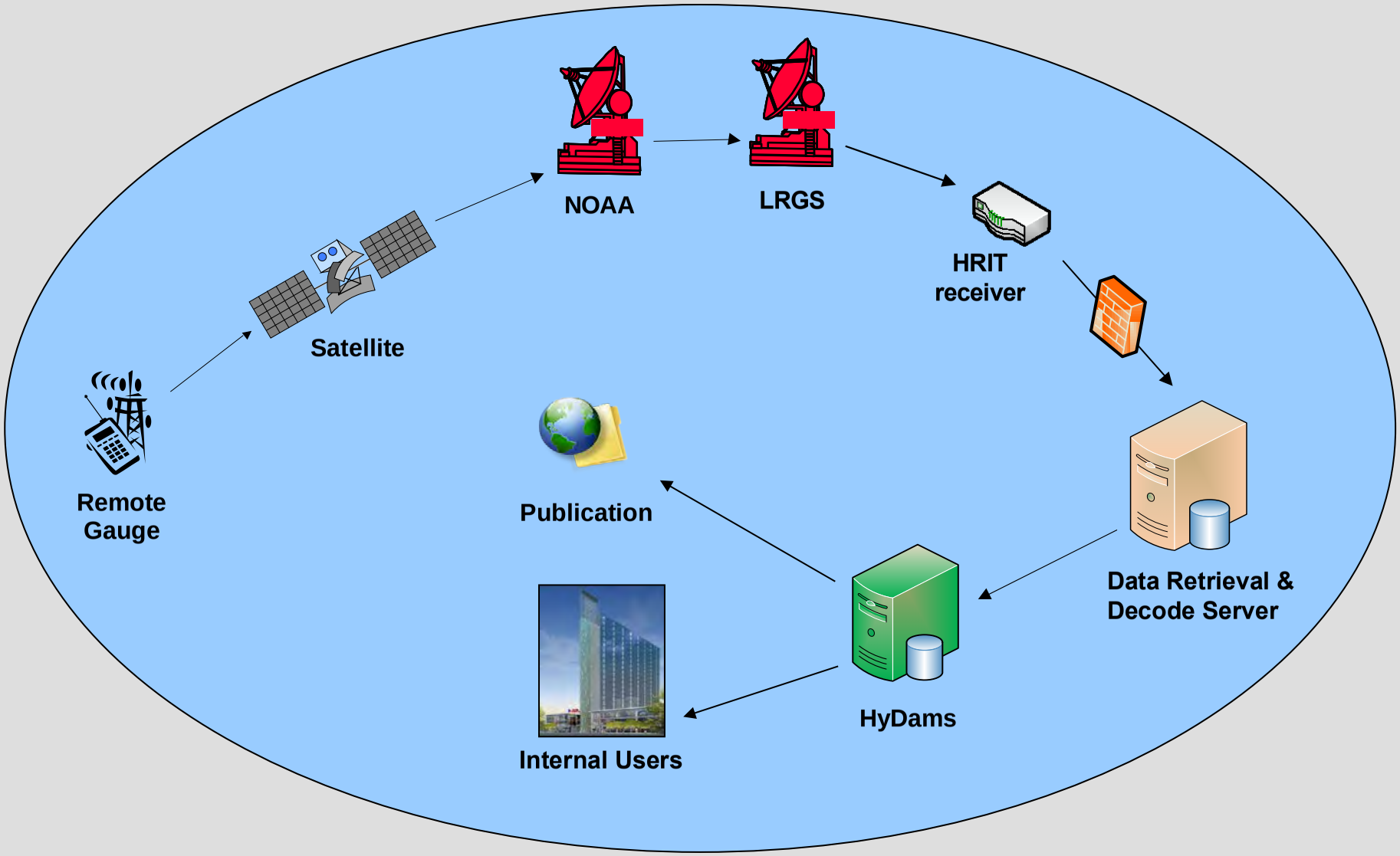
NOTES:

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.

