Manitoba Hydro

Wastewater Treatment Lagoon Laurie River Generating Stations – Environment Act Proposal

Prepared by:

AECOM
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Project Number:

60265529

Date:

December 2012

APEGM
Certificate of Authorization
AECOM Canada Ltd.
No. 4671 Date: December 19, 2012

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December 19, 2012

Tracey Braun, M.Sc.
Director, Environmental Assessment and Licensing
Manitoba Conservation and Water Stewardship
123 Main Street
Ste. 160 Union Station,
Winnipeg, MB R3C 1A5

Dear Ms. Braun:

Project No: **60265529.400**

Regarding: **Environment Act Proposal for Laurie River Generating Station Lagoon**

Please find enclosed 7 hard copies and 7 electronic copies of the *Environment Act* Proposal form and supporting information to obtain approval for the construction and operation of a new lagoon and related infrastructure at Manitoba Hydro's Laurie River Main Camp and Generating Stations filed on behalf of Manitoba Hydro. We understand that the proposed project is a Class II development under the Classes of Development Regulation and have accordingly included a cheque in the amount of $5,000 to cover the application fee. We trust that the information on the form and the attached supporting information is sufficient. Should you have any questions regarding the project or the attached information please do not hesitate to contact us.

Sincerely,
AECOM Canada Ltd.

Paul Barsalou

Paul Barsalou, M.Sc, P.Eng.
Project Engineer

AW:td
Encl.
cc: Manitoba Hydro

Distribution List

# of Hard Copies	PDF Required	Association / Company Name
4	1	Draft Report
6	25	Final Report – Manitoba Conservation and Water Stewardship
4	4	Final Report – Manitoba Hydro

Revision Log

Revision #	Revised By	Date	Issue / Revision Description
1	AW	December 2012	Final

AECOM Signatures

Report Prepared By:

Alison Weiss, P.Eng.
Environmental Engineer

Report Reviewed By:

Stephen J. Biswanger, P.Eng.
Manager, Remediation, Impact Analysis & Approvals, Environment

Print Form

Environment Act Proposal Form

Name of the development: Wastewater Treatment Lagoon Laurie River Generating Stations	
Type of development per Classes of Development Regulation (Manitoba Regulation 164/88): Class 2	
Legal name of the proponent of the development: Manitoba Hydro	Mailing address: PO BOX 815 STN MAIN Winnipeg, MB R3C 2P4
Location (street address, city, town, municipality, legal description) of the development: See attached Land Title Application	
Name of proponent contact person for purposes of the environmental assessment: Mr.Trevor Ouellette, P.Eng.	
Phone: 204-360-7217 Fax: 204-360-6143	Mailing address: Manitoba Hydro, Power Projects 360 Portage Avenue, 20th Floor Winnipeg, Manitoba, R3C 2P4
Email address: touellette@hydro.mb.ca	
Webpage address:	
Date: DEC 18, 2012	Signature of proponent, or corporate principal of corporate proponent: Trevor Ouellette Printed name: TREVOR OUELLETTE

A complete **Environment Act Proposal (EAP)** consists of the following components:

- **Cover letter**
- **Environment Act Proposal Form**
- **Reports/plans supporting the EAP** (see "Information Bulletin - Environment Act Proposal Report Guidelines" for required information and number of copies)
- **Application fee** (Cheque, payable to Minister of Finance, for the appropriate fee)

Per Environment Act Fees Regulation (Manitoba Regulation 168/96):

Class 1 Developments	$500
Class 2 Developments	$5,000
Class 3 Developments:	
Transportation and Transmission Lines	$5,000
Water Developments	$50,000
Energy and Mining	$100,000

Submit the complete EAP to:

Director
Environmental Assessment and Licensing Branch
Manitoba Conservation
Suite 160, 123 Main Street
Winnipeg, Manitoba R3C 1A5

For more information:
Phone: (204) 945-7100
Fax: (204) 945-5229
Toll Free: 1-800-282-8069, ext. 7100
http://www.gov.mb.ca/conservation/eal

0733 Rev 12 06
v1.1

EASEMENT AND LAND PURCHASE OR LEASE REQUEST

SAP REFERENCE		
WBS	Order or Network no. *	Network Activity *
P	240374	2010

PROJECT DESCRIPTION:

Project description *
Construction of a Lagoon and associated works for Laurie River Generating Station Camp site.

Purpose (MUST check at least one box in either Hydro or Gas section)

HYDRO: ☐ Transmission Line ..... kV ☒ Site ☐ Fibre Optic
☐ Sub-Transmission Line ..... kV ☐ Distribution Line ..... kV
☐ Budget Estimate ☐ Retracement

GAS: ☐ Transmission Line ..... mm ☐ Distribution Line ..... mm
☐ Service Line ..... mm ☐ Site

Particulars ☐ Overhead ☐ Underground

Joint Use * (MUST check at least one box; if Yes, then complete contact/company name)
MTS: ☐ Yes - ..... MTS CONTACT
☒ No
CABLE: ☐ Yes - ..... COMPANY NAME
☒ No

Method of acquisition ☐ Easement ☐ Purchase ☐ Lease ☒ Permit

Crossing approvals ☐ Pipeline ☐ Railway ☐ Navigable Waters

Permits required ☐ Access road ☒ Other, specify: Construction of a lagoon

PROPERTY DESCRIPTION:

City or municipality		Town or village: Laurie River Generating Station Camp Site	
Portion	Lot	Block	Plan: 36332 / 5751
Portion	Section	Township: 83	Range: 23 W
Portion	River Lot	Parish	

Latitude/longitude: 56 - 12' - 20" N 101 - 01' - 25" W

Physical description
Length: 230 meters Width: 180 meters * Drawing Reference no.: see attached

Special remarks
See attached figures 1, 2 and 3. Area is +\- 5.3 Ha which includes lagoon, influent line, effluent ditch and axcess road

REQUIRED BY yyyy mm dd	Requested by *	yyyy mm dd	Phone no. *	Organization unit title
2012 12 31	Trevor Ouellette	2012 12 14	360-7217	Power Supply
			Department: Power Projects	

Authorized by (Design Section Head or Delegate)	yyyy mm dd	Approved by (Property Department)	yyyy mm dd

CONFIRMATION OF LAND ACQUISITION:

FOR PROPERTY USE ONLY

This is to confirm the land acquisition requested above has been completed subject to the following conditions

File no.	Confirmed by (Property Department)	yyyy mm dd

DISTRIBUTION:

NAME - REGION

NAME - AREA

D.O. - DISTRICT

GAS DESIGN

Project Management Initials: ____ Designer: ____ Checked: ____ Approved: ____ ANSI D 558.8mm x 863.6mm

N

KAYKAYK LAKE

GRANVILLE LAKE

LAND TITLE FOR THIS AREA

RAIL LINE

AIRPORT

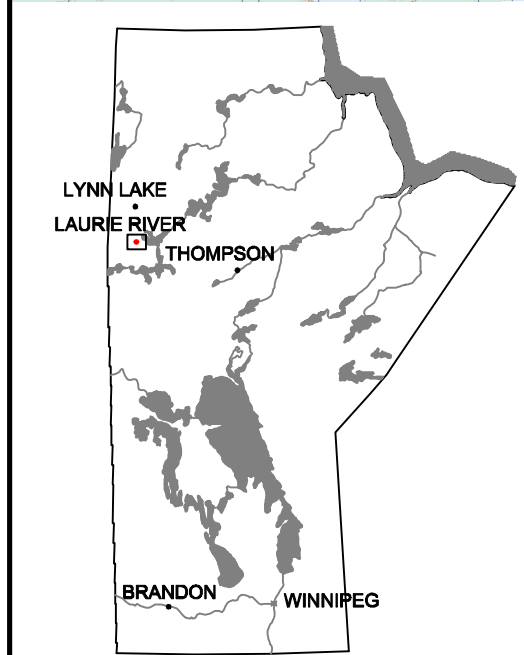
LAURIE RIVER
GENERATING STATION 2
56° 15' 12" N, 101° 07' 00" W

TROPHY LAKE

LAURIE RIVER

LAURIE RIVER
GENERATING STATION 1
56° 12' 20" N, 101° 01' 25" W

REID LAKE



GENERATING STATION 1

0 1250 2500 m

Issue Status: FUNCTIONAL

AECOM

Figure: 01

LAURIE RIVER
LOCATION PLAN

Manitoba Hydro
Laurie River Generating Stations 1 & 2
Wastewater Upgrades
Project No.: 60265529 Date: 2012-11-06

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Filename: P:\60265529\000-CADD\02-SHEETS\C\00\F-20-0001_LANDTITLES.DWG

Project Management Initials: Designer: ____ Checked: ____ Approved: ____ ANSI D 558.8mm x 863.6mm

N

N.W. QUARTER
SEC. 27
TP. 83, RGE. 23W.

N.E. QUARTER
SEC. 27
TP. 83, RGE. 23W.

S.W. QUARTER
SEC. 27
TP. 83, RGE. 23W.

S.E. QUARTER
SEC. 27
TP. 83, RGE. 23W.

PROPOSED BOUNDARY (TYP)

MANITOBA HYDRO
BENCHMARK
98mh24
6232968.114
375481.323
293.053

LAURIE RIVER MAIN CAMP

69 HYDRO LINE

N:6232972.723
E:375506.798

LAURIE RIVER
GENERATING STATION 1

N:6232944.649
E:375496.220

BENCHMARK

LAURIE RIVER

MANITOBA HYDRO
BENCHMARK
98mh25
6232918.025
375565.439
297.055

N:6232989.620
E:375804.981

N:6232925.776
E:375974.428

PROPOSED
CONSTRUCTION LIMITS

N:6232876.441
E:375762.338

N:6232848.368
E:375751.760

N:6232831.868
E:375939.046

N:6232802.049
E:375927.811

PROPOSED
EFFLUENT DITCH

EXISTING SLOUGH

N:6232759.579
E:375766.849

N:6232711.751
E:375893.789

N:6232716.085
E:376075.353

N:6232713.712
E:375701.025

N:6232693.220
E:376055.931

PROPOSED
LAGOON ACCESS ROAD

N:6232670.041
E:375733.113

EXISTING TRAIL

NATURAL DRAINAGE
TO LAURIE RIVER

0 50 100 m
1:2000

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Issue Status: FUNCTIONAL

AECOM

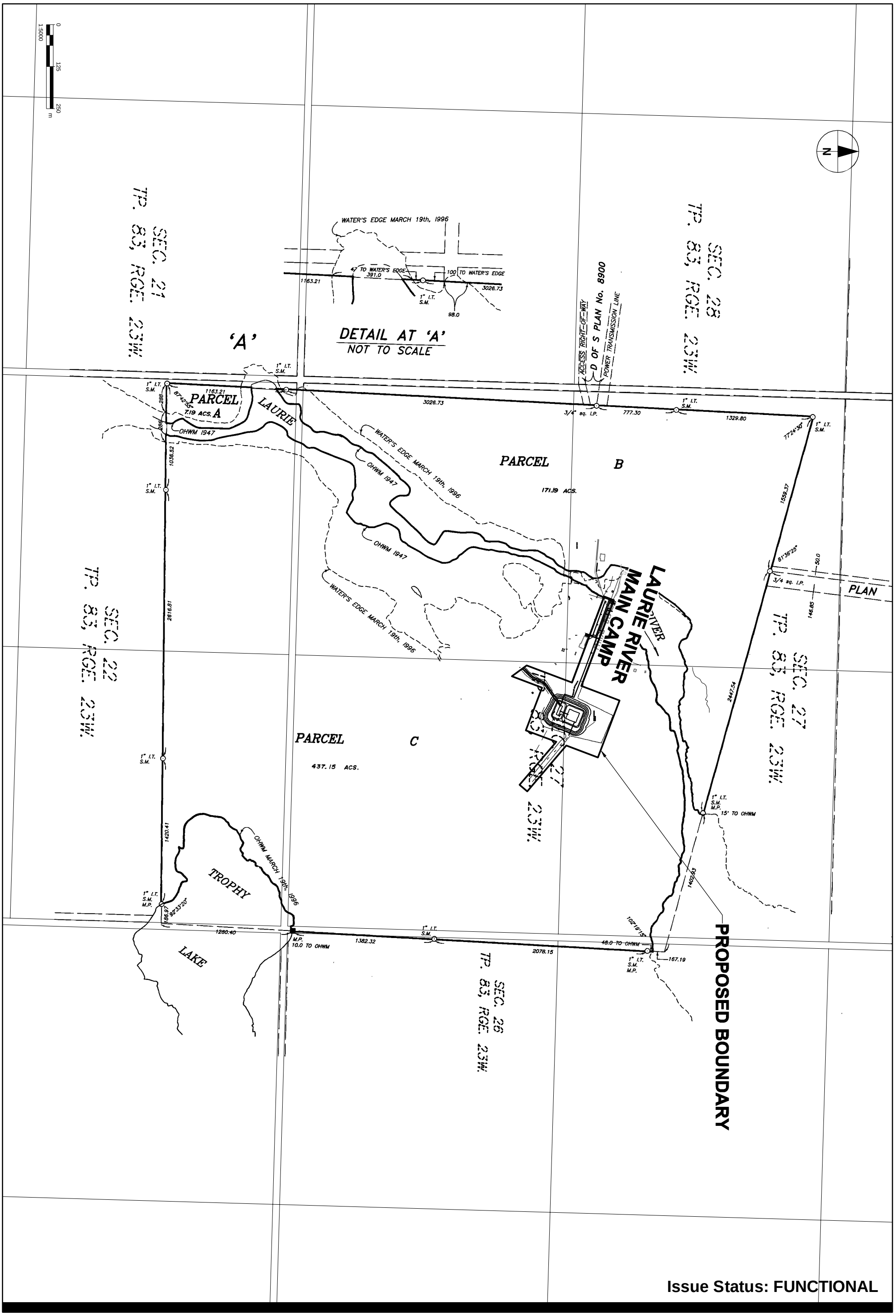
Figure: 02

LAURIE RIVER
SITE PLAN
PROPOSED LAGOON BOUNDARY

Manitoba Hydro
Laurie River Generating Stations 1 & 2
Wastewater Upgrades
Project No.: 60265529 Date: 2012-11-05

