SNC-Lavalin Inc.
148 Nature Park Way
Winnipeg, Manitoba
Canada R3P 0X7

Telephone: +1.204.786.8080
Fax: +1.204.786.7934

9 May 2016

Environmental Approvals Branch
Manitoba Conservation and Water Stewardship
Suite 160, 123 Main Street
Winnipeg, Manitoba R3C 1A5

ATTN: Ms. Tracey Braun, Director

RE: Environment Act Proposal for the Thicket Portage Sewage Lagoon

Dear Ms. Braun

SNC-Lavalin Inc. is pleased to submit this Environmental Act Proposal (EAP) for a Class 2 Wastewater Treatment Lagoon Ground on behalf of Indigenous and Municipal Relations of Manitoba (formerly Aboriginal and Northern Affairs of Manitoba).

The existing sequencing batch reactor (SBR) system is not meeting its effluent requirements and a feasibility study completed by Neegan Burnside in 2015 recommended a new wastewater treatment facility. Indigenous and Municipal Relations of Manitoba is proposing to construct a new wastewater treatment lagoon to replace the inadequate SBR system.

Please find enclosed four (4) hardcopies and one (1) electronic copy of the EAP submission which includes:

- A cheque for the application fee for a Class 2 development in the amount of $7,500;
- An Environmental Act Proposal Form; and
- An Environmental Assessment Report which includes the Application for Wastewater Treatment Facility Classification.

If you have any questions regarding our submission, or require further information, please do not hesitate to contact me at lyndsey.macbride@snclavalin.com or 204.786.8080.

Sincerely,

L. MacBride

Lyndsey MacBride, M.Sc., P.Geo.
SNC-LAVALIN INC.

Environment Act Proposal Form

Manitoba
Conservation and Water Stewardship

Name of the development: Thicket Portage Sewage Lagoon		
Type of development per Classes of Development Regulation (Manitoba Regulation 164/88): Class 2 - Wastewater treatment lagoon		
Legal name of the applicant: Indigenous & Municipal Relations		
Mailing address of the applicant: Room 108, 59 Elizabeth Drive		
Contact Person: Armand Barbeau		
City: Thompson	Province: Manitoba	Postal Code: R8N 1X4
Phone Number: 204-677-6737	Fax: 204-677-6525	email: Armand.Barbeau@g
Location of the development: Community of Thicket Portage		
Contact Person: Armand Barbeau		
Street Address:		
Legal Description: NW 10-73-02 W1		
City/Town: Thicket Portage	Province: Manitoba	Postal Code: R8N 1X4
Phone Number: 204-677-6737	Fax: 204-677-6525	email: Armand.Barbeau@g
Name of proponent contact person for purposes of the environmental assessment: Lyndsey MacBride, SNC-Lavalin Inc.		
Phone: 204-786-8080 Fax: 204-786-7934	Mailing address: 148 Nature Park Way, Winnipeg, Manitoba R3P 0X7	
Email address: lyndsey.macbride@snclavalin.com		
Webpage address: www.snclavalin.com		
Date: May 9/2016	Signature of proponent, or corporate principal of corporate proponent: [signature] Printed name: Armand Barbeau Director.	

ENVIRONMENT ACT PROPOSAL

THICKET PORTAGE SEWAGE LAGOON

Indigenous and Municipal Relations of Manitoba

SNC-LAVALIN INC.

May 2016

REPORT

Project n°633391

NOTICE TO READER

This report has been prepared and the work referred to in this report has been undertaken by SNC-Lavalin Inc. (SNC-Lavalin), for the exclusive use of [Indigenous and Municipal Relations of Manitoba] (the Client), who has been party to the development of the scope of work and understands its limitations. The methodology, findings, conclusions and recommendations in this report are based solely upon the scope of work and subject to the time and budgetary considerations described in the proposal and/or contract pursuant to which this report was issued. Any use, reliance on, or decision made by a third party based on this report is the sole responsibility of such third party. SNC-Lavalin accepts no liability or responsibility for any damages that may be suffered or incurred by any third party as a result of the use of, reliance on, or any decision made based on this report.

The findings, conclusions and recommendations in this report (i) have been developed in a manner consistent with the level of skill normally exercised by professionals currently practicing under similar conditions in the area, and (ii) reflect SNC-Lavalin's best judgment based on information available at the time of preparation of this report. No other warranties, either expressed or implied, are made with respect to the professional services provided to the Client or the findings, conclusions and recommendations contained in this report. The findings and conclusions contained in this report are valid only as of the date of this report and may be based, in part, upon information provided by others. If any of the information is inaccurate, new information is discovered or project parameters change, modifications to this report may be necessary.

This report must be read as a whole, as sections taken out of context may be misleading. If discrepancies occur between the preliminary (draft) and final version of this report, it is the final version that takes precedence. Nothing in this report is intended to constitute or provide a legal opinion.

SNC-Lavalin disclaims any liability to the Client and to third parties in respect of the use of (publication, reference, quoting, or distribution), any decision made based on, or reliance on this report or any of its contents.

EXECUTIVE SUMMARY

SNC-Lavalin Inc. (SNC-Lavalin) was retained by Indigenous and Municipal Relations of Manitoba (formerly Aboriginal and Northern Affairs of Manitoba) to prepare this Environment Act Proposal (EAP) for the proposed Thicket Portage Sewage Lagoon. The community is located 48 km south of Thompson and had a population of 148 people in 2014. A baseline study was completed for the project and included a desktop review of the biophysical, heritage and socio-economic environment.

A mechanical sequencing batch reactor (SBR) plant currently processes all of the wastewater from the community, which is serviced by a low pressure piped collection system. Solids are held in individual septic tanks until they are serviced annually when the winter road is opened. The solids are then pumped from each tank and hauled to the City of Thompson sewage treatment plant for disposal. A feasibility study determined that the current plant is unable to meet its design effluent requirements and recommended that the community be serviced by a new facultative lagoon (Neegan Burnside 2015), which would also eliminate the need to haul solids to Thompson. Three options for a new wastewater treatment facility were evaluated and a new facultative lagoon was the recommended system to meet the long-term needs of the community. Indigenous and Municipal Relations of Manitoba is proposing to construct a new wastewater treatment lagoon to replace the inadequate SBR system.

The proposed wastewater treatment system comprises a three-cell lagoon with an additional alum and UV treatment process. It is located south of the community adjacent to the community landfill. It will utilize the existing collection system, however the flow within the force-main will be reversed. A buried, 75 mm force-main will be constructed from the southern end of the existing collection system to the new lagoon. The wastewater will be pumped by the low pressure sewer system into the primary facultative cell and then will flow by gravity into the secondary cell, which is hydraulically connected to the primary cell. From the secondary cell, the effluent will be pumped to the alum treatment building and then to the tertiary cell. From the tertiary cell, the effluent will be pumped to the UV treatment and then discharged into an existing swale, which drains to an unnamed seasonal creek that discharges into Wintering Lake northwest of the community. The community's' drinking water source is derived from Landing Lake, south of the community. The proposed sewage lagoon will also accommodate the solids from the individual septic tanks, which will be pumped every two to three years in rotation and discharged into the primary cell via a sewage drop.

The lagoon has been designed in accordance with the Manitoba Conservation and Water Stewardship Design Objectives for Wastewater Treatment Lagoons (MCWS 2014). It has also been designed to meet the effluent requirements from MCWS (2014) and the Manitoba the Manitoba Water Quality Standards, Objectives and Guidelines criteria for industrial and municipal wastewater effluents discharged to a water body (Manitoba Water Stewardship 2011). Construction is

tentatively scheduled to commence in summer 2016, pending receipt of regulatory approvals, and is expected to take three to four months to complete.

Thicket Portage is located within the Sipiwesk Lake Ecodistrict, a part of the Hayes River Upland Ecoregion, which itself is part of the Boreal Shield Ecozone. The proposed site was partially cleared for use as part of the landfill in 2002, however, is no longer required for that purpose. The potential and/or expected project effects include:

- Dust and noise emissions during construction activities;
- Odours and air emissions during operation from the release of methane, H_2S and NO_X;
- Permanent displacement of soils to construct the lagoon;
- Removal of approximately 3.2 ha of forest to accommodate the pipeline and lagoon;
- Effluent discharge which will flow into Wintering Lake and may include coliforms, organic wastes, suspended solids and other contaminants; and
- Potential for effects to groundwater if the wastewater leaks/seeps through the lagoon liner into the groundwater or if there is a leak in the pipeline.

Indigenous and Municipal Relations of Manitoba is committed to avoiding or reducing adverse environmental effects associated with the proposed project wherever possible and has developed numerous mitigation and environmental design measures to reduce these effects. There are potential or expected residual effects following the mitigation measures; however, all effects were assessed to have a low significance rating.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

1 INTRODUCTION

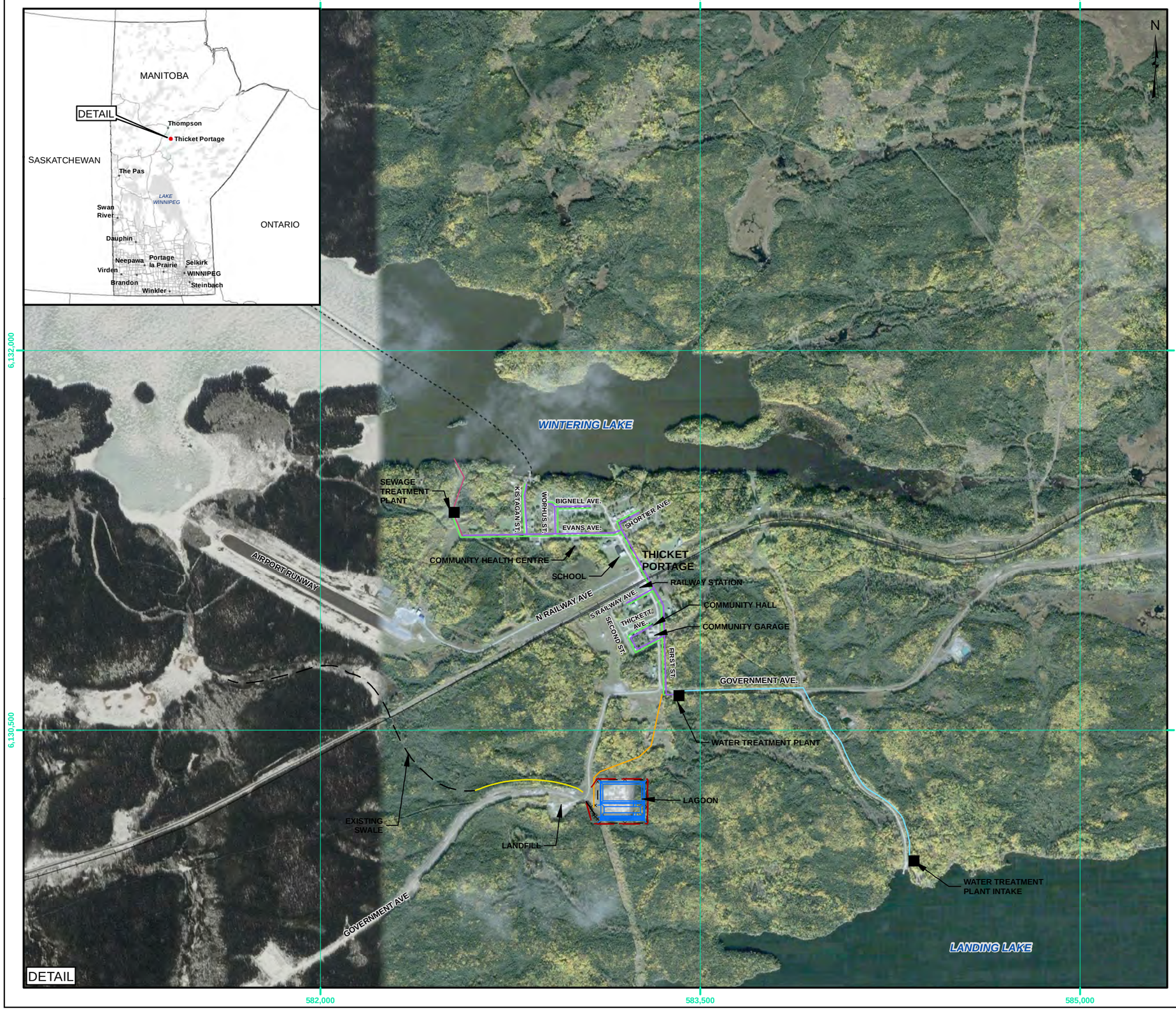
SNC-Lavalin Inc. (SNC-Lavalin) was retained by Indigenous and Municipal Relations of Manitoba (formerly Aboriginal and Northern Affairs of Manitoba) to prepare this Environment Act Proposal (EAP) for the proposed Thicket Portage Sewage Lagoon (**Figure 1.1**). The baseline study included a desktop review of the biophysical, heritage and socio-economic environment.

1.1 STATEMENT OF NEED

A mechanical sequencing batch reactor (SBR) plant currently processes all of the wastewater from the community, which is serviced by a low-pressure piped collection system. A feasibility study determined that the current plant is unable to meet its design effluent requirements and recommended that the community be serviced by a new facultative lagoon (Neegan Burnside 2015).

1.2 PROPONENT

Project Name:	Thicket Portage Sewage Lagoon
Proponent:	Indigenous and Municipal Relations of Manitoba
Contact:	Armand Barbeau Director LGD Division, Northern Region Room 108, 59 Elizabeth Drive Thompson MB R8N 1X4 Phone: 204-677-6737 E-mail: armand.barbeau@gov.mb.ca



LEGEND

- COMMUNITY BUILDING

PROPOSED WASTEWATER TREATMENT INFRASTRUCTURE

- PROPOSED 2" HDPE DISCHARGE PIPE
- PROPOSED DITCH
- PROPOSED DISCHARGE OF EFFLUENT INTO SWALE
- PROPOSED FORCEMAIN
- PROPOSED LAGOON FENCED BOUNDARY
- PROPOSED LAGOON LAYOUT

EXISTING SEWAGE TREATMENT INFRASTRUCTURE

- ABANDONED LINE
- EXISTING RAW WATER LINE
- EXISTING SEWAGE FORCEMAIN
- EXISTING SWALE
- EXISTING WATER MAIN
- COMMUNITY
- WINTER ROAD
- RAILWAY

NOTES

1. COORDINATE SYSTEM: NAD 1983 UTM ZONE 14N.
2. IMAGERY (APRIL 28, 2014) OBTAINED FROM GOOGLE EARTH.
3. HIGHWAYS AND ROADS OBTAINED FROM THE NATIONAL ROAD NETWORK MANITOBA EDITION 6.0 DATASET, 2013-04-12.
4. RAILWAYS OBTAINED FROM THE NATIONAL RAILWAY NETWORK MANITOBA EDITION 1.0 DATASET, 2013-04-05.

REFERENCE DRAWINGS

DWG No.	DATE	DESCRIPTION

REVISIONS

REV	DATE	DESCRIPTION	DRN BY	CHK

0 125 250 500 METRES

SCALE: 1:15,000

SNC·LAVALIN

CLIENT	PROJECT LOCATION
ABORIGINAL AND NORTHERN AFFAIRS OF MANITOBA	THICKET PORTAGE, MANITOBA

TITLE

LOCATION PLAN

DES BY	LM	DRN BY	JS	DATE 2016 04 25	FIG No. 1.1	REV 0
CHK BY		APP BY	XX	DWG No. 633391-E-02-E-001		11x17

Path: Z:\Manitoba Aboriginal and Northern Affairs\633391 Thicket Portage Lagoon\4.0 Execution\4.5 GIS and Drawings\GIS\Drawing\633391-E-02-E-001(Location Plan).mxd

1.3 PROJECT BACKGROUND

1.3.1 Existing Wastewater System

The existing wastewater treatment system is described below from the Thicket Portage Wastewater Feasibility Study (Neegan Burnside 2015).

1.3.1.1 Collection System

Residential homes and community buildings are serviced by a lower pressure piped sewage collection system (Neegan Burnside 2015). At each building there is two-chamber septic tank where raw sewage is collected and then pumped from the second chamber using individual pumps through the community a series of 50 mm and 75 mm diameter low-pressure sewage force-mains. Solids are held in the individual septic tanks until they are serviced annually when the winter road is opened. The solids are then pumped from each tank and hauled to the City of Thompson sewage treatment plant for disposal.

Community sewage is collected using the low pressure sewer system and is transported to the sewage treatment plant (STP) with discharge into the primary chamber of the trash tank. The sewage influent line undergoes an expansion approximately 75 m from the trash tank, to a 100 mm HDPE low-pressure sewage force-main.

The sewage influent line is in fair operation condition with no reported leaks or freezing problems (Neegan Burnside 2015).

1.3.1.2 Wastewater Treatment Plant

The current wastewater treatment plant was constructed in 1995 and is located in the northwest portion of the community (Neegan Burnside 2015). It is a sequencing batch reactor (SBR) system with a design capacity of 47 m^3/day. It includes a two chamber trash tank (11.6 m^3), a transfer tank (28.9 m^3) and a reactor tank (63.2 m^3). A wood framed building was constructed on top of the SBR tanks. The building consists of a single room that houses the electrical panel, control panel, UV system, aeration blowers, backup chlorine feeder and carbon feeder.

Sewage flows into the trash tank, then into the secondary trash tank, where grit and large suspended solids are removed. It also stores waste activated sludge that is pumped from the reactor tank. The sewage then flows, via gravity, into the transfer tank where it is stored before entering the reactor tank. It is then pumped into the reactor tank which has four stages – fill, aerate, settle and decant; biological oxidation takes place in the reactor tank. Neegan Burnside (2015) includes a more detailed description of the existing plant.

1.3.1.3 Wastewater Effluent Quality

The current SBR plant is not meeting its effluent requirements (Neegan Burnside 2015). Monthly samples showed frequent exceedances of biochemical oxygen demand (BOD), total suspended solids, ammonia, total coliform, fecal coliform, and more recently total phosphorus and total nitrogen (**Table 1.1**).

1.3.1.4 Existing System Assessment

A feasibility study determined that the current plant is unable to meet its design effluent requirements and recommended that the community be serviced by a new facultative lagoon (Neegan Burnside 2015), which would also eliminate the need to haul solids to Thompson.

Neegan Burnside (2015) identified many areas of concern with the existing SBR plant. The existing facility is showing a clear inability to meet the effluent standards on the system's operating licence, likely in part by inadequate wastewater equalization that should be occurring in the trash tank, and inability for year-round sludge removal. It is not anticipated that minor repairs would be able to bring it into compliance, and the study recommended a new wastewater treatment facility.

Table 1.1 – Thicket Portage Wastewater Effluent Analytical Results. License exceedances are bolded (Neegan Burnside 2015)

Date	BOD	Suspended Solids	Total Phosphorus	Ammonia	Total Nitrogen	Total Coliform	Fecal Coliform
	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(MPN)	(MPN)
License Limit	<30	<30		3		<1500	<200
13-Sep-10	**261**	**820**		0.422		**>110,000**	**110,000**
02-Oct-10	15.6	**45**		0.183		43	9
22-Dec-10	<6	12		**13.4**		4	<3
05-Jan-11	11.1	13		**15.3**		23	23
07-Feb-11	17.3	17		**21.9**		**2,300**	**210**
02-Mar-11	**72.5**	**180**		**24.2**		**9,300**	**9,300**
13-Apr-11	**200**	**450**		**29.6**		**110,000**	**24,000**
16-May-11	**143**	**20**		**33.8**		**>110,000**	**>110,000**
01-Jun-11	**37.3**	18		**29.2**		**4,300**	**750**
06-Jul-11	**290**	**500**		**35.0**		**110,000**	**46,000**
10-Aug-11	**102**	**240**		**25.6**		**>110,000**	**24,000**
31-Aug-11	**430**	**820**		**21.0**		**110,000**	**21,000**
03-Oct-11	**278**	**587**		0.425		**>110,000**	**46,000**
04-Nov-11	16.5	**208**		**15.4**		**24,000**	**9,300**
06-Dec-11	**105**	**228**		**27.1**		**46,000**	**7,500**
04-Jan-12	**30.4**	**72.5**		**23.8**		**>110,000**	**110,000**

Date	BOD	Suspended Solids	Total Phosphorus	Ammonia	Total Nitrogen	Total Coliform	Fecal Coliform
	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(MPN)	(MPN)
License Limit	<30	<30		3		<1500	<200
01-Feb-12	10.2	13		**21.4**		9	9
12-Mar-12	**85.5**	**290**		**30.7**		**110,000**	**46,000**
03-Apr-12	**97**	**401**		**17.5**		**>110,000**	**46,000**
09-May-12	**101**	**530**		**21.4**		**>110,000**	**>110,000**
12-Jun-12	**120**	**510**		**29.2**			
05-Jul-12	**179**	**390**		**24.9**		**>110,000**	**>110,000**
01-Aug-12	**128**	**405**		**15.5**		**>110,000**	**>110,000**
21-Feb-13	13.9	23.0		**37.8**		**24,000**	**9,300**
23-Mar-13	<6.0	13.0		**40.0**		930	**930**
15-Apr-13	15.0	**31.7**		**8.6**		**4,300**	**4,300**
03-Jun-13	8.6	8.0		**3.41**		**4,300**	**930**
08-Jul-13	18.7	**34.0**		**38.1**		**2,300**	**930**
05-Aug-13	7.7	10.0		**22.8**		**4,300**	75
04-Sep-13	**87.5**	**183.0**		**14.7**		**>110,000**	**46,000**
30-Sep-13	**49.2**	**97.0**		0.2		**24,000**	**24,000**
04-Nov-13	10.1	16.0		**31.7**		**9,300**	**4,300**
04-Dec-13	18.6	26.0		**19.7**		**24,000**	**930**
06-Jan-14	27.6	**42.0**	5.20	**36.7**	47.5	**2,300**	**430**
03-Feb-14	**60.0**	**134.0**	4.34	**23.4**	44.3	**110,000**	**110,000**
11-Mar-14	<6.0	8.8	0.01	**38.2**	44.7	930	35
08-Apr-14	**38.3**	**115.0**	6.16	**29.6**	49.3	**46,000**	**930**

1.4 ASSESSMENT OF ALTERNATIVES

Neegan Burnside (2015) evaluated three options for a new wastewater treatment facility, including: (i) a new facultative lagoon; (ii) a facultative lagoon and aerated submerged attached growth reactor (SAGR) system; and (iii) a new mechanical wastewater treatment plant. The new facultative lagoon was the recommended system to meet the long-term needs of the community. This was based on simplicity of operation, low maintenance needs, low capital and operational costs, and the availability of suitable land. Facultative lagoons offer a consistent effluent quality and are less susceptible to variations in flow than mechanical treatment alternatives, which are often experienced in small communities.

The feasibility study also assessed three locations for the lagoon, including: site of the decommissioned school lagoon immediately south of the community, a site southwest of the airport, and the chosen site east of the landfill. The first option was too close to the community and did not have as favorable of clays as the chosen option and the second was found to be too wet.

1.5 Regulatory Framework

A wastewater lagoon is considered a Class 2 development under Manitoba's *Environment Act* and will require a Class 2 Environment Act Licence (EAL). Wastewater treatment plants with a combined sewage and greywater flow of less than 10,000 L per day require also approval under the Onsite Wastewater Management System Regulation (MR 83/2003) under the *Environment Act* and must be installed by a certified installer.

Other permits that may be required for the project include a license to divert and use surface water under the Water Rights Act and a timber permit under the Forest Act.

1.6 Community Engagement

No formal public engagement process has taken place regarding the application for an Environment Act Licence for the proposed wastewater treatment facility. It is being constructed to replace an existing facility and is a necessary service for the community.

Indigenous and Municipal Relations of Manitoba and Neegan Burnside met with the Thicket Portage community council to discuss the project during the feasibility study and the community provided input into the siting of the lagoon (Neegan Burnside 2015). In 2016, the community provided a letter of support for the project (**Appendix A**).

2 DESCRIPTION OF DEVELOPMENT

2.1 PROJECT LOCATION AND COMMUNITY OVERVIEW

The Community of Thicket Portage is located on the Hudson Bay Railway line, 48 km south of Thompson and 256 km northeast of The Pas. The community lies on the southern shore of Wintering Lake, within Division No. 22 and NTS Map Sheet 63P, and can be accessed year round by railroad or air transportation. The community has winter road access for six to eight weeks each year, weather permitting.

The 2014 community population was 148 people, as reported by community representatives at the time (Neegan Burnside 2015). The community has approximately 50 housing units for a housing density of approximately three people per house (Government of Manitoba 2003).

The proposed site for the new wastewater lagoon is located directly south of the community of Thicket Portage and east of the landfill within NW-10-73-02-W1M. It is roughly centered in an area that had been previously cleared of trees and brush (**Figure 2.1** and **Figure 2.2**). Brush is located to the north, east and west of the proposed lagoon location with an existing roadway and landfill located directly to the west. The land is relatively flat but rises slightly towards the center of the cleared area.

583,000

583,250

6,130,250

N

FORCEMAIN FROM THICKET PORTAGE TO MANHOLE

PERIMETER DITCH

EXIST. CULVERT

2" HDPE

DISCHARGE DISTRIBUTION HEADER

3" HDPE

PRIMARY

PERIMETER DITCH

EXIST. FENCE

PROPOSED ACCESS ROAD

PROPOSED CULVERT

LAGOON

3" HDPE

GOVERNMENT ROAD

DISCHARGE PIPE 2" HDPE

OVERFLOW

GATE VALVE

FENCING

GATE

CONCRETE PAD FOR VACUUM SEPTIC TRUCK DUMP

SECONDARY

DISTRIBUTION HEADER

PUMP CHAMBER

2" HDPE

OVERFLOW

UV AND ALUM INJECTION BUILDING

OPTIONAL SAND BERM

TERTIARY

PUMP CHAMBER DISCHARGE

PERIMETER DITCH

bing™

583,000

583,250

LEGEND

PROPOSED WASTEWATER TREATMENT INFRASTRUCTURE

- EXISTING CULVERT
- EXISTING FENCE
- EXISTING ROAD
- PROPOSED 2" HDPE DISCHARGE PIPE
- PROPOSED DISCHARGE OF EFFLUENT INTO SWALE
- PROPOSED DITCH
- PROPOSED FORCEMAIN
- PROPOSED LAGOON FENCED BOUNDARY
- PROPOSED LAGOON LAYOUT
- PROPOSED MECHANICAL INFRASTRUCTURE
- PROPOSED OPTIONAL SAND BERM
- PROPOSED ROAD

NOTES

1. COORDINATE SYSTEM: NAD 1983 UTM ZONE 14N.
2. IMAGERY (APRIL 28, 2014) OBTAINED FROM GOOGLE EARTH.
3. HIGHWAYS AND ROADS OBTAINED FROM THE NATIONAL ROAD NETWORK MANITOBA EDITION 6.0 DATASET, 2013-04-12.
4. RAILWAYS OBTAINED FROM THE NATIONAL RAILWAY NETWORK MANITOBA EDITION 1.0 DATASET, 2013-04-05.

REFERENCE DRAWINGS

DWG No.	DATE	DESCRIPTION

REVISIONS

REV	DATE	DESCRIPTION	DRN BY	CHK

0 10 20 40 METRES

SCALE: 1:1,250

SNC·LAVALIN

CLIENT	PROJECT LOCATION
ABORIGINAL AND NORTHERN AFFAIRS OF MANITOBA	THICKET PORTAGE, MANITOBA

TITLE

PROPOSED LAGOON LAYOUT

DES BY	LM	DRN BY	JS	DATE	2016 04 25	FIG No. 2.1	REV 0
CHK BY		APP BY	XX	DWG No.	633391-E-02-E-002		11x17

Path: Z:\Manitoba Aboriginal and Northern Affairs\633391 Thicket Portage Lagoon\4.0 Execution\4.5 GIS and Drawings\GIS\Drawing\633391-E-02-E-002(Proposed Lagoon Layout).mxd

Figure 2.2 – Photograph showing the location of the proposed wastewater treatment lagoon, December 2015

2.2 Ownership of Land and Mineral Rights

The community of Thicket Portage is classified as a Northern Affairs Community and the proposed location for the wastewater treatment lagoon is located on crown land. Indigenous and Municipal Relations of Manitoba requested a Requisition for Entry in Crown Land Registry with the Crown Lands & Property Agency for the site (**Appendix B**). There are no active mining claims or mineral leases in the project area.

2.3 EXISTING LAND USE

The land is currently vacant. It was originally cleared for use as part of the landfill in 2002, however, the site was no longer needed because metals (derelict vehicles, appliances, etc.) are now segregated from the landfill and stockpiled for recycling.

2.4 PROPOSED WASTEWATER SYSTEM

The proposed wastewater system consists of a three-cell lagoon supplemented with an alum treatment and a UV treatment process. It will utilize the existing collection system; however, the flow of the force-main will be reversed. A buried, 75 mm pipeline will be constructed from the southern end of the existing collection system to the new lagoon. The wastewater will be pumped into the primary facultative cell and then will flow into the secondary cell, which is hydraulically connected to the primary cell. From the secondary cell, the effluent will be pumped through the alum treatment process and then to the tertiary cell. From the tertiary cell, the effluent will be pumped through the UV treatment process and then discharged into an existing swale, which drains to an unnamed seasonal creek and then discharges into Wintering Lake northwest of the community. The community derives its drinking water from Landing Lake to the south of the community. The proposed sewage lagoon will also accommodate the solids from the individual septic tanks, which will be pumped every two to three years in rotation and discharged into the primary cell via a sewage drop. Preliminary drawings for the proposed system are presented in **Appendix C**.

2.4.1 Site Selection

The site was selected by the Thicket Portage Community Council, in discussions with Neegan Burnside and Indigenous and Municipal Relations of Manitoba during the 2015 feasibility study and geotechnical investigation (Neegan Burnside 2015; Manalo 2015). Further geotechnical investigations were conducted by SNC-Lavalin (2016a) which confirmed the soil conditions at the site met the Manitoba Conservation and Water Stewardship Design Objectives (MCWS 2014). The location is in accordance with MCWS (2014), where:

- The outer toe of the dyke is greater than 400 m from the nearest residence and greater than 600 m from the community center;
- Prevailing winds are towards the west whereas the community is north of the site and the site is surrounded by trees;
- The site natural drains west towards a natural swale and the area is not habitually inundated; and
- The wastewater treatment system will be constructed more than 500 m from Landing Lake and is not within an area of porous soils.

2.4.2 Geotechnical Investigation

A geotechnical investigation was completed for the proposed project and is included in **Appendix D** (SNC-Lavalin 2016a). There was also a preliminary geotechnical investigation completed during the feasibility study (Manalo 2015). The objectives of the investigations were to: gain an understanding of the soil conditions; provide geotechnical recommendations for the design of a clay liner for the sewage lagoon; and, confirm depth to bedrock within the lagoon footprint and proposed sewage force-main route. SNC-Lavalin (2016a) determined the existing overburden within the proposed lagoon footprint consists of clay of sufficient thickness over the bedrock to construct a lagoon.

Manitoba Conservation's Environmental guidelines require that the proposed dykes and bottom of the proposed cells be provided with a layer consisting of at least one meter of soil having a permeability of less than $1x10^{-7}$ cm/s. Bulk soil samples were tested for their hydraulic conductivity. The results indicated a remolded hydraulic conductivity of 1.18×10^{-9} cm/s to 9.02×10^{-9} cm/s. The clay was found to range from low to high plasticity (CL to CH), had moisture contents from 17% to 45%, and the soil samples analysed revealed clay contents from 28% to 91%. The results were similar to those found by Manalo (2015) during the feasibility study.

The geotechnical field investigation and laboratory analysis recommends that the proposed pond liner and dyke bottom be constructed using the in-situ clay soil available on site. The lagoon footprint area should be stripped of all vegetation and organic clay prior to construction of the dykes. It is anticipated that approximately 200 mm of organic soil will be required to be stripped. The base of the existing lagoon will be scarified to a depth of 1.0 m below design bottom. The scarified soil should be compacted to 98% standard Proctor density at optimum moisture content in 200 mm lift thicknesses using a sheepsfoot roller.

2.4.3 Population Contributing Effluent

Neegan Burnside assessed the existing and projected population growth for the community (2015). The historic population in Thicket Portage ranges from 204 people in 1996 to 148 people in 2014 (**Table 2.1**). The historical trend is for the population to decrease over time and the community had a negative growth rate of -1.39% between 1985 and 2011. However, Neegan Burnside recommended long-term planning be based on a growth rate of 1.5% for the 20-year period from 2014 to 2034, because a negative growth rate could leave the community unable to handle flows if the population does increase. Based on this, the projected populations are 172 people in 2024 and 200 people in 2034.

Table 2.1 – Historic population in Thicket Portage (Government of Manitoba 2003 ; Neegan Burnside 2015)

Year	Population
2014	148
2011	138
2006	156
2001	137
1996	204
1991	192
1985	198

2.4.4 Lagoon Sizing

The following discussion of lagoon sizing is from the Design Memorandum for 60% Review (SNC-Lavalin 2016b) and subsequently updated draft construction specifications (**Appendix C**) The design is based on the Design Objectives for Wastewater Treatment Lagoons (MCWS 2014), Ten State Standards, and the EPA Guide to Septage Treatment and Disposal. The lagoon is sized for 240 days of storage, however, this design is conservative as it is designed for a 25 year population increase.

The average daily flow used in the lagoon sizing calculation is based on an estimated population of 200 people (for a total of 67 houses at a housing density of 3.0 persons/house) and a wastewater production of 300 L/capita.day at the 20 years horizon (Neegan Burnside 2015) which results in average daily flow of 60 m^3/day (Eq.1.);

$$300\ \frac{L}{capita.day} \times 67\ houses \times 3\ \frac{person}{house} = 60\ \frac{m^3}{day}$$

The effluent leaving a conventional septic tank (one not equipped with an effluent filter) typically has concentrations of 150 mg/L to 250 mg/L for biochemical oxygen demand $(BOD)_5$. Therefore, an effluent with a BOD_5 level of 200 mg/L at 60 m^3/day was selected in the lagoon design (Eq.2.). Moreover the septage of 67 houses with an estimated flow of 900 L/year.house and a BOD_5 of 9,600 mg/L will be discharged only during the summer (four months) to the lagoon and is added to the lagoon loading (Eq.3.). The total BOD_5 discharged into the lagoon is calculated to be 17 kg/day (12 kg/day from septic tank effluent and 5 kg/day from septage) (Eq.4.).

An organic loading capacity of 2.2 kg/1,000 m^2/ day for septic tank effluent is used in the design. This loading capacity is within the 10-State Standards recommended range of 1.7 to 4.0 kg/1,000 m^2/ day (Neegan Burnside 2015). The less stringent Manitoba Conservation Guideline of 5.6 kg/1,000 m^2/ day can also be used in design, which will result in smaller lagoon. Based on the EPA Guidelines a septage organic loading capacity of 0.84 kg/1,000 m^2/ day was used (Eq.5.).

