300\325\325.52\02\EAP\RM RockwoodSMI EAP.docx

P&R 8.227 JRCC

R-325.52

RURAL MUNICIPALITY OF ROCKWOOD

Environment Act Proposal
for the
Stony Mountain and SMI
Wastewater Treatment Lagoon Upgrade

Prepared by:

Brett McCormac, E.I.T.
Environmental Engineer-in-Training

Reviewed by:

Jerry Cousin, P. Eng.
President

July 2014

APEGM
Certificate of Authorization
J. R. Cousin Consultants Ltd.
No. 234 Date July 25/14

PROVINCE OF MANITOBA
G. R. COUSIN
14/07/25
REGISTERED PROFESSIONAL ENGINEER

JRCC
ENGINEERING CONSULTANTS

ACKNOWLEDGMENTS

To prepare this report various sources of information were investigated and researched. JR Cousin Consultants Ltd. (JRCC) wishes to thank the RM of Rockwood and the Stony Mountain Institution who contributed to the data and content of this report.

REMARKS

JR Cousin Consultants Ltd. has conducted this environment act proposal in accordance with generally accepted professional engineering principles and practices for the purpose of identifying conditions that may have an environmental impact on the site. The findings and recommendations reached in this report are based on information made available to JRCC during the investigation and conditions at the time of the site investigation. Conclusions derived in this report are intended to reduce, but not wholly eliminate the uncertainty regarding potential environmental concerns on the site, and recognizes reasonable limitations with regards to time, accuracy, work scope and cost. It is possible that environmental conditions may change from the date of this report. If conditions appear different from those encountered and expressed in this report, JRCC should be informed so that mitigation recommendations can be reviewed and adjusted as required. Historical data and information obtained from personal communication used in this report, are assumed to be correct, however JRCC has not conducted further investigations into the accuracy of this data. JRCC has produced this report for the use of the client, and takes no responsibility for any third party decisions or actions based on information contained in this report.

TABLE OF CONTENTS

Section Page of Section

Section | Page of Section

Appendix B

Manitoba Conservation and Water Stewardship Fisheries Branch, May 28, 2014 Email Correspondence

Manitoba Conservation Data Centre, May 1, 2014 Email Correspondence

Manitoba Historic Resources Branch, May 13, 2014 Email Correspondence

Appendix C

RM of Rockwood – Stony Mountain and SMI Lagoon Upgrade Preliminary Design Report

Appendix D

Plan 1: Lagoon Layout Plan with Setbacks to Existing Residences

Plan 2: Lagoon Drainage Route

Environment Act Proposal Form

Manitoba
Conservation and Water Stewardship

Name of the development: Stony Mountain and SMI Wastewater Treatment Lagoon Upgrade		
Type of development per Classes of Development Regulation (Manitoba Regulation 164/88): Class 2		
Legal name of the applicant: Rural Municipality of Rockwood		
Mailing address of the applicant: Box 902, Stonewall, Manitoba, R0C 2Z0		
Contact Person: Mr. Grant Thorsteinson, CAO		
City: Stonewall	Province: Manitoba	Postal Code: R0C 2Z0
Phone Number: 204-467-2272	Fax: 204-467-5329	email: cao@rockwood.ca
Location of the development: 11km north of Winnipeg		
Contact Person: Mr. Grant Thorsteinson, CAO		
Street Address: n/a		
Legal Description: S 1/2 of 02-13-02 EPM		
City/Town: RM of Rockwood	Province: Manitoba	Postal Code: R0C 2Z0
Phone Number: 204-467-2272	Fax: 204-467-5329	email: cao@rockwood.ca
Name of proponent contact person for purposes of the environmental assessment: Jerry Cousin, JR Cousin Consultants Ltd.		
Phone: 204-489-0474 Fax: 204-489-0487	Mailing address: 91 A Scurfield Blvd Winnipeg, Manitoba R3Y1G4	
Email address: jcousin@jrcc.ca		
Webpage address: www.jrcc.ca		
Date: 14/07/25	Signature of proponent, or corporate principal of corporate proponent: Printed name: Jerry Cousin	

1.0 INTRODUCTION AND BACKGROUND

The development described herein is for the upgrade and expansion of the existing RM of Rockwood and Stony Mountain Institution (SMI) wastewater treatment lagoons.

1.1 Introduction

The RM of Rockwood and SMI currently operate facultative lagoons side by side that both require repair and expansion to meet projected growth. The RM of Rockwood is proposing to convert the two facultative lagoons into a combined aerated lagoon. The works will include construction of two new aerated primary cells, construction of a new storage cell, construction of an aeration building, two lift stations and remedial dike works.

An Environment Act Licence is required from Manitoba Conservation for the construction and operation of the upgraded lagoon. JR Cousin Consultants Ltd. (JRCC) was retained for the related engineering services.

1.2 Contact Information

Mr. Jerry Cousin, P.Eng.
JR Cousin Consultants Ltd.
91A Scurfield Blvd.
Winnipeg, Manitoba
R3Y 1G4
Phone 204-489-0474, Fax 204-489-0487

Mr. Grant Thorsteinson
Chief Administrative Officer
RM of Rockwood
285 Main Street
Box 902
Stonewall, Manitoba
ROC 2Z0

1.3 Background Information

The RM of Rockwood and SMI lagoons are located side by side on the S 1/2 of 02-13-02 EPM, approximately 11 km north of Winnipeg. The SMI lagoon is a two cell lagoon constructed in the mid 1960's and is fed by a 300 mm gravity sewer pipe from the penitentiary. The RM of Rockwood lagoon services the community of Stony Mountain, rural residents connected to the Bristol Pipeline, an industrial park and septic tank cleanouts from RM of Rockwood rural residents. The two cell lagoon was constructed in the early 1990's and is fed by a 300 mm gravity sewer pipe from the community of Stony Mountain.

Both existing lagoons have 4:1 side slopes. The existing lagoons have an operating depth of 1.5 m, however the bottom 0.3 m of the cells are not discharged, resulting in a usable storage depth of 1.2 m. Both lagoons were constructed with 2.5 m deep cells, providing 1.0 m of freeboard.

The existing SMI lagoon has sufficient organic capacity to accommodate future growth projections but requires an expansion to the hydraulic capacity. The RM of Rockwood lagoon requires organic and hydraulic expansion to meet the design year 25 projected population.

Based on past investigations by JRCC, JRCC has determined that the dikes of the SMI and RM of Rockwood lagoon are leaking horizontally through a silty clay layer in the soil profile. The SMI lagoon dikes were found to be leaking more severely compared with the RM lagoon dikes.

1.4 Description of Previous Studies

A report entitled *Stony Mountain Institution – Lagoon Assessment Study* was completed by JRCC in April 2010. This report discussed various options for upgrade/repair/expansion of the existing SMI lagoon and also alternatives such as, construction of a sewage treatment plant, connection to the City of Winnipeg collection system and construction of a new aerated lagoon.

A letter report entitled *SMI and Stony Mountain Lagoon Geotechnical Investigation and Capital Cost Estimates* was completed by JRCC in December of 2011. The report discussed options to repair the existing lagoon dikes through various methodologies. The report also discussed options to expand both the RM of Rockwood and the SMI lagoons with either facultative or aerated lagoon cells.

A report entitled *RM of Rockwood – Assessment of Alternative Facultative/Aerated Lagoon Expansion Options and Capital Cost Estimates* was completed by JRCC in February of 2013. The report updated the population information from the previous letter report and discussed in detail a facultative lagoon expansion option and 3 aerated lagoon expansion options.

The RM of Rockwood reviewed the letter report and selected an aerated lagoon expansion option for construction.

A pre-design report for the selected option entitled *RM of Rockwood – Stony Mountain and SMI Lagoon Upgrade Preliminary Design Report* was completed by JRCC in May of 2014. The pre-design report is attached with this Environment Act Proposal document and is referenced several times throughout this document.

2.0 DESCRIPTION OF THE DEVELOPMENT

For each heading there is an information request from the Information Bulletin - Environment Act Proposal Report Guidelines. These requests are repeated herein in italics followed by the pertaining response.

2.1 Land Title/Location

Certificate of Title showing the owner(s) and legal description of the land upon which the development will be constructed; or, in the case of highways, rail lines, electrical transmission lines, or pipelines, a map or maps at a scale no less than 1:50,000 showing the location of the proposed development:

The proposed aerated lagoon expansion site is located immediately north and east of the existing RM of Rockwood and SMI lagoons within the S 1/2 of 02-13-02 EPM. The site is located on PT Plan 4077 WLTO.

The land is owned by Her Majesty the Queen – Canada (Stony Mountain Institution/SMI). The land is leased by the RM of Rockwood under a Lease Agreement commencing on April 1, 1992 and ending March 31, 2017. The lease agreement is attached in Appendix A. A new lease agreement is currently being worked on between the RM of Rockwood and SMI but is not yet finalized. The new agreement will be forwarded to Manitoba Conservation when it is finalized.

The Certificates of Title for the SE ¼ 2-13-2-E (Title No. 18189) and for the SW ¼ of 2-13-2-E (Title No. 18194) are attached in Appendix A.

2.2 Owner of Land and Mineral Rights

Owner of land upon which the development is intended to be constructed, and of mineral rights beneath the land, if different from surface owner:

The Crown Lands & Property Agency was contacted regarding the proposed development location. According to the Crown Lands & Property Agency records, the mines and minerals and sand and gravel in the S1/2 of 02-13-02 EPM are granted to individuals and the crown has no interest (see email correspondence from the Crown Lands & Property Agency, dated May 1, 2014 in Appendix A).

2.3 Existing Land Use

Existing land use on the site and on land adjoining it, as well as changes that will be made in such land use for the purposes of the development:

The proposed lagoon expansion site is the land directly northeast and south of the existing SMI lagoon cells, and is currently being used for agricultural purposes. The site is bordered by PR 321 to the south, a CPR rail line and PTH 7 to the west, the Stony Mountain Institution to the north and King Edward Road to the east (see Plan 1 in Appendix D).

Soil would be excavated in the area of the proposed lagoon expansion for construction of the lagoon dikes and drainage ditches. A sewage treatment building would be constructed on the north side of the

proposed aerated primary cells and an existing access road north of the site would be upgraded to access the new cells and building.

2.4 Land Use Designation/Zoning Designation

Land use designation for the site and adjoining land as identified in a development plan adopted under The Planning Act or The City of Winnipeg Act, and the zoning designation as identified in a zoning by-law, if applicable:

The existing lagoon site and lagoon expansion site is currently zoned AL (Agriculture Limited Zone), based on the zoning designations in the RM of Rockwood. A public utility service (i.e. wastewater treatment lagoon) is permitted under the zoning designation. Please see e-mail correspondence and attached Agricultural Zone Regulations 81-84 from the South Interlake Planning District sent June 6, 2014.

2.4.1 Land Classification

According to the Agriculture and Agri-Food Canada Manitoba Agri-Map the proposed lagoon expansion site has a "fine-medium" surface texture, a slope of "0 – 2%", "imperfect" soil drainage, "moderate limitations" of the soil capability for agriculture and "very low" risk of water erosion. According to the Canada Land Inventory Soil Capability for Agriculture map for the Selkirk region, the proposed lagoon expansion site is designated as $(3\frac{8}{W,S}4\frac{2}{S})$ which means Class 3 and Class 4 in an 8:2 ratio. The soils with a Class 3 rating have a limitation of excess water and soil limitations (3WS) and the soils with a Class 4 rating have soil limitations (4S).

According to the Nutrient Management Regulation 62/2008, soils designated as Class 3 are part of water quality management zone N1 and soils designated as Class 4 are designated as zone N2. Because the site is located in water quality management zone N1 or N2, there are no restrictions for construction of a wastewater treatment lagoon.

The Red River is designated as a "vulnerable water body" according to the Nutrient Management Regulation 62/2008, but the Grassmere Creek Drain is not. A river designated as vulnerable requires a 30 m nutrient buffer zone. The proposed lagoon is located approximately 12.6 km from the Red River and thus is not within the nutrient buffer zone.

2.5 Description of Development

Description of proposed development and schedule for stages of the development, including proposed dates for planning, design, construction, commissioning, operation, and decommissioning and/or termination of operation (if known), identifying major components and activities of the development as applicable (e.g. access road, airstrip, processing facility, waste disposal area, etc.).

2.5.1 Project Schedule

Lagoon design is proposed to begin upon receipt of an environmental licence. Lagoon construction works are proposed to begin in the spring of 2015, dependent upon approval of funding. Commissioning and operation of the lagoon is proposed to begin upon completion of construction and after approval for use is obtained from Manitoba Conservation.

2.5.2 Basis for Proposed Lagoon Expansion Site Selection

Manitoba Conservation's guidelines for the location of a wastewater treatment lagoon (Design Objectives for Standard Sewage Lagoons, Province of Manitoba, Environmental Management, July 1985) are outlined in the following table. A description of the proposed site in relation to each of the guidelines is also provided in the table.

Table A: Lagoon Expansion Site Location in Relation to Manitoba Conservation Guidelines

Manitoba Conservation Guideline	Proposed Relation to Site
1. Lagoons must be located a minimum of 460 m from any community centre.	The proposed new lagoon is located approximately 1.6 km from the nearest community centre (community of Stony Mountain).
2. Lagoons must be located a minimum of 300 m from any residence. (The distance is to be measured from the centreline of the nearest dike), this distance is shown on Plan 1, attached in the Appendix.	The proposed new lagoon is located over 300 m from the nearest resident.
3. Consideration should be given to sites in which prevailing winds are in the direction of uninhabited areas.	The prevailing winds are from the north and west. The lagoon is located south of the community of Stony Mountain and Stony Mountain Institution.
4. Sites with an unobstructed wind sweep across the lagoon are preferred.	The site surrounding the proposed lagoon is the existing lagoon and agricultural field with no nearby windbreaks.
5. Areas that are habitually flooded shall be avoided.	The proposed new lagoon dikes will constructed at or above the existing lagoon top of dike elevation which have had no reports of flooding.
6. Sewage lagoons are to be designed and constructed such that the interior surface of the proposed lagoon is underlain by at least one metre of soil having a hydraulic conductivity of 1×10^{-7} cm/sec or less. In areas sensitive to groundwater contamination, a flexible synthetic liner may be recommended.	Based on the geotechnical investigation, the in-situ soils will be capable of providing a consistent permeability of 1×10^{-7} cm/sec. A vertical cut-off wall constructed of re-compacted clay soils will be extended through the silt layer into the horizontal insitu liner.

The lagoon expansion area is located beyond all setback distances required by Manitoba Conservation, therefore there are no expected concerns for the location of the expansion cells. Plan 1 in Appendix D, shows the minimum setback distance requirements for the expanded lagoon to the local residents and community.

2.5.3 Lagoon Drainage Route

The discharge route from the lagoon will follow the existing lagoon discharge route from the storage cells into the Penitentiary Drain through existing and proposed ditches. Treated effluent will flow south through the 2nd order Penitentiary Drain for approximately 3.3 km. Treated effluent will then enter the 5th order Grassmere Creek Drain with flows southeast approximately 12.7 km to the Red River. The entire discharge route will be approximately 16 km before entering the Red River. The drainage route is shown on Plan 2 attached in Appendix D.

2.5.3.1 Fish Species Information

The Manitoba Conservation and Water Stewardship Fisheries Branch were contacted regarding any potential concerns with fish species along the drainage route. The Fisheries Branch indicated that given the fish presence in both waterbodies, ensuring the effluent meets or exceeds Manitoba Water Quality Standards, Objectives and Guidelines is very important.

The Fisheries Branch indicated the Grassmere Creek Drain supports a number of large and small bodied species. According to the Fish Inventory and Habitat Classification System (FIHCS) the following fish species have been found in the Grassmere Creek Drain: Fathead Minnow, Northern Pike, White Sucker and Yellow Perch. It was also noted that there is little to no flow and some standing pools in sections of the drain (2005).

The Fisheries Branch indicated the Red River at Selkirk also supports a number of large and small bodied species. It also supports a recreational fishery. According to the FIHCS the following common fish species have been found in the Red River at Selkirk: Bigmouth Buffalo, Black Bullhead, Black Crappie, Brook Stickleback, Brown Bullhead, Burbot, Carp, Central Mudminnow, Channel Catfish, Cicso, Emerald Shiner, Fathead Minnow, Freshwater Drum, Goldeye, Iowa Darter, Johnny Darter, Logperch, Longnose Sucker, Ninespine Stickleback, Northern Pike, River Darter, Rock Bass, Saugerm Shorthead Redhorse, Silver Chub, Silver Redhorse, Spottail Shiner, Tadpole Madtom, Trout Perch, Walleye, White Bass, White Sucker and Yellow Perch.

See May 28, 2014 email correspondence from Manitoba Conservation and Water Stewardship – Fisheries Branch in Appendix B.

2.5.3.2 Water Quality Information

Manitoba Conservation and Water Stewardship were contacted for water quality data in the Grassmere Creek Drain and the Red River at Selkirk. Summarized water quality

data from selected parameters are provided below for each location. The water quality data is an average from seven sampling locations along the Grassmere Creek Drain taken over 35 years, from January 1978 to October 2013. In respect to the Red River at Selkirk, the water quality data is an average from 1 sampling location taken from January 2010 to December 2013.

Table B: Average Water Quality in the Grassmere Creek Drain

Parameter	Average Concentration	Unit
Ammonia (NH_3)	0.22	mg/L
Biochemical Oxygen Demand	4.0	mg/L
Escherichia coli	3657	CFU/100 ml
Nitrogen Dissolved NO_3 & NO_2	0.46	mg/L
Nitrogen Total Kjeldahl (TKN)	2.4	mg/L
Oxygen Dissolved	8.6	mg/L
Phosphorus Total (P)	0.4	mg/L
Conductivity (at 25C)	1011	uS/cm
Total Suspended Solids (TSS)	69	mg/L
Turbidity	38	NTU

Parameters below the detectable limit were assumed to be at the detectable limit for the purposes of averaging.

Table C: Average Water Quality in the Red River at Selkirk

Parameter	Average Concentration	Unit
Ammonia (NH_3)	0.28	mg/L
Biochemical Oxygen Demand	2.4	mg/L
Escherichia coli	84	CFU/100 ml
Nitrogen Dissolved NO_3 & NO_2	0.82	mg/L
Nitrogen Total Kjeldahl (TKN)	1.74	mg/L
Oxygen Dissolved	9.2	mg/L
Phosphorus Total (P)	0.35	mg/L
Conductivity (at 25C)	823	uS/cm
Total Suspended Solids (TSS)	164	mg/L
Turbidity	99	NTU

Parameters below the detectable limit were assumed to be at the detectable limit for the purposes of averaging.

The effluent from the aerated lagoon is expected to meet the Provincial and Federal effluent regulations which include limits of 25mg/L BOD_5, 25mg/L TSS, 200 fecal coliform/100 ml sample, 1.0 mg/L total phosphorus and 1.25 mg/L un-ionized ammonia, expressed as (N).

Based on the average concentrations shown in Table B, the Grassmere Creek Drain has an average E-coli and TSS concentration above the discharge requirements of the lagoon and lower average concentration of BOD_5, total phosphorus and ammonia.

The Grassmere Creek Drain had high E-coli readings in 2002 and 2003, from 2006 – 2013 the average e-coli results are 47 CFU/100 ml.

Based on the average concentrations shown in Table C, the Red River at Selkirk has an average TSS concentration above the discharge requirements of the lagoon and lower average concentration of BOD_5, E-coli total phosphorus and ammonia.

2.5.4 Access Road

To access the lift stations, lagoon, truck dump and sewage treatment building, an access road approximately 660 m long will be constructed. The access road will be constructed north of the aeration cells. The road structure will include 150 mm A-Base, 200 mm C-Base and a non-woven geotextile on a compacted subgrade. In accordance with the 1993 RM of Rockwood Municipal Standards, the road will have a surface width of 6.1 m, with a 3% cross fall and 4:1 side slopes. The road surface will be placed 0.6 m above existing ground. Ditches will be constructed along the road to keep the subgrade dry. The road ditches will drain east towards the King Edward Road.

3.0 LAGOON SIZING

3.1 Population Contributing Effluent

The four main contributors to the proposed lagoon are:

- the community of Stony Mountain residential population
- trucked septic tank cleanouts from the Bristol Pipeline and general RM of Rockwood septic tank cleanouts
- an industrial park near Stony Mountain
- the Stony Mountain Institute.

A summary of the population contributing effluent from each group is provided in Table D, below. For more detailed population breakdowns see Section 3.0 of the *RM of Rockwood – Stony Mountain and SMI Lagoon Upgrade Preliminary Design Report* attached in Appendix C.

Table D: Summary of total 25 year (2039) design equivalent populations contributing effluent to the facility

Description	Number of Equivalent People* Design Year 25 (2039)
Community of Stony Mountain (including bussed-in students and commercial workers)	3,452
Bristol Pipeline and RM of Rockwood rural residents (on septic tanks)	469
Industrial Park	94
Stony Mountain Institute (inmates and staff)	1,578
Total	**5,593**

* Equivalent populations based on time spent at respective facility

3.2 Lagoon Loading

3.2.1 Organic Loading

The organic loading calculation is based upon the organics in typical residential wastewater and septage. The organic loading from SMI was based on past wastewater test results for similar facilities completed by Correctional Service Canada. A summary of the projected organic loading in design year 25 (2039) is described in Table E, below.

Table E: Summary of total 25 year (2039) design organic loading to the facility

Description	Organic Load (kg BOD_5/day)
Community of Stony Mountain	262.4
Septic Tank Cleanouts	9.9
Industrial Park	7.1
Stony Mountain Institute	235.8
Total	**515.2**

For a detailed breakdown of the organic loading see *RM of Rockwood – Stony Mountain and SMI Lagoon Upgrade Preliminary Design Report* Section 3.0 attached in Appendix C.

3.2.2 Hydraulic Loading

The hydraulic loading calculation is based upon available lift station meter readings, infiltration rates and typical wastewater production rates. A summary of the projected hydraulic loading in design year 25 (2039) is described in Table F, below.

Table F: Summary of total 25 year (2039) design hydraulic loading to the facility

Description	Average Day Flow (m^3)
Community of Stony Mountain	1,605
Septic Tank Cleanouts	9
Industrial Park	24
Stony Mountain Institute	1,022
Total	**2,660**

The storage capacity of the lagoon based on design year 25 loadings is 478,800 m^3 with 180 days of storage.

For a detailed breakdown of the hydraulic loading see *RM of Rockwood – Stony Mountain and SMI Lagoon Upgrade Preliminary Design Report* Section 3.0 attached in Appendix C.

4.0 LAGOON STORAGE CAPACITY

4.1 Lagoon Storage Period

Typically, facultative lagoons are required to maintain 230 days of storage (November 1 to June 15). Discussions have been completed with Manitoba Conservation to allow for discharge earlier in the spring (April 16) due to enhanced treatment from aeration of the primary cells, chemical addition and sand filtration and UV disinfection.

JRCC is hereby requesting an allowable discharge period of April 16 to October 31 (166 days of winter storage).

The storage cells will be sized to accommodate storage from November 1 to April 30 (180 days of winter storage) to provide a small buffer for spring conditions hindering early discharge.

4.2 Storage Cells

The proposed aerated lagoon system will utilize two aerated primary cells for wastewater treatment and utilize all four existing lagoon cells and two new lagoon cells as storage cells. The following section describes the lagoon storage cells.

The four existing lagoon cells, Stony Mountain Primary Cell, Stony Mountain Secondary Cell, Stony Mountain Institute Primary Cell and the Stony Mountain Institute Secondary Cell will be utilized for effluent storage. The Stony Mountain Institute cell dikes will be raised by 1.0 m. A new cell will be constructed east of the existing Stony Mountain Institute Lagoon and a cell will be created between the existing RM of Rockwood Lagoon and the Stony Mountain Institute Lagoon to provide additional storage capacity.

For a detailed breakdown of each storage cell including, elevations, dike dimensions, storage volumes, proposed cell upgrades, etc. see *RM of Rockwood – Stony Mountain and SMI Lagoon Upgrade Preliminary Design Report Section 4.0* attached in Appendix C.

4.2.1 Storage Cell 5 Sizing

The proposed Storage Cell 5 was not sized based on the required hydraulic storage of the system, but rather the cell was sized to utilize all available land east of the existing Stony Mountain Institute lagoon cells. A portion of the land was not available for lagoon expansion due to a 300 m setback from an existing residence. The remainder of the land was utilized resulting in a minimum setback of 312 m from the lagoon to the nearest residence.

The additional cost to construct Storage Cell 5 larger than required, to utilize all available area, would be lower than construction of a smaller cell at this stage and construction of an expansion cell in the future.

4.2.2 Secondary Cell Aeration Requirements

The cells will be designed with a maximum operating depth of 1.5m for Storage Cells 1 and 2, 2.5 m for the storage cells 3, 4 and 5 and 1.0 m for cell 6. A storage cell operating depth of 2.5 m would have some risk of the effluent becoming anaerobic and decreasing the wastewater quality unless additional aeration is provided to the cell. An operating depth in the cells of 2.1 m would have significantly less risk of the effluent becoming anaerobic.

The lagoon will be constructed with a maximum liquid level of 2.5 m but operated in Phase I with a maximum liquid level of 2.1 m and thus a linear aeration system would not be required in Cell 5 until design year 39 (2053) based on 180 days of wastewater storage.

Prior to design year 39, Phase II of the lagoon expansion will be constructed which involves installation of a linear tubing aeration system in Cell 5 with two 25 hp blowers (1 duty, 1 standby) installed in the sewage treatment building. The storage cell aeration system will provide 310 cfm of air to the cell. The sewage treatment building will be designed so the additional blowers can be easily added.

After design year 39 once the aeration system in Cell 5 is operational, all discharging of Storage Cells 3 and 4 will occur through Storage Cell 5 which would allow Cell 3 and Cell 4 to operate at the deeper depth of 2.5 m. Aeration of Storage Cell 3 and 4 passing through Storage Cell 5 will provide final polishing of the effluent prior to discharge.

Once Phase II is constructed, the aeration system will not need to operate year round as the liquid level in the cells will not exceed the 2.1 m operating depth, except in mid winter. The blowers will need to be operated from late fall, to ensure the aeration lines do not freeze, until the spring discharge is completed. The blowers can be turned off after the spring discharge until late fall.

4.2.3 Phase I – Total Storage Capacity

The proposed lagoon will have a total storage capacity from all 6 storage cells of 602,947 m^3 with a maximum operating level of 2.1 m. The proposed storage capacity is well beyond the design year 25 projected storage requirements of 478,800 m^3 based on 180 days of storage.

The lagoon would be suitable to design year 39 (2053) based on the projected populations and lagoon loadings with 180 day of storage.

4.2.4 Phase II – Total Storage Capacity

Once Phase II of lagoon construction is completed, the proposed lagoon will have a total storage capacity from all 6 storage cells of 711,812 m^3 with a maximum operating level of 2.5 m. The additional storage capacity would allow the lagoon to meet the design year 49 (2063) based on the projected populations and lagoon loadings with 180 day of storage.

5.0 LAGOON SEWAGE TREATMENT

5.1 Lagoon Treatment Requirements

A review of the *Wastewater System Effluent Regulations* June 28, 2012 and the *Manitoba Water Quality Standards, Objectives and Guidelines* November 28, 2011 was completed. The following table summarizes the treatment requirements:

Parameter	Federal Requirement	Provincial Requirement
$CBOD_5$	25 mg/L	25 mg/L
BOD_5		25 mg/L
Suspended Solids	25 mg/L	25 mg/L
Un-ionized Ammonia expressed as nitrogen (N) at 15°C	<1.25 mg/L	
Fecal Coliforms		200 per 100 mL
Phosphorus		1.0 mg/L

A sewage test sample was taken on April 23, 2014 to assess the nutrients in the existing lagoon cells. The following table summarizes the un-ionized ammonia and the phosphorous in the lagoon:

Parameter	RM Rockwood Stony Mountain		Stony Mountain Institute	
	Primary Cell	Storage Cell	Primary Cell	Storage Cell
Un-ionized ammonia	0.12 mg/L	0.11 mg/L	0.10 mg/L	0.06 mg/L
Phosphorus	4.09 mg/L	2.88 mg/L	1.71 mg/L	1.53 mg/L

Lab test results are available in Appendix C of the *RM of Rockwood – Stony Mountain and SMI Lagoon Upgrade Preliminary Design Report Section 5.0* attached in Appendix C of this report.

5.2 Lagoon Treatment Equipment

The proposed lagoon will treat BOD from the wastewater utilizing two deep aerated primary cells operated in series each with a combined retention time of 50 days at design year 25 flow rates. Air will be provided to the cells with two 40 hp blowers with a third on standby. The blowers will provide 1152 cfm through HDPE headers, floating laterals and fine bubble diffusers.

The peak hydraulic design flow rate of the treatment equipment (filters, UV, pumps) was calculated at 3,698 L/min based on a peak day flow of 1.6 times the average day flow, including rainfall in a maximum month with 20 hours per day for treatment.

Four 2.74 m diameter continuous gravity upflow sand filters with ferric chloride addition will be utilized to reduce phosphorus to < 1 mg/L.

UV disinfection will be completed with a Trojan UV Fit 32AL50 UV disinfection system designed with a minimum UVT of 40%.

A sewage treatment building will be constructed to house the treatment equipment as well as an office, washroom, etc. The building will be pre-engineered steel with a brick veneer exterior with a footprint of 340 m^2.

Treated effluent from the sewage treatment plant building will be directed into the storage cells during the winter storage period and directly to the ditch along King Edward Road during the summer discharge period.

Two lift stations will also be constructed as part of the works. Currently, both Stony Mountain and SMI have gravity sewer lines feeding the existing lagoons. With the new aeration cells at a higher elevation than the existing lagoon cells, lift stations are required to pump effluent into the cells. Flow meters will be installed in the lift stations to separately meter the flows from the RM of Rockwood and SMI.

For more details on the aerated primary cells, aeration system, peak flow rate calculations, filters, UV system, building, pump systems see *RM of Rockwood – Stony Mountain and SMI Lagoon Upgrade Preliminary Design Report Section 5.0* attached in Appendix C.

6.0 TOPOGRAPHY AND GEOTECHNICAL REVIEW

6.1 Geotechnical Investigations

A total of four geotechnical investigations have been completed for the RM of Rockwood and Stony Mountain lagoon sites as follows:

- March 2010 by JRCC
- December 2010 by Trek
- October 2011 by JRCC
- March 2014 by AMEC.

The investigations determined that the existing lagoon dikes have a soil profile consisting of topsoil followed by high plastic clay followed by a wet silt layer followed by high plastic clay. The investigations determined the existing lagoons have a sufficient horizontal liner but the vertical cut-off walls were not extended through the silty layer and the lagoons are likely leaking horizontally from the cells. It was determined that the SMI lagoon is leaking more severely than the RM of Rockwood lagoon.

Monitoring well sampling during the investigations determined that the aquifer has not been impacted by the leaking cells.

Test holes in the proposed new cell areas found a soil profile consisting of:

- topsoil (21/21 test holes)
- medium plastic, silty clay (16/21 test holes)
- silty, sandy, low plastic clay (21/21 test holes)
- high plastic clay (21/21 test holes)
- low plastic clay till (6/21 test holes).

The high plastic clay layer was deemed suitable for use as an insitu clay liner with vertical cut-off walls extending into the high plastic clay layer.

As part of the lagoon expansion a cut-off wall through the silty clay layer will be constructed surrounding the existing and proposed lagoon cells resulting in a horizontal and vertical clay liner with a hydraulic conductivity of less than 1×10^{-7} as per Manitoba Conservation requirements.

The complete summaries of the past investigations can be found in *RM of Rockwood – Stony Mountain and SMI Lagoon Upgrade Preliminary Design Report Section 2.1* attached in Appendix C.

6.2 Topography

A topographic GPS survey of the existing ground at the lagoon and the proposed lagoon expansion site was completed in October of 2013 using GPS survey equipment. The top of dike elevation of the SMI lagoon was 235.0 m and the existing top of dike elevation of the RM lagoon was found to be 236.00 m.

The lands around the lagoons gently slope from the northwest at an elevation of 236.0 m to the southeast at an elevation of 233.0 m.

For details see *RM of Rockwood – Stony Mountain and SMI Lagoon Upgrade Preliminary Design Report* Section 2.2 attached in Appendix C.

7.0 LAGOON OPERATION, MAINTENANCE AND DECOMMISSIONING

7.1 Operation and Maintenance

Maintenance of the aerated lagoon will include:

- Lagoon Cells and Access Roads
  - Maintaining the fencing, gate and lock
  - Ensuring the gate is locked at all times and only the local septic haulers and RM Public Works department have access to the site
  - Maintaining the intercell and discharge piping and valves
  - Maintaining grass cover on dikes to a height of no more than 0.3 m in height
  - Maintain a program to prevent and remove burrowing animals
  - Maintain truck turnaround area and spillway
  - Clearing of snow from the lagoon access road, truck turnaround area and spillway
  - Complete effluent sampling prior to discharge.
- Sewage Treatment Equipment
  - Monitor and service lift station pumps and meters
  - Record and monitor mag meters readings and lift station hour meters
  - The diffuser membranes will require minimal cleaning and maintenance. For cleaning, additional airflow will be introduced to the diffusers causing the membrane pores to flex, temporarily breaking off any formed precipitation or fouling. No chemical cleaning or water wash will be required
  - Diffusers will require replacement in approximately 12 years
  - Aeration blowers will require filter changes every 6 months, oil changes every year and belt replacement every 2 years
  - Refilling phosphorus reduction chemical and adjusting dosage rates based on laboratory testing of the lagoon effluent
  - Sand filters will require an airlift replacement once per year
  - Check UV bulbs and complete manual bulb cleaning where required. The UV will be equipped with an automatic wiping system as well as a chemical cleaning system to reduce operator maintenance
  - General building cleaning and maintenance.

7.2 Sludge Management

7.2.1 Aerated Primary Cells

In a typical facultative lagoon, solids in wastewater will settle to the bottom of the cell and accumulate as sludge. Oxygen is not available at the bottom of a facultative lagoon cell and thus the anaerobic sludge will accumulate over time. Based on past experience with facultative lagoons in Manitoba, sludge will require removal approximately every 20 – 25 years.

With aerated primary cells, the diffusers are suspended near the bottom of the cells which blow fine bubbles up through the wastewater. Wastewater will rise with the bubbles and fall between the diffusers creating convection currents within the aerated primary cells. Solids in the wastewater will fall through the downward motion of the wastewater between the diffusers. When the sludge reaches the bottom of the cell, oxygen provided by the diffusers allow aerobic sludge digestion to take place at the sludge-wastewater interface. The process results in minimal organic sludge accumulation in the cells.

Backwash from the sand filters will be sent to the primary cell which contains phosphorus and suspended solids. This will accumulate in the primary cell as well. The sludge from the filter backwash will also undergo aerobic sludge digestion with the oxygen provided by the diffusers to reduce the quantity of sludge in the cells.

Sludge accumulation projections were provided by Nelson Environmental Inc based on typical wastewater influent characteristics. It was calculated that the lagoon will generate approximately 12,356 m^3 of sludge over a 20 year time period. The total surface area in primary cell 1 and 2 is approximately 23,250 m^2 which results in an average sludge depth in the cells of 0.53 m.

After 20 years the actual sludge accumulation in the aerated primary cells should be evaluated and removed if the actual depth is 0.5 m or greater.

7.2.2 Existing Primary Cells

The existing SMI primary cell has been in operation since the mid 1960s and the RM of Rockwood primary cell has been in operation since the early 1990s. According to local lagoon operators the RM of Rockwood lagoon has not had the sludge removed since the lagoon was put into operation approximately 22 years ago. The SMI lagoon had the sludge removed by Assiniboine Injectors approximately 10 - 12 years ago.

Sludge accumulation in the existing primary cells (future storage cells) is not expected to increase significantly once the aerated primary cells and filtration system is installed as the storage cells will be receiving fully treated effluent. The sludge will not be removed from any of the existing cells as part of the lagoon upgrade and expansion works. Removing the sludge from the existing cells would provide slightly more storage capacity in the cells at a high cost. The expanded lagoon will have storage capacity well beyond design year 25 and thus removing the sludge to provide additional capacity is not required.

7.3 Lagoon Decommissioning

The existing lagoon cells will not be decommissioned as part of the lagoon upgrade and expansion works.

No date has been set for decommissioning of the upgraded and expanded lagoon system. Phase I of the lagoon system is designed for design year 39 loadings and Phase II is designed for design year 49 loadings, but with proper operation and maintenance could last well beyond the design period.

8.0 POTENTIAL ENVIRONMENTAL IMPACTS

The biophysical and socioeconomic environment as related to the development, and potential impacts of the development on the environment.

8.1 Releases to Air, Water, Land

8.1.1 Air

In general, **facultative** lagoons may generate some odours for a short time each spring during the thawing or turn-over period when water temperature inversion causes turbulence in the lagoon cells and gases produced from the anaerobic treatment process are brought to the surface. **Aerated** lagoons provide oxygen to the wastewater year round which prevents the lagoon from becoming anaerobic which greatly reduces the potential for odours.

There is a potential for greenhouse gas emissions during construction works from heavy equipment and transport vehicles. Impacts from dust generation are not expected as the construction area will meet the minimal setback distances from residences.

Environmental management practices to mitigate the above potential impacts to the air are provided in Section 9.1 of this report.

8.1.2 Water

Pollutants that may be released into surface and ground water during the operation of the lagoon include coliforms, organic wastes, suspended solids, and other materials that are typically disposed of into the sewer system in the RM of Rockwood. Pollutants in the wastewater produced by the community are expected to be residential in nature.

Pollutants that have a potential to be released into the surface or groundwater during the lagoon upgrade construction activities, include petroleum hydrocarbons (PHCs) from heavy equipment and sediments from soil erosion.

Surface Water

Surface water may be impacted if the wastewater is not sufficiently treated and subsequently discharged from the lagoon. Effluent discharged from the lagoon would flow into the Grassmere Creek and eventually reach the Red River at Selkirk. There is also potential to impact surface water via sedimentation from soil erosion in the discharge stream during the construction works.

The discharge from the lagoon should not cause or contribute to flooding in or along the drainage route. The lagoon would not be discharged during flood conditions. There is no potential to impact the navigation of surface waters as a result of the lagoon project, as the proposed drainage route to the Red River is not a navigable body of water.

Groundwater

There is a potential for groundwater impacts if wastewater leaks/seeps through the lagoon liner or forcemain pipe and into the groundwater below. There is also a potential for groundwater impacts from equipment leaks or fuel spills during construction.

Environmental management practices to mitigate the above potential impacts to water are provided in Section 9.2 of this report.

8.1.3 Land

The land would be significantly altered by construction of the new lagoon dikes, perimeter ditching and access road. A building would also be constructed north of the lagoon.

Pollutants that may be released to the land are predominantly petroleum hydrocarbons (PHCs), which could be released during construction activities. Equipment leaks, or re-fuelling incidences, could result in an impact to the land as a result of construction activities.

Disturbed areas can be impacted through soil erosion if not covered or re-vegetated. Environmental management practices to mitigate the above potential impacts to the land are provided in Section 9.3 of this report.

8.2 Wildlife

The proposed lagoon site is located in the "Lake Manitoba Plain" Ecoregion of Canada. Characteristic wildlife includes white-tailed deer, coyote, rabbit and ground squirrel. Bird species include waterfowl.

The Manitoba Conservation Data Centre was contacted regarding the proposed lagoon project and indicated that there were no occurrences of rare species at the proposed lagoon expansion site in their database. Refer to the Manitoba Conservation Wildlife and Ecosystem Branch, May 1, 2014 email correspondence, attached in Appendix B.

Impacts to wildlife and wildlife habitat are not expected, as the lagoon expansion is to be located on agricultural land which is regularly disturbed by farming activities.

8.3 Fisheries

Impacts to fish along the discharge route are unlikely as the lagoon effluent would be discharged after fish spawning has normally occurred and only when the treated effluent meets current Manitoba Conservation water quality guidelines for surface discharge.

8.4 Forestry

There are no potential impacts to forestry as the area of lagoon expansion has been previously cleared due to agriculture and no forestry areas would be impacted.

8.5 Vegetation

Characteristic vegetation in the Lake Manitoba Plain ecoregion is classified as being a transitional area between areas of boreal forest to the north and aspen parkland to the southwest. It is a mix of trembling aspen/oak groves and rough fescue grasslands.

Manitoba Conservation Wildlife and Ecosystem Protection Branch was contacted regarding occurrences of rare or endangered vegetative species in their database at the proposed lagoon expansion site. There were no occurrences of rare species identified at the development site. Refer to Manitoba Conservation Wildlife and Ecosystem Protection Branch email correspondence dated May 1, 2014, attached in Appendix B.

No significant impacts to vegetation in the development area are anticipated, as the site is currently agricultural land which is disturbed regularly through farming activities.

8.6 Noise Impacts

There is a potential for noise impacts in the immediate area due to the heavy equipment utilized during construction. Mitigation measures described in Section 9.4 below will be in place during the construction works.

The blowers within the building will have self-contained sound attenuation enclosures which will limit the sound levels to approximately 73 dB(A). The only other potential sources for noise impacts will be the maintenance vehicles (for lagoon effluent sampling or mowing grass), septic hauling trucks, and periodic chemical delivery trucks.

8.7 Health and Safety

There is a potential for impacts to the health and safety of workers and the public during the construction works. Mitigation measures described in Section 9.5 below will be in place during the construction works.

8.8 Heritage Resources

The Manitoba Historic Resources Branch was contacted regarding the proposed site. The Historic Resources Branch indicated that the potential to impact significant heritage resources is low and that they have no concerns with the project. Refer to the Manitoba Historic Resources Branch May 13, 2014 e-mail correspondence, attached in Appendix B.

While impacts to historic or heritage resources are not expected at the site, there is a potential for an unexpected discovery when excavating an area which has not previously been excavated. Mitigation measures described in Section 9.6 below will be in place during the construction works.

8.9 Socio-Economic Implications

The lagoon expansion is not expected to have adverse socio-economic impacts. In fact, construction related economic activity is likely to have a positive economic impact on the Community of Stony

Mountain. In addition, Stony Mountain and SMI would have increased wastewater capacity upon completion of the project, which will encourage future development and growth.

8.10 Aesthetics

The lagoon expansion is not expected to have adverse impacts on the general aesthetics of the area, as the lagoon construction would occur adjacent to the existing lagoon cells.

9.0 MANAGEMENT PRACTICE

Proposed environmental management practices to be employed to prevent or mitigate adverse implications from the impacts identified above.

9.1 Mitigation of Impacts to Air

To reduce the potential for odour nuisance in the community, the primary cell aeration system will be sized for the projected year 25 organic loadings, from the contributing populations. Nuisance odours as a result of organic loading are not expected due to the aeration system maintaining aerobic conditions year round.

Furthermore, the proposed lagoon upgrade/expansion would be located a minimum of 300 metres from the nearest resident, as required by Manitoba Conservation.

Specifications should indicate that emissions from construction equipment and transport vehicles shall be controlled through regular maintenance, and shall meet all provincial and local standards. Dust suppression methods (i.e. water spraying) should be utilized at the construction site if dry conditions create excessive dust through construction activities and transport, which becomes a nuisance to nearby residents. Due to the setback distance, it is unlikely that dust will have any impact on the community or to nearby residents.

9.2 Mitigation of Impacts to Water

9.2.1 Surface Water

Impacts to surface water from discharge of lagoon effluent are not expected, as the lagoon effluent would not be discharged unless Provincial and Federal discharge requirements are met, as follows:

1. The organic content of the effluent, as indicated by the five day biochemical oxygen demand would not be greater than 25 mg/L
2. The total suspended solids would not be greater than 25 mg/L
3. The fecal coliform content of the effluent, as indicated by the MPN index would not be greater than 200 per 100 ml of sample, or Escherichia coli content not greater than 200 per 100 ml of sample.
4. The total phosphorus content of the effluent would not exceed 1 mg/L
4. The un-ionized ammonia expressed as nitrogen (N) at 15^0C content of the effluent would not exceed 1.25 mg/L.

Erosion from excess material stockpiles would be prevented by the use of silt fencing at drainage locations and by either covering the soil stockpiles or seeding with grass. Clean rock (free of fine materials) from an appropriate land-based source would be utilized to eliminate occurrence of erosion at the lagoon discharge outlet. Silt fencing would be installed in the perimeter ditching during construction and should remain in place until grass growth is

established. Perimeter ditch slopes would be seeded with grass to control erosion and sediment entry into the discharge route. Disturbance of the soils adjacent to the perimeter ditches and discharge route would be minimized during construction.

To minimize impacts from construction equipment on surface waters, the construction specifications should outline to the contractor the requirements for handling and storage of fuels and hazardous materials during construction, as per Federal and Provincial regulations. The specification should state wording similar to the following:

- Diesel or gasoline should be stored in double walled tanks or have containment dikes around fuel containers for volumes greater than 68.2 L (15 gallons) or in compliance with provincial regulations
- Clean up material should be available at the site, consisting of a minimum of 25 kg of suitable commercial sorbent, 30 m^2 of 6 mil PVC, and an empty fuel barrel for spill collection and disposal
- Fuel storage and hazardous material areas established for project construction should be located a minimum of 100 m from a waterbody, and comply with provincial regulations
- Waste hazardous materials from construction activities and equipment must be properly collected and disposed of in compliance with provincial regulations
- In the event of spills or leaks of fuels and hazardous materials, the contractor or operator should notify the project engineer and Provincial Authorities.

Hazardous material handling and storage are to follow all Provincial and Federal regulations including WHMIS and spill containment requirements.

The specifications should state that when working near water with construction equipment:

- Construction equipment is to be properly maintained to prevent leaks and spills of fuels, lubricants, hydraulic fluids or coolants
- There can be no re-fueling or servicing of construction equipment within 100 m of a water body.

There would be no impacts to navigation as a result of the lagoon project, as the discharge route to the Red River is not a navigable body of water. If flooding occurs along the drainage route, the RM must not discharge the lagoon. The discharge should not cause or contribute to flooding in or along the drainage route.

9.2.2 Groundwater

Seepage of effluent from the lagoon is unlikely to affect groundwater as the new lagoon primary cells and storage cell extensions would utilize a clay liner, having a hydraulic conductivity less than 1 x 10^{-7} cm/sec, as required by Manitoba Conservation guidelines.

Mitigation of potential impacts to groundwater during the lagoon construction activities from fuel handling, equipment leaks or fuel spills, would follow the same procedures as described in Section 9.2.1 above.

9.3 Mitigation of Impacts to Land

The lagoon will utilize the insitu high plastic clay as the horizontal liner under the existing and proposed wastewater treatment lagoon cells. A vertical cut-off wall will be extended through the silty clay layer into the high plastic clay layer surrounding the new and proposed lagoon cells to completely seal the lagoon.

To minimize the potential for the release of Petroleum Hydrocarbon (PHC) pollutants into the soil, the mitigation measures described in Section 9.2.1 above outlining fuel-handling procedures should be followed.

To minimize the potential for slope erosion, the outside slopes of the dikes would be constructed with a 4:1 slope and the dike tops, outside slopes and soil stockpiles would be seeded with grass. The discharge outlet location would be covered with rip-rap to eliminate soil erosion into the ditch during discharge events.

9.4 Mitigation of Noise Impacts

To minimize the potential for noise impacts, specification should indicate that construction equipment and transport vehicles should have mufflers working properly, and construction activities should be limited to daylight hours only.

The aeration blowers would have self-contained sound attenuation enclosures which will should limit the sound levels to approximately 73 dB(A).

9.5 Mitigation of Impacts to Health and Safety

To minimize impacts to health and safety of workers and the public, the construction specifications should state that the Contractor have a safety program in place, in accordance with all Federal and Provincial Health and Safety Regulations. During construction, site access will be limited to the construction crew only. Personal protective equipment will be worn in accordance with the Contractor's safety program.

9.6 Mitigation of Impacts to Heritage Resources

If any significant historic or heritage resources are discovered in the course of excavation or construction, the specifications should identify that works are to temporarily cease and an investigation of the site is to be conducted by the RM, Manitoba Historic Resources Branch and any other authority as may be required.

10.0 RESIDUAL AND CUMULATIVE EFFECTS

Residual environmental effects remaining after the application of mitigation measures, to the extent possible expressed in quantitative terms relative to baseline conditions

No negative residual effects are anticipated through the construction and operation of the upgraded wastewater treatment lagoon, due to the mitigation measures described above. Positive residual effects are expected from the properly sized wastewater treatment system, which will allow for future development and expansion of SMI and the RM of Rockwood.

11.0 MONITORING AND FOLLOW-UP

Proposed follow-up activities that will be required at any stage of development (eg. Monitoring, inspection, surveillance, audit, etc.)

Monitoring of the lagoon operation is to be conducted by a trained lagoon operator, who is to ensure the lagoon is operated under the requirements of the environmental licence. The operator is to ensure liquid levels in the lagoon cells are maintained within the required limits, conduct sampling of lagoon effluent prior to discharge, and is to ensure water quality guidelines as described in the environmental licence are met. The lagoon operator would also be responsible for the operation and maintenance activities described in Section 7.1.

The construction contractor is to ensure that grass growth occurs on slopes and disturbed areas, after the construction activities are completed.

12.0 FUNDING AND APPROVALS

Name and address of any Government Agency or program (federal, provincial or otherwise) from which a grant or loan of capital funds have been requested (where applicable). Other federal, provincial or municipal approvals, licences, permits, authorizations, etc. known to be required for the proposed development, and the status of the project's application or approval.

Funding for this project will be through the Rural Municipality and other possible derived sources i.e. MWSB. No additional approvals, licences or permits are required for the lagoon construction and operation.

13.0 PUBLIC CONSULTATION

Results of any public consultations undertaken or to be undertaken in conjunction with project planning.

Public consultation by the RM of Rockwood has not been conducted to date. Public comments will be received by Manitoba Conservation through the public registry during the Environmental Act Proposal review period.

14.0 CONCLUSION

Based on the design of the project and the implementation of the mitigation measures identified in Section 9.0 above, no significant negative environmental impacts are anticipated.

The proponent would like to complete the requirements of the Environment Act Proposal as soon as possible so that the lagoon construction can begin by the time specified in Section 2.5.1 above.

JR Cousin Consultants Ltd. requests that a draft copy of the license be forwarded for review prior to the issue of the final license.

APPENDICES

Appendix A

Rockwood Institution – Boundary Plan

Certificate of Title 18189

Certificate of Title 18194

RM of Rockwood Lease Agreement

South Interlake Planning District June 6, 2014 Email Correspondence

Crown Lands & Property Agency, May 1, 2014 Email Correspondence

Appendix B

Manitoba Conservation and Water Stewardship Fisheries Branch, May 28, 2014 Email Correspondence

Manitoba Conservation Data Centre, May 1, 2014 Email Correspondence

Manitoba Historic Resources Branch, May 13, 2014 Email Correspondence

Appendix C

RM of Rockwood – Stony Mountain and SMI Lagoon Upgrade Preliminary Design Report

Appendix D

Plan 1: Lagoon Layout Plan with Setbacks to Existing Residences

Plan 2: Lagoon Drainage Route

Appendix A

Rockwood Institution – Boundary Plan

Certificate of Title 18189

Certificate of Title 18194

RM of Rockwood Lease Agreement

South Interlake Planning District June 6, 2014 Email Correspondence

Crown Lands & Property Agency, May 1, 2014 Email Correspondence

Rockwood Institution – Boundary Plan

DETAIL C

SITE ACQUISITION HISTORY

1. **SW 1/4 Sec. 11-13-2 EPM**

1873-08-30.....Surface, mines and minerals set apart and appropriated for penitentiary by P.C. 47, (recorded In Land Title Records as instrument 280374.
2004-03-19.....Current title to surface, mines and minerals showing accumulated authorized exceptions, created in the name of H.M.Q. Canada as No. 2005397.
Area including surface mines and minerals noted on title as Parcel 1.
Areas including mines and minerals only are noted on title as Parcel 2 and Parcel 3.

2. **SE 1/4 Sec. 11-13-2 EPM**

a) **1873-08-30**.....Surface, mines and minerals to Legal Subdivision 1 and S 1/2 Legal Subdivision 8, set apart and appropriated for penitentiary by P.C. 47 (LTO Inst. 280374).
Area remaining after authorized exceptions, remains under provisions of the Registry Act.
b) **1902-05-14 and 1902-06-26**.....Surface, mines and minerals to Legal Subdivision 7, transferred to H.M.Q. Canada by Deed 4630 dated May 14, 1902 and surface, mines and minerals to Legal Subdivision 2 transferred to H.M.Q. Canada by Deed 4696, dated June 26, 1902.
2004-12-02.....Current title to area remaining In Legal Subdivision 7 and 8, including surface, mines and minerals after authorized exceptions, created In the name of H.M.Q. Canada as No. 2057245.
Area including surface, mines and minerals, noted on title as Parcel B, Plan 43321.
Area including mines and minerals only is described on title as Parcel A, Plan 43321, except Parcel A, Plan 16545.

3. **NW 1/4 Sec. 2-13-2 EPM**

1892-09-19.....Surface, mines and minerals transferred to H.M.Q. Canada by Deed 61R (Deed number to be verified).
Area remains under provisions of The Registry Act.

4. **NE 1/4 Sec. 2-13-2 EPM**

1873-08-30.....Surface, mines and minerals to Legal Subdivisions 15 and 16 set apart and appropriated for penitentiary by P.C. 47.
1895-12-13.....Title 18280 to surface, mines and minerals In NE 1/4 Sec. 2-13-2 EPM created In the name of H.M.Q. Canada.
Title Is subject to Caveat 250741 by Manitoba Telephone System as shown on plan.

5. **SE 1/4 Sec. 2-13-2 EPM**

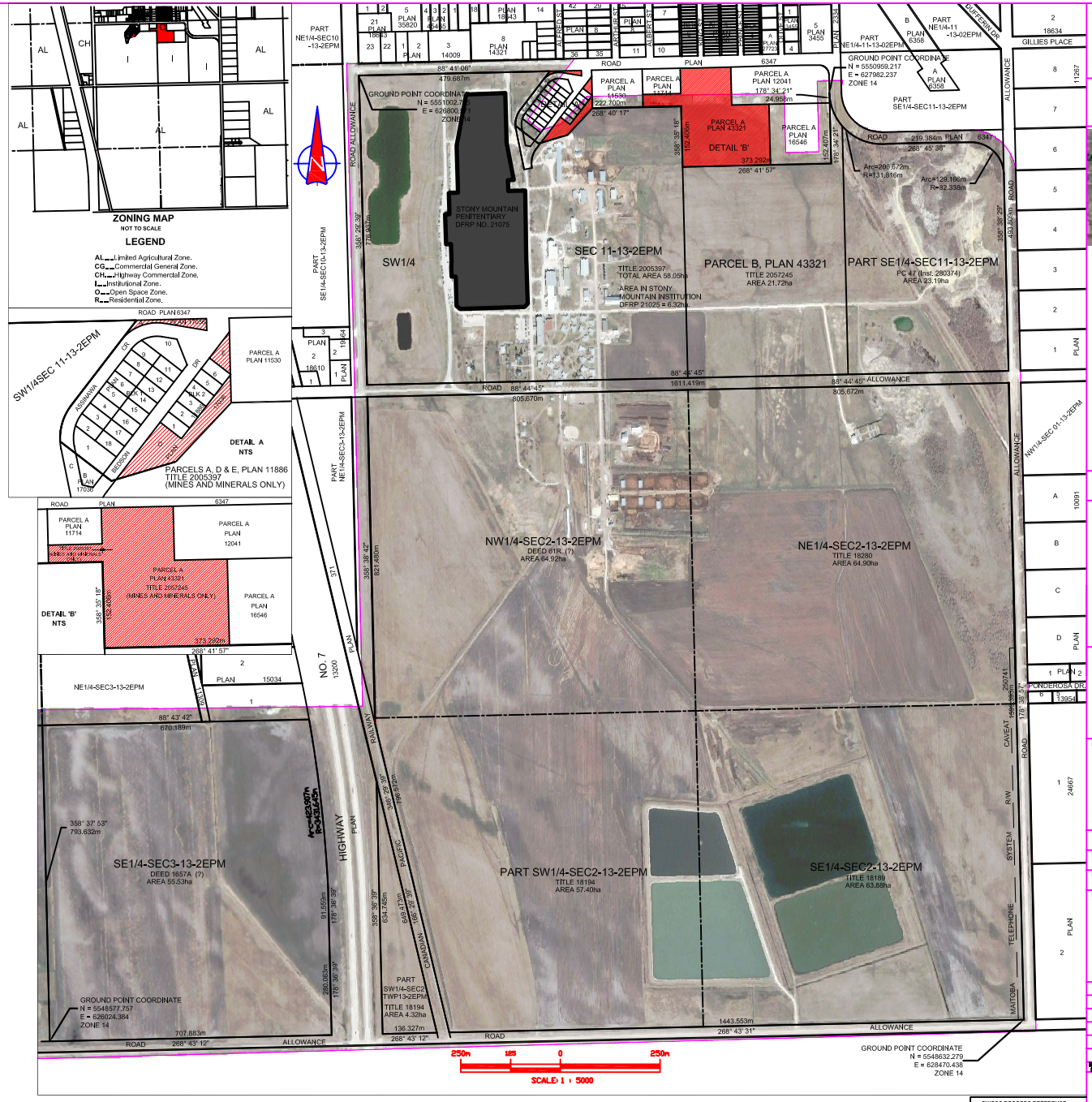
1895-11-27.....Title 18189 to surface, mines and minerals created In the name of H.M.Q. Canada.
Title Is subject to Caveat 250741 by Manitoba Telephone System as shown on plan.

6. **SW 1/4 Sec. 2-13-2 EPM**

1895-11-28.....Title 18194 to surface mines and minerals created in the name of H.M.Q. Canada.
1921-09-28.....Surface mines and minerals within Plan 371 transferred by H.M.Q. Canada to Canadian Pacific Railway.
Surface, mines and minerals to portion within Plan 22956 subsequently transferred by H.M.Q. Canada to Manitoba. (Date of transfer to be verified).

7. **SE 1/4 Sec. 3-13-2 EPM**

1889-10-12.....Surface mines and minerals of described portion transferred to H.M.Q. Canada for Canadian Pacific Railway (Plan 371 - 0.08 acres). Transfer recorded as Deed 1657.
1902-03-28.....Surface mines and minerals to remaining portion transferred to H.M.Q. Canada by Deed recorded as 1657A. (Deed number to be verified).
Surface, mines and minerals to portion within Plan 13200 subsequently transferred to Manitoba. (Date of transfer to be verified).



PWGSC – At – 6412284

Public Works and Government Services Canada
Travaux publics et Services gouvernementaux Canada

REAL PROPERTY SERVICES
Western Region
SERVICES IMMOBILIERS
Région de l'ouest

LOCATION MAP

LEGEND

1. Ground point coordinates, boundaries and designations are derived from Manitoba cadastral fabric data base.
2. Bearings are grid, referred to the central meridian of UTM zone 14 (99° W).
3. Imagery obtained from Google Earth and aligned to the cadastral fabric.
4. Distances are horizontal at ground level.
5. To Convert ground distances to grid, multiply by a combined scale factor of 0.99976.
6. Building outlines are derived from imagery.
7. Site boundaries shown thus ——————
8. Building outlines shown thus. – – – – – –
9. Mines and Minerals held by H.M.Q. Canada shown thus.....
10. All plans of survey referred to are recorded In the Winnipeg Land Titles Office.
11. Land use zoning designation by South Interlake Planning District.
12. Turn on layer G-TL-RME for guide to layering standards

SITE ACQUISITION HISTORY

See Detail C

STATUS OF TITLE OR INTEREST

H.M.Q. ownership to some Parcels is recorded in Land Titles by Titles under the Real Property Act and to other Parcels by entries under the Registry Act.
Copies of records obtained by transmission, mostly of poor quality.
Onsite research of Land Titles Records required.
Road allowance adjoining NW 1/4 and NE 1/4 Sec. 2-13-2-EPM Is not developed and Is being utilized by the Facility. Road Allowance should be legally closed and area transferred to H.M.Q. Canada.

Client/Client

CORRECTIONAL SERVICES CANADA

Project title/Titre du projet

BOUNDARY PLAN
ROCKWOOD INSTITUTION

R.M. ROCKWOOD, MANITOBA

Drawn by/Dessiné par: YSP

PWGSC Committee Project Manager/ Gestionnaire de projet de Travaux publics

PWGSC Professional and Technical Services Manager/ Gestionnaire des services professionnels et techniques: W.V.

Drawing title/Titre du dessin

BOUNDARY PLAN
ROCKWOOD INSTITUTION
SE 1/4 SEC. 2, SEC. 3 AND PARTS SW AND SE 1/4 SEC. 11-13-2 EPM

DFRP PROPERTY NUMBER 12746

Revision/Révision	Description/Description	Date/Date
5		
4		
3		
2		
1		
0	Drawing Completion	

Project No./No. de projet	Sheet/Feuille	Revision no./ No. de révision
422424	1 OF 1	0

PWGSC RECORDS REFERENCE
36-1280

ROCKWOOD INSTITUTION

Certificate of Title 18189

MANITOBA

Cert. No. — 19189

18189

Certificate of Title

UNDER THE REAL PROPERTY ACT

HER MAJESTY THE QUEEN

in the Right of Canada,

is now seized of an estate in fee simple in possession subject to such encumbrances liens and interests as are notified by memorandum underwritten (or endorsed hereon) in all that piece or parcel of land known and described as follows The South East quarter of Section Two in the ~~Thirteenth~~ Township and Second Range East of the Principal Meridian in Manitoba containing One hundred and Sixty acres More or Less.

ADDRESS FOR SERVICE

N.D.

INST TYPE: T/L NO: 2128581

FOR: ROAD PLAN 22956 EXC M & M

REG: 97 10 3 114

NEW TITLE:

Set Consolidated Duty Paced

IN WITNESS WHEREOF I have hereunto signed my name and affixed my Seal of office this Twenty seventh day of November One thousand ~~eight~~ hundred and Ninety five.

