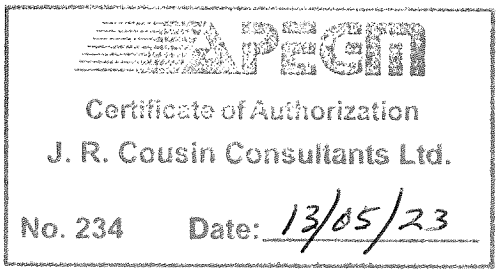
P&R #8.195 JRCC
B-246.10

RURAL MUNICIPALITY OF BROKENHEAD

Environment Act Proposal
for the
Wastewater Treatment Lagoon Expansion



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January 2013
Revised May 2013

ACKNOWLEDGMENTS

To prepare this report various sources of information were investigated and researched. J. R. Cousin Consultants Ltd. (JRCC) wishes to thank the RM of Brokenhead who contributed to the data and content of this report.

REMARKS

J. R. 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.

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Environment Act Proposal Form

Name of the development: RM OF BROKENHEAD WASTEWATER TREATMENT LAGOON EXPANSION	
Type of development per Classes of Development Regulation (Manitoba Regulation 164/88): WASTEWATER TREATMENT LAGOON - CLASS 2 DEVELOPMENT	
Legal name of the proponent of the development: RURAL MUNICIPALITY OF BROKENHEAD	Mailing address: 72013 ROAD 42 EAST BOX 490 GEAUSEJOUR, MB R0E 0C0
Location (street address, city, town, municipality, legal description) of the development: NW and SW ¼ 15-13-06 EPM	
Name of proponent contact person for purposes of the environmental assessment: MR. JERRY COUSIN	
Phone: (204) 489-0474 Fax: (204) 489-0487	Mailing address: J.R. COUSIN CONSULTANTS LTD. 91A SCURFIELD BLVD. WINNIPEG, MB, R3Y 1G4
Email address: jcousin@jrcc.ca	
Webpage address: www.jrcc.ca	
Date: 13/01/22	Signature of proponent, or corporate principal of corporate proponent: BM Cousin per/ Printed name: JERRY COUSIN

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

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

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

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

Submit the complete EAP to:

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

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

1.0 INTRODUCTION AND BACKGROUND

The development described herein is for expansion of the existing RM of Brokenhead wastewater treatment lagoon.

1.1 Introduction

The RM of Brokenhead is proposing to expand the existing wastewater treatment lagoon servicing the communities of Garson, Tyndall and Henryville as well as the truck haul loadings from the rural residents in the RM of Brokenhead. A lagoon expansion is required to accommodate the future proposed growth in the municipality. An Environment Act Licence is required from Manitoba Conservation for the construction and operation of the upgraded lagoon. J. R. Cousin Consultants Ltd. (JRCC) was retained for the related engineering services.

1.2 Contact Information

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Ms. Christine Hutlet
Chief Administrative Officer
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1.3 Background Information

The RM of Brokenhead lagoon was constructed in 2004 to service the communities of Garson, Tyndall and Henryville. A piped wastewater collection system, a water treatment plant and piped water distribution system were installed along with the lagoon construction. The lagoon will continue to service the communities of Garson, Tyndall and Henryville as well as the rural residents in the RM of Brokenhead.

The lagoon is currently operated under Environmental Licence No. 2646 R, issued on April 26, 2004 and revised on September 18, 2008. Based on higher than anticipated growth in the communities the wastewater treatment lagoon requires expansion and therefore a new environment act license is required.

1.4 Description of Previous Studies

A report entitled *R.M. of Brokenhead – Geotechnical Soils Investigation for Proposed Garson/Tyndall Lagoon Site* was completed by JRCC based on the January 2002 site investigation. This report identifies the presence of high plastic clay at the proposed lagoon site that could be used to construct a lagoon liner.

The Environmental Submission for the existing RM of Brokenhead wastewater treatment lagoon as well as water treatment plant and water distribution and wastewater collection piping was submitted by JRCC in March of 2002.

A Clean Environment Commission (CEC) public hearing was held on June 19 and 20, 2003 and continued on August 18 and 19, 2003. The Manitoba Clean Environment Commission report summarizing the hearings was submitted in November 2003. The repot recommended issuing a lagoon licence providing a 30 m buffer zone was maintained to the Devil's Creek riparian zone among other things.

A letter report entitled *RM of Brokenhead Water and Sewer Assessment Letter Report* was completed by JRCC in June of 2011. The report assessed the capacity of the existing wastewater treatment lagoon and the water treatment plant and reviewed the current and projected loadings for a 20 year design period. The report identified the primary cell of the lagoon was organically overloaded and growth in Garson, Tyndall and Henryville should be postponed until expansion of the lagoon occurs.

The *Rural Municipality of Brokenhead Wastewater Treatment Lagoon Expansion Feasibility Study* was completed by JRCC in June of 2012. Two subsequent letter reports were also completed as addendums to the feasibility study entitled *RM of Brokenhead Aerated Lagoon Assessment and Capital Cost Estimate*, July 2012 and *RM of Brokenhead – Assessment of Alternative Facultative/Aerated Lagoon Expansion Options and Capital Cost Estimates*, September 2012. The feasibility study with addendums was used to establish the conceptual design of the lagoon expansion. Various options were discussed, a geotechnical and topographic investigation was completed and cost estimates were provided.

2.0 DESCRIPTION OF THE DEVELOPMENT

For each heading there is an information request from the Environment Act Proposal Form. 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 lagoon expansion site is located immediately east of the existing RM of Brokenhead lagoon within the NW and SW ¼ of 15-13-06 EPM. The site is located on parcel "A" in legal plan no. 43287 WLTO. A copy of the Land Titles Transaction (Winnipeg – 2054799), a copy of the land title no. 2054799/1 registered on November 19, 2004 and the legal plan of works in the W. ½ 15-13-6 EPM, instrument no. 3066483, plan no. 43287 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, the mines and minerals and sand and gravel at the existing and proposed lagoon site are privately owned with the surface title for Parcel "A" Works Plan 43287 WLTO excluding such portion as may be required for the right of way and station grounds of the Canadian Pacific Railway in W ½ of 15-13-6 EPM (see email correspondence from the Crown Lands & Property Agency, dated January 8, 2013 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 east of the existing lagoon cells, and is currently being used for agricultural purposes. The surrounding lands adjacent to the site are all agricultural fields with the existing lagoon bordering the site to the west and the lagoon access road and the Devil's Creek bordering the site to the south (see Plan L1 in Appendix E).

A gas pipeline easement exists in the south end of Parcel "A" in the SW ¼ of 15-13-06 EPM. A 114.3 mm (4.5 in) steel high pressure gas transmission line is buried in the easement approximately 4.6 m from the north edge of the easement. According to Manitoba Hydro, the minimum cover during installation was 750 mm, however the current soil cover cannot be confirmed. According to Manitoba Hydro there is no setback from the gas line easement but no construction is to occur on the easement. If construction is to occur within 3 m of the gas line a Manitoba Hydro safety watch would be required. The lagoon expansion would be constructed away from the gas line easement which is at least 4.6 m from the gas line and therefore a safety watch would not be required.

E-mail correspondence from Manitoba Hydro and the Manitoba Hydro record drawing of the gas line is attached in Appendix A.

Soil would be excavated in the area of the proposed lagoon expansion for construction of the lagoon dikes and drainage ditches. The existing lagoon access road would continue to be utilized, which connects to Mile Road 74N.

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 lagoon expansion site is zoned as A80 (agricultural), based on zoning designations in the RM of Brokenhead.

2.4.1 Land Classification

According to the Agriculture and Agri-Food Canada Manitoba Agri-Map the proposed lagoon expansion site has a "fine" surface texture, a slope of "0 – 2%", "imperfect" soil drainage, "no significant 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 Class 3.

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

The Devil's Creek is not considered a "vulnerable" water body and the setback area is covered with permanent vegetation, thus the setback to the Devil's Creek should be a minimum of 3 m, based on the requirements of a 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 summer of 2013, 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. No date for decommissioning has been set for the lagoon.

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 1.9 km from the nearest community centre (community of Tyndall).
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 L1, 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 north and northwest of Garson and Tyndall.
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.

Manitoba Conservation Guideline	Proposed Relation to Site
5. Areas that are habitually flooded shall be avoided.	The proposed new lagoon dikes will constructed at a higher elevation than the existing lagoon dikes 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 x 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 x 10^{-7} cm/sec in most locations. Some of soils in the north portion of the new storage cell will be lined with re-worked and re-compacted clay.

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 L1 in Appendix E, shows the minimum setback distance requirements for the expanded lagoon to the local residents and community.

2.5.3 Lagoon Drainage Route

The drainage route from the expanded lagoon will follow the existing licensed drainage route from the RM of Brokenhead lagoon. The drainage route from the expansion cells will flow through perimeter ditches to the Devil's Creek (3rd Order Drain). The Devil's Creek flows approximately 30 km north to the Upper Devil's Lake which then enters the Red River. The total length of the drainage route from the lagoon to the Red River is approximately 36.5 km. The drainage route is shown on Plan L3 attached in the Appendix E.

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 fisheries concerns should be addressed given the existing drainage route will be used, erosion and sediment control measures are implemented where needed and the effluent meets or exceeds Manitoba Water Quality Standards, Objectives and Guidelines.

The Fisheries Branch indicated the Devil's Creek supports a number of large and small bodied species, at minimum providing seasonal spawning, rearing and foraging habitat. In the Fish Inventory and Habitat Classification System (FIHCS), Devil's Creek is classified as a Class 2 waterbody – a waterbody that has slight limitations to the production of fish. It also supports a recreational

fishery. According to the FIHCS the following fish species have been found in Devil's Creek: Central Mudminnow, Johnny Darter, Blacksided Darter, Brook Stickleback, Fathead Minnow, Blacknose Dace, Black Crappie, Brown Bullhead, Burbot, Common Carp, Channel Catfish, Emerald Shiner, Freshwater Drum, Goldeye, Northern Pike, Rock Bass, Sauger, Tadpole Madtom, Trout Perch, Walleye, White Bass, White Sucker and Yellow Perch.

The Fisheries Branch indicated they would prefer the discharge outlet to be located on the far east side of the lagoon to maximize the length of the discharge channel before entering the Devil's Creek. The Fisheries Branch also indicated they would prefer the discharge channel to meander with some widened sections for pools to provide an extra buffer to achieve water quality limits prior to entering a fish bearing creek and create fish habitat.

See January 9, 2013 email correspondence from Manitoba Conservation and Water Stewardship – Fisheries Branch.

2.5.3.2 Water Quality Information

Manitoba Conservation and Water Stewardship were contacted for water quality data in the Devil's Creek. Summarized water quality data from selected parameters are provided below. The water quality data is an average from six sampling locations along the Devil's Creek. All samples were taken on May 15, 2003. No other water quality data for the Devil's Creek was available.

Table B: Average Water Quality in the Devil's Creek

Parameter	Average Concentration	Unit
Ammonia Dissolved	0.07	mg/L
Escherichia coli*	43	CFU/100ML
Nitrogen Dissolved NO_3 & NO_2	L0.01	mg/L
Nitrogen Total Kjeldahl (TKN)	0.9	mg/L
Oxygen Dissolved	8.6	mg/L
Phosphorus Total (P)	0.07	mg/L
Conductivity (at 25C)	654	uS/cm
Total Suspended Solids (TSS)	20.3	mg/L
Turbidity	7.4	NTU

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

Based on the average concentrations shown in Table B, the Devil's Creek has naturally low nutrient levels (phosphorus and nitrogen).

2.5.4 Access Road

The expanded lagoon site would continue to be accessed by the all weather lagoon access road which runs off of Mile Road 74N. A new truck turnaround area and spillway will be constructed to provide access to the new primary cells.

2.5.5 Population Contributing Effluent

The population, for which the lagoon was originally designed, is discussed below. Also the current and future (design year 20) populations contributing effluent to the lagoon is discussed. Wastewater production rates used for design are based on actual water meter readings from the water treatment plant and the lift station to the lagoon from 2008 – 2011 and are discussed below.

Population projections and organic and hydraulic loading to design year 20 (2032) are shown on Table 1 attached in Appendix B. The lagoon has been sized to utilize the maximum available land area east of the existing lagoon, as per the RM of Brokenhead Council resolution passed on February 1, 2012.

2.5.5.1 Existing Lagoon Design Parameters

The following information on the original design population was obtained from the *RM of Brokenhead Village of Garson, Community of Tyndall, Community of Henryville Municipal Water and Sewer System Pre-Design Report* by JRCC in February 2002.

The 2004 total population of Garson, Tyndall and Henryville used in the design was 1,025 people which included the 37 bussed in student equivalent population. The water demand used in design was 360 L/person/day with 15% added for infiltration and 33.3% of the daily raw water intake added to account for reject water from the WTP for a total wastewater production of 594 L/person/day.

The existing lagoon was designed for an organic loading of 45.64 kg BOD_5/ha/day. This permissible organic loading is less than the typical loading for a lagoon of 56 kg BOD_5/ha/day and was decreased so that odours from the lagoon would not become an issue. This decision was made following the Clean Environment Commission (CEC) hearing. The existing Environmental Licence permits a maximum loading in the primary cell of 56 kg BOD_5/ha/day.

2.5.5.2 Current and Projected Population of Garson, Tyndall and Henryville

The current population of Garson, Tyndall and Henryville was estimated based on the number of building permits issued from 2005 – 2011, provided by the

Brokenhead River Planning District. The total number of building permits issued in Garson and Tyndall is provided in the following table. No building permits were issued for Henryville.

Table C – Building Permits Issued in Garson and Tyndall

Year	Garson	Tyndall	Total
2005	5	15	20
2006	5	13	18
2007	16	14	29
2008	10	18	28
2009	6	7	13
2010	12	11	23
2011	21	4	25
TOTAL	**75**	**82**	**157**

There have been 157 houses built in Garson and Tyndall from 2005 – 2011 resulting in an increase to the 2004 population of approximately 550 people (assuming an occupancy of 3.5 people/household for new developments). Therefore, the 2012 population of Garson, Tyndall and Henryville including the bussed in student equivalent population is estimated at 1,578 people (1,025 people + 553 people). This results in an average annual growth rate of 6.4% over the 7 year time period.

Future growth in Garson, Tyndall and Henryville will be based on the number of committed and proposed development lots since the 2004 mainline installation.

According to JRCC office records, 173 water services were installed to unoccupied lots in 2005. Based on the occupancy rate of 3.5 people/household for new developments, 606 people are committed to be added to the 2004 total population of Garson, Tyndall and Henryville from these lots.

There are also 79 lots in Tyndall and 62 lots in Garson which have been approved for development and are in various stages of completion. When all 141 lots become serviced and occupied at an occupancy rate of 3.5 people/household, 494 people are committed to be added to the 2004 total population of Garson, Tyndall and Henryville from these lots.

There are also 3 subdivisions in the planning stage which include a 100 lot development east of the school in Tyndall, a proposed 123 lot subdivision on the west side of Tyndall and a proposed 36 lot subdivision in the south end of Garson that the RM would like to include in the population count. Once all 259

of the proposed lots become serviced and occupied at an occupancy rate of 3.5 people/household, 907 people will be added to the 2004 total population of Garson, Tyndall and Henryville from these lots.

The lagoon will be constructed to utilize the maximum available land area which will allow an additional 758 people in Garson, Tyndall and Henryville to be serviced by the lagoon. This results in an additional 216 lots which are available for development once the lagoon expansion is complete.

Table D – Summary of Development in Garson and Tyndall

Time	Development	Population
2004	417 occupied houses serviced in 2004	988
2005	173 unoccupied lots serviced in 2005 (some are now occupied)	606
Future Committed	141 lots are committed to be serviced (69 currently serviced)	494
Future Proposed	259 lots are proposed to be developed and serviced in Garson and Tyndall	907
Future Available	216 lots are available for development based on constructing the lagoon for the maximum available land	758
Total	990 houses are to be serviced by the water and sewer system upon completion of the committed and proposed development and 216 lots are available for development	3,753

For the purposes of this study it can be assumed that Garson, Tyndall and Henryville will reach the future population of 3,753 people by the design year 20 (2032). The growth rate from 2012 to 2032 will be approximately 4.56% over the 20 year time period. This is a decrease of 1.84% from the population growth rate of 6.4% observed from 2005 – 2011.

2.5.5.3 Population of the RM of Brokenhead

The Garson/Tyndall/Henryville lagoon will also services the remainder of the RM of Brokenhead rural residents by truck haul from a combination of septic and holding tanks.

The population of the RM of Brokenhead is estimated based on Canada Census data provided by Statistics Canada.

Table E – RM of Brokenhead Populations from 1991 - 2006

Year	Population*	Annual Population Growth Rate (%)
1991	3,645	
1996	3,834	1.04
2001	3,877	0.22
2006	3,940	0.32
2011	4,635	3.53
Average Growth Rate		1.36

*Note: The RM of Brokenhead population includes the populations of Garson, Tyndall and Henryville.

The future growth will be based on the average annual growth rate of 1.36% observed between 1991 and 2011. The 2011 population of Garson, Tyndall and Henryville was 1,451 people and therefore the population of rural residents was 3,184 people (4,635 – 1,451). Applying a growth rate of 1.36% to the 2011 rural resident population of 3,184, the 2012 population would be 3,228 people and the 2032 population would be 4,230 people.

According to municipal officials from the RM of Brokenhead approximately 75% of the rural residents are serviced by septic tanks and 25% are serviced by holding tanks.

The following table indicates the 2006 population and the projected 2012 and 2032 RM populations and the portion of the population serviced by septic tanks and holding tanks.

Table F – RM of Brokenhead Projected Populations from 2011 - 2032

Year	Population of RM of Brokenhead	Population on Septic Tanks	Population on Holding Tanks
2011	3,184	2,388	796
2012	3,228	2,421	807
2032	4,230	3,172	1,058

2.5.6 Reported Water Consumption and Effluent Production

2.5.6.1 Reported Water Consumption of Garson/Tyndall/Henryville

Raw water usage and water consumption data from 2008 – 2011 was obtained from the water treatment plant operator. The actual daily per capita water

usage for the Communities was calculated based on actual population information and summarized in the following table:

Table G – Actual Water Usage from the RM of Brokenhead WTP

Year	2008	2009	2010	2011
Average Daily Raw Water Usage (m^3/day)	155	245	286	335
Average Daily Water Consumption (m^3/day)	115	171	205	237
Percentage Reject (Reject Water/Raw Water Intake)	25.1%	29.9%	28.3%	29.3%
Estimated Population (Calculated based on building permits issued since 2004)	1,254	1,286	1,342	1,405
Actual Average Per Capita Water Consumption (L/person/day)	91	133	153	169

As shown in Table G, the per capita water usage has increased from 2008 to 2011. The highest per capita water usage (not including reject water) in 2011 of 169 L/person/day is still much lower than the 360 L/person/day water usage (not including reject water) assumed in the 2004 design. This low water usage could be contributed to water conservation habits of Community members who relied on well water and holding tanks in the past. As development continues in the Communities the population demographic may change as possibly younger families move in and the per capita water consumption may continue to rise. In the June 2011 Water and Sewer Assessment Letter Report a design water consumption rate of 200 L/person/day was used based on the 2010 actual value of 153 L/person/day. With the increase in actual water consumption from 2010 – 2011, a water consumption rate of 225 L/person/day will be used in design for the purposes of this study.

The percentage of reject water per raw intake water ranged from 25.1% to 29.9% between 2008 and 2011, calculated from actual water use records provided by the WTP operator. The percentage of reject water per raw intake water of 30.0% will be utilized in this study to determine the projected hydraulic loadings to the lagoon. This reject water percentage is slightly lower than the number used in the original design of 33.3%.

2.5.6.2 Reported Wastewater Production of Garson/Tyndall/Henryville

Reported effluent flows to the lagoon from 2008 – 2011 were obtained from the lagoon operator as measured from a flow meter at the lift station. The

calculated daily infiltration for the Communities is summarized in the following table:

Table H – Actual Wastewater Sent to the RM of Brokenhead Lagoon

Year	2008	2009	2010	2011
Average Wastewater Flow to Lagoon (m^3/day)	193	266	286	297
Reported Average Per Capita Wastewater Production (L/person/day)	154	207	213	211
Infiltration (m^3/day) (Wastewater Flow to Lagoon - Raw Water Usage)	39	21	-1	-38
Reported Average Per Capita Infiltration (L/person/day)	31	16	-1	-27
Percentage Infiltration (Reject Water/Daily Water Usage)	34%	12%	-0.3%	-16%

As shown in Table H, the infiltration decreased from 34% of daily water usage in 2008 to -16% in 2010. This data most likely contains errors as in 2011 and 2010, less water was sent to the lagoon than was drawn from the raw water well. Every Community should experience infiltration into the sewer system, and no measures to reduce infiltration have been implemented since 2008. Errors could be introduced by inaccurate flow meters, flow meters not being properly calibrated in the lift station and/or in the WTP, power outages resulting in lower readings, truck fill and hydrant flushing.

For the purposes of design, the infiltration percentage assumed in the original design of 15% of the per capita water usage or 34 L/person/day (15% of 225 L/person/day) will continue to be utilized.

2.5.6.3 Wastewater Production from Rural Residents

The hydraulic loading from the rural residents on septic tanks is based on a typical septage contribution rate of 200 L/person/year, during the summer period of 135 days.

The rural residents from the RM of Brokenhead on holding tanks can be assumed to have a lower water consumption rate from community residents on the piped system due to water conservation habits. A water consumption of 200 L/person/day will be used for the rural residents serviced by holding tanks. Reject water and infiltration do not apply to residents on holding tanks and

therefore the total wastewater production from rural residents on holding tanks will be 200 L/person/day.

2.5.7 Lagoon Loading

2.5.7.1 Organic Loading

The organic loading calculation is based upon the organics in typical residential wastewater. A value of 0.076 kg BOD_5/person/day was utilized to estimate the organic loading from the residents within Garson, Tyndall and Henryville that are connected to the existing piped wastewater collection system and for rural residents in the RM of Brokenhead serviced by holding tanks. An organic strength of 7.0 kg BOD_5/m^3 was utilized to calculate the organic loading from rural residents from the RM of Brokenhead serviced by septic tanks based upon a typical septage contribution rate of 200 L/person/year, during the summer period of 135 days.

The design year 20 daily organic loading is:

- 285.2 kg BOD_5/day (i.e. 3,753 x 0.076) from Garson, Tyndall and Henryville
- 3.8 kg BOD_5/day (i.e. 50 x 0.076) from the equivalent population of bussed in students
- 80.4 kg BOD_5/day (i.e. 1,058 x 0.076) from the rural residents on holding tanks
- 32.9 kg BOD_5/day (i.e. 200 x 3,172/135 x 7/1,000) from the rural residents on septic tanks.

The total organic loading in design year 20 (2032) is 402.3 kg BOD_5/day.

2.5.7.2 Hydraulic Loading

As stated above, the per capita water consumption rate for Garson, Tyndall and Henryville used for design will be 225 L/person/day. In addition, the total wastewater production will also include 30% of the raw water intake or 96 L/person/day to account for reject water and an additional 15% of the per capita daily water demand or 34 L/person/day to account for infiltration. In total, the wastewater production from Garson, Tyndall and Henryville is 355 L/person/day.

The total wastewater production from rural residents from the RM of Brokenhead serviced by holding tanks used in design is 200 L/person/day.

The hydraulic loading from the rural residents on septic tanks is based on a typical septage contribution rate of 200 L/person/year, during the summer period of 135 days. Therefore, hydraulic loading from septic tanks will not count towards the winter storage requirements.

The projected year 20 (2032) daily hydraulic loadings to the lagoon are:

- 1,350 m^3/day (3,803 x 355/1000) from the Garson, Tyndall and Henryville populations including the bussed-in students
- 211 m^3/day (1,058 x 200/1000) from the RM of Brokenhead rural residents on holding tanks
- 5 m^3/day (3,172 x 200/135/1000) from the RM of Brokenhead rural residents on septic tanks.

The projected year 20 (2032) total daily hydraulic loadings to the lagoon is 1,566 m^3/day and the 230 day storage requirements are 360,264 m^3.

2.5.8 Existing Lagoon Capacity

The organic and hydraulic storage capacities of the lagoon were determined from record drawings of the existing lagoon and confirmed by aerial photographs.

2.5.8.1 Existing Organic Treatment Capacity

Based on the results of the CEC hearing the primary cell of the Garson/Tyndall/Henryville lagoon was over sized to reduce the impact of possible odours from the lagoon. A higher population growth rate was used for design of the primary cell which resulted in a maximum organic loading rate in the existing primary cell of 45.64 kg BOD_5/ha/day. The existing lagoon Environment Licence # 2646 R Clause 23a) specifies that the organic loading on the primary cell shall not exceed 56 kg BOD_5/ha/day. Therefore, even though the lagoon was originally designed for the reduced organic loading rate of 45.64 kg BOD_5/ha/day, the typical organic loading rate of 56 kg BOD_5/ha/day is permitted.

The effluent surface area at a depth of 0.75 m in the primary cell of the lagoon was estimated to be 21,955 m^2. The standard per capita organic loading of 0.076 kg BOD_5/person/day was assumed. Therefore, the lagoon has an organic capacity of:

Organic Capacity of Lagoon	**123.0 kg BOD_5/day or 1,617 people**
	Based on 56.0 kgBOD_5/ha/day

The existing organic capacity of 123.0 kg BOD_5/day is approximately 279.3 kg BOD_5/day less than the projected year 20 required treatment capacity of 402.3 kg BOD_5/day.

2.5.8.2 Existing Hydraulic Storage Capacity

Per provincial guidelines, the hydraulic storage capacity of a lagoon is determined from the volume of the top half of the primary cell and the storage cell volume, between a liquid level of 0.3 m and 1.5 m above the storage cell floor. The 230 day storage capacity of the existing lagoon is:

Hydraulic Capacity of Lagoon 178,200 m^3

The existing hydraulic storage capacity is currently 182,064 m^3 less than the projected design year 20 required hydraulic capacity of 360,264 m^3.

2.5.9 Future Lagoon Organic Loading Rate

Provincial guidelines stipulate that the organic loading of a lagoon must not exceed 56 kg BOD_5/ha/day in the primary cell. The effluent surface area at a 0.75 m depth in the primary cell is used in this calculation. Based on the results of the CEC hearing the primary cell of the Garson/Tyndall/Henryville lagoon was over sized to reduce the impact of possible odours from the lagoon by increasing the population growth rate for organic sizing. The typical organic loading rate of 56 kg BOD_5/ha/day is permitted as specified in the Environment Licence, even though the lagoon was designed for a lower loading rate.

The existing lagoon has been in operation for approximately 8 years and according to the RM of Brokenhead, there have been no formal complaints regarding odours from the lagoon. It is recommended that the typical loading rate of 56 kg BOD_5/ha/day, as specified in the existing Environment Licence, be utilized for design of the lagoon expansion. All sizing calculations have been completed based on the organic loading rate of 56 kg BOD_5/ha/day. If a reduced organic loading rate is required for design, the primary cell sizing would have to be re-assessed.

2.5.10 Lagoon Expansion Cells

The existing lagoon is currently overloaded organically and does not have sufficient hydraulic capacity to meet the 20 year design loadings. Lagoon expansion is required to meet both the current and future organic and hydraulic loading requirements.

Consideration was given by the RM of Brokenhead to construct an aerated lagoon expansion to reduce the footprint of the expansion cell, provide mitigation of potential odour generation and provide overall enhanced wastewater treatment. After review of

budgets it was determined that capital costs of an aerated lagoon expansion were too high at this stage of the project. It was decided that a facultative lagoon expansion would be constructed with the intention that the new facultative lagoon cells would be converted to aerated lagoon cells in the future.

The dikes of the expansion cells are proposed to be constructed with total height from the cell floor to top of dike of 3.5 m. The new primary cell #1 would have a 1.0 m weir constructed to ensure the cells are not operated above a 1.5 m liquid level with a 1.0 m freeboard while operating as a facultative lagoon. When aeration lines are added to the new cells in the future, the weir will be removed and a maximum liquid level of 2.5 m will be utilized with a 1.0 m freeboard. The location of the weir is shown on Plan L2 and the weir detail is shown on Plan L4, attached in Appendix E.

The new expansion cells will be constructed with a 5:1 inner dike slope and a 4:1 outer dike slope. The discharge pipe invert in the new storage cell will be 0.3 m above the cell floor elevation. A liquid storage period of 230 days was utilized in cell sizing as per Manitoba Conservation requirements.

A detailed description of the expansion cells are provided below.

2.5.10.1 New Primary Cells

New Primary Cells as Facultative Cells

Based on the existing ground elevations in the lagoon expansion area and cut and fill calculations completed for the proposed new cells east of the existing lagoon, a large surplus of soil would be obtained if the top of dike elevation of the existing cells was met. To balance the cut and fill quantities, reducing the required earthwork, the new cell top of dike would have to be constructed at a higher elevation than the existing lagoon. This will also reduce the amount of high plastic clay excavated from the floor of the lagoon, increasing the depth of the insitu clay liner.

The storage cells of a lagoon cannot be constructed at a higher elevation than the primary cells because flow from the primary cells to the storage cells is by gravity. Therefore, new primary cells will be constructed east of the existing lagoon at a higher elevation than the existing lagoon cells and with a total dike height of 3.5 m. A new storage cell will be constructed north of the new primary cells, also at a higher elevation than the existing lagoon and also with a total dike height of 3.5 m. This will allow the lagoon to operate by gravity and allow aeration to be added to the lagoon in future. The existing lagoon east dike will have to be raised to meet the new cell top of dike elevation.

Once aeration is added to the new lagoon cells in the future, two aerated primary cells are required to provide sufficient retention time for BOD reduction. This is why two new primary cells will be constructed at this stage of the project. The existing forcemain is proposed to be re-routed to the new primary cells. A manhole is proposed to be installed and a forcemain will be installed to each new primary cell. The manhole will allow approximately half the incoming wastewater to be directed to the new primary cell #1 and half the wastewater to the new primary cell #2.

The existing primary cell will be converted to a storage cell and the existing truck turnaround and spillway will be abandoned. A new truck turnaround area and spillway will have to be constructed at the new primary cell #1.

The new primary cell #1 and primary cell #2, when operated as facultative cells, will each have an area at a height 0.75 m from the cell floor of 36,060 m^2. The total combined surface are of 72,120 m^2 is sufficient to provide an organic treatment capacity of 403.9 kg BOD_5/day at an organic treatment rate of 56 kg BOD_5/ha/day. This is 1.6 kg BOD_5/day greater than the projected year 20 organic loadings. The combined hydraulic storage in the "top half" of the primary cells will be 56,350 m^3.