Manitoba Hydro	MANITOBA HYDRO
	HYDRAULIC OPERATIONS DEPARTMENT
	WUSKWATIM GENERATING STATION
DRAWN BY	GENERAL ARRANGEMENT
YEAR 2017	PROJECT ANNUAL WATER LEVEL REPORT — FIGURE 3

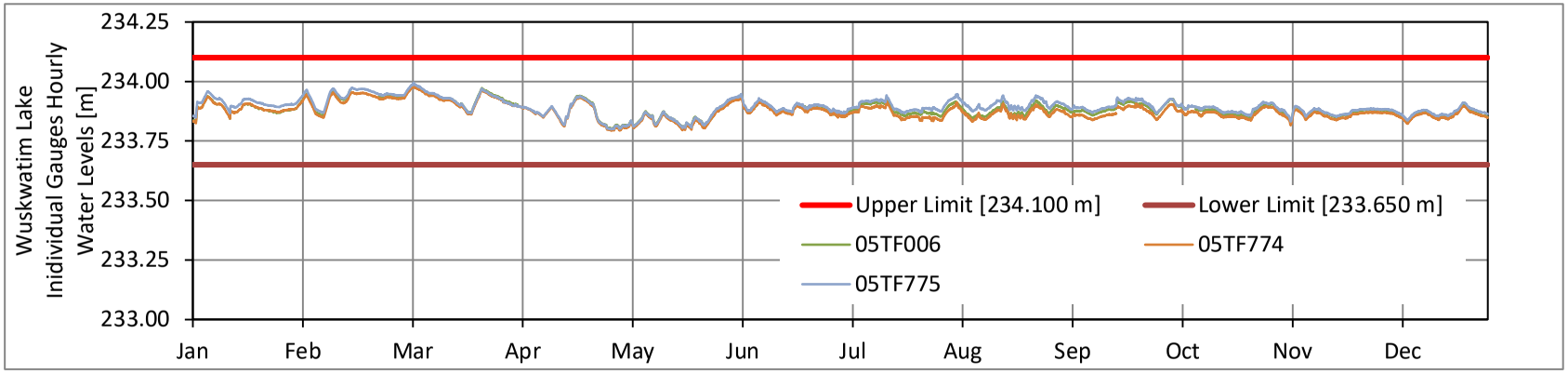
E SIZE – 671 x 952

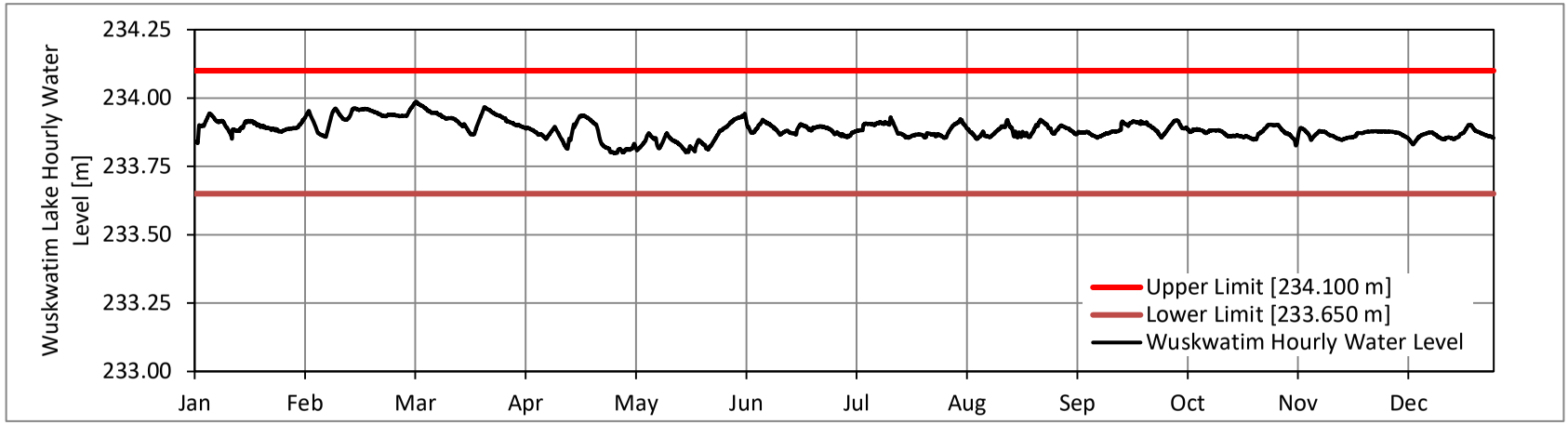
FOR MICROFILM USE ONLY



Manitoba Hydro	MANITOBA HYDRO	
	HYDRAULIC OPERATIONS DEPARTMENT	