Signed in the presence of

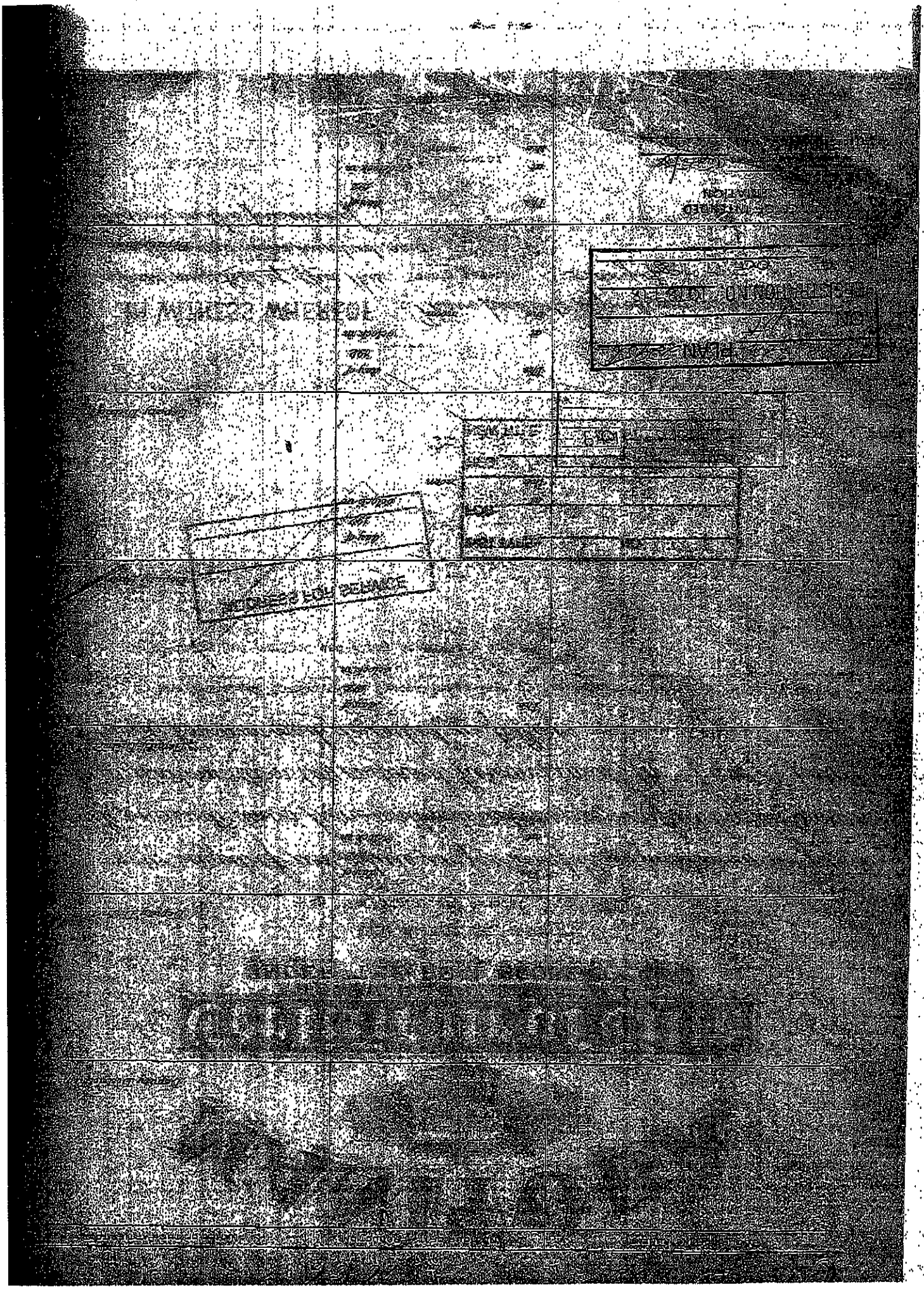
R. A. M. Clifford

W. E. Viscaree

(SEAL)

Deputy District Registrar

for District Registrar



Certificate of Title 18194

18194

MANITOBA

Certificate of Title

UNDER THE REAL PROPERTY ACT

HER MAJESTY THE QUEEN

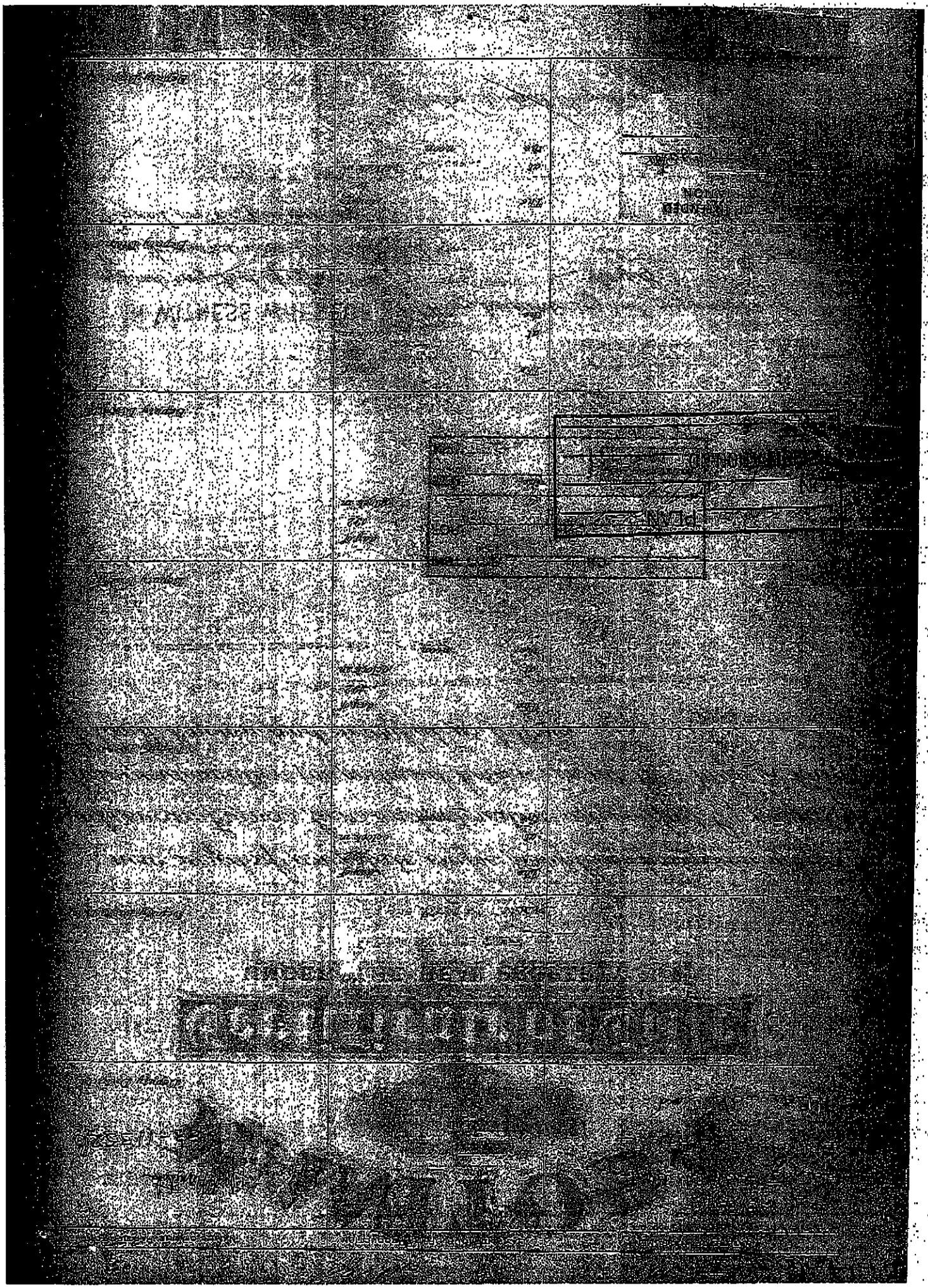
In the Right of Canada

owner in fee simple in possession subject to
such encumbrances liens and interests as are notified by memorial
underwritten or endorsed hereon and to the exceptions mentioned
in section 74 of the Real Property Act of

Section Two in the Fifteenth Township and Second Range East of the Principal Meridian

containing One hundred and sixty acres more or less

IN WITNESS WHEREOF



RM of Rockwood Lease Agreement

DATED THIS 14TH DAY OF JULY, A.D., 1993.

BETWEEN:

HER MAJESTY THE QUEEN – CANADA
(STONY MOUNTAIN INSTITUTION / SMI)

- AND -

THE RURAL MUNICIPALITY OF ROCKWOOD

LEASE AGREEMENT

RE: STONY MOUNTAIN LAGOON

(ROCKWOOD'S BY-LAW #39/93)

This indenture made in triplicate this 14TH day of JULY, A.D., 1993

BETWEEN:

HER MAJESTY THE QUEEN, in Right of Canada, represented herein by the Solicitor General

(hereinafter called "the Lessor")

OF THE FIRST PART

- and -

THE RURAL MUNICIPALITY OF ROCKWOOD

(hereinafter called "the Lessee")

OF THE SECOND PART

WITNESSETH that the Lessor, in consideration of the rents, covenants, provisoes and conditions hereinafter reserved and contained, hath demised and leased, and, by these presents, doth demise and lease unto the Lessee:

ALL AND SINGULAR those certain parcels of land shown as B, C and D in Schedule "A" attached (hereinafter referred to as "the said land") containing approximately 19.81 hectares situate lying and being portions of:

SE 11, NE 2 and S 1/2 Sec.2, Twp.13, Rge.2 EPM near Stony Mountain, Manitoba.

TO HAVE AND TO HOLD the said lands for the term of Twenty Five (25) years commencing on the First (1st) day of April, 1992, and ending on March 31st, 2017.

And paying therefor, to the Lessor, or performing specified services in lieu of such payment, subject to the provisions of this lease, in each and every year of the said term, rent as follows:

(a) for the first five (5) year period of this lease, in lieu of payment, operating the Lessor's existing lagoon in the SE quarter of Section 2, Township 13, Range 2, EPM more particularly shown as Parcel "A" on Schedule "A" attached hereto and forming part of this lease and providing all

necessary day to day operational services including but not limited to operation of the lagoon, ditching, grass maintenance, weed control, periodic discharge of contents as required and not less than once per annum, submission of samples to provincial authorities and obtaining of necessary approvals prior to any discharge;

(b) For succeeding five year periods, rent or performance of services in lieu of rent, determined in accordance with paragraph 10 hereof;

It is agreed that the word "Lessor" when used herein shall mean the Sovereign and shall include the Successors and Assigns of the Sovereign; the word "Lessee" or other words relative thereto, or of like import, shall mean and include, irrespective of gender or number, the party or parties of the second part as above designated or described, and their or any of their successors or assigns; the words "Solicitor General" shall mean the person holding the position, or acting in the capacity, of the Solicitor General, for the time being, or such person duly appointed to act in that behalf.

And further agreed by and between the said parties hereto that these Presents are made and executed upon and subject to the covenants, provisoes, conditions and reservations hereinafter set forth and contained, and that the same and every of them representing and expressing the exact intention of the parties, are to be strictly observed, performed and complied with, namely:

1. (a) That the Lessee will pay all rental herein reserved at the time and in the manner in these Presents set forth, without any abatement or deduction whatever.

(b) That where the Lessee performs services in lieu of payment of rent, such services are to be provided in a first class workmanlike manner to the standard reasonably to be expected from an operator of such a facility and in compliance with all laws, by-laws, regulations and ordinances applicable to such a facility and its operation, or which would otherwise apply if this lagoon was not located on property of Her Majesty the Queen in Right of Canada, without reduction or deterioration in quantity or quality of service for any reason whatsoever, excepting only war, insurrection, acts of nature, or any other circumstances beyond the control of the Lessee by the expenditure of reasonable efforts;

(c) That the Lessee will pay and be responsible for municipal and other taxes, whether general or specific, local improvements and charges and rates of any kind in respect of the said land and hereby acknowledges it shall make no application for any grants in lieu of such taxes, rates or charges.

2. That the Lessee shall comply with all laws, by-laws, regulations and ordinances which apply to the said land and any use thereof, or which would otherwise apply if the said land was not owned by Her Majesty the Queen in Right of Canada.

3. That the Lessee shall not make any assignment of these Presents, nor any transfer or sublease of any of the lands, rights or privileges demised or leased hereunder, without obtaining the consent in writing of the Solicitor General to such assignment transfer or sublease, which consent shall be granted solely at the discretion of the Solicitor General and may be withheld for any reason.

4. That the Lessor, Her servants or agents, shall have full and free access for purposes of surveying or other work, to any and every part of the said land; PROVIDED that the Lessor will take all reasonable care, in entering on the said land, to avoid interference with the operations of the Lessee hereunder.

5. That the said land shall be used for the construction and operation of a 6 metre wide right of way for a wastewater sewer main and sewerage lagoon having a pond area and a buffer zone of 18.85 hectares for a total of 19.81 hectares more particularly shown as parcels B, C, and D in schedule A attached;

6. The lessee shall ensure that the lagoon is utilized for the processing of domestic waste from residential and commercial effluent only and that no industrial wastes or effluent enter. It is agreed however, that in a specific case, on the lessee seeking the Lessor's permission in advance, the lessor may permit entry of such industrial waste or effluent on it being shown to its satisfaction that:

a) it will not cause harm to the lessor's property or the environment, and

b) it is unavoidable except at an expense disproportionate to the harm likely to be caused.

7. No construction, replacement, renovation, or removal shall be performed until:

(i) after submission of detailed plans and specifications to the Lessee and issuance of written approval thereof by the lessee;

(ii) the Lessee has obtained all necessary approvals, licenses, or permits which apply to such work, or which would apply if the said lands were not owned by Her Majesty the Queen in Right of Canada, and in the event no such approval, license or permit can be obtained because the land is owned by Her Majesty the Queen in Right of Canada, the lessee shall demonstrate to the Lessor's satisfaction that it has met the standards which would otherwise have resulted in the issuance of such approval, license or permit.

8. That in respect of the Lessor's lagoon contained within Parcel A and the Lessee's lagoon contained within Parcels B, C and D, the lessee will provide the lessor annually with an operating plan, a repair and maintenance plan and a contingency plan in the event of abnormal flooding or other acts of nature that would adversely affect the operation of the lagoons.

9. That the lessee will on an annual basis, have the effluent from the stabilization ponds on the said lands analyzed by a reputable laboratory and the results submitted to the lessor for his information and action if necessary.

10. That the rental for the next ensuing five (5) year period shall be reviewed and determined three (3) months prior to the expiry of each five (5) year period of the term of this lease or any renewals thereof (the "review date"). The new rental shall be the fair market rent based on the highest and best use of the land which would be payable as between persons dealing in good faith as of the review date. The lessor shall communicate the new rental rate to the Lessee on the review date and the Lessee may dispute the rental by notice in writing received by the Lessor within 30 days after the review date failing which the new rental rate shall be deemed to be final for the next ensuing five (5) year period. If notice is received by the Lessor from the Lessee as above provided and the parties are thereafter unable to agree on a new rental rate, then the determination of the fair market rental for the next ensuing five (5) year period shall be referred to the Federal Court of Canada.

On a rental being determined and final, the Lessor may at its option accept the performance of specified services as hereinbefore set forth in lieu of part or all of the rental which would otherwise be payable.

11. That the Lessee shall have the option to renew this lease prior to the expiration of the term of this lease, for a further term of 10 years on the same terms and conditions save the option to renew and the amount of rental, by providing the Lessor with written notice of the exercise of the option, not later than three (3) months prior to the expiry of the term.

12. That the Lessee shall not have any claim or demand against the Lessor for detriment, damage, injury or loss of any nature whatsoever or howsoever caused to the said land, or to any person or property, including any crop, cattle, motor or other vehicles, farm implements, materials, supplies, articles, effects or things at any time brought, placed, made or being on or about the said land, unless damage or injury is due to the negligence of any officer or servant of Her Majesty the Queen in Right of Canada while acting within the scope of his duties or employment.

13. That no buildings or structures whatsoever, shall be erected by the Lessee on the said land, without the written permission of the Lessor.

14. The lessor shall have the use of the buffer zone for agricultural or other purposes until it is required by the lessee for expansion purposes.

15. That access to the lagoons shall at all times be restricted to the lessor and agents for the lessee who have been listed with and approved by the lessor.

16. That the Lessee shall not construct, erect, place or install on the said land any poster, advertising sign or display without first obtaining the consent, in writing, of the Lessor.

17. That the Lessee shall not discharge, cause or permit to be discharged or howsoever to pass into the lagoon sewer systems, storm drains or surface drainage facilities at the said land or elsewhere any deleterious material, noxious, contaminated or poisonous substances, all as determined by the Lessor whose decision shall be final.

18. That the Lessee shall at all times indemnify and save harmless the Lessor from and against all claims and demands, loss, costs, legal fees, damages, actions, suits or other proceedings by whomsoever made, brought or prosecuted, in any manner based upon, occasioned by or attributable to the execution of these Presents, or any action taken or things done or maintained by virtue hereof, or the exercise in any manner of rights arising hereunder, except claims for damage resulting from the negligence of any officer or servant of Her Majesty the Queen in Right of Canada while acting within the scope of his duties or employment.

19. That the Lessee shall not, during the currency of this Lease, do, cause or permit to be done any act or thing that will interfere or cause interference with the natural drainage on the said land and shall keep the mouths of all under-drains on the said land open and free from obstruction and in good running order at all times during the said term and will not suffer or permit such drains, or the water courses in any open ditches on the said land to become obstructed, but will continuously keep them free and clear of obstruction to ensure the unimpeded escape of the water therein, all at the cost and expense of the Lessee and to the satisfaction of the Lessor.

20. That the Lessee shall not lop, cut down or disturb any trees growing on the said land.

21. That the Lessee shall comply with all federal, provincial, municipal or local environmental protection statutes which apply to the said lands and any use thereof, or which would otherwise apply if the said lands were not owned by Her Majesty the Queen in Right of Canada.

22. Pursuant to the provisions of the statute in such case made and provided, no member of the House of Commons of Canada shall be admitted to any share or part of this Lease, or to any benefit to arise therefrom.

23. That, notwithstanding anything in this Lease contained, if the rent above reserved, or any part thereof, shall be in arrears, or unpaid, whether or not the same shall have been in any manner demanded, or in case default, breach or non-observance be made or suffered by the Lessee at any time or times, in, or in respect of any of the covenants, provisoes, conditions and reservations herein contained, which on the part of the Lessee ought to be observed or performed, then, and in every such case, provided such non-payment of rent, default, breach or non-observance is not cured within thirty days from the date of notice thereof in writing

from the Lessor to the Lessee and signed by or on behalf of the Solicitor General, the Lessor may terminate this Lease by giving to the Lessee thirty (30) days notice in writing signed by or on behalf of the Solicitor General, and either delivered to the Lessee or any officer of the Lessee, or mailed addressed to the last known place of business or office of the Lessee, at any of Her Majesty's Post Offices, and thereupon, after the expiration of such period of notification, this Lease shall be ended, but the Lessee shall not, by reason of any action taken or things performed or required under this Clause, be entitled to any compensation whatever; Provided that, unless required by the Solicitor General, no goods, chattels, materials, effects or things shall be removed from the premises of the Lessor until all rent due or to become due under this Lease is fully paid.

24. That, notwithstanding anything in this Lease contained, if the rent above reserved or any part thereof, shall be in arrear, or unpaid for thirty days (30) next after any of the days or times hereinbefore appointed for payment thereof, whether or not the same shall have been in any manner demanded, or in case default, breach or non-observance be made or suffered by the Lessee at any time or times, in, or in respect of any of the covenants, provisoes, conditions and reservations herein contained, which on the part of the Lessee ought to be observed or performed, then, and in every such case, it shall be lawful for the Lessor, Her servants or agents, to re-enter and thereafter to have, possess and enjoy the said land and all improvements thereon.

And it is hereby understood and agreed that any default, breach, or non-observance of the specified services and conditions of performance to be provided in lieu of payment of rent as set out above shall be deemed to be a default in payment of rent entitling the Lessor to exercise all such remedies as are available at law or pursuant to this Lease in the event of non-payment of rent.

And no acceptance of rent subsequent to any breach or default, other than non-payment of rent, or any condoning, excusing or overlooking by the Lessor on previous occasions of breaches or defaults similar to that for which re-entry is made shall be taken to operate as a waiver of this condition nor in any way to defeat or affect the rights of the Lessor hereunder.

25. At the expiration or sooner termination of this Lease, the Lessee covenants to return and restore the land to its natural state as before the Lessee entered into this lease, to a condition which is satisfactory to the Solicitor General's representative.

IN WITNESS WHEREOF the parties hereto have executed this Lease the day, month and year first above written.

EXECUTED IN THE PRESENCE OF:

LESSOR:

Her Majesty the Queen in Right of Canada, as represented by the Solicitor General.

Witness

Witness

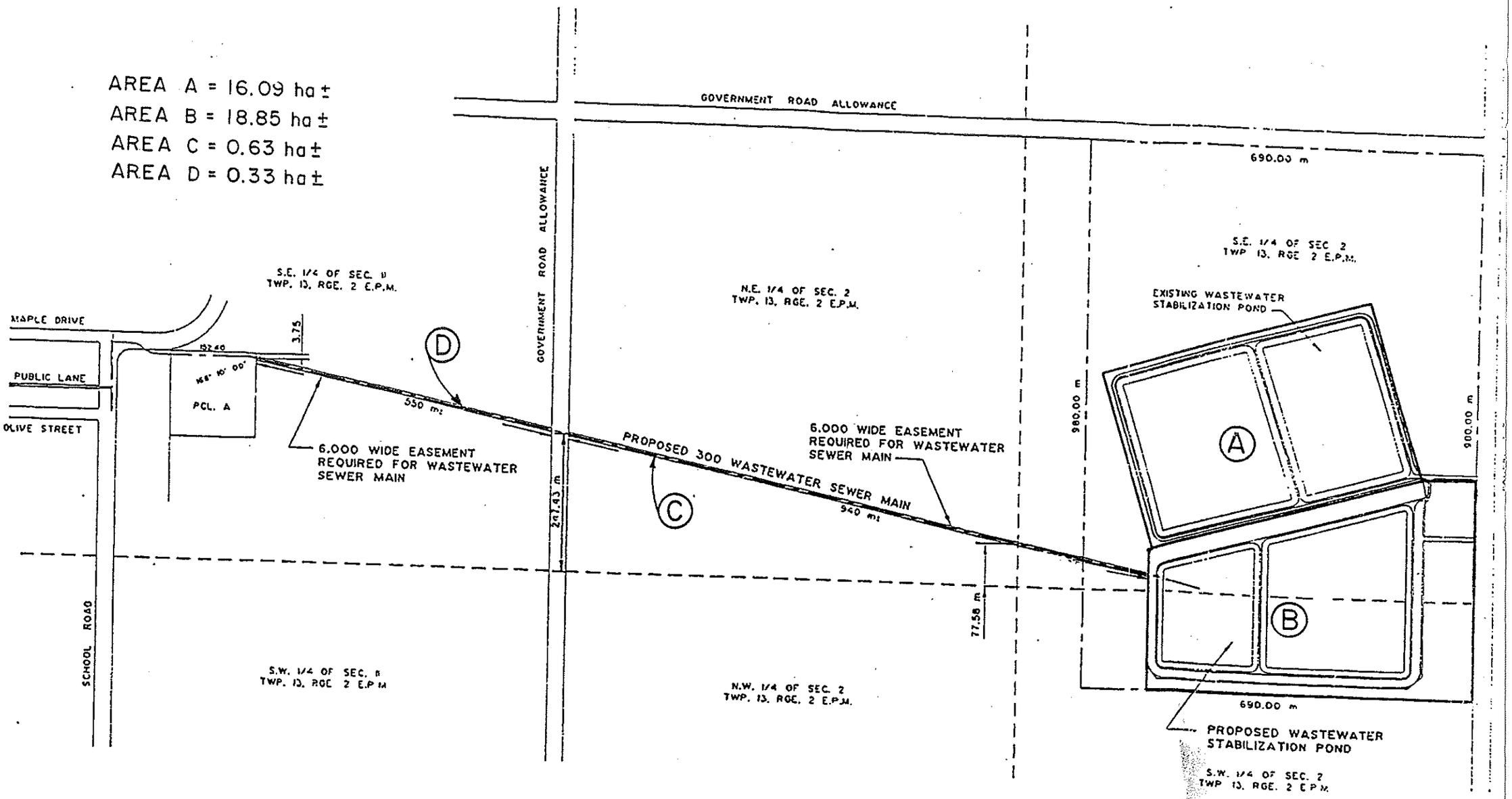
LESSEE:

R.M. OF ROCKWOOD
LEON VANDEKERCKHOVE, REEVE

JANIS L. GLUCHI, ADMINISTRATOR

SCHEDULE A

AREA A = 16.09 ha ±
AREA B = 18.85 ha ±
AREA C = 0.63 ha ±
AREA D = 0.33 ha ±



South Interlake Planning District June 6, 2014 Email Correspondence

Brett McCormac

From: South Interlake Planning District [info@sipd.ca]
Sent: June-06-14 9:34 AM
To: bmccormac@jrcc.ca
Subject: RE: Lagoon Expansion
Attachments: rwd al.pdf

Hi Brett

Sorry for the late response on this question….

The land is currently zoned AL (I have attached the bulk table for your ease of reference). Please note from the bulk table that a Public Utility Service is a permitted use under this zone (lagoon being one of those uses).

Roberta

Roberta L. Van Caeyzeele, CMMA
Administrative Officer
South Interlake Planning District
Box 1219
285 Main Street
Stonewall, MB
R0C 2Z0
(204) 467-5587 – Phone
(204) 467-8383 – fax
info@sipd.ca

From: Jonna Peltz [mailto:info@rockwood.ca]
Sent: June-04-14 4:24 PM
To: 'sipd'
Cc: brett@barnesduncan.com
Subject: FW: Lagoon Expansion

Hi Planning,

Can you answer this one for me.
Thanks
Jonna

From: Brett McCormac [mailto:bmccormac@jrcc.ca]
Sent: June 4, 2014 3:53 PM
To: 'Jonna Peltz'
Subject: RE: Lagoon Expansion

Thank you,

Is the land zoned for a particular purpose? Agricultural?

The land is the S 1/2 of 02-13-02 EPM.

Brett McCormac, E.I.T.
Environmental Engineer-in-Training

J.R. Cousin Consultants Ltd.
Phone: (204) 489-0474
Fax: (204) 489-0487
www.jrcc.ca

***

From: Jonna Peltz [mailto:info@rockwood.ca]
Sent: June-04-14 3:47 PM
To: bmccormac@jrcc.ca
Subject: Lagoon Expansion

Hi Brett,

In response to your email that you sent Lori, the lagoon expansion does fall under the jurisdicition of the Rockwood Zoning Bylaws.

Thanks

Jonna L. Peltz, CMMA
Asst. CAO
R.M. OF ROCKWOOD

82.0 AL: Agriculture Limited Zone

82.1 General Purpose

To provide a Zone that accommodates agricultural activities in proximity to Stony Mountain, Balmoral, Gunton, Gross Isle, the Rural Settlement Centres and other sensitive areas.

82.2 Permitted Uses

1) Agricultural Activities (40)
2) Animal Shelter and Veterinary Service (33)
3) Farm Produce Outlet (41)
4) Farmstead Dwelling (41)
5) Government Service (43)
6) Greenhouse, Plant and Tree Nursery (36)
7) Home Occupation (32, 88)
8) Non-Commercial Farm (42, 94)
9) Public Utility Service (43)
10) Specialized Agriculture (42)
11) Single Family Dwelling

82.3 Conditional Uses

1) Aggregate Extraction Operation (42, 101, 102)
2) Agri-Business (40)
3) Agricultural Implement Sales and Service (41)
4) Agricultural Product Storage (41)
5) Agriculture Support Industry (41)
6) Auctioneering Establishment (33)
Bed and Breakfast Home (32, 90)
Bulk Storage Facility (39)
9) Car Broker (34, 92)
10) Carnival (34)
11) Cemetery (43)
12) Composting (10, 84)
13) Cottage Dwelling (31)
14) Equestrian Establishment (41)
15) Group Home (32)
16) Guest Cabin (32)
17) Home Industry (32, 87)
18) Limited Contractor Service (36)
19) Livestock Operation (42, 95, 96)
20) Mobile Home Dwelling (31)
21) Outdoor Recreation Participant Service
22) Outfitter (37)
23) Protective and Emergency Service (43)
24) Public Park (45)
25) Protective and Emergency Service (43)
26) Secondary Suite (32, 108)
27) Small Animal Breeding and Boarding Establishment (38, 100)
28) Small Scale Industrial – Farm Related (40)
29) Small Scale Industrial – Non-Farm Related (40)
30) Temporary Mobile Home Dwelling (33, 93)
31) Tourist Campsite (45)
32) Wind Turbine Personal Use (43)

82.4 Site Regulations for Agricultural and Residential Use Classes: Permitted and Conditional Uses

1) Site Area	min. 32.37 ha. (80.00 acres)
2) Site Width	min. 182.88 m. (600.00 ft.)
3) Front Yard	min. 38.10 m. (125.00 ft.)
4) Rear Yard	min. 7.62 m. (25.00 ft.)
5) Side Yard	min. 7.62 m. (25.00 ft.)
6) Building Height	max. 10.67 m. (35.00 ft.)
7) Dwelling Unit	min. 74.32 sq. m. (800 sq. ft.)

82.5 Site Regulations for Non-Agricultural and Non-Residential Use Classes: Permitted and Conditional Uses

1) Site Area	min. 0.80 ha. (2.00 acres)
2) Site Width	min. 60.96 m. (200.00 ft.)
3) Front Yard	min. 22.86 m. (75.00 ft.)
4) Rear Yard	min. 7.62 m. (25.00 ft.)
5) Side Yard	min. 7.62 m. (25.00 ft.)
6) Building Height	max. 10.67 m. (35.00 ft.)

82.6 Site Regulations: Accessory Uses, Buildings and Structures

1) Site Area	N/A
2) Site Width	N/A
3) Front Yard	min. 38.10 m. (125.00 ft.)
4) Rear Yard	min. 7.62 m. (25.00 ft.)
5) Side Yard	min. 7.62 m. (25.00 ft.)
6) Building Height	max. 6.10 m. (20.00 ft.)

82.7 Additional Regulations for Permitted and Conditional Uses

1) A Home Occupation shall be developed in accordance with Section 42.0 of this By-law.

2) A Non-Commercial Farm shall be developed in accordance with Section 48.0 of this By-law.

3) A Livestock Operation shall be developed in accordance with Section 49.0 of this By-law.

4) The maximum building height regulation of 10.67 m. (35.00 ft.) shall not apply to farm buildings.

5) Water supply and sewage disposal shall be provided in accordance with *The Environment Act, The Public Health Act, The Water Protection Act* and *The Drinking Water Safety Act.*

6) A Mobile Home Dwelling is allowed when on the same site with a permitted use or conditional use development where, in the opinion of Council, the dwelling is essential for the maintenance, operation and care of the permitted use or conditional use.

7) Buildings, structures and hedges adjacent to Provincial Trunk Highways, Provincial Roads and Provincial Access Roads shall be setback in accordance with *The Highways Protection Act* and *The Highways and Transportation Act.*

8) Despite Section 82.4 of this By-law, the site regulations for new residential lots created as per Policy 3.6, Policy 3.7, and Policy 3.8 in the *South Interlake Planning District Development Plan* shall be in accordance with Section 82.5 of this By-law.

9) Despite Section 82.4 of this By-law, the following Agricultural Use Class developments shall be subject to the site regulations listed under Section 82.5 of this By-law:
   a) Agri-Business;
   b) Agricultural Implement Sales and Service;
   c) Agricultural Product Storage;
   d) Agriculture Support Industry;
   e) Farm Produce Outlet; and
   f) Small Animal Breeding and Boarding Establishment.

10) A Group Home shall be operated by a live-in owner and only as a secondary use.

82.8 Additional Regulations for Conditional Uses Only

1) A Home Industry shall be developed in accordance with Section 41.0 of this By-law.

2) A Bed and Breakfast Home shall be developed in accordance with Section 43.0 of this By-law.

3) A Car Broker shall be developed in accordance with Section 46.0 of this By-law.

4) A Temporary Mobile Home Dwelling shall be developed in accordance with Section 47.0 of this By-law.

5) A Small Animal Breeding and Boarding Establishment shall be developed in accordance with Section 51.0 of this By-law.

6) A dwelling unit is allowed in conjunction with a Tourist Campsite development if it is occupied by the owner/operator or a site watchperson or caretaker, if necessary.

7) An Aggregate Extraction Operation shall be developed in accordance with Section 52.0 of this By-law.

8) Blasting activities within Aggregate Extraction Operations shall be set back a minimum of 15.24 m. (50.00 ft.) from all property lines, except where the property line is between two Aggregate Extraction Operations.

Crown Lands & Property Agency, May 1, 2014 Email Correspondence

Brett McCormac

From: Little, Karen (CLPA) [Karen.Little@gov.mb.ca]
Sent: May-01-14 2:21 PM
To: 'Brett McCormac'
Subject: RE: RM of Rockwood/SMI Aerated Lagoon Expansion - Mines and Minerals

Good afternoon Brett, according to our records this date, the mines & minerals and sand & gravel in S ½ 2-13-2 EPM were originally granted in 1875, 1877 to individuals. The Crown has no interests.

To determine the current ownership of these under-rights you will need to do titles searches at The Winnipeg Land Titles Office.

Sincerely,

Karen Little
Supervisor of Crown Lands Registry

Crown Lands and Property Agency
308 - 25 Tupper Street North
Portage la Prairie MB R1N 3K1
P 204-239-3805 F 204-239-3560
Toll Free 1-866-210-9589
karen.little@gov.mb.ca

CLPA

An Agency of the Manitoba Government

From: Brett McCormac [mailto:bmccormac@jrcc.ca]
Sent: April-25-14 1:51 PM
To: Little, Karen (CLPA)
Subject: RM of Rockwood/SMI Aerated Lagoon Expansion - Mines and Minerals

Hi,

J.R. Cousin Consultants Ltd. (JRCC) is preparing an Environmental Act Proposal for the aerated lagoon expansion of the existing RM of Rockwood and Stony Mountain Institute (SMI) lagoons. The lagoon expansion is to occur immediately north and east of the existing lagoons.

The lagoon expansion will be located on the S1/2 of 02-13-02-E.

Could you please confirm the owner of the mineral rights for this property.

Thank you,

Brett McCormac, E.I.T.
Environmental Engineer-in-Training

J.R. Cousin Consultants Ltd.
Phone: (204) 489-0474
Fax: (204) 489-0487
www.jrcc.ca

***

Appendix B

Manitoba Conservation and Water Stewardship Fisheries Branch, May 28, 2014 Email Correspondence

Manitoba Conservation Data Centre, May 1, 2014 Email Correspondence

Manitoba Historic Resources Branch, May 13, 2014 Email Correspondence

Manitoba Conservation and Water Stewardship Fisheries Branch, May 28, 2014 Email Correspondence

Brett McCormac

From: Janusz, Laureen R (CWS) [Laureen.Janusz@gov.mb.ca]
Sent: May-28-14 3:12 PM
To: Brett McCormac
Cc: Klein, Geoff (CWS); Biggin, Wade (CWS)
Subject: RM of Rockwood/SMI Aerated Lagoon Expansion - Fisheries Info
Attachments: EAST_SAINT_PAUL_FIHCS_REQUEST_20140514.pdf

Hi Brent,

My apologies for the delay. Wade has provided the attached information from the FIHCS. He included a number of drains in the vicinity as well as the Red River. As I may have mentioned before there is no ability in FIHCS to identify locations where fish were found so the list covers everything that has been caught in the Red River. I have cc'd the Regional Fisheries Manager to see if he has any specific habitat information. Given the fish presence in both waterbodies ensuring the effluent meets or exceeds the Water Quality Standards, Objectives and Guidelines is very important.

Any other questions/concerns please email. Have a great day.

Laureen Janusz
Fisheries Science and Fish Culture Section
Fisheries Branch,
Manitoba Conservation and Water Stewardship
Box 20, 200 Saulteaux Crescent
Winnipeg, MB R3J 3W3

Phone: 204.945.7789
Cell: 204.793.1154
Fax: 204.948-2308
Email: Laureen.Janusz@gov.mb.ca

From: Biggin, Wade (CWS)
Sent: May-14-14 10:41 AM
To: Janusz, Laureen R (CWS)
Subject: RE: RM of Rockwood/SMI Aerated Lagoon Expansion - Fisheries Info

I researched a bit and found some drains Milani did work on in the area. Only some comments associated with them but none the less, they had been worked on.

From: Janusz, Laureen R (CWS)
Sent: May-14-14 8:31 AM
To: Biggin, Wade (CWS)
Subject: FW: RM of Rockwood/SMI Aerated Lagoon Expansion - Fisheries Info

Hi Wade,

Hope you're having a good day! I was wondering if you could pull together the list of fish species from Grassmere Drain and the Red River. They have asked for the area East St Paul but we don't have the ability to provide that from FIHCS. If you don't mind just send it to me. They are also looking for any fisheries concerns so I'll speak to Geoff prior to responding with all the information. Thanks a mil. LJ

Laureen Janusz
Fisheries Science and Fish Culture Section
Fisheries Branch,
Manitoba Conservation and Water Stewardship
Box 20, 200 Saulteaux Crescent
Winnipeg, MB R3J 3W3

Phone: 204.945.7789
Cell: 204.793.1154
Fax: 204.948-2308
Email: Laureen.Janusz@gov.mb.ca

From: Brett McCormac [mailto:bmccormac@jrcc.ca]
Sent: April-25-14 2:18 PM
To: Janusz, Laureen R (CWS)
Subject: RM of Rockwood/SMI Aerated Lagoon Expansion - Fisheries Info

Hi Laureen,

J.R. Cousin Consultants Ltd. (JRCC) is preparing an Environmental Act Proposal for the aerated lagoon expansion of the existing RM of Rockwood and Stony Mountain Institute (SMI) lagoons. The lagoon expansion is to occur immediately north and east of the existing lagoons. The lagoon expansion will be located on the S1/2 of 02-13-02-E.

The aerated lagoon will have highly treated effluent with phosphorus reduction and UV disinfection.

The discharge route from the lagoon will be south through the 2nd order penitentiary drain for approximately 3.3 km. Effluent will then enter the 5th order Grassmere Creek Drain will flows southeast approximately 12.7 km to the Red River. The entire discharge route will be approximately 16 km before entering the Red River. A plan of the discharge route is attached.

Could you please respond with any comments or concerns you have with the proposed project. Also, could you please provide a list of the fish species that are found in the Red River around East St, Paul.

Brett McCormac, E.I.T.
Environmental Engineer-in-Training

J.R. Cousin Consultants Ltd.
Phone: (204) 489-0474
Fax: (204) 489-0487
www.jrcc.ca

***

Manitoba Conservation Data Centre, May 1, 2014 Email Correspondence

Brett McCormac

From: Friesen, Chris (CWS) [Chris.Friesen@gov.mb.ca]
Sent: May-01-14 10:33 AM
To: 'Brett McCormac'
Subject: RE: RM of Rockwood/SMI Aerated Lagoon Expansion

Brett

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
Biodiversity Information Manager
Manitoba Conservation Data Centre
204-945-7747
chris.friesen@gov.mb.ca
http://www.gov.mb.ca/conservation/cdc/

From: Brett McCormac [mailto:bmccormac@jrcc.ca]
Sent: April-25-14 1:45 PM
To: Firlotte, Nicole (CWS); Friesen, Chris (CWS)
Subject: RM of Rockwood/SMI Aerated Lagoon Expansion

Hi,

J.R. Cousin Consultants Ltd. (JRCC) is preparing an Environmental Act Proposal for the aerated lagoon expansion of the existing RM of Rockwood and Stony Mountain Institute (SMI) lagoons. The lagoon expansion is to occur immediately north and east of the existing lagoons.

The lagoon expansion will be located on the S1/2 of 02-13-02-E.

Could you please confirm there are no 'species at risk' known to exist on the property.

Thank you,

Brett McCormac, E.I.T.
Environmental Engineer-in-Training

J.R. Cousin Consultants Ltd.
Phone: (204) 489-0474
Fax: (204) 489-0487
www.jrcc.ca

***

Manitoba Historic Resources Branch, May 13, 2014 Email Correspondence

Brett McCormac

From: Sitchon, Myra (TCHSCP) [Myra.Sitchon@gov.mb.ca]
Sent: May-13-14 9:54 AM
To: 'Brett McCormac'
Subject: No concerns - RM of Rockwood/SMI Aerated Lagoon Expansion

Good morning,
In response to your memo regarding the above-noted proposal, I have examined Branch records for areas of potential concern. The potential to impact significant heritage resources is low, and, therefore, the Historic Resources Branch has no concerns with the proposed proposal.

If at any time however, significant heritage resources are recorded in association with these lands during development, the Historic Resources Branch may require that an acceptable heritage resource management strategy be implemented by the developer to mitigate the effects of development on the heritage resources.

If you have any questions or comments, please contact me at 945-6539.

Thanks,
Myra

Myra L. Sitchon, *Ph.D.*
Impact Assessment Archaeologist,
Archaeological Assessment Services Unit,
Historic Resources Branch
Main Floor- 213 Notre Dame Avenue, Winnipeg, MB R3B 1N3
myra.sitchon@gov.mb.ca

Phone: (204) 945-6539
Toll Free: 1-800-282-8069+extension(6539)
Fax: (204) 948-2384
Website: http://www.manitoba.ca/heritage

Manitoba
Tourism, Culture, Heritage, Sport and Consumer Protection

Appendix C

RM of Rockwood – Stony Mountain and SMI Lagoon Upgrade Preliminary Design Report

Rural Municipality of Rockwood

Stony Mountain
and
SMI Lagoon Upgrade
Preliminary Design Report

July 2014

JRC ENGINEERING CONSULTANTS

RURAL MUNICIPALITY OF ROCKWOOD

Stony Mountain

and

SMI Lagoon Upgrade

Preliminary Design Report

PROVINCE OF MANITOBA
J.R.L. COUSIN
Member
22391
REGISTERED PROFESSIONAL ENGINEER
14/07/02

APEGM
Certificate of Authorization
J. R. Cousin Consultants Ltd.
No. 234 Date: 14/07/02

Prepared by:

Jason Cousin, P.Eng.
Senior Municipal Engineer

Reviewed by:

Jerry Cousin, P.Eng.
President

Issued: July 2014

JRCC ENGINEERING CONSULTANTS

ACKNOWLEDGMENTS

To prepare this preliminary design report, various sources of information were investigated and researched. JR Cousin Consultants Ltd. thanks the RM of Rockwood who contributed data and content for this pre-design report.

REMARKS

The findings and recommendations in this report were prepared in accordance with generally accepted professional engineering principles and practices. The findings and recommendations were based upon objective data available to us at the time of forming our opinions and the accuracy of the report depends upon the accuracy of this data.

TABLE OF CONTENTS

Section Page of Section

Section Page of Section

Appendix A

Appendix B

JRCC Test Holes - March 2010

Trek Geotechnical Test Holes - December 2010

JRCC Test Holes - October 2011

National Testing Laboratories Test Results - November 2011

AMEC - Geotechnical Investigation SMI Lagoon Upgrades SE2-13-2EPM RM of Rockwood, Manitoba - March 2014

Appendix C

ALS Sewage Test Results

Appendix D

Detailed Cost Estimate

Appendix E

Plan EX1: Lagoon Test Holes and Existing Ground Contours

Plan L1: Lagoon Layout Plan

Plan L2: Lagoon Sections - Storage Cell 3 and Storage Cell 4 Dike Modifications

Plan L3: Lagoon Sections - Aeration Cell 1 and Storage Cell 5, Storage Cell 1 Keyway

Plan L4: Lagoon Pipe Layout Plan

Plan L5: Site Drainage, Perimeter Liner, Perimeter Fencing

Plan P1: Sewage Treatment Process Diagram

Plan S1: Sewage Treatment Building - South and West Elevation

Plan S2: Sewage Treatment Building - North and East Elevation

Plan S3: Sewage Treatment Building - Overall Layout

Plan LS1: Stony Mountain Lift Station Section Views

EXECUTIVE SUMMARY

Geotechnical Investigation

Onsite investigation of geotechnical conditions were conducted in 2010, 2011 and 2014 by JR Cousin Consultants Ltd. (JRCC), Trek Geotechnical Inc. (Trek) and AMEC Environment and Infrastructure (AMEC). The various investigations reviewed existing dike soils for seepage, soil conditions for lagoon liner repair and lagoon expansions. The review of the existing dikes found them to have significant potential for seepage and identified that liner repairs are required.

The general soil profile in the area is a topsoil underlain by a layer of high plastic clay, followed by a varying thickness of silt. Beneath the silt lies a layer of high plastic clay. Hydraulic conductivity testing was completed on various soils and identified that the upper and lower high plastic clays meet Manitoba Conservation's permeability requirements for a soil liner. The silt layer was tested and does not meet Manitoba Conservation's permeability requirements for a soil liner.

Topographical Survey

A topographical survey was completed in October 2013 of the lagoon site and the proposed expansion area. The existing Stony Mountain Lagoon top of dike is 236.0 m. The existing Stony Mountain Institute top of dike is 235.0 m. The land around the lagoons is gently sloping from the northwest at an elevation of 236.0 m to the southeast at an elevation of 233.0 m.

Population and Wastewater Production

The sewage treatment facility will service the community of Stony Mountain residential population, truck septic tanks from the Bristol Pipeline and general RM of Rockwood septic tank cleanout, an industrial park near Stony Mountain, and the Stony Mountain Institute, resulting in a combine year 2039 design population of 5,592.

The design organic loading to the sewage treatment facility is 515.2 kg BOD_5/day. The design average day sewage flow to the sewage treatment facility is 2,660 m^3 per day.

Lagoon Storage Capacity

Typically lagoons are required to maintain 230 days of storage (November 1 to June 15). Discussions have been completed with Manitoba Conservation to allow for discharge earlier in the spring (April 16) due to enhanced treatment from the filters and UV unit in the sewage treatment building. The storage cells will be sized to accommodate storage from November 1 to May 1 (180 day storage) to provide a small buffer for spring conditions hindering early discharge. The storage period will use 180 days as opposed to 230 days. The existing RM of Rockwood cells and the existing SMI cells would have a combined storage capacity of 263,016 m^3 if the primary cells were converted to storage cells and no further modifications completed. The design year 25 (2039), 180 day storage requirement is 477,090 m^3 and the 230 day storage requirement is 609,615 m^3. Additional storage capacity is required to meet both the 230 day and the 180 day design storage requirements.

To accommodate the design storage requirements, the four existing lagoon cells, Stony Mountain Primary Cell, Stony Mountain Secondary Cell, Stony Mountain Institute Primary Cell and the Stony Mountain Institute Secondary

Cell will be utilized for effluent storage. The operating depth of the Stony Mountain Institute cells will be increased from 1.5 m to 2.1 m. A new cell will also be constructed east of the existing Stony Mountain Institute Lagoon to provide the additional storage capacity required. An additional cell will also be created between the existing RM of Rockwood Lagoon and the Stony Mountain Institute Lagoon. The new storage cell and modification to the existing SMI cells will be completed to accommodate a future 2.5 m operating depth. In the future, when the cells are operated at 2.5 m depth, aeration will be required in the storage cell. The total storage capacity of the lagoon cells at the 2.1 m operating depth is 602,947 m^3, which exceeds the year 25, 180 day storage requirement and almost meets the year 25, 230 day storage requirement. Should the 180 day discharge not be operated, the aeration system in the new storage cell would be required in year 2038 to obtain the required storage capacity. At the 2.5 m operating level with aeration in the new Storage Cell 5, the storage capacity will be increased to 711,812 m^3.

To resolve the existing storage cell liner issues, a new key way will be installed around the existing Stony Mountain lagoon cells and keyed into the lower high plastic clay. To provide a liner around the existing Stony Mountain Institute cells, the new storage cell and aeration dikes will surround the existing lagoon. The new dikes will have a keyway into the lower high plastic clay. Once the upgrades are completed, a continuous keyway will surround the entire facility providing a liner meeting Manitoba Conservation's requirements.

Lagoon Sewage Treatment

The BOD treatment of the facility will be completed using two partial mix aeration cells with a combined 50 day hydraulic retention. The cells will operate at a constant depth of 4.0 m. Aeration will be provided to the two cells using a floating aeration header system with fine bubble diffusers. Positive displacement blowers will be installed in a new sewage treatment building located on site.

The sewage treatment facility will be designed to accommodate an average day flow rate of 2,217 L/min and a peak flow rate of 3,698 L/min. At the design flow rates, the system will accommodate the daily flow in a 20 hour operating day.

Phosphorous and TSS reduction will be completed using four 2.74 m diameter gravity upflow sand filters. Ferric chloride coagulant will be injected in the piping upstream of the sand filters. A continuous reject stream will be returned to Aeration Cell 1, where the removed phosphorous will settle to the bottom of the cell.

To disinfect the effluent, a pressure flow ultraviolet (UV) disinfection system will be provided. The UV will be equipped with an automatic wiping system as well as a chemical cleaning system to reduce operator maintenance. All of the effluent will pass through the UV to be disinfected prior to being discharged into the storage cells or to the King Edward Road ditch.

Testing was completed on the un-ionized ammonia and the results identified the un-ionized ammonia was below the discharge requirements. No formal ammonia reduction process has been included in the sewage treatment system.

A sewage treatment building will house all of the process and testing equipment for the wastewater treatment system. The building will be a pre-engineered steel building with a brick veneer exterior and will have a 340 m^2 footprint. Due to the filter height requirements, the building will have a split level roof to accommodate the equipment.

A water holding tank equipped with a small pump and pressure tank will provide a water supply at the sewage treatment building.

Two main pumping systems are required in the sewage treatment system: the filter feed pumps and the treated effluent discharge pumps. Both systems will be designed with a submersible duplex pumping system.

A new 660 m access road to King Edward Road will be constructed the new lift stations, sewage treatment building and sewage truck dump spillway.

Lift Stations

Both the existing community of Stony Mountain and the Stony Mountain Institute gravity sewer collection systems allow the sewage to flow directly into the respective existing primary cells. The new aeration cells will be operating at a higher elevation than the existing lagoon, resulting in the need for lift stations to pump the effluent into the aeration cells. For metering purposes between the two sewage collection systems, two separate lift stations will be provided to pump the effluent from the gravity sewer system from the community of Stony Mountain and the Stony Mountain Institute.

The lift stations will be designed using precast concrete barrels and duplex pumping systems. The Stony Mountain lift station will be designed to accommodate a wet weather flow of 82.9 L/s. The Stony Mountain Institute lift station will be designed to accommodate a wet weather flow of 52.7 L/s. Backup power will be provided to the lift stations from a genset located in the sewage treatment building.

Cost Estimate

The following is a summarization of the capital costs for a 2014/2015 construction season. The costs for each year after this projection period should be inflated per prevailing inflation and market conditions.

Class C Cost Estimate

Description	Total
Sewage Treatment Facility	$8,297,180
5% GST	$414,900
15% Contingency	$1,244,600
Total Construction	**$9,956,680**

1.0 INTRODUCTION

The RM of Rockwood and the Stony Mountain Institution (SMI) retained JR Cousin Consultants Ltd. (JRCC) to provide engineering services for the pre-design, design and construction administration services for an aerated lagoon expansion. This document presents the Preliminary Design Report for this project.

The RM of Rockwood and SMI operate facultative lagoons side by side that both require repair and expansion to meet projected growth. This report discusses plans to convert the two facultative lagoons into a combined aerated lagoon. The works will include construction of two new aerated primary cells, construction of a new storage cell, construction of an aeration building, two lift stations and remedial dike works. The report contains a description of our proposed design complete with class "C" capital cost estimates of required works.

1.1 Scope of Services

The scope of work for this project is to provide all engineering and environmental services required to prepare the designs, the necessary environmental assessment and to carry out the construction administration of the sewage treatment facility servicing both the community of Stony Mountain and the SMI. The design will include the repair of the existing leaking lagoon cells, installation of an aeration system, construction of new aeration cells, construction of additional storage cells and phosphorous treatment. The upgraded system is being designed to accommodate a 25 year growth (year 2039).

1.2 Existing Facilities

The RM of Rockwood and SMI lagoons are located side by side on the S 1/2 of 02-13-02 EPM approximately 11 km north of Winnipeg. The SMI lagoon is a two cell lagoon constructed in the mid 1960's and is fed by a 300 mm gravity sewer pipe from the penitentiary. The RM of Rockwood lagoon services the community of Stony Mountain, rural residents connected to the Bristol Pipeline, an industrial park and septic tank cleanouts from RM of Rockwood rural residents. The two cell lagoon was constructed in the early 1990's and is fed by a 300 mm gravity sewer pipe from the community of Stony Mountain.

The existing lagoons are constructed with soil liners, and based on past JRCC site investigations it is suspected that all of the cells could be subject to leakage. Both existing lagoons have 4:1 side slopes. The existing lagoons have an operating depth of 1.5 m, however the bottom 0.3 m of the cells are not discharged, resulting in a usable storage depth of 1.2 m. Both lagoons were constructed with 2.5 m deep cells, providing 1.0 m of freeboard. The hydraulic capacities of the existing lagoon cells, once the existing primary cells are converted to storage cells, are summarized in Table A.

Table A: Existing Hydraulic Capacity

Description	Hydraulic Capacity
Rockwood Primary Cell	38,935 m^3
Rockwood Storage Cell	77,635 m^3
SMI Primary Cell	81,108 m^3
SMI Storage Cell	65,338 m^3

The existing SMI lagoon has sufficient organic capacity to accommodate future growth projections but requires an expansion to the hydraulic capacity. The RM of Rockwood lagoon requires organic and hydraulic expansion to meet the design year 25 projected population.

Based on past investigations by JRCC, JRCC has determined that the dikes of the SMI and RM of Rockwood lagoon are leaking horizontally through a silty clay layer in the soil profile. The SMI lagoon dikes were found to be leaking more severely compared with the RM lagoon dikes.

2.0 SITE INVESTIGATIONS

2.1 Past Geotechnical Investigations

There have been four geotechnical investigations completed for the RM of Rockwood/SMI lagoon sites. The geotechnical investigations are as follows:

- Investigation by JRCC in March, 2010
- Investigation by Trek in December, 2010
- Investigation by JRCC in October, 2011
- Investigation by AMEC in March, 2014.

The following sections provide a brief summary of the past investigations.

2.1.1 Investigation by JRCC March 2010

A geotechnical investigation was completed by JRCC in March 2010 as part of the *SMI Lagoon Assessment Study*, April 2010. A total of eight test holes were drilled at the site, four on the top of dike, two north and two east of the SMI lagoon. The test holes north and east of the lagoon found the soil profile consisted of organic topsoil between 0.2 and 0.5 m thick, followed by high plastic clay soil down to 1.5 to 2.8 m below the ground surface. A wet silt layer was observed from 1.5 m to between 2.5 and 3.0 m below ground, followed by a high plastic clay layer, observed to the bottom of the test holes.

The test holes taken on the lagoon dikes found the soil profile consisted of a clay topsoil layer 0.3 to 0.8 m thick followed by a high plastic clay layer to 3.0 m underlain by a wet silt layer to a depth of 3.5 to 4.2 m followed by high plastic clay to the bottom of the test holes.

There were two Shelby tube samples extracted from TH2, taken on the east lagoon dike, from 1.5 - 2.1 m and 3.0 - 3.6 m. The Shelby tube sample from 3.0 - 3.6 m contained wet silt and it was determined by JRCC and AMEC laboratory personnel the sample would not achieve a hydraulic conductivity of 1×10^{-7} cm/s. Test results indicated the sample from 1.5 - 2.1 m had a hydraulic conductivity of 5.7×10^{-9} cm/s. This shows some of the soils used in the lagoon dikes are suitable for use as a lagoon liner, however, the cut-off wall does not extend through the silty layer.

As part of the geotechnical investigation completed in 2010, Friesen Drillers installed two monitoring wells into the aquifer, one to the northeast and one east of the existing SMI lagoon cells. The testing on the water samples taken from the wells concluded that the aquifer had not been impacted by the leaky lagoon cells.

Test holes locations and test hole logs by JRCC are shown on Plan EX1, attached in Appendix E.

2.1.2 Investigation by Trek Geotechnical December 2010

Trek Geotechnical Inc. completed a sub-surface investigation report dated January, 2011. There were eleven test holes drilled west and north of the existing RM of Rockwood lagoon. The general soil profile observed in the test holes was topsoil approximately 0.1 m thick followed by a complex zone of clay, silts and clay and silts between 0.9 and 2.2 m thick. A layer of high plastic silty clay was present in all test holes either at the surface or below the complex zone with a thickness ranging from 1.7 to 5.8 m. Silt till was encountered below the high plastic silty clay layer starting at depths ranging between 3.3 and 6.7 m below the ground surface.

Laboratory analysis on the silt layer encountered in eight of the test holes, ranging from 0.7 to 2.2 m thick, found a Plasticity Index of 25, based on one test. Laboratory analysis on the silty clay layer ranged between 1.7 and 5.8 m thick, found a Plasticity Index between 51 and 68, based on six tests. The silt till layer was encountered starting at depths between 3.3 and 6.7 m below ground. Laboratory analysis of the silt till layer found a Plasticity Index of 9, based on one test.

Sloughing and seepage was observed in eight of the test holes at depths ranging from 4.4 to 6.7 m.

The following table summarizes the hydraulic conductivity tests performed on the soil samples:

Table 2.1: Hydraulic conductivity analysis by Trek

Test Hole	Depth (m)	Soil Classification	Hydraulic Conductivity (cm/s)
TH10-01	1.5	Silty Clay	2.3×10^{-9}
TH10-02	3.0	Clay and Silt	1.4×10^{-8}
TH10-06	4.6	Silt Till	1.6×10^{-7}
TH10-07	3.0	Silty Clay	6.5×10^{-8}
TH10-08	3.0	Silty Clay	2.9×10^{-8}
TH10-10	1.5	Silty Clay	3.8×10^{-9}

This shows all samples with the exception of TH10-06 at 4.6 m would be suitable for an insitu lagoon liner.

Test holes locations and test hole logs by Trek Geotechnical Inc. are shown on Plan EX1, attached in Appendix E.

2.1.3 Investigation by JRCC October 2011

A geotechnical investigation was completed by JRCC in October, 2011 as part of the *SMI and Stony Mountain Lagoon Geotechnical Investigation and Capital Cost Estimate Letter Report*, December 2011. A total of 21 test holes were excavated on the land surrounding the RM and SMI lagoons.

The average soil profile consisted of organic topsoil in all 21 test holes between 0.2 and 0.8 m thick with an average depth of 0.4 m. In 16 of the test holes a medium plastic, silty, loose clay was observed between 0.2 and 1.5 m thick with an average thickness of 0.9 m. In all 21 test holes a silty, sandy, low plastic clay was observed between 0.6 and 3.4 m thick with an average thickness of 1.2 m. A grey, hard, high plastic clay was observed in all test holes an average of 2.1 m below the ground surface, ranging between 1.0 and 3.6 m. The grey high plastic clay layer was between 3.3 and 4.8 m thick. 15 test holes terminated in the grey high plastic clay layer. In 6 of the test holes a gravely, silty, sandy low plastic clay was observed beneath the high plastic clay layer, starting at an average of 5.0 m below the ground surface and ranging between 4.3 and 5.8 m. The layer was observed to be between 0.3 and 1.9 m thick, with 6 test holes terminated in the layer.

Massive caving of the test holes and high rate water infiltration were observed in TH6 - TH8 that were located just east of the SMI lagoon dikes. This indicates that the SMI lagoon is likely leaking through the silty, sandy low plastic clay layer and saturating the soils nearby.

Laboratory analysis was completed by National Testing Laboratories Ltd. A bagged sample from the medium plastic clay layer and two bagged samples from the high plastic clay layer were considered suitable for use as a clay liner based on Plasticity Index analysis. A bagged sample from the silty low plastic clay layer was found to be not suitable for use as a clay liner.

Two Shelby tube samples were also submitted for analysis. A sample from the silty low plastic clay layer achieved a hydraulic conductivity of 5.7 $x10^{-5}$ cm/s and a sample from the high plastic clay layer achieved a hydraulic conductivity of 4.8 $x10^{-9}$ cm/s. The Shelby tube testing confirmed the results of the bagged sample testing, i.e. the silty low plastic clay layer is not suitable for use as a lagoon liner and the high plastic clay layer is suitable for use as a clay liner.

The investigation concluded the high plastic clay layer observed an average of 2.1 m below the ground surface could be used as an insitu clay lagoon liner. Vertical cut-off walls consisting of high plastic clay soils would have to be extended a minimum of 1.0 m into the high plastic clay. It is evident that vertical clay cut-off walls were not constructed as part of the original lagoon works as the silt layer was shown not to be able to meet the hydraulic conductivity guideline of 1 x 10^{-7} cm/s. The high plastic clay layer was observed to start between 1.0 and 3.6 m below the ground surface and the vertical cut-off wall must extend at least 2.0 to 4.6 m below the ground surface, depending on the location of the cut-off wall.

Test holes locations and test hole logs by JRCC are shown on Plan EX1, attached in Appendix E.

2.1.4 Investigation by AMEC March 2014

A geotechnical investigation was completed by AMEC Environment and Infrastructure in March 2014 to determine building foundation requirements, dike slope stability requirements and provide additional site test holes in the lagoon expansion area. A total of eight test holes were drilled on the land surrounding the SMI lagoon cells and in the existing SMI dikes.

Based on the slope stability analysis of the dikes, the inside slopes of the aeration cells were recommended to be 5.5:1 slopes and the inside slopes of the storage cells were recommended to be 4:1. The outside slopes of all the dikes are recommended to be 4:1 slopes.

Test holes locations and test hole logs by AMEC are shown on Plan EX1, attached in Appendix E. A copy of their geotechnical report is included in Appendix B.

2.2 Topographical Survey

A topographical survey of the existing lagoon and proposed lagoon expansion site was completed in October of 2013 using GPS survey equipment. The survey data supplemented data collected during the October 2011 geotechnical investigation.

2.2.1 Existing Lagoons

The existing lagoons were surveyed as part of the topographic survey. The existing top of dike elevation of the SMI lagoon was found to be 235.04 m and the existing top of dike elevation of the RM lagoon was found to be 236.00 m.

2.2.2 Lagoon Expansion Areas

The area for lagoon expansion east of the existing SMI lagoon is relatively flat and slopes slightly north. The elevation at the south end of the site is approximately 233.0 m and slopes upward to 234.0 m at the north end of site, approximately 750 m away. A drainage ditch exists approximately 30 m east of the SMI toe of dike and is approximately 1 m deep. North of the existing SMI lagoon the land slopes slightly upward to the northwest from an elevation of 234.0 m to 234.5 m.

The land west of the existing RM lagoon slopes to the west from an elevation of 234.5 m to 235.5 m, approximately 300 m away. North of the existing RM lagoon the land slopes upward to the north from an elevation of 234.5 m to 236.0 m.

3.0 POPULATION AND WASTEWATER PRODUCTION

To properly assess the future loading demands placed on the Stony Mountain lagoon, the existing sewage streams, future sewage streams and future growth must be understood. At the present time there are four main contributors to the lagoon: The community of Stony Mountain residential population, truck septic tanks from the Bristol Pipeline and general RM of Rockwood septic tank cleanout, an industrial park near Stony Mountain, and the Stony Mountain Institute. The following sections will review the current loadings and anticipated future loadings from each sewage segment.

3.1 Community of Stony Mountain Residential Population

3.1.1 Population Growth

The historical population data was obtained from Census Canada. Census Canada only reported Stony Mountain's population in 2011. The population was reported to be 1,696.

Stony Mountain is growing quickly with many residential developments planned. A growth rate of 2.5% is proposed for the future growth planning.

Using the projected growth rate of 2.5%, the 25 year design population (year 2039) is 3,387.

3.1.2 Stony Mountain Commercial

The current population of commercial people working in, but not living in the community of Stony Mountain is estimated at 30 people. The commercial population is expected to grow at a rate equal to the community of Stony Mountain. Using a 2.5% growth rate, the 25 year design population (year 2039) is 56. The commercial population is assumed to have an occupancy equivalence of 1/3, based on the amount of time spent at the commercial facilities, and would therefore represent an equivalent population of 19 people (56/3).

3.1.3 Bussed in Students

The community of Stony Mountain has one school (K-8) that services both the community of Stony Mountain and the surrounding Municipality of Rockwood. Based on discussions with the Transportation Coordinator for the Interlake School Division on September 12, 2013, 114 students are bussed into the community of Stony Mountain schools. The school has a total attendance of 212 students. The population of bussed in students would have an assumed occupancy of 1/3 the population, based on the amount of time spent at school, and would therefore represent a current equivalent population of 38 people (114/3). The population of the bussed in students to the school is estimated to have a growth rate matching the RM of Rockwood.

Table B: RM of Rockwood Census Canada Historic Population and Growth Rate

Year	Population	% Growth/Year
1996	7,504	0.4%
2001	7,654	0.1%
2006	7,692	0.7%
2011	7,964	

Based on the above table, the population growth rate has had steady growth over the last 15 years, with an average growth rate of 0.7% the last 5 years.

Using the projected growth rate of 0.7%, the 25 year design population (year 2039) of students is 137, resulting in an equivalent load of 46 people.

3.1.4 Organic Load

The organic loading calculation is based upon the organics in typical residential wastewater and septage. A typical value of 0.076 kg BOD_5/person/day was utilized to estimate the organic loading. Based on the combined residential population and the bussed in students, a year 2039 design population is 3,452, generating 262.4 kg BOD_5/day. (3,452 x 0.076).

3.1.5 Hydraulic Load

The hydraulic load generated by the sewage collection sewer system is based on the water consumption, the infiltration and water treatment plant process water.

The historical water usage records from 2011 and 2012 for the community of Stony Mountain were reviewed. In 2011, the community of Stony Mountain utilized 136,683 m^3 of water. Using a population of 1,744 (1,696 plus 38 equivalent students, plus 10 commercial), results in a per capita water usage of 215 L/person/day. In 2012, the community of Stony Mountain utilized 162,364 m^3 of water. Using a population of 1,786 (1,738 plus 38 equivalent students, plus 10 commercial), results in a per capita water usage of 249 L/person/day.

Historical lift station hour meter readings were reviewed to assess the actual sewage flow directed to the lagoon. Based on the design sewage collection system, only a portion of the community's flow passes through a lift station, with the balance being on gravity flow directly to the lagoon. Reviewing the 1990 Poetker MacLaren Lavalin Inc. record drawings, the portion of the community east of Main Street does not get pumped. A housing count was completed of the east portion of community based on the June 23, 2013 Google Earth images. A total of 202 homes are located in the east portion of community. The school is also located in the east portion of community. Using a housing density of 3.7 people per house in Stony Mountain based on Census Canada 2011 and a school population of 70 (212/3), the total population represented by the east portion of community is 817 (202 x 3.7 + 70. The balance of the estimated 1,781 (year 2013) population is 964 and contributes to the lift station loading.

Lift Station 2, the south lift station, pumps the remaining portion of the sewage from the community of Stony Mountain. The lift station is equipped with a duplex submersible pumping system. The pump model in the lift station is a CP3152.181 MT with curve 63-432-00-5330 with a 14.9 kW motor. The lift station pumps the sewage to MH 7 via a 495 m, 200 mm diameter forcemain. A desktop system analysis was completed on the lift station and forcemain, and the lift station is estimated to pump at 1,781 L/min.

Using the hour meter readings from 2011, the lift station pumps an average of 482.4 m^3 per day, resulting in a sewage flow of 500.4 L/person/day. Subtracting the 2011 water usage 214.7 L/person/day from the total sewage flow results in an infiltration rate of 285.7 L/person/day. In 2012 the lift station pumped an average of 399.9 m^3 per day, resulting in a sewage flow of 414.8 L/person/day. Subtracting the 2012 water usage of 249.1 L/person/day from the total sewage flow results in an infiltration rate of 165.7 L/person/day.