New Primary Cells as Aerated Cells

When aeration lines are added to the primary cells in future, the primary cells will have the capacity to treat approximately 650 kg BOD_5/day. This is much greater than the projected design year 20 population. Once the primary cells are aerated, the liquid level in the cells will be constant and no hydraulic storage will be achieved in the cells.

2.5.10.2 New Storage Cell

New Storage Cells as Facultative Cells

A new storage is proposed to be constructed north of the new primary cell #2. The new storage cell will have a flat bottom area of approximately 252 m x 368 m. The cell will have the storage capacity of approximately 118,000 m^3 from the discharge pipe invert elevation (0.3 m above the cell floor) to the maximum liquid level (1.5 m above the cell floor). The existing lagoon cells with the existing primary cell converted to a storage cell have a storage capacity of approximately 187,830 m^3. The new primary cells will have a combined storage capacity in the "top half" of the cell of 56,350 m^3. Therefore, the total storage capacity in the lagoon will be approximately 362,180 m^3. This is approximately 1,916 m^3 greater than the required storage capacity in design year 20.

New Storage Cells as Aerated Cells

When aeration lines are added to the storage cell in future, the maximum liquid level will become 2.5 m above the cell floor. The total storage capacity of the cell will become 223,480 m^3 and the overall storage capacity of the lagoon system will become 411,313 m^3.

In future, if additional hydraulic storage capacity is required, the dikes of the existing lagoon cells could be raised and aeration lines added to further increase capacity.

A layout plan of the proposed new cells is shown on Plan L2 attached in Appendix E.

2.5.11 Topography and Geotechnical Review

A field investigation was completed on March 27, 2012 to determine the suitability of the proposed lagoon expansion site for construction of the lagoon cells.

The complete Geotechnical and Topographic Investigation report with appendices is attached in Appendix C. The test hole locations and the topographic contour lines are shown on Plan 1 of the Geotechnical and Topographic Investigation report.

2.5.11.1 Past Geotechnical Investigations

Past Geotechnical Investigation by JRCC

A geotechnical investigation for construction of the existing RM of Brokenhead lagoon site was performed by JRCC in January of 2002. The report found the soil profile in the test holes consisted of topsoil followed by a minimum of 4.6 m of high plastic clay with varying levels of silt. The laboratory analysis confirmed the clay would be suitable for use as a lagoon liner in the insitu conditions or when re-worked and re-compacted.

GW Driller's Well Logs

Four driller's well logs from 15-13-06 EPM were reviewed. The well logs indicated the soil profile consisted of clay followed by till underlain by gravel and limestone.

2.5.11.2 Current Geotechnical Investigations

Test Holes

Twelve test holes (TH1 – TH12) were drilled during the geotechnical investigation. Test holes were drilled to a depth of 6.1 m (20'). The following is a summary of the soil profile at the proposed lagoon expansion site.

The soil profile consisted of an average of 0.3 m of black topsoil followed by a grey, hard, blocky high plastic clay from an average of 0.3 m – 1.2 m. The following layer varied between the test holes, in TH1, TH8 and TH10 – TH12 the layer was a high plastic, homogonous grey clay with an average depth of 1.6 m. In TH2 – TH7 the layer was a grey high plastic clay with silt inclusions, some sand and trace gravel with an average depth of 2.3 m. The final layer in TH4 – TH5, TH7 and TH10 – TH12 was a light brown silty, sandy till with trace of low plastic clay. This layer of till was also found in TH6 from 3.0 – 5.5 m, TH9 from 0.9 – 1.5 m and TH12 from 2.0 – 2.1 m.

Bedrock was not encountered in any of the test holes. Caving of the test holes was observed in TH3 at 5.8 m, TH5 at 4.1 m and TH6 at 1.9 m.

Details of the soil profile in each test hole can be found in the test hole logs attached in Appendix C.

Groundwater

Short-term groundwater conditions were assessed in each test hole by observing standing water elevations in the holes prior to backfilling. Standing water was observed in TH5 at 5.7 m and water infiltration was observed in TH6 at a depth of 1.9 m. No water infiltration or standing water was observed in the remainder of the test holes.

Groundwater in the test holes depends on high static groundwater conditions and on seasonal conditions, i.e. snowmelt and rainy seasons. Other assumptions relating to the groundwater elevation cannot be made at this time, as water levels will normally fluctuate seasonally.

Laboratory Analysis

Laboratory classification analysis of fourteen bagged soil samples indicated ten of the samples were deemed fat clay (CH), two of the samples were deemed sandy lean clay (CL) and two samples were deemed an inorganic clay and silt (CI). The Plasticity Index of the samples classified as CH varied between 38 and 64 and the percentage of clay varied between 48.8% and 86.7%. The

Plasticity Index of the samples classified as CL and CI varied between 11 and 23 and the percentage of clay varied between 19.8% and 34.2%. Based on past experience, the laboratory has commented that homogeneous soils with a plasticity index greater than 25 and a clay content greater than 50% would typically be expected to have a hydraulic conductivity of 1 x 10^{-7} cm/sec or less. Plasticity Index analysis (i.e. Atterberg limits) of the soils indicated that all of the bagged soil samples submitted with the exceptions of TH5 3.0 – 6.1 m, TH6 0.9 – 2.1 m, TH6 2.1 – 3.0 m and TH12 2.1 – 3.3 m were considered to have potential for use as an insitu clay liner or a re-moulded and re-compacted clay liner.

AMEC indicates that the bagged soil samples suitability for use as a clay liner is dependent upon the soils being homogeneous with no preferential flow paths. It is also 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. These silt and sand layers along with rocks, boulders or fissures in the soil can create preferential flow paths which can lead to an increased hydraulic conductivity.

A Shelby tube sample from TH2 1.5 – 2.1 m was submitted to AMEC to determine the insitu hydraulic conductivity for potential use as a lagoon liner. The sample achieved a hydraulic conductivity (k_{20}) of 8.18 x 10^{-9} cm/sec. This hydraulic conductivity is lower than the Manitoba Conservation requirement of 1 x 10^{-7} cm/sec and is therefore deemed suitable for use as an insitu clay lagoon liner.

Discussion and Recommendations

Based on laboratory analysis the entire soil profile found in TH6 would not be suitable for use as an insitu lagoon liner or when re-worked and re-compacted. The soil profile of TH12 has suitable high plastic clay from 0.3 – 2.0 m and unsuitable clay from 2.0 – 6.0 m. The unsuitable clay found in the horizontal liner would have to be excavated and suitable high plastic clay from the cell excavation would have to be hauled in and re-compacted and re-worked.

TH5 and TH11 had a top of unsuitable material 3.0 and 2.7 m below the ground surface, respectively, with suitable high plastic clay above the unsuitable material. Depending on the exact depth of the horizontal clay liner determined during final design, there is some risk of not meeting the Manitoba Conservation requirement of a 1.0 m thick clay liner, especially if the depth to unsuitable material is higher in some locations than observed in the test holes.

TH10, completed south of TH6 and TH12, had a top of unsuitable material 4.3 m below the ground surface with suitable high plastic clay above the unsuitable material. TH4 and TH7, also taken south of TH10 each had a top of unsuitable material 4.9 m below the ground surface with suitable high plastic clay material above the unsuitable material.

Therefore the horizontal liner of the proposed lagoon expansion cells is recommended to be constructed with an insitu clay liner 1.0 m below the cell floor elevation approximately south of a line running through TH10, as shown on Plan L2. The exact location of this line would have to be determined by multiple on-site test holes completed during construction of the lagoon. Any layers of unsuitable material as found in TH9 from 0.9 – 1.5 m will have to be removed and replaced with re-worked and re-compacted high plastic clay.

The horizontal liner of the proposed lagoon expansion cells would have to be excavated and re-compacted with 1.0 m of suitable high plastic clay, approximately north of a line running through TH10. The area, which must be re-worked and re-compacted, may be larger or smaller than that shown on the plans, depending on the extent of the pockets of unsuitable material found during construction.

For all new perimeter dikes, a 3.0 m wide vertical cut-off wall will have to be constructed extending a minimum of 1.0 m into the horizontal liner surrounding the entire lagoon. Also, the clay soils 1.0 m below the cell floor elevation under the inside dike slope will also be re-worked and re-compacted. This will result in an "L" shaped cut-off wall under the dikes. If the lagoon horizontal liner is tested by Manitoba Conservation and does not pass the requirements near the perimeter dikes, the dike would have to be removed to re-work and re-compact the clay soils beneath. If during lagoon construction the clay soils beneath the inside dike slope are re-worked and re-compacted, there will be little risk of not meeting the Manitoba Conservation requirements and having to remove the dikes.

2.5.11.3 Topography

A topographic GPS survey of the test hole locations and existing ground locations across the proposed lagoon expansion site was completed on March 27, 2012 along with the geotechnical investigation. The existing ground at the proposed expansion site was relatively flat with some low lying areas. From the topographic survey data, the existing ground elevations varied from 235.04 m to 237.38 m with an average elevation of approximately 236.23 m.

The top of dike elevation of the existing Cell #6 was approximately 237.22 m, which is approximately 1.0 m above the average surrounding ground elevation.

2.5.12 Lagoon Regulatory Requirements

2.5.12.1 Province of Manitoba Design Objectives

The Province of Manitoba Design Objectives for Standard Sewage Lagoons was used as a guideline in the layout and design of the lagoon.

Organic Loading

As stated in Section 2.5.9, based on the results of the CEC hearing the existing lagoon was designed with a maximum organic loading rate of 45.64 kg BOD_5/ha/day. The Environment Licence # 2646 R states that a maximum organic loading in the primary cell of 56 kg BOD_5/ha/day is permitted. According to the RM of Brokenhead there have been no formal complaints regarding odour issues from the lagoon in the past eight years and therefore it is recommended that the lagoon expansion be designed with the typical organic treatment capacity of 56 kg BOD_5/ha/day in the primary cell as permitted by the existing Environmental Licence.

Hydraulic Loading

The lagoon cannot be discharged between November 1 and June 15 (230 day winter storage period) as per current guidelines. Therefore, the lagoon must have the storage capacity for this time period based upon half the volume of the primary cell and the storage cell volume from the invert of the discharge pipe (0.3 m) to the maximum liquid level (1.5 m).

Lagoon Liner

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 the absence of soils with a hydraulic conductivity of 1×10^{-7} cm/sec or less, the interior surfaces of a lagoon could be lined with a synthetic liner.

Effluent Quality Requirements

Any new or expanding wastewater treatment lagoons are required to meet the Manitoba Water Quality Standards, Objectives and Guidelines - Tier 1 Water Quality Standards at a minimum, for discharged effluent. The effluent standards specific to the RM of Brokenhead lagoon would be:

- 200 fecal coliforms/100 mL or 200 E. coli/100 mL

- 25 mg/L BOD
- 25 mg/L TSS
- 1 mg/L Total Phosphorus.

2.5.12.2 Nutrient Management Plan

New nutrient reduction guidelines were released in the *Manitoba Water Quality Standards, Objectives, and Guidelines, November 28, 2011*. The regulations include province wide standards for phosphorus reduction and where site-specific conditions warrant, nitrogen reduction. Under the new nutrient standards, a 1.0 mg/L phosphorus limit immediately applies for all new, expanding or modified wastewater treatment facilities. The exception being small wastewater treatment facilities which serve less than 2,000 equivalent people which have the option of implementing a nutrient reduction strategy instead of the 1.0 mg/L phosphorus limit. Nutrient reduction strategies include, but are not limited to, effluent irrigation, trickle discharge or constructed wetlands.

Nitrogen reduction to 15 mg/L is required on a site-specific basis depending on the receiving environment for new and expanding wastewater treatment facilities serving more than 10,000 equivalent people.

The RM of Brokenhead lagoon is sized to treat well over 2,000 residents and therefore it is expected the 1.0 mg/L phosphorous reduction guideline will apply to the expanded lagoon. The lagoon is sized to treat less than 10,000 equivalent people and therefore it is not expected that a nitrogen limit will apply.

Phosphorous Concentrations in the Existing Lagoon

A nutrient sampling and testing program was developed for the existing RM of Brokenhead lagoon. The nutrient concentration of the lagoon wastewater was tested on a semi-monthly basis with samples taken from the storage cell #1 and storage cell #2 at both the intercell pipe location (wastewater from the primary cell) and the discharge pipe location. The total phosphorous concentrations found in the cells from five tests between March and October 2012 are summarized in the following table.

Table I – Phosphorous concentrations in the existing lagoon

Location	Total Phosphorus Concentration (mg/L)				
	Mar	Apr	Jun	Aug	Oct
Cell 1 Intercell	1.37	4.68	7.27	10.40	9.57

Location	Total Phosphorus Concentration (mg/L)				
	Mar	Apr	Jun	Aug	Oct
Cell 1 Discharge	2.73	3.83	2.69	2.65	3.37
Cell 2 Intercell	0.349	3.99	7.72	9.93	8.44
Cell 2 Discharge	0.583	4.03	3.20	3.45	3.10

Based on the results of the testing some natural phosphorus reduction is occurring in the lagoons which is especially evident in the test results from June, August and October. However, the phosphorus concentration at the discharge pipe locations is still greater than 1.0 mg/L and therefore it is likely phosphorous reduction measures will have to be implemented for the RM of Brokenhead lagoon.

Full test results from ALS laboratories Ltd. are attached in Appendix D.

Based upon the new guidelines and the nutrient testing program results, the following options were considered to address nutrient management, with particular emphasis on phosphorus reduction for the RM of Brokenhead lagoon.

Phosphorus Reduction by Filtration

Sewage treatment plant technology, such as chemical addition and filtration systems could be utilized to reduce the phosphorus concentration in the lagoon. The effluent could be pumped to a filtration building and filtered through a continuous backwash sand filter or a cloth disk filter prior to discharge. A chemical flocculent such as alum or ferric would have to be added to the wastewater prior to filtration. Backwash containing the phosphorus would be sent back to the primary cell where it would settle out into sludge. The sludge can accumulate in the lagoon for approximately 20 – 25 years before requiring removal.

This level of treatment is costly as equipment and housing is required as well as annual operating costs and chemical costs. An electrical power source is also required, such as a hydro line to the lagoon.

Phosphorus Reduction by Surface Chemical Treatment

Phosphorus could be reduced by application of chemicals such as alum to wastewater in the storage cells, if prior to discharge the phosphorus concentration in the wastewater is found to be greater than 1.0 mg/L. The alum would be broadcast onto the surface of the storage cells utilizing a gas driven pump and spray system from the top of the dike, or from a boat on the surface

of the storage cells. The alum produces a chemical reaction with the phosphorus causing a pin floc. The pin floc of phosphorus and the turbidity settle to the bottom as sludge. The effluent can then be discharged from the storage cell with a reduced level of phosphorus.

The chemical would have to be overdosed by approximately two or three times compared to chemical addition rates with filtration to achieve the required phosphorus reduction as it is difficult to control the amount of chemical provided, the mixing will be inefficient and the required chemical dosage is difficult to determine. Overall the methodology would be very operator intensive, inefficient, and logistically difficult to complete and would carry risk of not sufficiently reducing the phosphorus, requiring the process to be repeated.

Phosphorus Reduction by Chemical Addition and Settling

Phosphorus could be reduced by alum or ferric addition in the forcemain, before the wastewater is sent to the primary cells. The chemical would mix with the phosphorus in the wastewater and form pin flocs which would settle to the bottom of the lagoon cells as sludge. Typically this methodology of adding chemical is utilized with up-flow sand filters to filter out the phosphorous, without the filters the effectiveness of this methodology is not well known. Chemical dosage rates would be greater than if filtration were utilized but less than surface chemical application as there would be much better mixing of the chemical with the wastewater.

Once the system is operational, the rate of chemical addition can be altered based on phosphorous test results in the storage cells, however there is some risk that the system won't be able to meet the phosphorous limit. If the chemical feed system is unsuccessful at consistently reducing the total phosphorous concentration to 1.0 mg/L, surface spreading of chemical may also be required on a case by case basis prior to discharge.

Constructed Wetlands

Constructed wetlands are used to polish treated effluent from a lagoon, and have the potential to provide nutrient reduction. However, they can require large land areas for construction, have increased odour potential, can favour mosquito breeding (due to vegetation type, very shallow effluent, and minimal wind action), can cause higher *E. coli* concentrations due to increase wildlife including mammals, waterfowl, reptiles and amphibians, and can add significant cost to the project. In addition, the use of constructed/engineered

wetlands requires further investigation regarding their effectiveness under climatic conditions in Manitoba.

Constructed wetlands were investigated during design of the existing RM of Brokenhead lagoon and were deemed not feasible due to the large area required, increased odour potential, the high capital cost, the increased mosquito breeding area and the additional wildlife which would increase the *E. coli* levels.

These disadvantages are still applicable and cause the option not to be feasible.

Public Awareness

In conjunction with nutrient reduction methods through treatment, preventative measures can also be taken to reduce nutrients in the wastewater influent. As the majority of the influent to the RM of Brokenhead lagoon would be residential in nature, the RM is encouraged to inform residents and schools in the community of nutrient reducing strategies, such as using non-phosphate based soap and cleaning products for domestic use and composting food waste instead of using a garburator. This would reduce the amount of phosphorus being released into the lagoon and reduce the requirements for treatment.

Proposed Option

It is proposed that phosphorus in the RM of Brokenhead lagoon be reduced by chemical addition and settling. Chemical such as alum would be added to the wastewater in the existing lift station building which directs all effluent to the lagoon. This would allow the alum to have ample mixing time with the wastewater in the approximately 3.2 km forcemain. As stated, the rate of chemical addition can be altered based on phosphorous test results in the storage cells and if the system is unable to reduce the phosphorus concentration below 1.0 mg/L, surface chemical treatment can be applied on a case by case basis, prior to discharge.

The sludge containing the phosphorus would accumulate in the lagoon cells and require removal after approximately 20 - 25 years. Based on file data, facultative lagoons in Manitoba without phosphorus reduction systems have some natural phosphorus reduction by settling in the lagoon. With the chemical addition and settling system, additional phosphorus will bind with the alum and settle out. When sludge is removed from the lagoon, some of the phosphorus would likely remain bound to the alum in the sludge potentially causing difficulty for plant uptake if the sludge was land applied. The sludge would also contain the phosphorus not chemically bound which would be

available for plant uptake. At the time of sludge removal, the best practice technology for use of nutrients, organic matter and energy will be reviewed and evaluated.

2.5.13 Summarized Selected Design Criteria

The following selected criteria are proposed for design purposes:

- A total equivalent design year 20 population of 3,753 residents of Garson, Tyndall and Henryville, an equivalent full time population of 50 bussed-in students, 3,172 rural residents serviced by septic tanks and 1,058 rural residents serviced by holding tanks
- A total daily organic loading in design year 20 of 402.3 kg BOD_5/day
- Construction of two new primary cells with a combined surface area of 72,120 m^2 at 0.75 m height from the floor, providing a daily organic treatment capacity of 403.9 kg BOD_5/day at an organic loading rate of 56 kg BOD_5/ha/day and a hydraulic storage volume in the top half of 56,350 m^3
- A design year 20 hydraulic loading to the lagoon of 360,264 m^3
- Construction of a new storage cell with a total hydraulic storage capacity above the invert elevation of 118,000 m^3
- A total hydraulic capacity of the lagoon of 362,180 m^3
- The new primary and storage cells will be facultative for now with the intention that aeration will be added in the future
- The new cells will have a 3.5 m total dike height but a 1.0 m weir will be installed to ensure a maximum 1.5 m liquid level with a 1.0 m freeboard is utilized while the cells are facultative
- The inner dike slope of the new cells will be 5:1 and the outer slope will be 4:1
- Phosphorus will be reduced by a chemical addition system in the existing lift station with mixing in the forcemain and settling in the lagoon cells.
- The existing primary cell will be converted to a storage cell
- The existing forcemain will be diverted to a manhole and two forcemain will be installed to deliver half the wastewater to each new primary cell
- A new truck turnaround area and concrete spillway will be constructed at the new primary cell
- The southwest top of dike of the new primary cell will be graveled to maintain road access to the existing truck turnaround area

- Capped piping will be installed in the new primary cell #2 and the new storage cell so that in future when aeration is added, piping from the primary cell to the aeration building and piping from the aeration building to the storage cell can be installed
- The discharge pipe invert is to be 0.3 m above the cell floor elevation of the new storage cell
- Discharge from the lagoon is to follow the existing licensed discharge route to the Devil's Creek
- The horizontal liner will be constructed with a minimum 1.0 m insitu clay liner except in the location at the north end of the proposed cell, as shown on Plan L2, where a minimum 1.0 m thick re-worked liner will be required
- A 3.0 m wide vertical cut-off wall constructed with re-worked clay soils will extend a minimum of 1.0 m into the horizontal clay liner and extend to the top of dike elevation
- The soils 1.0 m below the inside dike slope from the cell floor elevation to 1.0 m below the cell floor elevation will be re-worked and re-compacted to reduce the risk of removing the dike if Manitoba Conservation guidelines are not met from the insitu clay liner
- The fencing along the east side of the existing lagoon will be removed and a 1.2 m high four strand barbed wire fence would be installed around the perimeter of the new lagoon cells
- Valve markers will be installed at the new discharge and intercell pipe locations.

2.5.14 Lagoon Construction Details

2.5.14.1 General, Conceptual Liner Design and Construction Techniques

Conceptual layout plans for the lagoon expansion cells are provided in Appendix E.

The organic topsoil from the lagoon expansion area would be removed and stockpiled. Approximately 50% of the outside of the dike is permitted to be constructed with topsoil. The topsoil will also be used as dressing on the dikes and perimeter ditches. The new lagoon would be excavated to the cell floor elevation. In the required areas at the north end of the expansion cell, the clay soils from 1.0 m below the cell floor elevation would be excavated and re-worked and re-compacted a sheepsfoot roller to 95% Standard Proctor Density on a maximum 150 mm (6 in.) compacted lift. If the soils 1.0 m below the cell floor elevation are deemed unsuitable for use as a re-worked and re-compacted

clay liner, suitable clay soils from a borrow area will be excavated and hauled in.

The vertical cut-off walls will be constructed with excavated clay soils from the cell area or from a borrow pit. The cut-off wall will extend from the top of dike elevation to an at least 1.0 m below the cell floor elevation. The vertical cut-off wall will be construction with similar construction techniques as the horizontal liner, as described above.

The soils 1.0 m below the inside dike slope from the cell floor elevation to 1.0 m below the cell floor elevation will be re-worked and re-compacted with similar construction techniques as the horizontal liner, as described above. If any soils are deemed unsuitable for use as a re-worked and re-compacted clay liner, suitable clay soils from a borrow area will be excavated and hauled in.

The flat bottom of the new lagoon cells will be 3.5 m lower than the top of dike. A 1.0 m weir would be installed at the top of dike so that the cells could not be operated at a liquid level greater than 1.5 m while facultative. The inner dike slopes would be constructed at 5:1 slope and the outer dike slopes would be constructed at 4:1.

A discharge pipe will be installed in the new storage cell 0.3 m above the cell floor elevation. Rip rap would be installed at the intercell and discharge piping locations to reduce erosion. Silt fencing would be placed around the lagoon construction area at locations which are thought to drain from the site. Perimeter ditches would be constructed surrounding the new cells and tied into the existing perimeter ditches. Upon completion of construction, the excess topsoil that was stripped off the new cell area would be placed on the outside of the dikes and the area would be seeded. A barbed wire fence surrounding the new lagoon cells would be constructed and attached to the existing fence.

2.5.14.2 Construction Details

All topsoil would be removed to a depth of approximately 300 mm from the new cell area.

Construction of lagoon liner (cell bottom and cut-off walls) should be in accordance with the following specifications:

1. The liner shall be constructed of clay;
2. The liner shall be at least one metre in thickness;

3. The liner shall have a hydraulic conductivity of 1 x 10^{-7} cm/sec or less at all locations.

Prior to placement of the embankment material and liner material to be compacted, the foundation should be scarified to a depth of 150 mm (6 in.) compacted with a minimum of eight passes of a sheepsfoot roller. Complete foundation preparation should be approved by the Engineer before any embankment or liner material is placed. Embankment (both common topsoil and relatively impermeable soil) and liner material (medium-high plastic clay soil), should be compacted with a minimum of eight passes of a sheepsfoot roller on a 150 mm (6 in.) compacted lift.

The lagoon construction specifications should indicate that the sheepsfoot roller shall have a minimum foot pressure of no less than 1,700 kPa (250 psi). The drum diameter of the sheepsfoot roller would not be less than 1,200 mm (4 ft.). Each roller would be equipped with cleaning fingers designed to prevent the accumulation of material between the tamping feet. The foot pressure would be calculated by taking the total mass of the roller and dividing it by the greater of: the area of the maximum number of tamping feet in one row parallel to the axis of the roller, or by 5 percent of the total foot area. The roller foot would be at least 200 mm (8 in.) long and would have a minimum foot area of at least 4,500 mm^2 (7 $in.^2$).

A limited range of moisture content should be permitted. Specifications should state that the material shall not be so wet nor so dry that compaction equipment cannot compact the fill into a homogeneous mass. Material too wet shall be dried or wasted as directed by the Engineer and material too dry shall be wetted as directed by the Engineer. All constructed earthen lagoon components shall be graded to a tolerance of +/- 50 mm (2 in.).

The specifications should state that the dikes and embankment are to be seeded with a grass such as brome.

The outer slope and perimeter drainage system would prevent surface drainage from entering into the lagoon and the ponding of surface drainage around the perimeter of the lagoon.

2.5.15 Decommissioning

The existing lagoon spillway would be decommissioned to prevent future truck haul dumping into the lagoon storage cells. The spillway on the interior slope will be abandoned in place and posts with a chain and signage will be installed across the

spillway on the outside of the dike to prevent future truck-haul dumping. The forcemain to the lagoon would be diverted into the new primary cells and the existing forcemain inlet at the existing lagoon primary cell would be abandoned in place.

2.5.16 Lagoon Maintenance

Maintenance of the expanded lagoon will include:

- 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
- Refilling phosphorus reduction chemical at the lift station and adjusting dosage rates based on laboratory testing of the lagoon effluent
- 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
- Clearing of snow from the lagoon approach and truck turnaround.

3.0 POTENTIAL ENVIRONMENTAL IMPACTS

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

3.1 Releases to Air, Water, Land

3.1.1 Air

In general, nuisance odours occur in facultative lagoons that are improperly sized and organically overloaded. Odours are also generated under anaerobic conditions. During the summer the lagoon would be aerobic at the surface, facultative in the middle and anaerobic at the bottom. Minimal to no treatment would occur in the winter due to the ice cover on the surface; the treatment process would predominantly be anaerobic during winter. Therefore, the lagoon 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. Prevailing winds in the area can carry odours if the area is exposed and wind breaks are not utilized around the lagoon cells.

There is also 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 4.1 of this report.

3.1.2 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 Brokenhead. 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 ground water 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 Devil's Creek and eventually reach the Red River. 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 is not in the immediate vicinity of 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 4.2 of this report.

3.1.3 Land

The land would be significantly altered by construction of the new lagoon dikes and perimeter ditching. Fencing would be installed around the perimeter of the new lagoon cells.

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 4.3 of this report.

3.2 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, January 9, 2013 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.

3.3 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.

3.4 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.

3.5 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 January 9, 2013, 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.

3.6 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 4.4 below will be in place during the construction works. Other than maintenance vehicles (for lagoon effluent sampling or mowing grass) or septic hauling trucks, the operation of the lagoon itself, will not have a potential for noise impacts.

3.7 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 4.5 below will be in place during the construction works.

3.8 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 January 23, 2013 memorandum, 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 4.6 below will be in place during the construction works.

3.9 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. In addition the community would have increased wastewater capacity upon completion of the project, which will encourage future development and growth in the community.

3.10 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.

4.0 MANAGEMENT PRACTICE

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

4.1 Mitigation of Impacts to Air

To reduce the potential for odour nuisance in the community, the primary cell will be sized for the projected year 20 organic loadings, from the surrounding population. The organic loading rate of 56 kg BOD_5/ha as permitted by the existing Environmental Licence was used for primary cell sizing. The organic loading rate will affect the odours generated from a wastewater treatment lagoon during peak organic loading. Nuisance odours as a result of organic over-loading are not expected.

Although the lagoon would likely generate some odours for a short time each spring, during the thawing or turn-over period, prevailing (i.e. northwesterly) winds should not cause odours to drift toward the community, as the nearest community (Tyndall) is located approximately 1.9 km from the lagoon. Furthermore, the proposed lagoon upgrade 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.

4.2 Mitigation of Impacts to Water

4.2.1 Surface Water

Impacts to surface water from discharge of lagoon effluent are not expected, as the lagoon effluent would not be discharged unless Tier I Manitoba Water Quality Standards, Objectives and Guidelines 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.

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 near the lagoon 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.

4.2.2 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 of 1 x 10^{-7} cm/sec or less, as required by Manitoba Conservation guidelines.

The re-directed portion of forcemain will be pressure tested prior to commissioning and maintained by the RM of Brokenhead during operation to prevent underground wastewater leaks.

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 4.2.1 above.

4.3 Mitigation of Impacts to Land

As the lagoon would utilize a clay liner, seepage to the surrounding land is expected to be negligible. To minimize the potential for the release of Petroleum Hydrocarbon (PHC) pollutants into the soil, the mitigation measures described in Section 4.2.1 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.

4.4 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.

4.5 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.

4.6 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.

5.0 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 the communities.

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

7.0 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.

8.0 PUBLIC CONSULTATION

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

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

9.0 CONCLUSION

Based on the design of the project and the implementation of the mitigation measures identified in Section 4.0 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.