Last saved by: GRAHNG (2012-12-12) Last Plotted: 2012-12-12
Filename: P:\60265529\000-CADD\02-SHEETS\C\00\F-20-0003_LANDTITLES.DWG

Project Management Initials: Designer: ____ Checked: ____ Approved: ____ ANSI D 558.8mm x 863.6mm



Manitoba Hydro
Laurie River Generating Stations 1 & 2
Wastewater Upgrades
Project No.: 60265529 Date: 2012-11-05

LAURIE RIVER
LOCATION PLAN
PROPOSED LAGOON OVERLAY
PLAN 36332

AECOM

Figure: 03

Executive Summary

Manitoba Hydro is proposing to construct a wastewater treatment lagoon and related infrastructure for wastewater collection at the Laurie River Main Camp site to treat wastewater generated at the Main Camp and Generating Stations 1 and 2 (GS#1 and GS#2) (the Project). The project will also include replacement of existing water supply piping. The purpose of the Project is to provide a wastewater treatment system to replace the non-functioning Rotating Biological Contactor (RBC) unit that is presently in place at the Main Camp and address some maintenance/operational issues with existing infrastructure.

The project site is located approximately 69 km south of the Town of Lynn Lake along the south side of Laurie River.

The proposed project includes:

The construction and operation of:

- The new Laurie River wastewater treatment lagoon, gravity sewer, lift station, forcemain, access road, outfall and effluent ditch;
- The new water and sewer pipelines; and
- The new holding tanks and related infrastructure at GS#1 and GS#2

The project also includes decommissioning of the existing RBC and water and sewer pipelines

Construction activities are anticipated to begin in late spring 2013, following issuance of the *Environment Act* Licence. With this schedule, the lagoon will be operational by September 2013. The existing RBC will be decommissioned following commissioning of the new lagoon system.

Overview of Environmental Studies

The environmental setting (baseline) for the assessment was characterized using existing information sources and limited environmental field studies. The information and studies addressed the physical, biological and socio-economic components of the environment.

Summary of Environmental Effects

The potential environmental effects of the proposed works on the physical, biological and socio-economic components were considered in the assessment.

With the selected design, construction sequence and the implementation of the proposed mitigation measures and monitoring programs, the proposed works are not anticipated to result in any significant adverse environmental effects.

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Appendices

1. Introduction

Manitoba Hydro is proposing to construct a new wastewater treatment lagoon and related infrastructure at the Laurie River Main Camp. As part of the project, the existing the water and sewer pipelines for the Laurie River Main Camp buildings will also be replaced. Further, new holding tanks and related infrastructure will be installed at the generating station facilities. The purpose of the Project is to provide improved wastewater treatment at the Laurie River Main Camp and generating stations and to replace existing aging infrastructure.

The majority of the work will be undertaken at the Laurie River Main Camp approximately 69 km south of the Town of Lynn Lake, Manitoba as shown in **Figure 1**.

1.1 Background

The Laurie River Generating Stations were originally constructed by Sheritt Gordon Mines to supply power to Sheritt Gordon's mining operations in the local area. The two generating stations were put into operation in 1952 and 1958. The locations of the two generating stations (GS#1 and GS#2) are shown in **Figure 1**. On June 1, 1970, Manitoba Hydro took over operation of the generating stations from Sheritt Gordon Mines.

The Laurie River Generating Stations are supported by the infrastructure at the Laurie River Main Camp. Manitoba Hydro has 10 buildings at the Main Camp including a kitchen, six houses and maintenance buildings. The Laurie River provides water to the site buildings, which is chlorinated prior to distribution, via underground pipe. Sewage from the buildings flows in gravity sewers to an existing rotating biological contactor wastewater treatment plant (WWTP) that discharges effluent to the Laurie River. The location of the existing WWTP is shown in **Figures 2** and **3**. The existing WWTP provides minimal wastewater treatment and requires replacement.

1.1.1 Existing and Historical Licences

According to Manitoba Hydro and a search on the Manitoba Conservation website, the existing WWTP does not have a Clean Environment Commission Order or *Environment Act* Licence.

1.1.2 Project Funding

Project funding will be provided by Manitoba Hydro.

1.2 Project Purpose

The purpose of the Project is to improve wastewater treatment at the Laurie River Main Camp and generating stations and to replace aging water and sewer infrastructure. The proposed project includes the construction of a lagoon to the east of the existing Laurie River Main Camp including a lagoon access road, gravity sewer, lift station, forcemain and effluent ditch. As part of the project, the existing underground water and sewer pipelines at the Laurie River Main Camp will also be replaced. A new forcemain and holding tank will be installed at GS#1 and GS#2 for sanitary wastewater.

The purpose of this report is to assess the environmental effects of the construction, operation and decommissioning activities associated with the proposed project.

1.3 Scope of Project

The scope of the Project includes:

The construction and operation of:

- The new Laurie River wastewater treatment lagoon, gravity sewer, lift station, forcemain, access road, outfall and effluent ditch;
- The new water and sewer pipelines; and
- The new holding tanks and related infrastructure at GS#1 and GS #2

The project also includes decommissioning of the existing WWTP and water and sewer pipelines

1.4 Regulatory Process

This report has been prepared pursuant to *The Environment Act* (Manitoba) to obtain an *Environment Act* Licence for the Project. The wastewater treatment lagoon is classified as a Class 2 Development under the Classes of Development Regulation (164/88).

Lagoon construction and use is not listed as a designated project under the *Regulations Designating Physical Activities* and as such, it is not expected that an environmental assessment under the *Canadian Environmental Assessment Act, 2012* (now in force) will be required.

1.4.1 Environmental Permits and Approvals

Based on communication with Manitoba Conservation and Water Stewardship, work permits will be required for project clearing. Two work permits will be obtained; one for winter cutting of trees; and, a second permit to pile the trees and burn them in summer. An application for the work permits will be filed by Manitoba Hydro coincident with submission of this *Environment Act* Proposal.

2. Project Description

The proposed Project consists of the following general components:

1. The construction and operation of:
   - The new Laurie River wastewater treatment lagoon, gravity sewer, lift station, forcemain, access road, outfall and effluent ditch;
   - The new water and sewer pipelines; and
   - The new holding tanks and related infrastructure at GS#1 and GS#2.

2. Decommissioning of the existing WWTP and water and sewer pipelines

A description of the project location as well as the activities associated with the project components are described in the following subsections. The Functional Design Report for the proposed project including project drawings is provided in **Appendix A**.

2.1 Project Location

The majority of the work will be undertaken the Laurie River Main Camp approximately 69 km south of the Town of Lynn Lake, Manitoba as shown in **Figure 1.** The locations of GS#1 and GS#2 where the holding tanks and related infrastructure will be installed are shown in **Figure 1**.

2.1.1 Existing Land Use/Land Use Designation

The project site (including the wastewater treatment lagoon and holding tanks at GS#1 and GS#2) is situated on Crown land. Manitoba Hydro has prepared an application to transfer ownership of the land to Manitoba Hydro; a copy of the application is provided with the *Environment Act* Proposal Form.

AECOM conducted a site visit from July 10 to 13, 2012. The proposed site of the lagoon and effluent discharge ditch includes a typical boreal area dominated by black spruce and mossy (sphagnum) ground cover. The developed portion of the Laurie River Main Camp site is disturbed and includes mowed grass over the entire site. There is currently no developed land use at the location of the proposed project. Details on site vegetation are provided in Section 4.3.1.

A portion of the proposed footprint for the lagoon has been previously cleared as shown in **Figure 4,** however additional clearing will be required for the lagoon as well as the forcemain, effluent outfall, and access road. It is estimated that the total clearing required will be approximately 2 ha.

Bedrock is located near the ground surface in some areas of the project site. It is estimated that blasting will be required for the lift station (20 m^3) and the raw water supply line (20 m^3). The blasting required is minimal and will likely be completed over a one day period.

2.2 Project Schedule

The two main schedule constraints at the site are that heavy equipment must be transported to site by train and that the construction window is relatively short due to weather. Clearing of site vegetation will likely occur in May 2013 pending the issue of a work permit. Lagoon construction is also anticipated to begin in May 2013. The wastewater lagoon, water and sewer pipelines and holding tanks are expected to be operational by September 2013. Decommissioning of the existing WWTP and water and sewer pipelines will occur at the end of the construction period once the new lagoon is completed.

2.3 Existing Facilities

All wastewater at the Laurie River Main Camp is directed to the existing WWTP. The existing WWTP is a rotating biological contactor (RBC) that provides minimal wastewater treatment. The axle on the RBC is broken, resulting in ineffective wastewater treatment. Discharge from the existing WWTP occurs through a short surface pipe directed towards the Laurie River with effluent trickling over land to the Laurie River. There is no outfall pipe located within the Laurie River.

At present, the water fixtures have been disconnected and there are currently composting toilets at Generating Station (GS)#1 and GS#2.

2.4 Wastewater Treatment Lagoon

2.4.1 Design

Camp Populations

The design population has been estimated to be 20 people for six months of the year and five people for six months of the year. These design populations were determined through interviews with Manitoba Hydro management personnel and are typical staff numbers experienced at the site. The difference in site populations are based on influxes of people during hydro line maintenance activities or internal maintenance activities at the generating stations. **Table 1** breaks down the various estimated wastewater flows to the lagoon based on the populations during each 6 month period. The data presented in **Table 1** is based on data collected at other Manitoba Hydro sites and other communities. All wastewater flows from the Laurie River generating stations will be transported by truck to the proposed lagoon and flows from the Laurie River Main Camp will be piped to the proposed lagoon.

An allowance of 20% of additional flow has been included to account for reject flows from a potential future water treatment plant.

Table 1: Annual Flow Distribution

Six Months (182 Days)				
Flow	**Flow (lpcd)**	**Population**	**Daily Flow (L/d)**	**Total Hydraulic Volume (L)**
Population	250	20	5,000	910,000
Kitchen Waste	100	20	2000	364,000
Truck Waste			100	18,200
Water Treatment Plant Reject (assume 20%)				258,440
			Sub-Total	**1,550,640 L**
Six Months (183 days)				
Flow	**Flow (lpcd)**	**Population**	**Flow (L/d)**	**Total Hydraulic Volume (L)**
Population	250	5	1,250	228,750
Kitchen Waste	200	5	1,000	183,000
Truck Waste			100	18,300
Water Treatment Plant Reject (assume 20%)			470	86,010
			Sub-Total	**516,060 L**
			Total	**2,066,700 L** **Use 2,067,000 L**

Note:

1. *No value for infiltration has been estimated as the piping will be all new.*

Lagoon Sizing

Due to the northern location of this lagoon, the primary cell will be sized based on the Federal guidelines for organic loading of 22 kg BOD/ha/day. Provincial guidelines limit the amount of organic loading to 56 kg BOD/ha/day assuming an influent BOD loading rate of 0.076 kg BOD/person/day. By using the Federal guidelines, the primary cell will be larger but will also allow for increased treatment during the colder months. Constructability considerations resulted in a slightly larger proposed primary cell size to accommodate more efficient construction with available equipment.

The organic loading is provided below:

Per capita loading	0.076 kg BOD / capita / day
Loading during 5 person period	0.38 kg BOD/day
Loading during 20 person period	1.52 kg BOD / day
Average loading	0.95 kg BOD / day

Primary Cell Sizing

- Maximum design loading rate — 22 kg BOD / hectare / day
- Surface area required during average flow period
  - 0.95 kg BOD / 22 *10,000 m^2/hectare — 432 m^2 of surface area
- Surface area required during maximum flow period
  - 1.52 kg BOD / 22 *10,000 m^2/hectare — 691 m^2 of surface area

Although the primary cell area was calculated based on loading, a larger cell was selected based on constructability with available larger equipment.

