WATERWAY APPROVALS AND MONITORING
ASSET MANAGEMENT DIVISION
ASSET PLANNING AND DELIVERY

WATER POWER ACT LICENCES
2021 ANNUAL WATER LEVELS AND FLOWS COMPLIANCE REPORT

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ENGINEERS GEOSCIENTISTS MANITOBA
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EXECUTIVE SUMMARY

Manitoba Hydro operates its generating system in accordance with the Water Power Act licences issued by the Province of Manitoba. Individual licences for each hydro generating facility contain constraints on water levels, outflows, and flow rates of change. In order to document a common understanding of compliance with the regulator on water regime terms of the Water Power Act licences, Manitoba Hydro develops Licence Implementation Guides for its generating facilities for review and approval by Manitoba Environment, Climate and Parks.

This report contains information on data collection, verification, and reporting related to Water Power Act licences, as well as a summary of licence compliance during the year. Separate annual reports are issued for Wuskwatim Generating Station and Keeyask Generating Station.

The data used in preparing this report was obtained from Manitoba Hydro's database and Environment and Climate Change Canada. Manitoba Hydro processed the data and evaluated it against licence conditions as described in the approved Licence Implementation Guides.

During the 2021 calendar year, there was 1 deviation from licence constraints that was reportable to Manitoba Environment, Climate and Parks. Manitoba Hydro investigated the reasons for the deviation and the findings are included in the report appendices.

1. TABLE OF CONTENTS

APPENDICES

1.0 INTRODUCTION

1.1 Background

The Province of Manitoba issues Water Power Act licences to Manitoba Hydro for the operation of its generating system. Figure 1 shows an overall Manitoba Hydro system map. Manitoba Hydro operates its generating stations, control structures, and reservoirs in accordance with constraints set out in the licences. Each licence pertains to a specific location or facility and has a variable life of up to 50 years, at which point it must be renewed. There are 13 individual licence documents for existing Manitoba Hydro facilities that identify 26 licence constraints on water levels, outflows, and flow rates of change. In order to document a common understanding of compliance with the water regime terms of the Water Power Act licences, Manitoba Hydro develops Licence Implementation Guides for its generating facilities for review and approval by Manitoba Environment, Climate and Parks.

The first Water Power Act Licences Annual Report was issued for the 2007 calendar year. The report was developed after the Clean Environment Commission review of Wuskwatim to assist Manitoba in determining whether Manitoba Hydro operates its system in compliance with the Water Power Act licences. Prior to this report, Manitoba Hydro regularly provided Manitoba with raw data records from the generating stations. Separate annual reports are issued for Wuskwatim Generating Station and Keeyask Generating Station.

1.2 Objective

The objective of this report is to summarize compliance with Water Power Act licences and provide relevant water levels, flow data and flow rates of change for the 2021 calendar year.

1.3 Outline

This report contains general information on data collection and reporting pertaining to the operation of the Manitoba Hydro system in accordance with applicable Water Power Act licences. Section 1.0 contains the introduction to the report, including background information on the licensing process, objective and outline of the report. Following the introduction is Section 2.0, which describes data collection, transfer, storage and verification processes. Section 3.0 describes the Water Power Act data reporting process and includes information about data sources and data analysis used in the preparation of this report. A summary table of licence compliance during the 2021 calendar year for all relevant sites is included in Section 4.0. Conclusions and recommendations are in Section 5.0. The report appendices contain specific information for each licensed site, and include maps, photos, project descriptions, data collection descriptions, charts and comments on 2021 data, and summaries of maintenance/construction and dam safety activities. Appendix O contains a summary of

Manitoba Hydro's Potentially Contaminated Sites Management Program including major projects related to Water Power.

The enclosed storage device contains all relevant data collected at each site and used in the preparation of this report. This data has been reviewed and outliers removed. Wind-eliminated data is provided for Grand Rapids forebay (Cedar Lake), Lake Winnipeg Regulation water levels and Southern Indian Lake.

2.0 DATA COLLECTION

2.1 Water Level Gauges

Manitoba Hydro collects data from a number of water level gauges throughout the province and surrounding area. The operation and maintenance of these gauges is the responsibility of different groups within the corporation (plant staff, maintenance staff, and hydrometrics staff) as well as Water Survey of Canada. For the purpose of this report, Waterway Approvals and Monitoring staff compiled data from these gauges. Manitoba Hydro uses the recorded water level data to ensure compliance with the Water Power Act licence conditions. The water level data was also used to calculate flows based on rating curves and discharge tables.

2.2 Data Transmission and Storage

The water level data at the majority of generating stations are recorded in wet wells using a float with a steel tape draped over a pulley on a motor or transmitter, which drives an electronic device in the control room. This device accepts the output of the motor or transmitter and outputs a signal to the Remote Terminal Unit (RTU) for transmission to the System Control Centre. Meridium and PI applications record and push data to the HyDams hydrometric database.

Remote gauges collect water level data at locations other than generating stations. Manitoba Hydro gauges 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. Figure 2 and Figure 3 show the data transmission and storage process. The water level and flow data at remote locations is collected and published according to the Quality Control and Assurance processes and procedures established by Water Survey of Canada. The 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 accuracy and includes recognition of the impact of other related environmental and contextual factors.

2.3 Data Verification

The HyDams database contains data with varying levels of quality assurance (QA) and quality control (QC). QA/QC procedures vary from simple manual checks to comprehensive national programs.

There are essentially three levels of QA/QC within Manitoba Hydro:

- Plant/Maintenance staff compare readings with manual measurements at specific time intervals (varying from weekly to bi-annually) depending on the particular gauge location. Some locations have dedicated regular work orders, while others are checked on an as-needed basis.
- Hydrometric Technologists/Analysts use software to check and correct selected gauge data in near real time prior to and following input into databases.
- The Hydrometric Section of the Waterway Approvals and Monitoring Department collaborates on a national strategy in partnership with Water Survey of Canada and Manitoba Infrastructure to operate and maintain gauges. The comprehensive program provides standards for the collection, analysis, publication and dissemination of hydrometric data and information.

3.0 WATER POWER ACT DATA REPORTING

3.1 Monitoring & Reporting Process

This report contains information on data collection, verification, and reporting related to Water Power Act licences, as well as a summary of deviations from licence conditions during the calendar year. Detailed water level and flow data, as well as licence limits and specific information for each Water Power Act Licence location, are included in the appendices.

3.2 Data Sources

The water level and flow data used in preparing this report was obtained from Manitoba Hydro's hydrometric database HyDams and Environment and Climate Change Canada. The HyDams database contains various types of data ranging from real-time (previous hour) high resolution data (e.g. 5 minute), hourly data and daily average data. Wind-eliminated water level data was used for the Grand Rapids forebay (Cedar Lake), Lake Winnipeg Regulation and Southern Indian Lake.

3.3 Data Analysis & Event Reporting

The report appendices contain detailed information and an analysis for each location regulated under a Water Power Act licence. Manitoba Hydro processed data and evaluated it against licence conditions as described in approved Licence Implementation Guides. Table 1 shows a breakdown of licence limit deviations at each location.

Table 1: Water Power Act Licences: Summary of Events for 2021

Licence	Location	Constraint	Reportable Events	Appendix
Pointe du Bois Site	Pointe du Bois G.S.	Max Elevation	0	A
Slave Falls Site	Slave Falls G.S.	Max Elevation	0	B
Seven Sisters Falls	Seven Sisters G.S.	Max Elevation	0	C
McArthur Falls Site	McArthur Falls G.S.	Max Elevation	0	D
Great Falls Site	Great Falls G.S.	Max Elevation	0	E
Pine Falls Site	Pine Falls G.S.	Max Elevation	0	F
Kelsey Site	Kelsey G.S.	Max Elevation	1	G
Kettle Rapids Site	Kettle G.S.	Max Elevation	0	H
Long Spruce Site	Long Spruce G.S	Max Elevation	0	I
Limestone Site	Limestone G.S.	Max Elevation	0	J
Grand Rapids Site	Grand Rapids G.S.	Max Elevation	0	K
Lake Winnipeg Regulation	Jenpeg G.S.	Outflow Rate of Change	0	L
	Lake Winnipeg	Water Level Range	0	
	Lake Winnipeg	Min Outflow	0	
	Playgreen Lake	Water Level Range	0	
	Kiskittogisu Lake	Water Level Range	0	
	Kiskitto Lake	Water Level Range	0	
Churchill River Diversion	Southern Indian Lake	Water Level Range	0	M
	Southern Indian Lake	Max Drawdown	0	
	Notigi C.S.	Max Weekly Outflow	0	
	Thompson Pumphouse	Max Elevation	0	
	Thompson Sea Plane Base	Max Elevation	0	
	Notigi C.S.	Outflow Rate of Change	0	
	Notigi C.S.	Min Elevation	0	
	Missi Falls C.S.	Min Outflow	0	
	Missi Falls C.S.	Outflow Rate of Change	0	
		Total	1	

4.0 SUMMARY OF FINDINGS

During the 2021 calendar year, there was 1 reportable event of water levels and flows not in compliance with licence limits as shown in Table 1. The Hydraulic Licensing and Support Section investigated this event to determine the reason for its occurrence and reported the results to Manitoba Environment, Climate and Parks. Table 2 shows a brief summary of events and full details of the findings of the reportable events are included in the appendices of this report.

Table 2: Brief Summary of Reportable Events for 2021

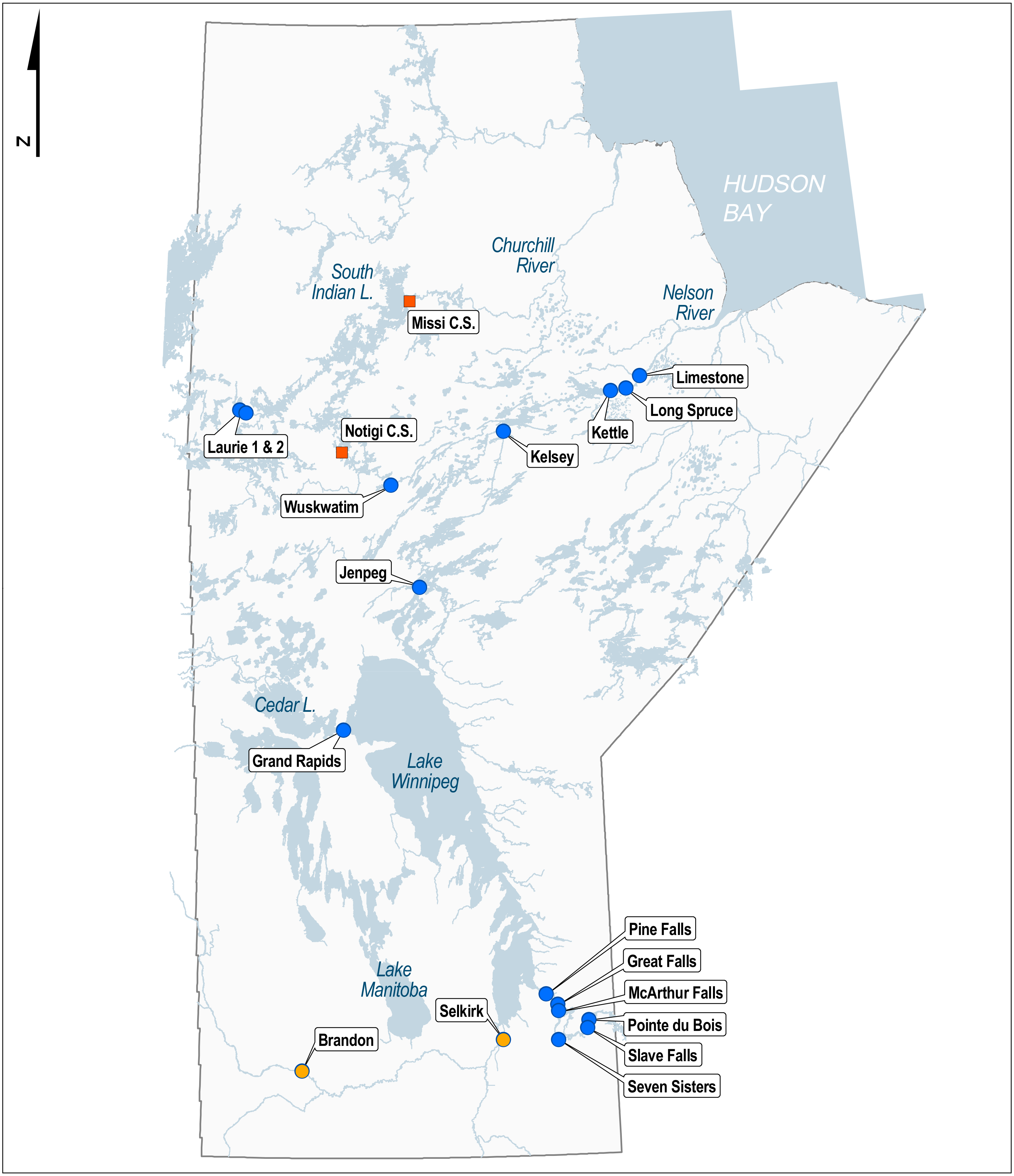
Date	Location	Licence Constraint	Explanation
May 28, 2021	Kelsey GS	Max forebay level	Underestimate of required flow increase during wind event

5.0 CONCLUSIONS & RECOMMENDATIONS

During the 2021 calendar year, there was 1 deviation from licence constraints that was reportable to Manitoba Environment, Climate and Parks.

Manitoba Hydro continues to fulfill its obligation to monitor the hydraulic system. In the event of licence deviations, Manitoba Hydro reports findings to internal and external stakeholders.

In response to the incident at Kelsey GS, site supervisors reminded station operators of the importance of quickly getting the forebay back below the licence limit.

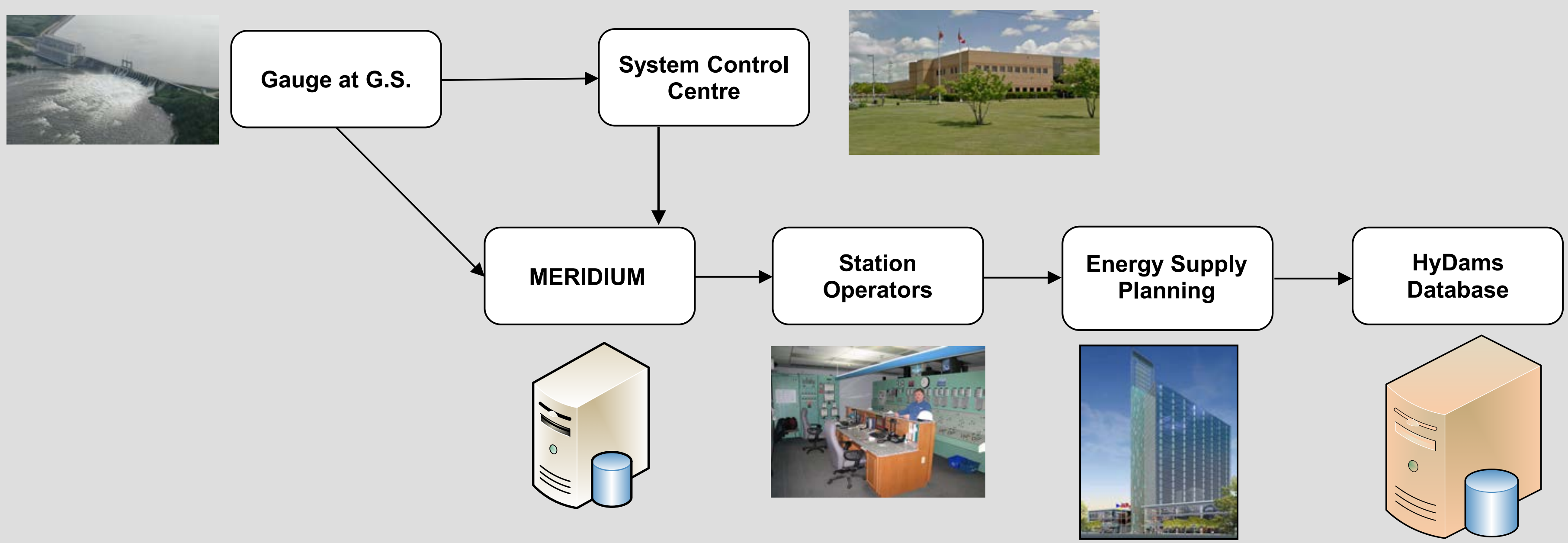


0 60 120 240 Kms

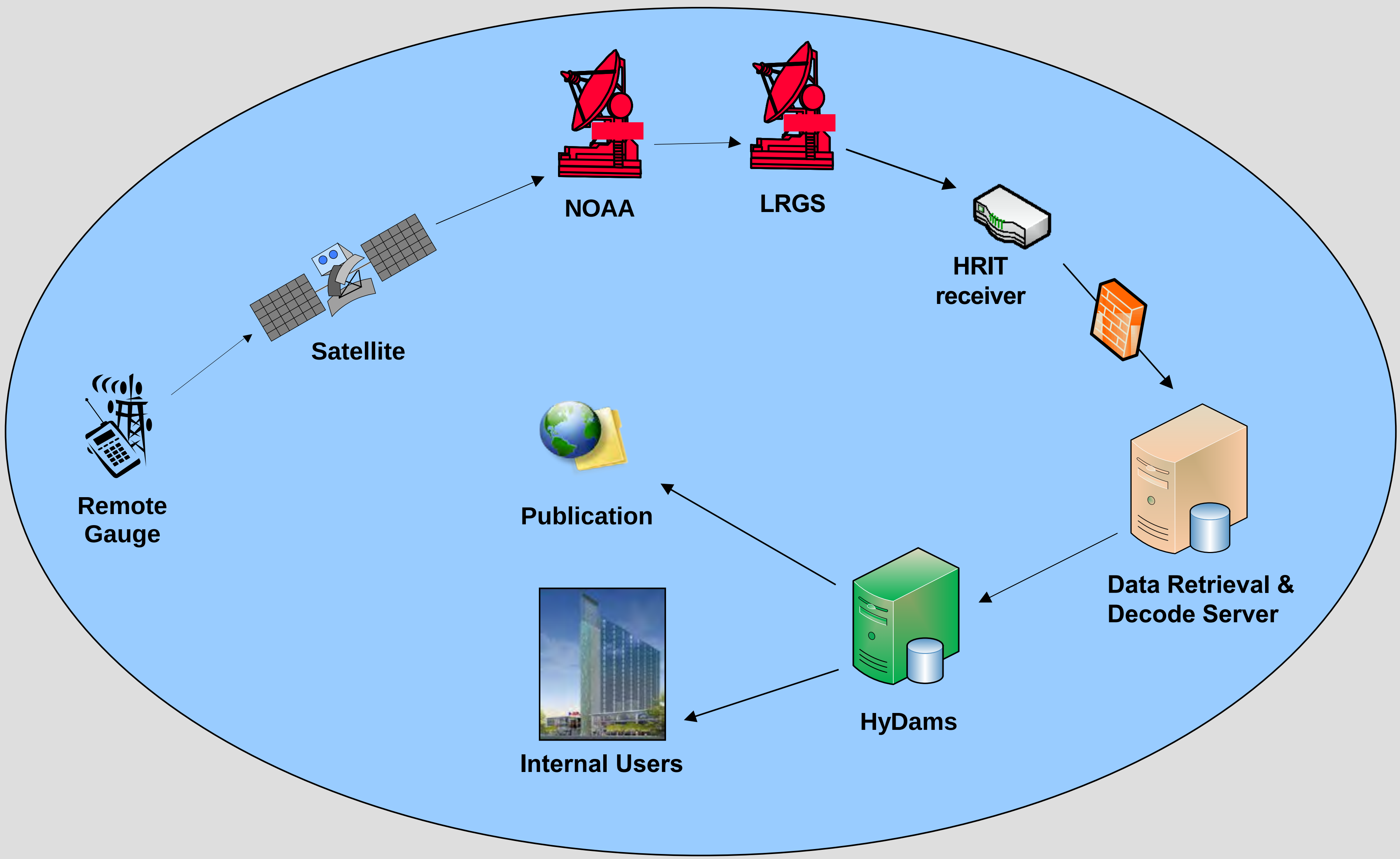
Manitoba Hydro
Overall System Map

FIGURE 1

Hydraulic Generating Station
Thermal Generating Station
Control Structure



Manitoba Hydro	MANITOBA HYDRO	
	WATERWAY APPROVALS AND MONITORING DEPARTMENT	
	HYDROLOGIC DATA ACQUISITION AND MANAGEMENT SYSTEM	
	GENERATING STATION DATA PROCESS MAP	
	PROJECT WATER LEVELS AND FLOWS REPORT	FIGURE 2



Manitoba Hydro	MANITOBA HYDRO
	WATERWAY APPROVALS AND MONITORING DEPARTMENT
	HYDROLOGIC DATA ACQUISITION AND MANAGEMENT SYSTEM
	REMOTE DATA PROCESS MAP
	PROJECT WATER LEVELS AND FLOWS REPORT — FIGURE 3

APPENDIX A

POINTE DU BOIS GENERATING STATION
WATER POWER ACT LICENCE

1.0 INTRODUCTION

Pointe du Bois Generating Station is located on the Winnipeg River approximately 160 km northeast of Winnipeg by road. The geographical location of the station is shown in Figure A-1. A photograph of the station is shown in Figure A-2. A site map is shown in Figure A-3.

The Pointe du Bois Generating Station was built by City Hydro, later known as Winnipeg Hydro, and was acquired by Manitoba Hydro in 2002. The in-service date for the first unit of the generating station was 1911. All 16 units were commissioned by 1926. This is currently the oldest power plant still in operation on the Winnipeg River.

For this reporting year (2021), Manitoba Hydro operated the Pointe du Bois Generating Station in accordance with the second Short-Term Extension Licence (STEL) for the Development of Water Power at the Pointe du Bois site on the Winnipeg River. Manitoba Water Stewardship (now Manitoba Conservation and Climate) issued this licence in accordance with the provisions of the Water Power Act on March 8, 2017. The second STEL was for a term of five years that expired January 1, 2022.

The licence history of this generating station includes a final licence, four renewal licences, and a STEL. The final licence was issued under the Dominion Water Power Act for a term of 20 years computed from November 1, 1911. Subsequently, four renewal licences were issued under The Water Power Act for a further term of 20 years each effective from January 1, 1932, January 1, 1952, January 1, 1972, and January 1, 1992 respectively. The first STEL was issued for a five year term effective from January 1, 2012.

Manitoba Hydro submitted the application for a Fifth Renewal Licence on August 1, 2007. The intent to modernize the facility as outlined in that application changed and a January 21, 2010 letter to the Province provided notification of a change in scope to build a new spillway, concrete and earth dams with upgrades to the existing powerhouse. The Pointe du Bois Spillway Replacement Project commenced in late 2011 and was completed in 2015.

This appendix contains information specific to the Pointe du Bois Generating Station, including a description of the project, major construction specifications and operating parameters, and Water Power Act licensing requirements. The appendix also includes a description of the data collection process and summaries of 2021 forebay level compliance, major system upgrades or changes, and dam safety activities.

2.0 PROJECT DESCRIPTION

The Pointe du Bois Generating Station is a run-of-river hydroelectric generating facility consisting of a powerhouse, west gravity dam, main and south earthfill dams, a spillway access bridge and a 7-bay spillway. The STEL states that the station has a capacity of 85 MW. Pointe du Bois is the oldest station in the Manitoba Hydro system. Construction of the first phase of development began on or shortly after 1906 with the completion of double horizontal shaft Francis Turbines units one to four and unit seven in 1911/12. Additional units were added in 1914, 1919, 1921, 1922, 1925 and 1926 when the sixteenth and final unit became operational. In October 1995, Unit 11 was rerunnered and its capacity increased from 5.15 MW to 5.67 MW. Unit 1 was replaced with a Straflo turbine and commissioned on November 2, 1999 with a rating of 8.35 MW. Unit 15 in 2004 and Unit 16 in 2006 were also upgraded, each with increased capacity of 6.8 MW. All these upgrades increased the total capacity of the generating station to 85 MW (114,000 HP). A spillway access bridge was constructed in 2010. In 2015, the Pointe du Bois Spillway Replacement Project was completed and involved the replacement of the east gravity dam, spillway bays and rockfill dam with a new 7-bay spillway as well as main and south earthfill dams. In 2016, Units 3, 5, 7, and 11 were decommissioned and removed from the generating station.

Tables 1 and 2 summarize the operating parameters, and principal structures of the Pointe du Bois Generating Station.

Table A-1: Construction Specifications and Operating Parameters of the Pointe du Bois Generating Station

Construction Period	1909 to 1926
Licensed Capacity (Jan. 1, 2017- Jan. 1 2022)	85 MW (114,000 horsepower)
Average Annual Generation (2002-2021)	391 million kW-h
Waterfall Drop (head)	14 m
Maximum Licence Forebay Elevation (measured at the inner forebay)*	299.04 m (981.1 ft)
Normal Operating Maximum Forebay Elevation (measured at the outer forebay)	299.1 m

*981.1 ft Dominion Water Power Survey Datum or 981.6 ft Geodetic Survey of Canada (GS or C), Canadian Government Vertical Datum (CGVD) 1928, 1929 Local Adjustment)

Table A-2: Principal Structures for the Pointe du Bois Generating Station

Powerhouse	Number of Units	11 double horizontal shaft Francis Turbines and one Straflo turbine
	Length	135 m
	Discharge Capacity (at full gate)	712 m^3/s
	Power Production Unit 1 Units 2, 4 Units 6, 8 Units 9, 10 Units 12-14	 1 unit @ 8.35 MW 2 units @ 3.88 MW 2 units @ 5.07 MW 2 units @ 5.15 MW 3 units @ 5.44 MW

	Units 15, 16 Units 3, 5, 7, 11	2 units @ 6.80 MW 4 units removed in 2016
Spillway	Number of Bays	7 bays
	Bay Opening	13 m
	Discharge Capacity (at full supply level**)	4,915 m^3/s
Main and South Earthfill Dams	Material	Impervious core with granular and crushed rock filters and outer rockfill shells
	Crest Elevation	301.1 m
	Available Freeboard	2 m

*Full Supply Level is 299.1 m measured at the outer forebay

The forebay at Pointe du Bois consists of two parts: the inner forebay, located between the powerhouse and the spillway access bridge, and the outer forebay, extending upstream of the spillway access bridge to Lamprey Falls. The inner forebay elevation is subject to rapid changes due to wind, flow changes and operations. The outer forebay encompasses a larger area and does not experience the same rapid changes as the inner forebay. The forebay has a total area of 25.1 sq. km and a fetch length of approximately 5 km. The maximum operating level is 299.1 m measured at the outer forebay.

The Pointe du Bois Generating Station is operated from the control room on site and is continuously staffed. Maintenance and emergency staff are located at the station.

3.0 WATER POWER ACT LICENSING REQUIREMENTS

Condition #5 of the licence stipulates that:

> *"The Licensee shall not raise the headwater of the development, as measured at the powerhouse, to an elevation higher than 981.1 feet above mean sea level, Dominion Water Power Survey Datum (with wind effect eliminated). A higher elevation may be created only with written permission by the Director and in accordance with Section 72 of the Regulation."*

The maximum elevation of 981.1 ft (299.04 m) as specified in the licence refers to the elevation measured at the inner forebay, Dominion Water Power Survey Datum. Currently all Winnipeg River generating stations are operated in terms of elevations above sea level, GS of C, CGVD 1928, 1929 local adjustment. To convert from the Dominion Water Power Survey Datum to the GS of C, CGVD 1928, 1929 Local Adjustment a 0.5 foot (0.15 m) correction is added. Therefore the maximum level allowed by licence is 981.6 feet (299.19 m), GS of C, CGVD 1928, 1929 Local Adjustment.

Historically the plant has been operated to maintain an outer forebay level of 299.1 m, and people in the area are accustomed to this water regime. This limit on the outer forebay provides sufficient buffer that water levels in the inner forebay remain in compliance with the licence.

4.0 DATA COLLECTION AT GAUGES

The components of the inner and outer forebay gauges are identical in construction. The forebay water levels are recorded using an ultrasonic transducer and a data logger. The transducer is installed in a stilling well at a depth of 2 m and is protected from the elements by a small shelter (outer forebay gauge). The data logger transmits a signal to the control room through a cable running to the spillway and across the pole line where it enters the powerhouse at the north-east side of the gateroom.

The outer forebay gauge is located upstream of the spillway access bridge. The inner forebay gauge is located in the north-east section of the gateroom in the powerhouse, upstream of the Unit 1 intake. The map located in Figure A-3 displays the location of the two gauges.

5.0 DATA ANALYSIS

Manitoba Hydro prepared the Pointe du Bois Generating Station Licence Implementation Guide for Water Levels[1] to document a common understanding of compliance with the water regime terms of the Pointe du Bois Water Power Act Licence. The guide was approved by Manitoba in 2017.

During the 2021 calendar year, forebay water levels at the Pointe du Bois Generating Station were in compliance with the licence limit 100 % of the time.

Figure A-4 shows hourly water level readings for the Pointe du Bois inner forebay from January 1, 2021 to December 31, 2021.

6.0 MAJOR SYSTEM UPGRADES/CHANGES

Maintenance and construction activities that occurred during the 2021 calendar year include:

- Overhauled local service Unit 2

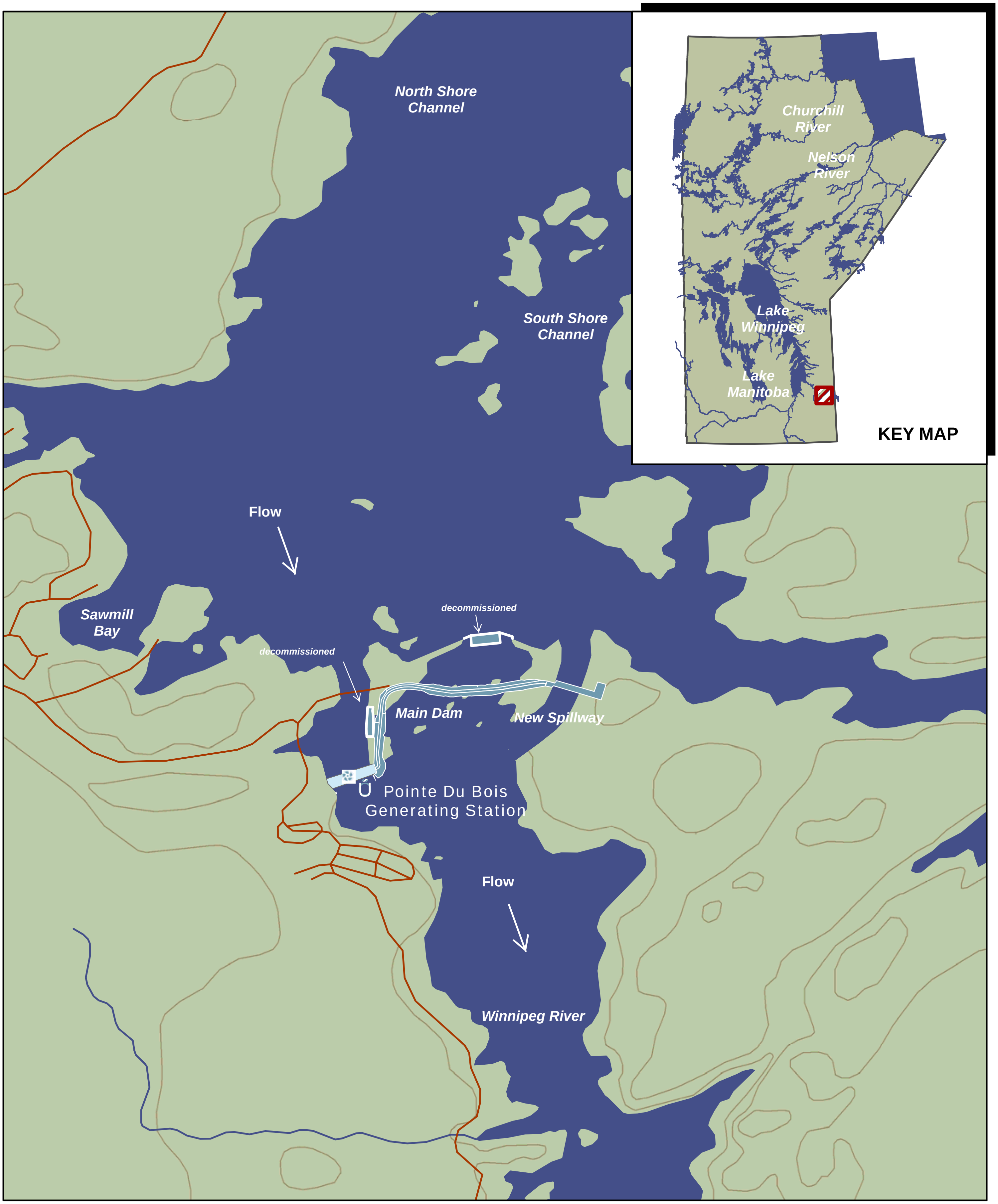
[1] Manitoba Hydro. 2017. Pointe du Bois Generating Station Licence Implementation Guide for Water Levels.

7.0 DAM SAFETY

Manitoba Hydro operates and maintains the generating station and associated structures at Pointe du Bois based on the Canadian Dam Association Dam Safety Guidelines. A summary of dam safety activities for 2021 is provided on page A-10.

8.0 CLOSURE

Manitoba Hydro continues to operate the Pointe du Bois Generating Station in accordance with the Short-term Extension Licence under The Water Power Act for the development of water power at the Pointe du Bois Site on the Winnipeg River.



Manitoba Hydro

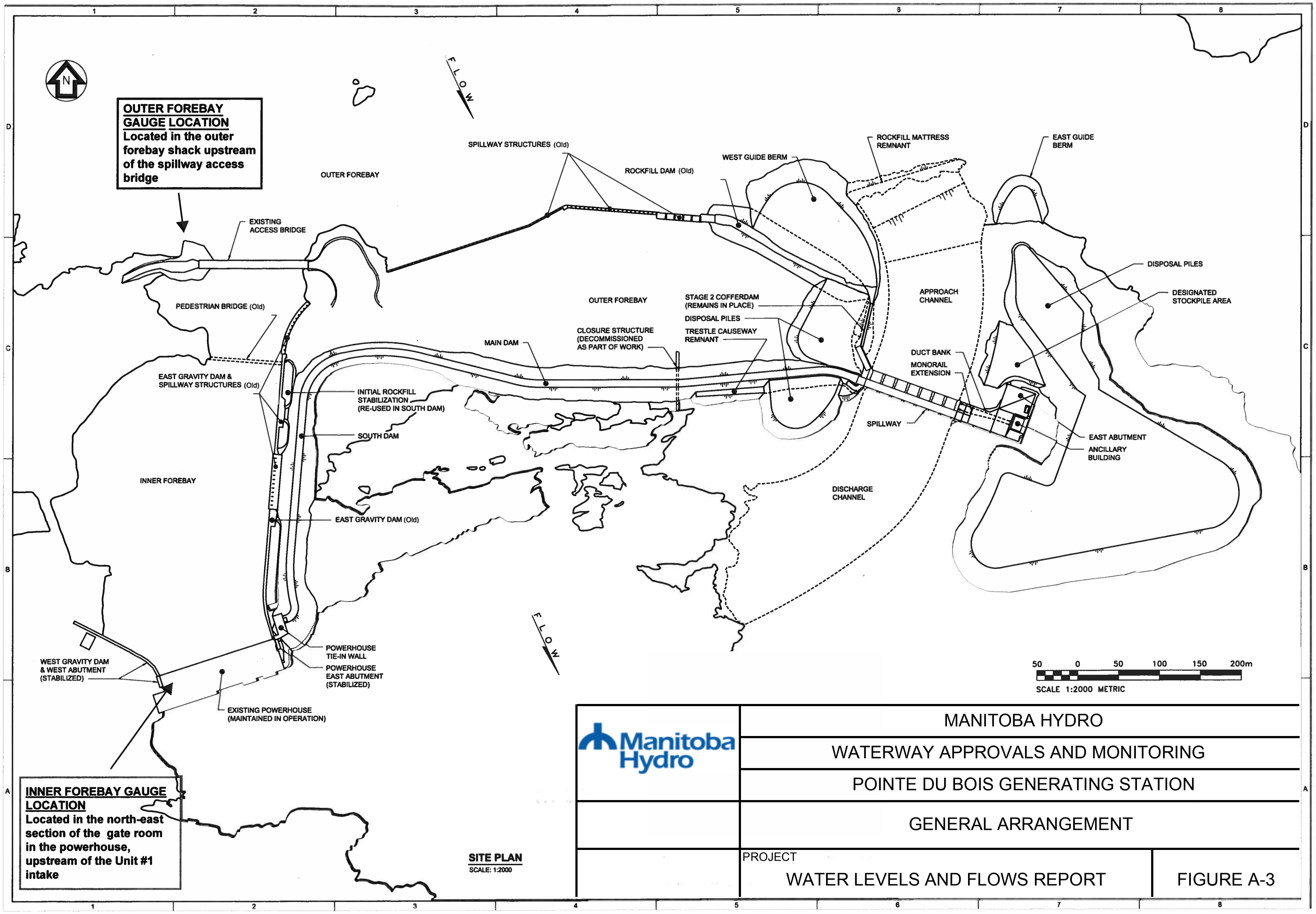
0.45 0.225 0 0.45 km

POINTE DU BOIS G.S. GEOGRAPHICAL LOCATION

FIGURE A-1

Generating Station
Dam
Road

Manitoba Hydro	MANITOBA HYDRO
	WATERWAY APPROVALS AND MONITORING
	POINTE DU BOIS GENERATING STATION
	PHOTOGRAPH OF GENERATING STATION
	PROJECT WATER LEVELS AND FLOWS REPORT — FIGURE A-2



MANITOBA HYDRO

WATERWAY APPROVALS AND MONITORING

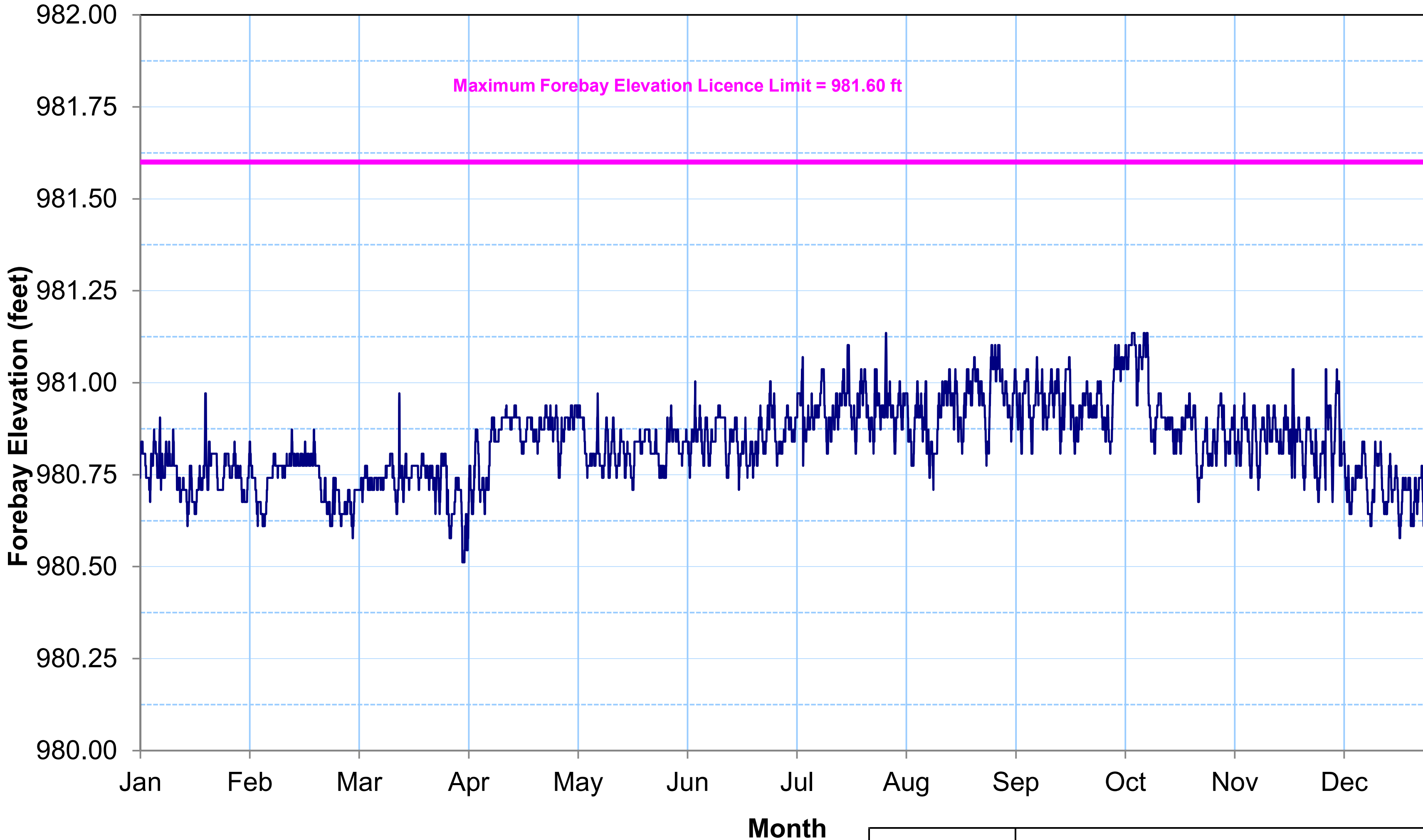
POINTE DU BOIS GENERATING STATION

GENERAL ARRANGEMENT

PROJECT

WATER LEVELS AND FLOWS REPORT

FIGURE A-3



Daily Averaged Forebay Elevation Statistics 1978 - 2021

Maximum	**= 981.15 feet**
Minimum	**= 977.03 feet**
Mean	**= 980.33 feet**

Manitoba Hydro	MANITOBA HYDRO
	WATERWAY APPROVALS AND MONITORING
	POINTE DU BOIS GENERATING STATION
	HOURLY FOREBAY ELEVATIONS (2021)
	PROJECT Water Levels and Flows Report — FIGURE A-4

Pointe du Bois 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
	Cursory winter inspection of concrete dams	Dam Safety	1	1
	Spillway bay inspection - civil components	Dam Safety	1	1
	Unscheduled inspection – west frost wall	Dam Safety	1	-
	Unscheduled inspection - spillway	Dam Safety	1	-
	Condition survey – intake structure	Dam Safety & Contractor	1	1
	Condition survey – sub-apron drainage gallery	Dam Safety	1	1
	Unit inspection – civil components	Mechanical Design & Contractor	2	2
	Routine inspection of embankment dams	Site - Utility	12	12
	Routine inspection of concrete dams	Site - Utility	6	6
	Forebay monitor (gauge) check	Site - Operator	12	12
	Outer forebay gauge inspection	Site - Elec	1	1
	Tailrace monitor (gauge) check	Site - Operator	12	12
	Spillway inspection	Site - Operator	50	52
	Hydraulic conditions inspection	Dam Safety	1	1
Analyses	Instrumentation data review (Concrete Dams)	Dam Safety	30	30
	Instrumentation data review (Embankment Dams)	Dam Safety	12	12
Maintenance and Testing	Spillway gate functional testing	Site - Elec/Mech	6	7 (1 per gate)
	Spillway gate full flow test	Site - Elec/Mech	1	1
	Spillway emergency generator - functional gate lift test	Site - Elec	0*	1
	Spillway emergency generator test runs	Site - Elec	11	12
	Spillway gate heater maintenance	Site - Elec	7	7 (1 per gate)
	Spillway gate hoist maintenance	Site - Elec	7	7 (1 per gate)
	Spillway gate hoist maintenance	Site - Mech	7	7 (1 per gate)
	Spillway emergency generator maintenance	Mechanical Services	1	1
Program	Dam Safety Emergency Plan - updates	Dam Safety	1	1
	Dam Safety Reference Manual - Revision	Dam Safety	-	-
	Delivered DS Training - Routine Inspections	Dam Safety	1	As Required
	Delivered DS Training - Emergency Preparedness	Dam Safety	0	As Required

* Not completed due to low flow conditions on the Winnipeg River, COVID-19 restrictions & low staffing levels in 2021. Completing the lifting a gate with the power from the spillway emergency generator is a priority in 2022.

APPENDIX B

SLAVE FALLS GENERATING STATION
WATER POWER ACT LICENCE

1.0 INTRODUCTION

Slave Falls Generating Station is located on the Winnipeg River, approximately 160 km northeast of Winnipeg by road and 10 km down river from Pointe du Bois. The station is accessible by private road from Pointe du Bois. The geographical location of the station is shown in Figure B-1. A photograph of the station is shown in Figure B-2. An overall site map is shown in Figure B-3.

The Slave Falls Generating Station was constructed between 1928 and 1948. The plant was built by City Hydro, later known as Winnipeg Hydro. Manitoba Hydro acquired Slave Falls in 2002.

Manitoba Hydro operates the Slave Falls Generating Station in accordance with the Renewal Licence for the Development of Water Power at the Slave Falls site on the Winnipeg River. This licence was issued in accordance with the provisions of The Water Power Act on June 30, 1982. The Renewal Licence was valid for a term of 40 years and was in effect until January 1, 2022. Manitoba Hydro requested a Second Renewal Licence on September 12, 2017.

This appendix contains information specific to the Slave Falls Generating Station, including a description of the project, major construction specifications and operating parameters, and Water Power Act licensing requirements. The appendix also includes a description of the data collection process and summaries of 2021 forebay level compliance, major system upgrades or changes, and dam safety activities.

2.0 PROJECT DESCRIPTION

The Slave Falls Generating Station is a run-of-river hydroelectric generating facility consisting of an 8-unit close-coupled intake/powerhouse with a generating capacity of 71.6 MW, a 28-bay north spillway, 7-bay north sluiceway, 3-bay ice sluiceway, 2-bay regulating sluiceway, concrete non-overflow dams, and earthfill dikes. Table B-1 and B-2 summarize the operating parameters, and principal structures of the Slave Falls Generating Station.

Table B-1: Construction Specifications and Operating Parameters of the Slave Falls Generating Station

Construction Period	1928 to 1948
Licensed Capacity	71.6 MW (96,000 horsepower)
Average Annual Generation	455 million kW-h
Waterfall Drop (head)	9.75 m
Maximum Licence Forebay Elevation	284.62 m (933.8 ft)
Maximum Operating Forebay Elevation	284.62 m

Table B-2: Principal Structures for the Slave Falls Generating Station

Powerhouse	Number of Units	8 vertical propeller type turbines
	Length	180 m
	Discharge Capacity (at full gate)	962.8 m^3/s
	Unit Power Production	8.94 MW (12,000 horsepower)
Spillway	Number of Bays	North spillway - 28 North sluiceway - 7 Ice sluiceway - 3 Regulating sluiceway - 2
	Discharge Capacity (at full supply level*)	4,454 m^3/s
Rockfill Dam	Material	Granite rockfill
	Crest Elevation	287.9 m
	Available Freeboard	3.28 m

*Full Supply Level is 284.62 m measured at the forebay

The forebay at Slave Falls has a total area of 6.47 sq. km and a fetch length of approximately 4 km. The forebay's operating water level is 284.62 m.

The Slave Falls generating units are remotely controlled from the Pointe du Bois Generating Station control room. Maintenance and emergency staff are stationed at both generating stations.

3.0 WATER POWER ACT LICENSING REQUIREMENTS

Condition #4 of the licence stipulates that:

> *"The Licensee shall not raise the headwater of its development to an elevation higher than 933.8 feet above mean sea level, Canadian Geodetic Datum 1929 Adjustment. A higher elevation may be created only with written permission by the Minister and in accordance with Section 72 of the Regulations."*

4.0 DATA COLLECTION AT GAUGE

The forebay gauge is located one-third of the way down the plant near the intake. The transducer is submerged at a depth of 2 m inside of a stilling well which is connected to the forebay by a pipe. The transducer is ultrasonic and reports back to a data logger. A map showing the location of the gauge is shown on Figure B-3.

5.0 DATA ANALYSIS

Manitoba Hydro prepared the Slave Falls Generating Station Licence Implementation Guide for Water Levels[1] to document a common understanding of compliance with the water regime terms of the Slave Falls Water Power Act Licence. The report was approved by Manitoba in 2017.

During the 2021 calendar year, forebay water levels at the Slave Falls Generating Station were in compliance with the licence limit 100 % of the time.

Figure B-4 shows hourly water level readings for the Slave Falls forebay from January 1, 2021 to December 31, 2021.

6.0 MAJOR SYSTEM UPGRADES/CHANGES

Maintenance and construction activities that occurred during the 2021 calendar year include:

- Upstream safety boom, downstream buoys and new portage installed
- Replaced transformer bank 2
- Installed second hoist on seven bay sluiceway
- Installed gate room fall protection
- Repaired the Unit 3 Automatic Voltage Regulator
- Instrumented and surveyed tramway deck for movement
- Safety / fall protection issues related to stairs, handrails and ladders addressed
- Replaced roller trains on Sluiceway Gate 7 and performed dry and wet testing

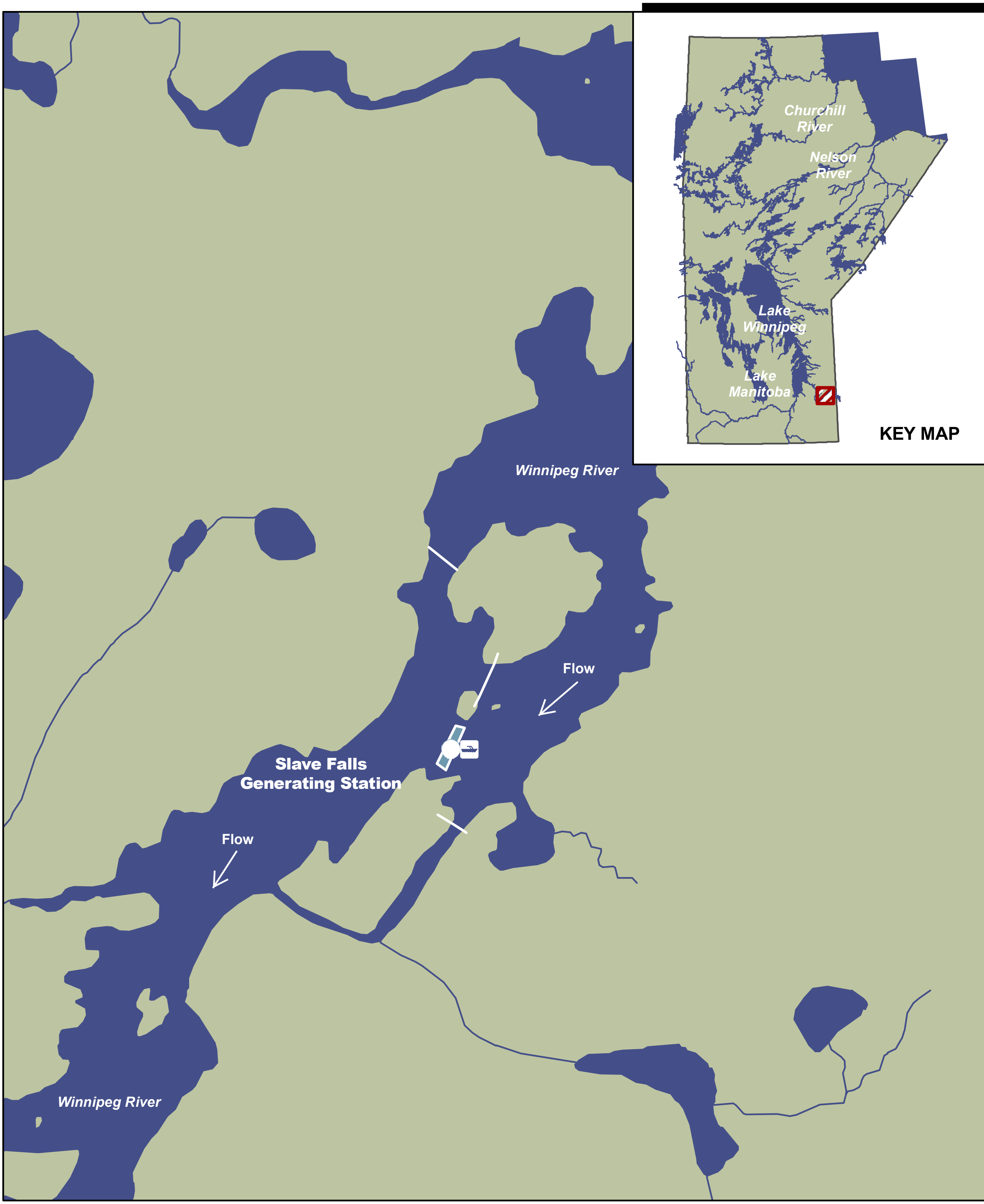
7.0 DAM SAFETY

Manitoba Hydro operates and maintains the generating station and associated structures at Slave Falls based on the Canadian Dam Association Dam Safety Guidelines. A summary of dam safety activities for 2021 is provided on pages B-8 and B-9.

8.0 CLOSURE

Manitoba Hydro continues to operate the Slave Falls Generating Station in accordance with the Renewal Licence under The Water Power Act for the Development of water power at the Slave Falls Site on the Winnipeg River.

[1] Manitoba Hydro. 2017. Slave Falls Generating Station Licence Implementation Guide for Water Levels.



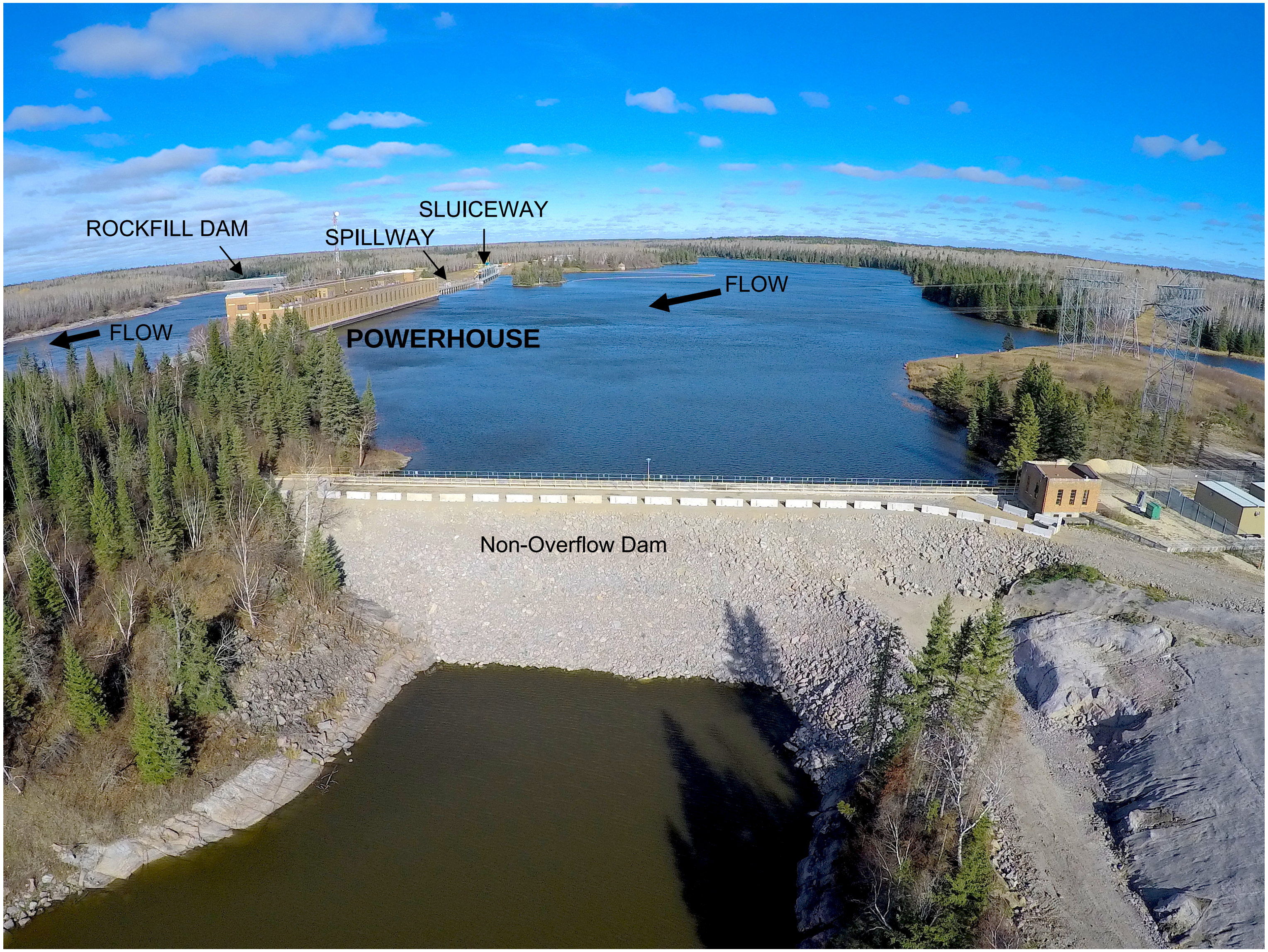
Manitoba Hydro

0.5 0.25 0 0.5 km

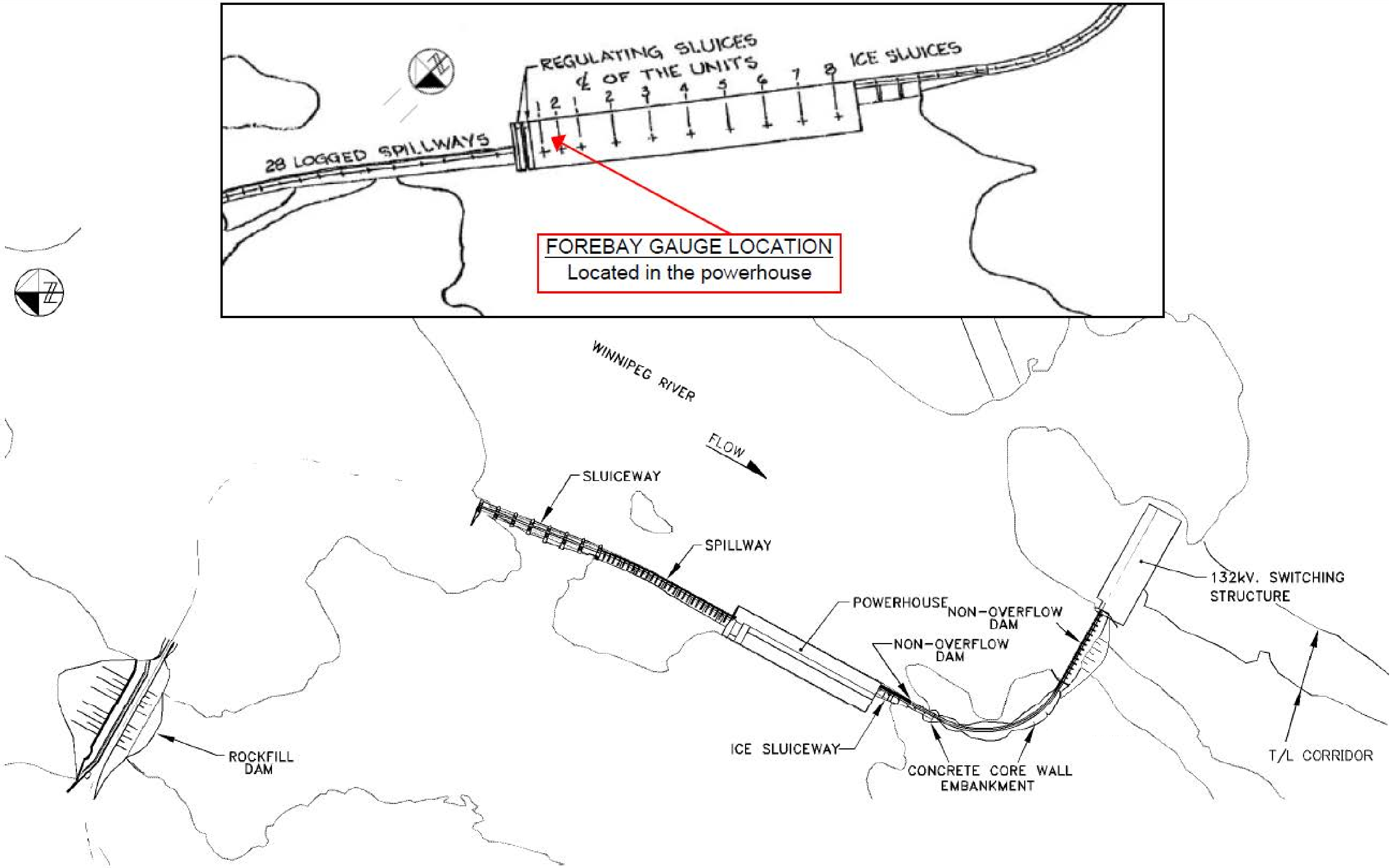
SLAVE FALLS G.S.
GEOGRAPHICAL LOCATION

FIGURE B-1

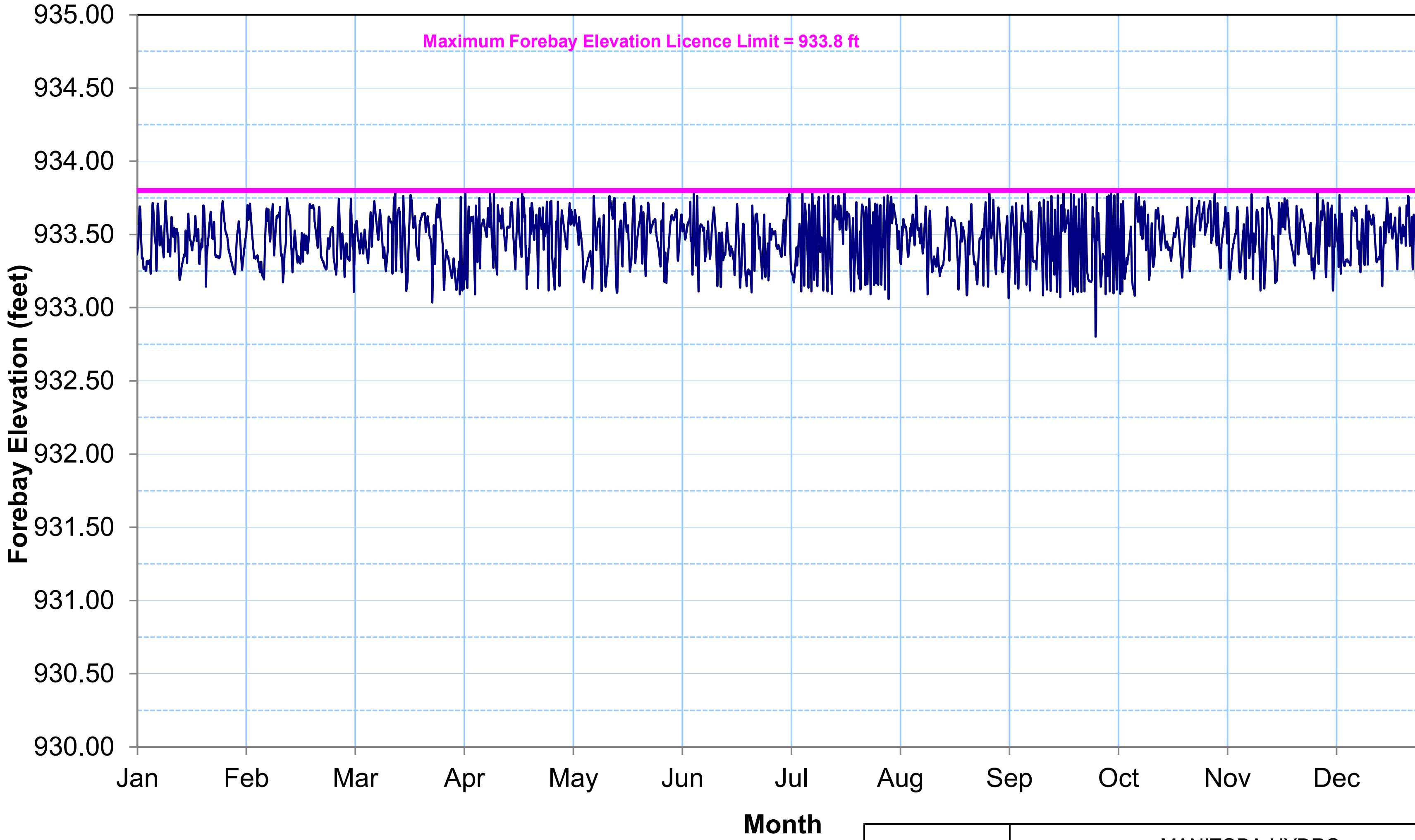
Generating Station
Dam
Road



MANITOBA HYDRO	
WATERWAY APPROVALS AND MONITORING	
SLAVE FALLS GENERATING STATION	
PHOTOGRAPH OF GENERATING STATION	
PROJECT WATER LEVELS AND FLOWS REPORT	FIGURE B-2



Manitoba Hydro	MANITOBA HYDRO
	WATERWAY APPROVALS AND MONITOIRNG
	SLAVE FALLS GENERATING STATION
	GENERAL ARRANGEMENT
	PROJECT WATER LEVELS AND FLOWS REPORT — FIGURE B-3



Daily Averaged Forebay Elevation Statistics 1978 - 2021

Maximum	**= 934.35 feet**
Minimum	**= 927.72 feet**
Mean	**= 933.38 feet**

Manitoba Hydro	MANITOBA HYDRO
	WATERWAY APPROVALS AND MONITORING
	SLAVE FALLS GENERATING STATION
	HOURLY FOREBAY ELEVATIONS (2021)
	PROJECT Water Levels and Flows Report / FIGURE B-4

Slave Falls GS Dam Safety 2021 Activities List

	ACTIVITIES	Performed By	Tasks Completed	Tasks Planned
Inspections	Engineering inspection of embankment dams	Dam Safety	1	1
	Unscheduled inspection of embankment dams	Dam Safety	0	-
	Engineering inspection of concrete dams	Dam Safety	1	1
	Cursory Winter inspection of concrete dams	Dam Safety	1	1
	Cursory Post Spill Inspection - 7–Bay Sluiceway	Dam Safety	1	0
	Unit inspection - civil components	Dam Safety	2	2
	Condition survey – 7-Bay Sluiceway – LiDAR and photogrammetry scan	Dam Safety	1	1
	Sluiceway Bay Inspection - 7-Bay Sluiceway	Dam Safety	1	1
	Condition survey – 28-Bay Spillway – Timber Gates	Dam Safety	1	1
	Condition survey – 7-Bay Sluiceway – Post Spill Inspection	Dam Safety	1	1
	Routine inspection of rockfill dam	Site - Utility	12	12
	Routine inspection of other embankment dams	Site - Utility	1	1
	Routine inspection of concrete dams	Site - Utility	6	6
	Routine inspection of road deck movement	Site - Utility	51	52
	7-Bay sluiceway gate gain heater inspection	Site - Elec	17	26
	Spillway inspection	Site - Operating	47	52
	Forebay/tailrace gauge inspection	Site - Operating	11	12
	Hydraulic conditions inspection	Dam Safety	1	1
Analyses	Engineering analyses (Concrete Dams)	GDD (Structural & Consultants)	7	-
	Instrumentation data review (Concrete Dams)	Dam Safety	15	15
Maintenance and Testing	7-Bay sluiceway gate functional testing	Site - Elec/Mech	0*	1
	Lift a sluiceway gate with power from the sluiceway emergency generator	Site - Elec	0*	1
	7-Bay sluiceway gate gain heater maintenance	Site - Elec	7	7 (1 per gate)
	7-Bay sluiceway gate heater maintenance	Site - Elec	6	6 (1 per gate)
	7-Bay sluiceway south hoist (1) maintenance	Site - Elec	1	1
	7-Bay sluiceway north hoist (2) maintenance	Site - Elec	1	1
	Regulating gate hoist maintenance	Site - Elec	2	2 (1 per gate)
	7-Bay sluiceway gate maintenance	Site - Mech	7	7 (1 per gate)
	7-Bay sluiceway south hoist (1) maintenance	Site - Mech	1	1

	ACTIVITIES	Performed By	Tasks Completed	Tasks Planned
	7-Bay sluiceway north hoist (2) maintenance	Site - Mech	1	1
	Regulating gate hoist inspection	Site - Mech	2	2 (1 per gate)
	Sluiceway emergency generator test runs	Site - Operating	12	12
	28-Bay spillway gate functional testing	Site - Utility	1	1
	Spillway emergency generator maintenance	Mechanical Services	1	1
Program	Dam Safety Emergency Plan - updates	Dam Safety	1	1
Program	Dam Safety Reference Manual - Revision	Dam Safety	0	0
Program	Delivered DS Training - Routine Inspections	Dam Safety	1	As Required
Program	Delivered DS Training - Emergency Preparedness	Dam Safety	0	As Required

* Not completed due to low flow conditions on the Winnipeg River, COVID-19 restrictions & low staffing levels in 2021. Completing the spillway functional testing is a priority in 2022.