J. R. 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

Land Titles Transactions (Instrument Number 3066485)

Land Title Number 2054799/1

Legal Plan No. 43287

Crown Lands & Property Agency, January 8, 2013 Email Correspondence

Manitoba Hydro, May 10, 2013 Email Correspondence

Manitoba Hydro Gas Line Record Drawing

APPENDIX B

Table 1: Population, Hydraulic and Organic Loading Projections for the RM of Brokenhead Lagoon

Manitoba Conservation and Water Stewardship Fisheries Branch, January 9, 2013 Email Correspondence

Manitoba Conservation Wildlife and Ecosystem Protection Branch, January 9, 2013 Email Correspondence

Manitoba Historic Resources Branch, January 23, 2013 Memorandum

APPENDIX C

RM of Brokenhead Geotechnical and Topographic Investigation for the Wastewater Treatment Lagoon Expansion

APPENDIX D

Test Results from ALS Laboratories, dated March 26, 2012

Test Results from ALS Laboratories, dated May 07, 2012

Test Results from ALS Laboratories, dated June 28, 2012

Test Results from ALS Laboratories, dated August 22, 2012

Test Results from ALS Laboratories, dated October 24, 2012

APPENDIX E

Title Page

Plan L1: Proposed Lagoon Expansion Location Plan with Setbacks

Plan L2: Proposed Lagoon Expansion Layout with Test Hole Locations

Plan L3: Lagoon Discharge Route

Plan L4: Perimeter Dike and Intercell Dike Details

Plan L5: Existing Lagoon Dike Upgrade, Liquid Level Control Weir, Perimeter Dike and Piping Flange and Marker Details

Plan L6: Perimeter Dike at Transition Between Re-Worked and Insitu Liner and at Splitter Manhole Details

Plan L7: Splitter Manhole, Valve, Valve Marker, Site Marker, Rip Rap and Forcemain Trench Details

Plan L8: Spillway, Silt Fence, Truck Turnaround, Gate, Fence, and Lock Details

Appendix A

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Manitoba Hydro Gas Line Record Drawing

Land Titles Transactions (Instrument Number 3066485)

2054799

District: SELKIRK
Instrument Number: 3066485

M.A.V.A.S.
Land Titles Transactions

Date Run: Nov 30, 2004

'ew CT#: Winnipeg - 2054799 **Status:** Active

Instrument Type REQUEST TO ISSUE TITLE
Vendor THE RURAL MUNICIPALITY OF BROKENHEAD
Consolidated? No

Sale Date Nov 19, 2004
Consideration $0
Sworn Value $0

\THE RURAL MUNICIPALITY OF BROKENHEAD\

IS REGISTERED OWNER SUBJECT TO SUCH ENTRIES RECORDED HEREON, IN THE FOLLOWING DESCRIBED LAND:

PARCEL "A" WORKS PLAN 43287 WLTO
EXC, SUCH PORTION AS MAY BE REQUIRED FOR THE RIGHT OF WAY AND STATION GROUNDS OF THE CANADIAN PACIFIC RLY,
IN W 1/2 OF 15-13-6 EPM.

New Plan

Address:
THE R. M. OF BROKENHEAD
BOX 490
BEAUSEJOUR, MB.
R0E 0C0

From CT: Winnipeg - A93194 PART
Winnipeg - 1984011 PART

Roll entries for this instrument: 110 - RM OF BROKENHEAD **Roll:** 50500 R
110 - RM OF BROKENHEAD **Roll:** 51000 R
110 - RM OF BROKENHEAD **Roll:** 50500 R
110 - RM OF BROKENHEAD **Roll:** 51000 R

Land Title Number 2054799/1

DATE: 2013/05/14 TITLE SEARCH MUNPH04
TSTL (1 OF 9) TITLE DISPLAY - WINNIPEG PAGE: 01

TITLE NUMBER.....	2054799/1	TITLE STATUS.....	ACCEPTED
REGISTRATION DATE..	2004/11/19	ASSESSMENT OFFICE..	** MANITOBA **
COMPLETION DATE....	2004/11/25	CONSOLIDATION.....	NO

LEGAL DESCRIPTION:

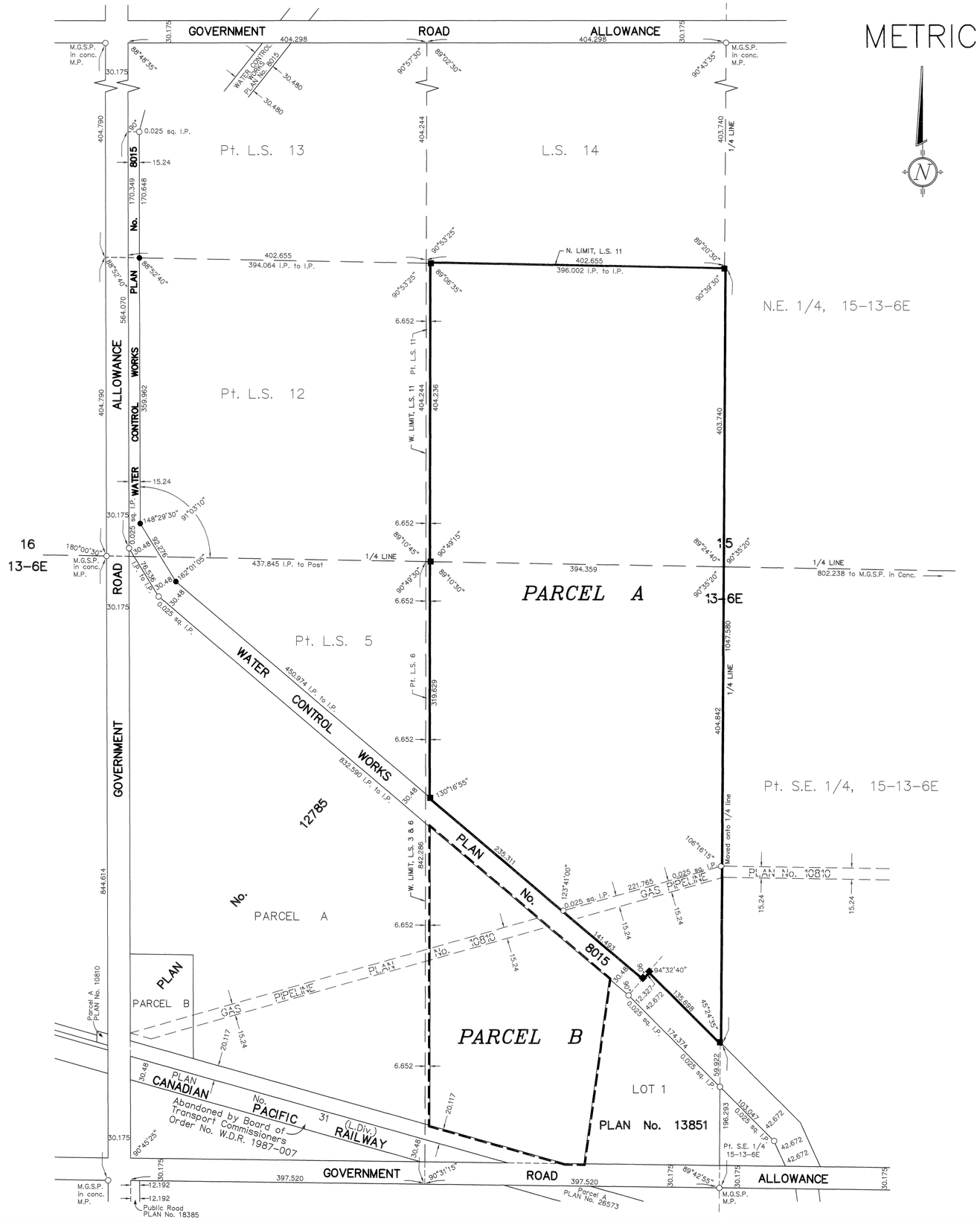
THE RURAL MUNICIPALITY OF BROKENHEAD

IS REGISTERED OWNER SUBJECT TO SUCH ENTRIES RECORDED HEREON, IN THE FOLLOWING DESCRIBED LAND:

PARCEL "A" WORKS PLAN 43287 WLTO
EXC, SUCH PORTION AS MAY BE REQUIRED FOR THE RIGHT OF WAY AND STATION GROUNDS OF THE CANADIAN PACIFIC RLY,
IN W 1/2 OF 15-13-6 EPM.

TX: ____
DA: _____

Legal Plan No. 43287



DEPOSIT No. 1187/2004
ORIGINAL

PLAN OF WORKS

IN PART OF

W. 1/2, Sec. 15, Twp. 13, Rge. 6 E.P.M.

TO BE EXPROPRIATED UNDER THE EXPROPRIATION ACT (MANITOBA)

AND

PLAN OF SURVEY

IN PART OF

S.W. 1/4, Sec. 15, Twp. 13, Rge. 6 E.P.M.

RURAL MUNICIPALITY OF BROKENHEAD MANITOBA

SCALE = 1:3000

0 60 120 180 240 300m

NOTES

ALL DISTANCES ARE IN METRES AND MAY BE CONVERTED TO FEET BY MULTIPLYING BY 3.28084.
SURVEY MONUMENTS FOUND ON THE GROUND ARE DESCRIBED AND SHOWN THUS ——————○
IRON POSTS 0.025 x 0.025 x 0.914, MARKED M.L.S. ARE PLACED AT ALL POINTS SHOWN THUS ——■
IRON POSTS 0.019 x 0.019 x 0.762, MARKED M.L.S. ARE PLACED AT ALL POINTS SHOWN THUS ——●
LAND REQUIRED FOR WORKS IS SHOWN AS PARCEL A FOR DESCRIPTIVE PURPOSES AND IS BORDERED THUS ——————
PARCEL B IS SHOWN BORDERED THUS — — — — — FOR DESCRIPTIVE PURPOSES ONLY AND IS NOT AFFECTED BY THIS EXPROPRIATION.
ALL PLANS REFERRED TO ARE OF RECORD IN THE WINNIPEG LAND TITLES OFFICE.

AFFIDAVIT

I, WILLIAM WALLACE SHEPHERD, OF THE CITY OF WINNIPEG, MANITOBA LAND SURVEYOR, MAKE OATH AND SAY THAT I DID PERSONALLY SUPERINTEND THE SURVEY REPRESENTED BY THIS PLAN, THAT THE SURVEY WAS MADE BETWEEN THE DATES OF MARCH 9th AND OCTOBER 27th, 2004, AND THAT THE SURVEY AND PLAN ARE CORRECT AND TRUE TO THE BEST OF MY KNOWLEDGE AND BELIEF.

MANITOBA LAND SURVEYOR

SWORN TO BEFORE ME AT THE CITY OF WINNIPEG
THIS 17th DAY OF November, 2004.

A SURVEYOR AUTHORIZED TO PRACTISE
UNDER THE LAND SURVEYORS ACT.

THIS IS THE PLAN REFERRED TO IN DECLARATION OF EXPROPRIATION
OF THE RURAL MUNICIPALITY OF BROKENHEAD No. 1996

CHIEF ADMINISTRATIVE OFFICER

DETACHED FROM REGISTERED INSTRUMENT No. 3066483
AND FILED IN THE WINNIPEG LAND TITLES OFFICE
THIS 19th DAY OF NOVEMBER, 2004
AS PLAN No. 43287.

FOR DISTRICT REGISTRAR

REGISTRATION No. 3066484.

THIS APPROVAL IS VALID FOR
12 MONTHS UNLESS REGISTERED
APPROVED THIS 19th DAY OF NOVEMBER, 2004

EXAMINER OF SURVEYS

RE-APPROVED THIS___DAY OF _____, _____.

EXAMINER OF SURVEYS

Shepherd & Stevens
PROFESSIONAL SURVEYORS
504-115 Bannatyne Ave.
Winnipeg, MB R3B 0R3

File No. 04/313
Drawing: 04-313.DWG

#2
PLAN 43287
FEE: #70 00 XX
LEVENE TAIMAN GUTKIN GOLUB
#105

3066484
LAND TITLES OFFICE
70
NOV 19 2004
WINNIPEG, MAN.

Crown Lands & Property Agency, January 8, 2013 Email Correspondence

Brett McCormac

From: Little, Karen (CLPA) [Karen.Little@gov.mb.ca]
Sent: January 8, 2013 3:05 PM
To: 'Brett McCormac'
Subject: RE: RM of Brokenhead Lagoon Expansion - Mines and Minerals

Good afternoon Brett, according to our records this date, the mines & minerals and sand & gravel in W ½ 15-13-6 EPM were originally granted in 1877 & 1878. The Crown has no interests.

Based on Certificate of Title 2054799 , the mines & minerals and sand & gravel are privately owned and with this surface title for Parcel "A" Works Plan 43287 WLTO Excluding such portion as may be required for the right of way and station grounds of the Canadian Pacific Railway in W ½ of 15-13-6 EPM.

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 MB Infrastructure and Transportation

From: Brett McCormac [mailto:bmccormac@jrcc.ca]
Sent: January-02-13 10:36 AM
To: Little, Karen (CLPA)
Subject: RM of Brokenhead Lagoon Expansion - Mines and Minerals

Hi Karen,

J.R. Cousin Consultants Ltd. (JRCC) is preparing an Environmental Act Proposal for expansion of the existing RM of Brokenhead Lagoon. The lagoon expansion is proposed to be located directly east of the existing lagoon within the NW and SW ¼ of 15-13-06 EPM. I attached the land title transaction for the property.

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

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 Hydro, May 10, 2013 Email Correspondence

Brett McCormac

From: Greaves, Andrew [agreaves@hydro.mb.ca]
Sent: May 10, 2013 2:41 PM
To: 'Brett McCormac'
Subject: RE: Gas Transmission Pipeline - RM of Brokenhead
Attachments: SW_15-13-6E.PDF; SE_15-13-6E.PDF; SafeExcavationAndSafetyWatchGuidelines.pdf

Hi Brett,

Please see attached for as builts.

Additionally:

- Pipe is 114.3 mm (4 NPS) Steel transmission pipe
- Minimum required cover during installation would have been 750 mm, however we cannot guarantee that this cover has remained the same since install
- There are no setback requirements from our easement, however there should be no construction on our easement.
- If any work is being performed within 3 meters of the pipe a Manitoba Hydro safety watch is required. Please see attached safe excavation pamphlet.
- Offset of pipe is displayed on asbuilts but must be traced for accurate location

Thanks

Andrew Greaves, P.Eng.
Manitoba Hydro
Ph: 204-360-4170
Cell: 204-479-2850

From: Brett McCormac [mailto:bmccormac@jrcc.ca]
Sent: Wednesday, May 08, 2013 8:59 AM
To: Greaves, Andrew
Subject: FW: Gas Transmission Pipeline - RM of Brokenhead

Hi,

I have not received the record drawings requested in the e-mail below. Please forward me the drawings at your earliest convenience.

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

From: Brett McCormac [mailto:bmccormac@jrcc.ca]
Sent: May 2, 2013 11:52 AM

To: 'agreaves@hydro.mb.ca'
Subject: Gas Transmission Pipeline - RM of Brokenhead

Hi,

As discussed on the phone, attached is a location plan of our proposed lagoon expansion in relation to the gas pipeline easement. Please send me the record drawings of the gas pipeline in 15-13-6E. If not indicated on the record drawings we would like to know the following information:

1. Where is the pipeline within the easement
2. What is the size and type of pipe
3. What is the depth of bury
4. When was the pipeline installed
5. Is there any setbacks from the edge of the gas line easement for construction of a lagoon
6. Any other relevant information

Thank you.

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

J.R. Cousin Consultants Ltd.
Phone: (204) 489-0474
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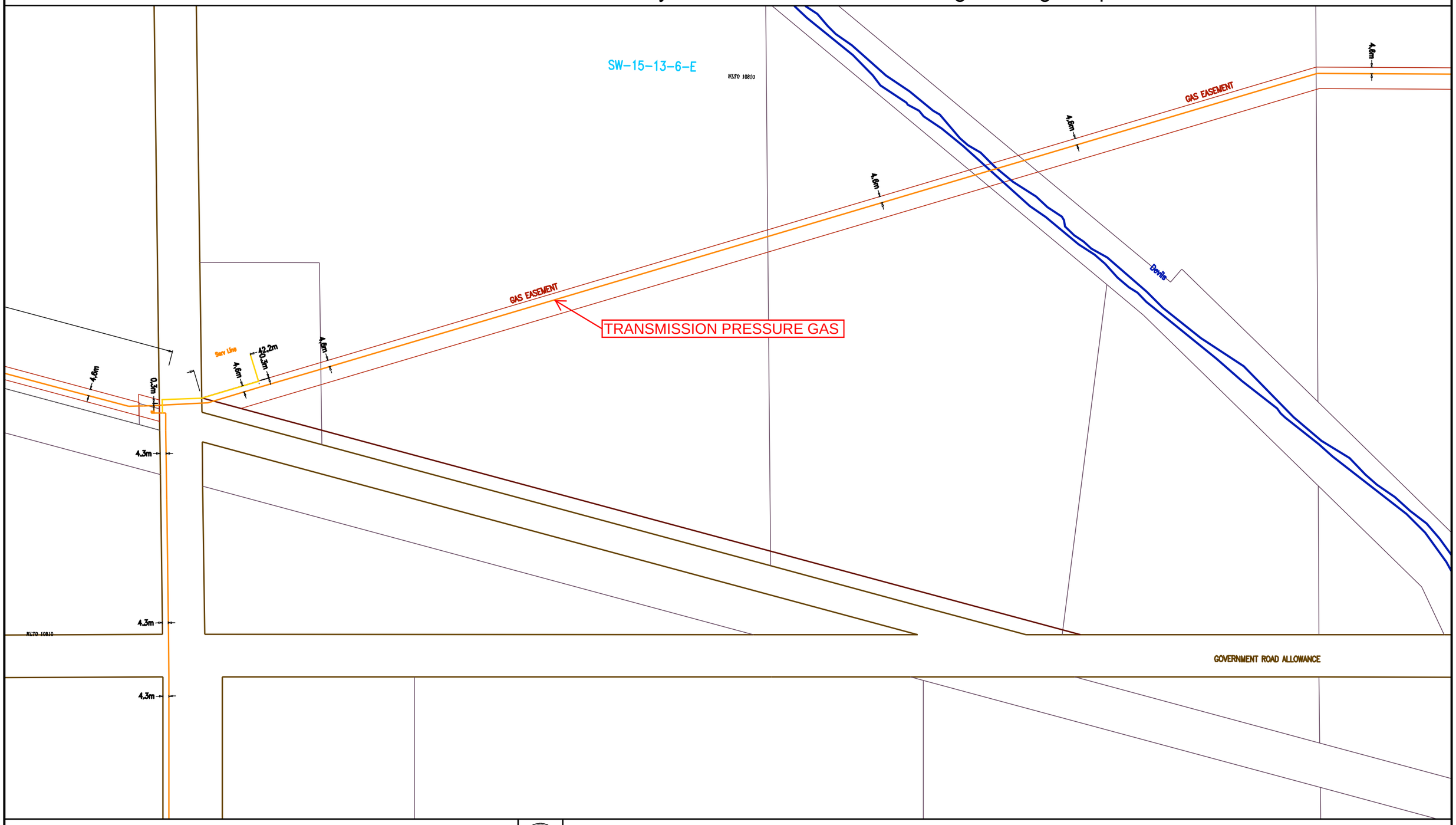
Manitoba Hydro Gas Line Record Drawing

NOTE :This plot is to be used for general pipe routing information only.
All other data to be confirmed by the Gas Distribution Planning & Design Dept.



NOTE: Maximum Operating Presure (MOP) is 420 kpa unless otherwise noted.
Outside Diameter (O.D.) of pipe in millimeters unless otherwise noted.

Appendix B

Table 1: Population, Hydraulic and Organic Loading Projections for the RM of Brokenhead Lagoon

Manitoba Conservation and Water Stewardship Fisheries Branch, January 9, 2013 Email Correspondence

Manitoba Conservation Wildlife and Ecosystem Protection Branch, January 9, 2013 Email Correspondence

Manitoba Historic Resources Branch, January 23, 2013 Memorandum

Table 1: Population, Hydraulic and Organic Loading Projections for the RM of Brokenhead Lagoon

TABLE 1

POPULATION, HYDRAULIC, AND ORGANIC LOADING PROJECTIONS FOR THE RM OF BROKENHEAD LAGOON

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
		POPULATION					ORGANIC LOADING						HYDRAULIC LOADING							
PROJECT YEAR	YEAR	POPULATION GROWTH PER YEAR Garson/Tyndall /Henryville	BUSSED-IN STUDENTS		R.M. OF BROKENHEAD RURAL RESIDENTS	R.M. OF BROKENHEAD RURAL RESIDENTS	DAILY PER CAPITA BOD	BOD PRODUCTION	DAILY BOD PRODUCTION	DAILY BOD PRODUCTION	DAILY BOD PRODUCTION	SURFACE AREA REQ'RD AT 0.75 M DEPTH Based on loading rate of 56 kg BOD_5/ha/day	DAILY/CAPITA WATER DEMAND	REJECT	INFILTRATION*	DAILY/CAPITA WATER DEMAND Including 30% reject water and 15% infiltration	DAILY/CAPITA WATER DEMAND Rural Residents on Holding Tanks	YEARLY/CAPITA SEPTAGE PRODUCTION From Rural Residents on Septic Tanks	TOTAL DAILY WASTEWATER PRODUCTION	230 Day WASTEWATER PRODUCTION
			1.15% Growth/year		Serviced by Septic Tanks	Serviced by Holding Tanks	Piped and Holding Tanks	Septic Tanks	Piped and Holding Tanks	Septic Tanks	Total	(Col 12/56 kgBOD_5/ha)* 1000	Piped Systems	30% of daily per capita raw water demand	15% of daily per capita water demand (Piped Systems only)				*	Col 20 * 230
		4.56%	Actual	Equivalent (1/3)	1.36% Growth/year	1.36% Growth/year	(kg)	(kg/m^3)	(Col 3 + Col 5 + Col 7)*Col 8	(Col 6 * Col 19/ 135 days)* (Col 9/1000)	Col 10 + Col 11	(m^2)	(L/person/day)	(Col 14 / 0.7) *0.3	Col 14 * 0.15	Col 14 + Col 15 + Col 16	(L/person/day)	(litres/year)	(m^3/day)	(m^3)
0	2012	1,538	118	40	2,421	807	0.076	7.0	181.3	25.1	206.4	36,851	225	96	34	355	200	200	725	166,791
1	2013	1,609	120	40	2,454	818	0.076	7.0	187.5	25.4	212.9	38,025	225	96	34	355	200	200	753	173,105
2	2014	1,682	121	41	2,488	830	0.076	7.0	194.0	25.8	219.8	39,255	225	96	34	355	200	200	781	179,711
3	2015	1,759	123	41	2,522	841	0.076	7.0	200.7	26.2	226.9	40,513	225	96	34	355	200	200	811	186,515
4	2016	1,839	124	42	2,556	852	0.076	7.0	207.7	26.5	234.2	41,824	225	96	34	355	200	200	842	193,647
5	2017	1,923	125	42	2,591	864	0.076	7.0	215.0	26.9	241.9	43,192	225	96	34	355	200	200	874	201,069
6	2018	2,010	127	43	2,626	876	0.076	7.0	222.6	27.2	249.8	44,614	225	96	34	355	200	200	908	208,818
7	2019	2,102	128	43	2,662	888	0.076	7.0	230.5	27.6	258.1	46,092	225	96	34	355	200	200	943	216,894
8	2020	2,198	130	44	2,698	900	0.076	7.0	238.8	28.0	266.8	47,638	225	96	34	355	200	200	980	225,379
9	2021	2,298	131	44	2,734	912	0.076	7.0	247.3	28.4	275.7	49,224	225	96	34	355	200	200	1,018	234,108
10	2022	2,403	133	45	2,772	924	0.076	7.0	256.3	28.7	285.0	50,896	225	96	34	355	200	200	1,058	243,328
11	2023	2,512	134	45	2,809	937	0.076	7.0	265.5	29.1	294.7	52,620	225	96	34	355	200	200	1,099	252,838
12	2024	2,627	136	46	2,848	950	0.076	7.0	275.3	29.5	304.9	54,443	225	96	34	355	200	200	1,143	262,921
13	2025	2,747	137	46	2,886	962	0.076	7.0	285.4	29.9	315.3	56,305	225	96	34	355	200	200	1,188	273,284
14	2026	2,872	139	47	2,926	976	0.076	7.0	296.0	30.3	326.4	58,279	225	96	34	355	200	200	1,236	284,229
15	2027	3,003	141	47	2,965	989	0.076	7.0	307.0	30.7	337.7	60,306	225	96	34	355	200	200	1,285	295,537
16	2028	3,140	142	48	3,006	1,002	0.076	7.0	318.4	31.2	349.6	62,431	225	96	34	355	200	200	1,337	307,416
17	2029	3,283	144	48	3,046	1,016	0.076	7.0	330.4	31.6	362.0	64,636	225	96	34	355	200	200	1,390	319,750
18	2030	3,432	145	49	3,088	1,030	0.076	7.0	342.8	32.0	374.9	66,939	225	96	34	355	200	200	1,446	332,656
19	2031	3,589	147	49	3,130	1,044	0.076	7.0	355.8	32.5	388.3	69,338	225	96	34	355	200	200	1,505	346,133
20	2032	3,753	149	50	3,172	1,058	0.076	7.0	369.4	32.9	402.3	71,845	225	96	34	355	200	200	1,566	360,264

(Col 3 + Col 5)(Col 17)/1000 + Col 7 * Col 18/1000 + Col 6 * Col 19/135/1000

Manitoba Conservation and Water Stewardship Fisheries Branch

January 9, 2013 Email Correspondence

Brett McCormac

From: Janusz, Laureen R (MWS) [Laureen.Janusz@gov.mb.ca]
Sent: January 9, 2013 4:38 PM
To: 'Brett McCormac'
Cc: Klein, Geoff (MWS); Kroeker, Derek (MWS)
Subject: Information Request Devil's Creek re: RM of Brokenhead Lagoon Expansion

Hi Brett,

I had a discussion with our regional fisheries biologist in Gimli regarding the proposed lagoon expansion. Derek noted that the existing discharge route really is very short before it enters Devil's Creek. I'm assuming your information request below is centered on the need to prepare an environment act proposal. We were wondering if there is an opportunity to change the discharge outlet and channel to extend the length to which the effluent would travel prior to reaching the creek. With the lagoon expansion going to the east a new discharge outlet and channel could be constructed on the far east side of new lagoon. Ideally, if the channel could have a meander or two with some widened sections for pools, it could potentially serve two purposes – provide an extra buffer to achieve water quality limits prior to entering a fish bearing creek and create fish habitat. We recognize that the effluent is to meet or exceed Water Quality's Standards, Objectives and Guidelines prior to release, however from experience situations occur where emergency discharge is required.

Your consideration and thoughts on this would be appreciated. Thanks Brett.

Laureen Janusz
Fisheries Science and Fish Culture Section
Fisheries Branch
Conservation and Water Stewardship
Phone: 204 945-7789
Cell: 204 793-1154
Email: Laureen.Janusz@gov.mb.ca

From: Janusz, Laureen R (MWS)
Sent: January-07-13 5:44 PM
To: 'Brett McCormac'
Cc: Klein, Geoff (MWS); Kroeker, Derek (MWS)
Subject: Information Request Devil's Creek re: RM of Brokenhead Lagoon Expansion

Hi Brett,

Sorry for the delay in responding. Given what information you have provided below typically as long as the existing drainage route will be used, erosion and sediment control measures are implemented where needed and the effluent meets or exceeds Manitoba Water Quality Standards, Objectives and Guidelines fisheries concerns should be addressed.

This is important given Devil's Creek supports a number of large and small bodied species, at minimum providing seasonal spawning, rearing and foraging habitat and it enters Lake Winnipeg. In the Fish Inventory and Habitat Classification system, Devil's Creek is classified as a Class 2 waterbody – a waterbody that has slight limitations to the production of fish. It also supports a recreational fishery. The following fish species have been found in Devil's Creek : Central Mudminnow, Johnny Darter, Blacksided Darter, Brook Stickleback, Fathead Minnow, Blacknose Dace, Black Crappie, Brown Bullhead, Burbot, Common Carp, Channel Catfish, Emerald Shiner, Freshwater Drum, Goldeye, Northern Pike, Rock Bass, Sauger, Tadpole Madtom, Trout Perch, Walleye, White Bass, White Sucker and Yellow Perch.

Brett, please note that information from FIHCS comes from a number of sources and as such we cannot guarantee the species listed are 100% accurate. Also the species when entered are not linked to a location so the list includes everything reported to be found in the creeks.

I have cc'd the regional fisheries staff should there be additional information or any correction to what has been provided.

Laureen Janusz
Fisheries Science and Fish Culture Section
Fisheries Branch
Conservation and Water Stewardship
Phone: 204 945-7789
Cell: 204 793-1154
Email: Laureen.Janusz@gov.mb.ca

From: Brett McCormac [mailto:bmccormac@jrcc.ca]
Sent: January-02-13 10:32 AM
To: Janusz, Laureen R (MWS)
Subject: RM of Brokenhead Lagoon Expansion - Fisheries

Hi Laureen,

J.R. Cousin Consultants Ltd. (JRCC) is preparing an Environmental Act Proposal for expansion of the existing RM of Brokenhead Lagoon. The lagoon expansion is proposed to be located directly east of the existing lagoon within the NW and SW ¼ of 15-13-06 EPM.

The drainage route from the expanded lagoon will follow the existing licenced drainage route to the Devil's Creek. The creek runs north and encounters Upper Devil's Lake before reaching the Red River.

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 Devil's Creek, if available.

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 Conservation Wildlife and Ecosystem Protection Branch

January 9, 2013 Email Correspondence

Brett McCormac

From: Friesen, Chris (CON) [Chris.Friesen@gov.mb.ca]
Sent: January 9, 2013 8:33 AM
To: 'Brett McCormac'
Subject: RE: RM of Brokenhead - Species at Risk

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 and Ecosystem Protection Branch, Manitoba Conservation.

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: January-02-13 10:39 AM
To: Firlotte, Nicole (CON); Friesen, Chris (CON)
Subject: RM of Brokenhead - Species at Risk

Hello,

J.R. Cousin Consultants Ltd. (JRCC) is preparing an Environmental Act Proposal for expansion of the existing RM of Brokenhead Lagoon. The lagoon expansion is proposed to be located directly east of the existing lagoon within the NW and SW ¼ of 15-13-06 EPM. The land is currently an agricultural field.

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, January 23, 2013 Memorandum

Manitoba

Memorandum

DATE: January 23, 2013

TO: Brett McCormac
JR Cousin Consultants Ltd.
91 A Scurfield Boulevard
Winnipeg MB

FROM: Gordon Hill
Impact Assessment Archaeologist
Historic Resources Branch
Main Floor 213 Notre Dame Avenue
Winnipeg MB
R3B 1N3
PHONE NO: (204) 945-7730

SUBJECT: HERITAGE RESOURCES

YOUR FILE:

HRB FILE: AAS-12-5434

LAGOON EXPANSION
W 1/2 15-13-6 EPM
RM BROKENHEAD

In response to your memo regarding the above-noted project, 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 project.

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 affects of development on the heritage resources.

If you have any questions or require further comments, please contact me at 945-7730.