The 2012 hour meter readings were further reviewed to determine if the infiltration was substantially lower during the storage period of November 1 to June 15. Using the lift station hour meter reading from January 1, 2012 to June 15, 2012 and November 1, 2012 to December 31, 2012, the average day sewage flow was 388.2 m^3/day. The storage period would typically be November 1 of a given year to June 15 of the following year, however only detailed daily records of 2012 and not a combination of 2011 and 2012 were available, therefore only the 2012 data was used. After subtracting the water usage, an infiltration flow rate of 153.6 L/person/day was calculated. The average infiltration rate between June 16, 2012 and October 31, 2012 was 196.7 L/person/day. Based on the analysis it was determined the infiltration rate was relatively constant throughout 2012.

The annual changes in infiltration are more significant than the seasonal variations in the flows. Based on the 2011 and 2012 infiltration rates during the storage period, an infiltration rate of 190 L/person/day will be used for design.

The pump hour meters for 2012 were also reviewed to determine the longest runtime day. The longest runtime on the lift station pumps resulted in an infiltration rate of 1,166 L/person/day during that day. The peak infiltration rate does not affect the lagoon storage size, however it does affect the peak loads for the pumping systems.

The community of Stony Mountain is considering upgrading their raw water pump house to a water treatment plant. Through discussions with the RM of Rockwood, there is no intention of installing a membrane water treatment unit, therefore a process water allowance of 25 L/person/day (10% of water usage) has been included for a future water treatment plant.

Using a combined sewage loading of 465 L/person/day (250 L/person/day water usage + 190 L/person/day infiltration + 25 L/person/day WTP Process water) and the year 2039 design piped population of 3,452 results in an average day sewage hydraulic load of 1,605 m^3/day.

3.2 Septic Tank Cleanouts

3.2.1 Population

The Stony Mountain lagoon is sized to accommodate the septic tank pump outs from the Bristol Pipeline area and additional RM of Rockwood rural residents. The Bristol Pipeline area has an estimated 350 people. There is no anticipated growth along the Bristol Pipeline.

An allowance has been provided to accommodate an initial 100 RM of Rockwood rural residents' septic cleanouts, with a growth rate of 0.7%, matching the RM of Rockwood growth rate. The year 2039 rural septic tank cleanout design population is 119 people. The balance of the RM of Rockwood septic tank cleanouts would be sent to other lagoons within the municipality.

Based on the 2011 Canada Census, the RM of Rockwood had a population of 7,964 and 2,638 occupied private dwellings, resulting in a population density of 3.0 people/home.

The annual combined Bristol Pipeline and RM of Rockwood rural residents' septic tank pump out allowance is 469 people, representing 156 homes (469/3).

3.2.2 Organic Load

Truck hauled septage from surrounding rural septic tanks also needs to be considered in organic loading to the lagoon. Using the rural housing population of 3.0 people/household and assuming each septic tank is 4,500 L and is pumped out annually, each septic tank pump out generates 4.96 kg BOD_5. The tank loading is based on 200 L/person/year of septage at 0.007 kg BOD_5/L and 0.000196 kg BOD_5/L of non septage sewer. ((200 x 3.0 x 0.007) + (4,500-200 x 3.0) x 0.000196 = 4.96 kg BOD_5)

Septage is permitted to be hauled to the lagoon over the time period of 135 days, as specified by Manitoba Conservation in the Environmental Licence. Within the 135 day hauling period, it is likely the majority of the hauling will occur during the normal Monday to Friday work week resulting in only 96 days effluent is hauled to the lagoon. Based on the 156 septic tank pump outs and 96 hauling days, an average of 1.6 tanks need to be pumped out daily. Since only full tanks will be pumped out, the organic load will be based on two tank pump outs daily, resulting in a septic tank cleanout organic load of 9.9 kg BOD_5/day.

3.2.3 Hydraulic Load

The daily hydraulic loading from the septic tank cleanout is anticipated to be 9,000 L/day (2 x 4,500).

During the typical storage period of a lagoon from November to June, the septic tank clean out would not contribute to the overall storage requirement as the septic tank cleanouts do not occur during the storage period.

3.3 Industrial Park

3.3.1 Population

The RM of Rockwood constructed a 56 lot industrial park that is serviced by the Stony Mountain lagoon through sewage holding tanks. There are currently five lots developed in the industrial park. Varied natures of industries are permitted in the development. An allowance of five workers per property has been included, resulting in a full industrial park population of 280 people. The industrial park population is assumed to have an occupancy equivalence of 1/3, based on the amount of time spent at the facilities, and would therefore represent an equivalent population of 94 people (280/3).

3.3.2 Organic Load

The organic loading calculation is based upon the similar sewage to the community of Stony Mountain. A typical value of 0.076 kg BOD_5/person/day was utilized to estimate the organic loading. Based on the industrial park equivalent population, a year 2039 design population is 94, generating 7.1 kg BOD_5/day (94 x 0.076).

3.3.3 Hydraulic Load

Given the trucked hauled sewage service of the industrial park, it is anticipated that only dry industries will be constructed. The water usage equivalent to the community of Stony Mountain of 250 L/person/day has been assumed. No infiltration allowance has been included for the holding tanks.

Using a sewage loading of 250 L/person/day and the year 2039 design industrial park equivalent population of 94, a daily sewage hydraulic load of 24 m^3 is generated.

3.4 Stony Mountain Institute

3.4.1 Population Growth

The current and projected inmate and staff populations were provided by Correctional Service Canada personnel in an email on January 14, 2014. The current inmate population of SMI is 771 inmates and the current population of Rockwood Institute is 247 inmates. The combined current inmate population is 1,018.

The future inmate population would consider double bunking the max number of units plus a potential 50 bed increase for a total increase of 292 inmates. Therefore the total future inmate population would be 1,310.

The AECOM *Stony Mountain Institution and Rockwood Institution Preliminary Design Report*, 2012 was reviewed to determine the design population for the Stony Mountain Institute/Rockwood Institute number of staff. According to the report the current capacity is 682 staff and the future capacity is 802 staff. The staff number of 802 was confirmed in a phone conversation with SMI on January 16, 2014.

The staff at the facility are assumed to have an occupancy equivalence of 1/3, based on the amount of time spent at the facilities, and would therefore represent an equivalent population of 268 people (802/3).

Combining both the inmates and the staff equivalency after the expansion is completed results in a total design population of 1,578.

3.4.2 Organic Load

Based on a review of the organic loadings provided by Correctional Service Canada of four existing facilities, the BOD_5 loading varied between 0.116 and 0.252 kg BOD_5/inmate/day with an average of 0.180 kg BOD_5/inmate/day. The organic loading was calculated based on number of inmates, BOD_5 samples and the average day flow of the facility. The total flow for the facility included both the inmates and the staff, but the loading was presented based on number of inmates.

Using the ratio of inmates to equivalent full time staff, there is projected to be 4.89 (1,310/268) inmates per staff based on the design population.

Following typical municipal loadings of 0.076 kg BOD_5/person/day for both inmates and staff, the adjusted BOD_5/person/day to represent both the staff and the inmates loading on a per inmate basis would be 0.092 kg BOD_5/person/day ((1,310+268) x 0.076/1,310). Based on the results obtained from Correction Service Canada of 0.180 kg BOD_5/inmate/day, the correction facilities produce on average twice as much BOD_5 loading on a per capita basis than typical municipal sewage.

For the design of the Stony Mountain Institute the organic loading of the entire facility will be based on the inmate population of 1,310, generating 0.180 kg BOD_5/inmate/day, resulting in a daily BOD_5 loading of 235.8 kg.

3.4.3 Hydraulic Load

The hydraulic load generated by the sewage collection sewer system is based on the water consumption, the infiltration and the water treatment plant process water. Correctional Services Canada was contacted and has no records of the sewage flows leaving the facilities.

The AECOM report reviewed the water consumption of the Stony Mountain Institute and reported a 2011 water usage rate of 494 L/person/day. They further identified a Correctional Services Canada Technical Criteria Document recommends a 500 L/person/day water usage, in addition to laundry and industrial issues at the facility. The report identified that the water treatment plant would be designed to supply only the 500 L/person/day. This value will be used for the design of the sewage treatment system.

Correction Services Canada identified that in 2012 the facility utilized 509 L/inmate/day. They acknowledge the use of 250 L/person/day would be acceptable for the facilities staff.

A discussion occurred with Correction Services Canada about the infiltration in their system. Since they do not have any data they advised they intend on completing a study of their flows to determine the infiltration rate. With the lack of available flow data currently available, infiltration on the sewage collection system is anticipated to be similar to the community of Stony Mountain. An infiltration allowance of 190 L/person/day has been included.

Stony Mountain Institute is no longer considering constructing a new water treatment plant at this time. They are considering connecting to a rural pipeline system for their water supply. No water treatment process water will be included in the sewage treatment system sizing.

Based on the design inmate population of 1,310 at a water usage of 500 L/person/day and the design equivalent staff of 268 at a water usage of 250 L/person/day, and infiltration allowance of 190 L/person/day for the entire population of 1,578, a daily sewage hydraulic load of 1,022 m^3 is generated.

3.5 Sewage Treatment Loading Summary

3.5.1 Organic Load Summary

The total 25 year (2039) design organic load to the facility is summarized in the following table:

Description	Organic Load kg BOD_5/day
Community of Stony Mountain	262.4
Septic Tank Cleanout	9.9
Industrial Park	7.1
Stony Mountain Institute	235.8
Total	515.2

3.5.2 Hydraulic Load Summary

The total 25 year (2039) design hydraulic load to the facility is summarized in the following table:

Description	Average Day Flow (m^3)
Community of Stony Mountain	1,605
Septic Tank Cleanout	9
Industrial Park	24
Stony Mountain Institute	1,022
Total	2,660

4.0 LAGOON STORAGE CAPACITY

Typically lagoons are required to maintain 230 days of storage (November 1 to June 15). Discussions have been completed with Manitoba Conservation to allow for discharge earlier in the spring (April 16) due to enhanced treatment from the filters and UV unit in the sewage treatment building. The early discharge will depend on the ability of the receiving stream to accept the discharge without causing flooding or icing. The storage cells will be sized to accommodate storage from November 1 to May 1 (180 day storage) to provide a small buffer for spring conditions hindering early discharge. The storage period will use 180 days as opposed to 230 days. As a result, the storage volume produced over the winter will be reduced.

The four existing lagoon cells, Stony Mountain Primary Cell, Stony Mountain Secondary Cell, Stony Mountain Institute Primary Cell and the Stony Mountain Institute Secondary Cell will be utilized for effluent storage. The operating depth of the Stony Mountain Institute cells will be increased from 1.5 m to 2.5 m. A new cell will also be constructed east of the existing Stony Mountain Institute Lagoon to provide the additional storage capacity required. An additional cell will also be created between the existing RM of Rockwood Lagoon and the Stony Mountain Institute Lagoon.

4.1 Stony Mountain Primary Cell (Storage Cell 1)

The existing Stony Mountain Primary Cell will become Storage Cell 1. The existing cell floor elevation is 233.5 m with the top of dike at 236.0 m. The flat bottom area of the cell is 29,836 m^2. The cell was designed to operate with a liquid depth of 1.5 m and a 1 m freeboard. The cell will have a usable operating depth of 1.2 m as the bottom 0.3 m will not be drained. The storage capacity of Storage Cell 1 is 38,935 m^3.

The existing cell has demonstrated concerns of seepage in a lower silt layer. A 2 m wide clay cut off wall will be constructed along the north and west sides of the existing exterior dike toe to improve the liner through the silt layer. The keyway will key 0.6 m into the lower clay and extend 0.3 m above the existing ground.

4.2 Stony Mountain Secondary Cell (Storage Cell 2)

The existing Stony Mountain Secondary Cell will become Storage Cell 2. The existing cell floor elevation is 233.5 m with the top of dike at 236.0 m. The flat bottom area of the cell is 61,023 m^2. The cell was designed to operate with a liquid depth of 1.5 m and a 1 m freeboard. The cell will have a usable operating depth of 1.2 m as the bottom 0.3 m will not be drained. The storage capacity of Storage Cell 2 is 77,635 m^3.

The existing cell has demonstrated concerns of seepage in a lower silt layer. A 2 m wide clay cut off wall will be constructed along the south and west sides of the existing exterior dike toe to improve the liner through the silt layer. The keyway will key 0.6 m into the lower clay and extend 0.3 m above the existing ground.

4.3 Stony Mountain Institute Primary Cell (Storage Cell 3)

The existing Stony Mountain Institute Primary Cell will become Storage Cell 3. The existing cell floor elevation is 232.5 m. The flat bottom area of the cell is 63,856 m^2. The top of dike will be left unchanged at 235.0 m, however the cell operating depth will be increase to 2.5 m. The dikes surrounding the cell, new Storage Cell 5 and the existing RM cells will have dikes at 236.0 m, providing freeboard to the cell. The existing dikes will act as intercell dikes. The cell will have a usable operating depth of 2.2 m as the bottom 0.3 m will not be drained. The storage capacity of Storage Cell 3 will become 153,453 m^3.

There are existing concerns with seepage through the existing silt layer below the existing lagoon dikes. A section of the north side of the dike will be raised and become a portion of the new Aeration Cell 1 south dike. Containment of this portion of the existing primary cell will occur through the proposed north Aeration Cell 1 dike. There will be a section of the north dike that is not adjacent to the proposed aeration cell. This section of dike will be raised to accommodate the proposed operating level and a new keyway will be constructed in the expanded dike. The keyway will key 0.6 m into the clay below the existing silt layer and extend to the top of dike.

A section of the east side of the existing primary cell will be raised and become a portion of the new Aeration Cell 2 west dike. Containment of this portion of the existing primary cell will occur through the proposed east Aeration Cell 2 dike. There will be a section of the east dike that is not adjacent to the proposed aeration cell. This section of dike along will be surrounded by the new Storage Cell 5. The west side of the lagoon is surrounded by the existing RM lagoon. A section of dike will be constructed at the north and south ends of the space between the existing RM and SMI lagoons to provide a continuous dike around the cell.

4.4 Stony Mountain Institute Storage Cell (Storage Cell 4)

The existing Stony Mountain Institute Storage Cell will become Storage Cell 4. The existing cell floor elevation is 232.5 m. The flat bottom area of the cell is 51,044 m^2. The top of dike will be left unchanged at 235.0 m, however the cell operating depth will be increase to 2.5 m. The dikes surrounding the cell, new Storage Cell 5 and the existing RM cells will have dikes at 236.0 m, providing freeboard to the cell. The existing dikes will act as intercell dikes. The cell will have a usable operating depth of 2.2 m as the bottom 0.3 m will not be drained. The storage capacity of Storage Cell 4 will become 124,137 m^3.

There are existing concerns with seepage through the existing silt layer below the existing lagoon dikes.

The east and south side of the existing storage cell will be surrounded by the new Storage Cell 5. The west side of the lagoon is surrounded by the existing RM lagoon. A section of dike will be constructed at the north and south ends of the space between the existing RM and SMI lagoons to provide a continuous dike around the cell.

4.5 New Storage Cell (Storage Cell 5)

A new storage cell will be constructed on the east side to the Stony Mountain Institute Lagoon and will become Storage Cell 5. The cell floor elevation will be set to 232.5 m to match the existing Stony Mountain

lagoon floor. The flat bottom area of the cell will be 127,098 m^2. The cell size was designed to maximize the use of the land and maintain the minimum 300 m setback requirement to residences. The top of dike will be constructed to 236.0 m. The cell is designed to operate with a liquid depth of 2.5 m and a 1 m freeboard. The cell will have a usable operating depth of 2.2 m as the bottom 0.3 m will not be drained. The storage capacity of Storage Cell 5 will become 305,340 m^3.

A keyway will be constructed in the new dikes surrounding Storage Cell 5. The keyway will key 0.6 m into the clay below the existing silt layer and extend to the top of dike. The keyway will be constructed a minimum of 2 m wide. The inside slopes of the dike will be constructed with a 4.5:1 slope. The exterior slopes of the dike will be constructed with a 4:1 slope.

4.6 Area between Rockwood and SMI Lagoon (Storage Cell 6)

By constructing a dike between the existing SMI and Rockwood primary cells and storage cells, an additional long narrow cell is constructed. The existing ground between the two cells varies between 233.4 m and 234.4 m, excluding the existing drainage ditch. The flat bottom area between the dikes is approximately 8,411 m^2. Assuming an average floor level of 234.0 m and an operating level of 235.0 m, the storage capacity of the area would be 12,312 m^3. The existing floor area will be left with variable depths and will not be regraded.

4.7 Storage Cell 5 Aeration

To allow the storage cells to be operated at a depth of 2.5 m, aeration is required to ensure the effluent does not go anaerobic. Storage Cell 5 would have a linear tubing aeration system. A header would be installed along the east dike of the cell and blowers will be located in the sewage treatment building. Two 25 hp blowers will be provided to act as a duty standby configuration. The blowers will produce 310 cfm of air.

To allow Storage Cell 3 and Storage Cell 4 to operate at the deeper depth of 2.5 m, all discharging of Storage Cells 3 and 4 will occur through Storage Cell 5. Aeration of Storage Cell 3 and 4 passing through Storage Cell 5 will provide final polishing of the effluent prior to discharge.

The aeration system does not need to operate year round as the liquid level in the cells will not exceed the 2.1 m operating depth, except in mid winter. The blowers will need to be operated in late fall to ensure the aeration lines do not freeze and can be turned off after the spring discharge is completed.

4.8 Maximum Storage Cell Capacity

The total storage capacity of the facility with the six cells is summarized as follows:

Description	Storage Volume
Storage Cell 1 -1.5 m	38,935 m^3
Storage Cell 2 -1.5 m	77,635 m^3
Storage Cell 3 - 2.5 m	153,453 m^3
Storage Cell 4 - 2.5 m	124,137 m^3

Description	Storage Volume
Storage Cell 5 -2.5 m	305,340 m^3
Storage Cell 6 -1 m	12,312 m^3
Total	711,812 m^3

The available storage in Storage Cells 1 to 6 far exceeds the year 25 (2039), 180 day storage requirement of 477,090 m^3 as well as the 230 day storage requirement of 609,615 m^3.

Refer to various dike cross sections on plans L2 and L3 in Appendix E for details the dike construction.

4.9 Storage Cell 5 Aeration Staging

A discussion occurred with the RM of Rockwood Council at a meeting on April 23, 2014 regarding the available storage capacity in the expanded and modified storage cells. Given the excess storage capacity well beyond the 25 year anticipated requirement, Council decided to limit the operating depth of the Storage Cells 3, 4, and 5 to 2.1 m. The total storage capacity of the facility with the six cells limited to a 2.1 m operating level is summarized as follows:

Description	Storage Volume
Storage Cell 1 - 1.5 m	38,935 m^3
Storage Cell 2 -1.5 m	77,635 m^3
Storage Cell 3 - 2.1 m	128,498m^3
Storage Cell 4 - 2.1 m	104,248m^3
Storage Cell 5 - 2.1 m	246,713m^3
Storage Cell 6 - 0.6	6,918m^3
Total	602,947m^3

By limiting the current operating depth, the aeration system installation in Storage Cell 5 can be postponed until year 2038, based on current growth projections and a 230 storage period. Using the 180 day storage period, the lagoon would still have growth potential.

The dikes around Storage Cell 3, 4 and 5 will still be constructed to allow a future 2.5 m operating depth and space will be provided in the sewage treatment building to accommodate the additional future blowers.

5.0 LAGOON SEWAGE TREATMENT

5.1 Lagoon Treatment Requirements

A review of the *Wastewater System Effluent Regulations* June 28, 2012 and the *Manitoba Water Quality Standards, Objectives and Guidelines* November 28, 2011 was completed. The following table summarizes the treatment requirements:

Parameter	Federal Requirement	Provincial Requirement
$CBOD_5$	25 mg/L	25 mg/L
BOD_5		25 mg/L
Suspended Solids	25 mg/L	25 mg/L
Un-ionized Ammonia expressed as nitrogen (N) at 15°C	<1.25 mg/L	
Fecal Coliforms		200 per 100 mL
pH		
Phosphorus		1.0 mg/L

A sewage test sample was taken on April 23, 2014 to assess the nutrients in the existing lagoon cells. The following table summarizes the un-ionized ammonia and the phosphorous in the lagoon:

Parameter	RM Rockwood Stony Mountain		Stony Mountain Institute	
	Primary Cell	Storage Cell	Primary Cell	Storage Cell
Un-ionized ammonia	0.12 mg/L	0.11 mg/L	0.10 mg/L	0.06 mg/L
Phosphorus	4.09 mg/L	2.88 mg/L	1.71 mg/L	1.53 mg/L

Lab test results are available in Appendix C.

5.2 BOD Treatment

5.2.1 Aeration Cells

To meet the sewage treatment requirements, two aeration cells are proposed. Both cells will be partial mix aeration cells maintaining a 4 m liquid level for efficient oxygen transfer. Fine bubble diffusers will direct the air into the cells. A total of 50 days retention time in summer between the cells will be provided based on the average day flow. Due to site configurations, Aeration Cell 1 will be slightly smaller than Aeration Cell 2. Aeration Cell 1 will be located along the north dike of the existing SMI primary cell and Aeration Cell 2 will be located along the east dike of the existing SMI primary cell. Refer to Plan L1 in Appendix E for the Aeration Cell locations. The aeration cells were sized providing a sludge allowance of 0.3 m. The majority of the air will be directed to the first cell. The reduced air in the second aeration cell reduces the turbulence in the water, allowing better settling to occur.

The lagoon cells will be designed to accommodate the year 25 average day loading rate of 2,660 m^3/day. The 50 day hydraulic retention will help attenuate the daily peaks in the system as the sewage will be able to pond in the freeboard zone of the cell. The 50 day hydraulic retention also allows the system to accommodate peak organic loads.

5.2.2 Aeration Cell Construction

The 50 day storage requirement will be completed in two rectangular cells. Both cells will be 5.0 m deep, providing 1 m free board and 4 m of liquid depth. A minimum summer usable storage of 51,000 m^3 will be provided. The flat bottom area of Aeration Cell 1 will be 11,250 m^2 and the flat bottom area of Aeration Cell 2 will be 12,000 m^2.

To be in compliance with Manitoba Conservation guidelines, a hydraulic conductivity of 1.0 x 10^{-7} cm/sec is required for the liner. Several test holes were completed in the vicinity of the aeration cells. In 2010, JRCC completed five test holes, in 2011, JRCC completed an additional three test holes, and in 2014, AMEC completed four test holes. The soils in the test holes are variable, with an upper high to medium plastic clay, followed by a silt layer, underlain by a high plastic clay layer. The bottom of the silt layer varies between 2.4 m and 3.6 m deep. To provide a liner around the exterior side of the aeration cells, a clay cut off wall will be constructed 0.6 m into the lower high plastic clay. In 2011, a hydraulic conductivity test was completed on a sample of the high plastic clay at a depth of 1.9 to 2.5 m in TH 12. Although the test hole was not directly under the aerated lagoon cell, the soil is considered representative of the lower high plastic clay below the aerated lagoon. The test results provide a hydraulic conductivity of 4.8 x 10^{-9} cm/sec, demonstrating the lower clay provides the required liner protection.

The interior slopes of the cell will be excavated and built up at a 5.5:1 slope with the insitu clay material on the inside slopes. The lagoon will be constructed with the top of the dikes 3.0 m wide. The exterior slopes will be constructed using a 4:1 slope with a mixture of insitu silt and clay material. To minimize erosion potential on the interior dikes, 1.0 m of vertical rip rap will be installed, 0.5 m below and 0.5 m above the normal water level.

A concrete truck dump spillway will be constructed at the northwest corner of Aeration Cell 1 to accommodate the truck hauled sewage. The existing spillway to the community of Stony Mountain lagoon will be decommissioned.

Refer to Plan L2 in Appendix E for the dike cross section details.

5.2.3 Aeration Header System

The first section of the aeration header will be a galvanized metal pipe used to dissipate the heat produced by the blowers. The remaining portion of the header is proposed to be a shallow buried HDPE pipe that will connect to and supply air to the floating laterals.

Each lateral will be individually valved for ease of air balancing and maintenance. Laterals will connect to the shallow buried header, and float on the water surface. Laterals will be secured

against wind action with a stainless steel cable system. The cables will be fastened to anchors in the lagoon berm using a self-adjusting lateral tensioning assembly. All header and lateral piping, joints, and fittings will be thermally fused HDPE. With floating laterals the cells do not have to be dewatered or taken out of service for aeration system installation or maintenance. All maintenance can be performed from a boat with a two person crew. All header, lateral, and feeder piping will be designed to accommodate increased airflow for high pressure and volume cleaning without increasing header friction losses by more than 1 psi. This allows for management of additional organic load, improved diffuser maintenance and additional odour control.

5.2.4 Positive Displacement Blowers

Air supply for the Aeration Cells will be provided by two 40 hp positive displacement blowers with a third stand by blower. The blowers will provide 1,152 cfm at a discharge pressure of 7.5 psi and be capable of operating at high pressures intermittently for diffuser and piping purging. The blowers will be located in the sewage treatment building and will be equipped with sound attenuating enclosures. Sound levels in the blower room will be designed not to exceed 71 dB(A). A silencer will be installed on the blower discharge piping leaving the building to the aeration cells to provide further sound attenuation. Additional sound attenuation will be provided on the blower air intakes using a combination of sound attenuation louvers as well as intake silencers.

The blowers will be controlled with variable frequency drives to provide an efficient operation of the equipment. During the initial years of operation when the system demand is below the Year 25 design oxygen transfer requirements, the operator will be able to reduce the blower operating speed, minimizing the power consumption.

5.2.5 Aeration Diffusers

Submerged fine bubble membrane diffusers will be used to provide oxygen to the wastewater. The diffusers will be constructed with a HDPE air distribution body with individual tubular micro-porous membrane fingers extending outwards in a horizontal plane.

The diffuser membranes will require minimal cleaning and maintenance. For cleaning, additional airflow will be introduced to the diffusers causing the membrane pores to flex, temporarily breaking off any formed precipitation or fouling. No chemical cleaning or water wash will be required. The diffusers will be suspended at a constant level near the floor with a marine grade rope directly under the floating lateral, connected with a self-weighted feeder line. The rope will be attached to the floating header for ease of retrieval from a boat, without any special equipment.

5.3 Average Day and Peak Flow Requirements

The system will be designed to treat an average day hydraulic load of 1,847 L/min. All treatment systems with mechanical equipment need down time each day for maintenance. It is reasonable to allow 4 hours a day for maintenance, leaving only 20 hours/day for treatment. Factoring in the daily downtime

for equipment maintenance, the average day hydraulic design flow rate becomes 2,217 L/min. The system will be designed to accommodate peak loads by temporarily increasing the treatment rate of the system.

Peak hydraulic loading to the treatment facility is caused by rainfall directly into the cell and sewage flows greater than average day flows. To ensure the cells do not overtop during the peak hydraulic loading conditions, the system must have provisions to accommodate the peak hydraulic loads. Environment Canada's Website was reviewed to determine normal precipitation in Stony Mountain area. The Canadian Climate Normals from 1971-2000 at this reporting station identify the largest month's average monthly rainfall to be 88.9 mm. To account for some higher than average monthly rainfall, a 100 mm monthly rainfall will be included in the sizing of the treatment systems downstream of the aeration cells (i.e. pumps, filters). Ministry of Ontario Environment's (MOE) publication *Design Guidelines for Sewage Works 2008* recommends sewage treatment plants be designed to accommodate peak flows between two to three times average day flows. Aerated lagoons do not need to accommodate as high of peak hydraulic flows suggested for the sewage treatment plants because of the ability to pond peak flows in the freeboard zone of the lagoon cells.

Monthly rainfall of 100 mm over the two aeration cells water surface and interior dike area of approximately 54,600 m^2 generates 5,460 m^3 of precipitation. Ignoring any evaporation effects during the peak rainfall month results in a hydraulic loading rate of 126 L/min.

The historical lift station hour meter readings were reviewed to assess peak day flows in the community of Stony Mountain. The 10 day, 15 day, 20 day, 30 day and 40 day average hour meter readings were compared to the yearly average hour meter readings and are summarized in the following table:

	Average Hours/day	Peaking Factor
2012 Annual Average	3.74	
Max 10 day Running Average	6.93	1.85
Max 15 day Running Average	5.87	1.57
Max 20 day Running Average	5.65	1.51
Max 30 day Running Average	5.48	1.46
Max 40 day Running Average	5.08	1.36

Increasing the sewage treatment facility's hydraulic capacity to 1.6 times the average day flow provides sufficient treatment capacity to accommodate the Max 15 day running average. The peak flows greater than 1.6 times the average day would be left to be stored in the aerations cells, temporarily raising the water levels. Based on the Max 10 day Running Average peaking factor of 1.85 times the average day, the aeration cells could accommodate 38 consecutive peak days with a rise of 0.5 m to the lagoon level. Using the 1.6 times peaking factor, the peak flow treatment capacity is 2,956 L/min.

Combining both the rainfall peak of 126 L/min and the sewage peak flow of 2,956 L/min results in a total system design peak flow of 3,082 L/min. As previously mentioned, all treatment systems with mechanical equipment need down time each day for maintenance. It is reasonable to allow four hours a

day for maintenance, leaving only 20 hours/day for treatment. Factoring in the daily downtime for equipment maintenance, the intermittent peak hydraulic design flow rate becomes 3,698 L/min.

The aerated lagoon system will initiate the peak flow rate based on lagoon water level set points in the pumping control systems.

5.4 Phosphorous Reduction - Continuous Backwash Gravity Sand Filter System

To achieve the desired phosphorus reduction levels of < 1 mg/L, filtering the effluent is required. Continuous gravity upflow sand filters will be used to remove the phosphorus. Ferric Chloride will be added to the effluent in the piping upstream of the filters to coagulate the phosphorous for removal by the filtration process. The effluent will be pumped from the inlet chamber and divided evenly between the filters. A typical filter loading rate is 120 to 200 L/min/m^2 for phosphorus with gravity upflow filters. Using four 2.74 m diameter filters and the 25 year average day design flow of 2,217 L/min, the filter loading rate will be 94 L/min/m^2 which is reasonable. The flow rate assumes the flow will occur 20 hours per day, allowing four hours per day for maintenance. During intermittent peak flow events, of 3,698 L/min, the filter loading rate will be 157 L/min/m^2. This is a reasonable loading rate for intermittent peak flow events. By using four filters rather than one large filter, the system gains redundancy in the event of problems with any single filter, as some treatment could still occur while one filter is out of service for repairs and maintenance.

The filters operate continuously by maintaining a reject stream, thereby not needing a backwash operation. The reject rate for a 2.74 m diameter sand filter is 49 to 57 L/min. The reject stream is directed back to the first aeration cell. The filtered effluent stream will be directed to treated effluent pumping chamber for UV disinfection and discharge.

In addition to phosphorous reduction, the filters also reduce the total suspended solids in the waste stream to maintain the design effluent quality 10 mg/L.

5.5 UV Disinfection

Disinfection of the effluent will be completed by a pressure flow ultraviolet (UV) disinfection systems, rated to disinfect the average day flow of 2,217 L/min. The Trojan UV Fit 32AL50 UV disinfection system is designed to accommodate a flow of 3,636 L/min with a UVT of 40%, based on a 30 day geometric mean. During an intermittent peak flow event, the flow would be increased to 3,698 L/min, which would marginally exceed the UV system rating. The disinfection ability of the sewage is directly related to the UVT. If the UVT increased to 45%, the UV reactor rating would be increased to 4,692 L/min. Typical UVT for sewage through the sand filter is between 40% and 45%. To reduce manual operational maintenance, the UV disinfection system will be equipped with an automatic bulb wiping system. A chemical cleaning system will also be added to improve the automatic cleaning system. The UV unit will be designed to reduce the fecal coliforms to 200 per 100 ml, provided that a UV transmittance of 40% is continuously maintained.

If direct discharge to the environment will occur from the sewage treatment system to bypass the storage, additional sample testing will be required during peak flows to ensure proper disinfection is being maintained.

5.6 Un-ionized Ammonia Reduction

Based on the low un-ionized ammonia test results, no formal ammonia reduction process has been included in the sewage treatment system.

5.7 Sewage Treatment Building

The sewage treatment building will house all of the process and testing equipment for the wastewater treatment system. The sewage treatment building will be divided into rooms, including an office, washroom, blower/electrical/genset room and a mechanical room. The mechanical room will house the filter, UV unit, ferric chloride chemical storage, effluent pumps, lab equipment and work bench.

Due to the noise generated by the blowers, genset and air compressor, the interior walls of the building between the blower/electrical/genset room and the rest of the building will be fully insulated for maximum noise absorption. As additional sound attenuation, each blower will be installed in a self-contained sound attenuation enclosure.

A PLC control system including full SCADA capabilities with trending and historical data will be included in the system design.

The building requires a 340 m^2 footprint to accommodate the design spatial demand of the equipment. It will be constructed using a pre-engineered steel building with a brick veneer exterior. Due to the filter height requirements, the building will have a split level roof to accommodate the equipment. Refer to the Sewage Treatment Building Overall Layout plan for building layout details in Appendix E.

The sewage treatment building will not be connected to the community's piped water system. A water holding tank will be required at the sewage treatment building for its own domestic needs. A small pump and pressure tank located in the sewage treatment building will supply the water. The building sewage discharge will flow into the Aeration Cell 1.

The building will be equipped with an emergency genset power supply to ensure air flow to the cells remains uninterrupted and provide power to both sewage lift stations. The genset will be sized to run one blower to maintain pressure in the air lines to prevent freezing of the air lines in winter and one pump in each lift station.

5.8 Discharge from the Sewage Treatment Building

Once the effluent is disinfected in the sewage treatment building, the treated effluent will be pumped to Storage Cell 1, Storage Cell 3 or the ditch along King Edward Road. A tee and gate valves will be installed outside of the sewage treatment building to direct the flow between the storage cells and the ditch.

A 586 m treated effluent discharge pipe will be installed between the sewage treatment building and Storage Cell 1. The piping alignment will follow the exterior dike of the aeration cell and pass by Storage Cell 3. A tee and valve will be provided to allow the effluent to be diverted to Storage Cell 1 or Storage Cell 3.

Under average design flow operation, a 300 mm diameter pipe will be flowing at 2,217 L/min, resulting in a pipe velocity of 0.59 m/s. Under peak flow conditions of 3,698 L/min, the pipe will be operating at a velocity of 0.98 m/s. A minimum pipe velocity of 0.6 m/s is recommended to provide a cleaning velocity in the pipe. Under maximum flow conditions, the cleaning velocity will be obtained. The discharge pipe will be constructed using 300 mm diameter HDPE DR 17 piping.

A 300 mm, 35 m treated effluent pipe will also be installed heading east from the sewage treatment building to the new perimeter lagoon ditch on the east side of the lagoon. The perimeter lagoon ditch on the east side of the lagoon will connect to the ditch on the west side of King Edward Road, 436 m north of PR 321. A section of the existing ditch on the west side of King Edward Road will be regraded to ensure positive drainage to the PR 321 ditch. Once in the King Edward Ditch south of PR 321, the treated effluent will follow the existing discharge path.

5.9 Pumping Systems

Two main pumping systems are required in the sewage treatment system: the filter feed pumps and the treated effluent discharge pumps. Both systems will be designed with a submersible duplex pumping system, similar to the lift stations on the gravity sewer system.

5.9.1 Filter Feed Pump

The filter feed pump will normally operate at the average day flow of 2,217 L/min, however will be sized to accommodate the peak intermittent flow rate of 3,698 L/min. The pump will be controlled based on the start and stop set point levels of the lagoon. In addition to the average day flow and peak flow, the pump must accommodate a reject rate of 57 L/min per filter, resulting in a pump capacity requirement of 2,445 L/min for the average day flow and 3,926 L/min. The pump will lift the effluent from the bottom of the liquid control manhole and discharge the effluent at the top of the filter. The normal static head on the pump is 8.2 m. Using a combination of 200 mm and 250 mm internal building piping, system operating head will be 11.6 m under peak flow conditions. The pumps will be VFD driven to optimize the pump performance and to maintain constant flow.

5.9.2 Treated Effluent Discharge Pump

The discharge pump will normally operate at the average day flow of 2,217 L/min, however must be sized to accommodate the peak intermittent flow rates of 3,698 L/min. The pump will lift the effluent from the bottom of the treated discharge chamber and pump the effluent through the UV disinfection system and to the storage cells or the discharge ditch.

Depending upon the lagoon water level, there is a negative static head on the pump, however under start up conditions, the pump must overcome a static head of 6.4 m. The normal static

head on the pump varies between a vacuum of 2.5 m and a vacuum of 1 m. Using a combination of 200mm and 250 mm internal piping and 300 mm piping to the storage cells, the system operating head will be 7.4 m under peak flow conditions. The pump will be VFD driven to optimize the pump performance. A 150 mm modulated plug valve will be installed on the discharge line to ensure the system does not siphon and to provide a minimum 2.1 m back pressure on the pump during low storage cell levels.

5.10 Lagoon Access Road

To access the lift stations, lagoon, truck dump and sewage treatment building, an access road approximately 660 m long will be constructed. The access road will be constructed north of the aeration cells. The road structure will include 150 mm A-Base, 200 mm C-Base and a non-woven geotextile on a compacted subgrade. In accordance with the 1993 RM of Rockwood Municipal Standards, the road will have a surface width of 6.1 m, with a 3% cross fall and 4:1 side slopes. The road surface will be placed 0.6 m above existing ground. Ditches will be constructed along the road to keep the subgrade dry. The road ditches will drain east towards the King Edward Road.

A 600 mm culvert will be installed through the new access road where it connects to King Edward Road and at the east end of Aeration Cell 2 to allow the existing drainage ditch going through the proposed lagoon expansion area to be rerouted.

6.0 LIFT STATIONS

Both the existing community of Stony Mountain and the Stony Mountain Institute gravity sewer collection systems allow the sewage flow directly into the respective existing primary cells. The new aeration cells will be operating at a higher elevation than the existing lagoon, resulting in the need for lift stations to pump the effluent into the aeration cells. For metering purposes between the two sewage collection systems, two separate lift stations will be provided to pump the effluent from the gravity sewer system from the community of Stony Mountain and the Stony Mountain Institute. Both lift stations will be located near the northwest corner of the aeration cells. Refer to plan LS1 in Appendix E for the location.

Each lift station will be equipped with a mag meter to record the flow entering the sewage treatment facility. Electrical service to the lift station will come from the Sewage Treatment Building. Backup power will be provided to each lift station from a genset installed in the Sewage Treatment Building. Each lift station will have its own control panel mounted above the lift station barrel.

6.1 Community of Stony Mountain

To connect the lift station to the existing community of Stony Mountain gravity sewer collection systems, a new manhole needs to be installed on the community gravity sewer line and the sewer line needs to be extended 120 m. The existing sewer line at the manhole connection location has been determined to be 231.65 m based the inverts of adjacent manholes measured during the JRCC 2013 survey. The Poetker MacLaren Lavalin 1990 design drawings show the existing sewer pipe is a 300 mm diameter sewer.

The new sewer line invert at the lift station will be 231.65 m - (120 m x 0.3% + 0.10 m) = 231.24 m. An allowance of 0.1 m has been provided to accommodate connections to the existing sewer line.

6.1.1 Pumping Capacity

The lift station pumping capacity must accommodate both the dry weather flow and the wet weather flow.

The dry weather flow has been calculated using the design population of 3,452, a Harmon peaking factor of 3.39, a water usage of 250 L/person/day, a future water treatment process allowance of 25 L/person/day, and the infiltration rate of 190 L/person/day. The dry weather flow was calculated to be 44.0 L/s. The Harmon peaking factor was applied to the water usage portion (250 L/person/day) of the sewage only, a max day factor of 2.5 was applied to the future water treatment process allowance and no peaking factor was included for the infiltration.

The wet weather flow has been calculated using the design population of 3,452, a Harmon peaking factor of 3.39, a water usage of 250 L/person/day, a future water treatment process allowance of 25 L/person/day, and the peak infiltration rate of 1,166 L/person/day. The wet weather flow is assumed to be 82.9 L/s. The Harmon peaking factor was applied to the water usage portion of the sewage only, a max day factor of 2.5 was applied to the future water treatment process allowance and no peaking factor was included for the infiltration.

The lift station will be a below ground, 2.4 m dia. pre-cast concrete barrel type lift station with a duplex pumping system. The barrel will have a pump operating sump of 1.5 m depth to provide sufficient drawdown capacity for the pumps to minimize stop-start cycles. The lift station floor will be set at 228.99 m. The barrel would be waterproofed to minimize infiltration. A concrete ring would be installed on the bottom of the barrel to prevent floatation of the lift station barrel during periods of high ground water.

6.1.2 Forcemain and Pump Selection

The forcemain will be approximately 95 m long to connect the lift station to Aeration Cell 1. Forcemain sizing was completed for the wet weather design flow of 82.9 L/s. In calculating the pipe losses, DR-17 HDPE piping was used with a Hazen-Williams pipe roughness coefficient of 120.

Using a 300 mm pipe, the design flow resulted in a friction loss of 0.7 m at a velocity of 1.3 m/s. The velocity in the forcemain exceeds the Ten State Standard minimum velocity requirements of 0.6 m/s, thereby providing the minimum cleaning velocities.

Based on the lift station elevation and the proposed aerated lagoon operating level 236 m, the lift station will be pumping against 6.8 m of static head. When combining with the friction head of 0.7 m from the forcemain to the static head and adding 1.5 m for internal station losses, and a 1 m safety factor, the pump must be able to produce a total head of 10.0 m at a flow rate of 82.9 L/s.

Pump selection was completed for the sewage flow of 82.9 L/s. The Flygt NP 3153 LT with the 207 mm impeller, 200 mm discharge outlet and a 14.9 kW motor is recommended. The pump selection provides a single pump flow of 82.9 L/s at a system head of 10.0 m and a pipe velocity of 1.3 m/s. When both pumps operate, the flow will increase to 120.7 L/s at a system head of 12.2 m and a pipe velocity of 1.9 m/s. The single pump flow provides sufficient capacity to meet the design requirements and satisfies the minimum cleaning velocity of 0.6 m/s.

6.1.3 Gravity Sewer Extension

Based on the wet weather flow rate of 82.9 L/s, and a slope of 0.3% the extension of the existing gravity sewer line will be completed with 375 mm PVC pipe. During the wet weather flows, the pipe will be flowing approximately 75 % full. During dry weather flows of 44.0 L/s the pipe will be flowing approximately 50 % full.

6.2 Stony Mountain Institute

To connect the lift station to the existing Stony Mountain Institute gravity sewer collection system, a new manhole needs to be installed on the Institute gravity sewer line and the sewer line needs to be extended 185 m. The existing sewer line at the manhole connection location has been determined to be at an elevation of 233.51 m based the inverts of adjacent manholes measured during the JRCC 2013 survey. No design drawings are available to determine the existing pipe diameter. The sewer line is always surcharged and the pipe size could not be determined on site.

The new sewer line invert at the lift station could be 233.51 m - (185 m x 0.3% + 0.10 m) = 232.86 m, based on minimum pipe slopes. However, the existing gravity sewer line is mounded for frost protection. To install the pipe with a minimum 2.4 m of cover, the invert at the lift station becomes 231.6 m.

6.2.1 Pumping Capacity

The lift station pumping capacity must accommodate both the dry weather flow and the wet weather flow.

The dry weather flow has been calculated using the inmate design population of 1,310, a Harmon peaking factor of 3.72, a water usage of 500 L/person/day, equivalent employee design population of 268, a Harmon peaking factor of 4.10, a water usage of 250 L/person/day, and the infiltration rate of 190 L/person/day. The dry weather flow is calculated to be 34.9 L/s. The Harmon peaking factors were applied to the water usage portion of the sewage only and no peaking factor was included for the infiltration.

The wet weather flow has been calculated using the inmate design population of 1,310, a Harmon peaking factor of 3.72, a water usage of 500 L/person/day, design population of 268, a Harmon peaking factor of 4.10, a water usage of 250 L/person/day, and the infiltration rate of 190 L/person/day. The wet weather flow is assumed to be 52.7 L/s. The Harmon peaking factors were applied to the water usage portion of the sewage only and no peaking factor was included for the infiltration.

The lift station will be a below ground, 2.4 m dia. pre-cast concrete barrel type lift station with a duplex pumping system. The barrel will have a pump operating sump of 1.5 m depth to provide sufficient drawdown capacity for the pumps to minimize stop-start cycles. The lift station floor will be set at 229.55 m. The barrel would be waterproofed to minimize infiltration. A concrete ring would be installed on the bottom of the barrel to prevent floatation of the lift station barrel during periods of high ground water.

6.2.2 Forcemain and Pump Selection

The forcemain will be approximately 87 m long to connect the lift station to Aeration Cell 1. Forcemain sizing was completed for the wet weather design flow of 52.7 L/s. In calculating the pipe losses, DR-17 HDPE piping was used with a Hazen-Williams pipe roughness coefficient of 120.

Using a 300 mm pipe, the design flow resulted in a friction loss of 0.3 m at a velocity of 0.8 m/s. The velocity in the forcemain exceeds the Ten State Standard minimum velocity requirements of 0.6 m/s, thereby providing the minimum cleaning velocities.

Based on the lift station elevation and the proposed aerated lagoon operating level 236 m, the lift station will be pumping against 6.5 m of static head. When combining with the friction head of 0.3 m from the forcemain to the static head and adding 0.8 m for internal station losses, and a

1 m safety factor, the pump must be able to produce a total head of 8.6 m at a flow rate of 52.7 L/s.

Pump selection was completed for the sewage flow of 52.7 L/s. The Flygt NP 3127 LT with the 202 mm impeller, 202 mm discharge outlet and a 7.5 kW motor is recommended. The pump selection provides a single pump flow of 58.9 L/s at a system head of 8.6 m and a pipe velocity of 0.9 m/s. When both pumps operate, the flow will increase to 96.9 L/s at a system head of 10.2 m and a pipe velocity of 1.5 m/s. The single pump flow provides sufficient capacity to meet the design requirements and satisfies the minimum cleaning velocity of 0.6 m/s.

6.2.3 Gravity Sewer Extension

Based on the wet weather flow rate of 52.7 L/s, and a slope of 0.3% the extension of the existing gravity sewer line will be completed with 300 mm PVC pipe. During the wet weather flows, the pipe will be flowing approximately 80 % full. During dry weather flows of 34.9 L/s the pipe will be flowing approximately 60 % full.

7.0 COST ESTIMATE

7.1 General

The cost estimate is based on report information. This cost estimate is an opinion of probable costs. This opinion is based on assumptions as to the actual conditions that will be encountered onsite; the specific decision and design of other design professionals engaged i.e. geotechnical soils analysis; the means and methods of construction the Contractor will utilize; the costs and extent of labour, equipment and materials the Contractor will employ; Contractor's techniques in determining prices and market conditions at the time; and other factors over which JR Cousin Consultants Ltd. has no control. Given the assumptions that must be made, JR Cousin Consultants Ltd. cannot guarantee the accuracy of our opinions of cost.

7.2 Summarized Capital Costs

An itemized budget class "C" cost estimate of construction costs is presented in Appendix D. The following is a summarization of the capital costs for the required works for a 2014/2015 construction season. The costs for each year after this projection period should be inflated per prevailing inflation and market conditions.

Class C Cost Estimate

Description	Total
Sewage Treatment Facility	$8,297,180
5% GST	$414,900
15% Contingency	$1,244,600
Total Construction	**$9,956,680**

APPENDIX

Appendix A

Table 1: Population, Hydraulic and Organic Loading Projections for RM of Rockwood and Community of Stony Mountain

Table 2: Population, Hydraulic and Organic Loading Projections for SMI

Appendix B

JRCC Test Holes - March 2010

Trek Geotechnical Test Holes - December 2010

JRCC Test Holes - October 2011

National Testing Laboratories Test Results - November 2011

AMEC - Geotechnical Investigation SMI Lagoon Upgrades SE2-13-2EPM RM of Rockwood, Manitoba - March 2014

Appendix C

ALS Sewage Test Results

Appendix D

Detailed Cost Estimate

Appendix E

Plan EX1: Lagoon Test Holes and Existing Ground Contours

Plan L1: Lagoon Layout Plan

Plan L2: Lagoon Sections - Storage Cell 3 and Storage Cell 4 Dike Modifications

Plan L3: Lagoon Sections - Aeration Cell 1 and Storage Cell 5, Storage Cell 1 Keyway

Plan L4: Lagoon Pipe Layout Plan

Plan L5: Site Drainage, Perimeter Liner, Perimeter Fencing

Plan P1: Sewage Treatment Process Diagram

Plan S1: Sewage Treatment Building - South and West Elevation

Plan S2: Sewage Treatment Building - North and East Elevation

Plan S3: Sewage Treatment Building - Overall Layout

Plan LS1: Stony Mountain Lift Station Section Views

Appendix A

Table 1: Population, Hydraulic and Organic Loading Projections for RM of Rockwood and Community of Stony Mountain

Table 2: Population, Hydraulic and Organic Loading Projections for SMI

Table 1

POPULATION, HYDRAULIC, AND ORGANIC LOADING PROJECTIONS FOR RM OF ROCKWOOD AND COMMUNITY OF STONY MOUNTAIN

Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7	Col 8	Col 9	Col 10	Col 11	Col 12	Col 13	Col 14	Col 15	Col 16	Col 17	Col 18	Col 19	Col 20	Col 21	Col 22	Col 23	Col 24	Col 25	Col 26	Col 27
		POPULATION												ORGANIC LOADING				HYDRAULIC LOADING								
PROJECT YEAR	YEAR	TOWN OF STONY MOUNTAIN 2.50%	BUSSED-IN STUDENTS 0.70% Growth/year Actual	 Equivalent (1/3)	COMMERCIAL BUSINESS 2.50% Growth/year Actual	 Equivalent (1/3)	TOTAL PIPED POPULATION	56 LOT INDUSTRIAL PARK ON HOLDING TANKS Actual	 Equivalent (1/3)	Rural Residents Connected to Bristol pipeline on Septic Tanks	Rural Residents Septic Tank Pump Outs 0.70%	Rural Septic Tank Pump Outs per day Residents per Home 3.0	TOTAL	DAILY PER CAPITA BOD Piped and Holding Tanks (kg)	DAILY BOD PRODUCTION Piped and Holding Tanks (kg)	DAILY BOD PRODUCTION Septic Tanks 4.96 kg/day	DAILY BOD PRODUCTION Total (kg)	DAILY/CAPITA WATER DEMAND Piped and Holding Tank Systems (L/person/day)	WTP PROCESS WATER 10% of daily per capita raw water demand (L/person/day)	INFILTRATION (L/person/day)	TOTAL DAILY PIPED WASTEWATER PRODUCTION (m^3)	TOTAL DAILY HOLDING TANK WASTEWATER PRODUCTION (m^3)	TOTAL DAILY TRUCKED SEPTIC TANK WASTEWATER PRODUCTION (m^3)	DAILY WASTEWATER FLOW (m^3)	180 Day WASTEWATER PRODUCTION (m^3)	230 Day WASTEWATER PRODUCTION (m^3)
0	2011	1,696																								
0	2012	1,738																								
0	2013	1,781	112	38	30	10	1,829	25	9	350	0	2	2,188	0.076	139.7	9.9	**149.6**	250		190	805	2	9	816	**145,262**	**185,612**
0	2014	1,826	113	38	31	11	1,875	35	12	350	0	2	2,237	0.076	143.4	9.9	**153.3**	250		190	825	3	9	837	**149,040**	**190,440**
1	2015	1,872	114	38	32	11	1,921	45	15	350	100	2	2,386	0.076	147.1	9.9	**157.1**	250		190	845	4	9	858	**152,818**	**195,268**
2	2016	1,919	114	39	32	11	1,969	55	19	350	101	2	2,439	0.076	151.1	9.9	**161.0**	250		190	866	5	9	880	**156,800**	**200,355**
3	2017	1,967	115	39	33	12	2,018	65	22	350	101	2	2,491	0.076	155.0	9.9	**165.0**	250	25	190	938	6	9	953	**169,897**	**217,090**
4	2018	2,016	116	39	34	12	2,067	75	25	350	102	2	2,544	0.076	159.0	9.9	**168.9**	250	25	190	961	6	9	976	**174,133**	**222,503**
5	2019	2,066	117	39	35	12	2,117	85	29	350	103	2	2,599	0.076	163.1	9.9	**173.0**	250	25	190	984	7	9	1,001	**178,498**	**228,081**
6	2020	2,118	118	40	36	12	2,170	95	32	350	104	2	2,656	0.076	167.4	9.9	**177.3**	250	25	190	1,009	8	9	1,026	**183,069**	**233,922**
7	2021	2,171	118	40	37	13	2,224	105	35	350	104	2	2,713	0.076	171.7	9.9	**181.6**	250	25	190	1,034	9	9	1,052	**187,724**	**239,869**
8	2022	2,225	119	40	37	13	2,278	115	39	350	105	2	2,772	0.076	176.1	9.9	**186.0**	250	25	190	1,059	10	9	1,078	**192,424**	**245,875**
9	2023	2,281	120	41	38	13	2,335	125	42	350	106	2	2,833	0.076	180.7	9.9	**190.6**	250	25	190	1,086	11	9	1,105	**197,330**	**252,143**
10	2024	2,338	121	41	39	14	2,393	135	45	350	106	2	2,894	0.076	185.3	9.9	**195.2**	250	25	190	1,113	11	9	1,133	**202,319**	**258,519**
11	2025	2,396	122	41	40	14	2,451	145	49	350	107	2	2,957	0.076	190.0	9.9	**199.9**	250	25	190	1,140	12	9	1,161	**207,354**	**264,952**
12	2026	2,456	123	41	41	14	2,511	155	52	350	108	2	3,021	0.076	194.8	9.9	**204.7**	250	25	190	1,168	13	9	1,190	**212,511**	**271,541**
13	2027	2,517	123	42	42	15	2,574	165	55	350	109	2	3,088	0.076	199.8	9.9	**209.7**	250	25	190	1,197	14	9	1,220	**217,919**	**278,452**
14	2028	2,580	124	42	43	15	2,637	175	59	350	109	2	3,155	0.076	204.9	9.9	**214.8**	250	25	190	1,226	15	9	1,250	**223,372**	**285,420**
15	2029	2,645	125	42	45	15	2,702	185	62	350	110	2	3,224	0.076	210.1	9.9	**220.0**	250	25	190	1,256	16	9	1,281	**228,947**	**292,544**
16	2030	2,711	126	43	46	16	2,770	195	65	350	111	2	3,296	0.076	215.5	9.9	**225.4**	250	25	190	1,288	16	9	1,313	**234,774**	**299,989**
17	2031	2,779	127	43	47	16	2,838	205	69	350	112	2	3,369	0.076	220.9	9.9	**230.9**	250	25	190	1,320	17	9	1,346	**240,646**	**307,492**
18	2032	2,848	128	43	48	16	2,907	215	72	350	113	2	3,442	0.076	226.4	9.9	**236.3**	250	25	190	1,352	18	9	1,379	**246,556**	**315,044**
19	2033	2,919	129	43	49	17	2,979	225	75	350	113	2	3,517	0.076	232.1	9.9	**242.0**	250	25	190	1,385	19	9	1,413	**252,717**	**322,917**
20	2034	2,992	130	44	50	17	3,053	235	79	350	114	2	3,596	0.076	238.0	9.9	**248.0**	250	25	190	1,420	20	9	1,448	**259,091**	**331,061**
21	2035	3,067	131	44	52	18	3,129	245	82	350	115	2	3,676	0.076	244.0	9.9	**254.0**	250	25	190	1,455	21	9	1,484	**265,587**	**339,362**
22	2036	3,144	131	44	53	18	3,206	255	85	350	116	2	3,757	0.076	250.1	9.9	**260.0**	250	25	190	1,491	21	9	1,521	**272,167**	**347,769**
23	2037	3,223	132	45	54	19	3,287	265	89	350	117	2	3,843	0.076	256.6	9.9	**266.5**	250	25	190	1,528	22	9	1,560	**279,127**	**356,662**
24	2038	3,304	133	45	56	19	3,368	275	92	350	117	2	3,927	0.076	263.0	9.9	**272.9**	250	25	190	1,566	23	9	1,598	**286,042**	**365,498**
25	2039	3,387	134	45	57	20	3,452	280	94	350	118	2	4,014	0.076	269.5	9.9	**279.4**	250	25	190	1,605	24	9	1,638	**293,162**	**374,596**

Table 2

POPULATION, HYDRAULIC, AND ORGANIC LOADING PROJECTIONS FOR SMI

Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7	Col 8	Col 9	Col 10	Col 11	Col 12
PROJECT DESIGN TIMELINE	**POPULATION**			**HYDRAULIC LOADING**						**ORGANIC LOADING**	
	INMATE POPULATION	STAFF POPULATION		DAILY/CAPITA WATER DEMAND INMATE	DAILY/CAPITA WATER DEMAND STAFF	INFILTRATION	DAILY WASTEWATER VOLUME	180 Day WASTEWATER PRODUCTION	230 Day WASTEWATER PRODUCTION	DAILY PER INMATE BOD	DAILY BOD PRODUCTION
	Total Number	Actual	Equivalent (1/3)	(L/person/day)	(L/person/day)	(L/person/day)	(m^3)	(m^3)	(m^3)	(kg)	(kg)
Current	1,018	537	179	554	250	190	836	150,507	192,315	0.180	150.5
Projected	1,310	802	268	500	250	190	1,022	183,928	235,019	0.180	235.8

Appendix B

JRCC Test Holes - March 2010

Trek Geotechnical Test Holes - December 2010

JRCC Test Holes - October 2011

National Testing Laboratories Test Results - November 2011

AMEC - Geotechnical Investigation SMI Lagoon Upgrades SE2-13-2EPM RM of Rockwood, Manitoba - March 2014

JRCC Test Holes - March 2010

J. R. Cousin Consultants Ltd.

TEST HOLE LOGS

SYMBOL INDEX


GW. : Well graded gravels and gravel sand mixtures, little or no fines


GP. : Poorly graded gravels, gravel - sand mixtures, little or no fines


GM. : Silty gravels, gravel-sand-silt mixtures


GC. : Clayey gravels, gravel-sand-clay mixtures


SW. : Well graded sands, gravelly sands, little or no fines


SP. : Poorly graded sands, or gravelly sands, little or no fines


SM. : Silty sands, sand-silt mixtures


SC. : Clayey sands, sand-clay mixtures


ML. : Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity


CL. : Inorganic clays of low plasticity, gravelly clays, sandy or silty clays, lean clays


OL. : Organic silts and organic silty clays of low plasticity


CI. : Inorganic clays of medium or intermediate plasticity


MH. : Inorganic silts, fine sandy or silty soils


CH. : Inorganic clays of high plasticity, fat clays


OH. : Organic clays of medium to high plasticity, organic silts


Pt. : Peat, humus, swamp soils with high organic contents


TOPSOIL

The soil logs are based upon objective data available to us at the time of forming our opinions. The soil logs indicate site specific soil characteristics and must not be generalized over larger areas due to the limited number of test holes as compared to that of an unlimited number of test holes. Every effort is made to evaluate the information by methods generally recognized. The soil logs represent our opinions. J. R. Cousin Consultants Ltd. cannot be responsible for actual site conditions proved to be materially at variance from our analysis or from the data generalization over untested areas.

J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

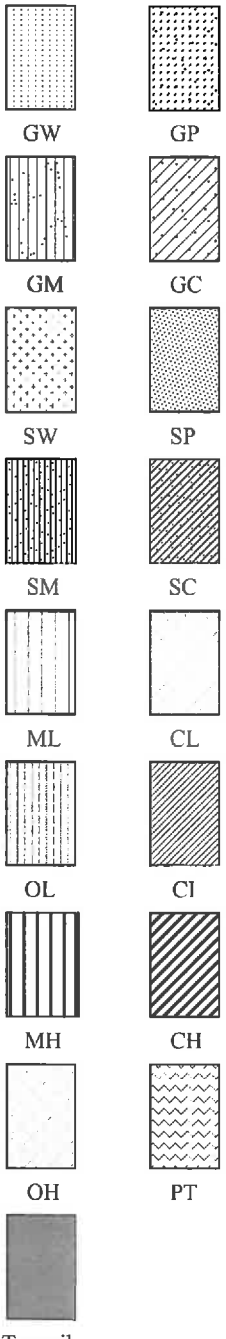
LOCATION : SE 2-13-2 E

DATE : March 4, 2010

PROJECT : Stony Mountain Institute Lagoon Assessment Study

TEST HOLE # 1

DEPTH OF SAMPLE	FIELD CLASSIFICATION
0m / 0	TOPSOIL - Frozen, black, some medium plastic clay
2'	
1m / 4'	CLAY - Medium plastic, brown, silt inclusions, damp, stiff
6'	
2m / 8'	CLAY - Medium plastic, grey/ brown, silt and iron inclusions, damp, medium stiff
3m / 10'	
12'	
4m / 14'	CLAY - Medium plastic, grey/ brown, silt inclusions, wet, soft
16'	
5m / 18'	CLAY - High plastic, grey/ brown, saturated, very soft
6m / 20'	Water at 1.8m after 3.5 hours



The soil logs are based upon objective data available to us at the time of forming our opinions. The soil logs indicate site specific soil characteristics and must not be generalized over larger areas due to the limited number of test holes as compared to that of a unlimited number of test holes. Every effort is made to evaluate the information by methods generally recognized. The soil represent our opinions. J.R. Cousin Consultants Ltd. cannot be responsible for actual site conditions proved to be materially at variance from our analysis or **from the data generalization over untested areas.**

J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

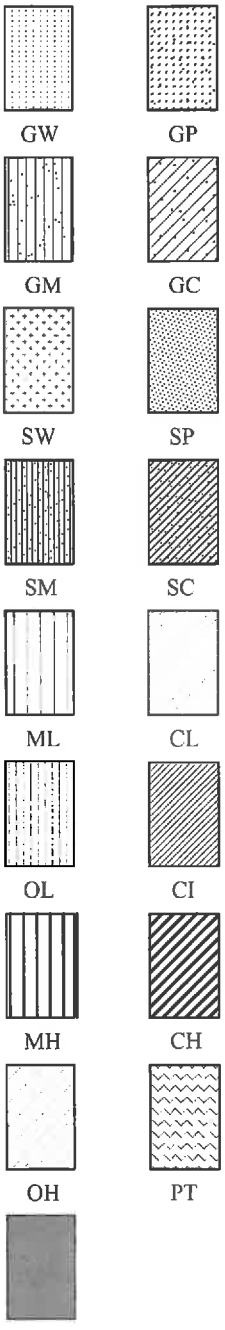
LOCATION : SE 2-13-2 E

DATE : March 4, 2010

PROJECT : Stony Mountain Institute Lagoon Assessment Study

TEST HOLE # 2

DEPTH OF SAMPLE	FIELD CLASSIFICATION
0m / 0	TOPSOIL - Frozen, high plastic clay, black to dark brown, some stones
2'	
1m / 4'	CLAY - High plastic, dark brown, silt inclusions, damp, stiff
6'	
2m / 8'	CLAY - High plastic, brown, silt inclusions, moist, medium stiff
3m / 10'	
12'	SILTY CLAY - Low plastic, tan, sandy, wet, very soft
4m / 14'	
16'	
5m / 18'	CLAY - High plastic, grey, wet, soft
6m / 20'	Water at 1.5m after 4 hours



The soil logs are based upon objective data available to us at the time of forming our opinions. The soil logs indicate site specific soil characteristics and must not be generalized over larger areas due to the limited number of test holes as compared to that of a unlimited number of test holes. Every effort is made to evaluate the information by methods generally recognized. The soil represent our opinions. J.R. Cousin Consultants Ltd. cannot be responsible for actual site conditions proved to be materially at variance from our analysis or from the data generalization over untested areas.