APPENDIX C

SEVEN SISTERS GENERATING STATION
WATER POWER ACT LICENCE

1.0 INTRODUCTION

The Seven Sisters Generating Station is located approximately 90 km northeast of the City of Winnipeg, and approximately 72 km upstream of Lake Winnipeg. The geographical location of the station is shown in Figure C-1. A photograph of the station is shown in Figure C-2. An overall site map is shown in Figure C-3.

The Seven Sisters Generating Station was constructed in two stages between 1929 and 1952 and has the greatest generation capacity of the Manitoba Hydro plants located on the Winnipeg River.

Manitoba Hydro currently operates the Seven Sisters Generating Station with a Third Short-Term Extension Licence (STEL) issued in accordance with the provisions of The Water Power Act on October 1, 2020. The STEL is in effect until September 30, 2025. The operating terms of the STEL are identical to those of the final licence issued on June 3, 1966. Manitoba Hydro requested a renewal licence on January 19, 1978.

This appendix contains information specific to the Seven Sisters Generating Station, including a description of the project, major construction specifications and operating parameters, and Water Power Act licensing requirements. The appendix also includes a description of the data collection process and summaries of 2021 forebay level compliance, major system upgrades or changes, and dam safety activities.

2.0 PROJECT DESCRIPTION

The Seven Sisters Generating Station is a run-of-river hydroelectric generating facility consisting of a six unit powerhouse with a capacity of 180.6 MW and a two bay gated sluiceway dividing a 27 bay spillway into two sections. The spillway at Seven Sisters is flanked to the north and south by non-overflow wing-walls. The powerhouse is incorporated into the north wing-wall. Forebay containment dikes extend for 5.6 km upstream on the Winnipeg River's north shore and 7.2 km upstream on the south shore. Tables C-1 and C-2 summarize the operating parameters, and principal structures of the Seven Sisters Generating Station.

Table C-1: Construction Specifications and Operating Parameters of the Seven Sisters Generating Station

Construction Period	1929 to 1952 (two-stages)
Licensed Capacity	167.8 MW (225,000 horsepower)
Average Annual Generation	1,004 million kW-h
Waterfall Drop (head)	18.6 m
Maximum Licence Forebay Elevation	274.17 m (899.5 ft)
Maximum Operating Forebay Elevation	274.17 m

Table C-2: Principal Structures for the Seven Sisters Generating Station

Powerhouse	Number of Units	6
	Length	128.2 m
	Discharge Capacity (at full gate)	1,040 m^3/s
	Power Production Unit 1 Unit 2 Unit 3 Unit 4 Unit 5, 6	 1 unit @ 31.3 MW/unit = 31.3 MW 1 unit @ 30.7 MW/unit = 30.7 MW 1 unit @ 30.5 MW/unit = 30.5 MW 1 unit @ 32.1 MW/unit = 32.1 MW 2 units @ 28.0 MW/unit = 56.0 MW TOTAL =180.6 MW
Spillway	Number of Bays	Two spillways with 27 bays, divided by a sluiceway with 2 bays
	Total Length	225 m
	Discharge Capacity (at full supply level*)	4,014 m^3/s
Dikes and Non Overflow Dams	Material	Rock with a clay core
	Crest Elevation	Dams: 276.0 m Dikes: 276.2 m
	Available Freeboard	Earth Structures: 2.0 m Concrete Structures: 1.8 m

*Full Supply Level is 274.17 m measured at the forebay

The forebay at Seven Sisters Generating Station creates Natalie Lake, which is 11 km long, and between 0.8 km and 2.4 km wide. The lake has a total area of 21 sq. km and a fetch length of approximately 6.5 km. The normal forebay water level is 274.17 m.

Seven Sisters is remotely operated from the System Control Centre in Winnipeg. Maintenance and emergency staff are stationed at the Winnipeg River Operations Centre located adjacent to the Great Falls Generating Station.

3.0 WATER POWER ACT LICENSING REQUIREMENTS

Condition #4 of the licence stipulates that:

> *"The Licensee shall not raise the headwater of the development to an elevation higher than 899.5 above mean sea level, Canadian Geodetic Datum 1929 Adjustment, provided, however, that with the consent of the Licensee of the next development upstream, namely, Slave Falls Generating Station, and with the prior written approval of the Director, the Licensee may raise and maintain the headwater elevation in accordance with Section 72 of the Regulations."*

4.0 DATA COLLECTION AT GAUGE

The forebay stilling well is located in the gate-room near the house unit intake. The stilling well is connected to the forebay through a wrought iron pipe embedded in the pier separating Unit 1 intake from the house unit intake, with the piping routed through an isolating valve in the pump room.

The forebay gauge consists of a float attached to a steel tape that is draped over a pulley connected to a Selsyn (self-synchronous) system. This system electronically transmits the angular position of the pulley to a receiving device in the control room. The position information is converted to a water level, indicated on a display and also output to the Remote Transmittal Unit for transmission to the System Control Centre. The station operators at Seven Sisters check the calibration of the gauge by comparing manual measurements with electronic readings in the control room once a week or as required.

Water level readings are affected by Unit 1 operations due to the close proximity of the gauge to the intake of the unit. The drawdown caused by the operation of the unit causes the readings to be artificially low, thus a sudden outage of unit operations will cause a temporary spike in water level reading. A map showing the location of the gauge is shown on Figure C-3.

5.0 DATA ANALYSIS

Manitoba Hydro prepared the Seven Sisters Generating Station Licence Implementation Guide for Water Levels[1] to document a common understanding of compliance with the water regime terms of the Seven Sisters Water Power Act Licence. The report was approved by Manitoba in 2017.

During the 2021 calendar year, forebay water levels at the Seven Sisters Generating Station were in compliance with the licence limit 100 % of the time.

Figure C-4 shows all hourly water level readings at the Seven Sisters forebay from January 1, 2021 to December 31, 2021.

[1] Manitoba Hydro. 2017. Seven Sisters Generating Station Licence Implementation Guide for Water Levels.

6.0 MAJOR SYSTEM UPGRADES/CHANGES

Maintenance and construction activities that occurred during the 2021 calendar year include:

- Replaced transformer bank 6
- Repaired the house unit upper gate shaft linkage system
- Mechanically cleared vegetation at Pinawa Control Dam
- Storage frame for sluiceway stoplogs was installed
- Replace roofing system
- Repaired (90% complete) the headblocks on House unit and Units 1, 2 and 3

7.0 DAM SAFETY

Manitoba Hydro operates and maintains the generating station and associated structures at Seven Sisters based on the Canadian Dam Association Dam Safety Guidelines. A summary of dam safety activities for 2021 is provided on page C-9.

8.0 CLOSURE

Manitoba Hydro continues to operate the Seven Sisters Generating Station in accordance with the Second Short Term Extension Licence under The Water Power Act for the development of water power at the Seven Sisters Site on the Winnipeg River.

Manitoba Hydro

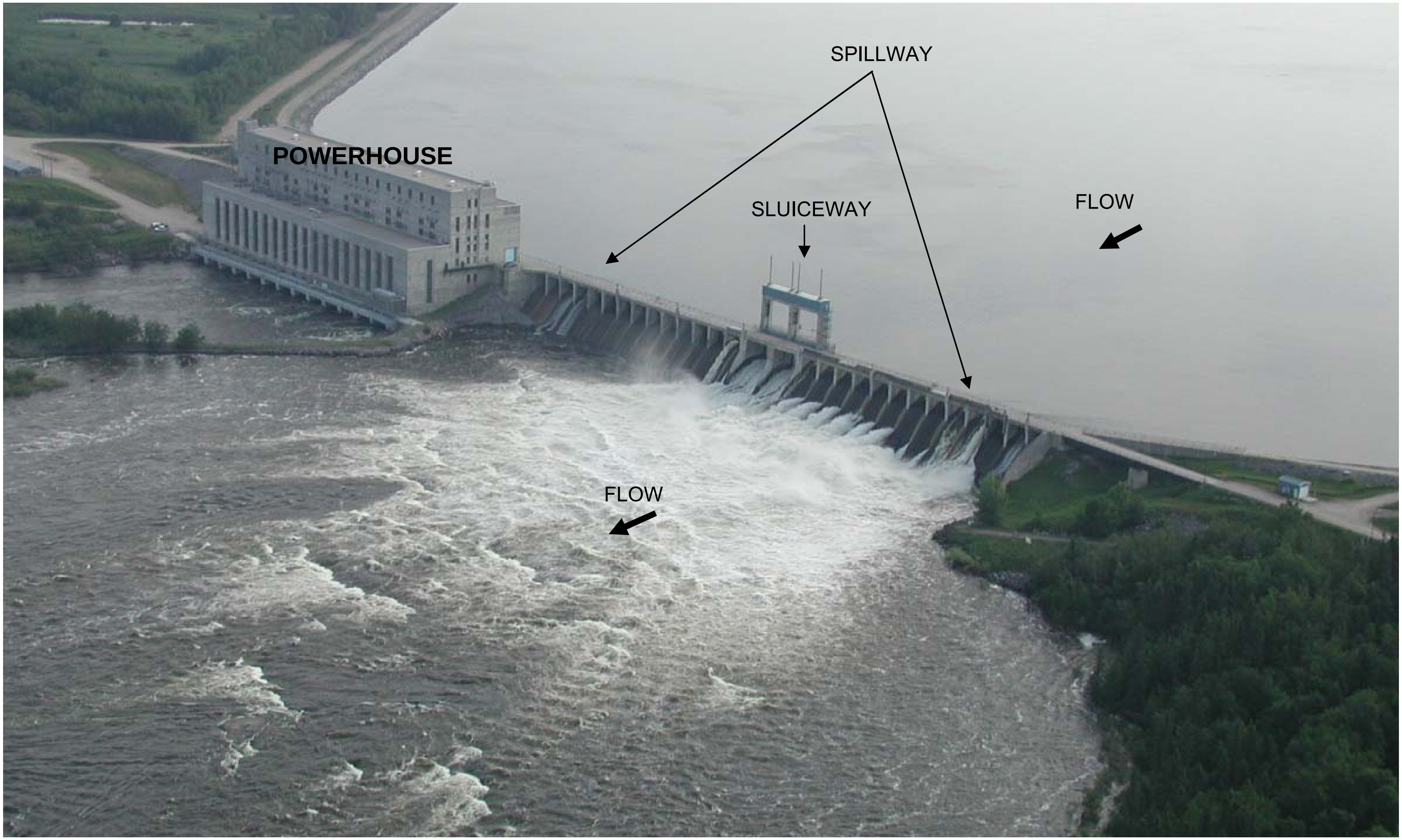
0.5 0.25 0 0.5 km

N

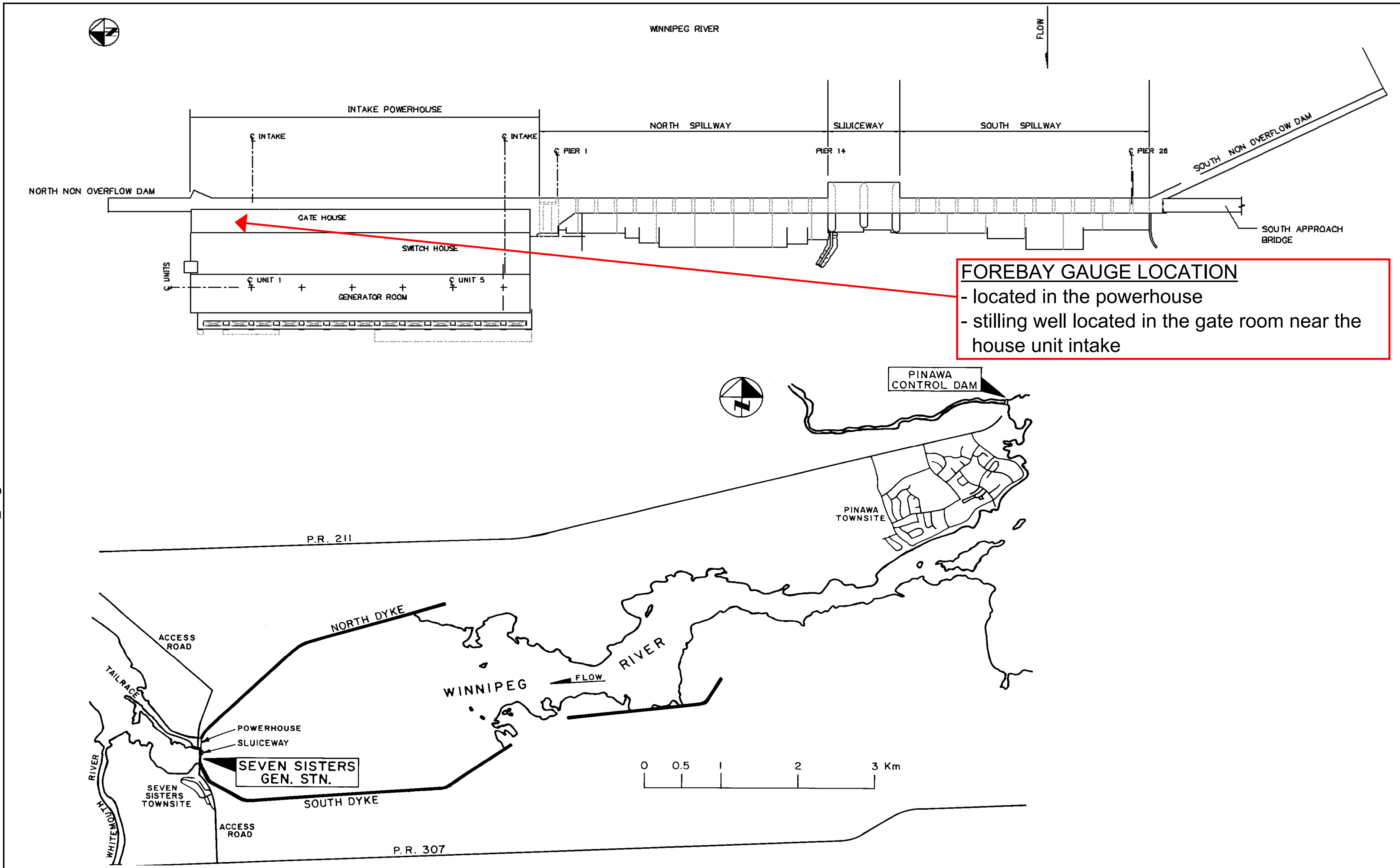
SEVEN SISTERS G.S.
GEOGRAPHICAL LOCATION

FIGURE C-1

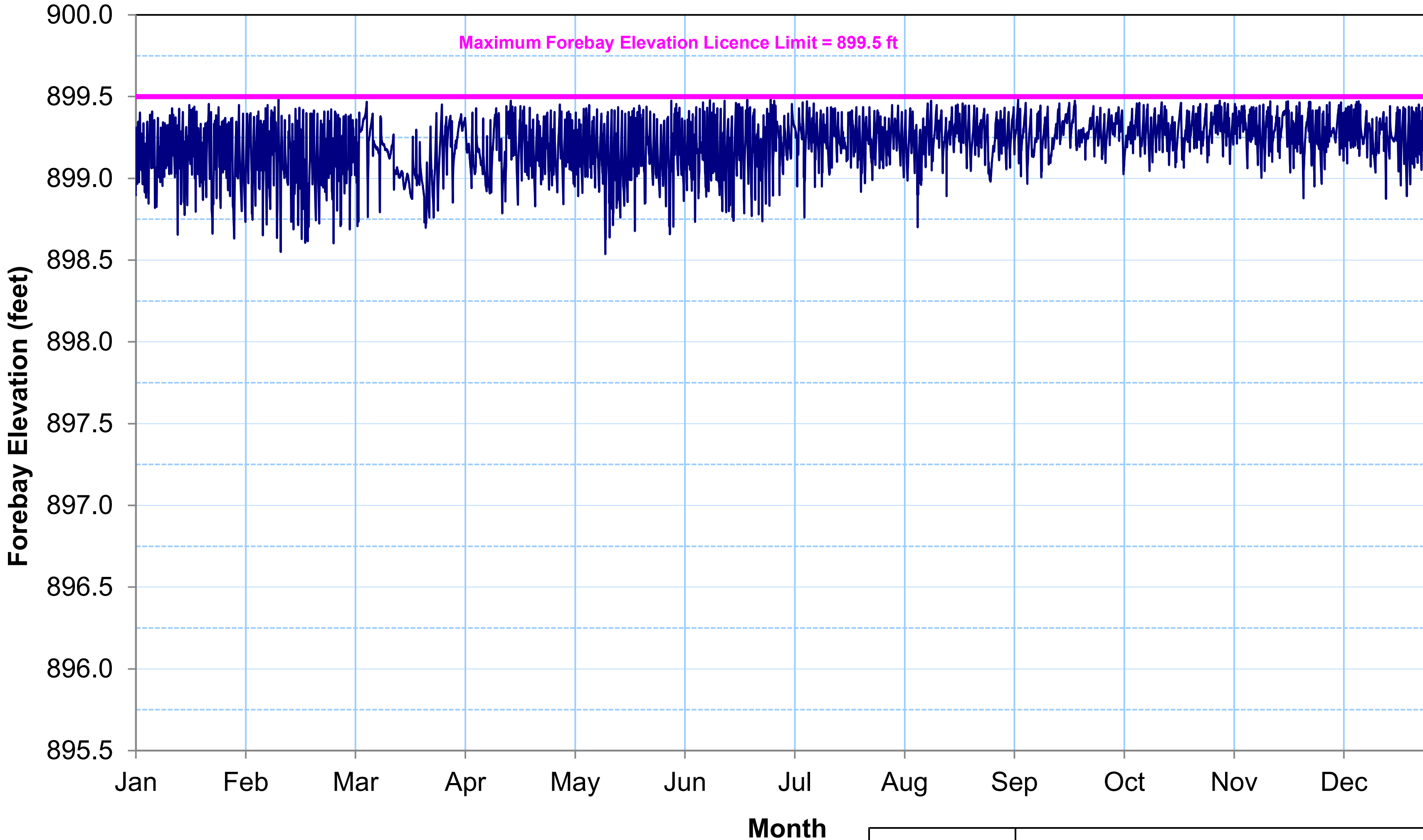
Generating Station
Dam
Road



Manitoba Hydro	MANITOBA HYDRO	
	WATERWAY APPROVALS AND MONITORING	
	SEVEN SISTERS GENERATING STATION	
	PHOTOGRAPH OF GENERATING STATION	
	PROJECT WATER LEVELS AND FLOWS REPORT	FIGURE C-2



Manitoba Hydro	MANITOBA HYDRO
	WATERWAY APPROVALS AND MONITORING
	SEVEN SISTERS GENERATING STATION
	GENERAL ARRANGEMENT
	PROJECT WATER LEVELS AND FLOWS REPORT — FIGURE C-3



Daily Averaged Forebay Elevation Statistics 1977 - 2021

Maximum = 899.84 feet
Minimum = 894.80 feet
Mean = 899.00 feet

	MANITOBA HYDRO
	WATERWAY APPROVALS AND MONITORING
	SEVEN SISTERS GENERATING STATION
	HOURLY FOREBAY ELEVATIONS (2021)
PROJECT Water Levels and Flows Report	FIGURE C-4

Seven Sisters GS Dam Safety Activities List

	ACTIVITIES	Performed By	Tasks Completed	Tasks Planned
Inspections	Engineering inspection of embankment dams	Dam Safety	1	1
	Unscheduled inspection of embankment dams	Dam Safety	1	-
	Engineering inspection of concrete dams	Dam Safety	1	1
	Unscheduled inspection of spillway	Dam Safety	1	-
	Cursory winter inspection of concrete dams	Dam Safety	1	1
	Unit inspection – civil components	Dam Safety	0	1
	Routine inspection of embankment dams	Site - Utility	12	12
	Routine inspection of concrete dams	Site - Utility	6	6
	Forebay/tailrace gauge inspection	Site - Operating	41	52
	Spillway inspection	Site - Operating	44	52
	Hydraulic conditions inspection	Dam Safety	1	1
Analyses	Instrumentation data review (Concrete Dams)	Dam Safety	31	31
Maintenance and Testing	Sluiceway gate functional testing	Site - Elec/Mech	2	2 (1 per gate)
	Sluiceway emergency generator - functional gate lift test	Site - Elec	1	1
	Sluiceway emergency generator test runs	Site - Operating	10	12
	Sluiceway gate heater maintenance	Site - Elec	2	2 (1 per gate)
	Sluiceway gate gain heater maintenance	Site - Elec	2	2 (1 per gate)
	Sluiceway gate gain heat controller maintenance	Site - Elec	1	1
	Sluiceway hoist maintenance	Site - Elec	2	2 (1 per gate)
	North and South spillway spud hoist maintenance	Site - Elec	1	1
	Sluiceway gate maintenance	Site - Mech	2	2 (1 per gate)
	North and South spillway spud hoist maintenance	Site - Mech	1	1
	Spillway emergency follower maintenance	Site - Mech	1	1
	Sluiceway emergency generator maintenance	Mechanical Services	1	1
Program	Dam Safety Emergency Plan	Dam Safety	1	1
	Dam Safety Reference Manual - Revision	Dam Safety	-	-
	Delivered DS Training - Routine Inspections	Dam Safety	1	As Required
	Delivered DS Training - Emergency Preparedness	Dam Safety	0	As Required

APPENDIX D

MCARTHUR FALLS GENERATING STATION
WATER POWER ACT LICENCE

1.0 INTRODUCTION

The McArthur Falls Generating Station is located approximately 120 km northeast of the City of Winnipeg, 15 km north of the Town of Lac du Bonnet and 30 km downstream of the Seven Sisters Generating Station. The geographical location of the station is shown in Figure D-1. A photograph of the station is shown in Figure D-2. An overall site map is shown in Figure D-3.

Manitoba Hydro currently operates the McArthur Falls Generating Station with a Third Short-Term Extension Licence (STEL) issued in accordance with the provisions of The Water Power Act on October 1, 2020. The STEL is in effect until September 30, 2025. The operating terms of the STEL are identical to those of the final licence issued on November 30, 1965. Manitoba Hydro requested a renewal licence on February 6, 1999.

This appendix contains information specific to the McArthur Falls Generating Station, including a description of the project, major construction specifications and operating parameters, and Water Power Act licensing requirements. The appendix also includes a description of the data collection process and summaries of 2021 forebay level compliance, major system upgrades or changes, and dam safety activities.

2.0 PROJECT DESCRIPTION

Construction of the McArthur Falls Generating Station began in 1952 and was completed in 1955. McArthur Falls is the newest of the six generating stations operating on the Winnipeg River. The generating station consists of an eight unit powerhouse with a capacity of 60 MW and approximately 8.5 km of dikes. The plant also has an 8-bay spillway, with 4 bays which can be opened remotely by equipment installed in the plant. Tables D-1 and D-2 summarize the operating parameters, and principal structures of the McArthur Falls Generating Station.

Table D-1: Construction Specifications and Operating Parameters of the McArthur Falls Generating Station

Construction Period	1952 to 1955
Licensed Capacity	60 MW (80,000 horsepower)
Average Annual Generation	396 million kW-h
Waterfall Drop (head)	7.0 m
Maximum Licence Forebay Elevation	254.8 m (836.0 ft)
Maximum Operating Forebay Elevation	254.76 m

Table D-2: Principal Structures for the McArthur Falls Generating Station

Powerhouse	Number of Units	8
	Length	177 m
	Discharge Capacity (at full gate)	962.8 m^3/s
	Unit Power Production	7.5 MW
Spillway	Number of Bays	Sluiceway with 8 bays
	Sluiceway Bay Opening	12.2 m
	Discharge Capacity (at full supply level*)	6,220 m^3/s
Dikes	Material	Earth and rockfill
	Crest Elevation	256.6 m
	Available Freeboard	0.4 m

*Full Supply Level is 254.76 m measured at the powerhouse

The forebay at the McArthur Falls Generating Station was created by increasing the size of Lake Lac du Bonnet. The lake has a total area of 115 sq. km and a fetch length of approximately 12 km. The forebay's normal water level is 254.76 m.

McArthur Falls is remotely operated from the System Control Department in Winnipeg. Maintenance and emergency staff are stationed at the Winnipeg River Operations Centre located adjacent to the Great Falls Generating Station. The reservoir is maintained at a relatively constant level throughout the year, and the plant is operated almost exclusively in a run-of-the-river mode.

3.0 WATER POWER ACT LICENSING REQUIREMENTS

Condition #4 of the licence stipulates that:

> *"The Licensee shall not raise the headwater of its development to an elevation higher than 836.0 above mean sea level, Canadian Geodetic Datum 1929 Adjustment. A higher elevation may be created only with prior written permission by the Director and in accordance with Section 72 of the Regulations."*

4.0 DATA COLLECTION AT GAUGES

There are three forebay stilling wells or float chambers, all of which are in or near the powerhouse service bay, near the control room. One houses the remote indicating gear, second is a mechanical float to indicate visual (only) level, while the third has an alarm float to indicate if the forebay level is too high.

The forebay gauge consists of a float attached to a steel tape that is draped over a pulley connected to a Selsyn (self-synchronous) system. This system electronically transmits the angular position of the pulley to a receiving device in the control room. The position information is converted to a water level, indicated on a display and also output to the Remote Transmittal Unit for transmission to the System Control Centre.

The station operators at McArthur Falls check the calibration of the gauge by comparing manual measurements with electronic readings in the control room once a week or as required. A map showing the location of the gauge is shown in Figure D-3.

5.0 DATA ANALYSIS

Manitoba Hydro prepared the McArthur Falls Generating Station Licence Implementation Guide for Water Levels[1] to document a common understanding of compliance with the water regime terms of the McArthur Falls Water Power Act Licence. The report was approved by Manitoba in 2017.

During the 2021 calendar year, forebay water levels at the McArthur Falls Generating Station were in compliance with the licence limit 100 % of the time.

Figure D-4 shows hourly water level readings for the McArthur GS forebay from January 01, 2021 to December 31, 2021.

6.0 MAJOR SYSTEM UPGRADES/CHANGES

Maintenance and construction activities that occurred during the 2021 calendar year include:

- Mechanically cleared vegetation at dike 1 west
- Storage frame for draft tube stoplogs was installed
- Installed new U1&2 Breakers

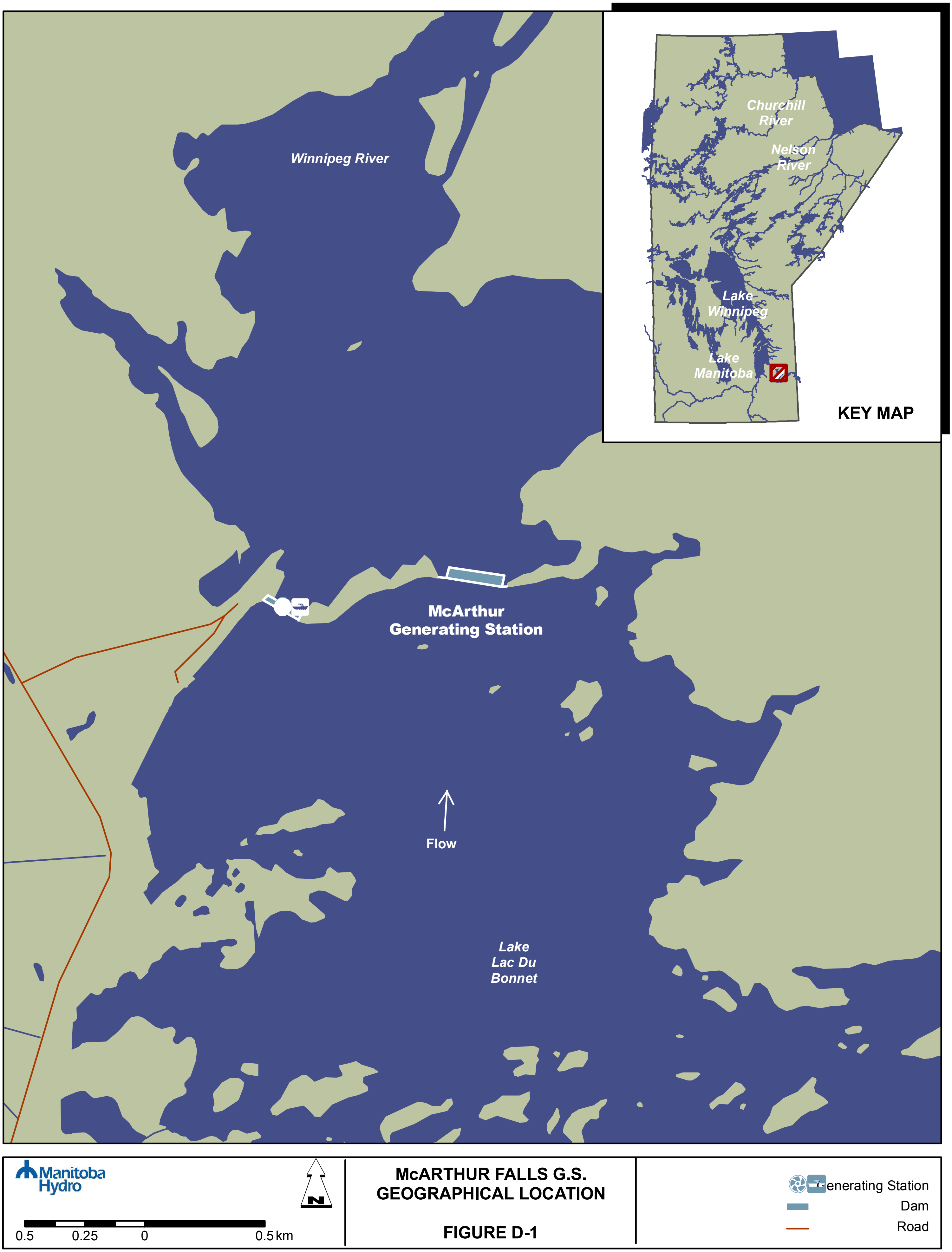
7.0 DAM SAFETY

Manitoba Hydro operates and maintains the generating station and associated structures at McArthur Falls based on the Canadian Dam Association Dam Safety Guidelines. A summary of dam safety activities for 2021 is provided on page D-9.

[1] Manitoba Hydro. 2017. McArthur Falls Generating Station Licence Implementation Guide for Water Levels.

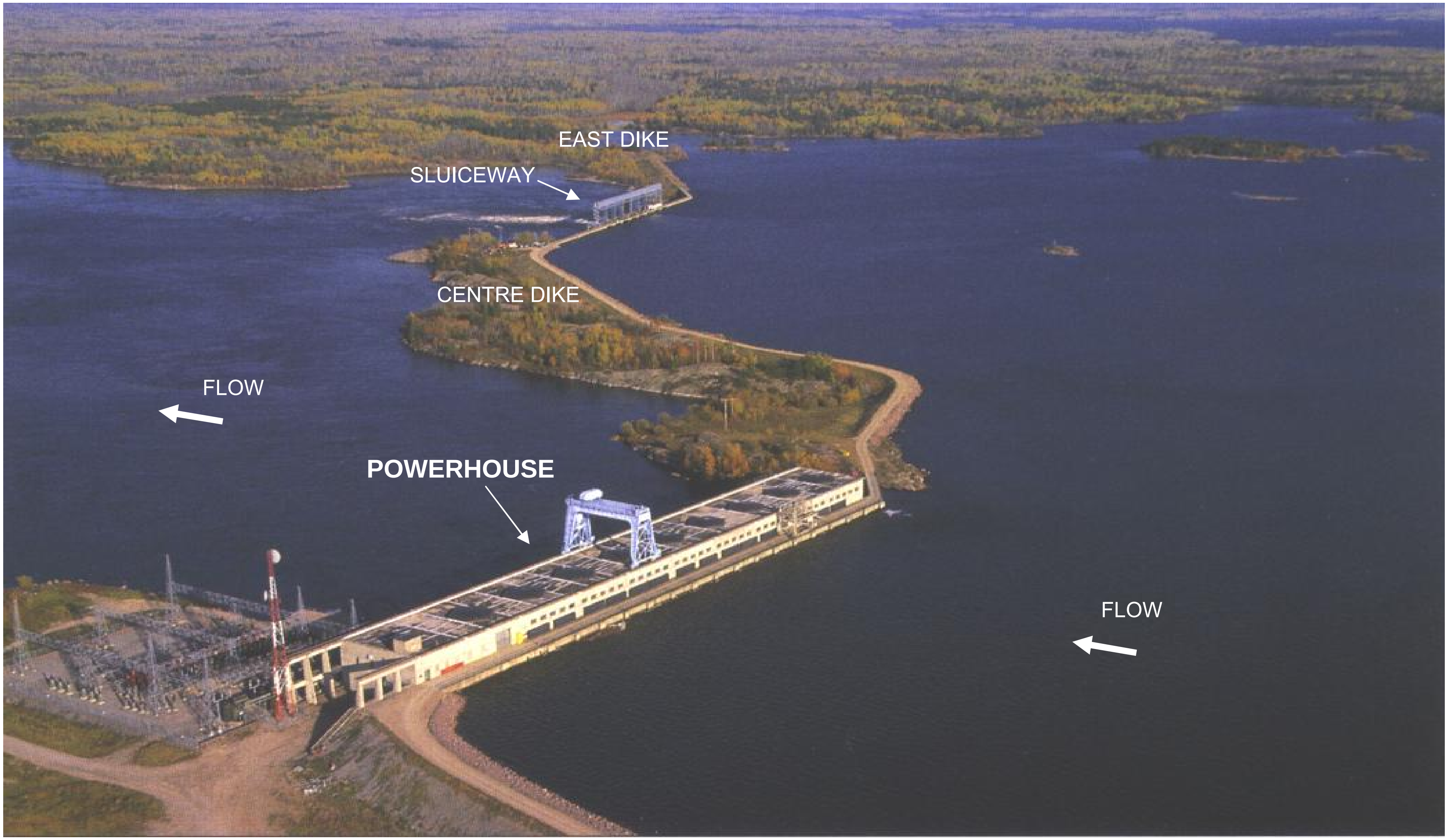
8.0 CLOSURE

Manitoba Hydro continues to operate the McArthur Falls Generating Station in accordance with the Second Short Term Extension Licence under The Water Power Act for the development of water power at the McArthur Falls Site on the Winnipeg River.

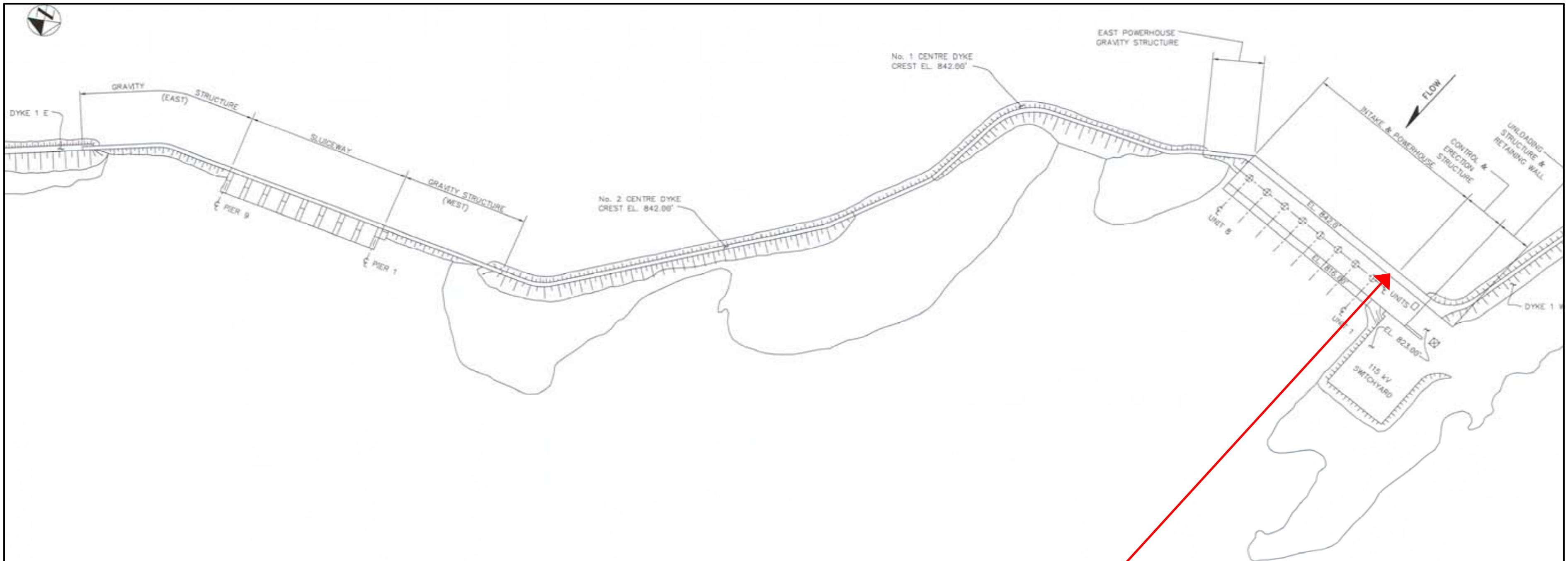


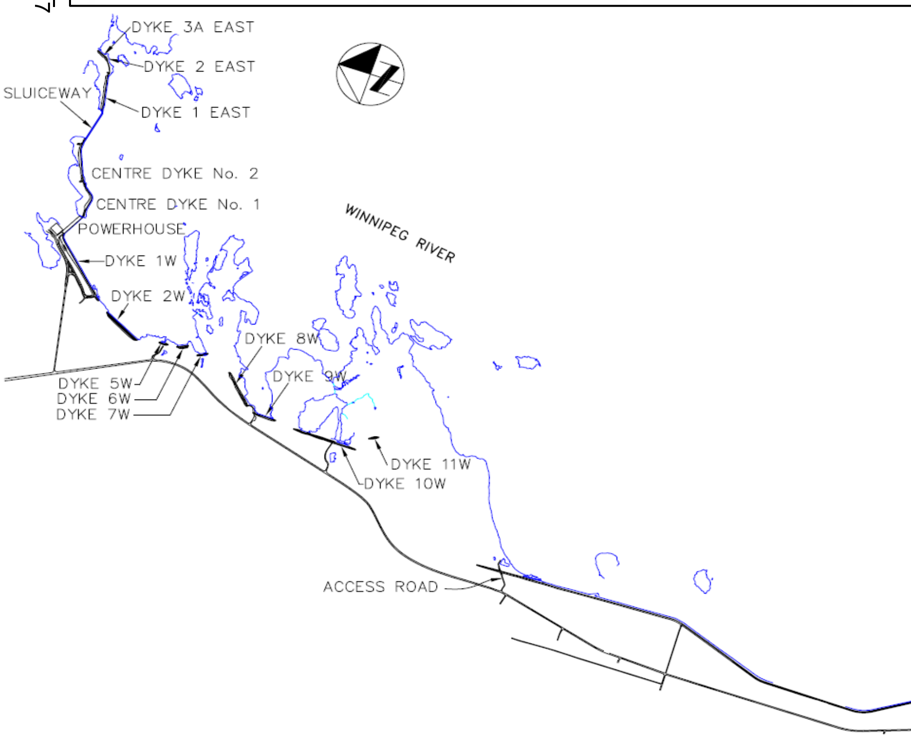
McARTHUR FALLS G.S.
GEOGRAPHICAL LOCATION

FIGURE D-1



Manitoba Hydro	MANITOBA HYDRO
	WATERWAY APPROVALS AND MONITORING
	MCARTHUR FALLS GENERATING STATION
	PHOTOGRAPH OF GENERATING STATION
	PROJECT WATER LEVELS AND FLOWS REPORT — FIGURE D-2





FOREBAY GAUGE LOCATION
- located in the powerhouse
- stilling wells located in or near the powerhouse service bay, near the control room

Manitoba Hydro

MANITOBA HYDRO

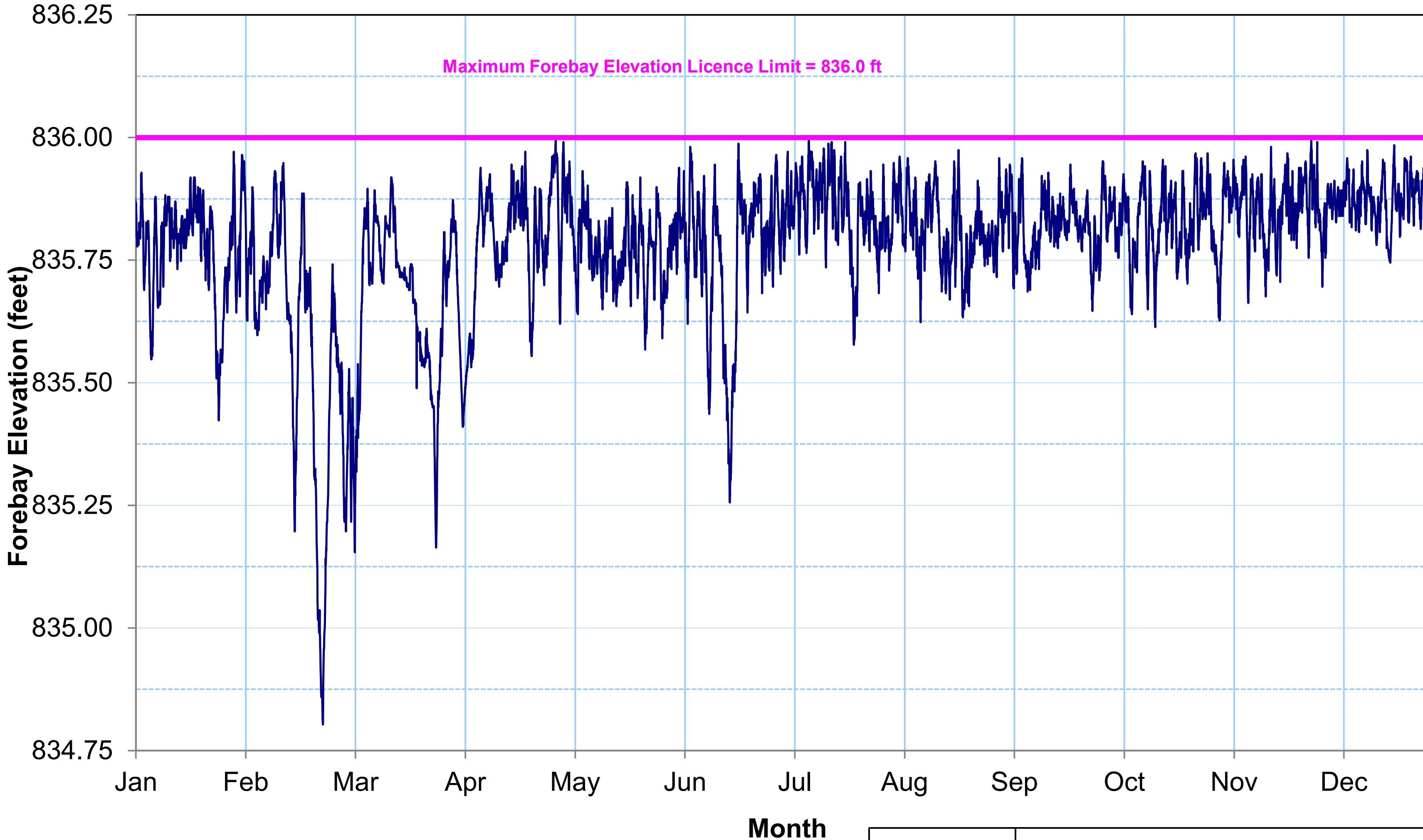
WATERWAY APPROVALS AND MONITORING

MCARTHUR FALLS GENERATING STATION

GENERAL ARRANGEMENT

PROJECT
WATER LEVELS AND FLOWS REPORT

FIGURE D-3



<u>Daily Averaged Forebay Elevation Statistics 1977 - 2021</u>

Maximum	**= 836.24 feet**
Minimum	**= 834.29 feet**
Mean	**= 835.70 feet**

Manitoba Hydro	MANITOBA HYDRO
	WATERWAY APPROVALS AND MONITORING
	MCARTHUR GENERATING STATION
	HOURLY FOREBAY ELEVATIONS (2021)
	PROJECT Water Levels and Flows Report
	FIGURE D-4

McArthur GS Dam Safety Activities List

	ACTIVITIES	Performed By	Tasks Completed	Tasks Planned
Inspections	Engineering inspection of embankment dams	Dam Safety	1	1
	Cursory inspection of dikes 1 and 9 west	Dam Safety	1	1
	Engineering inspection of concrete dams	Dam Safety	1	1
	Cursory winter inspection of concrete dams	Dam Safety	1	1
	Unit inspection – civil components	Dam Safety	1	2
	Spillway bay inspection – civil components	Dam Safety	0	2
	Condition survey - spillway	Dam Safety	1	1
	Route inspection of dikes 1 and 9 west	Site - Utility	26	26
	Spillway inspection	Site - Utility	12	12
	Routine inspection of dike 11 west	Site - Utility	1	1
	Routine inspection of concrete dams	Site - Utility	6	6
	Forebay/tailrace gauge inspection	Site - Operating	12	12
	Spillway inspection	Site - Utility	52	52
	Hydraulic conditions inspection	Dam Safety	1	1
Analyses	Instrumentation data review (Concrete Dams)	Dam Safety	3	3
	Instrumentation data review (Embankment Dams)	Dam Safety	3	3
Maintenance and Testing	Spillway gate functional testing	Site - Elec/Mech	6	8 (1 per gate)
	Spillway emergency generator - functional gate lift test	Site - Elec	0*	1
	Spillway emergency generator test runs	Site - Elec	12	12
	Spillway emergency generator maintenance	Site - Elec	1	1
	Spillway gate heater maintenance	Site - Elec	4	4 (1 per gate)
	Spillway gate gain heater maintenance	Site - Elec	8	8 (1 per gate)
	Spillway gate gain heat controller maintenance	Site - Elec	1	1
	Spillway gate hoist maintenance	Site - Elec	8	8 (1 per gate)
	Spillway gate hoist maintenance	Site - Mech	8	8 (1 per gate)
	Spillway gates 1 to 8 sealing	Site - Utility	1	1
	Spillway emergency generator maintenance	Mechanical Services	1	1
Program	Dam Safety EPP - updates	Dam Safety	1	1
	Dam Safety Reference Manual - Revision	Dam Safety	-	-
	Delivered DS Training - Routine Inspections	Dam Safety	1	As Required
	Delivered DS Training - Emergency Preparedness	Dam Safety	0	As Required

* Not completed due to low staffing levels in 2021. Completing a spillway gate lift with the spillway emergency generator is a priority in 2022.

APPENDIX E

GREAT FALLS GENERATING STATION
WATER POWER ACT LICENCE

1.0 INTRODUCTION

Great Falls Generating Station is located approximately 130 km northeast of the City of Winnipeg and 25 km north of the Town of Lac du Bonnet. The geographical location of the station is shown in Figure E-1. A photograph of the station is shown in Figure E-2. An overall site map is shown in Figure E-3.

Manitoba Hydro operates the Great Falls Generating Station in accordance with the First Renewal Licence for the Development of Water Power at the Great Falls Site on the Winnipeg River. This licence was issued in accordance with the provisions of The Water Power Act on February 10, 1999. The renewal licence is valid for a term of 50 years and is in effect until January 1, 2032.

This appendix contains information specific to the Great Falls Generating Station, including a description of the project, major construction specifications and operating parameters, and Water Power Act licensing requirements. The appendix also includes a description of the data collection process and summaries of 2021 forebay level compliance, major system upgrades or changes, and dam safety activities.

2.0 PROJECT DESCRIPTION

The Great Falls Generating Station was constructed in two stages between 1914 and 1928. It is the second largest plant on the Winnipeg River with a capacity of 138.8 MW. The generating station is a run-of-river hydroelectric generating facility consisting of a 6-unit powerhouse, a 4 bay gated sluiceway, and a railway dike on the south side of the river. Tables E-1 and E-2 summarize the operating parameters, and principal structures of the Great Falls Generating Station.

Table E-1: Construction Specifications and Operating Parameters of the Great Falls Generating Station

Construction Period	1914 to 1928
Licensed Capacity	136 MW (182,300 horsepower)
Average Annual Generation	871 million kW-h
Waterfall Drop (head)	17.7 m
Maximum Licence Forebay Elevation	248.0 m (813.6 ft)
Maximum Operating Forebay Elevation	247.5 m

Table E-2: Principal Structures for the Great Falls Generating Station

Powerhouse	Number of Units	6 vertical shaft, fixed blade turbine
	Length	116 m
	Discharge Capacity (at full gate)	990.0 m^3/s
	Power Production Unit 1,5 Unit 2,4,6 Unit 3	 2 units @ 24.2 MW/unit = 48.4 MW 3 units @ 20.9 MW/unit = 62.7 MW 1 unit @ 27.7 MW/unit = 27.7 MW TOTAL = 138.8 MW
Spillway	Number of Bays	Sluiceway with 4 bays
	Total Length	79.7 m
	Discharge Capacity (at full supply level*)	4,140 m^3/s
Embankment Dams and Dikes	Material	Dikes: Rockfill and clay fill Non Overflow Dams: Concrete
	Crest Elevation	East Dike and Dam: 250.0 m West Dike: 248.6 m
	Available Freeboard	Earth Structures: 1.1 m Concrete Structures: 2.5 m

*Full Supply Level is 247.5 m measured at the powerhouse

Great Falls has a total forebay area of approximately 10 sq. km and has a fetch length of approximately 4 km. The normal forebay water level is 247.5 m.

Great Falls is operated remotely from the System Control Centre in Winnipeg. Maintenance and emergency staff are stationed at the Winnipeg River Operations Centre located adjacent to the Great Falls Generating Station.

The Great Falls reservoir is normally operated for optimum energy production within the Manitoba Hydro system in accordance with instructions issued by System Control Center. The reservoir is maintained at a nearly constant level about 0.6 m below the licence limit throughout the year to optimize efficiency at McArthur and Great Falls generating stations. Raising the forebay level would increase the efficiency at Great Falls, but decrease the efficiency at McArthur to a greater degree.

3.0 WATER POWER ACT LICENSING REQUIREMENTS

Condition #5 of the licence stipulates that:

> *"The Licensee shall not raise the headwater of the development, as measured at the powerhouse higher than the wind eliminated elevation of 813.6 feet*

above mean sea level, Canadian Geodetic Datum, 1929 adjustment (814.0 feet, Winnipeg River Survey Datum). A higher elevation may be created only with written permission from the Minister in accordance with Section 72 of the Regulation."

4.0 DATA COLLECTION AT GAUGE

The forebay stilling well is located on the forebay deck, protected from the weather by a heated shelter. The stilling well is connected to the forebay through piping embedded in the headblock at Unit #6. Alarms are connected to the remote level indicating gauge.

The forebay gauge consists of a float attached to a steel tape that is draped over a pulley connected to a Selsyn (self-synchronous) system. This system electronically transmits the angular position of the pulley to a receiving device in the control room. The position information is converted to a water level, indicated on a display and also output to the Remote Transmittal Unit for transmission to the System Control Centre.

The station operators at Great Falls check the calibration of the gauge by comparing manual measurements with electronic readings in the control room once a week or as required. A map showing the location of the gauge is shown in Figure E-3.

5.0 DATA ANALYSIS

Manitoba Hydro prepared the Great Falls Generating Station Licence Implementation Guide for Water Levels[1] to document a common understanding of compliance with the water regime terms of the Great Falls Water Power Act Licence. The report was approved by Manitoba in 2017.

During the 2021 calendar year, forebay water levels at the Great Falls Generating Station were in compliance with the licence limit 100 % of the time.

Figure E-4 shows hourly water level readings for the Great Falls forebay from January 1, 2021 to December 31, 2021.

6.0 MAJOR SYSTEM UPGRADES/CHANGES

Maintenance and construction activities that occurred during the 2021 calendar year include:

- Completed part of phase 3 of flow augmentation dyke work

[1] Manitoba Hydro. 2017. Great Falls Generating Station Licence Implementation Guide for Water Levels.

- Repairs undertaken in the parking lot around an office trailer (to address sink holes that had developed under the trailer)
- Upgraded security infrastructure
- Installed north wall fan maintenance platform

7.0 DAM SAFETY

Manitoba Hydro operates and maintains the generating station and associated structures at Great Falls based on the Canadian Dam Association Dam Safety Guidelines. A summary of dam safety activities for 2021 is provided on page E-9.

8.0 CLOSURE

Manitoba Hydro continues to operate the Great Falls Generating Station in accordance with the First Renewal Licence under The Water Power Act for the development of water power at the Great Falls Site on the Winnipeg River.