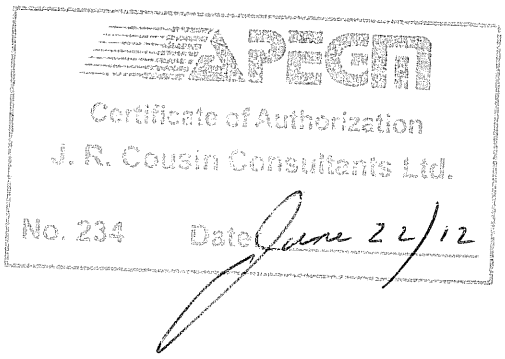
C. Gordon Hill

Appendix C

RM of Brokenhead Geotechnical and Topographic Investigation for the Wastewater Treatment Lagoon Expansion

RM OF BROKENHEAD

Geotechnical and Topographic Investigation for the Wastewater Treatment Lagoon Expansion



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

June 2012

ACKNOWLEDGMENTS

To prepare this report various sources of information were investigated and researched. The firm of J. R. Cousin Consultants Ltd. wishes to thank the RM of Brokenhead who assisted with organization and onsite works.

REMARKS

Conclusions reached in this report are based upon the generalization of data available to us at the time of forming our opinions. Information in this document may rely on previous studies, investigative work and data by others. JRCC cannot be responsible for actual site conditions proved to be at variance with any generalized data. This report was completed in accordance with generally accepted professional engineering principles and practice. Any use of this report by a third party is the responsibility of the third party, JRCC accepts no responsibility for third party decisions or actions based on the report. No other warranty or guarantee expressed, implied or statutory is made.

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APPENDIX

1.0 INTRODUCTION

J. R. Cousin Consultants Ltd. (JRCC) conducted a topographic and geotechnical investigation for the proposed wastewater treatment lagoon expansion for the RM of Brokenhead Garson/Tyndall/Henryville lagoon. The potential lagoon expansion site investigated was east of the existing lagoon within the NW and SW ¼ of Section 15-13-06 EPM. A total of 12 test holes were drilled across the site to determine the suitability of the soils for use as a clay lagoon liner. Test hole locations are shown on Plan 1 attached in the Appendix.

This report outlines the findings of the geotechnical and topographic investigation at the proposed lagoon expansion site and evaluates the soils to determine their suitability for use as a lagoon liner as well as any potential difficulties associated with construction.

2.0 BACKGROUND

The existing RM of Brokenhead lagoon has a primary cell and two secondary cells located in the NW and SW ¼ of Section 15-13-06 EPM. The existing lagoon is overloaded and requires expansion.

2.1 Past Geotechnical Investigation

A geotechnical investigation for construction of the existing RM of Brokenhead lagoon site was performed by JRCC in January of 2002. Seven test holes were excavated and representative soil samples were sent to Eng Tech Consulting Ltd. for analysis. The report found the soil profile in the test holes consisted of topsoil followed by a minimum of 4.6 m of high plastic clay with varying levels of silt. The laboratory analysis confirmed the clay would be suitable for use as a lagoon liner in the insitu conditions or when re-worked and re-compacted.

Past test hole locations are shown on Plan 1 attached in the Appendix. Past test hole logs are also included in the Appendix.

2.2 GW Driller's Well Logs

Four driller's well logs from 15-13-06 EPM were reviewed. The well logs indicated the soil profile consisted of clay followed by till underlain by gravel and limestone. The clay layer extended to an average depth of 8.9 m below the ground surface. The layer of till extended from 8.9 m to 22.9 m below the ground surface followed by the limestone layer to a maximum observed depth of 54.9 m.

The static groundwater level recorded in the wells was 18.3 m above the ground surface in one of the wells, 0.6 m below the ground surface in two of the wells and was not reported on the fourth well.

GW Driller's Well logs are included in the Appendix.

3.0 TOPOGRAPHIC INVESTIGATION

A topographic GPS survey of the test hole locations and existing ground locations across the proposed lagoon expansion site was completed on March 27, 2012 along with the geotechnical investigation. The existing ground at the proposed expansion site was relatively flat with some low lying areas. From the topographic survey data, the existing ground elevations varied from 235.04 m to 237.38 m with an average elevation of approximately 236.23 m. The top of dike elevation of the existing Cell #6 was approximately 237.22 m, which is approximately 1.0 m above the average surrounding ground elevation.

Contour lines from the topographic survey are shown on Plan 1 in the Appendix.

4.0 GEOTECHNICAL FIELD INVESTIGATION

The onsite geotechnical investigation for the proposed lagoon expansion site was conducted on March 27, 2012. Paddock Drilling Ltd. was employed to conduct the test holes using a track-mounted drill rig under direct supervision by JRCC's field representative.

Twelve test holes (TH1 – TH12) were drilled during the geotechnical investigation. Test holes were drilled to a depth of 6.1 m (20 ft). Test hole locations are shown on Plan 1, in the Appendix.

The subsurface soil profile within each test hole was logged, water conditions were noted and representative soil samples were collected as the soils varied along the profile. The samples were visually field-classified. Fourteen selected bagged soil samples from the test holes were sealed and submitted to AMEC Earth and Environmental for testing. One Shelby tube sample (TH2 1.5 – 2.1m) was also sent to AMEC to determine the insitu hydraulic conductivity. Details of the laboratory analysis are provided in Section 5.0 of this report. Following completion of drilling, an assessment of the short term groundwater conditions was completed. All test holes were then backfilled with bentonite mixed with the auger cuttings.

4.1 Soil Profile

Details of each individual soil profile, including depth and description of each layer as well as comments on bedrock and groundwater infiltration can be found in the test hole logs attached in the Appendix. The following is a summary of the soil profile at the proposed lagoon expansion site.

The soil profile consisted of an average of 0.3 m of black topsoil followed by a grey, hard, blocky high plastic clay from an average of 0.3 m – 1.2 m. The following layer varied between the test holes, in TH1, TH8 and TH10 – TH12 the layer was a high plastic, homogonous grey clay with an average depth of 1.6 m. In TH2 – TH7 the layer was a grey high plastic clay with silt inclusions, some sand and trace gravel with an average depth of 2.3 m. The final layer in TH4 – TH5, TH7 and TH10 – TH12 was a light brown silty, sandy till with trace of low plastic clay.

This layer of till was also found in TH6 from 3.0 – 5.5 m, TH9 from 0.9 – 1.5 m and TH12 from 2.0 – 2.1 m.

Bedrock was not encountered in any of the test holes. Caving of the test holes was observed in TH3 at 5.8 m, TH5 at 4.1 m and TH6 at 1.9 m.

4.2 Groundwater

Short-term groundwater conditions were assessed in each test hole by observing standing water elevations in the holes prior to backfilling. Caving and sloughing of the test hole walls was also observed and recorded. Standing water was observed in TH5 at 5.7 m and water infiltration was observed in TH6 at a depth of 1.9 m. No water infiltration or standing water was observed in the remainder of the test holes.

Groundwater in the test holes depends on high static groundwater conditions and on seasonal conditions, i.e. snowmelt and rainy seasons. Other assumptions relating to the groundwater elevation cannot be made at this time, as water levels will normally fluctuate seasonally.

Contractors will be made aware of the geotechnical conditions encountered onsite, as dewatering and trench stabilization may be required during construction, depending on the depth of excavation determined during final design.

5.0 LABORATORY TESTING AND ANALYSIS AND DISCUSSION

Representative soil samples from the proposed lagoon site were submitted to AMEC Earth and Environmental for testing and analysis. The testing and analysis included determining the following:

- Atterberg Limits (plastic limit, liquid limit, and plasticity index, ASTM D4318)
- Soil Classification (ASTM D2487)
- Moisture Content (ASTM D2216)
- Particle Size Analysis (Hydrometer test, ASTM D422).

The Shelby tube sample was subjected to a Hydraulic Conductivity test (ASTM D5084-03).

Laboratory classification analysis of the bagged soil samples indicated ten of the samples were deemed fat clay (CH), two of the samples were deemed sandy lean clay (CL) and two samples were deemed an inorganic clay and silt (CI). The Plasticity Index of the samples classified as CH varied between 38 and 64 and the percentage of clay varied between 48.8% and 86.7%. The Plasticity Index of the samples classified as CL and CI varied between 11 and 23 and the percentage of clay varied between 19.8% and 34.2%. Based on past experience, the laboratory has commented that homogeneous soils with a plasticity index greater than 25 and a clay content greater than 50% would typically be expected to have a hydraulic conductivity of 1×10^{-7} cm/sec or less. Plasticity Index analysis (i.e. Atterberg limits) of the soils

indicated that all of the bagged soil samples submitted with the exceptions of TH5 3.0 – 6.1 m, TH6 0.9 – 2.1 m, TH6 2.1 – 3.0 m and TH12 2.1 – 3.3 m were considered to have potential for use as an insitu clay liner or a re-moulded and re-compacted clay liner. See Table 1 of the AMEC Test Results, attached in the Appendix.

AMEC indicates that the bagged soil samples suitability for use as a clay liner is dependent upon the soils being homogeneous with no preferential flow paths. It is also 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. These silt and sand layers along with rocks, boulders or fissures in the soil can create preferential flow paths which can lead to an increased hydraulic conductivity.

A Shelby tube sample from TH2 1.5 – 2.1 m was submitted to AMEC to determine the insitu hydraulic conductivity for potential use as a lagoon liner. The sample achieved a hydraulic conductivity (k_{20}) of 8.18 x 10^{-9} cm/sec. This hydraulic conductivity is lower than the Manitoba Conservation requirement of 1 x 10^{-7} cm/sec and is therefore deemed suitable for use as an insitu clay lagoon liner. The bagged soil sample from the same layer had a clay content of 79.7% and a Plasticity Index of 61 and was deemed to have potential for use as an insitu lagoon liner or when re-worked and re-compacted. The hydraulic conductivity analysis confirms that the soil layer could be used as an insitu clay lagoon liner.

Details of AMEC Earth and Environmental test results and analysis, dated June 20, 2012 are attached in the Appendix.

6.0 LAGOON LINER REQUIREMENTS

6.1 Current Guidelines

Manitoba Conservation guidelines require that a standard wastewater treatment lagoon clay liner be 1.0 metre in thickness and have a hydraulic conductivity (i.e. the potential rate of fluid movement through the soil) of 1 x 10^{-7} cm/sec or less. This low rate is to protect the underlying groundwater from lagoon seepage. Generally, the higher a soil's plasticity the more likely a soil can achieve a hydraulic conductivity of 1 x 10^{-7} cm/sec.

6.2 Typical Lagoon Liner Construction Options

The liner of a lagoon can be constructed by using the insitu (undisturbed) soils if the soils can consistently achieve a hydraulic conductivity of 1 x 10^{-7} cm/sec or less in their insitu conditions.

If the insitu soils cannot be used the liner can be constructed by excavating and re-compacting suitable high plastic clay soils to form the liner.

If the clay content of the soils is so low that even when excavated and re-compacted, the soils cannot consistently achieve a hydraulic conductivity of 1 x 10^{-7} cm/sec, a liner constructed of high plastic clay from a borrow pit, or a synthetic geomembrane liner would be required.

6.3 Liner for the RM of Brokenhead Lagoon Expansion

Based on the laboratory Plasticity Index analysis, all of the bagged soil samples deemed a fat clay (CH) will be suitable for use as an insitu clay liner or when re-worked and re-compacted. This was confirmed by the insitu Shelby tube sample from TH2 1.5 – 2.1 m that achieved a hydraulic conductivity of 8.18 x 10^{-9} cm/sec. The bagged soil samples which were deemed a sandy lean clay (CL) or an inorganic clay and silt (CI) are not suitable for use as a clay lagoon liner. The similar layer of soils which are not suitable for a lagoon liner were found in TH4 – TH5, TH7 and TH10 – TH12 from a starting depth ranging from 2.7 to 4.9 m below ground to the termination of the test holes at 6.1 m. The layer of unsuitable soil was also found in TH9 from 0.9 – 1.5 m and TH12 from 2.0 – 3.4 m. The entire soil profile found in TH6 would not be suitable for use as an insitu lagoon liner or when re-worked and re-compacted.

The maximum elevation of the start of the unsuitable till material is approximately 233.8 m observed in TH5 and TH11. If the lagoon expansion were designed to meet the existing lagoon top of dike elevations, the top of dike would be at an elevation of approximately 237.22 m, the cell floor would be at an elevation of 234.72 m and the bottom of the insitu liner would be at an elevation of 233.72 m. The start of the till material in TH5 and TH11 is higher than the bottom of the insitu liner, providing less than 1.0 m of liner material at TH5 and TH11. See Plan 2, attached in the Appendix for a summary of the test hole logs showing the elevation of the proposed liner.

The entire soil profile found in TH6 would not be suitable for use as an insitu lagoon liner or when re-worked and re-compacted. The soil profile of TH12 has suitable high plastic clay from 0.3 – 2.0 m and unsuitable clay from 2.0 – 6.0 m. The clay liner would be approximately 1.9 m – 2.9 m below the ground surface at TH12, which is in the unsuitable clay material. The unsuitable clay found would have to be excavated and suitable high plastic clay from a borrow area would have to be hauled in and re-compacted and re-worked.

TH10, completed just south of TH5, TH6, TH11 and TH12, had a top of unsuitable material elevations of 231.8 m with suitable high plastic clay above the unsuitable material. This results in an insitu clay liner depth of 2.9, which is greater than the Manitoba Conservation requirement of 1.0 m. TH4 and TH7, also taken south of TH10 would have suitable clay liner depths of 2.6 m and 3.6 m, respectively.

Therefore the horizontal liner of the proposed lagoon expansion cells could be constructed with an insitu clay liner 1.0 m below the cell floor elevation approximately south of a line running through TH10, as shown on Plan 1. The exact location of this line would have to be determined by multiple on-site test holes completed during construction of the lagoon. Any layers of unsuitable material as found in TH9 from 0.9 – 1.5 m will have to be removed and replaced with re-worked and re-compacted high plastic clay.

The horizontal liner of the proposed lagoon expansion cells would have to be excavated and re-compacted with 1.0 m of suitable high plastic clay, approximately north of a line running through TH10. The area, which must be re-worked and re-compacted, may be larger than that shown on the plans, depending on the extent of the pockets of unsuitable material found during construction.

For all new perimeter dikes, a 3.0 m wide vertical cut-off wall will have to be constructed extending a minimum of 1.0 m into the horizontal liner surrounding the entire lagoon. Also, the clay soils 1.0 m below the cell floor elevation under the inside dike slope should be re-worked and re-compacted approximately 100 m south of the line through TH10. If the lagoon horizontal liner is tested by Manitoba Conservation and does not pass the requirements near the perimeter dikes, the dike would have to be removed to re-work and re-compact the clay soils beneath. If during lagoon construction the clay soils beneath the inside dike slope are re-worked and re-compacted, there will be little risk of not meeting the Manitoba Conservation requirements and having to remove the dikes.

7.0 SUMMARY AND RECOMMENDATIONS

7.1 Summary

The topography of the proposed site was relatively flat with an average elevation of approximately 236.23 m. The top of dike elevation of the existing RM of Brokenhead lagoon was 237.22 m.

Soils at the proposed lagoon expansion site were investigated by JRCC. Representative soil samples were analyzed by AMEC Earth and Environmental to determine their suitability for use as an insitu lagoon liner or a re-worked and re-compacted lagoon liner.

Based on the laboratory Plasticity Index analysis of the bagged soil samples submitted, ten of the samples were a fat clay (CH) and were deemed to have potential for use as an insitu lagoon liner or a re-worked and re-compacted lagoon liner. The remaining four samples were sandy lean clay (CL) and inorganic clay and silt (CI) and were not deemed suitable for use as an insitu liner or when re-worked and re-compacted. The Shelby tube sample from TH2 1.5 – 2.1 m achieved a hydraulic conductivity of 8.18×10^{-9} cm/sec showing it would be suitable for use as an insitu clay lagoon liner.

7.2 Recommendations

Based on the soil conditions encountered during the geotechnical investigation and the results of the laboratory analysis it is recommended the flat bottom liner of the RM of Brokenhead lagoon expansion cells be constructed partially with the insitu soils and partially with a re-worked and re-compacted liner. The flat bottom liner south of the line approximately through TH10, as shown

on Plan 1, could be constructed with insitu clay 1.0 m below the cell floor elevation. Any layers of unsuitable material found in the insitu portion of the liner, such as TH9 from 0.9 – 1.5 m will have to be removed and replaced with re-worked and re-compacted high plastic clay.

The flat bottom liner north of the line approximately through TH10, would have to be excavated and re-compacted with 1.0 m of suitable high plastic clay. The pockets of unsuitable clay material found in TH6 and TH12 would have to be removed and replaced with suitable high plastic clay from a borrow area. The exact location of the line dividing the re-worked liner from the insitu liner would have to be determined by multiple on-site test holes completed during construction of the lagoon. The amount of clay material that would have to be replaced from a borrow area would also have to be determined on-site during construction. The area, which must be re-worked and re-compacted, may be larger than that shown on the plans, depending on the extent of the pockets of unsuitable material found during construction. See Plan 1 attached in the Appendix for the approximate location of the line dividing the insitu liner and the re-worked and re-compacted liner. See Plan 2 for a summary of the test hole logs showing the elevation of the proposed liner.

It is recommended for all new perimeter dikes, a 3.0 m wide vertical cut-off wall be constructed extending a minimum of 1.0 m into the horizontal liner surrounding the entire lagoon. Also, it is recommended the clay soils 1.0 m below the cell floor elevation under the inside dike slope should be re-worked and re-compacted approximately 100 m south of the line through TH10.

7.3 Closure

The conclusions and recommendations in this report are based on the results of the site investigation and laboratory analysis. In addition, soil and groundwater conditions between test hole locations were generalized to provide an overall assessment of the geotechnical site conditions. If conditions that appear different from those encountered at the test hole locations as described in this report, or if the assumptions stated herein are not in agreement with the design, JRCC should be informed so the recommendations can be reviewed and adjusted as required.

The geotechnical investigation and topographic review was conducted for identifying geotechnical and topographic conditions suitable for construction of the RM of Brokenhead lagoon expansion. Although no environmental issues were identified during the geotechnical investigation and topographic review, it does not necessarily follow that such issues do not exist. If the client or any other parties have any environmental concerns regarding the proposed site and works, an appropriate environmental assessment must be conducted.

It is not uncommon for soil conditions to be highly variable across a site. Previous construction activities and placement of fill at a site can augment the variability of soil conditions, especially surficial soil conditions. A contingency must be included in any construction budget to allow for potential variations in soil conditions, which may result in modification of the design and construction procedures.

APPENDIX

Plan 1: Proposed Lagoon Expansion Site with Test Hole Locations and Topographic Contour Lines

Plan 2: Summary of Test Hole Logs with Elevations

Test Hole Logs

2002 Past Test Hole Logs

AMEC Earth and Environmental Test Results, dated June 20, 2012

GW Driller's Well Logs

Plan 1: Proposed Lagoon Expansion Site with Test Hole Locations and Topographic Contour Lines

Plan 2: Summary of Test Hole Logs with Elevations

RESIDENCE

2002-TH 5

R300.000

EXISTING SECONDARY CELL TO BE COMBINED WITH EXISTING PRIMARY CELL

2002-TH 4

2002-TH 3

2002-TH 6

NW 1/4 15-13-06 EPM

EXISTING PRIMARY CELL

2002-TH 2

EXISTING SECONDARY CELL

2002-TH 1

2002-TH 7

SW 1/4 15-13-06 EPM

R300.000

RESIDENCE

R300.000

TH 6

RE-WORKED AND RE-COMPACTED CLAY LINER FROM BORROW

TH 5

TH 11

TH 12

TH 10

APPROXIMATE TRANSITION FROM INSITU LINER (SOUTH) TO RE-WORKED AND RE-COMPACTED LINER (NORTH)

PROPOSED NEW SECONDARY CELL

PROPERTY LINE OF AREA OWNED BY RM FOR POTENTIAL LAGOON EXPANSION

TH 7

TH 4

INSITU CLAY LINER

TH 8

TH 3

PROPOSED NEW SECONDARY CELL

INSITU CLAY LINER

TH 9

TH 2

TH 1

NE 1/4 15-13-06 EPM

SE 1/4 15-13-06 EPM

SCALE BAR
(IN METRES)

50 0 25 50 100 150 200 250

1:2500

No.	REVISIONS	DATE	INITIALS

B.M. ELEV.

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

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Engineering Excellence since 1981

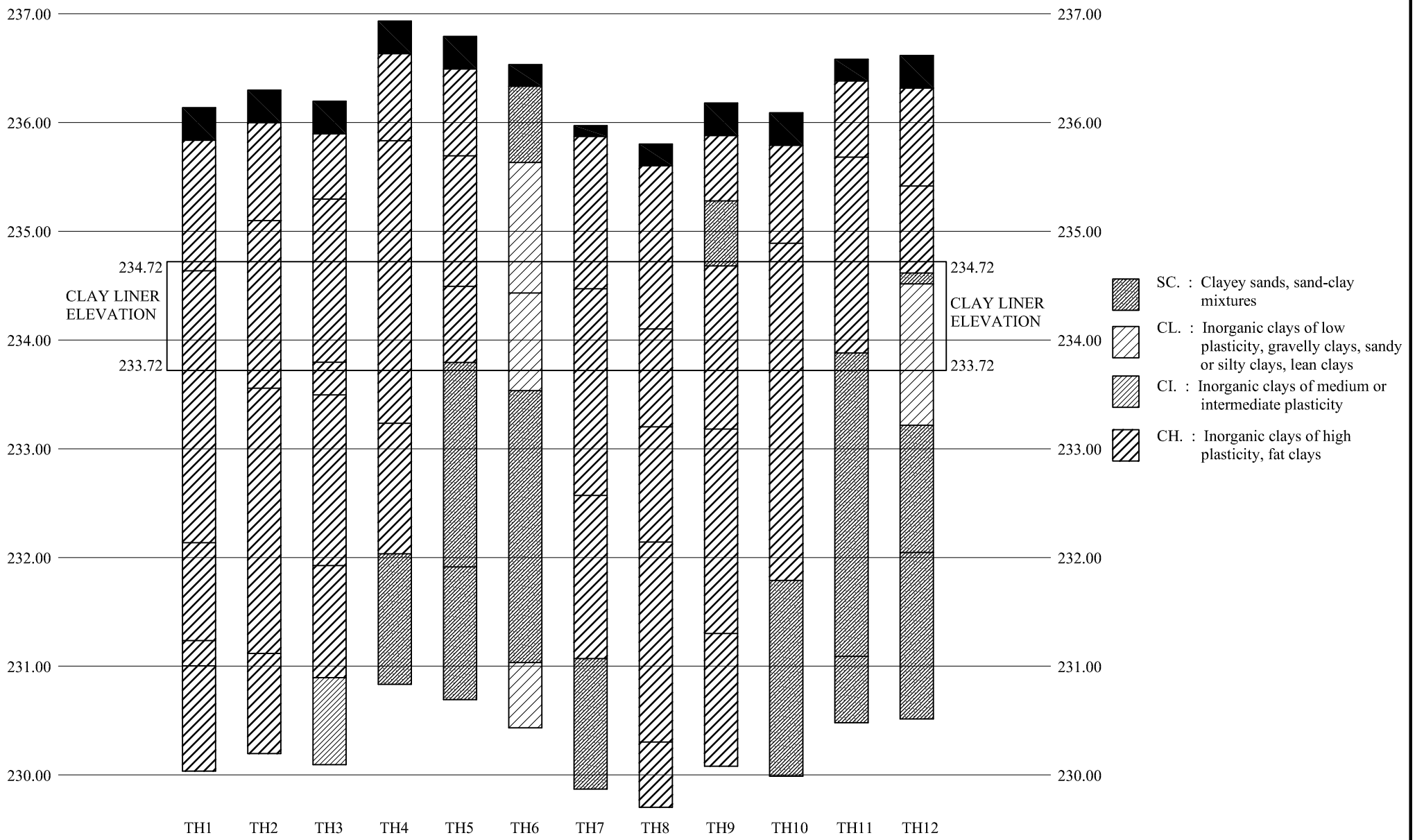
CODE: B-246.09
DESIGNED BY: JC
DRAWN BY: BM
REVIEWED BY: JC

PROJECT: RM OF BROKENHEAD - GARSON/TYNDALL/HENRYVILLE LAGOON FEASIBILITY STUDY

TITLE: PROPOSED LAGOON EXPANSION SITE WITH TEST HOLE LOCATIONS AND TOPOGRAPHIC CONTOUR LINES

SCALE:	DATE:	PLAN:	SHEET:
1:2500	12/06/07	1	1 of 2

Jul 23, 2012 - 10:31am F:\2005\246 Brokenhead RM\246.09 GTH Lagoon Feasibility Study\04 Drawings\Dwg\Feasibility Study\Lagoon Layout.dwg



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email: info@jrcc.ca website: www.jrcc.ca

DATE: 12/06/21	CLIENT: R.M. OF BROKENHEAD
SCALE: 1:50	PROJECT: GARSON/TYNDALL/HENRYVILLE LAGOON FEASIBILITY STUDY
PLAN NO.: 2	TITLE: SUMMARY OF TEST HOLE LOGS WITH ELEVTATIONS

Test Hole Logs

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 : R.M. of Brokenhead

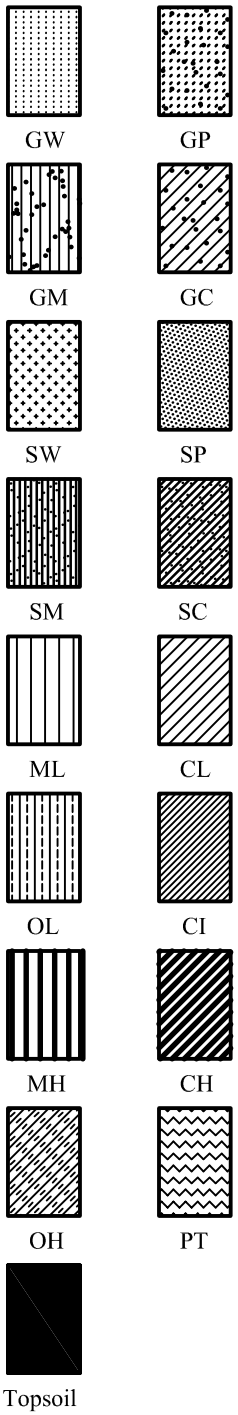
DATE : March 27, 2012

ELEVATION: 236.163

PROJECT : GTH Lagoon Feasibility Study

TEST HOLE # 1

DEPTH OF SAMPLE		FIELD CLASSIFICATION
0m	0	TOPSOIL - Black, clayey, organic, silty, trace sand
	2'	
1m		CLAY - High plastic, grey, trace silt, moist, hard, blocky
	4'	
	6'	
2m		
	8'	
		CLAY - High plastic, grey, trace silt, damp, hard, homogenous
3m	10'	
	12'	
4m		
	14'	CLAY - High plastic, grey, trace sand, moist, hard, silt inclusions
	16'	
5m		CLAY - High plastic, grey, wet, soft, silt and sand inclusions
	18'	
		CLAY - High plastic, grey, wet, soft, silt inclusions
6m	20'	NO WATER, NO CAVING



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J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : R.M. of Brokenhead

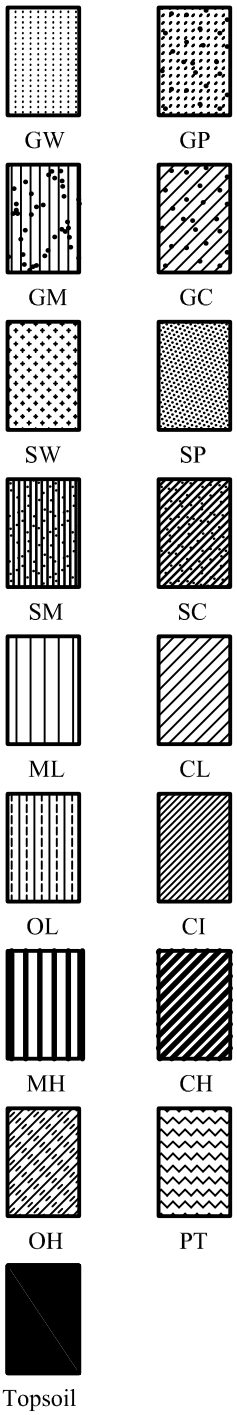
DATE : March 27, 2012

ELEVATION: 236.297

PROJECT : GTH Lagoon Feasibility Study

TEST HOLE # 2

DEPTH OF SAMPLE	FIELD CLASSIFICATION
0m / 0	TOPSOIL - Black, clayey, organic, silty, trace sand
2'	CLAY - High plastic, grey, trace silt, moist, hard, blocky
1m / 4'	
6'	CLAY - High plastic, grey, with silt inclusions, trace sand and gravel, moist, hard
2m / 8'	
3m / 10'	
12'	CLAY - High plastic, grey, some silt inclusions, trace sand, moist, hard
4m / 14'	
16'	
5m	
18'	CLAY - High plastic, grey, trace silt, wet, soft
6m / 20'	NO WATER, NO CAVING



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J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : R.M. of Brokenhead

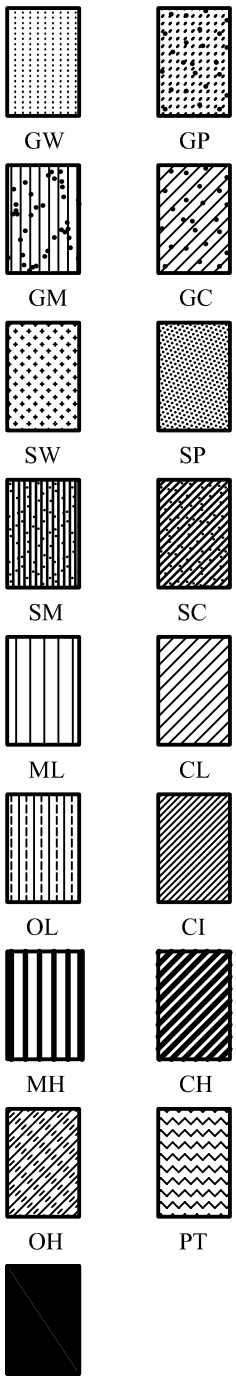
DATE : March 27, 2012

ELEVATION: 236.195

PROJECT : GTH Lagoon Feasibility Study

TEST HOLE # 3

DEPTH OF SAMPLE		FIELD CLASSIFICATION
0m	0	TOPSOIL - Black, clayey, organic, silty, trace sand
	2'	CLAY - High plastic, grey, trace silt, moist, hard, blocky
1m		
	4'	
		CLAY - High plastic, grey/light brown, with silt inclusions, some sand
	6'	
2m		
	8'	CLAY - High plastic, grey/light brown, with gravel, with silt inclusions, some sand
3m	10'	
		CLAY - High plastic, grey, some silt, wet, soft, very sticky
	12'	
4m		
	14'	
	16'	CLAY - High plastic, grey, wet, soft, homogenous
5m		
	18'	
		CLAY - High plastic, grey, with silt, trace sand, very wet, very soft
6m	20'	NO WATER, CAVING 5.8 m