J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

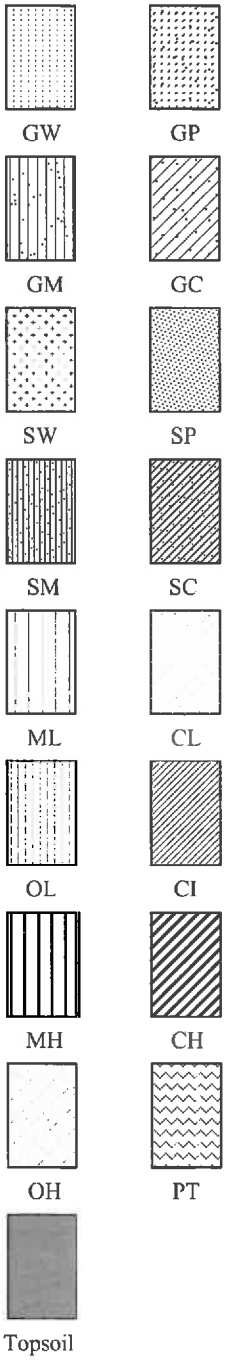
LOCATION : SE 2-13-2 E

DATE : March 4, 2010

PROJECT : Stony Mountain Institute Lagoon Assessment Study

TEST HOLE # 3

DEPTH OF SAMPLE	FIELD CLASSIFICATION
0m / 0	TOPSOIL - Frozen, black, contains organics
2'	CLAY - High plastic, brown, silt lenses, damp, stiff
1m / 4'	
6'	SILTY CLAY - Low plastic, tan, sand inclusions, wet, very soft
2m / 8'	
	CLAY - High plastic, grey/ brown, moist, medium stiff
3m / 10'	
12'	CLAY - High plastic, grey/ brown, moist, soft
4m / 14'	
16'	
5m	CLAY - High plastic, grey/ brown, moist, very soft
18'	
6m / 20'	Water at 5.8m after 4.5 hours



The soil logs are based upon objective data available to us at the time of forming our opinions. The soil logs indicate site specific soil characteristics and must not be generalized over larger areas due to the limited number of test holes as compared to that of a unlimited number of test holes. Every effort is made to evaluate the information by methods generally recognized. The soil represent our opinions. J.R. Cousin Consultants Ltd. cannot be responsible for actual site conditions proved to be materially at variance from our analysis or **from the data generalization over untested areas.**

J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

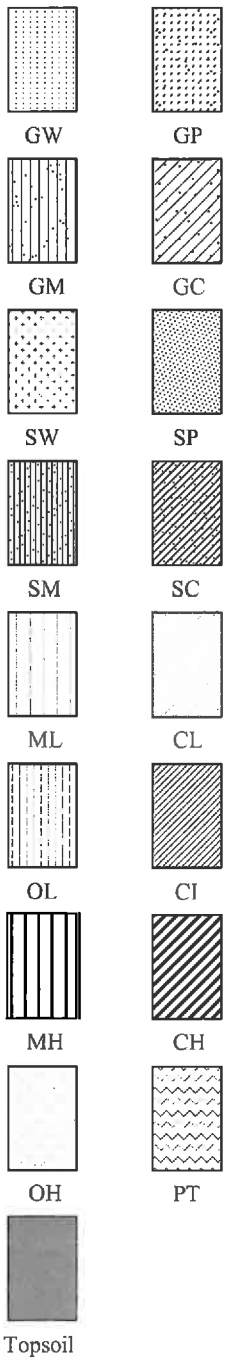
LOCATION : SE 2-13-2 E

DATE : March 4, 2010

PROJECT : Stony Mountain Institute Lagoon Assessment Study

TEST HOLE # 4

DEPTH OF SAMPLE	FIELD CLASSIFICATION
0m / 0	TOPSOIL - Frozen, high plastic clay, black
2'	CLAY - High plastic, dark brown, some silt and stone, damp, stiff
1m / 4'	
6'	CLAY - High plastic, dark brown, silt inclusions, damp, stiff
2m / 8'	
	CLAY - Medium plastic, light brown, silt inclusions, damp, medium stiff
3m / 10'	SILTY CLAY - Low plastic, tan, sand inclusions, wet, very soft
12'	CLAY - High plastic, grey/ brown, silt inclusions, damp, stiff
4m / 14'	
16'	CLAY - High plastic, grey/ brown, moist, soft
5m / 18'	
6m / 20'	Water at 2.3m after 5 hours



The soil logs are based upon objective data available to us at the time of forming our opinions. The soil logs indicate site specific soil characteristics and must not be generalized over larger areas due to the limited number of test holes as compared to that of a unlimited number of test holes. Every effort is made to evaluate the information by methods generally recognized. The soil represent our opinions. J.R. Cousin Consultants Ltd. cannot be responsible for actual site conditions proved to be materially at variance from our analysis or from the data generalization over untested areas.

J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

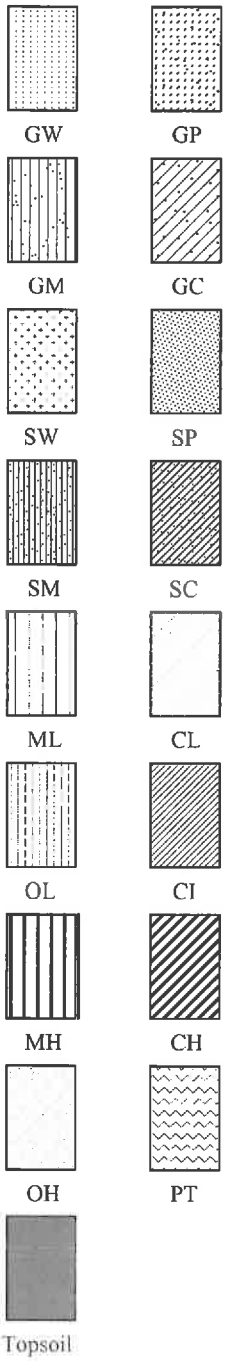
LOCATION : SE 2-13-2 E

DATE : March 4, 2010

PROJECT : Stony Mountain Institute Lagoon Assessment Study

TEST HOLE # 5

DEPTH OF SAMPLE	FIELD CLASSIFICATION
0m / 0	TOPSOIL - Frozen, black, some organics
2' / 1m	CLAY - High plastic, brown, some silt and organics, damp, soft
4'	
6' / 2m	SILTY CLAY - Low plastic, tan, sand inclusions, wet, very soft
8'	
10' / 3m	
12'	
14' / 4m	CLAY - High plastic, grey/ brown, silt inclusions, moist, very soft
16'	
18' / 5m	
20' / 6m	Water at 1.7m after 4 hours



The soil logs are based upon objective data available to us at the time of forming our opinions. The soil logs indicate site specific soil characteristics and must not be generalized over larger areas due to the limited number of test holes as compared to that of a unlimited number of test holes. Every effort is made to evaluate the information by methods generally recognized. The soil represent our opinions. J.R. Cousin Consultants Ltd. cannot be responsible for actual site conditions proved to be materially at variance from our analysis or from the data generalization over untested areas.

J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

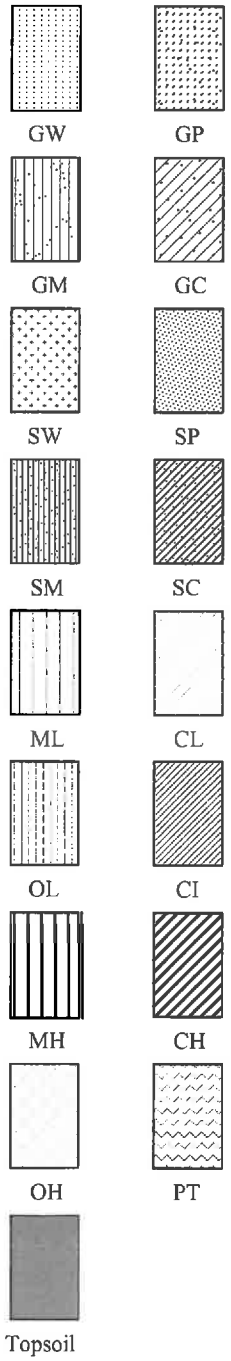
LOCATION : SE 2-13-2 E

DATE : March 4, 2010

PROJECT : Stony Mountain Institute Lagoon Assessment Study

TEST HOLE # 6

DEPTH OF SAMPLE	FIELD CLASSIFICATION
0m / 0	TOPSOIL - Frozen, black, some organics
2'	CLAY - High plastic, brown, silt lenses, damp, stiff
1m / 4'	
6'	SILTY CLAY - Low plastic, tan, sand inclusions, wet, very soft
2m / 8'	
3m / 10'	CLAY - High plastic, grey/ brown, silt inclusions, moist, soft
12'	
4m / 14'	
16'	
5m / 18'	CLAY - High plastic, grey/ brown, moist, very soft
6m / 20'	Water at 2.3m after 2.5 hours



The soil logs are based upon objective data available to us at the time of forming our opinions. The soil logs indicate site specific soil characteristics and must not be generalized over larger areas due to the limited number of test holes as compared to that of a unlimited number of test holes. Every effort is made to evaluate the information by methods generally recognized. The soil represent our opinions. J.R. Cousin Consultants Ltd. cannot be responsible for actual site conditions proved to be materially at variance from our analysis or from the data generalization over untested areas.

J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

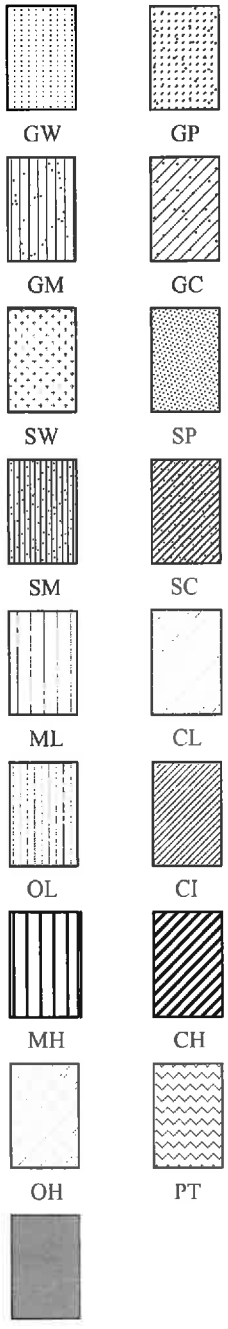
LOCATION : SE 2-13-2 E

DATE : March 4, 2010

PROJECT : Stony Mountain Institute Lagoon Assessment Study

TEST HOLE # 7

DEPTH OF SAMPLE	FIELD CLASSIFICATION
0m / 0	TOPSOIL - Frozen, black, high plastic clay, some organics
2' / 1m	CLAY - High plastic, dark brown, silt inclusions, damp, stiff
4' / 6' / 2m	
8' / 3m / 10'	SILTY CLAY - Low plastic, tan, wet, very soft
12' / 4m / 14'	CLAY - Medium plastic, grey/ brown, silt inclusions, moist, stiff
16' / 5m / 18'	CLAY - High plastic, grey/ brown, silt inclusions, moist, medium stiff
6m / 20'	Water at 1.7m after 6.5 hours



The soil logs are based upon objective data available to us at the time of forming our opinions. The soil logs indicate site specific soil characteristics and must not be generalized over larger areas due to the limited number of test holes as compared to that of a unlimited number of test holes. Every effort is made to evaluate the information by methods generally recognized. The soil represent our opinions. J.R. Cousin Consultants Ltd. cannot be responsible for actual site conditions proved to be materially at variance from our analysis or from the data generalization over untested areas.

J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

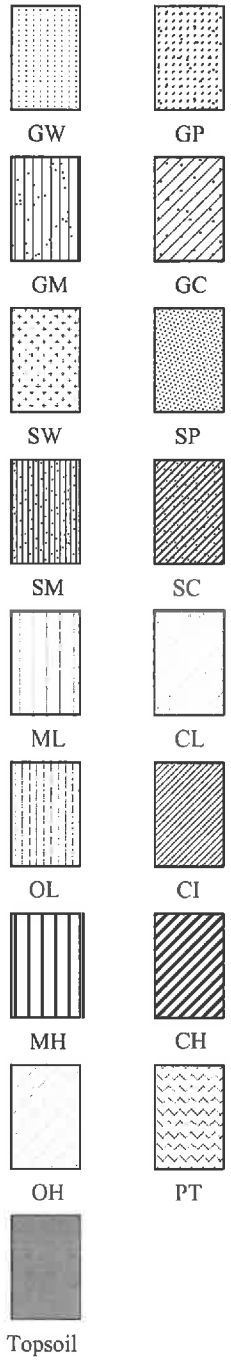
LOCATION : SE 2-13-2 E

DATE : March 4, 2010

PROJECT : Stony Mountain Institute Lagoon Assessment Study

TEST HOLE # 8

DEPTH OF SAMPLE	FIELD CLASSIFICATION
0m / 0	TOPSOIL - Frozen, black, some organics
2'	CLAY - Medium plastic, black/brown, silt inclusions, damp, stiff
1m / 4'	
6'	CLAY - High plastic, brown, silt lenses, moist, stiff
2m / 8'	
3m / 10'	SILTY CLAY - Low plastic, tan, wet, very soft
12'	
4m / 14'	CLAY - High plastic, brown/ grey, silt inclusions, moist, soft
16'	
5m / 18'	CLAY - High plastic, grey, moist, very soft
6m / 20'	Water at 1.7m after 6 hours



The soil logs are based upon objective data available to us at the time of forming our opinions. The soil logs indicate site specific soil characteristics and must not be generalized over larger areas due to the limited number of test holes as compared to that of a unlimited number of test holes. Every effort is made to evaluate the information by methods generally recognized. The soil represent our opinions. J.R. Cousin Consultants Ltd. cannot be responsible for actual site conditions proved to be materially at variance from our analysis or from the data generalization over untested areas.

Trek Geotechnical Test Holes - December 2010

Sub-Surface Log

Test Hole TH10-01
1 of 1

TREK GEOTECHNICAL

Client: SNC Lavalin
Project Name: Stony Mountain Institute Sub-Surface Investigation
Contractor: Paddock Drilling Ltd.
Method: 125 mm Solid Stem Auger, RM 30 Track Mount

Project Number: 0019 002 00
Location: UTM 14 N-5547475.3 E-626870.8
Ground Elevation: 234.8 m Existing Ground
Date Drilled: 20 December 2010

Sample Type: Grab | Shelby Tube | Split Spoon | Split Barrel | Core

Particle Size Legend: Clay | Silt | Sand | Gravel | Cobbles | Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
	0		SILT - some clay, trace sand - light brown - dry to moist, firm - low plasticity		G1	
233.3	1.5		- moist, soft, intermediate plasticity below 1.2 m		G2	
	2.0		CLAY - silty - brown - moist, firm - high plasticity		T1	
	3.5		- trace silt inclusions (<10 mm diam.), trace gravel (<10 mm diam.) below 3.4 m		G3	
	4.5				G4	
229.6	5.0		- trace organics, trace silt inclusions (<20 mm diam.) below 4.6 m - grey, soft below 4.6 m		G5	
	5.5		SILT (Till) - trace to some clay, trace to some fine grained sand, trace to some gravel (<25 mm diam.) - light grey - moist to wet, compact - low plasticity		T2	
	6.0				G6	
227.2	7.5		END OF TEST HOLE AT 7.6 m IN SILT TILL		G7	

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21
Particle Size (%): 0 20 40 60 80 100
PL MC LL: 0 20 40 60 80 100
Undrained Shear Strength (kPa): 0 50 100 150 200 250
△ Torvane △ | ✤ Pocket Pen. ✤ | ⊠ Qu ⊠ | ○ Field Vane ○

Notes:
1. Sloughing observed below 5.9 m below ground.
2. No seepage observed.
3. Water level observed at 1.1 m below ground level 24 hours after drilling.
4. Test hole backfilled to surface with bentonite chips above zone of sloughing.

Logged By: Stephen Renner **Reviewed By:** Jared Baldwin **Project Engineer:** Jared Baldwin

SUB-SURFACE LOG STONY MOUNTAIN INSTITUTE DRILLING INVESTIGATION BOREHOLE LOGS.GPJ TREK GEOTECHNICAL.GDT 24/1/11

Sub-Surface Log

Test Hole TH10-02
1 of 1

Client: SNC Lavalin
Project Number: 0019 002 00
Project Name: Stony Mountain Institute Sub-Surface Investigation
Location: UTM 14 N-5547891.1 E-626853.3
Contractor: Paddock Drilling Ltd.
Ground Elevation: 235.7 m Existing Ground
Method: 125 mm Solid Stem Auger, RM 30 Track Mount
Date Drilled: 20 December 2010

Sample Type: Grab | Shelby Tube | Split Spoon | Split Barrel | Core

Particle Size Legend: Clay | Silt | Sand | Gravel | Cobbles | Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
	0		CLAY - some silt - brown - moist, firm - high plasticity		G8	
233.9	1.5				G9	
	2.0		CLAY AND SILT - some sand, trace to some silt inclusions (<10 mm diam.), trace silt lenses (<20 mm diam., <5 mm thick), trace gravel (fine grained) (<10 mm diam.) - brown silt, grey clay - moist, soft - high plasticity clay, low plasticity silt - stratified (<15 mm thick)		G10	
	3.0				T3	
	4.5				G11	
230.5	5.0					
	5.5		SILT (Till) - trace to some clay, trace to some sand, trace to some gravel (<25 mm diam.) - light brown - moist to wet, compact - low plasticity		G12	
229.3	6.0				S1	> 50
			END OF TEST HOLE AT 6.4 m IN SILT TILL			

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21
Particle Size (%): 0 20 40 60 80 100
PL MC LL: 0 20 40 60 80 100
Undrained Shear Strength (kPa): 0 50 100 150 200 250
△ Torvane △ ✤ Pocket Pen. ✤ ☒ Qu ☒ O Field Vane O

Notes:
1. Power auger refusal at 6.4 m below ground.
2. No sloughing observed.
3. Seepage observed at 5.2 m below ground.
4. SPT refusal at 6.4 m below ground.
5. Water level observed at 2.5 m below ground level immediately after drilling.
6. Water level observed at 2.1 m below ground level 24 hours after drilling.
7. Test hole backfilled to surface with bentonite chips.

Logged By: Stephen Renner | Reviewed By: Jared Baldwin | Project Engineer: Jared Baldwin

SUB-SURFACE LOG STONY MOUNTAIN INSTITUTE DRILLING INVESTIGATION BOREHOLE LOGS.GPJ TREK GEOTECHNICAL.GDT 24/1/11

Sub-Surface Log

Test Hole TH10-03
1 of 1

TREK GEOTECHNICAL

Client:	SNC Lavalin	**Project Number:**	0019 002 00
Project Name:	Stony Mountain Institute Sub-Surface Investigation	**Location:**	UTM 14 N-5547683.2 E-626857.1
Contractor:	Paddock Drilling Ltd.	**Ground Elevation:**	235.2 m Existing Ground
Method:	125 mm Solid Stem Auger, RM 30 Track Mount	**Date Drilled:**	20 December 2010

Sample Type: Grab | Shelby Tube | Split Spoon | Split Barrel | Core

Particle Size Legend: Clay | Silt | Sand | Gravel | Cobbles | Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
234.6	0.5		CLAY - silty, trace organics, dark brown - dry to moist, firm to stiff - intermediate plasticity		G13	
233.7	1.5		SILT - some clay, trace sand - light brown - moist, soft - low to intermediate plasticity		G14	
	2.0		CLAY - silty, trace silt inclusions (<10 mm diam.), trace oxidation, trace organics - brown - moist, firm to stiff - high plasticity - laminated (<1 mm thick)		T4	
	2.5				G15	
	3.0				G16	
	4.0		- trace to some silt inclusions (<10 mm diam.), trace silt lenses (<20 mm diam., <2 mm thick), trace gravel (<12.5 mm diam.), grey, soft below 3.7 m		G17	
	5.0		- trace silt inclusions (<25 mm diam.), trace to some sand below 5.0 m		T5	
229.1	6.0				G18	
	6.5		SILT(Till) - trace to some clay, trace to some sand (fine grained), trace gravel (<10 mm diam.) - light grey - wet, compact - low plasticity		G19	
227.6	7.5					

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21
Particle Size (%): 0 20 40 60 80 100
PL MC LL: 0 20 40 60 80 100
Undrained Shear Strength (kPa): 0 50 100 150 200 250
△ Torvane △ ✤ Pocket Pen. ✤ ☒ Qu ☒ ○ Field Vane ○

END OF TEST HOLE AT 7.6 m IN SILT TILL

Notes:
1. Sloughing observed below 5.2 m below ground.
2. Seepage observed at 6.1 m below ground.
3. SPT not performed in SILT (Till) due to sloughing.
4. Water level observed at 2.3 m below ground level immediately after drilling.
5. Water level observed at 1.7 m below ground level 24 hours after drilling.
6. Test hole backfilled to surface with bentonite chips above zone of sloughing.

Logged By: Stephen Renner | Reviewed By: Jared Baldwin | Project Engineer: Jared Baldwin

SUB-SURFACE LOG STONY MOUNTAIN INSTITUTE DRILLING INVESTIGATION BOREHOLE LOGS.GPJ TREK GEOTECHNICAL.GDT 24/1/11

Sub-Surface Log

Test Hole TH10-04
1 of 1

TREK GEOTECHNICAL

Client:	SNC Lavalin	**Project Number:**	0019 002 00
Project Name:	Stony Mountain Institute Sub-Surface Investigation	**Location:**	UTM 14 N-5547421.2 E-627022.9
Contractor:	Paddock Drilling Ltd.	**Ground Elevation:**	235.1 m Existing Ground
Method:	125 mm Solid Stem Auger, RM 30 Track Mount	**Date Drilled:**	20 December 2010

Sample Type: Grab | Shelby Tube | Split Spoon | Split Barrel | Core

Particle Size Legend: Clay | Silt | Sand | Gravel | Cobbles | Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
	0.5		SILT - sandy, trace clay - light brown - dry to moist, soft - low plasticity		G26	
234.2	1.0		CLAY - some silt, trace silt inclusions (<5mm diam.), trace silt lenses (<25 mm diam.), trace oxidation, trace organics - brown - moist, firm - high plasticity - blocky		G27	
	1.5				T8	
	2.0		- trace silt inclusions (<20 mm diam.), dark brown below 2.1 m			
	2.5		- soft to firm below 2.4 m			
	3.0				G28	
	3.5		- trace precipitates at 3.4 m			
	4.0					
	4.5				G29	
	5.0		- trace sand (fine grained), trace gravel (<20 mm diam.), trace cobble, very soft to soft below 4.6 m		T9	
	5.5					
	6.0				G30	
228.4	6.5					
	7.0		SILT (Till) - trace to some sand, trace to some gravel (<20 mm diam.), trace silt, trace clay - light grey - moist to wet, compact - no to low plasticity		G31	
227.0	8.0				S3	15

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21
Particle Size (%): 0 20 40 60 80 100
PL MC LL: 0 20 40 60 80 100
Undrained Shear Strength (kPa): 0 50 100 150 200 250
△ Torvane △ | ✿ Pocket Pen. ✿ | ⊠ Qu ⊠ | ○ Field Vane ○

END OF TEST HOLE AT 8.1 m IN SILT TILL

Notes:
1. Sloughing observed below 6.7 m below ground.
2. Seepage observed at 6.7 m below ground.
3. Water level observed at 2.3 m below ground level immediately after drilling.
4. Water level observed at 1.4 m below ground level 24 hours after drilling.
5. Test hole backfilled to surface with bentonite chips above zone of sloughing.

Logged By: Stephen Renner | Reviewed By: Jared Baldwin | Project Engineer: Jared Baldwin

SUB-SURFACE LOG STONY MOUNTAIN INSTITUTE DRILLING INVESTIGATION BOREHOLE LOGS.GPJ TREK GEOTECHNICAL.GDT 24/1/11

Sub-Surface Log

Test Hole TH10-05
1 of 1

TREK GEOTECHNICAL

Client:	SNC Lavalin	**Project Number:**	0019 002 00
Project Name:	Stony Mountain Institute Sub-Surface Investigation	**Location:**	UTM 14 N-5548147.2 E-627109.2
Contractor:	Paddock Drilling Ltd.	**Ground Elevation:**	235.5 m Existing Ground
Method:	125 mm Solid Stem Auger, RM 30 Track Mount	**Date Drilled:**	21 December 2010

Sample Type: Grab | Shelby Tube | Split Spoon | Split Barrel | Core

Particle Size Legend: Clay | Silt | Sand | Gravel | Cobbles | Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)	Bulk Unit Wt (kN/m³) 16 17 18 19 20 21 / Particle Size (%) 0 20 40 60 80 100 / PL MC LL 0 20 40 60 80 100	Undrained Shear Strength (kPa) Δ Torvane Δ, Pocket Pen., ☒ Qu ☒, O Field Vane O 0 50 100 150 200 250
234.5	0.5 / 1.0		SILT - sandy, trace clay - light brown - moist, soft - low plasticity		G57			
	1.5 / 2.0 / 2.5		CLAY - silty - brown - moist, firm to stiff - high plasticity - trace silt inclusions (<10 mm diam.) below 1.8 m - firm below 2.1 m		G58 B 1-3			
232.5	3.0		END OF TEST HOLE AT 3.0 m IN CLAY		G59			

Notes:
1. No sloughing observed.
2. No seepage observed.
3. Additional test holes drilled 1 m and 2 m north of TH10-05 to retrieve bulk sample for CBR test.
4. Test hole backfilled to surface with bentonite chips.

Logged By: Stephen Renner | Reviewed By: Jared Baldwin | Project Engineer: Jared Baldwin

SUB-SURFACE LOG STONY MOUNTAIN INSTITUTE DRILLING INVESTIGATION BOREHOLE LOGS.GPJ TREK GEOTECHNICAL.GDT 24/1/11

TREK GEOTECHNICAL

Sub-Surface Log

Test Hole TH10-06
1 of 1

Client:	SNC Lavalin	**Project Number:**	0019 002 00
Project Name:	Stony Mountain Institute Sub-Surface Investigation	**Location:**	UTM 14 N-5547911.1 E-627166.8
Contractor:	Paddock Drilling Ltd.	**Ground Elevation:**	235.7 m Existing Ground
Method:	125 mm Solid Stem Auger, RM 30 Track Mount	**Date Drilled:**	21 December 2010

Sample Type: Grab | Shelby Tube | Split Spoon | Split Barrel | Core

Particle Size Legend: Clay | Silt | Sand | Gravel | Cobbles | Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
	0.0		SILT - some clay, trace sand - light brown - moist, soft - low plasticity		G44	
	1.5		- sandy (fine grained, poorly graded), trace clay below 1.5 m		G45 T14	
233.5	2.0		CLAY - some silt, trace silt inclusions (<10 mm diam.), trace oxidation, trace organics - dark brown - moist, firm to stiff - high plasticity - blocky		G46 G47 T15	
	3.7		- trace silt inclusions (<20 mm diam.), trace gravel (<20 mm diam.), grey, soft below 3.7 m - trace oxidation, trace organics at 4.0 m		G48 T16	
230.8	4.9		SILT (Till) - sandy (fine grained), trace to some clay, trace gravel (<20mm diam.) - light brown - moist to wet, compact - low plasticity		G49 G50	
					G51 S5	24
227.6	8.1		END OF TEST HOLE AT 8.1 m IN SILT TILL			

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21
Particle Size (%): 0 20 40 60 80 100
PL MC LL: 0 20 40 60 80 100
Undrained Shear Strength (kPa): 0 50 100 150 200 250
Torvane | Pocket Pen. | Qu | Field Vane

Notes:
1. Sloughing observed below 6.7 m below ground.
2. Seepage observed at 6.7 m below ground.
3. Water level observed at 1.8 m below ground level immediately after drilling.
4. Test hole backfilled to surface with bentonite chips above zone of sloughing.

Logged By: Stephen Renner | Reviewed By: Jared Baldwin | Project Engineer: Jared Baldwin

SUB-SURFACE LOG STONY MOUNTAIN INSTITUTE DRILLING INVESTIGATION BOREHOLE LOGS.GPJ TREK GEOTECHNICAL.GDT 24/1/11

Sub-Surface Log

Test Hole TH10-07
1 of 1

TREK GEOTECHNICAL

Client:	SNC Lavalin	**Project Number:**	0019 002 00
Project Name:	Stony Mountain Institute Sub-Surface Investigation	**Location:**	UTM 14 N-5547473.8 E-627172.0
Contractor:	Paddock Drilling Ltd.	**Ground Elevation:**	235.1 m Existing Ground
Method:	125 mm Solid Stem Auger, RM 30 Track Mount	**Date Drilled:**	20 December 2010

Sample Type: Grab | Shelby Tube | Split Spoon | Split Barrel | Core

Particle Size Legend: Clay | Silt | Sand | Gravel | Cobbles | Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
234.2	0		CLAY (Fill) - silty, trace sand, trace organics - dark brown - dry to moist, firm - intermediate plasticity		G32	
	1.0		CLAY - some silt to silty - brown - moist, firm - high plasticity		G33	
	1.5		- trace silt inclusions (<2 mm diam.) below 1.9 m.			
	2.0					
	2.5		- dark brown, firm below 2.4 m			
	3.0				G34	
	3.5				T10	
	4.0		- trace organics at 3.7 m - trace silt inclusions (<20 mm diam.), trace gravel (<20 mm diam.), grey, soft below 4.0 m		G35	
	4.5					
	5.0				T11	
229.6	5.5		SILT (Till) - trace to some fine grained sand, trace to some gravel (<20 mm diam.), trace clay - light brown - moist to wet, compact - no to low plasticity		G36	
	6.0				S4	11
	6.5					
	7.0					
227.5	7.5				G37	

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21
Particle Size (%): 0 20 40 60 80 100
PL MC LL: 0 20 40 60 80 100
Undrained Shear Strength (kPa): 0 50 100 150 200 250
Torvane △ | Pocket Pen. ✿ | Qu ☒ | Field Vane ○

END OF TEST HOLE AT 7.6 m IN SILT TILL

Notes:
1. Sloughing observed below 6.1 m below ground.
2. Seepage observed at 6.1 m below ground.
3. Water level observed at 2.3 m below ground level immediately after drilling.
4. Water level observed at 1.5 m below ground level 24 hours after drilling.
5. Test hole backfilled to surface with bentonite chips above zone of sloughing.

Logged By: Stephen Renner **Reviewed By:** Jared Baldwin **Project Engineer:** Jared Baldwin

SUB-SURFACE LOG STONY MOUNTAIN INSTITUTE DRILLING INVESTIGATION BOREHOLE LOGS.GPJ TREK GEOTECHNICAL.GDT 24/1/11

TREK GEOTECHNICAL

Sub-Surface Log

Test Hole TH10-08
1 of 1

Client: SNC Lavalin
Project Number: 0019 002 00
Project Name: Stony Mountain Institute Sub-Surface Investigation
Location: UTM 14 N-5547697.6 E-627009.7
Contractor: Paddock Drilling Ltd.
Ground Elevation: 235.7 m Existing Ground
Method: 125 mm Solid Stem Auger, RM 30 Track Mount
Date Drilled: 20 December 2010

Sample Type: Grab | Shelby Tube | Split Spoon | Split Barrel | Core

Particle Size Legend: Clay | Silt | Sand | Gravel | Cobbles | Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
235.4	0.0		ORGANICS - Topsoil			
	0.5		SILT - some sand (fine grained), trace clay - light brown - moist, soft - low plasticity		G20	
233.9	1.5					
	2.0		CLAY - some silt, trace silt inclusions (<10 mm diam.), trace silt lenses (<25 mm diam., <5 mm thick) - brown - moist, firm to stiff - high plasticity		G21	
	3.0				T6	
	4.0		- some silt lenses (<25 mm diam., <5 mm thick), trace to some gravel (<5 mm diam.), trace precipitates below 3.7 m - trace cobble (<75 mm diam.) at 3.7 m		G22	
	4.5		- some silt inclusions (<20 mm diam.), trace sand, trace gravel (<12.5 mm diam.) below 4.3 m.		G23	
	5.0		- grey, soft below 4.9 m - trace silt seams (<1 mm thick), trace organics (black) at 4.9 m		T7	
229.9	5.5					
	6.0		SILT (Till) - trace to some fine grained sand, trace to some gravel (<20 mm diam.), trace clay - light grey - moist to wet, compact - no to low plasticity		G24	
	6.5				S2	16
	7.0					
228.1	7.5				G25	

END OF TEST HOLE AT 7.6 m IN SILT TILL

Notes:
1. Sloughing observed below 5.8 m below ground.
2. Seepage observed at 5.8 m below ground.
3. Water level observed at 2.8 m below ground level immediately after drilling.
4. Water level observed at 1.7 m below ground level 24 hours after drilling.
5. Test hole backfilled to surface with bentonite chips above zone of sloughing.

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21
Particle Size (%): 0 20 40 60 80 100
PL MC LL: 0 20 40 60 80 100
Undrained Shear Strength (kPa): 0 50 100 150 200 250
Torvane △ | Pocket Pen. ✤ | Qu ⊠ | Field Vane ○

Logged By: Stephen Renner **Reviewed By:** Jared Baldwin **Project Engineer:** Jared Baldwin

SUB-SURFACE LOG STONY MOUNTAIN INSTITUTE DRILLING INVESTIGATION BOREHOLE LOGS.GPJ TREK GEOTECHNICAL.GDT 24/1/11

Sub-Surface Log

Test Hole TH10-09
1 of 1

TREK GEOTECHNICAL

Client:	SNC Lavalin	**Project Number:**	0019 002 00
Project Name:	Stony Mountain Institute Sub-Surface Investigation	**Location:**	UTM 14 N-5547977.2 E-627018.2
Contractor:	Paddock Drilling Ltd.	**Ground Elevation:**	235.6 m Existing Ground
Method:	125 mm Solid Stem Auger, RM 30 Track Mount	**Date Drilled:**	21 December 2010

Sample Type: Grab | Shelby Tube | Split Spoon | Split Barrel | Core

Particle Size Legend: Clay | Silt | Sand | Gravel | Cobbles | Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
235.5	0		ORGANICS - Topsoil			
	0.5		CLAY - some silt, trace silt seams (<5 mm thick.), trace organics - dark brown - moist, stiff to very stiff - high plasticity - blocky			
	1.0					
	1.5				G52	
			- some organics at 1.5 m			
	2.0		- trace silt inclusions, trace oxidation below 1.8 m		T17	
	2.5		- trace to some sand (fine grained), trace to some gravel (<20 mm diam.), soft below 2.1 m		G53	
	3.0				G54	
232.3						
	3.5		SILT (Till) - trace to some sand, trace to some gravel (<20 mm diam.), trace clay - light grey - moist to wet, dense - low plasticity		T18	
	4.0				G55	
	4.5					
230.6	5.0				S6 / G56	> 50

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21
Particle Size (%): 0 20 40 60 80 100
PL MC LL: 0 20 40 60 80 100
Undrained Shear Strength (kPa): 0 50 100 150 200 250
△ Torvane △ ✤ Pocket Pen. ✤ ☒ Qu ☒ ○ Field Vane ○

END OF TEST HOLE AT 5.0 m IN SILT TILL

Notes:
1. Power auger refusal at 4.9 m below ground.
2. Sloughing observed below 4.4 m below ground.
3. Seepage observed below 4.4 m below ground.
4. SPT refusal at 5.0 m below ground.
5. Water Level observed at 2.4 m below ground level immediately after drilling.
6. Test hole backfilled to surface with bentonite chips above zone of sloughing.

Logged By: Stephen Renner Reviewed By: Jared Baldwin Project Engineer: Jared Baldwin

SUB-SURFACE LOG STONY MOUNTAIN INSTITUTE DRILLING INVESTIGATION BOREHOLE LOGS.GPJ TREK GEOTECHNICAL.GDT 24/1/11

Sub-Surface Log

Test Hole TH10-10
1 of 1

TREK GEOTECHNICAL

Client:	SNC Lavalin	**Project Number:**	0019 002 00
Project Name:	Stony Mountain Institute Sub-Surface Investigation	**Location:**	UTM 14 N-5547684.4 E-627232.2
Contractor:	Paddock Drilling Ltd.	**Ground Elevation:**	235.2 m Existing Ground
Method:	125 mm Solid Stem Auger, RM 30 Track Mount	**Date Drilled:**	20 December 2010

Sample Type: Grab | Shelby Tube | Split Spoon | Split Barrel | Core

Particle Size Legend: Clay | Silt | Sand | Gravel | Cobbles | Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
235.1	0		ORGANICS - Topsoil			
	0.5		SILT - some clay, some sand, brown - moist, soft - low plasticity		G38	
234.3	1.0		CLAY - trace to some silt, trace organics - brown - moist, firm - high plasticity - laminated (<2 mm thick)		G39	
	1.5				T12	
	2.0		- trace silt inclusions (<10 mm diam.) below 1.5 m			
	2.5		- trace inclusions (<40 mm diam.) below 2.4 m			
	3.0				G40	
	3.5		- soft to firm below 3.0 m			
	4.0		- trace oxidation below 4.0 m			
	4.5		- trace gravel (<12.5 mm diam.) below 4.3 m		G41	
	5.0		- trace silt inclusions (<2 mm diam.), trace precipitates, grey, soft below 4.6 m		T13	
	5.5					
229.4	6.0		SILT (Till) - trace to some clay, trace to some sand, trace to some gravel - light grey - moist to wet, dense - low plasticity		G42	
	6.5					
	7.0				G43	
227.9			END OF TEST HOLE AT 7.3 m IN SILT TILL			

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21

Particle Size (%): 0 20 40 60 80 100

PL MC LL: 0 20 40 60 80 100

Undrained Shear Strength (kPa): 0 50 100 150 200 250

△ Torvane △ ✤ Pocket Pen. ✤ ☒ Qu ☒ ○ Field Vane ○

Notes:
1. Power auger refusal at 7.3 m below ground.
2. Sloughing observed below 6.2 m below ground.
3. Seepage observed below 6.2 m below ground.
4. Water level observed at 1.9 m below ground level immediately after drilling.
5. Test hole backfilled to surface with bentonite chips above zone of sloughing.

Logged By: Stephen Renner **Reviewed By:** Jared Baldwin **Project Engineer:** Jared Baldwin

SUB-SURFACE LOG STONY MOUNTAIN INSTITUTE DRILLING INVESTIGATION BOREHOLE LOGS.GPJ TREK GEOTECHNICAL.GDT 24/1/11

TREK GEOTECHNICAL

Sub-Surface Log

Test Hole TH10-11
1 of 1

Client:	SNC Lavalin	**Project Number:**	0019 002 00
Project Name:	Stony Mountain Institute Sub-Surface Investigation	**Location:**	UTM 14 N-554827.4 E-627225.6
Contractor:	Paddock Drilling Ltd.	**Ground Elevation:**	235.9 m Existing Ground
Method:	125 mm Solid Stem Auger, RM 30 Track Mount	**Date Drilled:**	21 December 2010

Sample Type: Grab | Shelby Tube | Split Spoon | Split Barrel | Core

Particle Size Legend: Clay | Silt | Sand | Gravel | Cobbles | Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
234.9	0.5		CLAY - silty, trace organics - dark brown - dry to moist, firm to stiff - intermediate plasticity		G61	
234.3	1.0		SILT - some clay, some sand (fine grained), light brown - moist to wet, soft - low to intermediate plasticity		G60	
	1.5				G62	
	2.0		CLAY - some silt, trace silt inclusions (<10 mm diam.) - brown - moist, firm to stiff - high plasticity		B 4-6	
	2.5					
232.8	3.0				G63	

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21
Particle Size (%): 0 20 40 60 80 100
PL MC LL: 0 20 40 60 80 100
Undrained Shear Strength (kPa): 0 50 100 150 200 250
△ Torvane △ ✤ Pocket Pen. ✤ ☒ Qu ☒ ○ Field Vane ○

END OF TEST HOLE AT 3.0 m IN CLAY

Notes:
1. No sloughing observed.
2. No seepage observed.
3. Additional test holes drilled 1 m and 2 m north of TH10-11 to retrieve bulk sample for CBR test.
4. Test hole backfilled to surface with bentonite chips.

Logged By: Stephen Renner | Reviewed By: Jared Baldwin | Project Engineer: Jared Baldwin

SUB-SURFACE LOG STONY MOUNTAIN INSTITUTE DRILLING INVESTIGATION BOREHOLE LOGS.GPJ TREK GEOTECHNICAL.GDT 24/1/11

JRCC Test Holes - October 2011

J. R. Cousin Consultants Ltd.

TEST HOLE LOGS

SYMBOL INDEX


GW. : Well graded gravels and gravel sand mixtures, little or no fines


GP. : Poorly graded gravels, gravel - sand mixtures, little or no fines


GM. : Silty gravels, gravel-sand-silt mixtures


GC. : Clayey gravels, gravel-sand-clay mixtures


SW. : Well graded sands, gravelly sands, little or no fines


SP. : Poorly graded sands, or gravelly sands, little or no fines


SM. : Silty sands, sand-silt mixtures


SC. : Clayey sands, sand-clay mixtures


ML. : Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity


CL. : Inorganic clays of low plasticity, gravelly clays, sandy or silty clays, lean clays


OL. : Organic silts and organic silty clays of low plasticity


CI. : Inorganic clays of medium or intermediate plasticity


MH. : Inorganic silts, fine sandy or silty soils


CH. : Inorganic clays of high plasticity, fat clays


OH. : Organic clays of medium to high plasticity, organic silts


Pt. : Peat, humus, swamp soils with high organic contents


TOPSOIL

The soil logs are based upon objective data available to us at the time of forming our opinions. The soil logs indicate site specific soil characteristics and must not be generalized over larger areas due to the limited number of test holes as compared to that of an unlimited number of test holes. Every effort is made to evaluate the information by methods generally recognized. The soil logs represent our opinions. J. R. Cousin Consultants Ltd. cannot be responsible for actual site conditions proved to be materially at variance from our analysis or from the data generalization over untested areas.

J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 5547305.77 N
627758.79 E

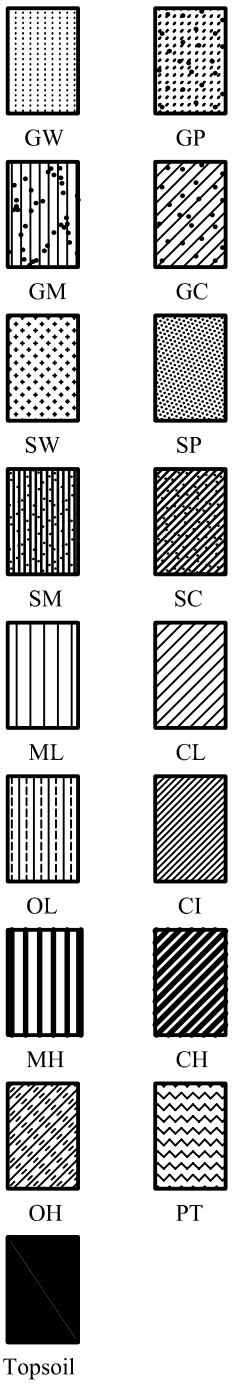
DATE : October 4, 2011

ELEVATION: 233.367 m

PROJECT : Stony Mountain and SMI Lagoons Geotechnical Investigation

TEST HOLE # 1

DEPTH OF SAMPLE	FIELD CLASSIFICATION
0m / 0	TOPSOIL - black, organic, loose, dry, some roots
2'	
1m / 4'	CLAY - low-medium plastic, light brown, silty, firm, some sand, damp
6'	
2m / 8'	SILTY CLAY - low plastic, light brown, wet, loose, sandy
3m / 10'	
12'	
4m / 14'	CLAY - high plastic, gray, moist, hard
16'	
5m / 18'	
6m / 20'	BOTTOM OF HOLE: 6.2m NOTE: no water infiltration or caving of the walls observed at the time of excavation, cave-in to 4.1m observed after 5.5h



The soil logs are based upon objective data available to us at the time of forming our opinions. The soil logs indicate site specific soil characteristics and must not be generalized over larger areas due to the limited number of test holes as compared to that of a unlimited number of test holes. Every effort is made to evaluate the information by methods generally recognized. The soil represent our opinions. J.R. Cousin Consultants Ltd. cannot be responsible for actual site conditions proved to be materially at variance from our analysis or from the data generalization over untested areas.

J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 5547308.68 N
627934.61 E

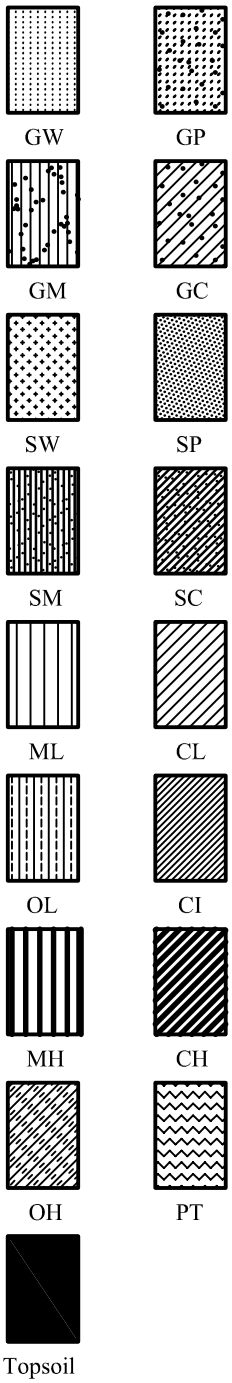
DATE : October 4, 2011

ELEVATION: 235.287 m

PROJECT : Stony Mountain and SMI Lagoons Geotechnical Investigation

TEST HOLE # 2

DEPTH OF SAMPLE	FIELD CLASSIFICATION
0m – 0	TOPSOIL - black, organic, loose, dry, some roots
2'	CLAY - low-medium plastic, light brown, silty, firm, some sand, dry
1m – 4'	
6'	SILTY CLAY - low plastic, light brown, wet, loose, sandy
2m – 8'	
3m – 10'	
12'	CLAY - high plastic, gray, moist, hard
4m – 14'	
16'	
5m	
18'	
6m – 20'	BOTTOM OF HOLE: 6.2m NOTE: no caving of the walls and some water infiltration at 1.3 - 2.7m observed at the time of excavation, minor cave-in at 2.2 m and small puddles at 6.2m observed after 5h



The soil logs are based upon objective data available to us at the time of forming our opinions. The soil logs indicate site specific soil characteristics and must not be generalized over larger areas due to the limited number of test holes as compared to that of a unlimited number of test holes. Every effort is made to evaluate the information by methods generally recognized. The soil represent our opinions. J.R. Cousin Consultants Ltd. cannot be responsible for actual site conditions proved to be materially at variance from our analysis or from the data generalization over untested areas.

J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 5547313.57 N
628105.93 E

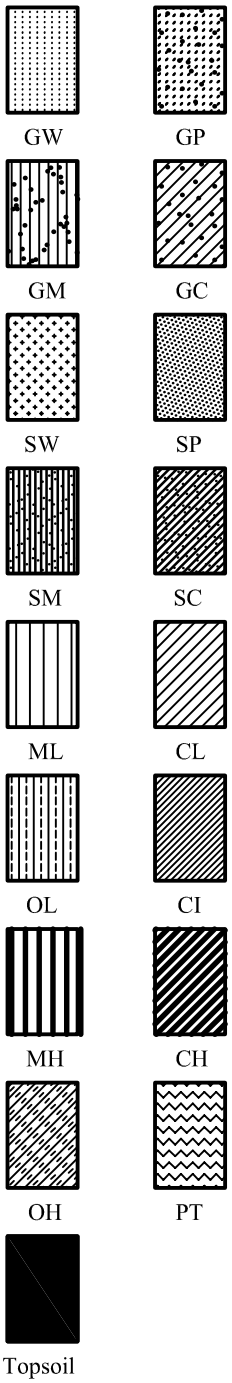
DATE : October 4, 2011

ELEVATION: 233.084 m

PROJECT : Stony Mountain and SMI Lagoons Geotechnical Investigation

TEST HOLE # 3

DEPTH OF SAMPLE	FIELD CLASSIFICATION
0m / 0	TOPSOIL - black, organic, loose, dry, some roots
2'	CLAY - low-medium plastic, light brown, silty, firm, some sand, damp
1m / 4'	SILTY CLAY - low plastic, light brown, wet, loose, sandy
6'	CLAY - high plastic, gray, moist, hard
2m	SILTY CLAY - low plastic, light brown, wet, loose, sandy
8'	
3m / 10'	
12'	
4m / 14'	CLAY - high plastic, gray, moist, hard
16'	
5m	
18'	
6m / 20'	BOTTOM OF HOLE: 6.2m NOTE: no caving of the walls and no water infiltration at the time of excavation, no caving and no standing water after 3h



The soil logs are based upon objective data available to us at the time of forming our opinions. The soil logs indicate site specific soil characteristics and must not be generalized over larger areas due to the limited number of test holes as compared to that of a unlimited number of test holes. Every effort is made to evaluate the information by methods generally recognized. The soil represent our opinions. J.R. Cousin Consultants Ltd. cannot be responsible for actual site conditions proved to be materially at variance from our analysis or from the data generalization over untested areas.

J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 5547449.79 N
628123.46 E

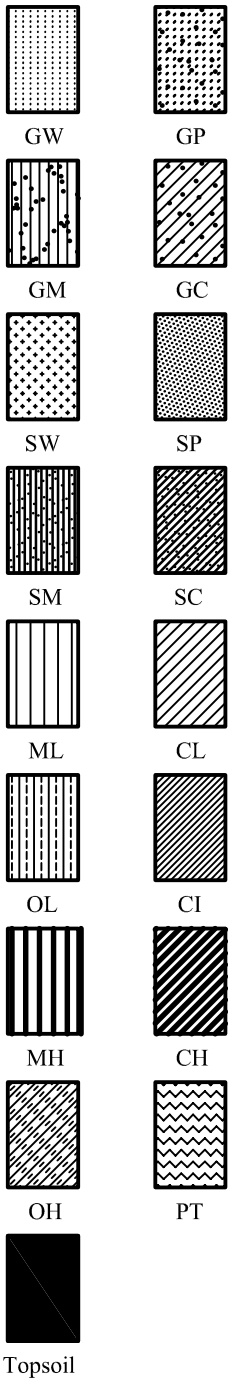
DATE : October 4, 2011

ELEVATION: 233.188 m

PROJECT : Stony Mountain and SMI Lagoons Geotechnical Investigation

TEST HOLE # 4

DEPTH OF SAMPLE	FIELD CLASSIFICATION
0m – 0	TOPSOIL - black, organic, loose, dry, some roots
2'	CLAY - low-medium plastic, light brown, silty, loose, some sand, moist
1m – 4'	
6'	SILTY CLAY - low plastic, light brown/tan, very wet, very soft, sandy
2m – 8'	
3m – 10'	
12'	CLAY - high plastic, gray, moist, hard
4m – 14'	
16'	
5m – 18'	
6m – 20'	BOTTOM OF HOLE: 6.2m NOTE: no caving of the walls and no water infiltration at the time of excavation, minor cave-in at 2.0m and no standing water after 3h



The soil logs are based upon objective data available to us at the time of forming our opinions. The soil logs indicate site specific soil characteristics and must not be generalized over larger areas due to the limited number of test holes as compared to that of a unlimited number of test holes. Every effort is made to evaluate the information by methods generally recognized. The soil represent our opinions. J.R. Cousin Consultants Ltd. cannot be responsible for actual site conditions proved to be materially at variance from our analysis or from the data generalization over untested areas.

J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 5547563.77 N
628126.65 E

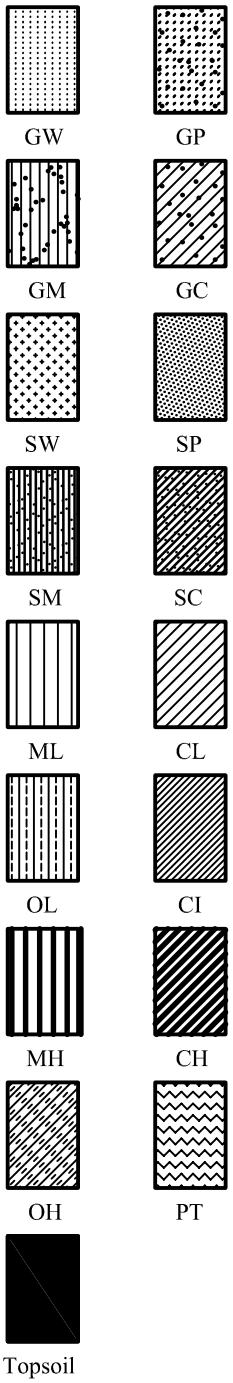
DATE : October 4, 2011

ELEVATION: 233.247 m

PROJECT : Stony Mountain and SMI Lagoons Geotechnical Investigation

TEST HOLE # 5

DEPTH OF SAMPLE	FIELD CLASSIFICATION
0m – 0	TOPSOIL - black, organic, loose, dry, some roots
2'	CLAY - low-medium plastic, light brown, silty, loose, some sand, moist
1m – 4'	
6'	SILTY CLAY - low plastic, light brown/tan, wet, soft, sandy
2m – 8'	
3m – 10'	
12'	CLAY - high plastic, gray, moist, hard
4m – 14'	
16'	
5m	
18'	
6m – 20'	BOTTOM OF HOLE: 6.2m NOTE: no caving of the walls and no water infiltration at the time of excavation, no caving and no standing water after 2.5h



The soil logs are based upon objective data available to us at the time of forming our opinions. The soil logs indicate site specific soil characteristics and must not be generalized over larger areas due to the limited number of test holes as compared to that of a unlimited number of test holes. Every effort is made to evaluate the information by methods generally recognized. The soil represent our opinions. J.R. Cousin Consultants Ltd. cannot be responsible for actual site conditions proved to be materially at variance from our analysis or from the data generalization over untested areas.

J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 5547563.66 N
628020.61 E

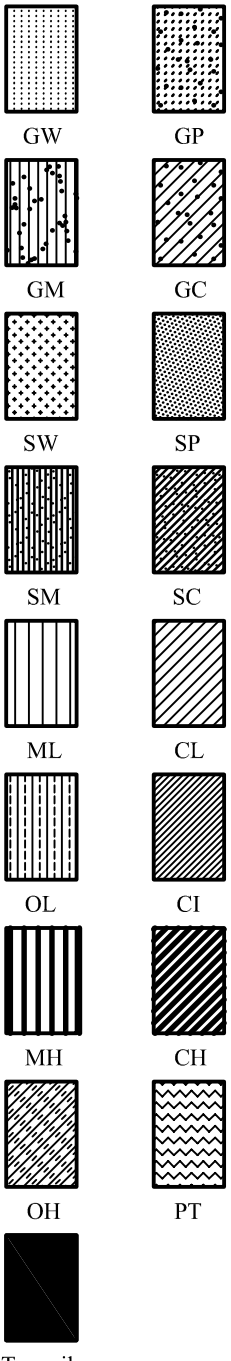
DATE : October 4, 2011

ELEVATION: 234.043 m

PROJECT : Stony Mountain and SMI Lagoons Geotechnical Investigation

TEST HOLE # 6

DEPTH OF SAMPLE	FIELD CLASSIFICATION
0m – 0	TOPSOIL - black, organic, loose, dry, some roots
2'	
1m – 4'	CLAY - low-medium plastic, light brown, silty, loose, some sand, wet
6'	
2m – 8'	SILTY CLAY - low plastic, light brown/tan, saturated, soft, sandy
3m – 10'	
12'	
4m – 14'	CLAY - high plastic, gray, wet, hard
16'	BOTTOM OF HOLE: 4.8m NOTE: massive caving of the walls from 0 - 3.6m and some water infiltration observed during excavation, standing water at 3.8m observed after 1h hole had to be "V'd" to minimize caving during excavation
5m – 18'	
6m – 20'	



The soil logs are based upon objective data available to us at the time of forming our opinions. The soil logs indicate site specific soil characteristics and must not be generalized over larger areas due to the limited number of test holes as compared to that of a unlimited number of test holes. Every effort is made to evaluate the information by methods generally recognized. The soil represent our opinions. J.R. Cousin Consultants Ltd. cannot be responsible for actual site conditions proved to be materially at variance from our analysis or from the data generalization over untested areas.

J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 5547722.77 N
627969.81 E

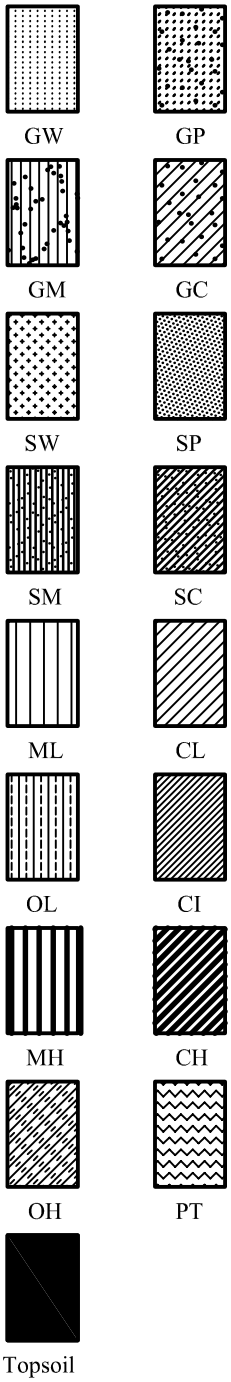
DATE : October 4, 2011

ELEVATION: 233.915 m

PROJECT : Stony Mountain and SMI Lagoons Geotechnical Investigation

TEST HOLE # 7

DEPTH OF SAMPLE	FIELD CLASSIFICATION
0m – 0	TOPSOIL - black, organic, loose, dry, some roots
2'	
1m	
4'	CLAY - low-medium plastic, light brown, silty, loose, some sand, moist
6'	
2m	
8'	SILTY CLAY - low plastic, light brown/tan, moist, soft, sandy
3m	
10'	
12'	CLAY - high plastic, gray, wet, hard
4m	BOTTOM OF HOLE: 3.8m NOTE: massive caving of the walls from 1.8 - 3.5m and high rate water infiltration at 3.5m observed during excavation, massive cave-ins observed after 1.0h
14'	
16'	
5m	
18'	
6m – 20'	



The soil logs are based upon objective data available to us at the time of forming our opinions. The soil logs indicate site specific soil characteristics and must not be generalized over larger areas due to the limited number of test holes as compared to that of a unlimited number of test holes. Every effort is made to evaluate the information by methods generally recognized. The soil represent our opinions. J.R. Cousin Consultants Ltd. cannot be responsible for actual site conditions proved to be materially at variance from our analysis or from the data generalization over untested areas.

J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 5547907.57
627910.88 E

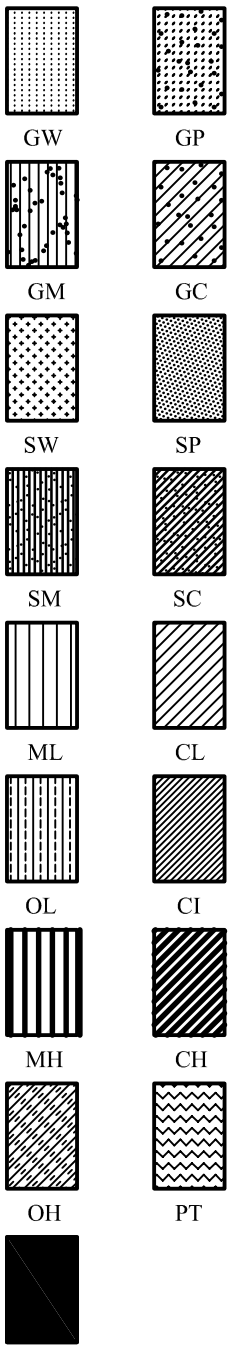
DATE : October 4, 2011

ELEVATION: 233.839 m

PROJECT : Stony Mountain and SMI Lagoons Geotechnical Investigation

TEST HOLE # 8

DEPTH OF SAMPLE	FIELD CLASSIFICATION
0m / 0	TOPSOIL - black, organic, loose, dry, some roots
2'	
1m / 4'	CLAY - low-medium plastic, light brown, silty, loose, some sand, very wet
6'	
2m / 8'	SILTY CLAY - low plastic, light brown/tan, very wet, soft, sandy
3m / 10'	
12'	CLAY - high plastic, gray, wet, hard
	BOTTOM OF HOLE: 3.8m NOTE: caving of the walls from 0 - 3.6m and water infiltration observed during excavation, hole filled immediately
4m / 14'	
16'	
5m / 18'	
6m / 20'	



The soil logs are based upon objective data available to us at the time of forming our opinions. The soil logs indicate site specific soil characteristics and must not be generalized over larger areas due to the limited number of test holes as compared to that of a unlimited number of test holes. Every effort is made to evaluate the information by methods generally recognized. The soil represent our opinions. J.R. Cousin Consultants Ltd. cannot be responsible for actual site conditions proved to be materially at variance from our analysis or from the data generalization over untested areas.

J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 5547954.39 N
627759.16 E

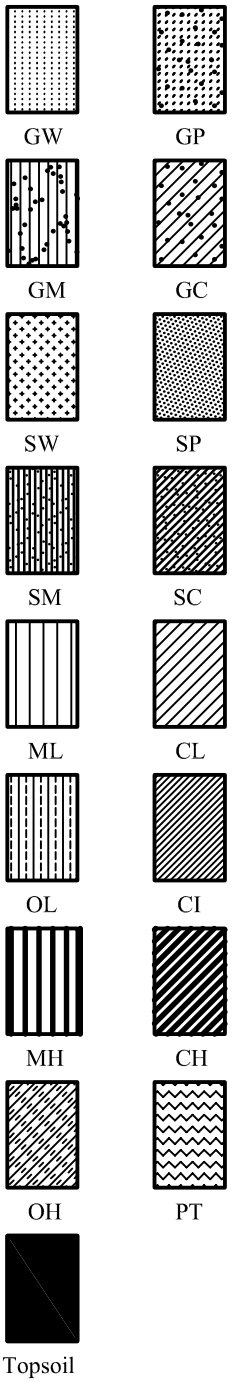
DATE : October 5, 2011

ELEVATION: 234.043 m

PROJECT : Stony Mountain and SMI Lagoons Geotechnical Investigation

TEST HOLE # 9

DEPTH OF SAMPLE	FIELD CLASSIFICATION
0m / 0	TOPSOIL - black, organic, loose, dry, some roots
2'	CLAY - low-medium plastic, light brown, silty, loose, some sand, damp
1m / 4'	
6'	SILTY CLAY - low plastic, light brown/tan, very wet, very soft, sandy
2m / 8'	
3m / 10'	
12'	CLAY - high plastic, gray, moist, hard
4m / 14'	
16'	
5m	
18'	
6m / 20'	BOTTOM OF HOLE: 6.1m NOTE: no caving of the walls and no water infiltration observed during excavation, cave-in from 1.0 - 3.5m observed after 7h



The soil logs are based upon objective data available to us at the time of forming our opinions. The soil logs indicate site specific soil characteristics and must not be generalized over larger areas due to the limited number of test holes as compared to that of a unlimited number of test holes. Every effort is made to evaluate the information by methods generally recognized. The soil represent our opinions. J.R. Cousin Consultants Ltd. cannot be responsible for actual site conditions proved to be materially at variance from our analysis or from the data generalization over untested areas.

J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 554787856.16 N
627572.45 E

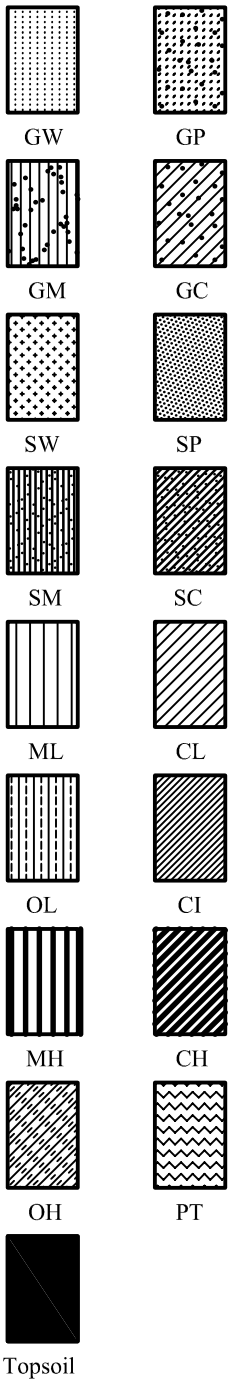
DATE : October 5, 2011

ELEVATION: 234.464 m

PROJECT : Stony Mountain and SMI Lagoons Geotechnical Investigation

TEST HOLE # 10

DEPTH OF SAMPLE	FIELD CLASSIFICATION
0m / 0	TOPSOIL - black, organic, loose, dry, some roots
2'	
1m / 4'	CLAY - low-medium plastic, light brown, silty, loose, some sand, damp
6'	
2m / 8'	SILTY CLAY - low plastic, light brown/tan, very wet, very soft, sandy
10'	
3m / 12'	CLAY - high plastic, gray, moist, hard
4m / 14'	
16'	
5m / 18'	
6m / 20'	BOTTOM OF HOLE: 6.1m NOTE: no caving of the walls and slight water infiltration observed during excavation



The soil logs are based upon objective data available to us at the time of forming our opinions. The soil logs indicate site specific soil characteristics and must not be generalized over larger areas due to the limited number of test holes as compared to that of a unlimited number of test holes. Every effort is made to evaluate the information by methods generally recognized. The soil represent our opinions. J.R. Cousin Consultants Ltd. cannot be responsible for actual site conditions proved to be materially at variance from our analysis or from the data generalization over untested areas.

J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 5547974.24 N
627404.09 E

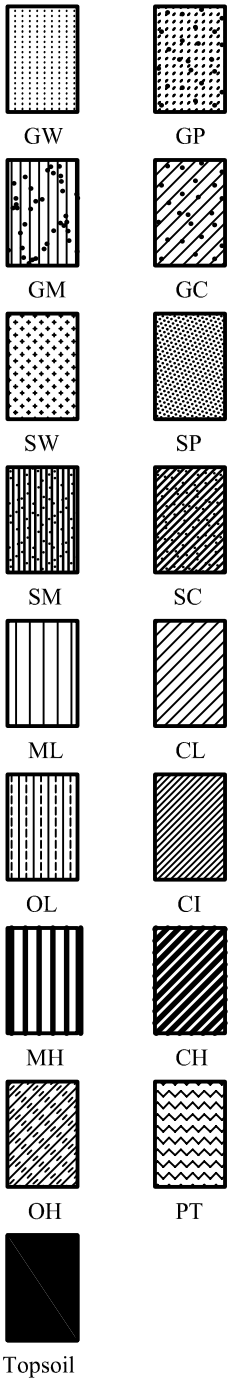
DATE : October 5, 2011

ELEVATION: 234.628 m

PROJECT : Stony Mountain and SMI Lagoons Geotechnical Investigation

TEST HOLE # 11

DEPTH OF SAMPLE	FIELD CLASSIFICATION
0m – 0	TOPSOIL - black, organic, loose, dry, some roots
2'	CLAY - low-medium plastic, light brown, silty, loose, some sand, damp
1m – 4'	SILTY CLAY - low plastic, light brown/tan, damp, sandy
6'	
2m – 8'	
3m – 10'	
12'	CLAY - high plastic, gray, moist, hard
4m – 14'	
16'	
5m – 18'	
6m – 20'	BOTTOM OF HOLE: 5.9m NOTE: no caving of the walls and no water infiltration observed during excavation, no cave-ins and no standing water observed after 5h



The soil logs are based upon objective data available to us at the time of forming our opinions. The soil logs indicate site specific soil characteristics and must not be generalized over larger areas due to the limited number of test holes as compared to that of a unlimited number of test holes. Every effort is made to evaluate the information by methods generally recognized. The soil represent our opinions. J.R. Cousin Consultants Ltd. cannot be responsible for actual site conditions proved to be materially at variance from our analysis or from the data generalization over untested areas.