	HYDROLOGIC DATA ACQUISITION AND MANAGEMENT SYSTEM	
	REMOTE DATA PROCESS MAP	
	PROJECT WATER LEVELS AND FLOWS REPORT	FIGURE 4

Wuskwatim Generating Station - Wuskwatim Lake Hourly Water Levels
Compliance Report for 2019

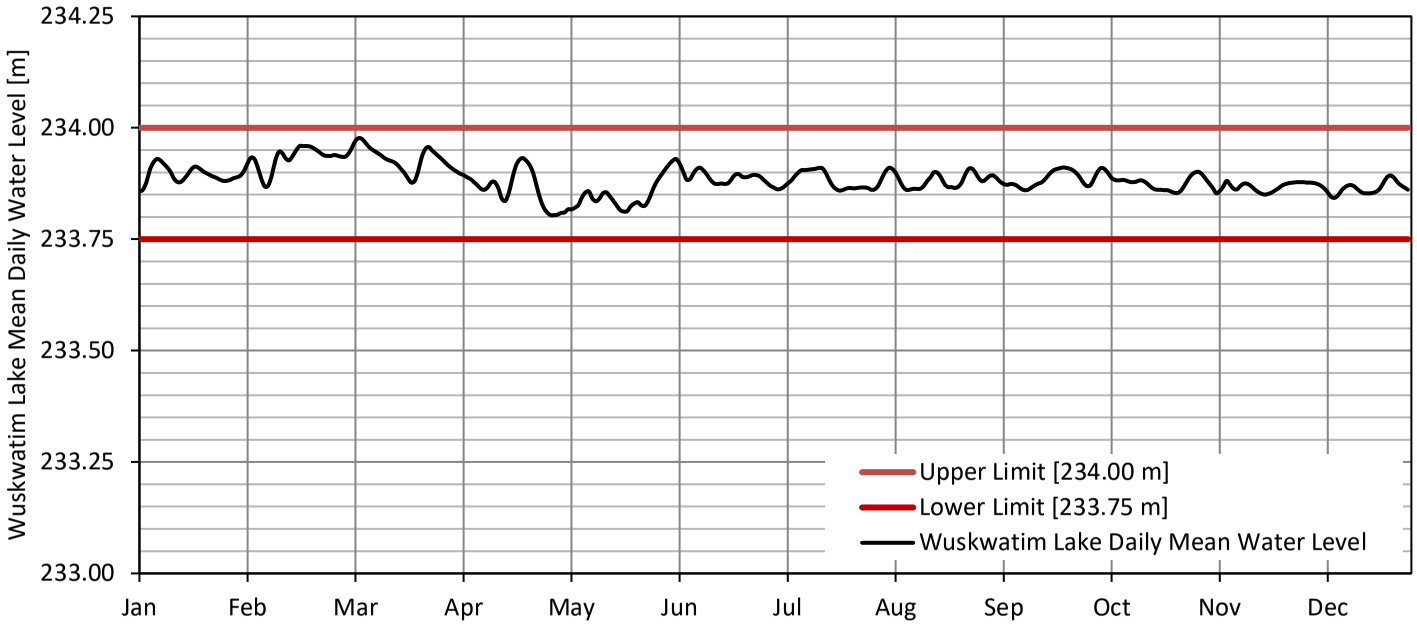




Note:
Wuskwatim Hourly Water Level is calculated using Wuskwatim Lake gauges 05TF006, 05TF774 & 05TF775.