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J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : R.M. of Brokenhead

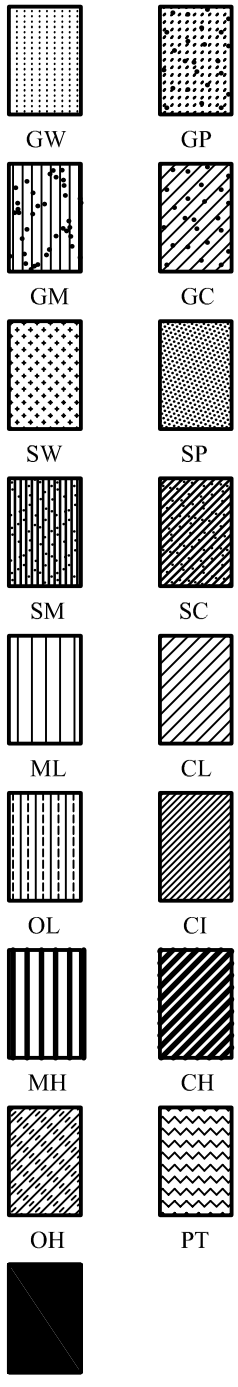
DATE : March 27, 2012

ELEVATION: 236.933

PROJECT : GTH Lagoon Feasibility Study

TEST HOLE # 4

DEPTH OF SAMPLE		FIELD CLASSIFICATION
0m	0	TOPSOIL - Black, clayey, organic, silty, trace sand
	2'	CLAY - High plastic, grey, trace silt, moist, hard, blocky
1m	4'	
	6'	
2m	8'	CLAY - High plastic, grey/brown, some silt inclusions, trace sand, damp, hard
3m	10'	
	12'	
4m	14'	CLAY - High plastic, grey, wet, soft, homogenous
	16'	
5m	18'	TILL - Light brown, silty, sandy, some gravel and low plastic clay, very wet, very soft
6m	20'	NO WATER, NO CAVING



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J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

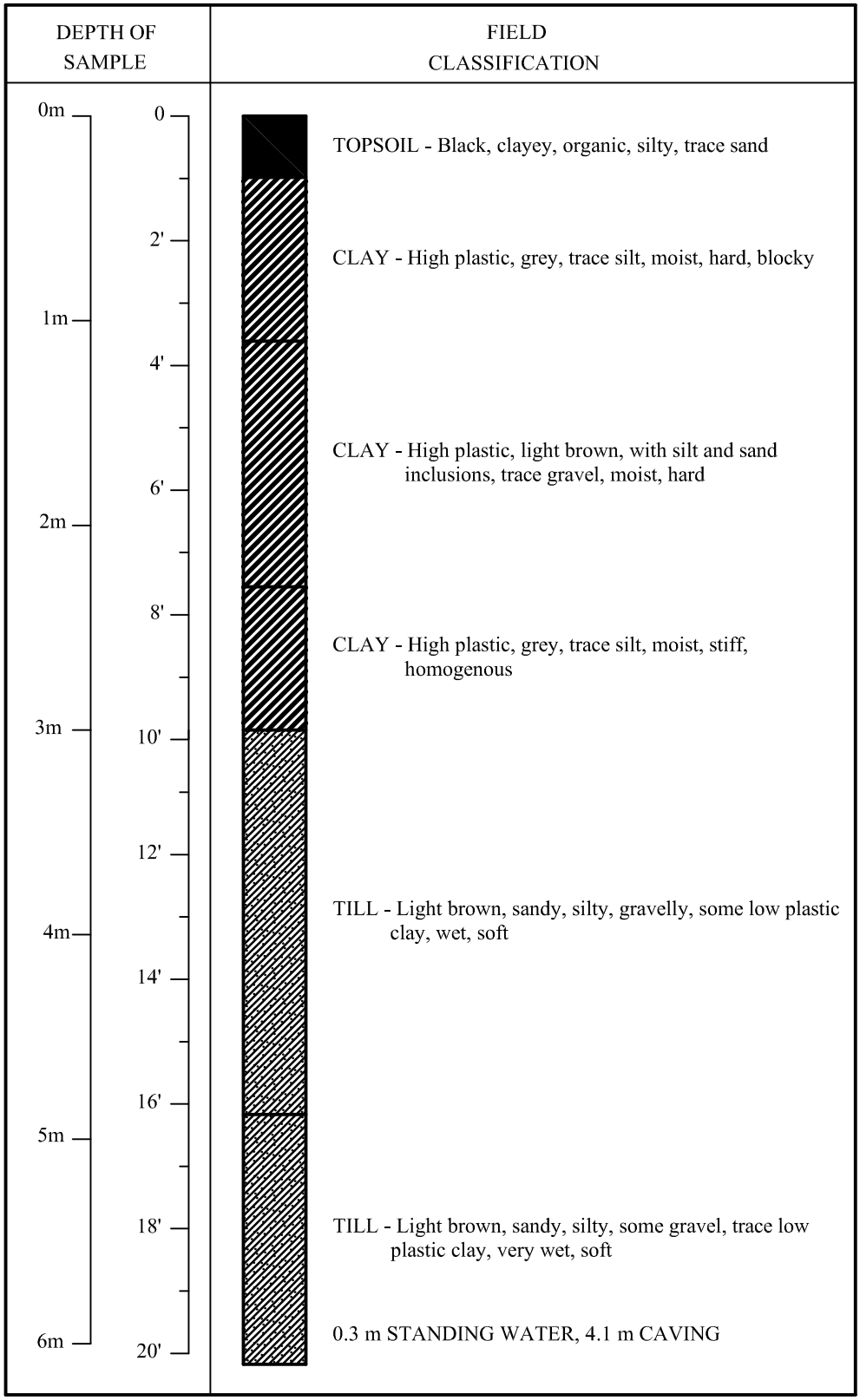
LOCATION : R.M. of Brokenhead

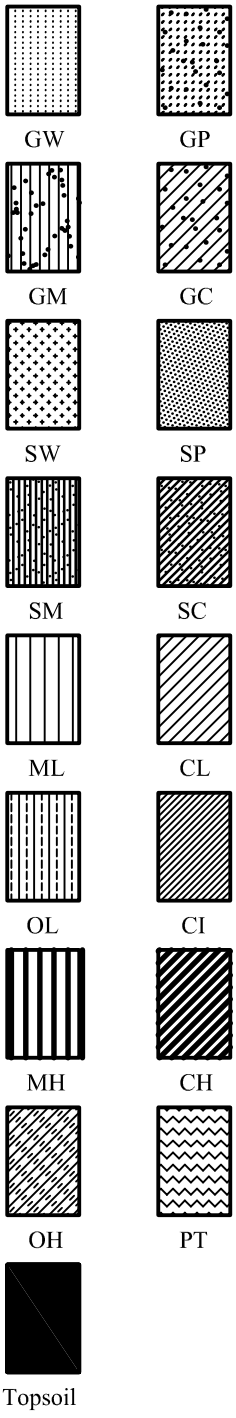
DATE : March 27, 2012

ELEVATION: 236.823

PROJECT : GTH Lagoon Feasibility Study

TEST HOLE # 5





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J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : R.M. of Brokenhead

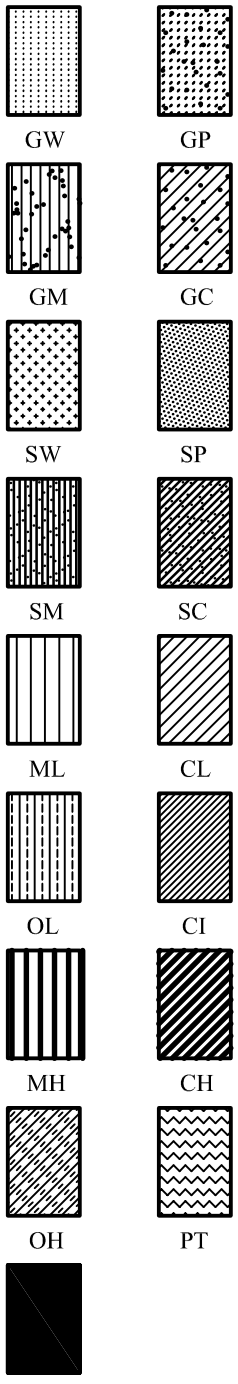
DATE : March 27, 2012

ELEVATION: 236.533

PROJECT : GTH Lagoon Feasibility Study

TEST HOLE # 6

DEPTH OF SAMPLE		FIELD CLASSIFICATION
0m	0	TOPSOIL - Black, clayey, organic, silty, trace sand
	2'	TILL - Silty, sandy, with trace gravel, trace medium plastic clay, moist, hard
1m	4'	
	6'	SILTY CLAY - Medium plastic, brown, with some sand, trace gravel, moist, stiff
2m	8'	
	10'	SILTY CLAY - Medium plastic, light brown, some sand and gravel, wet, stiff
3m	12'	
4m	14'	TILL - Light brown, sandy, silty, some gravel and low plastic clay, very soft, very wet
	16'	
5m	18'	
6m	20'	CLAY - Medium plastic, light brown, with silt, sand, gravel, wet, stiff
		WATER SEEPAGE AT 1.9 m, CAVING AT 1.9 m



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J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : R.M. of Brokenhead

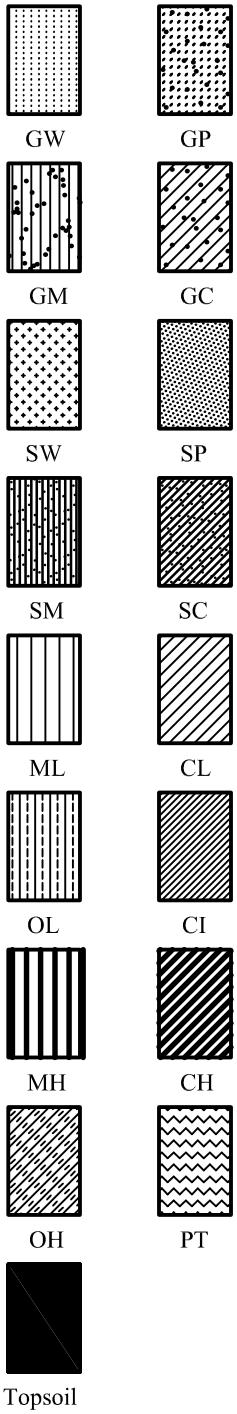
DATE : March 27, 2012

ELEVATION: 235.971

PROJECT : GTH Lagoon Feasibility Study

TEST HOLE # 7

DEPTH OF SAMPLE		FIELD CLASSIFICATION
0m	0	TOPSOIL - Black, clayey, organic, silty, trace sand
	2'	CLAY - High plastic, dark grey, some silt, wet, soft, blocky
1m	4'	
	6'	
2m	8'	CLAY - High plastic, brown, with silt, trace gravel, sand inclusions
3m	10'	
	12'	
4m	14'	CLAY - High plastic, brown, moist, firm, homogenous
	16'	
5m	18'	TILL - Sandy, silty, with medium-high plastic clay, wet, soft
6m	20'	NO WATER, NO CAVING



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J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : R.M. of Brokenhead

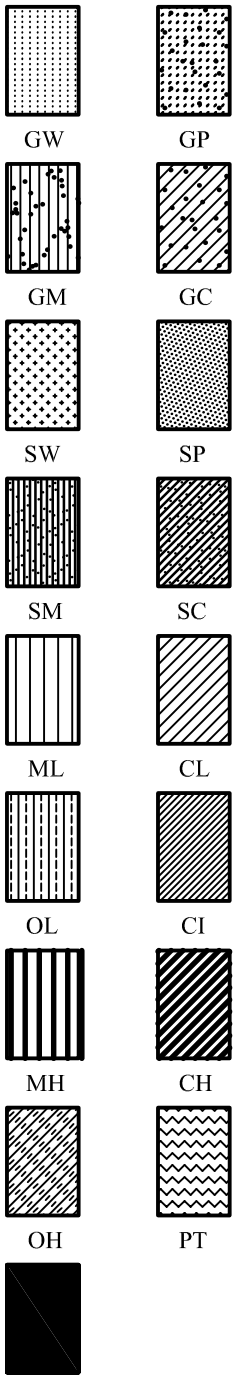
DATE : March 27, 2012

ELEVATION: 235.802

PROJECT : GTH Lagoon Feasibility Study

TEST HOLE # 8

DEPTH OF SAMPLE		FIELD CLASSIFICATION
0m	0	TOPSOIL - Black, clayey, organic, silty, trace sand
	2'	
1m		CLAY - High plastic, dark grey, trace silt, moist, hard, blocky
	4'	
	6'	
2m		CLAY - High plastic, grey, moist, stiff, homogenous
	8'	
3m	10'	CLAY - High plastic, grey, with silt and sand inclusions, trace gravel, moist
	12'	
4m		
	14'	CLAY - High plastic, grey, with silt and sand inclusions, wet, soft
	16'	
5m		
	18'	CLAY - High plastic, grey, wet, soft, homogenous
6m	20'	NO WATER, NO CAVING



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J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : R.M. of Brokenhead

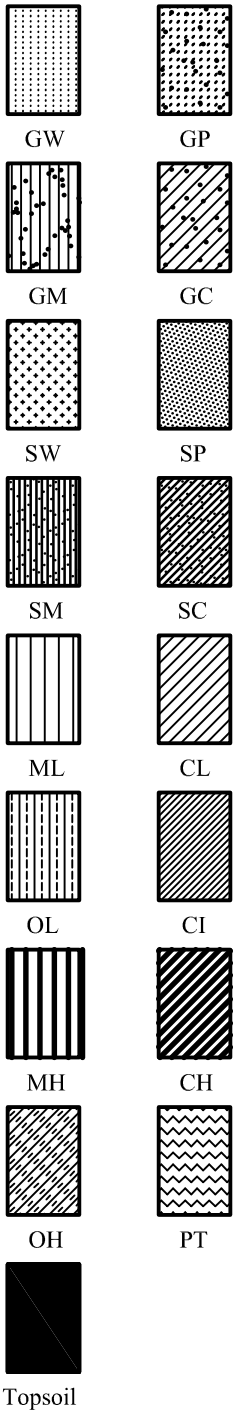
DATE : March 27, 2012

ELEVATION: 236.180

PROJECT : GTH Lagoon Feasibility Study

TEST HOLE # 9

DEPTH OF SAMPLE		FIELD CLASSIFICATION
0m	0	TOPSOIL - Black, clayey, organic, silty, trace sand
	2'	CLAY - High plastic, grey, some silt, damp, hard, blocky
1m	4'	TILL - Light brown, silty, sandy, trace clay, damp, loose
	6'	
2m	8'	CLAY, High plastic, grey, with silt inclusions, damp, hard
3m	10'	
	12'	
4m	14'	CLAY - High plastic, grey, moist, stiff, homogenous
	16'	
5m	18'	CLAY - High plastic, grey, some silt inclusions, moist, soft
6m	20'	NO WATER, NO CAVING



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J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : R.M. of Brokenhead

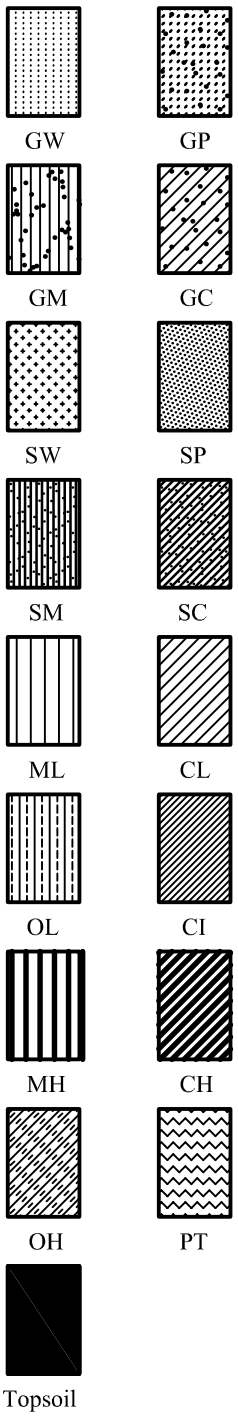
DATE : March 27, 2012

ELEVATION: 236.089

PROJECT : GTH Lagoon Feasibility Study

TEST HOLE # 10

DEPTH OF SAMPLE	FIELD CLASSIFICATION
0m / 0	TOPSOIL - Black, clayey, organic, silty, trace sand
2'	CLAY - High plastic, grey, some silt and sand, moist, hard, blocky
1m / 4'	
6'	
2m / 8'	CLAY - High plastic, grey, trace silt, moist, stiff
3m / 10'	
12'	
4m / 14'	
16'	TILL - Light brown, silty, sandy, some gravel and low plastic clay, wet, soft
5m / 18'	
6m / 20'	NO WATER, NO CAVING



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J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : R.M. of Brokenhead

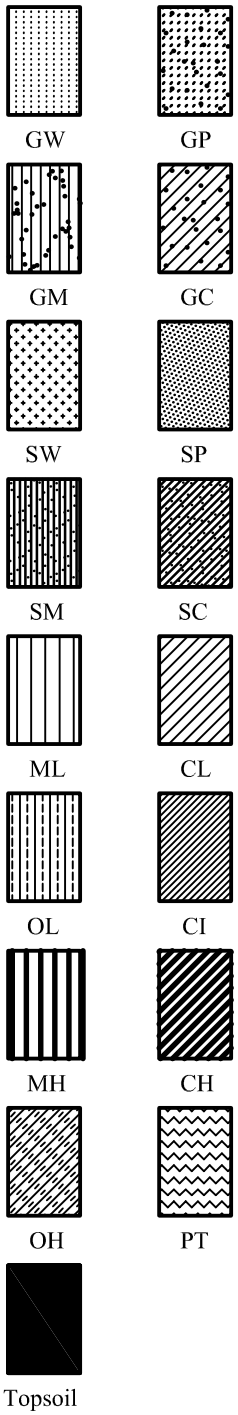
DATE : March 27, 2012

ELEVATION: 236.581

PROJECT : GTH Lagoon Feasibility Study

TEST HOLE #11

DEPTH OF SAMPLE		FIELD CLASSIFICATION
0m	0	TOPSOIL - Black, clayey, organic, silty, trace sand
	2'	CLAY - High plastic, dark grey, with trace silt, moist, hard, blocky
1m	4'	
	6'	CLAY - High plastic, brown, with some silt and sand, moist, hard
2m	8'	
3m	10'	
	12'	
4m	14'	TILL - Silty, sandy, some gravel and medium plastic clay, wet, soft
	16'	
5m	18'	
		TILL - Silty, sandy, some gravel and medium plastic clay, very wet, very soft
6m	20'	NO WATER, NO CAVING



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J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : R.M. of Brokenhead

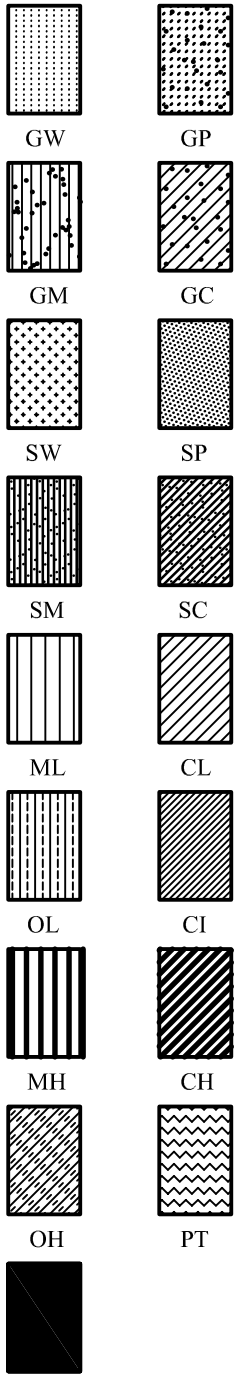
DATE : March 27, 2012

ELEVATION: 236.615

PROJECT : GTH Lagoon Feasibility Study

TEST HOLE # 12

DEPTH OF SAMPLE	FIELD CLASSIFICATION
0m / 0	TOPSOIL - Black, clayey, organic, silty, trace sand
2'	CLAY - High plastic, grey, with silt and sand inclusions, moist, hard, blocky
1m / 4'	CLAY - High plastic, brown, moist, hard
6'	TILL - Silty, sandy, some gravel and low plastic clay, wet, soft
2m / 8'	CLAY - Medium plastic, dark grey, some silt and sand inclusions, moist, hard
3m / 10'	TILL - Very sandy, silty, trace low plastic clay, very wet, soft, loose
12' / 4m / 14'	TILL - Very sandy, silty, trace low plastic clay, wet, soft, loose
16' / 5m / 18'	NO WATER, NO CAVING
6m / 20'	



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2002 Past Test Hole Logs

J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : RM of Brokenhead

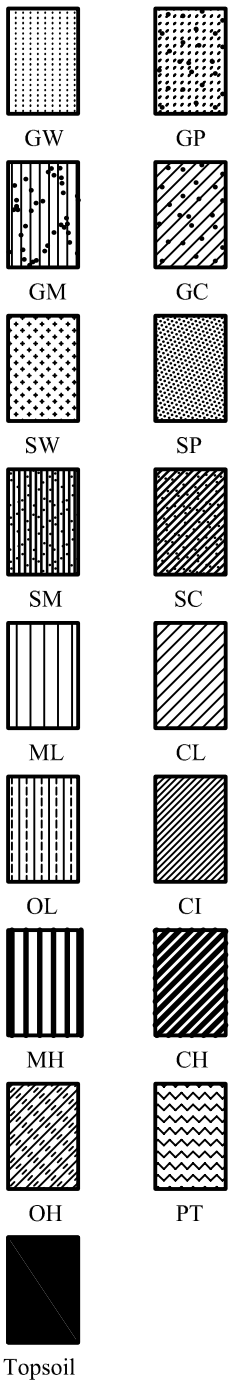
DATE : January 15, 2002

LOCATION OF BORING : NW 15-13-6E

PROJECT : Garson/Tyndall Proposed Wastewater Lagoon G-201.02

TEST HOLE # 1

DEPTH OF SAMPLE		FIELD CLASSIFICATION
0m	0	Topsoil
	2'	High plastic clay, black, with silt, with organics, frozen
1m	4'	
	6'	High plastic clay, brown, some silt, trace sand, slightly moist
2m	8'	
		High plastic clay, mix of brown and yelowish brown, some silt, trace sand, slightly moist
3m	10'	
	12'	
4m	14'	
		High plastic clay, brown, with silt, trace sand, moist
	16'	
5m	18'	
6m	20'	



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J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : RM of Brokenhead

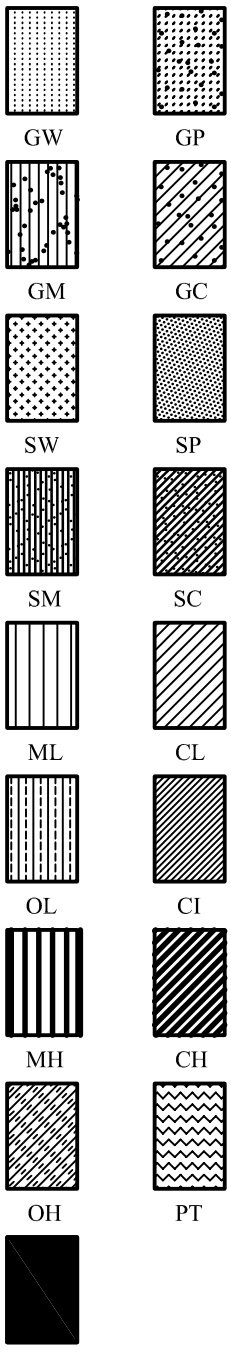
DATE : January 15, 2002

LOCATION OF BORING : NW 15-13-6E

PROJECT : Garson/Tyndall Proposed Wastewater Lagoon G-201.02

TEST HOLE # 2

DEPTH OF SAMPLE	FIELD CLASSIFICATION
0m / 0	Topsoil
2'	High plastic clay, black, with silt, with organics, frozen
1m / 4'	
6'	
2m / 8'	High plastic clay, brown, some silt, trace sand, slightly moist
3m / 10'	
12'	
4m / 14'	
16'	
5m / 18'	
6m / 20'	



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J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : RM of Brokenhead

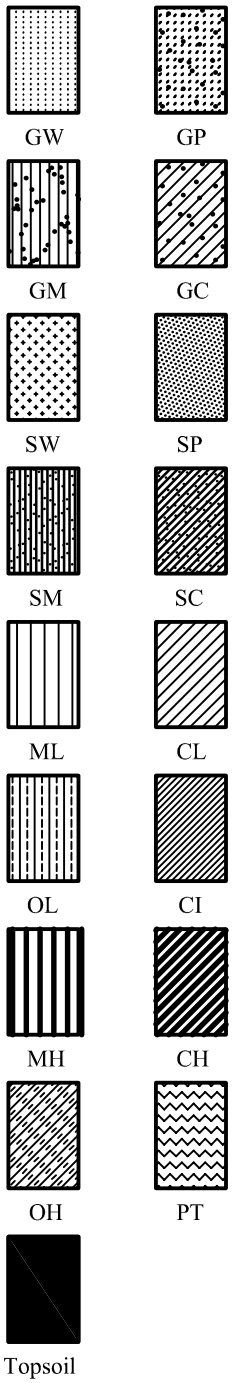
DATE : January 15, 2002

LOCATION OF BORING : NW 15-13-6E

PROJECT : Garson/Tyndall Proposed Wastewater Lagoon G-201.02

TEST HOLE # 3

DEPTH OF SAMPLE		FIELD CLASSIFICATION
0m	0	Topsoil
	2'	
1m		
	4'	High plastic clay, brown, some silt, trace sand, slightly moist
	6'	
2m		
	8'	High plastic clay, light brown, with silt , some gravel, trace sand, moist
3m		
	10'	
	12'	High plastic clay, brown, some silt, trace sand, slightly moist
4m		
	14'	
	16'	
5m		
	18'	
6m	20'	



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J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : RM of Brokenhead

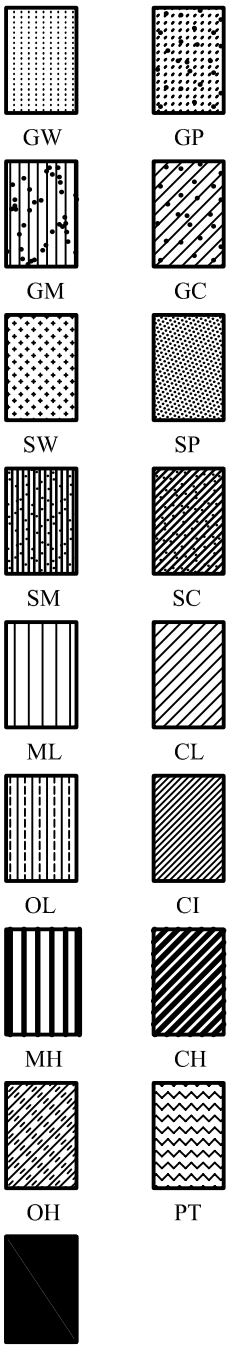
DATE : January 15, 2002

LOCATION OF BORING : NW 15-13-6E

PROJECT : Garson/Tyndall Proposed Wastewater Lagoon G-201.02

TEST HOLE # 4

DEPTH OF SAMPLE	FIELD CLASSIFICATION
0m – 0	Topsoil
2'	
1m – 4'	High plastic clay, brown, some silt, trace sand, slightly moist
6'	
2m – 8'	High plastic clay, light brown, with silt, trace gravel, trace sand, moist
3m – 10'	
12'	High plastic clay, brown, some silt, trace sand, slightly moist
4m – 14'	
16'	
5m – 18'	
6m – 20'	



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J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : RM of Brokenhead

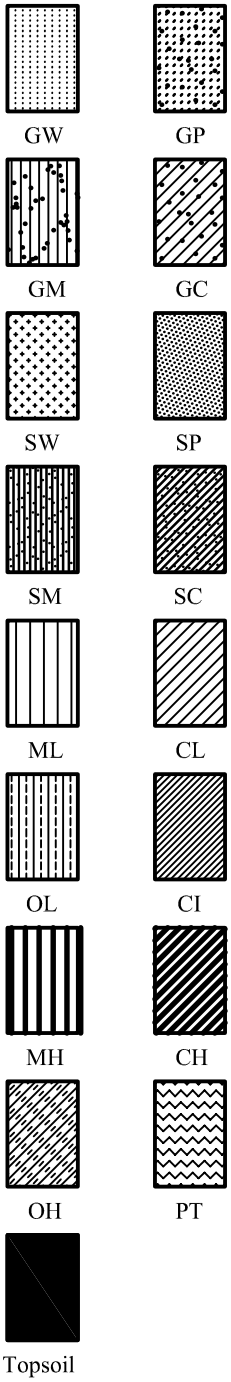
DATE : January 15, 2002

LOCATION OF BORING : NW 15-13-6E

PROJECT : Garson/Tyndall Proposed Wastewater Lagoon G-201.02

TEST HOLE # 5

DEPTH OF SAMPLE	FIELD CLASSIFICATION
0m / 0	Topsoil
	High plastic clay, black, some silt, trace sand, frozen
2'	
1m	High plastic clay, brown, some silt, trace sand, slightly moist
4'	High plastic clay, light brown, trace silt and sand, moist
6'	
2m	
8'	
3m / 10'	High plastic clay, brown, some silt, trace sand, slightly moist
12'	
4m	
14'	
16'	
5m	
18'	
6m / 20'	



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J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : RM of Brokenhead

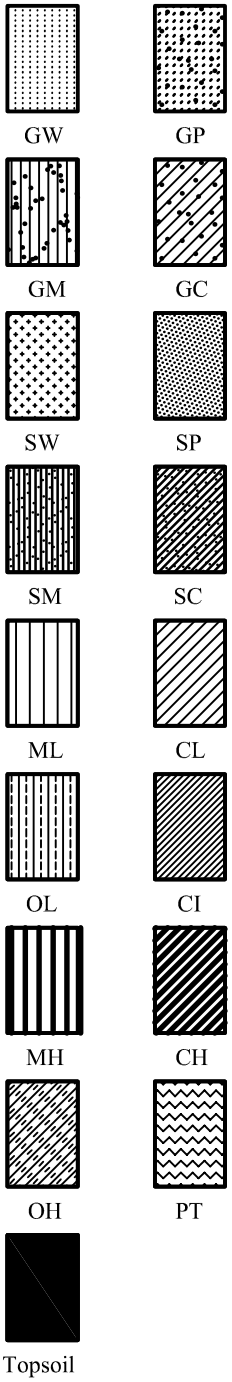
DATE : January 15, 2002

LOCATION OF BORING : NW 15-13-6E

PROJECT : Garson/Tyndall Proposed Wastewater Lagoon G-201.02

TEST HOLE # 6

DEPTH OF SAMPLE		FIELD CLASSIFICATION
0m	0	Topsoil
	2'	High plastic clay, black, some silt, trace sand, frozen
1m		
	4'	High plastic clay, brown, some silt, trace sand, slightly moist
		High plastic clay, light brown, trace silt and sand, moist
	6'	
2m		
	8'	
3m	10'	High plastic clay, brown, some silt, trace sand, slightly moist
	12'	
4m		
	14'	
	16'	
5m		
	18'	Silt, clayey, light brown, trace sand, trace gravel, wet
6m	20'	High plastic clay, light brown, with silt, trace sand, slightly moist



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J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : RM of Brokenhead

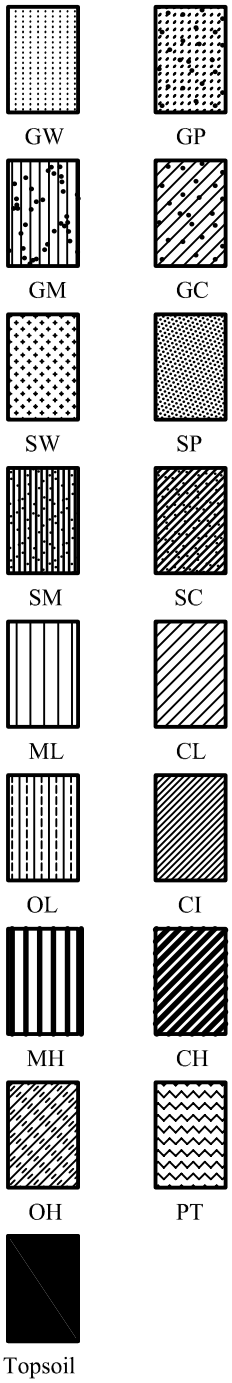
DATE : January 15, 2002

LOCATION OF BORING : NW 15-13-6E

PROJECT : Garson/Tyndall Proposed Wastewater Lagoon G-201.02

TEST HOLE # 7

DEPTH OF SAMPLE	FIELD CLASSIFICATION
0m / 0	Topsoil
2'	
1m	High plastic clay, brown, some silt, trace sand, slightly moist
4'	
6'	
2m	
8'	
3m / 10'	High plastic clay, brown, some silt, trace sand, slightly moist
12'	
4m	
14'	
16'	
5m	
18'	
6m / 20'	



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AMEC Earth and Environmental Test Results, dated June 20, 2012

20 June 2012
Project No. WX10949-02

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

Attention: **Mr. Brett McCormac**

Re: Soils Analysis
Lagoon Feasibility Study
RM of Brokenhead, Manitoba

1.0 INTRODUCTION

As authorized by Mr. Brett McCormac, of J.R. Cousin Consultants Ltd. (JRCC), AMEC Environment and Infrastructure, a division of AMEC Americas Ltd. (AMEC), has completed an evaluation of 15 soil samples (15 grab samples and one Shelby tube sample) that were submitted to our office by JRCC. In addition to the testing, comments with respect to suitability of the submitted soil samples for lagoon liner construction were also requested.