J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 5547982.76 N
627259.71 E

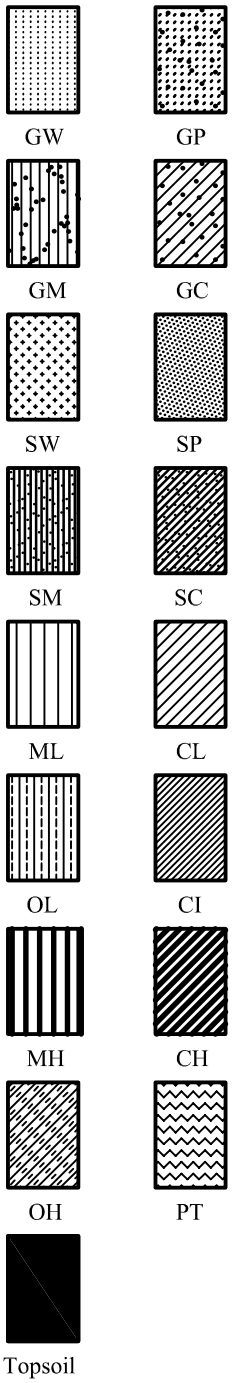
DATE : October 5, 2011

ELEVATION: 234.662 m

PROJECT : Stony Mountain and SMI Lagoons Geotechnical Investigation

TEST HOLE # 12

DEPTH OF SAMPLE	FIELD CLASSIFICATION
0m / 0	TOPSOIL - black, organic, loose, dry, some roots
2'	
1m / 4'	SILTY CLAY - low plastic, light brown/tan, damp, loose sandy
6'	CLAY - low-medium plastic, light brown, silty, loose, some sand, moist
2m / 8'	
10'	
3m / 12'	CLAY - high plastic, gray, moist, hard
4m / 14'	
16'	
5m / 18'	
6m / 20'	BOTTOM OF HOLE: 6.1m NOTE: no caving of the walls and no water infiltration observed during excavation, no cave-ins and no standing water observed after 5h



The soil logs are based upon objective data available to us at the time of forming our opinions. The soil logs indicate site specific soil characteristics and must not be generalized over larger areas due to the limited number of test holes as compared to that of a unlimited number of test holes. Every effort is made to evaluate the information by methods generally recognized. The soil represent our opinions. J.R. Cousin Consultants Ltd. cannot be responsible for actual site conditions proved to be materially at variance from our analysis or from the data generalization over untested areas.

J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 5547867.80 N
627078.18 E

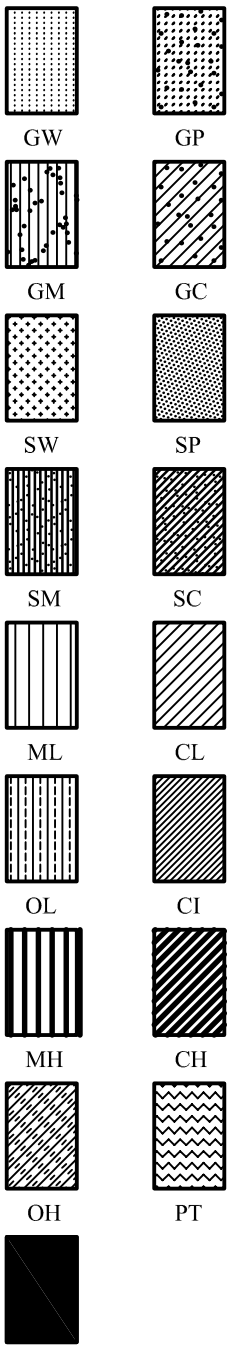
DATE : October 5, 2011

ELEVATION: 235.591 m

PROJECT : Stony Mountain and SMI Lagoons Geotechnical Investigation

TEST HOLE # 13

DEPTH OF SAMPLE	FIELD CLASSIFICATION
0m – 0	TOPSOIL - black, organic, loose, dry, some roots
2'	CLAY - low-medium plastic, light brown, silty, loose, some sand, moist
1m – 4'	
6'	
2m – 8'	CLAY - high plastic, gray, moist, hard
3m – 10'	
12'	
4m – 14'	
16'	CLAY - low-medium plastic, light brown, silty, wet with gravel, rocks and boulders up to 30cm
5m – 18'	BOTTOM OF HOLE: 5.5m NOTE: no caving of the walls and no water infiltration observed during excavation, hole filled in immediately
6m – 20'	



The soil logs are based upon objective data available to us at the time of forming our opinions. The soil logs indicate site specific soil characteristics and must not be generalized over larger areas due to the limited number of test holes as compared to that of a unlimited number of test holes. Every effort is made to evaluate the information by methods generally recognized. The soil represent our opinions. J.R. Cousin Consultants Ltd. cannot be responsible for actual site conditions proved to be materially at variance from our analysis or from the data generalization over untested areas.

J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 5547683.51 N
627067.82 E

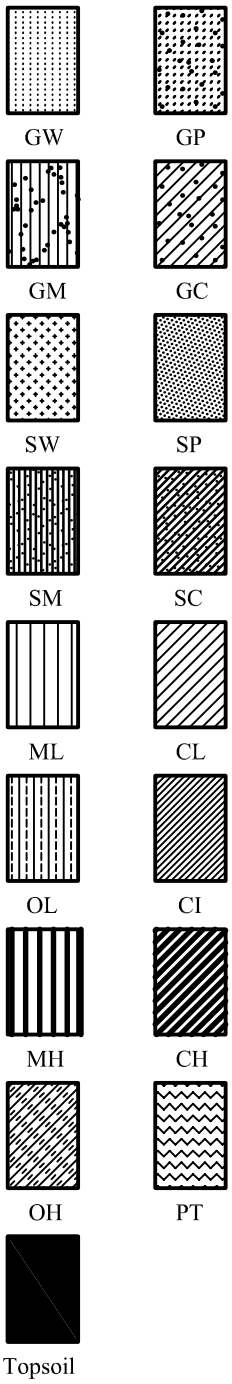
DATE : October 5, 2011

ELEVATION: 235.599 m

PROJECT : Stony Mountain and SMI Lagoons Geotechnical Investigation

TEST HOLE # 14

DEPTH OF SAMPLE	FIELD CLASSIFICATION
0m / 0	TOPSOIL - black, organic, loose, dry, some roots
2'	SILT - sandy, dry, loose, trace gravel
1m / 4'	CLAY - medium plastic, dark gray, silty, loose, crumbly, moist
6' / 2m	
8'	CLAY - high plastic, gray, moist, hard
3m / 10'	
12'	
4m / 14'	
16'	CLAY - medium plastic, gray, silty, very wet, very soft with gravel, small stones and boulders up to 30cm
5m / 18'	
6m / 20'	BOTTOM OF HOLE: 6.0m NOTE: slight caving of the test hole near the bottom, standing water 0.1 m deep at completion of excavation



The soil logs are based upon objective data available to us at the time of forming our opinions. The soil logs indicate site specific soil characteristics and must not be generalized over larger areas due to the limited number of test holes as compared to that of a unlimited number of test holes. Every effort is made to evaluate the information by methods generally recognized. The soil represent our opinions. J.R. Cousin Consultants Ltd. cannot be responsible for actual site conditions proved to be materially at variance from our analysis or from the data generalization over untested areas.

J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 5547478.27 N
627065.41 E

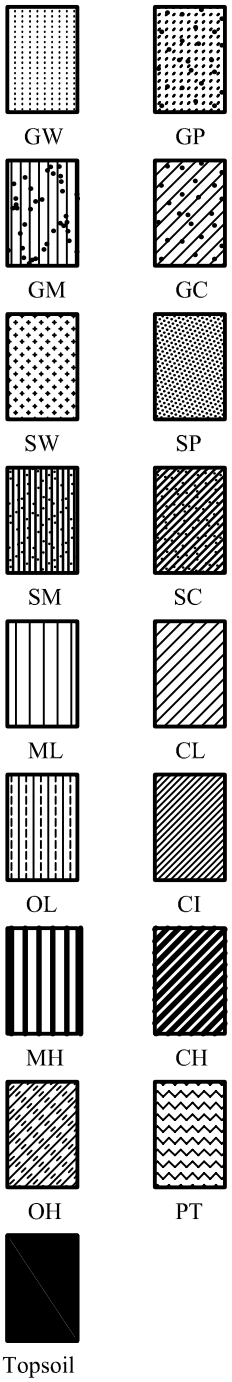
DATE : October 5, 2011

ELEVATION: 235.362 m

PROJECT : Stony Mountain and SMI Lagoons Geotechnical Investigation

TEST HOLE # 15

DEPTH OF SAMPLE		FIELD CLASSIFICATION
0m	0	TOPSOIL - black, organic, loose, dry, some roots
	2'	SILT - sandy, dry, loose, trace gravel
1m	4'	CLAY - medium plastic, dark gray, silty, loose, crumbly, moist
	6'	
2m	8'	CLAY - high plastic, gray, moist, hard
3m	10'	
	12'	
4m	14'	
	16'	CLAY - medium plastic, gray, silty, very wet, very soft with gravel, small stones and boulders up to 30cm
5m	18'	
6m	20'	BOTTOM OF HOLE: 6.0m NOTE: slight caving of the test hole near the bottom, standing water 0.1 m deep at completion of excavation



The soil logs are based upon objective data available to us at the time of forming our opinions. The soil logs indicate site specific soil characteristics and must not be generalized over larger areas due to the limited number of test holes as compared to that of a unlimited number of test holes. Every effort is made to evaluate the information by methods generally recognized. The soil represent our opinions. J.R. Cousin Consultants Ltd. cannot be responsible for actual site conditions proved to be materially at variance from our analysis or from the data generalization over untested areas.

J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 5547374.53 N
627163.53 E

DATE : October 5, 2011

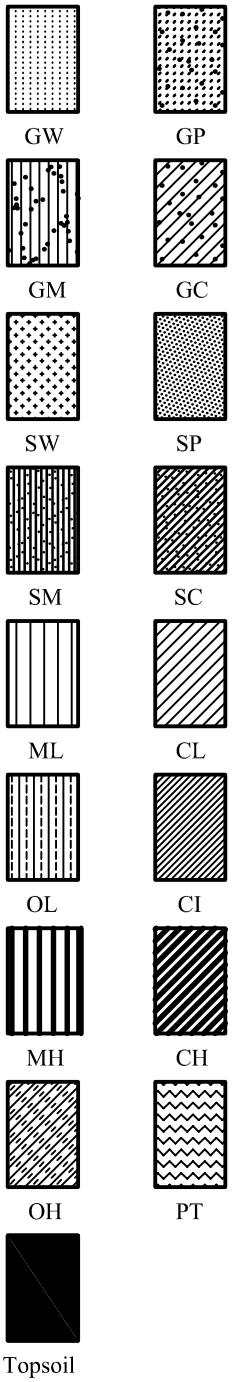
ELEVATION: 235.267 m

PROJECT : Stony Mountain and SMI Lagoons Geotechnical Investigation

TEST HOLE # 16

DEPTH OF SAMPLE		FIELD CLASSIFICATION
0m	0	TOPSOIL - black, organic, loose, dry, some roots
	2'	SILTY CLAY - low plastic, light brown/tan, dry, loose sandy
1m	4'	
	6'	
2m	8'	CLAY - high plastic, gray, wet, firm
3m	10'	
	12'	
4m	14'	
	16'	
5m	18'	CLAY - high plastic, gray, very wet, soft
		GRAVEL - loose, very wet
6m	20'	BOTTOM OF HOLE: 6.1m

NOTE: slight caving of the test hole at 5.8 m, standing water 0.1 m deep at completion of excavation, standing water observed at 5.5 m after 0.5 h



The soil logs are based upon objective data available to us at the time of forming our opinions. The soil logs indicate site specific soil characteristics and must not be generalized over larger areas due to the limited number of test holes as compared to that of a unlimited number of test holes. Every effort is made to evaluate the information by methods generally recognized. The soil represent our opinions. J.R. Cousin Consultants Ltd. cannot be responsible for actual site conditions proved to be materially at variance from our analysis or from the data generalization over untested areas.

J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 5547359.67 N
627407.16 E

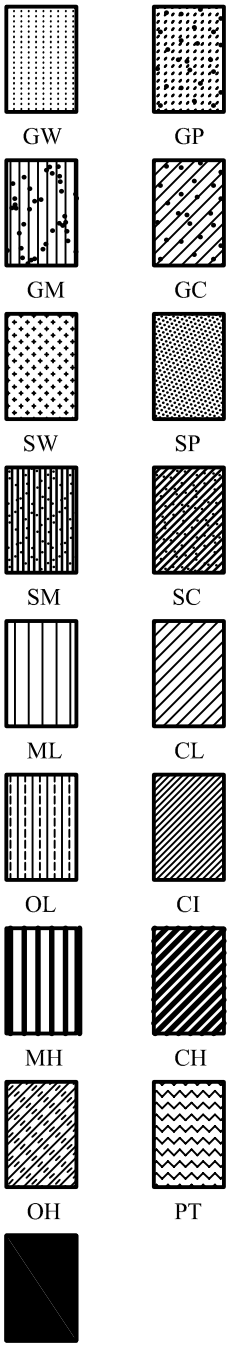
DATE : October 4, 2011

ELEVATION: 234.325 m

PROJECT : Stony Mountain and SMI Lagoons Geotechnical Investigation

TEST HOLE # 17

DEPTH OF SAMPLE		FIELD CLASSIFICATION
0m	0	TOPSOIL - black, organic, loose, dry, some roots
	2'	CLAY - low-medium plastic, light brown, silty, loose, some sand, dry
1m	4'	SILTY CLAY - low plastic, light brown/tan, dry, loose sandy
2m	6'	
	8'	
3m	10'	CLAY - high plastic, gray, wet, firm
	12'	
4m	14'	
	16'	
5m	18'	
6m	20'	BOTTOM OF HOLE: 6.1m NOTE: no caving of the walls and no water infiltration observed during excavation, hole filled in immedietly



The soil logs are based upon objective data available to us at the time of forming our opinions. The soil logs indicate site specific soil characteristics and must not be generalized over larger areas due to the limited number of test holes as compared to that of a unlimited number of test holes. Every effort is made to evaluate the information by methods generally recognized. The soil represent our opinions. J.R. Cousin Consultants Ltd. cannot be responsible for actual site conditions proved to be materially at variance from our analysis or from the data generalization over untested areas.

J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 5547361.26 N
627620.97 E

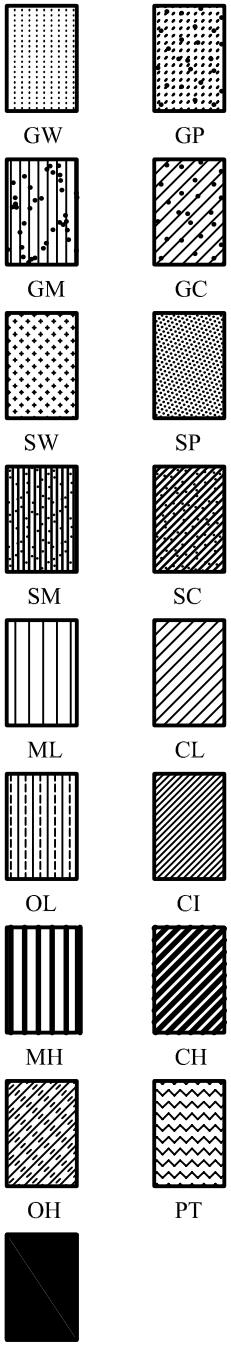
DATE : October 4, 2011

ELEVATION: 233.412 m

PROJECT : Stony Mountain and SMI Lagoons Geotechnical Investigation

TEST HOLE # 18

DEPTH OF SAMPLE	FIELD CLASSIFICATION
0m – 0	TOPSOIL - black, organic, loose, dry, some roots
2'	CLAY - low-medium plastic, light brown, silty, loose, some sand, dry
1m – 4'	
6'	SILTY CLAY - low plastic, light brown/tan, dry, loose sandy
2m – 8'	
3m – 10'	CLAY - high plastic, gray, wet, firm
12'	
4m – 14'	
16'	
5m – 18'	
6m – 20'	BOTTOM OF HOLE: 5.9 m NOTE: no caving of the walls and no water infiltration observed during excavation, some low rate water infiltration observed at 2.6 m after 0.5 h



The soil logs are based upon objective data available to us at the time of forming our opinions. The soil logs indicate site specific soil characteristics and must not be generalized over larger areas due to the limited number of test holes as compared to that of a unlimited number of test holes. Every effort is made to evaluate the information by methods generally recognized. The soil represent our opinions. J.R. Cousin Consultants Ltd. cannot be responsible for actual site conditions proved to be materially at variance from our analysis or from the data generalization over untested areas.

J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 5547451.36 N
627358.58 E

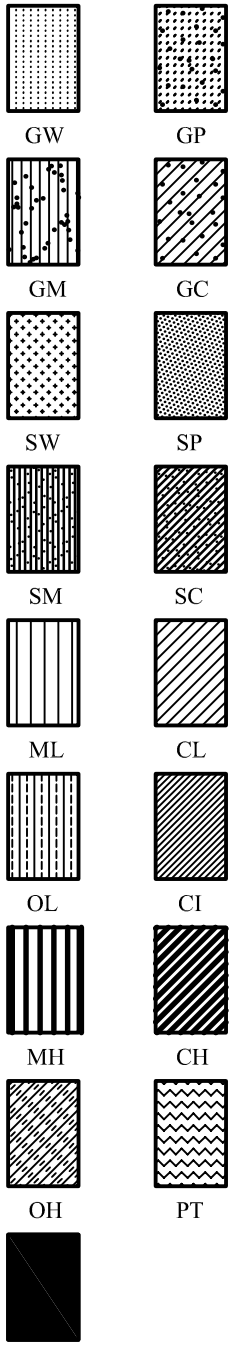
DATE : October 5, 2011

ELEVATION: 233.872 m

PROJECT : Stony Mountain and SMI Lagoons Geotechnical Investigation

TEST HOLE # 19

DEPTH OF SAMPLE	FIELD CLASSIFICATION
0m – 0	TOPSOIL - black, organic, loose, dry, some roots
2'	SILTY CLAY - low plastic, light brown/tan, wet, soft, loose, sandy
1m – 4'	
6'	
2m – 8'	
3m – 10'	CLAY - high plastic, gray, wet, firm
12'	
4m – 14'	
16'	
5m – 18'	CLAY - medium plastic, gray, very wet, soft, silty, gravel, some stones up to 10 cm
6m – 20'	BOTTOM OF HOLE: 5.9 m NOTE: no caving of the walls and no water infiltration observed during excavation, no caving and a small puddle at the bottom of the hole observed after 3.0 h



The soil logs are based upon objective data available to us at the time of forming our opinions. The soil logs indicate site specific soil characteristics and must not be generalized over larger areas due to the limited number of test holes as compared to that of a unlimited number of test holes. Every effort is made to evaluate the information by methods generally recognized. The soil represent our opinions. J.R. Cousin Consultants Ltd. cannot be responsible for actual site conditions proved to be materially at variance from our analysis or from the data generalization over untested areas.

J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 5547607.79 N
627356.65 E

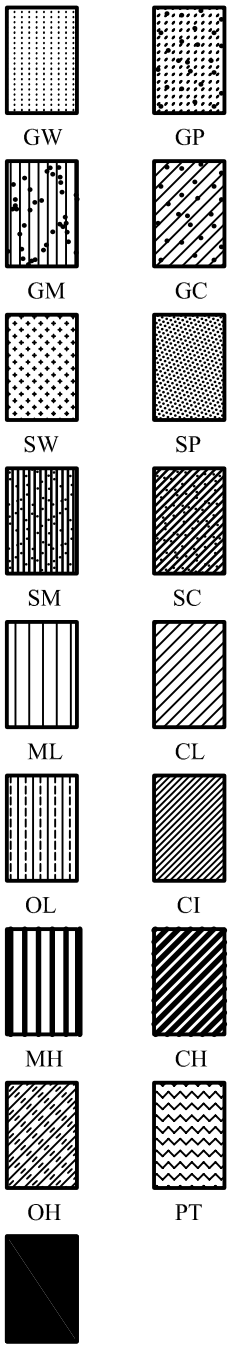
DATE : October 5, 2011

ELEVATION: 234.133

PROJECT : Stony Mountain and SMI Lagoons Geotechnical Investigation

TEST HOLE # 20

DEPTH OF SAMPLE	FIELD CLASSIFICATION
0m / 0	TOPSOIL - black, organic, loose, dry, some roots
2'	SILTY CLAY - low plastic, light brown/tan, wet, soft, loose, sandy
1m / 4'	
6'	
2m / 8'	CLAY - high plastic, gray, wet, firm
3m / 10'	
12'	
4m / 14'	
16'	CLAY - low plastic, gray, moist, firm, silty, sandy, gravel
5m / 18'	
6m / 20'	BOTTOM OF HOLE: 5.9 m NOTE: no caving of the walls and no water infiltration observed during excavation, slight caving observed at 5.5 m and small puddles observed after 3.0 h



The soil logs are based upon objective data available to us at the time of forming our opinions. The soil logs indicate site specific soil characteristics and must not be generalized over larger areas due to the limited number of test holes as compared to that of a unlimited number of test holes. Every effort is made to evaluate the information by methods generally recognized. The soil represent our opinions. J.R. Cousin Consultants Ltd. cannot be responsible for actual site conditions proved to be materially at variance from our analysis or from the data generalization over untested areas.

J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 5547722.64 N
627353.65 E

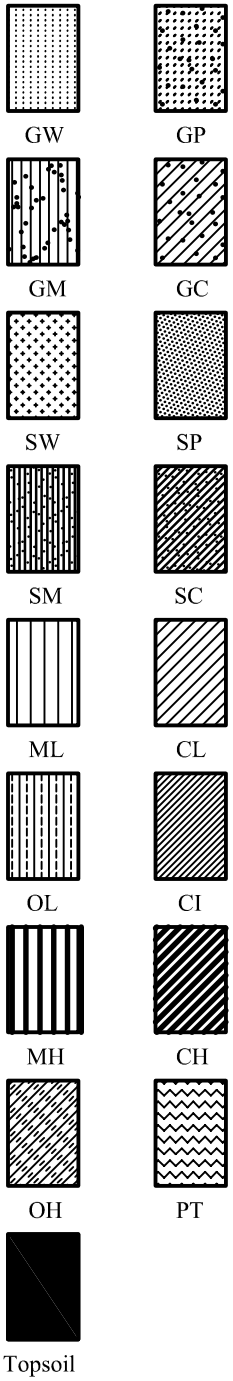
DATE : October 5, 2011

ELEVATION: 234.157 m

PROJECT : Stony Mountain and SMI Lagoons Geotechnical Investigation

TEST HOLE # 21

DEPTH OF SAMPLE	FIELD CLASSIFICATION
0m / 0	TOPSOIL - black, organic, loose, dry, some roots
2'	CLAY - low-medium plastic, light brown, silty, loose, moist
1m / 4'	SILTY CLAY - low plastic, light brown/tan, very wet, very soft, loose, sandy
6'	
2m / 8'	
3m / 10'	CLAY - high plastic, gray, wet, firm
12'	
4m / 14'	
16'	
5m / 18'	
6m / 20'	BOTTOM OF HOLE: 5.9 m NOTE: no caving of the walls and no water infiltration observed during excavation, no caving and no standing water observed after 4.0 h



The soil logs are based upon objective data available to us at the time of forming our opinions. The soil logs indicate site specific soil characteristics and must not be generalized over larger areas due to the limited number of test holes as compared to that of a unlimited number of test holes. Every effort is made to evaluate the information by methods generally recognized. The soil represent our opinions. J.R. Cousin Consultants Ltd. cannot be responsible for actual site conditions proved to be materially at variance from our analysis or from the data generalization over untested areas.

National Testing Laboratories Test Results - November 2011

THE NATIONAL TESTING LABORATORIES LIMITED
Established in 1923

199 Henlow Bay
Winnipeg, MB R3Y 1G4
Phone (204) 488-6999
Fax (204) 488-6947
Email info@nationaltestlabs.com
www.nationaltestlabs.com

J.R. Cousin Consultants Ltd.
91 A Scurfield Blvd.
Winnipeg, Manitoba
R3Y 1G4

November 10, 2011

Project: Stony Mountain and SMI Lagoon Sites

Attention: Brett McCormac

Soil samples were submitted to our laboratory on October 7, 2011. The following tests were conducted on selected soil samples:

- water content (ASTM D2216)
- particle size analysis (ASTM D422)
- liquid limit, plastic limit, and plasticity index (ASTM D4318)
- soil classification (ASTM D2487)
- hydraulic conductivity (ASTM D5084)
- visual classification

The test results for the soil samples are summarized in the following tables and in the attached particle size analysis and hydraulic conductivity reports.

An assessment of the bagged soil samples was conducted to determine whether the soil represented by the bagged samples could be used in-situ as a landfill liner and would obtain a hydraulic conductivity of less than 1.0×10^{-7} cm/sec without being reworked, and when re-moulded and re-compacted.

Based upon previous testing conducted in our laboratory, homogeneous soil samples with a plasticity index greater than 25 and a clay content greater than 50% will typically have a hydraulic conductivity of 1.0×10^{-7} cm/sec or less. Sample TH12 0.3-1.7 m had a plasticity index of 7 and a clay content of 20.5, which does not fall within this range. This sample is not considered suitable for use as a lagoon liner. The remaining bagged samples were considered suitable for use as a lagoon liner. Our comments regarding the potential use of the material as a lagoon liner are based upon the soil being homogeneous with no preferential flow paths and being properly placed and compacted to maximum density near its optimum moisture content. It should be noted that estimating the hydraulic conductivity of a soil based upon classification test results (plasticity index and particle size analysis) alone might be misleading if the soil contains layers of sand, silt, or organic material.

The hydraulic conductivity results for the Shelby tube sample TH12 1.9-2.5 m is less than the specified maximum hydraulic conductivity value of 1.0×10^{-7} cm/s for lagoon liners. The hydraulic conductivity results for the Shelby tube sample TH12 0.3-0.9 m exceeds the specified maximum hydraulic conductivity value of 1.0×10^{-7} cm/s for lagoon liners.

We appreciate the opportunity to assist you in this project. Please call if you have any questions regarding this report.

Aron Piamsalee, B.Sc., EIT
Geotechnical Project Manager

THE NATIONAL TESTING LABORATORIES LIMITED

TABLE 1
SUMMARY OF WATER CONTENT, PARTICLE SIZE, ATTERBERG LIMITS, SOIL CLASSIFICATION TEST DATA
STONY MOUNTAIN AND SMI LAGOON SITES

Testhole	Depth (m)	Visual Classification	Water Content (%)	Gravel (%) 75 to 4.75 mm	Sand (%)			Silt (%) <0.075 to 0.005 mm	Clay (%) <0.005 mm	Liquid Limit	Plastic Limit	Plasticity Index	Soil Classification ASTM D2487	Potential use as a lagoon liner when re-moulded and re-compacted	Potential use as a lagoon liner without being reworked
					Coarse <4.75 to 2.0 mm	Medium <2.0 to 0.425 mm	Fine <0.425 to 0.075 mm								
TH9	0.3 - 1.2	brown,firm, moist, high plasticity silty clay with trace organic material and trace sand	23.4	0.0	0.0	0.1	1.9	33.0	65.0	53	18	35	CH (Fat Clay)	Yes	Yes
TH9	2.4 - 6.1	brown, stiff, moist, high plasticity clay with trace silt	42.3	0.0	0.0	0.0	0.2	8.2	91.6	89	29	60	CH (Fat Clay)	Yes	Yes
TH12	0.3 - 1.7	tan, soft, moist, low plasticity clayey silt with some sand	16.7	0.0	0.0	0.1	12.8	66.6	20.5	23	16	7	CL-ML (Silt)	No	No
TH12	1.9 - 6.1	brown, stiff, moist, high plasticity clay with trace silt	51.7	0.0	0.0	0.0	0.4	9.4	90.2	86	22	64	CH (Fat Clay)	Yes	Yes

Notes:
1. A high speed stirring device was used for 1 minute to disperse the test samples for particle size analysis.
2. Atterberg limits conducted in accordance with ASTM D4318 Method B (one-point liquid limit).
3. The soil samples were air-dried during sample preparation for Atterberg limits and particle size analysis.

TABLE 2
SUMMARY OF HYDRAULIC CONDUCTIVITY TEST DATA
STONY MOUNTAIN AND SMI LAGOON SITES

Sample ID	Depth (m)	Hydraulic Conductivity, "k_{20}"
TH12	0.3 – 0.9	5.7×10^{-5} cm/s
TH12	1.9 – 2.5	4.8×10^{-9} cm/s

THE NATIONAL TESTING LABORATORIES LIMITED
Established in 1923

PARTICLE SIZE ANALYSIS
ASTM D422

J.R. Cousin Consultants Ltd.
91A Scurfield Blvd.
Winnipeg, Manitoba
R3Y 1G4

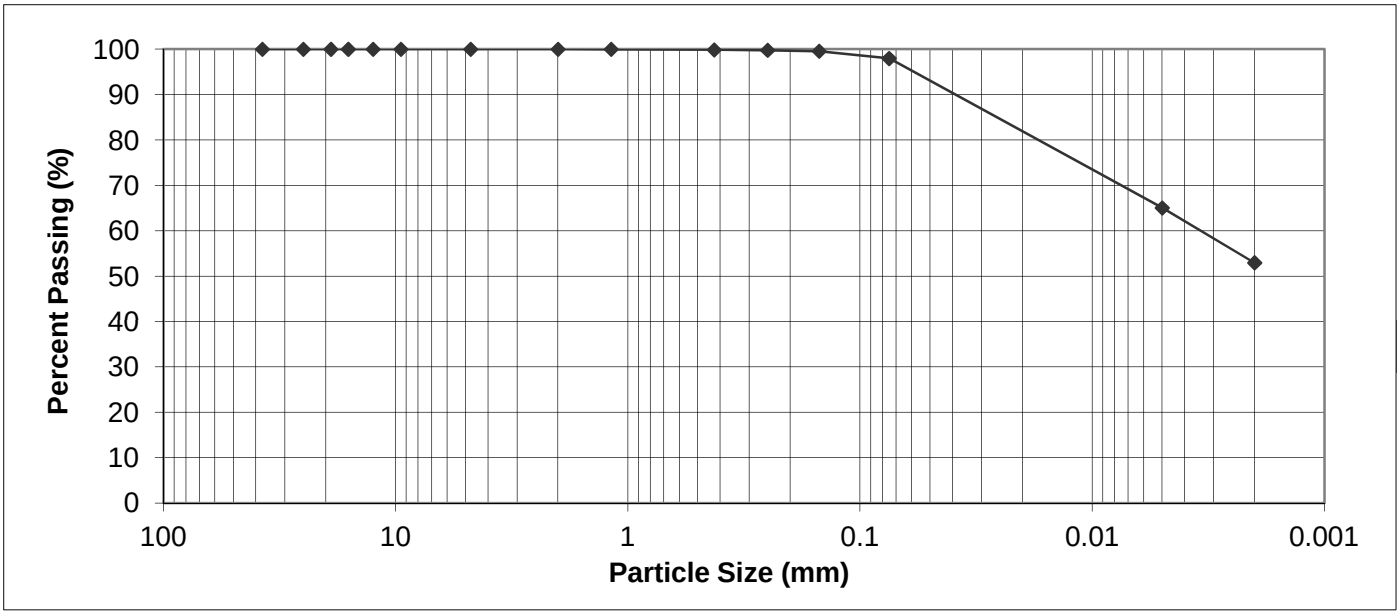
PROJECT: Stony Mountain and SMI Lagoon

Attention: Brett McCormac

PROJECT NO.: JRC-1105

SAMPLED BY: J.R. Cousin
SAMPLE ID: TH9 @ 0.3 - 1.2 m

DATE RECEIVED: October 7, 2011
TESTED BY: Sothea Bun



PARTICLE SIZE	PERCENT PASSING
37.50 mm	100.0
25.00 mm	100.0
19.00 mm	100.0
16.00 mm	100.0
12.50 mm	100.0
9.50 mm	100.0
4.75 mm	100.0
2.00 mm	100.0

PARTICLE SIZE	PERCENT PASSING
1.18 mm	100.0
0.425 mm	99.9
0.250 mm	99.8
0.150 mm	99.6
0.075 mm	98.0
0.005 mm	65.0
0.002 mm	52.9
0.001 mm	NT

Gravel, % 75 to 4.75 mm	Sand, %			Silt, % <0.075 to 0.005 mm	Clay, % <0.005 mm	Colloids, % < 0.001 mm
	Coarse <4.75 to 2.0 mm	Medium <2.0 to 0.425 mm	Fine <0.425 to 0.075 mm			
0.0	0.0	0.1	1.9	33.0	65.0	NT

Note: Colloids content not tested

October 15, 2011

REVIEWED BY: Aron Piamsalee, B.Sc, EIT

THE NATIONAL TESTING LABORATORIES LIMITED
Established in 1923

PARTICLE SIZE ANALYSIS
ASTM D422

J.R. Cousin Consultants Ltd.
91A Scurfield Blvd.
Winnipeg, Manitoba
R3Y 1G4

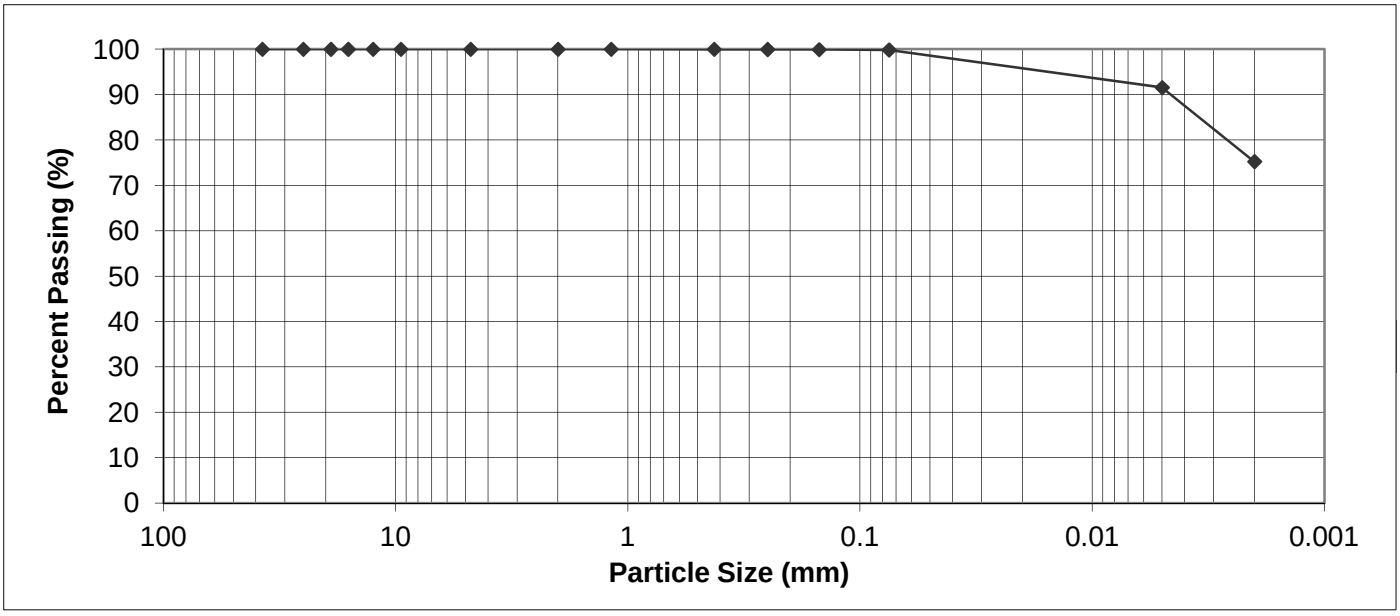
PROJECT: Stony Mountain and SMI Lagoon

Attention: Brett McCormac

PROJECT NO.: JRC-1105

SAMPLED BY: J.R. Cousin
SAMPLE ID: TH9 @ 2.4 - 6.1 m

DATE RECEIVED: October 7, 2011
TESTED BY: Sothea Bun



PARTICLE SIZE	PERCENT PASSING
37.50 mm	100.0
25.00 mm	100.0
19.00 mm	100.0
16.00 mm	100.0
12.50 mm	100.0
9.50 mm	100.0
4.75 mm	100.0
2.00 mm	100.0

PARTICLE SIZE	PERCENT PASSING
1.18 mm	100.0
0.425 mm	100.0
0.250 mm	100.0
0.150 mm	99.9
0.075 mm	99.8
0.005 mm	91.6
0.002 mm	75.2
0.001 mm	NT

Gravel, % 75 to 4.75 mm	Sand, %			Silt, % <0.075 to 0.005 mm	Clay, % <0.005 mm	Colloids, % < 0.001 mm
	Coarse <4.75 to 2.0 mm	Medium <2.0 to 0.425 mm	Fine <0.425 to 0.075 mm			
0.0	0.0	0.0	0.2	8.2	91.6	NT

Note: Colloids content not tested

October 15, 2011

REVIEWED BY: Aron Piamsalee, B.Sc, EIT

THE NATIONAL TESTING LABORATORIES LIMITED
Established in 1923

PARTICLE SIZE ANALYSIS
ASTM D422

J.R. Cousin Consultants Ltd.
91A Scurfield Blvd.
Winnipeg, Manitoba
R3Y 1G4

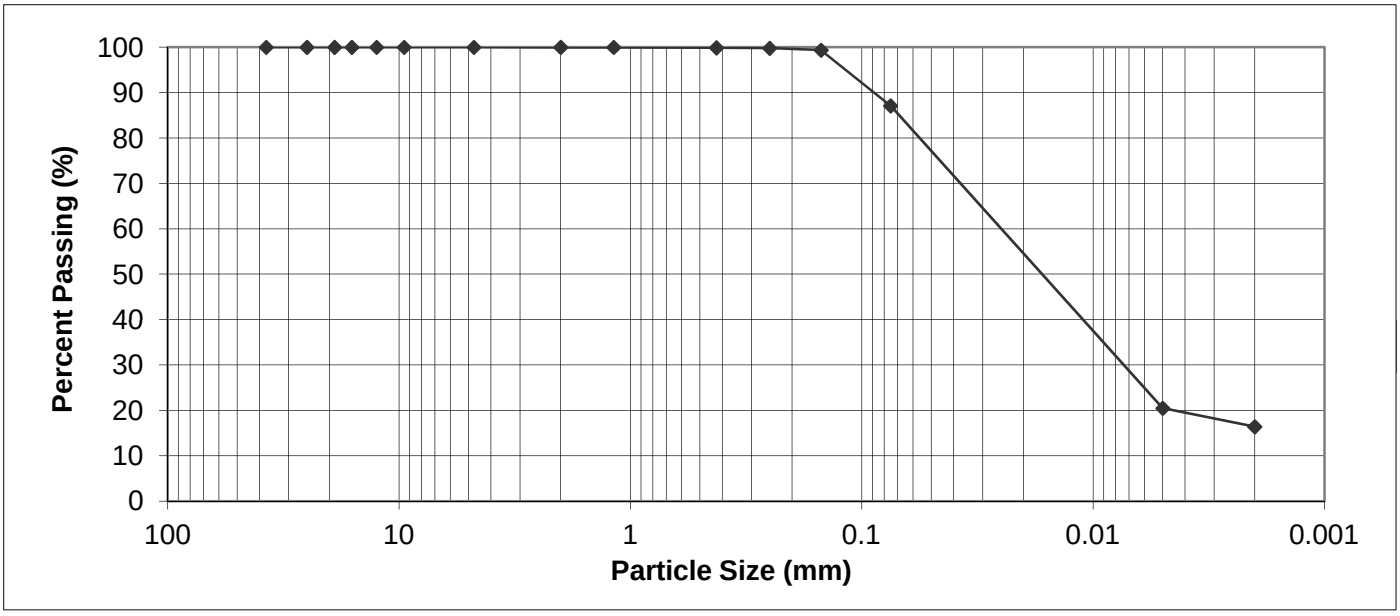
PROJECT: Stony Mountain and SMI Lagoon

Attention: Brett McCormac

PROJECT NO.: JRC-1105

SAMPLED BY: J.R. Cousin
SAMPLE ID: TH12 @ 0.3-1.7 m

DATE RECEIVED: October 7, 2011
TESTED BY: Sothea Bun



PARTICLE SIZE	PERCENT PASSING
37.50 mm	100.0
25.00 mm	100.0
19.00 mm	100.0
16.00 mm	100.0
12.50 mm	100.0
9.50 mm	100.0
4.75 mm	100.0
2.00 mm	100.0

PARTICLE SIZE	PERCENT PASSING
1.18 mm	100.0
0.425 mm	99.9
0.250 mm	99.8
0.150 mm	99.4
0.075 mm	87.1
0.005 mm	20.5
0.002 mm	16.4
0.001 mm	NT

Gravel, % 75 to 4.75 mm	Sand, %			Silt, % <0.075 to 0.005 mm	Clay, % <0.005 mm	Colloids, % < 0.001 mm
	Coarse <4.75 to 2.0 mm	Medium <2.0 to 0.425 mm	Fine <0.425 to 0.075 mm			
0.0	0.0	0.1	12.8	66.6	20.5	NT

Note: Colloids content not tested

October 15, 2011

REVIEWED BY: Aron Piamsalee, B.Sc, EIT

THE NATIONAL TESTING LABORATORIES LIMITED
Established in 1923

PARTICLE SIZE ANALYSIS
ASTM D422

J.R. Cousin Consultants Ltd.
91A Scurfield Blvd.
Winnipeg, Manitoba
R3Y 1G4

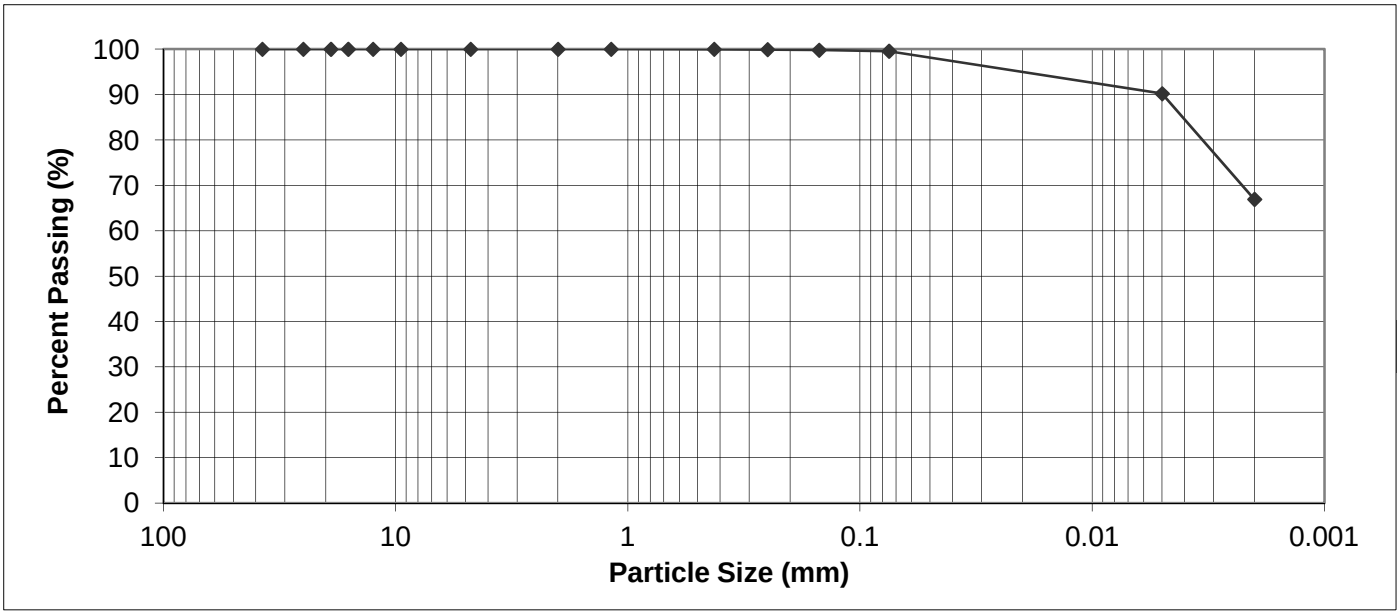
PROJECT: Stony Mountain and SMI Lagoon

Attention: Brett McCormac

PROJECT NO.: JRC-1105

SAMPLED BY: J.R. Cousin
SAMPLE ID: TH12 @ 1.9 - 6.1 m

DATE RECEIVED: October 7, 2011
TESTED BY: Sothea Bun



PARTICLE SIZE	PERCENT PASSING
37.50 mm	100.0
25.00 mm	100.0
19.00 mm	100.0
16.00 mm	100.0
12.50 mm	100.0
9.50 mm	100.0
4.75 mm	100.0
2.00 mm	100.0

PARTICLE SIZE	PERCENT PASSING
1.18 mm	100.0
0.425 mm	100.0
0.250 mm	99.9
0.150 mm	99.8
0.075 mm	99.6
0.005 mm	90.2
0.002 mm	66.9
0.001 mm	NT

Gravel, % 75 to 4.75 mm	Sand, %			Silt, % <0.075 to 0.005 mm	Clay, % <0.005 mm	Colloids, % < 0.001 mm
	Coarse <4.75 to 2.0 mm	Medium <2.0 to 0.425 mm	Fine <0.425 to 0.075 mm			
0.0	0.0	0.0	0.4	9.4	90.2	NT

Note: Colloids content not tested

October 15, 2011

REVIEWED BY: Aron Piamsalee, B.Sc, EIT

THE NATIONAL TESTING LABORATORIES LIMITED
Established in 1923

HYDRAULIC CONDUCTIVITY
ASTM D5084

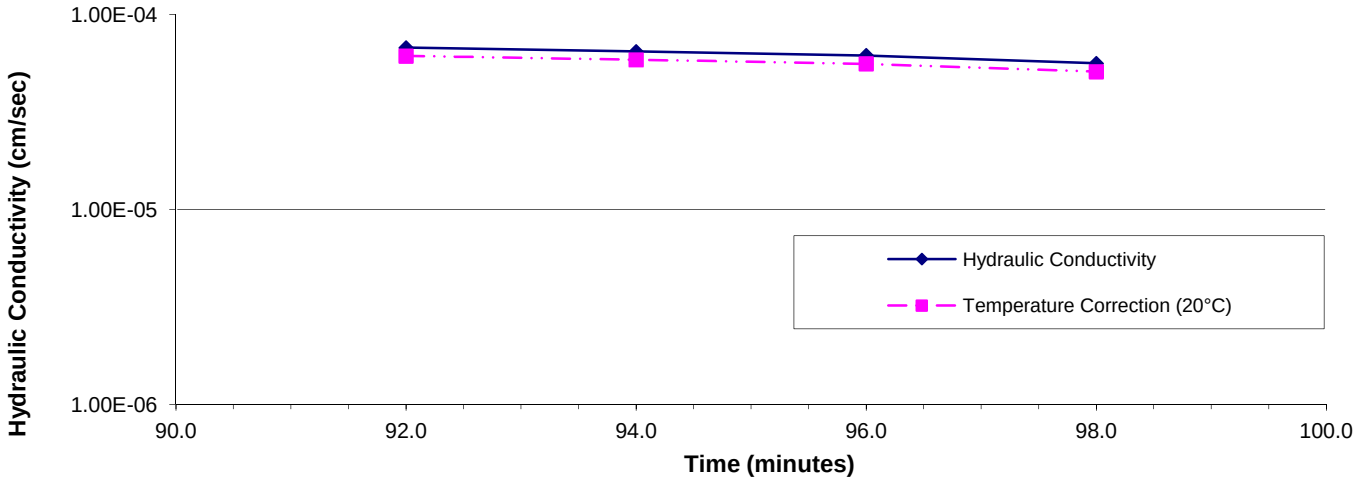
J.R. Cousin Consultants Ltd.
91 A Scurfield Blvd.
Winnipeg, Manitoba
R3Y 1G4

PROJECT: Stony Mountain and SMI Lagoon Sites

Attention: Brett McCormac

SAMPLE I.D.:	**TH12 at 0.3 - 0.9 m**
SOIL TYPE:	Brown, dry to moist, medium plasticity clayey silt some sand
DATE TESTED:	Oct 8th to Nov 4th
CONFINING PRESSURE (kPa):	137.9
EFFECTIVE SATURATION STRESS (kPa):	34.5
HYDRAULIC GRADIENT:	19.9
TYPE OF PERMEANT LIQUID:	De-aired Water
HYDRAULIC CONDUCTIVITY, "k" (cm/s):	6.3E-05
HYDRAULIC CONDUCTIVITY, "k_{20}" (cm/s):	**5.7E-05**

	Height (mm)	Diameter (mm)	Wet Mass (g)	Dry Density (g/cm^3)	Water Content (%)	Saturation (%)
Initial Reading	74.1	72.2	531.1	1.464	19.6	62.3
Final Reading	74.4	73.2	560.2	1.408	27.0	79.3



November 9, 2011

REVIEWED BY: Aron Piamsalee, B.Sc., EIT

THE NATIONAL TESTING LABORATORIES LIMITED
Established in 1923

HYDRAULIC CONDUCTIVITY
ASTM D5084

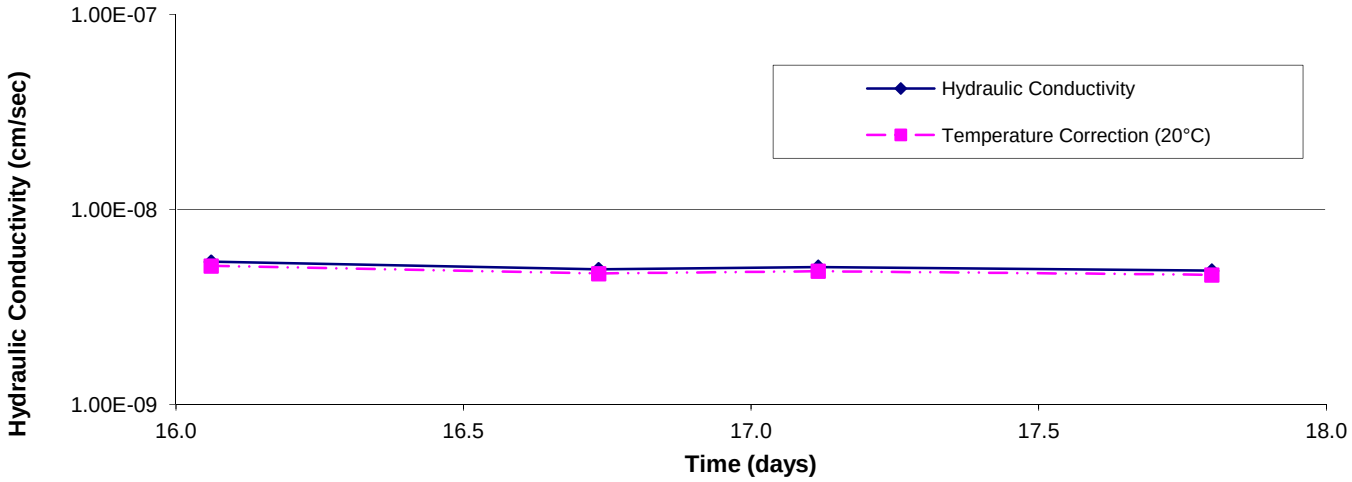
J.R. Cousin Consultants Ltd.
91 A Scurfield Blvd.
Winnipeg, Manitoba
R3Y 1G4

PROJECT: Stony Mountain and SMI Lagoon Sites

Attention: Brett McCormac

SAMPLE I.D.:	**TH12 at 1.9 - 2.5 m**
SOIL TYPE:	Brown, firm, moist, high plasticity clay trace silt
DATE TESTED:	October 11th to 29th
CONFINING PRESSURE (kPa):	137.9
EFFECTIVE SATURATION STRESS (kPa):	34.5
HYDRAULIC GRADIENT:	20.4
TYPE OF PERMEANT LIQUID:	De-aired Water
HYDRAULIC CONDUCTIVITY, "k" (cm/s):	5.1E-09
HYDRAULIC CONDUCTIVITY, "k_{20}" (cm/s):	**4.8E-09**

	Height (mm)	Diameter (mm)	Wet Mass (g)	Dry Density (g/cm^3)	Water Content (%)	Saturation (%)
Initial Reading	71.9	72.5	507.6	1.131	51.2	99.4
Final Reading	72.6	72.3	513.0	1.112	54.8	103.3



November 9, 2011

REVIEWED BY: Aron Piamsalee, B.Sc., EIT

199 Henlow Bay, Winnipeg, Manitoba R3Y 1G4 Phone (204) 488-6999 Fax (204) 488-6947 Email info@nationaltestlabs.com

AMEC - Geotechnical Investigation SMI Lagoon Upgrades SE2-13-2EPM
RM of Rockwood, Manitoba - March 2014

GEOTECHNICAL INVESTIGATION
SMI LAGOON UPGRADES
SE2-13-2EPM
RM OF ROCKWOOD, MANITOBA

Submitted to:

J.R. Cousin Consultant Ltd.

91A Scurfield Blvd.
Winnipeg, Manitoba
R3Y 1N4

Submitted by:

AMEC Environment & Infrastructure
A Division of AMEC Americas Limited

440 Dovercourt Drive
Winnipeg, Manitoba
R3Y 1N4
Office: (204) 488-2997
Fax: (204) 489-8261

21 March 2014
R1. 5 May 2014

WX17351

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

1.0 INTRODUCTION

At the request of Mr. Jason Cousin, P. Eng. of J.R. Cousin Consultants Ltd. (JRCC), AMEC Environment & Infrastructure, a division of AMEC Americas Limited (AMEC), completed a geotechnical investigation for the proposed upgrades to the existing Stony Mountain Institute (SMI) wastewater lagoon facility in the RM of Rockwood, Manitoba. The purpose of the geotechnical investigation was to verify the subsurface soil and groundwater conditions at the site in order to provide geotechnical recommendations for foundation design and construction for the aeration building, and to provide evaluation of the suitability of common fill for use as clay liner material. Slope stability assessments of new dikes and future dike raises, and the potential for "piping" through the existing leaking dike on the west side of the lagoon, were also to be completed. The scope of work for the project was outlined in AMEC's proposal number WPG2014.020, dated 28 January 2014. Authorization to proceed was received from Mr. Cousin on 29 January 2014.

This report summarizes the field and laboratory testing programs, describes the subsurface conditions encountered at the test hole locations, provides comment on the suitability of common fill for lagoon construction, and presents the results of stability analyses for new cell and dike construction and future dike raises, and presents foundation recommendations for the proposed aeration buildings.

2.0 SITE AND PROJECT DESCRIPTION

2.1 Site Description

The SMI Wastewater Lagoon Facility is located within the RM of Rockwood, and is specifically located within the southeast quadrant of Section 2, Township 13, Range 2 east of the primary meridian (SE2-13-2EPM). The site is bounded by Stony Mountain Institute to the north, King Edward Road to the east, PR 321 to the south, and Highway 7 to the west. At the time of the geotechnical investigation, the site was occupied by four existing cells as illustrated in Figure 1.

Based on review of the topography provided by JRCC and the test hole elevations collected by AMEC, prairie level undulated gently between approximate elevations 233 m and 234 m. The cells of particular interest to the proposed upgrades are the SMI Primary cell and SMI secondary cell, each constructed to an existing nominal cell floor elevation of 232.5 m and existing top of dike nominal elevation of 235.0 m.

2.2 Proposed Development

Based on information provided by JRCC AMEC understood the proposed SMI upgrade would include the following new construction and modifications, as illustrated in Figure 1:

- New primary cell 1 (~75 by 50 m by 3 to 4 m deep) at the northeast corner of the existing SMI primary cell, with a cell floor elevation of 232.0 m; a top of dike elevation of 237.0 m; and a normal operating liquid level of 236.0 m.

- New primary cell 2 (~200 by 100 m by 3 to 4 m deep) along the east perimeter of the existing SMI primary cell, with a cell floor elevation of 232.0 m; a top of dike elevation of 237.0 m; and a normal operating liquid level of 236.0 m.
- New storage cell 3 (bottom area of ~100,000 m^2) at southeast corner of existing facility, bordering the east and south perimeters of the existing SMI secondary cell, with a cell floor elevation of 232.5 m, a top of dike elevation 236.0 m; and a normal operating liquid level of 235.0 m.
- A new aeration building adjacent to the new primary cell; and
- Possible future raising of perimeter dikes of existing cells and raising of water over top of existing internal dikes.

With respect to construction of the new cells, AMEC understood that lagoon construction was being directed at excavating to the proposed cell floor elevations, and re-using the excavated material for construction of the dikes. Given anticipation of silt at and extending up to between 1.2 m and 2.2 m below the proposed cell floor elevations, AMEC understood that the clay component of the dikes would be keyed into the highly plastic clay underlying the silt to provide containment meeting Manitoba Environment Regulations. In this regard, AMEC understood that the cell floor liner would comprise an in-situ liner composed of the highly plastic clay underlying the silt, and that containment through the silt would be provided by a clay keyway and/or cutoff wall. The location of the clay keyway or cutoff wall were not outlined in the sections provided by JRCC; and in this regard, AMEC assumed the new dikes would be keyed through the silt layer and into the underlying highly plastic clay between the toe of the existing dikes and the toe of the new slopes.

AMEC understood that the aeration building will be a pre-engineered steel building constructed with a structural slab foundation. The building dimensions will be approximately 21.3 m x 15.6 m. The building will include 2 concrete pumping chambers approximately 3 m below the slab. The building will be constructed on the perimeter dike, and accordingly will be underlain by 2 m to 3 m of fill. Foundation loads were not provided.

3.0 EXISTING INFORMATION

The following relevant information was provided by JRCC and reviewed by AMEC for use in developing an overview of the site, as well as to supplement the scope of work and geotechnical information obtained by AMEC in this investigation:

- 2011 Test Hole Logs 1 through 21, J.R. Cousin Consultants Ltd., dated 5 October 2011.
- 2010 Test Hole Logs 1 through 8, J.R. Cousin Consultants Ltd., dated 4 March 2010.
- 2010 Test Hole Logs TH10-01 through TH10-10, Trek Geotechnical, dated 20 and 21 December, 2010.
- NTL Soils Test Report, National Testing Laboratories, 10 November, 2011.
- Hydrogeological Assessment – Stony Mountain Institute – Wastewater Lagoon Facility, Friesen Drillers Ltd., Revision date 16 April 2010.

4.0 GEOTECHNICAL INVESTIGATION PROGRAM

Prior to initiating drilling, AMEC notified public utility providers (i.e. Manitoba Hydro, MTS, RM of Rockwood, etc.) of the intent to drill in order to clear public utilities, and where required, met with said representatives on-site.

On 13 and 14 February 2014, AMEC supervised the drilling of a total of nine test holes at the approximate locations illustrated in Figure 1. The holes were drilled using a track mounted Acker drill rig equipped with 125 mm diameter solid stem augers; operated by Maple Leaf Drilling Ltd. of Winnipeg, Manitoba. The number and depth of the test holes was in keeping with the scope of work outlined in AMEC Proposal 2014.020.

During drilling, AMEC field personnel visually classified the soil stratigraphy within the boreholes in accordance with the Modified Unified Soil Classification System (MUSCS); as well as noted any observed seepage and/or sloughing conditions. Disturbed grab samples were collected at selected depths from the auger cuttings, while relatively undisturbed Shelby tube samples were also collected at selected test holes and selected depths. The in-situ relative consistency of cohesive overburden was evaluated within the test holes using pocket penetrometer readings. The recorded pocket penetrometer readings are shown on the logs.

Upon completion of drilling, the depth to slough and groundwater level within each test hole was obtained after an elapsed time of about 10 minutes. Subsequently, the test holes were backfilled with bentonite to a minimum of 3 m below grade, with the remainder of the test hole backfill with auger cuttings to grade.

All samples collected were sealed in the field and shipped to AMEC's Winnipeg laboratory for review by the project engineer and testing. A laboratory testing program was conducted on selected soil samples obtained from the test holes. The laboratory testing program consisted of moisture content determinations, three Atterberg Limits, two Particle Size Analyses by Hydrometer method, and two unconfined compressive strength tests.

Detailed test hole logs summarizing the sampling, field testing, laboratory test results, and subsurface conditions encountered at the test hole locations are presented in Appendix A. Actual depths noted on the test hole logs may vary by ± 0.3 m from those recorded due to the method by which the soil cuttings are returned to the surface. Summaries of the terms and symbols used on the test hole log and of the Modified Unified Soil Classification System are also presented in Appendix A.

5.0 SUBSURFACE CONDITIONS

5.1 Stratigraphy

Consistent with the regional geology and anticipated conditions, the stratigraphy at the test hole locations consisted of the following, in descending order from grade level:

- Topsoil
- Upper Weathered clay or clay fill
- Silt
- Lower High Plastic Clay

Brief descriptions of each of the soil layers bulleted above is presented below: For detailed descriptions, the test hole logs in Appendix A should be consulted.

Topsoil

Topsoil was encountered at the surface of each of AMEC's test holes, and ranged in thickness from 75 mm at the crest of the east dike of the existing SMI Primary Cell (TH05 and TH05A) to 600 mm below prairie surface at TH06. The topsoil was generally described as low plastic with some clay to clayey, frozen, and black.

Upper Weathered Clay or Clay Fill

Clay fill was encountered beneath the topsoil at TH05 and TH05A, along the existing dike, and extended to about 1.8 m below grade, or elevation 233.3 m. The clay fill was described as silty with some sand and trace gravel, medium plastic, frozen, damp when thawed, dark brown, and contained occasional limestone, silt, and sand inclusions. A single in-situ moisture content of about 24 percent was obtained on a thawed sample collected from about 1.5 m below grade.

Weathered clay was encountered beneath topsoil at each of the test holes advanced outside the footprint of the existing lagoons, as well as below the clay fill at TH05 and TH05A. The weathered clay was generally described as silty with trace sand, medium to high plastic, frozen, brown, and contained frequent silt and sand lenses. In-situ moisture contents within the clay ranged from about 13 percent to 33 percent, with results predominantly between 20 and 25 percent. Atterberg limits completed on three samples from TH02, TH04, and TH08 indicated liquid limits ranging from 34 percent to 65 percent, and plastic limits ranging from 16 percent to 24 percent (CI to CH). Particle size analyses completed by AMEC on two of the same clay samples (Th02 and TH04) indicated gravel, sand, silt, and clay (<0.002 mm) fractions of 0 percent, 2.0 to 4.0 percent, 30.1 to 42.7 percent, and 55.3 to 65.9 percent, respectively.

Review of one particle size analysis completed by NTL on a sample of the upper clay collected in 2011 by JRCC at their Test Hole 9 indicated gravel, sand, silt, and clay (<0.002 mm) fractions of 0 percent, 2.0 percent, 45.1 percent, and 52.9 percent, respectively. A liquid limit of 53 percent and a plastic limit of 18 percent were observed on the same sample (CH).

Silt

Consistent with historical drill records at the site and typical soil conditions in the region, shallow silt was encountered beneath the weathered clay at all test holes advanced outside of the footprint and dikes of the existing SMI lagoons. Specific to AMEC's test holes only, the silt was encountered between approximate elevations 230.8 to 232.5 m (i.e. 1.2 m to 3.0 m below grade), and extended to between approximate elevations 230.2 m and 231.3 m. The findings are consistent with JRCC's 2011 test hole findings which; with the exception of a single elevated encounter at 234.1 m; indicated silt was encountered between approximate elevations 231.8 to 232.8 m and extended to between approximate elevation 230.2 m and 231.6 m.

Unexpectedly, a thin layer of silt was also encountered at TH05 and TH05A advanced through the east dike of existing SMI cell #1. Specifically, the silt was encountered at approximate elevation 232.1 m and extended to approximate elevation 231.1 m.

The silt at all locations was generally described as clayey to some clay with trace sand, low plastic, wet, soft, and light brown. In-situ moisture contents within the silt ranged from about 21 percent to 27 percent. Review of one particle size analysis completed by NTL on a sample of the silt collected in 2011 by JRCC at their Test Hole 12 indicated gravel, sand, silt, and clay (<0.002 mm) fractions of 0 percent, 12.9 percent, 70.7 percent, and 16.4 percent, respectively. A liquid limit of 23 percent and a plastic limit of 16 percent were observed on the same sample (CL-ML).