Facilities required:

- One facultative pond with a maximum depth of 1.5 m and effective depth of 1.2 m;
- One anaerobic storage pond with 183 days of storage capacity, with a maximum depth of 3.2 m and effective depth of 2.9 m;
- One settling lagoon with a maximum depth of 0.75 m and a surface area of 480 m^2;
- These calculations are based on lagoon depths of 1.5 m and 3.2 m for the primary and secondary cells, respectively.
- The surface area of the primary lagoon is calculated at a depth of 1.2 m above the cell floor.

A summary of the design parameters is presented in **Table 2.2**.

Table 2.2 – Summary of lagoon design parameters; all dimensions are approximate

	Units	Primary	Secondary	Tertiary
Treatment		Facultative	Anaerobic	Settling
Design depth	m	1.5	3.2	1.0
Effective depth	m	1.2[a]	2.9	n/a
Design volume	m^3	17,110	10,978	n/a
Storage time	days	57	183	n/a
x (inside edge to inside edge)	m	154	143.8	175
y (inside edge to inside edge)	m	65	24	3
Liner		1 m scarified and compacted overlain by 1 m thick clay liner		
Berm		clay lined with a geosynthetic liner to prevent erosion		
Bottom of berm width	m	7.5	12.6	4.5
Top of berm width	m	3 m top berm width to allow a vehicle to drive around the top of the dike for maintenance purposes		

[a]Total volume of primary cell is calculated to be 17,110 m^3. However only the volume of water above the invert of the discharge pipe is available for water storage.

2.4.5 Lagoon Design Calculations

The following lagoon design calculations are from the Design Memorandum for 60% Review (SNC-Lavalin 2016b).

- BOD_5 discharge from septic tank effluent (Eq.2.):

$$60\ \frac{m^3}{day} \times 200\ \frac{mg}{L}\ BOD = 12\ \frac{kg}{day}$$

- BOD_5 discharge from septage (Eq.3.):

$$900\ \frac{L}{year.house} \times 9{,}600\ \frac{mg}{L}\ BOD\ \times 67\ houses = 5\ \frac{kg}{day}$$

- Total discharged BOD_5 (Eq.4.):

$$12\ \frac{kg}{day} + 5\ \frac{kg}{day} = 17\ \frac{kg}{day}$$

- The minimum surface area required for the primary lagoon is calculated based on the total BOD_5 loading. Therefore (Eq.5.):

$$\frac{12\ \frac{kg}{day}}{2.2\ \frac{kg}{1{,}000m^2.day}} + \frac{5\ \frac{kg}{day}}{0.84\ \frac{kg}{1{,}000m^2.day}} = 11{,}406\ m^2$$

- The minimum total storage volume in the primary and secondary cell is calculated based on the total storage time of 240 days (57+183=240) days (Eq.6.):

$$60\ \frac{m^3}{day} \times 240\ day = 14{,}400\ m^3$$

- Primary lagoon effective volume (Eq.7.):

$$11{,}406\ m^2 \times 1.2\ m\ (appx) = 13{,}688\ m^3$$

- Primary lagoon storage volume (Eq.8.):

$$13{,}688\ m^3 \times 0.25\ (\frac{0.3\ m}{1.2\ m}) = 3{,}422\ m^3$$

- Secondary lagoon storage volume (Eq.9.):

$$14{,}400\ m^3 - \ 3{,}422\ m^3 = 10{,}978 m^3$$

- Secondary lagoon area (Eq.10.):

$$10{,}978\ m^3 \div 2.9\ m = 3{,}785\ m^2$$

- Total required land area (Eq.11.):

$$11{,}406\ m^2 + 3{,}785\ m^2 = 1{,}5191\ m^2 = 1.51\ ha$$

2.4.6 Lagoon Regulatory Requirements

The treatment facility has been designed to meet the effluent requirements from the Design Objectives for Wastewater Treatment Lagoons (MCWS 2014) and the Manitoba Water Quality Standards, Objectives and Guidelines (Manitoba Water Stewardship 2011) criteria for industrial and municipal wastewater effluents discharged to a water body (**Table 2.3**).

Table 2.3 – Effluent Limits

Parameter	Standard/Objective/Guideline	Source
Carbonaceous BOD_5	25 mg/L	MCWS 2011 & 2014
BOD	25 mg/L	MCWS 2011
TSS	25 mg/L (unless caused by algae)	MCWS 2011 & 2014
Fecal Coliform or E.Coli	200/100mL	MCWS 2014
Nitrogen at 15°C	1.25 mg/L	MCWS 2014
Total Nitrogen	15 mg/L	MCWS 2011
Total Phosphorus	1 mg/L	MCWS 2011 & 2014

2.4.7 Wastewater Treatment Process

The lagoon layout includes three cells as described below and shown in **Table 2.2** and **Appendix C**; all dimensions are approximate. Each lagoon cell will be surrounded by a berm and there is also a perimeter berm enclosing all three cells. The lagoon will also be surrounded by a fence and perimeter ditch. There will be three manholes across the front of the lagoon; one manhole will be the receiving manhole for the force-main and septic truck and the other two will be for pump stations.

Wastewater will be pumped from the wastewater collection system to the treatment lagoon via a buried low pressure force-main. The force-main will consist of insulated 75 mm diameter HDPE at a depth of approximately 2.4 m metres below ground surface. The wastewater will enter the primary lagoon, and flow through an equalization pipe to the secondary lagoon. From the secondary lagoon, the wastewater will be pumped through the alum treatment process and into the tertiary cell. From the tertiary cell, the water will be pumped through the UV treatment process prior to being discharged.

In the event of a mechanical failure, the system has been designed to cascade from one cell to another and eventually to the discharge outlet through armoured dips in the berms. In this event, the wastewater would undergo a similar treatment process minus the alum and UV treatment.

2.4.7.1 Lagoon Treatment

Primary Cell – The primary cell consists of a facultative lagoon with both an anaerobic zone at the bottom and an aerobic zone at the top. Aeration at the top layer will occur due to photosynthesis and wind motion. Biodegradable organic matter will be consumed by facultative bacteria, releasing methane and carbon dioxide. Bacteria and algae produced as a result of degradation of organic matter and photosynthetic activity will settle into the sludge layer where they will become an additional source of food for the anaerobic bacteria. Facultative lagoons are effective for removal of BOD_5 and suspended solids. Most of the biomass will also settle in the primary lagoon. H_2S is oxidized to at top layer before leaving, preventing the release of odors. This cell provides an average of 57 days of flow storage. The bottom 1.2 m is to avoid freezing and the top 0.3 m are available for water storage.

Secondary Cell – The secondary cell is an anaerobic cell where anaerobic process stabilizes organic matter by anaerobic micro-organisms, converting it to carbon dioxide and methane. If sulphur is present, hydrogen sulphide, an odorous compound, may be produced. Particulate matter that does not get degraded will settle to the bottom. This cell provides an average of 187 days of flow storage.

Tertiary Cell – The tertiary cell is a settling cell and acts like a clarifier to increase nutrient removal. The elongated shape is beneficial for this function. Alum already added as a coagulant will precipitate phosphorous in this cell. The resultant flocs will accumulate at the bottom of the cell and result in higher reduction of phosphorous. A sand berm is also incorporated in the tertiary cell acting as a filter to assist in the removal of phosphorous. This cell is not designed for water storage and is only expected to contain water during the summer months.

2.4.7.2 Alum and UV Treatment

The alum and UV treatment will be housed in a heated container building on the west side of the lagoon. The building is anticipated to be a converted pre-assembled Sea-Can that has to be sized to fit chemical storage tanks and required pumping and piping. A 200 amp power link will extend from the nearby 240 kV line to supply power to the building.

The effluent will be pumped from the secondary cell through the alum treatment where alum will be added. Phosphate present in the anaerobic cell (secondary cell) will be removed progressively by alum coagulation. The process involves the addition of aluminum sulphate as a coagulant to react with soluble phosphate to form solid precipitates that are removed in tertiary cell. An alum dosage of 50 mg/L is recommended, however, further jar testing will be conducted during start-up to determine the best chemical dosage. Equipment that will be used in the process of removing phosphorus by alum coagulation includes chemical (alum) storage tanks, chemical feed pumps, a piping system, and controls equipment. The effluent is pumped into the tertiary cell after alum treatment.

Micro-organisms need to be removed or destroyed by any disinfection process before treated wastewater can be discharged to the receiving waters. UV disinfection is one of the most commonly applied disinfection methods in lagoon treatment systems. Micro-organisms absorb UV light produced by low pressure mercury lamps that lethally damages their genetic material. Effluent will be pumped from the tertiary cell to the UV treatment building for disinfection. Sand filtration in the tertiary cell is incorporated to provide additional filtration of the water to assist with phosphorous removal.. Equipment that will be used for UV disinfection include medium- pressure mercury lamps, a UV disinfection reactor, and a control box.

2.4.8 Discharge

The outfall for the wastewater treatment system will exit from the alum/UV treatment building. The outfall will consist of a 75 mm diameter HDPE pipeline that will discharge the treated effluent to an existing culvert beneath Government Road. The pipeline will be approximately 62 m in length and will be buried 0.5 m beneath the ground surface. The culvert is approximately 20 m long and discharges into a natural swale which only contains water during spring freshet and significant rain events. The swale then drains into a swampy area, an unnamed creek, and eventually into Wintering Lake. The discharge path is approximately 550 m long and additional nutrient uptake and cooling of effluent to ambient temperatures is expected to occur along the route. Discharge will occur intermittently between June 16 and October 31 at a rate of approximately 32 US gallons per minute.

2.4.9 Access Roads

A small section of roadway needs to be constructed in order to allow septic trucks to access the septage drop manhole. The road extension will run parallel to the existing road and is approximately 150 m long. The road surface will consist of 300 mm of “A” base.

The top surface of the lagoon berms will be compacted to provide access to and around the wastewater treatment lagoon for maintenance activities.

2.4.10 Truck Dump

There will be a truck drop for septage that will be hauled to the proposed wastewater treatment plant. The septage drop will be located west of the lagoon and north of the alum/UV treatment building. It will consist of a concrete splash pad and a manhole which will direct the sewage into the lagoon.

2.4.11 Fence

A two metre high, chain-linked perimeter fence will be constructed around the wastewater treatment system to provide for safety and security.

2.4.12 Lagoon Construction Detail

The following lagoon construction details are from the Design Memorandum for 60% Review (SNC-Lavalin 2016b).

- The septic tank effluent flows to the inlet manhole and then discharges to the primary cell through a discharge distribution line. The septic trucks discharge either directly to the manhole or by using a 4” camlock fitting;
- A freeboard provision of one metre is incorporated into the lagoon berm design;
- A three metre top berm top width is incorporated to allow for a vehicle to drive around the top of the dike for maintenance purposes;
- The discharge pipe invert from the primary cell is located 1.2 m above the cell floor;
- The discharge window for the tertiary cell is considered to be June 15 to October 31, to allow for ammonia reduction in the effluent and to avoid icing problems;
- The effluent discharge from the primary cell to the secondary is continuous;
- The discharge pipe invert from the secondary cell is located 0.3 m above the cell floor;

- The secondary cell discharge is pumped to the tertiary cell. The flow passes through the UV/alum building where alum is added;
- The discharge pipe invert from the tertiary cell is located 0.75 m above the cell floor;
- The tertiary cell effluent is collected and pumped into a UV disinfection unit;
- ¼ of the primary cell capacity is considered in estimating the total storage volume (top 0.3 m);
- All the primary, secondary, and tertiary cells are rectangular shape;
- GEOTEX@ 4×4HF will be used to line the berms of the lagoon for erosion control;
- All the cell interconnecting piping will be valved as shown in the drawings;
- The berm slope in the primary, secondary, and tertiary cells is set at three horizontal to one vertical, based on the preliminary geotechnical investigations;
- Approximately 1.50 ha of land is required for the proposed lagoon construction;
- A tertiary cell is incorporated into the design as a clarification stage for the removal of phosphorous;
- A sand berm is incorporated in the tertiary cell as a bacterial and physical filter (sand filter) to assist in the removal of phosphorous.

The lagoon cells will take a few years to fill once constructed. Construction of the lagoon is expected to require the following heavy equipment: an excavator, backhoe, bulldozer, and a compactor. Fuel for construction will be purchased from the community.

2.4.13 Classification of the Wastewater Treatment System

The proposed wastewater treatment system must be classified in accordance with the Water and Wastewater Facilities Operators Regulation 77/2003 under the *Environment Act*. The completed application for the wastewater treatment facility classification is included in **Appendix E**.

2.4.14 Lagoon Operation and Maintenance

Operation will include pumping of the secondary cell effluent to the tertiary cell and tertiary cell effluent to a UV unit respectively. Additional operation will include the discharge of the septage to primary lagoon during the summer months.

The regular maintenance required for the system will include:

- Maintenance of mechanical equipment and building;
- Keeping pipelines, diversion boxes and screens clean;

- Road maintenance: scraping and leveling once every second year or as required. Dust inhibitors and snow removal as required. Re-surfacing and re-compaction about every five to seven years;
- Ditch and berm maintenance (mowing) once per year;
- Inspection of berms for burrowing animals;
- Collection of effluent samples for laboratory analysis to ensure compliance with Environment Act License;
- Periodic replacement of the sand filter in the tertiary cell as required due to clogging; and
- Sludge removal from the cells via dredging. Sludge will like need to be removed from the cells roughly as follows : once every 20 years from the primary cell, rarely from the secondary cell, and once every five years from the tertiary cell.

2.4.14.1 Operator Requirements

The lagoon operators will be classified as a Class 1 or 2 operator. The operator will be required to: exercise valves; perform regular inspections of the force-main, lift stations, the inter-cell overflow manhole and outfall; review and set the alum injection rate; perform maintenance of the UV system; remove aquatic plants and rodents which can damage the cell liner or caused structural damage to the dyke itself; and sample the effluent and review the analytical results.

2.4.15 Decommissioning

Indigenous and Municipal Relations of Manitoba has long-term plans for the continued operation of the wastewater treatment facility and plans to operate this facility as long as it is required by the community and in good working condition. In the future, should the lagoon require decommissioning, all applicable regulations and guidelines will be followed. The overall objective of decommissioning and reclamation will be to return lands disturbed to a condition that is physically stable, safe and environmentally consistent with the land use and landscape of the day. At the time of facility closure, the following decommissioning activities are anticipated:

- The building and associated equipment will be removed;
- Storage tanks and associated piping will be emptied, cleaned and removed;
- Aboveground pipelines will be removed. Subsurface pipelines will be purged, capped and buried;
- Areas where contaminated soils may be present will be assessed and remediated as required;
- Water retention ponds will be backfilled;
- Surface drainage conditions will be restored to a state similar to pre-existing conditions; and

- Disturbed areas will be reclaimed, including re-contouring, replacing topsoil, and revegetating to restore the land surface to as near as possible to the original conditions.

2.4.16 Schedule

Construction is tentatively scheduled to commence in summer 2016, pending receipt of regulatory approvals, and is expected to take three to four months to complete. The design life of the facilities is as follows: 50-year lagoon and road life, 25-year life of building structure, and 10-year life of mechanical equipment (pumps and piping).

2.5 EMPLOYMENT

Construction of the lagoon will require a crew of about 10 to 12 workers, for four months, working 10-hour days. This equates to between 10,000 and 12,000 hours of employment.

During operation, two operators are required for average operation time of 0.5 hours per day.

3 DESCRIPTION OF ENVIRONMENT

3.1 PHYSICAL ENVIRONMENT

3.1.1 Physiography, Terrain and Soils

Thicket Portage is located within the Sipiwesk Lake Ecodistrict, a part of the Hayes River Upland Ecoregion, which itself is part of the Boreal Shield Ecozone. In this ecozone, massive Archean rocks form broad sloping uplands and lowlands that make up the relief of the landscape. Elevations range in the area from 244 meters above sea level (masl) to 195 masl (Smith et al. 1998). A topographic map is included as **Figure 3.1**. The area has undergone multiple periods of glaciation which have carved out huge numbers of small to large lakes, which make up a significant portion of the landscape. These lakes are linked by multiple bedrock banked rivers and tributaries, including the Nelson River and the Hayes River. These rivers and lakes all drain towards Hudson Bay. Glacial till deposits are common but fairly discontinuous and range from acidic sandy till in the southern part of the ecoregion, to calcareous, sandy to loamy cobbly till in the northern regions. Exposed Precambrian bedrock is common throughout the ecoregion (Smith et al. 1998).

Organic matter has been deposited in the bog and fen peatlands that are widespread in the ecoregion. Many of these bogs and fens have varying degrees of permafrost that extends past the bog into the underlying mineral materials. Typically, permafrost is common in the northern half of the Hayes River Upland Ecoregion, but only sporadically appears in the peatlands in the southern half of the ecoregion. In some areas permafrost extends as deep as 30 m (likely a relic of historic climate conditions), but under current conditions permafrost only develops to a much shallower depth.

In the Sipiwesk Lake Ecodistrict, most of the mineral soils are dominantly well to imperfectly drained Gray Luvisols and some Eutric Brunisols that have developed on clayey deposits (Smith et al. 1998, Ehrlich et al. 1959). Horizon development in the area is uneven, which is a feature of former permafrost conditions. Peatland areas are a complex of poorly drained Typic and Terric Fibrisolic and Mesisolic Organic soils over loamy to clayey glaciolcaustrine sediments.

LEGEND

MAJOR ELEVATION CONTOUR (masl)

MINOR ELEVATION CONTOUR (masl)

NOTES

1. COORDINATE SYSTEM: NAD 1983 UTM ZONE 14N.
2. ELEVATION CONOTURS DERIVED FROM CANADIAN DIGITAL ELEVATION DATA. VERTICAL ACCURACY IS RATED AT APPROXIMATELY +-4 METRES WITHIN THE AREA.
3. IMAGERY DATED MARCH 5, 2002. SERVICE LAYER CREDITS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEX, GETMAPPING, AEROGRID, IGN, IGP, SWISSTOPO, AND THE GIS USER COMMUNITY

REFERENCE DRAWINGS

DWG No.	DATE	DESCRIPTION

REVISIONS

REV	DATE	DESCRIPTION	DRN BY	CHK

0 50 100 200 300 400 METRES

SCALE: 1:10,000

SNC·LAVALIN

CLIENT	PROJECT LOCATION
ABORIGINAL AND NORTHERN AFFAIRS OF MANITOBA	THICKET PORTAGE, MANITOBA

TITLE

TOPOGRAPHY

DES BY LM	DRN BY LC	DATE 2016 04 25	FIG No. **3.1**	REV 0
CHK BY	APP BY	DWG No. 633391-E-24-001		11x17

Path: \\SLI1653\projects\Manitoba Aboriginal and Northern Affairs\633391 Thicket Portage Lagoon\4.0 Execution\4.5 GIS and Drawings\GIS\Drawing\633391-E-24-001(Topography).mxd

3.1.2 Climate

Thicket Portage is located in the Sipiwesk Lake Ecodistrict, characterized by short, cool summers and long, cold winters. Climate normals from 1981 to 2010 for the region were obtained from the Thompson Environment Canada meteorological station located at 55° 48' 00" N and 97° 51' 00" W at an elevation of 224 masl (**Table 3.1**; Environment Canada 2015). In general, precipitation falls as snow during the winter months, with the greatest snowfalls occurring in October through April. Annual average precipitation is 509 mm, with 37 % occurring as snowfall. The daily average temperature is approximately -2.9 ºC and ranges between a mean of 16.2 ºC in July and -23.9 ºC in January.

3.1.3 Surface Water

Thicket Portage is located on the southern shore of Wintering Lake and immediately north of Landing Lake. Both of these lakes eventually drain into the Nelson River System. The Nelson River drains into Hudson Bay. In addition, thousands of lakes, wetlands, and bogs are present in the depressional zones surrounding the community of Thicket Portage.

The Water Science and Management Branch of Manitoba Conservation and Water Stewardship was contacted for water quality data for Wintering Lake. They did not have water quality data for Wintering Lake (**Appendix A**).

Table 3.1 – Climate Normals (1981-2010) for Thompson, Manitoba (Environment Canada 2015)

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
temperature - mean (°C)	-23.9	-20.1	-12.5	-2.2	6.1	12.6	16.2	14.5	7.8	0.1	-12.0	-20.9	-2.9
temperature – mean maximum (°C)	-18.3	-13.5	-5.0	4.8	13.1	19.8	23.1	21.4	13.6	4.4	-7.3	-15.7	3.4
temperature – extreme maximum (°C)	8.1	8.2	15.9	29.4	32.6	37.4	35.9	34.6	32.2	24.6	13.4	5.0	37.4
temperature – mean minimum (°C)	-29.3	-26.5	-19.9	-9.1	-0.8	5.4	9.1	7.6	1.9	-4.3	-16.6	-26.2	-9.1
temperature – extreme minimum (°C)	-48.9	-47.8	-48.3	-34.4	-18.3	-5.6	-1.1	-3.5	-11.1	-27.1	-41.2	-47.6	-48.9
rainfall – total (mm)	0.1	0.3	1.0	6.7	36.9	66.6	80.9	70.7	59.2	16.6	1.1	0.1	340.2
snowfall – total (cm)	22.7	18.9	23.4	23.0	11.2	1.1	0.0	0.0	3.0	21.4	35.4	27.0	187.0
precipitation – total (mm) [a]	19.5	16.5	22.5	29.0	47.4	67.8	80.9	70.7	62.1	37.1	32.9	22.8	509.2
wind speed - mean (km/h)	10.8	11.0	11.9	13.6	13.5	12.5	11.1	11.3	11.8	11.7	10.7	9.8	11.6
wind speed – maximum gust (km/hr)	81	74	83	87	93	130	105	93	82	80	80	95	130
wind direction	W	W	W	NE	NE	NE	W	W	W	W	W	W	W

[a] The sum of the total rainfall and the water equivalent of the total snowfall observed during the day. In most cases a 10:1 ratio can be applied to the amount of snow to determine its water equivalent.

3.1.4 Surficial Geology and Groundwater

The surficial geology compilation map series were reviewed for the region (Matile and Keller 2006a and 2006b). The area falls within the Precambrian Shield where the terrane tends to be dominated by discontinuous sediment cover with numerous bedrock outcrops. Quaternary sediments in the area are commonly thick, but discontinuous. The project area includes offshore glaciolacustrine sediments and Precambrian bedrock. The glaciolacustrine sediments consist of clay and silt with minor sand and range from one to 20 metres thick.

Geotechnical investigations of the proposed lagoon site and sewage pipeline route were conducted on 4 November 2014 (Manalo 2015) and 27 January 2016 (SNC-Lavalin 2016a). The study area consisted of approximately 0.2 m of organic topsoil (grass covered) at the surface underlain by low to high plastic clay, with varying amounts of silt. Bedrock was as shallow as 0.3 m along a portion of the pipeline route to greater than 6.1 m at the lagoon site. The organic clay was dark grey to black with a low plasticity. The underlying native clay contained varying amounts of silt varved into the clay. The clay varied from low to high plastic (CL to CH), moist to wet, and had a very stiff consistency becoming firm with depth.

Standpipe piezometers were not installed within any of the boreholes; however, the water level and sloughing conditions were recorded prior to the backfilling of each borehole. Water seepage and levels ranged from 3.4 m to 4.3 m below existing ground surface within 10 minutes after the completion of borehole drilling while sloughing ranged from 2.8 m to 3.1 m below the existing ground elevation. However, seepage into the boreholes was slow. There is no appreciable groundwater in the vicinity, and it is not used for any purpose.

3.2 Biological Environment

The Manitoba Conservation Data Centre was contacted for a search of their database for rare species in the project area and no occurrences were found (**Appendix A**).

3.2.1 Vegetation

The vegetation in the region is typical of the Boreal Shield Ecozone. The majority of the landscape is dominated by stands of coniferous trees, such as jack pine (*Pinus banksiana*) and black spruce (*Picea mariana*). Coniferous trees are used as a source of timber for commercial logging near Thicket Portage (Government of Manitoba 2003).

Some deciduous trees such as trembling aspen (*Populus tremuloides*) and balsam poplar (*Populus balsamifera*) are common in the southern sections of the ecoregion, especially near rivers and other water sources. Understory vegetation in the region consists of mosses and small shrubs like blueberry (*Vaccinium spp*), rock cranberry (*Vacciunium macrocarpon*), Labrador tea (*Rhododendron spp.*), and lichens.

A forest inventory map of the area shows the forest cover type as consisting of both softwood and hardwood (**Figure 3.2**). However, the majority of the forest cover at the site was cleared in 2002.

Areas where exposed bedrock is common have little vegetation, and bedrock is typically only covered with lichens and the occasional conifer where some exposed soil has developed. Fen vegetation consists of sedges, brown mosses, and tamarack (*Larix laricina*), while bog vegetation is characterized by black spruce, ericaceous shrubs, and mosses (Smith et al. 1998).

A number of vascular plants are listed by the Manitoba Conservation Data Centre (MCDC) that have the potential to be found within the Hayes River Upland Ecoregion (MCDC 2013). These species are listed in **Table 3.2**.

LEGEND

PROPOSED WASTEWATER TREATMENT INFRASTRUCTURE

- PROPOSED 2" HDPE DISCHARGE PIPE
- PROPOSED DISCHARGE OF EFFLUENT INTO SWALE
- PROPOSED FORCEMAIN
- PROPOSED LAGOON FENCED BOUNDARY
- PROPOSED LAGOON LAYOUT

FOREST INVENTORY COVER TYPE

SOFTWOOD
- S, 10
- S, 13
- S, 14
- S, 15

HARDWOOD
- H, 90
- H, 98
- H,99

SOFTWOOD-HARDWOOD MIXEDWOOD
- M, 51
- M, 53
- M, 54
- M, 58

HARDWOOD-SOFTWOOD MIXEDWOOD
- N, 82

Cover Type	
S	Softwood (>76%)
M	Softwood-Hardwood Mixedwood (51-75% Softwood)
N	Hardwood-Softwood Mixedwood (26-50% Softwood)
H	Hardwood (<25%Softwood)

Cover Type	Subtype	Dominant Species	Secondary Species
S	10	White Spruce (71-100%)	-
S	11	White Spruce (40-70%)	Balsam Fir, Black Spruce
S	13	Black Spruce (71-100%)	-
S	14	Black Spruce (40-70%)	Jack Pine
S	15	Black Spruce (40-70%)	White Spruce
M	51	White Spruce (<51%)	Black Spruce
M	53	Black Spruce (>51%)	Hardwoods
M	54	Black Spruce (<51%)	Jack Pine and Hardwoods
M	58	Black Spruce (<51%)	White Spruce and Hardwoods
N	82	Trembling Aspen	Black and White Spruce
H	90	Trembling Aspen	Balsam Poplar
H	98	Balsam Poplar	Trembling Aspen
H	99	Undifferentiated Hardwoods	-

NOTES

1. COORDINATE SYSTEM: NAD 1983 UTM ZONE 14N.
2. FOREST INVENTORY DATA PROVIDED BY THE MANITOBA LAND INITIATIVE.
3. IMAGERY (APRIL 28, 2014) OBTAINED FROM GOOGLE EARTH.

REFERENCE DRAWINGS

DWG No.	DATE	DESCRIPTION

REVISIONS

REV	DATE	DESCRIPTION	DRN BY	CHK

0 50 100 200 300 400 METRES

SCALE: 1:10,000

SNC · LAVALIN

CLIENT: ABORIGINAL AND NORTHERN AFFAIRS OF MANITOBA

PROJECT LOCATION: THICKET PORTAGE, MANITOBA

TITLE: FOREST INVENTORY COVER TYPE

DES BY LM	DRN BY JS	DATE 2016 04 25	FIG No. 3.2	REV 0	
CHK BY	APP BY	DWG No. 633391-E-22-E-001	11x17		

Path: Z:\Manitoba Aboriginal and Northern Affairs\633391 Thicket Portage Lagoon\4.0 Execution\4.5 GIS and Drawings\GIS\Drawing\633391-E-22-E-001(Forest Inventory).mxd

Table 3.2 – MCDC-Listed Plants with the Potential for Occurrence

Scientific Name	Common Name	G-Ranking	S-Ranking
Astragalus bodinii	Milkvetch	G4	S1
Botrychium matricariifolium	Daisy-leaf Moonwort	G5	S1?
Carex loliacea	Rye-grass Sedge	G5	S2
Carex maritima	Seaside Sedge	G4G5	S2
Carex microglochin	False Uncina Sedge	G5?	S2
Carex pauciflora	Few -flowered Sedge	G5	S3
Diphasiastrum sitchense	Ground-fir	G5	S1
Glyceria pulchella	Graceful Manna Grass	G5	S2
Gymnocarpium jessoense	Northern Oak Fern	G5	S3S4
Huperzia selago	Mountain Club-moss	G5	S2S3
Platanthera hookeri	Hooker's Orchid	G4	S2
Platanthera orbiculata	Round-leaved Bog Orchid	G5	S3
Potamogeton robbinsii	Robbin's Pondweed	G5	S2
Potamogeton strictifolius	Straightleaf Pondweed	G5	S3
Woodsia alpina	Northern Woodsia	G4	S1

3.2.2 Wildlife

The ecoregion provides habitat for a number of mammal and bird species. Moose (*Alces alces*), Woodland caribou (*Rangifer tarandus*), black bears (*Ursus americanus*), wolves (*Canis lupus*), lynx (*Lynx canadensis*), and snowshoe hare (*Lepus americanus*) are some common mammals in the region. Many waterfowl and other migratory birds use the area in the summer for nesting and rearing. Many birds also live as permanent residents in the area, such as spruce grouse (*Falcipennis canadensis*), Canada jays (*Perisoreus canadensis*), ravens (*Corvus corax*), and multiple species of owls (*Bubo* and *Strix spp*).

A number of species listed by the Manitoba Conservation Data Centre (MCDC) have the potential to be found within the Hayes River Upland Ecoregion (MCDC 2013). These species are primarily vertebrate species, with a single insect included on the list (**Table 3.3**).

Table 3.3 – MCDC-Listed Wildlife with the Potential for Occurrence

Scientific Name	Common Name	G-Ranking	S-Ranking
Ardea herodias	Great Blue Heron	G5	S4S5B
Chordeiles minor	Common Nighthawk	G5	S3B
Contopus cooperi	Olive-sided Flycatcher	G4	S3S4B
Euphagus carolinus	Rusty Blackbird	G4	S3S4B
Rangifer tarandus caribou	Caribou	G5T4	S2S3
Strix varia	Barred Owl	G5	S4B
Thamnophis sirtalis parietalis	Red-sided Garter Snake		S4
Erynnis lucilius	Columbine Dusky Wing	G4	S2S3

3.2.3 Fish and Fish Habitat

Since the ecoregion has many lakes and rivers, fish and fish habitat are common. Sport fish that are common in the region include pike (*Esox lucius*), walleye (*Sander vitreus*), sauger (*Sander canadensis*), yellow perch (*Perca flavescens*), lake whitefish (*Coregonus clupeiformis*), and more. There are also many forage fish species, including numerous shiner and chub species (Stewart and Watkinson 2004). Lakes in the area are commonly used for subsidence and commercial fishing in the area (Government of Manitoba 2003). Local fishermen used the rail line nearby to ship their fish to packing stations at Wabowden or The Pas (Manitoba Conservation and Stewardship 2012).

Fish require a number of different substrate types for depending on their life stage. The area is home to a diverse set of habitat types that allow for the continued survival and reproduction of fish. The rivers and their tributaries provide both habitat and migration routes. Hydroelectric stations along some of the rivers in the region do serve as migration barriers for fish.

Lake sturgeon (*Acipenser fulvescens*) are present in the nearby lakes and rivers, and commercial fishing for both the fish and its eggs has taken place historically in the region (MacDonnell 1997). However, due to declines in production and fish populations, the commercial fishing operations have all closed. Lake sturgeon are now protected and only First Nations communities can harvest the fish. The Nelson River population is considered endangered during the most recent assessment (Committee on the Status of Endangered Wildlife in Canada - COSEWIC 2006).

3.3 SOCIO-ECONOMIC ENVIRONMENT

3.3.1 Thicket Portage

The community is governed by a mayor and council under *The Northern Affairs Act* (Government of Manitoba 2003). It was originally known as Franklin Portage after the Franklin expedition, and is one of the portages used to connect the Nelson River system with Wintering Lake. Tree-planting, fishing and trapping are seasonal activities, supplemented by employment in local services such as health care and council. The community has a water treatment plant which went into service in 2014 and draws water from Landing Lake, south of the community.

Community facilities in Thicket Portage include:

- Community Hall
- Thicket Portage Community School
- Canada Post
- Water Treatment Plant
- Sewage Treatment Plan
- Community Garage
- Airport

3.3.2 Heritage Resources

The Manitoba Historic Resources Branch (HRBB) examined the proposed area of disturbance in conjunction with their records, and did not have any concerns with the proposed project (**Appendix A**).

4 DESCRIPTION OF ENVIRONMENTAL EFFECTS AND MITIGATION MEASURES

4.1 EFFECTS AND MITIGATIVE MEASURES

This chapter identifies potential environmental effects of the proposed project and suggests mitigative measures to eliminate or reduce these effects

4.1.1 Atmospheric Environment

4.1.1.1 Effects

Potential effects to the atmospheric environment include:

- Air and noise emissions from heavy equipment during construction (approximately four pieces of heavy equipment required for construction).
- Air emissions from the sewage haul truck during the non-winter months of operation.
- Release of methane, H_2S, and NO_X during wastewater treatment.
- Dust from clearing/grubbing of vegetation, excavating/compacting/grading of lagoon and berms, and traffic on gravel roads.
- Odours generated during operation (release of H_2S under anaerobic conditions) and maintenance (sludge removal) of the lagoon.

4.1.1.2 Mitigation

The following are mitigation and environmental design measures to minimize effects to the atmospheric environment:

- Use of dust suppression during construction (e.g., spraying roads with water) and appropriate speed limits.
- Vehicle idling will be kept to a minimum and vehicles will be properly maintained.
- Hearing protection will be provided to construction workers if required.
- Disturbed/exposed areas will be re-vegetated as soon as practical where required.
- The lagoon is designed to meet organic loading requirements outlined by MCWS (2014).
- The proposed lagoon is located approximately 440 m from the nearest residence and approximately 610 m from the community center. Prevailing winds are from the west and are not expected to cause odours to drift towards the community which is located to the north.
- The wastewater treatment system will be kept in good working condition to minimize the emissions of methane, H_2S and NO_X.

4.1.2 Aquatic Environment

4.1.2.1 Effects

The wastewater treatment system will release effluent into the natural swale which will flow into Wintering Lake, and may include coliforms, organic wastes, suspended solids and other contaminants which could affect water quality and fish.