2.0 LABORATORY TESTING

The Shelby tube and 11 grab samples obtained by JRCC were submitted to AMEC's office on 29 March 2012, with 4 additional grab samples submitted on 8 June 2012. On receipt, the grab samples were visually classified by AMEC staff in accordance with the Modified Unified Soil Classification System and were tested for moisture content, particle size (hydrometer method) and Atterberg limits. The visual classification and laboratory testing results are summarized in Table 1 with the laboratory data summary also appended to this report.

AMEC Earth & Environmental
A Division of AMEC Americas Limited
440 Dovercourt Drive
Winnipeg, Manitoba
Canada R3Y 1N4
Tel +1 (204) 488-2997
Fax +1 (204) 489-8261
www.amec.com

Table 1: Lab Results

Sample Number	Depth	Water Content (%)	Atterberg Limits			Particle Size Analysis			
			Liquid Limit (%)	Plastic Limit (%)	Plasticity Index	% Gravel	% Sand	% Silt	% Clay
TH1	0.3 – 1.5m	35.8	93	29	64	0	1.6	11.7	86.7
	Classification: CLAY (CH) - some silt, highly plastic, moist, firm, grey, trace sand								
TH2	1.2 – 2.7m	42.1	95	34	61	0	2.2	18	79.7
	Classification: CLAY (CH) - some silt, highly plastic, moist, firm, dark brown, trace sand								
TH2	2.7 – 5.1m	50.8	70	23	47	0	2.1	28.5	69.4
	Classification: CLAY (CH) - some silt, highly plastic, moist, firm, dark brown, trace sand								
TH3	0.0 – 0.3m	31.8	83	32	51	0	8.7	30.9	60.4
	Classification: CLAY (CH) - silty, highly plastic, moist, firm, black, trace sand and organics								
TH5	1.1 – 2.3m	24.4	69	22	47	0	11.0	27.9	61.1
	Classification: CLAY (CH) - silty, high plastic, moist, firm, black, trace sand and organics								
TH5	2.3 – 3.0m	44.5	85	28	57	0	6.6	23.3	70.1
	Classification: CLAY (CH) - some silt, highly plastic, moist, firm, dark brown, trace sand								
TH5	3.0 – 6.1m	18.2	26	11	15	0	26.5	52.7	20.7
	Classification: SILT (CL) – some clay and sand, low plastic, moist to very moist, soft, light brown								
TH6	0.9 – 2.1m	18.9	36	13	23	0	20.6	45.2	34.2
	Classification: CLAY and SILT (CI) – some sand, medium plastic, moist, soft, brown								
TH6	2.1 – 3.0m	13.2	21	10	11	0	27.7	52.5	19.8
	Classification: SILT (CL) – sandy, some clay, low plastic, moist, soft, light brown								
TH7	1.5 – 3.4m	33.8	66	18	48	0	5.6	29.4	64.9
	Classification: CLAY (CH) - silty , trace sand, high plastic, moist, soft, brown								
TH9	0.3 – 0.9m	29.3	80	26	54	0	2.9	28.3	68.8
	Classification: CLAY (CH) – some silt, highly plastic, moist, firm, grey, trace sand								
TH10	1.2 – 4.3m	43.1	95	32	63	0	2.2	18.0	79.7
	Classification: CLAY (CH) – some silt, highly plastic, moist, firm, brown, trace sand								
TH11	0.3 – 2.7m	35.2	57	19	38	0	11.0	40.6	48.4
	Classification: CLAY & SILT (CH) –highly plastic, moist, firm brown, trace sand								
TH12	2.1 – 3.3m	16.1	32	11	21	1.2	29.8	41.7	27.3
	Classification: SILT (CI) – some sand and clay, medium plastic, moist, firm, brown, trace gravel								

A hydraulic conductivity test was completed on the Shelby tube sample (TH2 @ 1.5 – 2.1m). The hydraulic conductivity of the soil sample was 8.18×10^{-9} cm/sec.

3.0 DISCUSSION

AMEC was also requested to comment on the suitability of the soils for use as a liner in their in-situ condition, based on the visual assessment and the test results. It is expected that the soils which were tested and are classified as medium to high plastic clays (Samples TH1 (0.3 to 1.5 and 1.2 to 2.7 m), TH2 (2.7 to 5.1 m), TH3 (0.0 to 0.3 m), TH5 (1.1 to 2.3 m and 2.3 to 3.0 m), TH6 (0.9 to 2.1 m), TH7 (1.5 to 3.4 m), TH9 (0.3 to 0.9 m), TH10 (1.2 to 4.3 m) and TH1 (0.3 to 2.7 m)), will have a hydraulic conductivity of less than 1×10^{-7} cm/sec in their natural condition. It should be noted that the hydraulic conductivity is subject to the in-situ soil structure including the amount of fissuring, the inter-connectivity of the fissures and effects of freeze thaw and as a result, shallower soils generally have a greater likelihood of having a higher in-situ hydraulic conductivity.

For samples tested and determined to be low plastic silt, a permeability greater than 1×10^{-7} cm/sec is expected, even if remoulded and compacted.

Ultimately permeability testing at the final lagoon liner elevation should be undertaken to determine the hydraulic conductivity of the soil and to verfiy whether remoulding of the clay is necessary.

4.0 CLOSURE

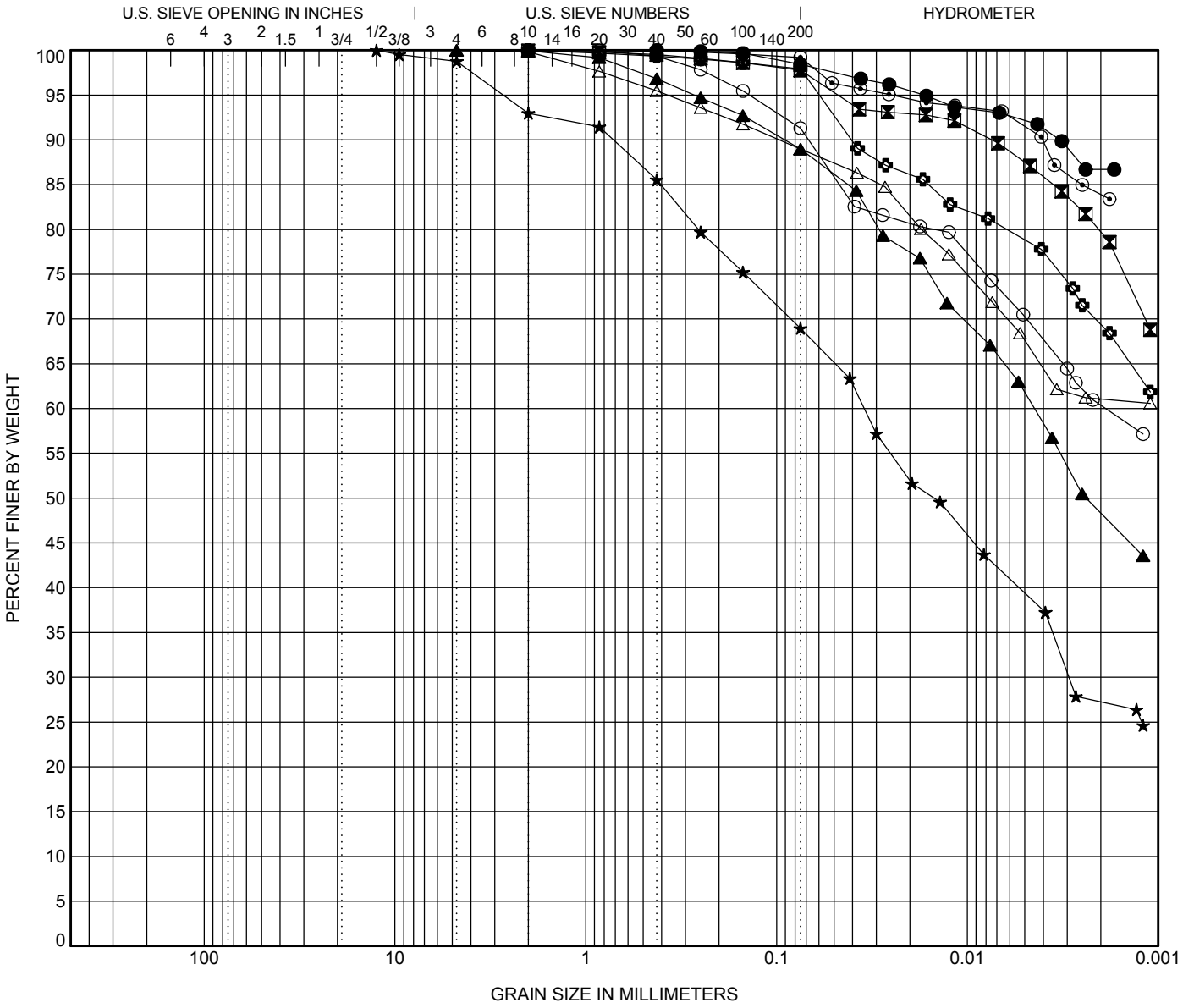
AMEC trusts that the forgoing is sufficient for your present requirements. Should you require additional information, please contact Mr. Gluck at this office.

Sincerely,
AMEC EARTH & ENVIRONMENTAL

Jorden Wiwcharyk, EIT
Geotechnical Engineer-In-Training

Trevor Gluck, P. Eng.
Senior Geotechnical Engineer

Reviewed By:
Harley Pankratz, P. Eng.
VP; Eastern Prairies/Northern Alberta



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Sample ID	Depth	MC	LL	PL	PI	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**TH1**	**0.3 m**	**35.8**	**93**	**29**	**64**	**0.425**				**0.0**	**1.6**	**11.7**	**86.7**
⊠	**TH10**	**1.2 m**	**43.1**	**95**	**32**	**63**	**2**					**2.2**	**18.0**	**79.7**
▲	**TH11**	**0.9 m**	**35.2**	**57**	**19**	**38**	**4.75**	**0.004**			**0.0**	**11.0**	**40.6**	**48.4**
★	**TH12**	**2.1 m**	**16.1**	**32**	**11**	**21**	**12.5**	**0.035**	**0.003**		**1.2**	**29.8**	**41.7**	**27.3**
⊙	**TH2**	**1.2 m**	**42.1**	**95**	**34**	**61**	**2**				**0.0**	**0.8**	**15.3**	**83.9**
✿	**TH2**	**2.7 m**	**50.8**	**70**	**23**	**47**	**2**				**0.0**	**2.1**	**28.5**	**69.4**
○	**TH3**	**0 m**	**31.8**	**83**	**32**	**51**	**2**	**0.002**			**0.0**	**8.7**	**30.9**	**60.4**
△	**TH5**	**1.1 m**	**24.4**	**69**	**22**	**47**	**4.75**				**0.0**	**11.0**	**27.9**	**61.1**

AMEC Earth & Environmental

PHONE: FAX:

CLIENT LOGO:

CLIENT: **JRCC**

PROJECT: RM of Brokenhead Lagoon Feasibility Study

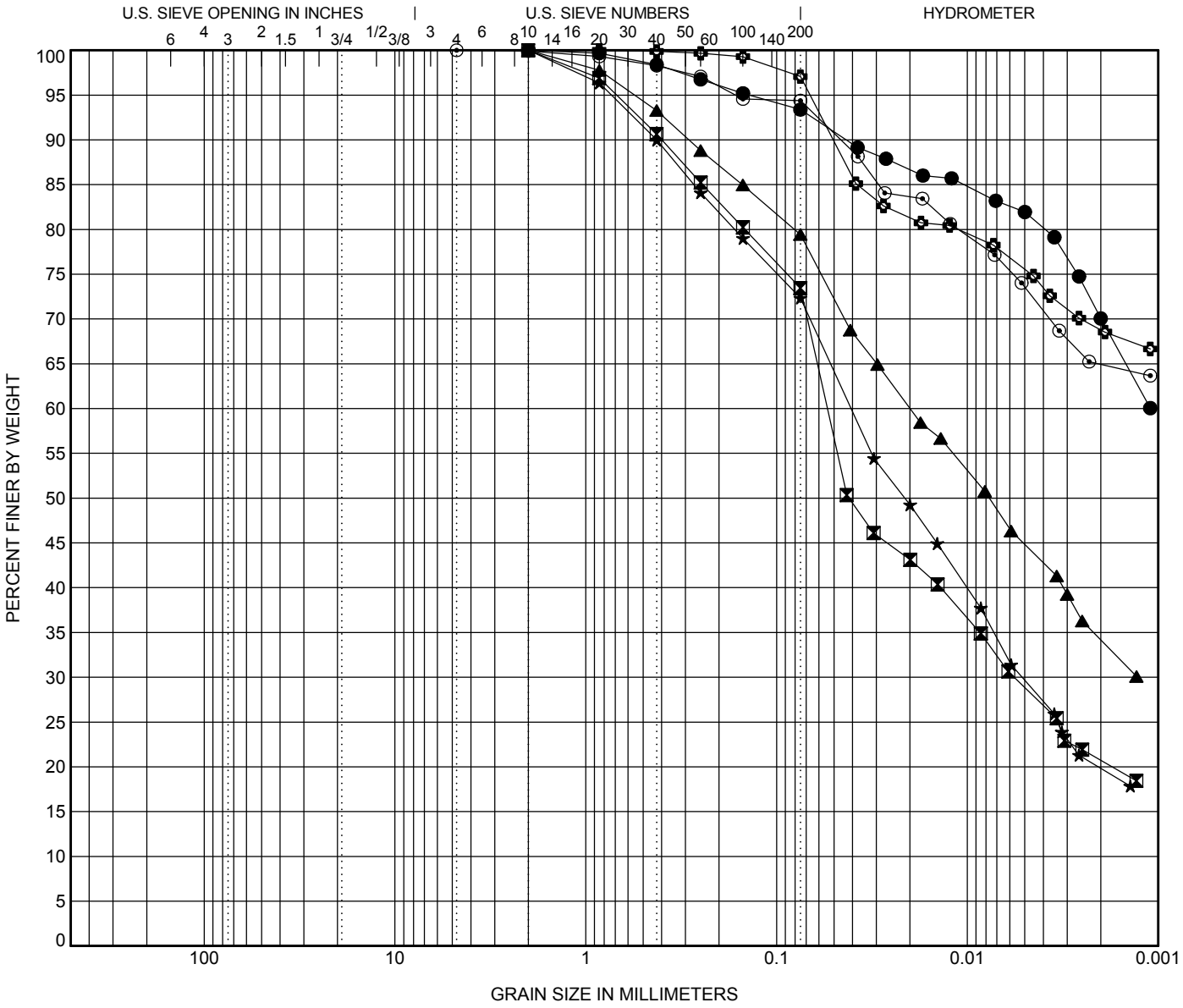
DRAWN BY: TG | DATUM: N/A | DATE: June 19, 2012

TITLE: PARTICLE SIZE DISTRIBUTION

CHK'D BY: TG | REV. NO.: 0 | PROJECT No.: WX10949

PROJECTION: N/A | SCALE: AS SHOWN | FIGURE No.: **1**

10949.GPJ 12/06/19 12:15 PM (WPG - GRAIN SIZE WITH ATTERBERG & MC)



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Sample ID	Depth	MC	LL	PL	PI	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**TH5**	**2.3 m**	**44.5**	**85**	**28**	**57**	**2**				**0.0**	**6.6**	**23.3**	**70.1**
⊠	**TH5**	**3 m**	**18.2**	**26**	**11**	**15**	**2**	**0.054**	**0.006**		**0.0**	**26.5**	**52.7**	**20.7**
▲	**TH6**	**0.9 m**	**18.9**	**36**	**13**	**23**	**2**	**0.02**			**0.0**	**20.6**	**45.2**	**34.2**
★	**TH6**	**2.1 m**	**13.2**	**21**	**10**	**11**	**2**	**0.041**	**0.005**		**0.0**	**27.7**	**52.5**	**19.8**
⊙	**TH7**	**1.5 m**	**33.8**	**66**	**18**	**48**	**4.75**				**0.0**	**5.6**	**29.4**	**64.9**
✿	**TH9**	**0.3 m**	**29.3**	**80**	**26**	**54**	**2**				**0.0**	**2.9**	**28.3**	**68.8**

AMEC Earth & Environmental

PHONE: FAX:

CLIENT LOGO:

CLIENT: **JRCC**

PROJECT: RM of Brokenhead Lagoon Feasibility Study

TITLE: PARTICLE SIZE DISTRIBUTION

DRAWN BY:	DATUM:	DATE:
TG	N/A	June 19, 2012
CHK'D BY:	REV. NO.:	PROJECT No.:
TG	0	WX10949
PROJECTION:	SCALE:	FIGURE No.:
N/A	AS SHOWN	**1**

10949.GPJ 12/06/19 12:15 PM (WPG - GRAIN SIZE WITH ATTERBERG & MC)

HYDRAULIC CONDUCTIVITY REPORT

CSA CERTIFIED CONCRETE TESTING LABORATORY
IN ACCORDANCE WITH STD A 283

ASTM D 5084

TO: JR Cousin
91 Scurfield Boulevard
Winnipeg, Manitoba
R3Y 1G4

PROJECT NO: WX10949
CLIENT: JRCC
DATE SUBMITTED: 29-Mar-12

PROJECT: RM of Brokenhead

TEST HOLE: TH2
SAMPLE NO.: Not Provided
SAMPLE DEPTH: 1.5 to 2.1m

PERMEANT: De-Aired Tap Water
HYDRAULIC GRADIENT: 19.10

CONSTANT HEAD METHOD (K = cQL/thA)

	Sample Height, L (cm)	Sample Dia. (cm)	Water Content (%)	Dry Density (kg/m^3)	Degree of Saturation (%)	Cell Pressure (kPa)	Back Pressure (kPa)	Differential Pressure, h (kPa)
Initial	7.36	7.24	32.5%	1450	99.8%	241.4	200.0	13.8
Final	7.48	7.28	35.4%	1413	102.8%			

Date & Time		Time, t	Flow (Q)		Temp. Corr, c	Hyd. Cond. Corrected, K (cm/s)
Start	End	(seconds)	Influent (ml)	Effluent (ml)		
4/18/12 8:23 AM	4/19/12 9:58 AM	92100	0.50	0.80		1.34E-08
4/19/12 9:58 AM	4/20/12 12:34 PM	95760	0.30	0.50		7.94E-09
4/20/12 12:34 PM	4/22/12 1:00 PM	174360	0.60	0.90		8.18E-09
4/22/12 1:00 PM	4/23/12 6:00 PM	104400	0.30	0.50		7.28E-09
4/23/12 6:00 PM	4/24/12 11:00 AM	61200	0.30	0.30		9.32E-09

Soil Description: Clay (CH) - silty, high plastic

Average Temperature Corrected Value (cm/s): 8.18E-09

AMEC Earth & Environmental
A Division of AMEC Americals Limited

Per:

Brad Wiebe, M.Sc., P.Eng.
Associate Geotechnical Engineer

Reporting of these results constitutes a testing service only.
Engineering interpretation or evaluation of the test results is provided only on written request.

AMEC Earth Environmental Limited
440 Dovercourt Drive
Winnipeg, Manitoba
R3Y 1N4

Tel +1 (204) 488-2997
Fax +1 (204) 489-8261

GW Driller’s Well Logs

LOCATION: NW15-13-6E

Well_PID: 47683
Owner: J KOROLEWICH
Driller: Stasiuk & Sons Drilling Inc.
Well Name:
Well Use: PRODUCTION
Water Use: Domestic,Livestock
UTMX: 664609.113
UTMY: 5552607.24
Accuracy XY: UNKNOWN
UTMZ:
Accuracy Z:
Date Completed: 1983 May 09

WELL LOG

From (ft.)	To (ft.)	Log
0	18.0	BROWN CLAY
18.0	64.0	BROWN TILL
64.0	66.0	GRAVEL AND SAND
66.0	82.9	BROWN ROCK

WELL CONSTRUCTION

From (ft.)	To (ft.)	Casing Type	Inside Dia.(in)	Outside Dia.(in)	Slot Size(in)	Type	Material
0	67.0	casing	4.30				GALVANIZED
67.0	82.9	open hole	4.00				

Top of Casing: 1.0 ft. below ground

PUMPING TEST

Date: 1983 May 09
Pumping Rate: 30.0 Imp. gallons/minute
Water level before pumping: 2.0 ft. below ground
Pumping level at end of test: 4.0 ft. below ground
Test duration: hours, minutes
Water temperature: ?? degrees F

LOCATION: SE15-13-6E

Well_PID: 36953
Owner: A PAWLICK
Driller: Paul Slusarchuk Well Drilling LTd.
Well Name:
Well Use: PRODUCTION
Water Use: Domestic

UTMX: 665432.607
UTMY: 5551810.46
Accuracy XY: UNKNOWN
UTMZ:
Accuracy Z:
Date Completed: 1979 Aug 30

WELL LOG

From (ft.)	To (ft.)	Log
0	35.0	CLAY
35.0	68.0	TILL
68.0	75.0	GRAVEL
75.0	124.9	LIMESTONE

WELL CONSTRUCTION

From (ft.)	To (ft.)	Casing Type	Inside Dia.(in)	Outside Dia.(in)	Slot Size(in)	Type	Material
0	77.2	casing	4.00			T & C	GALVANIZED
77.2	124.9	open hole	3.90				

Top of Casing: 1.0 ft. below ground

PUMPING TEST

Date: 1979 Aug 30
Pumping Rate: 12.0 Imp. gallons/minute
Water level before pumping: ft. below ground
Pumping level at end of test: ?? ft. below ground
Test duration: 1 hours, minutes
Water temperature: ?? degrees F

LOCATION: SW15-13-6E

Well_PID: 155399
Owner: DARYL GROSSER
Driller: Perimeter Drilling Ltd.
Well Name:
Well Use: PRODUCTION
Water Use: Domestic
UTMX: 664939
UTMY: 5551472
Accuracy XY: 1 EXACT [<5M] [GPS]
UTMZ: 234
Accuracy Z: 4 FAIR - Shuttle at Centroid
Date Completed: 2009 Jul 15

WELL LOG

From (ft.)	To (ft.)	Log
0	2.0	TOP SOIL
2.0	34.0	CLAY
34.0	84.0	TILL
84.0	85.0	BROKEN LIMESTONE
85.0	180.0	LIMESTONE

WELL CONSTRUCTION

From (ft.)	To (ft.)	Casing Type	Inside Dia.(in)	Outside Dia.(in)	Slot Size(in)	Type	Material
0	88.0		5.00			INSERT	PVC
88.0	180.0	OPEN HOLE	4.50				
		CASING GROUT					CEMENT

Top of Casing: 2.5 ft. above ground

PUMPING TEST

Date: 2009 Jul 15
Pumping Rate: ?? Imp. gallons/minute
Water level before pumping: 60.0 ft. above ground
Pumping level at end of test: 3.0 ft. above ground
Test duration: ??? hours, ?? minutes
Water temperature: ?? degrees F

LOCATION: SW15-13-6E

Well_PID: 140056
Owner: TERRY PANISIAK
Driller: Maple Leaf Enterprises LTd.
Well Name:
Well Use: PRODUCTION
Water Use: Domestic
UTMX: 664637.297
UTMY: 5551793.04
Accuracy XY:
UTMZ:
Accuracy Z:
Date Completed: 2006 Sep 07

WELL LOG

From (ft.)	To (ft.)	Log
0	30.0	CLAY
30.0	35.0	CLAY WITH STONES
35.0	55.0	BROWN TILL
55.0	57.0	GREY TILL

57.0	85.0	GREY SILT WITH BOULDERS
85.0	88.0	LIMESTONE
88.0	91.0	SOFT WHITE LIMESTONE OR SHALE
91.0	160.0	LIMESTONE (SAND LAYERS IN LIMESTONE AFTER 135')

WELL CONSTRUCTION

From (ft.)	To (ft.)	Casing Type	Inside Dia.(in)	Outside Dia.(in)	Slot Size(in)	Type	Material
0	87.0	CASING	5.00			WELDED	PVC
82.0	92.0	CASING	4.00			WELDED	PVC
92.0	160.0	CASING	3.90				
0	70.0						

BENTONITE

Top of Casing: 4.0 ft. above ground

PUMPING TEST

Date:	2006 Sep 07
Pumping Rate:	20.0 Imp. gallons/minute
Water level before pumping:	2.0 ft. below ground
Pumping level at end of test:	40.0 ft. below ground
Test duration:	1 hours, minutes
Water temperature:	?? degrees F

REMARKS

GARSON, PUMPED WITH AIR. 4 GPM AT 130', 20 GPM AT 160. GLUED 5" EXTENSION TO 4' ABOVE GRD, WELL MAY FLOW IN WET YEARS.