Manitoba Hydro

0.5 0.25 0 0.5 km

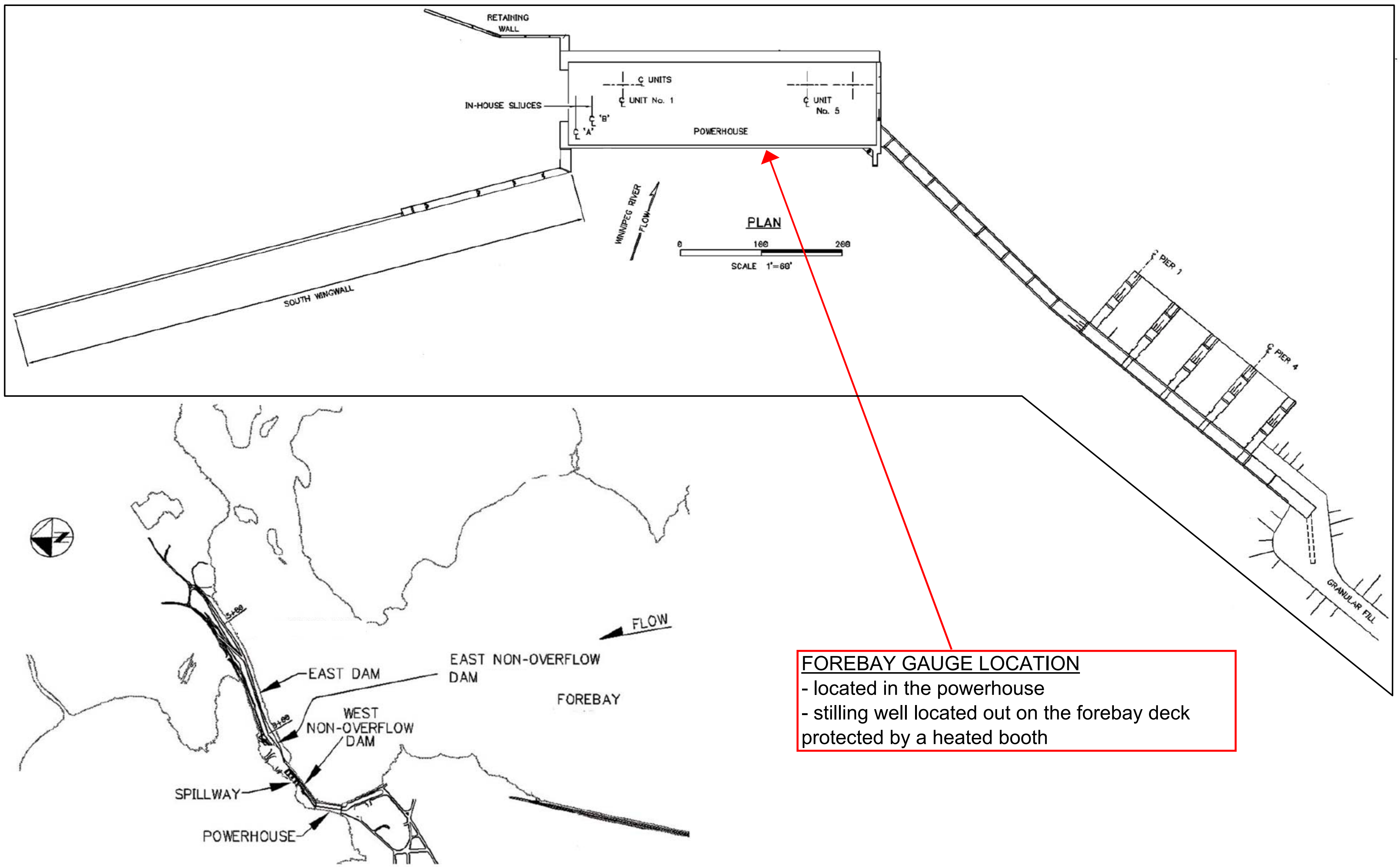
N

GREAT FALLS G.S.
GEOGRAPHICAL LOCATION

FIGURE E-1

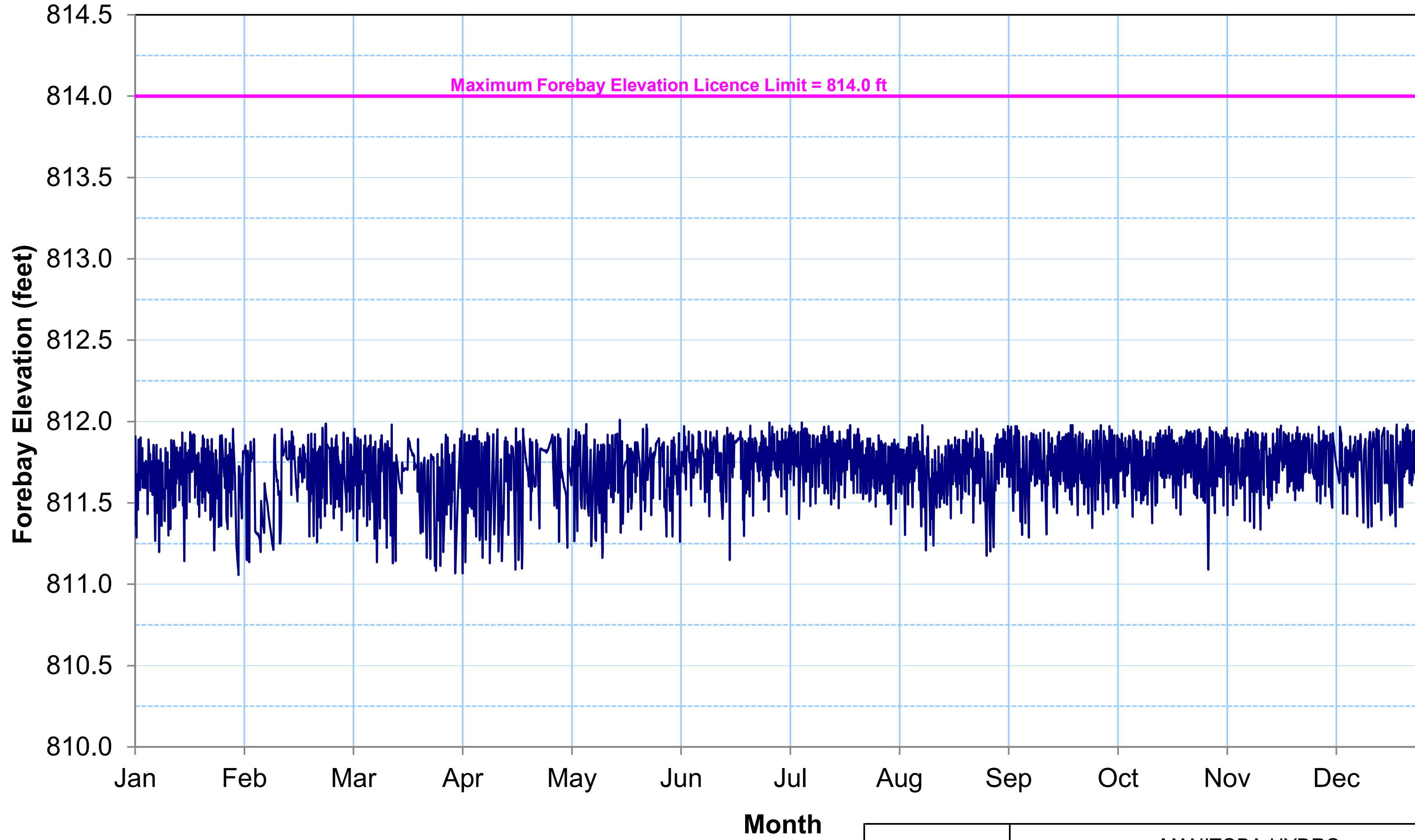
Generating Station
Dam
Road

	MANITOBA HYDRO
	WATERWAY APPROVALS AND MONITORING
	GREAT FALLS GENERATING STATION
	PHOTOGRAPH OF GENERATING STATION
	PROJECT WATER LEVELS AND FLOWS REPORT — FIGURE E-2



FOREBAY GAUGE LOCATION
- located in the powerhouse
- stilling well located out on the forebay deck protected by a heated booth

Manitoba Hydro	MANITOBA HYDRO	
	WATERWAY APPROVALS AND MONITORING	
	GREAT FALLS GENERATING STATION	
	GENERAL ARRANGEMENT	
	PROJECT WATER LEVELS AND FLOWS REPORT	FIGURE E-3



Daily Averaged Forebay Elevation Statistics 1977 - 2021

Maximum	**= 813.03 feet**
Minimum	**= 805.62 feet**
Mean	**= 811.47 feet**

Manitoba Hydro

MANITOBA HYDRO

WATERWAY APPROVALS AND MONITORING

GREAT FALLS GENERATING STATION

HOURLY FOREBAY ELEVATIONS (2021)

PROJECT
Water Levels and Flows Report

FIGURE E-4

Great Falls GS Dam Safety Activities List

	ACTIVITIES	Performed By	Tasks Completed	Tasks Planned
Inspections	Engineering inspection of embankment dams	Dam Safety	1	1
	Cursory inspection of west dike	Dam Safety	1	1
	Unscheduled inspection of embankment dams	Dam Safety	1	-
	Engineering inspection of concrete dams	Dam Safety	1	1
	Cursory Winter inspection of concrete dams	Dam Safety	1	1
	Unit inspection – civil components	Dam Safety	1	1
	Spillway bay inspection - civil components	Dam Safety	1	1
	Routine inspection of west dike	Site - Utility	25	26
	Routine inspection of other embankment dams	Site - Utility	12	12
	Routine inspection of concrete dams	Site - Utility	6	6
	Spillway inspection	Site - Utility	50	52
	Hydraulic conditions engineering inspection	Dam Safety	1	1
	Spillway gate inspection	Site - Operating	50	52
	Forebay/tailrace gauge inspection	Site - Operating	12	12
Analyses	Instrumentation data review (Concrete Dams)	Dam Safety	6	6
Maintenance and Testing	Spillway gate functional testing	Site - Elec/Mech	0*	4 (1 per gate)
	Spillway emergency generator - functional gate lift test	Site - Elec	0*	1
	Spillway gate hoist maintenance	Site - Elec	4	4 (1 per gate)
	Spillway gate heater maintenance	Site - Elec	4	4 (1 per gate)
	Spillway gate gain heater maintenance	Site - Elec	1	1
	Dam aerators maintenance (Summer, Winter)	Site - Elec	2	2
	Spillway gate hoist maintenance	Site - Mech	4	4 (1 per gate)
	Spillway gate maintenance	Site - Mech	4	4 (1 per gate)
	Spillway emergency generator test runs	Site - Operating	12	12
	Spillway emergency generator maintenance	Mechanical Services	1	1
Program	Dam Safety Emergency Plan - updates	Dam Safety	1	1
	Dam Safety Reference Manual - revision	Dam Safety	-	-
	Delivered DS Training - Routine Inspections	Dam Safety	1	As Required
	Delivered DS Training - Emergency Preparedness	Dam Safety	0	As Required

* Not completed due to low flow conditions on the Winnipeg River, COVID-19 restrictions & low staffing levels in 2021. Completing the spillway functional testing is a priority in 2022.

APPENDIX F

PINE FALLS GENERATING STATION
WATER POWER ACT LICENCE

1.0 INTRODUCTION

The Pine Falls Generating Station is located on the lower stretch of the Winnipeg River, approximately 120 km north-east of the City of Winnipeg and 40 km north of the Town of Lac du Bonnet. It is the final generating station to use the waters of the Winnipeg River before they enter Lake Winnipeg. The geographical location of the station is shown in Figure F-1. A photograph of the station is shown in Figure F-2. An overall site map is shown in Figure F-3.

Pine Falls Generating Station was built between 1949 and 1952, and then received upgrades during the 1990s to increase the output from 82 MW to 90 MW and allow for better control and monitoring of the station. Units 3 and 4 were upgraded between 2016 and 2020, further increasing the output to 100.6 MW.

Manitoba Hydro currently operates the Pine Falls Generating Station with a Third Short Term Extension Licence (STEL) issued in accordance with the provisions of The Water Power Act on October 1, 2020. The STEL is in effect until September 30, 2025. The operating terms of the STEL are identical to those of the final licence issued on November 30, 1965. Manitoba Hydro requested a renewal licence on June 18, 1997.

This appendix contains information specific to the Pine Falls Generating Station, including a description of the project, major construction specifications and operating parameters, and Water Power Act licensing requirements. The appendix also includes a description of the data collection process and summaries of 2021 forebay level compliance, major system upgrades or changes, and dam safety activities.

2.0 PROJECT DESCRIPTION

Pine Falls consists of a 6-unit powerhouse with a capacity of 100.6 MW, a 6-bay sluiceway, and earthworks. The station is located adjacent to Highway 11, and serves as the river crossing for vehicular traffic. Tables F-1 and F-2 summarize the operating parameters, and principal structures of the Pine Falls Generating Station.

Table F-1: Construction Specifications and Operating Parameters of the Pine Falls Generating Station

Construction Period	1949 to 1952
Licensed Capacity	85 MW (114,000 horsepower)
Average Annual Generation	606 million kW-h
Waterfall Drop (head)	11.3 m
Maximum Licence Forebay Elevation	229.2 m (752 ft)
Maximum Operating Forebay Elevation	229.2 m

Table F-2: Principal Structures for the Pine Falls Generating Station

Powerhouse	Number of Units	6
	Length	151.2 m
	Discharge Capacity (at full gate)	951 m^3/s
	Unit Power Production Units 1-2 Units 3-4 Units 5-6	 2 units @ 14.17 MW/unit = 28.34 MW 2 units @ 19.50 MW/unit = 39.0 MW 2 units @ 16.63 MW/unit = 33.26 MW TOTAL = 100.6 MW
Spillway	Number of Bays	6
	Sluiceway Bay Opening	12.19 m
	Discharge Capacity (at full supply level*)	3,822 m^3/s
Non Overflow Dam	Material	Unreinforced concrete gravity structure
	Crest Elevation	230.4 m
	Available Freeboard	1.22 m

*Full Supply Level is 229.2 m measured at the forebay

The forebay at Pine Falls Generating Station has a total area of 9 sq. km and a fetch length of approximately 3 km. The forebay's normal water level is 229.2 m.

Pine Falls is remotely operated from the System Control Department in Winnipeg. Maintenance and emergency staff are stationed at the Winnipeg River Operations Centre located adjacent to the Great Falls Generating Station.

3.0 WATER POWER ACT LICENSING REQUIREMENTS

Condition #4 of the licence stipulates that:

> *"The Licensee shall not raise the headwater of its development to an elevation higher than 752.0 above mean sea level, Canadian Geodetic Datum 1929 Adjustment. A higher elevation may be created only with prior written permission by the Director and in accordance with Section 72 of the Regulations."*

4.0 DATA COLLECTION AT GAUGE

The forebay stilling well used for the remote gauge is located in the gate room beside the head-gates for Unit #1 and is connected to the forebay through pipe embedded in the pier. A second stilling well has been added to the powerhouse (connected via the cooling water intakes) near Unit #6 to sound an alarm if the forebay level rises too high.

The forebay gauge consists of a float attached to a steel tape that is draped over a pulley connected to a Selsyn (self-synchronous) system. This system electronically transmits the angular position of the pulley to a receiving device in the control room. The position information is converted to a water level, indicated on a display and also output to the Remote Transmittal Unit for transmission to the System Control Centre.

The station operators at Pine Falls check the calibration of the gauge by comparing manual measurements with electronic readings in the control room once a week or as required. A map showing the location of the gauge is shown in Figure F-3.

5.0 DATA ANALYSIS

Manitoba Hydro prepared the Pine Falls Generating Station Licence Implementation Guide for Water Levels[1] to document a common understanding of compliance with the water regime terms of the Pine Falls Water Power Act Licence. The report was approved by Manitoba in 2017.

During the 2021 calendar year, forebay water levels at the Pine Falls Generating Station were in compliance with the licence limit 100 % of the time.

Figure F-4 shows hourly water level readings for the Pine Falls forebay from January 1, 2021 to December 31, 2021.

6.0 MAJOR SYSTEM UPGRADES/CHANGES

Maintenance and construction activities that occurred during the 2021 calendar year include:

- Installed new turbine and upgraded generator on Unit 3
- Repaired the tailrace crane
- Installed vibration monitoring on Unit 2
- Repaired 4 locations (tailrace PR 304 bridge) with significant concrete deterioration impacting bearing capacity (Mb Infrastructure undertook repairs - temporary timber blocking placed under the diaphragms at the 4 locations)
- Upgraded security infrastructure

[1] Manitoba Hydro. 2017. Pine Falls Generating Station Licence Implementation Guide for Water Levels.

7.0 DAM SAFETY

Manitoba Hydro operates and maintains the generating station and associated structures at Pine Falls based on the Canadian Dam Association Dam Safety Guidelines. A summary of dam safety activities for 2021 is provided on page F-9.

8.0 CLOSURE

Manitoba Hydro continues to operate the Pine Falls Generating Station in accordance with the Second Short Term Extension Licence under The Water Power Act for the Development of water power at the Pine Falls Site on the Winnipeg River.

Manitoba Hydro

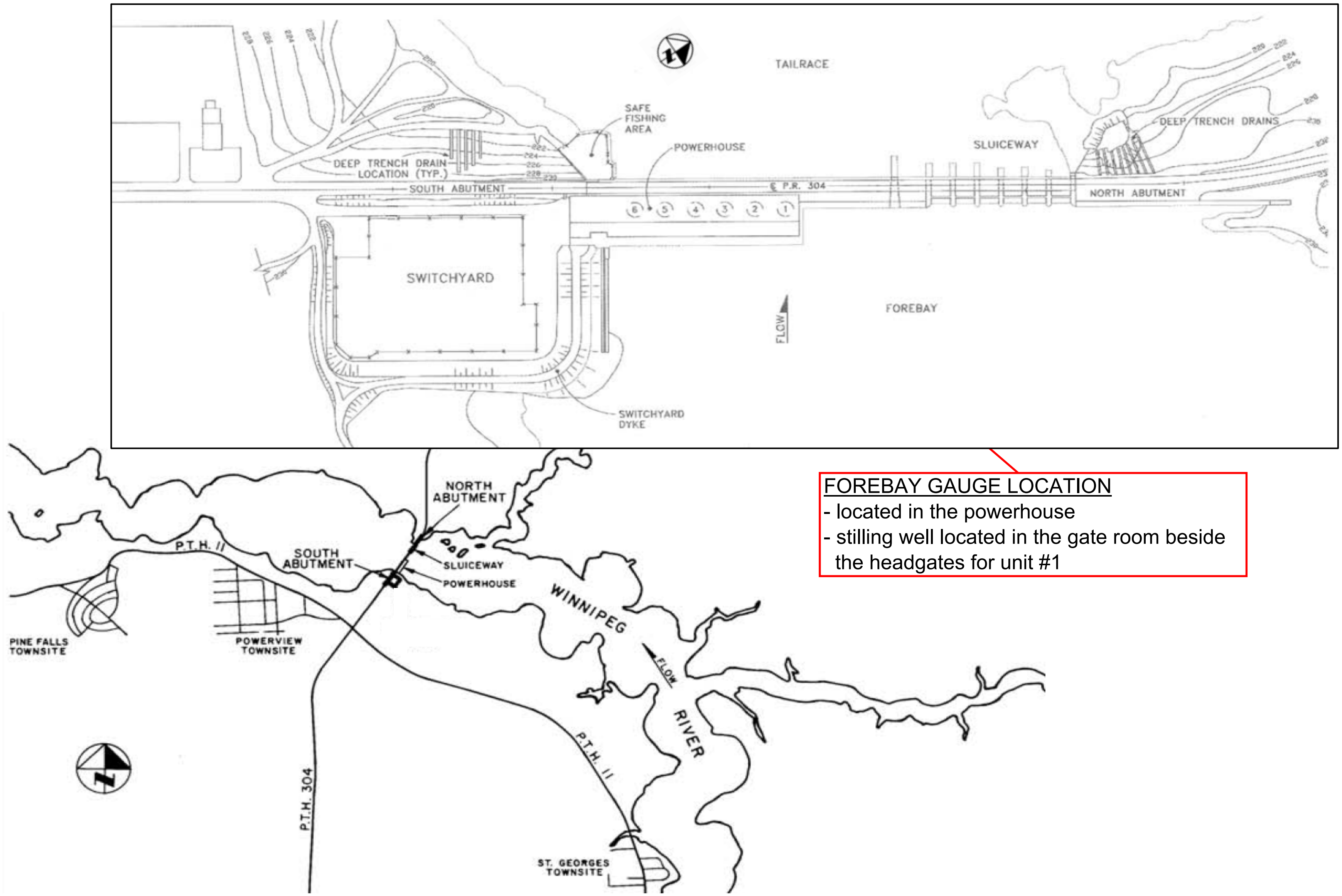
0.5 0.25 0 0.5 km

PINE FALLS G.S.
GEOGRAPHICAL LOCATION

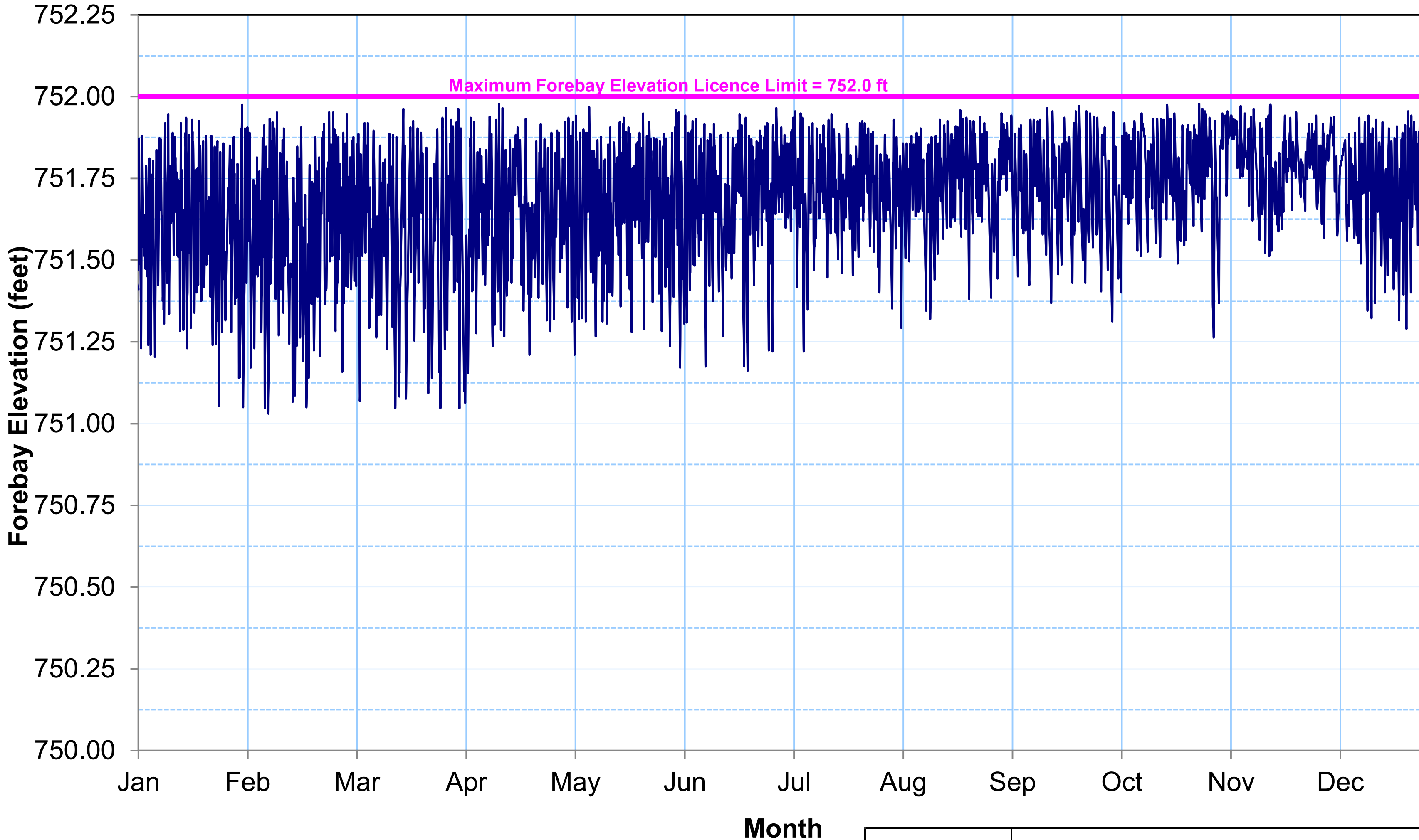
FIGURE F-1

Generating Station
Dam
Road

Manitoba Hydro	MANITOBA HYDRO	
	WATERWAY APPROVALS AND MONITORING	
	PINE FALLS GENERATING STATION	
	PHOTOGRAPH OF GENERATING STATION	
	PROJECT WATER LEVELS AND FLOWS REPORT	FIGURE F-2



Manitoba Hydro	MANITOBA HYDRO
	WATERWAY APPROVALS AND MONITORING
	PINE FALLS GENERATING STATION
	GENERAL ARRANGEMENT
	PROJECT WATER LEVELS AND FLOWS REPORT — FIGURE F-3



Daily Averaged Forebay Elevation Statistics 1977 - 2021

Maximum	**= 752.28 feet**
Minimum	**= 749.00 feet**
Mean	**= 751.75 feet**

MANITOBA HYDRO

WATERWAY APPROVALS AND MONITORING

PINE FALLS GENERATING STATION

HOURLY FOREBAY ELEVATIONS (2021)

PROJECT
Water Levels and Flows Report

FIGURE F-4

Pine Falls 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
	Cursory Winter inspection of concrete dams	Dam Safety	1	1
	Spillway bay inspection - civil components	Dam Safety	0	3
	Unit inspection – civil components	Dam Safety	0	2
	Routine inspection of switchyard dyke	Site - Utility	12	12
	Routine inspection of concrete dams	Site - Utility	6	6
	Forebay gauge calibration	Sire - Operator	12	12
	Tailrace gauge calibration	Site - Operator	20/7	20 weekly/ 7 monthly
	Spillway inspection	Site - Elec	51	52
	Spillway hoist house inspection	Site - Elec	11	12
	Spillway sluicegate inspection	Site - Mech	25	26
	Spillway hoist house inspection	Site - Utility	52	52
	Hydraulic conditions inspection	Dam Safety	1	1
Maintenance and Testing	Spillway gate functional testing	Site - Elec/Mech	5	6 (1 per gate)
	Spillway emergency generator - functional gate lift test	Site - Elec	1	1
	Spillway emergency generator test runs	Site - Elec	12	12
	Spillway gate radiant heater maintenance (only on gates 1 and 2)	Site - Elec	4	4 (2 per gate)
	Spillway gate heater maintenance	Site - Elec	6	6 (1 per gate)
	Spillway gate gain heater maintenance	Site - Elec	6	6 (1 per gate)
	Spillway gate gain controller maintenance	Site - Elec	1	1
	Spillway gate hoist maintenance	Site - Elec	6	6 (1 per gate)
	Spillway gate hoist maintenance	Site - Mech	6	6 (1 per gate)
	Spillway gate maintenance	Site - Mech	6	6 (1 per gate)
	Spillway emergency generator maintenance	Mechanical Services	1	1
Program	Dam Safety EPP - updates	Dam Safety	1	1
	Dam Safety Reference Manual - Revision	Dam Safety	-	-
	Delivered DS Training - Routine Inspections	Dam Safety	1	As Required
	Delivered DS Training - Emergency Preparedness	Dam Safety	0	As Required

APPENDIX G

KELSEY GENERATING STATION
WATER POWER ACT LICENCE

1.0 INTRODUCTION

Kelsey Generating Station is located on the Nelson River approximately 680 km north of the City of Winnipeg and approximately 137 km upstream of the Kettle Generating Station. The site can be accessed by air or by rail from Thompson. The geographical location of the station is shown in Figure G-1. A photograph of the station is shown in Figure G-2. An overall site map is shown in Figure G-3.

The Kelsey Generating Station was built between 1957 and 1961 making it the first generating station to be built by Manitoba Hydro on the Nelson River. The station was originally built to supply both the City of Thompson and the International Nickel Company's (INCO) mining and smelting operations in the Moak Lake and Mystery Lake areas with electricity. Six years after completion the generating station was linked to the province's electrical system.

Manitoba Hydro currently operates the Kelsey Generating Station with a Second Short-Term Extension Licence (STEL) issued in accordance with the provisions of The Water Power Act on December 19, 2019. The Second STEL is in effect from January 1, 2020 to and including January 1, 2025. Manitoba Hydro requested a renewal licence on December 17, 2010.

This appendix contains information specific to the Kelsey Generating Station, including a description of the project, major construction specifications and operating parameters, and Water Power Act licensing requirements. The appendix also includes a description of the data collection process and summaries of 2021 forebay level compliance, major system upgrades or changes, and dam safety activities.

2.0 PROJECT DESCRIPTION

The Kelsey Generating Station consists of an intake structure, a 7-unit powerhouse (plus two house units), wing walls, main dam, dikes, and a 9-bay sluiceway. Tables G-1 and G-2 summarize the operating parameters, and principal structures of the Kelsey Generating Station.

Table G-1: Construction Specifications and Operating Parameters of the Kelsey Generating Station

Construction Period	1957 to 1961
Licensed Capacity	315.8 MW (423,500 horsepower)
Average Annual Generation	1,815 million kW-h
Waterfall Drop (head)	17.1 m
Maximum Licence Forebay Elevation	184.4 m (605.0 ft)
Maximum Operating Forebay Elevation	184.4 m

Table G-2: Principal Structures for the Kelsey Generating Station

Powerhouse	Number of Units	7 vertical turbines
	Length	205.5 m
	Discharge Capacity (at full gate)	2,100 m^3/s
	Unit Power Production Unit 1-7	7 units @ 45.11 MW/unit = 315.8 MW
Spillway	Number of Bays	Sluiceway with 9 bays
	Total Length	142.6 m
	Discharge Capacity (at full supply level*)	8,500 m^3/s
Dams and Dikes	Material	Main Dam: Rockfill Centre Dike: Rolled earth fill Dikes 2E and 2W: Compacted sand fill Dike 1E: Impervious fill and sand Dike 1W: Rolled earth fill and rockfill
	Crest Elevation	Main Dam: 186.6 m Centre Dike: 186.2 m Dikes 1E and 1W: 186.2 m Dikes 2E and 2W: 185.9 m
	Available Freeboard	Main Dam: 2.2 m Centre Dike: 1.8 m Dikes 1E and 1W: 1.8 m Dikes 2E and 2W: 1.5 m

*Full Supply Level is 184.4 m measured at the powerhouse

The Kelsey Generating Station reservoir consists of the forebay, Nelson River, and Sipiwesk Lake upstream of the station. The forebay at Kelsey Generating Station has a total area of 708 sq. km and a fetch length of approximately 9.5 km. The forebay normal water level is 184.4 m.

Kelsey Generating Station is typically operated in run-of-the-river mode meaning inflows are passed and water is not typically stored for later use. During this typical operating mode, the forebay is held constant at just below 184.4 m. At times, the reservoir is drawn down to supplement flows over a period of several weeks and is refilled at a later time when energy demand is lower. Daily cycling of flows occurs infrequently during times when Nelson River flow is below generating station capacity.

3.0 WATER POWER ACT LICENSING REQUIREMENTS

Condition #4 of the licence stipulates that:

> *"The Licensee shall not raise the headwater of its development to an elevation higher than 605 above mean sea level, Canadian Geodetic Datum 1929 Adjustment. A higher elevation may be created only with prior written permission by the Director and in accordance with Section 72 of the Regulations."*

4.0 DATA COLLECTION AT GAUGE

The forebay still well is located in the Unit #1 hoist house. The forebay gauge consists of a float attached to a steel tape that is draped over a pulley connected to a Selsyn (self-synchronous) system. This system electronically transmits the angular position of the pulley to a receiving device in the control room. The position information is converted to a water level, indicated on a display and also output to the Remote Transmittal Unit for transmission to the System Control Centre.

The station operators at Kelsey check the calibration of the gauge by comparing manual measurements with electronic readings in the control room once a month or as required. A map showing the location of the gauge is shown in Figure G-3.

5.0 DATA ANALYSIS

Manitoba Hydro prepared the Kelsey Generating Station Licence Implementation Guide for Water Levels[1] to document a common understanding of compliance with the water regime terms of the Kelsey Water Power Act Licence. The report was approved by Manitoba in 2018.

During the 2021 calendar year, Manitoba Hydro was compliant with the Kelsey Generating Station forebay upper limit 99.9 % of the time. There was once incident when the forebay water level exceeded the licence limit of 605.0 ft on May 28, 2021. The details of the incident are further discussed in the correspondence with Manitoba Environment, Climate, and Parks (previously Manitoba Conservation and Climate) included in this appendix.

Figure G-4 shows all hourly water level readings for the Kelsey forebay from January 1, 2021 to December 31, 2021.

[1] Manitoba Hydro. 2018. Kelsey Generating Station Licence Implementation Guide for Water Levels.

6.0 MAJOR SYSTEM UPGRADES/CHANGES

Maintenance and construction activities that occurred during the 2021 calendar year include:

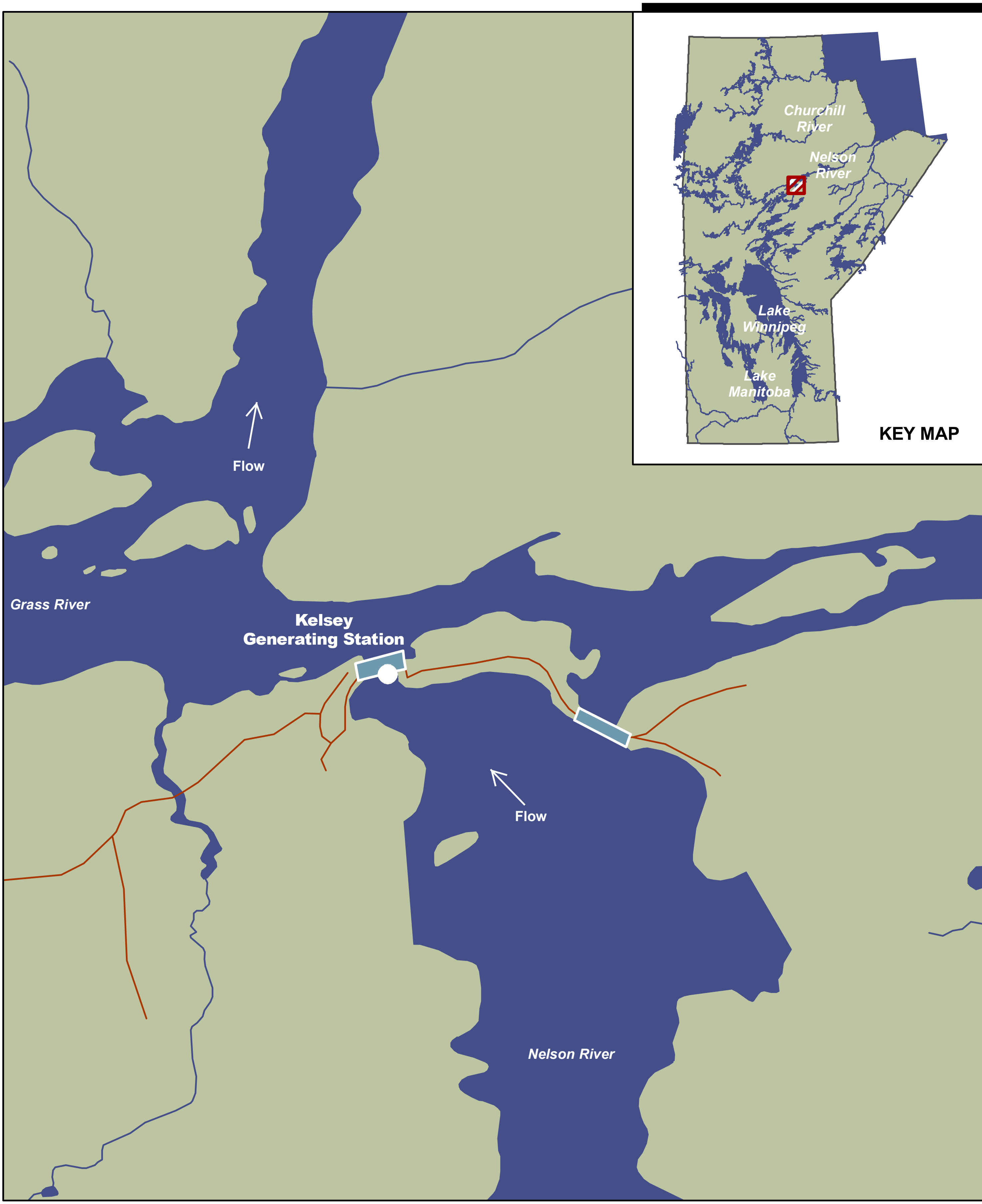
- Replaced intake and tailrace deck seal
- Upgraded airport runway and replaced lighting
- Short term emergency repairs undertaken to address leakage at the Kelsey Sewage Lagoon
- Zebra mussels mitigation upgrades and treatment
- Sprayed herbicide and mechanically cleared vegetation on embankment dams

7.0 DAM SAFETY

Manitoba Hydro operates and maintains the generating station and associated structures at Kelsey based on the Canadian Dam Association Dam Safety Guidelines. A summary of dam safety activities for 2021 is provided on page G-9.

8.0 CLOSURE

Manitoba Hydro continues to operate the Kelsey Generating Station in accordance with the Short-Term Extension Licence under The Water Power Act for the development of water power at the Kelsey Site on the Nelson River.



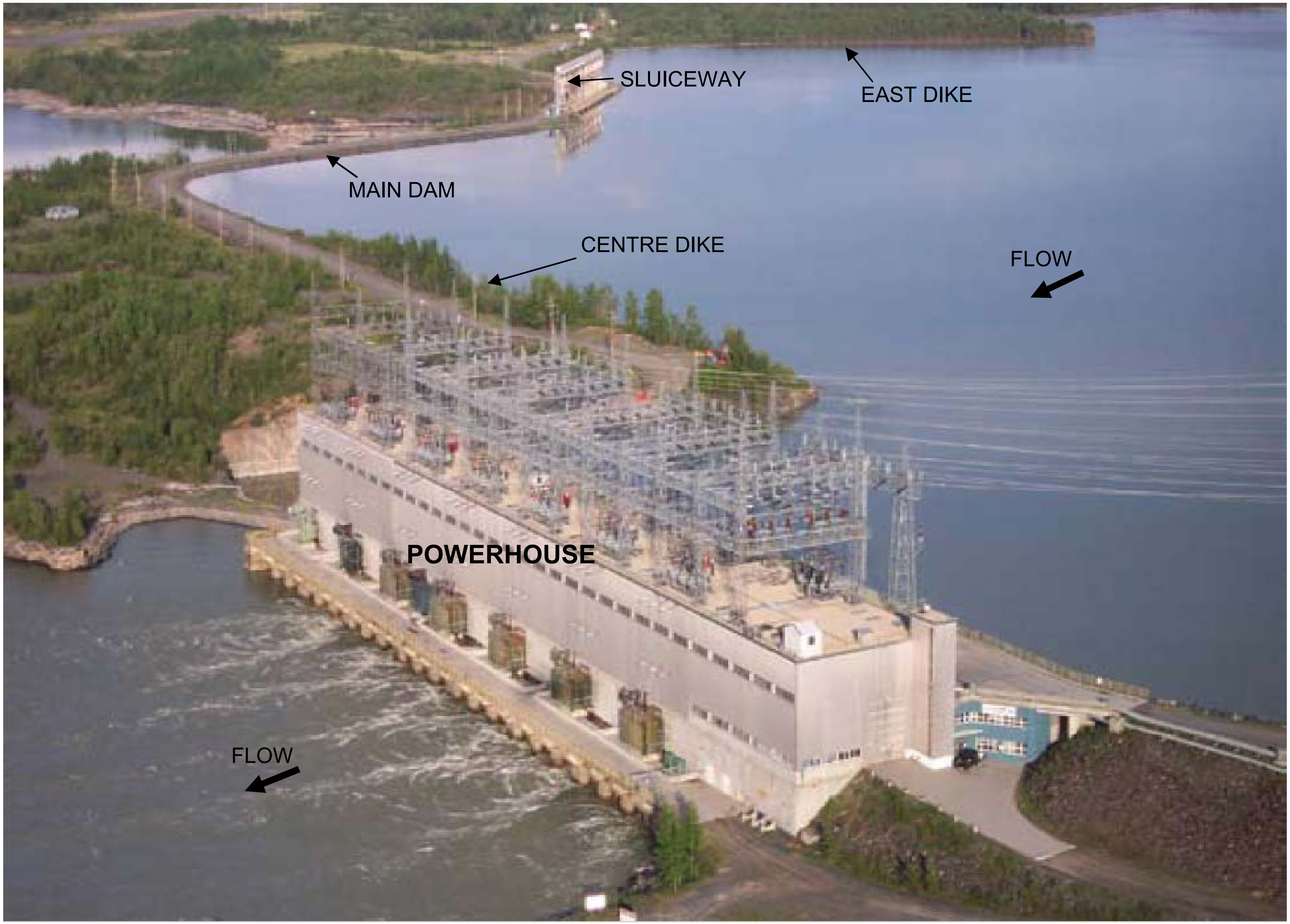
Manitoba Hydro

0.5 0.25 0 0.5 km

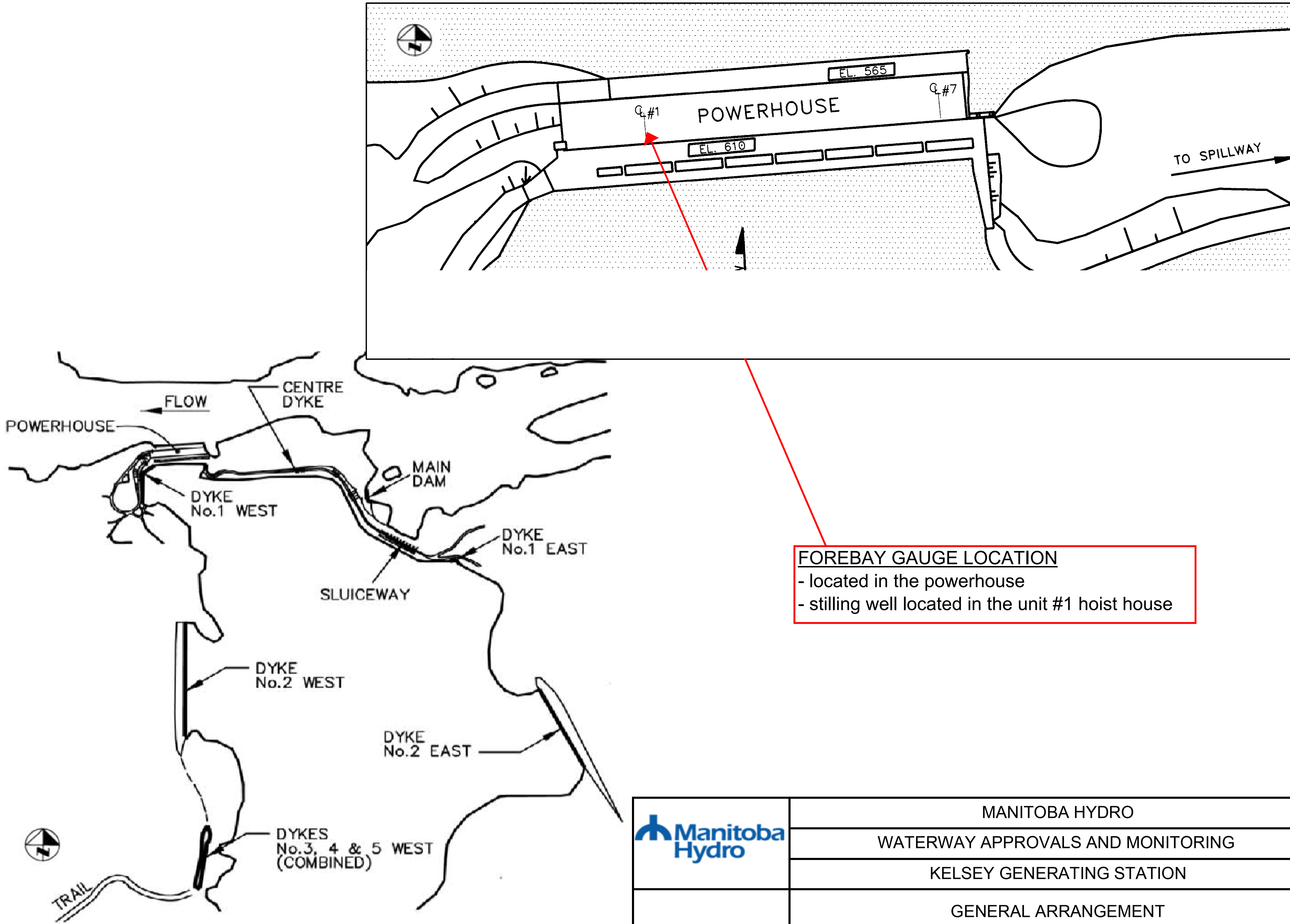
KELSEY G.S.
GEOGRAPHICAL LOCATION

FIGURE G-1

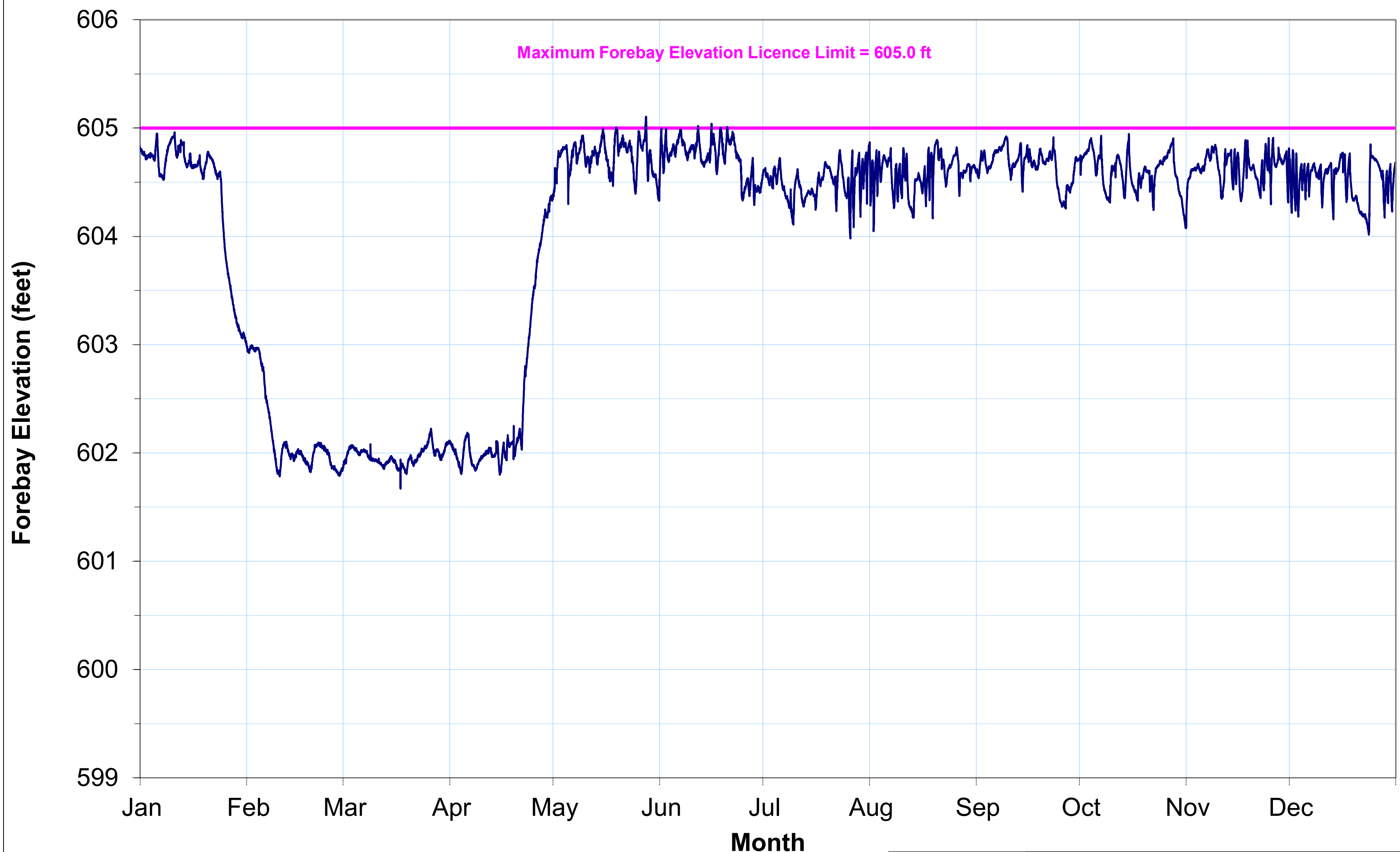
Generating Station
Dam
Road



Manitoba Hydro	MANITOBA HYDRO
	WATERWAY APPROVALS AND MONITORING
	KELSEY GENERATING STATION
	PHOTOGRAPH OF GENERATING STATION
	PROJECT WATER LEVELS AND FLOWS REPORT — FIGURE G-2



Manitoba Hydro	MANITOBA HYDRO
	WATERWAY APPROVALS AND MONITORING
	KELSEY GENERATING STATION
	GENERAL ARRANGEMENT
	PROJECT WATER LEVELS AND FLOWS REPORT — FIGURE G3



Daily Averaged Forebay Elevation Statistics 1977 - 2021

Maximum	**= 605.60 feet**
Minimum	**= 597.80 feet**
Mean	**= 604.22 feet**

Manitoba Hydro	MANITOBA HYDRO
	WATERWAY APPROVALS AND MONITORING
	KELSEY GENERATING STATION
	HOURLY FOREBAY ELEVATIONS (2021)
	PROJECT Water Levels and Flows Report — FIGURE G-4

Kelsey 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	1	1
	Sluiceway bay inspection – civil components	Dam Safety	2	2
	Unscheduled Inspection of sluiceway	Dam Safety	1	-
	Routine inspection of embankment dams	Site - Utility	12	12
	Routine inspection of freeboard embankment dams	Site - Utility	1	1
	Routine inspection of concrete dams	Site - Utility	6	6
	Forebay metering detector inspection	Site - Elec	1	1
	Tailrace metering detector inspection	Site - Elec	1	1
	Forebay and tailrace level gauge check	Site - Operating	51	52
	Spillway inspection	Site - Operating	48	52
	Hydraulic conditions inspection	Dam Safety	1	1
Analyses	Engineering (Embankment Dams)	Geotechnical and Geological Section	1	1
	Instrumentation data review (Concrete Dams)	Dam Safety	14	14
Maintenance and Testing	Spillway gate functional testing	Site - Elec/Mech	0*	9 (1 per gate)
	Spillway gate functional full flow test	Site - Elec/Mech	0	0
	Spillway emergency generator - functional gate lift test	Site - Elec	0*	2
	Lift a spillway gate with the diesel hydraulic hoist	Site - Mech	0*	1
	Test and operate diesel hoist system	Site – Operating	11	12
	Spillway emergency generator test runs	Site - Operating	11	12
	Spillway gate heater maintenance	Site - Elec	4	4 (1 per gate)
	Spillway gate gain heater controller maintenance	Site - Elec	4	4 (4 panels)
	Spillway gate hoist maintenance	Site - Elec	9	9 (1 per gate)
	Spillway gate hoist maintenance	Site - Mech	9	9 (1 per gate)
	Spillway gate maintenance	Site - Mech	9	9 (1 per gate)
	Spillway emergency generator maintenance	Mechanical Services	1	1
Program	Dam Safety EPP - updates	Dam Safety	1	1
	Dam Safety Reference Manual - Revision	Dam Safety	-	-
	Delivered DS Training - Routine Inspections	Dam Safety	0	As required
	Delivered DS Training - Emergency Preparedness	Dam Safety	0	As required

* Not completed due to extreme low water flow conditions in 2021. Completing the spillway functional testing is a priority in 2022.

Manitoba Hydro

2021 06 07

Ms. L. Pyles
Acting Director, Environmental Approvals Branch
Manitoba Conservation and Climate
EABDirector@gov.mb.ca

Dear Ms. Pyles:

KELSEY GENERATING STATION – WATER POWER ACT LICENCE – FOREBAY LEVEL ABOVE LICENCE LIMIT

The following is an explanation of the events that caused the forebay level at the Kelsey Generating Station to rise above the licence limit specified in Article 4 of the Kelsey Water Power Act Licence on May 28, 2021.

On May 28, from 11:00 to 17:00, the Kelsey forebay water level exceeded the licence limit of 605.0 ft by a maximum of 0.1 ft (Figure 1). Investigation of the incident has revealed that strong south winds caused an increase in the Kelsey forebay level. The initial operating response was appropriate as total station outflow was increased when the forebay exceeded the upper limit. However, operators underestimated the amount of spill required and waited too long before further increasing spill resulting in the upper limit being exceeded for seven hours. In order to help limit the duration of similar events in the future, site supervisors are reminding operators of the importance of quickly getting the forebay level back below the licence limit.

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

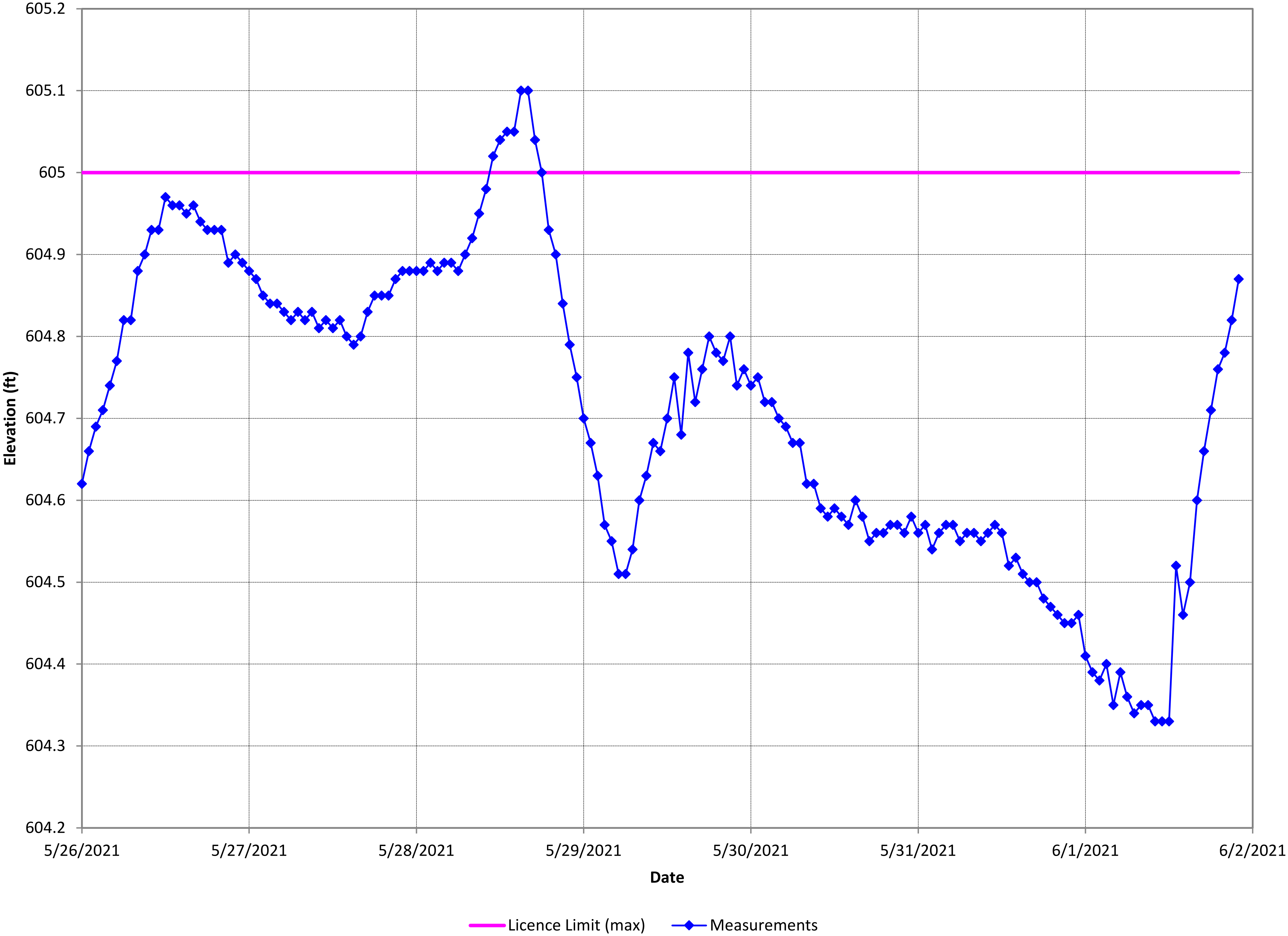
Yours truly,

Original signed by: *Wes Penner*

W.V. Penner, P.Eng
Manager, Waterway Approvals and Monitoring Department

PGC/00111-07311-0049_00.docx
Att.

Figure 1: Kelsey GS - 7 Day Elevation Licence Compliance



Manitoba
Conservation and Climate

Environmental Stewardship Division
Environmental Approvals Branch
1007 Century St
Winnipeg MB R3H 0W4
T 204-945-8321 - **F** 204-945-5229
www.gov.mb.ca/sd

August 13, 2021

Wes Penner, Manager
Waterway Approvals and Monitoring Department
Manitoba Hydro
16th Floor, 360 Portage Avenue
Winnipeg MB R3C 0G8

Dear Wes Penner:

Thank you for your letter dated June 7, 2021, regarding reporting of an out-of-compliance event with the Water Power Act Licence (Licence) issued to Manitoba Hydro for the Kelsey Generating Station. The out-of-compliance report identifies that the event that occurred on May 28, 2021 resulted in a rise in the forebay water level at the Kelsey Generating Station above the upper limit as specified in Article 4 of the Licence.

The forebay water level rose above the licence upper limit of elevation 605.0 ft. (184.404 m) for a period of seven hours, peaking at an approximate elevation of 605.10 ft. (184.435 m) due to strong south winds. Even though Manitoba Hydro's initial operating response was to increase the total station outflow to quickly meet the licensing limit, operators underestimated the volume and duration of the spill which prolonged the duration of the non-compliance event. It is our understanding that to mitigate this activity in future, Manitoba Hydro is reminding operators of the importance of quickly bringing the forebay level back below the licence limit.

Thank you for providing an explanation of the non-compliance event. Manitoba Hydro is requested to include a reference of this event in the 2021 Annual Water Levels and Flows Report.

If you have any questions concerning this letter, please contact Puru Singh, Senior Water Use Licensing Engineer, Environmental Approvals Branch, at Purushottam.Singh@gov.mb.ca or 204-945-3613.

Sincerely,

Laura Pyles
Acting Director

c. Asit Dey, Puru Singh – Environmental Approvals Branch

APPENDIX H

KETTLE GENERATING STATION
WATER POWER ACT LICENCE

1.0 INTRODUCTION

Kettle Generating Station is located on the lower Nelson River approximately 700 km northeast of the City of Winnipeg and approximately 3 km upstream from the Canadian National Railway's river crossing near the Town of Gillam. The geographical location of the station is shown in Figure H-1. A photograph of the station is shown in Figure H-2. An overall site map is shown in Figure H-3.

The Kettle Generating Station is the second largest plant on the lower Nelson River and in the Manitoba Hydro system. It was constructed between 1966 and 1974.

Manitoba Hydro operates the Kettle Generating Station in accordance with the Final Licence for the Development of Water Power at the Kettle Rapids Site on the Nelson River. This licence was issued in accordance with the provisions of The Water Power Act on July 19, 1990. The licence is valid for a term of fifty years and is in effect until November 1, 2022. Manitoba Hydro requested a renewal licence in September 12, 2017.

This appendix contains information specific to the Kettle Generating Station, including a description of the project, major construction specifications and operating parameters, and Water Power Act licensing requirements. The appendix also includes a description of the data collection process and summaries of 2021 forebay level compliance, major system upgrades or changes, and dam safety activities.

2.0 PROJECT DESCRIPTION

The Kettle Generating Station consists of an intake structure, a 12-unit powerhouse with a generating capacity of 1,252.8 MW, main earth dams, ancillary dams and dikes, and an 8-bay spillway. Tables H-1 and H-2 summarize the operating parameters, and principal structures of the Kettle Generating Station.

Table H-1: Construction Specifications and Operating Parameters of the Kettle Generating Station

Construction Period	1966 to 1974
Licensed Capacity	1,252.8 MW (1,680,000 horsepower)
Average Annual Generation	7,038 million kW-h
Waterfall Drop (head)	30.0 m
Maximum Licence Forebay Elevation	141.12 m (463.0 ft)
Maximum Operating Forebay Elevation	141.12 m

Table H-2: Principal Structures for the Kettle Generating Station

Powerhouse	Number of Units	12
	Length	365.76 m
	Discharge Capacity (at full gate)	4,620 m^3/s
	Power Production Units 1-12	12 units @ 104.4 MW = 1252.8 MW
Spillway	Number of Bays	Sluiceway with 8 bays
	Total Length	120.1 m
	Discharge Capacity (at full supply level*)	9,060 m^3/s
Dams and Dikes	Material	Rockfill and Impervious fill
	Crest Elevation	Main Dam North: 144.17 m Main Dam South: 144.17 to 144.48 m Saddle Dam: 144.2 to 144.8 m Butneau Dam: 143.0 to 144.5 m Dike 1: 143.0 m Dikes 2A/2B/2C: 142.95 m Dike 3: 142.95 m Dike 4: 143.87 m Dike 5: 144.48 m Dike 6: 144.50 m
	Concrete Wave Barrier Height	Main Dam North: 146.3 m Main Dam South: 146.3 m Saddle Dam: 146.2 m
	Available Freeboard (from crest elevation at full supply level*)	Main Dam North : 3.05 m Main Dam South: 3.05 m to 3.36 m Saddle Dam: 3.08 m to 3.68 m Dike 1: 1.88 to 3.38 m Dikes 2A/2B/2C: 1.83 m Dike 3: 1.83 m Dike 4: 2.75 m Dike 5: 3.36 m Dike 6: 3.38 m

*Full Supply Level is 141.12 m measured at the powerhouse

The forebay at Kettle enlarged Stephens Lake. The forebay has a total area of 337 sq. km and a fetch length of approximately 36 km.

The level of Stephens Lake is controlled for optimum energy production within the Manitoba Hydro system through operation of Kettle GS. This includes a daily and weekly cycling pattern that allows Manitoba Hydro to match energy production to consumption patterns. Flows are increased each morning during the workweek and maintained until late afternoon or evening when they are decreased to reach lowest levels overnight. There is a similar daily pattern on the weekend although flows are lower because there is less energy demand. On a weekly cycle, Stephens Lake is generally drawn down during the workweek when energy demand is higher and the lake is re-filled over the weekend. Long Spruce GS and Limestone GS are operated as run-of-the-river generating stations, with flow patterns matching releases from Kettle GS.

The operators and maintenance personnel of the Kettle Generating Station are located on site. Support and technical services are also located in the nearby town of Gillam.

3.0 WATER POWER ACT LICENSING REQUIREMENTS

Condition #5 of the licence stipulates that:

> *"The Licensee shall not raise the headwater, as measured at the powerhouse, higher than 463.0 feet above mean sea level, Canadian Geodetic Datum. A higher elevation may be created only with written permission by the Director in accordance with Section 72 of the Regulation."*

4.0 DATA COLLECTION AT GAUGE

The forebay still well is located on the fifth floor intake deck between Unit #6 & #7 intakes. The forebay gauge consists of a float attached to a steel tape that is draped over a pulley connected to a Selsyn (self-synchronous) system. This system electronically transmits the angular position of the pulley to a receiving device in the control room. The position information is converted to a water level, indicated on a display and also output to the Remote Transmittal Unit for transmission to the System Control Centre.

The station operators at Kettle check the calibration of the gauge by comparing manual measurements with electronic readings in the control room once a month or as required. A map showing the location of the gauge is shown in Figure H-3.

5.0 DATA ANALYSIS

Manitoba Hydro prepared the Kettle Generating Station Licence Implementation Guide for Water Levels[1] to document a common understanding of compliance with the water regime terms of the Kettle Water Power Act Licence. The report was approved by Manitoba in 2018.

[1] Manitoba Hydro. 2018. Kettle Generating Station Licence Implementation Guide for Water Levels.

During the 2021 calendar year, forebay water levels at the Kettle Generating Station were in compliance with the licence limit 100 % of the time.

Figure H-4 shows hourly water level readings for the Kettle Generating Station forebay from January 1, 2021 to December 31, 2021.