4.1.2.2 Mitigation

The following are mitigation and environmental design measures to minimize effects to surface water:

- The system has been designed to meet the appropriate discharge limits, and will be a significant improvement over the current system which is not meeting its licensed requirements.
- The discharge path includes discharge into a seasonal natural swale where there will be some uptake of effluent nutrients into the ground prior to entering Wintering Lake.
- Discharge will occur over intermittently between June 16 and October 31 at a rate of no more than 32 US gallons per minute.
- There will be a part-time operator responsible for inspecting and maintaining the wastewater treatment system so that it functions properly.

4.1.3 Groundwater

4.1.3.1 Effects

Although there is no viable aquifer in the vicinity, there is potential for effects to groundwater if the wastewater leaks/seeps through the lagoon liner into the groundwater or if there is a leak in the pipeline.

4.1.3.2 Mitigation

The following are mitigation and environmental design measures to minimize effects to groundwater:

- The pipeline will be buried and constructed of HDPE to minimize the potential for leaks.
- The lagoon will be constructed with a liner with of at least one metre of soil having a permeability of less than $1x10^{-7}$ cm/s (geotechnical investigation indicated a remolded hydraulic conductivity of 1.8×10^{-9} cm/s to 9.0×10^{-9} cm/s) as per the MCWS (2014) Design Objectives for Wastewater Treatment Lagoons.
- Indigenous and Municipal Relations of Manitoba will investigate/repair leaks if discovered.

4.1.4 Terrain and Soils

4.1.4.1 Effects

The project will require disturbance to approximately 5.0 ha of land from the surface and approximately 40,000 m^3 of soils will be excavated. Potential effects to soils include:

- Removal of soils during clearing and excavation.
- Potential soil compaction/mixing from heavy equipment during construction.
- Soil loss from erosion due to wind and precipitation/runoff during construction.
- Discharge from the lagoon could result in erosion along the discharge path during operation.
- Potential for erosion of berms during operation.

4.1.4.2 Mitigation

The following are mitigation and environmental design measures to minimize effects to soils:

- A construction environmental management plan will be developed to outline best management practices to minimize effects to soil during construction activities.
- Overburden soils will be removed in a separate lift and stockpiled to preserve materials for re-use on the berms.
- The material used to construct the berms will be taken from the lagoon excavation to avoid the need for a borrow source.
- Vehicle and equipment movement will be limited to designated pathways in and around work areas to minimize effects to soil.
- Disturbed/exposed areas will be kept to a minimum and re-vegetation of disturbed areas will occur as soon as practically possible.
- Discharge from the lagoon will be released at a rate of no more than 32 US gallons per minute.
- A geosynthetic liner will be used to prevent erosion of lagoon berms during operation.

4.1.5 Vegetation

4.1.5.1 Effects

Potential effects to vegetation include:

- The proposed lagoon requires an area of approximately 4.15 ha. Approximately 1.87 ha has already been cleared and an additional 2.28 ha of forest will need to be cleared to accommodate the lagoon, fence and perimeter ditch. The pipeline and 20 m ROW will require clearing of approximately 0.89 ha of land.
- Clearing may result in an increased abundance of invasive and noxious plant species.

4.1.5.2 Mitigation

The following are mitigation and environmental design measures to minimize effects to vegetation:

- The lagoon was sited in a partially cleared area where less forest needs to be removed.
- Clearing for the work area will be limited as much as possible and will encompass an area of approximately 10 m around the lagoon.
- Invasive and noxious plant species will be managed as required during construction and operation.

4.1.6 Wildlife

4.1.6.1 Effects

Potential effects to wildlife include:

- Loss of wildlife habitat.
- Potential destruction/damage to migratory bird nests.
- Sensory disturbance during construction which may result in short-term avoidance of the area.
- Management of burrowing animals during the operation period to prevent these animals from burrowing into the side of the lagoon dykes.

4.1.6.2 Mitigation

The following are mitigation and environmental design measures to minimize effects to wildlife:

- A construction environmental management plan will be developed to outline best management practices to minimize effects to wildlife.
- Migratory birds and their eggs are protected under the *Migratory Birds Convention Act*. Avoidance guidelines established by Environment and Climate Change Canada recommend scheduling disruptive activities (including construction) outside of the migratory bird nesting season during the breeding season in potential migratory bird habitat (Environment and Climate Change Canada 2016). This period occurs between mid-April and mid-August within the project area, and birds in this area are most likely to tree nesters. Clearing during the breeding bird period will be avoided if possible. If avoidance of clearing during this window is not possible, migratory bird nest sweeps should be conducted and setbacks placed.
- A perimeter fence will be constructed around the wastewater treatment system to prevent wildlife from entering the facility.

4.1.7 Socio-economic Effects

4.1.7.1 Effects and Mitigation

Potential effects to the socio-economic environment are minimal, as the land is partially cleared and not currently used for commercial purposed, so hunting or harvesting activities will not be affected. There will be some temporary jobs created during construction, however, the part-time jobs created during operation will replace those for the existing wastewater treatment plant.

4.1.8 Heritage Resources

4.1.8.1 Effects

The Manitoba Historic Resources Branch (HRB) examined the proposed area of disturbance in conjunction with their records, and did not have any concerns with the proposed project (**Appendix A**). Although heritage resources are not expected, there is the potential for an unexpected discovery during excavation.

4.1.8.2 Mitigation

If any suspected heritage resources are discovered during construction, work will cease until a heritage resource management strategy is implemented to mitigate the effects of development on the heritage resources.

4.1.9 Accidents and Malfunctions

4.1.9.1 Effects

Potential effects from accidents and malfunctions include:

- Malfunction of the mechanical alum/UV system, where the effluent being discharged to Wintering Lake could exceed the licensed requirements.
- Potential risk of a fuel spill (i.e. hydraulic fluid) during construction due to the use of heavy equipment has the potential to affect soils and groundwater.

4.1.9.2 Mitigation

The following are mitigation and environmental design measures to minimize effects from accidents and malfunctions:

- In the event of a mechanical failure, the system has been designed to overflow from one cell to another and eventually to the discharge outlet; hence, would undergo a similar treatment process minus the alum and UV treatment. There will be a part-time operator responsible for inspecting and maintaining the wastewater treatment system so that a mechanical failure will be quickly identified and addressed.
- Heavy equipment utilized on site during construction will be properly maintained and visually inspected for issues/leaks on a daily basis. There will be spill kits onsite to manage any spills that may occur. Any reportable spills of a hazardous substance will be immediately cleaned up and reported to Manitoba Conservation Emergency Spill line at 204-944-4888.
- A construction environmental management plan will be implemented during construction and will include measures to prevent and manage accidental releases to the environment.

4.1.10 Effects of the Environment on the Project

4.1.10.1 Effects

Severe weather, including high winds, heavy precipitation and storm events has the potential to affect the project during construction. It may affect material placement/compaction, grading, re-vegetation as well as result in erosion and/or dust.

4.1.10.2 Mitigation

The following are mitigation and environmental design measures to minimize effects from severe weather:

- Material stockpiles will be protected from extreme weather events as required.
- Dust suppression, such as spraying roads or material stockpiles, will be completed as required.
- Erosion control materials will be utilized as required.
- A construction environmental management plan will include provisions to stop work in the event of extreme weather.

4.1.11 Cumulative Effects Assessment

The cumulative effects assessment considers the anticipated residual environmental effects of the project in combination with other past, present and/or reasonably foreseeable future projects or activities in the area. Thicket Portage is a remote community and there are no other known major projects in the area that will interact with this project.

4.2 SIGNIFICANCE OF RESIDUAL EFFECTS

4.2.1 Residual Effects Assessment Criteria

Residual effects are effects remaining after application of mitigation measures. To assess the significance of these residual effects, a number of factors/criteria must be considered including: direction, magnitude, geographic extent, duration, frequency, and likelihood. Each criterion has a relative ranking scheme associated with it, as described in **Table 4.1**.

Table 4.1 – Criteria Used to Assess Residual Effects

Criteria	Description
Direction	The direction of the effect with respect to the effects on the environment: • positive • neutral • negative
Magnitude	A measure of the significance or scale of the effect: • negligible (no measurable effect) • low (above background conditions, but within established criteria or acceptable natural variation) • medium (substantially above background conditions, but within established criteria or acceptable natural variation) • high (likely to exceed established criteria and acceptable natural variation)
Geographic extent	The geographic area potentially affected: • site-specific • local • regional
Duration	The length of time over which the effects occur: • finite (occurring only during construction) • short-term (lasting longer than construction, but less than the project life) • medium-term (lasting the life of the project) • long-term (remaining after project closure and decommissioning)
Frequency	The frequency of occurrence of the effect over the specified duration; • infrequent (occurs once over the duration of the disturbance) • frequent (occurs periodically over the duration of disturbance) • continuous (occurs continuously over the duration of disturbance)
Likelihood	The probability of occurrence of the effect: • none • unlikely • likely • very likely

The activities associated with the project were first assessed according to the above criteria, and then evaluated together to predict the overall environmental consequence. Environmental consequence was determined as:

Minimal describes effects with a low magnitude, short- to medium-term duration, infrequent to continuous occurrence, unlikely to occur, and restricted in extent to the project area. The potential effect may result in a slight decline in the resource in the study area during construction phase, but the resource should return to pre-construction levels.

Low describes effects with a low to medium magnitude, short- to long-term duration, infrequent to continuous occurrence, unlikely to very likely to occur, and restricted in geographic extent to the project or local area. The potential effect may result in a slight decline in the resource in the study area during the life of the project. Research, monitoring, and/or recovery initiatives would not normally be required.

Moderate describes effects with a medium magnitude, short- to long-term duration, frequent to continuous occurrence, likely or very likely to occur, and extend outside of the project area to adjacent areas. Potential effect could result in a decline in resource to lower-than-baseline but stable levels in the region after project closure and into the foreseeable future. Regional management actions such as research, monitoring, and/or recovery initiatives may be required.

High describes refers to major effects with a high magnitude, long-term duration, continuous in occurrence, likely or very likely to occur, and extend outside of the project area to adjacent areas. Potential effect could threaten sustainability of the resource and should be considered a management concern. Research, monitoring, and/or recover initiatives should be considered.

The effect is considered to be significant if the rating is moderate or high, and is considered to be not significant if the rating is determined to be minimal or low.

4.2.2 Summary of Residual Effects

Residual effects, i.e., effects that remain after application of mitigation measures, are expected to occur to air quality, groundwater and soils, surface water, vegetation, and wildlife habitat. The residual effects were assessed in terms of their direction, magnitude, geographic extent, duration, frequency and likelihood**. Table 4.2** provides a summary of the residual effects and significance for each of the environmental component. All effects were assessed with a low significance rating.

Table 4.2 – Residual effects and significance

Predicted Residual Effect	Direction	Magnitude	Extent	Duration	Frequency	Likelihood	Significance
Construction							
Disturbance to soils	negative	low	project site	long-term	infrequent	very likely	low
Loss of forest	negative	low	project site	long-term	infrequent	very likely	low
Loss of wildlife habitat	negative	low	project site	long-term	infrequent	very likely	low
Disturbance or mortality to wildlife and migratory birds	negative	low	project site	short-term	infrequent	unlikely	low
Dust/noise during construction	negative	low	project site	short-term	frequent	likely	low
Operation							
Production of methane, NO_X, and odours	negative	low	local	medium-term	frequent	very likely	low
Wastewater migration into subsurface	negative	medium	project site	long-term	frequent	unlikely	low
Effluent discharge to surface water	negative	low	local	long-term	frequent	very likely	low
Disturbance or mortality to small burrowing mammals	negative	low	project site	medium-term	frequent	likely	low

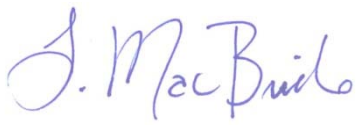
4.3 MONITORING

Regular effluent samples will be collected as required by the Environment Act License. A part-time operator will conduct regular monitoring, inspection and maintenance of the wastewater treatment system as outlined in **Section 2.4.14.**

5 CLOSURE

This Environment Act Proposal has been prepared by SNC-Lavalin Inc. on behalf of Indigenous and Municipal Relations of Manitoba for submission to Manitoba Conservation and Water Stewardship. Should you have any questions or comments please contact us at +1.204.786.8080.

Prepared by:



Lyndsey MacBride, M.Sc., P.Geo.

SNC-LAVALIN INC.

Reviewed by:

Ed Wolowich, M.Sc., C.S.O., P.Eng.

SNC-LAVALIN INC.

6 REFERENCES

Committee on the Status of Endangered Wildlife in Canada. 2006. COSEWIC Assessment and Update Status Report on the Lake Sturgeon (*Acipenser fulvescens*) in Canada. URL: http://www.sararegistry.gc.ca/virtual_sara/files/cosewic/sr_Lake_Sturgeon_0807_e.pdf (accessed February 2016).

Ehrlich, W.A., Pratt, L.E., Barr, J.A., and Leclaire, F.P. 1959. Soil Survey of a Cross-Section through the Upper Nelson River Basin along the Hudson Bay Railway in Northern Manitoba. Manitoba Department of Agriculture and Conservation.

Environment Canada. 2015. Canadian Climate Normals. URL: http://climate.weather.gc.ca/climate_normals/index_e.html (accessed November 2015).

Environment and Climate Change Canada. 2016. Avoidance Guidelines and General Nesting Periods of Migratory Birds in Canada. EC, Ottawa, ON. URL: https://www.ec.gc.ca/paom-itmb/default.asp?lang=En&n=AB36A082-1 (accessed April 2016).

Government of Manitoba. 2003. Thicket Portage Community Profile. URL: http://www.gov.mb.ca/ana/publications/community_profiles/pubs/thicket_portage_2003.pdf (accessed November 2015).

H. Manalo Consulting Ltd. 2015. Geotechnical Report – Feasibility Study for Thicket Portage WWSP, Thicket Portage, Manitoba. Prepared for: Neegan Burnside Ltd. Project No. 14-148.

MacDonnell, D.S. 1997. The Nelson River Lake Sturgeon Fishery: From the Perspective of the Bayline Communities of Pikwitnoei, Thicket Portage, and Wabowden. M.Sc. Practicum: Natural Resource Institute, University of Manitoba.

Manitoba Conservation and Water Stewardship (MCWS). 2012. A Profile of Manitoba's Commercial Fishery. Fisheries Branch. URL: http://www.manitoba.ca/waterstewardship/fisheries/commercial/history.pdf (Accessed February 2016).

Manitoba Conservation and Water Stewardship (MCWS). 2014. Information Bulletin – Design Objectives for Wastewater Treatment Lagoons. URL: https://www.gov.mb.ca/conservation/eal/publs/lagoon.design.guidelines.pdf (accessed March 2016).

Manitoba Conservation Data Centre. 2013. Occurrence of Species by Ecoregion. URL: http://www.gov.mb.ca/conservation/cdc/ecoreg/hayesriver.html (Accessed February 2016).

Manitoba Water Stewardship. 2011. Manitoba Water Quality Standards, Objectives and Guidelines. URL: https://www.gov.mb.ca/waterstewardship/water_quality/quality/website_notice_mwqsog_2011.html (accessed March 2016).

Matile GLD and Keller GR. 2006a. Surficial geology of west-central Manitoba SG-WCMB *in* Surficial Geology Compilation Map Series of Manitoba, Manitoba Science, Technology, Energy and Mines, Manitoba Geological Survey, Surficial Geology Compilation Map Series SG-CMS, 1 DVD, map at 1:250 000 scale.

Matile GLD and Keller GR. 2006b Surficial geology of the Sipiwesk map sheet (NTS 63P), Manitoba; Map SG-63P *in* Surficial Geology Compilation Map Series of Manitoba, Manitoba Science, Technology, Energy and Mines, Manitoba Geological Survey, Surficial Geology Compilation Map Series SG-CMS, 1 DVD, map at 1:250 000 scale.

Neegan Burnside. 2015. Thicket Portage Wastewater Treatment Feasibility Study, Final Report 300034704. Prepared for Manitoba Aboriginal and Northern Affairs. May 2015.

Smith, R.E., Veldhuis, H., Mills, G.F., Eilers, R.G., Fraser, W.R., and Lelyk, G.W. 1998. Terrestrial Ecozones, Ecoregions, and Ecodistricts of Manitoba. An Ecological Stratification of Manitoba's Natural Landscapes. Agriculture and Agri-Food Canada: Research Branch Technical Bulletin 1998-9E.

Stewart, K. and Watkinson, D.A. 2004. The Freshwater Fishes of Manitoba. University of Manitoba Press. 276pp.

SNC-Lavalin Inc. 2016a. Geotechnical Investigation for the Proposed Thicket Portage Sewage Lagoon.

SNC-Lavalin Inc. 2016b. Thicket Portage Lagoon - Design Memorandum for 60% Review. Prepared for: Manitoba Aboriginal and Northern Affairs.

APPENDIX A

Correspondence

Thicket Portage Community
Administrative Officer
Box 60
Thicket Portage, MB R0B 1R0

Telephone: 204.266-3296
Fax: 204.266.3256

10 March 2016

Project #633391

SNC-Lavalin Inc.
148 Nature Park Way
Winnipeg, MB R3P 0X7

ATTN: Edward Wolowich, Project Manager

RE: Proposed Thicket Portage Sewage Lagoon

Dear Mr. Wolowich,

The Thicket Portage Community Council has reviewed SNC-Lavalin's preliminary design of the proposed new sewage lagoon for our community, dated February 2, 2016, and we hereby state our approval and support for the project.

The lagoon location and design is as presented in concept by Neegan Burnside last year during their consultation with us, and agreed to at that time. As you are aware, our current wastewater treatment plant is not operating properly, and is in urgent need of replacement. Improperly treated, and at times, untreated waste water is currently being discharged to Wintering Lake; consequently, this posses a significant concern to the health and safety of our people.

Sincerely, mayor

Thicket Portage Community.

Manitoba

Memorandum

DATE: January 15, 2016

TO: Lyndsey MacBride
Operations Manager,
Impact Assessment and
Community Engagement, MB
Environment and Water
Infrastructure
SNC-Lavalin
Lyndsey.MacBride@snclavalin.com

FROM: Christina Nesbitt
Impact Assessment
Archaeologist
Historic Resources Branch
Main Floor 213 Notre Dame
Avenue
Winnipeg MB
R3B 1N3
Christina.Nesbitt@gov.mb.ca

PHONE NO: (204) 945-8145

SUBJECT: Sewage treatment system/lagoon
Thicket Portage
HRB Review and Comments

HRB FILE: AAS-15-9945

Further to your memo requesting a heritage screening for the above sewage treatment system and lagoon for Thicket Portage (Planned Area), the Historic Resources Branch (HRB) has examined the applicabe areas proposed for development in conjunction with the Branch's records for areas of potential concern, and can advise you that HRB has no concerns with the project at this time.

However, pleased be advised that if any heritage resources are encountered in association with the Planned Area during development, the Developer is required to notify HRB and HRB may require that a heritage resource management strategy be implemented to mitigate the effects of development on the heritage resources.

If you have any questions or comments, please feel free to contact the undersigned at the above noted address, phone number, or e-mail.

Christina Nesbitt

MacBride, Lyndsey

From: Jacobs, Kevin (CWS) [Kevin.Jacobs@gov.mb.ca]
Sent: November 10, 2015 2:20 PM
To: MacBride, Lyndsey
Subject: RE: Thicket Portage Sewage Lagoon - Wintering Lake Water QualityData

Hello Lyndsey,

Thank you for the email. With respect to your query, unfortunately we do not have water quality data for Wintering Lake in our database.

Regards,

Kevin Jacobs, M.Sc.
Senior Water Protection Officer
Water Science and Management Branch
Manitoba Conservation and Water Stewardship
Suite 160- 123 Main Street (Box 20)
Winnipeg, Manitoba
R3C 1A5
Phone: 204 945 4304
Fax: 204 948 2357

From: MacBride, Lyndsey [mailto:Lyndsey.MacBride@snclavalin.com]
Sent: November-10-15 2:09 PM
To: Jacobs, Kevin (CWS)
Cc: Hamilton, Katie
Subject: Thicket Portage Sewage Lagoon - Wintering Lake Water Quality Data

Hi Kevin,

SNC-Lavalin Inc. is preparing an Environment Act Proposal on behalf of Aboriginal and Northern Affairs of Manitoba for a new sewage treatment system/lagoon in Thicket Portage, MB. The proposed lagoon will discharge effluent into Wintering Lake.

I am requesting any water quality data you may have for Wintering Lake, preferably in the past ten years.

Any information would be greatly appreciated.

Regards,

Lyndsey MacBride, *M.Sc., P.Geo.*
Operations Manager, Impact Assesment & Community Engagement, MB
Environment & Water
Infrastructure

Tel.: 204-786-8080 x 294
Cell.: 204-479-1468
Fax: 204-786-7934

MacBride, Lyndsey

From: Friesen, Chris (CWS) [Chris.Friesen@gov.mb.ca]
Sent: March 7, 2016 8:47 AM
To: MacBride, Lyndsey
Subject: RE: CDC Screening - Thicket Portage, MB

Hi Lyndsey

No occurrences known in this area, either. Thanks for checking.

Chris Friesen
Coordinator
Manitoba Conservation Data Centre
204-945-7747
chris.friesen@gov.mb.ca
http://www.gov.mb.ca/conservation/cdc/

From: MacBride, Lyndsey [mailto:Lyndsey.MacBride@snclavalin.com]
Sent: March-03-16 2:31 PM
To: Friesen, Chris (CWS)
Subject: RE: CDC Screening - Thicket Portage, MB

Hi Chris,

I have realized that my original request did not include the discharge path of the effluent coming out of the new sewage lagoon. I've attached an image showing the new infrastructure (orange), and the discharge path (pink). The discharge is following a natural drainage path and will not require disturbance, however, it will carry effluent and I wanted to make sure this area is screened as well.

Thank you,

Lyndsey MacBride, *M.Sc., P.Geo.*
Operations Manager, Impact Assesment & Community Engagement, MB
Environment & Water
Infrastructure

Tel.: 204-786-8080 x 294
Cell.: 204-479-1468
Fax: 204-786-7934

SNC-Lavalin
148 Nature Park Way
Winnipeg | Manitoba | Canada | R3P 0X7

From: Friesen, Chris (CWS) [mailto:Chris.Friesen@gov.mb.ca]
Sent: November 9, 2015 9:59 AM
To: MacBride, Lyndsey
Cc: Hamilton, Katie
Subject: RE: CDC Screening - Thicket Portage, MB

Lyndsey

Thank you for your information request. I completed a search of the Manitoba Conservation Data Centre's rare species database and found no occurrences at this time for your area of interest.

The information provided in this letter is based on existing data known to the Manitoba Conservation Data Centre at the time of the request. These data are dependent on the research and observations of CDC staff and others who have shared their data, and reflect our current state of knowledge. **An absence of data in any particular geographic area does not necessarily mean that species or ecological communities of concern are not present**; in many areas, comprehensive surveys have never been completed. Therefore, this information should be regarded neither as a final statement on the occurrence of any species of concern, nor as a substitute for on-site surveys for species as part of environmental assessments.

Because the Manitoba CDC's Biotics database is continually updated and because information requests are evaluated by type of action, any given response is only appropriate for its respective request. Please contact the Manitoba CDC for an update on this natural heritage information if more than six months pass before it is utilized.

Third party requests for products wholly or partially derived from Biotics must be approved by the Manitoba CDC before information is released. Once approved, the primary user will identify the Manitoba CDC as data contributors on any map or publication using Biotics data, as follows as: Data developed by the Manitoba Conservation Data Centre; Wildlife Branch, Manitoba Conservation and Water Stewardship.

This letter is for information purposes only - it does not constitute consent or approval of the proposed project or activity, nor does it negate the need for any permits or approvals required by the Province of Manitoba.

We would be interested in receiving a copy of the results of any field surveys that you may undertake, to update our database with the most current knowledge of the area.

If you have any questions or require further information please contact me directly at (204) 945-7747.

Chris Friesen
Coordinator
Manitoba Conservation Data Centre
204-945-7747
chris.friesen@gov.mb.ca
http://www.gov.mb.ca/conservation/cdc/

From: MacBride, Lyndsey [mailto:Lyndsey.MacBride@snclavalin.com]
Sent: October-30-15 1:03 PM
To: Friesen, Chris (CWS)
Cc: Hamilton, Katie
Subject: CDC Screening - Thicket Portage, MB

Hi Chris,

We are preparing an Environment Act Proposal for a new sewage treatment system/lagoon in Thicket Portage, MB, and I am requesting a screening of the CDC for the project area. Please see the coordinates and map below:

NW 582320 m E / 6131540 m N
NE 583805 m E / 6131490 m N
SW 582980 m E / 6129465 m N
SE 584625 m E / 6129950 m N

Thanks in advance for your help,

Lyndsey MacBride, *M.Sc., P.Geo.*
Operations Manager, Impact Assesment & Community Engagement, MB
Environment & Water
Infrastructure

Tel.: 204-786-8080 x 294
Cell.: 204-479-1468
Fax: 204-786-7934

SNC-Lavalin
148 Nature Park Way
Winnipeg | Manitoba | Canada | R3P 0X7

APPENDIX B

Requisition for Entry in Crown Land Registry

Requisition for Entry in Crown Land Registry

CLPA
Crown Lands & Property Agency

Branch Crown Lands Date May 6, 20 16

Please make the following **Temporary** entry/entries

SEE BELOW Sec. Twp. Range P.M.

DETAILS OF ENTRY/ENTRIES

RESERVED ON BEHALF OF MANITOBA ABORIGINAL & NORTHERN AFFAIRS FOR THE PURPOSE OF A WASTEWATER LAGOON, ACCESS ROAD AND FORCE MAIN FOR THE COMMUNITY OF THICKET PORTAGE AS PER ATTACHMENT, FILED AT THE CROWN LANDS & PROPERTY AGENCY AT PORTAGE LA PRAIRIE, MANITOBA.

RESERVATION REQUESTED BY COMMUNITY AND RESOURCE DEVELOPMENT OFFICER, ALVIN MURDOCK'S E-MAIL DATED MAY 6, 2016.

TWP 73-2 WPM
-PT NE 9
-PT NW 10

Encumbrance Name: SLAG THICKET
Encumbrance ID # : 70782

I hereby certify that the above entry or entries has/have been (recorded/deleted or cancelled) in the Township Register/s

6 day of May 20 16

K Little
Supervisor of Records

Requested by Alvin Murdock
Aboriginal & Northern Affairs

Entry/Entries Authorized
Karen Little
Supervisor of Crown Lands Registry
Authorizing Officer

NOTE - This form must be submitted in duplicate to the "Chief of Land Registry". The duplicate being returned to the office concerned duly certified. The original being filed in the Lands Branch.

Copies sent by e-mail to:

David Hastman - Regional Land Manager
Alvin Murdock – A/NA
TLE - Neepawa

APPENDIX C

Engineering Drawings

PLOTTED: April 18, 2016

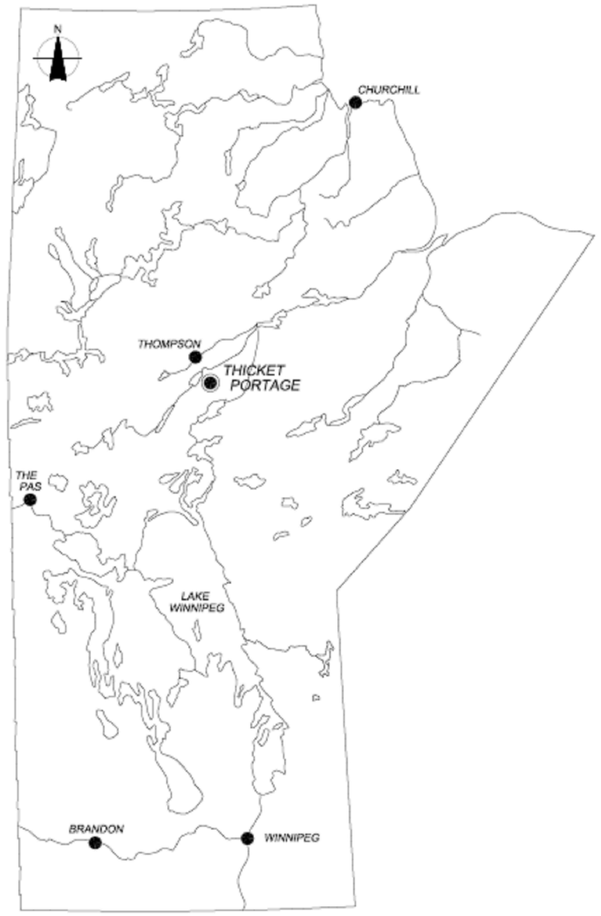
PAPER SIZE: ISO A1 (594.00 X 841.00 MM)

MANITOBA ABORIGINAL AND NORTHERN AFFAIRS

Manitoba
Aboriginal and Northern Affairs

THICKET PORTAGE - SEWAGE LAGOON

DRAWING INDEX



LOCATION PLAN

ISSUED FOR 90% SUBMISSION

ISSUE DATE: April 18, 2016

Project Number: 15103196

SNC·LAVALIN

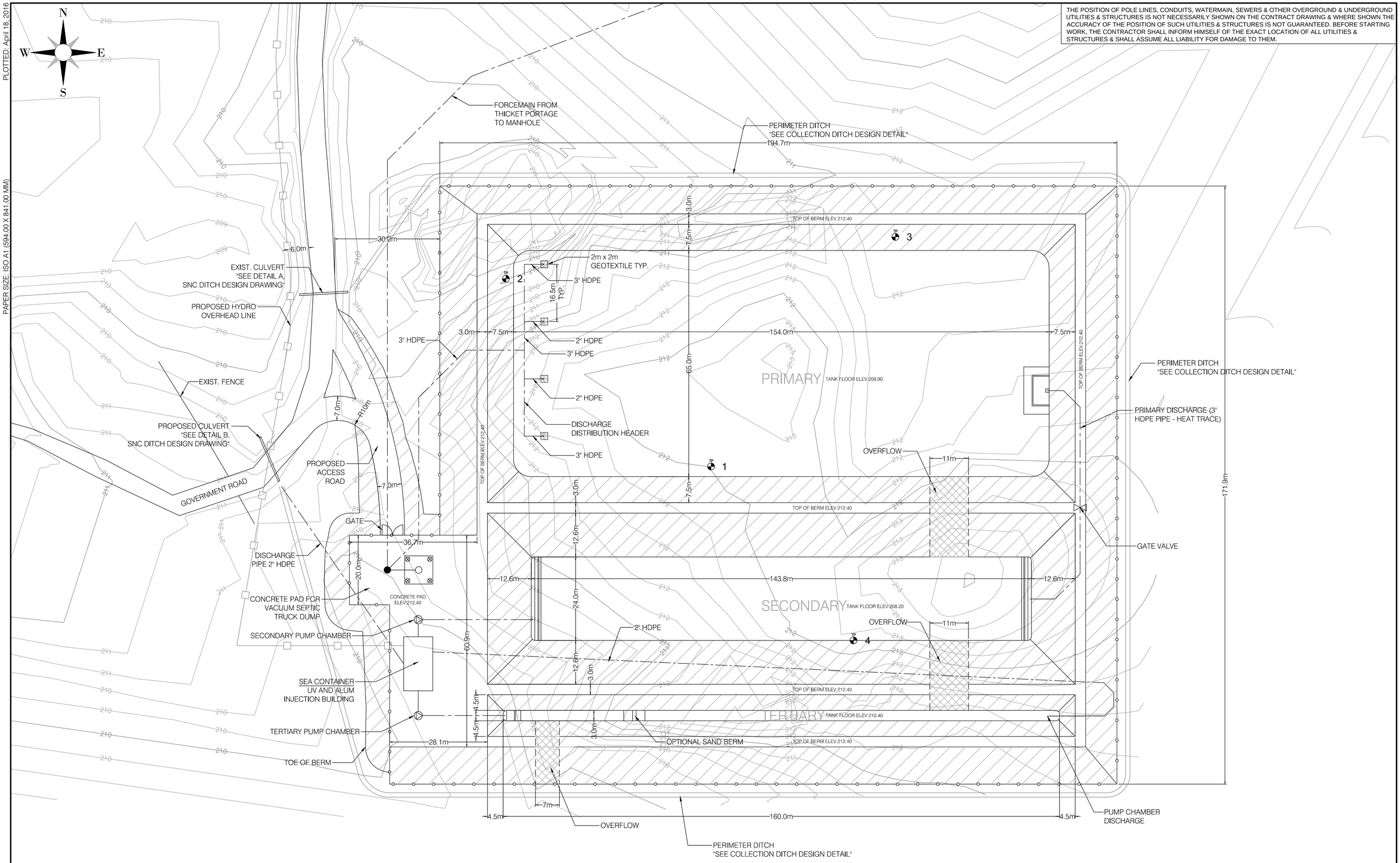
BEARPAW ENGINEERING
& PROJECT MANAGEMENT
39 SCURFIELD BLVD.
WINNIPEG, MB R3Y1G4
PH: (204) 421-9199
FAX: (204) 421-9149
www.BearPawCorporation.com

PLOTTED: April 18, 2016

PAPER SIZE: ISO A1 (594.00 X 841.00 MM)

N W E S

THE POSITION OF POLE LINES, CONDUITS, WATERMAIN, SEWERS & OTHER OVERGROUND & UNDERGROUND UTILITIES & STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWING & WHERE SHOWN THE ACCURACY OF THE POSITION OF SUCH UTILITIES & STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL UTILITIES & STRUCTURES & SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM.



GEOMEMBRANE TO BE APPLIED TO THE SOUTH & EAST SIDES OF THE CELL TO PREVENT EROSION DUE TO WAVE ACTION.