Clay

Consistent with historical drill records at the site and typical soil conditions in the region, highly plastic clay was encountered beneath the shallow silt layer at all test hole locations between approximate elevations 230.2 m and 231.3 m; and extended to the prescribed termination depths of 6 m to 10 m below surface achieved between elevations 222.9 m and 228.4 m. The clay was silty, highly plastic, moist increasing to very moist to wet with depth, very stiff to firm at the silt/clay interface and softening with depth, and brown. In-situ moisture contents within the clay ranged from about 36 percent to 58 percent. Unconfined compressive strength tests were completed on two Shelby tube samples collected from TH01; the results of which are summarized in Table 1.

Table 1: Summary of Unconfined Compressive Strength Tests

Test Hole	Depth (m)	Elev. (m)	UCS (kPa)	£NMM=EBF	Bulk Density (kg/m^3)	Moisture Content (%)
TH01	4.6 – 5.2	229.3 – 228.7	78	3.6	1685	58
TH01	7.6 – 8.2	226.3 – 225.7	42	9.0	1814	46

Review of particle size analyses completed by NTL on two samples of the highly plastic clay underlying the silt collected in 2011 by JRCC at their Test Hole location 9 and 12 indicated gravel, sand, silt, and clay (<0.002 mm) fractions of 0 percent, 0.2 to 0.4 percent, 24.6 to 30.0

percent, and 66.9 to 75.2 percent, respectively. Liquid limits of 86 to 89 percent and plastic limits of 22 to 29 percent were observed on the same samples (CH).

5.2 Groundwater and Sloughing Conditions

Seepage and sloughing conditions were noted during drilling, and the depth to the accumulated water level within the test hole was measured about ten minutes after drilling at each test hole location. Installation of wells for long term monitoring of groundwater levels was not within the AMEC's scope of work.

Sloughing of the wet silt layer during drilling was observed at all test hole locations with the exception of TH04, TH05A, and TH08. Slight seepage from the wet silt layer during drilling was only observed at TH07 and TH08; however, inspection of all silt samples indicated wet silt susceptible to seepage and slow release of porewater. The depths to slough and groundwater noted upon auger drilling completion are summarized in Table 2.

Table 2: Slough and Groundwater Levels Upon Drilling Completion

Test hole	Test hole Elev. (m)	Termination Depth (m)	Depth to Slough (m)	Depth to Groundwater (m)
TH01	233.9	10.7	7.0	7.0 (El. 226.9)
TH02	234.0	6.1	4.3	4.3 (El. 229.7)
TH03	233.6	10.7	4.3	4.3 (El. 229.3)
TH04	233.7	6.6	No appreciable slough	No appreciable groundwater
TH05	235.1	4.6*	n/a	n/a
TH05A	235.1	6.7	No appreciable slough	No appreciable groundwater
TH06	233.3	6.1	4.9	4.9 (El. 228.4)
TH07	233.2	6.7	6.4	6.4 (El. 226.5)
TH08	233.2	6.1	No appreciable slough	No appreciable groundwater

* Groundwater level inferred level with slough.

It should be noted that only short-term seepage and sloughing conditions were observed and that groundwater levels can fluctuate annually, seasonally, or as a result of construction activity. Review of groundwater levels measured by JRCC in 2010 indicated groundwater accumulation to between elevations 228.0 m and 232.3 m in open boreholes over a period of 3.5 hours to 6 hours. These groundwater levels correlated well with silt layer elevations.

Overall, groundwater levels within the open boreholes at the site are expected to be governed by seepage from the lagoon and perched groundwater within the silt layer. AMEC recommends that the groundwater table be assumed at the top of the silt layer for design and construction considerations.

6.0 GEOTECHNICAL RECOMMENDATIONS

6.1 General Evaluation

The stratigraphy and soil conditions encountered within the test holes advanced at the site are considered typical of conditions within the Stony Mountain region. From a foundations perspective for the aeration building, soil conditions are considered suitable for the use of a variety of pile foundation alternatives including bored cast-in-place (CIP) concrete friction piles, driven steel piles, or driven pre-cast pre-stressed concrete piles (PPCPs). Selection of which pile foundation alternative to employ will depend on foundation loads, allocation of construction and performance risks, and cost estimates. Based on till not having been encountered within 10 m of grade, AMEC anticipated that cast-in-place concrete friction piles would comprise the preferred foundation alternative. In this regard, foundation recommendations presented in this report have been limited to bored CIP concrete friction piles. Recommendations for alternate pile types can be provided upon request.

With respect to common fill and re-use of common fill as dike and liner material, the upper weathered clay is considered suitable for re-use, however, blending of the material is recommended to remove the sand and silt lenses frequently observed. The shallow low plastic silt is considered unsuitable for use as low permeable liner material, or as a construction material in general. Based on average prairie level and top of silt elevation of 233.5 and 231.8 m respectively, and an average topsoil thickness of 0.4 m across the site, the quantity of medium to high plastic clay in the footprint of the proposed new cells is estimated to be in the range of 1.1 m to 1.3 m per square meter of footprint. Review of historical investigation at the site indicated that additional quantities of suitable clay exist within the site west of the RM of Rockwood cells, as well as at depths below the cell floor elevations.

The following sections provide discussion and recommendations as they pertain to: borrow material for lagoon construction; dike stability; bored concrete friction piles; downdrag and dragload on foundation extending through fill; frost design considerations; and foundation concrete.

6.2 Temporary Excavations

AMEC anticipates that temporary excavations will be required for construction of clay cutoff wall and/or keying of new dikes through the shallow silt and into the underlying high plastic clay. Furthermore, temporary excavations will be required for the installation of any pipelines into and out off the lagoon. Based on cell floor elevations of 232.0 m to 232.5 m and silt layer depths to between elevations 230.2 m and 231.3 m, excavation beyond 3 m to 4 m below grade is not expected for construction of the cutoff walls. The depth of the excavation will depend on construction staging, and can be limited by partially or fully excavating the pond area in advanced of the constructing the cutoff wall.

Soils conditions over the depth of the excavation will depend on the starting elevation for the excavation. Assuming initial grading to 0.3 m above the cell floor design elevation (i.e. elevation 232.8 m) prior to excavating the trench for the cutoff walls, AMEC anticipated soil conditions

over the depth of the excavation would consist of 0.3 m to 2.0 m of clay underlain by silt, followed by highly plastic clay anticipated between elevations 230.2 m and 231.6 m. Generally, favourable base conditions are expected for excavations extending in the underlying highly plastic clay soils; however, sloughing and some influx of groundwater could be encountered, and should be anticipated, from the wet silt layer. If encountered, it is anticipated that groundwater seepage could be handled by grading the base of the excavation to temporary sumps from which collected groundwater could be removed by pumping.

As a minimum, all excavations should comply with the requirements of Manitoba Workplace Safety and Health. Excavation works should be undertaken by an experienced contractor and should also be monitored by knowledgeable safety and geotechnical personnel. Workers should not be allowed into open excavations without proper protection and appropriate confined space training.

In accordance with Manitoba Workplace Safety and Health, vertical trench excavations within which works are required to enter are permitted up to a maximum of 1.2 m below grade prior to requiring the use of shoring or other suitable support structure. Where excavations are required to extend to depths greater than 1.2 m below grade, or where instability within the upper 1.2 m of a vertical trench excavation is observed, either a 'Y' type sloped excavation or a trench box supported excavation should be adopted. Given the susceptibility of the wet silt to sloughing, AMEC recommends that the sideslopes of short term excavations extending through silty clay and wet silt layers be cut back to inclinations no steeper than 1H:1V (Horizontal:Vertical). Flatter inclinations may be required particularly where active groundwater seepage is encountered, or where considerable sloughing from the silt is observed.

Construction planning should be directed at minimizing the length of time an excavation is left open and accordingly, work should be completed in small sections. The stability of all excavations should be monitored on an ongoing basis and inspected regularly for signs of instability. If sloughing of the sidewalls is observed, the cut slope angle should be flattened until a stable angle of repose for the soil has been attained. Alternatively, if sloughing of the upper soils somewhere within the excavation depth is an issue, a benched excavation could be maintained at the interface of the unstable and stable soils to allow a collection area for sloughing of the upper soils. Where signs of instability (i.e. tension cracks, sloughing soils, toe bulging, etc) are detected, these conditions should be brought to the immediate attention of AMEC so that appropriate solutions to the problem areas can be determined.

Stockpiles of materials and excavated soil should be placed away from the excavation crest by a minimum distance equal to the depth of excavation. Similarly, wheel loads should be kept back at least 1 m from the crest of the excavation.

Backfill quality requirements and recommendation for placement and compaction for the clay cutoff walls and for construction of the clay keys beneath new dikes are presented in Section 6.3.

Backfill quality requirements for utility trenches should be assessed during design from a standpoint of pipe support, referring to the manufacturer's recommendations for bedding and

compaction below, adjacent and immediately above the pipes. Any requirements for imported trench backfill material should also be established. All trench backfill should be free of excessive organic content and of any deleterious material such as tree roots, litter, silt, etc.

Trench backfill overlying any underground utility installations should be compacted to a minimum 95 percent of SPMDD within landscaped areas and to a minimum of 98 percent of SPMMD within areas providing bearing support (such as for overlying dike fill) at soil moisture contents near or slightly above (i.e. 0 to + 2 percent) the OMC to minimize potential for fill settlement. More stringent backfill criteria may be required for pipe support, and the pipe manufacturers specifications should be referenced in this regard.

6.3 Lagoon Construction Recommendations

6.3.1 Borrow Material

AMEC envisaged and understood that common fill resulting from excavation of the new cells would be used to construct the cutoff wall and the clay core of the dikes. Based on soil conditions observed at the borehole locations, common fill from the lagoon excavations will consist of silty clay with frequent silt and sand lenses, underlain by shallow wet silt.

For evaluation purposes, 'suitable' borrow for liner construction is defined as material that is both 'satisfactory' from a design performance requirement, and of 'favourable' constructability (i.e. material handling, placement, and workability).

In accordance with regulations for lagoon design and operation set forth by Manitoba Environment, 'satisfactory' core and liner materials for wastewater facilities shall be capable of meeting or exceeding a hydraulic conductivity criterion of $1x10^{-7}$ cm/s. The ability of materials encountered at the site to meet this performance requirement was assessed based on correlation of material index properties (i.e. Atterberg Limit and Particle Size Analysis) to anticipated hydraulic conductivity results. Hydraulic conductivity results from existing information were also referenced.

Recognizing that borrow materials can be wetted and/or dried to achieve the desired moisture content for placement and compaction, borrow material is sometimes not evaluated as unsuitable solely on the basis of excessive moisture content. Notwithstanding however, at some point above or below optimum moisture content, the effort it requires to moisture condition excessively dry or wet soils becomes impractical and uneconomical. In this regard, the favourability of borrow material was evaluated on the basis of constructability indicated by the liquidity index (LI) of the test samples given by the following expression:

$$LI = \frac{w - PL}{LL - PL}$$

Where: w = in-situ gravimetric moisture content (%)
PL = Plastic Limit (%)
LL = Liquid Limit (%)

The constructability of the material was characterized using the criteria in Table 3.

Table 3: Constructability Evaluation Criteria

Liquidity Index	Constructability Qualification
LI < 0.0	Marginal, Dry
0.0 <= LI <= 0.1	Suitable, Dry of OMC
0.1 <= LI < 0.2	Preferred, Near OMC
0.2 to 0.3	Suitable, Slightly Wet of OMC
0.3 <= LI < 0.5	Marginal, Very Moist
0.5 <= LI	Unsuitable, Wet

In-situ moisture content results, Atterberg Limit results, and the resulting characterization of constructability based on the liquidly index for each of the test samples are summarized in Table 4. National Laboratories Testing Ltd. results on samples obtained from JRCC's 2011 test holes are also included although it should be appreciated that considerable changes to moisture conditions can occur over a few years at shallow depths.

Table 4: Atterberg Limit Results and Estimated Optimum Moisture Contents

Sample ID and Depth	In-situ Moisture Content (%)	Liquid Limit	Plastic Limit	Liquidity Index	Constructability of in-situ Moisture Condition	Hydraulic Conductivity* (cm/sec)
TH02, 1.5 ft	± 24	53	20	0.12	Preferred, Near OMC	n/a
TH04, 6.5 ft	29.4	65	24	0.14	Preferred, Near OMC	n/a
TH08, 4.5 ft	16.9	34	16	0.05	Usable, Dry	n/a
JRCC 2011-TH09, 0.3-1.2 m	23.4	53	18	0.15	Preferred, Near OMC	n/a
JRCC 2011-TH09, 2.4-6.1 m	42.3	89	29	0.22	Suitable, Slightly Wet of OMC	n/a
JRCC 2011-TH12, 0.3-1.7 m	16.7	23	16	0.10	* material unsuitable for performance criterion	5.7×10^{-5} cm/s
JRCC 2011-TH12, 1.9-6.1 m	51.7	86	22	0.46	Marginal, Very Moist	4.8×10^{-9} cm/s

* As completed on Shelby Tube Samples and reported by National Testing Laboratories, NTL Soils Test Report, 10 November, 2011

Based on evaluation of the results, 'suitable' clay borrow meeting both the performance criterion and of preferred or 'favourable' constructability based on in-situ moisture conditions and liquidity index is anticipated between average elevations 233.5 m and 231.7 m. Contrarily, the shallow

silt underlying the clay to between approximate elevation 230.2 m and 231.6 m is unsuitable from both the ability of the material to meet the performance criteria and material constructability, and in this regard, excavated silts should be carefully separated from suitable clay and wasted or stockpiled on site for alternate re-use. The highly plastic clay below the silt above elevation 229.5 m is also considered 'suitable' clay borrow meeting both the performance criterion and of preferred or 'favourable' constructability based on in-situ moisture conditions. Below elevation 229.5 m, higher moisture conditions are more likely to be result in liquidity indexes of 0.5 or greater thereby necessitating 'unfavourable' levels of material conditioning (i.e. scarification, disking, drying and blending).

Regarding drying, moisture contents can be reduced by as much as 3 to 5 percent in a day during optimum drying conditions, generally by excavating, spreading and disking. An alternative measure may be to blend clay with higher than optimum moisture contents with drier material. Some of the clay borrow above the silt layer may have moisture contents considerably below the optimum moisture condition and these materials could be separated during borrow excavation to be used for blending with wetter materials as needed.

6.3.2 General Subgrade Preparation and Dike Construction

AMEC understood that seepage between the cells is not an issue, and in this regard, cutoff walls are not required between existing cells. The following is a list of general geotechnical recommendations for lagoon construction, construction of new dikes, and construction of the cutoff wall beneath the new perimeter dykes. The location of the clay cutoff walls were not outlined in the sections provided by JRCC; and in this regard, AMEC assumed the cutoff walls would be completed beneath the approximate centreline of the new perimeter dikes.

1. All topsoil/organic clay should be stripped from within the footprint of new dykes. Organics can be stockpiled and used for vegetation of the exterior dike slopes.
2. AMEC understands that JRCC proposes to excavate to the pond floor elevation, and that all existing soils (i.e. silt) at the pond floor elevation and beneath the footprint of the berm will be left in place. Potential seepage through unsuitable soils at the pond floor level will be addressed with a clay cutoff wall extending through unsuitable soils and into suitable clay below.
3. Although AMEC understood that the silt layer would be left in place within the area of the cell floor, AMEC recommends consideration be given to subexcavation of the silt beneath the footprint of new dikes. Generally, wet silt such as that encountered at the site provides for unfavourable subgrade conditions for placement and compaction of overlying dike fill.
4. Excavation to the cell floor elevations should maintain the existing sidelopes of adjacent existing dikes (i.e. at slopes of 4H:1V). Suitable excavated materials should be set aside and used as required. The suitable materials, consisting of medium to high plastic clay, should be separated into separate stockpiles and used for cut-off wall construction. Geotechnical personnel should be present at all times during

borrow and placement to monitor the selection of suitable soils. Any poor quality materials such as wet silt, cobbles, boulders or tree roots; should be wasted.

5. Recommendations for temporary excavation of the key/cutoff wall are provided in Section 6.2.
6. The clay subgrade at the base of the trenches for the cutoff walls should be scarified and compacted to a minimum of 95% of the standard Proctor maximum dry density (SPMDD - ASTM Method D-698). The fill used to construct the cutoff wall should consist of 'suitable' medium to high plastic clay placed in lifts that are compatible with the compaction equipment used, but typically using uniform compacted lifts 200 mm in thickness, and uniformly compacted to a minimum 95 percent of SPMDD. The ability of compaction equipment to uniformly compact lifts over 200 mm thick should be confirmed with a test strip program. All material must be placed at moisture contents ranging from zero percent to 5 percent wet of optimum moisture content.
7. Clay subgrade and clay fill should be protected from frost and drying effects during construction and at all times prior to commissioning.
8. The dike crest should be wide enough to permit service vehicles to access the cell (3.0 to 4.0 m wide, minimum).
9. Perimeter dikes should be finished by using topsoil and seeding to mitigate erosion.

6.4 Dike Stability

6.4.1 Methodology

AMEC completed a series of slope stability analyses to assess dike slope requirements. The analyses were conducted using SLOPE/W, a limit equilibrium software package developed by Geo-Slope International.

Three slope cross-sections (Cross-Section 1, Cross-Section 2, and Cross-Section 3) illustrating the generalized soil stratigraphy and range of existing slope profiles and geometry at the site are illustrated in Figure 2 through Figure 4. The cross-sections were developed from three design sections of the proposed SMI Lagoon upgrades by JRCC, which presented AMEC with key information on existing and new cell floor elevations, dike crest elevations, maximum liquid levels, and preliminary slope configurations.

The generalized soil stratigraphy for the models was developed through interpolation of soil conditions and average elevations of each soil layer within AMEC's test holes as well as JRCC's 2011 test holes. With the exception of medium to high plastic clay used to construct the core of new perimeter berms and cutoff walls through shallow silt into suitable underlying clays, AMEC understood that fill used to construct the dikes would consist of common fill comprised of a mix of silt and clay. However, to simplify modelling, the stability of new slopes were conservatively modelled using clay strength parameters. Drained and undrained soil properties for the slope stability analyses were selected based on AMEC's previous experience with the soils in the vicinity of the site, and are summarized in Table 5. The selected values are considered to be representative of the soil types expected.

Table 5: Material Properties for Slope Stability Analyses

Material	Unit Weight (kN/m^3)	Drained Condition		Undrained Condition	
		Cohesion (kPa)	Internal friction angle (degrees)	Cohesion (kPa)	Internal friction angle (degrees)
Rip-Rap	22	0	40	0	40[1]
Dike Clay Fill	17	3	20	3[3]	20[1,3]
Silt	18	0	20	0	20[1]
Clay above Elev. 228.5 m	16.5	3	16	3	16[1]
Clay Below Elev. 228.5 m	17.5	3	16	$0.22\ \sigma'_v \geq 20$	0[2]

1. Dilative volume change in shear
2. Contractive volume change in shear
3. Cohesion of 13 kPa and friction angle of 0 degrees assumed for Cross-Section 3, excavation only.

Groundwater conditions for each of the design conditions were selected in accordance with AMEC's understanding of pond level during operation. Seepage analyses were completed using SEEP/W to estimate groundwater conditions within the berms for drawdown conditions, the results of which were imported into the Slope/W analyses.

In reviewing the cross-sections developed by AMEC, it is noted that AMEC has left the silt layer in place beneath existing dikes (i.e. Cross-Section 1). This was done on the basis of silt encountered beneath the dike at TH05. Although AMEC understood that subexcavation of the silt layer would not be completed beneath the footprint of new berms, the stratigraphy in AMEC's slope/W models have assumed subexcavation of the silt and replacement with low permeability clay beneath the entire footprint of the new berms. The replacement of the silt layer with clay in the model has been done such that seepage analysis and estimation of groundwater conditions within the berm during drawdown events does not rely on drainage through a silt layer that may not be present at all locations. Sensitivity analyses indicated that where silt layers remain beneath the berms, drainage into the silt layer lowers the groundwater table within the berms leading to slightly higher slope stability estimates (i.e. 1.4 versus 1.3 for Cross-Section 1 and drawdown of the new cell).

Excluding impacts of drainage on estimated groundwater levels through the berm for drawdown scenarios, the assumption of clay fill versus silt has little impact on the stability of the critical slip surfaces illustrated in this report given the strength of the clay fill versus that of the silt differs only by a cohesion of 3 kPa

With respect to factors of safety, a target factor of safety of 1.4 to 1.5 is considered appropriate for long term slope stability for both interior and exterior pond/dike slopes under the normal operating condition. A target factor of safety of 1.2 to 1.3 is considered appropriate for short term slope stability for both interior and exterior pond/dike slopes under the construction and extreme operating conditions. Five pond level and groundwater conditions were considered for

the purpose of evaluating the stability of slopes from construction through long term operations, and are summarized as follows:

1. Construction Condition – Excavation
2. Normal Operating Condition – Interior Dikes
3. Normal Operating Condition – Exterior Perimeter Dikes
4. Extreme Operating Condition – Interior Dikes
5. Extreme Operating Condition – Exterior Dikes

1. Construction Condition – The construction condition was developed to represent excavation adjacent to the existing cells for the dike raises and new cell construction. Specifically, sub-excavation to the pond floor level was assumed for the new cells, and it was assumed that the existing cells would remain full at the existing maximum liquid level. The worst case construction condition for the new cells inherently consists of excavation adjacent to the existing dikes as opposed to excavation of the perimeter dikes. In this regard, slope stability modelling results presented here-in for the excavation condition for the new cells (Cross-Section 1 and Cross Section 2) are limited to two interior dike configurations, and are presented in Figure 2 and Figure 3.

The construction condition for cross-section 3 (Figure 4) consisted of excavation along the exterior north perimeter of the existing SMI Cell for construction of a clay cutoff wall through the underlying silt layer. The configuration shown assumed a 1H:1V excavation commencing slightly downslope of the toe of the existing dike.

2. Normal Operating Condition – Interior Dikes – The normal operating condition for interior dikes between two cells was developed to represent final construction and operation of the adjacent ponds at maximum liquid levels given by 1 m below crest elevation. Steady state seepage analyses were completed to determine normal groundwater conditions through the dike.

3. Normal Operating Condition – Exterior Perimeter Dikes – The normal operating condition for dikes along the exterior perimeter of the new cells was developed to represent final construction and operation of the ponds at maximum liquid level given by 1 m below crest elevation. Steady state conditions were assumed to represent long term normal groundwater conditions through the dike. Given the critical potential slip surfaces for the interior dikes originate at the crest of the dike and exit at the toe of the interior slope, and given the interior slope configuration for perimeter dikes is expected to be identical to the interior dikes, the critical potential slip surface for perimeter dikes is inherently the same as for interior dikes, or better. In this regard, slope stability analysis results for perimeter dikes may be taken as shown for interior dikes.

4. Extreme Operating Condition – Interior Dikes – The extreme operating condition for interior dikes was developed to represent dewatering of one of the ponds as may be required for cell maintenance while maintaining operation of the adjacent pond. Given assumption of rapid drawdown and clay slopes, undrained conditions are expected to develop over the short term

(i.e. where the dewatering rate is faster than the permeability of the dike material), and in this regard, undrained shear strength parameters were used to evaluate temporary stability. Transient seepage analyses were also completed to estimate groundwater drawdown through the dikes with time, and long term stability analysis for the drawdown condition were also completed using drained soil strength parameters and equilibrated steady state porewater pressures.

5. Extreme Operating Condition – Perimeter Dikes – The extreme operating condition for exterior dikes was developed to represent dewatering of the pond as may be required for cell maintenance. However, given the critical potential slip surfaces for the interior dikes originate at the crest of the dike and exit at the toe of the interior slope, and given the interior slope configuration for perimeter dikes is expected to be identical to the slope configuration for the interior dikes, the critical potential slip surface for exterior perimeter dikes is inherently the same as for interior dikes. In this regard, slope stability analysis results for perimeter dikes may be taken as shown for interior dikes.

6.4.2 Stability of Existing Dikes – Construction Condition

The construction condition is described in Section 6.4.1, and was evaluated for Cross-Sections 1 and Cross-Section 2 considering excavation of the cells adjacent to the existing dikes. As previously discussed, the existing dikes extend above prairie level and in this regard, the worst case construction condition inherently consists of excavation adjacent to the existing dikes. Stability analyses for the excavation condition were completed using drained soil parameters.

Results for cross-section 1 presented in Figure 2-A indicated a factor of safety of about 1.3 against deep seated failure of the east dike of the existing SMI primary cell (i.e. failures originating at or upslope of the internal crest of the pond and exiting at or beyond the toe of the slope and into the pond bottom) upon excavation to elevation 231.2 m (i.e. the base of the silt layer) for the adjacent new Aeration Cell 2.

Results for cross-section 2 presented in Figure 3-A indicated a factor of safety of 1.2 against deep seated failure of the east dike of existing SMI secondary cell upon excavation to elevation 231.2 m (i.e. the base of the silt layer) for the adjacent new Storage Cell 3.

Results for cross-section 3 presented in Figure 4-A indicated a factor of safety of 1.3 against deep seated failure of the north dike of the existing SMI primary cell (i.e. failures originating at or upslope of the internal crest of the pond and exiting at or beyond the toe of the slope and into the excavation). Notwithstanding, additional analyses of the excavation assuming drained soil strength parameters indicated a reduction in the factor of safety of the 1H:1V excavation slopes to about 1.1. In this regard, excavation for construction of the clay key should be staged to limit the duration of the excavation.

6.4.3 Stability of New and Raised Dikes – Normal Operation

The normal operating condition is described in Section 6.4.1, and was evaluated for raising of the SMI primary and SMI secondary cells for cross-sections 1, 2, and 3. Stability analyses for normal operating conditions were completed using drained soil parameters.

Results for cross-section 1 presented in Figure 2-B indicated a factor of safety of 2.4 against deep seated failure of the east dike of existing SMI primary cell under normal 'steady-state' operating conditions defined by maximum liquid level maintained in both ponds. As exterior dikes for the new aeration cells will similarly be constructed to a crest elevation of 237.0 m, and given pore pressures through exterior dikes will be lower than those for interior dikes, the factor of safety for the interior face of perimeter dikes under normal 'steady-state' operating conditions will be equal to or greater than the stability of the interior dike.

Results for cross-section 2 presented in Figure 3-B indicated a factor of safety of 2.2 against deep seated failure of the east and south dike of existing SMI secondary cell under normal 'steady-state' operating conditions defined by maximum liquid level maintained in both ponds. As exterior dikes for the new storage cell will similarly be constructed to a crest elevation of 236.0 m, and given porepressures through exterior dikes will be lower than those for interior dikes, the factor of safety for the interior face of perimeter dikes under normal 'steady-state' operating conditions will be equal to or greater than the stability of the interior dike.

Results for cross-section 3 presented in Figure 4-B indicated a factor of safety of 1.6 against deep seated failure of the exterior face of the north dike of existing SMI primary cell under normal 'steady-state' operating conditions defined by maximum liquid level maintained in the existing SMI storage cell 1. Similarly, results for cross-section 3 presented in Figure 4-C indicated a factor of safety of 2.4 against deep seated failure of the interior face of the north dike of existing SMI primary cell under normal 'steady-state' operating conditions defined by maximum liquid level maintained in the existing SMI storage cell 1.

As can be seen from the results presented above, the proposed slope configurations meet the minimum recommended factor of safety of 1.4 to 1.5 under normal 'steady' operating conditions.

6.4.4 Stability of New and Raised Dikes – Extreme Operation

The extreme condition is described in Section 6.4.1, and was evaluated for dewatering of each of the new cells and the existing cells assuming the adjacent cell remains in operation at maximum liquid level. Stability analyses for rapid drawdown were completed for two soil stress and porewater cases as follows:

Case 1. Stability analysis completed using undrained soil strength parameters and a dewatered pond while maintaining porewater pressures and effective soil stresses consistent with long term operation of both ponds prior to dewatering (i.e. instantaneous dewatering); and

Case 2. Stability analysis completed using drained soil strength parameters and equilibrated steady state porewater pressures and soil stresses (i.e. sustained dewatering).

5.5H:1V Aeration Cell Slopes – Cross-Section 1

For the extreme condition defined by maximum liquid level maintained in the new Aeration Cell and rapid dewatering of the existing SMI Cell, results for cross-section 1 indicated a factor of

safety of 1.6 for Case 1 and 1.6 for Case 2 against deep seated failure of the east dike of existing SMI primary cell. Results for Case 2 are illustrated in Figure 2-C. For the extreme condition defined by maximum liquid level maintained in the existing SMI cell and rapid dewatering of the new Aeration Cell, results presented in Figure 2-D indicated a factor of safety of 2.0 for Case 1 and 1.3 for Case 2 against deep seated failure of the new dike raise. Results for Case 2 are illustrated in Figure 2-D.

4H:1V New Storage Cell 3 Slopes – Cross-Section 2

For the extreme condition defined by maximum liquid level maintained in the new Storage Cell and rapid dewatering of the existing SMI storage Cell, results for cross-section 2 indicated a factor of safety of 1.8 for Case 1 and 1.4 for Case 2 against deep seated failure of the east dike of existing SMI primary cell. Results for Case 2 are illustrated in Figure 3-C. For the extreme condition defined by maximum liquid level maintained in the existing SMI cell and rapid dewatering of the new Aeration Cell, results presented in Figure 2-D indicated a factor of safety of 2.0 for Case 1 and 1.2 for Case 2 against deep seated failure of the new dike raise. Results for Case 2 are illustrated in Figure 3-D.

4H:1V Slopes for Raising of Existing SMI Cell Perimeter Dikes – Cross-Section 3

For the extreme condition defined by rapid dewatering of the existing SMI storage Cell, results for cross-section 3 indicated a factor of safety of 1.7 for both Cases 1 and 2 against deep seated failure of the interior face of the existing SMI primary cell dikes. Results for Case 2 are illustrated in Figure 4-D.

6.4.5 Final Recommended Sideslope Configurations

Based on the slope stability results presented in Sections 6.4.2 through 6.4.4, the following final slope configuration are considered acceptable as meeting recommended factor of safety targets for normal and extreme operating conditions:

- Interior slopes for the new primary (aeration) cells at the northeast corner of the existing SMI primary cell and along the east perimeter of the existing SMI primary cell should be no steeper than 5.5H:1V. This recommendation is applicable to dike raises and new dike construction, and is provided on the basis of a cell floor elevation of 232.0 m; a top of dike elevation of 237.0 m; and a normal operating liquid level of 236.0 m

- Interior slopes for the new Storage Cell 3 at southeast corner of existing facility, bordering the east and south perimeters of the existing SMI secondary cell, should be no steeper than 4H:1V. This recommendation is applicable to dike raises and new dike construction, and is provided on the basis of a cell floor elevation of 232.5 m, a top of dike elevation 236.0 m; and a normal operating liquid level of 235.0 m.

- Exterior slopes for new perimeter dike construction as well as the slopes interior to existing cells for dike raises should be no steeper than 4H:1V.

6.5 Piping of West Berm of Existing Cell

AMEC understood that previous investigations at the site have identified seepage through the west berm of the existing RM of Rockwood cells, and as such, Manitoba Environment has identified a concern to JRCC with respect to ground loss or "piping" through the existing berm following a raise in water level of the existing cells.

AMEC undertook a review of hydraulic gradients through existing and new berms as part of developing groundwater conditions for slope stability modelling for construction of the new cells. In all instances, seepage results indicated hydraulic gradients of less than 0.3 at the toe of the berm slopes. In this regard, the risk of piping of the west berms of the existing RM of Rockwood cells is considered very low, even with an associated raise in the liquid level to 234 m.

6.6 Bored Concrete Piles

6.6.1 Axial Compressive Resistance – Bored Concrete Piles

Bored concrete piles may be designed as friction piles. The unfactored (ultimate) axial compressive resistance of a single, bored concrete pile may be determined using the unfactored unit shaft friction values outlined in Table 6.

Table 6: Unit Shaft Friction for Bored Concrete Friction Piles - ULS

Depth Below Existing Grade[1] (m)	Assumed Soil Type	Unfactored Unit Shaft Friction (kPa)
0 to X	All	0
X to 229	Firm to Stiff Clay	40
229 to 223	Soft to Firm Clay	30

[1] X = 1.5 m below slab/crawlspace grade in heated areas, or the depth of frost penetration in unheated areas, as recommended to account for possible movement of the soil away from the perimeter of the pile.

Based on the *2005 National Building Code of Canada* (NBCC 2005), a geotechnical resistance factor, Φ = 0.4 should be applied to the unfactored geotechnical compressive resistance of the pile to obtain the factored geotechnical resistance at the Ultimate Limit State (ULS) for compressive loading conditions. The following recommendations also apply to the design of bored cast-in-place concrete piles.

- The weight of the embedded portion of the pile may be neglected in the design.
- The pile embedment depth, pile diameter, steel reinforcement and concrete compressive strength should be determined by the structural engineer, as required, to provide sufficient resistance to the applied loads.

- For conventionally bored straight shaft piles, the minimum pile spacing should be at least three pile diameters in order to act as single piles.
- Frost design considerations are outlined in Section 6.8.
- Recommendations for uplift resistance calculations are provided in Section 6.6.2.
- A void space (minimum of 150 mm thick) should be constructed, using a compressible and biodegradable material, below all piles caps and to accommodate movements of the underlying soil.

Recommended procedures for the installation of conventionally bored, cast in-place concrete piles are:

- Wet soil conditions and sloughing of the shallow silt layer were noted during drilling. Should sloughing soil conditions and/or water bearing silt or sand layers be encountered during pile installation, steel casing should be installed in the augered excavations to control caving and groundwater seepage so that piles are cast in clean, dry holes. The level of fresh concrete in the casing must be maintained above the caving or seepage zone as the casing is withdrawn, and should be sufficiently high to equilibrate pressures inside and exterior of the casing to prevent collapse or squeezing of the sidewall into the pile bore.
- All piles should be poured immediately after completion of drilling to reduce the potential for seepage and swelling or squeezing of the pile bore, as well as to mitigate stress relief which could negative impact pile settlement performance. Concrete should be poured in accordance with the latest edition of Canadian Standards Association A23.1 (Concrete Materials and Methods of Concrete Construction). Where required, dewatering of pile test holes should be managed using a bailing bucket or a submersible pump subject to actual field conditions.
- A qualified and experienced inspector should be on site during the entire period of pile installation. The inspector should keep complete and accurate records of the pile installations.

6.6.2 Tensile (Uplift) Resistance – Bored Concrete Piles

In the case of straight shaft friction piles, the uplift resistance of a single pile will be provided by the sustained downward load on the pile (if applicable) and shaft friction along the length of pile embedded below the depth of frost penetration. The unfactored (ultimate) uplift resistance of a friction pile can be determined using the unfactored unit shaft friction values outlined in Table 6.

Based on the *2005 National Building Code of Canada* (NBCC 2005), a geotechnical resistance factor, $\Phi = 0.3$ should be applied to the unfactored geotechnical tensile resistance of the pile to obtain the factored geotechnical resistance at the Ultimate Limit State (ULS) for tensile loading conditions.

6.6.3 Serviceability and Pile Settlement – Bored Concrete Piles

The settlement of a single pile depends on the applied load, strength-deformation properties of the foundation soils, load transfer mechanism, load distribution over the pile embedment depth, and the relative proportions of the load carried by shaft friction and end-bearing. A pile settlement limit value was not specified by the structural agent for use in developing geotechnical resistance limits for the serviceability limit state design criterion. Notwithstanding, assuming good workmanship, inclusive of good excavation, the predicted settlement of a bored friction pile at working loads equal to a maximum given by the factored shaft frictional resistance of the pile is 0.5 to 1.5 percent of the shaft diameter plus the elastic shortening of the pile due to the compressive load acting on the pile.

6.6.4 Lateral Resistance (Single Pile)

Significant horizontal (or lateral) loading conditions requiring evaluation of lateral load resistance of piles is not anticipated. Consequently, recommendations pertaining to the lateral load resistance of piles are not provided here-in.

Where the lateral load capacities or magnitude of movements of piles are critical, it is recommended that the lateral deflections and design capacities of piles or groups of piles be evaluated using Reese's method of p-y curves. This method models the strength-deformation characteristics using load-displacement curves for the various soil strata, and the non-linear behaviour of the soil. With the method of p-y curves, solutions may be obtained through an iterative procedure performed using LPILE Software for single piles, and extended to pile groups by using GROUP Software to analyze the behaviour of piles in a group subjected to both axial and lateral loadings. The analytical procedure provides lateral pile deflections, generated bending moments, shear forces, and the soil reaction computed at close intervals over the depth of the pile. This type of analysis with group action effects could be conducted by AMEC on request.

6.6.5 Pile Group Effects

Generally, piles will behave individually in compression (i.e. Group efficiency $\eta = 1.0$) when a minimum centre-to-centre spacing of 5 pile diameters is provided between adjacent piles, and will behave individually laterally when the center-to-center spacing is greater than 3 diameters in the direction transverse to loading (side-by-side), and greater than 8 diameters in the direction parallel to loading (in-line). However, for circumstances in which piles are closely spaced and/or the piles are connected by a rigid pile cap forcing equal settlement behaviour at the pile heads, interaction between the piles will occur and should be considered in design.

6.7 Downdrag, "Drag Load", and Negative Shaft Friction

Construction of the dikes for the new primary aeration cells will result in fill thicknesses of 2 m to 3 m within and immediately adjacent to the foundation footprint of the proposed aeration building. Given the nature of the soils at the Site, the additional surcharge load imposed by the fill is expected to result in consolidation of the existing highly plastic clays underlying the

proposed dikes. In this regard, the foundation (piles) will be subject to downdrag and/or 'drag load' conditions.

For clarity, the term downdrag refers to the downward settlement of a deep foundation unit due to settlement at the neutral plane of the pile, where the neutral plane may be defined as the point of zero relative movement between the soil and pile at the soil/pile interface. Contrarily, the term 'drag load' refers to the load (or the integration of negative shaft friction above the neutral plane) transferred to a deep foundation unit resulting from the downward movement of soil relative to the pile at the soil/pile interface. The terms are inversely related; that is the 'drag load' is at its maximum when the downdrag is at its minimum, and vice-versa. From a geotechnical perspective, downdrag is a settlement issue, and needs to be considered in evaluating the settlement performance of piles. Contrarily, the 'drag load' is a structural design issue, and needs be considered in evaluating the structural strength of piles.

With respect to 'drag load', the 'drag-load" induced on a pile is given by negative shaft friction integrated over the length of pile above the neutral plane. For cast-in-place concrete friction piles, the neutral plane may be taken as lying at a depth approximately equal to the lower third point of the pile embedment length. The negative shaft friction shall be taken as the unit shaft friction values outlined in Table 6. As per the Canadian Foundation Engineering Manual (CFEM 2006), the resulting 'drag load' is additive to sustained (or permanent) loads only, and need not be included with live loads. In other words, 'drag load' and live load do not act simultaneously. In evaluating the structural strength of the piles, two loading conditions must be considered: a single load scenario consisting of the sum of 'drag load' and sustained loads (i.e. excludes transient live loads); and the load combination scenario of sustained load (excluding 'drag load') and transient live loads.

With respect to downdrag, the downdrag of a pile foundation is given by settlement at the neutral plane. Between the pile head and the neutral plane, settlement of the piled foundation at the pile head is due to axial shortening of the pile. Given AMEC understanding that the piles will extend through 2 to 3 m of new fill placed at the site, primary consolidation of highly plastic clay below the neutral plane could result in additional pile settlement of 50 mm to 100 mm above typical friction pile foundation settlement up to about 2.0 percent of the pile diameter. This evaluation has been presented on the assumption of 9 m long piles, and assumed soil consolidation parameters and changes in effective stress. Changes in effective stress below the neutral plane will depend on final fill configuration, and the location of the neutral plane will depend on foundation configuration and foundation loads. AMEC can review the final foundation configuration for potential downdrag upon request once a foundation configuration has been completed.

With respect to the estimate range of consolidation settlement discussed above, it should be noted that this settlement is long term 'total' consolidation settlement of the clay under the additional surcharge imposed by the fill at the site. In other words, all structures supported within the fill and soil above the neutral plane would also settle with consolidation of the soil beneath the neutral plane.

6.8 Frost Design Considerations

6.8.1 Frost Penetration Depth

The upper stratigraphy at the test hole locations, and across the site, is considered moderately to highly frost susceptible in the presence of water, and as such, frost effects should be considered for foundations or surface structures sensitive to movement. Based on historical temperature data for the Stony Mountain area, a design frost penetration, assuming cohesive soils from ground surface, may be taken as 2.4 m below final grade in unheated areas that will not have regular snow or vegetative ground cover. Where the structure is of sufficient size and where there is beneficial heat loss into the soil from the superstructure and/or foundations, the depth of frost penetration may be reduced along the perimeter of the structure. Alternatively, the depth of frost penetration (and thus frost effects) may potentially be reduced by installing insulation. AMEC can provide recommended insulation details for specific development conditions upon request.

6.8.2 Pile Foundations

Frost forces applied to pile foundations include adfreeze pressures acting along the pile shafts within the depth of frost penetration. If pile caps are used and extend beyond the perimeter of the underlying pile, then frost heave forces acting on the undersides of the pile caps, as well as any connecting supports (i.e. lateral tie between the piles) will also need to be considered.

6.8.2.1. Frost Heave

To reduce the potential of frost heave pressures, a void-forming product should be installed beneath the underside of the pile caps and any other structural element located within the depth of frost penetration. The recommended minimum thickness of the void should be 150 mm. Alternatively, a compressible material may be used in lieu of a void forming material, and the uplift pressures may be taken as the crushing strength of the compressible medium. It is recommended that a frost heave of 150 mm be assumed in determining the required thickness for the void-filler and the associated uplift pressures associated with the thickness used.

The finished grade adjacent to each pile cap or grade beam should be capped with well compacted clay and sloped away so that the surface runoff is not allowed to infiltrate and collect in the void space or in the compressible medium.

6.8.2.2. Adfreeze Stresses

Resistance to adfreeze and frost heave forces will be provided by the sustained vertical loads on the foundation, the buoyant weight of the foundation and dead weight of the structure, and the soil uplift resistance component provided by the length of the pile extending below the depth of frost penetration. In the case of straight shaft piles supporting lightly–loaded unheated facilities, the piles should be embedded a minimum of 9 m below final grade in order to provide sufficient frictional resistance against potential adfreeze stresses. For heated structures which allow beneficial heat loss into the soil, minimum pile lengths of 6 m are recommended. Where

piles for heated structures are exposed to unheated conditions during construction, they should be designed for the unheated condition.

Adfreeze stresses along the sides of pile caps and buried substructures can be reduced by the installation of a 'bond-break' or 'friction reducer' within the zone of frost penetration. Friction reducers could consist of a system of poly wrapped sono-tubes. A smooth geosynthetic liner material, fixed to the shaft of the pile or to the sides of the pile cap would also be a suitable bond-break.

6.9 Foundation Concrete

Where concrete elements outlined in this report and all other concrete in contact with the local soil will be subjected in service to weathering, sulphate attack, a corrosive environment, or saturated conditions, the concrete should be designed, specified, and constructed in accordance with concrete exposure classifications outlined in the latest edition of CSA standard A23.1, Concrete Materials and Methods of Concrete Construction. In addition, all concrete must be supplied in accordance with current Manitoba and National Building Code requirements.

Based on significant data gathered through previous work in the Winnipeg area, water soluble sulphate concentrations in the soil are typically in the range of 0.2% to 2.0%. As such, the degree of sulphate exposure at the site may be considered as 'severe' in accordance with current CSA standards, and the use of sulphate resistance cement (Type HS or HSb) is recommended for concrete in contact with the local soil. Furthermore, air entrainment should be incorporated into any concrete elements that are exposed to freeze-thaw to enhance its durability.

It should be recognized that there may be structural and other considerations, which may necessitate additional requirements for subsurface concrete mix design.

6.10 Construction Monitoring and Testing

All engineering design recommendations presented in this report are based on the assumption that an adequate level of testing and monitoring will be provided during construction and that all construction will be carried out by a suitably qualified contractor experienced in foundation and earthworks construction. An adequate level of testing and monitoring is considered to be:

- for earthworks: full-time monitoring and compaction testing.
- for deep foundations: design review and full time monitoring during construction.
- for concrete construction: testing of plastic and hardened concrete in accordance with the latest editions of CSA A23.1 and A23.2; and review of concrete supplier's mix designs for conformance with prescribed and/or performance concrete specifications.

AMEC requests the opportunity to review the design drawings, and the installation of the foundations, to confirm that the geotechnical recommendations have been correctly interpreted. AMEC would be pleased to provide any further information that may be needed during design and to advise on the geotechnical aspects of specifications for inclusion in contract documents.

7.0 CLOSURE

The findings and recommendations presented in this report were based on geotechnical evaluation of the subsurface conditions observed during the site investigation described in this report. If conditions other than those reported in this report are noted during subsequent phases of the project, or if the assumptions stated herein are not in keeping with the design, this office should be notified immediately in order that the recommendations can be verified and revised as required. Recommendations presented herein may not be valid if an adequate level of inspection is not provided during construction, or if relevant building code requirements are not met.

The site investigation conducted and described in this report was for the sole purpose of identifying geotechnical conditions at the project Site. Although no environmental issues were identified during the fieldwork, this does not indicate that no such issues exist. If the owner or other parties have any concern regarding the presence of environmental issues, then an appropriate level environmental assessment should be conducted.

Soil conditions, by their nature, can be highly variable across a site. The placement of fill and prior construction activities on a site can contribute to the variability especially in near surface soil conditions. A contingency should always be included in any construction budget to allow for the possibility of variation in soil conditions, which may result in modification of the design and construction procedures.

This report has been prepared for the exclusive use of J.R. Cousin Consultants Ltd., and their agents, for specific application to the project described in this report. The data and recommendations provided herein should not be used for any other purpose, or by any other parties, without review and written advice from AMEC. Any use that a third party makes of this report, or any reliance or decisions made based on this report, are the responsibility of those parties. AMEC accepts no responsibility for damages suffered by a third party as a result of decisions made or actions based on this report.

This report has been prepared in accordance with generally accepted soil and foundation engineering practices. No other warranty, either expressed or implied, is made.

Respectfully submitted,
AMEC Environment & Infrastructure,
A Division of AMEC Americas Limited

PROVINCE OF MANITOBA
5 MAY 2014
K. W.
JOHNSON
Member
24333
REGISTERED PROFESSIONAL ENGINEER

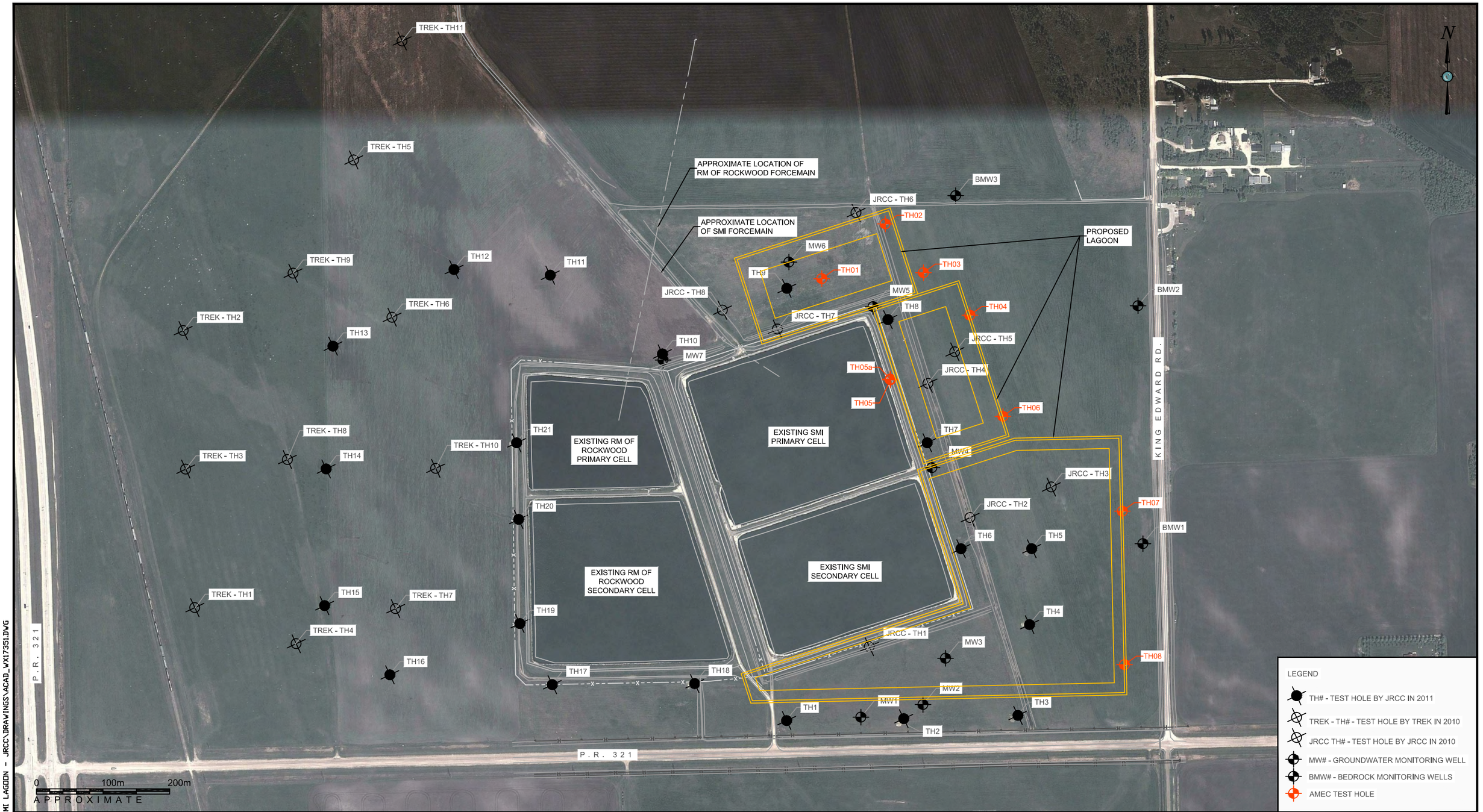
Kelly Johnson, P. Eng.
Senior Geotechnical Engineer

APEGM
Certificate of Authorization
AMEC Environment & Infrastructure, a
Division of AMEC Americas Limited
No. 555 Date: 5 MAY 2014

Reviewed by:

Harley Pankratz, P.Eng.
Vice President, Eastern Prairies/Northern Alberta

FIGURES



P:\JOBS\17300'S\17350'S\17351 SMI LAGOON - JRCC\DRAWINGS\ACAD_WX17351.DVG

NOTE:
- SITE FEATURES AND LOCATION ARE APPROXIMATE ONLY.
- DRAWINGS PROVIDED BY CLIENT.
- IMAGES FROM GOOGLE EARTH PRO.

CLIENT LOGO

CLIENT:
J.R. COUSIN CONSULTANTS LTD.

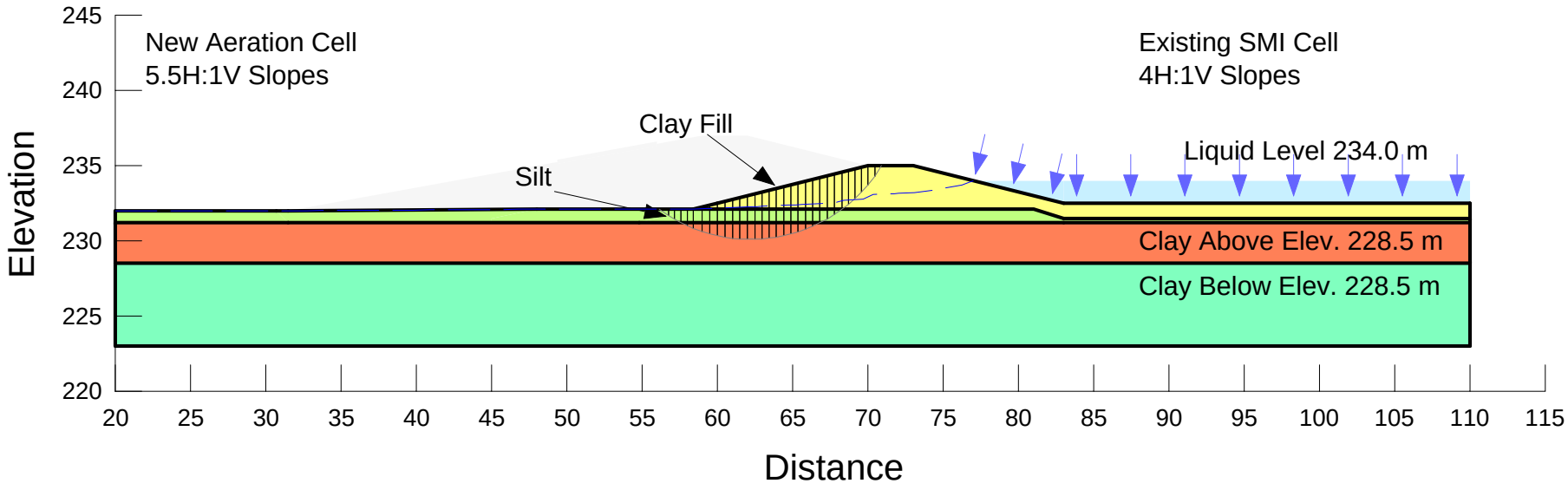
AMEC Environment & Infrastructure
440 DOVERCOURT DRIVE WINNIPEG, MANITOBA R3Y 1N4 PHONE: 204.488.2997 FAX:204.489.8261

DWN BY: MD
CHK'D BY: KJ
DATUM: NAD83
PROJECTION: UTM Zone 14 U
SCALE: AS SHOWN

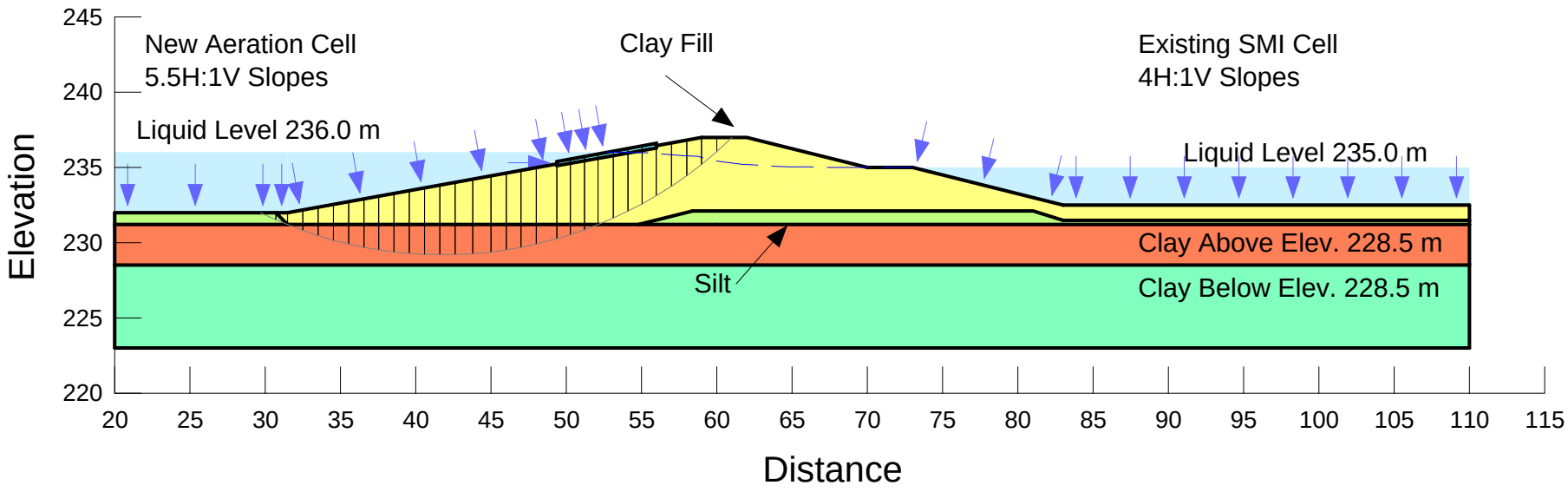
GEOTECHNICAL INVESTIGATION
SMI LAGOON UPGRADES
STONY MOUNTAIN, MANITOBA

TEST HOLE LOCATION PLAN AND PROPOSED LAGOON UPGRADES

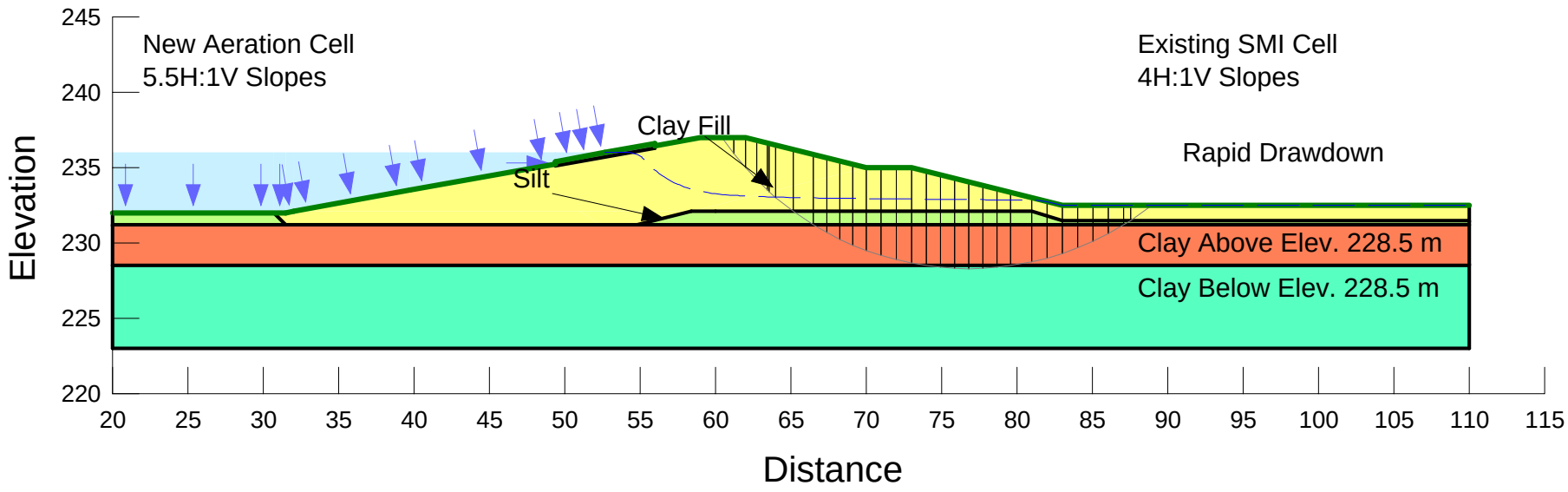
DATE: MARCH 2014
PROJECT NO: WX17351
REV. NO.: A
FIGURE NO: FIGURE 1



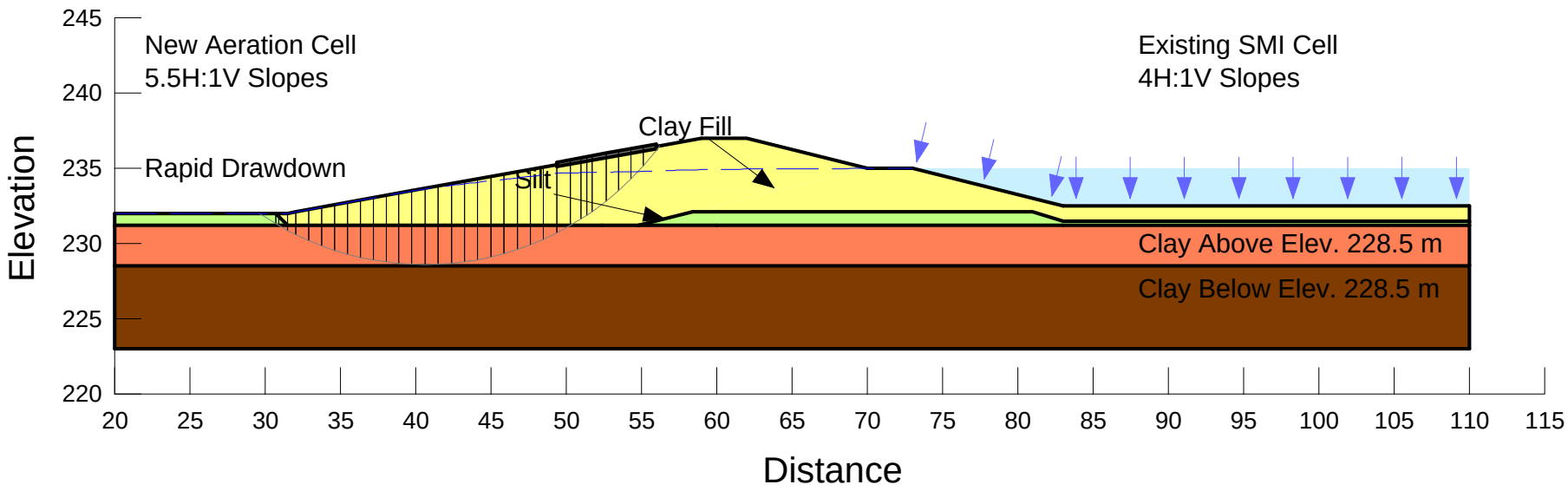
A) Construction Condition – Excavation of New Cell Adjacent to Existing Cell, Critical Factor of Safety 1.6



B) Normal Operating Condition – Post Construction, Both Ponds Full to Maximum Liquid Level, Critical Factor of Safety 2.4

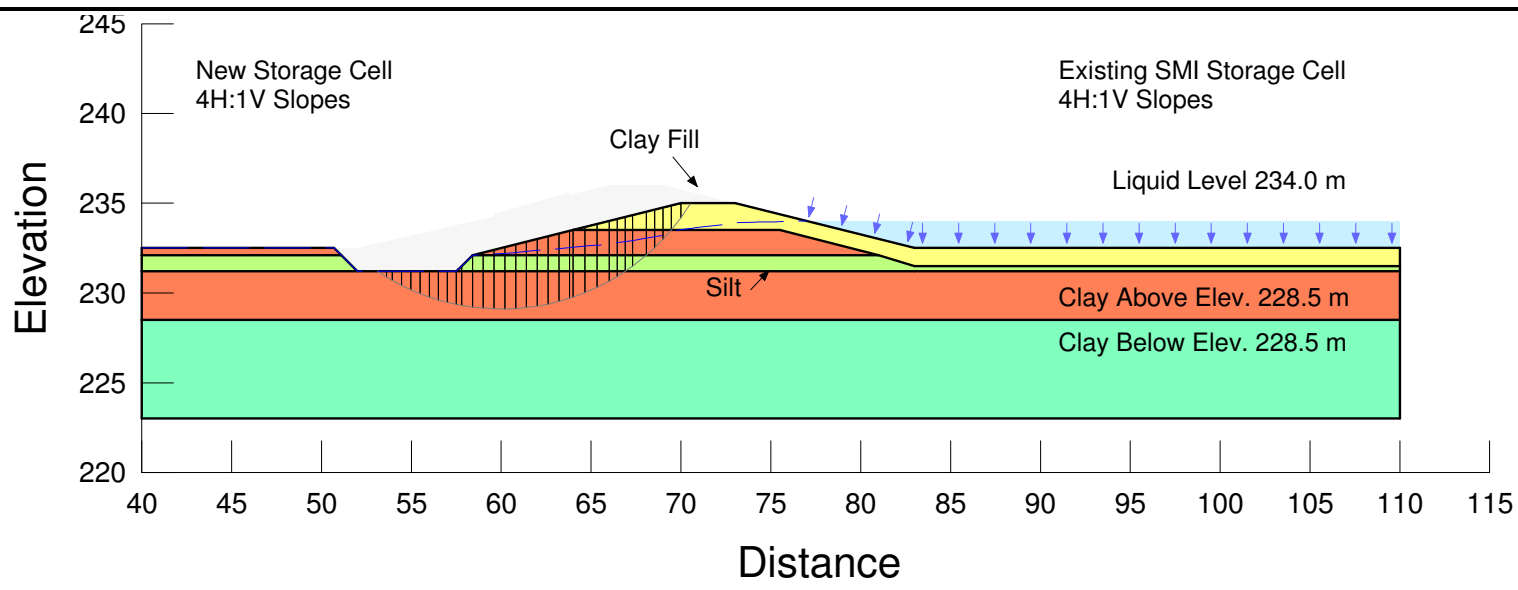


C) Extreme Condition – Rapid Drawdown of Existing SMI Secondary Cell, Critical Factor of Safety 1.6