The primary and secondary cells are sized with the following characteristics:

- Liquid depth of primary and secondary cells 1.5 m
- Freeboard of 1 m
- Dike slope of 4:1
- Primary cell storage – (1/2 volume of cell)
- Secondary cell storage – top 1.2 m of 1.5 m depth
- Common berm width – 3 m
- Perimeter berm width – 3 m

The primary cell calculations result in the following dimensions:

- Volume (entire cell) — 747 m^3
- Storage Volume (1/2 volume of cell) — 374 m^3
- Surface area (not including 1 m freeboard) — 819 m^2

The secondary cell size is:

- Total Volume of secondary cell 2,070 m^3
- Total Storage volume (top 1.2 m) 1,759 m^3
- Sludge Storage at bottom of cell 311 m^3
- Surface area (not including 1 m freeboard) 1,848 m^2
- Total Storage volume (primary and secondary)
  - 374 m^3 + 1759 m^3 : (2,067 m^3 minimum) 2,155 m^3

Recommended cell dimensions, to optimize space would be as follows:

- Primary Cell Dimensions (inside top of berm) 1,375 m^2
- Secondary Cell Dimensions (inside top of berm) = 50 x 52 = 2,600 m^2
- Total Lagoon Dimensions (including outside berms) = 56 x 88.5 = 4,956 m^2

Anticipated Effluent Quality

The wastewater treatment lagoon has been designed to treat effluent to meet the effluent discharge limits as outlined in **Table 2**.

Table 2: Anticipated Effluent Limits

Parameter	Value
TP (1)	< 1 mg/L
BOD_5	25 mg/L
TSS	25 mg/L (excluding growing algae)
Fecal Coliform	200 MPN / 100 mL sample
Total Coliform	1,500 MPN / 100 mL sample

Note: (1): Anticipated phosphorus level following natural uptake in drainage channel.

As well, it is anticipated that at the time of discharge the effluent will contain approximately:

- 10 mg/L ammonia;
- 10 mg/L organic nitrogen;
- 1 mg/L nitrates;
- 20 mg/L total Kjeldahl nitrogen (TKN); and
- pH of 7-9.

The wastewater lagoon is designed for one year of storage and the primary cell is designed for a low loading rate. At times when there is limited camp activity during the year, the population will be lower and the lagoon may only partially fill, with an equivalent of significantly more than one year of storage. During these low use periods, the effluent quality is anticipated to be better than noted. The lagoon has been designed considering the 6 months with increased camp populations and 6 months with reduced populations. These operating conditions are not anticipated to require more than one discharge event per year.

Prior to the release of any treated effluent, a sampling program will be implemented to ensure effluent limits as outlined in **Table 2** are met.

2.4.2 Construction

Gravity Sewer Piping and Lift Station

The gravity sewer collecting wastewater from the Laurie River Main Camp buildings currently flows towards the existing WWTP (towards GS#1). A new gravity collection sewer line will be required for the new lagoon. The future gravity collection line will be directed away from the GS#1 and a new lift station will be provided near the maintenance garage. The gravity sewer piping will be HDPE, insulated and heat traced. The sewer will be installed approximately 2 m below the ground surface. No blasting will be required for the installation of the gravity sewer. The locations of the proposed gravity sewer and lift station are shown in **Figures 2** and **3**.

Forcemain Piping

Sewage will be pumped to the lagoon via a new forcemain from the new lift station. The forcemain will be insulated and heat traced, with the proposed alignment shown in **Figures 2** and **3**.

Wastewater Treatment Lagoon

The proposed lagoon will be constructed over a period of 5 months (May to September 2013) after an *Environment Act* Licence is issued. A portion of the proposed lagoon location has been cleared by previous activities, however additional clearing will be required for the access road, gravity sewer, lift station, forcemain, lagoon cells, and the effluent ditch. To avoid the bird nesting season, trees will be cut, piled and burned under permit (to be obtained) in winter months. A second work permit will be obtained for grubbing the area, in advance of the construction season.

A clay liner will provide containment for the lagoon cells. A geotechncial survey indicated that the site will provide an adequate amount of clay for construction of the lagoon from within the cell and the perimeter ditching within the construction area. The on-site clay will be re-worked and compacted to a minimum of 1 m thickness. The proposed clay lined lagoon cells will meet the Provincial hydraulic conductivity requirements of $1x10^{-7}$ cm/s and minimum thickness requirement of 1 m.

The exterior and interior dykes will have a 4:1 slope. Existing soils sourced from the excavation of the lagoon cells will be used to construct the dyke structures. Design details for the proposed lagoon are included in the drawings in **Appendix A**.

Perimeter ditching will be incorporated around the lagoon to collect and direct surface runoff away from the lagoon dykes. Overall, drainage off the site will continue to flow in the same direction with perimeter ditches constructed around the lagoon to direct water to the effluent ditch.

A pipe with a valve will be used to interconnect the two lagoon cells. An overflow will also be provided between the two cells and will be used only if there are problems with the valve (such as freezing). This overflow will provide a backup transfer method for conveying wastewater between the two lagoon cells and will not discharge from the lagoon.

Outfall

The outfall for the lagoon will be located near the northeast corner of the secondary cell. The outfall will consist of a 200 mm diameter HDPE pipe that will drain the secondary cell into the drainage ditch and subsequently to Laurie River via existing natural drainage channels as shown in **Figure 2**. The outfall

pipe will be approximately 50 m in length and will empty onto a rip-rap spillway, which will direct effluent into the natural drainage route. The outfall will be sized to drain within a one week period, however with valves, the flow rate will be restricted to allow a "trickle" flow over a three week discharge period.

Truck Dump

The proposed work will include two truck dumps for hauled waste. The first location will be a manhole adjacent to the main lift station and the second will be on the berm leading into the primary cell. The primary truck dump will be located at the lift station shown in **Figures 2** and **3**.

At the lagoon, the lagoon fence will transition from the toe of slope to the top of slope in this area. A gate will be constructed with steel bars for the lower half which will allow sewage to pass through permitting dumping without requiring the gate to be opened.

A septic hauling permit will be obtained by Manitoba Hydro for transporting the wastewater from GS#1 and GS#2 to the lagoon. The equipment used to transfer the wastewater will consist of a trailer with a 2 m^3 insulated polyethylene tank. A flexible pipe will be used to fill and discharge the tank.

Access Road

An access road is required to service the proposed lagoon site. The access road will be 6 m wide. The road cross section will consist of a compacted subgrade and a pit run travel surface. The alignment of the access road is shown in **Figures 2** and **3**.

Fencing

A chain link fence with a height of 1.8 metres will be located at the toe of the dyke on both the primary cell and secondary cell. This fence will provide security against wildlife as well as provide a measure of safety for people.

Raw Water Line

As part of system maintenance in preparation for future water treatment plant (WTP) replacement, the raw water line will be replaced at GS#1. The replacement line will follow the same route as the existing line – extending from the station, across the exterior of the station, through the camp and back to the GS, as shown in **Figure 3**. This line will be constructed of insulated high density polyethylene (HDPE) pipe that will be looped and heat traced to reduce freezing potential. HDPE pipe is proposed as it is resilient and it can be thawed if it becomes frozen. Double heat tracing will be installed although only one line will be energized at a time. Conventional hydrants will be placed on the raw water lines.

Treated Water Line

At present water treatment consists of chlorination at GS#1. In the future, it is anticipated that the existing water treatment system will be replaced with a new WTP adjacent to the main garage as shown in **Figure 3**. To avoid additional disturbance due to future piping installation, a new high density polyethylene, looped, insulated and heat traced water line will be installed as part of the proposed project on the site as shown in **Figures 2** and **3**. The new piping will convey the chlorinated water from the existing water treatment system in the short term. It is expected that the piping will also be suitable for use once a future water treatment system is designed, approved, and constructed.

Holding Tank and Infrastructure at GS#1

A short forcemain will be installed from GS#1 to a truck fill located uphill from GS#1 so that holding tank waste can be safely removed from the holding tank in the Station. The alignment of the forcemain is shown in **Figure 3**. The installation of the forcemain addresses existing issues with backing the hauling truck down the slope, adjacent to the Station due to frequent poor weather conditions. The forcemain will be 50mm in diameter and will be heat traced and insulated.

The existing composting toilet at GS#1 will be replaced and the following will be undertaken at GS#1:

- Install a new toilet and reconnect the bathroom sink to the Station untreated service water system
- Provide a sign saying “Non-Potable Water – Do not Drink”
- Reroute piping for the existing bathroom to a new enclosed lift station within the Generating Station.
- Install a self enclosed lift station (such as the Environment -1 units) designed for low flow and high head and use 120 volt service.
- Install float controls and provide exterior vent for the lift station. A high level alarm light will turn on when it is time to empty the system or the operator can plan to empty it every 1 or 2 weeks.

Due to the low water usage at the GS it is not practical to pipe potable water back to the Station from the camp and it is not practical to pump wastewater up the hill into the main camp wastewater system.

Infrastructure at GS#2

Upgrades at GS#2 will be similar to those described in the previous section for GS#1 with the exception that the lift station will pump through a flexible temporary septic truck pipe running from the GS#2 building to the hauling vehicle. Hauling trucks will connect to the forcemain at the edge of the GS#2 building to pump out the wastewater for disposal at the new lagoon.

Borrow Source

The area proposed for the development of the project site will provide an adequate amount of clay for construction of the lagoon. Clay for re-compaction will come from within the footprint of the cell and perimeter ditching.

Manitoba Hydro is currently preparing a new quarry development near Laurie River GS#2. This is the preferred quarry for the proposed development. The quarry is anticipated to be available by June 2013 and is located at the following coordinates:

NW Corner:	56 14 47N	101 8 18W
NE Corner:	56 14 41N	101 7 54W
SW Corner:	56 14 20N	101 8 34W
SE Corner:	56 14 20N	101 8 14W

If the proposed quarry is not available in time for the proposed project, an alternative location is proposed; however, the alternative location is further away from the worksite (18 kilometers away from the site towards the air field) and is not preferred. It is unknown whether the alternative site has been previously permitted, however it has historically been used as an aggregate source and has already been cleared

(Photograph 14 in **Appendix B**). An application will be forwarded to the Province for use of approximately 700 m^3 of granular materials at the existing alternative borrow location if required. It has granular material that can be used for both road construction and pipe bedding with some aggregate screening work required. An existing stockpile of granular material at the Laurie River Main Camp will also provide material suitable for pipe bedding.

2.4.3 Operation

Operator Requirements

An application will be made to Manitoba Conservation to classify the treatment and collection facility. It is anticipated that the lagoon will be classified as a small or Class 1 system, however this will only be determined once an application has been submitted (typically at the end of design). The collection system will likely be listed as a small or Class 1 system as well. This means that the same level of operator should be able to oversee both systems on the site.

The operator would be responsible for the sampling of the effluent and understanding the results of the laboratory analysis in order to operate the system as required.

Phosphorus Removal

Two methods of phosphorus reduction were examined closely for the project, including alum dosing and natural plant uptake. The option of phosphorus removal through a "trickle" discharge and natural uptake along the discharge route was selected over alum precipitation primarily due to handling procedures and precautions necessary for alum dosing. In addition, the relative contribution of phosphorus loading to the Laurie River from the proposed lagoon discharge is not anticipated to result in significant phosphorus levels in the river. This option also helps to minimize sludge production in the lagoon cells and reduces subsequent disposal requirements.

The discharge route is a total of 700 m in length including flowing through a natural wetland area immediately prior to discharge. Phosphorus will be drawn out of solution along this drainage route by soil adsorption as well as plant uptake. It is anticipated that phosphorus levels will be below 3 mg/L when discharged and are estimated to fall below 1 mg/L prior to entering the receiving stream.

Discharge

Effluent will not be discharged between the 1st day of November of any year and the 15th day of June the following year. The proposed wastewater treatment lagoon effluent will be discharged through a 50 m outfall onto a rip rap spillway. The effluent will then flow along approximately 200 m of existing drainage path, through 500 m of natural wetland and out to the Laurie River. The drainage path would be cleared of trees but the ground cover would remain. **Figure 2** shows the location of the lagoon effluent ditch and the approximate drainage path to Laurie River.

The highest flow during discharge will be when the primary cell is isolated and the secondary cell is discharged over a 3 week period. Over this time, the volume discharged will be 1678 m^3 or an average flow rate of 55.5 L/min (3.3 m^3/hour).