LEGEND:

- PROPOSED FENCING
- PROPOSED PIPE
- HYDRO LINE
- GEOTEXTILE
- BOLLARD
- PUMP CHAMBER
- CAM LOCK
- MANHOLE
- TEST PITS

PROFESSIONAL SEALS

NO.	YYYY/MM/DD	ISSUE / REVISION	DRN	CHK	DES	ENG
3	2016/04/18	90% SUBMISSION	NJM	ZX	NJM	FGD
2	2016/03/18	60% SUBMISSION	NJM	ZX	NJM	FGD
1	2016/01/19	ISSUED TO CLIENT	NJM	ZX	NJM	FGD

BEARPAW ENGINEERING & PROJECT MANAGEMENT
39 SCURFIELD BLVD.
WINNIPEG, MB R3Y1G4
PH: (204) 421-9199
FAX: (204) 421-9149
www.BearPawCorporation.com

CONTROL - UTM ZONE 16 NAD 83

POINT	NORTHING	EASTING	ELEVATION	DESCRIPTION
CP1				
CP2				
CP3				
CP4				

SCALE: IF THIS BAR IS NOT 25mm LONG, ADJUST YOUR PLOTTING SCALE — 25mm

PROJECT TITLE: THICKET PORTAGE LAGOON

CLIENT: ABORIGINAL & NORTHERN AFFAIRS

DRAWING TITLE: SITE PLAN (NOTES & DIMENSIONS)

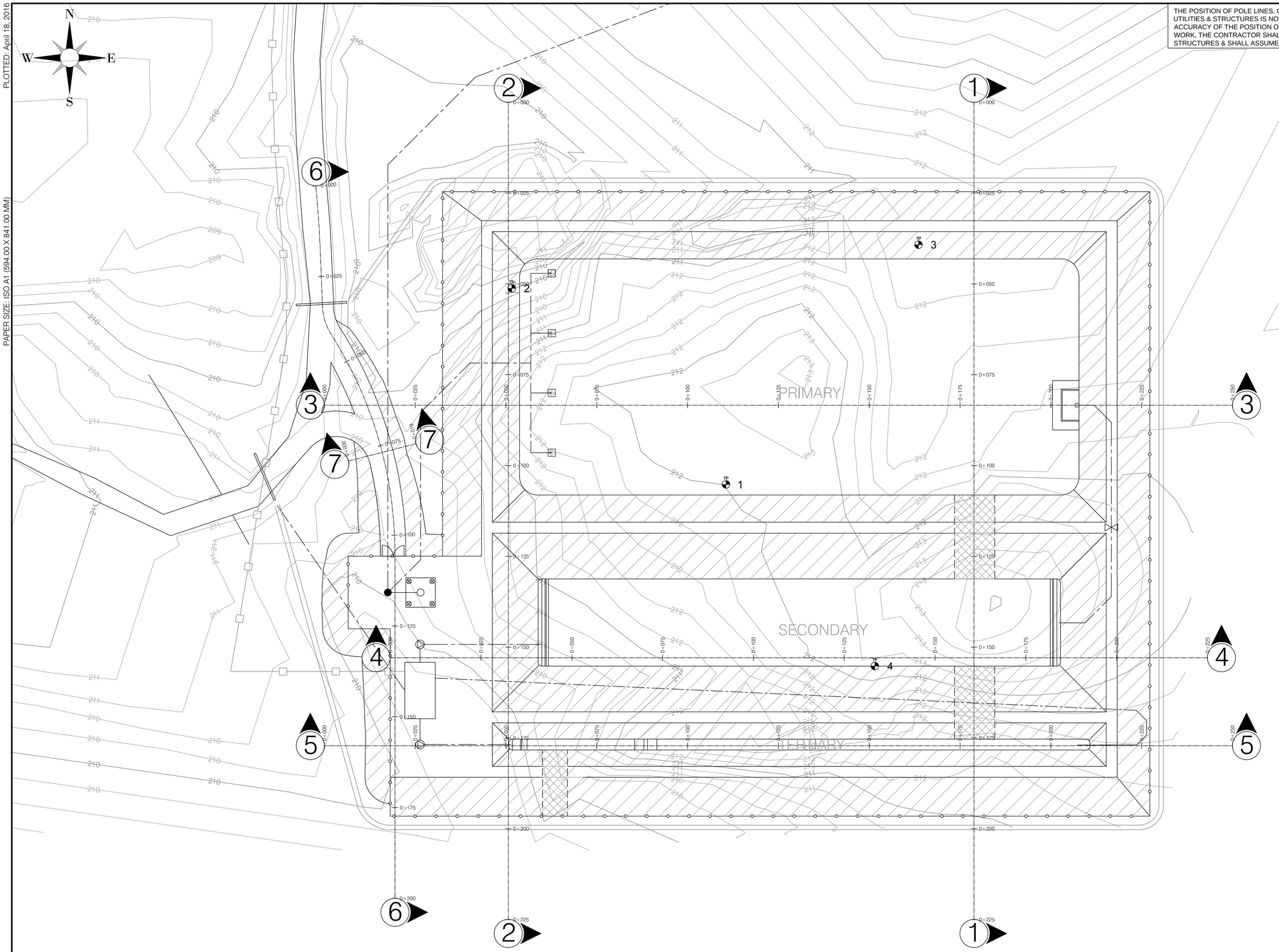
PROJECT NO: 15103196

DWG NO: A

PLOTTED: April 18, 2016

PAPER SIZE: ISO A1 (594.00 X 841.00 MM)

THE POSITION OF POLE LINES, CONDUITS, WATERMAIN, SEWERS & OTHER OVERGROUND & UNDERGROUND UTILITIES & STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWING & WHERE SHOWN THE ACCURACY OF THE POSITION OF SUCH UTILITIES & STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL UTILITIES & STRUCTURES & SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM.



GEOMEMBRANE TO BE APPLIED TO THE SOUTH & EAST SIDES OF THE CELL TO PREVENT EROSION DUE TO WAVE ACTION.

LEGEND:

- PROPOSED FENCING
- PROPOSED PIPE
- HYDRO LINE
- GEOTEXTILE
- BOLLARD
- PUMP CHAMBER
- CAM LOCK
- MANHOLE
- TEST PITS

PROFESSIONAL SEALS

NO.	YYYY/MM/DD	ISSUE / REVISION	DRN	CHK	DES	ENG
3	2016/04/18	90% SUBMISSION	NJM	ZX	NJM	FGD
2	2016/03/18	60% SUBMISSION	NJM	ZX	NJM	FGD
1	2016/01/19	ISSUED TO CLIENT	NJM	ZX	NJM	FGD

BEARPAW ENGINEERING
& PROJECT MANAGEMENT
39 SCURFIELD BLVD.
WINNIPEG, MB R3Y1G4
PH: (204) 421-9199
FAX: (204) 421-9149
www.BearPawCorporation.com

CONTROL - UTM ZONE 16 NAD 83

POINT	NORTHING	EASTING	ELEVATION	DESCRIPTION
CP1				
CP2				
CP3				
CP4				

SCALE: IF THIS BAR IS NOT 25mm LONG, ADJUST YOUR PLOTTING SCALE — 25mm

PROJECT TITLE: THICKET PORTAGE LAGOON

CLIENT: ABORIGINAL & NORTHERN AFFAIRS

DRAWING TITLE: SITE PLAN (ALIGNMENTS)

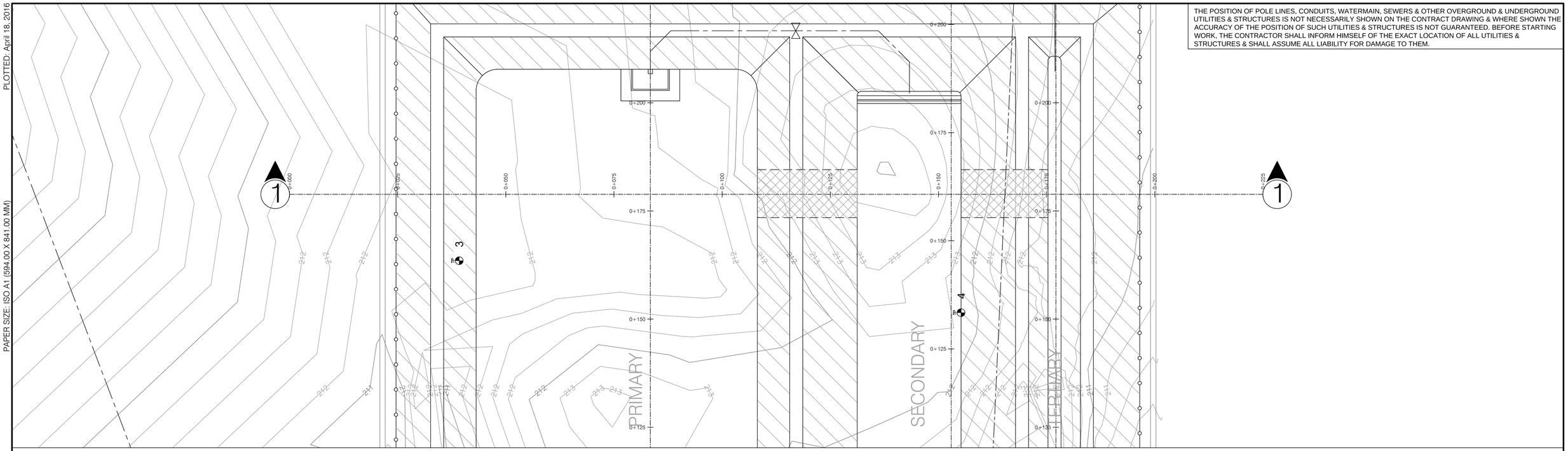
PROJECT NO: 15103196

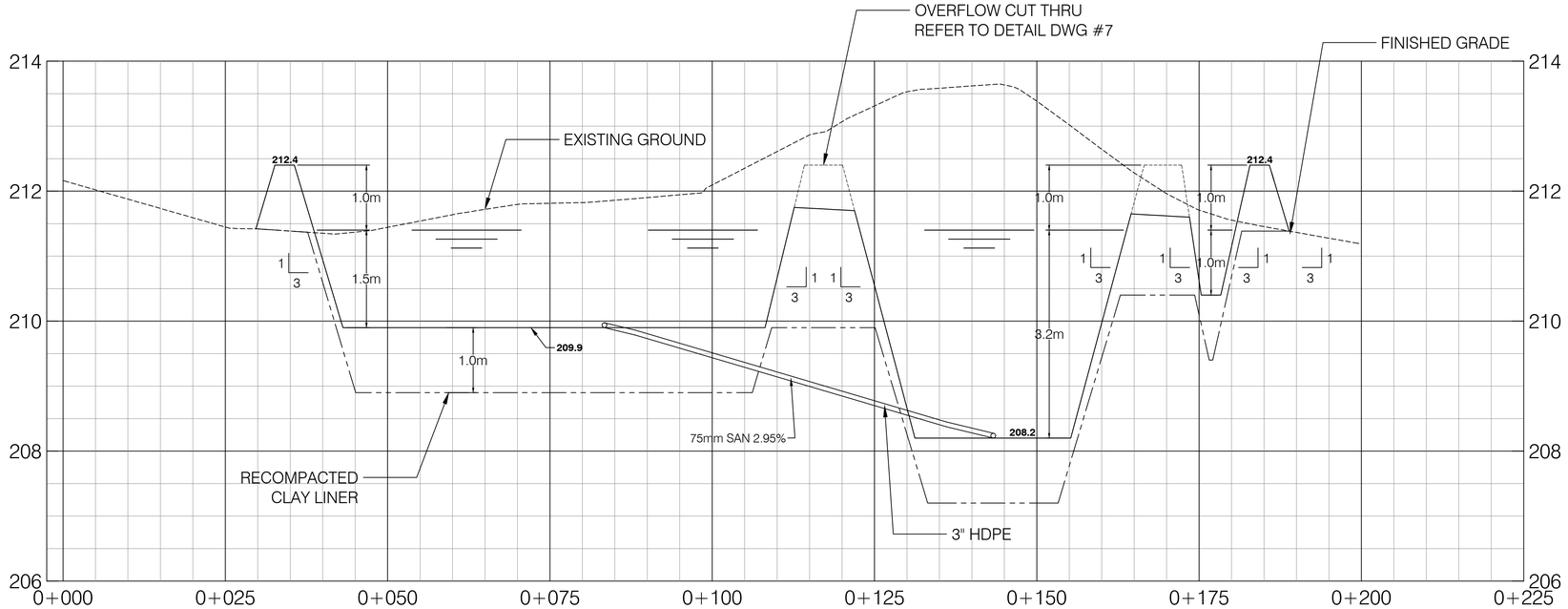
DWG NO: B

PLOTTED: April 18, 2016

PAPER SIZE: ISO A1 (594.00 X 841.00 MM)

THE POSITION OF POLE LINES, CONDUITS, WATERMAIN, SEWERS & OTHER OVERGROUND & UNDERGROUND UTILITIES & STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWING & WHERE SHOWN THE ACCURACY OF THE POSITION OF SUCH UTILITIES & STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL UTILITIES & STRUCTURES & SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM.





PROFILE SCALE
H = 1:250
V = 1:25

1 LAGOON CELLS CROSS SECTION PROFILE

LEGEND:

- PROPOSED FENCING
- PROPOSED PIPE
- HYDRO LINE
- GEOTEXTILE
- BOLLARD
- PUMP CHAMBER
- CAM LOCK
- MANHOLE
- TEST PITS

PROFESSIONAL SEALS

NO.	YYYY/MM/DD	ISSUE / REVISION	DRN	CHK	DES	ENG
3	2016/04/18	90% SUBMISSION	NJM	ZX	NJM	FGD
2	2016/03/18	60% SUBMISSION	NJM	ZX	NJM	FGD
1	2016/01/19	ISSUED TO CLIENT	NJM	ZX	NJM	FGD

BEARPAW ENGINEERING
& PROJECT MANAGEMENT
39 SCURFIELD BLVD.
WINNIPEG, MB R3Y1G4
PH: (204) 421-9199
FAX: (204) 421-9149
www.BearPawCorporation.com

CONTROL - UTM ZONE 16 NAD 83

POINT	NORTHING	EASTING	ELEVATION	DESCRIPTION
CP1				
CP2				
CP3				
CP4				

SCALE: IF THIS BAR IS NOT 25mm LONG, ADJUST YOUR PLOTTING SCALE — 25mm

PROJECT TITLE: THICKET PORTAGE LAGOON

CLIENT: ABORIGINAL & NORTHERN AFFAIRS

DRAWING TITLE: LAGOON CELLS CROSS SECTION PROFILE

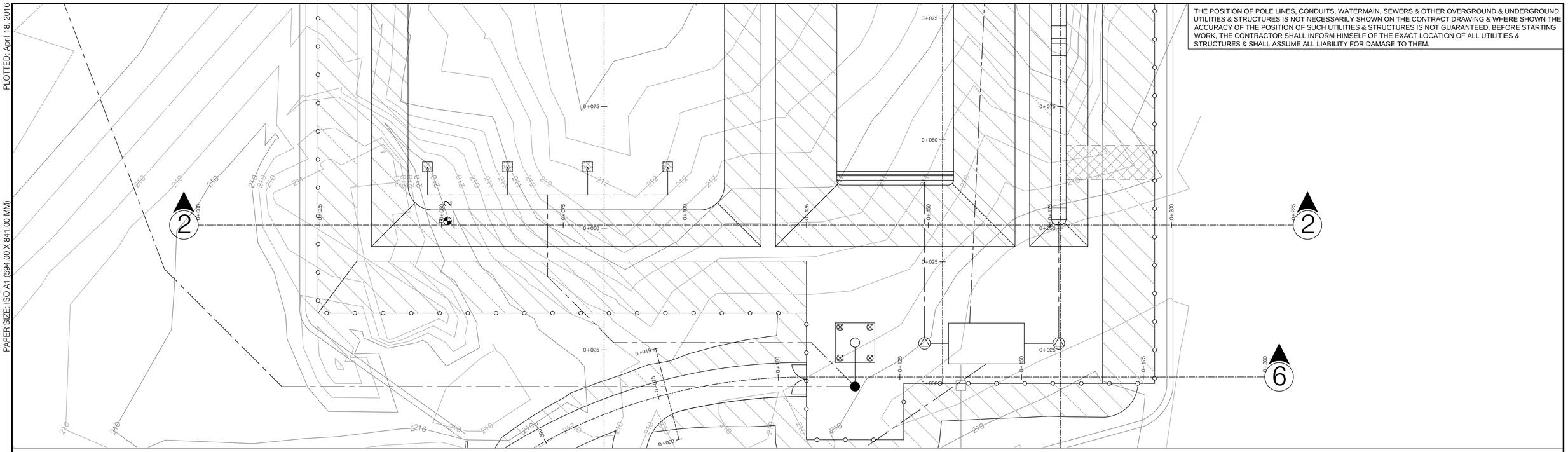
PROJECT NO: 15103196

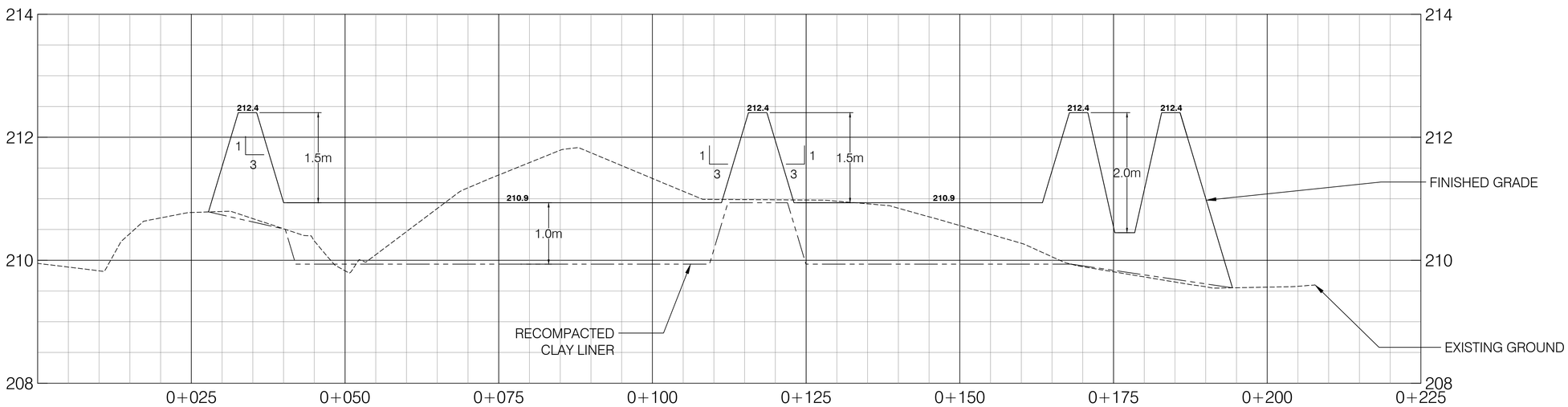
DWG NO: 1

PLOTTED: April 18, 2016

PAPER SIZE: ISO A1 (594.00 X 841.00 MM)

THE POSITION OF POLE LINES, CONDUITS, WATERMAIN, SEWERS & OTHER OVERGROUND & UNDERGROUND UTILITIES & STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWING & WHERE SHOWN THE ACCURACY OF THE POSITION OF SUCH UTILITIES & STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL UTILITIES & STRUCTURES & SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM.





PROFILE SCALE
H = 1:250
V = 1:25

2 BERM CROSS SECTION PROFILE

LEGEND:

- PROPOSED FENCING
- PROPOSED PIPE
- HYDRO LINE
- GEOTEXTILE
- BOLLARD
- PUMP CHAMBER
- CAM LOCK
- MANHOLE
- TEST PITS

PROFESSIONAL SEALS

NO.	YYYY/MM/DD	ISSUE / REVISION	DRN	CHK	DES	ENG
3	2016/04/18	90% SUBMISSION	NJM	ZX	NJM	FGD
2	2016/03/18	60% SUBMISSION	NJM	ZX	NJM	FGD
1	2016/01/19	ISSUED TO CLIENT	NJM	ZX	NJM	FGD

BEARPAW ENGINEERING
& PROJECT MANAGEMENT
39 SCURFIELD BLVD.
WINNIPEG, MB R3Y1G4
PH: (204) 421-9199
FAX: (204) 421-9149
www.BearPawCorporation.com

CONTROL - UTM ZONE 16 NAD 83

POINT	NORTHING	EASTING	ELEVATION	DESCRIPTION
CP1				
CP2				
CP3				
CP4				

SCALE: IF THIS BAR IS NOT 25mm LONG, ADJUST YOUR PLOTTING SCALE — 25mm

PROJECT TITLE: THICKET PORTAGE LAGOON

CLIENT: ABORIGINAL & NORTHERN AFFAIRS

DRAWING TITLE: BERM CROSS SECTION PROFILE

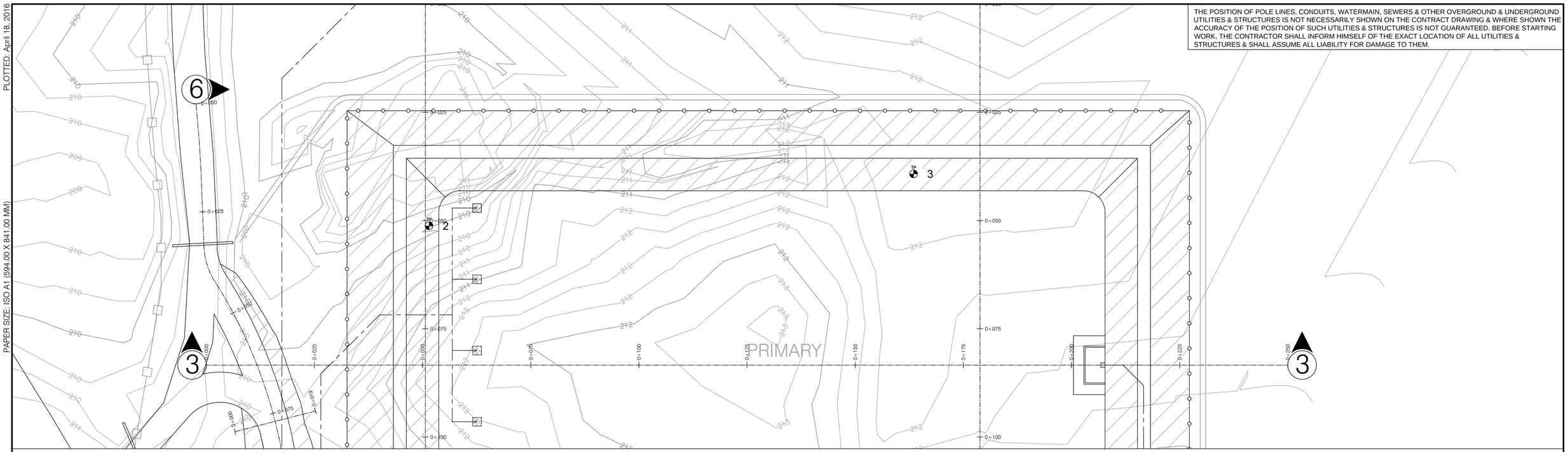
PROJECT NO: 15103196

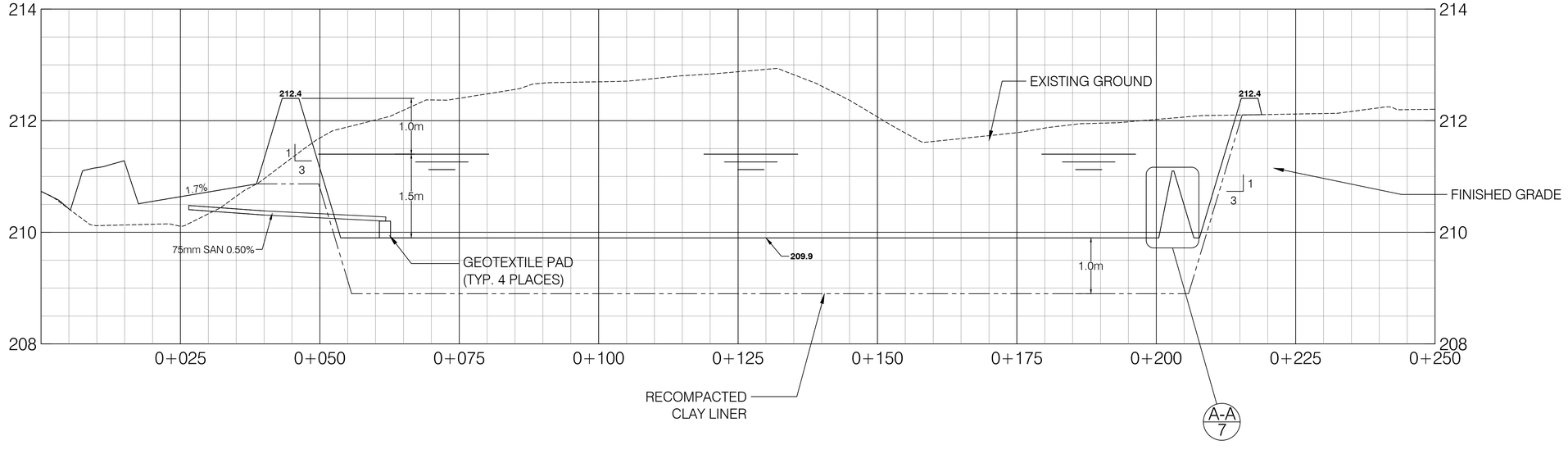
DWG NO: 2

PLOTTED: April 18, 2016

PAPER SIZE: ISO A1 (594.00 X 841.00 MM)

THE POSITION OF POLE LINES, CONDUITS, WATERMAIN, SEWERS & OTHER OVERGROUND & UNDERGROUND UTILITIES & STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWING & WHERE SHOWN THE ACCURACY OF THE POSITION OF SUCH UTILITIES & STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL UTILITIES & STRUCTURES & SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM.





PROFILE SCALE
H = 1:250
V = 1:25

3 PRIMARY CELL PROFILE

LEGEND:

- PROPOSED FENCING
- PROPOSED PIPE
- HYDRO LINE
- GEOTEXTILE
- BOLLARD
- PUMP CHAMBER
- CAM LOCK
- MANHOLE
- TEST PITS

PROFESSIONAL SEALS

NO.	YYYY/MM/DD	ISSUE / REVISION	DRN	CHK	DES	ENG
3	2016/04/18	90% SUBMISSION	NJM	ZX	NJM	FGD
2	2016/03/18	60% SUBMISSION	NJM	ZX	NJM	FGD
1	2016/01/19	ISSUED TO CLIENT	NJM	ZX	NJM	FGD

BEARPAW ENGINEERING
& PROJECT MANAGEMENT
39 SCURFIELD BLVD.
WINNIPEG, MB R3Y1G4
PH: (204) 421-9199
FAX: (204) 421-9149
www.BearPawCorporation.com

CONTROL - UTM ZONE 16 NAD 83

POINT	NORTHING	EASTING	ELEVATION	DESCRIPTION
CP1				
CP2				
CP3				
CP4				

SCALE: IF THIS BAR IS NOT 25mm LONG, ADJUST YOUR PLOTTING SCALE — 25mm

PROJECT TITLE: THICKET PORTAGE LAGOON

CLIENT: ABORIGINAL & NORTHERN AFFAIRS

DRAWING TITLE: PRIMARY CELL PROFILE

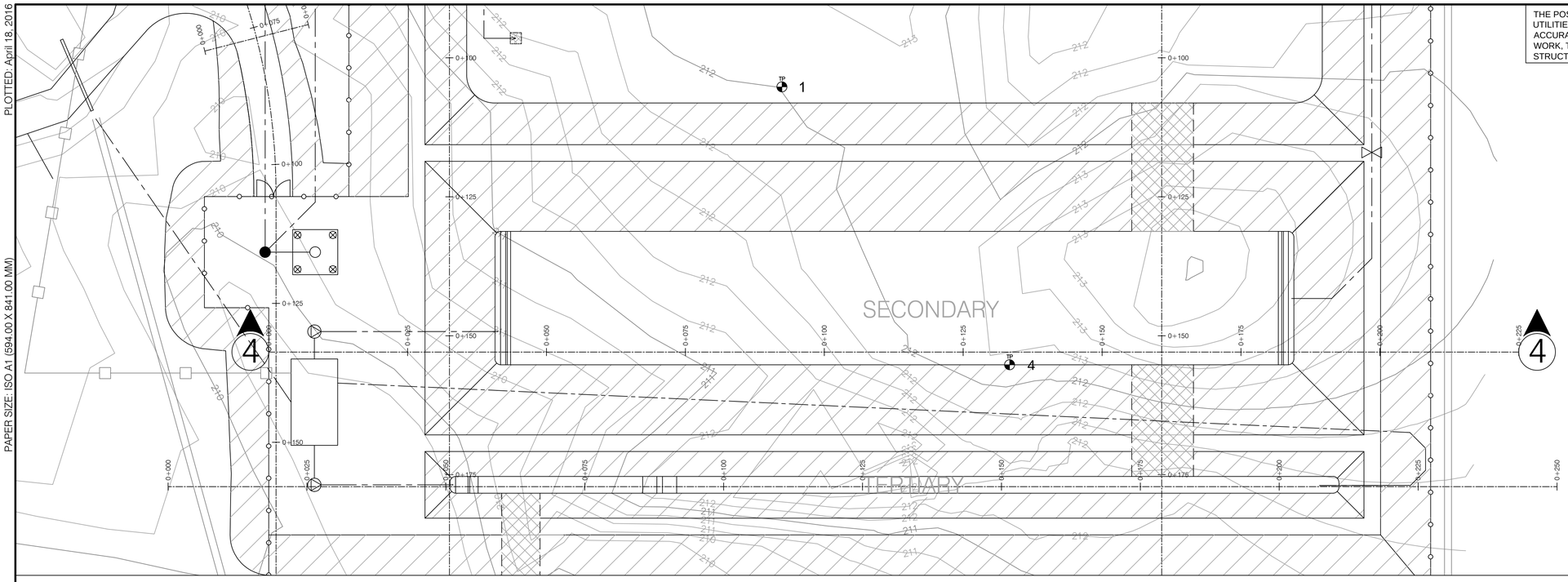
PROJECT NO: 15103196

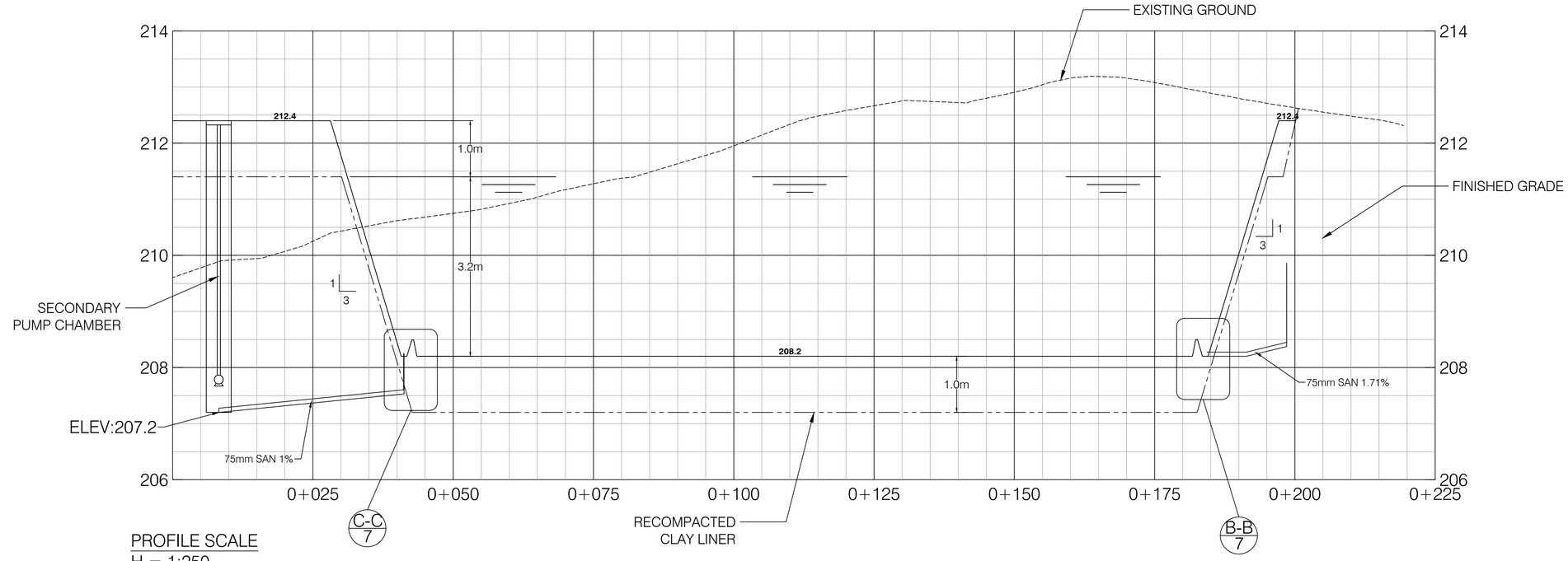
DWG NO: 3

PLOTTED: April 18, 2016

PAPER SIZE: ISO A1 (594.00 X 841.00 MM)

THE POSITION OF POLE LINES, CONDUITS, WATERMAIN, SEWERS & OTHER OVERGROUND & UNDERGROUND UTILITIES & STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWING & WHERE SHOWN THE ACCURACY OF THE POSITION OF SUCH UTILITIES & STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL UTILITIES & STRUCTURES & SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM.