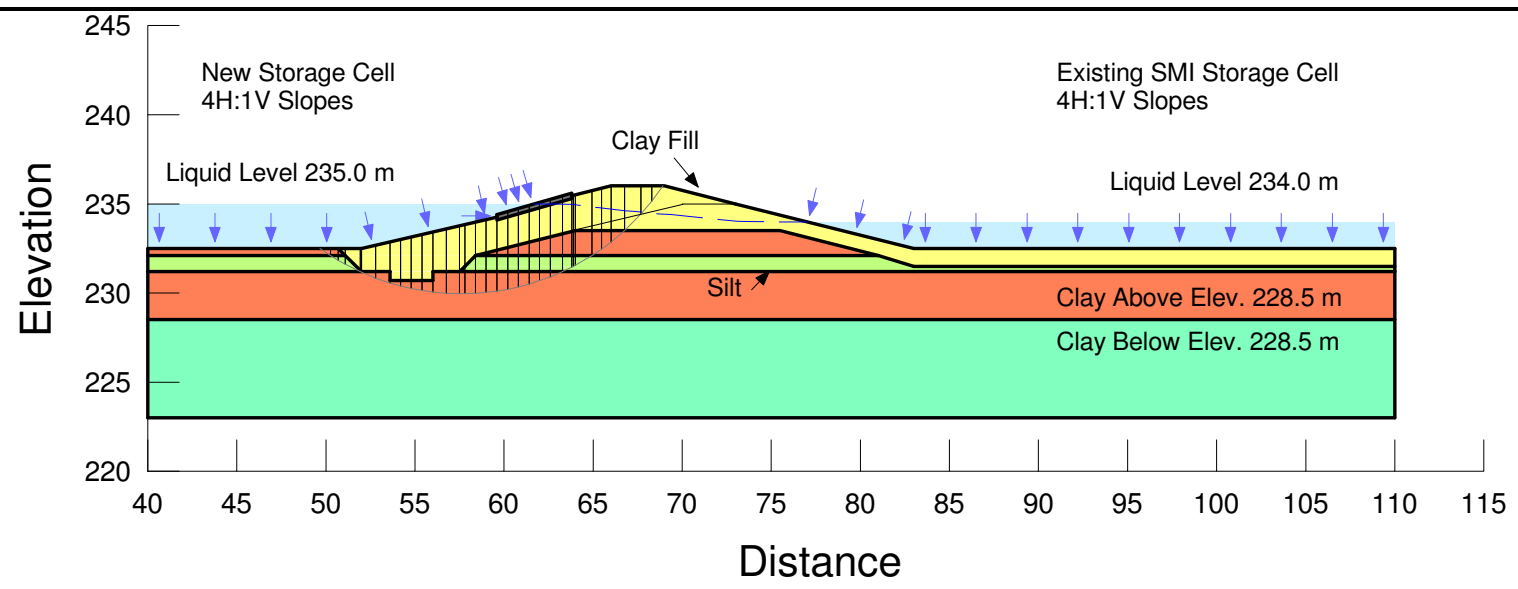


D) Extreme Condition – Rapid Drawdown of New Storage Cell, Critical Factor of Safety, Critical Factor of Safety 1.3

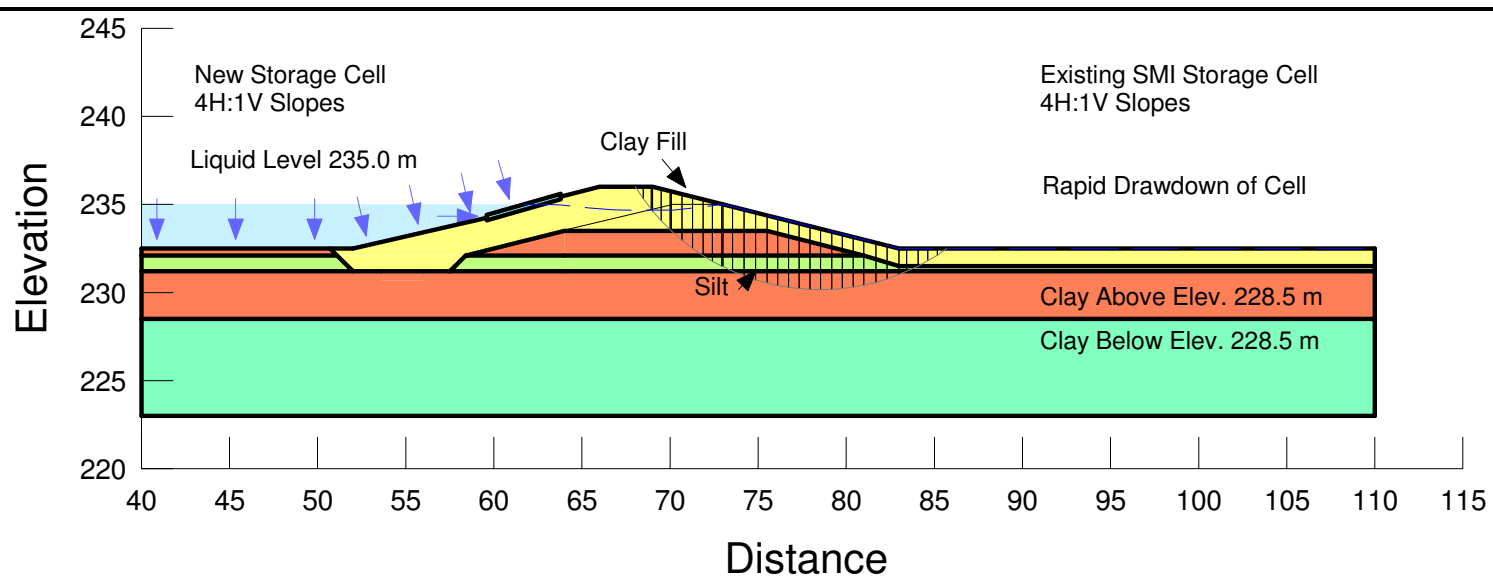
amec *Environment & Infrastructure A Division of AMEC Americas Limited*		**J.R. COUSIN CONSULTANTS LTD.**		**POND SLOPE STABILITY CROSS SECTION #1** **SMI LAGOON UPDRAGES SE 2-13-2 EPM, MANITOBA**
Drawn by: KWJ	Scale: As Shown	Date: 2 Apr. 2014	Proj. No.: WX17351	Figure: 2



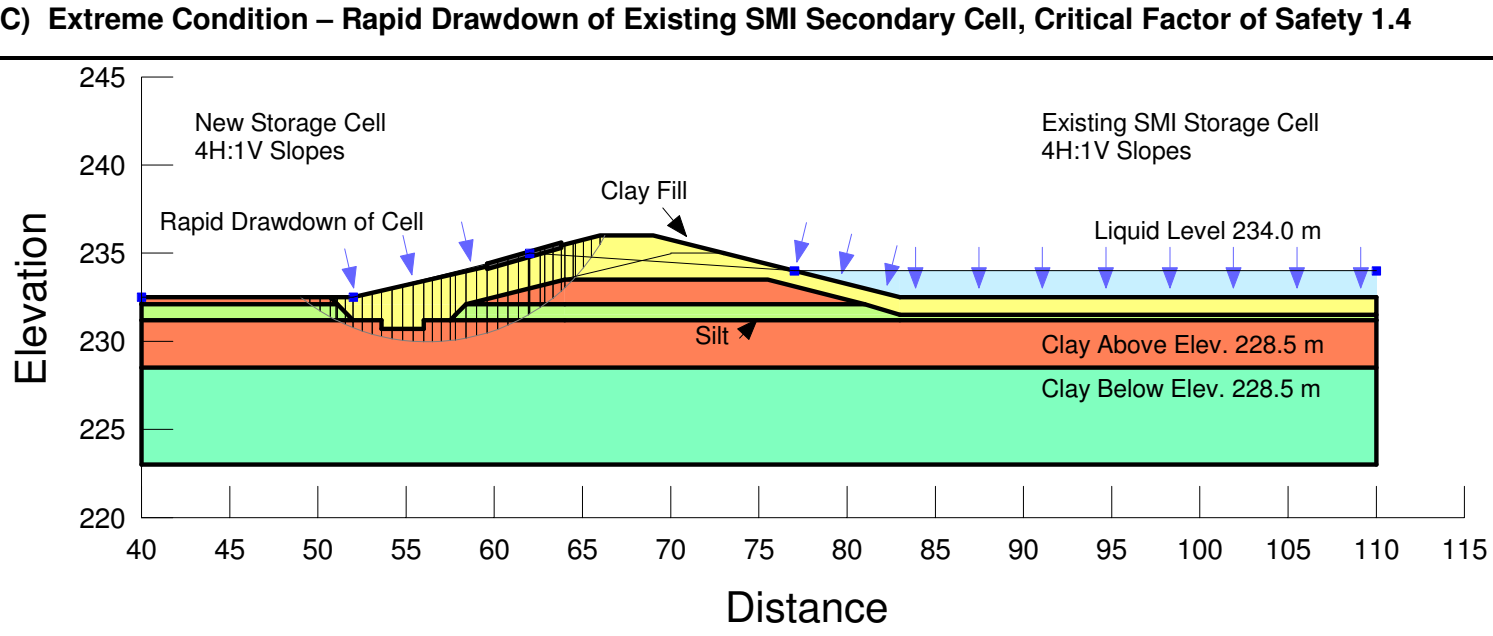
A) Construction Condition – Excavation of New Cell Adjacent to Existing Cell, Critical Factor of Safety 1.2



B) Normal Operating Condition – Post Construction, Both Ponds Full to Maximum Liquid Level, Critical Factor of Safety 2.2

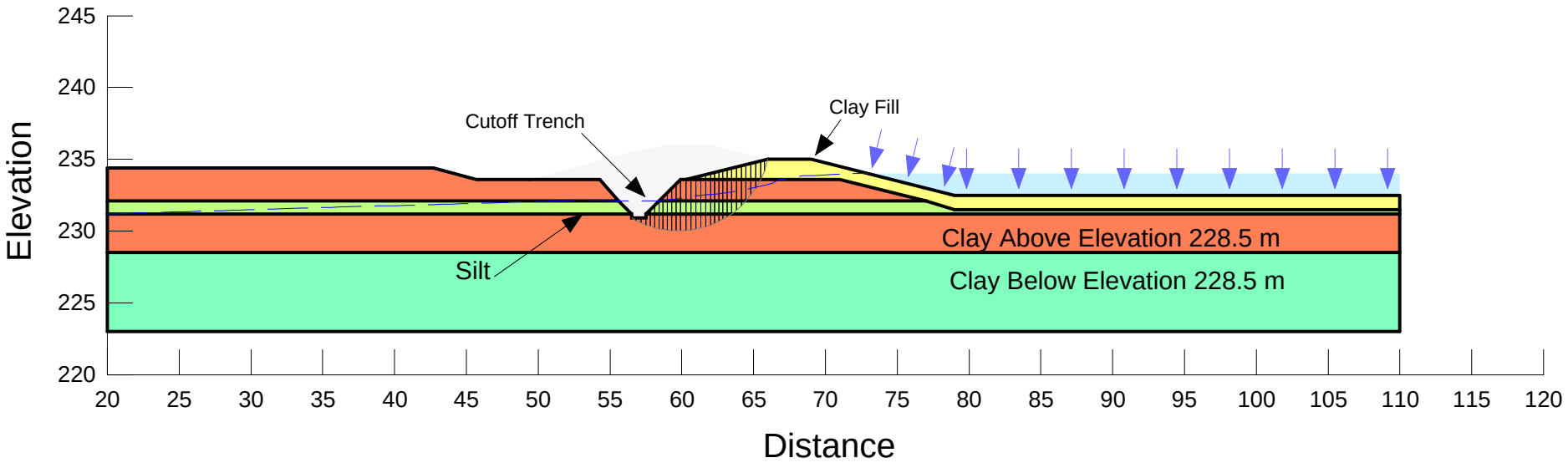


C) Extreme Condition – Rapid Drawdown of Existing SMI Secondary Cell, Critical Factor of Safety 1.4

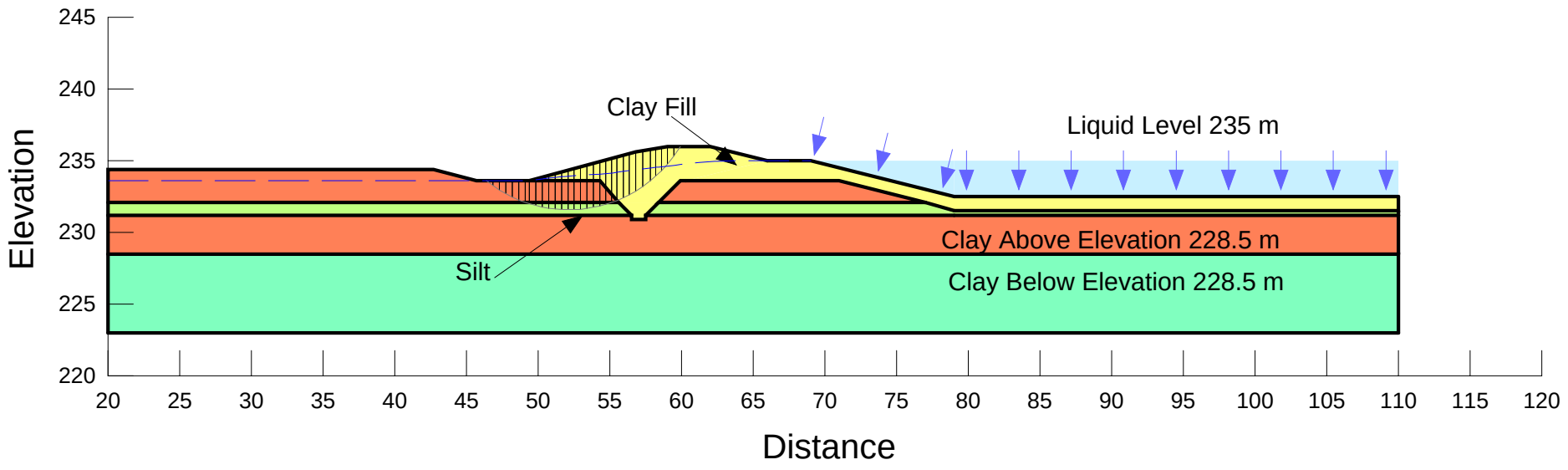


D) Extreme Condition – Rapid Drawdown of New Storage Cell, Critical Factor of Safety 1.2

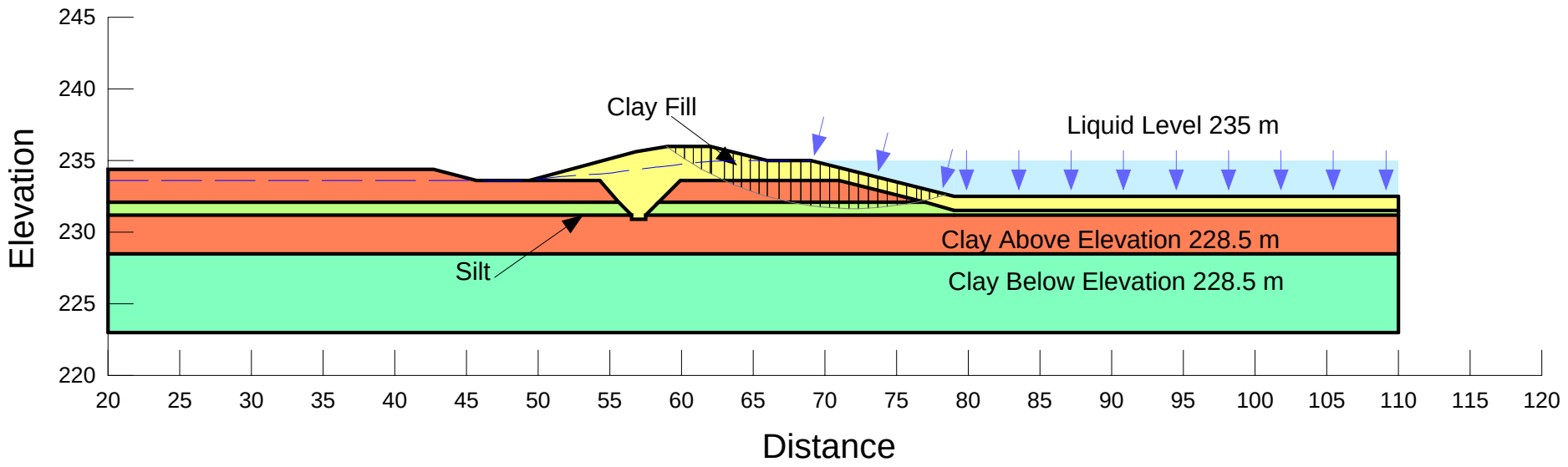
amec *Environment & Infrastructure A Division of AMEC Americas Limited*		**J.R. COUSIN CONSULTANTS LTD.**			**POND SLOPE STABILITY CROSS SECTION #2** **SMI LAGOON UPDRAGES SE 2-13-2 EPM, MANITOBA**
Drawn by: KWJ	Scale: As Shown	Date: 24 Mar. 2014	Proj. No.: WX17351	Figure: 3	



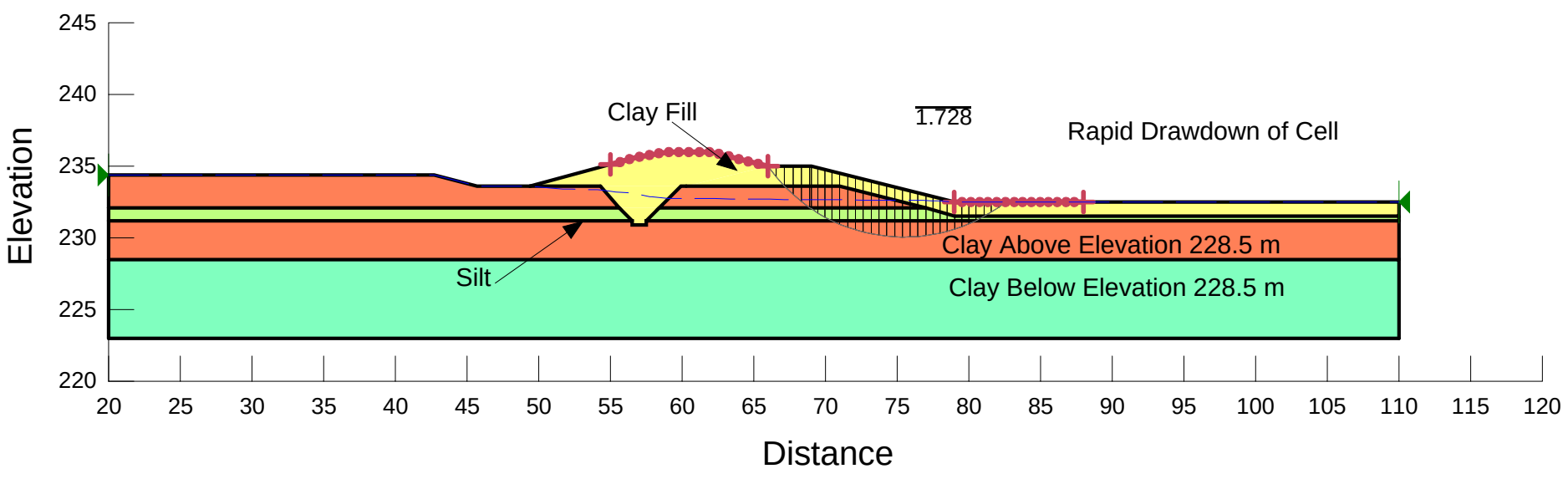
A) Construction Condition – Excavation of Cutoff Trench Adjacent to Existing Cell, Critical Factor of Safety 1.3



B) Normal Operating Condition – Pond Full to Maximum Liquid Level, Critical Factor of Safety 1.6 for Exterior Slope



C) Normal Operating Condition – Pond Full to Maximum Liquid Level, Critical Factor of Safety 2.4 for Interior Slope



D) Extreme Condition – Rapid Drawdown of Cell, Factor of Safety 1.7 for Interior Slope

amec *Environment & Infrastructure* *A Division of AMEC Americas Limited*		**J.R. COUSIN CONSULTANTS LTD.**			**POND SLOPE STABILITY CROSS SECTION #3** **SMI LAGOON UPDRAGES SE 2-13-2 EPM, MANITOBA**
Drawn by: KWJ	Scale: As Shown	Date: 24 Mar. 2014	Proj. No.: WX17351	Figure: 4	

APPENDIX A

PROJECT: Geotechnical Investigation	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **TH01**
CLIENT: JR Cousin Consultants	DRILL TYPE: Track Mounted Auger	PROJECT NO: WX17351
LOCATION: N5547973.7 E627816.1	DRILL METHOD: Solid Stem Auger	ELEVATION: 233.89 m

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	ELEVATION (m)
0		OL	TOPSOIL - 200mm thick, some clay to clayey, low plastic, frozen, black		1		Borehole Coordinates in UTM	
		CI-CH	CLAY - silty, trace sand, medium to high plastic, frozen, brown, abundant silt lenses and silt inclusions		2			233
1								
			SILT - some clay, trace sand, low plastic, wet, soft, light brown		3			
2		ML			4			232
			CLAY - silty, trace sand, high plastic, moist, very stiff, brown		5			
3								231
			- very moist, firm, dark brown, occasional silt inclusions below 3.7m					
4					6			230
					7		UCS Result (S7): Failure Stress: 78 kPa Failure Strain: 3.6 % Bulk Density: 1685 kg/m^3 Dry Density: 1064 kg/m^3	
5			- increasing silt, wet, soft below 5.2m					229
					8			
6		CH						228
					9			
7					10		UCS Result (S10): Failure Stress: 42 kPa Failure Strain: 9.0 % Bulk Density: 1814 kg/m^3 Dry Density: 1245 kg/m^3	227
			- occasional cobble below 7.9m - occasional oxidation and till inclusions below 8.2m					
8								226
					11			
9								225
					12			
10			END OF HOLE AT 10.7m Notes: - Sloughing below 1.4m and no seepage observed upon completion of drilling. - Test hole remained open to 7m for 10 minutes upon completion of drilling. - Backfilled with auger cuttings and bentonite.					224
11								223
12								222
13								221

17351 SMI LAGOON - JRCC.GPJ 14/05/07 01:13 PM (GEOTECHNICAL REVISED WITH UTM INPUTS)

amec

AMEC Environment & Infrastructure
Winnipeg, Manitoba

LOGGED BY: NB	COMPLETION DEPTH: 10.7 m
REVIEWED BY: KJ	COMPLETION DATE: 14 February 2014
Figure No. A1	Page 1 of 1

PROJECT: Geotechnical Investigation	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **TH02**
CLIENT: JR Cousin Consultants	DRILL TYPE: Track Mounted Auger	PROJECT NO: WX17351
LOCATION: N5548055.9 E627911.3	DRILL METHOD: Solid Stem Auger	ELEVATION: 233.97 m

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	ELEVATION (m)
0		OL	TOPSOIL - 450mm thick, some clay to clayey, low plastic, frozen, black		1		Borehole Coordinates in UTM	
			CLAY - silty, trace sand, medium to high plastic, frozen, brown, frequent silt and sand lenses		2			
1		CI-CH						233
					3		Hydrometer Analysis Results @ "1.4m":	
					4		Gravel= 0.0%	
2							Sand= 2.0%	232
		ML	SILT - some clay, trace sand, low plastic, wet, soft, light brown		5		Silt= 42.7%	
							Clay= 55.3%	
3					6			231
			CLAY - silty, trace sand, high plastic, moist, firm, dark brown					
4								230
		CH	- very moist, soft below 4.6m		7			
5								229
6					8			228
			END OF HOLE AT 6.1m Notes: - Sloughing from 2.1m to 3.1m and no seepage observed upon completion of drilling. - Test hole remained open to 4.3m for 10 minutes upon completion of drilling. - Backfilled with auger cuttings and bentonite.					
7								227
8								226
9								225
10								224
11								223
12								222
13								

amec
AMEC Environment & Infrastructure
Winnipeg, Manitoba

LOGGED BY: NB	COMPLETION DEPTH: 6.1 m
REVIEWED BY: KJ	COMPLETION DATE: 14 February 2014
Figure No. A2	Page 1 of 1

PROJECT: Geotechnical Investigation	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **TH03**
CLIENT: JR Cousin Consultants	DRILL TYPE: Track Mounted Auger	PROJECT NO: WX17351
LOCATION: N5547982.5 E627968.6	DRILL METHOD: Solid Stem Auger	ELEVATION: 233.61 m

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	ELEVATION (m)
0		OL	TOPSOIL - 150mm thick, some clay to clayey, low plastic, frozen, black		1		Borehole Coordinates in UTM	233
1		CI-CH	CLAY - silty, trace sand, high plastic, frozen, brown, abundant silt and sand lenses		2			
2		ML	SILT - some clay, trace sand, low plastic, wet, soft, light brown		3			232
3					4			231
4			CLAY - trace silt, trace sand, high plastic, moist, stiff, brown		5			
5			- occasional silt inclusions, dark brown below 4.6m		6			230
6			- very moist, firm below 5.2m		7			229
7		CH	- very moist to wet, soft below 6.1m		8			228
8					9			227
9			- occasional till inclusions below 9.1m		10			226
10					11			225
11					12			224
12			END OF HOLE AT 10.7m Notes: - Sloughing below 1.5m and no seepage observed upon completion of drilling. - Test hole remained open to 4.3m for 110 minutes upon completion of drilling. - Backfilled with auger cuttings and bentonite.		13			223
13								222
								221

17351 SMI LAGOON - JRCC.GPJ 14/05/07 01:13 PM (GEOTECHNICAL REVISED WITH UTM INPUTS)

amec

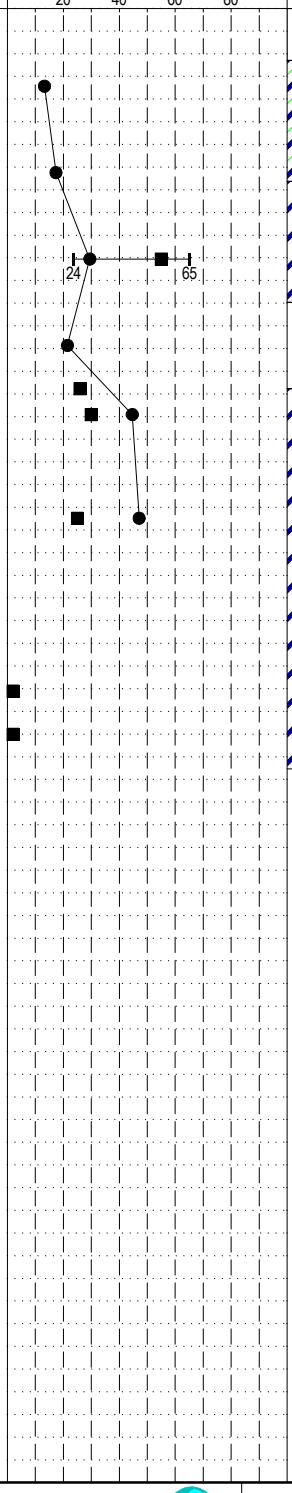
AMEC Environment & Infrastructure
Winnipeg, Manitoba

LOGGED BY: NB	COMPLETION DEPTH: 10.7 m
REVIEWED BY: KJ	COMPLETION DATE: 14 February 2014
Figure No. A3	Page 1 of 1

PROJECT: Geotechnical Investigation	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **TH04**
CLIENT: JR Cousin Consultants	DRILL TYPE: Track Mounted Auger	PROJECT NO: WX17351
LOCATION: N5547918.9 E628038.3	DRILL METHOD: Solid Stem Auger	ELEVATION: 233.66 m

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand



Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	ELEVATION (m)
0		OL	TOPSOIL - 450mm thick, some clay to clayey, low plastic, frozen, black		1		Borehole Coordinates in UTM	
1		CI-CH	CLAY - silty, trace sand, medium to high plastic, frozen, damp and hard when thawed, light brown - damp, hard below 1.1m		2 3			233
2		CH	CLAY - silty, trace sand, high plastic, damp, very stiff, brown, frequent sand and silt inclusions		4		Hydrometer Analysis Results @ "2.1m": Gravel= 0.0% Sand= 4.0% Silt= 30.1% Clay= 65.9%	232
3		ML	SILT - some clay to clayey, trace sand, low plastic, wet, soft, light brown		5 6			231
4		CH	CLAY - silty, trace sand, high plastic, moist to very moist, stiff, brown - occasional oxidation below 4m		7 8			230
5			- very moist, soft, dark brown below 4.6m					229
6			- very moist to wet below 5.8m		9 10			228 227
7			END OF HOLE AT 6.7m Notes: - No sloughing and no seepage observed upon completion of drilling. - Test hole remained open to 6.1m for 10 minutes upon completion of drilling. - Backfilled with auger cuttings and bentonite.					226
8								225
9								224
10								223
11								222
12								221
13								

17351 SMI LAGOON - JRCC.GPJ 14/05/07 01:13 PM (GEOTECHNICAL REVISED WITH UTM INPUTS)

amec

AMEC Environment & Infrastructure
Winnipeg, Manitoba

LOGGED BY: NB	COMPLETION DEPTH: 6.1 m
REVIEWED BY: KJ	COMPLETION DATE: 14 February 2014
Figure No. A4	Page 1 of 1

PROJECT: Geotechnical Investigation	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **TH05**
CLIENT: JR Cousin Consultants	DRILL TYPE: Track Mounted Auger	PROJECT NO: WX17351
LOCATION: N5547821.8 E627919.3	DRILL METHOD: Solid Stem Auger	ELEVATION: 235.1 m

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	ELEVATION (m)
0		OL	TOPSOIL - 75mm thick, some clay to clayey, low plastic, frozen, black		1		Borehole Coordinates in UTM	235
1		CI	CLAY (FILL) - silty, some sand, trace gravel, medium plastic, frozen, damp when thawed, dark brown, occasional limestone inclusions, occasional silt and sand inclusions		2			234
2		CH	CLAY - silty, trace sand, moist, very stiff, brown, frequent silt and sand layers - firm below 2.4m		3 4			233
3		ML	SILT - some clay, some sand, low plastic, wet, soft, light brown		5 6 7			232
4		CH	CLAY - silty, trace sand, high plastic, moist, very stiff, brown		8			231
5			END OF HOLE AT 4.6m DUE TO LOST AUGER IN HOLE				- Test hole blocked at 4.6m. Moved test hole location 1m north, see TH05A for details	230
6								229
7								228
8								227
9								226
10								225
11								224
12								223
13								

17351 SMI LAGOON - JRCC.GPJ 14/05/07 01:13 PM (GEOTECHNICAL REVISED WITH UTM INPUTS)

amec

AMEC Environment & Infrastructure
Winnipeg, Manitoba

LOGGED BY: NB	COMPLETION DEPTH: 4.6 m
REVIEWED BY: KJ	COMPLETION DATE: 14 February 2014
Figure No. A5	Page 1 of 1

PROJECT: Geotechnical Investigation	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **TH05A**
CLIENT: JR Cousin Consultants	DRILL TYPE: Track Mounted Auger	PROJECT NO: WX17351
LOCATION: N5547822.8 E627918.7	DRILL METHOD: Solid Stem Auger	ELEVATION: 235.09 m

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	ELEVATION (m)
0			See TH05 for stratigraphy				Borehole Coordinates in UTM	235
1								234
2								233
3								232
4								231
5		CH	CLAY - silty, trace sand, high plastic, moist to very moist, firm, brown					230
6					9			229
					10			
7			END OF HOLE AT 6.7m Notes: - No sloughing and slight seepage observed upon completion of drilling. - Test hole remained open to 6.7m for 10 minutes upon completion of drilling. - Backfilled with auger cuttings and bentonite.					228
8								227
9								226
10								225
11								224
12								223
13								

17351 SMI LAGOON - JRCC.GPJ 14/05/07 01:13 PM (GEOTECHNICAL REVISED WITH UTM INPUTS)

amec

AMEC Environment & Infrastructure
Winnipeg, Manitoba

LOGGED BY: NB	COMPLETION DEPTH: 6.7 m
REVIEWED BY: KJ	COMPLETION DATE: 14 February 2014
Figure No. A6	Page 1 of 1

PROJECT: Geotechnical Investigation	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **TH06**
CLIENT: JR Cousin Consultants	DRILL TYPE: Track Mounted Auger	PROJECT NO: WX17351
LOCATION: N5547767 E628087.9	DRILL METHOD: Solid Stem Auger	ELEVATION: 233.3 m

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	ELEVATION (m)
0		OL	TOPSOIL - 300mm thick, some clay to clayey, low plastic, frozen, black, frequent organic/wild grass inclusions		1		Borehole Coordinates in UTM	233
1		CI-CH	CLAY - silty, trace sand, medium to high plastic, frozen, light brown, frequent sand and silt lenses		2			232
2			- moist, very stiff below 1.4m		3			
		CL-ML	SILT - clayey, trace sand, low plastic, wet, soft, light brown		4			231
3					5			
			CLAY - silty, trace sand, high plastic, moist, stiff, brown		6			230
4					7			
		CH	- very moist, firm, dark brown below 4.6m		8			229
5								228
6					9			
			END OF HOLE AT 6.1m Notes: - Sloughing from 1.7m to 3.1m and no seepage observed upon completion of drilling. - Test hole remained open to 4.9m for 10 minutes upon completion of drilling. - Backfilled with auger cuttings and bentonite.					227
7								226
8								225
9								224
10								223
11								222
12								221
13								

17351 SMI LAGOON - JRCC.GPJ 14/05/07 01:13 PM (GEOTECHNICAL REVISED WITH UTM INPUTS)

amec

AMEC Environment & Infrastructure
Winnipeg, Manitoba

LOGGED BY: NB	COMPLETION DEPTH: 6.1 m
REVIEWED BY: KJ	COMPLETION DATE: 14 February 2014
Figure No. A7	Page 1 of 1

PROJECT: Geotechnical Investigation	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **TH07**
CLIENT: JR Cousin Consultants	DRILL TYPE: Track Mounted Auger	PROJECT NO: WX17351
LOCATION: N5547624.5 E628267.1	DRILL METHOD: Solid Stem Auger	ELEVATION: 233.18 m

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	ELEVATION (m)
0		OL	TOPSOIL - 600mm thick, some clay to clayey, low plastic, frozen, black		1		Borehole Coordinates in UTM	233
1		CI	CLAY - silty, trace sand, medium to high plastic, frozen, dark brown		2			232
2		ML	SILT - some clay, trace sand, low plastic, frozen, light brown - wet, soft below 1.5m		3 4			231
3					5			
4		CH	CLAY - silty, trace sand, high plastic, moist, stiff, brown - occasional silt inclusions, occasional oxidation below 3.1m		6 7			230 229
5					8			228
6			- very moist, soft, dark grey below 5.2m		9 10			227
7			END OF HOLE AT 6.7m Notes: - No sloughing and slight seepage observed upon completion of drilling. - Test hole remained open to 6.4m for 10 minutes upon completion of drilling. - Backfilled with auger cuttings and bentonite.					226
8								225
9								224
10								223
11								222
12								221
13								

17351 SMI LAGOON - JRCC.GPJ 14/05/07 01:13 PM (GEOTECHNICAL REVISED WITH UTM INPUTS)

amec

AMEC Environment & Infrastructure
Winnipeg, Manitoba

LOGGED BY: NB	COMPLETION DEPTH: 6.1 m
REVIEWED BY: KJ	COMPLETION DATE: 14 February 2014
Figure No. A8	Page 1 of 1

PROJECT: Geotechnical Investigation	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **TH08**
CLIENT: JR Cousin Consultants	DRILL TYPE: Track Mounted Auger	PROJECT NO: WX17351
LOCATION: N5547394.2 E628270.4	DRILL METHOD: Solid Stem Auger	ELEVATION: 233.21 m

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	ELEVATION (m)
0		OL	TOPSOIL - 300mm thick, some clay to clayey, low plastic, frozen, black		1		Borehole Coordinates in UTM	233
1		CI	CLAY - and silt, trace to some sand, medium plastic, frozen, light brown - damp, stiff below 0.8m		2			232
2		CH	CLAY - silty, trace sand, high plastic, moist, very stiff, brown, occasional sand lenses		3			231
					4			
		ML	SILT - some clay, trace sand, low plastic, wet, soft, brown		5			
3		CH	CLAY - silty, trace sand, high plastic, moist, very stiff, brown, occasional sand lenses		6			230
4			- firm below 3.6m		7			229
					8			
5								228
6			- dark grey at 6.0m		9			227
			END OF HOLE AT 6.1m Notes: - No sloughing and slight seepage from 2.4m to 2.7m observed upon completion of drilling. - Test hole remained open to 6.1m for 10 minutes upon completion of drilling. - Backfilled with auger cuttings and bentonite.					
7								226
8								225
9								224
10								223
11								222
12								221
13								

16 34

17351 SMI LAGOON - JRCC.GPJ 14/05/07 01:13 PM (GEOTECHNICAL REVISED WITH UTM INPUTS)

amec

AMEC Environment & Infrastructure
Winnipeg, Manitoba

LOGGED BY: NB	COMPLETION DEPTH: 6.1 m
REVIEWED BY: KJ	COMPLETION DATE: 14 February 2014
Figure No. A9	Page 1 of 1

EXPLANATION OF TERMS AND SYMBOLS

The terms and symbols used on the borehole logs to summarize the results of field investigation and subsequent laboratory testing are described in these pages.

It should be noted that materials, boundaries and conditions have been established only at the borehole locations at the time of investigation and are not necessarily representative of subsurface conditions elsewhere across the site.

TEST DATA

Data obtained during the field investigation and from laboratory testing are shown at the appropriate depth interval.

Abbreviations, graphic symbols, and relevant test method designations are as follows:

*C	Consolidation test	*ST	Swelling test
D_R	Relative density	TV	Torvane shear strength
*k	Permeability coefficient	VS	Vane shear strength
*MA	Mechanical grain size analysis	w	Natural Moisture Content (ASTM D2216)
	and hydrometer test	w_l	Liquid limit (ASTM D 423)
N	Standard Penetration Test (CSA A119.1-60)	w_p	Plastic Limit (ASTM D 424)
N_d	Dynamic cone penetration test	E_f	Unit strain at failure
NP	Non plastic soil	γ	Unit weight of soil or rock
pp	Pocket penetrometer strength	γ_d	Dry unit weight of soil or rock
*q	Triaxial compression test	ρ	Density of soil or rock
q_u	Unconfined compressive strength	ρ_d	Dry Density of soil or rock
*SB	Shearbox test	C_u	Undrained shear strength
SO_4	Concentration of water-soluble sulphate	→	Seepage
		▼	Observed water level

* The results of these tests are usually reported separately

Soils are classified and described according to their engineering properties and behaviour.

The soil of each stratum is described using the Unified Soil Classification System[1] modified slightly so that an inorganic clay of "medium plasticity" is recognized.

The modifying adjectives used to define the actual or estimated percentage range by weight of minor components are consistent with the Canadian Foundation Engineering Manual[2].

Relative Density and Consistency:

Cohesionless Soils

Relative Density	SPT (N) Value
Very Loose	0-4
Loose	4-10
Compact	10-30
Dense	30-50
Very Dense	>50

Cohesive Soils

Consistency	Undrained Shear Strength c_u (kPa)	Approximate SPT (N) Value
Very Soft	0-12	0-2
Soft	12-25	2-4
Firm	25-50	4-8
Stiff	50-100	8-15
Very Stiff	100-200	15-30
Hard	>200	>30

Standard Penetration Resistance ("N" value)
The number of blows by a 63.6kg hammer dropped 760 mm to drive a 50 mm diameter open sampler attached to "A" drill rods for a distance of 300 mm after an initial penetration of 150 mm.

[1] "Unified Soil Classification System", Technical Memorandum 36-357 prepared by Waterways Experiment Station, Vicksburg, Mississippi, Corps of Engineers, U.S. Army. Vol. 1 March 1953.

[2] "Canadian Foundation Engineering Manual", 3rd Edition, Canadian Geotechnical Society, 1992.

MODIFIED UNIFIED CLASSIFICATION SYSTEM FOR SOILS

MAJOR DIVISIONS			SYMBOLS: USCS	SYMBOLS: GRAPH	SYMBOLS: COLOUR	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA
COARSE GRAINED SOILS (MORE THAN HALF BY WEIGHT LARGER THAN 75um)	GRAVELS MORE THAN HALF THE COARSE FRACTION LARGER THAN 4.75mm	CLEAN GRAVELS (TRACE OR NO FINES)	GW		RED	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	$C_u=D_{60}/D_{10}$ >4; $C_c=(D_{30})^2/(D_{10}xD_{60})$ = 1 to 3
			GP		RED	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS
		DIRTY GRAVELS (WITH SOME OR MORE FINES)	GM		YELLOW	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES	ATTERBERG LIMITS BELOW "A" LINE OR PI LESS THAN 4
			GC		YELLOW	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES	ATTERBERG LIMITS ABOVE "A" LINE AND PI MORE THAN 7
	SANDS MORE THAN HALF THE COARSE FRACTION SMALLER THAN 4.75mm	CLEAN SANDS (TRACE OR NO FINES)	SW		RED	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	$C_u=D_{60}/D_{10}$ >6; $C_c=(D_{30})^2/(D_{10}xD_{60})$ = 1 to 3
			SP		RED	POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS
		DIRTY SANDS (WITH SOME OR MORE FINES)	SM		YELLOW	SILTY SANDS, SAND-SILT MIXTURES	ATTERBERG LIMITS BELOW "A" LINE OR PI LESS THAN 4
			SC		YELLOW	CLAYEY SANDS, SAND-CLAY MIXTURES	ATTERBERG LIMITS ABOVE "A" LINE AND PI MORE THAN 7
FINE-GRAINED SOILS (MORE THAN HALF BY WEIGHT SMALLER THAN 75um)	SILTS BELOW "A" LINE NEGLIGIBLE ORGANIC CONTENT	W_L < 50%	ML		GREEN	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY SANDS OF SLIGHT PLASTICITY	CLASSIFICATION IS BASED UPON PLASTICITY CHART (SEE BELOW)
		W_L > 50%	MH		BLUE	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SAND OR SILTY SOILS	
	CLAYS ABOVE "A" LINE NEGLIGIBLE ORGANIC CONTENT	W_L < 30%	CL		GREEN	INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY OR SILTY CLAYS, LEAN CLAYS	
		30% < W_L < 50%	CI		GREEN-BLUE	INORGANIC CLAYS OF MEDIUM PLASTICITY, SILTY CLAYS	
		W_L > 50%	CH		BLUE	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	
	ORGANIC SILTS & CLAYS BELOW "A" LINE	W_L < 50%	OL		GREEN	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY	WHENEVER THE NATURE OF THE FINES CONTENT HAS NOT BEEN DETERMINED, IT IS DESIGNATED BY THE LETTER "F", E.G. SF IS A MIXTURE OF SAND WITH SILT OR CLAY
		W_L > 50%	OH		BLUE	ORGANIC CLAYS OF HIGH PLASTICITY	
HIGHLY ORGANIC SOILS			PT		ORANGE	PEAT AND OTHER HIGHLY ORGANIC SOILS	STRONG COLOUR OR ODOUR, AND OFTEN FIBROUS TEXTURE

SPECIAL SYMBOLS

LIMESTONE		OILSAND	
SANDSTONE		SHALE	
SILTSTONE		FILL (UNDIFFERENTIATED)	

SOIL COMPONENTS

FRACTION	U.S. STANDARD METRIC SIEVE SIZE		DEFINING RANGES OF PERCENT BY WEIGHT OF MINOR COMPONENTS	
GRAVEL	PASSING	RETAINED	PERCENT	DESCRIPTOR
COARSE	76mm	19mm		
FINE	19mm	4.75mm	35 - 50	AND
SAND				
COARSE	4.75mm	2.00mm	30 - 35	Y / EY
MEDIUM	2.00mm	425µm	10 - 20	SOME
FINE	425µm	75µm		
FINES (SILT OR CLAY BASED ON PLASTICITY)	75µm		1 - 10	TRACE

OVERSIZED MATERIAL

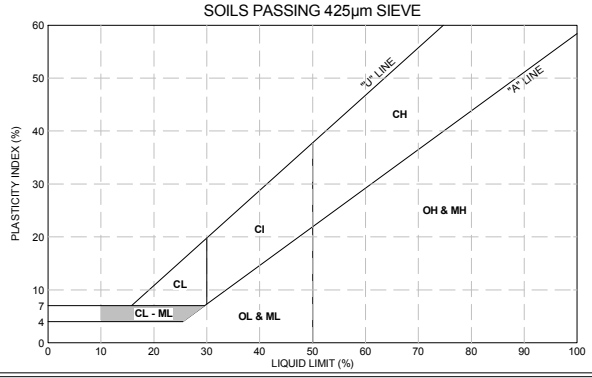
ROUNDED OR SUBROUNDED:

COBBLES 76mm to 200mm
BOULDERS > 200mm

NOT ROUNDED:

ROCK FRAGMENTS ? 76mm
ROCKS > 0.76 CUBIC METRE IN VOLUME

PLASTICITY CHART FOR SOILS PASSING 425µm SIEVE



NOTES:

1. ALL SIEVE SIZES MENTIONED ARE U.S. STANDARD ASTM E.11.
2. COARSE GRAINED SOILS WITH TRACE TO SOME FINES GIVEN COMBINED GROUP SYMBOLS, E.G. GW-GC IS A WELL GRADED GRAVEL SAND MIXTURE WITH TRACE TO SOME CLAY.
3. DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS.

AMEC Environment & Infrastructure
a Division of AMEC Americas Limited

Appendix C

ALS Sewage Test Results

J.R. Cousin Consultants
ATTN: JASON COUSIN
91A Scurfield Boulevard
Winnipeg MB R3Y 1G4

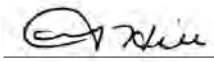
Date Received: 24-APR-14
Report Date: 30-APR-14 14:03 (MT)
Version: FINAL

Client Phone: 204-489-0474

Certificate of Analysis

Lab Work Order #: L1446721

Project P.O. #: NOT SUBMITTED
Job Reference: R-325.52
C of C Numbers:
Legal Site Desc:



Gail Hill
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1446721-1 ROCKWOOD PRIMARY							
Sampled By: Jason Cousin on 23-APR-14 @ 15:00							
Matrix: Lagoon							
Miscellaneous Parameters							
Phosphorus (P)-Total	4.09		0.010	mg/L		28-APR-14	R2828730
Un-ionized ammonia							
Ammonia by colour							
Ammonia, Total (as N)	20.3	DLA	1.0	mg/L		29-APR-14	R2830136
Temperature supplied by Client							
Temperature, Client Provided	1.5		0.1	Degree C		24-APR-14	R2827127
Un-ionized ammonia							
Ammonia, Un-ionized (as N)	0.119		0.010	mg/L		30-APR-14	
pH supplied by Client							
pH, Client Supplied	7.80		0.10	pH		24-APR-14	R2827127
L1446721-2 STONY STORAGE							
Sampled By: Jason Cousin on 23-APR-14 @ 15:00							
Matrix: Lagoon							
Miscellaneous Parameters							
Phosphorus (P)-Total	1.53		0.010	mg/L		28-APR-14	R2828730
Un-ionized ammonia							
Ammonia by colour							
Ammonia, Total (as N)	2.00	DLA	0.10	mg/L		28-APR-14	R2829421
Temperature supplied by Client							
Temperature, Client Provided	1.5		0.1	Degree C		24-APR-14	R2827127
Un-ionized ammonia							
Ammonia, Un-ionized (as N)	0.057		0.010	mg/L		29-APR-14	
pH supplied by Client							
pH, Client Supplied	8.50		0.10	pH		24-APR-14	R2827127
L1446721-3 STONY PRIMARY							
Sampled By: Jason Cousin on 23-APR-14 @ 15:00							
Matrix: Lagoon							
Miscellaneous Parameters							
Phosphorus (P)-Total	1.71		0.010	mg/L		28-APR-14	R2828730
Un-ionized ammonia							
Ammonia by colour							
Ammonia, Total (as N)	3.52	DLA	0.10	mg/L		28-APR-14	R2829421
Temperature supplied by Client							
Temperature, Client Provided	1.9		0.1	Degree C		24-APR-14	R2827127
Un-ionized ammonia							
Ammonia, Un-ionized (as N)	0.104		0.010	mg/L		29-APR-14	
pH supplied by Client							
pH, Client Supplied	8.50		0.10	pH		24-APR-14	R2827127
L1446721-4 ROCKWOOD STORAGE							
Sampled By: Jason Cousin on 23-APR-14 @ 15:00							
Matrix: Lagoon							
Miscellaneous Parameters							
Phosphorus (P)-Total	2.88		0.010	mg/L		28-APR-14	R2828730
Un-ionized ammonia							
Ammonia by colour							
Ammonia, Total (as N)	12.1	DLA	1.0	mg/L		29-APR-14	R2830136
Temperature supplied by Client							
Temperature, Client Provided	1.6		0.1	Degree C		24-APR-14	R2827127
Un-ionized ammonia							
Ammonia, Un-ionized (as N)	0.113		0.010	mg/L		30-APR-14	
pH supplied by Client							

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1446721-4 ROCKWOOD STORAGE Sampled By: Jason Cousin on 23-APR-14 @ 15:00 Matrix: Lagoon **pH supplied by Client**							
pH, Client Supplied	8.00		0.10	pH		24-APR-14	R2827127

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Appendix D

Detailed Cost Estimate

Item #	Description	Unit	Quantity	Unit Price	Amount
1	Lagoon Excavation	cubic metre	220,000	$6.50	$1,430,000.00
2	Lagoon Cutoff Wall Excavation	cubic metre	35,000	$8.50	$297,500.00
3	Lagoon Slope Rip-Rap	sq. metre	20,200	$26.00	$525,200.00
4	Lagoon Rip-Rap Existing SMI Top Dike	sq. metre	14,300	$26.00	$371,800.00
5	Top Soil and Seeding	lump sum	1	$30,000.00	$30,000.00
6	Perimeter Fence	lineal metre	2,210	$15.00	$33,150.00
7	Lagoon Signage	lump sum	1	$4,500.00	$4,500.00
8	Aeration Piping Trenching	lineal metre	387	$60.00	$23,220.00
9	Concrete Approach Pad and Spillway	lump sum	1	$37,500.00	$37,500.00
10	Intercell Piping				
	a) 300 mm Intercell Piping	lineal metre	72	$225.00	$16,200.00
	b) 450 mm Intercell Piping	lineal metre	90	$325.00	$29,250.00
11	450 mm Effluent Piping Aeration Cell 2 to STB	lineal metre	330	$325.00	$107,250.00
12	300 mm Effluent Piping STB to Storage Cells	lineal metre	637	$225.00	$143,325.00
13	200 mm Building Sewer to Aeration Cell 1	lineal metre	55	$200.00	$11,000.00
14	100 mm Aeration Cell Liquid Level Indication	lineal metre	60	$150.00	$9,000.00
15	Gate Valves				
	a) 100 mm Gate Valve	each	1	$2,850.00	$2,850.00
	b) 200 mm Gate Valve	each	1	$3,500.00	$3,500.00
	c) 250 mm Gate Valve	each	2	$4,500.00	$9,000.00
	d) 300 mm Gate Valve	each	7	$6,500.00	$45,500.00
	e) 450 mm Gate Valve	each	3	$10,000.00	$30,000.00
16	Effluent Discharge Outfall	lump sum	1	$7,500.00	$7,500.00
17	Filling Lagoon	lump sum	1	$15,000.00	$15,000.00
18	Lift Stations				
	a) Rockwood Lift Station	lump sum	1	$320,000.00	$320,000.00
	b) SMI Lift Station	lump sum	1	$315,000.00	$315,000.00
19	Install MH on Existing WWS				
	a) Rockwood Sewer	lump sum	1	$9,500.00	$9,500.00
	b) SMI Sewer	lump sum	1	$8,000.00	$8,000.00
20	Gravity Sewer				
	a) 300 mm Gravity Sewer	lineal metre	155	$250.00	$38,750.00
	b) 375 mm Gravity Sewer	lineal metre	91	$275.00	$25,025.00
21	300 mm Lift Station Forcemain	lineal metre	192	$225.00	$43,200.00
21	Manhole Risers	lineal metre	12	$2,375.00	$28,500.00
22	Manhole Frame and Cover	each	3	$1,000.00	$3,000.00
23	Television and Mandrel Testing	lineal metre	246	$20.00	$4,920.00
24	Abondon Existing Gravity Sewer Forcemains and Spillways	lump sum	1	$26,750.00	$26,750.00
25	Existing Fence Removal	lump sum	1	$5,000.00	$5,000.00
26	Supply and Place Granular				
	a) A-Base	tonne	2,200	$28.00	$61,600.00
	c) C-Base	tonne	5,400	$26.00	$140,400.00
27	Non-Woven Geotextile	sq. metre	8,380	$3.50	$29,330.00
28	Culverts				
	a) 450 mm Culvert	lineal metre	34	$275.00	$9,350.00
	b) 600 mm Culvert	lineal metre	28	$300.00	$8,400.00
29	Regrade Existing Ditch	lineal metre	645	$18.00	$11,610.00
30	Sewage Treatment Building Civil Works	lump sum	1	$1,255,300.00	$1,255,300.00
31	Sewage Treatment Building Mechanical Works	lump sum	1	$852,500.00	$852,500.00
32	Sewage Treatment Building Electrical Works	lump sum	1	$623,100.00	$623,100.00
33	Aeration and Filter Equipment	lump sum	1	$1,050,000.00	$1,050,000.00
34	Site Grading Around Building	lump sum	1	$12,500.00	$12,500.00
35	Water Holding Tank	lump sum	1	$6,500.00	$6,500.00
36	Mobilization/Demobilization, Insurance & Bonding	lump sum	1	$193,700.00	$193,700.00
37	Material Testing Cash Allowance	lump sum	1	$18,000.00	$18,000.00
38	Hydro/MTS Cash Allowance	lump sum	1	$15,000.00	$15,000.00
				Subtotal Construction Costs	**$8,297,180.00**
				GST 5%	$414,900.00
				Contigency 15%	$1,244,600.00
				Class C Cost Estimate Total	**$9,956,680.00**

Appendix E

Plan EX1: Lagoon Test Holes and Existing Ground Contours

Plan L1: Lagoon Layout Plan

Plan L2: Lagoon Sections - Storage Cell 3 and Storage Cell 4 Dike Modifications

Plan L3: Lagoon Sections - Aeration Cell 1 and Storage Cell 5, Storage Cell 1 Keyway

Plan L4: Lagoon Pipe Layout Plan

Plan L5: Site Drainage, Perimeter Liner, Perimeter Fencing

Plan P1: Sewage Treatment Process Diagram

Plan S1: Sewage Treatment Building - South and West Elevation

Plan S2: Sewage Treatment Building - North and East Elevation

Plan S3: Sewage Treatment Building - Overall Layout

Plan LS1: Stony Mountain Lift Station Section Views

SCALE BAR
(IN METRES)

50 0 25 50 100 150 200 250

1:2500

No.	REVISIONS	DATE	INITIALS
	B.M. EL.		

LOCATIONS OF UNDERGROUND STRUCTURES/UTILITIES AS SHOWN ARE BASED ON AVAILABLE INFORMATION BUT NO GUARANTEE IS GIVEN OR IMPLIED THAT ALL EXISTING UNDERGROUND STRUCTURES/UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL UNDERGROUND STRUCTURES/UTILITIES MUST BE OBTAINED FROM THE APPROPRIATE AUTHORITY/OWNER, BY THE CONTRACTOR, BEFORE PROCEEDING WITH CONSTRUCTION.

ENGINEER'S SEAL

PRELIMINARY

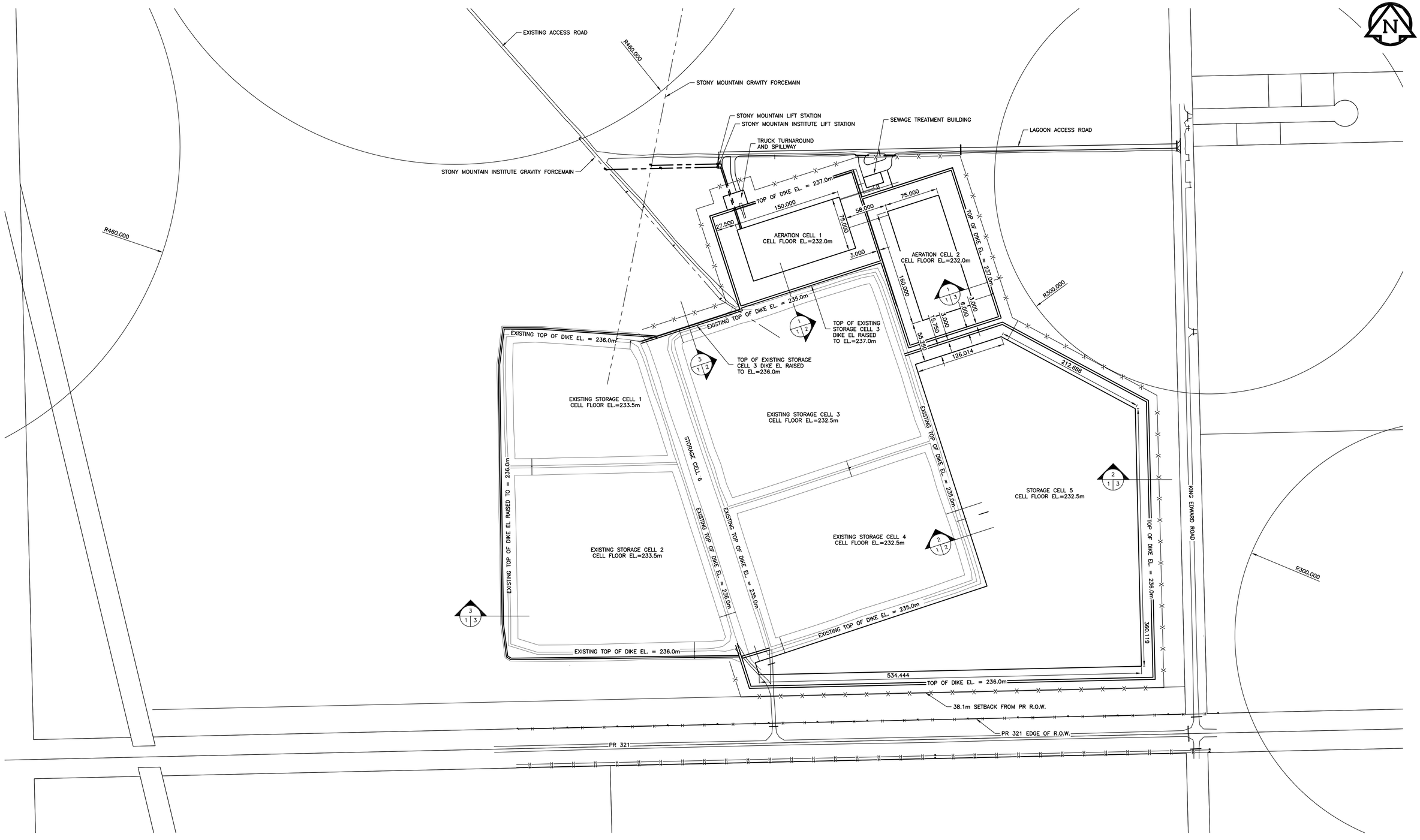
JR Cousin Consultants Ltd.
91A Scurfield Blvd. Winnipeg MB R3Y 1G4
p. (204) 489-0474
f. (204) 489-0487
www.jrcc.ca
ENGINEERING CONSULTANTS
ENGINEERING EXCELLENCE SINCE 1981

CODE:	R–325.52
DESIGNED BY:	JRC
DRAWN BY:	OT
REVIEWED BY:	JRC

PROJECT:
R.M. OF ROCKWOOD – STONY MOUNTAIN
LAGOON AND SEWAGE TREATMENT BUILDING

TITLE:
LAGOON TESTHOLES AND
EXISTING GROUND CONTOURS

SCALE:	DATE:	PLAN:	SHEET:
1:2500	14/04/14	EX1	1 of 11



SCALE BAR
(IN METRES)

50 0 25 50 100 150 200 250

1:2500

No.	REVISIONS	DATE	INITIALS

B.M. EL.

LOCATIONS OF UNDERGROUND STRUCTURES/UTILITIES AS SHOWN ARE BASED ON AVAILABLE INFORMATION BUT NO GUARANTEE IS GIVEN OR IMPLIED THAT ALL EXISTING UNDERGROUND STRUCTURES/UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL UNDERGROUND STRUCTURES/UTILITIES MUST BE OBTAINED FROM THE APPROPRIATE AUTHORITY/OWNER, BY THE CONTRACTOR, BEFORE PROCEEDING WITH CONSTRUCTION.

ENGINEER'S SEAL

PRELIMINARY

JR Cousin Consultants Ltd.
91A Scurfield Blvd. Winnipeg MB R3Y 1G4
p. (204) 489-0474
f. (204) 489-0487
www.jrcc.ca
ENGINEERING CONSULTANTS
ENGINEERING EXCELLENCE SINCE 1981

CODE:	R-325.52
DESIGNED BY:	JRC
DRAWN BY:	OT
REVIEWED BY:	JRC

PROJECT:
R.M. OF ROCKWOOD – STONY MOUNTAIN
LAGOON AND SEWAGE TREATMENT BUILDING

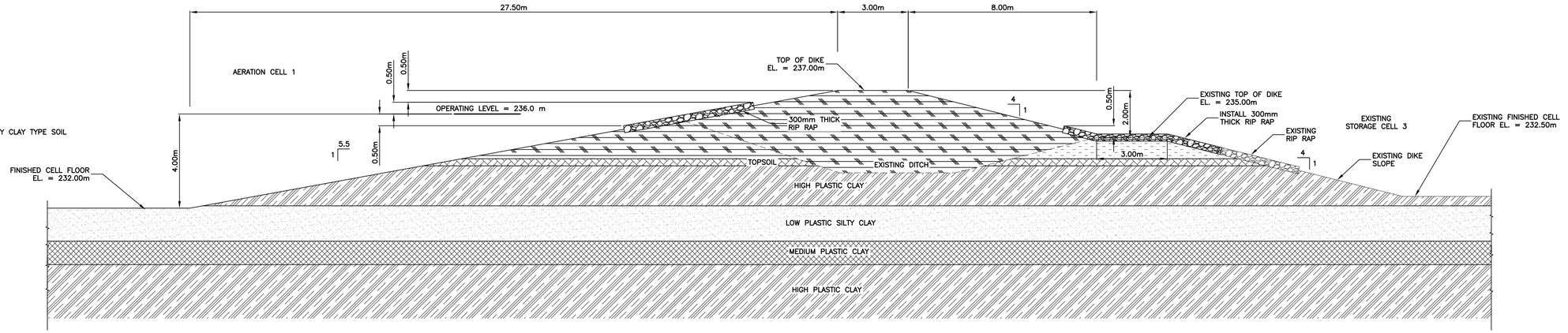
TITLE:
LAGOON LAYOUT PLAN

SCALE:	DATE:	PLAN:	SHEET:
1:2500	14/04/14	L1	2 of 11

May 16, 2014 - 12:38pm P:\325\325 Rockwood RM\325.52 RM Stat Lagoon Design and Construction\04 Drawings\dwg\Pre-Design\L01, L1, L4, L5.dwg

LEGEND:

- EXCAVATED AND COMPACTED HIGH PLASTICITY CLAY TYPE SOIL
- LOW PLASTICITY SILTY CLAY TYPE SOIL
- EXCAVATED AND COMPACTED MATERIAL
- HIGH PLASTICITY CLAY TYPE SOIL
- MEDIUM TO HIGH PLASTICITY CLAY TYPE SOIL
- LOW–MEDIUM PLASTICITY CLAY TYPE SOIL
- CONCRETE
- RIP RAP
- EXISTING DIKE
- TOPSOIL
- MEDIUM PLASTICITY CLAY TYPE SOIL

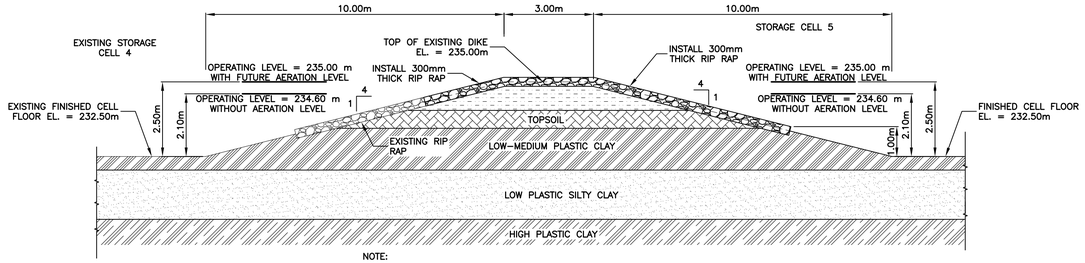


NOTE:

– SECTION MATERIAL IS BASED ON JRCC–TH7 (2010).

1 | 1 | 2 AERATION CELL 1 AND STORAGE CELL 3 INTERCELL DIKE

SCALE = 1:100

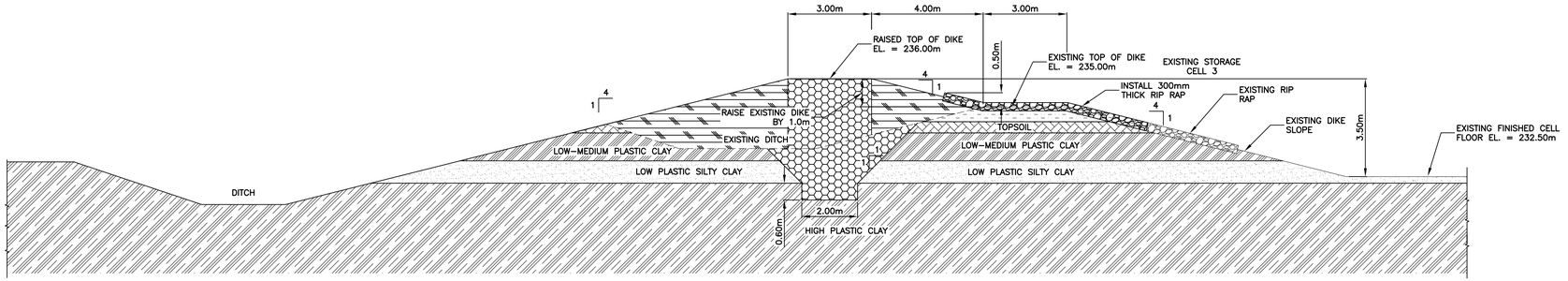


NOTE:

– SECTION MATERIAL IS BASED ON TH6 (JRCC–2011).