Sludge Disposal

The lagoon has been designed with light loading rates and a full year of treatment. For this reason, sludge buildup will be slow. It is anticipated that the sludge will not need to be removed for 25 years.

After approximately 15 years of operation, work will be done to confirm this estimate with completion of a sludge survey.

It is anticipated that the sludge will be dewatered in the future using large sludge filter bags (Geo Bags). With this method, lagoon sludge will be pumped directly into a filter bag that will retain the solids while allowing water to pass through small openings in the bag. The bag will be allowed to sit on the internal dyke of the lagoon, in the freeboard zone so that all free liquid will drain back to the lagoon cell. After an estimated 6-month period, the bag of retained material will be cut open and the sludge will be transported to a permitted landfill by truck. A separate application will be submitted in the future for sludge disposal as required.

Maintenance Activities

Maintenance of the wastewater treatment lagoon and collection system will include:

- Maintaining fence and gate to keep animals out;
- Maintaining the lift station;
- Maintaining valves;
- Maintaining even grass cover on dykes, and mowing so that growth is less than 0.3 m in height;
- Removing all reeds, rushes and trees within the lagoon and on the dykes to below the low water line;
- Maintaining the discharge route and pipeline to allow proper drainage;
- Maintaining a program to prevent and remove burrowing animals;
- Maintaining the access road into the lagoon area; and
- Visually inspecting the control structure and weir between the cells.

Site staff will have a schedule for significant maintenance periods and should be able to anticipate when a significant population is coming to site. If there are no plans for significant activity at the generating stations, the staff may choose to only discharge half of the lagoon in the fall, so that there is more water cover over the pipes to minimize the potential for freezing.

2.4.4 Decommissioning

Decommissioning of the existing WWTP will occur following the commissioning of the new lagoon. Decommissioning activities will include the disconnection and removal of all equipment and the WWTP building. Materials will be crushed and placed in a Sea Can Container for rail transport to an approved landfill. Exposed pipelines will be removed.

The existing water and sewer pipelines at the Laurie River Main Camp will also be removed, crushed and placed in the Sea Can Container for transport to an approved landfill during the construction phase.

There are currently no plans to decommission the proposed lagoon and related infrastructure. If however, at some point in the future decommissioning of the lagoon is required, a decommissioning plan will be filed with the appropriate regulatory agencies for review and approval in advance of decommissioning.

Decommissioning of the proposed lagoon at some point in the future would involve dewatering the lagoon and disposing of the sludge remaining in the cell. It is anticipated that the liquid portion of the lagoon would be discharged to the Laurie River along the approved discharge route in accordance with

Environment Act Licence requirements. Sludge would likely be dewatered using Geo Bags or a similar product with the dewatered sludge transported in water-tight containers (to prevent spills) to an approved landfill for disposal. Once the sludge is removed from the lagoon, the dikes would be leveled and the site would be regraded for drainage. Pipelines would be removed where possible, or capped in place. Structures such as lift stations would be removed and disposed of at an approved landfill. The site would likely be revegetated via seeding or natural succession by surrounding vegetation.

3. Assessment Approach

The environmental assessment considers effects to the environment as a result of the following activities:

- The construction, operation, and future decommissioning of:
  - The new Laurie River wastewater treatment lagoon, gravity sewer, lift station, forcemain, access road, outfall and effluent ditch;
  - The new water and sewer pipelines; and
  - The new holding tanks and related infrastructure at GS#1 and GS#2.
- Decommissioning of the existing WWTP and water and sewer pipelines (during the project construction phase)

3.1 Geographic Boundaries

The following are the spatial boundaries defined for this report. However, where specifically noted, these boundaries may be adjusted to suit the valued ecosystem component affected.

- The project site includes any land that will be disturbed by project activities.
- The project area includes any area, up to 1,000 m beyond the project site, which could be disturbed by project effects. This includes effects during construction, such as noise, vehicle emissions, traffic, etc.
- The project regional boundary includes any area, up to 10 km beyond the project area that may be affected by the construction, operation or decommissioning activities of the Project.

3.2 Temporal Boundaries

The assessment considered the period from start of construction to future decommissioning of the proposed wastewater treatment lagoon and collection system. This period is anticipated to start in 2013 with construction and continue well into the future through operation and decommissioning. The temporal boundaries of the assessment were divided into the construction, operation and decommissioning phases as outlined below.

3.2.1 Construction Phase

The start of the construction phase is dependent on the issuance of the *Environment Act* Licence, which is anticipated by March 2013. Clearing of site vegetation will likely occur in March 2013. Construction is anticipated to begin in May 2013 with the wastewater lagoon, water and sewer pipelines and holding tanks expected to be operational by September 2013. During construction, temporary sewage holding tanks will be used as necessary with the contents hauled to the existing RBC; decommissioning of the existing RBC and water and sewer pipelines will occur as part of the construction phase once the lagoon is constructed.

3.2.2 Operation Phase

Operation of the project is anticipated to occur from September 2013 into the future.

3.2.3 Decommissioning Phase

There are currently no plans to decommission the proposed new lagoon and related infrastructure. It is anticipated that the new lagoon will operate for several years into the future as such no plans to decommission the proposed lagoons have been developed. If however, this infrastructure needs to be decommissioned at some point in the future, a site decommissioning plan will be filed with appropriate regulators prior to decommissioning.

3.3 Environmental Components

This environmental assessment considered the existing environment without the proposed Project as the baseline condition. The amount of detail and effort in analysing the various environmental components was proportional to their potential to be affected by the Project. The environmental components were organized into the following sections:

- Physical Environment – Topography, Air, Climate, Soils, Surface Water and Groundwater;
- Terrestrial Environment – Flora, Fauna and Protected Species;
- Aquatic Resources and Habitat (including Protected Species);
- Socio-Economic Environment – Resource Use, Heritage Resources, Aesthetics and Land Use including Protected Areas.

3.4 Project/Environment Interaction

The Project-environment interaction matrix in **Table 3** identifies the work and activities associated with the Project that may affect the environment. Predicted changes to the environment caused by the Project were assessed against existing conditions.

3.5 Mitigation Measures

Mitigation measures are presented in association with the potential effects identified. As required, mitigation measures that have been built into the project design have also been identified.

3.6 Assessment of Residual Adverse Effects

Following the application of mitigation measures, any measurable (i.e. greater than negligible in magnitude) residual adverse effects were identified and described (where possible). The characterization of effects related to all phases of the project including construction, operation and decommissioning. The assessment approach considered the nature and magnitude of any residual effect (post mitigation) along with its temporal characteristics and spatial boundaries. The factors and definitions considered in the assessment of the environmental effects are outlined in **Table 4**.

Table 3: Identification of Potential Environmental/Social Component Interactions with the Project

	Environmental Components										Social Components[2]			
	Topography	Air and Noise	Climate	Soil	Surface Water	Groundwater	Flora	Fauna	Aquatic Resources	Protected Species	Land Use including Protected Areas	Resource Use	Heritage Resources	Aesthetics
Construction Phase														
Clearing and Grubbing		X	X	X			X	X		X			X	X
Transportation and Stockpiling of Materials	X	X	X	X				X		X				X
Excavating, Infilling and Compaction for Access Road (including borrow materials)	X	X	X	X				X		X			X	X
Blasting, Excavating, Backfilling and Compaction for pipelines, lift station and lagoon (including borow materials)	X	X	X	X	X			X	X	X			X	
Replacement of Water and Sewer Pipelines at the Main Camp		X	X	X				X		X				
Blasting, Excavating, Backfilling and Compaction for new Lift Station, Forcemain and Holding Tanks at GS#1 and GS#2	X	X	X	X	X			X	X	X			X	X
Decomissioning of Existing WWTP and Washrooms at GS#1 and GS#2		X						X		X				
Waste Disposal			X	X	X	X	X	X	X	X				
Restoration and Revegetation		X	X	X			X	X		X				X
Operation Phase														
Lagoon Use		X	X											X
Lagoon Discharge				X	X		X		X	X				
Maintenance Activities		X	X				X	X		X				X
Decommissioning Phase														
Sludge Dewatering		X												X
Lagoon Discharge				X	X		X		X	X				
Storage, Handling and Transportation of Waste (including dewatered sludge)		X	X	X	X	X	X		X	X				
Removal and Disposal of Wastewater Treatment System Facilties (pipelines, dykes, etc.)	X	X	X	X	X	X	X		X	X				X
Restoration and Revegetation		X	X	X			X	X		X				X

Notes
1. x = identified interaction
2. only indirect interactions with SCs as a result of an direct project/EC interactions were considered

Table 4: Factors and Definitions Considered in Assessing Environmental Effects

Project Phase:	**Refers to the phase of the project as construction, operation or closure.**
Potential Effect:	Classification of the type of effects possible during a specific project phase.
Magnitude of Effect:	Refers to the estimated percentage of population or resource that may be affected by activities associated with the construction, operation and decommissioning of the proposed project. Where possible and practical, the population or resource base has been defined in quantitative or ordinal terms (e.g., hectares of soil types, units of habitat). Magnitude of effect has been classified as either less than (<) 1%, 1% to 10%, or greater than (>) 10% of the population or resource base. Where the magnitude of an effect has been defined as virtually immeasurable and represents a non-significant change from background in the population or resource, the effect is considered negligible. An exception to this is in terms of potential human health effects where, for example health issues due to water-borne diseases amounting to 1% of the population being affected would still be considered major.
Direction of Effect:	Refers to whether an effect on a population or a resource is considered to have a positive, adverse or neutral effect.
Duration of Effect:	Refers to the time it takes a population or resource to recover from the effect. If quantitative information was lacking, duration was identified as short-term (<1 year), moderate term (1 to 10 years) and long term (>10 years).
Frequency of Effect:	Refers to the number of times an activity occurs over the project phase, and is identified as once, rare, intermittent, or continuous.
Scope of Effect:	Refers to the geographical area potentially affected by the effect and was rated as Project Site, Project Area or Project Region as defined in Section 3. Where possible, quantitative estimates of the resource affected by the effect were provided.
Degree of Reversibility:	Refers to the extent an adverse effect is reversible or irreversible over a 10-year period.
Residual Effect:	A qualitative assessment of the residual effect remaining after employing mitigation measures in reducing the magnitude and/or the duration of the identified effect on the environment.

Magnitude of Effect	**Direction of Effect**	**Duration of Effect**	**Frequency of Effect**	**Scope of Effect**	**Degree of Reversibility of Effect**
Negligible (immeasurable)	Positive	Short term (< 1 year)	Once	Project Site	Reversible
Minor (<1%)	Adverse	Moderate (1 to 10 years)	Rare	Project Area	Irreversible
Moderate (1 to 10%)	Neutral	Long term (>10 years)	Intermittent	Project Region	
Major (>10%)			Continuous		

4. Existing Environmental Setting

4.1 Project Setting

The project site is located approximately at the community of Laurie River approximately 69 km south of the Town of Lynn Lake, Manitoba. The project site is approximately 350 m northeast of the Laurie River. **Appendix B** includes photographs of the project site. Throughout the Project Area and broader Project Region, the environment is characterized by numerous waterbodies. As such, no other suitable location was identified that would provide additional separation distance between the Project Site and waterbodies while minimizing pumping distances for the proposed lagoon.

4.2 Physical Environment

The project site is located within the Granville Lake Ecodistrict of the Churchill River Upland Ecoregion within the Boreal Shield Ecozone (Smith *et al*. 1998).

4.2.1 Air Quality

In Manitoba, air quality issues tend to be local in nature and primarily relate to odour and other pollutants released from specific local sources or activities (i.e. industry, motor vehicles and forest fires). Outdoor air quality is generally good (Manitoba Conservation 2010).

The Project is located in the boreal forest region of northern Manitoba, approximately 69 km south of the Town of Lynn Lake, Manitoba. There is no ambient air quality data for the project area or Lynn Lake. Air quality monitoring stations are operated at Thompson and Flin Flon; however, air quality data in Thompson and Flin Flon is influenced by smelting operations and as such is not considered representative of the project site.

Greenhouse Gases

In 2008, Manitoba emitted approximately 21.9 million tonnes of greenhouse gases (GHGs), approximately 3% of the total GHG emissions in Canada. Approximately 12.8 million tonnes was emitted from the energy sector and 7.6 million tonnes was emitted by the agriculture sector. (Environment Canada 2010). A brief discussion of greenhouse gas emissions anticipated from the project operation is provided in Section 5.4.1.

4.2.2 Climate

The nearest climate station is Environment Canada's Lynn Lake A meteorological station. Since Lynn Lake A is the nearest station (approximately 69 km from the site), it is relied upon as indicative of climatic conditions at the Laurie River site. **Table 5** shows the monthly temperature and precipitation and **Table 6** shows the most frequent wind direction and average wind speed over the 1971-2000 normal period. **Table 7** shows other relevant weather parameters for the Lynn Lake A meteorological station.