Manitoba Hydro	MANITOBA HYDRO
	HYDRAULIC OPERATIONS DEPT.
	WUSKWATIM GENERATING STATION
	WUSKWATIM LAKE HOURLY WL (2019)
	PROJECT ANNUAL WATER LEVEL REPORT — FIGURE 5

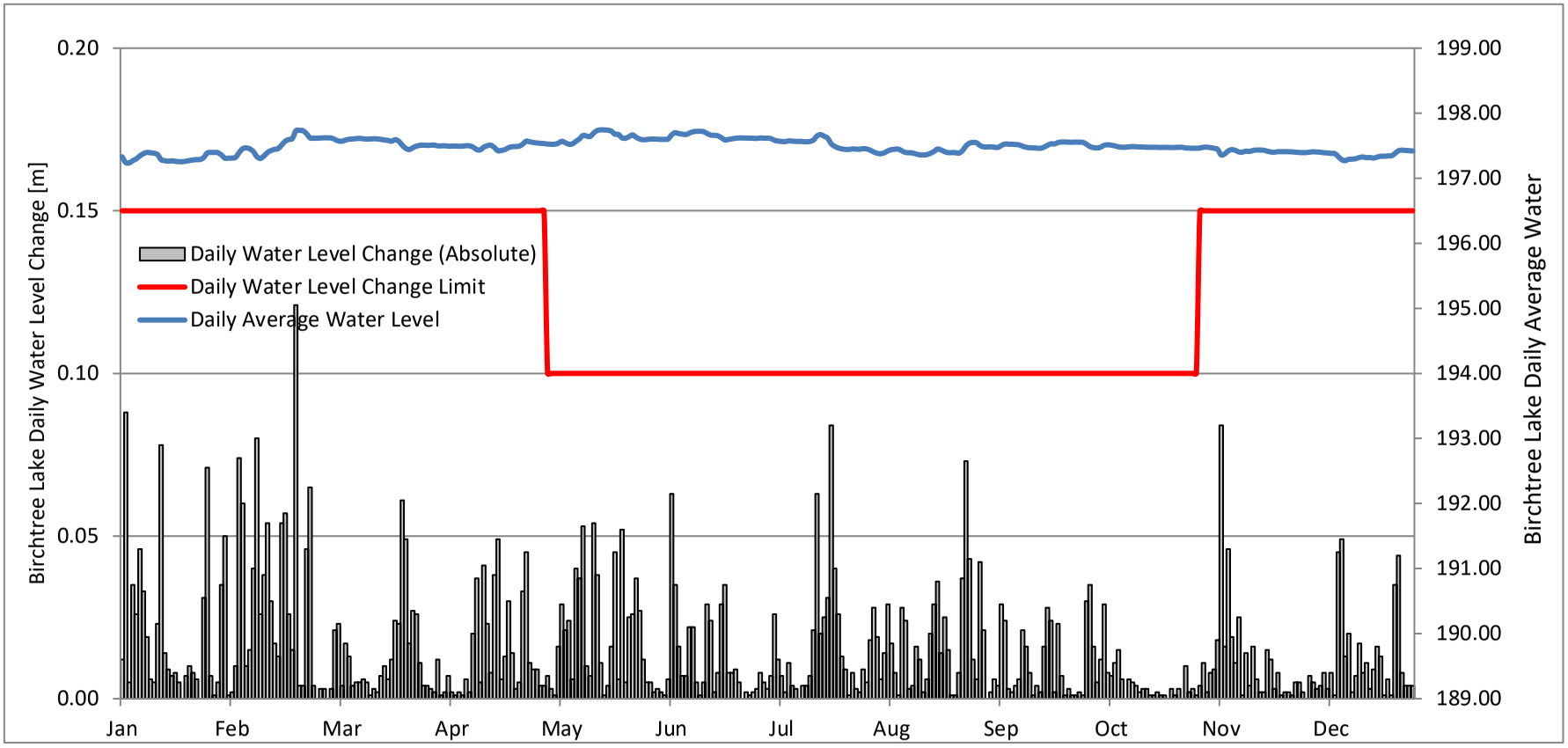
Wuskwatim Generating Station - Wuskwatim Lake Mean Daily Water Level Compliance Report for 2019