6.0 MAJOR SYSTEM UPGRADES/CHANGES

Maintenance and construction activities that occurred during the 2021 calendar year include:

- Replaced intake and tailrace deck seal
- Upgraded fire water piping and pumps
- Replaced dewatering header and piping
- Replaced the electrical cables on the Spillway
- Zebra mussels mitigation upgrades and treatment
- Replaced the unit 1 intake gate cylinder

7.0 DAM SAFETY

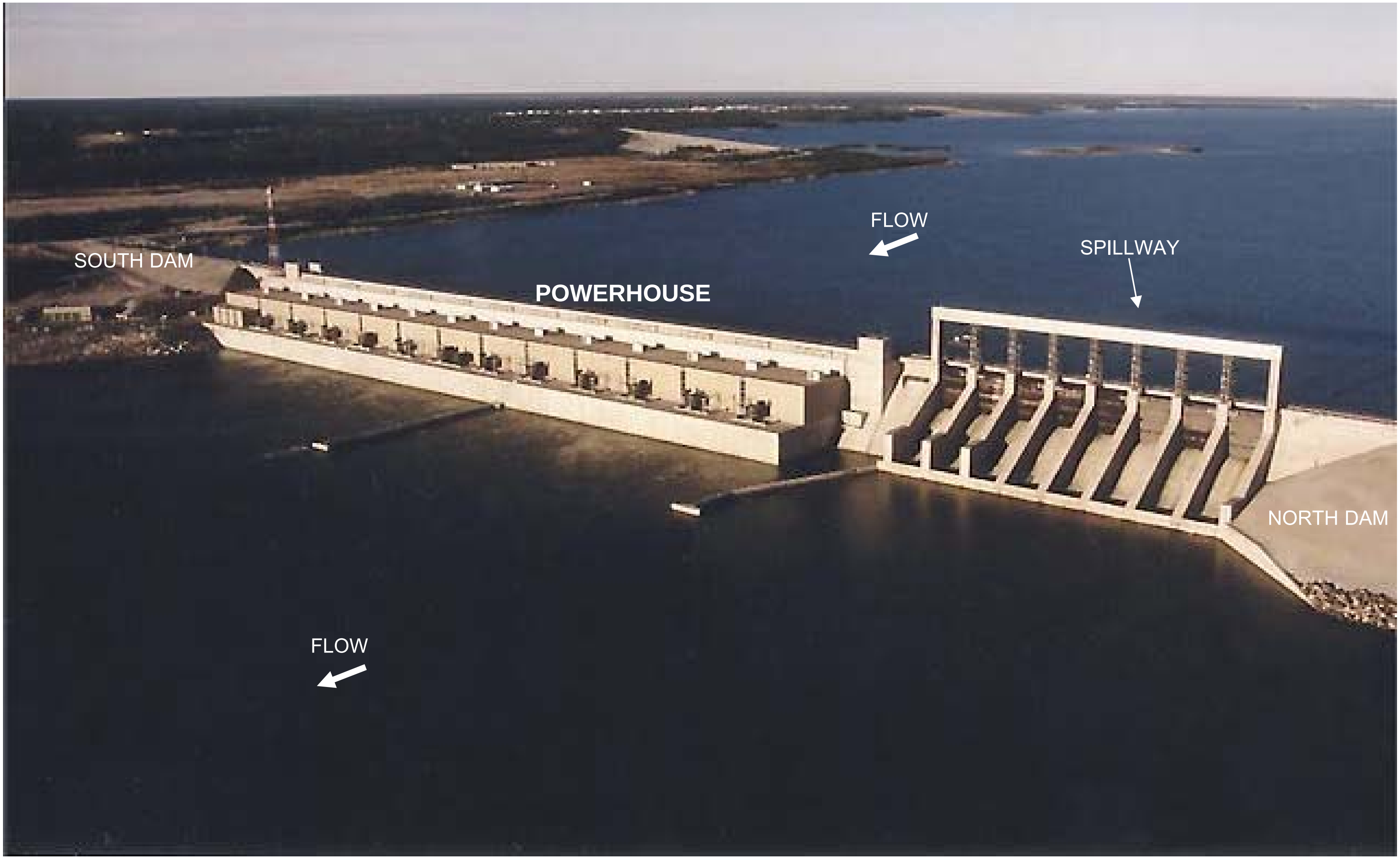
Manitoba Hydro operates and maintains the generating station and associated structures at Kettle based on the Canadian Dam Association Dam Safety Guidelines. A summary of dam safety activities for 2021 is provided on page H-9.

8.0 CLOSURE

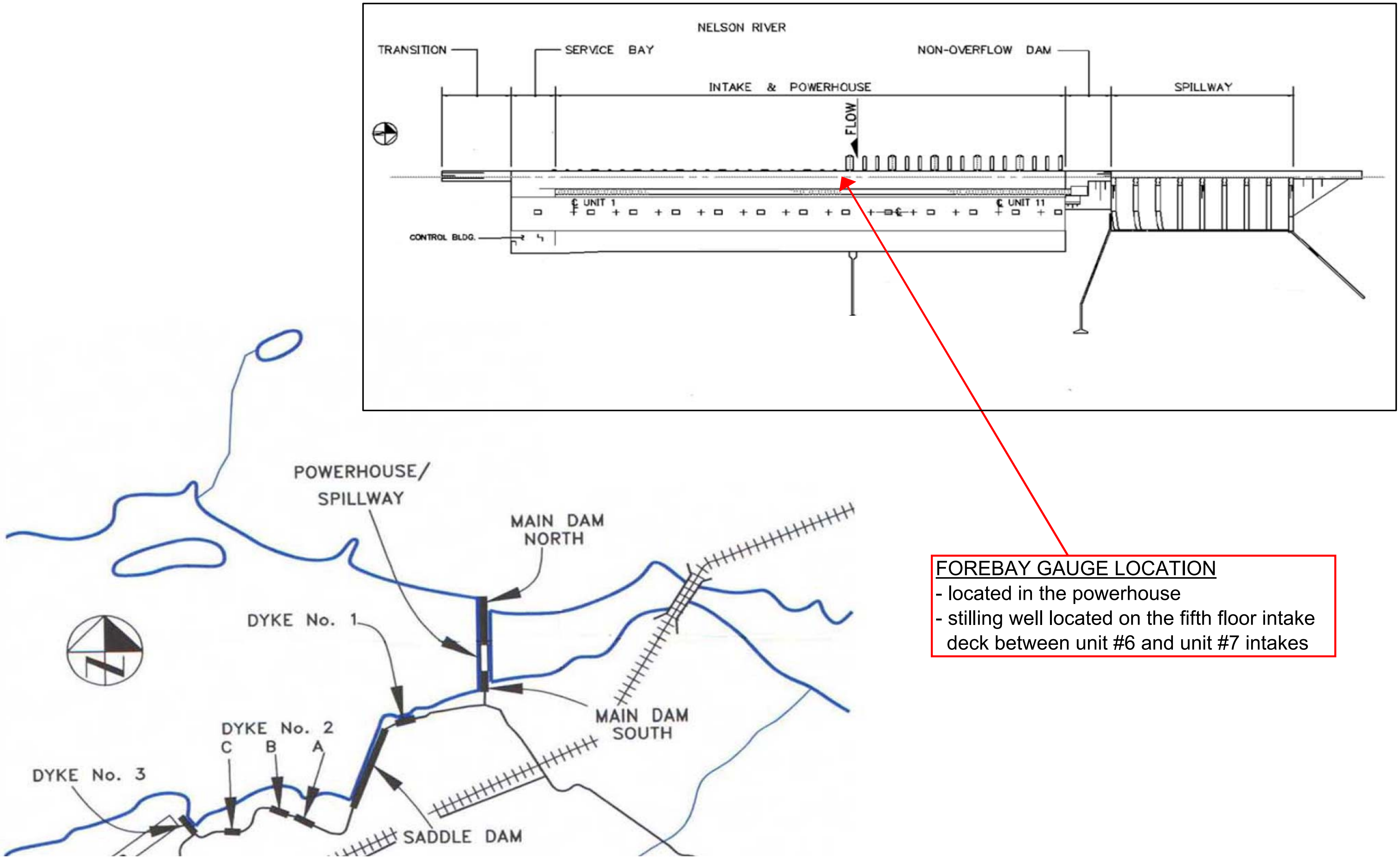
Manitoba Hydro continues to operate the Kettle Generating Station in accordance with the Final Licence under The Water Power Act for the development of water power at the Kettle Site on the Nelson River.

KETTLE G.S.
GEOGRAPHICAL LOCATION

FIGURE H-1



MANITOBA HYDRO	
WATERWAY APPROVALS AND MONITORING	
KETTLE GENERATING STATION	
PHOTOGRAPH OF GENERATING STATION	
PROJECT WATER LEVELS AND FLOWS REPORT	FIGURE H-2



MANITOBA HYDRO

WATERWAY APPROVALS AND MONITORING

KETTLE GENERATING STATION

GENERAL ARRANGEMENT

PROJECT

WATER LEVELS AND FLOWS REPORT

FIGURE H3

Daily Averaged Forebay Elevation Statistics 1977 - 2021

Maximum = 463.48 feet
Minimum = 451.21 feet
Mean = 460.38 feet

Manitoba Hydro	MANITOBA HYDRO
	WATERWAY APPROVALS AND MONITORING
	KETTLE GENERATING STATION
	HOURLY FOREBAY ELEVATIONS (2021)
PROJECT Water Levels and Flows Report	FIGURE H-4

Kettle GS Dam Safety Activities List

	ACTIVITIES	Performed By	Tasks Completed	Tasks Planned
Inspections	Engineering inspection of embankment dams	Dam Safety	1	1
	Cursory inspection of embankment dams	Dam Safety	1	1
	Engineering inspection of concrete dams	Dam Safety	1	1
	Unit inspection - civil components	Dam Safety	1	1
	Spillway bay inspection - civil components	Dam Safety	1	1
	Routine inspection of embankment dams	Site - Utility	12	12
	Routine inspection of freeboard embankment dams	Site - Utility	1	1
	Routine inspection of concrete dams	Site - Utility	6	6
	Forebay/Tailrace gauge checks	Site - Operating	11	12
	Spillway inspection	Site - Operating	11	12
	Hydraulic conditions inspection	Dam Safety	1	1
Analyses	Instrumentation data review (Concrete Dams)	Dam Safety	15	15
	Instrumentation data review (Embankment Dams)	Dam Safety	24	24
Maintenance and Testing	Spillway gate functional testing	Site - Elec/Mech	8	8 (1 per gate)
	Spillway gate full flow test	Site - Elec/Mech	2	2
	Spillway gas engine - functional gate lift test	Site - Elec	0	1
	Spillway gas engine test runs	Site - Operating	11	12
	Spillway gate heater maintenance	Site - Elec	6	6 (1 per gate)
	Spillway gate gain heater maintenance	Site - Elec	8	8 (1 per gate)
	Spillway gate gain heater controller maintenance	Site - Elec	0	1
	Spillway gate hoist maintenance	Site - Elec	8	8 (1 per gate)
	Spillway gate hoist maintenance	Site - Mech	8	8 (1 per gate)
	Spillway gate maintenance	Site - Mech	8	8 (1 per gate)
	Spillway gas engine maintenance	Site - Mech	1	1
	Spillway gas engine maintenance	Mechanical Services	1	1
Program	Dam Safety EPP - updates	Dam Safety	1	1
	Dam Safety Reference Manual - Revision	Dam Safety	-	-
	Delivered DS Training - Routine Inspections	Dam Safety	0	As required
	Delivered DS Training - Emergency Preparedness	Dam Safety	0	As required

APPENDIX I

LONG SPRUCE GENERATING STATION
WATER POWER ACT LICENCE

1.0 INTRODUCTION

Long Spruce Generating Station is located on the Nelson River approximately 745 km northeast of the City of Winnipeg, 27 km east of the Town of Gillam and 16 km downstream of Manitoba Hydro's Kettle Generating Station. The geographical location of the station is shown in Figure I-1. A photograph of the station is shown in Figure I-2. An overall site map is shown in Figure I-3.

The Long Spruce Generating Station was built between 1971 and 1979 and was Manitoba Hydro's fourth generating station built on the Nelson River. The station is situated on a stretch of the river known as the Long Spruce Rapids which is upstream of the Limestone Generating Station and downstream of the Kettle Generating Station. Long Spruce was designed for run of river operation.

Manitoba Hydro operates the Long Spruce Generating Station in accordance with the Final Licence for the Development of Water Power at the Long Spruce Site on the Nelson River. This licence was issued in accordance with the provisions of The Water Power Act on July 19, 1990. The licence is valid for a term of 50 years and is in effect until April 28, 2028.

This appendix contains information specific to the Long Spruce Generating Station, including a description of the project, major construction specifications and operating parameters, and Water Power Act licensing requirements. The appendix also includes a description of the data collection process and summaries of 2021 forebay level compliance, major system upgrades or changes, and dam safety activities.

2.0 PROJECT DESCRIPTION

The Long Spruce Generating Station consists of an intake structure, a 10-unit powerhouse with a capacity of 1,007 MW, earth main dams and dikes, and a 6-bay spillway. The generating station also provides a river crossing, allowing the Henday Converter Station to be accessed by highway. Table I-1 and I-2 summarize the operating parameters and construction specifications of the Long Spruce Generating Station.

Table I-1: Construction Specifications and Operating Parameters of the Long Spruce Generating Station

Construction Period	1973 to 1979
Licensed Capacity	1,007 MW (1,350,000 hp)
Average Annual Generation	6,212 million kW-h
Waterfall Drop (head)	24.4 m
Maximum Licence Forebay Elevation	110.3 m (362.0 ft)
Maximum Operating Forebay Elevation	Ice Cover: 110.3 m Open Water: 110.0 m

Table I-2: Principal Structures for the Long Spruce Generating Station

Powerhouse	Number of Units	10
	Length	265.2 m
	Discharge Capacity (at full gate)	4,590 m^3/s
	Unit Power Production Unit 1-10	10 units @ 100.7 MW/unit = 1,007 MW
Spillway	Number of Bays	Sluiceway with 6 bays
	Total Length	103.6 m
	Discharge Capacity (at open water full supply level*)	9,700 m^3/s
Dams and Dikes	Material	Main Dam: Fill Dike: Granular semi-previous fill
	Crest Elevation	Main Dam: 113.1 m to 113.4 m Dike: 111.6 m to 113.4 m
	Available Freeboard (at open water full supply level*)	Main Dam: 3.1 m to 3.4 m Main Dam: 1.6 m to 3.4 m

*Full Supply Level is 110.0 m during open water measured at the forebay

The forebay at Long Spruce has a total area of 36 sq. km and a fetch length of approximately 10 km. The forebay's operating water level is 110.0 m during open water period, and 110.3 m during ice cover period. The forebay level is reduced in the open water period to allow for sufficient freeboard for wind setup and wave up rush in case of a severe storm.

The Long Spruce Generating Station was designed and is operated as a run-of-river generating station. The outflow from the station is governed by the releases from Stephens Lake at the Kettle Generating Station.

The operators and maintenance personnel of the Long Spruce Generating Station are located on site. Support and technical services are also located in the nearby town of Gillam.

3.0 WATER POWER ACT LICENSING REQUIREMENTS

Condition #5 of the licence stipulates that:

> *"The Licensee shall not raise the headwater of the development, as measured at the powerhouse, higher than 362.0 feet above mean sea level, Canadian*

Geodetic Datum. A higher elevation may be created only with written permission by the Director in accordance with Section 72 of the Regulation."

4.0 DATA COLLECTION AT GAUGE

The forebay still well is located on the fifth floor in the south stairwell beside unit 1. The forebay gauge consists of a float attached to a steel tape that is draped over a pulley connected to a Selsyn (self-synchronous) system. This system electronically transmits the angular position of the pulley to a receiving device in the control room. The position information is converted to a water level, indicated on a display and also output to the Remote Transmittal Unit for transmission to the System Control Centre.

The station operators at Long Spruce check the calibration of the gauge by comparing manual measurements with electronic readings in the control room once a month or as required. A map showing the location of the gauge is shown in Figure I-3.

5.0 DATA ANALYSIS

Manitoba Hydro prepared the Long Spruce Generating Station Licence Implementation Guide for Water Levels[1] to document a common understanding of compliance with the water regime terms of the Long Spruce Water Power Act Licence. The report was approved by Manitoba in 2018.

During the 2021 calendar year, forebay water levels at the Long Spruce Generating Station were in compliance with the licence limit 100 % of the time.

Figure I-4 shows hourly water level readings for the Long Spruce Generating Station forebay from January 1, 2021 to December 31, 2021.

6.0 MAJOR SYSTEM UPGRADES/CHANGES

Maintenance and construction activities that occurred during the 2021 calendar year include:

- Replaced intake and tailrace deck seal
- Upgraded Unit 9 protection
- Installed Unit 5 turbine pit monorail
- Removed weirs at offtake 3 and station 55+54 south dike
- Placed riprap at upstream end of the South dyke
- Zebra mussel mitigation upgrades and treatment

[1] Manitoba Hydro. 2018. Long Spruce Generating Station Licence Implementation Guide for Water Levels.

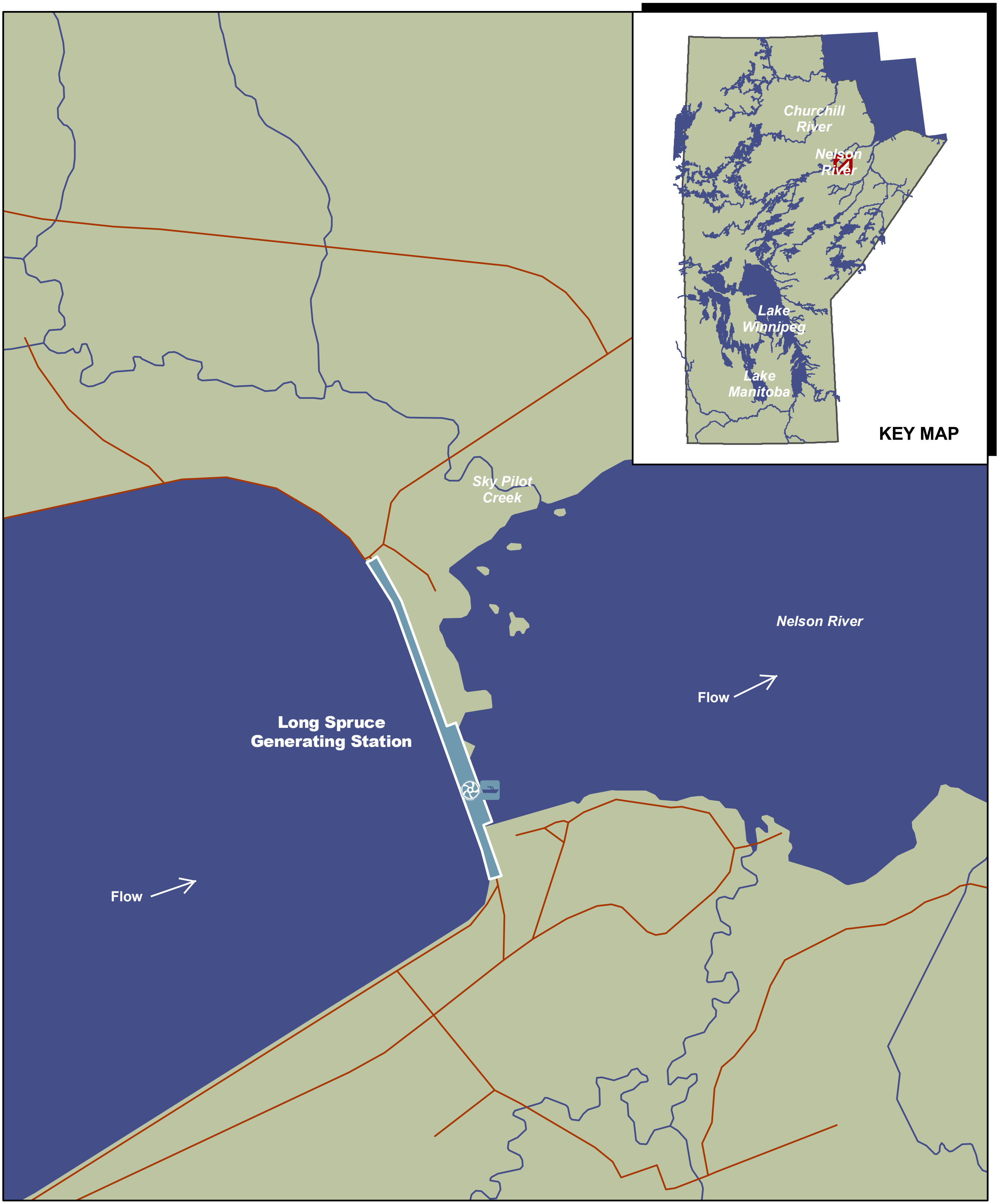
- Stabilized the South Transition structure

7.0 DAM SAFETY

Manitoba Hydro operates and maintains the generating station and associated structures at Long Spruce based on the Canadian Dam Association Dam Safety Guidelines. A summary of dam safety activities for 2021 is provided on page I-9.

8.0 CLOSURE

Manitoba Hydro continues to operate the Long Spruce Generating Station in accordance with the Final Licence under The Water Power Act for the development of water power at the Long Spruce Site on the Nelson River.



Manitoba Hydro

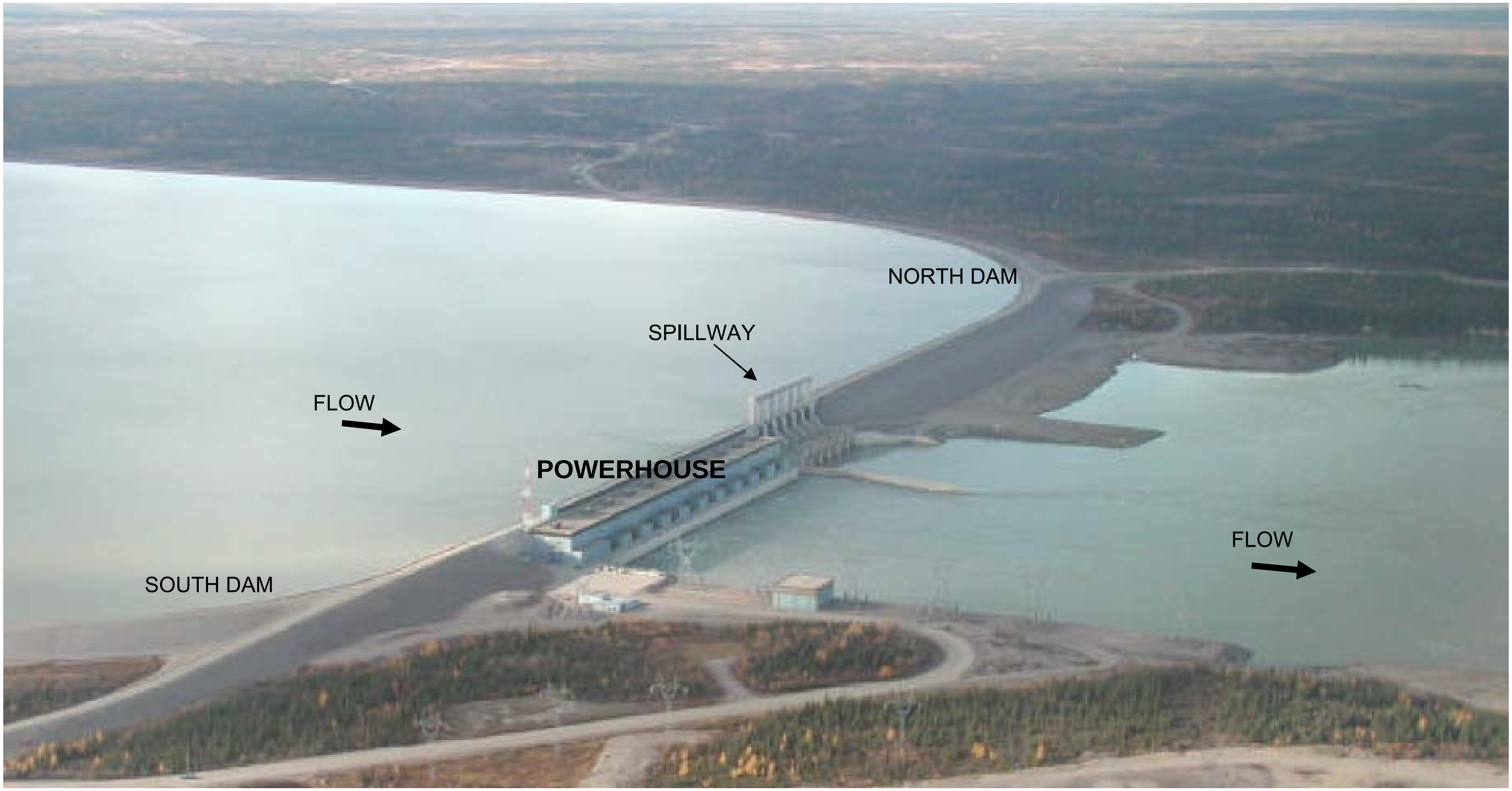
0.5 0.25 0 0.5 km

N

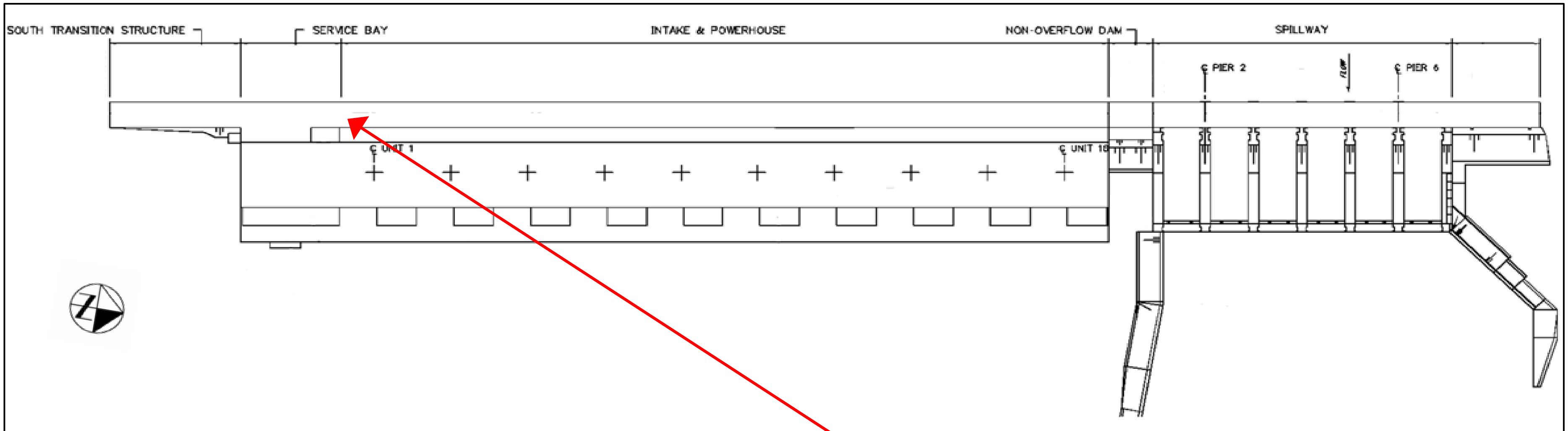
LONG SPRUCE G.S.
GEOGRAPHICAL LOCATION

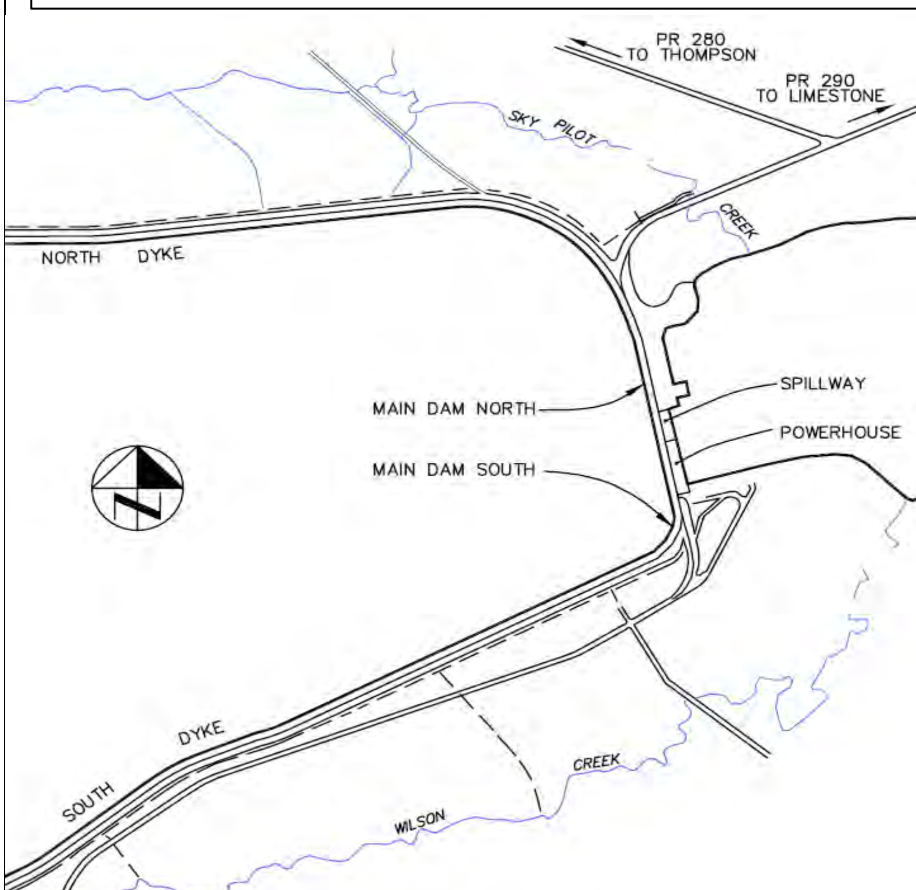
FIGURE I-1

Generating Station
Dam
Road



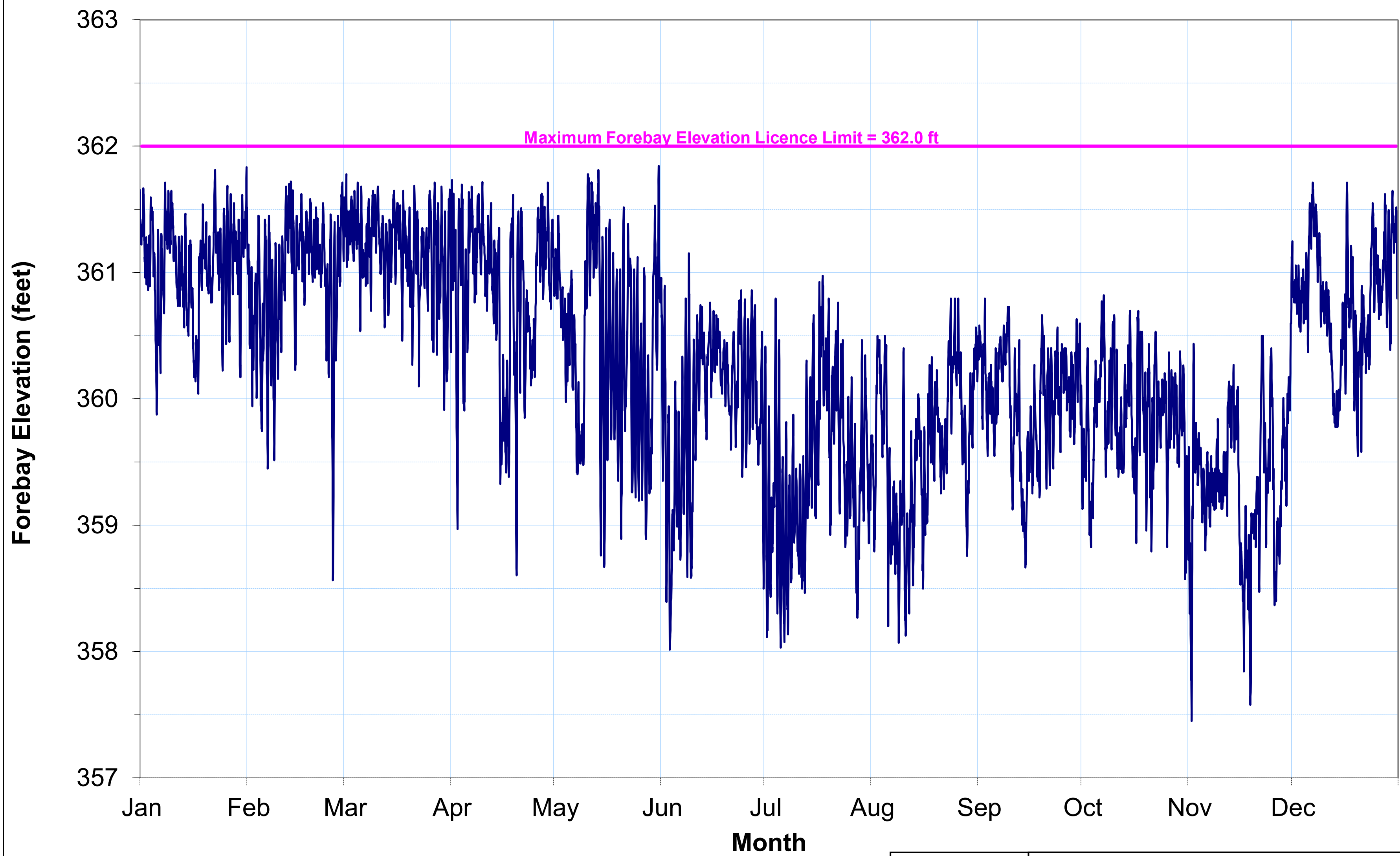
MANITOBA HYDRO	
WATERWAY APPROVALS AND MONITORING	
LONG SPRUCE GENERATING STATION	
PHOTOGRAPH OF GENERATING STATION	
PROJECT WATER LEVELS AND FLOWS REPORT	FIGURE I-2





FOREBAY GAUGE LOCATION
- located in the powerhouse
- stilling well is located on the fifth floor in the south stairwell beside unit 1

Manitoba Hydro	MANITOBA HYDRO
	WATERWAY APPROVALS AND MONITORING
	LONG SPRUCE GENERATING STATION
	GENERAL ARRANGEMENT
	PROJECT WATER LEVELS AND FLOWS REPORT — FIGURE I-3



Daily Averaged Forebay Elevation Statistics 1978 - 2021
Maximum = 362.30 feet
Minimum = 349.50 feet
Mean 360.56 feet

Manitoba Hydro	MANITOBA HYDRO
	WATERWAY APPROVALS AND MONITORING
	LONG SPRUCE GENERATING STATION
	HOURLY FOREBAY ELEVATIONS (2021)
	PROJECT Water Levels and Flows Report — FIGURE I-4

Long Spruce GS Dam Safety Activities List

	ACTIVITIES	Performed By	Tasks Completed	Tasks Planned
Inspections	Engineering inspection of embankment dams	Dam Safety	1	1
	Cursory inspection of embankment dams	Dam Safety	1	1
	Engineering inspection of concrete dams	Dam Safety	1	1
	Unit Inspection – civil components	Dam Safety	1	1
	Routine inspection of dikes and dams	Site - Utility	12	12
	Routine inspection of concrete dams	Site - Utility	6	6
	Forebay gauge check	Site - Operating	12	12
	Tailrace gauge check	Site - Operating	12	12
	Spillway inspection	Site - Operating	12	12
	Spillway gate gain heater checks	Site - Operating	12	12
	Hydraulic conditions inspection	Dam Safety	1	1
Analyses	Instrumentation data review (Concrete Dams)	Dam Safety	7	7
	Instrumentation data review (Embankment Dams)	Dam Safety	5	5
Maintenance and Testing	Spillway gate functional testing	Site - Elec/Mech	6	6 (1 per gate)
	Spillway gate full flow test	Site - Elec/Mech	1	1
	Spillway gas engine 1 test run	Site - Operating	52	52
	Spillway gas engine 2 test run	Site - Operating	52	52
	Spillway gate heater maintenance	Site - Elec	4	4 (1 per gate)
	Spillway gate hoist maintenance	Site - Elec	6	6 (1 per gate)
	Spillway gate hoist maintenance	Site - Mech	6	6 (1 per gate)
	Spillway gate maintenance	Site - Mech	6	6 (1 per gate)
	Spillway gas engine 1 maintenance	Site - Mech	1	1
	Spillway gas engine 2 maintenance	Site - Mech	1	1
	Spillway gas engine 1 maintenance	Mechanical Services	1	1
	Spillway gas engine 2 maintenance	Mechanical Services	1	1
Program	Dam Safety EPP - updates	Dam Safety	1	1
	Dam Safety Reference Manual - Revision	Dam Safety	-	-
	Delivered DS Training - Routine Inspections	Dam Safety	0	As required
	Delivered DS Training - Emergency Preparedness	Dam Safety	0	As required

APPENDIX J

LIMESTONE GENERATING STATION
WATER POWER ACT LICENCE

1.0 INTRODUCTION

The Limestone Generating Station is located 750 km north of the City of Winnipeg and 260 km south of the northern town of Churchill. Limestone is located on the lower Nelson River, 23 km downstream from the Long Spruce Generating Station, which is 18 km downstream from the Kettle Generating Station. The geographical location of the station is shown in Figure J-1. A photograph of the station is shown in Figure J-2. An overall site map is shown in Figure J-3.

The Limestone Generating Station is the largest in the province and is Manitoba Hydro's fifth generating station built on the Nelson River in northern Manitoba. Limestone was constructed between 1985 and 1992 making it the newest generating station in operation on the Nelson River. The station is operated as a run-of-the-river generating station.

Manitoba Hydro operates the Limestone Generating Station in accordance with the Interim Licence and Supplementary Interim Licence for the Development of Water Power at the Limestone Site on the Nelson River. The Interim Licence was issued in accordance with the provisions of The Water Power Act on July 9, 1976. The Supplementary Interim Licence was issued on October 15, 1984. Manitoba Hydro requested a Final Licence for Limestone Generating Station on February 9, 2012.

This appendix contains information specific to the Limestone Generating Station, including a description of the project, major construction specifications and operating parameters, and Water Power Act licensing requirements. The appendix also includes a description of the data collection process and summaries of 2021 forebay level compliance, major system upgrades or changes, and dam safety activities.

2.0 PROJECT DESCRIPTION

The Limestone Generating Station consists of an intake structure, a 10-unit powerhouse with a capacity of 1,347 MW, earth main dams and dikes, and a 7-bay spillway. Tables J-1 and J-2 summarize the operating parameters and construction specifications of the Limestone Generating Station. The

Table J-1: Construction Specifications and Operating Parameters of the Limestone Generating Station

Construction Period	1985 to 1992
Licensed Capacity	1,104 MW (1,480,000 hp)*
Average Annual Generation	8,233 million kW-h
Waterfall Drop (head)	27.6 m
Maximum Licence Forebay Elevation	85.3 m (280.0 ft)
Maximum Operating Forebay Elevation	85.3 m

*Licenced capacity is based on higher tailwater assuming fully developed Conawapa GS

Table J-2: Principal Structures for the Limestone Generating Station

Powerhouse	Number of Units	10
	Length	268.5 m
	Discharge Capacity (at full gate)	5,000 m^3/s
	Unit Power Production Unit 1-10	10 units @ 134.7 MW/unit TOTAL = 1,347 MW
Spillway	Number of Bays	Spillway with 7 bays
	Total Length	118.0 m
	Discharge Capacity (at full supply level*)	9,500 m^3/s
Dams	Material	Impervious fill and granular fill
	Crest Elevation	88 m
	Available Freeboard	2.7 m

*Full Supply Level is 85.3 m measured at the forebay

The forebay at Limestone Generating Station has a total area of 27.1 sq. km and a fetch length of approximately 12 km. The forebay's normal water level is 85.3 m. The majority of the forebay is contained by the natural river banks, which has minimized the need for dikes.

As the most downstream run-of-river station on the Nelson River, the operation of Limestone is controlled by the releases from Stephens Lake, upstream of the Kettle Generating Station.

The operators and maintenance personnel of the Limestone Generating Station are located on site. Support and technical services are also located in the nearby town of Gillam.

3.0 WATER POWER ACT LICENSING REQUIREMENTS

Condition #8 of the licence stipulates that:

> *"The Licensee shall not raise the headwater of its development to an elevation higher than 280.0 feet above mean sea level, Canadian Geodetic Datum. A higher elevation may be created only with prior written permission by the Minister and in accordance with Section 72 of the Regulations."*

4.0 DATA COLLECTION AT GAUGE

The forebay gauge consists of a float attached to a steel tape that is draped over a pulley connected to a Selsyn (self-synchronous) system. This system electronically transmits the angular position of the pulley to a receiving device in the control room. The position information is converted to a water level, indicated on a display and also output to the Remote Transmittal Unit for transmission to the System Control Centre. The station operators at Limestone check the calibration of the gauge by comparing manual measurements with electronic readings in the control room once a month or as required. A map showing the location of the gauge is shown on Figure J-3. The gauge is located in a still-well located on the sixth floor at the Unit #1 intake gates.

5.0 DATA ANALYSIS

Manitoba Hydro prepared the Limestone Generating Station Licence Implementation Guide for Water Levels[1] to document a common understanding of compliance with the water regime terms of the Limestone Water Power Act Licence. The report was approved by Manitoba in 2018.

During the 2021 calendar year, forebay water levels at the Limestone Generating Station were in compliance with the licence limit 100 % of the time.

Figure J-4 shows hourly water level readings for the Limestone forebay from January 1, 2021 to December 31, 2021.

6.0 MAJOR SYSTEM UPGRADES/CHANGES

Maintenance and construction activities that occurred during the 2021 calendar year include:

- Refurbished Unit 8 rotor and stator
- Re-wedged Unit 10 stator
- Zebra mussels mitigation upgrades and treatment

7.0 DAM SAFETY

Manitoba Hydro operates and maintains the generating station and associated structures at Limestone based on the Canadian Dam Association Dam Safety Guidelines. A summary of dam safety activities for 2021 is provided on page J-9.

[1] Manitoba Hydro. 2018. Limestone Generating Station Licence Implementation Guide for Water Levels.

8.0 CLOSURE

Manitoba Hydro continues to operate the Limestone Generating Station in accordance with the Interim Licence and Supplementary Interim Licence under The Water Power Act for the development of water power at the Limestone Site on the Nelson River.

Manitoba Hydro

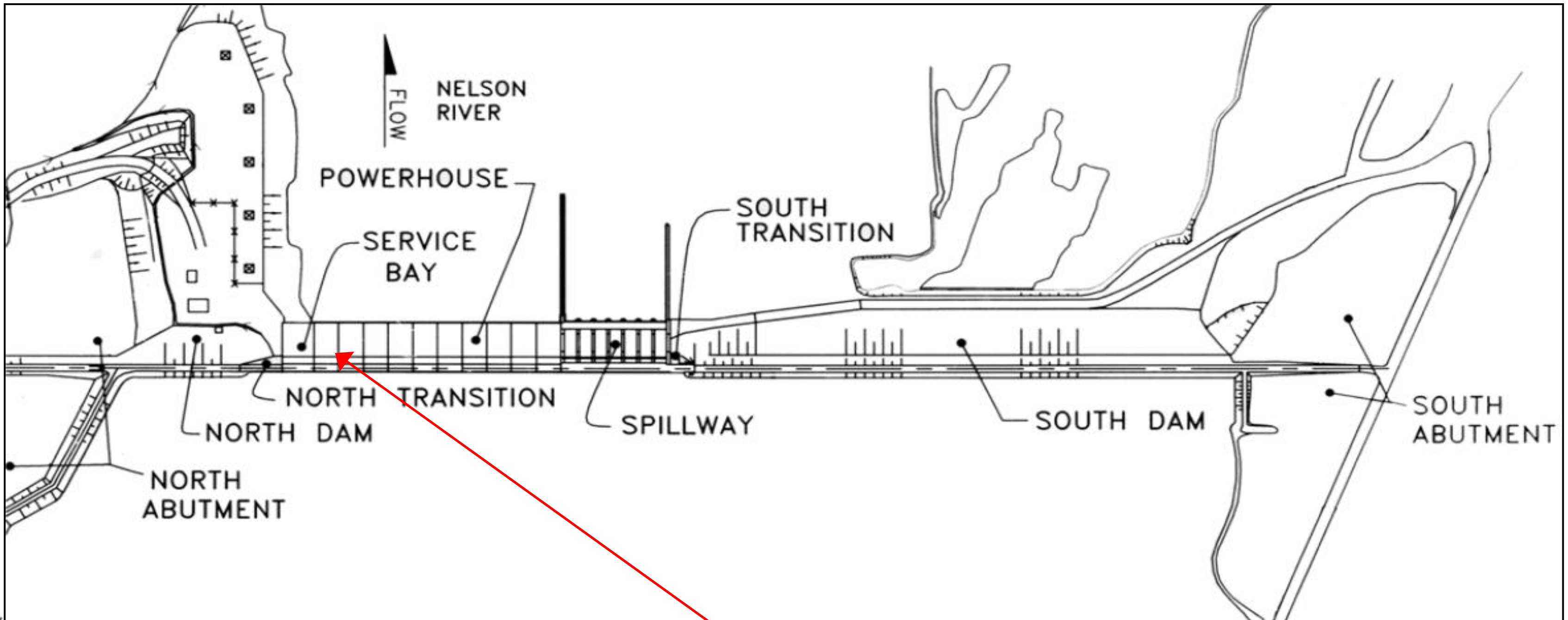
0.5 0.25 0 0.5 km

LIMESTONE G.S.
GEOGRAPHICAL LOCATION

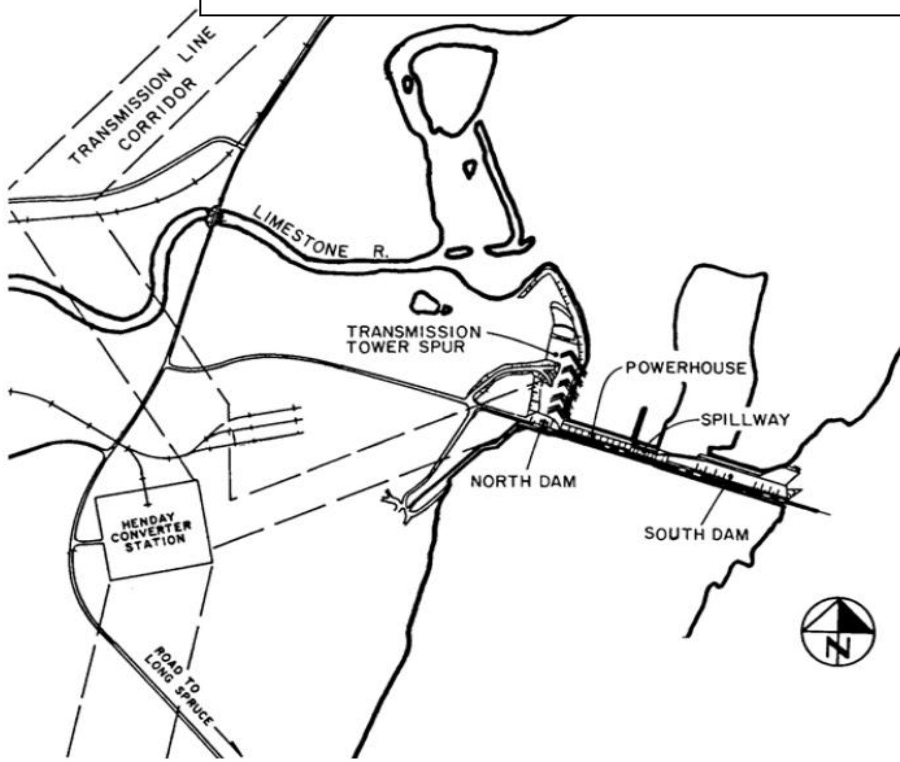
FIGURE J-1

Generating Station
Dam
Road

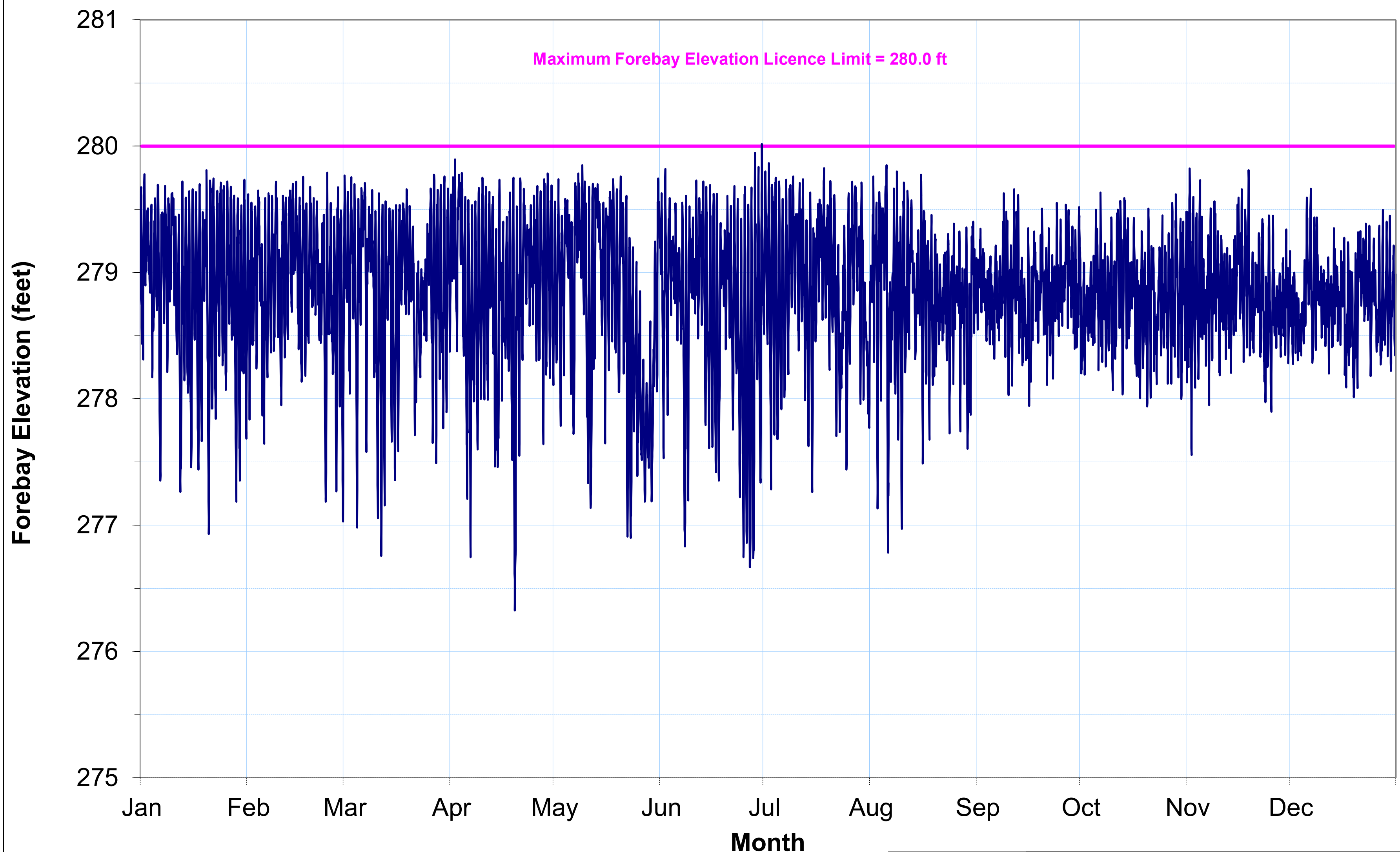
Manitoba Hydro	MANITOBA HYDRO	
	WATERWAY APPROVALS AND MONITORING	
	LIMESTONE GENERATING STATION	
	PHOTOGRAPH OF GENERATING STATION	
	PROJECT WATER LEVELS AND FLOWS REPORT	FIGURE J-2



FOREBAY GAUGE LOCATION
- located in the powerhouse
- stilling well is located on the sixth floor by unit #1 intake gates



Manitoba Hydro	MANITOBA HYDRO
	WATERWAY APPROVALS AND MONITORING
	LIMESTONE GENERATING STATION
	GENERAL ARRANGEMENT
	PROJECT WATER LEVELS AND FLOWS REPORT — FIGURE J-3



Daily Averaged Forebay Elevation Statistics 1991 - 2021

Maximum	**= 279.72 feet**
Minimum	**= 261.78 feet**
Mean	**= 278.53 feet**

Manitoba Hydro	MANITOBA HYDRO
	WATERWAY APPROVALS AND MONITORING
	LIMESTONE GENERATING STATION
	HOURLY FOREBAY ELEVATIONS (2021)
	PROJECT Water Levels and Flows Report — FIGURE J-4

Limestone GS Dam Safety Activities List

	ACTIVITIES	Performed By	Tasks Completed	Tasks Planned
Inspections	Engineering inspection of embankment dams	Dam Safety	1	1
	Cursory inspection of embankment dams	Dam Safety	1	1
	Routine inspection of embankment dams	Site - Utility	12	12
	Engineering inspection of concrete dams	Dam Safety	1	1
	Spillway bay inspection - civil components	Dam Safety	1	1
	Unscheduled spillway bay inspection	Dam Safety	0	-
	Condition survey - spillway	Dam Safety	1	1
	Routine inspection of concrete dams	Site - Utility	6	6
	Forebay/tailrace level gauge calibration	Site - Operating	12	12
	Spillway weekly inspection	Site - Operating	52	52
	Spillway monthly inspection	Site - Operating	12	12
	Hydraulic conditions inspection	Dam Safety	1	1
Analyses	Instrumentation data review (Concrete Dams)	Dam Safety	16	16
Maintenance Testing	Spillway gate functional testing	Site - Elec/Mech	5	7 (1 per gate)
	Spillway gate full flow test	Site - Elec/Mech	1	1
	Spillway gas engine - functional gate lift test	Site - Elec	0	1
	Spillway gas engine test runs	Site - Operating	12	12
	Spillway hoist maintenance	Site - Elec	7	7 (1 per gate)
	Spillway gate heater maintenance	Site - Elec	7	7 (1 per gate)
	Spillway gate gain heater controller maintenance	Site - Elec	1	1
	Spillway gate gain heater controller alarm check (6yr)	Site - Elec	1	1
	Spillway gate maintenance	Site - Mech	7	7 (1 per gate)
	Spillway hoist maintenance	Site - Mech	7	7 (1 per gate)
	Spillway gas engine maintenance	Site - Mech	1	1
	Spillway gas engine maintenance (6yr)	Site - Mech	1	1
	Spillway gas engine maintenance	Mechanical Services	1	1
Program	Dam Safety EPP - updates	Dam Safety	1	1
	Dam Safety Reference Manual - Revision	Dam Safety	-	-
	Delivered DS Training - Routine Inspections	Dam Safety	0	As required
	Delivered DS Training - Emergency Preparedness	Dam Safety	0	As required

APPENDIX K

GRAND RAPIDS GENERATING STATION
WATER POWER ACT LICENCE

1.0 INTRODUCTION

Grand Rapids Generating Station is located on the Saskatchewan River approximately 400 km by air northwest of Winnipeg. Access to the station is via Highway 6 from Winnipeg, and a local gravel airstrip for light aircraft. The geographical location of the station is shown in Figure K-1. A photograph of the station is shown in Figure K-2. An overall site map is shown in Figure K-3.

Built between 1960 and 1968, Grand Rapids Generating Station is the first hydroelectric generating station Manitoba Hydro built in northern Manitoba after the Winnipeg River had been fully developed. Grand Rapids is Manitoba Hydro's only generating station on the Saskatchewan River and is operated with a dam and reservoir with a waterfall drop of 36.6 m.

Manitoba Hydro currently operates the Grand Rapids Generating Station with a Second Short-Term Extension Licence (STEL) issued in accordance with the provisions of The Water Power Act on December 12, 2014. The Second STEL is in effect from January 1, 2020 to and including January 1, 2025. Manitoba Hydro requested a renewal of the Final Licence on December 17, 2010.

This appendix contains information specific to the Grand Rapids Generating Station, including a description of the project, major construction specifications and operating parameters, and Water Power Act licensing requirements. The appendix also includes a description of the data collection process and summaries of 2021 forebay level compliance, major system upgrades or changes, and dam safety activities.

2.0 PROJECT DESCRIPTION

The Grand Rapids Generating Station consists of an intake structure, four penstocks, a 4-unit (plus house unit) powerhouse, wing walls, extensive dike structures, and a 4-bay spillway. The capacity of the generating station was increased to approximately 478.7 MW since major upgrades took place between 1995 and 2000. Tables K-1 and K-2 summarize the operating parameters and construction specifications of the Grand Rapids Generating Station.

Table K-1: Construction Specifications and Operating Parameters of the Grand Rapids Generating Station

Construction Period	1960 to 1968
Licensed Capacity	478.7 MW (642,000 horsepower)
Average Annual Generation	1,636 million kW-h
Waterfall Drop (head)	36.6 m
Maximum Licence Forebay Elevation	256.6 m (842.0 ft)
Maximum Operating Forebay Elevation	256.6 m

Table K-2: Principal Structures for the Grand Rapids Generating Station

Powerhouse	Number of Units	4
	Length	135.9 m
	Discharge Capacity (at full gate)	1,500 m^3/s
	Unit Power Production Units 1-3 Unit 4	3 units @ 122.29 MW/unit = 366.88 MW 1 unit @ 111.85 MW/unit = 111.85 MW TOTAL = 478.7MW
Spillway	Number of Bays	Spillway with 4 bays
	Total Length	116.0 m
	Discharge Capacity (at full supply level*)	3,940 m^3/s
Dikes	Material	Rockfill and impervious fill
	Crest Elevation	850.0 m
	Available Freeboard	Earth Structures: 2.44 m Concrete Structures: 3.05 m

*Full Supply Level is 256.6 m measured at Oleson Point

The Grand Rapids Generating Station reservoir consists of the station's forebay and Cedar Lake upstream of the station. The forebay at Grand Rapids has a total area of 3500 sq. km and a fetch length of approximately 21.5 km. The forebay's maximum operating water level is 256.6 m.

The reservoir for the Grand Rapids Generating Station is commonly known as Cedar Lake and is normally controlled for optimum energy production within the Manitoba system in accordance with instructions issued by the System Control Centre. The reservoir is normally drawn down in late winter/spring as required to meet peak winter energy demands and to provide storage for spring and summer inflows from the Saskatchewan River.

The operators and maintenance personnel of the Grand Rapids Generating Station are located on site.

Grand Rapids is the controlling station for the provincial power system. The units operate on load frequency control, meaning they respond to every change in the demand for electricity to keep the frequency constant on the system.

3.0 WATER POWER ACT LICENSING REQUIREMENTS

Condition #5 of the licence stipulates that:

> *"The Licensee shall not raise the headwater of its development to an elevation higher than 842.0 feet. A higher elevation may be created only*

with prior written permission by the Director and in accordance with Section 72 of the Regulations."

4.0 DATA COLLECTION AT GAUGES

Cedar Lake elevation is recorded by Manitoba Hydro. The Cedar Lake elevations near Oleson Point (05KL005) are recorded by a data logger with a pressure transducer that is located in a recorder shelter. The station is located near Oleson Point on Cedar Lake directly northwest of Fort Island. A map showing the location of the gauge is shown on Figure K-3.

High resolution (5 minute) water level data is collected with daily data being published according to the procedures and quality control assurance processes established by Water Survey of Canada. The 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 to applicable standards and includes recognition of the impact of other related environmental and contextual factors.

5.0 DATA ANALYSIS

Manitoba Hydro prepared the Grand Rapids Generating Station Licence Implementation Guide for Water Levels[1] to document a common understanding of compliance with the water regime terms of the Grand Rapids Water Power Act Licence. The report was approved by Manitoba in 2020.

During the 2021 calendar year, forebay water levels at the Grand Rapids Generating Station were in compliance with the licence limit 100 % of the time.

Figure K-4 shows daily water level readings for the Grand Rapids forebay as recorded at Cedar Lake at Oleson Point from January 1, 2021 to December 31, 2021.

6.0 MAJOR SYSTEM UPGRADES/CHANGES

Maintenance and construction activities that occurred during the 2021 calendar year include:

- Phase 1 of new fish hatchery equipment constructed and commissioned
- Unit 1 turbine shaft seal repair
- House Unit governor repair
- Intake headgate hoist cylinder manifold seal failure

[1] Manitoba Hydro. 2019. Grand Rapids Generating Station Licence Implementation Guide for Water Levels.

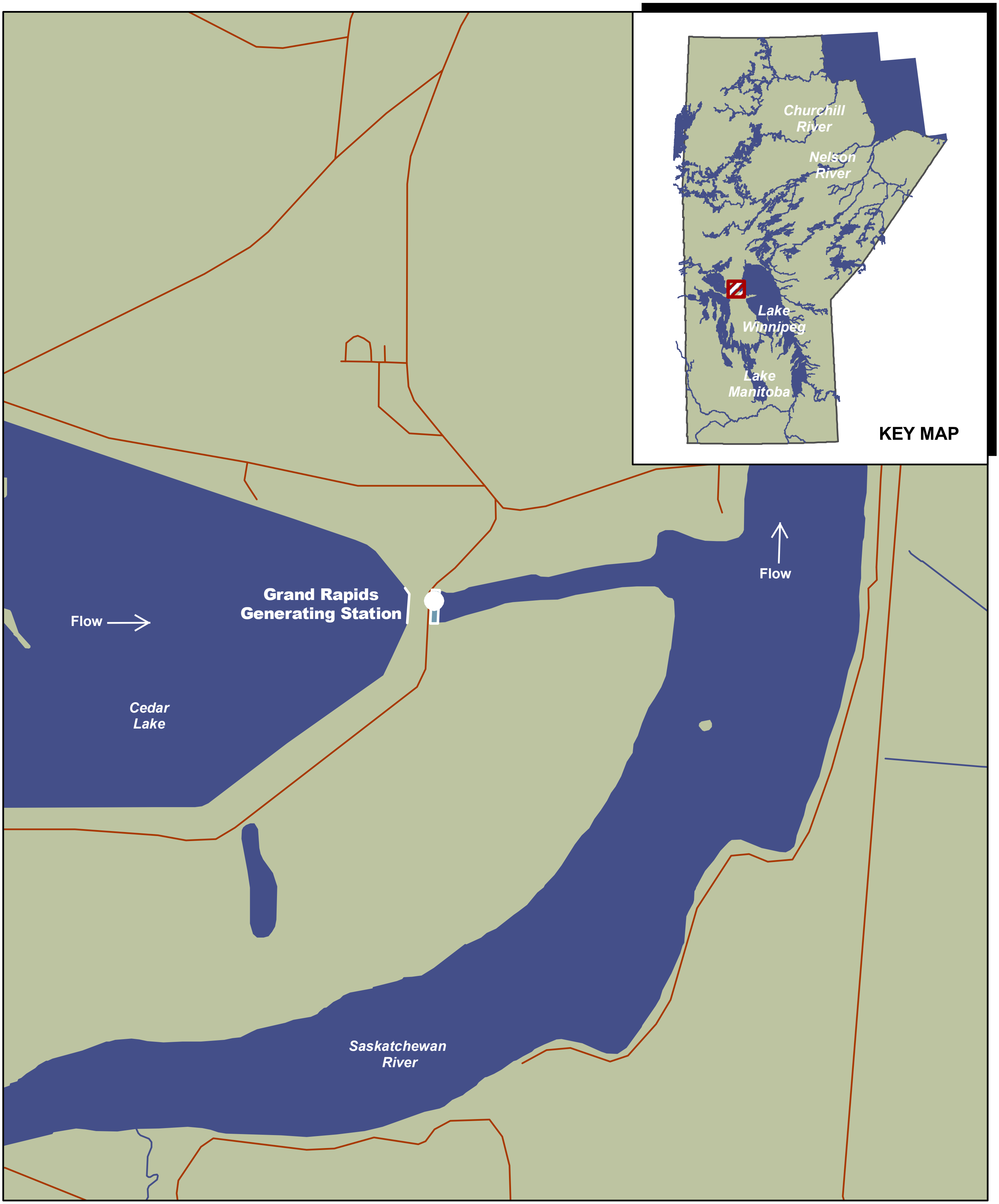
- Unit 4 weld repairs to the cracked runner
- Inspected intake and draft tube stoplogs
- Zebra mussels mitigation upgrades
- Upgraded security infrastructure

7.0 DAM SAFETY

Manitoba Hydro operates and maintains the generating station and associated structures at Grand Rapids based on the Canadian Dam Association Dam Safety Guidelines. A summary of dam safety activities for 2021 is provided on page K-9.