Table 5: Mean Monthly Temperatures and Precipitation Normals Lynn Lake A (1971-2000)

(Latitude 56°52'N, Longitude 101°04'W, Elevation 356.6 m)

Month	Mean Temperature (°C)	Mean Precipitation (mm)
January	-25	19.2
February	-20.6	16.4
March	-13.2	17.9
April	-2.6	23.1
May	6.2	41.3
June	12.9	62
July	16	79.6
August	14.3	69.9
September	7.1	56.9
October	-0.4	42.6
November	-12.6	29.5
December	-22.1	20.7
Annual	-3.3	479

Source: Canadian Climate Normals (Environment Canada 2012).

Table 6: Mean Monthly Wind Speed and Direction Normals Lynn Lake A (1971-2000)

(Latitude 56°52'N, Longitude 101°04'W, Elevation 356.6 m)

Month	Mean Wind Speed (km/h)	Most Frequent Direction
January	12.1	W
February	11.9	W
March	12	W
April	13	E
May	12.9	E
June	12.7	E
July	12.2	W
August	12	W
September	12.7	NW
October	12.9	NW
November	11.2	W
December	11.3	W
Annual	12.2	W

Source: Canadian Climate Normals (Environment Canada 2012).

Table 7: Lynn Lake A Extremes

(Latitude 56°52'N, Longitude 101°04'W, Elevation 356.6 m)

Parameter	Value and Date
Extreme Maximum Temperature (°C)	35.3 (August 11, 1991)
Extreme Minimum Temperature (°C)	-47.1 (December 19, 1989)
Extreme Daily Rainfall (mm)	50.3 (July 22, 1976)
Extreme Daily Snowfall (cm)	38.2 (November 2, 1988)
Extreme Maximum Hourly Wind Speed (km/h)	70 (December 25, 1999)
Extreme Maximum Wind Gust Speed/Direction (km/h)	120/W (May 8, 1987)
Extreme Wind Chill	-61.7 (January 29, 1971)

Source: Canadian Climate Normals (Environment Canada 2012).

4.2.3 Topography

Elevations in the Granville Lake Ecodistrict range from 405 masl to 225 masl. Slopes in this ecodistrict can range from level in peat-filled depressions to approximately 30 % in irregular, hummocky terrain. Rocky cliffs can extend up to 50 m above lakes and peat filled depressions within the ecodistrict. (Smith *et al.* 1998.)

A topographic survey was conducted at the proposed lagoon site and along the proposed gravity sewer, forcemain and outfall and drainage ditch alignments. Topography at the site varies from 298 masl at the Laurie River Main Camp to 284 masl along the effluent ditch. Elevations in the vicinity of the proposed lagoon are shown in **Figure 5**.

4.2.4 Geology

The Churchill River Upland Ecoregion is underlain by massive crystalline Precambrian (Proterozoic) rocks. The Granville Lake Ecodistrict is dominated by acidic granitoid bedrock. (Smith *et al.* 1998)

4.2.5 Soils

The soils of the Granville Lake Ecodistrict are characterized by undulating to hummocky morainal and bedrock plain covered by extensive clayey glaciolacustrine blankets and veneers at lower elevations. Sandy glaciofluvial deposits are also found within the ecodistrict and may be locally extensive. Peat-filled depressions and peat-covered, gently sloping lower slopes are typically underlain by clayey glaciolacustrine sediments. Agriculture and forestry are largely prevented by the severe climate, the poor drainage and slow heat conductance of the organic soils. Permafrost is present throughout the ecoregion; however it is discontinuous and typically found in organic deposits. (Smith *et al.* 1998)

A geotechnical investigation was conducted on October 22, 2010 at the lagoon site. In descending order, the general soil profile encountered was as follows:

- Topsoil
- Silty Clay (homogeneous and laminated)
- Silt
- Bedrock

Topsoil less than 200 mm thick was encountered at the ground surface. The topsoil was generally brown, moist and contained rootlets. Silty clay of variable thickness was encountered at ground surface, or beneath the topsoil in all test pit locations. In some locations, the clay was brown and homogeneous, in others it was laminated with layers of light brown clayey silt. Generally, the clay was moist and soft to firm. Low plasticity silt of variable clay and sand content was encountered in one test pit beneath the clay and one test pit near the ground surface beneath the topsoil.

Bedrock was encountered at the site at various depths. Along the forcemain alignment bedrock was encountered approximately 1.07 to 2.74 m below the ground surface and was not encountered at all in one test-hole. Within the proposed lagoon footprint, bedrock was encountered approximately 1.35 to 2.44 m below the ground surface. The outfall included bedrock at 0.3 to 1.52 m below the ground surface.

4.2.6 Surface Water

Surface Water Regime

The project falls within the Upper Churchill River drainage sub-basin of the Churchill River drainage basin (Manitoba Conservation 2003). The proposed lagoon will discharge to the Laurie River as shown in **Figure 2**. Historic flow data for the Laurie River below the GS#1 (hydrometric station 06EB005) was available from Environment Canada for 1976 and 1978-1982. Monthly mean discharge rates at this station are presented in **Table 8**.

Table 8: Historic Monthly Mean Discharge Rates for the Laurie River downstream of GS#1

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Mean
Monthly Mean Discharge (m^3/s) on Laurie River downstream ofGS#1; 1978-1982													
	24.2	24.7	23.1	26.1	32.7	26.8	23.8	24.2	25.0	23.1	25.2	22.7	25.9

Source:

1) Environment Canada 2010a

Surface Water Quality

Manitoba Conservation and Water Stewardship were contacted to determine the availability of water quality data for the project. Manitoba Conservation and Water Stewardship provided water quality data for the Laurie River between Eager Lake and McGavock Lake (station MB06EBS034) (several km upstream of the project site) and upstream of Granville Lake (station MB06EBS033) (downstream of the project site). A summary of the data provided by Manitoba Conservation and Water Stewardship is included in **Table 9**.

Table 9: Summary of Measured Water Quality in the Laurie River

	Ammonia (mg/L-N)	Nitrate/Nitrite (dissolved) (mg/L)	TKN (mg/L)	TP (mg/L)	TSS (mg/L)	pH
Laurie River Between Eager Lake and McGavock Lake (upstream of project site)						
Average of sample data 1976-1978	0.04 (soluble)	0.096	0.3	0.018	7.13	6.9
Laurie River Upstream of Granville Lake (downstream of project site)						
Sample February 15, 2000	0.01 (dissolved)	0.09	0.6	0.025	<5	6.9

Notes:

1) Where recorded values were less than the detection limit, the detection limit was used to determine average concentrations.
2) Source: Manitoba Conservation and Water Stewardship, Water Quality Management Section, 2012

4.2.7 Groundwater

During the geotechnical investigation conducted at the site, no groundwater seepage was observed during the test pit exploration. As such, it is not anticipated that groundwater dewatering will be required during construction.

A search using the 2009 Manitoba Conservation groundwater well database (GWDRILL) was completed to determine the registered wells within a 1.6 km radius of the proposed project site. No registered wells were found within the database for the searched area (Manitoba Water Stewardship, Groundwater Management Section 2009).

4.3 Terrestrial Environment

4.3.1 Flora

Forest cover in the Churchill River Upland Ecoregion is dominated by medium to tall closed black spruce and jack pine stands. White spruce, white birch and trembling aspen form an important component of the stands. Understory species include feather mosses, rock cranberry, blueberry, Labrador tea and lichen. The frequent occurrence of forest fires in the ecoregion has resulted in the widespread distribution of jack pine, white birch and trembling aspen. Basin bogs and peat plateau bogs are dominated by stands of stunted black spruce and ground cover consisting of Labrador tea, blueberry, bog rosemary and sphagnum moss. Fens are dominated by sedges and brown mosses. Tamarack stands and swamp birch shrub cover may also be encountered in fens. (Smith *et al.* 1998)

On July 10 to 13, 2012 AECOM visited the proposed lagoon site. Site visit photographs are included in **Appendix B**. Clearing for the new lagoon will occur in a stand of dense black spruce developed on mineral soil (**Appendix B** Photograph 1). Ground cover in the area is primarily sphagnum moss with typical boreal cover species. The forcemain from the lift station to the lagoon will pass through this stand of trees in a shrubby area a short distance to the lagoon. A shrub layer is noticeably absent from most of this area due to the dense nature of the black spruce stand (**Appendix B** Photograph 2).

Discharge from the lagoon will take place through an effluent ditch directed to an existing marsh. The area between the lagoon and the marsh includes dense black spruce near the lagoon that opens into a mixed spruce aspen forest as it approaches the marsh (**Appendix B** Photograph 3). The shore of marsh includes a rocky upland that drops noticeably to the water surface. The area near the outflow point from the effluent ditch to the marsh is very wet open bog (**Appendix B** Photograph 4). This boggy area forms a bay on the marsh, which then connects to the open water of the marsh. The marsh itself features a central rocky island with a tree cover of mixed spruce and aspen (**Appendix B** Photograph 5). Dense reed beds extend into most of the marsh, creating a typical open marsh structure very attractive to waterfowl (**Appendix B** Photograph 6).

Discharge from the marsh will follow a natural drainage channel between rocky uplands to the east and west (**Appendix B** Photographs 7 and 8) to the Laurie River as shown in **Figure 2.** The natural drainage channel flows through dense alder growth to the discharge point at Laurie River (**Appendix B** Photographs 9 and 10). The discharge point is a low lying part of the river shoreline that features dense alder and willow growth. It is not obviously a channel, but looks like a part of the normal river shoreline shrub growth. This outflow channel from the marsh to the River shows evidence of periodic flow most likely in the spring. There are erosion channels throughout this low lying discharge channel that suggest rapid flow when water is moving in this area (**Appendix B** Photograph 11). Spring flood and exceptional rain events most likely cause discharge from the marsh to the river. This flow is most likely rapid but of very short duration.

The adjoining uplands on the east and west sides of the outflow from the marsh to the Laurie River are well developed spruce and aspen stands with some shrubby growth (**Appendix B** Photograph 12). Ground cover is mossy with typical boreal woodland forbes and shrubs. The outflow channel itself is deep moss with extensive alder growth.

The clearing and construction of the lagoon and discharge ditch to the marsh will take place in the dense upland spruce stand northwest of the lake. Terrestrial surveys here revealed a typical boreal area dominated by black spruce and mossy (sphagnum) ground cover. Plant communities in this area are typical for the region and do not suggest the presence of rare or endangered species.

The Laurie River Main Camp site is disturbed and includes mowed grass over the entire site.

4.3.2 Fauna

The Churchill River Upland Ecoregion provides habitat for moose, woodland caribou, black bear, lynx, wolf, beaver, muskrat and snow-shoe hares. This ecoregion is also a winter range for barren-ground caribou. Various bird species including sandhill crane, grouse, waterfowl (ducks, geese and pelicans) and many other birds are found in this ecoregion. (Smith et al., 1998)

During the site visit conducted from July 10 – 13, 2012 by AECOM, some beaver activity was evident close to the marsh area and the Laurie River (**Appendix B** Photograph 13). Other than beaver, moose droppings were observed along the outflow channel and one bear track was seen in the lagoon area clearing. Wolves would also be expected in the area however no evidence of wolves was observed during the site visit.

4.4 Aquatic Resources and Habitat

The Laurie River is located in the Churchill River watershed. Fish species known to be present in the Churchill River watershed are listed in **Table 10**.

Table 10: List of Expected Aquatic Species in the Churchill River watershed that may be present in Laurie River

Family Name	Common Name	Species Name	Distribution
Petromyzontidae	silver lamprey	*Ichtyomyzon unicuspis*	N
Acipenseridae	lake sturgeon	*Acipenser fulvescens*	N
Cyprinidae	lake chub	*Couesius plumbeus*	N
	emerald shiner	*Notropis atherinoides*	N
	spottail shiner	*Notropis hudsonius*	N
	longnose dace	*Rhinichthys cataractae*	N
Catostomidae	longnose sucker	*Catostomus catostomus*	N
	white sucker	*Catostomus commersonii*	N
Esocidae	northern pike	*Esox lucius*	N
Salmonidae	cisco	*Coregonus artedi*	N
	lake whitefish	*Coregonus clupeaformis*	N
	shortjaw cisco	*Coregonus zenithicus*	N
	round whitefish	*Prosopium cylindraceum*	N
	Artic grayling	*Thymallus arcticus*	N
	rainbow trout	*Oncorhychus mykiss*	I
	brook trout	*Salvelinus fontinalis*	N
	lake trout	*Salvelinus namaycush*	N
Percopsidae	troutperch	*Percopsis omiscomaycus*	N
Gadidae	burbot	*Lota lota*	N
Gasterosteidae	brook stickleback	*Culaea inconstans*	N
	ninespine stickleback	*Pungitius pungitius*	N
Cottidae	slimy sculpin	*Cottus cognatus*	N
	spoonhead sculpin	*Cottus ricei*	N
Percidae	Iowa darter	*Etheostoma exile*	N
	johnny darter	*Etheostoma nigrum*	N
	yellow [erch	*Perca flavescens*	N
	sauger	*Sander canadensis*	N
	walleye	*Sander vitreus*	N

Notes: Estuarine species are excluded from this list. N = native; I = introduced; 0 = not previously captured in this watershed.