PROFILE SCALE
H = 1:250
V = 1:25

4 SECONDARY CELL PROFILE

LEGEND:

- PROPOSED FENCING
- PROPOSED PIPE
- HYDRO LINE
- GEOTEXTILE
- BOLLARD
- PUMP CHAMBER
- CAM LOCK
- MANHOLE
- TEST PITS

PROFESSIONAL SEALS

NO.	YYYY/MM/DD	ISSUE / REVISION	DRN	CHK	DES	ENG
3	2016/04/18	90% SUBMISSION	NJM	ZX	NJM	FGD
2	2016/03/18	60% SUBMISSION	NJM	ZX	NJM	FGD
1	2016/01/19	ISSUED TO CLIENT	NJM	ZX	NJM	FGD

BEARPAW ENGINEERING
& PROJECT MANAGEMENT
39 SCURFIELD BLVD.
WINNIPEG, MB R3Y1G4
PH: (204) 421-9199
FAX: (204) 421-9149
www.BearPawCorporation.com

CONTROL - UTM ZONE 16 NAD 83

POINT	NORTHING	EASTING	ELEVATION	DESCRIPTION
CP1				
CP2				
CP3				
CP4				

SCALE: IF THIS BAR IS NOT 25mm LONG, ADJUST YOUR PLOTTING SCALE — 25mm

PROJECT TITLE: THICKET PORTAGE LAGOON

CLIENT: ABORIGINAL & NORTHERN AFFAIRS

DRAWING TITLE: SECONDARY CELL PROFILE

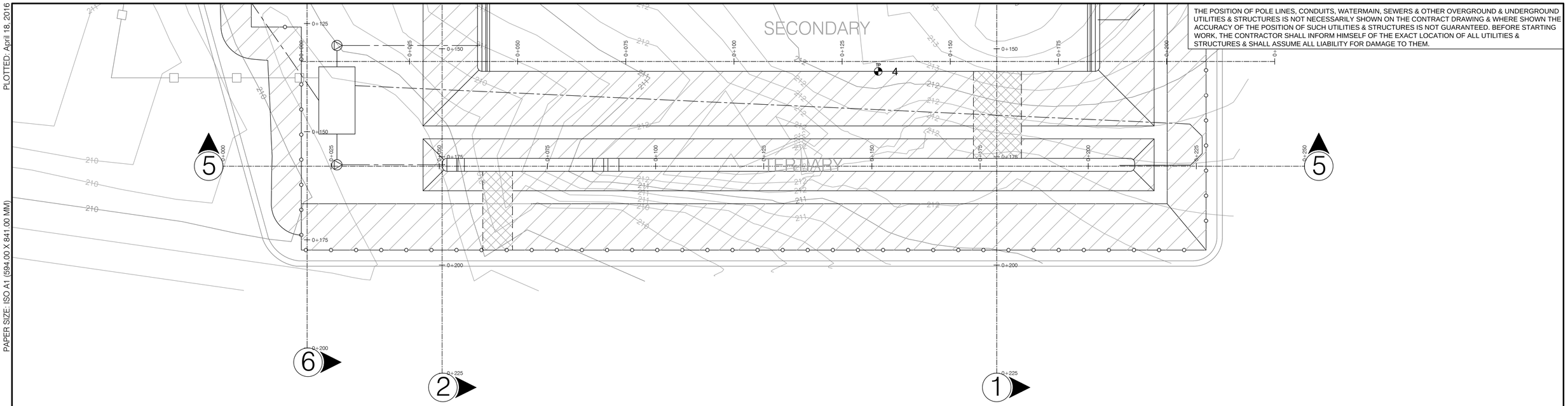
PROJECT NO: 15103196

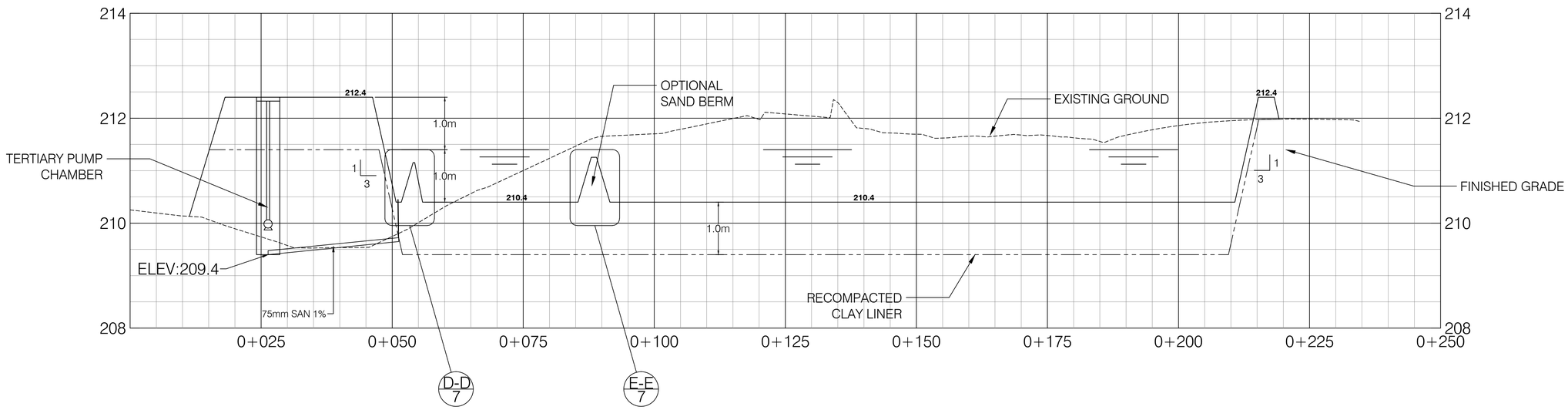
DWG NO: 4

PLOTTED: April 18, 2016

PAPER SIZE: ISO A1 (594.00 X 841.00 MM)

THE POSITION OF POLE LINES, CONDUITS, WATERMAIN, SEWERS & OTHER OVERGROUND & UNDERGROUND UTILITIES & STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWING & WHERE SHOWN THE ACCURACY OF THE POSITION OF SUCH UTILITIES & STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL UTILITIES & STRUCTURES & SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM.





PROFILE SCALE
H = 1:250
V = 1:25

5 TERTIARY CELL PROFILE

LEGEND:

- PROPOSED FENCING
- PROPOSED PIPE
- HYDRO LINE
- GEOTEXTILE
- BOLLARD
- PUMP CHAMBER
- CAM LOCK
- MANHOLE
- TEST PITS

PROFESSIONAL SEALS

NO.	YYYY/MM/DD	ISSUE / REVISION	DRN	CHK	DES	ENG
3	2016/04/18	90% SUBMISSION	NJM	ZX	NJM	FGD
2	2016/03/18	60% SUBMISSION	NJM	ZX	NJM	FGD
1	2016/01/19	ISSUED TO CLIENT	NJM	ZX	NJM	FGD

BEARPAW ENGINEERING
& PROJECT MANAGEMENT
39 SCURFIELD BLVD.
WINNIPEG, MB R3Y1G4
PH: (204) 421-9199
FAX: (204) 421-9149
www.BearPawCorporation.com

CONTROL - UTM ZONE 16 NAD 83

POINT	NORTHING	EASTING	ELEVATION	DESCRIPTION
CP1				
CP2				
CP3				
CP4				

SCALE: IF THIS BAR IS NOT 25mm LONG, ADJUST YOUR PLOTTING SCALE — 25mm

PROJECT TITLE: THICKET PORTAGE LAGOON

CLIENT: ABORIGINAL & NORTHERN AFFAIRS

DRAWING TITLE: TERTIARY CELL PROFILE

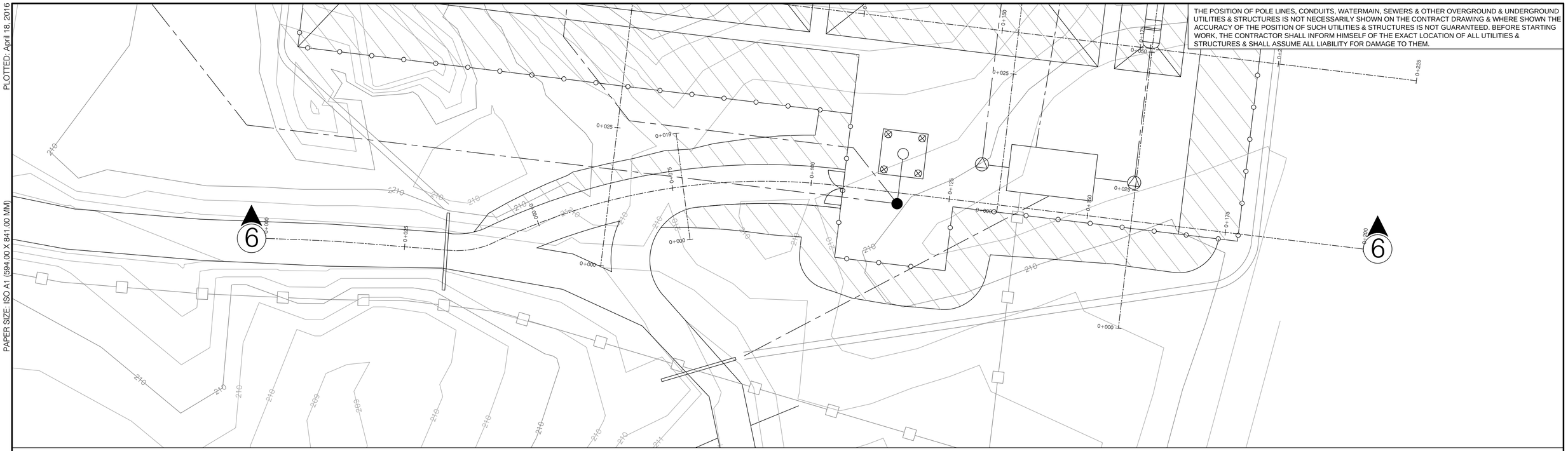
PROJECT NO: 15103196

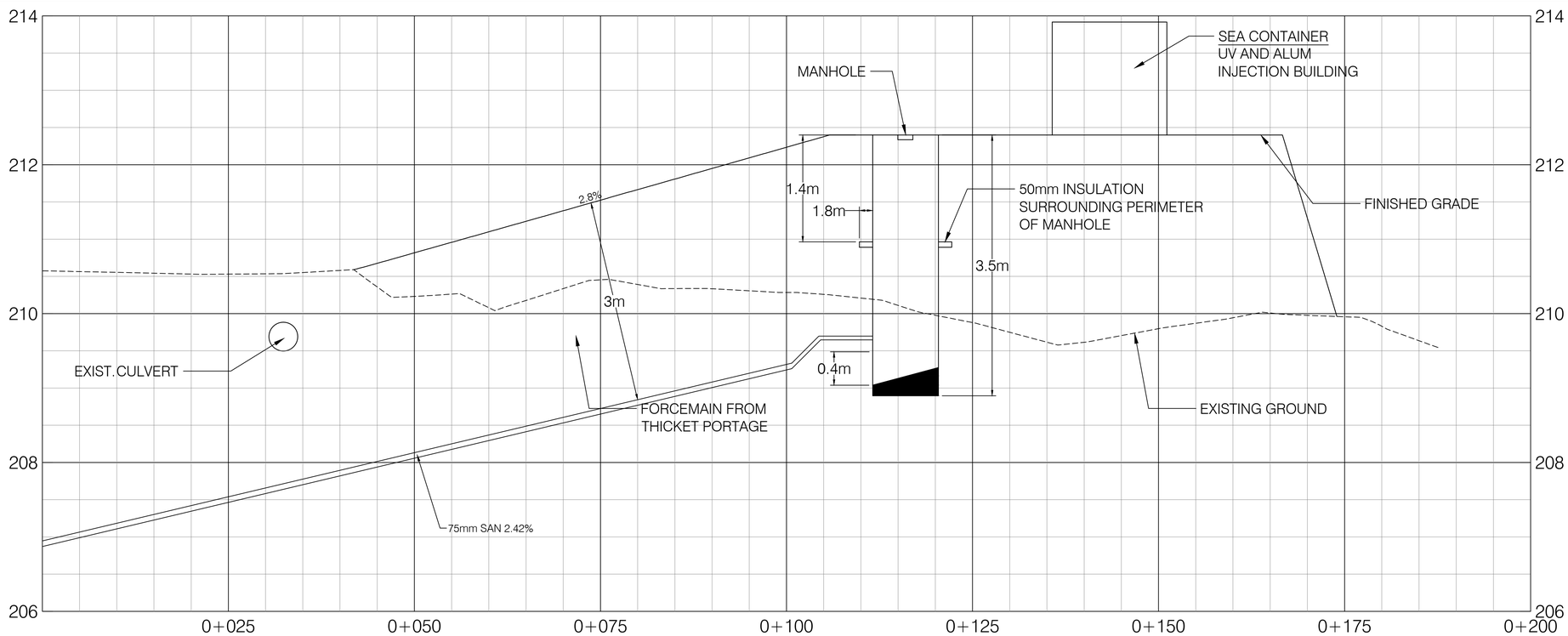
DWG NO: 5

PLOTTED: April 18, 2016

PAPER SIZE: ISO A1 (594.00 X 841.00 MM)

THE POSITION OF POLE LINES, CONDUITS, WATERMAIN, SEWERS & OTHER OVERGROUND & UNDERGROUND UTILITIES & STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWING & WHERE SHOWN THE ACCURACY OF THE POSITION OF SUCH UTILITIES & STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL UTILITIES & STRUCTURES & SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM.





PROFILE SCALE
H = 1:250
V = 1:25

6 ROAD & PAD PROFILE

LEGEND:

- PROPOSED FENCING
- PROPOSED PIPE
- HYDRO LINE
- GEOTEXTILE
- BOLLARD
- PUMP CHAMBER
- CAM LOCK
- MANHOLE
- TEST PITS

PROFESSIONAL SEALS

NO.	YYYY/MM/DD	ISSUE / REVISION	DRN	CHK	DES	ENG
3	2016/04/18	90% SUBMISSION	NJM	ZX	NJM	FGD
2	2016/03/18	60% SUBMISSION	NJM	ZX	NJM	FGD
1	2016/01/19	ISSUED TO CLIENT	NJM	ZX	NJM	FGD

BEARPAW ENGINEERING
& PROJECT MANAGEMENT
39 SCURFIELD BLVD.
WINNIPEG, MB R3Y1G4
PH: (204) 421-9199
FAX: (204) 421-9149
www.BearPawCorporation.com

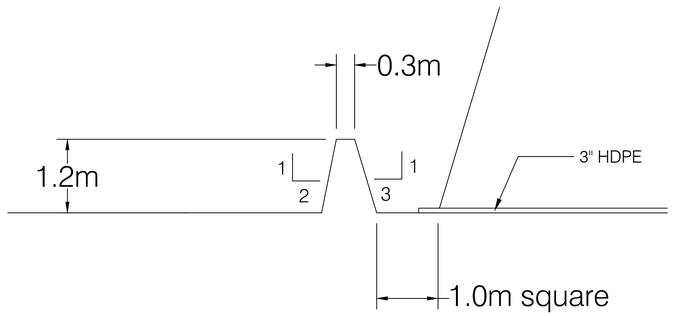
CONTROL - UTM ZONE 16 NAD 83

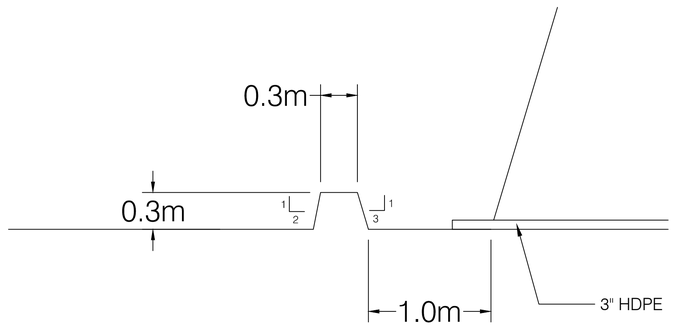
POINT	NORTHING	EASTING	ELEVATION	DESCRIPTION
CP1				
CP2				
CP3				
CP4				

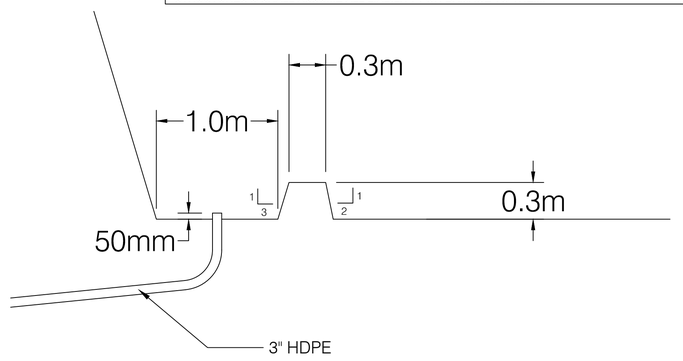
SCALE: IF THIS BAR IS NOT 25mm LONG, ADJUST YOUR PLOTTING SCALE — 25mm

PROJECT TITLE: THICKET PORTAGE LAGOON
CLIENT: ABORIGINAL & NORTHERN AFFAIRS
DRAWING TITLE: ROAD & PAD PROFILE
PROJECT NO: 15103196
DWG NO: 6

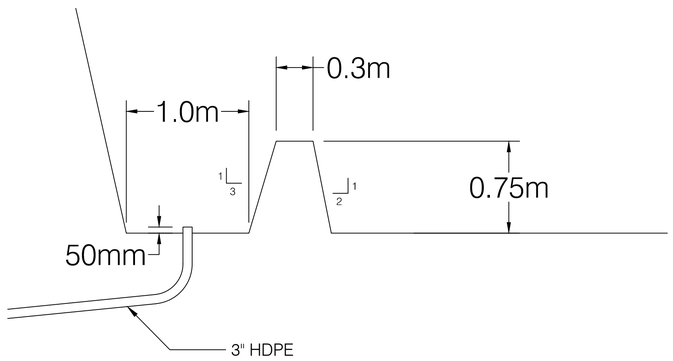
THE POSITION OF POLE LINES, CONDUITS, WATERMAIN, SEWERS & OTHER OVERGROUND & UNDERGROUND UTILITIES & STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWING & WHERE SHOWN THE ACCURACY OF THE POSITION OF SUCH UTILITIES & STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL UTILITIES & STRUCTURES & SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM.



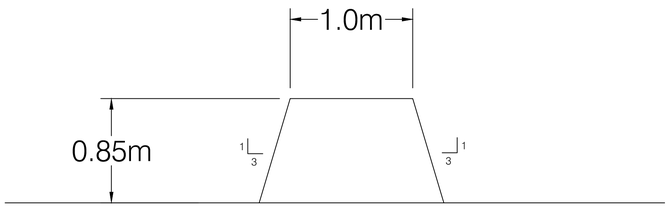




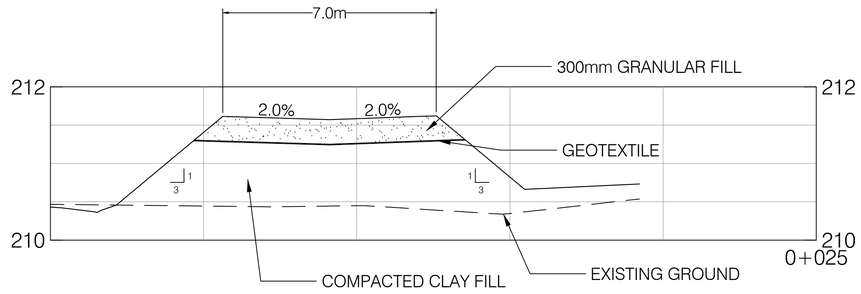
A-A SECTION
SCALE: 1:50



B-B SECTION
SCALE: 1:25



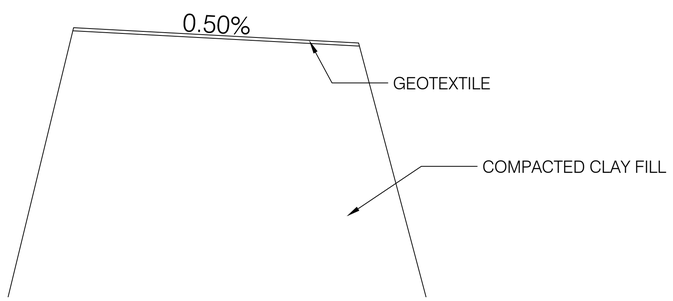
C-C SECTION
SCALE: 1:25



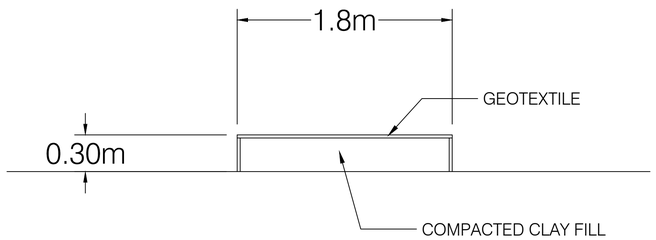
D-D SECTION
SCALE: 1:25

E-E SECTION
SCALE: 1:25

7 ACCESS ROAD CROSS-SECTION
SCALE: 1:75



OVERFLOW DETAIL
SCALE: 1:25



GEOTEX PAD DETAIL
SCALE: 1:25

LEGEND:

- PROPOSED FENCING
- PROPOSED PIPE
- HYDRO LINE
- GEOTEXTILE
- BOLLARD
- PUMP CHAMBER
- CAM LOCK
- MANHOLE
- TEST PITS

PROFESSIONAL SEALS

NO.	YYYY/MM/DD	ISSUE / REVISION	DRN	CHK	DES	ENG
3	2016/04/18	90% SUBMISSION	NJM	ZX	NJM	FGD
2	2016/03/18	60% SUBMISSION	NJM	ZX	NJM	FGD
1	2016/01/19	ISSUED TO CLIENT	NJM	ZX	NJM	FGD

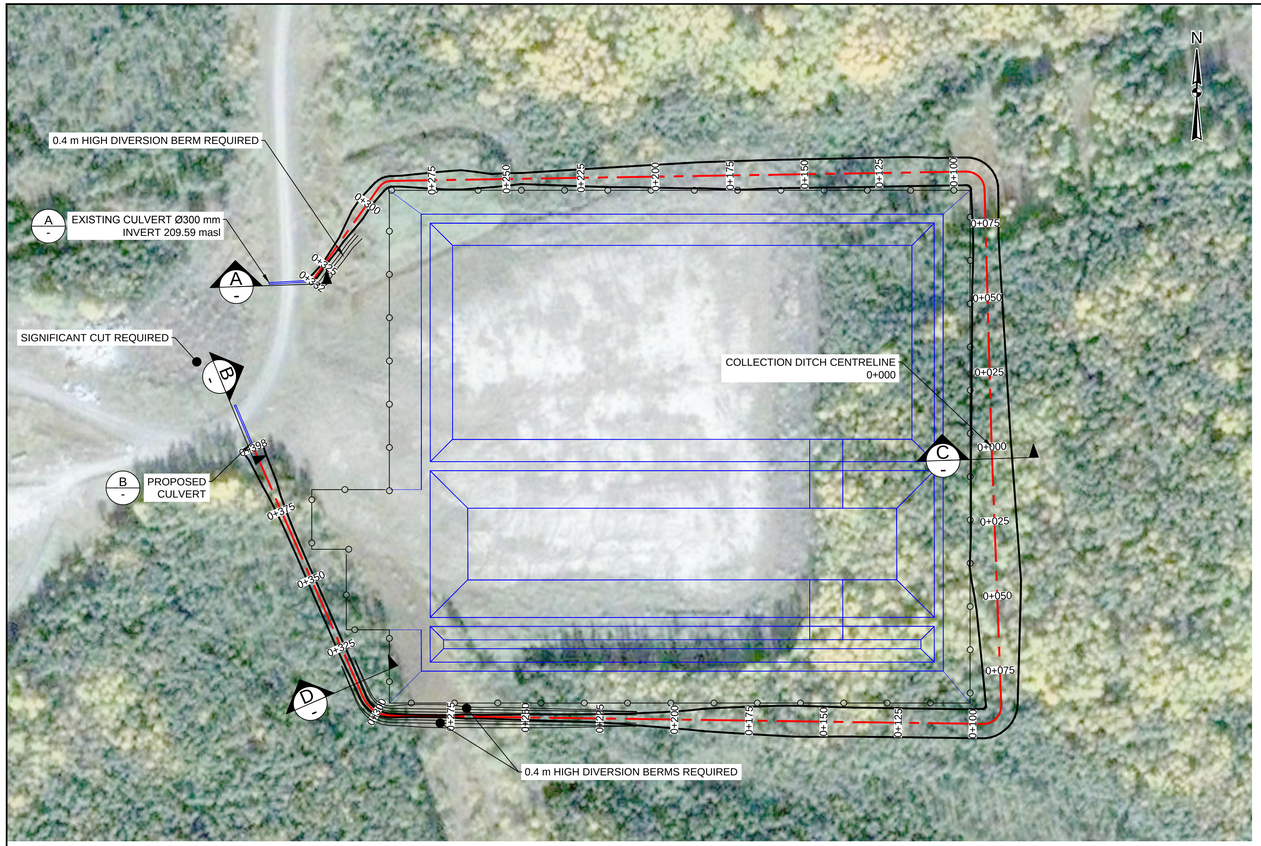
BEARPAW ENGINEERING
& PROJECT MANAGEMENT
39 SCURFIELD BLVD.
WINNIPEG, MB R3Y1G4
PH: (204) 421-9199
FAX: (204) 421-9149
www.BearPawCorporation.com

CONTROL - UTM ZONE 16 NAD 83

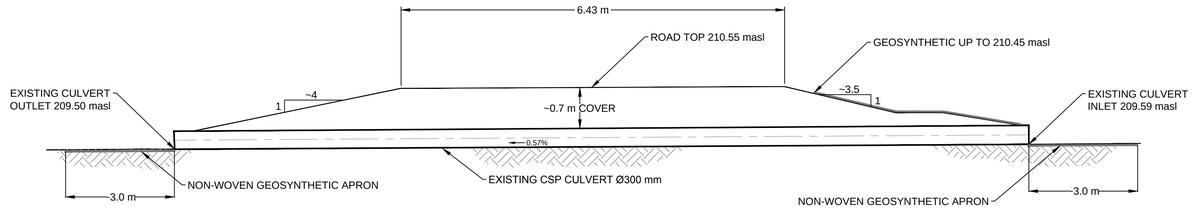
POINT	NORTHING	EASTING	ELEVATION	DESCRIPTION
CP1				
CP2				
CP3				
CP4				

SCALE: IF THIS BAR IS NOT 25mm LONG, ADJUST YOUR PLOTTING SCALE
25mm

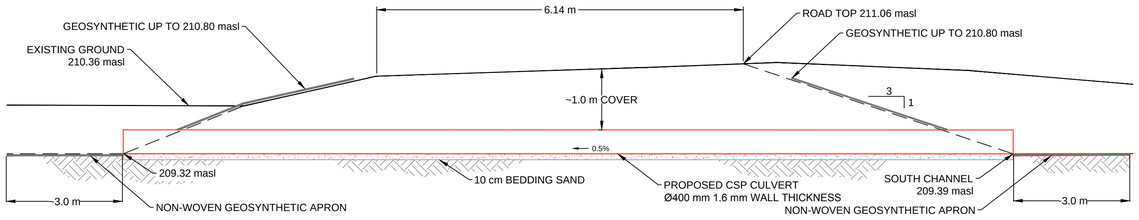
PROJECT TITLE: THICKET PORTAGE LAGOON
CLIENT: ABORIGINAL & NORTHERN AFFAIRS
DRAWING TITLE: MISCELLANEOUS DETAILS
PROJECT NO: 15103196
DWG NO: 7



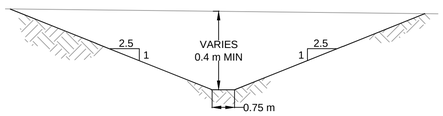
PLAN VIEW
SCALE 1:1,000



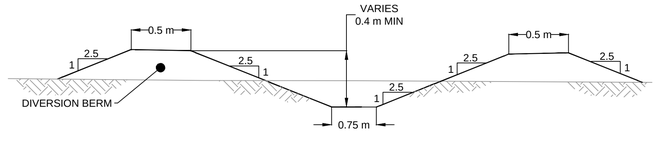
A - DETAIL A: EXISTING CULVERT
SCALE 1:50



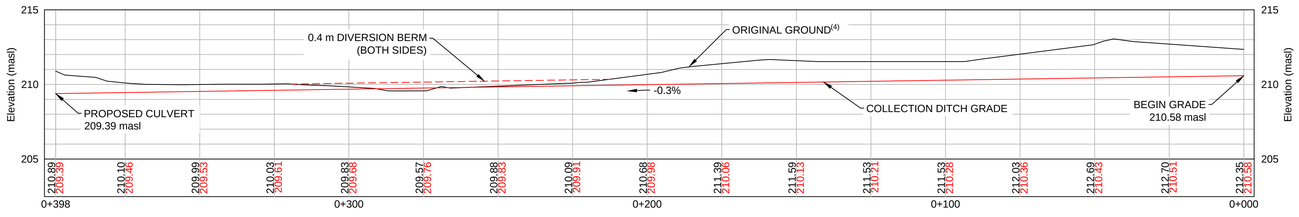
B - DETAIL B: PROPOSED CULVERT
SCALE 1:50



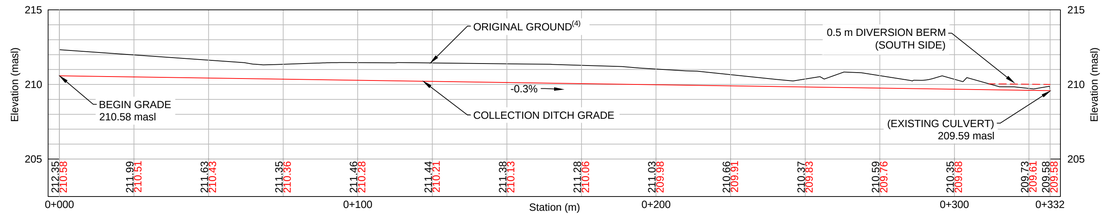
C - DETAIL C: TYPICAL DITCH CROSS SECTION
SCALE 1:100



D - DETAIL C: TYPICAL DITCH WITH BERM CROSS SECTION
SCALE 1:50



SOUTH PROFILE VIEW
H 1:1,000 V 1:200



NORTH PROFILE VIEW
H 1:1,000 V 1:200

ITEM	QUANTITY
SOUTH DITCH CUT	1,228 m^3
SOUTH DIVERSION BERM FILL	167 m^3
NORTH DITCH CUT	1,805 m^3
NORTH DIVERSION BERM FILL	20 m^3

DRAFT

LEGEND

- COLLECTION DITCH CENTERLINE
- LAGOON DESIGN
- FENCED BOUNDARY

NOTES

1. IMAGERY PROVIDED BY GOOGLE EARTH
2. DISTANCES AND MEASUREMENTS ARE IN METERS.
3. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL (masl).
4. ORIGINAL GROUND ELEVATIONS ARE FROM SURVEY. INTERPOLATED TOPOGRAPHY WHERE NECESSARY TO FACILITATE PRELIMINARY COLLECTION DITCH DESIGN.
5. SURVEY DATA IS NOT AVAILABLE ALONG THE DITCH ALIGNMENT.
6. THE DITCH AND CULVERT DESIGN IS NOT VERIFIED WITH A DRAINAGE FIELD INVESTIGATION
7. GRASSES LINING WITH ANY NATIVE SPECIES OR HYDROSEEDING IS RECOMMENDED TO MINIMIZE EROSION POTENTIAL.

Association of Professional Engineers and Geoscientists of Saskatchewan
CERTIFICATE OF AUTHORIZATION
SNC-Lavalin Inc., Environment Division
Number C1365
Permission to Consult held by:
Discipline | Sk. Reg. No. | Signature

REFERENCE DRAWINGS

DWG No	DESCRIPTION
-	-

REVISIONS

REV	DATE	DESCRIPTION	BY	CHK
-	-	-	-	-

STATUS	APP BY	DATE
DESIGN REPORT	-	-
APPROVED FOR TENDER	-	-
APPROVED FOR CONSTRUCTION	-	-
RECORD OF CONSTRUCTION	-	-

1:100 0 1 2 3 4 5 m
1:200 0 2.5 5 7.5 10 m

SNC·LAVALIN

CLIENT	PROJECT LOCATION
MANITOBA ABORIGINAL AFFAIRS	THICKET PORTAGE LAGOON

TITLE: COLLECTION DITCH DESIGN

DES BY	EA	DRN BY	AC	DATE	2016 04 13	FIG No	--	REV	0
CHK BY	-	APP BY	-	DWG No	633391-64-1			22X34	

P:\Manitoba Aboriginal Aff\Northern Affairs\633391 Thicket Portage Lagoons\4.0 Execution\4.5 GIS And Drawings\CAD\Lagoon Ditch Design\633391-64-1.dwg

APPENDIX D

Geotechnical Investigation

SNC-Lavalin Inc.
148 Nature Park Way
Winnipeg, MB
Canada R3P 0X7

Telephone: +1.204.786.8080
Fax: +1.204.786.7934

March 21, 2016

Manitoba Aboriginal and Northern Affairs Manitoba
Room 108, 59 Elizabeth Drive
Thompson, Manitoba, Canada R8N 1X4

ATTN: Gill Harkamaljeet

RE: Geotechnical Investigation for Proposed Thicket Portage Sewage Lagoon

1 INTRODUCTION

This report presents the results of the geotechnical investigation conducted by SNC-Lavalin for the proposed sewage lagoon to be constructed for the community of Thicket Portage. The lagoon is to be constructed within NW-10-73-02-W1M, South of the community of Thicket Portage and East of the existing landfill. The geotechnical investigation included a drilling program, field testing and laboratory soil testing. This letter summarizes the geotechnical investigation and provides geotechnical recommendations for the design of a clay liner for the sewage lagoon.

2 SITE LOCATION AND DESCRIPTION

The subject site is located directly south of the community of Thicket Portage which is located on the Hudson Bay Railway line, 48 km south of Thompson and 256 km northeast of The Pas. The location of the sewage lagoon is roughly centered in an area that had been previously cleared of trees and brush (See Figure 1, Appendix I). Brush is located to the North, East and West of the proposed lagoon location with an existing roadway and landfill located directly to the West. The land is relatively flat but rises slightly towards the center of the cleared area. At the time of the drilling program, the area was covered with approximately 0.6 m of snow.

3 SCOPE OF WORK

The objective of the geotechnical investigation was to gain an understanding of the soil conditions within the proposed lagoon area, in order to complete the design of the lagoon, including the proposed compacted clay liner system. Further, it was desired to confirm the depth to bedrock within the lagoon footprint and proposed sewage pipe route. The following scope of work was completed:

- Field investigation consisting of four geotechnical boreholes to 6.1 m within the proposed lagoon footprint, geotechnical field tests, logging of soils and collection of soil samples for laboratory testing. An additional five boreholes were drilled along the proposed sewage pipeline alignment to verify depth of bedrock. They ranged from 0.3 to 3.1 m below existing grade;

- Laboratory testing of selected soil samples obtained from the boreholes, including water contents, Atterberg limits, grain size distribution analysis, one point proctors and Hydraulic Conductivity tests; and,
- Preparation of a letter report summarizing the field investigation, laboratory testing and lagoon liner recommendations.

4 GEOTECHNICAL INVESTIGATION DETAILS

4.1 *Geotechnical Drilling Investigation*

The field investigation was conducted on January 27, 2016. Maple Leaf Drilling Ltd. from Winnipeg, Manitoba utilized a track-mounted geo-probe drill rig equipped with solid stem augers to drill the boreholes.

During this investigation the geotechnical boreholes were drilled to depths ranging from 5.2 to 6.1 m below existing grade within the proposed lagoon footprint and from 0.3 to 3.1 m below existing grade along the proposed sewage pipeline alignment.

The borehole coordinates were obtained using a handheld GPS unit. The locations of the boreholes are presented on site plan, as Figure 1 (Appendix I).

4.1.1 Borehole Drilling

A total of four boreholes were drilled within the proposed sewage lagoon footprint and five boreholes along the proposed sewage pipe alignment. Regardless of whether bedrock was encountered, the boreholes were drilled to a maximum depth of 6.1 m within the lagoon footprint and 3.1 m along the sewage pipe alignment.

Disturbed soil samples were collected from the auger cuttings (grab samples). All soil samples were transported to the SNC-Lavalin soil testing laboratory in Saskatoon, Saskatchewan. The soil samples were stored in a humidity-controlled room to prevent drying prior to testing. Soil samples collected from the boreholes are identified on the borehole logs in Appendix II.

Field testing included pocket penetrometer tests (PPs) conducted on all cohesive samples collected. The results of the field tests are presented on the borehole logs in Appendix II. The Terms and Symbols used on the borehole logs are provided in Appendix II, preceding the borehole logs.

The boreholes were backfilled with bentonite chips to the extent possible.

4.1.2 Geotechnical Laboratory Testing

Geotechnical laboratory tests were conducted on soil samples obtained from the boreholes. The laboratory analyses included water contents, Atterberg limits, grain size distribution analyses and one-point proctors and Hydraulic Conductivities on bulk samples. The detailed laboratory test results are provided in Appendix III. Select laboratory test results are also annotated on the borehole logs presented in Appendix II.

5 SUBSURFACE CONDITIONS

5.1.1 Soil Profile

The study area consisted of approximately 0.2 m of organic clay (grass covered) at the surface underlain by low to high plastic clay, with varying amounts of silt, to the depths explored.