8.0 CLOSURE

Manitoba Hydro continues to operate the Grand Rapids Generating Station in accordance with the Short-Term Extension Licence under The Water Power Act for the development of water power at the Grand Rapids Site on the Saskatchewan River.



Manitoba Hydro

0.5 0.25 0 0.5 km

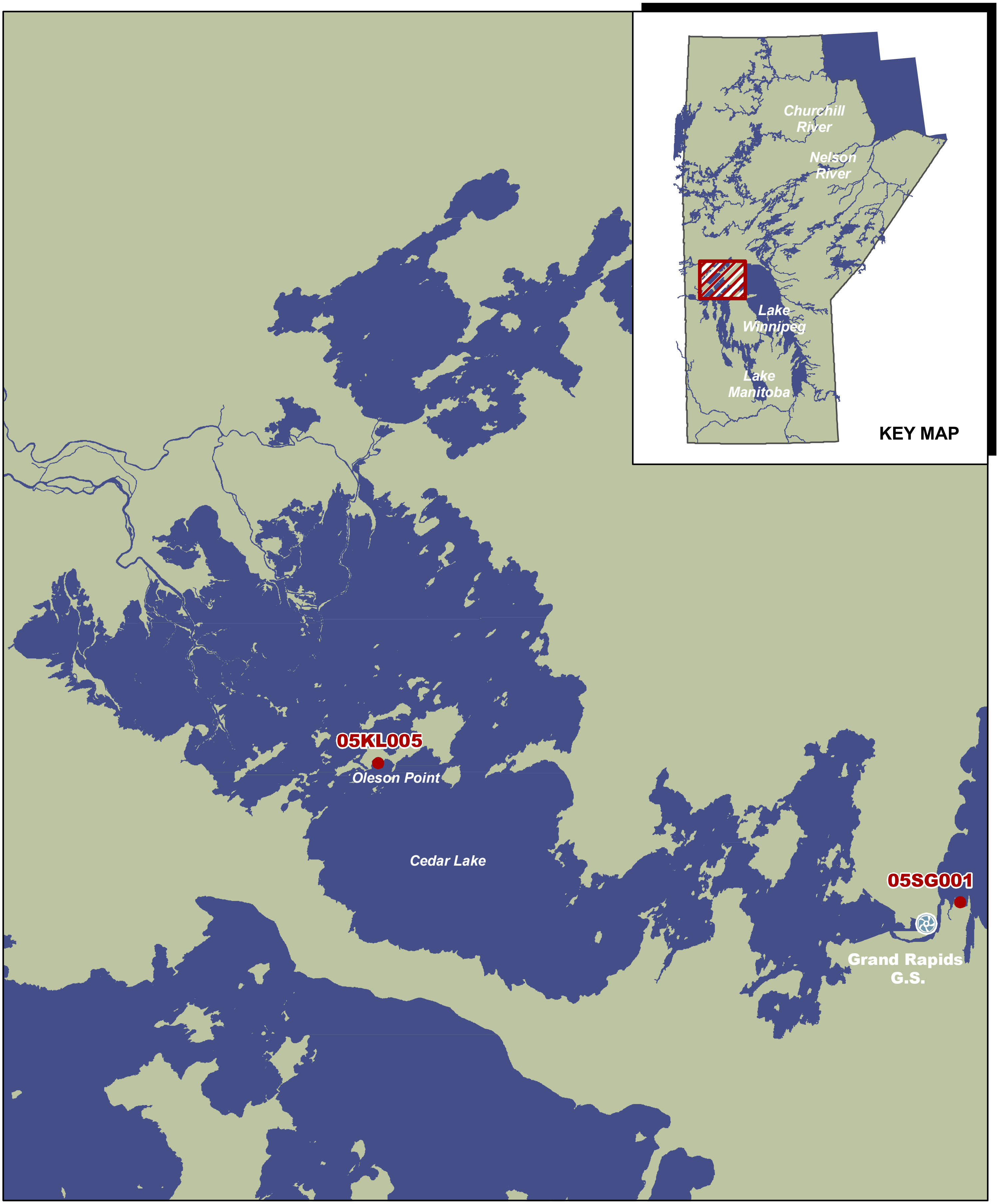
N

GRAND RAPIDS G.S.
GEOGRAPHICAL LOCATION

FIGURE K-1

Generating Station
Dam
Road

Manitoba Hydro	MANITOBA HYDRO
	WATERWAY APPROVALS AND MONITORING
	GRAND RAPIDS GENERATING STATION
	PHOTOGRAPH OF GENERATING STATION
	PROJECT WATER LEVELS AND FLOWS REPORT — FIGURE K-2



Manitoba Hydro

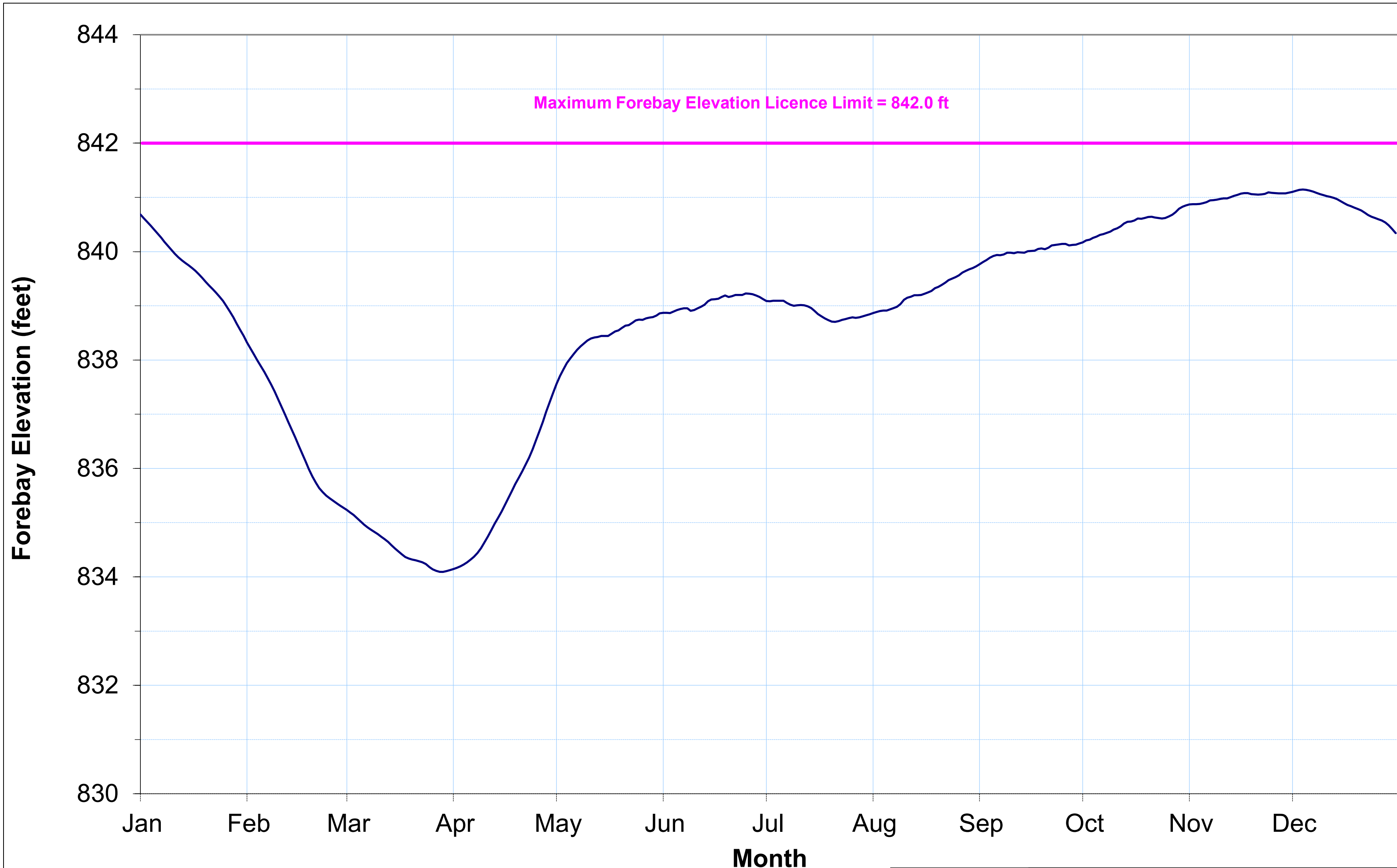
8 4 0 8 km

GRAND RAPIDS G.S.
GENERAL ARRANGEMENT

FIGURE K-3

Gauge Location

Generating Station



Daily Averaged Forebay Elevation Statistics 1982 - 2021

Maximum	**= 842.21 feet**
Minimum	**= 831.15 feet**
Mean	**= 838.78 feet**

MANITOBA HYDRO

WATERWAY APPROVALS AND MONITORING

GRAND RAPIDS GENERATING STATION

GRAND RAPIDS FOREBAY (CEDAR LAKE)
WIND ELIMINATED ELEVATIONS (2021)

PROJECT
Water Levels and Flows Report

FIGURE K-4

Grand Rapids GS Dam Safety Activities List

	ACTIVITIES	Performed By	Tasks Completed	Tasks Planned
Inspections	Engineering inspection of embankment dams	Dam Safety	1	1
	Cursory inspection of dikes 1 and 2, north and south	Dam Safety	1	1
	Engineering inspection of embankment and concrete dams including Moose Lake, One Man and Red Earth	Dam Safety	1	1
	Condition survey - spillway	Dam Safety	1	1
	Unscheduled inspection - spillway	Dam Safety	1	-
	Routine inspection of dikes 1 and 2 north, 1,2,3 and 4 south	Site - Utility	12	12
	Routine inspection of Cross Lake dikes 1-5, Dike 3A south	Site - Utility	1	1
	Routine inspection of Cross Lake 6 dike	Site - Utility	1	1
	Routine inspection of concrete dams	Site - Utility	6	6
	Spillway forebay gauge calibration	Site – Utility	11	12
	Powerhouse stillwell level readings (Forebay/Tailrace)	Site – Operating	26	26
	Spillway inspection	Site - Operating	10	12
	Hydraulic conditions inspection	Dam Safety	1	1
	Instrumentation data review (Concrete Dams)	Dam Safety	85	85
	Instrumentation data review (Embankment Dams)	Dam Safety	182	182
Maintenance and Testing	Spillway gate functional testing	Site - Elec/Mech	0*	4 (1 per gate)
	Spillway gas engine - functional gate lift test	Site – Elec/Mech	0*	1
	Spillway gate hoist maintenance	Site - Elec	4	4 (1 per gate)
	Spillway gate heat spring maintenance	Site - Elec	2	2 (1 per heated gate)
	Spillway gate heat fall maintenance	Site - Elec	1	2 (1 per heated gate)
	Spillway gate gain controller heater maintenance	Site - Elec	1	1
	Spillway gate hoist maintenance	Site - Mech	4	4 (1 per gate)
	Spillway gate maintenance/inspection	Site - Mech	4	4 (1 per gate)
	Spillway gas engine test run	Site - Mech	12	12
	Spillway gas engine maintenance	Mechanical Services	1	1
Program	Dam Safety EPP - updates	Dam Safety	1	1
	Dam Safety Reference Manual - Revision	Dam Safety	-	0
	Delivered DS Training - Routine Inspections	Dam Safety	0	As Required
	Delivered DS Training - Emergency Preparedness	Dam Safety	0	As Required

* Not completed due to low flow conditions, COVID-19 restrictions & low staffing levels in 2021. Completing the spillway functional testing is a priority in 2022.

APPENDIX L

LAKE WINNIPEG REGULATION
WATER POWER ACT LICENCE

1.0 INTRODUCTION

Lake Winnipeg Regulation (LWR) was announced by the Government of Manitoba in 1970 and developed by Manitoba Hydro to achieve two key objectives: to reduce shoreline flooding on Lake Winnipeg; and to support hydroelectricity generation to meet the growing demand in Manitoba. The project is a complex, engineered network of channels and structures that is used to control the outflow of water from the lake and allow higher outflow during flood conditions. It allows about 50% more water to flow out of the lake than would otherwise flow out naturally. Work on the Lake Winnipeg Regulation project began in 1970 with the construction of three channels and the Jenpeg Generating Station and Control Structure. LWR became operational in 1976 and Jenpeg Generating Station was completed in 1979.

In 2021, Manitoba Hydro operated Lake Winnipeg Regulation in accordance with the Interim Licence and Supplementary Interim Licence for the Regulation of Water Levels for Power Purposes on Lakes Winnipeg, Playgreen, and Kiskittogisu until May 11 and then in accordance with and the Final Licence for the Regulation of Lake Winnipeg Outflows for Water Power Purposes. The Interim Licence was issued in accordance with the provisions of The Water Power Act on November 18, 1970. The Supplementary Interim Licence was issued on August 8, 1972. Manitoba Hydro received the Water Power Act Final Licence on May 12, 2021.

This appendix contains information specific to Lake Winnipeg Regulation, including a description of the project, major construction specifications and operating parameters, and Water Power Act licensing requirements. The appendix also includes a description of the data collection process and summaries of 2021 water level and outflow compliance, major system upgrades or changes, and dam safety activities.

2.0 PROJECT DESCRIPTION

The details of the Lake Winnipeg Regulation project included three channels built to substantially increase the outflow potential of Lake Winnipeg, construction of Jenpeg Generating Station and Control Structure, and a dam at the outlet of Kiskitto Lake to prevent water from backing up into that lake.

To bypass natural constrictions in the Nelson River, three diversion channels were required: Two-Mile Channel, Eight-Mile Channel, and the Ominawin Bypass Channel. The amount of material excavated for the three channels totalled over 37.3 million m^3.

Two-Mile Channel connects Lake Winnipeg and Playgreen Lake as a second outlet for Lake Winnipeg. The channel is about 3.2 km long, 183–213 m wide, and about 9 m deep. The natural outlet is located east of Two-Mile Channel at Warren Landing. This outlet has a few major islands with one wider channel, and then transitions to one channel with numerous vegetated shallows, rock outcrops, and smaller islands. These features impede the flow of water during the open water season with even more significant flow constrictions in winter under ice cover.

Eight-Mile Channel provides a direct flow of water from Playgreen Lake to Kiskittogisu Lake, which allows water to flow more directly to the Nelson River. The channel is about 12.9 km long, ranges in width from about 213–366 m and is about 6 m deep. Without this channel, water could only flow downstream through a relatively narrow part of Playgreen Lake and then through an even narrower portion at the north end of the lake called Whiskey Jack Narrows.

The Ominawin Bypass Channel is located at the north end of the Kiskittogisu Lake and allows water flow to bypass the natural restrictions of the Ominawin Channel. The channel has a centre division (a rockfill groin) designed to reduce ice thickness. The Ominawin Bypass Channel is about 427 m wide, about 6 m deep, and about 3.4 km long.

Jenpeg Generating Station and Control Structure are located on the upper Nelson River at the point where the west channel of the Nelson River flows into Cross Lake. Jenpeg's primary purpose is to regulate the water outflow from Lake Winnipeg into the Nelson River. Its secondary function is to take advantage of a 7.3 m operating head (waterfall) at the site to produce electricity. Construction of Jenpeg began in 1972 and was completed seven years later. The generating station has a licensed capacity of 164 MW.

With the construction of the Jenpeg Generating Station and Control Structure and the subsequent increase in water levels along the Nelson River upstream of the station, it was necessary to build a dam at the outlet of Kiskitto Lake to prevent water from backing up into the lake. The Kiskitto Dam is about 600 m long, with a maximum height of 15 m. The lake is regulated within its natural range, and water levels are controlled to provide maximum benefit for fish, wildlife, and recreational activities. A total of 16 separate dikes with a length of 14 km protect the lake from the higher levels of the Nelson River's west channel. A gated culvert was installed to supply water from the Nelson River's west channel to Kiskitto Lake, while a small channel and control structure were built to regulate Kiskitto Lake's outflow.

3.0 METHODOLOGY

Manitoba Hydro prepared the Lake Winnipeg Regulation Licence Guide for Hydraulic Parameters[1] to document a common understanding of compliance with the water regime terms of the Lake Winnipeg Regulation Water Power Act Licence. The report was approved by Manitoba in 2016. Compliance with the various water regime terms of the

[1] Manitoba Hydro. 2016. Lake Winnipeg Regulation Licence Guide for Hydraulic Parameters.

licence will be calculated in the following sections using the methodology described in the guide.

4.0 JENPEG GENERATING STATION/CONTROL STRUCTURE

The Jenpeg Generating Station is located 525 km north of the City of Winnipeg, at the point where the west channel of the Nelson River flows into Cross Lake. The generating station is accessible by Provincial Highway #6 and Provincial Road #373. The nearest community is Cross Lake, which is about 19 km northeast of the station. The geographical location of the station is shown in Figure L-1. A photograph of the station is shown in Figure L-2. A site map is shown in Figure L-3.

4.1 PROJECT DESCRIPTION

The Jenpeg Generating Station and Control Structure consists of an intake structure, a 6 unit powerhouse, main earth dams, ancillary dams and dikes and a 5 bay spillway. Jenpeg's powerhouse and spillway structures are primarily used to control the outflow from Lake Winnipeg to provide greater flow reliability during the winter and enhance the availability and timing of water for electricity production by generating stations along the lower Nelson River. Tables L-1 and L-2 summarize the operating parameters and construction specifications of the Jenpeg Generating Station.

Table L-1: Principal Structures for the Jenpeg Generating Station

Powerhouse	Number of Units	6
	Length	169.3 m
	Discharge Capacity (at full gate)	2,633 m^3/s
	Unit Power Production	6 units @ 27.3 MW/unit = 164 MW
Spillway	Number of Bays	Spillway with 5 bays
	Total Length	79.3 m
	Discharge Capacity (at full supply level*)	4,616 m^3/s
Dams and Dikes	Material	Earthfill
	Crest Elevation (at design)	Main Dam: 220.0 m to 220.7 m East and West Dikes: 219.5 m Kiskitto Dam: 219.8 m Kiskitto Dike: 219.3 m to 220.0 m
	Available Freeboard (at full supply level*)	Main Dam: 2.46 m to 3.16 m East and West Dikes: 1.96 m Kiskitto Dam: 2.26 m Kiskitto Dike: 1.76 m to 5.8 m

*Full Supply Level at 217.54 m measured at the forebay.

Table L-2: Construction Specifications and Operating Parameters of the Jenpeg Generating Station

Construction Period	1972 to 1979
Licensed Capacity	164 MW (220,000 hp)
Average Annual Generation	832 million kW-h
Waterfall Drop (head)	7.31 m
Maximum 24 hour Outflow Rate of Change	424.75 m^3/s
Normal Forebay Elevation	Summer: 214.0 m to 217.54 m Winter: 214.27 m to 215.19 m

The Jenpeg reservoir consists of the forebay immediately upstream of the station, the outlet lakes (Playgreen Lake, North Playgreen Lake, and Kiskittogisu Lake) and Lake Winnipeg. The immediate forebay extends from the Kisipachewuk Channel north to the Jenpeg Generating Station, and has a fetch length of approximately 5.5 kilometres. The forebay's mean water level is 216.1 m and the operating range is 214.0 m to 217.54 m.

Jenpeg's primary purpose is to regulate the discharge in the West Channel of the Nelson River. The East Channel of the Nelson River is unregulated. The generation of electricity is Jenpeg's secondary function. The operational strategy for Jenpeg is devised by the Energy Supply Planning Department and issued to the System Control Department and Jenpeg station operators. Power production at Jenpeg is authorized by a separate Interim Water Power Act licence. Manitoba Hydro requested a Final Licence in 1999.

4.2 WATER POWER ACT LICENSING REQUIREMENTS

Section 3.5 of the Water Power Act Final Licence stipulates that:

> *"Subject to Section 3.5 of this Final Licence, but notwithstanding any other terms or conditions of this Final Licence, the Licensee shall operate Jenpeg Control Structure in such a manner that any increase or decrease in the rate of the discharge therefrom during any 24-hour period shall not exceed 425 cubic metres per second (15,000 cubic feet per second)."*

4.3 DATA COLLECTION

The Jenpeg total outflow is calculated based on rating curves for unit discharges and spill.

4.4 DATA ANALYSIS

During the 2021 calendar year, Manitoba Hydro was compliant with the Jenpeg outflow rate of change limit 100 % of the time.

Figure L-4 shows the 24-hour outflow rate of change at Jenpeg from January 1, 2021 to December 31, 2021.

5.0 LAKE WINNIPEG WATER LEVEL

5.1 WATER POWER ACT LICENSING REQUIREMENTS

Section 3.2 (a) of the Water Power Act Final Licence stipulates that:

> *"The Licensee may regulate outflows for power purposes when the wind eliminated water levels are between: (a) Lake Winnipeg – maximum 715.0 feet and minimum 711.0 feet, subject, however, to the provisions of Section 72 of the Regulations"*

In addition, Section 3.3 of the Water Power Act Final Licence stipulates that:

> *"The Licensee shall, during periods when the water level in Lake Winnipeg is above elevation 217.93 metres (715.0 feet) ASL, operate Jenpeg Control Structure in such a manner as to effect the maximum discharge possible under the circumstances then prevailing until the water level of Lake Winnipeg recedes to elevation 217.93 metres (715.0 feet) ASL."*

Also, Section 3.5 of the Water Power Act Final Licence stipulates that:

> *"Notwithstanding any other terms or conditions of this Final Licence, the Licensee shall, during periods when the water level in Lake Winnipeg is below elevation 216.71 metres (711 .0 feet) ASL, operate Jenpeg Control Structure as ordered by the Minister under Section 72 of the Water Power Regulation."*

5.2 GAUGE DESCRIPTION

Lake Winnipeg elevation is based on a complex formula used to calculate the wind eliminated level of the lake developed collaboratively by Manitoba Hydro, Manitoba and Water Survey of Canada (WSC). WSC water level gauging sites at various locations on the lake are used for calculating Lake Winnipeg wind eliminated elevation. A map showing the locations of the gauges is shown in Figure L-5.

There are eight water level gauges on Lake Winnipeg - seven gauges are operated by Water Survey of Canada, while the gauge at Montreal Point is operated by the Hydrometric Section of the Waterway Approvals and Monitoring Department under the terms of the Canada-Manitoba Cost Agreement on Water Quantity Surveys.

The Lake Winnipeg elevations at Gimli (05SB006) are recorded by a PDAS-2/HDR interfaced with PSE/SDI shaft encoder. The recording gauge is located on the east end of a boat dock in a shelter.

The Lake Winnipeg elevations at Victoria Beach (05SA003) are recorded by a data logger with a transmitter and shaft encoder. The equipment is housed in a shelter on a pier.

The Lake Winnipeg elevations at Berens River (05RD005) are recorded by a data logger with a transducer hooked up to a gas pressure system set to direct water levels (DWL). The real-time data is provided by a transmitter. The equipment is housed in a shelter on Forestry property.

The Lake Winnipeg elevations at George Island (05RE003) are recorded by a data logger and a transducer hooked up to a gas pressure system set to DWL. The recorder is housed in a shelter approximately 30 metres up the north shore of the harbour, which is located on the south-east shore of the island.

The Lake Winnipeg elevations at Mission Point (05SG001) are recorded by a data logger with a transducer. The recorder is housed in a shelter east of the settlement of Grand Rapids on Mission Point.

The Lake Winnipeg elevations at Pine Dock (05SD001) are recorded by a data logger and a pressure transducer connected to a telephone interface set to DWL. The recorder is housed in a shelter south of the pier.

The Lake Winnipeg elevations at Matheson Island Landing (05SD002) are recorded by a data logger and a transducer set to DWL. The recorder is housed in shelter at the north end of PR 234.

The Lake Winnipeg elevations at Montreal Point (05RF001) are recorded by a DCP and a pressure transducer housed in building with an antenna powered by a 12-volt battery and solar panel. It is located on a sand beach south of former Booth Fisheries station concrete foundation at Montreal Point.

5.3 Data Collection

Water level data is collected and published according to the procedures and quality control assurance processes established by Water Survey of Canada. The hourly 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 to applicable standards and includes recognition of the impact of other related environmental and contextual factors.

The data collection process is similar for most gauges located in the Lake Winnipeg Regulation area, including the gauges described in sections 5, 6, 7 and 8 (Playgreen Lake, Kiskittogisu Lake, Nelson River East Channel and Kiskitto Lake).

5.4 Data Analysis

During the 2021 calendar year, the wind eliminated Lake Winnipeg readings were between 711 and 715 feet 100 % of the time.

Figure L-6 shows the wind eliminated lake elevations between January 1, 2021 and December 31, 2021.

6.0 PLAYGREEN LAKE WATER LEVEL

6.1 Water Power Act Licensing Requirements

Section 3.2 (b) of the Water Power Act Final Licence stipulates that:

> *"The Licensee may regulate outflows for power purposes when the wind eliminated water levels are between: (b) Playgreen Lake – maximum 714.9 feet and minimum 707.0 feet, subject, however, to the provisions of Section 72 of the Regulations"*

6.2 Data Collection at Gauge

The elevation of Playgreen Lake is recorded above Whiskey Jack Narrows (05UB704). The gauge is located on the second point on the west shoreline of Playgreen Lake upstream of Whiskey Jack Narrows. A DCP and a pressure transducer powered by a 12-volt battery and solar panel, is housed in a shelter with an antenna. A site map showing the location of the gauge is shown in Figure L-7.

6.3 Data Analysis

During the 2021 calendar year, Playgreen Lake water level readings were in compliance with the licence limits 100 % of the time.

Figure L-8 shows daily average water level readings for Playgreen Lake between January 1, 2021 and December 31, 2021.

7.0 KISKITTOGISU LAKE WATER LEVEL

7.1 Water Power Act Licensing Requirements

Section 3.2 (c) of the Water Power Act Final Licence stipulates that:

> *"The Licensee may regulate outflows for power purposes when the wind eliminated water levels are between: (c) Kiskittogisu Lake – maximum 714.8 feet and minimum 706.0 feet, subject, however, to the provisions of Section 72 of the Regulations"*

7.2 Data Collection at Gauge

Kiskittogisu Lake elevations are recorded at Whiskey Jack Landing (05UB017). A DCP and a pressure transducer powered by a 12-volt battery and solar panel, is housed in a shelter with an antenna.

This gauge is operated by the Hydrometric Section of the Waterway Approvals and Monitoring Department under the terms of the Canada-Manitoba Cost Agreement on Water Quantity Surveys. The Hydrometric Section is responsible for the operation and maintenance of the gauge accompanied by the analysis and distribution of the data. The data is published by Water Survey of Canada in the national HYDAT database. A site map showing the location of the gauge is shown in Figure L-7.

7.3 Data Analysis

During the 2021 calendar year, Kiskittogisu Lake water level readings were in compliance with the licence limits 100 % of the time.

Figure L-9 shows daily average water level readings for Kiskittogisu Lake between January 1, 2021 and December 31, 2021.

8.0 LAKE WINNIPEG OUTFLOW

8.1 WATER POWER ACT LICENSING REQUIREMENTS

Section 3.4 of the Water Power Act Final Licence stipulates that:

> *"The Licensee shall operate Jenpeg Control Structure in such a manner that the combined outflow of water from Lake Winnipeg through the natural and artificial channels at any time shall not be less than 708 cubic metres per second (25,000 cubic feet per second)."*

8.2 DATA COLLECTION AT GAUGES

The total Lake Winnipeg outflow is calculated by combining the Jenpeg total outflow (as measured at the station) with the Nelson River East Channel flow (recorded from the gauge located near Norway House).

The Nelson River East Channel elevation is recorded on Forestry Island west of the village of Rossville and approximately 5.3 km from Fort Island (05UB001). A DCP and a pressure transducer powered by a 12-volt battery and solar panel, is housed in a shelter with an antenna. This elevation is used to calculate the river flow based on rating curves and discharge tables.

This gauge is operated by the Hydrometric Section of the Waterway Approvals and Monitoring Department under the terms of the Canada-Manitoba Cost Agreement on Water Quantity Surveys. The Hydrometric Section is responsible for the operation and maintenance of the gauge accompanied by the analysis and distribution of the data. The data is published by Water Survey of Canada in the national HYDAT database. A site map showing the location of the gauge is shown in Figure L-3.

8.3 DATA ANALYSIS

During the 2021 calendar year, the daily average total outflow from Lake Winnipeg was in compliance with the licence limit 100 % of the time.

Figure L-10 shows the daily average total outflow readings from Lake Winnipeg between January 1, 2021 and December 31, 2021.

9.0 KISKITTO LAKE WATER LEVEL

9.1 Water Power Act Licensing Requirements

Section 3.7of the Water Power Act Final Licence stipulates that:

> *"The Licensee shall operate the Kiskitto Inlet Control Structure and Black Duck Control Structure in such a manner as to regulate water levels in Kiskitto Lake within natural ranges subject to the orders of the Director."*

9.2 Data Collection at Gauge

Kiskitto Lake elevations are recorded on an island in the northeast part of Kiskitto Lake (05UB013). A DCP and a pressure transducer, powered by a 12-volt battery and solar panel housed in a building with an antenna, rain gauge and external temperature gauge. The shelter is located on the northern end of a small island approximately 8 km (5 miles) southwest of the confluence of Kisipachewuk Channel and the West Nelson River.

This gauge is operated by the Hydrometric Section of the Waterway Approvals and Monitoring Department under the terms of the Canada-Manitoba Cost Agreement on Water Quantity Surveys. The Hydrometric Section is responsible for the operation and maintenance of the gauge accompanied by the analysis and distribution of the data. The data is published by Water Survey of Canada in the national HYDAT database. A site map showing the location of the gauge is shown in Figure L-7.

9.3 Data Analysis

For the 2021 calendar year the water levels on Kiskitto Lake were within natural ranges and in compliance with the licence 100 % of the time.

Figure L-11 shows daily average water level readings for Kiskitto Lake between January 1, 2021 and December 31, 2021.

10.0 SYSTEM UPGRADES/CHANGES

Maintenance and construction activities that occurred during the 2021 calendar year include:

Lake Winnipeg Regulation

- Remediation of contaminated soils at 2 Mile and 8 Mile channels

Jenpeg Generating Station

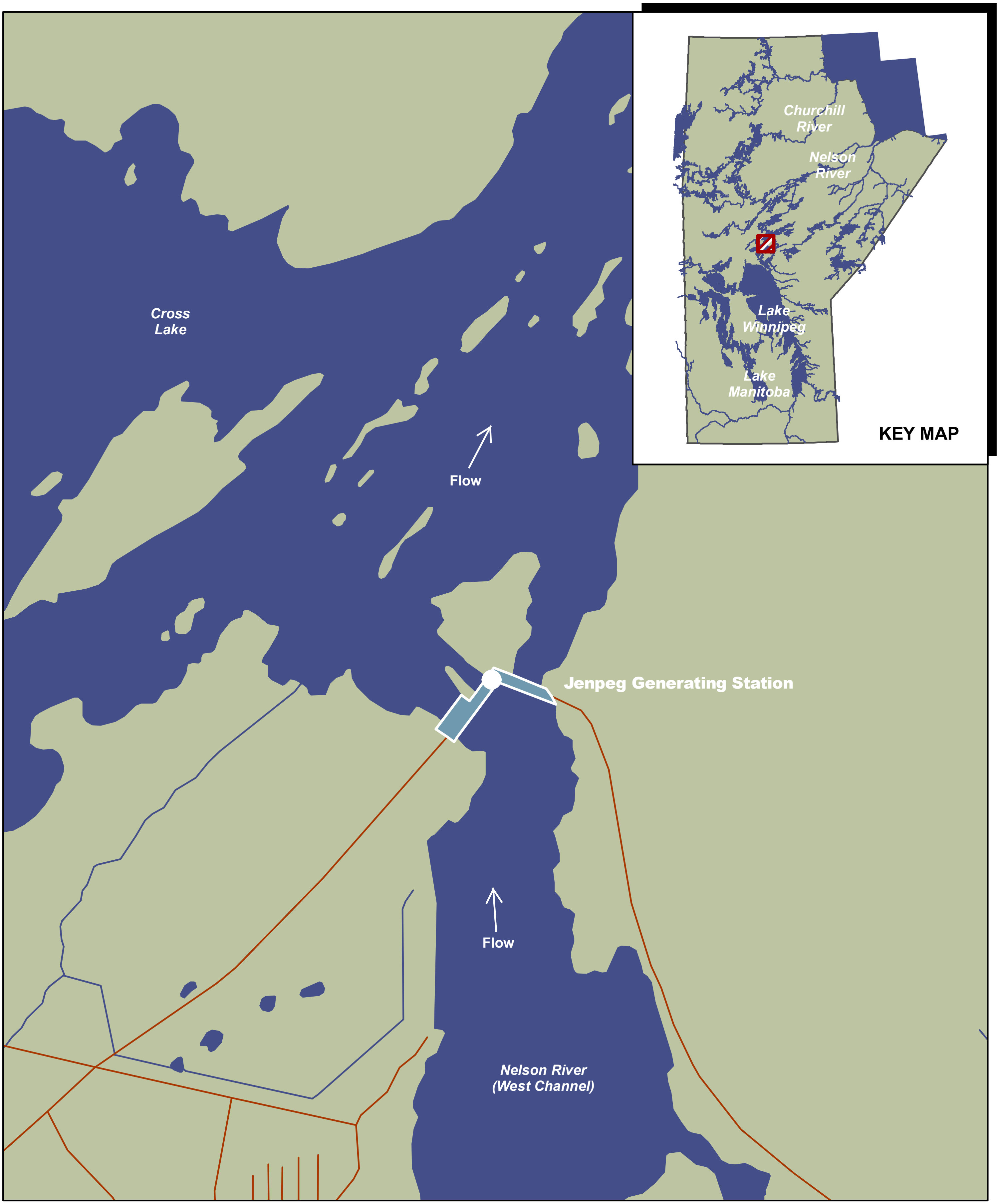
- Replacement of Unit Control & Monitoring systems on Units 3, 4 & 5
- Unit 6 waterhead repair
- Unit 6 GSU refurbishment
- Unit 4 runner trunnion seal replacement
- Sprayed herbicide to clear vegetation on embankment dams
- Repair of potholes and significant concrete deterioration impacting riding surface on intake deck was completed
- Upgraded security infrastructure
- Zebra mussels mitigation upgrades and treatment
- Fish Hatchery Upgrade and Expansion constructed and commissioned with outstanding water quality deficiencies

11.0 DAM SAFETY

Manitoba Hydro operates and maintains the generating station and associated structures at Jenpeg based on the Canadian Dam Association Dam Safety Guidelines. A summary of dam safety activities for 2021 is provided on page L-23.

12.0 CLOSURE

Manitoba Hydro continues to operate Lake Winnipeg Regulation in accordance with the Water Power Act Final Licence for the Regulation of Lake Winnipeg Outflows for Water Power Purposes.



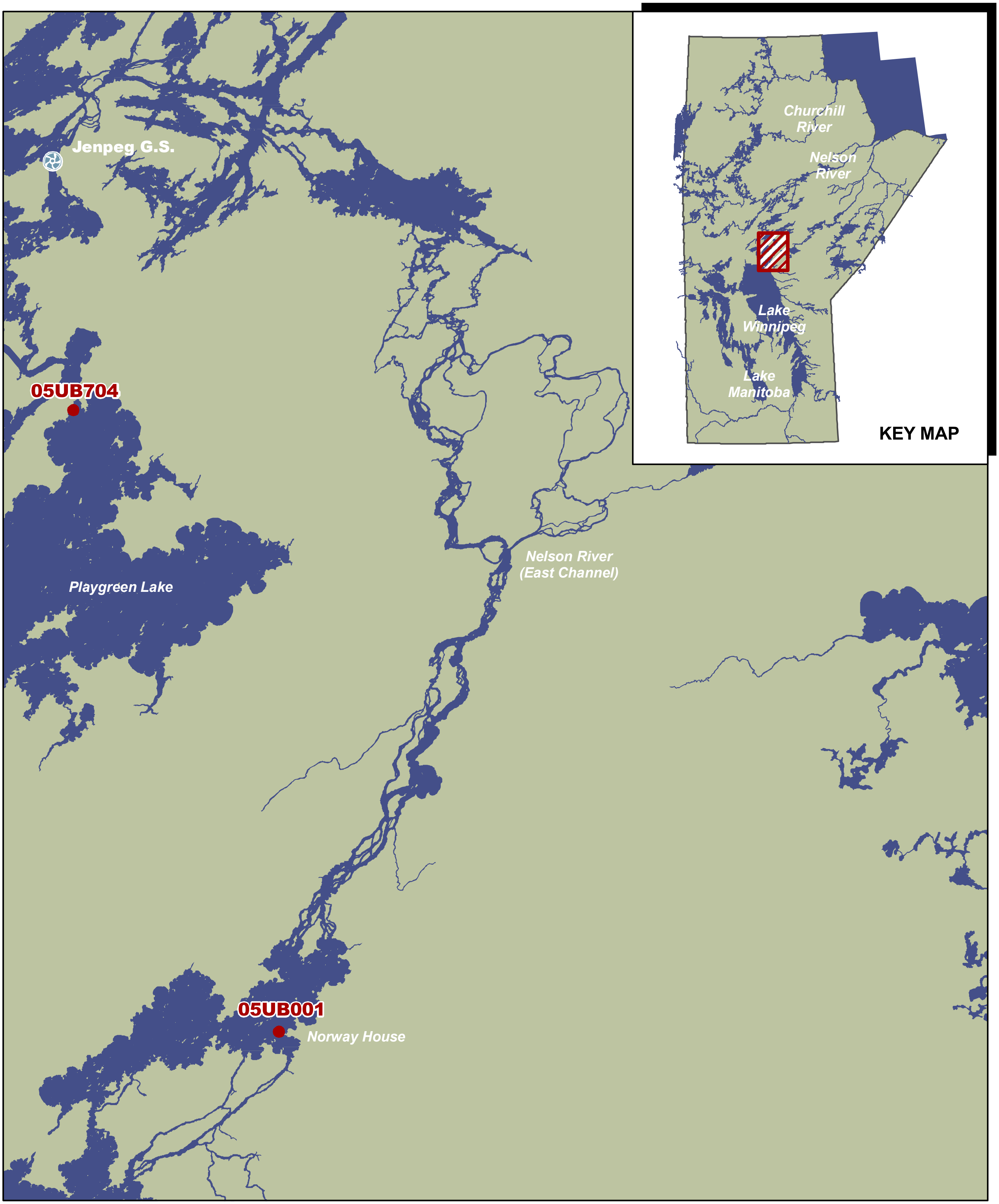
0.5 0.25 0 0.5 km

JENPEG G.S.
GEOGRAPHICAL LOCATION

FIGURE L-1

Generating Station
Dam
Road

Manitoba Hydro	MANITOBA HYDRO
	WATERWAY APPROVALS AND MONITORING
	JENPEG GENERATING STATION
	PHOTOGRAPH OF GENERATING STATION
	PROJECT WATER LEVELS AND FLOWS REPORT — FIGURE L-2



Manitoba Hydro

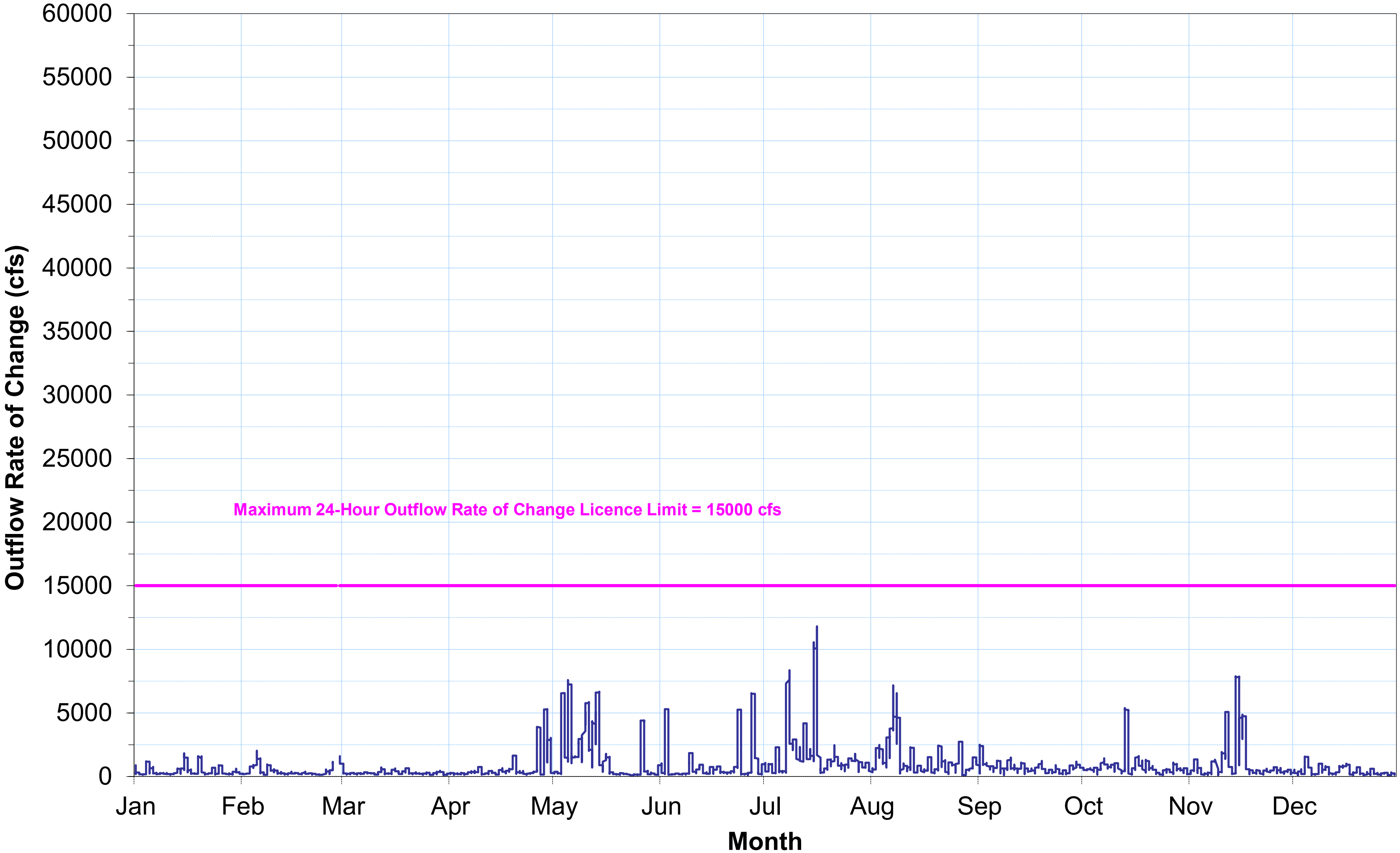
4 2 0 4 km

JENPEG G.S.
GENERAL ARRANGEMENT

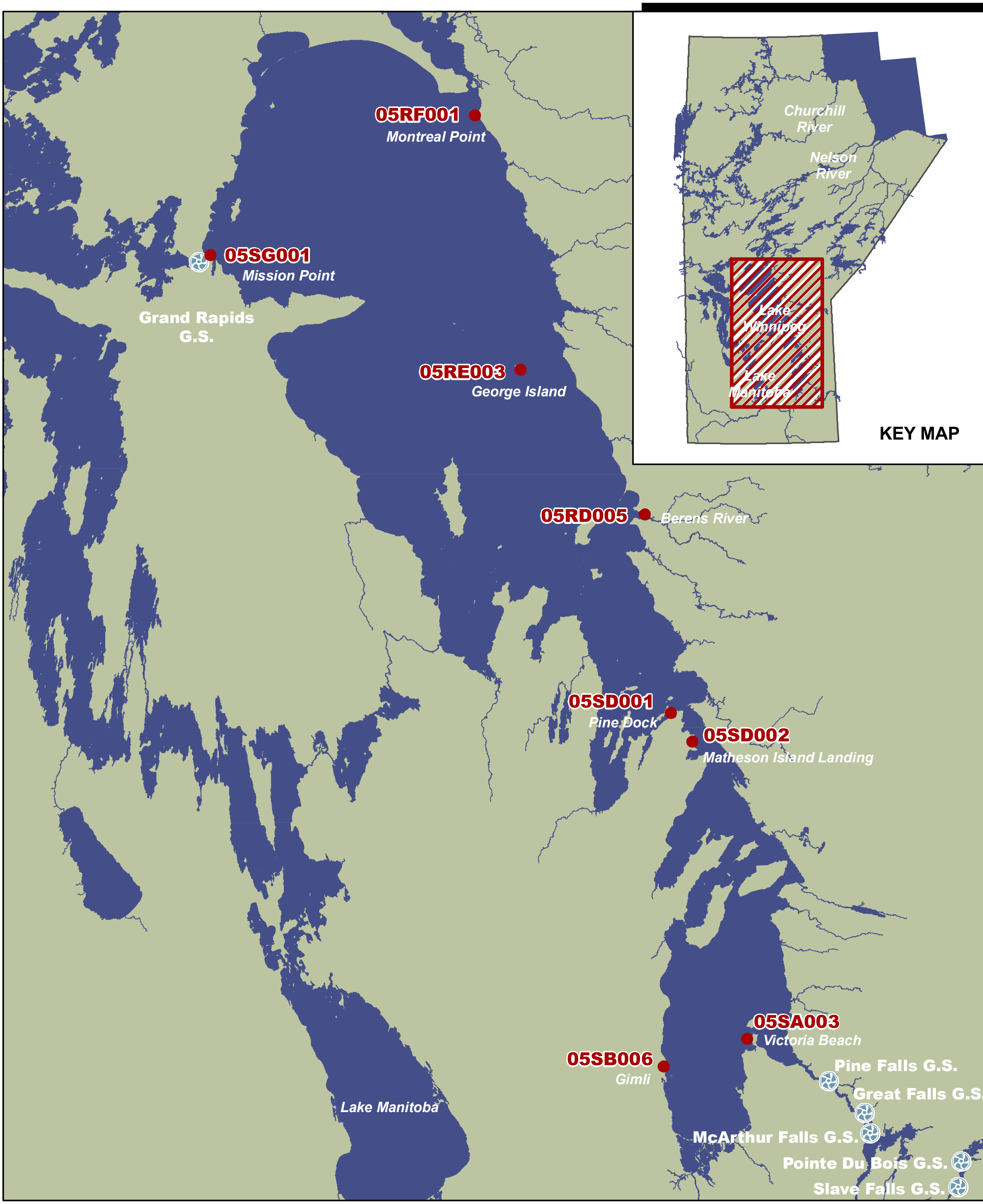
FIGURE L-3

Gauge Location

Generating Station



Manitoba Hydro	MANITOBA HYDRO	
	WATERWAY APPROVALS AND MONITORING	
	JENPEG GENERATING STATION	
	24-HOUR OUTFLOW RATES OF CHANGE (2021)	
	PROJECT Water Levels and Flows Report	FIGURE L-4



Manitoba Hydro

LAKE WINNIPEG
GENERAL ARRANGEMENT

FIGURE L-5

Daily Averaged Lake Elevation Statistics 1977 - 2021

Maximum	**= 716.90 feet**
Minimum	**= 711.39 feet**
Mean	**= 713.70 feet**

MANITOBA HYDRO

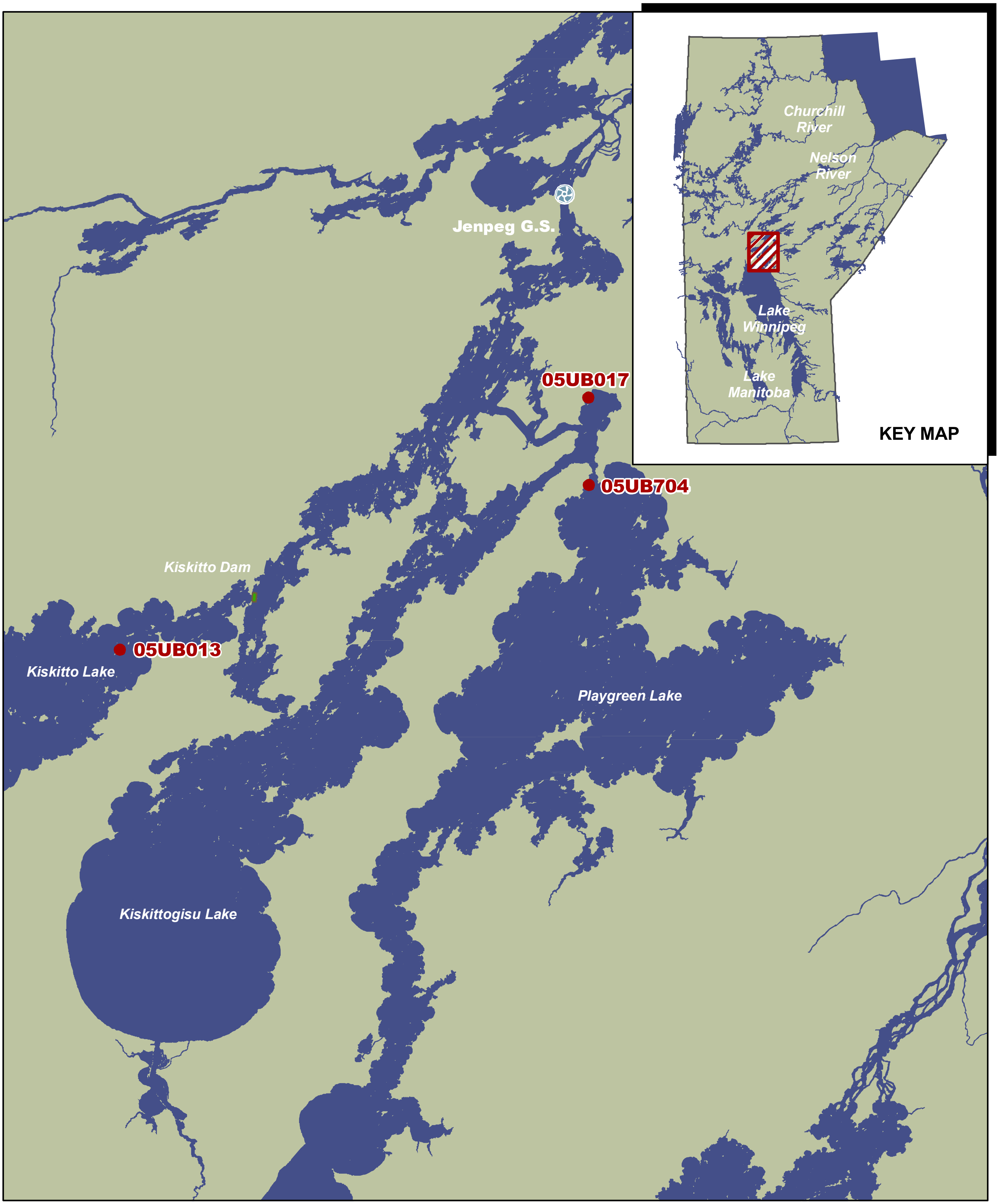
WATERWAY APPROVALS AND MONITORING

LAKE WINNIPEG

WIND ELIMINATED LAKE ELEVATIONS (2021)

PROJECT
Water Levels and Flows Report

FIGURE L-6

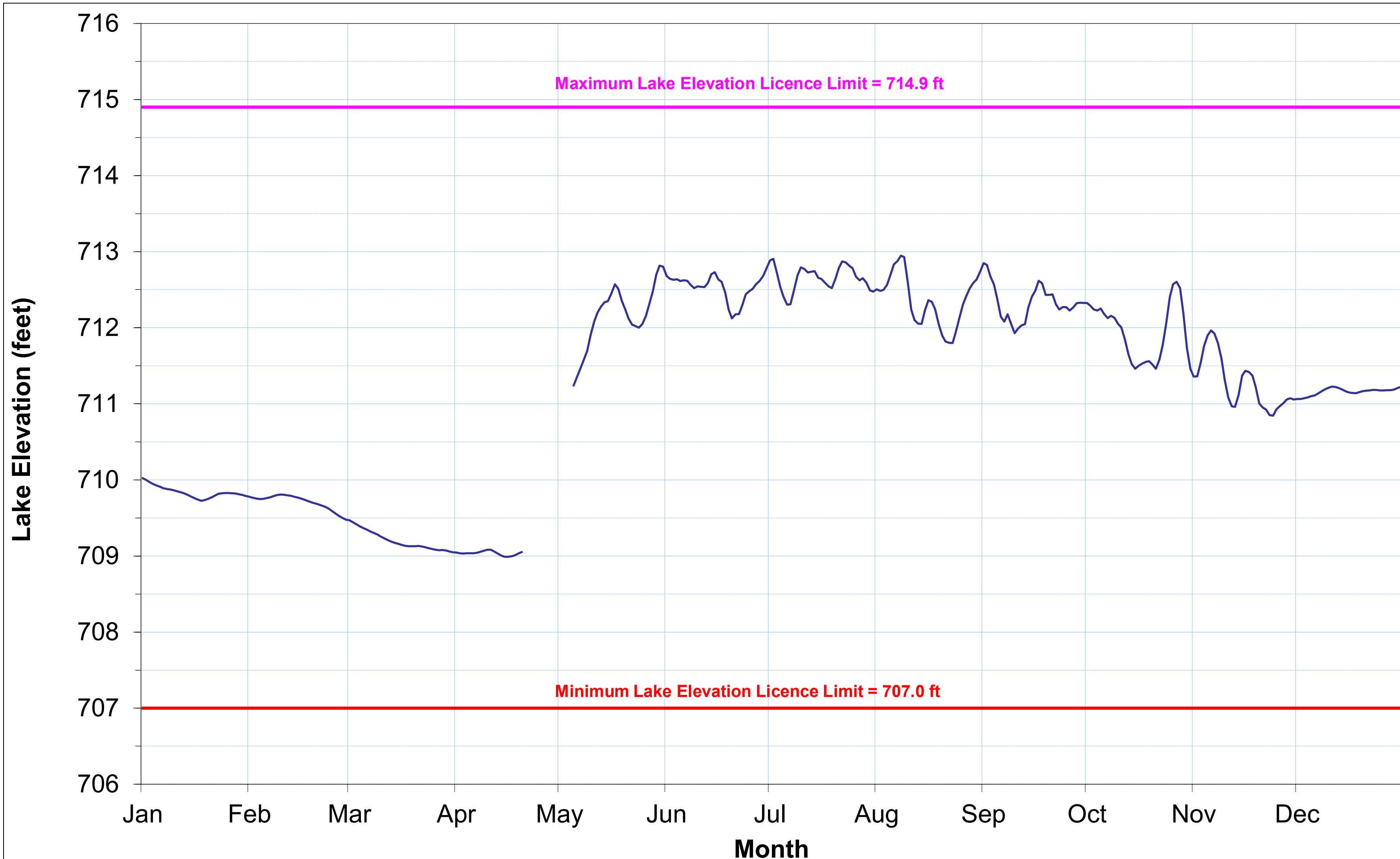


Manitoba Hydro

4 2 0 4 km

PLAYGREEN, KISKITTOGISU, & KISKITTO LAKES
GENERAL ARRANGEMENT
FIGURE L-7

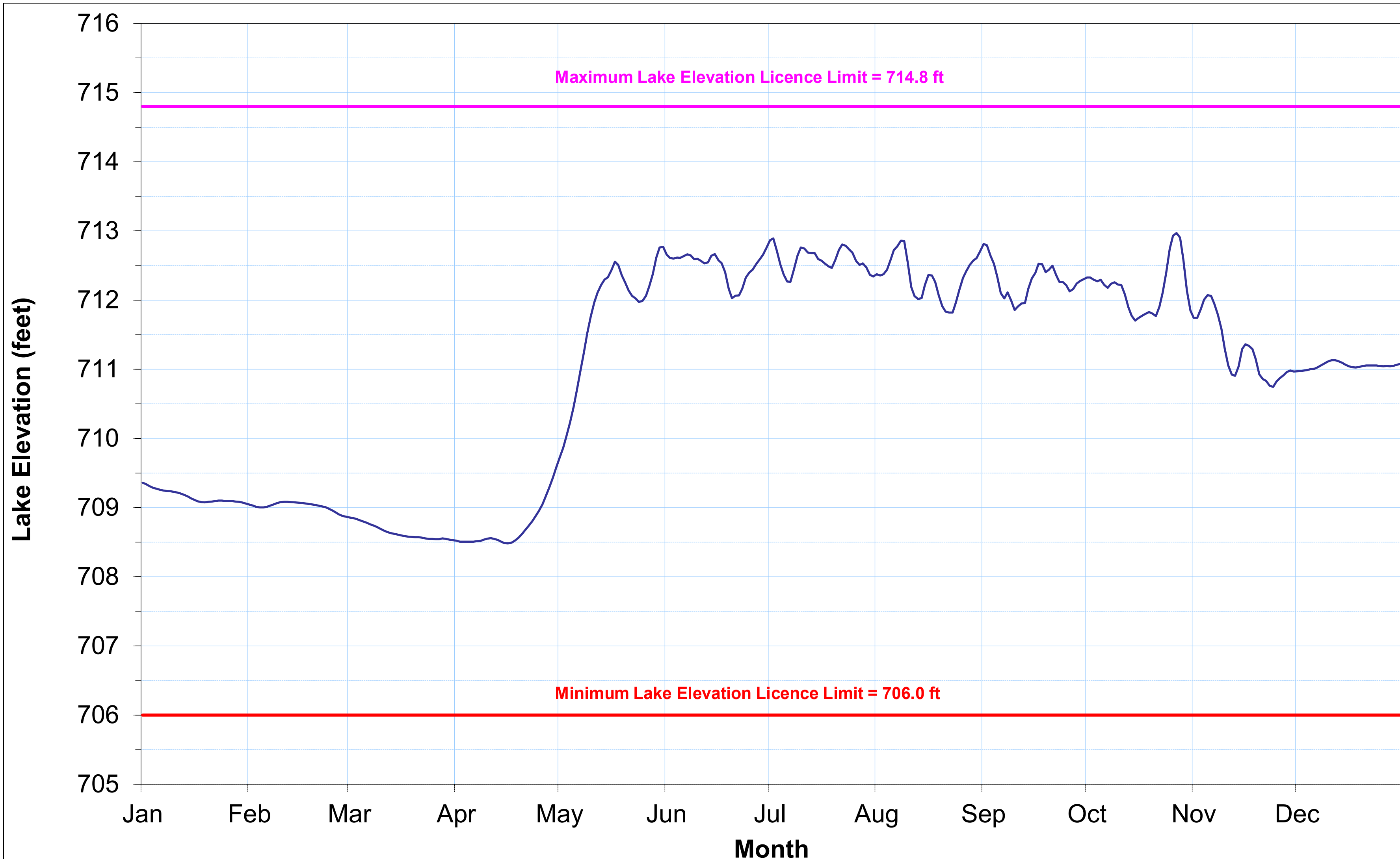
Gauge Location
Generating Station
Control Structure



Daily Averaged Lake Elevation Statistics 1996 - 2021

Maximum	**= 715.1 feet**
Minimum	**= 707.2 feet**
Mean	**= 711.8 feet**

Manitoba Hydro	MANITOBA HYDRO
	WATERWAY APPROVALS AND MONITORING
	PLAYGREEN LAKE
	WIND ELIMINATED LAKE ELEVATIONS (2021)
PROJECT Water Levels and Flows Report	FIGURE L-8



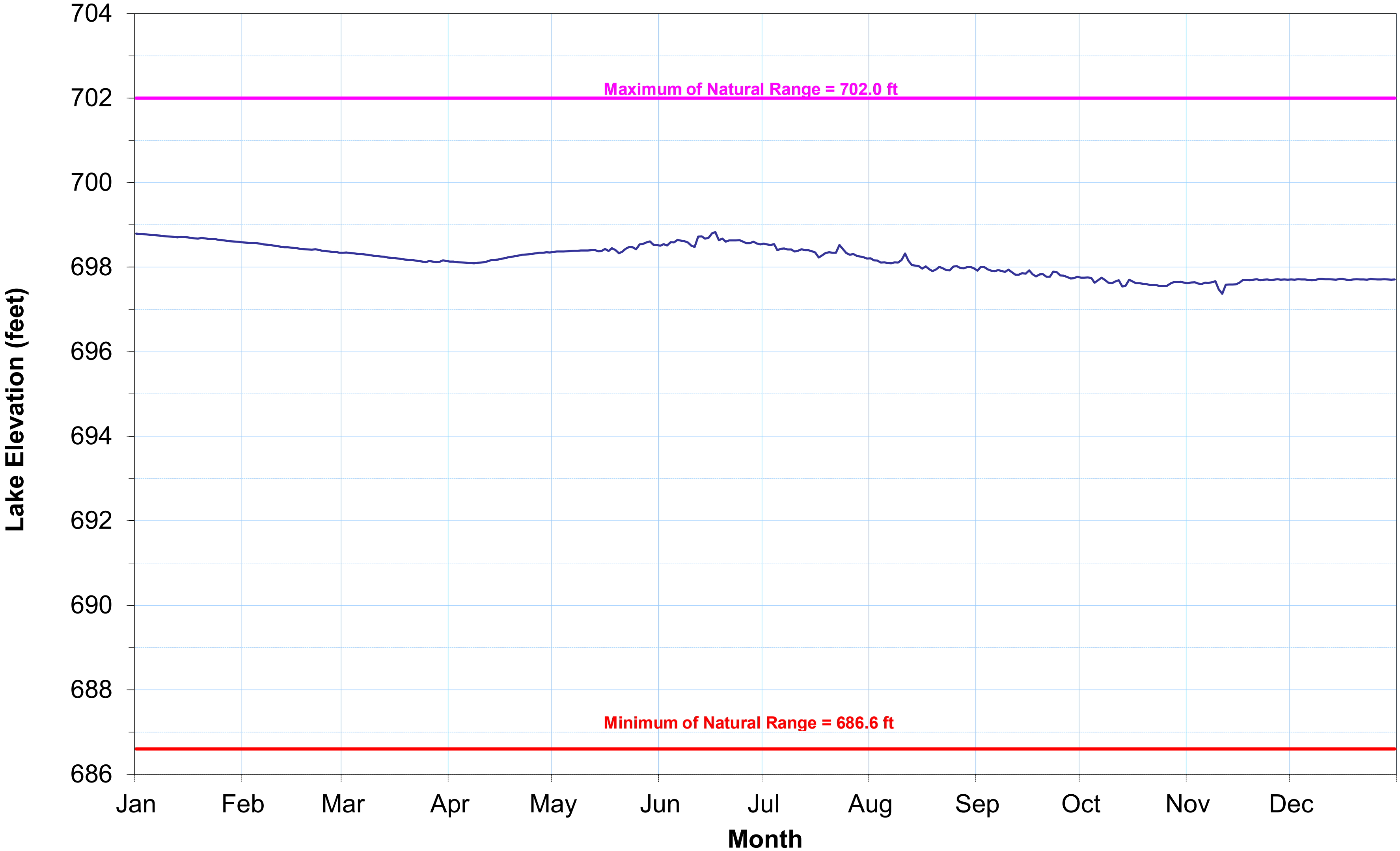
Daily Averaged Lake Elevation Statistics 1987 - 2021

Maximum = 714.9 feet
Minimum = 706.3 feet
Mean = 711.2 feet

	MANITOBA HYDRO
	WATERWAY APPROVALS AND MONITORING
	KISKITTOGISU LAKE
	WIND ELIMINATED LAKE ELEVATIONS (2021)
PROJECT Water Levels and Flows Report	FIGURE L-9

Daily Averaged Lake Outflow Statistics 1978 - 2021
Maximum = 181,081 cfs
Minimum = 22,243 cfs
Mean = 81,216 cfs

Manitoba Hydro	MANITOBA HYDRO
	WATERWAY APPROVALS AND MONITORING
	LAKE WINNIPEG
	DAILY AVERAGE OUTFLOW (2021)
PROJECT Water Levels and Flows Report	FIGURE L-10



Daily Averaged Lake Elevation Statistics 1971 - 2021

Maximum	**= 701.9 feet**
Minimum	**= 694.7 feet**
Mean	**= 698.8 feet**

MANITOBA HYDRO

WATERWAY APPROVALS AND MONITORING

KISKITTO LAKE

DAILY AVERAGE LAKE ELEVATIONS (2021)

PROJECT
Water Levels and Flows Report

FIGURE L-11

Jenpeg GS Dam Safety Activities List

	ACTIVITIES	Performed By	Tasks Completed	Tasks Planned
Inspections	Engineering inspection of embankment dams	Dam Safety	1	1
	Cursory inspection of Kiskitto dikes 6,7,9 and 10	Dam Safety	1	1
	Engineering inspection of Jenpeg GS concrete dams and Kiskitto Inlet Structure	Dam Safety	1	1
	Engineering inspection of Kiskitto Outlet Structure	Dam Safety	1	1
	Routine inspection of Jenpeg GS main dam, east dike, Kiskitto Main dam and dikes 5,6,7,8,9 and 10	Site - Utility	12	12
	Routine inspection of west dike 1	Site - Utility	2	2
	Routine inspection of Kiskitto Lake Outlet Control Structure	Site - Utility	2	2
	Routine inspection of Kiskitto freeboard dikes	Site - Utility	1	1
	Routine inspection of Jenpeg GS concrete dams and Kiskitto Inlet Structure	Site - Utility	6	6
	Spillway inspection	Site - Operating	51	52
	Forebay/tailrace gauge inspection	Site - Operating	8	8
	Verify forebay stillwell level	Site - Operating	4	4
	Verify tailrace stillwell level	Site - Operating	4	4
	Hydraulic conditions inspection	Dam Safety	1	1
Analyses	Instrumentation data review (Embankment Dams)	Dam Safety	14	14
Maintenance and Testing	Spillway gate functional testing	Site - Elec/Mech	5	5 (1 per gate)
	Spillway gas engine - functional gate lift test	Site - Mech	1	1
	Spillway gate hoist maintenance	Site - Elec	5	5 (1 per gate)
	Spillway gate gain heat controller maintenance	Site - Elec	1	1
	Spillway pier heat maintenance	Site - Elec	1	1
	Spillway gate heat maintenance	Site - Elec	5	5 (1 per gate)
	Spillway gate maintenance	Site - Mech	5	5 (1 per gate)
	Spillway gate hoist maintenance	Site - Mech	5	5 (1 per gate)
	Spillway gas engine maintenance	Site - Mech	1	1
	Spillway gas engine test runs	Site - Operating	51	52
	Spillway gas engine maintenance	Mechanical Services	0	1
Program	Dam Safety EPP - updates	Dam Safety	1	1
	Dam Safety Reference Manual - Revision	Dam Safety	-	-
	Delivered DS Training - Routine Inspections	Dam Safety	0	As Required
	Delivered DS Training - Emergency Preparedness	Dam Safety	0	As Required

APPENDIX M

CHURCHILL RIVER DIVERSION WATER POWER ACT LICENCE

1.0 INTRODUCTION

The Churchill River Diversion improves downstream hydropower generation by transferring water from the Churchill River to the Nelson River via the Rat River and the Burntwood River. The Churchill River Diversion was constructed between 1973 and 1977, and consists of the Missi Falls Control Structure, the South Bay Diversion Channel, the Notigi Control Structure, the Manasan Falls Ice Control Structure and the Churchill Weir. The locations of these structures are shown in Figure M-1.