4.5 Protected Species

Protected species are species that are endangered, threatened or are of special interest as defined by either Federal or Provincial legislation. In the Province of Manitoba, endangered, threatened or special interest species are protected by the Manitoba Endangered Species Act (MESA) which may have species that overlap with the Federal Species at Risk Act (SARA). A search of the MESA and Species at Risk Public Registry revealed occurrences within the Project Region of species listed as endangered, threatened or of special concern under SARA as shown in **Table 11**.

Table 11: List of Protected Species with Potential to Occur in the Project Region

Common Name	Scientific Name	SARA Status	MB Status
Boreal Woodland Caribou	*Rangifer tarandus caribou*	Threatened	Threatened
Common Nighthawk	*Chordeiles minor*	Threatened	Threatened
Short-eared Owl	*Asio flammeus*	Special Concern	Threatened
Yellow Rail	*Coturnicops noveboracensis*	Special Concern	Not Ranked
Shortjaw Cisco	*Coregonus zenithicus*	Threatened	Not Ranked
Monarch	*Danaus plexippus*	Special Concern	Not Ranked
Flooded Jellyskin	*Leptogium rivulare*	Threatened	Not Ranked

Source: Manitoba Conservation and Water Stewardship, 2012 and Government of Canada, 2012

As confirmed through field observations conducted in 2012, the wildlife habitats within the Project Area are considered to be typical for the region, with no unique or rare habitats encountered.

The shortjaw cisco has been identified in the Churchill River watershed as detailed in Section 4.4.

4.6 Socio-Economic Environment

The nearest communities to the project site include the Town of Lynn Lake located approximately 69 km north of the project site, Mathais Colomb Cree Nation located approximately 57 km southwest of the project site and Marcel Colomb First Nation located approximately 49 km northeast of the project site.

The Laurie River Lodge is a fly in fishing and bear hunting operation with cottages on McGavock Lake, an outpost camp on Kamuchawie Lake and tent camps on Runner Lake and Murray Lake. The closest camp to the project site is the main camp at McGavock Lake located approximately 35 km to the northwest of the project site. (Laurie River Lodge, 2012)

The Laurie River Main Camp provides housing for approximately 5 employees for half of the year and up to 20 employees over the remaining part of the year.

4.6.1 Land Use

Land use at the Main Camp and Project site is primarily related to the residential occupation of the camp by the staff and the required maintenance activities in addition to the operation of the camp and generating stations.

The nearest national park to the project site is Wapusk National Park of Canada, located approximately 447 km to the northeast while the nearest provincial park to the project site is Sand Lakes Provincial Park, located approximately 121 km to the north-northeast (Province of Manitoba, 2007).

There are no Wildlife Management Areas within 121 km of the project site (Manitoba Conservation and Water Stewardship 2012b).

4.6.2 Transportation

There is no road or winter road access to Laurie River. The main mode of transportation to the project site is by plane with an airport existing to the west of GS#2 as shown on **Figure 1**. Rail access is also provided near the airport as shown in **Figure 1**. Site roads connect GS#1 to GS#2 and to the rail station and airport.

4.7 Heritage Resources

The provincial Historic Resources Branch was contacted to determine the potential to impact significant historic resources during project construction. The Archaeological Unit of the Historic Resources Branch indicated that the potential to impact significant heritage resources was low and therefore the Branch has no concerns with the project. A copy of the correspondence received from the Historic Resources Branch is included in **Appendix C**.

5. Potential Environmental Effects and Mitigation

5.1 Introduction

This section identifies the interactions between the Project and the environment. The potential environmental effects are identified and, where required, general mitigation measures are discussed and identified for the physical, biological and socio-economic components of the environment. The residual effect has been described after the application of the mitigation measures. A summary of these assessments is outlined in **Table 12**. Refer to Section 3 for a description of the approach to the environmental assessment.

The potential for project interactions with environmental components and subsequent interactions with social components was analyzed by superimposing project elements onto existing natural conditions and applying standard mitigation measures. An underlying assumption of this method is that the Project will be constructed with due care for safety and environmental matters, using current and reasonable construction practices. Potential environmental effects that may be caused by malfunctions or accidents are discussed separately in **Section 5.5**

5.2 General Construction and Decommissioning Effects

5.2.1 Dust Generation

During vehicle, equipment and earth movement (including stockpiling), air quality may be affected by dust and particulates with subsequent effects on human health (including respiratory issues) and flora (dust deposition) during the construction and decommissioning phases. Dust also has the potential to be generated during construction during blasting activities.

To mitigate potential effects due to dust the disturbed/exposed areas will be kept to a minimum, blast mats will be used during blasting to contain dust, material stockpile heights will be limited and if required, additional dust suppression activities, such as spraying roads with water, will be completed.

With these mitigation methods employed as necessary, the residual effects of dust generation on air quality and subsequent effects on human health and flora are expected to be negligible in the project area.

5.2.2 Emissions Generation (including Greenhouse Gasses)

Vehicle and equipment movement at the project site will be necessary during the construction and decommissioning phases. Vehicle and equipment movement will be required for various activities including clearing and grubbing, transportation and stockpiling of materials, excavating, infilling, compaction, restoration and revegetation.

During construction and decommissioning activities, air quality may be affected due to vehicle and construction equipment emissions. Vehicle and equipment use during construction and decommissioning will also generate greenhouse gas emissions including carbon dioxide and nitrous oxides. Effects due to emissions generation include potential climate change effects and potential air quality effects with potential for subsequent effects on human health.

To mitigate the potential generation of emissions, vehicle and equipment idling will be kept to a minimum and vehicles and equipment will be properly maintained.

Based on the short construction (anticipated to be 5 months or less) and eventual decommissioning time frame, the quantity of emissions generated will be limited and are not anticipated to measurably degrade air quality in the project area. Further, based on the limited number of vehicles and/or equipment anticipated to be used during the construction and decommissioning of the Project, the amount of greenhouse gasses emitted is expected to be negligible in comparison to the amount emitted by the province as a whole (approximately 21.9 million tonnes in 2008). The residual effects due to emissions are anticipated to be negligible.

5.2.3 Waste Generation and Management

Wastes such as used oils, rags, drums and miscellaneous garbage will be generated during construction and decommissioning activities. Waste will also be generated in the decommissioning of the existing WWTP and replacement of the water and sewer pipelines at the Laurie River Main Camp. To prevent any potential adverse effects caused by the improper disposal of wastes such as adverse effects on soil and surface water quality (with potential consequent exposure to flora, aquatic resources and groundwater), all wastes will be disposed of appropriately at an approved disposal facility. Hazardous materials including waste oil, lubricants and other petroleum products will be removed (transported in accordance with provincial and federal TDG regulations) for offsite recycling or appropriate disposal. Equipment to be decommissioned will be removed, crushed and placed in a Sea Can Container for transport to a licensed landfill during the construction phase.

During the eventual decommissioning of the proposed lagoon, lagoon effluent and biosolids will need to be disposed of. Treated lagoon effluent will discharge to the Laurie River in accordance with the requirements of the future *Environment Act* Licence. Compliance with the licence is anticipated to mitigate potential effects on soils, and flora along the discharge route and surface water and aquatics in the receiving waterbody. A separate application will be filed for sludge management; it is anticipated that sludge will be dewatered using Geo Bags (or a similar product) and transported to an approved landfill for disposal. The sludge will be transported in water-tight containers to reduce the potential for spills during transport. Pipelines would be removed where possible, or capped in place. Structures such as lift stations would be removed and disposed of at an approved landfill.

With the implementation of the described mitigation measures, the residual effects during construction and decommissioning due to waste disposal are anticipated to be negligible in magnitude.

5.3 Specific Construction and Decommissioning Effects

5.3.1 Noise Generation

An increase in the noise level at the project site during construction and eventual decommissioning activities has the potential to influence people and wildlife in the surrounding area. Noise will be generated to varying degrees during construction and decommissioning activities, with most of the noise expected to be typical of heavy equipment such as trucks, graders, loaders and excavators. Blasting will be required for the project, however it is anticipated that blasting will be completed in one day during the construction period.

The closest human receptors to the project site are located at the Laurie River Main Camp. Construction work will occur within the camp for the water and sewer pipeline replacements, new gravity sewer and lift station construction and decommissioning of the existing WWTP. Work at the lagoon will occur approximately 150 m to the east of the camp.

No natural wildlife habitat exists at the Laurie River Main Camp as it is consists of buildings and mowed grass, however the surrounding areas are anticipated to provide wildlife habitat.

To mitigate potential effects on humans and fauna due to noise, vehicles and equipment will be properly maintained, work will be conducted during daylight hours only, site staff will be advised in advance that blasting will occur, blasts will be designed to be as small as possible and hearing protection will be provided to workers as required.

The short term nature of the construction phase and anticipated future decommissioning phase (5 months or less) and the likelihood that the local fauna are accustomed to some level of noise (as the Laurie River Main Camp is currently active) are anticipated to reduce the potential magnitude of the construction and future decommissioning noise effects on local fauna. If local fauna are deterred from the project site or portions of the project area, it is not anticipated that this will critically affect wildlife as similar habitats are anticipated to be abundantly available in the project area and region

Human receptors at the project site during construction and decommissioning will consist of Manitoba Hydro employees and contractors. It is anticipated that these receptors will be willing to accept minor noise nuisances during the construction and eventual decommissioning periods as the work will improve existing site infrastructure conditions. Communication with employees on the timing of blasting in particular is anticipated to reduce the potential for annoyance to residents.

With the implementation of the described mitigation measures, residual effects on humans and fauna due to noise are anticipated to be negligible.

5.3.2 Change in Relief

Changes to site topography will result from clearing, blasting, excavating , stockpiling and backfilling during construction. Two locations will require blasting (each less than 30 m^3) for the installation of the lift station and the raw water pipeline, however the topography surrounding these areas will be restored following the installation of the proposed equipment by backfilling the disturbed area. The lagoon construction will result in a change in the site topography due to the lagoon excavation and the addition of the new dikes. Perimeter ditching will allow the continued drainage of the area considering the changes to site topography.

The project decommissioning phase will include restoration of the topography at the site to match the surrounding area to the extent that is practical. Rehabilitation of the topography will include re-grading and contouring of the project site. The project effect on topography is considered neutral with the implementation of site rehabilitation during the decommissioning phase.

5.3.3 Soil Compaction and Mixing

As a result of incidental vehicle and equipment movement at the site during both construction and decommissioning, there is the potential to cause soil compaction and mixing of soil horizons which may reduce available air and water storage and change the soil structure. Soil compaction also has subsequent potential to change surface drainage patterns and reduce flora growth. Soil will also be compacted as part of the construction of the clay liner to prevent groundwater effects due to lagoon operation. No mitigation measures are proposed for soil compaction for the clay liner construction as this is an engineered requirement of the project.

To mitigate potential soil compaction and mixing of soil horizons, disturbed/exposed areas will be kept to a minimum with re-vegetation occurring as soon as practical where required. Topsoil will be stripped and

stockpiled on the site for use in surface treatment and revegetation. Equipment and vehicle movements will be limited to designated pathways within and around work areas and activities during periods of extensive precipitation/runoff will be limited. Compacted areas will be repaired as necessary including appropriate grading and re-vegetation after construction/decommissioning.

With the implementation of applicable mitigation measures, the potential residual effects on soils due to compaction and horizon mixing will be limited to an area less than the project site and negligible in magnitude.

5.3.4 Flora Loss

The proposed project will require the clearing of approximately 1.35 ha of land for the construction of the lagoon including the forcemain, outfall and access road. Clearing will reduce flora abundance at the project site and has the potential to reduce wildlife habitat in the project area. No protected flora species were observed in the site visit.

To mitigate potential effects due to loss of vegetation, vegetation clearing will be conducted in the winter months to avoid critical nesting periods, vehicle and equipment movements will be limited to designated pathways within and around work areas and disturbed surfaces will be kept to a minimum with re-vegetation occurring, or natural succession encouraged, as soon as practical where required during construction activities. As part of the eventual decommissioning of the proposed lagoon, the project site will be restored to the maximum extent that is practical and revegetation will occur.

The residual effects on vegetation are considered to be negligible in magnitude considering no protected or unique vegetation was encountered during the site visit and that similar vegetation is abundantly available in the project area and region.

The potential effects on wildlife due to vegetation loss are anticipated to be negligible as the clearing activities will avoid nesting seasons and as similar habitat lost to the project is abundantly available in the project area and region.