The organic clay was dark grey-to-black, low plasticity and frozen at the time of the drilling program. The underlying native clay contained varying amounts of silt varved into the clay. The clay varied from low to high plasticity (CL to CH), moist to wet, and had a very stiff consistency, becoming firm with depth. All of the boreholes were terminated in clay within the proposed lagoon footprint at a depth of 6.1 m below existing grade, with the exception of Borehole 02, which encountered refusal on suspected bedrock at a depth of 5.2 m below existing grade.

Along the proposed sewage pipeline route, refusal on suspected bedrock was encountered in Boreholes 05 through 08 at depths ranging from 0.3 m in Borehole 05 to 2.5 m in Borehole 08. Bedrock was not encountered to the depths explored (3.1 m) in Boreholes 09 and 10.

The depths to bedrock in all of the boreholes, if encountered, are shown in Table 1 below.

Table 1 – Depth to Bedrock

Borehole Identification and Location	Depth to Bedrock (m)
BH01 (Lagoon Footprint)	>6.1 (not encountered)
BH02 (Lagoon Footprint)	5.2
BH03 (Lagoon Footprint)	>6.1 (not encountered)
BH04 (Lagoon Footprint)	>6.1 (not encountered)
BH05 (Sewage Pipe Alignment)	0.76
BH06 (Sewage Pipe Alignment)	0.45
BH07 (Sewage Pipe Alignment)	0.91
BH08 (Sewage Pipe Alignment)	2.60
BH09 (Sewage Pipe Alignment)	>3.1 (not encountered)
BH10 (Sewage Pipe Alignment)	>3.1 (not encountered)

5.1.2 Groundwater Seepage and Sloughing

Standpipe piezometers were not installed within any of the boreholes; however, the water level and sloughing conditions were measured/noted prior to the backfilling of each borehole. Water seepage and levels ranged from 3.4 m to 4.3 m below existing ground surface within 10 minutes after the completion of borehole drilling while sloughing ranged from 2.8 m to 3.1 m below the existing ground elevation.

5.2 *Geotechnical Recommendations*

5.2.1 Clay Liner

Based on the information gathered through SNC-Lavalin's geotechnical investigation and by others presented in previous reports (Neegan Burnside), the existing overburden within the proposed lagoon footprint consists of clay of sufficient thickness over the bedrock to construct a lagoon.

The clay was brown, ranged from low to high plasticity (CL to CH), was moist to wet, varied from very stiff to firm with depth, and contained varying amounts of silt. Moisture contents ranged from 17% to 45%. Clay contents ranged from 28% to 91%. The results were similar to those found by Neegan Burnside during their preliminary investigation.

Manitoba Conservation's Environmental guidelines require that the proposed dykes and bottom of the proposed cells be provided with a layer consisting of at least one meter of soil having a permeability of less than $1x10^{-7}$ cm/s.

Bulk soil samples were taken from Borehole 01 and Borehole 03. Each bulk sample was reconditioned in our laboratory to its optimum moisture content. A one-point proctor was completed to determine its bulk unit weight at optimum moisture and the resulting samples were tested for their hydraulic conductivity. The results of the hydraulic conductivity tests indicated a remolded hydraulic conductivity of 1.18×10^{-9} cm/s to 9.02×10^{-9} cm/s in Boreholes 01 and 03 respectively.

Based on our field investigation and laboratory analysis, the proposed lagoon liner should be constructed with a 1.0 m thick compacted clay liner using the in-situ clay soil available on site. The lagoon footprint area should be stripped of all vegetation and organic clay prior to construction of the liner and berms. Based on the geotechnical boreholes, it is anticipated that approximately 200 mm of organic soil will be required to be stripped.

The base of the lagoon should be scarified to a depth of 1.0 m below design bottom. The scarified soil should be compacted using a sheepsfoot roller in 200 mm thick lifts (maximum) to a density of 98% of the Standard Proctor density and within +/- 2% of the optimum moisture content.

6 CLOSURE

If you have any questions regarding our submission, or require further information, please do not hesitate to contact the undersigned at +1.204.786.8080 Ext. 307.

Yours truly,

Jason Plohman, P.Eng.
Geotechnical Engineer
SNC-LAVALIN INC.

Enclosure:

APPENDICES
I Site Plan – Borehole Locations
II Borehole Logs
III Laboratory Testing Results

Enclosure 1

APPENDIX I

Borehole Location Plan

PLOTTED: March 18, 2016

PAPER SIZE: ISO A1 (594.00 X 841.00 MM)

THE POSITION OF POLE LINES, CONDUITS, WATERMAIN, SEWERS & OTHER OVERGROUND & UNDERGROUND UTILITIES & STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWING & WHERE SHOWN THE ACCURACY OF THE POSITION OF SUCH UTILITIES & STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL UTILITIES & STRUCTURES & SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

N

W E

S

TREATMENT PLANT

TO BE ABANDONED

EXISTING CULVERT

WATER TREATMENT PLANT

LAGOON

NOTE: SEPARATI
WATERMAINS AN
EXAGGERATED F

LEGEND:

SURVEY BOUNDARY

PROFESSIONAL SEALS

NO.	YYYY/MM/DD	ISSUE / REVISION	DRN	CHK	DES	ENG
1	2016/03/18	ISSUED TO CLIENT	NJM	ZX	NJM	FGD

BEARPAW ENGINEERING
& PROJECT MANAGEMENT
39 SCURFIELD BLVD.
WINNIPEG, MB R3Y1G4
PH: (204) 421-9199
FAX: (204) 421-9149
www.BearPawCorporation.com

CONTROL - UTM ZONE 16 NAD 83

POINT	NORTHING	EASTING	ELEVATION	DESCRIPTION
CP1				
CP2				
CP3				
CP4				

SCALE: IF THIS BAR IS NOT 25mm LONG, ADJUST YOUR PLOTTING SCALE

25mm

PROJECT TITLE:
THICKET PORTAGE LAGOON

CLIENT:
ABORIGINAL & NORTHERN AFFAIRS

DRAWING TITLE:
BOREHOLE LOCATIONS

PROJECT NO:
15103196

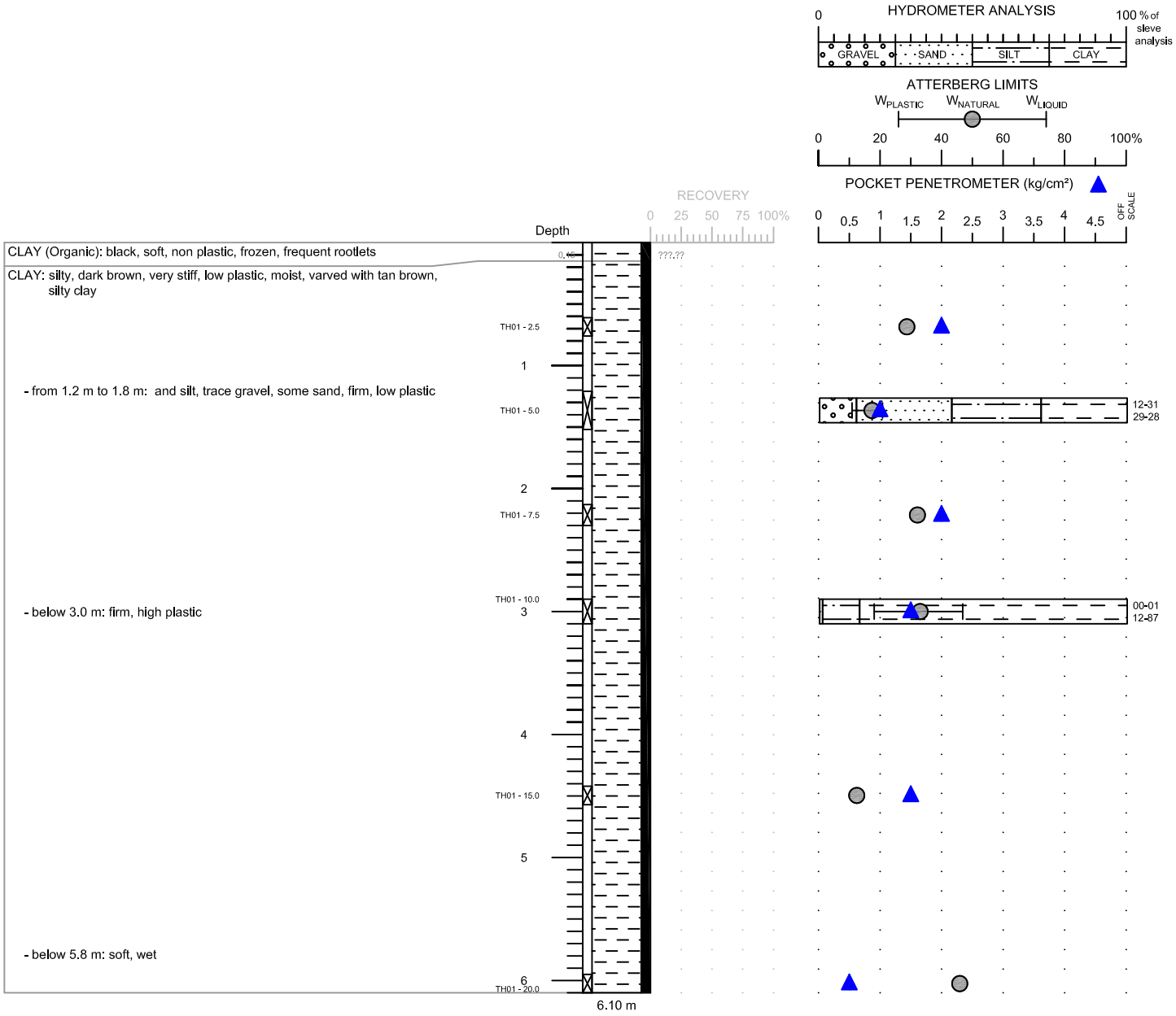
FIGURE 1

APPENDIX II

Borehole Logs

BOREHOLE 633391-01
MANITOBA ABORIGINAL AND NORTHERN AFFAIRS
THICKET PORTAGE SEWAGE LAGOON
2016

6130224 N 583164 E
NAD 83 ZONE 14
NW 10-73-02-W1



DRAFT

NOTES

1. Borehole ended at 6.1 m in soft clay.
2. Water seepage occurred at 3.7 m below existing grade with the final water level at 3.33 m within 10 minutes after the completion of drilling.
3. Borehole was backfilled with auger cuttings and bentonite.
4. Depths are in metres (m).
5. Elevations are in metres above sea level (masl).
6. Coordinates and elevations provided by

SNC·LAVALIN

CLIENT	PROJECT LOCATION
MANITOBA ABORIGINAL AND NORTHERN AFFAIRS	THICKET PORTAGE SEWAGE LAGOON

LIMITATION

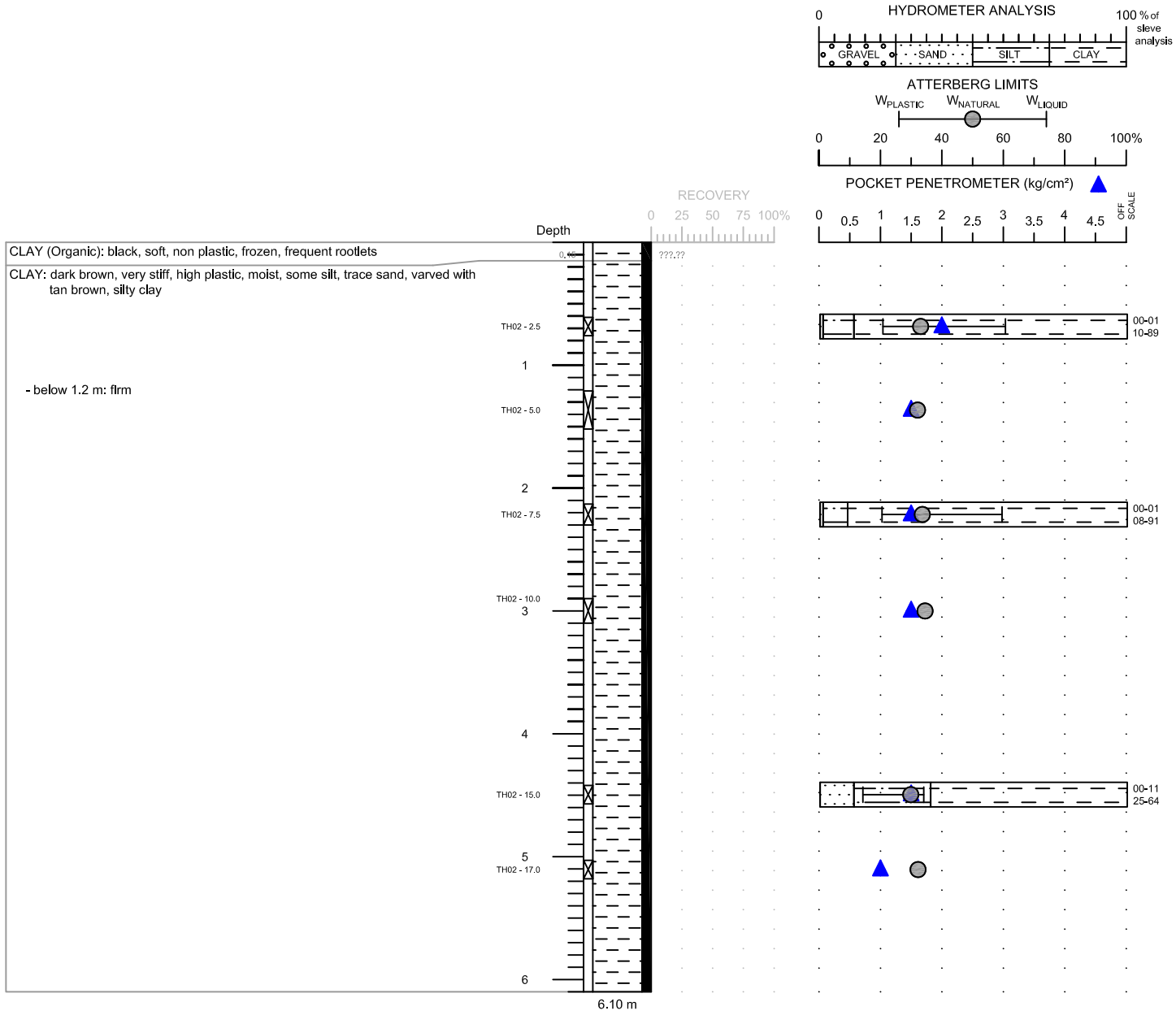
This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above will vary between locations and may vary with time.

CONTRACTOR	MAPLE LEAF DRILLING	SUPERVISOR	J. PLOHMAN, P.Eng.	APPROVED BY	
OPERATOR		LOGGED BY	J. PLOHMAN, P.Eng.	DRAWN BY	E. OVCINA
DRILL RIG TYPE	DRILL RIG GEOPROBE	DATE DRILLED	2016 01 28	PROJECT No.	633391
ABANDONMENT		DATE INSTALLED		SCALE	1:50 DATE 2016 03 07

P:\Manitoba Aboriginal And Northern Affairs\633391 Thicket Portage Lagoon\4.0 Execution\4.5 GIS And Drawings\CAD\BH-633391-01.dwg

BOREHOLE 633391-02
MANITOBA ABORIGINAL AND NORTHERN AFFAIRS
THICKET PORTAGE SEWAGE LAGOON
2016

6130279 N 583105 E
NAD 83 ZONE 14
NW 10-73-02-W1



DRAFT

NOTES

1. Borehole ended at 6.1 m in firm clay.
2. Water seepage occurred at 3.7 m below existing grade with the final water level at 3.33 m within 10 minutes after the completion of drilling.
3. Borehole was backfilled with auger cuttings and bentonite.
4. Depths are in metres (m).
5. Elevations are in metres above sea level (masl).
6. Coordinates and elevations provided by

SNC·LAVALIN

CLIENT	PROJECT LOCATION
MANITOBA ABORIGINAL AND NORTHERN AFFAIRS	THICKET PORTAGE SEWAGE LAGOON

LIMITATION

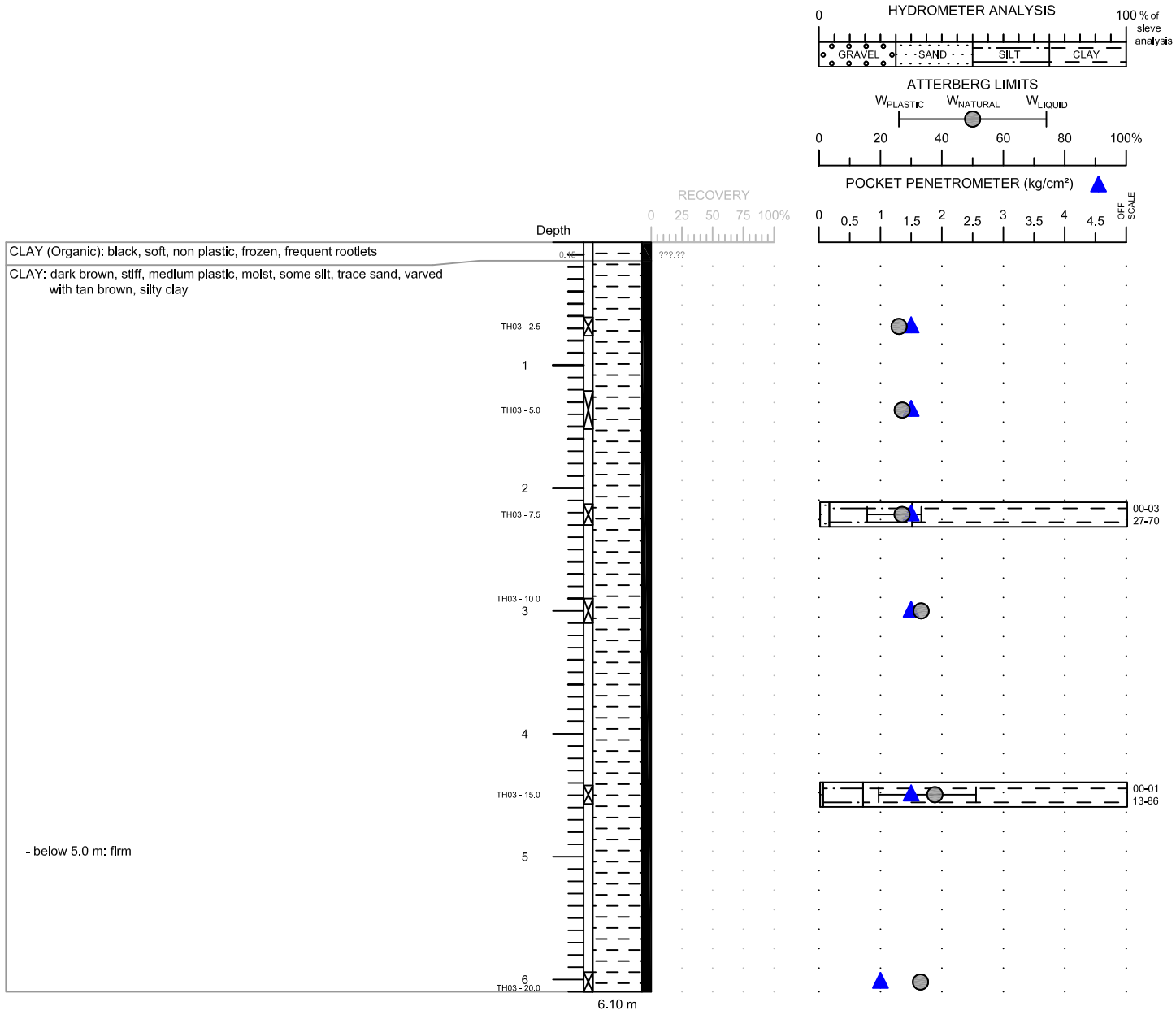
This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above will vary between locations and may vary with time.

CONTRACTOR	MAPLE LEAF DRILLING	**SUPERVISOR**	J. PLOHMAN, P.Eng.	**APPROVED BY**	
OPERATOR		**LOGGED BY**	J. PLOHMAN, P.Eng.	**DRAWN BY**	E. OVCINA
DRILL RIG TYPE	DRILL RIG GEOPROBE	**DATE DRILLED**	2016 01 28	**PROJECT No.**	633391
ABANDONMENT		**DATE INSTALLED**		**SCALE** 1:50	**DATE** 2016 03 07

P:\Manitoba Aboriginal And Northern Affairs\633391 Thicket Portage Lagoon\4.0 Execution\4.5 GIS And Drawings\CAD\BH-633391-02.dwg

BOREHOLE 633391-03
MANITOBA ABORIGINAL AND NORTHERN AFFAIRS
THICKET PORTAGE SEWAGE LAGOON
2016

6130290 N 583217 E
NAD 83 ZONE 14
NW 10-73-02-W1



DRAFT

NOTES

1. Borehole ended at 6.1 m in firm clay.
2. Water seepage occurred at 3.7 m below existing grade with the final water level at 3.33 m within 10 minutes after the completion of drilling.
3. Borehole was backfilled with auger cuttings and bentonite.
4. Depths are in metres (m).
5. Elevations are in metres above sea level (masl).
6. Coordinates and elevations provided by

SNC·LAVALIN

CLIENT	PROJECT LOCATION
MANITOBA ABORIGINAL AND NORTHERN AFFAIRS	THICKET PORTAGE SEWAGE LAGOON

LIMITATION

This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above will vary between locations and may vary with time.

CONTRACTOR	MAPLE LEAF DRILLING	SUPERVISOR	J. PLOHMAN, P.Eng.	APPROVED BY	
OPERATOR		LOGGED BY	J. PLOHMAN, P.Eng.	DRAWN BY	E. OVCINA
DRILL RIG TYPE	DRILL RIG GEOPROBE	DATE DRILLED	2016 01 28	PROJECT No.	633391
ABANDONMENT		DATE INSTALLED		SCALE	1:50 DATE 2016 03 07

APPENDIX III

Laboratory Test Results

ATTERBERG LIMITS TEST REPORT

(Test Reference: ASTM D 4318)

SNC·LAVALIN

Client:	Manitoba Aboriginal & Northern Affairs
Project	Thicket Portage Sewage Lagoon
Project #:	633391
Technician:	JA
Date:	16-Feb-2016

Sample: 01 BH-02 at 2.5ft (air-dried)

Percentage of sample retained on 425-um (No. 40) sieve: N/A

Plastic Limit

Tare #			
Tare Wt, g	12.82		
Wet + Tare, g	20.86		
Dry + Tare, g	19.42		
M%	21.8%		

Liquid Limit (method B)

# of Blows	25	26	
Tare Wt, g	14.24	14.18	
Wet + tare, g	28.06	26.78	
Dry + tare, g	22.84	22.04	
Water content	60.7%	60.3%	AVERAGE
Adjusted W/C	60.7%	60.6%	60.7%

SUMMARY

Plastic Limit: 21.8%

Liquid Limit: 60.7%

Plasticity Index: 38.8%

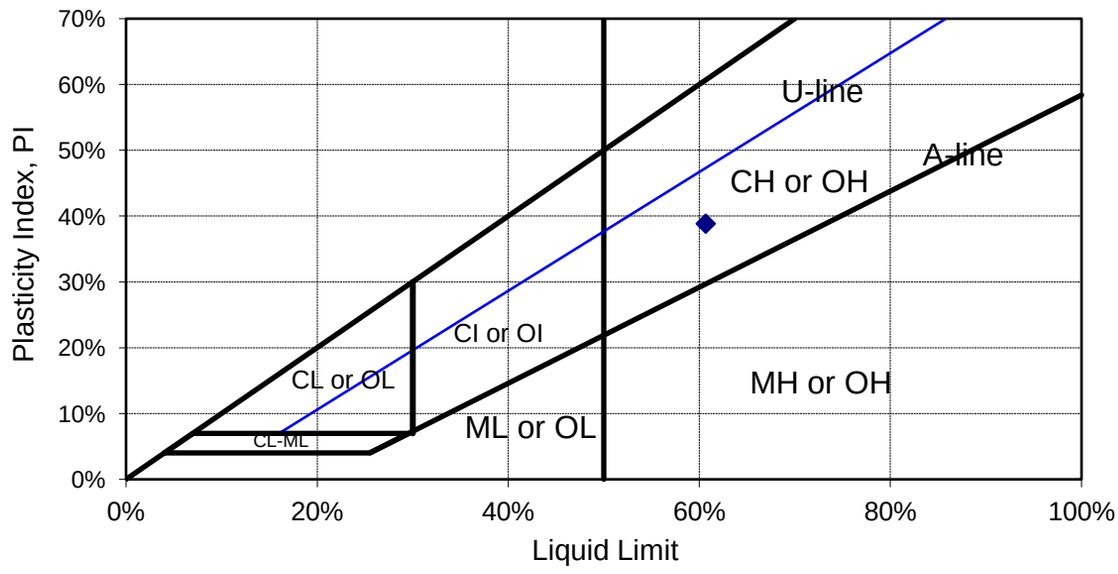
Classification: CH

Natural Water Content: 33.1%

Comments:

-

CERTIFIED BY CCIL



The testing services reported here have been performed in accordance with accepted local industry standards.

The results presented are for the sole use of the designated client only.

This report constitutes a testing service only. It does not represent any interpretation or opinion regarding specification compliance or material suitability.

Engineering interpretation will be provided by SNC Lavalin upon request.

ATTERBERG LIMITS TEST REPORT

(Test Reference: ASTM D 4318)

SNC·LAVALIN

Client:	Manitoba Aboriginal & Northern Affairs
Project	Thicket Portage Sewage Lagoon
Project #:	633391
Technician:	MC
Date:	16-Feb-2016

Sample: 02 BH-01 at 5ft (air-dried)

Percentage of sample retained on 425-um (No. 40) sieve: N/A

Plastic Limit

Tare #			
Tare Wt, g	14.48		
Wet + Tare, g	25.16		
Dry + Tare, g	24.11		
M%	10.9%		

Liquid Limit (method B)

# of Blows	26	27	
Tare Wt, g	14.38	14.00	
Wet + tare, g	22.83	21.81	
Dry + tare, g	21.38	20.48	
Water content	20.7%	20.5%	AVERAGE
Adjusted W/C	20.8%	20.7%	20.8%

SUMMARY

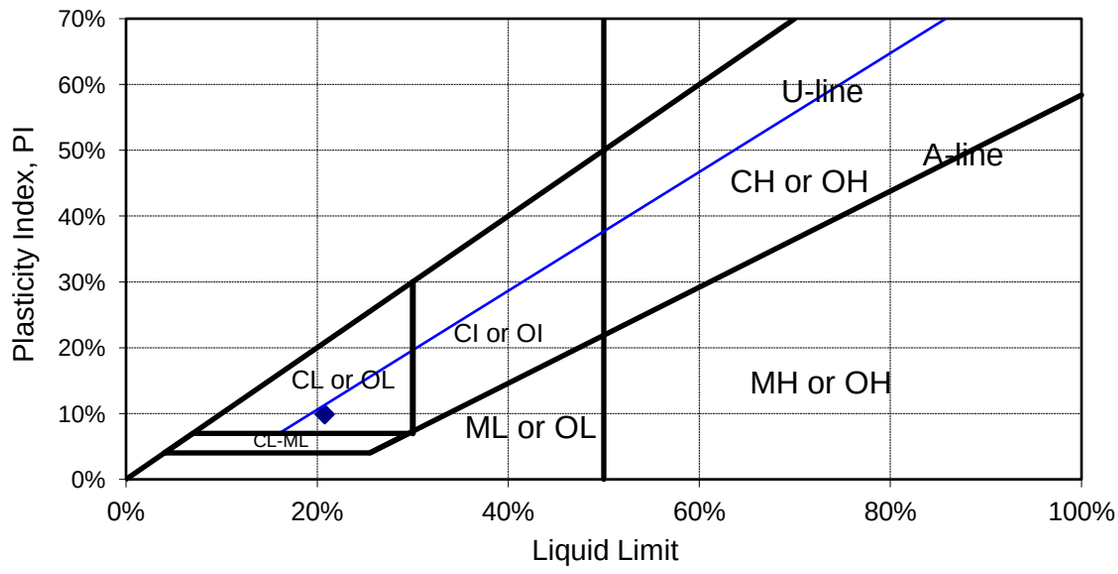
Plastic Limit:	10.9%
Liquid Limit:	20.8%
Plasticity Index:	9.9%
Classification:	CL

Natural Water Content: 17.4%

Comments:

-

CERTIFIED BY CCIL



The testing services reported here have been performed in accordance with accepted local industry standards.

The results presented are for the sole use of the designated client only.

This report constitutes a testing service only. It does not represent any interpretation or opinion regarding specification compliance or material suitability.

Engineering interpretation will be provided by SNC Lavalin upon request.

ATTERBERG LIMITS TEST REPORT

(Test Reference: ASTM D 4318)

SNC·LAVALIN

Client:	Manitoba Aboriginal & Northern Affairs
Project	Thicket Portage Sewage Lagoon
Project #:	633391
Technician:	MC
Date:	17-Feb-2016

Sample: 03 BH-02 at 7.5ft (air-dried)

Percentage of sample retained on 425-um (No. 40) sieve: N/A

Plastic Limit

Tare #			
Tare Wt, g	13.92		
Wet + Tare, g	23.27		
Dry + Tare, g	21.68		
M%	20.5%		

Liquid Limit (method B)

# of Blows	27	28	
Tare Wt, g	13.31	12.80	
Wet + tare, g	18.86	19.29	
Dry + tare, g	16.80	16.89	
Water content	59.0%	58.7%	AVERAGE
Adjusted W/C	59.6%	59.6%	59.6%

SUMMARY

Plastic Limit: 20.5%

Liquid Limit: 59.6%

Plasticity Index: 39.1%

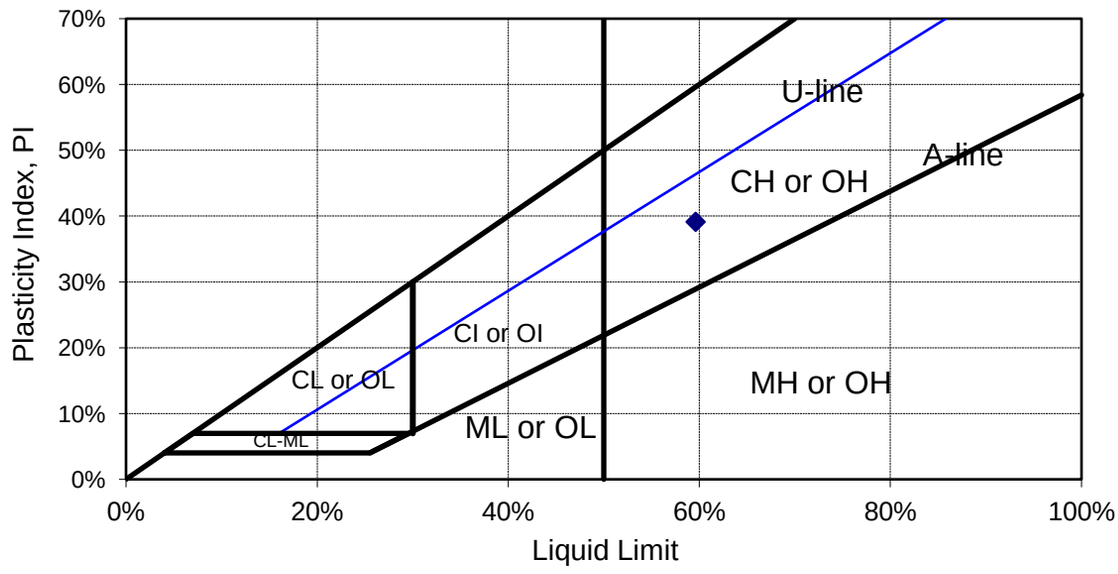
Classification: CH

Natural Water Content: 33.6%

Comments:

-

CERTIFIED BY CCIL



The testing services reported here have been performed in accordance with accepted local industry standards.

The results presented are for the sole use of the designated client only.

This report constitutes a testing service only. It does not represent any interpretation or opinion regarding specification compliance or material suitability.

Engineering interpretation will be provided by SNC Lavalin upon request.

ATTERBERG LIMITS TEST REPORT

(Test Reference: ASTM D 4318)

SNC·LAVALIN

Client:	Manitoba Aboriginal & Northern Affairs
Project	Thicket Portage Sewage Lagoon
Project #:	633391
Technician:	FG
Date:	18-Feb-2016

Sample: 03 BH-03 at 7.5ft (air-dried)

Percentage of sample retained on 425-um (No. 40) sieve: N/A

Plastic Limit

Tare #			
Tare Wt, g	14.56		
Wet + Tare, g	22.59		
Dry + Tare, g	21.50		
M%	15.7%		

Liquid Limit (method B)

# of Blows	23	24	
Tare Wt, g	13.97	14.35	
Wet + tare, g	22.32	26.63	
Dry + tare, g	20.22	23.55	
Water content	33.6%	33.5%	AVERAGE
Adjusted W/C	33.3%	33.3%	33.3%

SUMMARY

Plastic Limit: 15.7%

Liquid Limit: 33.3%

Plasticity Index: 17.6%

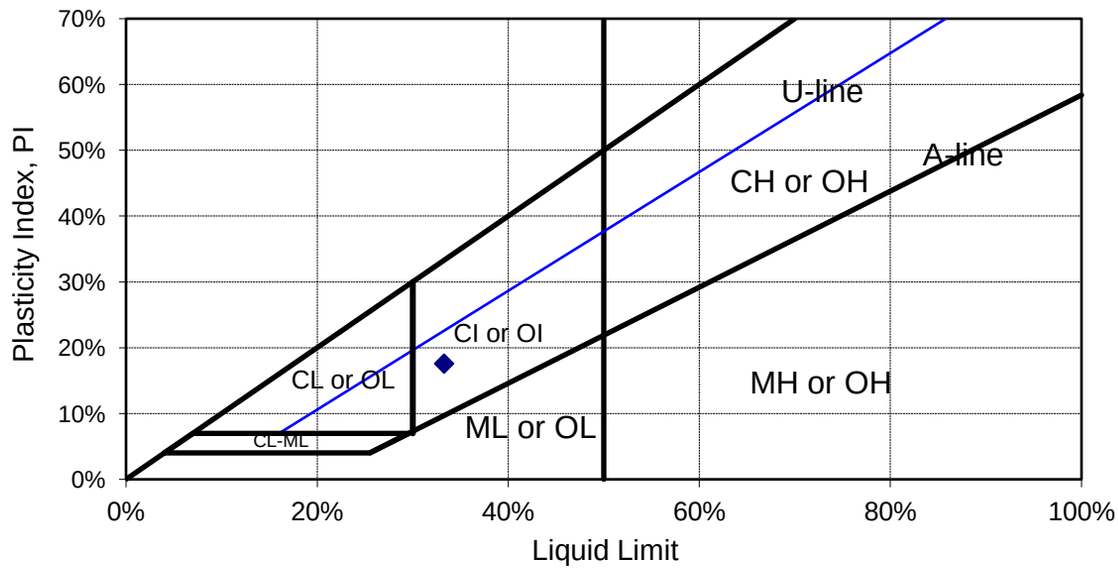
Classification: CI

Natural Water Content: 27.0%

Comments:

-

CERTIFIED BY CCIL



The testing services reported here have been performed in accordance with accepted local industry standards.