In 2021, Manitoba Hydro operated the Churchill River Diversion in accordance with the Interim Water Power Act Licence issued on May 11, 1973 and then in accordance with the Final Water Power Act Licence after it was issued on May 12. In the late 1970's and early 1980's, a series of test programs were conducted to explore the range of diversion flows that were possible without violating water level targets at Thompson and Nelson House. Following these test programs, annual requests to deviate from terms of the interim licence became standardized and known as the Augmented Flow Program (AFP). Approval for the AFP for January 1 to May 11 of the 2021 calendar year was authorized by the Deputy Minister of Conservation and Climate in a letter dated April 21, 2020, which is included in this appendix. The Final Water Power Act Licence includes the annual requested AFP changes so the annual approval is no longer required.

2.0 PROJECT DESCRIPTION

The Churchill River Diversion includes: control dams at the natural outlets of Southern Indian Lake at Missi Falls, an excavated diversion channel from South Bay on Southern Indian Lake to Issett Lake, control dams on the Rat River four miles downstream from Notigi Lake, and all necessary machinery and equipment required to store and divert water for the development of water power. The Manasan Falls Ice Control Structure was constructed to reduce the possibility of ice jamming at Thompson. The Churchill Weir was constructed to increase the reliability of the potable water supply to the town of Churchill, as well as to enhance recreation and aquatic habitat.

More particularly, the Churchill River Diversion project consists of the following:

- The Missi Falls Control Structure regulates the amount of water allowed to pass down the Churchill River and consists of six spillway bays as well as earth dams and dikes. The control structure is capable of discharging 3,200 m^3/s at a forebay level of 258.32 m. Major components include the spillway control structure, south channel dam, north channel dam, main dam, and south dike. The site is located in 13-96-5 WPM at the Southern Indian Lake outlet into the Churchill River. Electrical power required for the operation of this control structure is supplied by the house unit authorized under the Missi Falls Site Water Power Act licence.

- The South Bay Diversion Channel diverts water from the South Bay of Southern Indian Lake to Issett Lake. The channel is approximately 61 m wide at its base and 9.3 km long.

- The Notigi Control Structure regulates the amount of water diverted to the Nelson River. Major components consist of the spillway with three bays, an adjacent electrical service substation building, main dam and a saddle dam. The control structure is capable of discharging 1869 m^3/s at a forebay elevation of 258.32 m. The structure is located on the Rat River between Notigi Lake and Wapisu Lake in 19-79-12 WPM.

- The Manasan Falls Ice Control Structure is a passive control structure designed to reduce the risk of inundation due to ice in the City of Thompson. The project consists of an ice boom across the river upstream of a groin/gap structure, a by-pass channel with a concrete overflow weir and a flood channel protected with a fuse plug dike. The project is located in 36-77-4 WPM on the Burntwood River and was constructed in three stages between 1975 and 1988/89.

- The Churchill Weir was designed to increase water levels on the Churchill River to ensure a potable water source and to enhance recreation and aquatic habitat. The structure was built 10 km south of the Town of Churchill, just upstream of Mosquito Point. The structure consists of an overflow section and two dike sections. The overflow section is 2,300 m long with a 300 m fishway segment at the lowest point of the weir. The west dike is 140 m long and the east dike is 1,170 m long. Incorporated into the east dike are the Goose Creek fishway and an emergency flood relief section.

3.0 SOUTHERN INDIAN LAKE

3.1 WATER POWER ACT LICENSING REQUIREMENTS

3.1.1 Maximum Water Level

Section 3.2 of the Water Power Act Final Licence stipulates that:

> *"Subject to Section 3.4 of this Final Licence, and except as may be otherwise authorized by the Minister, the Licensee shall, during periods when the water level of Southern Indian Lake is above elevation 258.32 metres (847.5 feet) ASL, operate the Missi Falls and Notigi Control Structures in such a manner as to effect the maximum discharge possible under the circumstances then prevailing until the water level of*

Southern Indian Lake recedes to elevation 258.32 metres (847.5 feet) ASL."

3.1.2 Minimum Water Level

Section 3.3 of the Water Power Act Final Licence stipulates that:

> *"Subject to Section 3.5 of this Final Licence, and except as may be otherwise authorized by the Minister, the Licensee shall regulate the outflow from Southern Indian Lake so as to prevent the water level from receding below elevation 256.95 metres (843.0 feet) ASL."*

3.1.1 Maximum Lake Drawdown

Section 3.6(b) of the Water Power Act Final Licence stipulates that:

> *"Subject to Sections 3.3 and 3.4 of this Final Licence, but notwithstanding any other terms or conditions of this Final Licence, the Licensee shall operate the Missi Falls and Notigi Control Structures in such a manner that:*
> *(b) The maximum drawdown on Southern Indian Lake of 1.37 metres (4.5 feet) be staged over a period of time and in such a manner so as to minimize adverse impacts on Southern Indian Lake residents."*

3.2 DATA COLLECTION AT GAUGES

Four Water Survey of Canada water level gauging sites at various locations on Southern Indian Lake are used for calculating the lake's elevation. A map showing the locations of the gauges is shown on Figure M-2.

The Southern Indian Lake elevations at Opachuanau Lake (06EC007) are recorded by a data logger and a pressure transducer that is located in a shelter with a directional antenna. Real-time data is obtained by the data logger unit that is powered by a 12-volt battery, a voltage regulator and solar panel. The station is located in a small bay on the right bank of the Churchill River at the entrance to Southern Indian Lake (or exit of Opachuanau Lake).

The Southern Indian Lake elevations at South Bay (06EC003) are recorded by a data logger and a pressure transducer that is located in a shelter with a directional antenna. Real-time data is obtained by the unit that is powered by a 12-volt battery, a voltage regulator and solar panel. The station is located in the south-west corner of South Bay near the mouth of the diversion channel.

The Southern Indian Lake elevations at South Indian Lake (06EC001) are recorded by a data logger and a pressure transducer that is located in a shelter with a directional antenna. Real-time data is obtained by the unit that is powered by a 12-volt battery, a voltage regulator and solar panel. The station is located on the west side of a small island west of South Indian Lake.

The Southern Indian Lake elevations at Missi Falls (06EC006) are recorded by a data logger and a pressure transducer that is located in a shelter with a directional antenna. Real-time data is obtained by the unit that is powered by a 12-volt battery, a voltage regulator and solar panel. The station is located approximately 2 kilometres to the south-west of Missi Control Structure at the south end of the rock quarry and the north side of the old campsite.

The elevations from the above four locations are used to calculate a mean elevation and further processed using a 7-day moving mean to determine the wind-effect eliminated water level on Southern Indian Lake.

3.3 DATA ANALYSIS

For the 2021 calendar year, all water level readings were within the licence limits. Figure M-3 shows the wind eliminated water levels for SIL between January 1, 2021 and December 31, 2021.

The maximum drawdown from 847.5 feet (258.32 m) on SIL for the 2021 calendar year was 2.68 feet (0.82 m), 1.82 feet (0.55 m) less than the licence limit of 4.5 feet (1.37 m). Figure M-4 shows the maximum drawdown on the lake during 2021.

The peak water level on Southern Indian Lake was 847.44 feet (258.30 m) July 8, 2020. The subsequent minimum water level was 844.76 feet (257.48 m) on May 8, 2021. The drawdown of 2.68 feet (0.82 m) was staged over 304 days.

4.0 NOTIGI CONTROL STRUCTURE

4.1 PROJECT DESCRIPTION

Notigi Control Structure was built between 1974 and 1975 and is located on the Rat River between Notigi Lake and Wapisu Lake. It regulates the amount of water diverted to the Nelson River. The structure consists of three spillway bays, an adjacent electrical substation building and earth dams. The geographical location of the structure is shown in Figure M-5. A photograph of the station is shown in Figure M-6. Tables M-1 and M-2 summarize the general parameters of the Notigi Control Structure.

Table M-1: Construction Specifications and Operating Parameters of the Notigi Control Structure

Construction Period	1974 -1975
Maximum Licenced Average Weekly Outflows (AFP)	Open Water: 35,000 cfs (991.1 m^3/s) Ice Cover: 34,000 cfs (962.8 m^3/s)
Minimum Licenced Notigi Forebay Elevation	834.0 ft (254.2 m)
Normal Forebay Water Level	254.2 m to 258.3 m

Table M-2: Principal Structures for the Notigi Control Structure

Spillway	Number of Bays	Spillway with 3 bays
	Total Length	48.8 m
	Discharge Capacity (at reservoir elevation 258.3 m)	1,870 m^3/s
Earth and Rockfill Structures	Material	Main Dam: Rockfill Saddle Dam: Plastic Clay
	Crest Elevation (at design)	261.5 m
	Available Freeboard (at reservoir elevation 258.3 m)	3.2 m

The Notigi Control Structure is not normally manned. Operation of the spillway gates is directed by the Energy Supply Planning Department, with operations staff from Thompson traveling to Notigi to operate the gates as required.

In order to divert water from Southern Indian Lake, the Notigi forebay is routinely operated at a level which is below the Southern Indian Lake level.

4.2 Water Power Act Licensing Requirements

4.2.1 Maximum Outflow

Section 3.4 of the Water Power Act Final Licence stipulates that:

> *"(a) Between May 16th and October 31st the Licensee shall not release more than an average weekly flow of 991 cubic metres per second (35,000 cubic feet per second) through the Notigi Control Structure and shall vary the magnitude of the release through that*

structure from time to time so that the flow in the Burntwood River does not cause the water level at the Thompson Sea Plane Base to rise above 188.67 metres (619.0 feet) ASL.
(b) Between November 1st and May 15th the Licensee shall not release more than an average weekly flow of 963 cubic metres per second (34,000 cubic feet per second) through the Notigi Control Structure and shall vary the magnitude of the release through that structure from time to time so that the flow in the Burntwood River does not cause the water level at the Thompson Pumphouse to rise above 189.89 metres (623.0 feet) ASL."

4.2.2 Maximum Daily Flow Change

Section 3.6(a) of the Water Power Act Final Licence stipulates that:

> *"Subject to Sections 3.3 and 3.4 of this Final Licence, but notwithstanding any other terms or conditions of this Final Licence, the Licensee shall operate the Missi Falls and Notigi Control Structures in such a manner that:*
> *(a) Any increase or decrease in the rate of outflow through either structure during any calendar day shall not exceed 280 cubic metres per second (10,000 cubic feet per second)"*

4.2.3 Minimum Forebay Level

Section 3.6(c) of the Water Power Act Final Licence stipulates that:

> *"Subject to Sections 3.3 and 3.4 of this Final Licence, but notwithstanding any other terms or conditions of this Final Licence, the Licensee shall operate the Missi Falls and Notigi Control Structures in such a manner that:*
> *(c) The minimum water level immediately upstream of the Notigi Control Structure shall not be less than elevation 254.20 metres (834.0 feet) ASL"*

4.3 DATA COLLECTION AT GAUGES

4.3.1 Notigi Control Structure

The total outflow from Notigi is calculated using a number of equations that take into account the elevation of the forebay, number of spillway gates open, and their level of operation.

The forebay level at Notigi is calculated from the absolute position of the float in the still well as measured by a synchro transmitter mounted on top of the still well. This position is sent to a digital meter which displays the water level in feet. The signal is transmitted to Manitoba Hydro's System Control Centre to monitor water levels. Gate openings are also monitored electronically and transmitted along with the forebay water level to Manitoba Hydro's database, where outflows are calculated based on rating curves and discharge tables. A site map showing the location of the gauge is shown in Figure M-7.

4.3.2 Thompson Pumphouse and Seaplane Base

The Water Survey of Canada water level gauge (05TG001) is located in a shelter near the Thompson Pumphouse. Records are obtained by using a data logger with a transducer. A site map showing the location of the Thompson Pumphouse gauge is shown in Figure M-8.

The Manitoba Hydro water level gauge (05TG702) is located in a shelter at the Thompson seaplane base downstream of Miles Hart Bridge. Records are obtained by a data logger with a pressure transducer. A site map showing the location of the Seaplane Base gauge is shown in Figure M-9.

4.4 Data Analysis

For the 2021 calendar year, average weekly outflows at Notigi were below the maximum licence limit for all weeks. Figure M-10 shows the average weekly outflows at the Notigi Control Structure for week ending on Sunday between January 1, 2021 and December 31, 2021.

For the 2021 calendar year, all the elevations at Thompson Pumphouse and Seaplane Base were within the licence limits. Figure M-11 and M-12 show the daily average water levels recorded between January 1, 2021 and December 31, 2021.

For the 2021 calendar year, Manitoba Hydro was compliant with the Notigi outflow rate of change limit 100 % of the time. Figure M-13 shows the daily outflow rates of change for the Notigi Control Structure between January 1, 2021 and December 31, 2021.

For the 2021 calendar year, all Notigi forebay elevations were above the minimum licence limit. Figure M-14 shows daily average water levels for the Notigi Control Structure forebay between January 1, 2021 and December 31, 2021.

5.0 MISSI FALLS CONTROL STRUCTURE

5.1 Project Description

The Missi Falls Control Structure, built between 1973 and 1976, is located at the outlet of Southern Indian Lake into the Churchill River, 170 km north of Thompson. This structure regulates the amount of water allowed to pass down the Churchill River at the natural outlet from Southern Indian Lake. Missi Falls consists of six spillway bays and electrical services building containing a house unit, diesel generator, and service shop facilities. The geographical location of the structure is shown in Figure M-15. A photograph of the station is shown in Figure M-16 and the general arrangement is shown in Figure M-17. Tables M-3 and M-4 summarize the general parameters of the Missi Falls Control Structure.

Table M-3: Construction Specifications and Operating Parameters of the Missi Falls Control Structure

Construction Period	1973 -1976
Waterfall Drop (head)	6.1 m
Maximum 24 hour Outflow Rate of Change	10,000 cfs (283.2 m^3/s)
Minimum Licenced Outflow	Open Water: 500 cfs (14.2 m^3/s) Ice Cover: 1,500 cfs (42.5 m^3/s)
Normal Forebay Water Level	256.9 m to 258.3 m

Table M-4: Principal Structures for the Missi Falls Control Structure

House Unit	Number of Units	1
	Discharge Capacity (at full gate)	6.7 m^3/s
	Power Production	400 kW
Spillway	Number of Bays	Spillway with 6 bays
	Total Length	94.5 m
	Discharge Capacity (at full supply level*)	3,200 m^3/s
Dams and Dikes	Material	North Channel Dam: Rockfill and granular fill South Channel Dam: Granular fill and silty sand Main Dike: Rockfill and granular fill South Dike: Rockfill and granular fill
	Crest Elevation (at design)	North Channel Dam: 262.1 m South Channel Dam:261.5 m Main Dike: 261.2 m South Dike: 262.1 m
	Available Freeboard (at full supply level*)	North Channel Dam: 3.8 m South Channel Dam:3.2 m Main Dike: 2.9 m South Dike: 3.8 m

*Full Supply Level is 258.3 m measured at the spillway structure.

The Missi Falls Control Structure is not normally manned. Operation of the spillway gates is directed by the Energy Supply Planning Department, with operations staff from Thompson being dispatched to Missi Falls to operate the gates as required. Operations of the spillway gates occur at least six times a year, generally in the spring and fall.

5.2 WATER POWER ACT LICENSING REQUIREMENTS

5.2.1 Minimum Outflow

Section 3.5 of the Water Power Act Final Licence stipulates that:

> *"Releases from Missi Falls Control Structure shall not be less than 14 cubic metres per second (500 cubic feet per second) during the open water period and 42 cubic metres per second (1,500 cubic feet per second) during the ice cover period. Such greater releases as may be required for the needs of downstream interests shall be released as ordered by the Minister."*

5.2.2 Maximum Daily Flow Change

Section 3.6(a) of the Water Power Act Final Licence stipulates that:

> *"Subject to Sections 3.3 and 3.4 of this Final Licence, but notwithstanding any other terms or conditions of this Final Licence, the Licensee shall operate the Missi Falls and Notigi Control Structures in such a manner that:*
> *(a) Any increase or decrease in the rate of outflow through either structure during any calendar day shall not exceed 280 cubic metres per second (10,000 cubic feet per second)"*

5.3 DATA COLLECTION AT GAUGE

The total outflow from Missi is calculated using a number of equations that take into account the elevation of Southern Indian Lake upstream from the control structure, spillage, and house unit discharge.

The elevation of Southern Indian Lake upstream from the Missi Falls Control Structure is recorded at gauge 06EC006, described in Section 3.2. These elevations are used to calculate outflows based on rating curves and discharge tables. A site map showing the location of the gauge is shown in Figure M-2.

5.4 Data Analysis

For the 2021 calendar year, the hourly total outflow at Missi Falls Control Structure was more than the minimum licence requirement during winter and open water season. Figure M-18 shows the hourly total outflow readings at Missi Falls between January 1, 2021 and December 31, 2021.

For the 2021 calendar year, Manitoba Hydro was compliant with the Missi Falls outflow rate of change limit 100 % of the time. Figure M-19 shows the daily outflow rates of change at Missi Falls between January 1, 2021 and December 31, 2021.

6.0 SYSTEM UPGRADES/CHANGES

Maintenance and construction activities that occurred during the 2021 calendar year include:

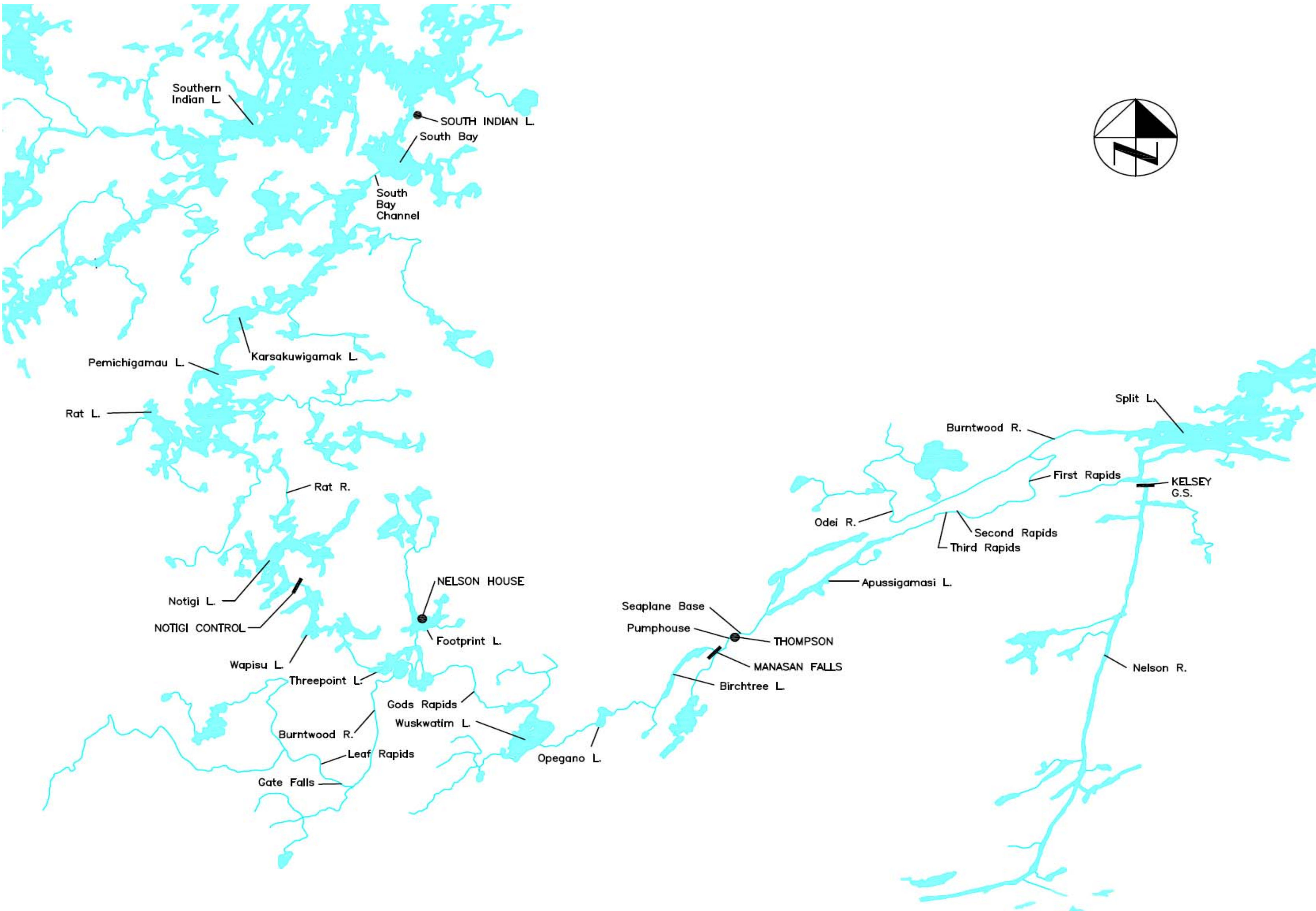
- Missi Falls Accommodations staff house replacement

7.0 DAM SAFETY

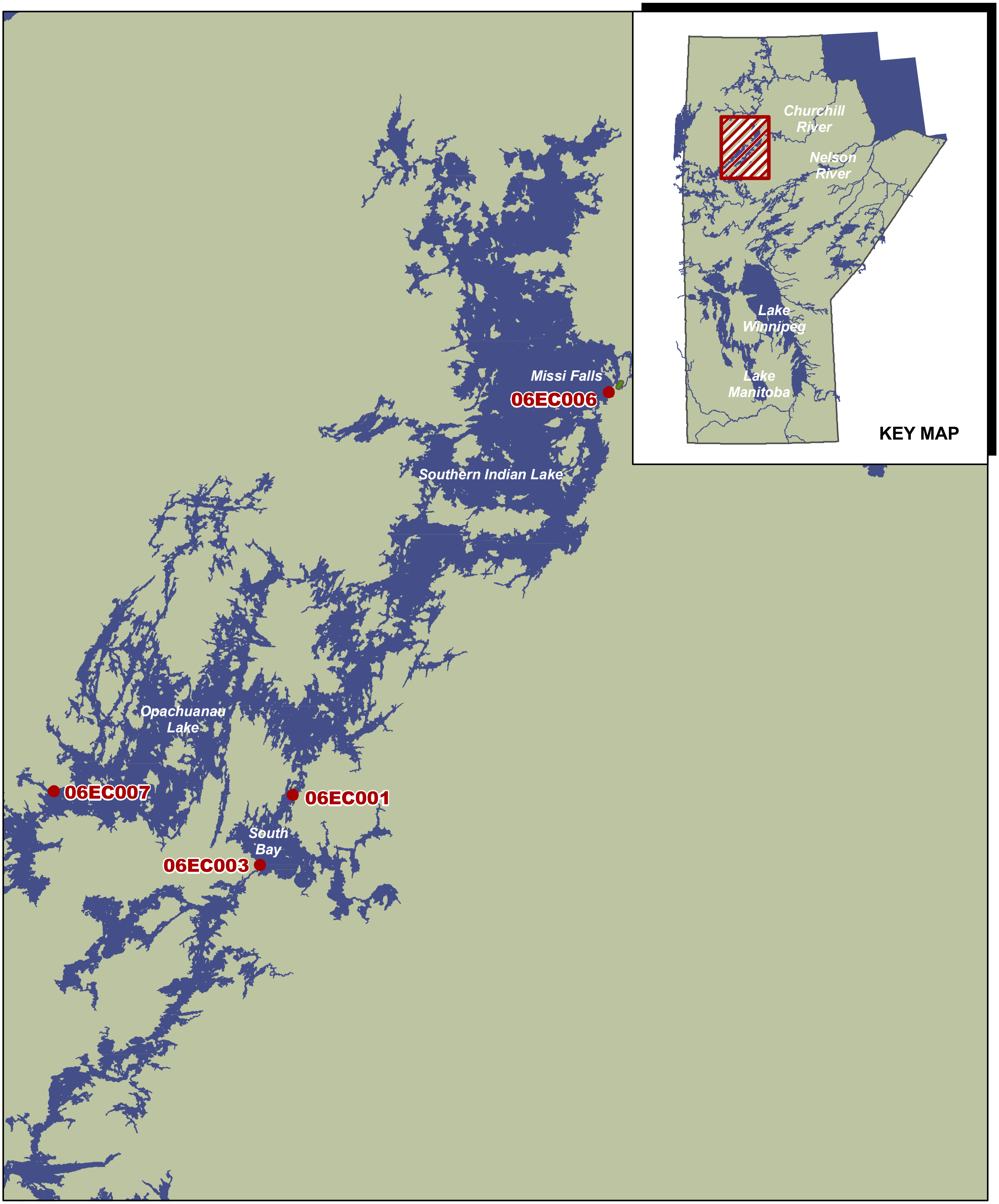
Manitoba Hydro operates and maintains the Churchill River Diversion and associated structures at Notigi and Missi Falls based on the Canadian Dam Association Dam Safety Guidelines. A summary of dam safety activities for 2021 is provided on pages M-34 and M-35.

8.0 CLOSURE

Manitoba Hydro continues to operate the Churchill River Diversion in accordance with the Water Power Act Final Licence for the diversion of water from the Churchill River to the Nelson River for power production.



Manitoba Hydro	MANITOBA HYDRO
	WATERWAY APPROVALS AND MONITORING
	CHURCHILL RIVER DIVERSION
	SITE PLAN
	PROJECT WATER LEVELS AND FLOWS REPORT — FIGURE M-1



Manitoba Hydro

9 4.5 0 9 km

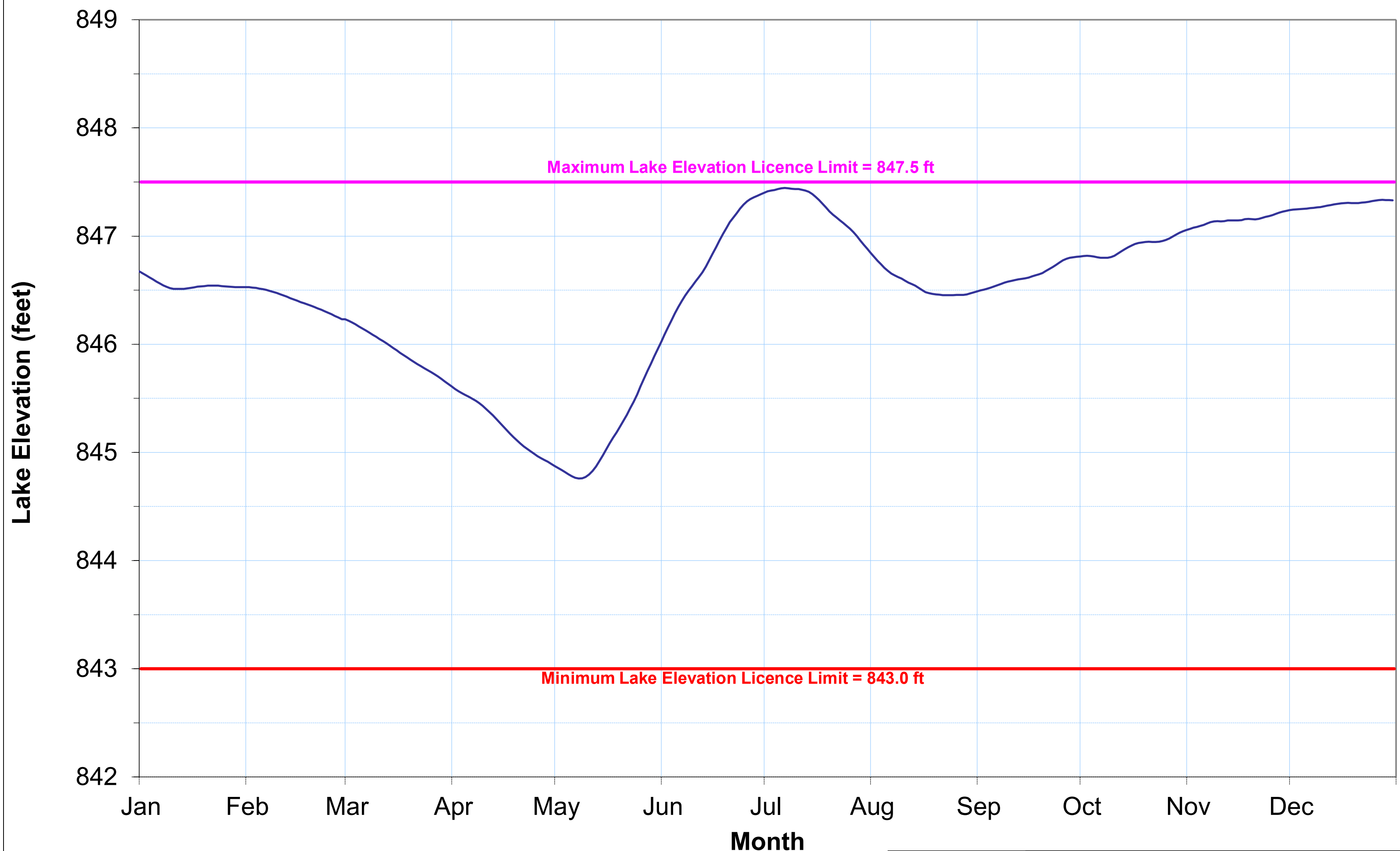
N

SOUTHERN INDIAN LAKE
GENERAL ARRANGEMENT

FIGURE M-2

Gauge Location

Control Structure



<u>Daily Averaged Elevation Statistics 1977 - 2021</u>

Maximum	**= 848.23 feet**
Minimum	**= 842.84 feet**
Mean	**= 845.72 feet**

MANITOBA HYDRO

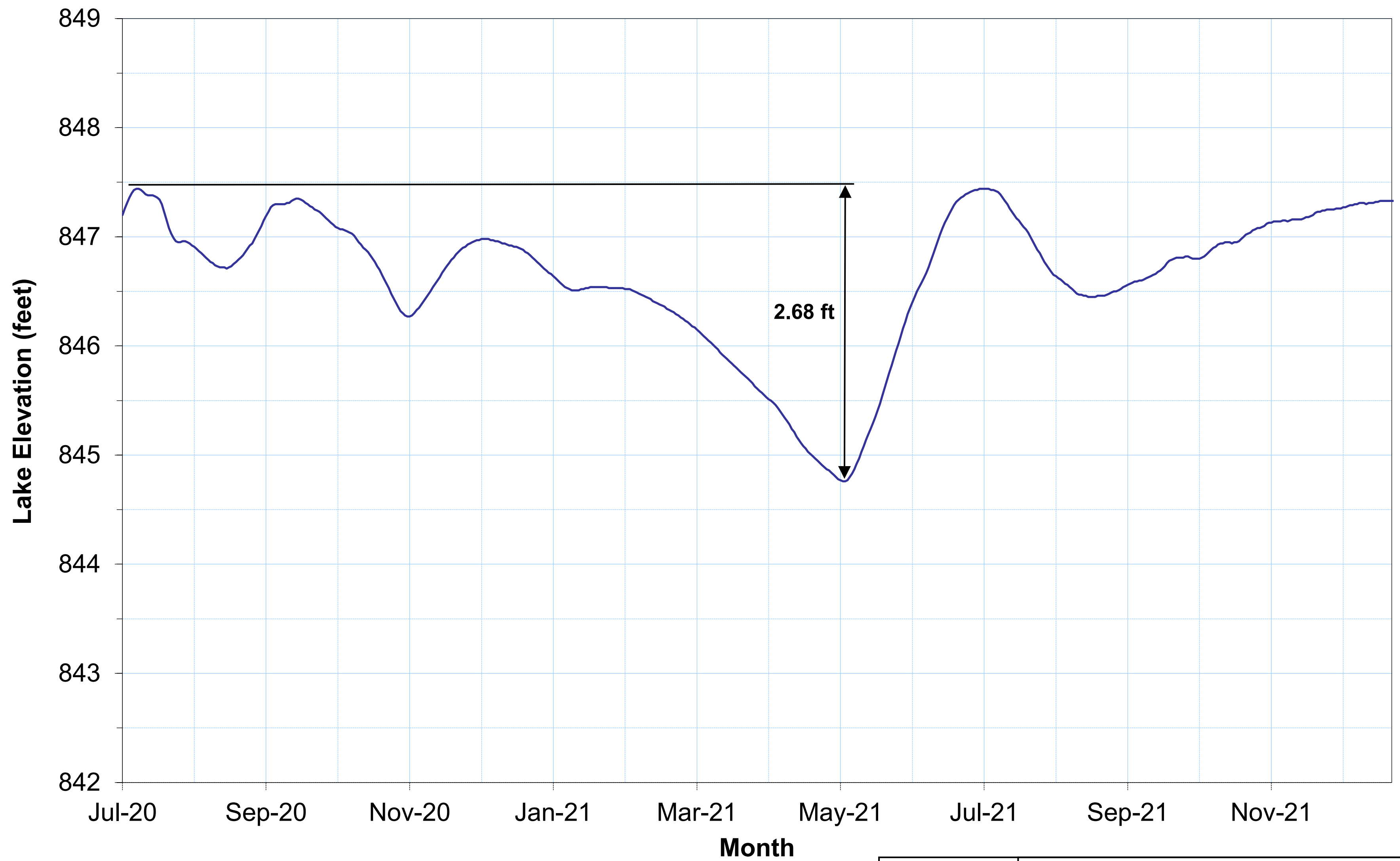
WATERWAY APPROVALS AND MONITORING

SOUTHERN INDIAN LAKE

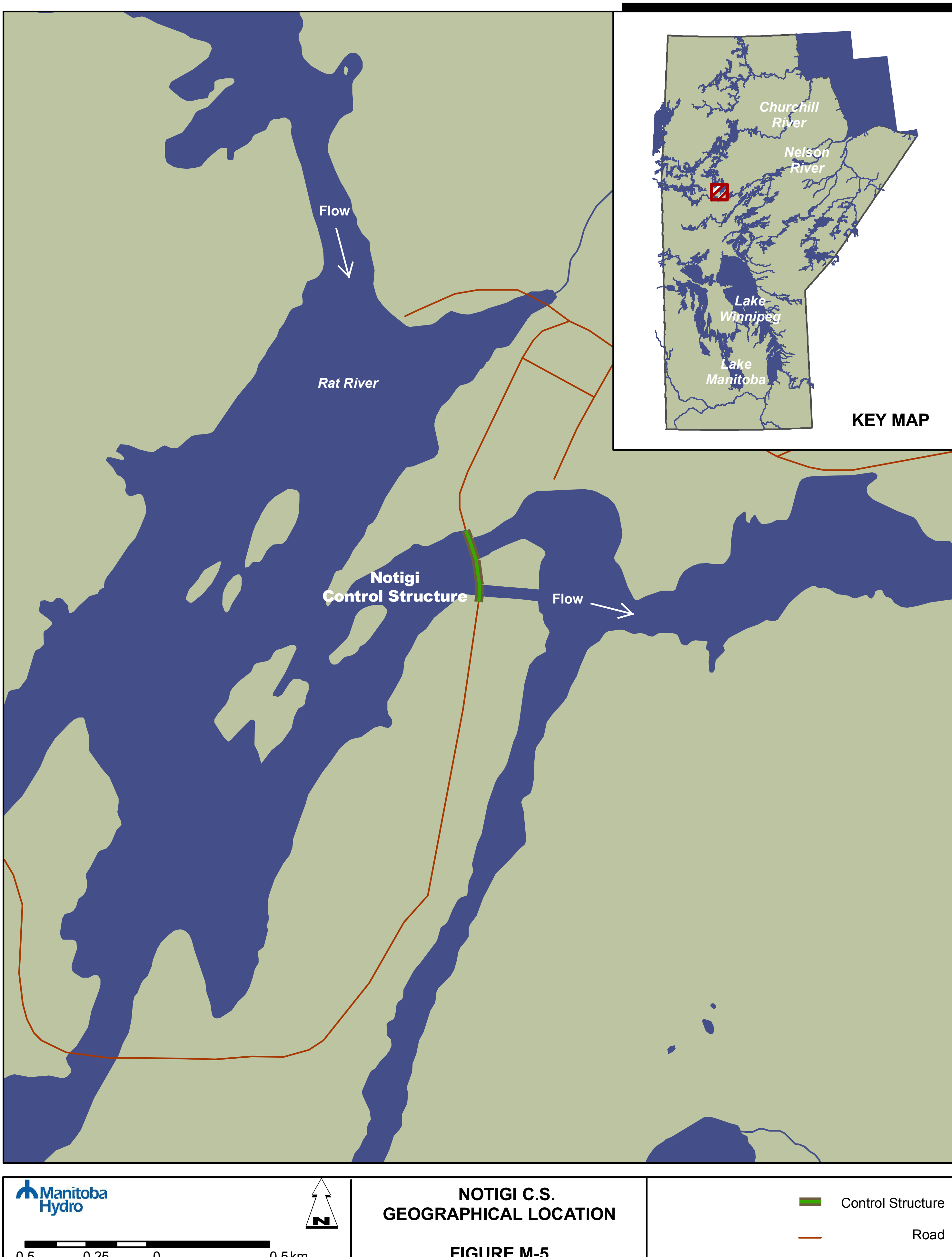
DAILY AVERAGE ELEVATIONS (2021)

PROJECT
Water Levels and Flows Report

FIGURE M-3

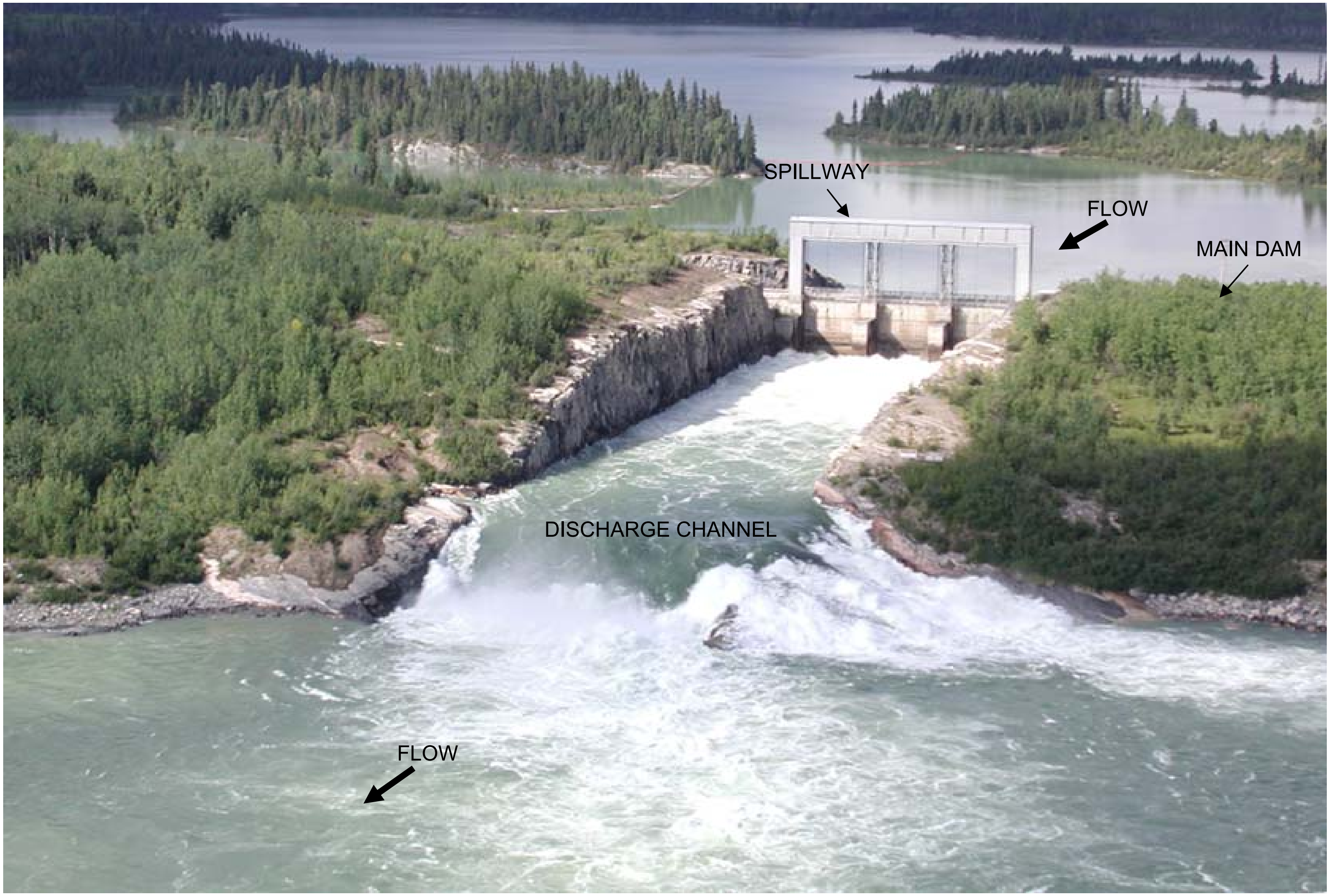


Manitoba Hydro	MANITOBA HYDRO
	WATERWAY APPROVALS AND MONITORING
	SOUTHERN INDIAN LAKE
	MAXIMUM DRAWDOWN FROM 847.5 FT IN 2021
	PROJECT Water Levels and Flows Report — FIGURE M-4

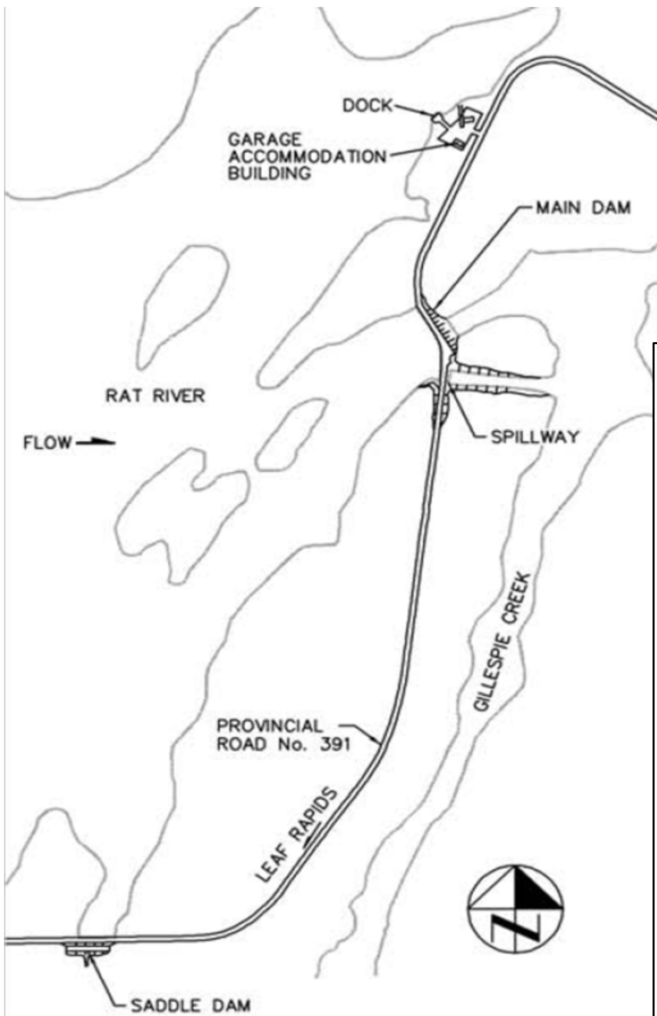


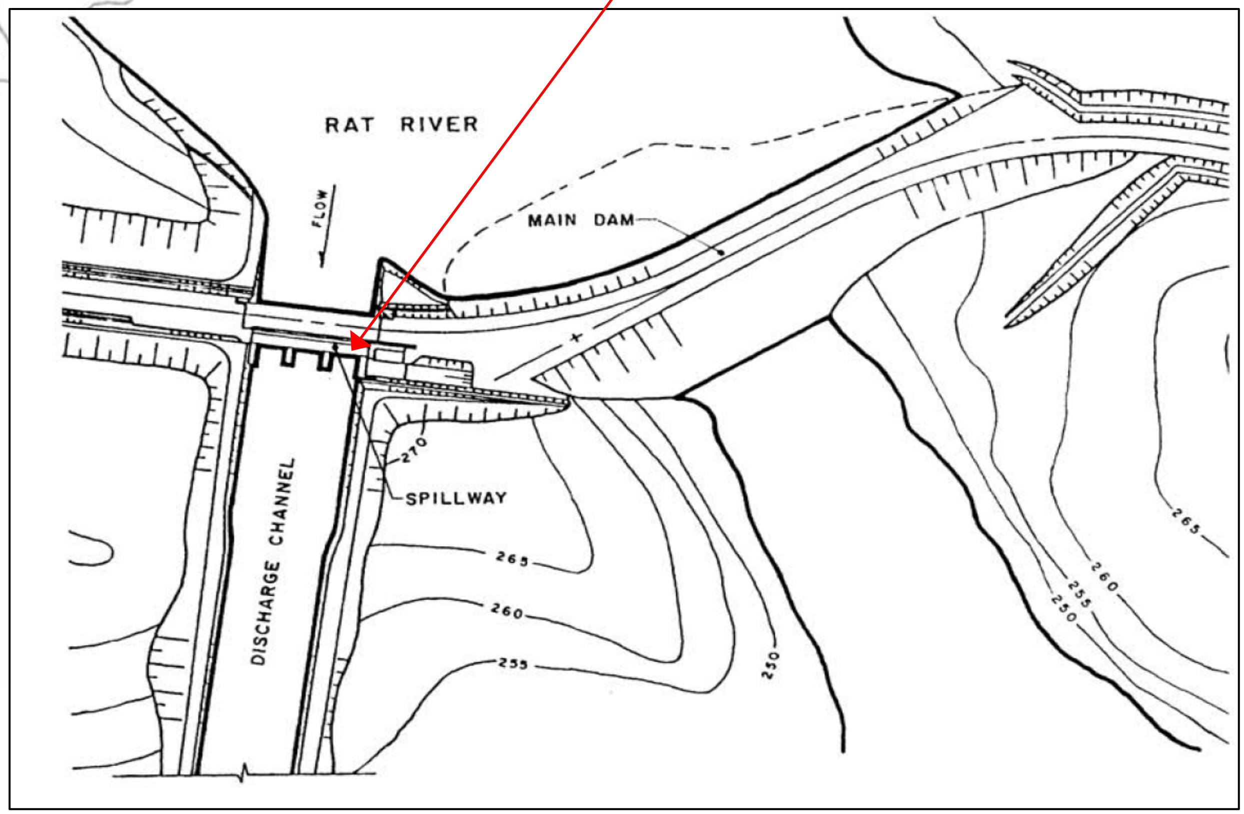
NOTIGI C.S.
GEOGRAPHICAL LOCATION

FIGURE M-5

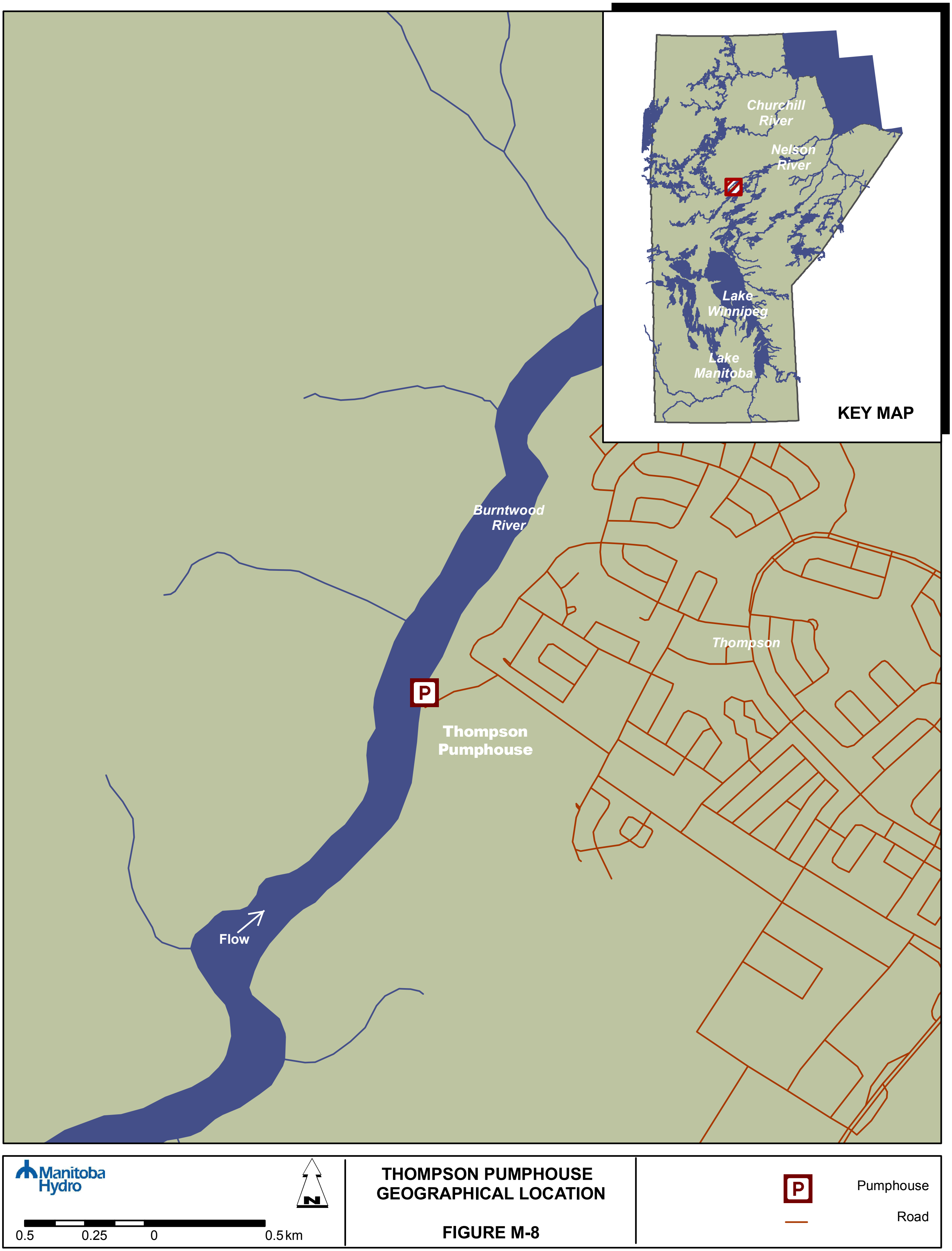


Manitoba Hydro	MANITOBA HYDRO
	WATERWAY APPROVALS AND MONITORING
	NOTIGI CONTROL STRUCTURE
	PHOTOGRAPH OF NOTIGI CONTROL STRUCTURE
	PROJECT WATER LEVELS AND FLOWS REPORT — FIGURE M-6



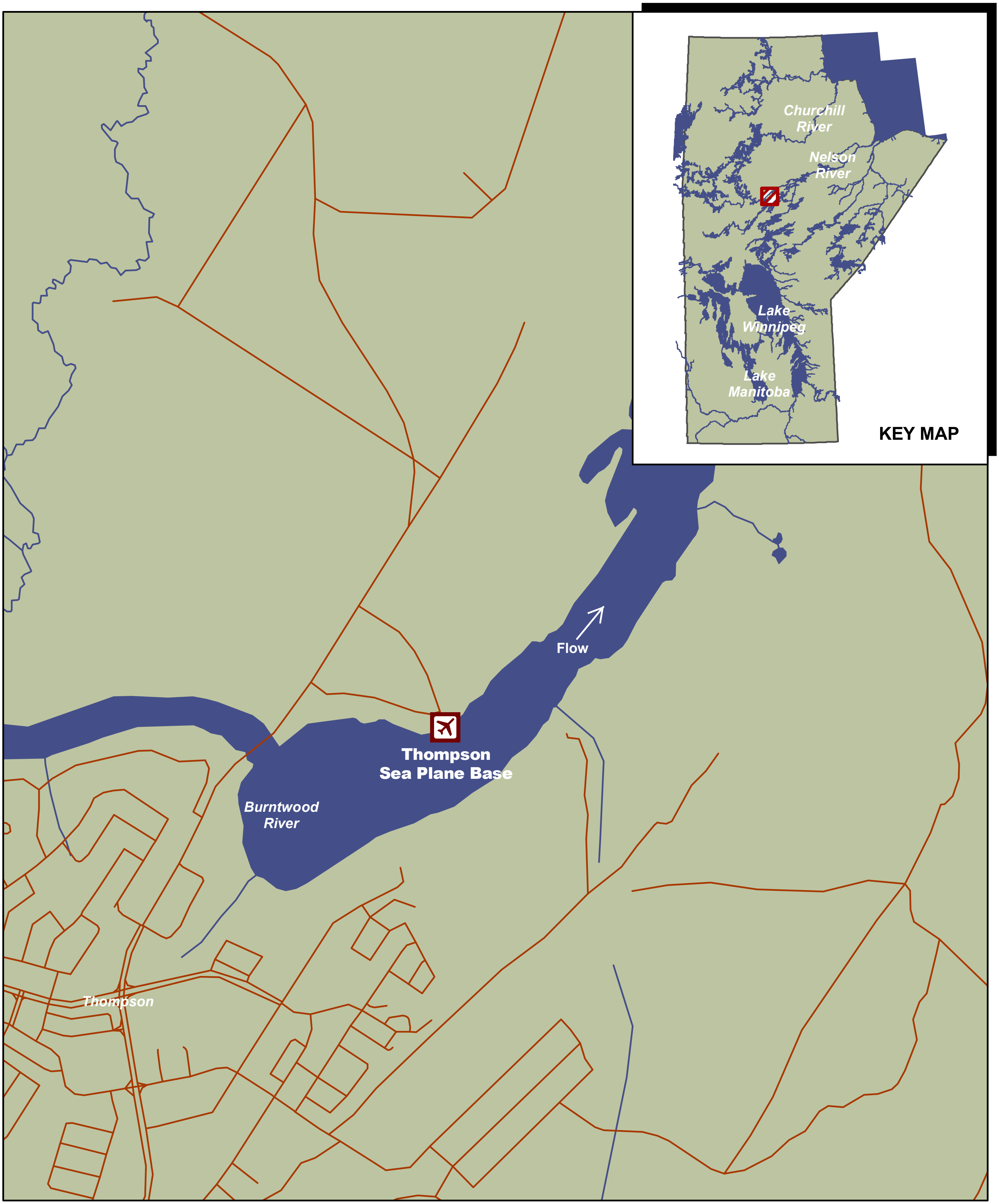


	MANITOBA HYDRO
Manitoba Hydro	WATERWAY APPROVALS AND MONITORING
	NOTIGI CONTROL STRUCTURE
	GENERAL ARRANGEMENT
	PROJECT WATER LEVELS AND FLOWS REPORT
	FIGURE M-7



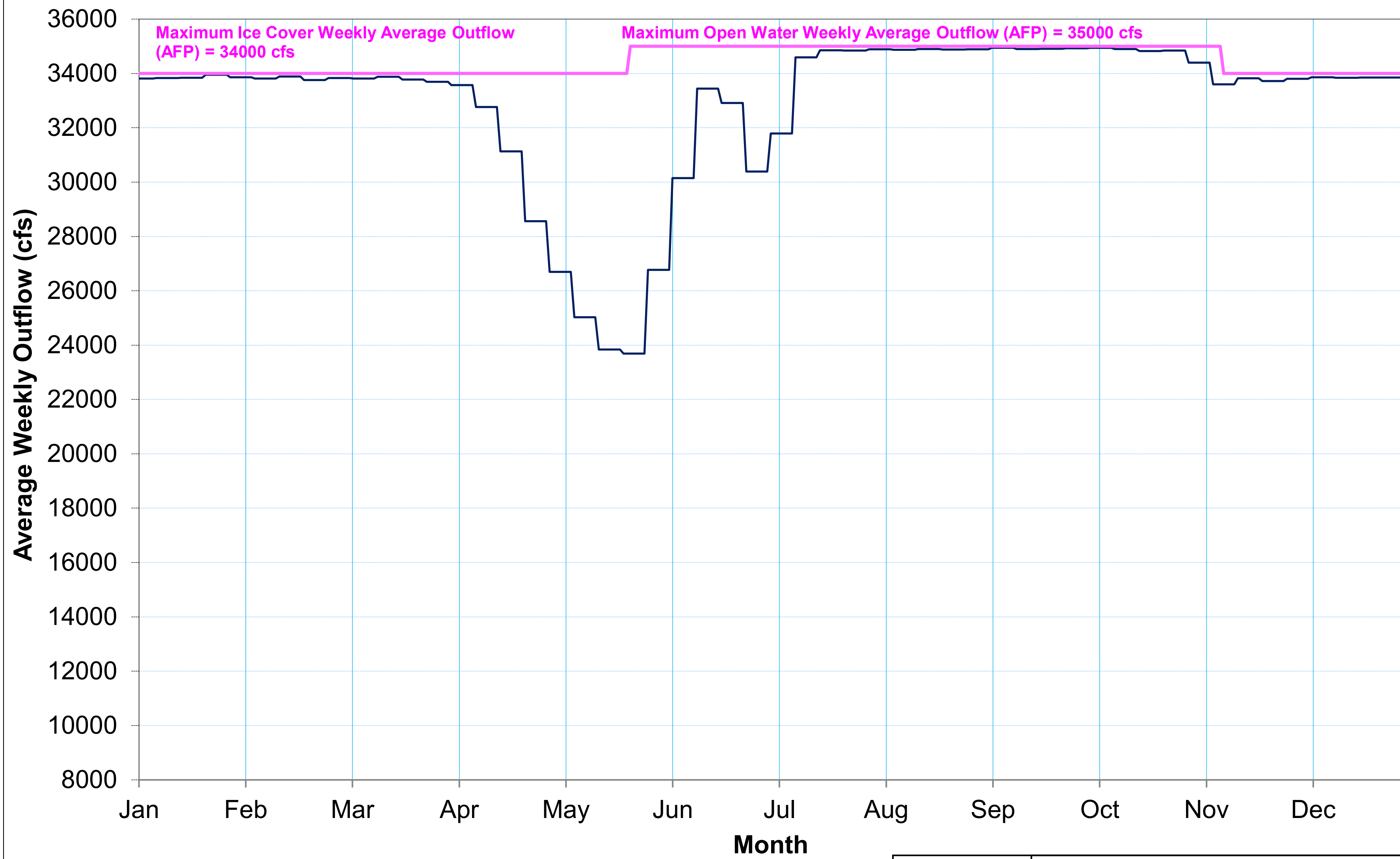
THOMPSON PUMPHOUSE GEOGRAPHICAL LOCATION