Appendix D

Test Results from ALS Laboratories, dated March 26, 2012
Test Results from ALS Laboratories, dated May 07, 2012
Test Results from ALS Laboratories, dated June 28, 2012
Test Results from ALS Laboratories, dated August 22, 2012
Test Results from ALS Laboratories, dated October 24, 2012

RM of Brokenhead
ATTN: GRANT PLISCHKE
PO Box 490
Beausejour MB R0E 0C0

Date Received: 20-MAR-12
Report Date: 26-MAR-12 12:39 (MT)
Version: FINAL

Client Phone: 204-268-5581

Certificate of Analysis

Lab Work Order #: L1125670

Project P.O. #: NOT SUBMITTED
Job Reference: RM OF BROKENHEAD
C of C Numbers:
Legal Site Desc:

Robert S. Kitlar
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1125670-1 CELL 1, INTERCELL							
Sampled By: GRANT PLISCHKE on 19-MAR-12 @ 15:00							
Matrix: SEWAGE/WASTE WATER							
Nitrate + Nitrite							
Nitrate as N							
Nitrate-N	0.062		0.050	mg/L		20-MAR-12	R2341149
Nitrate+Nitrite							
Nitrate and Nitrite as N	<0.071		0.071	mg/L		20-MAR-12	
Nitrite as N							
Nitrite-N	<0.050		0.050	mg/L		20-MAR-12	R2341149
Miscellaneous Parameters							
Phosphorus (P)-Total	1.37		0.010	mg/L		21-MAR-12	R2340701
pH	8.45		0.10	pH units		20-MAR-12	R2340361
Un-ionized ammonia							
Ammonia by colour							
Ammonia, Total (as N)	1.61	DLA	0.10	mg/L		24-MAR-12	R2342112
Temperature supplied by Client							
Temperature, Client Provided	5.0		0.1	Degree C		22-MAR-12	R2341321
Un-ionized ammonia							
Ammonia, Un-ionized (as N)	0.076		0.010	mg/L		25-MAR-12	
pH supplied by Client							
pH, Client Supplied	8.60		0.10	pH		22-MAR-12	R2341321
L1125670-2 CELL 2 INTERCELL							
Sampled By: GRANT PLISCHKE on 19-MAR-12 @ 15:00							
Matrix: SEWAGE/WASTE WATER							
Nitrate + Nitrite							
Nitrate as N							
Nitrate-N	<0.050		0.050	mg/L		20-MAR-12	R2341149
Nitrate+Nitrite							
Nitrate and Nitrite as N	<0.071		0.071	mg/L		20-MAR-12	
Nitrite as N							
Nitrite-N	<0.050		0.050	mg/L		20-MAR-12	R2341149
Miscellaneous Parameters							
Phosphorus (P)-Total	0.349		0.010	mg/L		21-MAR-12	R2340701
pH	8.36		0.10	pH units		20-MAR-12	R2340361
Un-ionized ammonia							
Ammonia by colour							
Ammonia, Total (as N)	0.82	DLA	0.10	mg/L		24-MAR-12	R2342112
Temperature supplied by Client							
Temperature, Client Provided	2.0		0.1	Degree C		22-MAR-12	R2341321
Un-ionized ammonia							
Ammonia, Un-ionized (as N)	0.059		0.010	mg/L		25-MAR-12	
pH supplied by Client							
pH, Client Supplied	8.90		0.10	pH		22-MAR-12	R2341321
L1125670-3 CELL 1, DISCHARGE							
Sampled By: GRANT PLISCHKE on 19-MAR-12 @ 15:00							
Matrix: SEWAGE/WASTE WATER							
Nitrate + Nitrite							
Nitrate as N							
Nitrate-N	0.062		0.050	mg/L		20-MAR-12	R2341149
Nitrate+Nitrite							
Nitrate and Nitrite as N	<0.071		0.071	mg/L		20-MAR-12	
Nitrite as N							
Nitrite-N	<0.050		0.050	mg/L		20-MAR-12	R2341149
Miscellaneous Parameters							

* 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
L1125670-3 CELL 1, DISCHARGE							
Sampled By: GRANT PLISCHKE on 19-MAR-12 @ 15:00							
Matrix: SEWAGE/WASTE WATER							
Phosphorus (P)-Total	2.73		0.010	mg/L		21-MAR-12	R2340701
pH	8.38		0.10	pH units		20-MAR-12	R2340361
Un-ionized ammonia							
Ammonia by colour							
Ammonia, Total (as N)	3.41	DLA	0.10	mg/L		24-MAR-12	R2342112
Temperature supplied by Client							
Temperature, Client Provided	2.0		0.1	Degree C		22-MAR-12	R2341321
Un-ionized ammonia							
Ammonia, Un-ionized (as N)	0.065		0.010	mg/L		25-MAR-12	
pH supplied by Client							
pH, Client Supplied	8.30		0.10	pH		22-MAR-12	R2341321
L1125670-4 CELL 2, DISCHARGE							
Sampled By: GRANT PLISCHKE on 19-MAR-12 @ 15:00							
Matrix: SEWAGE/WASTE WATER							
Nitrate + Nitrite							
Nitrate as N							
Nitrate-N	<0.050		0.050	mg/L		20-MAR-12	R2341149
Nitrate+Nitrite							
Nitrate and Nitrite as N	<0.071		0.071	mg/L		20-MAR-12	
Nitrite as N							
Nitrite-N	<0.050		0.050	mg/L		20-MAR-12	R2341149
Miscellaneous Parameters							
Phosphorus (P)-Total	0.583		0.010	mg/L		21-MAR-12	R2340701
pH	8.27		0.10	pH units		20-MAR-12	R2340361
Un-ionized ammonia							
Ammonia by colour							
Ammonia, Total (as N)	1.75	DLA	0.10	mg/L		24-MAR-12	R2342112
Temperature supplied by Client							
Temperature, Client Provided	3.0		0.1	Degree C		22-MAR-12	R2341321
Un-ionized ammonia							
Ammonia, Un-ionized (as N)	0.088		0.010	mg/L		25-MAR-12	
pH supplied by Client							
pH, Client Supplied	8.70		0.10	pH		22-MAR-12	R2341321

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Sample Parameter Qualifier Key:

Qualifier	Description
DLA	Detection Limit Adjusted For required dilution

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
NH3-COL-WP	Water	Ammonia by colour	APHA 4500 NH3 F
Ammonia in water samples forms indophenol when reacted with hypochlorite and phenol. The intensity is amplified by the addition of sodium nitroprusside and measured colourmetrically.			
NH3-UNION-CALC-WP	Water	Un-ionized ammonia	Calculation
NO2+NO3-CALC-WP	Water	Nitrate+Nitrite	CALCULATION
NO2-IC-WP	Water	Nitrite as N	EPA 300.1 IC
NO3-IC-WP	Water	Nitrate as N	EPA 300.1 IC
P-T-COL-WP	Water	Phosphorus, Total	APHA 4500 P PHOSPHORUS
This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.			
PH-CLIENT-WP	Water	pH supplied by Client	Supplied by client
PH-WP	Water	pH	APHA 4500H
The pH of a sample is the determination of the activity of the hydrogen ions by potentiometric measurement using a standard hydrogen electrode and a reference electrode.			
TEMP-CLIENT-WP	Water	Temperature supplied by Client	Result supplied by Client

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WP	ALS ENVIRONMENTAL - WINNIPEG, MANITOBA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

12 - 1329 Niakwa Rd. E.
Winnipeg, Manitoba R2J 3T4

Chain of Custody / Analytical Request Form

CHEMISTRY INFO: (204) 255 9739
MICRO INFO: (204) 255 9740 OR (204) 255 9737

WORK ORDER NO: L1125670

FOR LABORATORY USE ONLY (S
Sample Condition Upon Receipt: [illegible]
☐ Frozen ☐ Cold ☐ Ambient ☐ Broken ☐ Leakage ☐ Incorrect Sample Container
COMMENT: _____

LAB NO.: _____
DATE RECEIVED: 20mar12
TIME RECEIVED: 10:20
BY: _____ 17°

Date Sampled: 19/03/2012 Time: 3 : 00 A.M. ☐ P.M. ☑ Date Required: _____

Location: RM OF BROKENHEAD (Town, Community, City)

Submitter's Name Printed: GRANT PLISCHKE
Sample Submitted By: GRANT PLISCHKE

Community Code Number: 29.31

Rural Municipality/LGC/UVD: BROKEN HEAD

SAMPLE TYPE

DRINKING WATER
- ☐ Untreated Well
- ☐ Treated Well
- ☐ Treated Municipal
- ☐ Non-Treated Municipal
- ☐ Water-Surface-Raw
- ☐ Water-Surface-Treated

NON-DRINKING WATER
- ☑ Sewage/Waste Water
- ☐ Lake/River
- ☐ Swimming Pool
- ☐ Whirl Pool
- ☐ Other

PURPOSE OF TEST
☐ Private ☐ Real Estate ☐ Water Main

PLEASE PRINT & PRESS FIRMLY

NOTES & CONDITIONS
1. Quote number must be provided to insure proper pricing.
2. Failure to properly complete all portions of this form may delay analysis.
3. ALS's liability limited to cost of analysis.

SERVICE REQUESTED
☐ REGULAR ☐ PRIORITY (50% SURCHARGE) ☐ EMERGENCY (100% SURCHARGE)

LAB NUMBER	SAMPLE IDENTIFICATION
	#1 CELL 1, INTERCELL
	#2 CELL 2, INTERCELL
	#3 CELL 1, DISCHARGE
	#4 CELL 2 DISCHARGE
	#5 CELL 1, INTERCELL
	#6 CELL 1, DISCHARGE
	#7 CELL 2, INTERCELL
	#8 CELL 2 DISCHARGE
	CELL 1 INTERCELL 5°C 8.6 PH | DISCHARGE 2°C 8.3 PH
	CELL 2 INTERCELL 2°C 8.9 pH | DISCHARGE 3°C 8.7 pH

ALS CUSTOMER #: _____ QUOTE #: _____

REPORT TO BE SENT TO
NAME: GRANT PLISCHKE
COMPANY: RM OF BROKENHEAD
ADDRESS: BOX 490, BEAUSEJOUR, MB
CITY/TOWN: BEAUSEJOUR / PROV.: MB
POSTAL CODE: R0E 0C0
PHONE: 268-5581
BY: MAIL ☐ FAX ☐ _____ (FAX NUMBER)
PICKUP ☐ E-MAIL ☑ gtwater@xplornet.com (EMAIL ADDRESS)

CC
NAME: _____
ADDRESS: _____
CITY/TOWN: _____ / PROV.: _____
POSTAL CODE: _____
PHONE: _____
BY: MAIL ☐ FAX ☐ _____ (FAX NUMBER)
PICKUP ☐ E-MAIL ☐ _____ (EMAIL ADDRESS)

Analyses required AMMONIA (NH3) DISSOLVED
NITRATE + NITRATE-N - DISSOLVED
CALCULATION FOR UN-IONIZED AMMONIA
PHOSPHORUS TOTAL, PH, TEMPERTURE

BILLING ADDRESS SAME AS REPORT TO ☐
NAME: _____
COMPANY: _____
ADDRESS: _____
CITY/TOWN: _____ / PROV.: _____
POSTAL CODE: _____

SAMPLING INSTRUCTIONS ON REVERSE SIDE

PAYMENT PARTICULARS
☐ INVOICE NEEDED / CLIENT'S P.O. NO. _____
☐ INTERAC
☐ CASH Subtotal $ _____
☐ CHEQUE G.S.T. $ _____
☐ VISA / MASTERCARD Total $ _____
* OUR POLICY IS NOT TO ACCEPT SAMPLES FROM THE PRIVATE CITIZEN WITHOUT PREPAYMENT

Manitoba Technology Centre Ltd.
Part of the **ALS Laboratory Group**
12 - 1329 Niakwa Rd. E., Winnipeg, MB Canada R2J 3T4
Phone: +1 204 255 9720 Fax: +1 204 255 9721 www.alsglobal.com
A Campbell Brothers Limited Company

ACCOUNT COPY

ENTERED IN LIMS BY: _____

RM of Brokenhead
ATTN: GRANT PLISCHKE
PO Box 490
Beausejour MB R0E 0C0

Date Received: 25-APR-12
Report Date: 07-MAY-12 14:46 (MT)
Version: FINAL

Client Phone: 204-268-5581

Certificate of Analysis

Lab Work Order #: L1138943

Project P.O. #: NOT SUBMITTED
Job Reference: BROKENHEAD
C of C Numbers:
Legal Site Desc:

Robert S. Kitlar
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1138943-1 CELL #1 - INTERCELL							
Sampled By: GRAND PLISCHKE on 24-APR-12 @ 15:00							
Matrix: SEWAGE / WASTEWATER							
Nitrate + Nitrite							
Nitrate as N by Ion Chromatography							
Nitrate-N	<0.25	DLM	0.25	mg/L		25-APR-12	R2356904
Nitrate+Nitrite							
Nitrate and Nitrite as N	<0.35		0.35	mg/L		25-APR-12	
Nitrite as N by Ion Chromatography							
Nitrite-N	<0.25	DLM	0.25	mg/L		25-APR-12	R2356904
Miscellaneous Parameters							
Ammonia, Total (as N)	0.041		0.010	mg/L		27-APR-12	R2357424
Phosphorus (P)-Total	4.68		0.010	mg/L		30-APR-12	R2357838
Un-ionized ammonia							
Temperature supplied by Client							
Temperature, Client Provided	10.0		0.1	Degree C		25-APR-12	R2355991
Un-ionized ammonia							
Ammonia, Un-ionized (as N)	<0.010		0.010	mg/L		28-APR-12	
pH supplied by Client							
pH, Client Supplied	8.60		0.10	pH		25-APR-12	R2355991
L1138943-2 CELL #2 - INTERCELL							
Sampled By: GRAND PLISCHKE on 24-APR-12 @ 15:00							
Matrix: SEWAGE / WASTEWATER							
Nitrate + Nitrite							
Nitrate as N by Ion Chromatography							
Nitrate-N	0.30		0.25	mg/L		25-APR-12	R2356904
Nitrate+Nitrite							
Nitrate and Nitrite as N	<0.35		0.35	mg/L		25-APR-12	
Nitrite as N by Ion Chromatography							
Nitrite-N	<0.25	DLM	0.25	mg/L		25-APR-12	R2356904
Miscellaneous Parameters							
Ammonia, Total (as N)	8.3	DLA	1.0	mg/L		03-MAY-12	R2359521
Phosphorus (P)-Total	3.99		0.010	mg/L		30-APR-12	R2357838
Un-ionized ammonia							
Temperature supplied by Client							
Temperature, Client Provided	10.0		0.1	Degree C		25-APR-12	R2355991
Un-ionized ammonia							
Ammonia, Un-ionized (as N)	0.296		0.010	mg/L		03-MAY-12	
pH supplied by Client							
pH, Client Supplied	8.30		0.10	pH		25-APR-12	R2355991
L1138943-3 CELL #1 - DISCHARGE							
Sampled By: GRAND PLISCHKE on 24-APR-12 @ 15:00							
Matrix: SEWAGE / WASTEWATER							
Nitrate + Nitrite							
Nitrate as N by Ion Chromatography							
Nitrate-N	<0.25	DLM	0.25	mg/L		25-APR-12	R2356904
Nitrate+Nitrite							
Nitrate and Nitrite as N	<0.35		0.35	mg/L		25-APR-12	
Nitrite as N by Ion Chromatography							
Nitrite-N	<0.25	DLM	0.25	mg/L		25-APR-12	R2356904
Miscellaneous Parameters							
Ammonia, Total (as N)	0.056		0.010	mg/L		04-MAY-12	R2360636
Phosphorus (P)-Total	3.83		0.010	mg/L		30-APR-12	R2357838
Un-ionized ammonia							
Temperature 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
L1138943-3 CELL #1 - DISCHARGE							
Sampled By: GRAND PLISCHKE on 24-APR-12 @ 15:00							
Matrix: SEWAGE / WASTEWATER							
Temperature supplied by Client							
Temperature, Client Provided	9.0		0.1	Degree C		25-APR-12	R2355991
Un-ionized ammonia							
Ammonia, Un-ionized (as N)	<0.010		0.010	mg/L		07-MAY-12	
pH supplied by Client							
pH, Client Supplied	8.80		0.10	pH		25-APR-12	R2355991
L1138943-4 CELL #2 - DISCHARGE							
Sampled By: GRAND PLISCHKE on 24-APR-12 @ 15:00							
Matrix: SEWAGE / WASTEWATER							
Nitrate + Nitrite							
Nitrate as N by Ion Chromatography							
Nitrate-N	0.30		0.25	mg/L		25-APR-12	R2356904
Nitrate+Nitrite							
Nitrate and Nitrite as N	<0.35		0.35	mg/L		25-APR-12	
Nitrite as N by Ion Chromatography							
Nitrite-N	<0.25	DLM	0.25	mg/L		25-APR-12	R2356904
Miscellaneous Parameters							
Ammonia, Total (as N)	8.3	DLA	1.0	mg/L		03-MAY-12	R2359521
Phosphorus (P)-Total	4.03		0.010	mg/L		30-APR-12	R2357838
Un-ionized ammonia							
Temperature supplied by Client							
Temperature, Client Provided	9.0		0.1	Degree C		25-APR-12	R2355991
Un-ionized ammonia							
Ammonia, Un-ionized (as N)	0.425		0.010	mg/L		03-MAY-12	
pH supplied by Client							
pH, Client Supplied	8.50		0.10	pH		25-APR-12	R2355991

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Sample Parameter Qualifier Key:

Qualifier	Description
DLA	Detection Limit Adjusted For required dilution
DLM	Detection Limit Adjusted For Sample Matrix Effects

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
NH3-COL-WP	Water	Ammonia by colour	APHA 4500 NH3 F
Ammonia in water samples forms indophenol when reacted with hypochlorite and phenol. The intensity is amplified by the addition of sodium nitroprusside and measured colourmetrically.			
NH3-UNION-CALC-WP	Water	Un-ionized ammonia	Calculation
NO2+NO3-CALC-WP	Water	Nitrate+Nitrite	CALCULATION
NO2-IC-WP	Water	Nitrite as N by Ion Chromatography	EPA 300.1 (modified)
Anions in aqueous matrices are analyzed using ion chromatography with conductivity and/or UV absorbance detectors.			
NO3-IC-WP	Water	Nitrate as N by Ion Chromatography	EPA 300.1 (modified)
Anions in aqueous matrices are analyzed using ion chromatography with conductivity and/or UV absorbance detectors.			
P-T-COL-WP	Water	Phosphorus, Total	APHA 4500 P PHOSPHORUS
This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.			
PH-CLIENT-WP	Water	pH supplied by Client	Supplied by client
TEMP-CLIENT-WP	Water	Temperature supplied by Client	Result supplied by Client

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WP	ALS ENVIRONMENTAL - WINNIPEG, MANITOBA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Laboratory Group
ANALYTICAL CHEM

12 - 1329 Niakwa Rd. E.
Winnipeg, Manitoba R2J 3T4
(204) 255-9720
(204) 255-9721
Toll free: 1 800 607 7555

Chain of Custody / Analytical Request Form
CHEMISTRY INFO: (204) 255 9739
MICRO INFO: (204) 255 9740 OR (204) 255 9

Environme

L1138943-COFC

WORK ORDER NO:

FOR LI

LAB NO: L1138943

Sample Condition Upon Receipt: ☐ ACCEPTABLE ☐ NON ACCEPTABLE DATE RECEIVED: 25APR12

☐ Frozen ☐ Cold ☐ Ambient ☐ Broken ☐ Leakage ☐ Incorrect Sample Container TIME RECEIVED: 11:00

COMMENT: 17° BY: JB

Date Sampled: 24/04/2012 Time: 3 : 00 A.M. ☐ P.M. ☑ Date Required: REGULAR

Location: RM OF BROKENHEAD (Town, Community, City)

Submitter's Name Printed: GRANT PLISCHKE

Sample Submitted By: GRANT PLISCHKE

Community Code Number: 29.31

Rural Municipality/LGC/UVD: BROKENHEAD

SAMPLE TYPE

DRINKING WATER
- ☐ Untreated Well
- ☐ Treated Well
- ☐ Treated Municipal
- ☐ Non-Treated Municipal
- ☐ Water-Surface-Raw
- ☐ Water-Surface-Treated

NON-DRINKING WATER
- ☑ Sewage/Waste Water
- ☐ Lake/River
- ☐ Swimming Pool
- ☐ Whirl Pool
- ☐ Other

PURPOSE OF TEST
☐ Private ☐ Real Estate ☐ Water Main

PLEASE PRINT & PRESS FIRMLY

NOTES & CONDITIONS
1. Quote number must be provided to insure proper pricing.
2. Failure to properly complete all portions of this form may delay ana
3. ALS's liability limited to cost of analysis.

SERVICE REQUESTED
☐ REGULAR ☐ PRIORITY (50% SURCHARGE) ☐ EMERGENCY (100% SURCHAR

LAB NUMBER	SAMPLE IDENTIFICATION	
	#1 - CELL 1 INTERCELL	
	#2 - CELL 1 INTERCELL	
	#3 - CELL 2 INTERCELL	
	#4 - CELL 2 INTERCELL	
	#5 - CELL 1 DISCHARGE	
	#6 - CELL 1 DISCHARGE	
	#7 - CELL 2 DISCHARGE	
	#8 - CELL 2 DISCHARGE	
	CELL 1	
	INTER CELL	DISCHARGE
	PH 8.6 TEMP 10c	PH 8.8 TEMP 9c
	CELL 2	
	INTERCELL	DISCHARGE
	PH 8.3 TEMP 10c	PH 8.5 TEMP 9c

ALS CUSTOMER #: QUOTE #:

REPORT TO BE SENT TO

NAME: GRANT PLISCHKE
COMPANY: RM OF BROKENHEAD
ADDRESS: Box 490
CITY/TOWN: BEAUSEJOUR / PROV.: MB
POSTAL CODE: R0E 0C0
PHONE: 268-5581
BY: MAIL ☐ FAX ☑ 204-268-4169 (FAX NUMBER)
PICKUP ☐ E-MAIL ☑ gtwater@xplornet.c (EMAIL ADDRESS)

CC
NAME:
ADDRESS:
CITY/TOWN: / PROV.:
POSTAL CODE:
PHONE:
BY: MAIL ☐ FAX ☐ (FAX NUMBER)
PICKUP ☐ E-MAIL ☐ (EMAIL ADDRESS)

Analyses required AMONIA (NH3) DISSOLVED
NITRATE+NITRATE-N - DISSOLVED
CALCULATION FOR UN-IONIZED AMMONIA
PHOSPHORUS TOTAL

BILLING ADDRESS SAME AS REPORT TO ☑

NAME:
COMPANY:
ADDRESS:
CITY/TOWN: / PROV.:
POSTAL CODE:

SAMPLING INSTRUCTIONS ON REVERSE SIDE

PAYMENT PARTICULARS

☐ INVOICE NEEDED / CLIENT'S P.O. NO.
☐ INTERAC
☐ CASH Subtotal $
☐ CHEQUE G.S.T. $
☐ VISA / MASTERCARD Total $

* OUR POLICY IS NOT TO ACCEPT SAMPLES FROM THE PRIVATE CITIZEN WITHOUT PREPAYMENT

ENTERED IN LIMS BY:

Manitoba Technology Centre Ltd.
Part of the ALS Laboratory Group
12 - 1329 Niakwa Rd. E., Winnipeg, MB Canada R2J 3T4
Phone: +1 204 255 9720 Fax: +1 204 255 9721 www.alsglobal.com
A Campbell Brothers Limited Company

SUBMITTER COPY

RM of Brokenhead
ATTN: GRANT PLISCHKE
PO Box 490
Beausejour MB R0E 0C0

Date Received: 14-JUN-12
Report Date: 28-JUN-12 16:22 (MT)
Version: FINAL

Client Phone: 204-268-5581

Certificate of Analysis

Lab Work Order #: L1162338

Project P.O. #: NOT SUBMITTED
Job Reference: WP29.31
C of C Numbers:
Legal Site Desc:

GARRETT RONCERAY
Biology Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1162338-1 CELL 1 - INTERCELL							
Sampled By: GRANT PLISCHKE on 13-JUN-12 @ 14:50							
Matrix: SEWAGE / WASTEWATER							
Nitrate + Nitrite							
Nitrate as N by Ion Chromatography							
Nitrate-N	<0.25	DLM	0.25	mg/L		15-JUN-12	R2383802
Nitrate+Nitrite							
Nitrate and Nitrite as N	<0.35		0.35	mg/L		14-JUN-12	
Nitrite as N by Ion Chromatography							
Nitrite-N	<0.25	DLM	0.25	mg/L		15-JUN-12	R2383802
Miscellaneous Parameters							
Phosphorus (P)-Total	7.27	DLA	0.10	mg/L		15-JUN-12	R2382803
Un-ionized ammonia							
Ammonia by colour							
Ammonia, Total (as N)	23.7	DLA	1.0	mg/L		27-JUN-12	R2389667
Temperature supplied by Client							
Temperature, Client Provided	15.0		0.1	Degree C		15-JUN-12	R2382427
Un-ionized ammonia							
Ammonia, Un-ionized (as N)	0.576		0.010	mg/L		28-JUN-12	
pH supplied by Client							
pH, Client Supplied	7.96		0.10	pH		15-JUN-12	R2382427
L1162338-2 CELL 2 - INTERCELL							
Sampled By: GRANT PLISCHKE on 13-JUN-12 @ 14:50							
Matrix: SEWAGE / WASTEWATER							
Nitrate + Nitrite							
Nitrate as N by Ion Chromatography							
Nitrate-N	<0.25	DLM	0.25	mg/L		15-JUN-12	R2383802
Nitrate+Nitrite							
Nitrate and Nitrite as N	<0.35		0.35	mg/L		14-JUN-12	
Nitrite as N by Ion Chromatography							
Nitrite-N	<0.25	DLM	0.25	mg/L		15-JUN-12	R2383802
Miscellaneous Parameters							
Phosphorus (P)-Total	7.72	DLA	0.10	mg/L		15-JUN-12	R2382803
Un-ionized ammonia							
Ammonia by colour							
Ammonia, Total (as N)	23.5	DLA	1.0	mg/L		27-JUN-12	R2389667
Temperature supplied by Client							
Temperature, Client Provided	15.0		0.1	Degree C		15-JUN-12	R2382427
Un-ionized ammonia							
Ammonia, Un-ionized (as N)	0.976		0.010	mg/L		28-JUN-12	
pH supplied by Client							
pH, Client Supplied	8.20		0.10	pH		15-JUN-12	R2382427
L1162338-3 CELL 1 DISCHARGE							
Sampled By: GRANT PLISCHKE on 13-JUN-12 @ 14:50							
Matrix: SEWAGE / WASTEWATER							
Nitrate + Nitrite							
Nitrate as N by Ion Chromatography							
Nitrate-N	<0.25	DLM	0.25	mg/L		15-JUN-12	R2383802
Nitrate+Nitrite							
Nitrate and Nitrite as N	<0.35		0.35	mg/L		14-JUN-12	
Nitrite as N by Ion Chromatography							
Nitrite-N	<0.25	DLM	0.25	mg/L		15-JUN-12	R2383802
Miscellaneous Parameters							
Phosphorus (P)-Total	2.69		0.010	mg/L		15-JUN-12	R2382803
Un-ionized ammonia							

* 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
L1162338-3 CELL 1 DISCHARGE							
Sampled By: GRANT PLISCHKE on 13-JUN-12 @ 14:50							
Matrix: SEWAGE / WASTEWATER							
Ammonia by colour							
Ammonia, Total (as N)	1.01	DLA	0.10	mg/L		26-JUN-12	R2388644
Temperature supplied by Client							
Temperature, Client Provided	18.0		0.1	Degree C		15-JUN-12	R2382427
Un-ionized ammonia							
Ammonia, Un-ionized (as N)	0.080		0.010	mg/L		27-JUN-12	
pH supplied by Client							
pH, Client Supplied	8.40		0.10	pH		15-JUN-12	R2382427
L1162338-4 CELL 2 DISCHARGE							
Sampled By: GRANT PLISCHKE on 13-JUN-12 @ 14:50							
Matrix: SEWAGE / WASTEWATER							
Nitrate + Nitrite							
Nitrate as N by Ion Chromatography							
Nitrate-N	<0.25	DLM	0.25	mg/L		15-JUN-12	R2383802
Nitrate+Nitrite							
Nitrate and Nitrite as N	<0.35		0.35	mg/L		14-JUN-12	
Nitrite as N by Ion Chromatography							
Nitrite-N	<0.25	DLM	0.25	mg/L		15-JUN-12	R2383802
Miscellaneous Parameters							
Phosphorus (P)-Total	3.20		0.010	mg/L		15-JUN-12	R2382803
Un-ionized ammonia							
Ammonia by colour							
Ammonia, Total (as N)	3.81	DLA	0.10	mg/L		26-JUN-12	R2388644
Temperature supplied by Client							
Temperature, Client Provided	17.0		0.1	Degree C		15-JUN-12	R2382427
Un-ionized ammonia							
Ammonia, Un-ionized (as N)	0.094		0.010	mg/L		27-JUN-12	
pH supplied by Client							
pH, Client Supplied	7.90		0.10	pH		15-JUN-12	R2382427
L1162338-5 BOD CELL 2 - EAST							
Sampled By: GRANT PLISCHKE on 13-JUN-12 @ 14:50							
Matrix: SEWAGE / WASTEWATER							
Miscellaneous Parameters							
Biochemical Oxygen Demand	6.0		6.0	mg/L	14-JUN-12	19-JUN-12	R2384290
L1162338-6 CELL 2 - NORTH - TC/FC							
Sampled By: GRANT PLISCHKE on 13-JUN-12 @ 14:50							
Matrix: SEWAGE / WASTEWATER							
Total and Fecal Coliform by MPN							
Fecal Coliform							
Fecal Coliforms	1500		3	MPN/100mL		17-JUN-12	R2383874
Total Coliform							
Total Coliforms	24000		3	MPN/100mL		18-JUN-12	R2383874
L1162338-7 CELL 2 - WEST - TC/FC							
Sampled By: GRANT PLISCHKE on 13-JUN-12 @ 14:50							
Matrix: SEWAGE / WASTEWATER							
Total and Fecal Coliform by MPN							
Fecal Coliform							
Fecal Coliforms	9		3	MPN/100mL		17-JUN-12	R2383874
Total Coliform							
Total Coliforms	230		3	MPN/100mL		18-JUN-12	R2383874

* 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
L1162338-7 CELL 2 - WEST - TC/FC							
Sampled By: GRANT PLISCHKE on 13-JUN-12 @ 14:50							
Matrix: SEWAGE / WASTEWATER							
L1162338-8 CELL 2 - SOUTH - TC/FC							
Sampled By: GRANT PLISCHKE on 13-JUN-12 @ 14:50							
Matrix: SEWAGE / WASTEWATER							
Total and Fecal Coliform by MPN							
Fecal Coliform							
Fecal Coliforms	<3		3	MPN/100mL		17-JUN-12	R2383874
Total Coliform							
Total Coliforms	9		3	MPN/100mL		18-JUN-12	R2383874

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Sample Parameter Qualifier Key:

Qualifier	Description
DLA	Detection Limit Adjusted For required dilution
DLM	Detection Limit Adjusted For Sample Matrix Effects

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
BOD-WP	Water	Biochemical Oxygen Demand (BOD)	APHA 5210 B
The sample is incubated for 5 days at 20 degrees Celcius. Comparison of dissolved oxygen content at the beginning and end of incubation provides a measure of biochemical oxygen demand. If carbonaceous BOD is requested, TCMP is added to the sample to chemically inhibit nitrogenous oxygen demand. If soluble BOD is requested, the sample is filtered prior to analysis. Surface waters have a DL of 1 mg/L. Effluents are diluted according to their history and will have a sample DL of 6 mg/L or greater, depending on the dilutions used.			
FC-MPN-WP	Water	Fecal Coliform	APHA 9221A-C
The Most Probable Number (MPN) method is based on the Multiple Tube Fermentation technique. The results of examination of replicate tubes and dilutions of a sample are reported after confirmations specific to total coliform, fecal coliform and E. coli are performed. Results are reported in MPN/100 mL for water and MPN/gram for food and solid samples.			
NH3-COL-WP	Water	Ammonia by colour	APHA 4500 NH3 F
Ammonia in water samples forms indophenol when reacted with hypochlorite and phenol. The intensity is amplified by the addition of sodium nitroprusside and measured colourmetrically.			
NH3-UNION-CALC-WP	Water	Un-ionized ammonia	Calculation
NO2+NO3-CALC-WP	Water	Nitrate+Nitrite	CALCULATION
NO2-IC-WP	Water	Nitrite as N by Ion Chromatography	EPA 300.1 (modified)
Anions in aqueous matrices are analyzed using ion chromatography with conductivity and/or UV absorbance detectors.			
NO3-IC-WP	Water	Nitrate as N by Ion Chromatography	EPA 300.1 (modified)
Anions in aqueous matrices are analyzed using ion chromatography with conductivity and/or UV absorbance detectors.			
P-T-COL-WP	Water	Phosphorus, Total	APHA 4500 P PHOSPHORUS
This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.			
PH-CLIENT-WP	Water	pH supplied by Client	Supplied by client
TC-MPN-WP	Water	Total Coliform	APHA 9221A-C
The Most Probable Number (MPN) method is based on the Multiple Tube Fermentation technique. The results of examination of replicate tubes and dilutions of a sample are reported after confirmations specific to total coliform, fecal coliform and E. coli are performed. Results are reported in MPN/100 mL for water and MPN/gram for food and solid samples.			
TEMP-CLIENT-WP	Water	Temperature supplied by Client	Result supplied by Client

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WP	ALS ENVIRONMENTAL - WINNIPEG, MANITOBA, CANADA

Chain of Custody Numbers:

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

12 - 1329 Niakwa Rd. E.
Winnipeg, Manitoba R2J 3T4
Tel: (204) 255-9720

Chain of Custody / Analytical Request Form

CHEMISTRY INFO: (204) 255 9739
MICRO INFO: (204) 255 9740 OR (204) 255 9737

WORK ORDER NO: _____

L1162338-COFC

FOR LABORATORY USE ONLY
Sample Condition Upon Receipt: ☐ Frozen ☐ Cold ☐ Ambient ☐ Broken Container
COMMENT: _____
LAB NO.: _____
DATE RECEIVED: 15-MR-12
TIME RECEIVED: 1:50
BY: _____

Date Sampled: 13/06/2012 Time: 2 : 00 A.M. ☐ P.M. ☑
Location: RM OF BROKENHEAD (Town, Community, City)
Community Code Number: 29.31

Date Required: ASAP
Submitter's Name Printed: GRANT PLISCHKE
Sample Submitted By: SAME AS ABOVE
Rural Municipality/LGC/UVD: BROKENHEAD

SAMPLE TYPE
DRINKING WATER
☐ Untreated Well
☐ Treated Well
☐ Treated Municipal
☐ Non-Treated Municipal
☐ Water-Surface-Raw
☐ Water-Surface-Treated

NON-DRINKING WATER
☑ Sewage/Waste Water
☐ Lake/River
☐ Swimming Pool
☐ Whirl Pool
☐ Other

118

PURPOSE OF TEST
☐ Private ☐ Real Estate ☐ Water Main

PLEASE PRINT & PRESS FIRMLY

NOTES & CONDITIONS
1. Quote number must be provided to insure proper pricing.
2. Failure to properly complete all portions of this form may delay analysis.
3. ALS's liability limited to cost of analysis.