5.3.5 Soil Erosion

Soil may be lost during the construction and decommissioning phase due to erosion from wind and precipitation/runoff. Conditions favourable for erosion have the potential to occur during clearing and grubbing, excavation and infilling work, stockpiling, dike construction and eventual dike removal, site restoration, revegetation and movement of equipment on the site. Erosion of soil and material stockpiles due to wind has the potential to cause subsequent effects on air quality (dust and particulate matter), while erosion due to precipitation/runoff has the potential to cause subsequent effects on surface water quality and potentially on downstream fish habitat.

The project will disturb approximately 2 ha of land. Based on topography at the lagoon site (a change in elevation of approximately 4 m across the lagoon site with drainage flowing towards the marsh), erosion has the potential to occur at the project site with potential effects observed in the surrounding project area.

To mitigate potential effects due to erosion, an erosion and sediment control plan will be developed for the project outlining practices that should be adopted during project activities (use of silt fences etc). Further, soil stockpiles will not be placed in or along drainage routes to minimize soil loss.

Based on the nature of the soil at the site (silty clay according to the geotechnical investigation), erosive loss is anticipated to be minor and will be further reduced with the implementation of the described mitigation measures. Residual effects are anticipated to be negligible.

5.3.6 Heritage Resources Disturbance or Loss

The Archaeological Unit of the Historic Resources Branch indicated that the potential to impact significant heritage resources was low and that a Heritage Resources Impact Assessment would not be required in advance of construction.

If artifacts, historical features or skeletal remains are encountered during construction or decommissioning activities, work activities will stop immediately around the affected area with the find reported to the site supervisor. A qualified archaeologist may investigate and assess the find prior to the continuation of work. If skeletal remains are encountered during construction activities, the find will be immediately reported to the site supervisor and the RCMP.

With the implementation of mitigation measures above, residual effects to heritage resources are not anticipated.

5.4 Operational Effects

5.4.1 Lagoon Operation

Odour

During the operation phase, odour may be generated by the lagoon during the spring thaw. For the remainder of the year, odours are anticipated to be minimal as the lagoon will be aerobic and methane generation is not anticipated.

The closest building is approximately 150 m to the west of the lagoon within the Laurie River Main Camp. The separation distance between the nearest building and the lagoon, the existing vegetation buffer between the lagoon and the residents and the anticipated weak strength of the wastewater (minimal organic loading) are anticipated to minimize potential odour generation resulting in negligible effects due to odour.

Greenhouse Gas Emissions

Wastewater treatment can generate methane and nitrous oxide; potent greenhouse gasses. The proposed primary and secondary lagoon cells will be 1.5 m deep. According to the Intergovernmental Panel on Climate Change (IPCC), lagoons less than 1 m in depth generally provide aerobic conditions and negligible quantities of methane are generated, while lagoons deeper than 2-3 m however can produce significant amounts of methane. Additionally, aerobic shallow ponds and anaerobic lagoons are unlikely sources of nitrous oxides (Intergovernmental Panel on Climate Change 2006). As the lagoons will be less than 2 m in depth, significant amounts of methane and nitrous oxide emissions are not anticipated.

Further, an examination of Environment Canada's 2010 reported facility emissions found that no lagoons in Manitoba report GHG emissions. As such it is not anticipated that lagoons are a significant emitter of GHGs as no facilities currently meet the annual 50,000 tonnes of carbon dioxide equivalent reporting threshold (Environment Canada 2012).

Land Use, Resource Use and Aesthetics

Recreational activities within the project site and surrounding area are limited due to its remote location. As no outfitters, lodges, campgrounds or parks are located within the project site and surrounding area and the only access road to the site is privately owned by Manitoba Hydro, no effects to recreation and tourism are anticipated to occur as a result of the Project.

The project site and surrounding area are not used for commercial forestry, commercial fishing, or wild rice harvesting. As a result, no effects to these activities are expected to occur as a result of the Project.

No protected areas are located within 100 km of the project site. As such, the proposed operation of the lagoon is not anticipated to affect protected areas.

During the operation phase of the project, the aesthetics of the project area will be altered. The proposed lagoon site will change from partially treed lands to a diked and fenced lagoon site. To minimize potential aesthetic impacts, the vegetation buffer between the lagoon site and Laurie River Main Camp will be maintained. Therefore the residual effects are considered to be neutral.

5.4.2 Lagoon Discharge

The proposed lagoon will be discharged over a three week period at an approximate rate of 55 L/min or 3.3 m^3/hour. At the expected discharge rate, the effluent is expected to make up the majority of the flow within the effluent drainage channel however, the effluent discharge rate is significantly less (0.37%) than that of the Laurie River (24.58 m^3/s average between June-October) and would negligibly contribute flow to the Laurie River.

The proposed discharge is not anticipated to cause additional erosive effects along the drainage channel, as the peak discharge rate will be realized during the three-week “trickle” discharge period between June and October and a rip rap splash pad will be provided at the end of the outfall pipeline to dissipate erosive energy. These measures are also anticipated to mitigate potential flora loss along the drainage path due to erosion during lagoon discharge.

The proposed lagoon is designed to meet anticipated provincial *Environment Act* Licence effluent limits and improve the quality of effluent discharged to the Laurie River as the existing WWTP provides little to no wastewater treatment. Effluent will be sampled for compliance with the *Environment Act* Licence prior to discharge. The proposed lagoon will discharge to an existing natural channel that will discharge to a marsh area and will eventually drain to the Laurie River.

Based on the background water quality and mean monthly October flows noted in Section 4.2.6 an estimated total phosphorus load in the Laurie River upstream of the discharge location would be approximately 754 kg over a three week period. Compared to the anticipated total phosphorus load (approximately 4.9 kg) contributed by the discharge of the lagoon (3 mg/L at 55 L/min) in October, the resulting increase in total phosphorus would represent an increase of approximately 0.6% for the three week discharge period and approximately 0.03% on an annual basis. The phosphorus level in the effluent will be further managed by the trickle discharge that will allow additional time for the soils and vegetation along the proposed effluent discharge route to provide additional phosphorus uptake. The additional phosphorus load contributed by the proposed lagoon is therefore considered negligible and no substantial effects on water quality in the Laurie River are expected.

The lagoon will discharge treated water at ambient temperatures, and as such effects related to heated effluents such as effects related to the receiving water's oxygen carrying capacity and behaviour modification in fish are not anticipated.

The parameter in the lagoon effluent posing the highest potential for direct impacts to biota in the marsh would be ammonia due to its potential toxicity. The toxicity of ammonia to aquatic biota is based on the concentration of its unionized fraction, which is dependent upon temperature, pH and Total Dissolved Solids (TDS). At the theoretical extreme condition in the effluent of coinciding maximum ammonia concentration and pH (10 mg/L ammonia nitrogen and pH 9, very unlikely to occur during the fall discharge period), the corresponding unionized ammonia concentration would be 1.41 mg/L NH_3, assuming conservative effluent temperature and TDS concentrations of 8°C and 1,500 mg/L, respectively. This unionized ammonia concentration of 1.41 mg/L is lower than the acutely toxic concentrations* of ammonia for the standard test species Daphnia magna and the aquatic organisms that would be expected to inhabit the wetland in fall. Examples of these organisms and their acute toxicity concentrations for ammonia are found in **Table 12**:

Table 12: Toxic Concentrations of Ammonia by Species

Common Name	Species Name	Acutely Toxic Ammonia Concentration * (mg/L NH3)
Daphnid	*Daphnia magna*	1.61
Scud	*Crangonyx pseudogracilis*	2.32
Snail	*Helisoma trivolvis*	2.76
Isopod	*Asellus racovitzai*	4.95
Beetle	*Stenelmis sexilneata*	8.00
Caddisfly	*Philarctus quaeris*	10.20

*Note: * "Acutely toxic concentration" in this document refers to the mean literature LC50 concentration, as listed in Environment Canada and Health Canada (2001). The LC50 is the concentration that is lethal to 50% of test organisms in published laboratory experiments.*

Based on the above, risk of acute ammonia toxicity to aquatic life in the wetland will be extremely low. Protection against sub-lethal toxicity to aquatic organisms will be provided by dilution, assimilation of ammonia by vegetation in the wetland, volatilization and oxidation, and the periodic nature of the discharge.

The Manitoba Water Quality Standards, Objectives and Guidelines contain limits on ammonia for the protection of aquatic ecosystems. Ammonia Objectives are defined for waters with cold and cool water species and are pH and temperature dependant. The marsh is considered a cool water system and as such cool water equations were used to determine the applicable ammonia Objectives whereas the Laurie River is considered a cold water system.

Ammonia Objectives were calculated for the marsh for temperatures ranging from 5 to 20°C. No water quality data was available for the marsh, however the pH was assumed to be slightly acidic at 6.5 to represent the stagnant nature of this waterbody. For all temperatures examined, equation 1 for chronic exposure gave the most conservative ammonia Objective, 4.682 mg/L at 20°C. The ammonia Objective applies to the fully-mixed zone within the marsh. The effluent will be trickle discharged over a three week period with 1,678 m^3 of treated effluent discharged in total. No bathymetric information was available for the marsh, however using aerial photography, the surface area is estimated to be 10,312 m^2. If it is assumed that this water body is 0.3 m deep (however may be much deeper based on the open water

conditions in parts of the marsh), the marsh volume would be conservatively estimated to be 3,094 m^3. This volume in addition to aeration along the discharge route is anticipated to provide sufficient dilution and removal of ammonia so that the cool water Objectives within the marsh will be met.

No calculations for ammonia Objectives within the Laurie River were completed, as the discharge will negligibly contribute flow to the Laurie River therefore the effluent will be assimilated immediately downstream of the discharge channel.

Effects on fish and fish habitat including protected species are anticipated to be mitigated by the measures described above to protect surface water quality.

5.4.3 Maintenance Activities

During the operation phase of the project, a management program to deter burrowing animals from burrowing in the new lagoon will be developed. This may include trapping of nuisance species. Further, the management of vegetation in and around the lagoon will occur including mowing grass and removing all reeds, rushes and trees within the lagoon and on the dykes to below the water line.

The short-eared owl and the yellow rail are protected ground nesting species that may occur in the general region. The management of burrowing animals such as voles (primary diet for short-eared owl) as well as the activity at the site (including grass mowing) is anticipated to deter these species from the project site. Although the removal of voles from the project site has the potential to reduce the availability of a food source for the short-eared owl, as the project site is located in a remote location in northern Manitoba with similar habitat abundantly available surrounding the project site, this effect is anticipated to be negligible. Mowing activities also have the potential to affect short-eared owls or yellow rails that may be nesting on the lagoon dikes, however based on the maintenance activities at the site, it is anticipated that these species would nest elsewhere if they were present in the project region. For these reasons, it is not anticipated that the proposed maintenance activities will affect the short-eared owl or the yellow rail. Maintenance activities are not anticipated to notably affect any other sensitive wildlife species.

Vehicle and equipment emissions will be generated during maintenance activities including greenhouse gas emissions. Noise will also be generated during these activities. Based on the short time these emissions will be generated (a few hours a week during the spring, summer and fall), the limited number of emission sources at the project site (a few vehicles, a lawnmower etc.), and the remote nature of the site with abundant wildlife habitat surrounding the site, the emissions are not anticipated to measurably affect air quality, climate or noise receptors (humans and wildlife).

5.5 Accidents and Malfunctions

To prevent accidents and malfunctions, construction, operation and decommissioning activities will be conducted in accordance with all regulatory requirements. The following sections provide additional details on precautionary measures that are proposed to prevent or mitigate accidents and malfunctions. Worker protection in Manitoba is provided through standards, procedures and training legislated under the *Workplace Safety and Health Act*. All practices performed at the site will be carried out in accordance with the *Workplace Safety and Health Act* to minimize health and safety effects.

5.5.1 Fire

During construction, operation and decommissioning activities, there exists the potential for fires at the site that involve mechanical/electrical equipment, fuels, human-related occurrences, such as improper disposal of cigarette butts, and natural occurrences due to dry weather. Effects related to fires include, but are not limited to forest fire risk (vegetation and wildlife habitat loss); changes in vegetation

disposal of cigarette butts, and natural occurrences due to dry weather. Effects related to fires include, but are not limited to forest fire risk (vegetation and wildlife habitat loss); changes in vegetation composition including life cycles, patchiness and regeneration; harm to on-site personnel and equipment; and, the potential release of contaminants and hazardous materials into the environment (potential to affect soil, air, groundwater quality and surface water quality with potential subsequent effects on downstream fish and fish habitat).