FIGURE M-8



THOMPSON SEAPLANE BASE
GEOGRAPHICAL LOCATION

FIGURE M-9



	MANITOBA HYDRO
	WATERWAY APPROVALS AND MONITORING
	NOTIGI CONTROL STRUCTURE
	AVERAGE WEEKLY OUTFLOWS (2021)
	PROJECT Water Levels and Flows Report / FIGURE M-10

Daily Averaged Elevation Statistics 1977 - 2021

Maximum	**= 621.39 feet**
Minimum	**= 607.68 feet**
Mean	**= 615.96 feet**

Manitoba Hydro	MANITOBA HYDRO
	WATERWAY APPROVALS AND MONITORING
	THOMPSON PUMPHOUSE
	DAILY AVERAGE ELEVATIONS (2021)
	PROJECT Water Levels and Flows Report — FIGURE M-11

Daily Averaged Elevation Statistics 1977 - 2021

Maximum	**= 619.80 feet**
Minimum	**= 606.23 feet**
Mean	**= 614.76 feet**

MANITOBA HYDRO

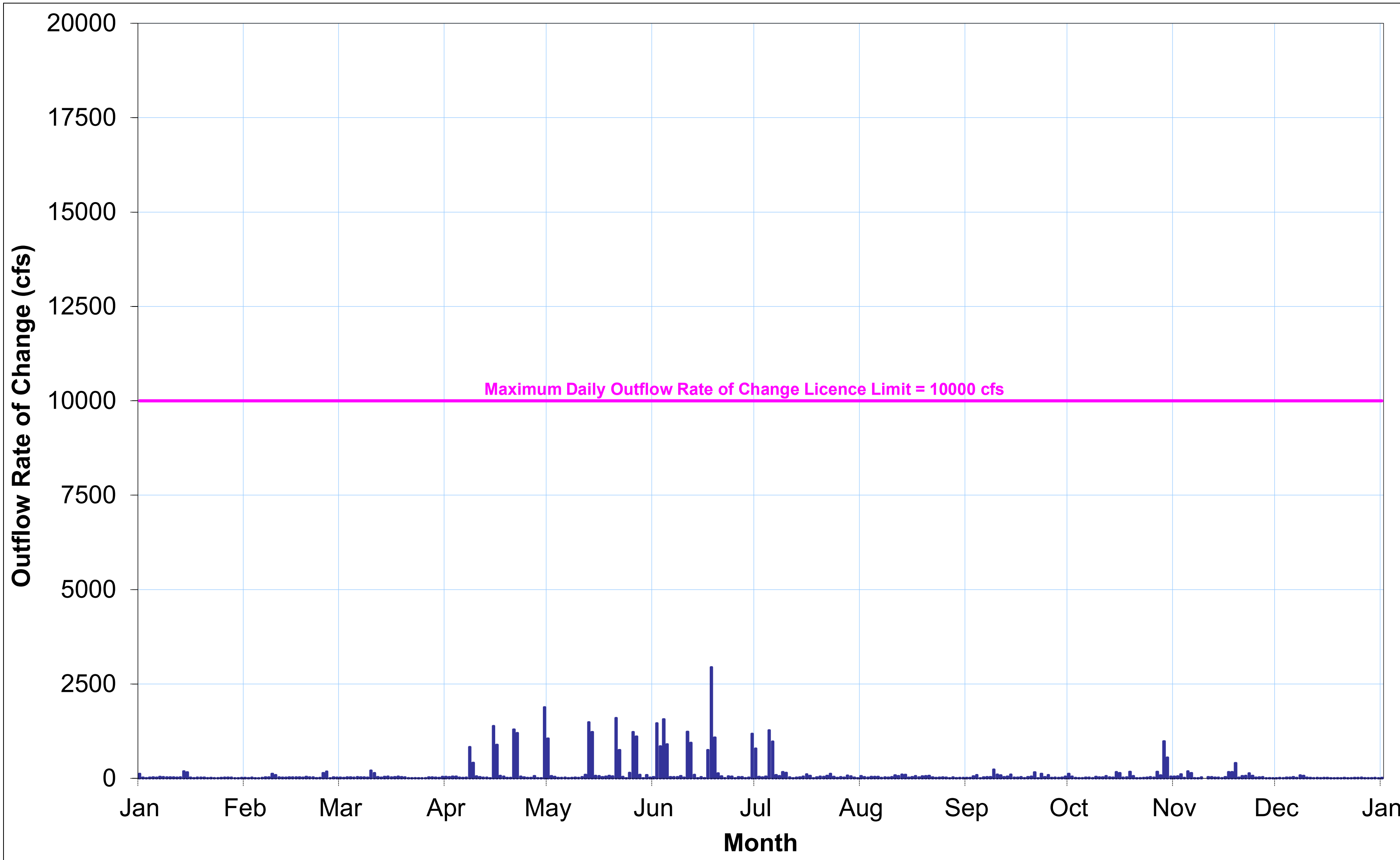
WATERWAY APPROVALS AND MONITORING

THOMPSON SEA PLANE BASE

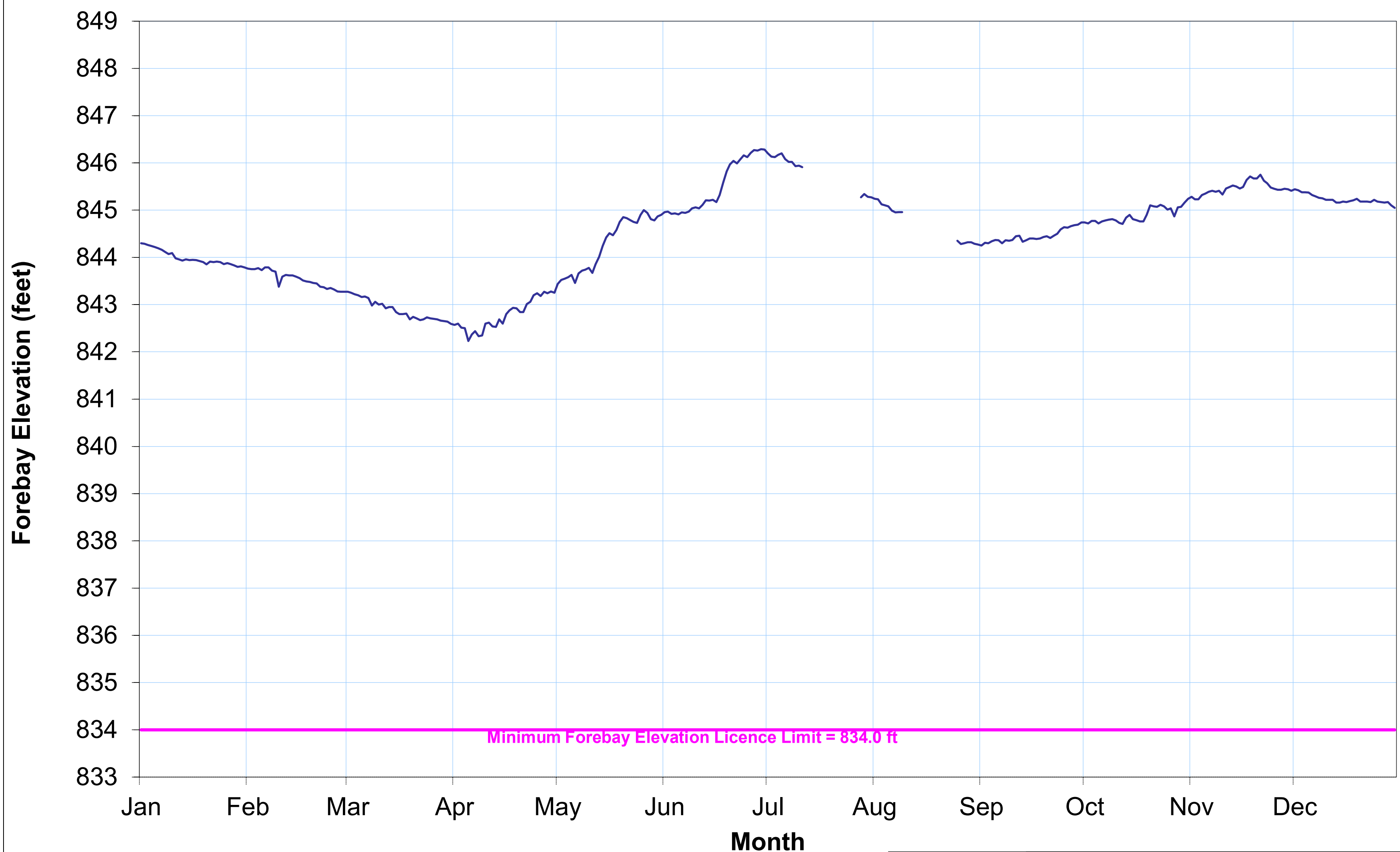
DAILY AVERAGE ELEVATIONS (2021)

PROJECT
Water Levels and Flows Report

FIGURE M-12



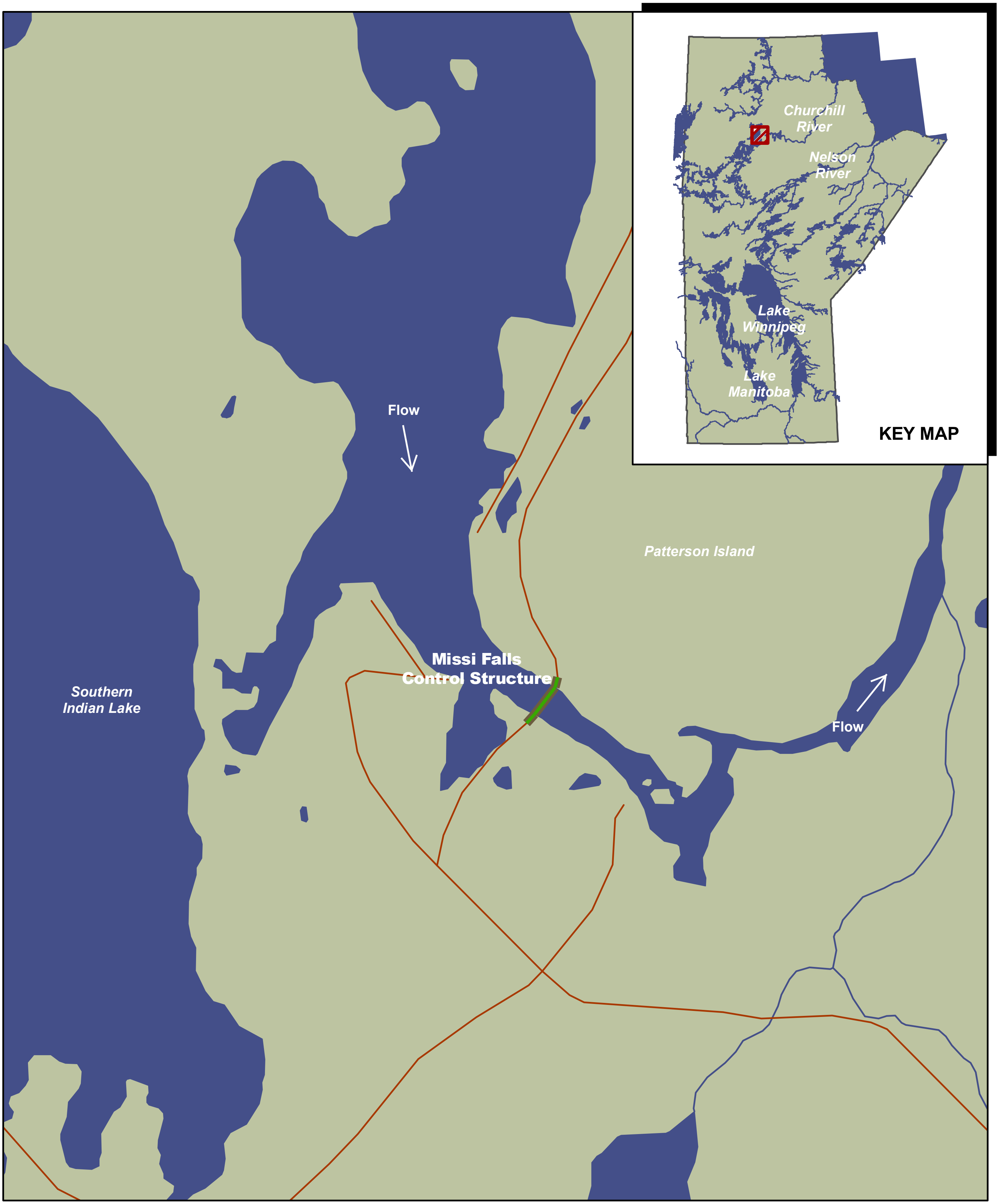
Manitoba Hydro	MANITOBA HYDRO
	WATERWAY APPROVALS AND MONITORING
	NOTIGI CONTROL STRUCTURE
	DAILY OUTFLOW RATES OF CHANGE (2021)
PROJECT Water Levels and Flows Report	FIGURE M-13



Daily Averaged Elevation Statistics 1977- 2021

Maximum = 848.72 feet
Minimum = 834.14 feet
Mean = 843.24 feet

Manitoba Hydro	MANITOBA HYDRO
	WATERWAY APPROVALS AND MONITORING
	NOTIGI CONTROL STRUCTURE
	DAILY AVERAGE FOREBAY ELEVATIONS (2021)
PROJECT Water Levels and Flows Report	FIGURE M-14



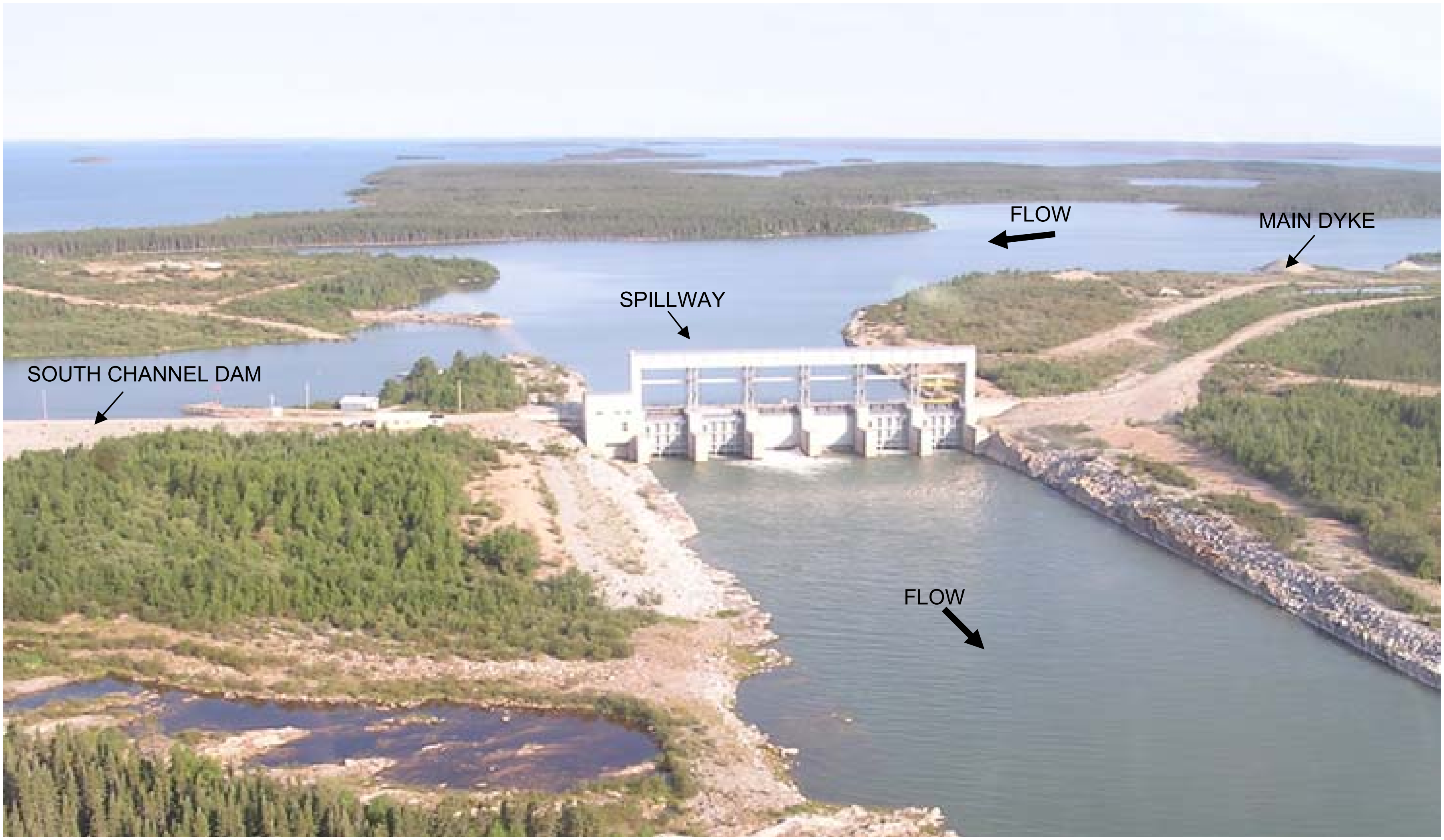
Manitoba Hydro

0.4 0.2 0 0.4 km

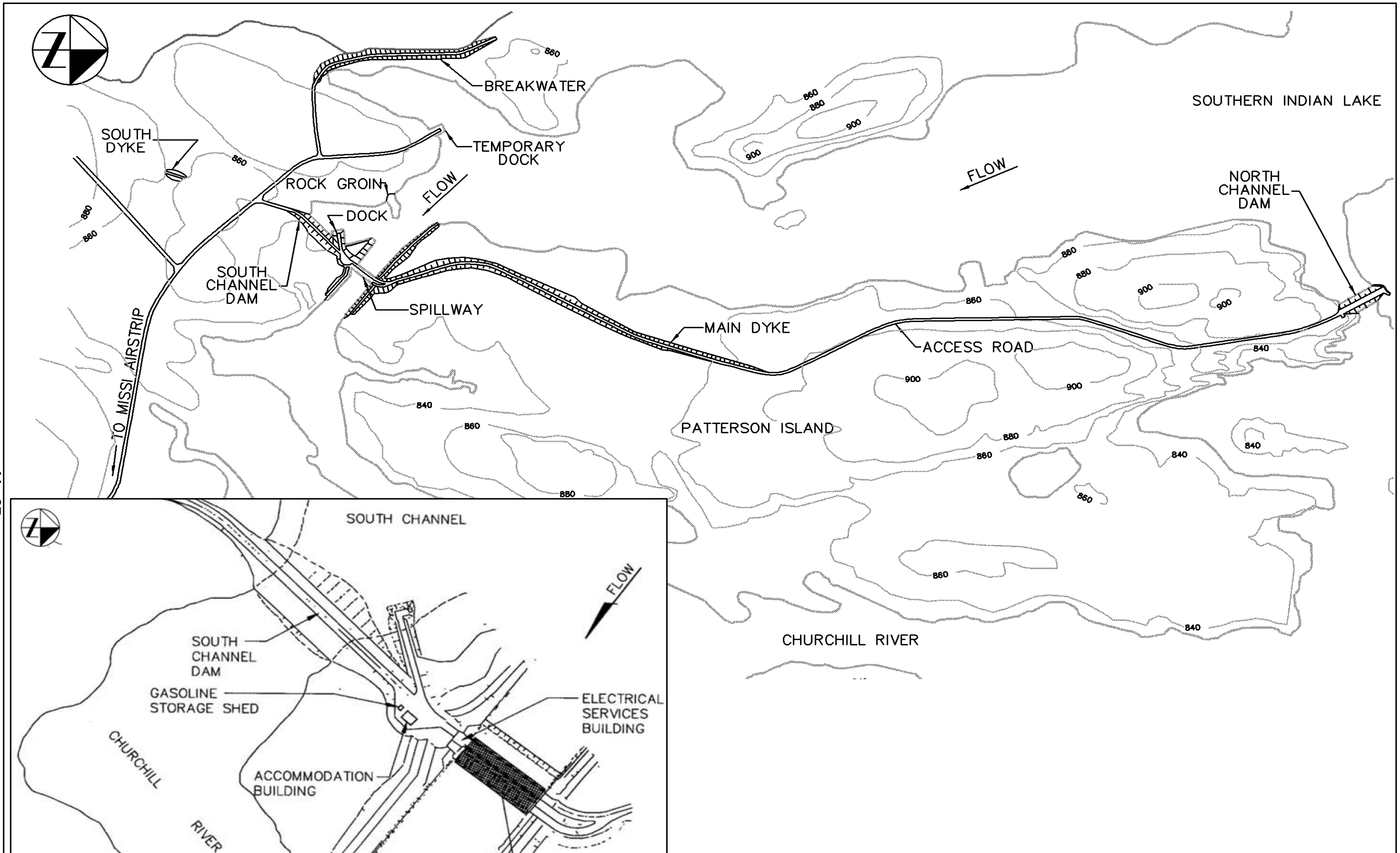
MISSI FALLS C.S.
GEOGRAPHICAL LOCATION

FIGURE M-15

Control Structure
Road



Manitoba Hydro	MANITOBA HYDRO
	WATERWAY APPROVALS AND MONITORING
	MISSI FALLS CONTROL STRUCTURE
	PHOTOGRAPH OF MISSI CONTROL STRUCTURE
	PROJECT WATER LEVELS AND FLOWS REPORT — FIGURE M-16



Manitoba Hydro

MANITOBA HYDRO

WATERWAY APPROVALS AND MONITORING

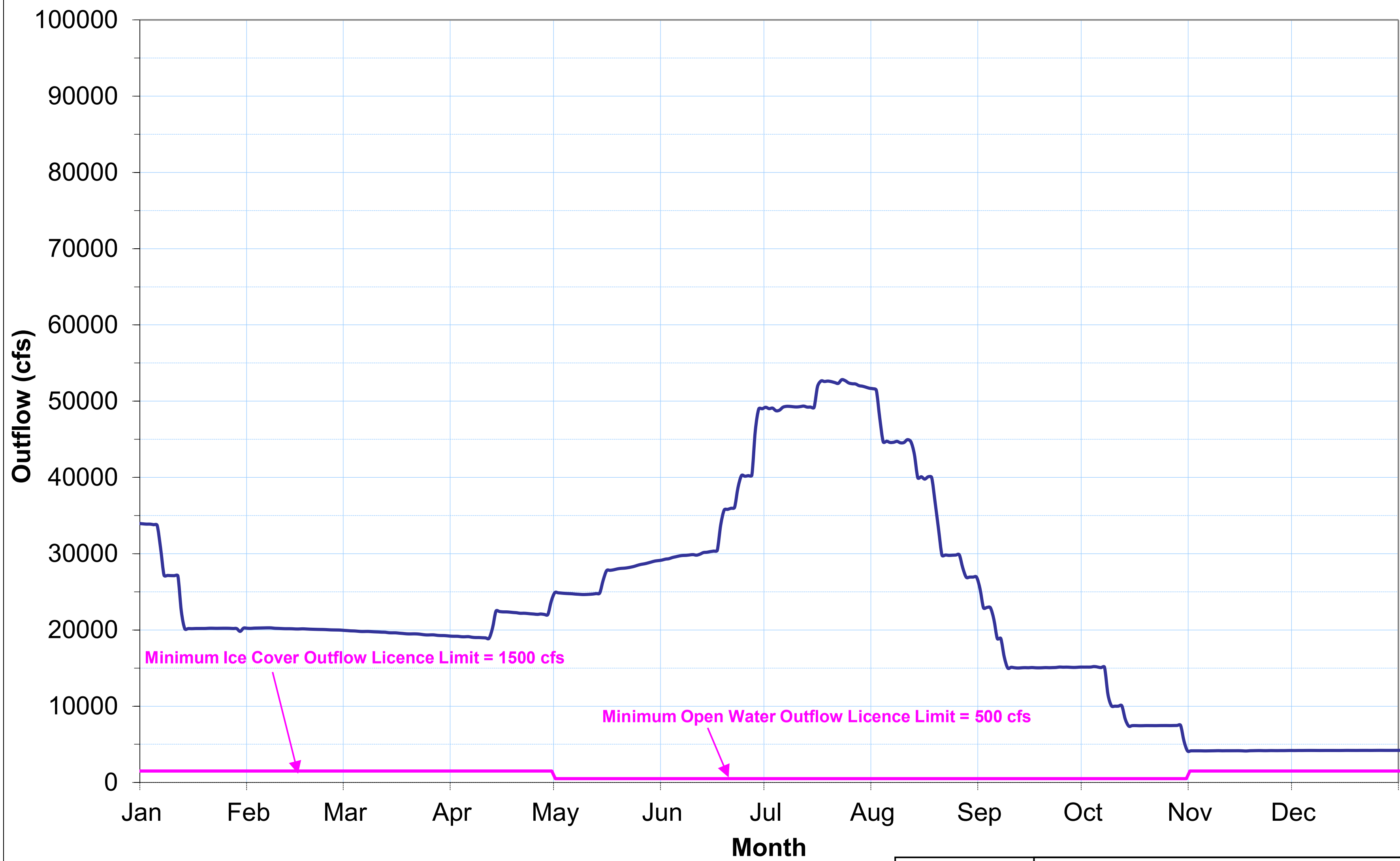
MISSI FALLS CONTROL STRUCTURE

GENERAL ARRANGEMENT

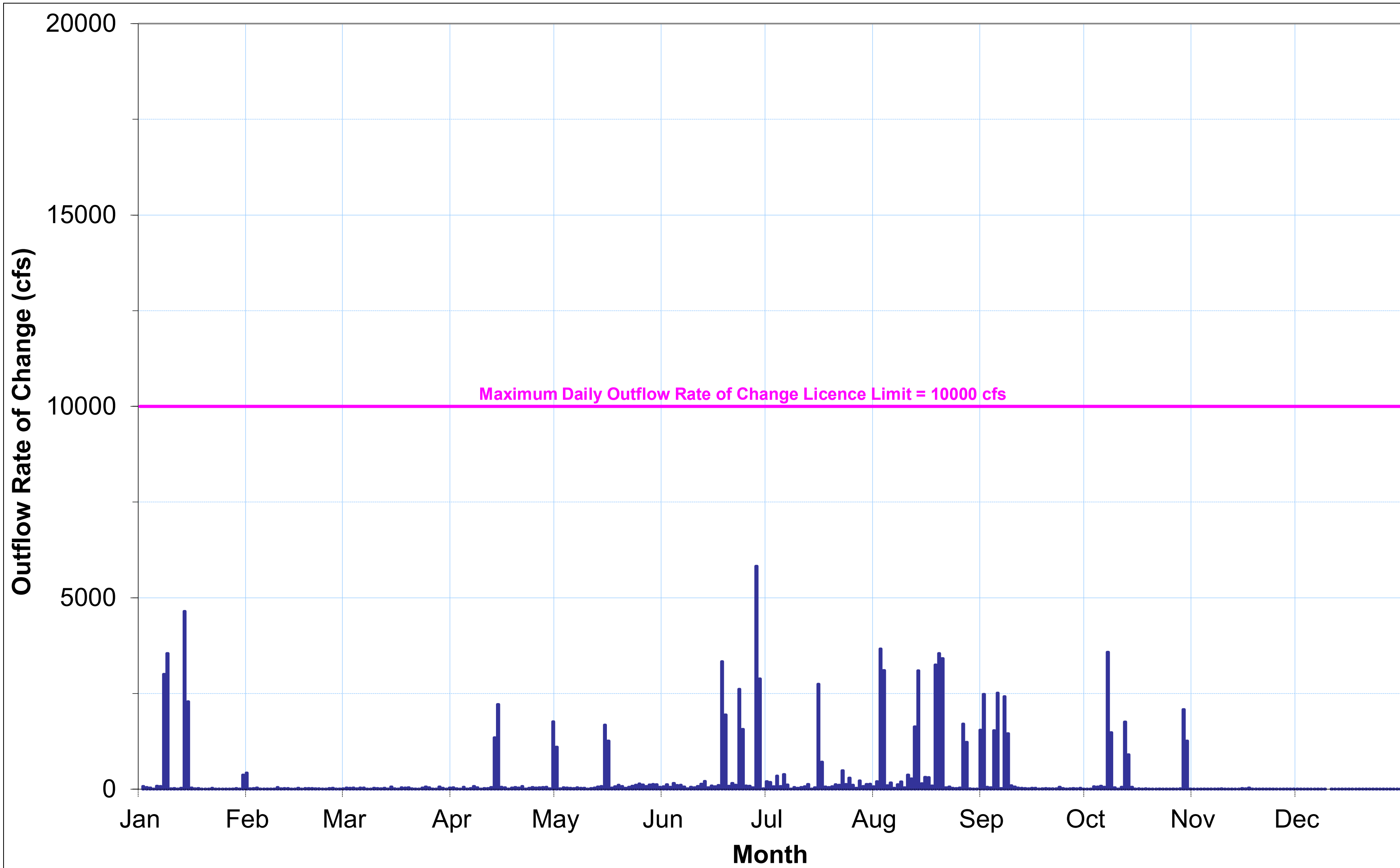
PROJECT

WATER LEVELS AND FLOWS REPORT

FIGURE M-17



	MANITOBA HYDRO
	WATERWAY APPROVALS AND MONITORING
	MISSI FALLS CONTROL STRUCTURE
	DAILY AVERAGE OUTFLOW (2021)
PROJECT Water Levels and Flows Report	FIGURE M-18



Manitoba Hydro	MANITOBA HYDRO
	WATERWAY APPROVALS AND MONITORING
	MISSI FALLS CONTROL STRUCTURE
	DAILY OUTFLOW RATES OF CHANGE (2021)
PROJECT Water Levels and Flows Report	FIGURE M-19

Churchill River Diversion Dam Safety Activities List

	ACTIVITIES	Performed By	Tasks Completed	Tasks Planned
Inspections	Engineering inspection of Manasan CS concrete dams	Dam Safety	1	1
	Engineering inspection of Notigi CS concrete dams	Dam Safety	1	1
	Engineering inspection of Missi Falls CS concrete dams	Dam Safety	1	1
	Engineering inspection of Manasan CS embankment dams	Dam Safety	1	1
	Engineering inspection of Notigi CS embankment dams	Dam Safety	1	1
	Engineering inspection of Missi Falls CS embankment dams	Dam Safety	1	1
	Routine inspection of Manasan CS embankment dams	Site - Utility	2	2
	Routine inspection of Notigi CS embankment dams	Site - Utility	3	3
	Routine inspection of Missi Falls CS embankment dams	Site - Utility	4	3
	Routine inspection of Manasan CS concrete dams	Site - Utility	2	2
	Routine inspection of Notigi CS concrete dams	Site - Utility	2	2
	Routine inspection of Missi Falls CS concrete dams	Site - Utility	2	2
	Missi Falls CS - Spillway inspection	Site - Elec	4	4
	Missi Falls CS - Spillway inspection	Site - Mech	4	4
	Notigi CS - Spillway inspection	Site - Utility	12	12
	Hydraulic conditions inspection	Dam Safety	1	1
Maintenance and Testing	Missi Falls CS - Spillway gate functional testing	Site - Elec/Mech	6	6 (1 per gate)
	Missi Falls CS – Spillway gate full flow test	Site - Elec/Mech	1	1
	Notigi CS - Spillway gate functional testing	Site - Elec/Mech	3	3 (1 per gate)
	Notigi CS – Spillway gate full flow test	Site - Elec/Mech	1	1
	Missi Falls CS - Spillway emergency gas engine - functional gate lift test	Site - Mech	1	1
	Missi Falls CS - Station emergency generator (Unit 2) - functional gate lift test	Site - Mech	1	1
	Notigi CS - Spillway emergency gas engine - functional gate lift test	Site – Mech	1	1
	Missi Falls CS - Spillway emergency gas engine test runs	Site - Mech	4	4
	Notigi CS - Spillway emergency gas engine test runs	Site - Utility	10	12
	Missi Falls CS - Spillway gate heater maintenance	Site - Elec	2	2 (1 per gate)
	Missi Falls CS - Spillway gate pre-winter gate heating	Site - Elec	1	1
	Notigi CS - Spillway gate heater maintenance	Site - Elec	3	3 (1 per gate)
	Missi Falls CS - Spillway gate gain heater maintenance	Site - Elec	2	2 (1 per gate)

	ACTIVITIES	Performed By	Tasks Completed	Tasks Planned
Maintenance and Testing	Missi Falls CS - Spillway gate gain heater controller maintenance	Site - Elec	1	1
	Notigi CS - Spillway gate gain heater maintenance	Site - Elec	3	3 (1 per gate)
	Notigi CS - Spillway gate gain heater controller maintenance	Site - Elec	1	1
	Missi Falls CS - Spillway gate hoist maintenance	Site - Elec	6	6 (1 per gate)
	Notigi CS - Spillway gate hoist maintenance	Site - Elec	3	3 (1 per gate)
	Missi Falls CS - Station emergency generator (Unit 2) test runs	Site - Elec	4	4
	Missi Falls CS - Station emergency generator (Unit 2) maintenance	Site - Elec	1	1
	Missi Falls CS - Station emergency generator (Unit 2) maintenance (6 yr)	Site - Elec	1	1
	Missi Falls CS - Spillway gate maintenance	Site - Mech	6	6 (1 per gate)
	Missi Falls CS - Spillway gate hoist maintenance	Site - Mech	6	6 (1 per gate)
	Notigi CS - Spillway gate hoist maintenance	Site - Mech	3	3 (1 per gate)
	Notigi CS - Spillway gate maintenance	Site - Mech	3	3 (1 per gate)
	Missi Falls CS - Station emergency generator (Unit 2) checks	Site - Mech	4	4
	Missi Falls CS - Station emergency generator (Unit 2) maintenance	Site - Mech	1	1
	Missi Falls CS - Station emergency generator (Unit 2) maintenance (6 yr)	Site - Mech	1	1
	Missi Falls CS - Station emergency generator (Unit 2) maintenance	Mechanical Services	0*	1
	Missi Falls CS - Spillway emergency gas engine maintenance	Mechanical Services	0*	1
	Notigi CS - Spillway emergency gas engine maintenance	Mechanical Services	1	1
Program	Missi Falls CS Dam Safety EPP - updates	Dam Safety	1	1
	Notigi CS Dam Safety EPP - updates	Dam Safety	1	1
	Manasan CS Dam Safety EPP - updates	Dam Safety	1	1
	Missi Falls CS Dam Safety Reference Manual - Revision	Dam Safety	-	-
	Notigi CS Dam Safety Reference Manual - Revision	Dam Safety	-	-
	Manasan CS Dam Safety Reference Manual - Revision	Dam Safety	-	-
	Delivered DS Training - Routine Inspections	Dam Safety	0	As Required
	Delivered DS Training - Emergency Preparedness	Dam Safety	0	As Required

*Maintenance on the Missi emergency generator and gas engine was not performed due to staffing shortages as a result of the IBEW strike and the Covid pandemic. Completing this maintenance work in 2022 is a high priority.

AUTHORIZATION
issued pursuant to
***THE WATER POWER ACT* (C.C.S.M. C. W60)**

Pursuant to the authority vested in me, I the undersigned, on behalf of the Minister of Conservation and Climate for the Province of Manitoba, hereby authorize:

Manitoba Hydro to deviate from Articles 9, 10, 11, 15(b), and 15(c) of its Churchill River Diversion Interim Licence for a one (1) year period from May 16, 2020 to May 15, 2021 as follows:

A. For a period from May 16, 2020 to May 15, 2021 to:
1. Permit the maximum water level of Southern Indian Lake to be increased from elevation 847.0 feet to 847.5 feet;
2. Permit the minimum water level of Southern Indian Lake to be decreased from elevation 844.0 feet to 843.0 feet;
3. Permit the drawdown of Southern Indian Lake to be 4.5 feet from elevation 847.5 feet to 843.0 feet; and
4. Permit the minimum water level immediately upstream of the Notigi Control Structure to be reduced from elevation 838.0 feet to 834.0 feet.

and

B. For the period May 16, 2020 to October 31, 2020 to:
1. Permit the average weekly flow at the Notigi Control Structure to be increased from 30,000 cfs to 35,000 cfs; and
2. Permit the allowable flow at Thompson to be controlled by a maximum elevation of 619.0 feet above sea level at the Thompson Seaplane Base;

and

C. For the period from November 1, 2020 to May 15, 2021 to:
1. Permit the average weekly flow at the Notigi Control Structure to be increased from 30,000 cfs to 34,000 cfs; and
2. Permit the allowable flow at Thompson to be set by maximum elevation of 623.0 feet at the Thompson Pumphouse.

Provided in all cases that:

1. The Nelson House Agreement, the Split Lake Agreement, the York Factory Agreement, or the City of Thompson Agreement would not be violated as a direct result of the Augmented Flow Program;
2. Manitoba Hydro agrees to terminate its program and decrease diversion flow to appropriate levels if at any time it appears that the above noted conditions may be violated, or if conditions arise which would present a hazard to local residents;
3. The Manager of the Water Power Act Licensing Section of my department be kept fully informed of all aspects of the Augmented Flow Program by means of monthly written reports;
4. Monthly written reports on the 2020/2021 Augmented Flow Program be forwarded to the Nelson House First Nation, Split Lake First Nation, York Factory First Nation, and affected communities;
5. Manitoba Hydro fully mitigate any effects of the altered levels and flows; and
6. The maximum drawdown on Southern Indian Lake of 4.5 feet be staged over a period of time and in such a manner so as to minimize adverse impacts on Southern Indian Lake residents.

Dated at the City of Winnipeg, in the Province of Manitoba this 21 day of April A.D. 2020.

Witness

Blair McTavish
A/Deputy Minister
Conservation and Climate

APPENDIX N

LAURIE RIVER #1 & #2 GENERATING STATIONS
WATER POWER ACT LICENCE

1.0 INTRODUCTION

The Laurie River #1 Generating Station is located approximately 200 km northwest of Thompson and approximately 125 km upstream of Southern Indian Lake. Figure N-1 is an overall site map of the Laurie River Development that shows the layout of the major project components including Laurie River #1 GS, Laurie River #2 GS, Russell Lake Dam, Eager Lake Dam, Loon River Diversion, Kamuchawie Lake Weir and gauge locations.

The Laurie River #1 Generating Station was built between 1950 and 1952 by Sherritt Gordon Mines Limited to supply their mining operations in the area. The generating station originally went into operation in 1952 and was transferred to Manitoba Hydro on May 1, 1970. Figure N-2 shows a photo of the Laurie River #1 GS powerhouse and spillway.

Manitoba Hydro operates Laurie River #1 Generating Station with a Third Short Term Extension Licence (STEL) issued in accordance with the provisions of The Water Power Act from October 1, 2021 to and including September 30, 2025. The operating terms of the STEL are identical to those of the final licence issued on June 17, 1958. Manitoba Hydro requested a renewal licence on June 9, 1989.

The Laurie River #2 GS is located approximately 210 km northwest of Thompson and approximately 10 km upstream of Laurie #1 GS as shown in Figure N-1.

The Laurie River #2 Generating Station was built between 1956 and 1958 by Sherritt Gordon Mines Limited to supply their mining operations in the area. The generating station originally went into operation in 1958 and was transferred to Manitoba Hydro on May 1, 1970. Figure N-5 shows a photo of the Laurie River #2 GS powerhouse and spillway.

Manitoba Hydro operates Laurie River #2 Generating Station with a Third Short Term Extension Licence (STEL) issued in accordance with the provisions of The Water Power Act from October 1, 2021 to and including September 30, 2025. The operating terms of the STEL are identical to those of the final licence issued on May 31, 1963. Manitoba Hydro requested a renewal licence on June 9, 1989.

This appendix contains information specific to Laurie River #1 and #2 Generating Stations, including a description of the project, major construction specifications, description of data collection, comments on 2021 water level data and summaries of major system upgrades or changes and dam safety activities.

2.0 PROJECT DESCRIPTION

Regulating structures associated with the Laurie River Development include the Laurie River #1 GS, Laurie River #2 GS, Russell Lake Control Dam, Eager Lake Control Dam, Loon River Dam, Loon River Diversion Channel and the Kamuchawie Lake Weir (a regulating structure not specifically included in the licence).

2.1 Laurie River #1 Generating Station

The Laurie River #1 GS consists of a powerhouse, spillway and gravity structures and has a capacity of 5 MW. Construction of the station was completed by Sherritt Gordon Mines Limited to supply their mining operations in the area. The generating station originally went into operation in 1952 and was officially transferred to Manitoba Hydro on May 1, 1970.

The station components include a two unit powerhouse, a five bay stoplog controlled spillway and three gravity dams. Figure N-3 shows the general arrangement of the concrete structures. Table N-1 summarizes major characteristics of the station. Table N-2 summarizes major characteristics of the Laurie River #1 powerhouse, spillway and gravity dams.

Table N-1: Laurie River #1 G.S. Major Characteristics

Construction Period	1950 to 1952
Licensed Capacity	5 MW (7,000 horsepower)
Average Annual Generation	26.5 million kW-h
Waterfall Drop (head)	16.6 m
Normal Maximum Forebay Elevation (NMFE)	46.6 m*
Available Freeboard @ NMFE - Conc. Structures	1.5 m (without wind or wave effects)

* Assumed local datum

Table N-2: Laurie River #1 G.S. Component Characteristics

Powerhouse	Number of Units	2
	Length	23.1 m
	Deck Elevation	48.16 m*
	Discharge Capability (at full gate)	34 m^3/s
	Power Production Unit 1 Unit 2	 2.5 MW (3,500 horsepower) 2.5 MW (3,500 horsepower)
Spillway	Number of Bays	5 bays
	Length	30.5 m
	Deck Elevation	48.16 m*
	Discharge Capability (at normal maximum forebay elevation)	295 m^3/s
East Gravity Structure	Length	114.9 m
	Design Crest Elevation	48.16 m*
Centre Gravity Structure	Length	5.5 m
	Design Crest Elevation	48.16 m*
West Gravity Structure	Length	99.7 m
	Design Crest Elevation	48.16 m*

* Assumed local datum

2.2 Laurie River #2 Generating Station

The Laurie River #2 GS consists of a powerhouse, spillway and gravity structures and has a name plate capacity of 5 MW. Construction of the station was completed by Sherritt Gordon Mines Limited to supply their mining operations in the area. The generating station originally went into operation in 1958 and was officially transferred to Manitoba Hydro on May 1, 1970.

The station components include a one unit powerhouse, a main dam, a five bay stoplog controlled spillway, three gravity dams and two dikes. Figure N-5 shows the general arrangements of the concrete and earth structures. Table N-3 summarizes major characteristics of the station. Table N-4 summarizes major characteristics of the Laurie River #2 powerhouse, spillway, gravity dams and dikes.

Table N-3: Laurie River #2 G.S. Major Characteristics

Construction Period	1956 to 1958
Licensed Capacity	5 MW (7,000 horsepower)
Average Annual Generation	28.5 million kW-h
Waterfall Drop (head)	18.1 m
Normal Maximum Forebay Elevation (NMFE)	64.9 m*
Available Freeboard @ NMFE - Conc. Structures	0.6 m (without wind or wave effects)
Available Freeboard @ NMFE - Earth Structures	2.1 m (without wind or wave effects)

* Assumed local datum

Table N-4: Laurie River #2 G.S. Component Characteristics

Powerhouse	Number of Units	1
	Length	15.8 m
	Deck Elevation	65.5 m*
	Discharge Capability (at full gate)	34 m^3/s
	Power Production Unit 1	 5 MW (7,000 horsepower)
Spillway	Number of Bays	5 bays
	Length	30.5 m
	Deck Elevation	65.5 m*
	Discharge Capability (at normal maximum forebay elevation)	440 m^3/s
South Gravity Structure	Length	57.0 m
	Design Crest Elevation	65.5 m*
Centre Gravity Structure	Length	56.1 m
	Design Crest Elevation	65.5 m*
North Gravity Structure	Length	51.8 m
	Design Crest Elevation	65.5 m*
Main Dam	Length	120.4 m
	Design Crest Elevation	67.1 m*
Dike A	Length	129.5 m
	Design Crest Elevation	67.1 m*
Dike B	Length	140.2 m
	Design Crest Elevation	67.1 m*

* Assumed local datum

2.3 Russell Lake Dam

Russell Lake Dam is an earthfill structure with a reinforced concrete, three bay stoplog controlled spillway located at the outlet of Russell Lake, approximately 30 km upstream of the Laurie River #2 Generating Station as shown in Figure N-1. The dam was constructed by Sherritt Gordon Mines Limited to impound water to ensure reliable winter flows at the Laurie River stations.

In 1982, because of its deteriorated condition, the dam was repaired by stabilizing the two wing walls using rockfill, thus closing the north and south bays for operations. The normal maximum operating elevation of Russell Lake was lowered from elevation 35.05 m to 34.14 m as a result of having only the centre bay available for operations. This lowering of 0.91 m does not prevent levels from exceeding 34.14 m as it is required for flood storage to compensate for the loss of discharge capacity. Figure N-8 shows a photograph of the Russell Lake Dam while Figure N-9 shows the general arrangement of the earth dam and control section.

Table N-5 summarizes the major characteristics of the earth structures and spillway.

Table N-5: Russell Lake Dam Characteristics

Construction Period		Early 1950's (~1952)
Normal Maximum Operating Elevation (NMOE)		34.14 m*
Available Freeboard @ NMOE - Conc. Structure		1.7 m (without wind or wave effects)
Available Freeboard @ NMOE - Earth Structure		2.0 m (without wind or wave effects)
Spillway	Number of Bays	3 bays (1 bay operational)
	Length	15.2 m
	Deck Elevation	35.8 m*
	Discharge Capability (at normal maximum operating elevation)	29 m^3/s
South Earthfill Dike	Length (approx.)	85.0 m
	Design Crest Elevation	36.12 m*
North Earthfill Dike	Length (approx.)	175.3 m
	Design Crest Elevation	36.12 m*

* Assumed local datum

2.3 Eager Lake Dam

Eager Lake Dam is an earthfill structure with a reinforced concrete, two bay stoplog controlled spillway located at the outlet of Eager Lake, approximately 70 km upstream of the Laurie River #2 Generating Station as shown in Figure N-1. The dam was constructed by Sherritt Gordon Mines Limited to impound water to ensure reliable winter flows at the Laurie River stations. Figure N-11 shows a photograph of the Eager Lake Dam and Figure N-12 shows general arrangement of the earth dam and control section.

Table N-6 summarizes the major characteristics of the earth structures and spillway.

Table N-6: Eager Lake Dam Characteristics

Construction Period		Mid 1950's (~ 1956)
Normal Maximum Operating Elevation (NMOE)		35.05 m*
Available Freeboard @ NMOE - Conc. Structure		1.2 m (without wind or wave effects)
Available Freeboard @ NMOE - Earth Structure		1.5 m (without wind or wave effects)
Spillway	Number of Bays	2 bays
	Length	10.7 m
	Deck Elevation	36.3 m*
	Discharge Capability (at normal maximum operating elevation)	113 m^3/s
South Earthfill Dike	Length (approx.)	10.0 m
	Design Crest Elevation	36.58 m*
North Earthfill Dike	Length (approx.)	210.0 m
	Design Crest Elevation	36.58 m*

* Assumed local datum

2.4 Loon River Dams and Diversion Channel

The diversion consists of two earthfill dams and a low concrete weir with an uncontrolled crest (i.e. no stoplogs or gates). The Loon River Diversion, constructed by Sherritt Gordon Mines Limited, increases the flow on the Laurie River by diverting all or the majority of the Loon River's flow into Russell Lake.

The works associated with the Loon River Diversion are located approximately 18 km downstream of Kamuchawie Lake near the southwest arm of Russell Lake as shown in Figure N-1. Figure N-14 shows a photograph of the Loon River Control Dam. Figures N-15 and N-16 show the general arrangement of the earth dams and control section.

Table N-7 summarizes the major characteristics of the earth structures and spillway.

Table N-7: Loon River Dams and Diversion Channel Major Characteristics

Construction Period		Early 1950's (~ 1953)
Loon Lake Maximum Daily Average Elevation		36.01 m*
Available Freeboard @ NME - Earth Structure		2.7 m (without wind or wave effects)
East Channel Dam	Length (approx.)	65.0 m
	Design Crest Elevation	38.1 m*
West Channel Dam	Length (approx.)	100.0 m
	Design Crest Elevation	38.1 m*

* Assumed local datum

3.0 DATA COLLECTION AT GAUGES

Laurie River #1 GS
The forebay water level at Laurie River #1 is measured using a water level (staff) gauge mounted on the east gravity structure. The On-site Operator determines the forebay water level daily by reading the staff gauge directly. Water level data is sent daily to the System Control Centre and the Energy Supply Planning Department. The Energy Supply Planning Department staff enters the data into a hydrometric database that is accessible to interested parties within Manitoba Hydro.

Laurie River #2 GS
The forebay water level at Laurie River #2 GS is measured using a water level (staff) gauge mounted on the centre gravity structure. The On-site Operator determines the forebay water level daily by reading the staff gauge directly. Water level data is sent daily to the System Control Centre and the Energy Supply Planning Department. The Energy Supply Planning Department staff enters the data into a hydrometric database that is accessible to interested parties within Manitoba Hydro.

Russell Lake
Environment and Climate Change Canada collects continuous water level data at the Russell Lake near Herriot (06EB006) gauging station. Real time and published data is available to the public on the Environment and Climate Change Canada website.

Eager Lake
Environment and Climate Change Canada collects continuous water level data at the Eager Lake near Tod Lake (06EB007) gauging station. Real time and published data is available to the public on the Environment and Climate Change Canada website.

Loon River
Manitoba Hydro collects continuous water level data at the Loon River Dam gauging station (06EB703). Quality assurance and verification procedures similar to those performed by Environment and Climate Change Canada are used by Manitoba Hydro to ensure data accuracy.

4.0 DATA ANALYSIS

Water levels for the 2021 calendar year are shown for Laurie River #1 GS, Laurie River #2 GS, Russell Lake, Eager Lake, and Loon River, in Figures N-4, N-10, N-13, N-16 and N-20 respectively, for the period between January 1, 2021 and December 31, 2021.

5.0 MAJOR SYSTEM UPGRADES/CHANGES

Maintenance and construction activities that occurred during the 2021 calendar year include:

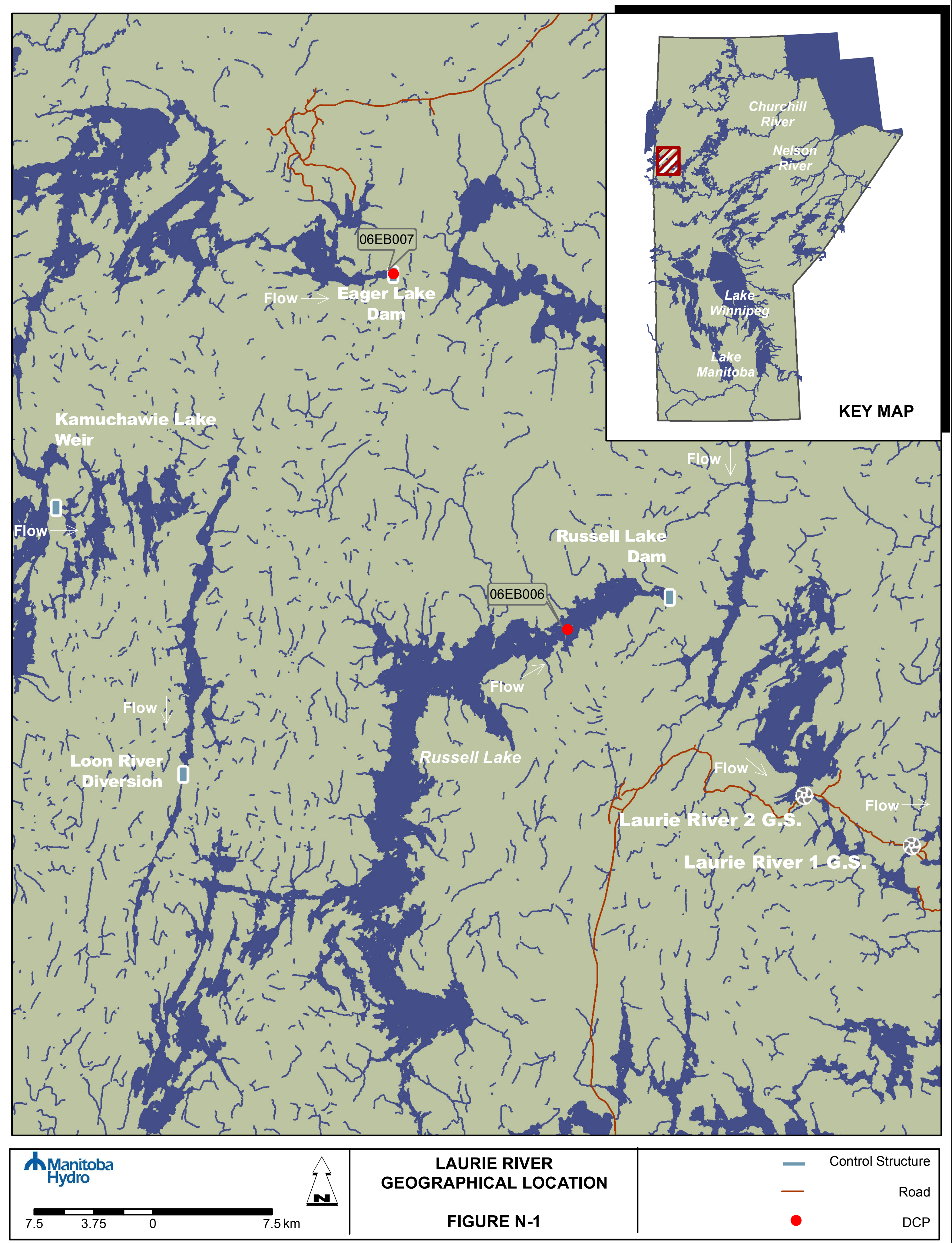
- Remediated hazardous material in accommodations

6.0 DAM SAFETY

Manitoba Hydro operates and maintains the generating station and associated structures at Laurie River #1 and #2 based on the Canadian Dam Association Dam Safety Guidelines. A summary of dam safety activities for 2021 is provided on page N-29.

7.0 CLOSURE

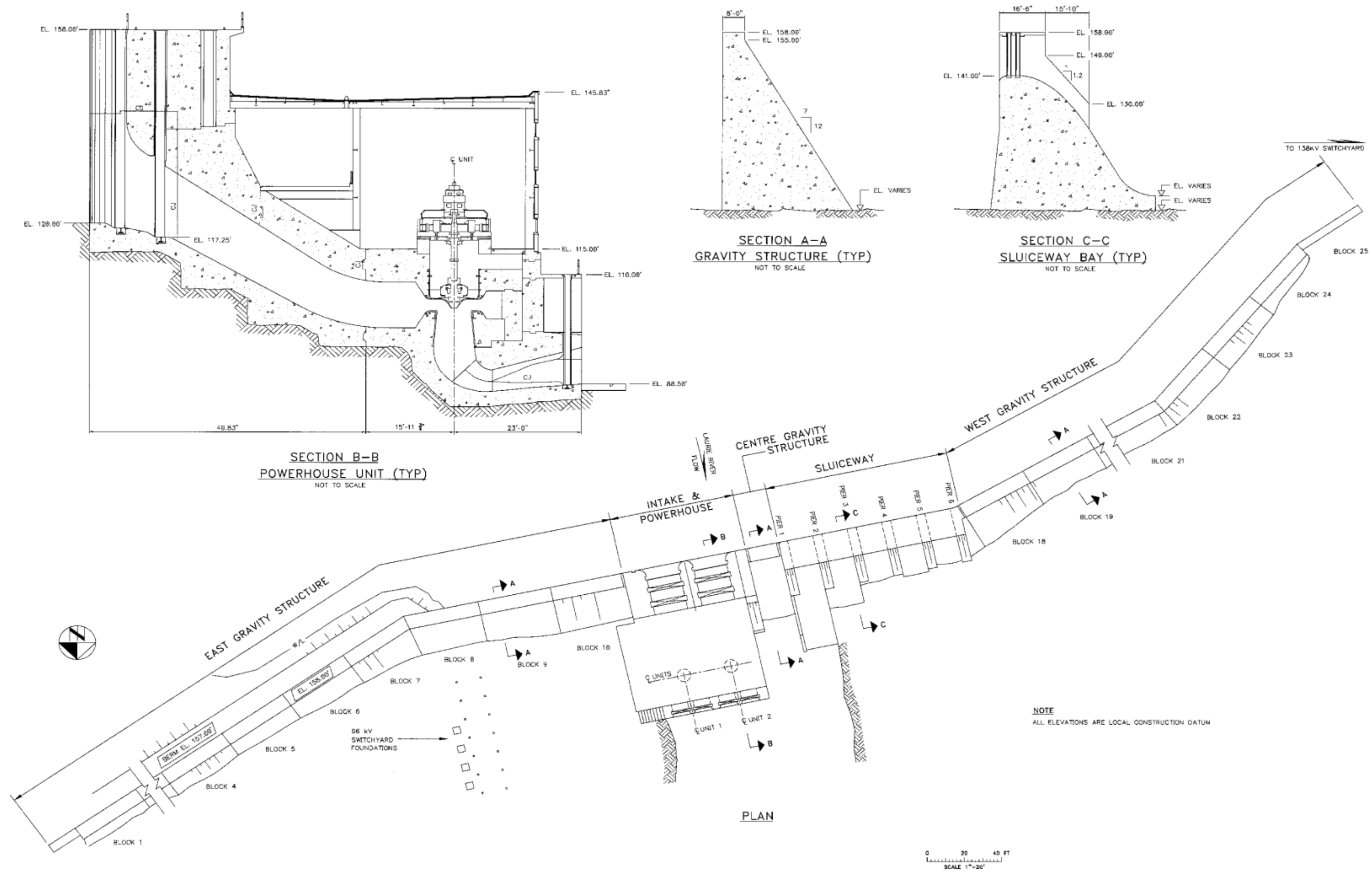
Manitoba Hydro continues to operate Laurie River #1 and #2 Generating Stations in accordance with their corresponding Second Short-term Extension Licence under The Water Power Act for the development of water power at the Laurie River Generating Stations.