2 | 1 | 2 STORAGE CELL 4 AND 5 INTERCELL DIKE

SCALE = 1:100



NOTE:

– SECTION MATERIAL IS BASED ON TH10 (JRCC–2011).

3 | 1 | 2 STORAGE CELL 3 RAISED DIKE

SCALE = 1:100

No.	REVISIONS	DATE	INITIALS

B.M. EL.

LOCATIONS OF UNDERGROUND STRUCTURES/UTILITIES AS SHOWN ARE BASED ON AVAILABLE INFORMATION BUT NO GUARANTEE IS GIVEN OR IMPLIED THAT ALL EXISTING UNDERGROUND STRUCTURES/UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL UNDERGROUND STRUCTURES/UTILITIES MUST BE OBTAINED FROM THE APPROPRIATE AUTHORITY/OWNER, BY THE CONTRACTOR, BEFORE PROCEEDING WITH CONSTRUCTION.

ENGINEER'S SEAL

PRELIMINARY

JR Cousin Consultants Ltd.
91A Scurfield Blvd. Winnipeg MB R3Y 1G4
p. (204) 489-0474
f. (204) 489-0487
www.jrcc.ca
ENGINEERING CONSULTANTS
ENGINEERING EXCELLENCE SINCE 1981

CODE:	R–325.52
DESIGNED BY:	JRC
DRAWN BY:	OT
REVIEWED BY:	JRC

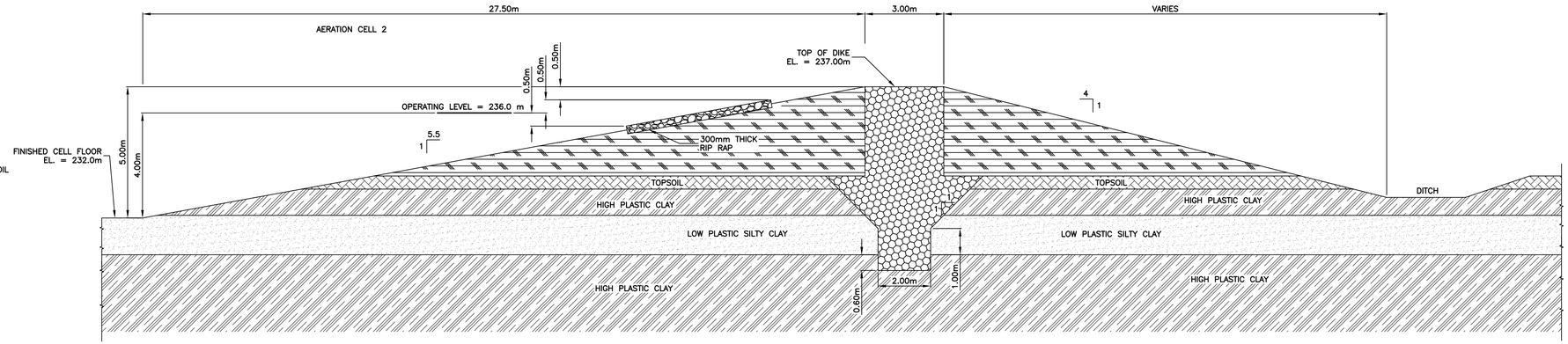
PROJECT: R.M. OF ROCKWOOD – STONY MOUNTAIN LAGOON AND SEWAGE TREATMENT BUILDING

TITLE: LAGOON SECTIONS
STORAGE CELL 3 AND STORAGE CELL 4 DIKE MODIFICATIONS

SCALE:	DATE:	PLAN:	SHEET:
1:100	14/04/14	L2	3 of 11

LEGEND:

- EXCAVATED AND COMPACTED HIGH PLASTICITY CLAY TYPE SOIL
- LOW PLASTICITY SILTY CLAY TYPE SOIL
- EXCAVATED AND COMPACTED MATERIAL
- HIGH PLASTICITY CLAY TYPE SOIL
- MEDIUM TO HIGH PLASTICITY CLAY TYPE SOIL
- LOW–MEDIUM PLASTICITY CLAY TYPE SOIL
- CONCRETE
- RIP RAP
- EXISTING DIKE
- TOPSOIL
- MEDIUM PLASTICITY CLAY TYPE SOIL

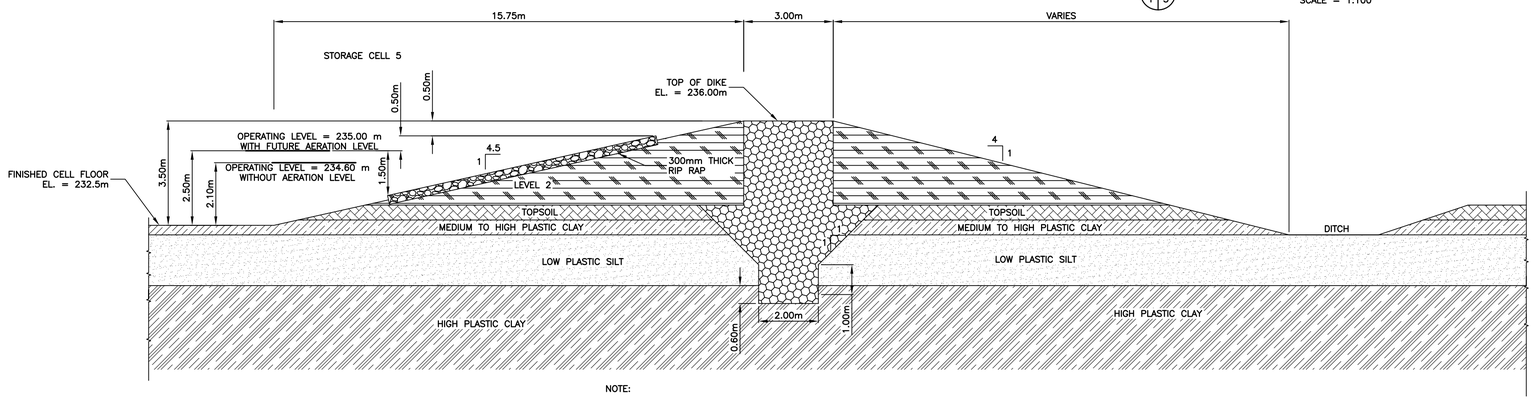


NOTE:

– SECTION MATERIAL IS BASED ON JRCC–TH5 (2010).

1 | 3 AERATION CELL 2 PERIMETER DIKE

SCALE = 1:100

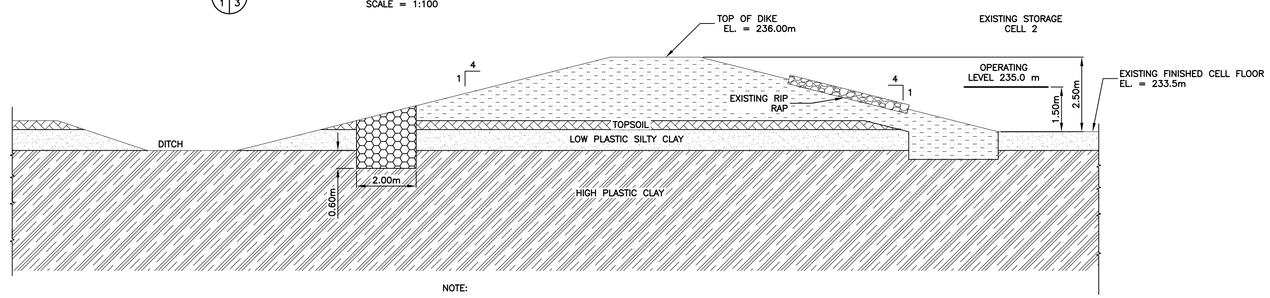


NOTE:

– SECTION MATERIAL IS BASED ON AMEC TH07.

2 | 1 | 3 STORAGE CELL 5 PERIMTER DIKE

SCALE = 1:100



NOTE:

– SECTION MATERIAL IS BASED ON TH19 (JRCC–2011).

3 | 1 | 3 STORAGE CELL 1 AND 2 KEYWAY

SCALE = 1:100

No.	REVISIONS	DATE	INITIALS
	B.M. EL.		

LOCATIONS OF UNDERGROUND STRUCTURES/UTILITIES AS SHOWN ARE BASED ON AVAILABLE INFORMATION BUT NO GUARANTEE IS GIVEN OR IMPLIED THAT ALL EXISTING UNDERGROUND STRUCTURES/UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL UNDERGROUND STRUCTURES/UTILITIES MUST BE OBTAINED FROM THE APPROPRIATE AUTHORITY/OWNER, BY THE CONTRACTOR, BEFORE PROCEEDING WITH CONSTRUCTION.

ENGINEER'S SEAL

PRELIMINARY

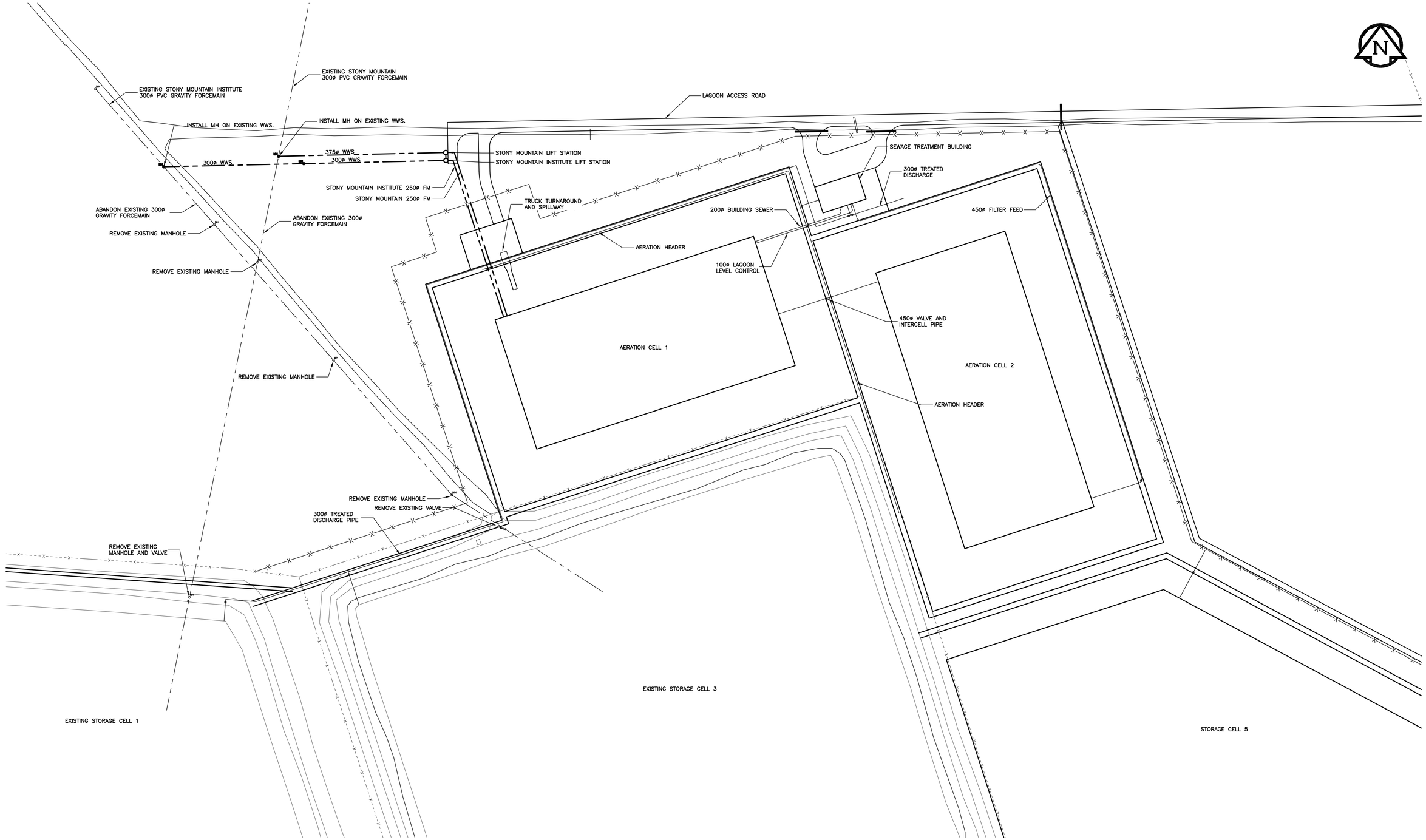
JR Cousin Consultants Ltd.
91A Scurfield Blvd. Winnipeg MB R3Y 1G4
p. (204) 489-0474
f. (204) 489-0487
www.jrcc.ca
ENGINEERING CONSULTANTS
ENGINEERING EXCELLENCE SINCE 1981

CODE:	R–325.52
DESIGNED BY:	JRC
DRAWN BY:	OT
REVIEWED BY:	JRC

PROJECT: R.M. OF ROCKWOOD – STONY MOUNTAIN
LAGOON AND SEWAGE TREATMENT BUILDING

TITLE: LAGOON SECTIONS
AERATION CELL 1 AND STORAGE CELL 5
STORAGE CELL 1 KEYWAY

SCALE:	DATE:	PLAN:	SHEET:
1:100	14/04/14	L3	4 of 11



SCALE BAR
(IN METRES)
20 0 10 20 40 60 80 100
1:1000

No.	REVISIONS	DATE	INITIALS

B.M. EL.

LOCATIONS OF UNDERGROUND STRUCTURES/UTILITIES AS SHOWN ARE BASED ON AVAILABLE INFORMATION BUT NO GUARANTEE IS GIVEN OR IMPLIED THAT ALL EXISTING UNDERGROUND STRUCTURES/UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL UNDERGROUND STRUCTURES/UTILITIES MUST BE OBTAINED FROM THE APPROPRIATE AUTHORITY/OWNER, BY THE CONTRACTOR, BEFORE PROCEEDING WITH CONSTRUCTION.

ENGINEER'S SEAL

PRELIMINARY

JR Cousin Consultants Ltd.
91A Scurfield Blvd. Winnipeg MB R3Y 1G4
p. (204) 489-0474
f. (204) 489-0487
www.jrcc.ca
ENGINEERING CONSULTANTS
ENGINEERING EXCELLENCE SINCE 1981

CODE:	R-325.52
DESIGNED BY:	JRC
DRAWN BY:	OT
REVIEWED BY:	JRC
PROJECT:	R.M. OF ROCKWOOD – STONY MOUNTAIN LAGOON AND SEWAGE TREATMENT BUILDING
TITLE:	LAGOON PIPE LAYOUT PLAN
SCALE:	1:1000
DATE:	14/04/14
PLAN:	L4
SHEET:	5 of 11

May 16, 2014 - 12:36pm K:\300\325 Rockwood RM\325.53 RM Lagoon Design and Construction\04 Drawings\dwg\Pre-Design\325_L1, L4, L5.dwg

REMOVE EXISTING CULVERT

18m – 450ø CULVERT

16m – 450ø CULVERT

14m – 600ø CULVERT
N INV: 232.80
S INV: 232.74

REMOVE EXISTING CULVERT AND INSTALL 14m – 600ø CULVERT

233.14

338 m DRAINAGE DITCH @ 0.1%

233.14

232.80

232.74

99 m DRAINAGE DITCH @ 0.47%

233.60

LAGOON INTERMITTENT CONTINUOUS DISCHARGE

239 m DRAINAGE DITCH @ 0.1%

132 m DRAINAGE DITCH @ 0.1%

PERIMETER FENCE

CONNECT PERIMETER FENCE TO EXISTING FENCING

REMOVE EXISTING FENCING

LAGOON STORAGE PRIMARY DISCHARGE LOCATION

232.50

REGRADE 209 m OF EXISTING DRAINAGE DITCH @ 0.05%

233.99

112 m DRAINAGE DITCH @ 0.05%

234.22

234.14

263 m DRAINAGE DITCH @ 0.05%

232.32

REMOVE EXISTING FENCING

REMOVE EXISTING FENCING

LAGOON PERIMETER CUTOFF WALL LINER

REMOVE EXISTING CULVERT

REGRADE 436 m OF EXISTING DRAINAGE DITCH @ 0.05%

REMOVE EXISTING FENCING

CONNECT PERIMETER FENCE TO EXISTING FENCING

233.75

232.77

REMOVE EXISTING CULVERT

LAGOON STORAGE OPTIONAL DISCHARGE LOCATION FOR CELL 1 AND 2

EXISTING 1050ø CULVERT
NORTH INV: 232.070
SOUTH INV: 231.952

232.47

232.10

SCALE BAR
(IN METRES)

40 0 20 40 80 120 160 200

1:2000

No.	REVISIONS	DATE	INITIALS

B.M. EL.

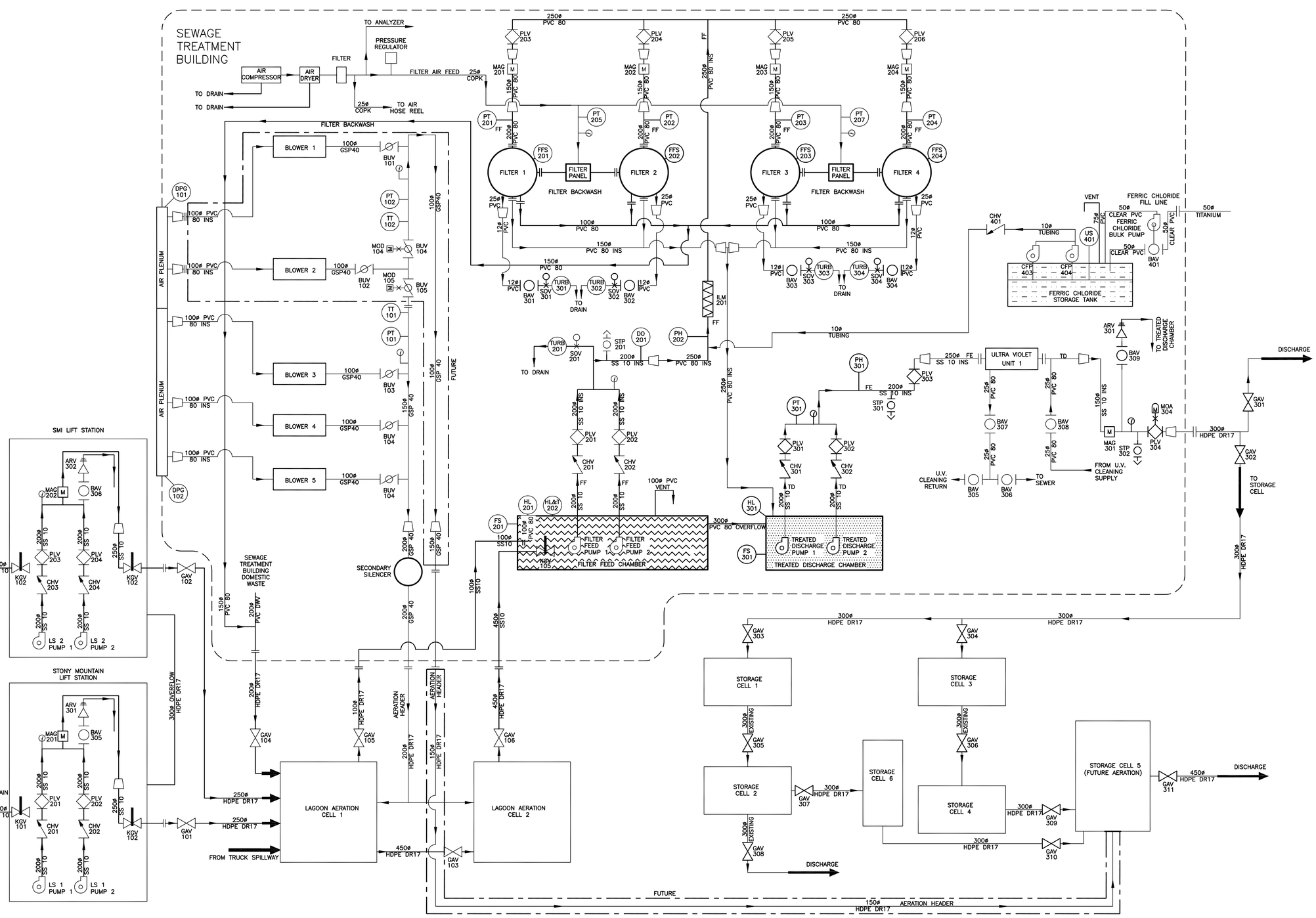
LOCATIONS OF UNDERGROUND STRUCTURES/UTILITIES AS SHOWN ARE BASED ON AVAILABLE INFORMATION BUT NO GUARANTEE IS GIVEN OR IMPLIED THAT ALL EXISTING UNDERGROUND STRUCTURES/UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL UNDERGROUND STRUCTURES/UTILITIES MUST BE OBTAINED FROM THE APPROPRIATE AUTHORITY/OWNER, BY THE CONTRACTOR, BEFORE PROCEEDING WITH CONSTRUCTION.

ENGINEER'S SEAL

PRELIMINARY

JR Cousin Consultants Ltd.
91A Scurfield Blvd. Winnipeg MB R3Y 1G4
p. (204) 489-0474
f. (204) 489-0487
www.jrcc.ca
ENGINEERING CONSULTANTS
ENGINEERING EXCELLENCE SINCE 1981

CODE:	R–325.52
DESIGNED BY:	JRC
DRAWN BY:	OT
REVIEWED BY:	JRC
PROJECT:	R.M. OF ROCKWOOD – STONY MOUNTAIN LAGOON AND SEWAGE TREATMENT BUILDING
TITLE:	SITE DRAINAGE, PERIMETER LINER, PERIMETER FENCING
SCALE:	1:2000
DATE:	14/04/14
PLAN:	L5
SHEET:	6 of 11



LEGEND

- PUMP
- MAG METER
- GATE VALVE (GENERAL)
- PLUG VALVE
- KNIFE GATE VALVE
- BALL VALVE
- BUTTERFLY VALVE
- SAMPLE TAP
- FLOW DIRECTION
- FLANGE CONNECTION
- UNION
- CHECK VALVE
- AIR RELEASE
- PRESSURE GAUGE
- SOLENOID VALVE
- MOTORIZED VALVE (DIGITAL – OPEN/CLOSED)
- MOTORIZED VALVE (ANALOG – CONTROL)
- REDUCER
- PLC INTERFACE
- DEVICE IDENTIFIER
- INLINE MIXER
- FUTURE DEVELOPMENT

PIPE MATERIAL CODE

CODE	PIPE MATERIAL AND RATING
SS10	STAINLESS STEEL SCHEDULE 10
ST40	STEEL PIPE, ANSI 150 # FLANGE RATING
GSP	GALVANIZED STEEL PIPE, ANSI 150 # FLANGE RATING
PVC40	PVC PIPE, SCHEDULE 40
PVC80	PVC PIPE, SCHEDULE 80
TUBING	TEFLON TUBING IN PVC SCH 40 CARRIER PIPE
CI	CAST IRON–DRAIN WASTE VENT PIPE
COPK	TYPE K COPPER PIPE
COPL	TYPE L COPPER PIPE
INS	INSULATED PIPE
HDPE DR17	HIGH DENSITY POLYETHYLENE DR17
CLEAR PVC	CLEAR PVC PIPE SCHEDULE 40

FE – FILTER EFFLUENT

FF – FILTER FEED

TD – TREATED DISCHARGE EFFLUENT

FR – FILTER BACKWASH

- TT TEMPERATURE TRANSMITTER
- PT PRESSURE TRANSDUCER
- DO DISSOLVED OXYGEN UNIT
- PH&R COMBINED PH & ORP SENSOR
- HL&T HYDROSTATIC LEVEL SENSOR WITH TEMPERATURE
- FFS FILTER FLOOD SWITCH
- BFS BUILDING FLOOD SWITCH
- US ULTRASONIC TRANSDUCER
- FS FLOAT SWITCH
- TURB TURBIDITY METER
- M MOTOR
- DPG DIFFERENTIAL PRESSURE GAUGE
- PH PH SENSOR
- HL HYDROSTATIC LEVEL SENSOR

No.	REVISIONS	DATE	INITIALS
			B.M. EL.

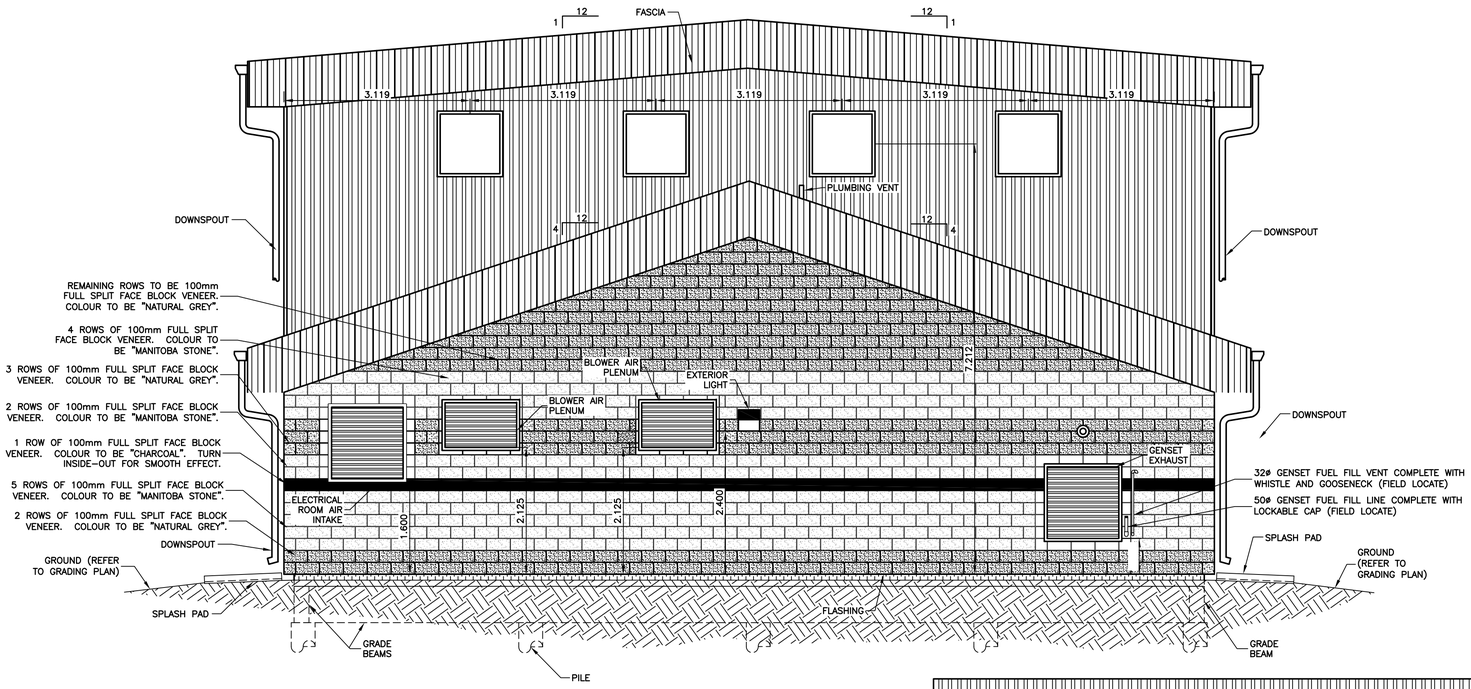
LOCATIONS OF UNDERGROUND STRUCTURES/UTILITIES AS SHOWN ARE BASED ON AVAILABLE INFORMATION BUT NO GUARANTEE IS GIVEN OR IMPLIED THAT ALL EXISTING UNDERGROUND STRUCTURES/UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL UNDERGROUND STRUCTURES/UTILITIES MUST BE OBTAINED FROM THE APPROPRIATE AUTHORITY/OWNER, BY THE CONTRACTOR, BEFORE PROCEEDING WITH CONSTRUCTION.

ENGINEER'S SEAL

PRELIMINARY

JR Cousin Consultants Ltd.
91A Scurfield Blvd. Winnipeg MB R3Y 1G4
p. (204) 489-0474
f. (204) 489-0487
www.jrcc.ca
ENGINEERING CONSULTANTS
ENGINEERING EXCELLENCE SINCE 1981

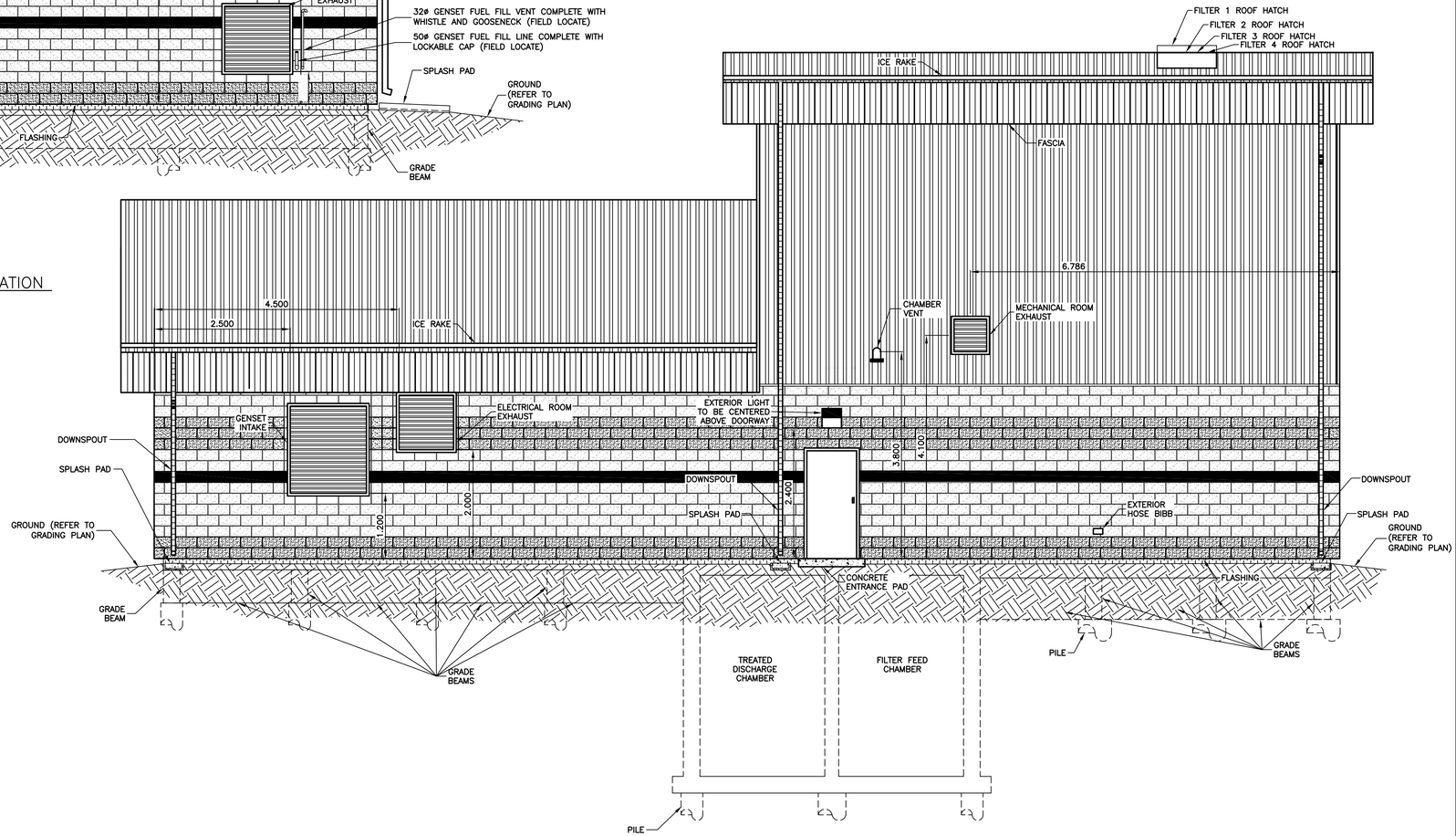
CODE:	R-325.52
DESIGNED BY:	JRC
DRAWN BY:	OT
REVIEWED BY:	JC
PROJECT:	R.M. ROCKWOOD – STONY MOUNTAIN LAGOON AND SEWAGE TREATMENT BUILDING
TITLE:	SEWAGE TREATMENT PROCESS DIAGRAM
SCALE:	NTS
DATE:	14/04/14
PLAN:	P1
SHEET:	7 of 11



NOTE:

REFER TO SPECIFICATION FOR ALL ROOF LOUVRES AND VENTS

1/1 WEST ELEVATION



2/1 SOUTH ELEVATION

NOTES:

- SUBMIT COLOUR SAMPLES FOR APPROVAL
- FINAL COLOURS TO BE DETERMINED BY OWNER DURING SHOP DRAWING REVIEW PROCESS.
- AROUND ALL LOUVERS AND OTHER OPENINGS THROUGH VENEER WALL TURN VENEER BLOCK INSIDE-OUT FOR "SMOOTH EFFECT" AROUND OPENING. COLOUR TO MATCH ROW COLOUR.
- COORDINATE PLACEMENT OF ALL LOUVRES WITH BUILDING SHOP DRAWINGS. ENSURE LOUVRE OPENINGS DO NOT INTERFERE WITH BUILDING COLUMN, BEAM, ETC.
- PROVIDE EXPANSION JOINT AS PER MASONRY MANUFACTURER RECOMMENDATIONS.
- REFER TO SPECIFICATION FOR ALL ROOF LOUVERS AND VENTS.

No.	REVISIONS	DATE	INITIALS
			B.M. EL.

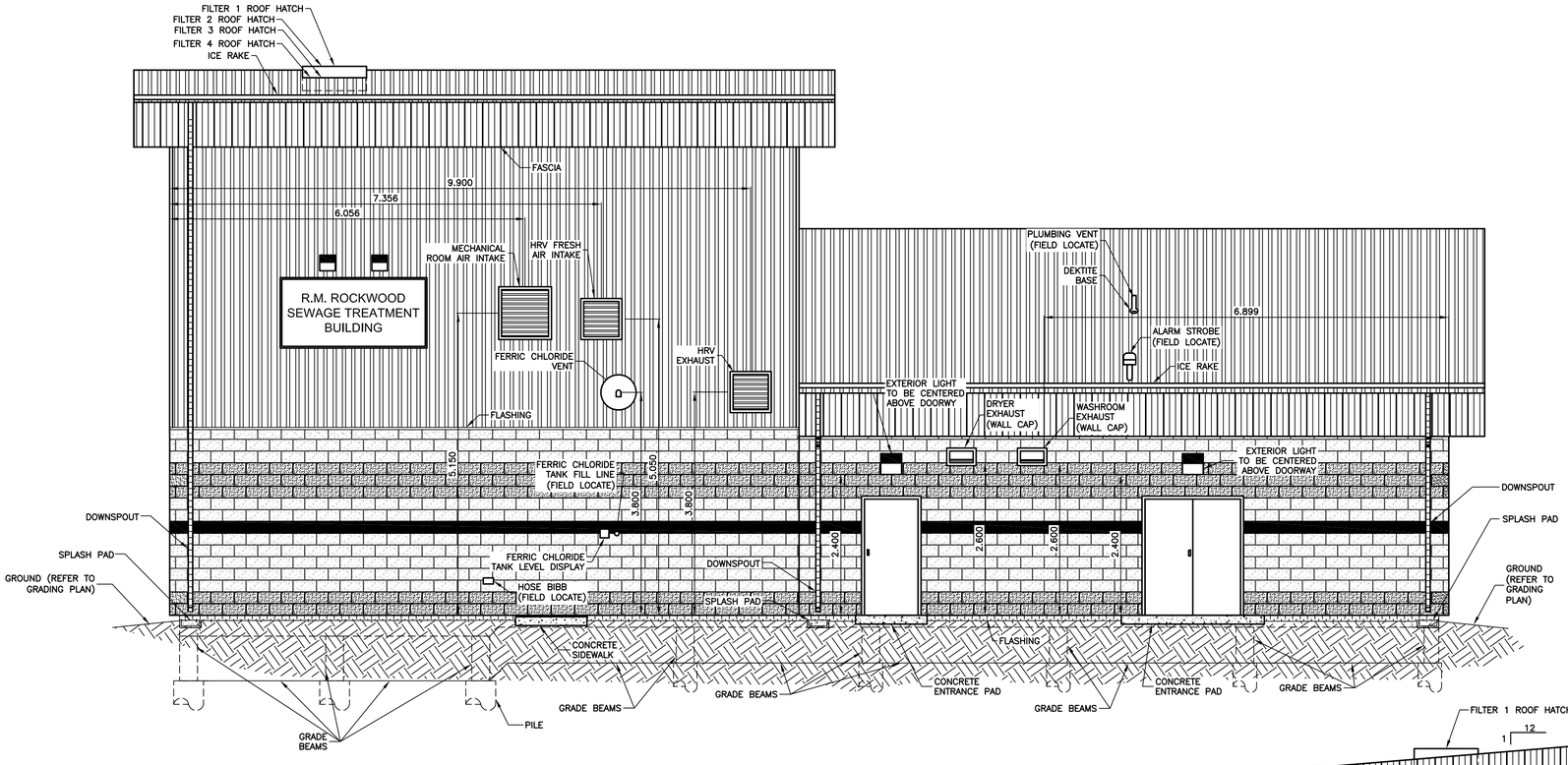
LOCATIONS OF UNDERGROUND STRUCTURES/UTILITIES AS SHOWN ARE BASED ON AVAILABLE INFORMATION BUT NO GUARANTEE IS GIVEN OR IMPLIED THAT ALL EXISTING UNDERGROUND STRUCTURES/UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL UNDERGROUND STRUCTURES/UTILITIES MUST BE OBTAINED FROM THE APPROPRIATE AUTHORITY/OWNER, BY THE CONTRACTOR, BEFORE PROCEEDING WITH CONSTRUCTION.

ENGINEER'S SEAL

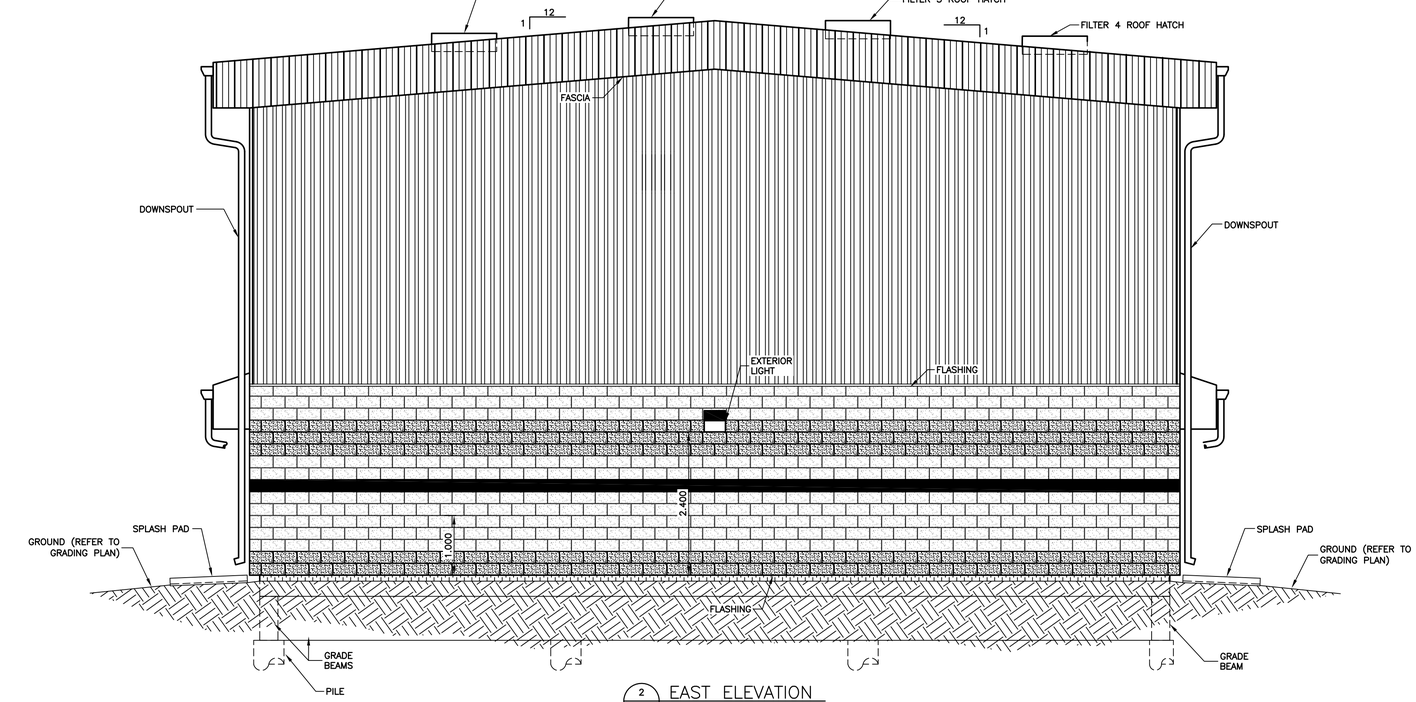
PRELIMINARY

JR Cousin Consultants Ltd.
91A Scurfield Blvd. Winnipeg MB R3Y 1G4
p. (204) 489-0474
f. (204) 489-0487
www.jrcc.ca
ENGINEERING CONSULTANTS
ENGINEERING EXCELLENCE SINCE 1981

CODE:	R-325.52
DESIGNED BY:	JRC
DRAWN BY:	OT
REVIEWED BY:	JC
PROJECT:	R.M. ROCKWOOD – STONY MOUNTAIN LAGOON AND SEWAGE TREATMENT BUILDING
TITLE:	SEWAGE TREATMENT BUILDING SOUTH AND WEST ELEVATION
SCALE:	1:50
DATE:	14/05/08
PLAN:	S1
SHEET:	8 of 11



1/2 NORTH ELEVATION



2/2 EAST ELEVATION

BUILDING COLOURS (INTERIOR)	
OBJECT	COLOUR
BUILDING DOORS (INTERIOR)	ANTIQUE LINEN
BUILDING DOOR TRIM (INTERIOR)	ANTIQUE LINEN
BUILDING INTERIOR WALL PANELS	WHITE WHITE
BUILDING INTERIOR ROOF (CEILING)	WHITE WHITE

BUILDING COLOURS (EXTERIOR)	
OBJECT	COLOUR
BUILDING TRIM (EXTERIOR)	ANTIQUE LINEN
BUILDING DOOR TRIM (EXTERIOR)	ANTIQUE LINER
BUILDING EXTERIOR WALL PANELS	ANTIQUE LINEN
BUILDING ROOF (EXTERIOR)	SLATE BLUE
BUILDING DOORS (EXTERIOR)	ANTIQUE LINEN
SOFFIT AND EAVES	SLATE BLUE
DOWNSPOUTS AND LOUVRES	ANTIQUE LINEN

NOTES:

- SUBMIT COLOUR SAMPLES FOR APPROVAL
- FINAL COLOURS TO BE DETERMINED BY OWNER DURING SHOP DRAWING REVIEW PROCESS.
- AROUND ALL LOUVERS AND OTHER OPENINGS THROUGH VENEER WALL TURN VENEER BLOCK INSIDE–OUT FOR "SMOOTH EFFECT" AROUND OPENING. COLOUR TO MATCH ROW COLOUR.
- COORDINATE PLACEMENT OF ALL LOUVRES WITH BUILDING SHOP DRAWINGS. ENSURE LOUVRE OPENINGS DO NOT INTERFERE WITH BUILDING COLUMN, BEAM, ETC.
- PROVIDE EXPANSION JOINT AS PER MASONRY MANUFACTURER RECOMMENDATIONS.
- REFER TO SPECIFICATION FOR ALL ROOF LOUVERS AND VENTS.

No.	REVISIONS	DATE	INITIALS

B.M. EL.

LOCATIONS OF UNDERGROUND STRUCTURES/UTILITIES AS SHOWN ARE BASED ON AVAILABLE INFORMATION BUT NO GUARANTEE IS GIVEN OR IMPLIED THAT ALL EXISTING UNDERGROUND STRUCTURES/UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL UNDERGROUND STRUCTURES/UTILITIES MUST BE OBTAINED FROM THE APPROPRIATE AUTHORITY/OWNER, BY THE CONTRACTOR, BEFORE PROCEEDING WITH CONSTRUCTION.

ENGINEER'S SEAL

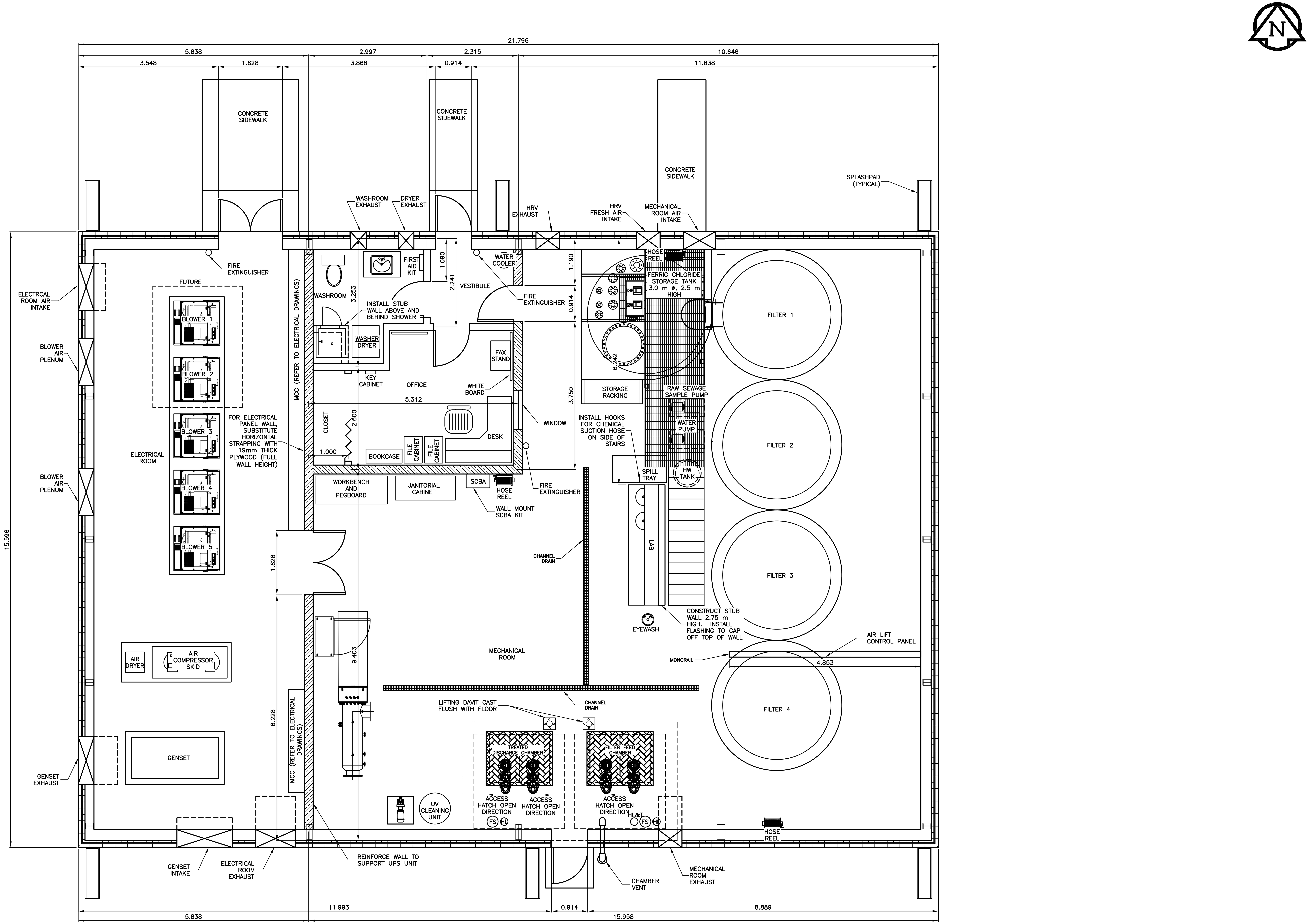
JR Cousin Consultants Ltd.
91A Scurfield Blvd. Winnipeg MB R3Y 1G4
p. (204) 489-0474
f. (204) 489-0487
www.jrcc.ca
ENGINEERING CONSULTANTS
ENGINEERING EXCELLENCE SINCE 1981

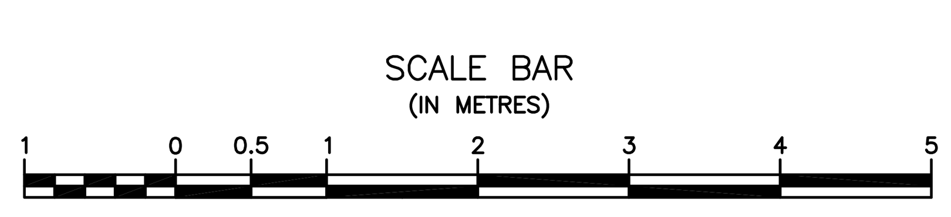
CODE:	R–325.52
DESIGNED BY:	JRC
DRAWN BY:	OT
REVIEWED BY:	JC

PROJECT: R.M. ROCKWOOD – STONY MOUNTAIN LAGOON AND SEWAGE TREATMENT BUILDING

TITLE: SEWAGE TREATMENT BUILDING NORTH AND EAST ELEVATION

SCALE:	DATE:	PLAN:	SHEET:
1:50	14/05/08	S2	9 of 11





No.	REVISIONS	DATE	INITIALS

B.M. EL.

LOCATIONS OF UNDERGROUND STRUCTURES/UTILITIES AS SHOWN ARE BASED ON AVAILABLE INFORMATION BUT NO GUARANTEE IS GIVEN OR IMPLIED THAT ALL EXISTING UNDERGROUND STRUCTURES/UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL UNDERGROUND STRUCTURES/UTILITIES MUST BE OBTAINED FROM THE APPROPRIATE AUTHORITY/OWNER, BY THE CONTRACTOR, BEFORE PROCEEDING WITH CONSTRUCTION.

ENGINEER'S SEAL

PRELIMINARY

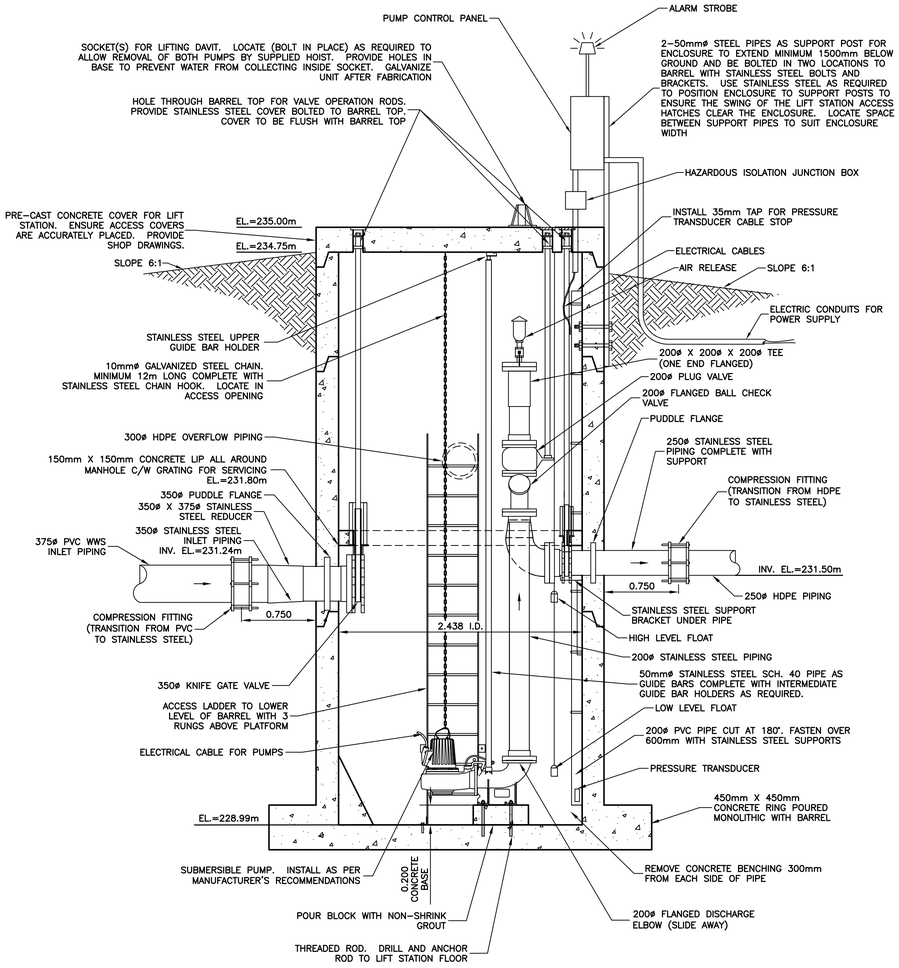
JR Cousin Consultants Ltd.
91A Scurfield Blvd. Winnipeg MB R3Y 1G4
p. (204) 489-0474
f. (204) 489-0487
www.jrcc.ca
ENGINEERING CONSULTANTS
ENGINEERING EXCELLENCE SINCE 1981

CODE: R-325.52
DESIGNED BY: JRC
DRAWN BY: OT
REVIEWED BY: JC

PROJECT: R.M. ROCKWOOD – STONY MOUNTAIN LAGOON AND SEWAGE TREATMENT BUILDING

TITLE: SEWAGE TREATMENT BUILDING OVERALL LAYOUT

SCALE: 1:50 | DATE: 14/04/14 | PLAN: S3 | SHEET: 10 of 11

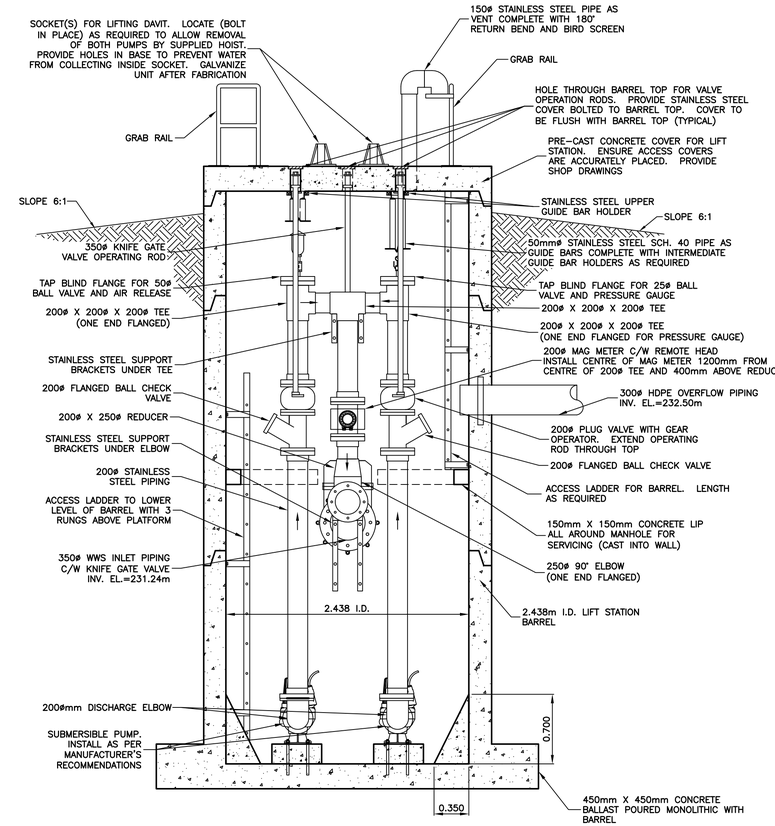


1/1 LIFT STATION SIDE SECTION A–A
SCALE = 1:30

HIGH LEVEL FLOAT	231.34
HIGH LEVEL ALARM	231.60
PUMP 2 START	231.34
PUMP 1 START	229.64
LOW LEVEL FLOAT	229.59
PUMP BASE	229.19
FLOOR	228.99

NOTES:

- PROVIDE VALVE ROD SUPPORTS.
- PROVIDE SUPPORT/RESTRAINT FOR ALL PIPING AS REQUIRED.
- ALL PIPING TO BE STAINLESS STEEL UNLESS OTHERWISE NOTED.



2/1 LIFT STATION FRONT SECTION B–B
SCALE = 1:30

No.	REVISIONS	DATE	INITIALS

B.M. EL.

LOCATIONS OF UNDERGROUND STRUCTURES/UTILITIES AS SHOWN ARE BASED ON AVAILABLE INFORMATION BUT NO GUARANTEE IS GIVEN OR IMPLIED THAT ALL EXISTING UNDERGROUND STRUCTURES/UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL UNDERGROUND STRUCTURES/UTILITIES MUST BE OBTAINED FROM THE APPROPRIATE AUTHORITY/OWNER, BY THE CONTRACTOR, BEFORE PROCEEDING WITH CONSTRUCTION.

ENGINEER'S SEAL

PRELIMINARY

JR Cousin Consultants Ltd.
91A Scurfield Blvd. Winnipeg MB R3Y 1G4
p. (204) 489-0474
f. (204) 489-0487
www.jrcc.ca
ENGINEERING CONSULTANTS
ENGINEERING EXCELLENCE SINCE 1981

CODE:	R-325.52
DESIGNED BY:	JRC
DRAWN BY:	OT
REVIEWED BY:	JR

PROJECT: R.M. OF ROCKWOOD – STONY MOUNTAIN LAGOON AND SEWAGE TREATMENT BUILIDNG

TITLE: STONY MOUNTAIN LIFT STATION SECTION VIEWS

SCALE:	DATE:	PLAN:	SHEET:
1:30	13/09/23	LS1	11 of 11

Appendix D

Plan 1: Lagoon Layout Plan with Setbacks to Existing Residences

Plan 2: Lagoon Drainage Route

SCALE BAR
(IN METRES)

100 0 50 100 200 300 400 500

1:5000

No.	REVISIONS	DATE	INITIALS
	B.M. EL.		

LOCATIONS OF UNDERGROUND STRUCTURES/UTILITIES AS SHOWN ARE BASED ON AVAILABLE INFORMATION BUT NO GUARANTEE IS GIVEN OR IMPLIED THAT ALL EXISTING UNDERGROUND STRUCTURES/UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL UNDERGROUND STRUCTURES/UTILITIES MUST BE OBTAINED FROM THE APPROPRIATE AUTHORITY/OWNER, BY THE CONTRACTOR, BEFORE PROCEEDING WITH CONSTRUCTION.

APEGM
Certificate of Authorization
J.R. Cousin Consultants Ltd.
No. 234 Date: 14/07/25

ENGINEER'S SEAL
PROVINCE OF MANITOBA
G.R. COUSIN
14/07/25
ENGINEER PROFESSIONAL ENGINEER

JR Cousin Consultants Ltd.
91A Scurfield Blvd. Winnipeg MB R3Y 1G4
p. (204) 489-0474
f. (204) 489-0487
www.jrcc.ca
ENGINEERING CONSULTANTS
ENGINEERING EXCELLENCE SINCE 1981

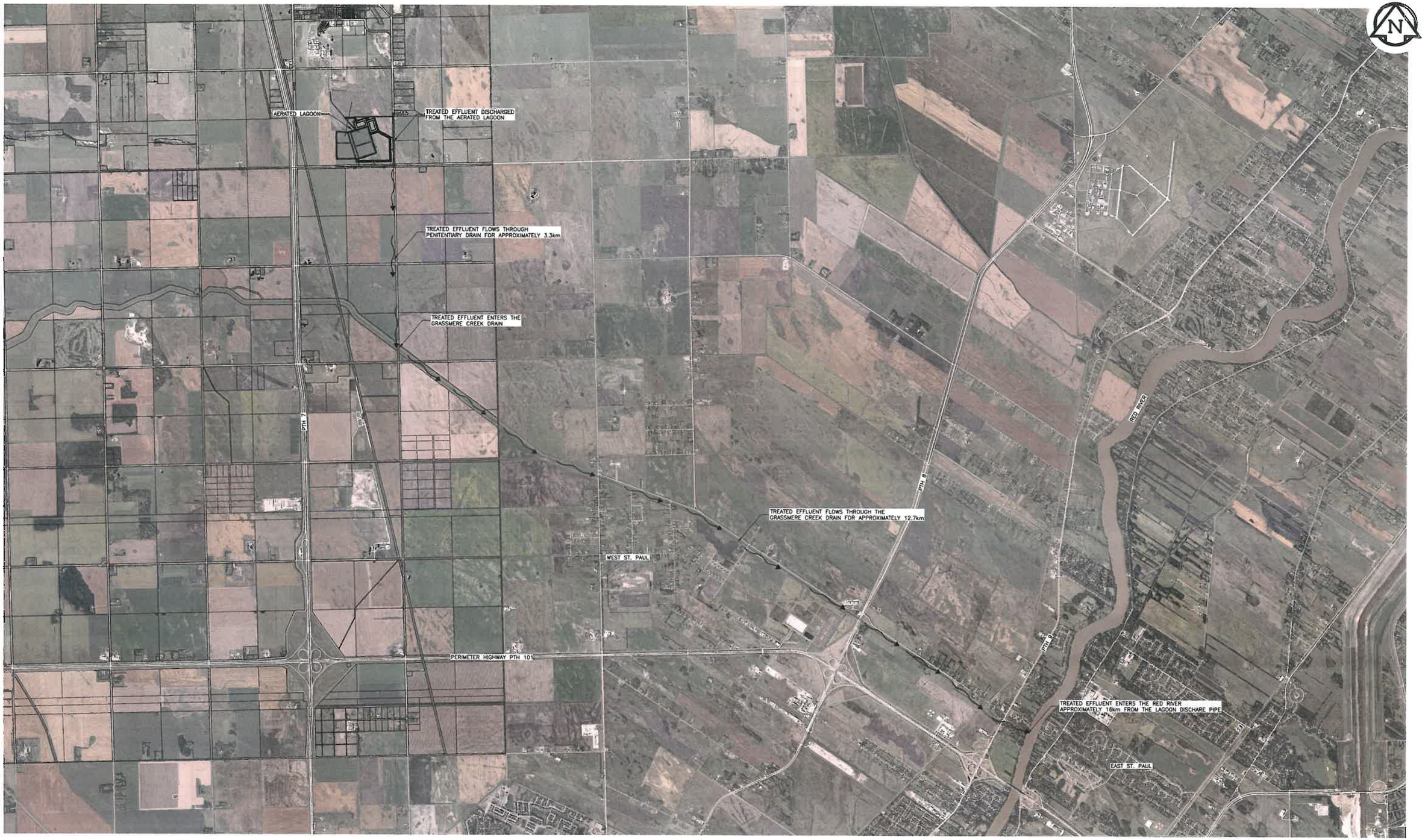
CODE:	R-325.52
DESIGNED BY:	JRC
DRAWN BY:	BM
REVIEWED BY:	JRC

PROJECT: R.M. OF ROCKWOOD - STONY MOUNTAIN LAGOON AND SEWAGE TREATMENT BUILDING

TITLE: LAGOON LAYOUT PLAN WITH SETBACKS TO EXISTING RESIDENCES

SCALE:	DATE:	PLAN:	SHEET:
1:5000	14/08/18	1	1 of 2

Jul 25, 2014 - 2:05pm P:\JRCB\JRCB Rockwood RM\MISSLE RM SSB Lagoon Design and Construction\AA Drawings\Civil\PLAN\PLAN.dwg



SCALE BAR
(IN METRES)

600 0 300 600 1200 1800 2400 3000

1:30000

No.	REVISIONS	DATE	INITIALS

B.M. EL.

LOCATIONS OF UNDERGROUND STRUCTURES/UTILITIES AS SHOWN ARE BASED ON AVAILABLE INFORMATION BUT NO GUARANTEE IS GIVEN OR IMPLIED THAT ALL EXISTING UNDERGROUND STRUCTURES/UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL UNDERGROUND STRUCTURES/UTILITIES MUST BE OBTAINED FROM THE APPROPRIATE AUTHORITY/OWNER, BY THE CONTRACTOR, BEFORE PROCEEDING WITH CONSTRUCTION.

Certificate of Authorization
J.R. Cousin Consultants Ltd.
No. 234 Date: 14/07/25

ENGINEER'S SEAL
PROVINCE OF MANITOBA
G.R. COUSIN
14/07/25
GEOSCIENCE PROFESSIONAL ENGINEER

JR Cousin Consultants Ltd.
91A Scurfield Blvd. Winnipeg MB R3Y 1G4
p. (204) 489-0474
f. (204) 489-0487
www.jrcc.ca
ENGINEERING CONSULTANTS
ENGINEERING EXCELLENCE SINCE 1981

CODE:	R-325.52
DESIGNED BY:	JRC
DRAWN BY:	BM
REVIEWED BY:	JRC

PROJECT: R.M. OF ROCKWOOD – STONY MOUNTAIN LAGOON AND SEWAGE TREATMENT BUILDING

TITLE: LAGOON DRAINAGE ROUTE

SCALE:	DATE:	PLAN:	SHEET:
1:30,000	14/06/18	2	2 of 2