The results presented are for the sole use of the designated client only.

This report constitutes a testing service only. It does not represent any interpretation or opinion regarding specification compliance or material suitability.

Engineering interpretation will be provided by SNC Lavalin upon request.

ATTERBERG LIMITS TEST REPORT

(Test Reference: ASTM D 4318)

SNC·LAVALIN

Client:	Manitoba Aboriginal & Northern Affairs
Project	Thicket Portage Sewage Lagoon
Project #:	633391
Technician:	FG
Date:	18-Feb-2016

Sample: 04 BH-01 at 10ft (air-dried)

Percentage of sample retained on 425-um (No. 40) sieve: N/A

Plastic Limit

Tare #			
Tare Wt, g	14.5		
Wet + Tare, g	24.21		
Dry + Tare, g	22.72		
M%	18.1%		

Liquid Limit (method B)

# of Blows	24	26	
Tare Wt, g	14.42	14.00	
Wet + tare, g	24.86	24.49	
Dry + tare, g	21.53	21.14	
Water content	46.8%	46.9%	AVERAGE
Adjusted W/C	46.6%	47.2%	46.9%

SUMMARY

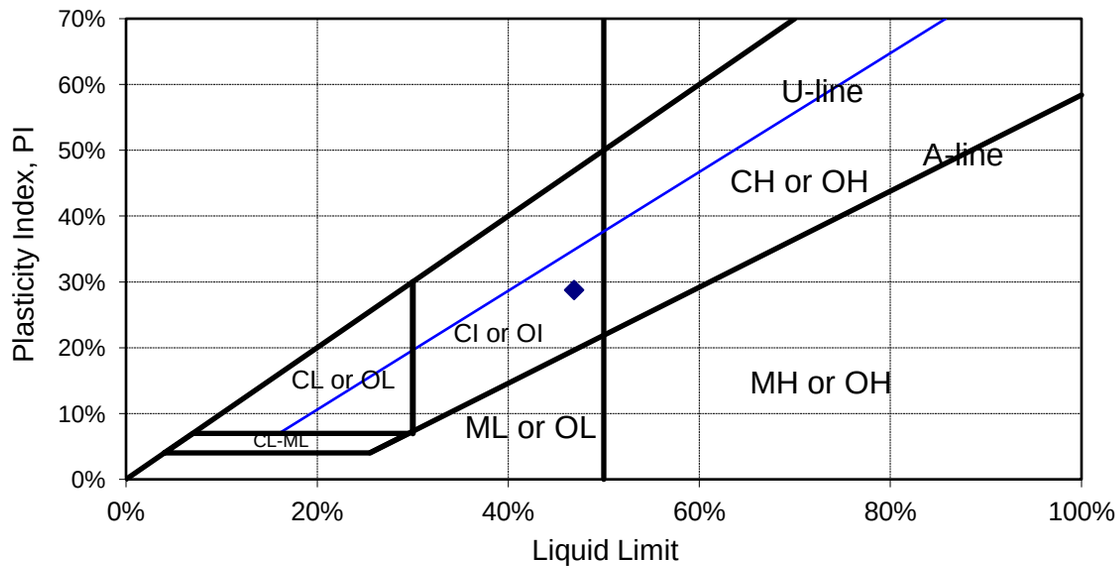
Plastic Limit:	18.1%
Liquid Limit:	46.9%
Plasticity Index:	28.8%
Classification:	CI

Natural Water Content: 33.1%

Comments:

-

CERTIFIED BY CCIL



The testing services reported here have been performed in accordance with accepted local industry standards.

The results presented are for the sole use of the designated client only.

This report constitutes a testing service only. It does not represent any interpretation or opinion regarding specification compliance or material suitability.

Engineering interpretation will be provided by SNC Lavalin upon request.

ATTERBERG LIMITS TEST REPORT

(Test Reference: ASTM D 4318)

SNC·LAVALIN

Client:	Manitoba Aboriginal & Northern Affairs
Project	Thicket Portage Sewage Lagoon
Project #:	633391
Technician:	MC
Date:	17-Feb-2016

Sample: 05 BH-02 at 15ft (air-dried)

Percentage of sample retained on 425-um (No. 40) sieve: N/A

Plastic Limit

Tare #			
Tare Wt, g	14.43		
Wet + Tare, g	24.58		
Dry + Tare, g	23.31		
M%	14.3%		

Liquid Limit (method B)

# of Blows	25	26	
Tare Wt, g	14.29	12.39	
Wet + tare, g	19.82	19.94	
Dry + tare, g	18.41	18.03	
Water content	34.2%	33.9%	AVERAGE
Adjusted W/C	34.2%	34.1%	34.1%

SUMMARY

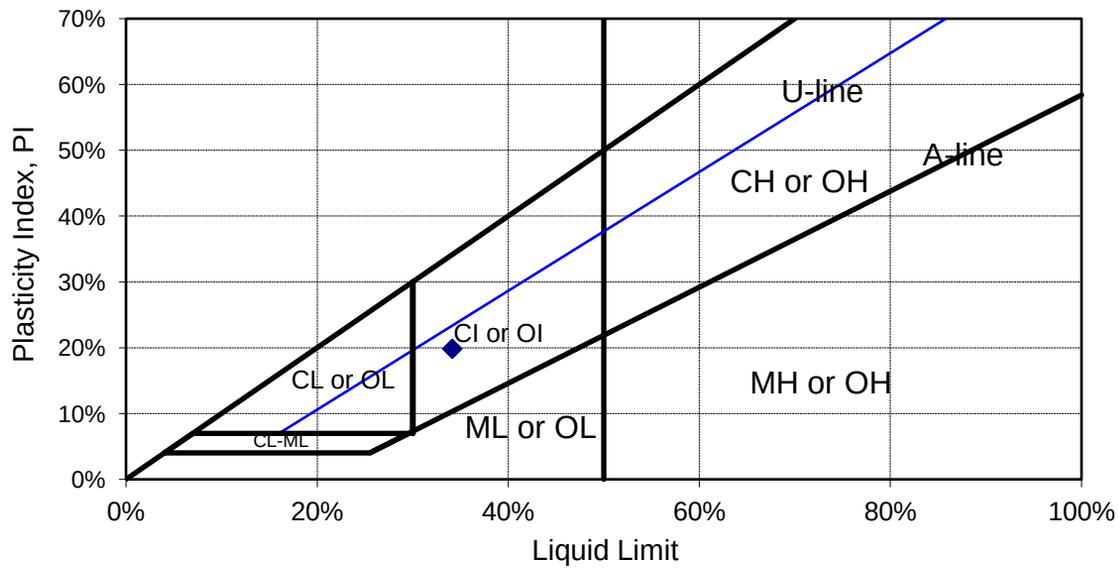
Plastic Limit:	14.3%
Liquid Limit:	34.1%
Plasticity Index:	19.8%
Classification:	CI

Natural Water Content: 29.9%

Comments:

-

CERTIFIED BY CCIL



The testing services reported here have been performed in accordance with accepted local industry standards.

The results presented are for the sole use of the designated client only.

This report constitutes a testing service only. It does not represent any interpretation or opinion regarding specification compliance or material suitability.

Engineering interpretation will be provided by SNC Lavalin upon request.

ATTERBERG LIMITS TEST REPORT

(Test Reference: ASTM D 4318)

SNC·LAVALIN

Client:	Manitoba Aboriginal & Northern Affairs
Project	Thicket Portage Sewage Lagoon
Project #:	633391
Technician:	RJ
Date:	18-Feb-2016

Sample: 05 BH-03 at 15ft (air-dried)

Percentage of sample retained on 425-um (No. 40) sieve: N/A

Plastic Limit

Tare #			
Tare Wt, g	14.22		
Wet + Tare, g	20.06		
Dry + Tare, g	19.11		
M%	19.4%		

Liquid Limit (method B)

# of Blows	19	18	
Tare Wt, g	13.58	14.04	
Wet + tare, g	21.34	23.21	
Dry + tare, g	18.64	20.04	
Water content	53.4%	52.8%	AVERAGE
Adjusted W/C	51.5%	50.7%	51.1%

SUMMARY

Plastic Limit: 19.4%

Liquid Limit: 51.1%

Plasticity Index: 31.7%

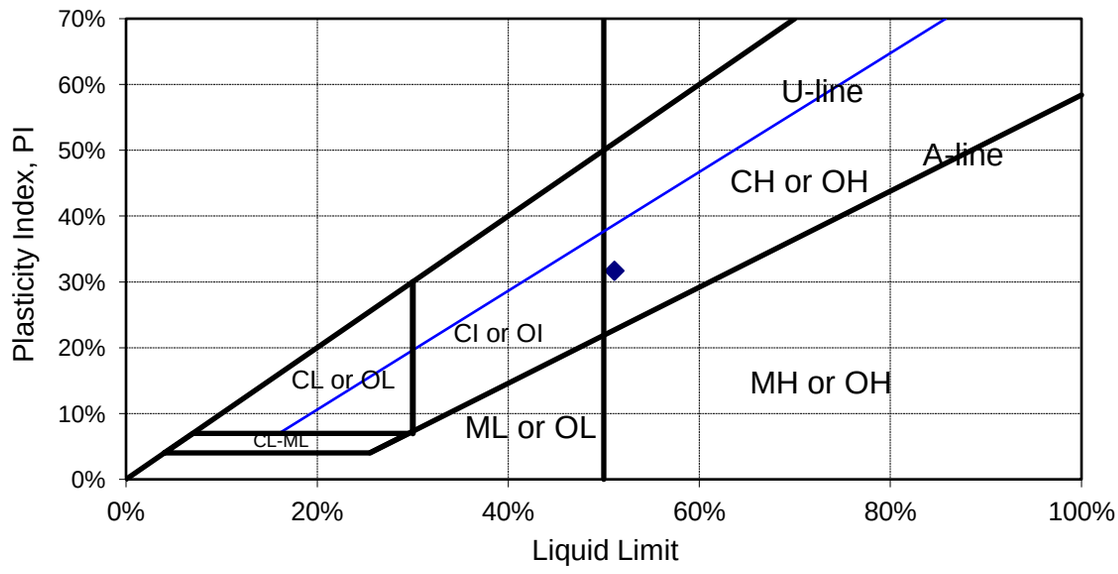
Classification: CH

Natural Water Content: 36.7%

Comments:

-

CERTIFIED BY CCIL



The testing services reported here have been performed in accordance with accepted local industry standards.

The results presented are for the sole use of the designated client only.

This report constitutes a testing service only. It does not represent any interpretation or opinion regarding specification compliance or material suitability.

Engineering interpretation will be provided by SNC Lavalin upon request.

PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

Sieve Analysis	Sieve	Diameter (mm)	% Finer
	3"	76.2	100
	2"	50.8	100
	1"	25.4	100
	3/4"	19.1	100
	3/8"	9.5	100
	# 4	4.75	100
	# 10	2.00	100
	# 20	0.850	100
	# 40	0.425	100
	# 60	0.250	100
	# 100	0.150	99
	# 200	0.075	99
Hydrometer Analysis		0.0545	97.2
		0.0386	96.7
Dispersing agent:		0.0274	96.2
Sodium Hexametaphosphate		0.0194	95.7
		0.0137	95.2
Dosage of dispersing agent:		0.0101	94.2
40 g/L		0.0072	91.3
		0.0051	89.4
		0.0037	87.5
		0.0026	84.7
		0.0019	82.2
		0.0012	69.1

SNC·LAVALIN

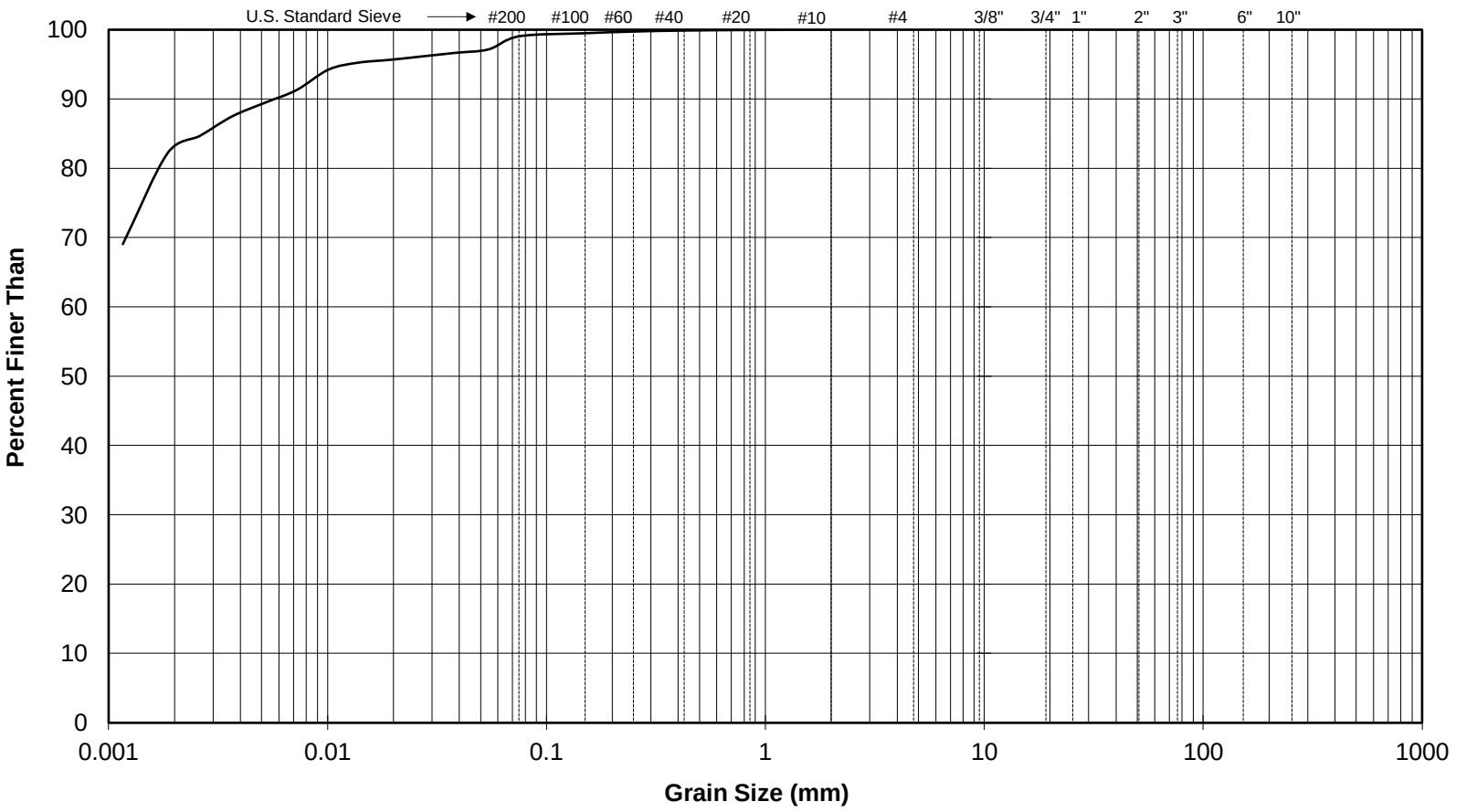
Client:	Manitoba Aboriginal & Northern Affairs
Project:	Thicket Portage Sewage Lagoon
Project #:	633391
Sample:	01 BH-02 at 2.5ft
Date:	22-Feb-16

Particle Size Distribution Summary

% GRAVEL	
% SAND	1
% SILT SIZE (<75μm>5μm)	9.8
% CLAY SIZE (<5μm)	89.2

Comments:

CERTIFIED BY CCIL



FINES (SILT, CLAY)	SAND			GRAVEL		COBBLES	BOULDERS
	Fine	Medium	Coarse	Fine	Coarse		

Unified Soil Classification System

The testing services reported here have been performed in accordance with accepted local industry standards.

The results presented are for the sole use of the designated client only.

This report constitutes a testing service only. It does not represent any interpretation or opinion regarding specification compliance or material suitability.

Engineering interpretation will be provided by SNC-Lavalin upon request.

PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

Sieve Analysis	Sieve	Diameter (mm)	% Finer
	3"	76.2	100
	2"	50.8	100
	1"	25.4	100
	3/4"	19.1	99
	3/8"	9.5	94
	# 4	4.75	88
	# 10	2.00	81
	# 20	0.850	75
	# 40	0.425	71
	# 60	0.250	67
	# 100	0.150	63
	# 200	0.075	57
Hydrometer Analysis		0.0625	52.6
		0.0449	49.4
Dispersing agent:		0.0320	47.8
Sodium Hexametaphosphate		0.0216	44.5
		0.0164	42.1
Dosage of dispersing agent:		0.0122	38.1
40 g/L		0.0087	34.8
		0.0063	30.8
		0.0045	27.0
		0.0032	23.9
		0.0023	22.7
		0.0014	15.3

SNC·LAVALIN

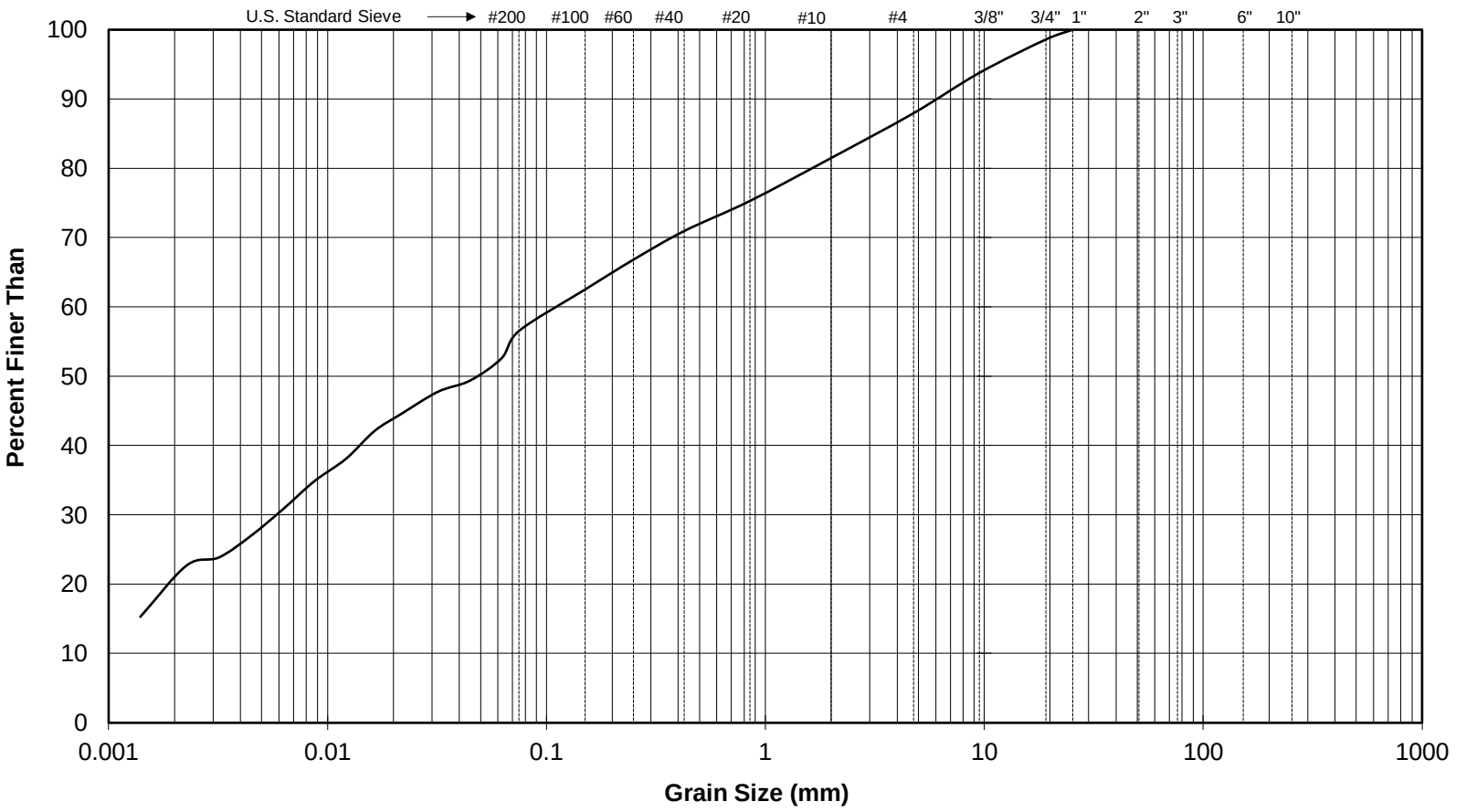
Client:	Manitoba Aboriginal & Northern Affairs
Project:	Thicket Portage Sewage Lagoon
Project #:	633391
Sample:	02 BH-01 at 5ft
Date:	22-Feb-16

Particle Size Distribution Summary

% GRAVEL	12
% SAND	31
% SILT SIZE (<75μm>5μm)	28.9
% CLAY SIZE (<5μm)	28.1

Comments:

CERTIFIED BY CCIL



The testing services reported here have been performed in accordance with accepted local industry standards.

The results presented are for the sole use of the designated client only.

This report constitutes a testing service only. It does not represent any interpretation or opinion regarding specification compliance or material suitability.

Engineering interpretation will be provided by SNC-Lavalin upon request.

PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

Sieve Analysis	Sieve	Diameter (mm)	% Finer
	3"	76.2	100
	2"	50.8	100
	1"	25.4	100
	3/4"	19.1	100
	3/8"	9.5	100
	# 4	4.75	100
	# 10	2.00	100
	# 20	0.850	100
	# 40	0.425	100
	# 60	0.250	100
	# 100	0.150	100
	# 200	0.075	99

Hydrometer Analysis		
	0.0382	99.4
Dispersing agent:	0.0271	98.4
Sodium Hexametaphosphate	0.0192	97.9
	0.0136	97.4
Dosage of dispersing agent:	0.0100	96.4
40 g/L	0.0071	94.4
	0.0051	91.6
	0.0037	88.7
	0.0026	84.0
	0.0019	78.4
	0.0012	67.3

SNC·LAVALIN

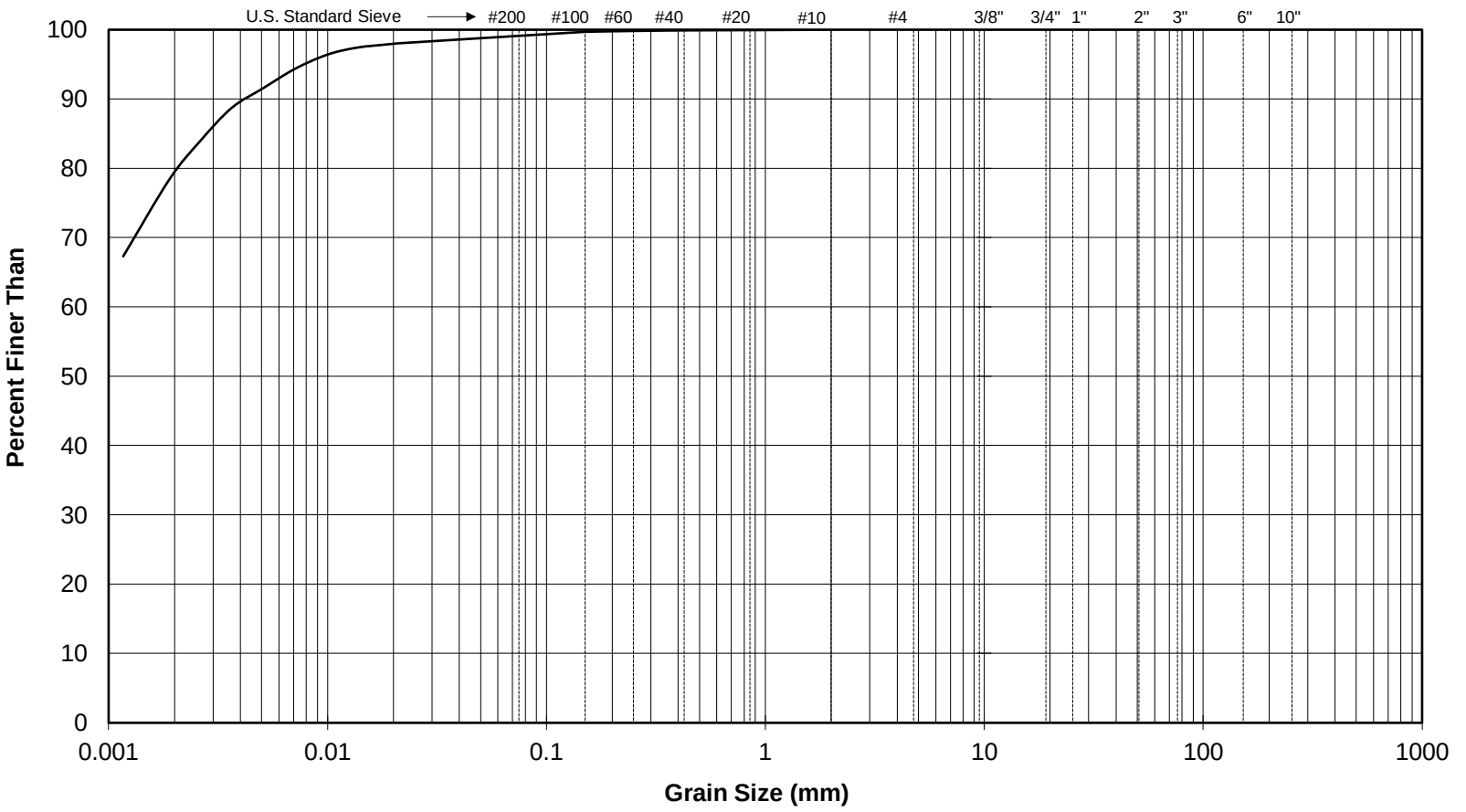
Client:	Manitoba Aboriginal & Northern Affairs
Project:	Thicket Portage Sewage Lagoon
Project #:	633391
Sample:	03 BH-02 at 7.5ft
Date:	22-Feb-16

Particle Size Distribution Summary

% GRAVEL	
% SAND	1
% SILT SIZE (<75μm>5μm)	7.6
% CLAY SIZE (<5μm)	91.4

Comments:

CERTIFIED BY CCIL



The testing services reported here have been performed in accordance with accepted local industry standards.

The results presented are for the sole use of the designated client only.

This report constitutes a testing service only. It does not represent any interpretation or opinion regarding specification compliance or material suitability.

Engineering interpretation will be provided by SNC-Lavalin upon request.

PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

Sieve Analysis	Sieve	Diameter (mm)	% Finer
	3"	76.2	100
	2"	50.8	100
	1"	25.4	100
	3/4"	19.1	100
	3/8"	9.5	100
	# 4	4.75	100
	# 10	2.00	100
	# 20	0.850	100
	# 40	0.425	99
	# 60	0.250	99
	# 100	0.150	98
	# 200	0.075	97

Hydrometer Analysis		
	0.0389	94.6
Dispersing agent:	0.0280	90.6
Sodium Hexametaphosphate	0.0200	88.6
	0.0143	86.6
Dosage of dispersing agent:	0.0106	82.6
40 g/L	0.0076	79.6
	0.0055	72.8
	0.0040	66.0
	0.0029	56.2
	0.0021	49.9
	0.0013	36.8

SNC·LAVALIN

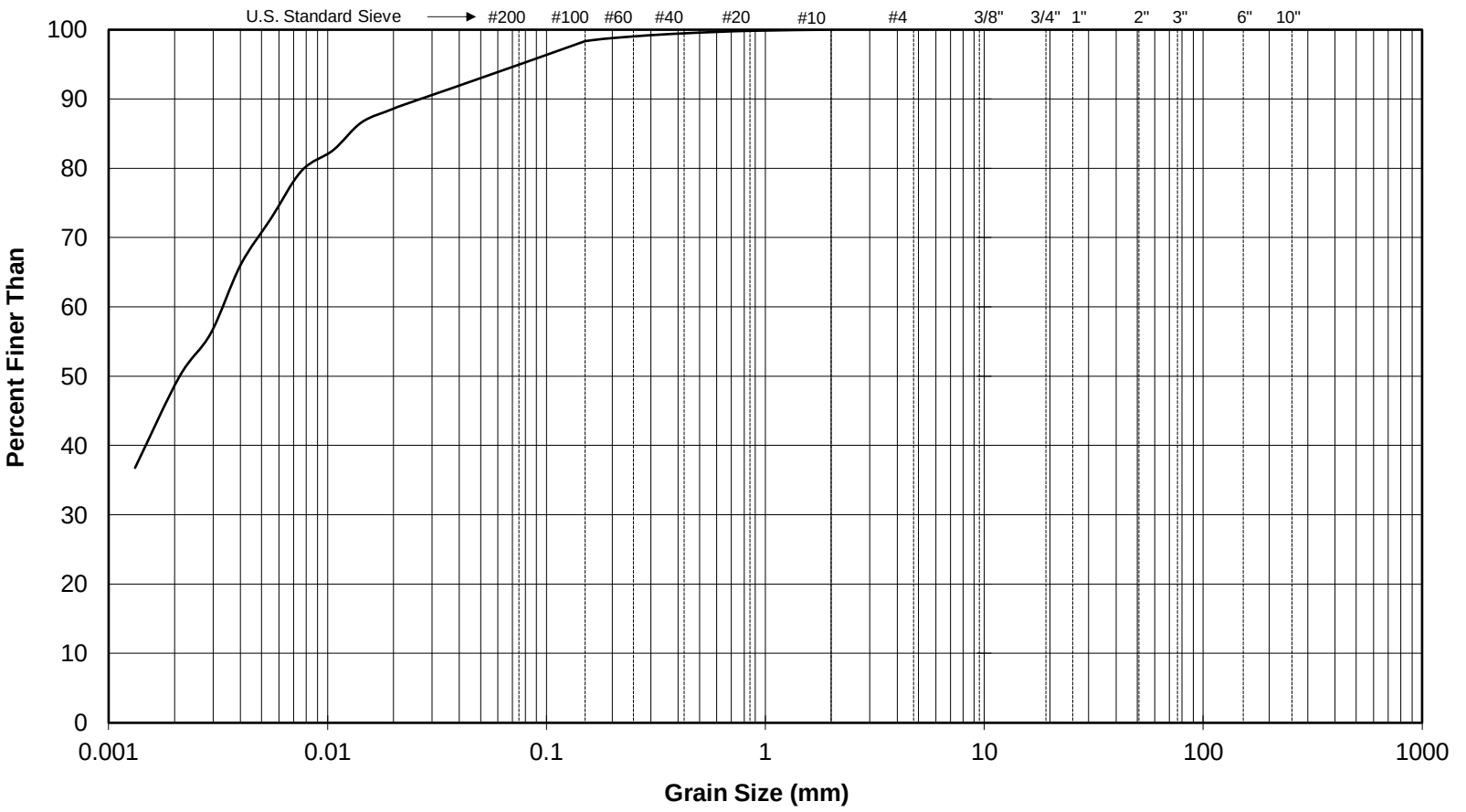
Client:	Manitoba Aboriginal & Northern Affairs
Project:	Thicket Portage Sewage Lagoon
Project #:	633391
Sample:	03 BH-03 at 7.5ft
Date:	22-Feb-16

Particle Size Distribution Summary

% GRAVEL	
% SAND	3
% SILT SIZE (<75μm>5μm)	26.5
% CLAY SIZE (<5μm)	70.5

Comments:

CERTIFIED BY CCIL



The testing services reported here have been performed in accordance with accepted local industry standards.

The results presented are for the sole use of the designated client only.

This report constitutes a testing service only. It does not represent any interpretation or opinion regarding specification compliance or material suitability.

Engineering interpretation will be provided by SNC-Lavalin upon request.

PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

Sieve Analysis	Sieve	Diameter (mm)	% Finer
	3"	76.2	100
	2"	50.8	100
	1"	25.4	100
	3/4"	19.1	100
	3/8"	9.5	100
	# 4	4.75	100
	# 10	2.00	100
	# 20	0.850	100
	# 40	0.425	100
	# 60	0.250	100
	# 100	0.150	100
	# 200	0.075	99
Hydrometer Analysis		0.0539	99.1
		0.0383	98.1
Dispersing agent:		0.0272	97.6
Sodium Hexametaphosphate		0.0193	97.1
		0.0136	96.6
Dosage of dispersing agent:		0.0100	95.1
40 g/L		0.0072	92.1
		0.0052	87.2
		0.0037	83.5
		0.0027	76.7
		0.0020	70.2
		0.0012	57.0

SNC·LAVALIN

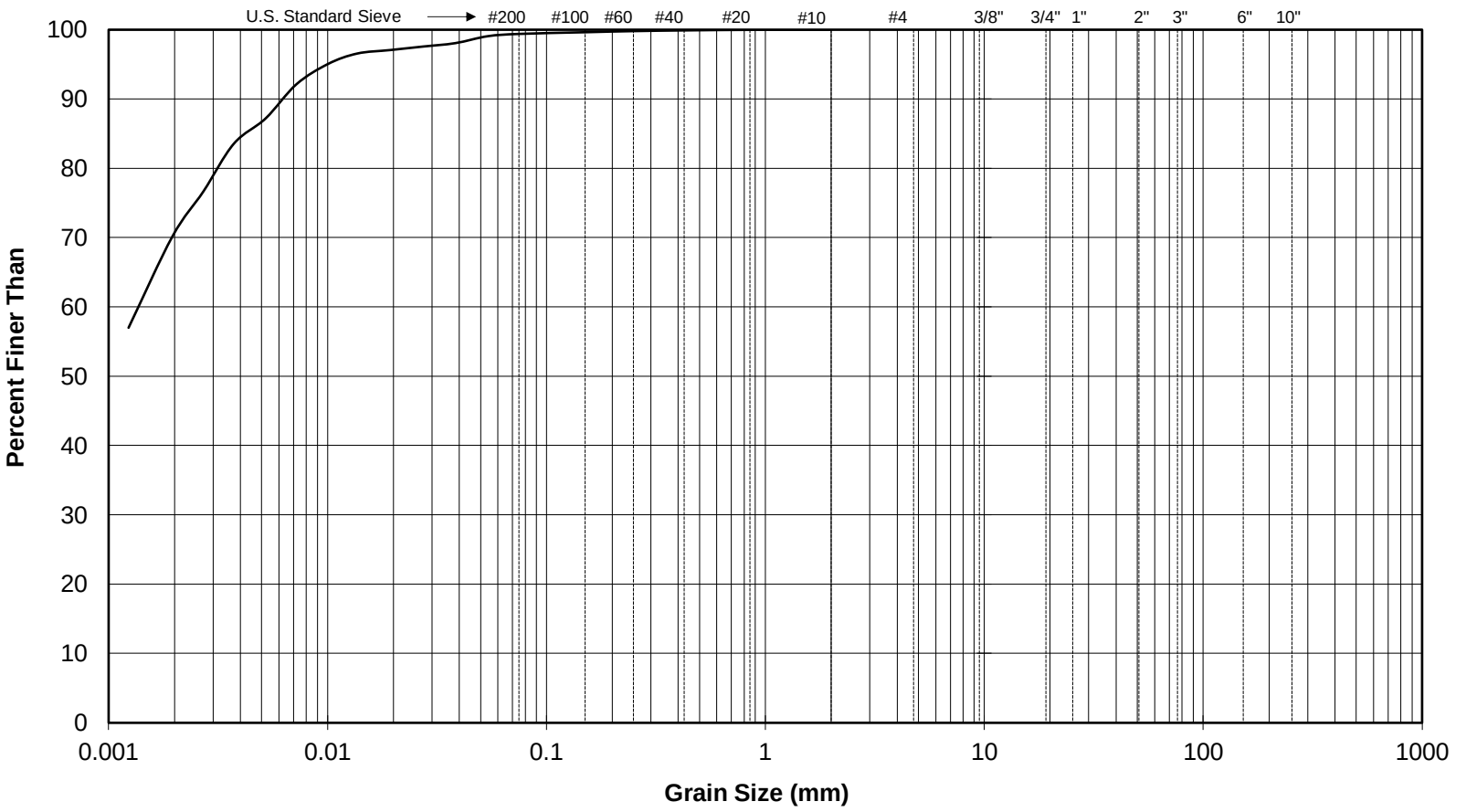
Client:	Manitoba Aboriginal & Northern Affairs
Project:	Thicket Portage Sewage Lagoon
Project #:	633391
Sample:	04 BH-01 at 10ft
Date:	22-Feb-16

Particle Size Distribution Summary

% GRAVEL	
% SAND	1
% SILT SIZE (<75μm>5μm)	12.3
% CLAY SIZE (<5μm)	86.7

Comments:

CERTIFIED BY CCIL



The testing services reported here have been performed in accordance with accepted local industry standards.