Note:
Wuskwatim Lake Mean Daily Water Level is calculated using Wuskwatim Lake gauges 05TF006, 05TF774 & 05TF775.

Manitoba Hydro	MANITOBA HYDRO	
	HYDRAULIC OPERATIONS DEPT.	
	WUSKWATIM GENERATING STATION	
	WUSKWATIM LAKE MEAN DAILY WL (2019)	
	PROJECT ANNUAL WATER LEVEL REPORT	FIGURE 6

Wuskwatim Generating Station - Birchtree Lake Daily Water Level Change Compliance Report for 2019



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

Manitoba Hydro	MANITOBA HYDRO	
	HYDRAULIC OPERATIONS DEPT.	
	WUSKWATIM GENERATING STATION	
	BIRCHTREE LAKE DAILY WL CHANGE (2019)	
	PROJECT ANNUAL WATER LEVEL REPORT	FIGURE 7

APPENDIX I

2019 WUSKWATIM DAM SAFETY ACTIVITIES LIST

Wuskwatim GS Dam Safety Activities List

	ACTIVITIES	Performed By	Tasks Completed	Tasks Planned
Inspections	Engineering inspection of embankment dams	Dam Safety	1	1
	Engineering inspection of concrete dams	Dam Safety	1	1
	Unit inspection - civil components	Dam Safety	0	0
	Spillway bay inspection - civil components	Dam Safety	3	3
	Routine inspection of embankment dams	Site - Utility	12	12
	Routine inspection of concrete dams	Site - Utility	6	6
	Spillway inspection	Site - Operating	51	52
	Forebay level monitoring	Site - Operating	12	12
	Tailrace level monitoring	Site - Operating	12	12
	Hydraulic conditions inspection	Dam Safety	1	1
Analyses	Engineering analyses (Concrete Dams)	N/A	0	0
	Engineering analyses (Embankment Dams)	N/A	0	0
	Instrumentation data review (Concrete Dams)	Dam Safety	24	24
	Instrumentation data review (Embankment Dams)	Dam Safety	12	12
Equipment	Spillway gate functional testing	Site - Elec/Mech	1	1
	Spillway emergency generator - functional gate lift test	Site - Elec	1	1
	Spillway emergency generator test runs	Site - Operating	12	12
	Station emergency generator maintenance	Site - Elec	1	1
	Spillway gate heater maintenance	Site - Elec	3	3 (1 per gate)
	Spillway gate hoist maintenance	Site - Elec	3	3 (1 per gate)
	Spillway gate hoist maintenance	Site - Mech	3	3 (1 per gate)
	Spillway gate inspection	Site - Mech	3	3 (1 per gate)
	Spillway emergency generator maintenance	AMD Field Services	1	1
Program	Dam Safety EPP - issue updates	Dam Safety	1	1
	Dam Safety Reference Manual - Revision	Dam Safety	0	0
	Delivered DS Training - Routine Inspections	Dam Safety	0	As required
	Delivered DS Training - Emergency Preparedness	Dam Safety	0	As required