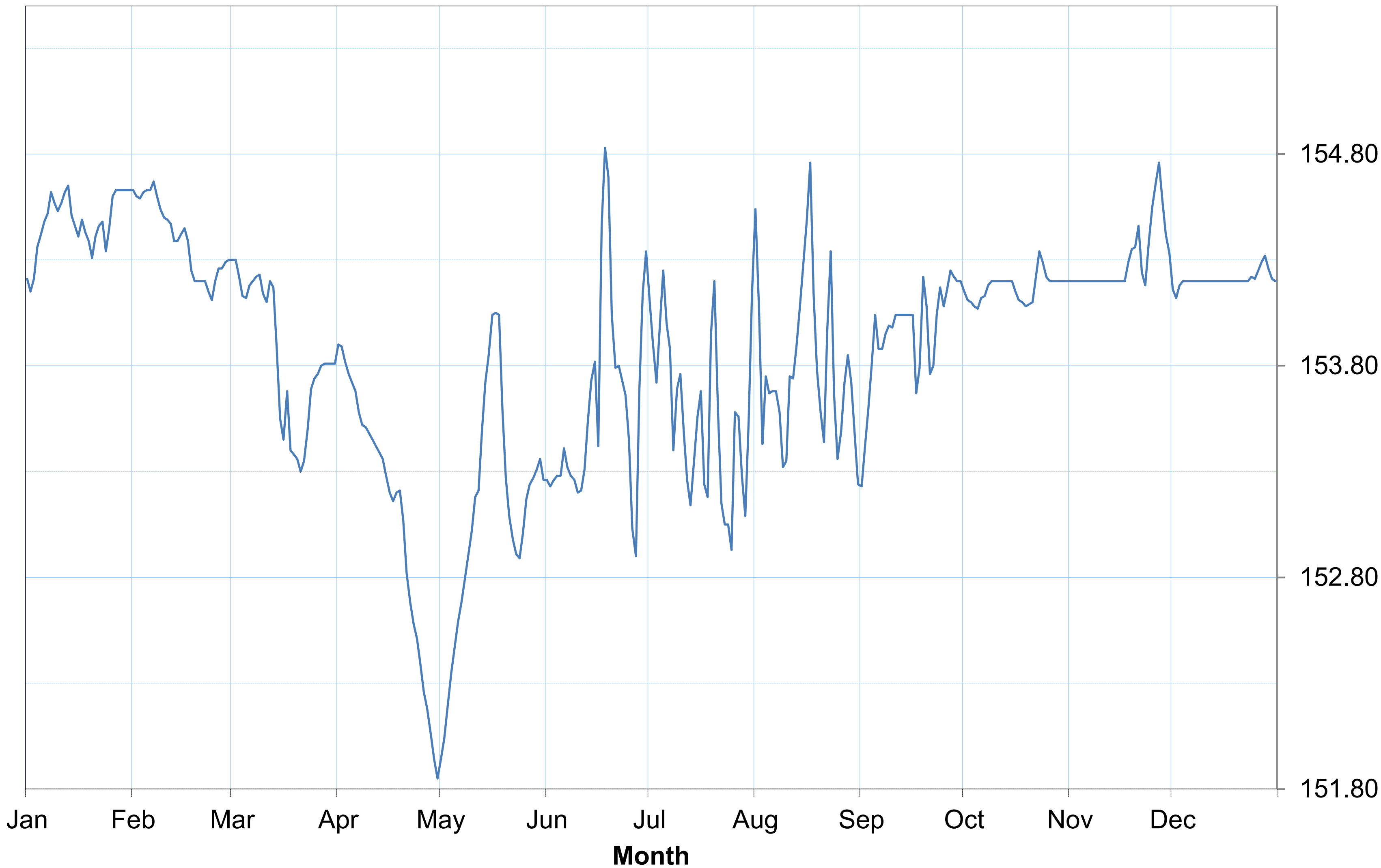
LAURIE RIVER
GEOGRAPHICAL LOCATION

FIGURE N-1

Manitoba Hydro	MANITOBA HYDRO
	WATERWAY APPROVALS AND MONITORING
	LAURIE RIVER #1 GENERATING STATION
	PHOTOGRAPH OF GENERATING STATION
	PROJECT WATER LEVELS AND FLOWS REPORT — FIGURE N-2



Manitoba Hydro	MANITOBA HYDRO
	WATERWAY APPROVALS AND MONITORING
	LAURIE RIVER #1 GENERATING STATION
	GENERAL ARRANGEMENT
	PROJECT WATER LEVELS AND FLOWS REPORT
	FIGURE N-3



Daily Averaged Lake Elevation (Local Datum) Statistics 1970 - 2021

Maximum	**= 156.50 feet**
Minimum	**= 144.10 feet**
Mean	**= 154.18 feet**

MANITOBA HYDRO

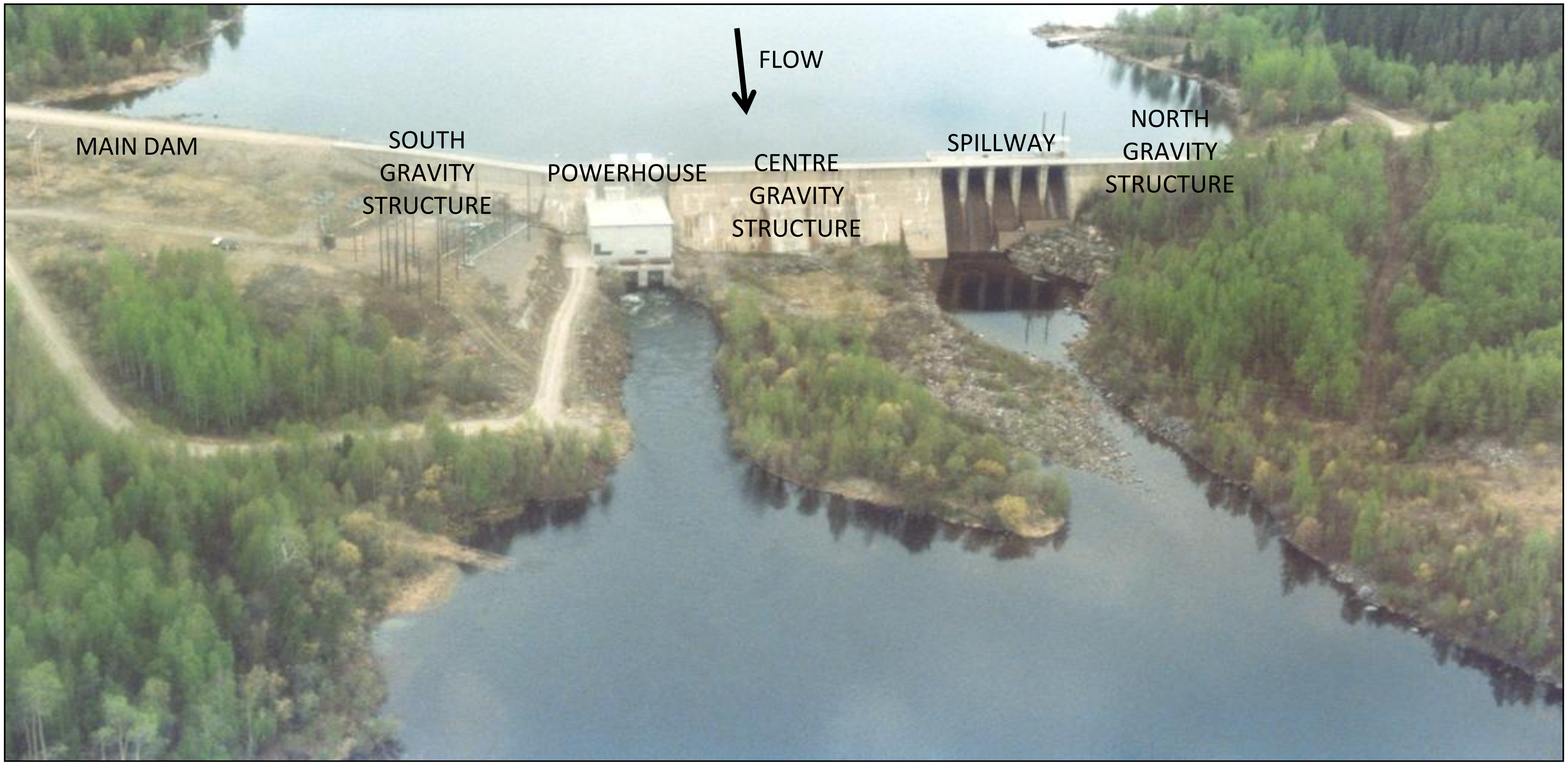
WATERWAY APPROVALS AND MONITORING

LAURIE RIVER #1 GS

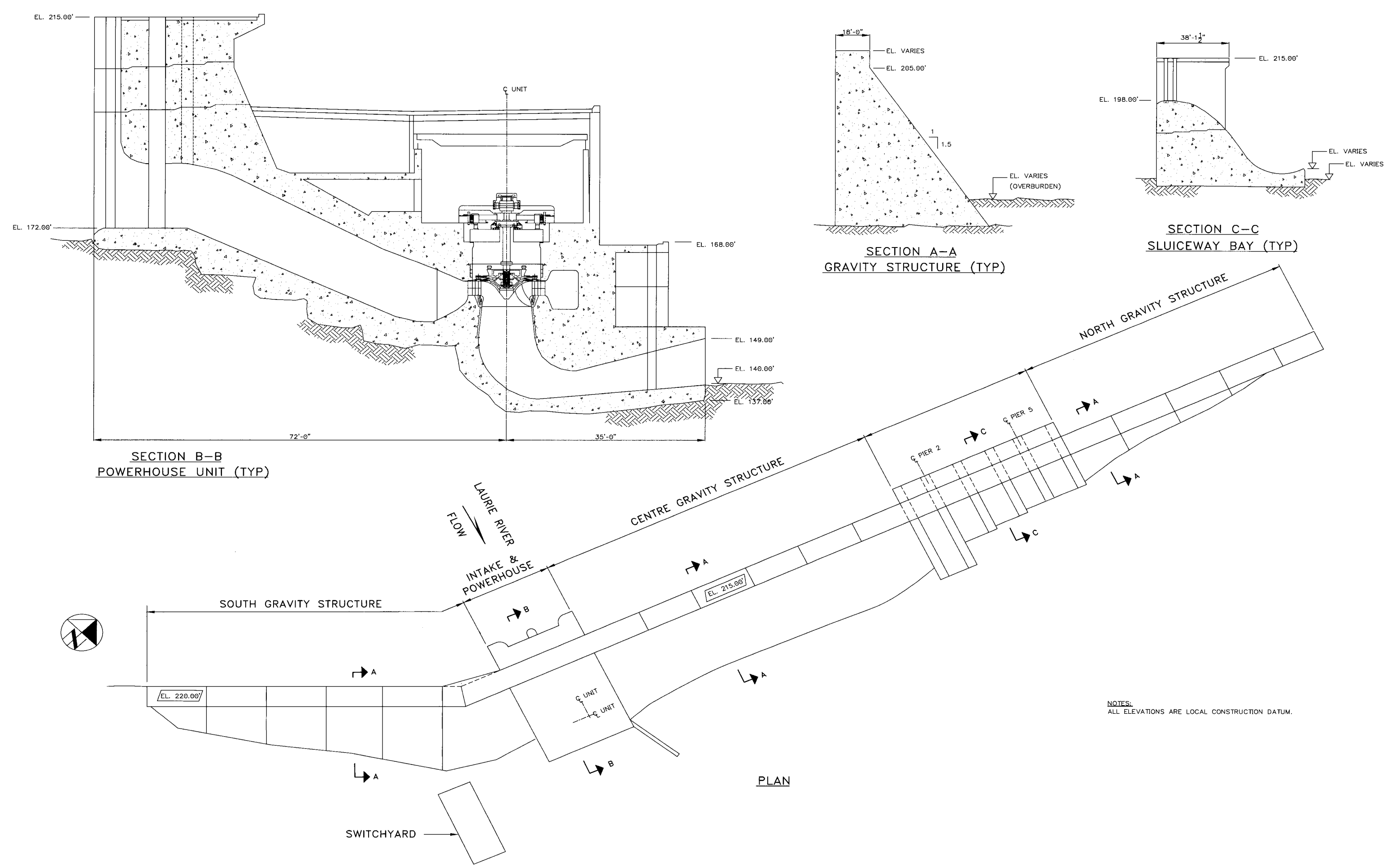
DAILY FOREBAY ELEVATIONS (2021)

PROJECT
Water Levels and Flows Report

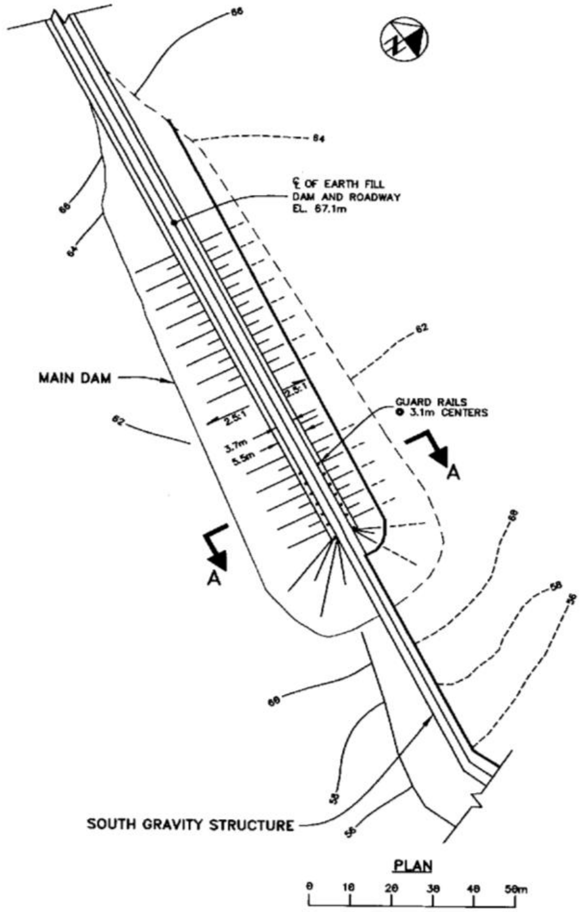
FIGURE N-4

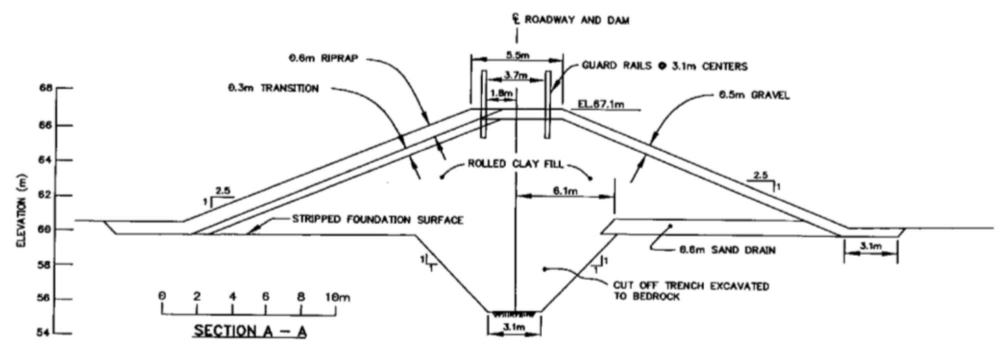


Manitoba Hydro	MANITOBA HYDRO
	WATERWAY APPROVALS AND MONITORING
	LAURIE RIVER #2 GENERATING STATION
	PHOTOGRAPH OF GENERATING STATION
	PROJECT WATER LEVELS AND FLOWS REPORT — FIGURE N-5

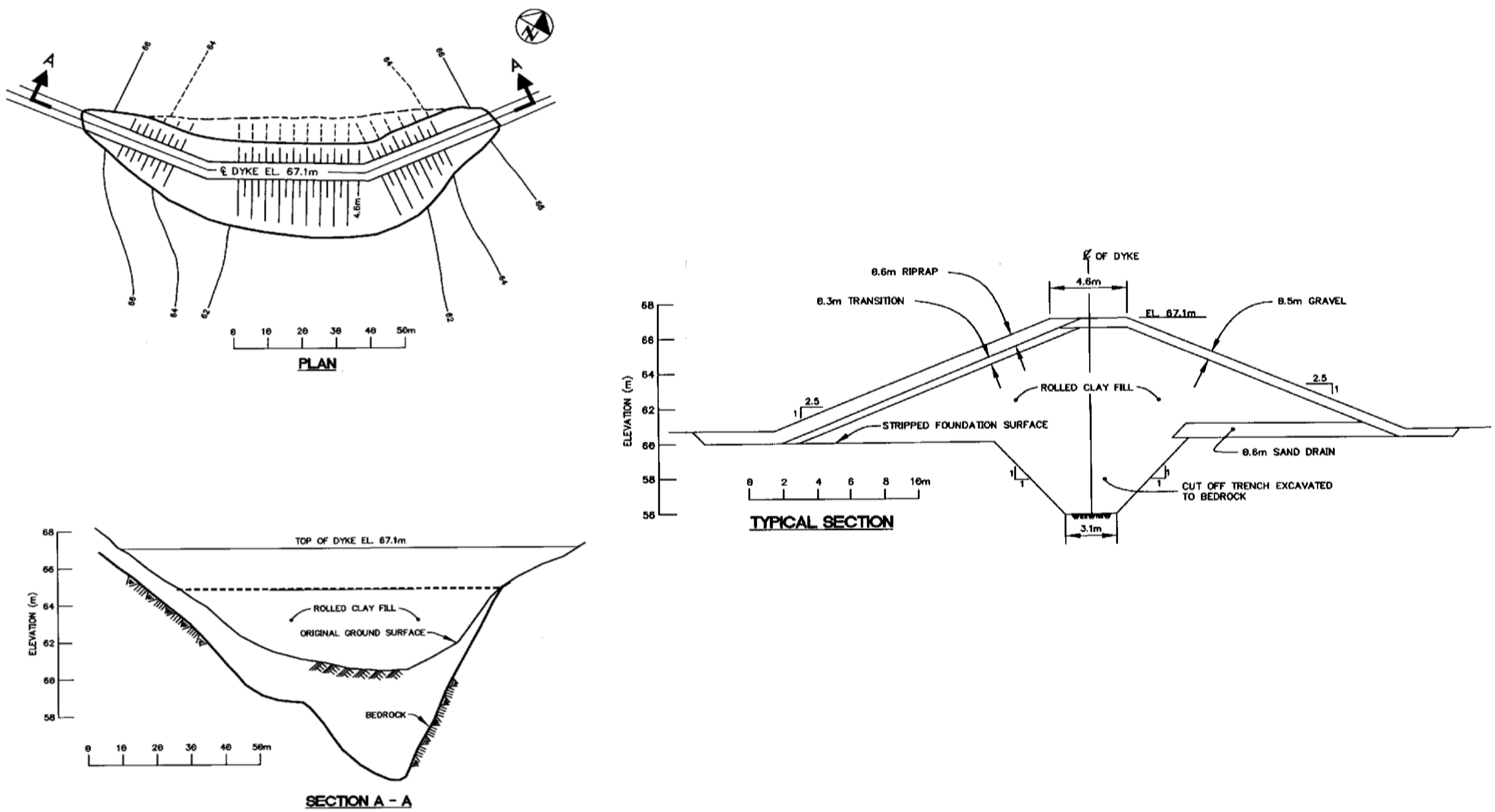


Manitoba Hydro	MANITOBA HYDRO
	WATERWAY APPROVALS AND MONITORING
	LAURIE RIVER #2 GENERATING STATION
	GENERAL ARRANGEMENT
	PROJECT WATER LEVELS AND FLOWS REPORT — FIGURE N-6

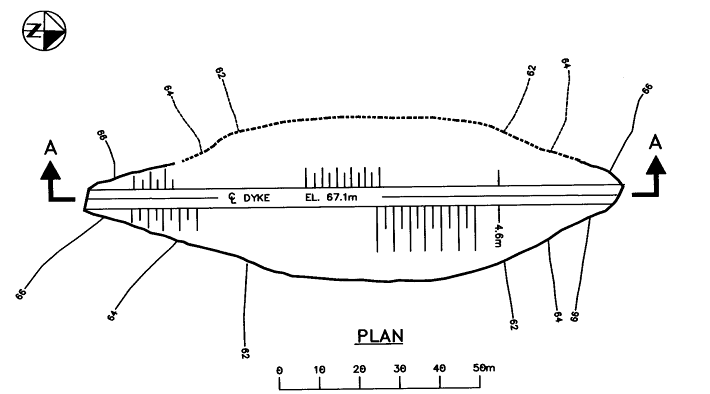




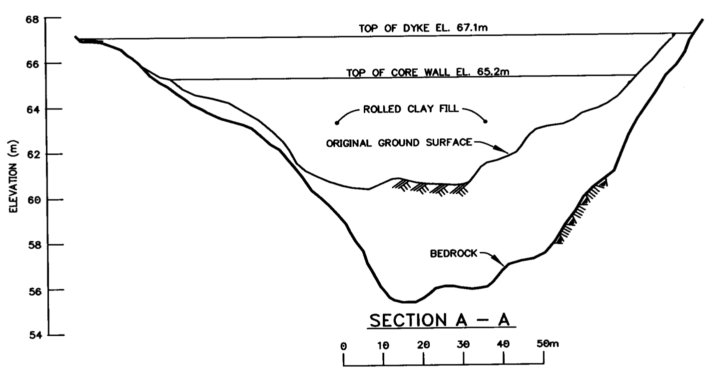
Manitoba Hydro	MANITOBA HYDRO
	WATERWAY APPROVALS AND MONITORING
	LAURIE RIVER #2 GENERATING STATION
	MAIN DAM GENERAL ARRANGEMENT
	PROJECT WATER LEVELS AND FLOWS REPORT — FIGURE N-7



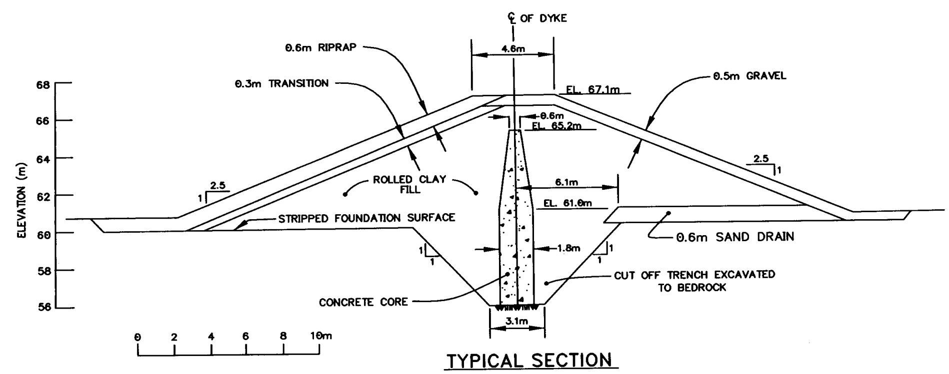
Manitoba Hydro	MANITOBA HYDRO
	WATERWAY APPROVALS AND MONITORING
	LAURIE RIVER #2 GENERATING STATION
	DYKE A GENERAL ARRANGEMENT
	PROJECT WATER LEVELS AND FLOWS REPORT — FIGURE N-8



PLAN

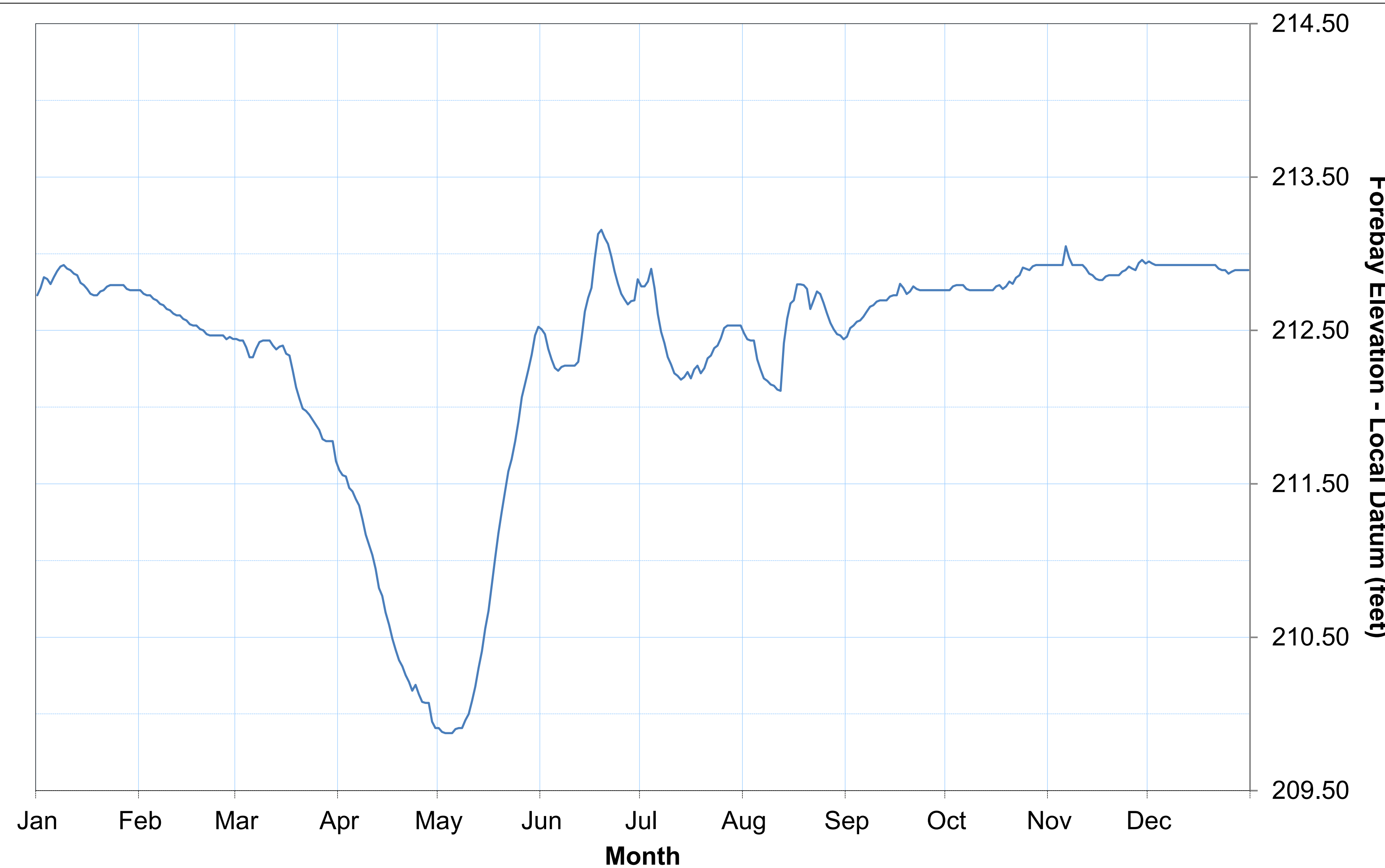


SECTION A – A



TYPICAL SECTION

Manitoba Hydro	MANITOBA HYDRO	
	WATERWAY APPROVALS AND MONITORING	
	LAURIE RIVER #2 GENERATING STATION	
	DYKE B GENERAL ARRANGEMENT	
	PROJECT WATER LEVELS AND FLOWS REPORT	FIGURE N-9



Daily Averaged Lake Elevation (Local Datum) Statistics 1970 - 2021

Maximum	**= 214.80 feet**
Minimum	**= 206.40 feet**
Mean	**= 212.38 feet**

Manitoba Hydro

MANITOBA HYDRO

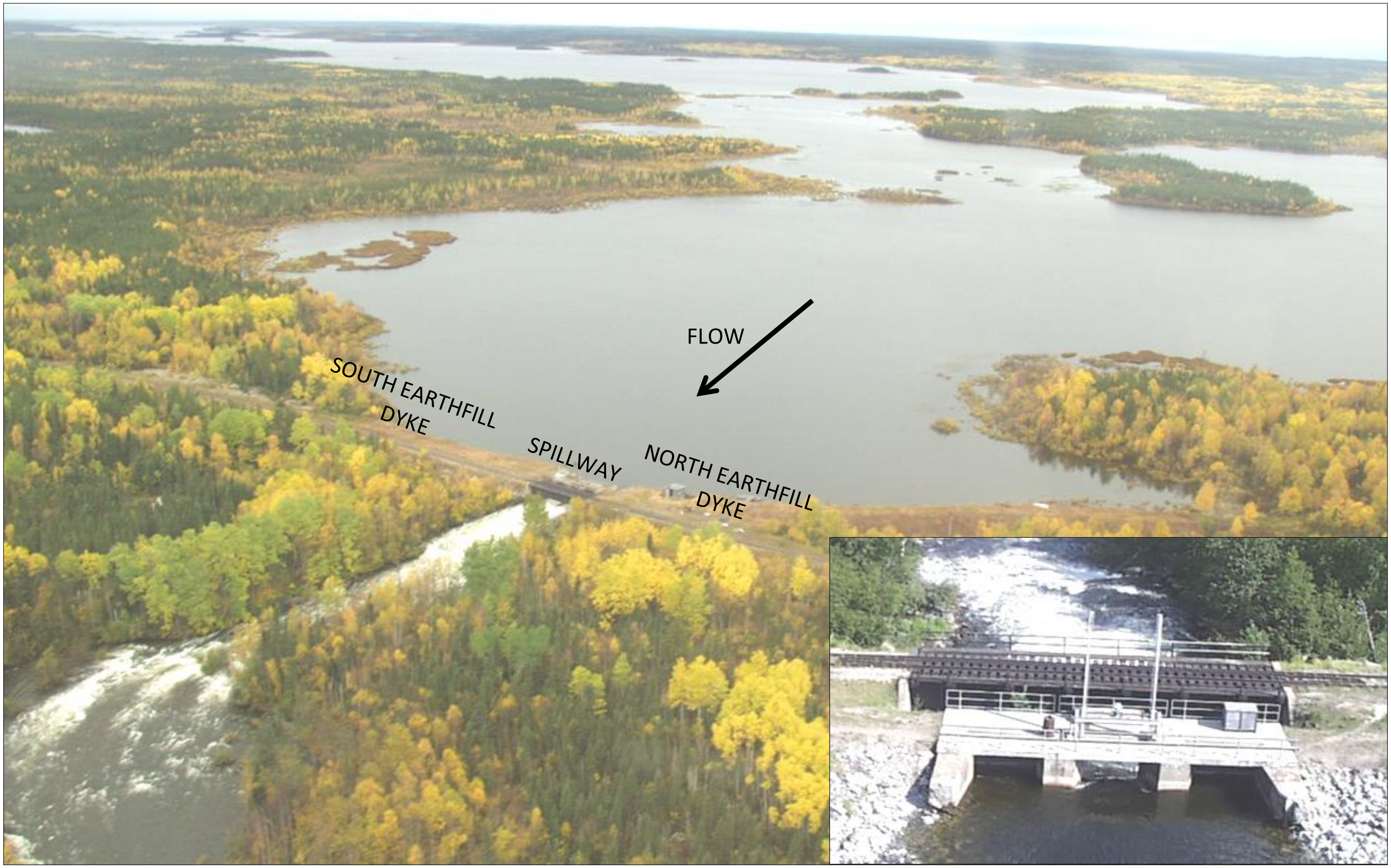
WATERWAY APPROVALS AND MONITORING

LAURIE RIVER #2 GS

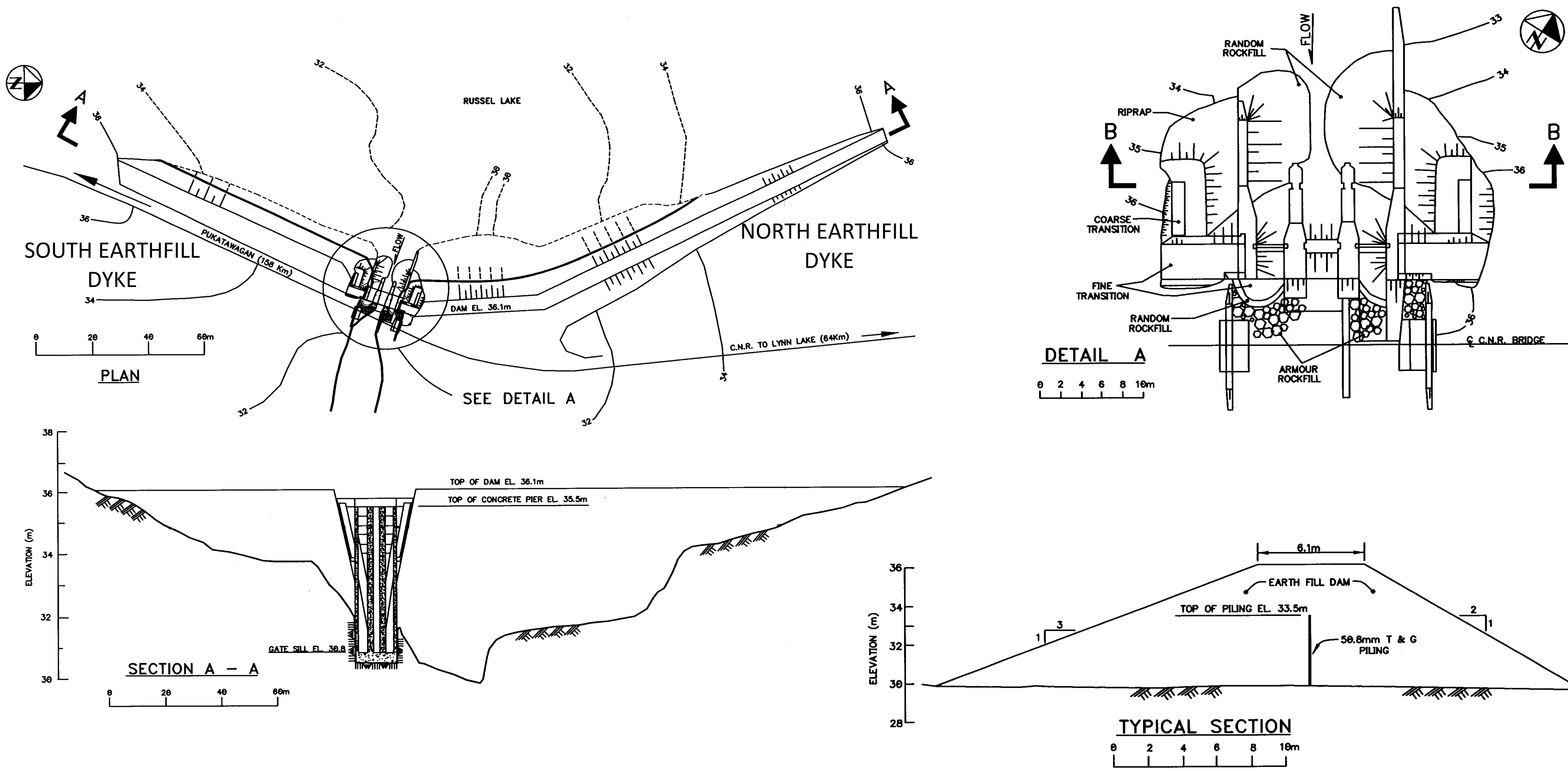
DAILY FOREBAY ELEVATIONS (2021)

PROJECT
Water Levels and Flows Report

FIGURE N-10



MANITOBA HYDRO	
WATERWAY APPROVALS AND MONITORING	
RUSSELL LAKE CONTROL DAM	
PHOTOGRAPH OF CONTROL STRUCTURE	
PROJECT WATER LEVELS AND FLOWS REPORT	FIGURE N-11



Manitoba Hydro	MANITOBA HYDRO
	WATERWAY APPROVALS AND MONITORING
	RUSSELL LAKE CONTROL DAM
	GENERAL ARRANGEMENT
	PROJECT WATER LEVELS AND FLOWS REPORT — FIGURE N-12

Daily Averaged Lake Elevation (Local Datum) Statistics 1961 - 2021

Maximum	**= 115.25 feet**
Minimum	**= 104.20 feet**
Mean	**= 110.10 feet**

Manitoba Hydro

MANITOBA HYDRO

WATERWAY APPROVALS AND MONITORING

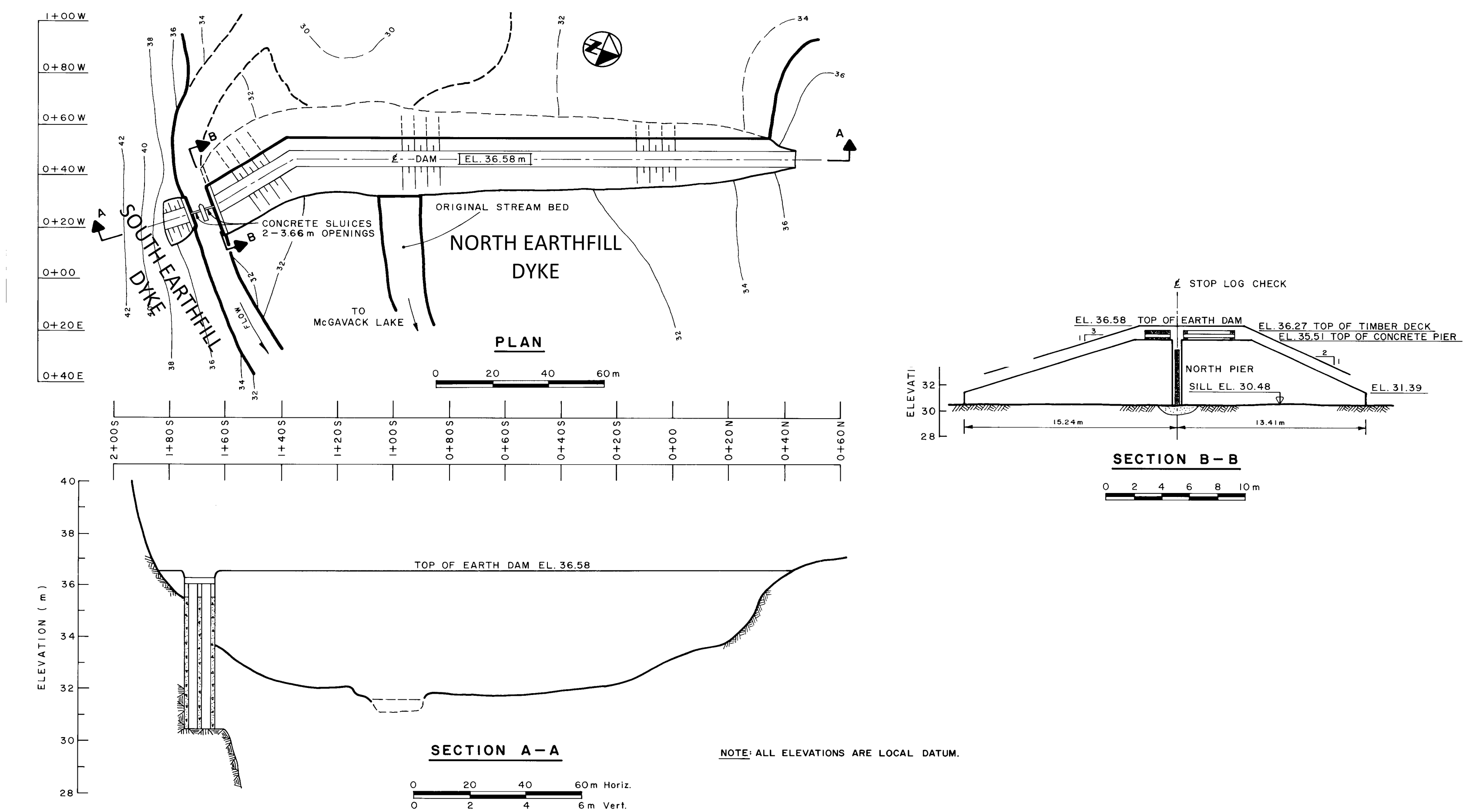
RUSSELL LAKE

DAILY LAKE ELEVATIONS (2021)

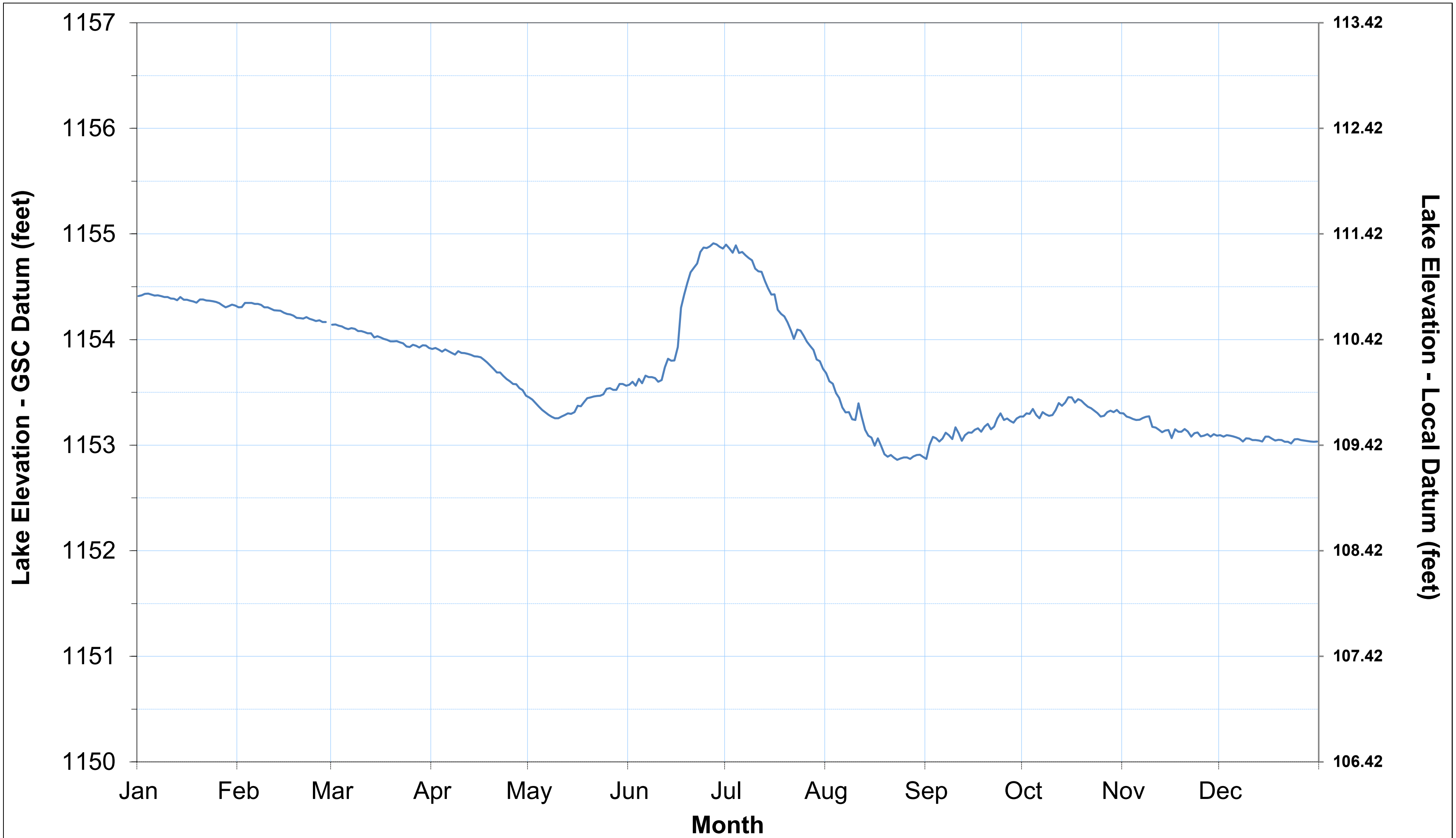
PROJECT
Water Levels and Flows Report

FIGURE N-13

Manitoba Hydro	MANITOBA HYDRO
	WATERWAY APPROVALS AND MONITORING
	EAGER LAKE CONTROL DAM
	PHOTOGRAPH OF CONTROL STRUCTURE
	PROJECT WATER LEVELS AND FLOWS REPORT — FIGURE N-14



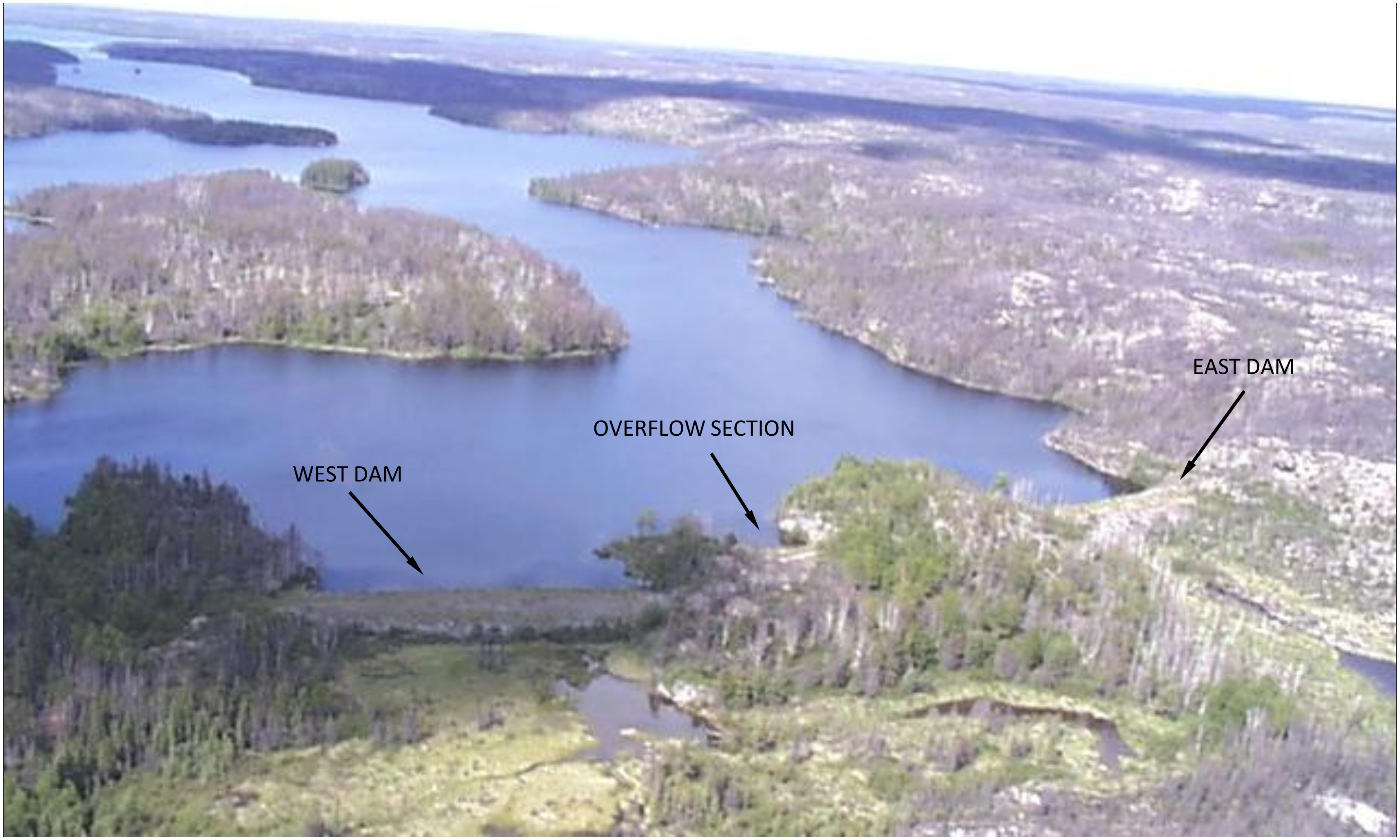
MANITOBA HYDRO	
WATERWAY APPROVALS AND MONITORING	
EAGER LAKE CONTROL DAM	
GENERAL ARRANGEMENT	
PROJECT WATER LEVELS AND FLOWS REPORT	FIGURE N-15



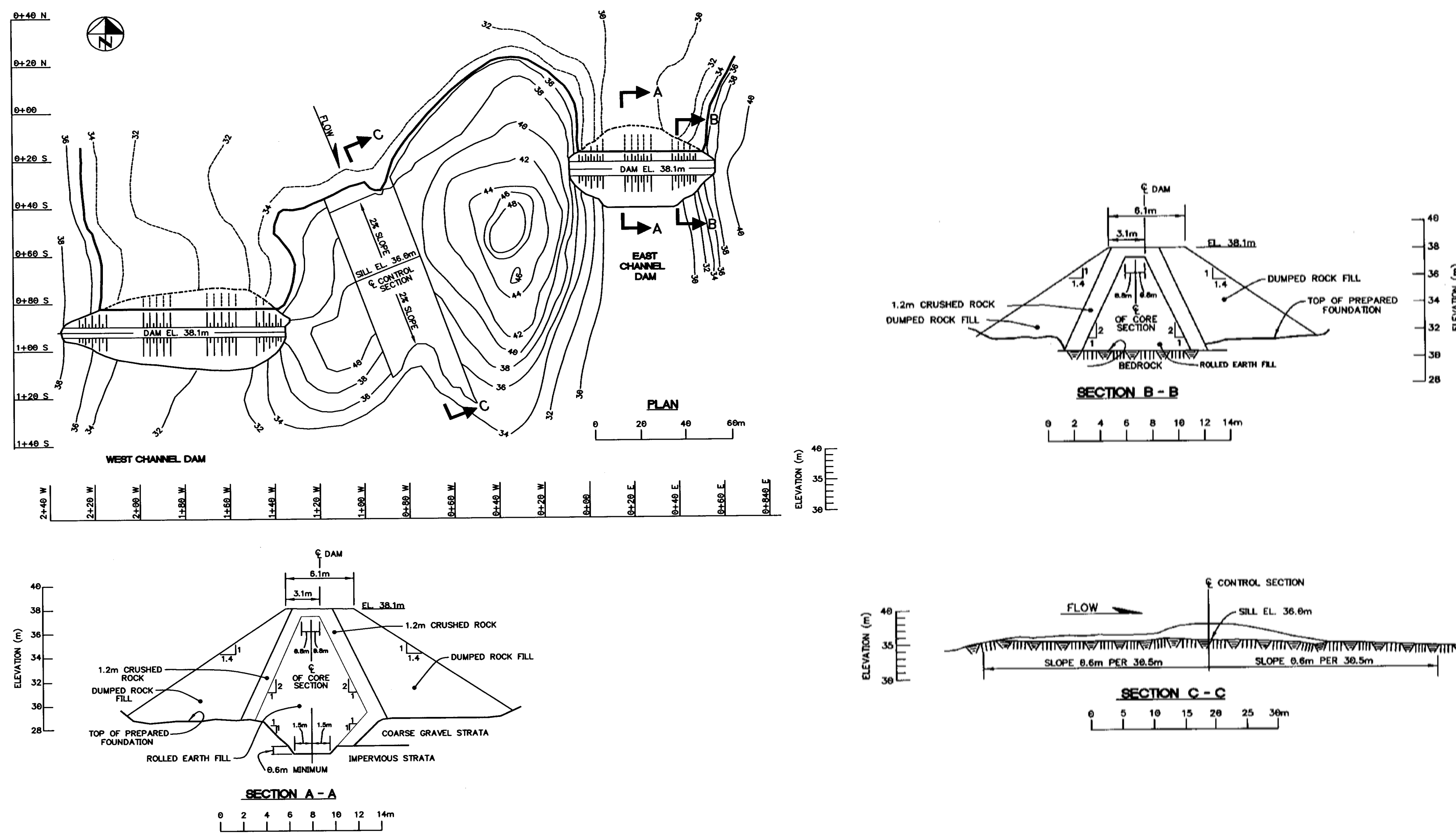
Daily Averaged Lake Elevation (Local Datum) Statistics 1970 - 2021

Maximum = 114.99 feet
Minimum = 105.71 feet
Mean = 109.31 feet

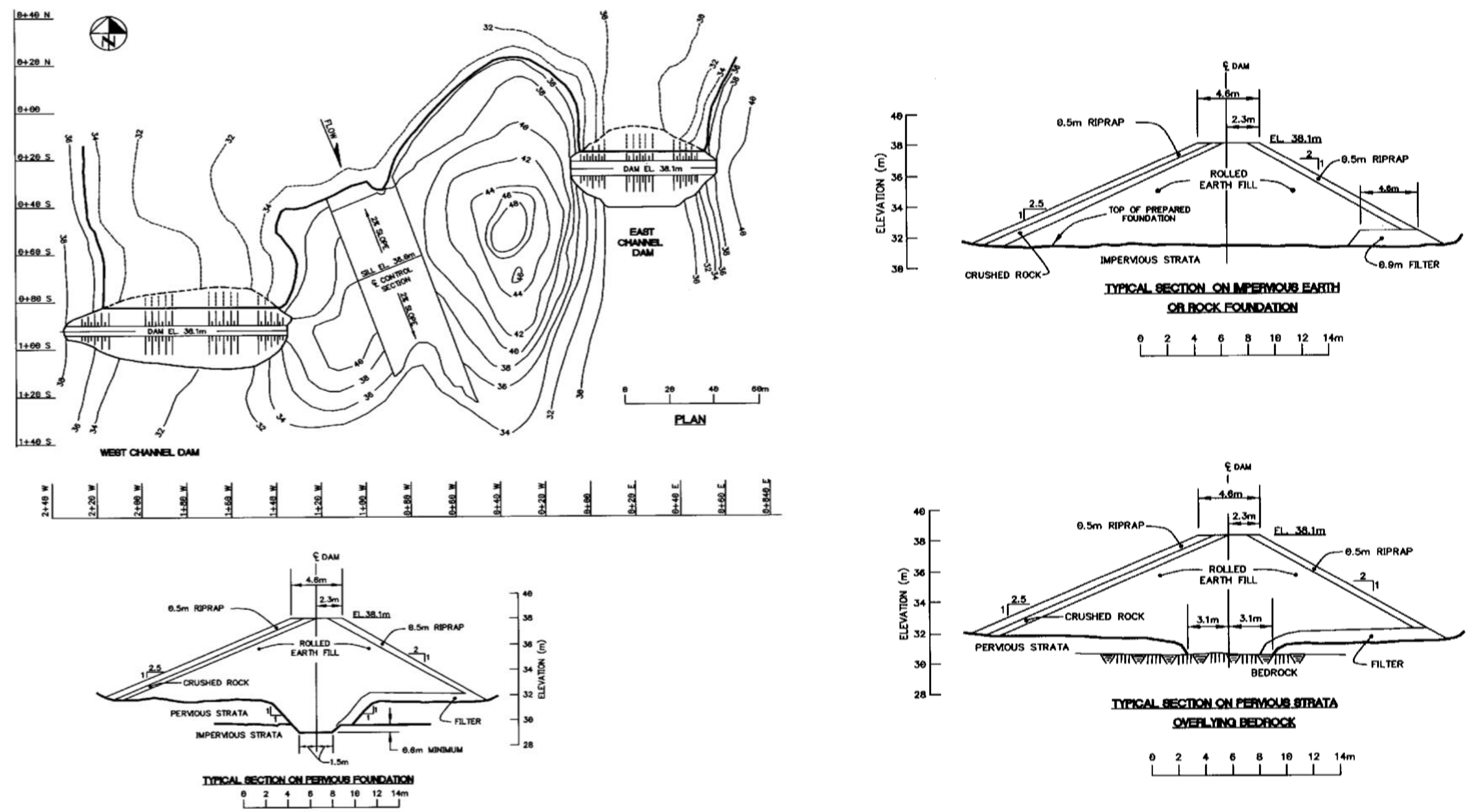
Manitoba Hydro	MANITOBA HYDRO
	WATERWAY APPROVALS AND MONITORING
	EAGER LAKE
	DAILY LAKE ELEVATIONS (2021)
PROJECT Water Levels and Flows Report	FIGURE N-16



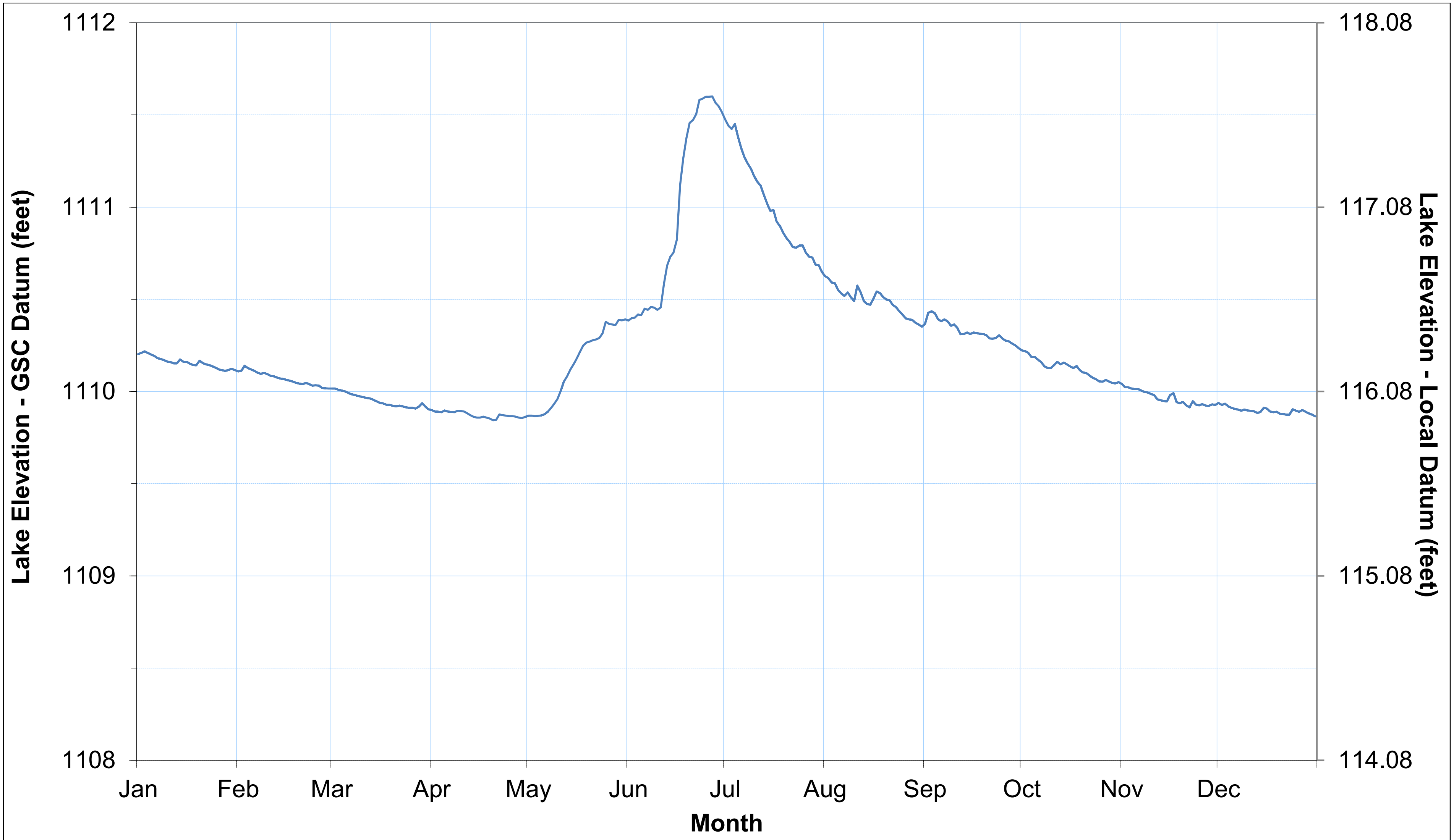
Manitoba Hydro	MANITOBA HYDRO
	WATERWAY APPROVALS AND MONITORING
	LOON LAKE CONTROL DAM
	PHOTOGRAPH OF CONTROL STRUCTURE
	PROJECT WATER LEVELS AND FLOWS REPORT — FIGURE N-17



Manitoba Hydro	MANITOBA HYDRO
	WATERWAY APPROVALS AND MONITORING
	LOON LAKE EAST DAM
	GENERAL ARRANGEMENT
	PROJECT WATER LEVELS AND FLOWS REPORT — FIGURE N-18



Manitoba Hydro	MANITOBA HYDRO
	WATERWAY APPROVALS AND MONITORING
	LOON LAKE WEST DAM
	GENERAL ARRANGEMENT
	PROJECT WATER LEVELS AND FLOWS REPORT — FIGURE N-19



Daily Averaged Lake Elevation Statistics 1999 - 2021

Maximum	**= 1112.07 feet**
Minimum	**= 1109.26 feet**
Mean	**= 1109.92 feet**

Manitoba Hydro	MANITOBA HYDRO
	WATERWAY APPROVALS AND MONITORING
	LOON LAKE NEAR LOON RIVER DAM
	DAILY LAKE ELEVATIONS (2021)
PROJECT Water Levels and Flows Report	FIGURE N-20

Laurie River Development 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	2
	Routine inspection of LR 2 embankments dams	Site - Utility	11	12
	Routine inspection of other embankment and concrete dams (Russell, Eager, Loon River weir, ECD and WCD)	Site - Utility	2	2
	Routine inspection of LR 1 concrete dams	Site - Utility	6	6
	Routine inspection of LR 2 concrete dams	Site - Utility	6	6
	Hydraulic conditions inspection	Dam Safety	1	1
Analyses	Engineering analyses (Embankment Dams)	Dam Safety	1	1
	Instrumentation data review (Concrete Dams)	Dam Safety	2	2
Maintenance and Testing	Spillway stoplog hoist functional testing station 1	Site - Elec	1	1
	Spillway stoplog hoist functional testing station 2	Site – Elec	1	1
	Spillway stoplog hoist maintenance Station 1	Site - Elec	1	1
	Spillway stoplog hoist maintenance Station 2	Site - Elec	1	1
	Spillway stoplog hoist maintenance Station 1	Site - Mech	1	1
	Spillway stoplog hoist maintenance Station 2	Site - Mech	1	1
	Eager CS hoist maintenance	Site - Mech	1	1
	Russell CS hoist maintenance	Site - Mech	1	1
Program	Dam Safety EPP - updates	Dam Safety	-	-
	Laurie River 1 - Dam Safety Reference Manual - Revision	Dam Safety	-	-
	Laurie River 2 - Dam Safety Reference Manual - Revision	Dam Safety	-	-
	Delivered DS Training - Routine Inspections	Dam Safety	0	As required
	Delivered DS Training - Emergency Preparedness	Dam Safety	0	As required

APPENDIX O

MANITOBA HYDRO'S CONTAMINATED SITES MANAGEMENT SUMMARY AND MAJOR PROJECTS RELATED TO WATER POWER

MANITOBA HYDRO'S CONTAMINATED SITES MANAGEMENT

SUMMARY AND MAJOR PROJECTS RELATED TO WATER POWER

Potentially Contaminated Sites Management Program Background

In 1996, the Potentially Contaminated Sites Management (PCSM) Program was initiated to manage the Corporation's environmental liability associated with sites that were contaminated by past activities. The Program includes surplus and orphaned sites, and maintains a database of environmental information for over 1,000 current and former sites, owned or operated by Manitoba Hydro.

The Corporation's philosophy for the Program is to provide a long-term annual budget to proactively identify, assess, and remediate sites on a priority basis based on the following factors: risk to environmental and/or human health, divestment of property, transfer of Northern Flood Agreement (NFA) Land Selection Areas/Treaty Entitlement Lands, changes in land-use at or near the site, elevated strategic importance to the Corporation, and to address potential issues ahead of increasingly stringent environmental legislation. Potentially contaminated sites had been identified by a number of means including review of historic records, consultation with local community and First Nation members, and interviews with former Manitoba Hydro and/or contractor employees. The Program is now focused on prioritizing sites and undertaking assessment and remediation activities.

The assessment and remediation of contaminated sites is governed by Manitoba's *Contaminated Sites Remediation Act* (CSRA), and associated regulations and guidelines. Environmental site assessment, remedial action plans, and remedial closure reports are submitted to Environment, Climate and Parks' Contaminated/Impacted Sites Program's Contaminated Sites Specialist for review and/or approval. Crown Work Permits are applied for and approved annually by Regional Environment, Climate and Parks Offices prior to any site work, as required.

Approximately $23.6 M to date since 2001, has been devoted to PCSM Program activities. Due to their scale, cost, and/or level of stakeholder engagement, larger projects are managed outside of the PCSM Program. Two of these are related to Water Power licensing including Two and Eight Mile Channel Remediation and the South Bay Channel Remediation Project.

Two and Eight Mile Channel Remediation

Manitoba Hydro has been actively investigating and remediating the Two and Eight Mile Channel sites since 2001. Intensive surficial debris clean-ups were completed by Norway House Cree Nation's (NHCN) contractors in the early 2000's, with subsurface investigations taking place in the mid-2000's, remediation beginning in 2008, and the construction of a soil treatment facility at Eight Mile Channel. A geomagnetic survey was conducted from 2016 to 2020 and will continue through 2022/23 at Two and Eight Mile Channel to identify construction-related debris. A subsequent debris removal program was initiated in 2019 and will continue through 2022/23. Remediation continued at Eight Mile Channel in 2019 and will continue into 2022. A soil treatment facility was constructed at Two Mile Channel in 2021. Remediation commenced in 2021 and is planned to continue through 2022/23.

Manitoba Hydro works collaboratively with NHCN leadership on all environmental related projects within the Cree Nation's Resource Management Area (RMA) to plan and execute all environmental work within the NHCN RMA. Formal meetings and presentations are held with NHCN leadership at least twice per year to discuss current and planned activities within the RMA.

Approximately $59 M has been spent to date since 2000 on remedial and debris clean-up activities at Two and Eight Mile Channel, and $20 M is projected for continued remedial activities from 2022/23 to 2027/28.

South Bay Diversion Channel Remediation Project

Historical activities during the construction of the South Bay Diversion Channel at Southern Indian Lake, located approximately 30 km South of O-Pipon-na-Piwin Cree Nation (OPCN), in the 1970's, resulted in the contamination of soil and the presence of residual construction debris at the former South Bay Channel area. In 2005 and 2006, geophysical surveys were conducted in the South Bay area to determine the presence of former construction debris. In 2007, an extensive intrusive environmental investigation was conducted at eighteen sites to assess and delineate soil and groundwater impacts and buried waste materials, and a remedial action plan was created. In 2008, an extensive clean-up of surficial waste materials was undertaken by OPCN's contracting company, South Bay Construction. The near-decade following, included extensive communication and negotiations with OPCN regarding the siting of the proposed soil treatment facility and additional non-intrusive investigations to ensure that all potentially impacted areas are included in future on-site investigations and the subsequent Remedial Plan.

Remediation activities include the design and construction of a soil treatment facility to treat contaminated soils and/or sediments, excavation and disposal of debris, access road updates and maintenance, and operation of the soil treatment facility. An additional environmental soil investigation commenced in 2021 and will continue through 2022/23 to complete the delineation of soil and/or sediment impacts, and a Remedial Plan will be authored and submitted to Manitoba Conservation and Climate along with the soil treatment facility design for their review and approval.

The remediation project also comprises several planned benefits for OPCN including the engagement of OPCN's joint venture construction company. Additionally, the greater community will be engaged through educational and capacity building opportunities throughout the duration of the project. Manitoba Hydro requests that representatives of OPCN are on-site during all project activities.

Approximately $1.4 M has been spent to date since 2009 on environmental investigation and debris clean-up activities at the South Bay Channel area, and approximately $ 13.1M is projected for continued remedial activities from 2022/23 to 2029/30.