The results presented are for the sole use of the designated client only.

This report constitutes a testing service only. It does not represent any interpretation or opinion regarding specification compliance or material suitability.

Engineering interpretation will be provided by SNC-Lavalin upon request.

PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

Sieve Analysis	Sieve	Diameter (mm)	% Finer
	3"	76.2	100
	2"	50.8	100
	1"	25.4	100
	3/4"	19.1	100
	3/8"	9.5	100
	# 4	4.75	100
	# 10	2.00	99
	# 20	0.850	98
	# 40	0.425	96
	# 60	0.250	94
	# 100	0.150	92
	# 200	0.075	89
Hydrometer Analysis		0.0573	86.2
		0.0412	82.2
Dispersing agent:		0.0294	80.2
Sodium Hexametaphosphate		0.0209	79.2
		0.0149	76.4
Dosage of dispersing agent:		0.0110	74.4
40 g/L		0.0079	70.4
		0.0057	65.7
		0.0041	60.9
		0.0030	54.0
		0.0021	49.5
		0.0013	39.6

SNC·LAVALIN

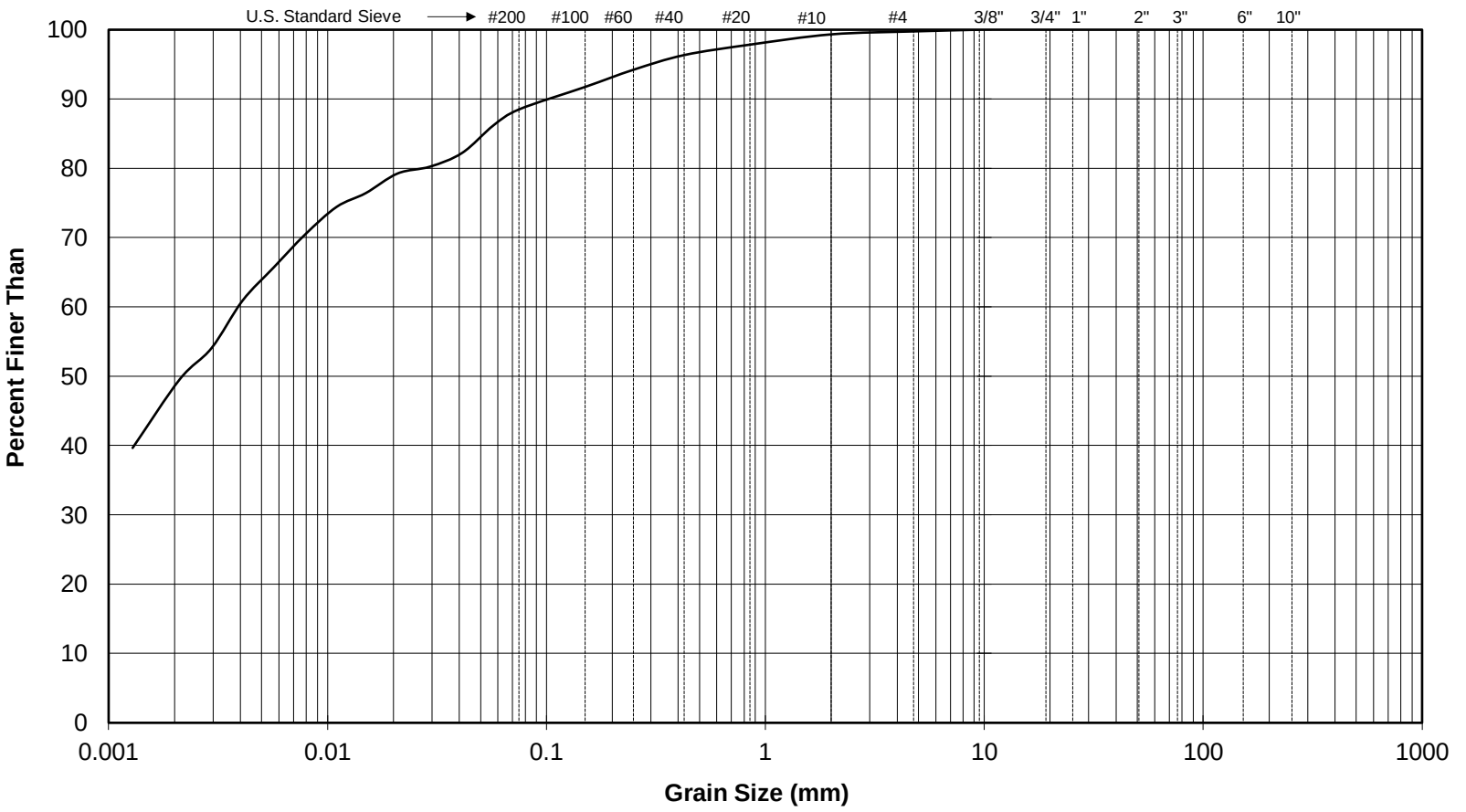
Client:	Manitoba Aboriginal & Northern Affairs
Project:	Thicket Portage Sewage Lagoon
Project #:	633391
Sample:	05 BH-02 at 15ft
Date:	22-Feb-16

Particle Size Distribution Summary

% GRAVEL	
% SAND	11
% SILT SIZE (<75μm>5μm)	25.4
% CLAY SIZE (<5μm)	63.6

Comments:

CERTIFIED BY CCIL



The testing services reported here have been performed in accordance with accepted local industry standards.

The results presented are for the sole use of the designated client only.

This report constitutes a testing service only. It does not represent any interpretation or opinion regarding specification compliance or material suitability.

Engineering interpretation will be provided by SNC-Lavalin upon request.

PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

Sieve Analysis	Sieve	Diameter (mm)	% Finer
	3"	76.2	100
	2"	50.8	100
	1"	25.4	100
	3/4"	19.1	100
	3/8"	9.5	100
	# 4	4.75	100
	# 10	2.00	100
	# 20	0.850	100
	# 40	0.425	100
	# 60	0.250	100
	# 100	0.150	99
	# 200	0.075	99
Hydrometer Analysis		0.0538	98.7
		0.0383	97.7
Dispersing agent:		0.0243	96.7
Sodium Hexametaphosphate		0.0183	94.7
		0.0138	94.3
Dosage of dispersing agent:		0.0101	93.7
40 g/L		0.0073	89.8
		0.0052	86.9
		0.0038	81.1
		0.0027	76.2
		0.0020	69.7
		0.0012	56.8

SNC·LAVALIN

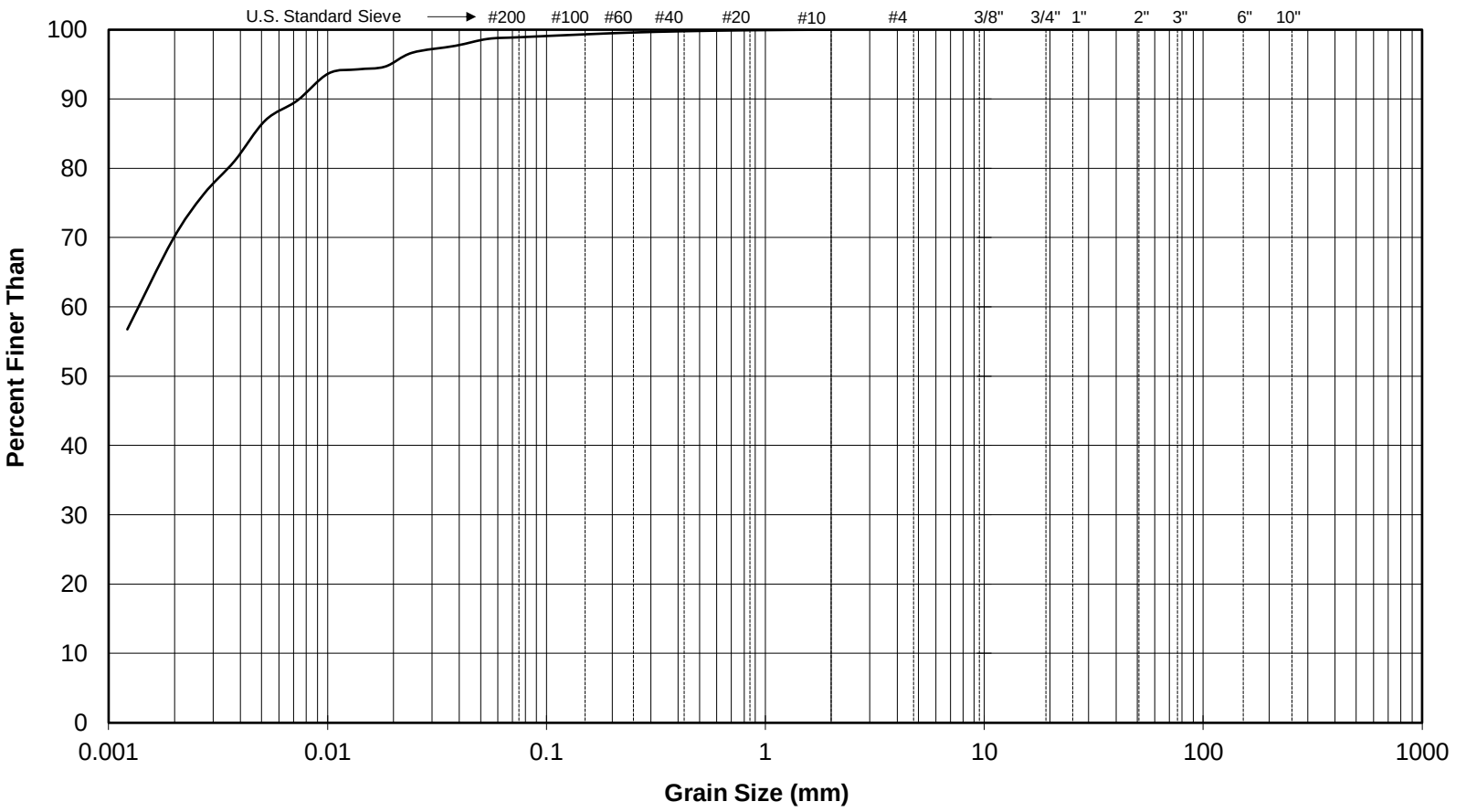
Client:	Manitoba Aboriginal & Northern Affairs
Project:	Thicket Portage Sewage Lagoon
Project #:	633391
Sample:	05 BH-03 at 15ft
Date:	22-Feb-16

Particle Size Distribution Summary

% GRAVEL	
% SAND	1
% SILT SIZE (<75μm>5μm)	12.9
% CLAY SIZE (<5μm)	86.1

Comments:

CERTIFIED BY CCIL



The testing services reported here have been performed in accordance with accepted local industry standards.

The results presented are for the sole use of the designated client only.

This report constitutes a testing service only. It does not represent any interpretation or opinion regarding specification compliance or material suitability.

Engineering interpretation will be provided by SNC-Lavalin upon request.

TRIAXIAL HYDRAULIC CONDUCTIVITY TEST REPORT

Test reference: ASTM D 5084

SNC·LAVALIN

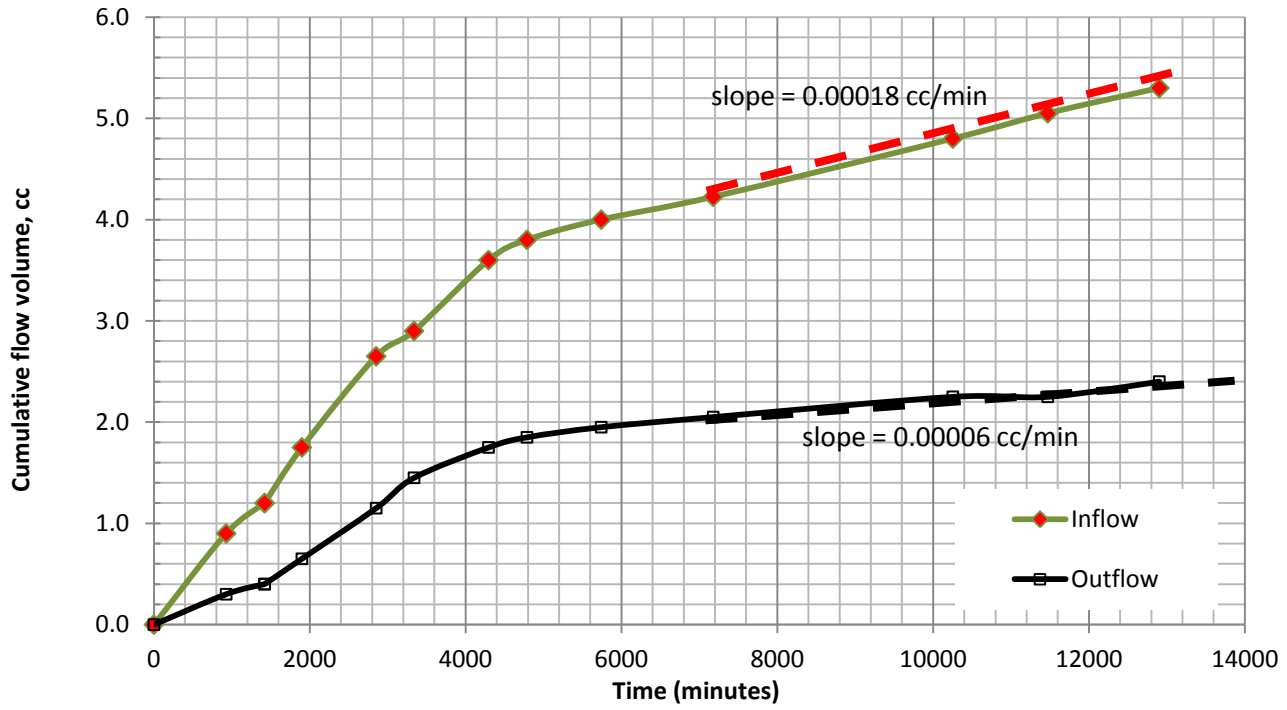
CLIENT:	Manitoba Aboriginal & Northern Affairs
PROJECT:	Thicket Portage Sewage Lagc
PROJECT No:	633391
DATE:	4-Mar-16

SAMPLE: BH1 Sample #7 Shelby specimen

Testing Summary:

Cell pressure =	230	kPa	Final Water Content =	29.2%	
Average back pressure =	200	kPa	Final Dry Density =	1521	kg/m^3
Head across specimen =	70.7	cm	Final deg of saturation =	100%	
Hydraulic gradient =	21.1				
Initial sample diameter =	101.06	mm	Inflow rate =	0.00018	cc/min
Initial sample height =	33.52	mm	Outflow rate =	0.00006	cc/min
Initial Water Content =	28.4%		Average flow rate =	0.00012	cc/min
Initial Dry Density =	1532	kg/m^3			
Initial Deg of saturation =	100%		**Hydraulic Conductivity (based on average flow rate):**		
Permeant:	de-aired tap-water		k = 1.18E-09 cm/s		

Comments:



The testing services reported here have been performed in accordance with accepted local industry standards.

The results presented are for the sole use of the designated client only.

This report constitutes a testing service only. It does not represent any interpretation or opinion regarding specification compliance or material suitability.

Engineering interpretation will be provided by SNC-Lavalin upon request.

TRIAXIAL HYDRAULIC CONDUCTIVITY TEST REPORT

Test reference: ASTM D 5084

SNC·LAVALIN

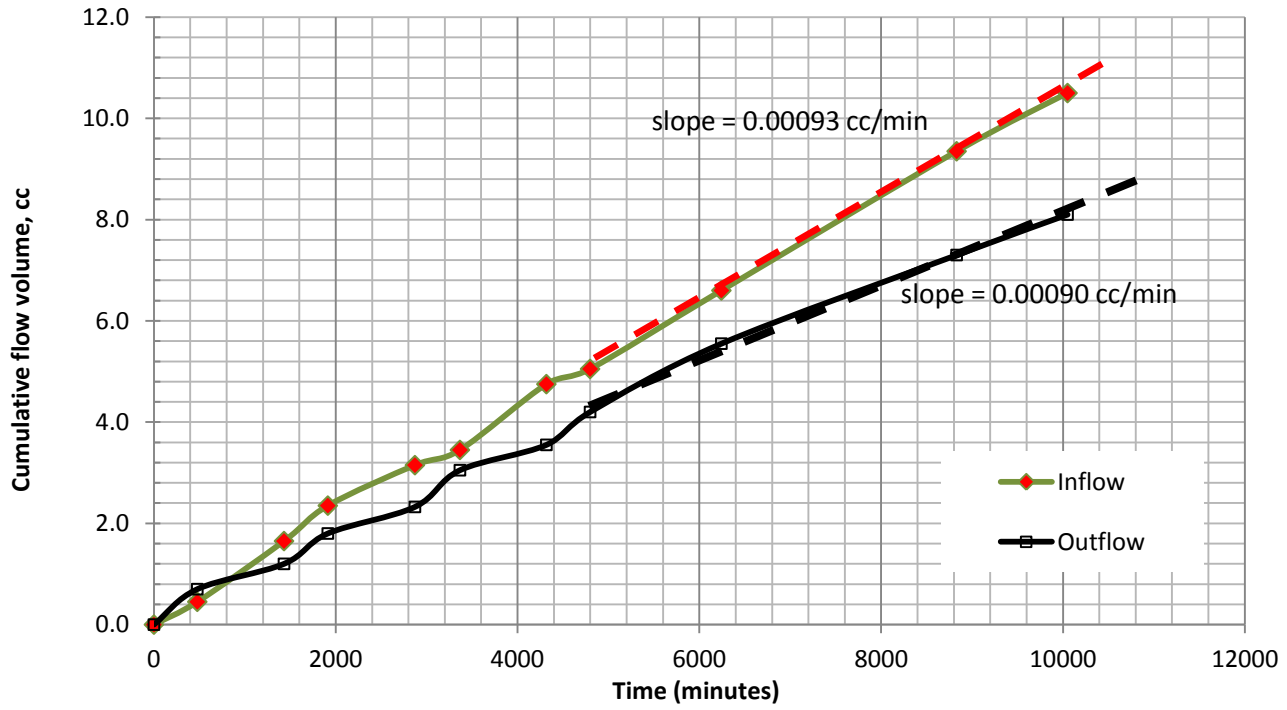
CLIENT:	Manitoba Aboriginal & Northern Affairs
PROJECT:	Thicket Portage Sewage Lagoon
PROJECT No:	633391
DATE:	1-Mar-16

SAMPLE: BH3 Sample #7 at 2.5-10ft Shelby specimen

Testing Summary:

Cell pressure =	230	kPa	Final Water Content =	29.8%	
Average back pressure =	200	kPa	Final Dry Density =	1496	kg/m^3
Head across specimen =	69.5	cm	Final deg of saturation =	100%	
Hydraulic gradient =	20.9				
Initial sample diameter =	101.54	mm	Inflow rate =	0.00093	cc/min
Initial sample height =	33.31	mm	Outflow rate =	0.00090	cc/min
Initial Water Content =	27.5%		Average flow rate =	0.00092	cc/min
Initial Dry Density =	1516	kg/m^3			
Initial Deg of saturation =	97%		**Hydraulic Conductivity (based on average flow rate):**		
Permeant:	de-aired tap-water		k = 9.02E-09 cm/s		

Comments:



The testing services reported here have been performed in accordance with accepted local industry standards.

The results presented are for the sole use of the designated client only.

This report constitutes a testing service only. It does not represent any interpretation or opinion regarding specification compliance or material suitability.

Engineering interpretation will be provided by SNC-Lavalin upon request.

SNC·LAVALIN

ONE POINT PROCTOR TEST

Client:	Manitoba Aboriginal & Northern Affairs
Project	Thicket Portage Sewage Lagoon
Project #:	633391
Date:	18-Feb-16

Sample: #7 BH#: TH1 Depth: 5-10ft

Date Sampled:	2016/02/03	Supplied By:	-
Date Received:	2016/02/10	Sampled By:	-
Date Tested:	2016/02/18	Tested By:	RJ
Sample Desc.:	Clay	Sample Location:	-

Per cent oversize material in sample (%): 0 Specific Gravity (assumed): 2.7

Density Determination		Corrected
Sample Name	TH1 #7	
Wt. sample + mold (g):	6118	
Wt. mold (g):	4316	
Wt. sample wet (g):	1802	
Volume of mold (m^3):	0.000938871	
Wet density (kg/m^3):	1919	
Dry density (kg/m^3):	1494	1494

1 pt. Sample W/C Determination		Corrected
Tare #:	M18	
Tare Mass (g):	89.7	
Wet sample + tare (g):	201.2	
Dry sample + tare (g):	176.51	
Water Content (%):	28.4	28.4

Oversize Material W/C = 0%

COMMENTS:

The testing services reported here have been performed in accordance with accepted local industry standards.

The results presented are for the sole use of the designated client only.

This report constitutes a testing service only. It does not represent any interpretation or opinion regarding specification compliance or material suitability.

Engineering interpretation will be provided by SNC-Lavalin upon request.

SNC·LAVALIN

ONE POINT PROCTOR TEST

Client:	Manitoba Aboriginal & Northern Affairs
Project	Thicket Portage Sewage Lagoon
Project #:	633391
Date:	18-Feb-16

Sample: #7 BH#: TH3 Depth: 2.5-10ft

Date Sampled:	2016/02/03	Supplied By:	-
Date Received:	2016/02/10	Sampled By:	-
Date Tested:	2016/02/18	Tested By:	RJ
Sample Desc.:	Clay	Sample Location:	-

Per cent oversize material in sample (%): 0 Specific Gravity (assumed): 2.7

Density Determination		Corrected
Sample Name	TH3 #7	
Wt. sample + mold (g):	6125	
Wt. mold (g):	4316	
Wt. sample wet (g):	1809	
Volume of mold (m^3):	0.000938871	
Wet density (kg/m^3):	1927	
Dry density (kg/m^3):	1512	1512

1 pt. Sample W/C Determination		Corrected
Tare #:	TFT	
Tare Mass (g):	83.98	
Wet sample + tare (g):	203.43	
Dry sample + tare (g):	177.69	
Water Content (%):	27.5	27.5

Oversize Material W/C = 0%

COMMENTS:

The testing services reported here have been performed in accordance with accepted local industry standards.

The results presented are for the sole use of the designated client only.

This report constitutes a testing service only. It does not represent any interpretation or opinion regarding specification compliance or material suitability.

Engineering interpretation will be provided by SNC-Lavalin upon request.

WATER CONTENT TEST REPORT

Test Reference: ASTM D2216-05)

SNC·LAVALIN

Client:	Manitoba Aboriginal & Northern Affairs
Project:	Thicket Portage Sewage Lagoon
Project #:	633391
Technician:	MC
Date:	12-Feb-15

Sample #	1	2	3	4	5	6
Test Hole #	01	01	01	01	01	01
Depth (ft)	2.5	5	7.5	10	15	20
Tare #						
Tare Mass (g)	31.17	31.02	31.10	30.91	31.09	31.17
Wet sample + tare (g)	124.38	213.52	154.53	150.89	200.77	171.73
Dry sample + tare (g)	103.59	186.50	124.50	121.09	181.99	127.49
Wt. Dry sample (g)	72.42	155.48	93.40	90.18	150.90	96.32
Water Content (%)	28.71	17.38	32.15	33.05	12.45	45.93
Sample #	1	2	3	4	5	6
Test Hole #	02	02	02	02	02	02
Depth (ft)	2.5	5	7.5	10	15	17
Tare #						
Tare Mass (g)	31.27	31.02	31.23	30.95	31.16	31.11
Wet sample + tare (g)	138.39	129.16	140.32	146.27	181.11	171.74
Dry sample + tare (g)	111.76	105.33	112.87	116.67	146.63	137.46
Wt. Dry sample (g)	80.49	74.31	81.64	85.72	115.47	106.35
Water Content (%)	33.08	32.07	33.62	34.53	29.86	32.23
Sample #	7	1	2	3	4	5
Test Hole #	02	03	03	03	03	03
Depth (ft)	5-10	2.5	5	7.5	10	15
Tare #						
Tare Mass (g)	36.91	31.11	31.35	30.98	31.15	31.03
Wet sample + tare (g)	142.50	144.77	132.50	175.59	160.68	162.48
Dry sample + tare (g)	116.29	121.28	110.94	144.82	128.37	127.19
Wt. Dry sample (g)	79.38	90.17	79.59	113.84	97.22	96.16
Water Content (%)	33.02	26.05	27.09	27.03	33.23	36.70

Comments: 7 BH-02 is a bulk sample

Samples 2 BH-01 and 5 BH-01 contained a lot of sand Sample 6 BH-01 had standing water

APPENDIX E

Application for Wastewater Treatment Facility Classification

Water & Wastewater Facility Operators Certification Program

Manitoba Conservation

Application for Wastewater Treatment Facility Classification

also available online at http://www.manitoba.ca/certification

Please print clearly or type and follow the instructions on the application form.
NOTE: If using Adobe Reader text can be inserted into form and tab between fields.

This application is pursuant to the Water and Wastewater Facility Operators Regulation issued under The Environment Act.

Name of Facility:	Thicket Portage Sewage Lagoon
Name of Facility Owner: (Municipality/Commission/ Company/Individual/etc)	Aboriginal and Northern Affairs of Manitoba
Civic Address of Facility:	NW 10-73-02 W1
Mailing Address of Owner:	Room 108, 59 Elizabeth Drive, Thompson, MB

Postal Code: R8N 1X4	Telephone: (204) 677-6737
Contact Person: Armand Barbeau	Position:

Cell or Pager:	Fax: (204) 677-6525	Email: Armand.Barbeau@gov.mb.ca

Is this a REAPPLICATION? ○ Yes ◉ No

Please complete the following. The information provided will be used to classify the wastewater treatment facility under the Water and Wastewater Facility Operators Regulation. In some cases actual numbers or answers must be supplied, but in most cases it will only be necessary to check the appropriate criteria.

Forward the completed form to:

Director
Environmental Assessment & Licensing Branch
Manitoba Conservation
160 – 123 Main Street
Winnipeg MB R3C 1A5

Please direct questions to:

Certification Program Coordinator
Phone: (204) 945-7065
Fax: (204) 945-5229

FOR MANITOBA CONSERVATION USE ONLY

Operation ID # _____

Stakeholder ID # _____

Approval ID # _____

EO/DWO _____

Application for Wastewater Treatment Facility Classification

SYSTEM *(choose all that apply)*			
1.	New or proposed Facility seeking classification	☑	
	Proposed start of operations (month / year) 09/01/2016		
	Existing Facility seeking classification (in operation prior to December 31, 2005)	☐	
	Facility has been in operation since (approximate month/year)		
2.	The facility **WILL** employ mechanical treatment processes	○	
	The facility **WILL NOT** employ mechanical treatment processes	◉	

SIZE *(refer to Supplemental Information for point designation) (2 point minimum to 20 point maximum)*				
1.	Maximum population or part served, peak day	# 200		1-10
2.	Design flow average day **Estimated** ○ **Actual** ○ (Circle volume option & units) **OR** Peak month's flow average day **Estimated** ○ **Actual** ○	60 ◉ m^3/day ○ gal/day _____ ○ m^3/day ○ gal/day		1-10

VARIATION IN RAW WASTE[1] *(choose all that apply) (0 point minimum to 6 point maximum)*			
1.	Variations do not exceed those normally or typically expected	☑	0
2.	Recurring deviations or excessive variations of 100-200% in strength	☐	2
	Recurring deviations or excessive variations of 100-200% in flow	☐	
	Recurring deviations or excessive variations of 100-200% in strength and flow	☐	
3.	Recurring deviations or excessive variations of more than 200% in strength	☐	4
	Recurring deviations or excessive variations of more than 200% in flow	☐	
	Recurring deviations or excessive variations of more than 200% in strength and flow	☐	
4.	Raw wastes subject to toxic waste discharges	☐	6
5.	Septage or truck-hauled waste discharge is accepted at the facility.	☑	0 - 4
	Estimated number of loads per day in peak haul times	2	

Application for Wastewater Treatment Facility Classification

PRELIMINARY TREATMENT *(choose all that apply)*			
1.	Facility pumping of main flow	☐	3
2.	Screening or comminution	☐	3
3.	Grit removal	☐	3
4.	Equalization	☐	1

PRIMARY TREATMENT *(choose all that apply)*			
1.	Clarifiers	☐	5
2.	Anaerobic treatment with biogas flare	☐	10
3.	Anaerobic treatment with biogas utilization facility	☐	15

SECONDARY TREATMENT *(choose all that apply)*			
1.	Fixed-film reactor	☐	10
2.	Activated sludge	☐	15
3.	Stabilization ponds without aeration (ie: sewage lagoon)	✔	5
4.	Stabilization ponds with aeration	☐	8

TERTIARY TREATMENT *(choose all that apply)*			
1.	Polishing ponds for advanced waste treatment	✔	2
2.	Chemical / physical advanced waste treatment without secondary treatment	☐	15
3.	Chemical / physical advanced waste treatment following secondary treatment	☐	10
4.	Biological or chemical / biological advanced waste treatment	☐	12
5.	Nitrification by designed extended aeration only	☐	5
6.	Ion exchange for advanced waste treatment	☐	10
7.	Reverse osmosis, electrodialysis and other membrane filtration techniques	☐	10
8.	Advanced waste treatment chemical recovery, carbon regeneration	☐	4

Application for Wastewater Treatment Facility Classification

9.	Media filtration	☐	5

ADDITIONAL TREATMENT PROCESSES *(choose all that apply)*			
1.	Chemical addition: *(Please list chemicals used, 2 pts per chemical to max. of 6)* aluminium Sulphate	☑	0 - 6
2.	Dissolved air floatation (other than for sludge thickening)	☐	8
3.	Intermittent sand filter	☐	2
4.	Recirculating intermittent sand filter	☐	3
5.	Microscreens	☐	5
6.	Generation of oxygen	☐	5

SOLIDS HANDLING *(choose all that apply)*			
1.	Storage (other than for stabilization)	☐	2
2.	Stabilization by storage (including any storage afterwards)	☐	4
3.	Gravity thickening	☐	2
4.	Mechanical dewatering	☐	8
5.	Anaerobic digestion of solids	☐	10
6.	Utilization of digester gas for heating or cogeneration	☐	5
7.	Aerobic digestion of solids	☐	6
8.	Air-drying of sludge	☑	2
9.	Solids reduction (including incineration and wet oxidation)	☐	12
10.	Disposal in landfill	☐	2
11.	Solids composting	☐	10
12.	Land application of biosolids by contractor	☑	2
13.	Land application of biosolids by facility personnel	☐	10

Application for Wastewater Treatment Facility Classification

DISINFECTION *(choose all that apply) (0 point minimum to 10 point maximum)*			
1.	Chlorination	☑	5
	Ultraviolet irradiation	☑	
2.	Ozonization	☐	10

EFFLUENT DISCHARGE *(choose all that apply) (0 point minimum to 10 point maximum)*			
1.	Discharge to surface water (ditch or lake or _____)	☑	0
2.	Mechanical post-aeration	☐	2
3.	Direct recycling and reuse	☐	6
4.	Land treatment and surface or subsurface disposal		4

INSTRUMENTATION *(choose one) (0 point minimum to 6 point maximum)*			
1.	SCADA or similar instrumentation systems are used to provide:		
	• Data with no process operation	◉	0
	• Data with limited process operation	○	2
	• Data with moderate process operation	○	4
	• Data with extensive or total process operation	○	6

LABORATORY CONTROL[2] *(choose all that apply) (0 point minimum to 15 point maximum)*			
1.	Bacteriological / Biological *(0 point minimum to 5 point maximum)*		
	• Lab work done outside the facility	☑	0
	• Membrane filter procedures	☐	3
	• Use of fermentation tubes or any dilution method of fecal coliform determination	☐	5
2.	Chemical / Physical *(0 point minimum to 10 point maximum)*		
	• Lab work done outside the facility	☑	0

Application for Wastewater Treatment Facility Classification

	• Push button or visual methods for simple tests such as pH or settleable solids *(List tests)*	☐	3
	• Additional procedures such as DO, COD, BOD, gas analysis, titration, solids content or volatile content *(List tests)*	☐	5
	• More advanced determinations such as specific constituents, nutrients, total oils or phenols *(List tests)*	☐	7
	• Highly sophisticated instrumentation such as atomic absorption or gas chromatograph *(List tests)*	☐	10

APPLICANT VERIFICATION	
I HEREBY DECLARE THAT ALL INFORMATION IN THIS APPLICATION IS TRUE.	
Name of Applicant[3]: (Print) Armand Barbeau	
Title: Director LGD Division, Aboriginal & Northern Affa	
Telephone: (204) 677-6737	Fax: (204) 677-6525
Email: Armand.Barbeau@gov.mb.ca	
Signature of Authorized Representative:	Date: May 9/2016

[1]The key concepts are frequency or intensity of deviation, or excessive variation from normal or typical fluctuations. The deviations in strength, toxicity, ratio of infiltration to inflow, or shock loads.

[2] The key concept is to credit laboratory analyses done on-site by facility personnel under the direction of an operator-in-charge with points from 0-15.

[3] Applicant must be an authorized representative of the owner/operating authority (i.e. manager, P. Eng., or overall responsible operator).

Print Application Form