All precautions necessary must be taken to prevent fire hazards at the site, including, but not limited to:

- All flammable waste will be removed on a regular basis and disposed of at an appropriate disposal site;
- Appropriate fire extinguisher(s) will be available on the site during all phases of the project. Such equipment will comply with and be maintained to, the manufacturers' standards;
- All on-site fire prevention/response equipment, including the fire hydrants will be checked on a routine basis to confirm the equipment is in proper working order at all times;
- Greasy or oily rags or materials subject to spontaneous combustion will be deposited and stored in appropriate receptacles away from surface water. This material will be removed from the site on a regular basis and be disposed of at an appropriate waste disposal facility;
- In periods of high forest fire risk, idling of vehicles will be reduced. Further, vehicles will be restricted to designated roads/trails to reduce potential fire ignition risk;
- All fuels will be stored in appropriate facilities (designed in compliance with regulatory requirements), to reduce the potential for accidental ignition; and,
- Cleared vegetation will be piled, burned or disposed of as specified in Manitoba Conservation and Water Stewardship work permits. If vegetation is burned, all fires will be monitored.

5.5.2 Spills

During construction, operation and decommissioning activities, there is potential for environmental effects due to fuel spills and/or leaks. Accidents (including transportation accidents) could also result in the accidental release of hazardous materials and/or equipment/vehicle fluids and fuels. A number of potential environmental concerns are also associated with the accidental release of chemicals and fuels resulting from improper storage and handling procedures. As a result of spills, effects on soils, vegetation, groundwater quality, surface water quality and subsequently fish and fish habitat as well as degradation of air quality and a direct threat to human health and safety are possibilities.

To prevent spills from occurring during project activities, the following procedures will be employed:

- All potentially hazardous products (if required on-site) will be transported in accordance with provincial and federal TDG regulations and stored in a pre-designated, safe and secure product storage area(s) in accordance with applicable legislation;
- Storage sites will be inspected periodically for compliance with requirements.
- Any used oils or other hazardous liquids will be collected and disposed of according to provincial requirements;
- Service and minor repairs of equipment performed on-site will be performed by trained personnel in appropriate areas;

- Vehicles and equipment will be maintained to minimize leaks. Regular inspections of hydraulic and fuel systems on equipment/machinery will be completed on a routine basis. When detected, leaks will be repaired immediately by trained personnel;
- Refuelling and equipment maintenance activities will occur at least 100 m away from a waterbody and in a location of minimal grade (grade in vicinity of the lagoon is estimated to be in the order of 1-3%) in a such a manner to prevent release of deleterious substances to a waterbody;
- Fuel transfers, including from tanker to storage tank and storage tank to equipment, will be attended at all times;
- Standard environmental management practices will be adhered to in order to minimize the risk of accidental spills and adverse effects;
- In the event of a spill, the following will occur:
    - The spill will be reported to Manitoba Hydro, Manitoba Conservation and Water Stewardship and Environment Canada as appropriate.
    - Measures will be taken immediately with a spill kit or suitable alternative to prevent migration of the spilled material. Recovery measures will also be implemented as necessary in consultation with the appropriate provincial authorities.
- If required, a remediation program will be undertaken with contaminated material appropriately managed (in accordance with federal and provincial regulations).
- On-site construction staff will be trained in how to deal with spills and clean-up procedures, including review of applicable Spill Response Plans and knowledge of how to properly deploy site spill kit materials; which will be readily accessible at the site at all times; and
- Concrete and concrete wash water (for lift station construction) will be appropriately disposed of via one of the two following options:
    - Waste concrete and concrete wash water will be disposed of via deposit to a shallow pit excavated to contain the waste concrete and allow surface infiltration of the wash water. The pit will be located on-site at least 100 m away from a drainage course to ensure that waste water does not migrate to surface water. Concrete will be removed for appropriate disposal or reuse on a regular basis.
    - Waste concrete and concrete wash water will be disposed of at the lagoon via the truck dump area. The amount of wash water will be negligible compared to the lagoon volume. By disposing of the wash water within the lagoon, sufficient treatment will be ensured before the wastewater is released to the downstream water ways.

5.5.3 Dike Failure

During the operation phase of the wastewater treatment lagoon, inadequate dike design and construction could result in dike failure and subsequent release of raw, partially treated or treated effluent to the environment. Environmental effects could include erosion, surface and groundwater quality effects, flora and fauna habitat loss, fish and fish habitat effects and human health and safety effects. To prevent lagoon dyke failure, the dykes will be geotechnically designed, by a registered professional engineer, to contain the liquid load. A perimeter drainage ditch will prevent the dikes from being weakened from standing water along the dikes. Regular inspection of dike integrity will also be conducted by Manitoba Hydro personnel. In the event that deficiencies are identified, appropriate repairs will be undertaken as soon as possible.

5.5.4 Pipeline and Pump Malfunction

To prevent pipeline and pump failure, new pipelines and pumps will be tested prior to operation to identify any potential issues, including any pipeline leaks. Regular inspection of the pumps and accessible pipelines will be conducted by Manitoba Hydro personnel. Pipelines used for the forcemain will be suitable for cold weather climates and/or insulated/heat traced to prevent cracking and/or failure due to freezing. The proposed outfall pipeline has a low potential for leaks as it will be a gravity pipeline. Further, in the event of a leak of this pipeline any leaks would be of treated effluent therefore minimizing potential environmental effects. In the event of an identified pipeline or pump failure, the location of the failure will be identified, the pipeline or pump will be repaired and/or replaced, and if required, appropriate remediation measures will be undertaken.

5.5.5 Clay Liner Failure

The proposed lagoon will be clay lined to prevent potential groundwater effects. During the construction process, compaction testing will be conducted at regular lift intervals to ensure adequate compaction is achieved in the clay liner. If leaks are identified during facility operation, Manitoba Hydro will notify Manitoba Conservation and Water Stewardship and investigate the source of the leak/contamination where possible. The investigation will be conducted with the intent to identify appropriate mitigation measures as well as to provide monitoring and investigations to confirm that the surrounding land/groundwater has not been contaminated. It is not anticipated that lagoon leaks would pose a risk to human health as groundwater is not used for drinking or other purposes.

5.5.6 Transportation Accidents

Transportation accidents can result in the release to the environment of vehicle fluids (such as diesel, oils etc.) and the material the vehicles were transporting (such as construction waste). Effects related to spills can include air, soil, surface water and groundwater quality effects with potential for subsequent effects on flora, fauna, aquatic resources and human health. In the event of a transportation accident resulting in a spill, appropriate remediation measures will be coordinated with Manitoba Conservation and Water Stewardship and undertaken in accordance with the nature of the spilled material.

6. Monitoring and Follow-Up

Follow-up programs verify the accuracy of the environmental assessment of a project and determine the effectiveness of measures taken to mitigate the adverse environmental effects of the project. For the proposed project, mitigation measures will be applied as described herein and a formal follow-up program is not anticipated to be required.

Monitoring programs involve the collection and analysis of data on the state a particular environment is in to identify changes or trends over time. Results from monitoring programs indicate the success of mitigation measures that are implemented to protect the environment. They are also used to ensure compliance with environmental standards/regulations and to assist in any potential project operational changes. During the operation phase of the Project, Manitoba Hydro will comply with the monitoring requirements outlined in the new *Environment Act* License for the lagoon, which would include effluent quality monitoring to minimize the potential for surface water quality effects on Laurie River.

Table 13: Summary of Environmental Effects

Project Phase	Contributing Action	Environmental Components Affected	Magnitude of Unmitigated Effect	Direction of Effect	Duration of Effect	Frequency of Effect	Scope of Effect	Mitigative Measures	Residual Effect
Construction & Decommissioning	Dust Generation	Air Quality Terrestrial - Flora	Minor on-site	Negative	Short Term	Intermittent	Project Site	-Minimizing the amount of disturbed/exposed area -Blast mats will be used during blasting to contain dust -Material stockpile heights will be limited -Spraying roads with water (if required)	Negligible
	Emissions Generation (including Greenhouse Gasses)	Air Quality - Exhaust emissions Air Quality - Greenhouse gas emissions	Negligible	Negative	Short Term Long Term	Continuous during working hours	Project Area Regional	-Vehicles/equipment to be well maintained -Vehicle idling kept to a minimum	Negligible
	Waste Generation and Management	Groundwater Surface Water Soil Aquatic Resources	Minor to Major	Negative	Short Term	Rare	Project Area	-Wastes disposed of appropriately at an approved disposal facility -Hazardous materials including waste oil, lubricants and other petroleum products will be removed for off-site recycling or appropriate disposal -Decommissioned equipment will be removed, crushed and placed in a Sea Can Container for transport to a licensed landfill -Treated effluent will discharge to the Laurie River in accordance with the requirements of the future *Environmental Act* licence during decommissioning -Sludge will be dewatered using Geo Bags (or similar product) and transported to an approved landfill in a water-tight container for disposal, structures such as lift stations will be disposed of at an approved landfill	Negligible
	Noise Generation	Air Quality Aesthetics Terrestrial - Fauna	Negligible to Minor	Negative	Short Term	Intermittent	Project Area	-Vehicles/equipment to be well maintained -Work will be conducted during daylight hours only -Site staff will be advised in advance that blasting will occur -Blasts will be designed to be as small as possible -Hearing protection will be provided to workers as required	Negligible
	Change in Relief	Topography	Minor	Neutral	Long Term	Once	Project Site	-During construction, disturbed areas will be restored following the installation of the proposed equipment by backfilling the disturbed area(s) -During decommissioning, the topography at the site will be graded to match the surrounding area	Negligible to Minor, Neutral
	Soil Compaction and Mixing	Groundwater Terrestrial - Flora Soil	Negligible	Negative	Long Term	Once	Project Site	-Disturbed/exposed areas will be kept to a minimum with revegetation occurring as soon as practical where required -Topsoil will be stripped and stockpiled on the site for use in surface treatment and revegetation -Equipment and vehicles will use existing roads/paths -Regrading and revegetation after construction and decommissioning	Negligible
	Flora Loss	Terrestrial - Flora Terrestrial - Fauna	Negligible to Minor	Negative	Short to Moderate Term Short Term	Once	Project Site	-Vegetation clearing to be conducted in the winter months -Vehicle/equipment movements be limited to designated pathways -Minimize disturbed areas -Revegetation	Negligible
	Soil Erosion	Surface Water Soil Aquatic Resources	Negligible to Minor Negligible	Negative	Short Term Moderate Term Short Term	Rare Intermittent Rare	Project Area	-An erosion and sediment control plan will be developed for the project prior to construction -Stockpiles will not be placed in or along drainage routes -Minimizing disturbed areas	Negligible
	Heritage Resources Disturbance or Loss	Heritage Resources	Negligible	Negative	Long Term	Once	Project Area	-Notify appropriate authorities if heritage resources are encountered, resulting in avoidance, comprehensive controlled surface collection and/or comprehensive mitigation excavation	Negligible

Table 13: Summary of Environmental Effects

Project Phase	Contributing Action	Environmental Components Affected	Magnitude of Unmitigated Effect	Direction of Effect	Duration of Effect	Frequency of Effect	Scope of Effect	Mitigative Measures	Residual Effect
Operation	Lagoon Operation	Air Quality - Odour	Negligible	Negative	Short term	Intermittent and seasonally	Project Area	None required	Negligible
	Greenhouse Gas Emissions	Air Quality	Negligible	Negative	Long term	Continuous	Regional	None required	Negligible decrease
	Land Use, Resource Use & Aesthetics	Recreational, land use and protected areas	Negligible	Neutral	Long Term	Continuous	Project Area	None	Negligible
		Aesthetics - lagoon					Project Site	-Vegetation buffer between the lagoon site and Laurie River Main Camp will be maintained	
	Lagoon Discharge	Surface Water - Quality	Negligible	Negative	Short to Moderate Term	Continuous during discharge period	Project Area to Region	-Effluent will be sampled for compliance with the *Environment Act* licence prior to discharge -A rip rap splash pad will be provided at the end of the outfall pipeline to dissipate erosive energy	Negligible
		Aquatic Resources							
		Surface Water - sediment & turbidity	Negligible	Negative	Short to Moderate Term	Intermittent	Project Area	-A rip rap splash pad will be provided at the end of the outfall pipeline to dissipate erosive energy	Negligible
		Aquatic Resources - sediment & turbidity							
		Terrestrial - Flora					Project Site		
		Soil - erosion							
	Maintenance Activities	Terrestrial - Fauna (nuisance species)	Negligible	Negative	Short Term	Intermittent	Project Site	-Control of nuisance species in lagoon area -Management of vegetation in and around the lagoon will occur including mowing grass and removing all reeds, rushes and trees within the lagoon and on the dykes to below the water line	Negligible

7. Conclusion

The proposed lagoon and infrastructure replacements will result in improved treatment and operability compared to the existing RBC. Based on the design of the Project and the implementation of mitigation measures identified in this environmental assessment, no significant adverse environmental effects are anticipated to occur as a result of the proposed Laurie River wastewater treatment lagoon and related infrastructure.

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