SERVICE REQUESTED
☐ REGULAR ☐ PRIORITY (50% SURCHARGE) ☐ EMERGENCY (100% SURCHARGE)

LAB NUMBER	SAMPLE IDENTIFICATION
	#1-CELL 1 INTERCELL 15° 7.96 PH
	#2 CELL 2 INTERCELL 15° 8.2 PH
	#3 CELL 1 DISCHARGE 18° 8.4 PH
	#4 CELL 2 DISCHARGE 17° 7.9 PH
	#5 BOD CELL 2 EAST
	#6 tc, FC CELL 2 NORTH
	#7 tc, FC CELL 2 WEST
	#8 tc, FC CELL 2 South

ALS CUSTOMER #: _____ QUOTE #: _____

REPORT TO BE SENT TO
NAME: GRANT PLISCHKE
COMPANY: RM OF BROKENHEAD
ADDRESS: Box 490
CITY/TOWN: BEAUSEJOUR / PROV.: MB
POSTAL CODE: R0E 0C0
PHONE: 204-268-5581
BY: MAIL ☐ FAX ☐ _____ (FAX NUMBER)
PICKUP ☐ E-MAIL ☑ gtwater@xplornet.com (EMAIL ADDRESS)

CC
NAME: _____
ADDRESS: _____
CITY/TOWN: _____ / PROV.: _____
POSTAL CODE: _____
PHONE: _____
BY: MAIL ☐ FAX ☐ _____ (FAX NUMBER)
PICKUP ☐ E-MAIL ☐ _____ (EMAIL ADDRESS)

Analyses required: AMMONIA (NH3) - Dissolved
NITRATE + NITRATE-N - Dissolved, Calculation
FOR UN-IONIZED AMMONIA
PHOSPHORUS, total, tc, FC, BOD

BILLING ADDRESS SAME AS REPORT TO ☐
NAME: _____
COMPANY: _____
ADDRESS: _____
CITY/TOWN: _____ / PROV.: _____
POSTAL CODE: _____

PAYMENT PARTICULARS
☐ INVOICE NEEDED / CLIENT'S P.O. NO. _____
☐ INTERAC
☐ CASH Subtotal $ _____
☐ CHEQUE G.S.T. $ _____
☐ VISA / MASTERCARD Total $ _____
* OUR POLICY IS NOT TO ACCEPT SAMPLES FROM THE PRIVATE CITIZEN WITHOUT PREPAYMENT

ENTERED IN LIMS BY: _____

SAMPLING INSTRUCTIONS ON REVERSE SIDE

Manitoba Technology Centre Ltd.
Part of the **ALS Laboratory Group**
12 - 1329 Niakwa Rd. E., Winnipeg, MB Canada R2J 3T4
Phone: +1 204 255 9720 Fax: +1 204 255 9721 www.alsglobal.com
A Campbell Brothers Limited Company

SUBMITTER COPY

RM of Brokenhead
ATTN: GRANT PLISCHKE
PO Box 490
Beausejour MB R0E 0C0

Date Received: 09-AUG-12
Report Date: 22-AUG-12 16:39 (MT)
Version: FINAL

Client Phone: 204-268-5581

Certificate of Analysis

Lab Work Order #: L1191708

Project P.O. #: NOT SUBMITTED
Job Reference:
C of C Numbers:
Legal Site Desc:

Barb Bayer
General Manager, Winnipeg

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1191708-1 PRIMARY INTERCELL WEST							
Sampled By: CLIENT on 08-AUG-12 @ 15:00							
Matrix: WASTEWATER							
Nitrate + Nitrite							
Nitrate as N by Ion Chromatography							
Nitrate-N	<0.25	DLM	0.25	mg/L		10-AUG-12	R2414919
Nitrate+Nitrite							
Nitrate and Nitrite as N	<0.35		0.35	mg/L		14-AUG-12	
Nitrite as N by Ion Chromatography							
Nitrite-N	<0.25	DLM	0.25	mg/L		10-AUG-12	R2414919
Miscellaneous Parameters							
Ammonia, Total (as N)	28.9	DLA	1.0	mg/L		22-AUG-12	R2421165
Phosphorus (P)-Total	10.4	DLA	0.10	mg/L		13-AUG-12	R2416973
Un-ionized ammonia							
Temperature supplied by Client							
Temperature, Client Provided	21.0		0.1	Degree C		10-AUG-12	R2414546
Un-ionized ammonia							
Ammonia, Un-ionized (as N)	2.26		0.010	mg/L		22-AUG-12	
pH supplied by Client							
pH, Client Supplied	8.30		0.10	pH		10-AUG-12	R2414546
L1191708-2 PRIMARY INTERCELL EAST							
Sampled By: CLIENT on 08-AUG-12 @ 15:00							
Matrix: WASTEWATER							
Nitrate + Nitrite							
Nitrate as N by Ion Chromatography							
Nitrate-N	<0.25	DLM	0.25	mg/L		10-AUG-12	R2414919
Nitrate+Nitrite							
Nitrate and Nitrite as N	<0.35		0.35	mg/L		14-AUG-12	
Nitrite as N by Ion Chromatography							
Nitrite-N	<0.25	DLM	0.25	mg/L		10-AUG-12	R2414919
Miscellaneous Parameters							
Ammonia, Total (as N)	24.0	DLA	1.0	mg/L		22-AUG-12	R2421165
Phosphorus (P)-Total	9.93	DLA	0.10	mg/L		13-AUG-12	R2416973
Un-ionized ammonia							
Temperature supplied by Client							
Temperature, Client Provided	22.0		0.1	Degree C		10-AUG-12	R2414546
Un-ionized ammonia							
Ammonia, Un-ionized (as N)	2.01		0.010	mg/L		22-AUG-12	
pH supplied by Client							
pH, Client Supplied	8.30		0.10	pH		10-AUG-12	R2414546
L1191708-3 DISCHARGE CELL #1							
Sampled By: CLIENT on 08-AUG-12 @ 15:00							
Matrix: WASTEWATER							
Nitrate + Nitrite							
Nitrate as N by Ion Chromatography							
Nitrate-N	<0.25	DLM	0.25	mg/L		10-AUG-12	R2414919
Nitrate+Nitrite							
Nitrate and Nitrite as N	<0.35		0.35	mg/L		14-AUG-12	
Nitrite as N by Ion Chromatography							
Nitrite-N	<0.25	DLM	0.25	mg/L		10-AUG-12	R2414919
Miscellaneous Parameters							
Ammonia, Total (as N)	0.444		0.010	mg/L		20-AUG-12	R2420418
Phosphorus (P)-Total	2.65		0.010	mg/L		13-AUG-12	R2416973
Un-ionized ammonia							
Temperature 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
L1191708-3 DISCHARGE CELL #1							
Sampled By: CLIENT on 08-AUG-12 @ 15:00							
Matrix: WASTEWATER							
Temperature supplied by Client							
Temperature, Client Provided	21.0		0.1	Degree C		10-AUG-12	R2414546
Un-ionized ammonia							
Ammonia, Un-ionized (as N)	0.078		0.010	mg/L		21-AUG-12	
pH supplied by Client							
pH, Client Supplied	8.70		0.10	pH		10-AUG-12	R2414546
L1191708-4 DISCHARGE CELL #2							
Sampled By: CLIENT on 08-AUG-12 @ 15:00							
Matrix: WASTEWATER							
Nitrate + Nitrite							
Nitrate as N by Ion Chromatography							
Nitrate-N	<0.25	DLM	0.25	mg/L		10-AUG-12	R2414919
Nitrate+Nitrite							
Nitrate and Nitrite as N	<0.35		0.35	mg/L		14-AUG-12	
Nitrite as N by Ion Chromatography							
Nitrite-N	<0.25	DLM	0.25	mg/L		10-AUG-12	R2414919
Miscellaneous Parameters							
Ammonia, Total (as N)	3.42	DLA	0.10	mg/L		21-AUG-12	R2420418
Phosphorus (P)-Total	3.45		0.010	mg/L		13-AUG-12	R2416973
Un-ionized ammonia							
Temperature supplied by Client							
Temperature, Client Provided	22.0		0.1	Degree C		10-AUG-12	R2414546
Un-ionized ammonia							
Ammonia, Un-ionized (as N)	0.638		0.010	mg/L		21-AUG-12	
pH supplied by Client							
pH, Client Supplied	8.70		0.10	pH		10-AUG-12	R2414546

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Sample Parameter Qualifier Key:

Qualifier	Description
DLA	Detection Limit Adjusted For required dilution
DLM	Detection Limit Adjusted For Sample Matrix Effects

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
NH3-COL-WP	Water	Ammonia by colour	APHA 4500 NH3 F
Ammonia in water samples forms indophenol when reacted with hypochlorite and phenol. The intensity is amplified by the addition of sodium nitroprusside and measured colourmetrically.			
NH3-UNION-CALC-WP	Water	Un-ionized ammonia	Calculation
NO2+NO3-CALC-WP	Water	Nitrate+Nitrite	CALCULATION
NO2-IC-WP	Water	Nitrite as N by Ion Chromatography	EPA 300.1 (modified)
Anions in aqueous matrices are analyzed using ion chromatography with conductivity and/or UV absorbance detectors.			
NO3-IC-WP	Water	Nitrate as N by Ion Chromatography	EPA 300.1 (modified)
Anions in aqueous matrices are analyzed using ion chromatography with conductivity and/or UV absorbance detectors.			
P-T-COL-WP	Water	Phosphorus, Total	APHA 4500 P PHOSPHORUS
This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.			
PH-CLIENT-WP	Water	pH supplied by Client	Supplied by client
TEMP-CLIENT-WP	Water	Temperature supplied by Client	Result supplied by Client

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WP	ALS ENVIRONMENTAL - WINNIPEG, MANITOBA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

L1191708-COFC

Form

10-023161

L1191708 Page ___ of ___

Report To Grant Kuschke	**Report Format / Distribution**	**Service Requested:** (Rush subject to availability)
Company: RM of Brokenhead	Standard: ✓ Other (specify):	Regular (Standard Turnaround Times)) ✓
Contact: Grant Kuschke	Select: PDF ✓ Excel ___ Digital ___ Fax ✓	Priority, Date Req'd: ___ (Surcharges apply)
Address: Box 490 Beausejour MB ROE 0C0	Email 1: gtwater@xplornet.com	Emergency (1 Business Day) - 100% Surcharge
	Email 2:	For Emergency < 1 Day, ASAP or Weekend - Contact ALS
Phone: 204-268-5581 Fax: 204-268-4169		**Analysis Request**
Invoice To Same as Report ? (circle) (Yes) or No (if No, provide details)	**Client / Project Information**	(Indicate Filtered or Preserved, F/P)
Copy of Invoice with Report? (circle) Yes or (No)	Job #:	
Company:	PO / AFE:	
Contact:	LSD:	
Address:		
Phone: Fax:	Quote #:	
Lab Work Order # (lab use only)	**ALS Contact:**	**Sampler:**

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Number of Containers
1	#1 PRIMARY ~~CELL~~ INTERCELL WEST	8/08/2012	3:00 pm	WASTEWATER	1
	#2 PRIMARY INTERCELL EAST				2
	#3 DISCHARGE CELL #1				3
	#4 DISCHARGE CELL #2				4
	#1 PH - 8.3 Temp - 21°				
	#2 PH - 8.3 temp - 22°				
	#3 PH - 8.7 temp - 21°				
	#4 PH - 8.7 temp - 22°				

Special Instructions / Regulations / Hazardous Details

NUTRIENTS (AMONIA (NH3-DISSOLVED, NITRATE+NITRATE-N-DISSOLVED, UNION 200 AMONIA, PHOSPHORUS

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date:	Time:	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
				9-Aug	13:42	20.8 °C				

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION | WHITE - LABORATORY COPY | YELLOW - CLIENT COPY | GENF 18.01 Front

RM of Brokenhead
ATTN: GRANT PLISCHKE
PO Box 490
Beausejour MB R0E 0C0

Date Received: 16-OCT-12
Report Date: 24-OCT-12 12:11 (MT)
Version: FINAL

Client Phone: 204-268-5581

Certificate of Analysis

Lab Work Order #: L1224333

Project P.O. #: NOT SUBMITTED
Job Reference: RM OF BROKENHEAD
C of C Numbers:
Legal Site Desc:

Barb Bayer
General Manager, Winnipeg

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1224333-1 #1 PRIMARY INTERCELL WEST							
Sampled By: GRANT PLISCLKE on 15-OCT-12 @ 14:00							
Matrix: SEWAGE WASTE WATER							
Nitrate + Nitrite							
Nitrate as N by Ion Chromatography							
Nitrate-N	<0.25	DLM	0.25	mg/L		18-OCT-12	R2460704
Nitrate+Nitrite							
Nitrate and Nitrite as N	<0.35		0.35	mg/L		24-OCT-12	
Nitrite as N by Ion Chromatography							
Nitrite-N	<0.25	DLM	0.25	mg/L		18-OCT-12	R2460704
Miscellaneous Parameters							
Ammonia, Total (as N)	28.0	DLA	1.0	mg/L		19-OCT-12	R2459890
Phosphorus (P)-Total	9.57	DLA	0.10	mg/L		18-OCT-12	R2458444
Un-ionized ammonia							
Temperature supplied by Client							
Temperature, Client Provided	3.0		0.1	Degree C		17-OCT-12	R2457157
Un-ionized ammonia							
Ammonia, Un-ionized (as N)	0.293		0.010	mg/L		22-OCT-12	
pH supplied by Client							
pH, Client Supplied	8.00		0.10	pH		17-OCT-12	R2457157
L1224333-2 #2 PRIMARY INTERCELL EAST							
Sampled By: GRANT PLISCLKE on 15-OCT-12 @ 14:00							
Matrix: SEWAGE WASTE WATER							
Nitrate + Nitrite							
Nitrate as N by Ion Chromatography							
Nitrate-N	<0.25	DLM	0.25	mg/L		18-OCT-12	R2460704
Nitrate+Nitrite							
Nitrate and Nitrite as N	<0.35		0.35	mg/L		24-OCT-12	
Nitrite as N by Ion Chromatography							
Nitrite-N	<0.25	DLM	0.25	mg/L		18-OCT-12	R2460704
Miscellaneous Parameters							
Ammonia, Total (as N)	25.8	DLA	1.0	mg/L		19-OCT-12	R2459890
Phosphorus (P)-Total	8.44	DLA	0.10	mg/L		18-OCT-12	R2458444
Un-ionized ammonia							
Temperature supplied by Client							
Temperature, Client Provided	4.0		0.1	Degree C		17-OCT-12	R2457157
Un-ionized ammonia							
Ammonia, Un-ionized (as N)	0.292		0.010	mg/L		22-OCT-12	
pH supplied by Client							
pH, Client Supplied	8.00		0.10	pH		17-OCT-12	R2457157
L1224333-3 #3 DISCHARGE CELL #2							
Sampled By: GRANT PLISCLKE on 15-OCT-12 @ 14:00							
Matrix: SEWAGE WASTE WATER							
Nitrate + Nitrite							
Nitrate as N by Ion Chromatography							
Nitrate-N	<0.25	DLM	0.25	mg/L		18-OCT-12	R2460704
Nitrate+Nitrite							
Nitrate and Nitrite as N	<0.35		0.35	mg/L		24-OCT-12	
Nitrite as N by Ion Chromatography							
Nitrite-N	<0.25	DLM	0.25	mg/L		18-OCT-12	R2460704
Miscellaneous Parameters							
Ammonia, Total (as N)	0.080		0.010	mg/L		17-OCT-12	R2457452
Phosphorus (P)-Total	3.10		0.010	mg/L		18-OCT-12	R2458444
Un-ionized ammonia							
Temperature 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
L1224333-3 #3 DISCHARGE CELL #2							
Sampled By: GRANT PLISCLKE on 15-OCT-12 @ 14:00							
Matrix: SEWAGE WASTE WATER							
Temperature supplied by Client							
Temperature, Client Provided	4.0		0.1	Degree C		17-OCT-12	R2457157
Un-ionized ammonia							
Ammonia, Un-ionized (as N)	<0.010		0.010	mg/L		18-OCT-12	
pH supplied by Client							
pH, Client Supplied	8.60		0.10	pH		17-OCT-12	R2457157
L1224333-4 #4 DISCHARGE CELL #1							
Sampled By: GRANT PLISCLKE on 15-OCT-12 @ 14:00							
Matrix: SEWAGE WASTE WATER							
Nitrate + Nitrite							
Nitrate as N by Ion Chromatography							
Nitrate-N	0.25		0.25	mg/L		18-OCT-12	R2460704
Nitrate+Nitrite							
Nitrate and Nitrite as N	<0.35		0.35	mg/L		24-OCT-12	
Nitrite as N by Ion Chromatography							
Nitrite-N	<0.25	DLM	0.25	mg/L		18-OCT-12	R2460704
Miscellaneous Parameters							
Ammonia, Total (as N)	3.04	DLA	0.10	mg/L		18-OCT-12	R2457452
Phosphorus (P)-Total	3.37		0.010	mg/L		18-OCT-12	R2458444
Un-ionized ammonia							
Temperature supplied by Client							
Temperature, Client Provided	4.0		0.1	Degree C		17-OCT-12	R2457157
Un-ionized ammonia							
Ammonia, Un-ionized (as N)	0.206		0.010	mg/L		18-OCT-12	
pH supplied by Client							
pH, Client Supplied	8.80		0.10	pH		17-OCT-12	R2457157

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Sample Parameter Qualifier Key:

Qualifier	Description
DLA	Detection Limit Adjusted For required dilution
DLM	Detection Limit Adjusted For Sample Matrix Effects

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
NH3-COL-WP	Water	Ammonia by colour	APHA 4500 NH3 F
Ammonia in water samples forms indophenol when reacted with hypochlorite and phenol. The intensity is amplified by the addition of sodium nitroprusside and measured colourmetrically.			
NH3-UNION-CALC-WP	Water	Un-ionized ammonia	Calculation
NO2+NO3-CALC-WP	Water	Nitrate+Nitrite	CALCULATION
NO2-IC-WP	Water	Nitrite as N by Ion Chromatography	EPA 300.1 (modified)
Anions in aqueous matrices are analyzed using ion chromatography with conductivity and/or UV absorbance detectors.			
NO3-IC-WP	Water	Nitrate as N by Ion Chromatography	EPA 300.1 (modified)
Anions in aqueous matrices are analyzed using ion chromatography with conductivity and/or UV absorbance detectors.			
P-T-COL-WP	Water	Phosphorus, Total	APHA 4500 P PHOSPHORUS
This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.			
PH-CLIENT-WP	Water	pH supplied by Client	Supplied by client
TEMP-CLIENT-WP	Water	Temperature supplied by Client	Result supplied by Client

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WP	ALS ENVIRONMENTAL - WINNIPEG, MANITOBA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

12 - 1329 Niakwa Rd. E.
Winnipeg, Manitoba, R2J 3T4

L1224333-COFC

Chain of Custody / Analytical Request Form
CHEMISTRY INFO: (204) 255 9739
FO: (204) 255 9740 OR (204) 255 9737

K ORDER NO: 1224333
AB NO.: L1224333
ATE RECEIVED: Oct 16/12
TIME RECEIVED: 9:45AM
BY: JA

FOR LABORATORY USE ONLY (SHADED
Sample Condition Upon Receipt: ☐ ACCEP
☐ Frozen ☐ Cold ☐ Ambient ☐ Broken ☐ Leakage ☐ Incorrect Sample Container
COMMENT:

17.6°C

Date Sampled: 15/10/2012 Time: 2 : 00 A.M. ☐ P.M. ☑ Date Required: ASAP

Location: RM OF BROKENHEAD
(Town, Community, City)

Community Code Number: 29.31

Submitter's Name Printed: GRANT RISCHKE
Sample Submitted By: GRANT RISCHKE
Rural Municipality/LGC/UVD:

SAMPLE TYPE
DRINKING WATER
- ☐ Untreated Well
- ☐ Treated Well
- ☐ Treated Municipal
- ☐ Non-Treated Municipal
- ☐ Water-Surface-Raw
- ☐ Water-Surface-Treated

PURPOSE OF TEST
☐ Private ☐ Real Estate ☐ Water Main

PLEASE PRINT & PRESS FIRMLY
NON-DRINKING WATER
- ☑ Sewage/Waste Water
- ☐ Lake/River
- ☐ Swimming Pool
- ☐ Whirl Pool
- ☐ Other

NOTES & CONDITIONS
1. Quote number must be provided to insure proper pricing.
2. Failure to properly complete all portions of this form may delay analysis.
3. ALS's liability limited to cost of analysis.

SERVICE REQUESTED
☐ **REGULAR** ☐ **PRIORITY** (50% SURCHARGE) ☐ **EMERGENCY** (100% SURCHARGE)

LAB NUMBER	SAMPLE IDENTIFICATION
	#1 PRIMARY INTERCELL WEST
	#2 PRIMARY INTERCELL EAST
	#3 DISCHARGE CELL #2
	#4 DISCHARGE CELL #1
	#1 PH-8 : TEMP- 3°
	#2 PH- 8 TEMP- 4°
	#3 PH- 8.6 TEMP- 4°
	#4 PH- 8.8 TEMP- 4°

ALS CUSTOMER #: *QUOTE #:*

REPORT TO BE SENT TO
NAME: GRANT RISCHKE
COMPANY: RM OF BROKENHEAD
ADDRESS: Box 490
CITY/TOWN: BEAUSEJOUR / PROV.: MB
POSTAL CODE: R0E 0C0
PHONE: 204-268-5581
BY: *MAIL* ☐ *FAX* ☑ 204-268-4169 (FAX NUMBER)
PICKUP ☐ *E-MAIL* ☑ (EMAIL ADDRESS)

CC
NAME:
ADDRESS:
CITY/TOWN: / PROV.:
POSTAL CODE:
PHONE:
BY: *MAIL* ☐ *FAX* ☐ (FAX NUMBER)
PICKUP ☐ *E-MAIL* ☐ (EMAIL ADDRESS)

Analyses required NUTRIENTS, AMONIA "NH3-Dissolved NITRATE + NITRATE-N DISSOLVED UN-IONIZED AMONIA, PHOSPHORUS

BILLING ADDRESS **SAME AS REPORT TO** ☐
NAME:
COMPANY:
ADDRESS:
CITY/TOWN: / PROV.:
POSTAL CODE:

PAYMENT PARTICULARS
☐ INVOICE NEEDED / CLIENT'S P.O. NO.
☐ INTERAC
☐ CASH Subtotal $
☐ CHEQUE G.S.T. $
☐ VISA / MASTERCARD Total $
* OUR POLICY IS NOT TO ACCEPT SAMPLES FROM THE PRIVATE CITIZEN WITHOUT PREPAYMENT

ENTERED IN LIMS BY:

SAMPLING INSTRUCTIONS ON REVERSE SIDE

Manitoba Technology Centre Ltd.
Part of the **ALS Laboratory Group**
12 - 1329 Niakwa Rd. E., Winnipeg, MB Canada R2J 3T4
Phone: +1 204 255 9720 Fax: +1 204 255 9721 **www.alsglobal.com**
A Campbell Brothers Limited Company

ACCOUNT COPY

Appendix E

Title Page

Plan L1:	Proposed Lagoon Expansion Location Plan with Setbacks
Plan L2:	Proposed Lagoon Expansion Layout with Test Hole Locations
Plan L3:	Lagoon Discharge Route
Plan L4:	Perimeter Dike and Intercell Dike Details
Plan L5:	Existing Lagoon Dike Upgrade, Liquid Level Control Weir, Perimeter Dike and Piping Flange and Marker Details
Plan L6:	Perimeter Dike at Transition Between Re-Worked and Insitu Liner and at Splitter Manhole Details
Plan L7:	Splitter Manhole, Valve, Valve Marker, Site Marker, Rip Rap and Forcemain Trench Details
Plan L8:	Spillway, Silt Fence, Truck Turnaround, Gate, Fence, and Lock Details

RM OF BROKENHEAD

LAGOON EXPANSION

ENVIRONMENT ACT PROPOSAL

PRELIMINARY
NOT FOR CONSTRUCTION

REDUCED DRAWING
50% SCALE

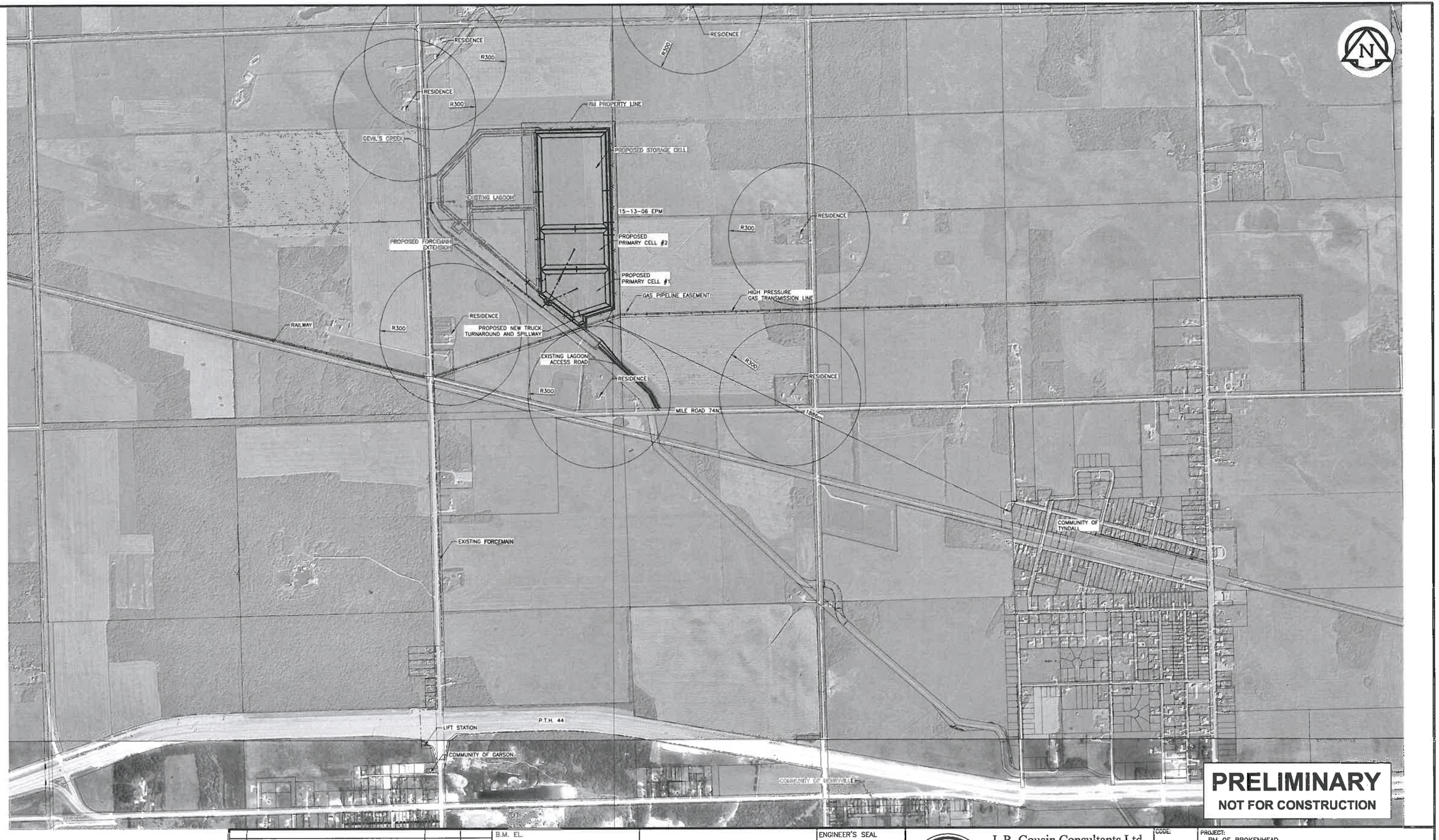
J. R. Cousin Consultants Ltd.
Consulting Engineers and Project Managers

91A Scurfield Blvd. Winnipeg, MB R3Y 1G4
ph: (204) 489-0474 fax: (204) 489-0487
email: info@jrcc.ca website: www.jrcc.ca

Engineering Excellence since 1981

PLAN INDEX

LAGOON



PRELIMINARY
NOT FOR CONSTRUCTION

SCALE BAR
(IN METRES)
150 0 75 150 300 450 600 750
1:7500

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: 13/05/23

ENGINEER'S SEAL
PROVINCE OF MANITOBA
J.R. COUSIN
13/05/23
INDUSTRIAL PROFESSIONAL ENGINEER

J. R. Cousin Consultants Ltd.
Consulting Engineers and Project Managers
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ph: (204) 489-0474 fax: (204) 489-0487
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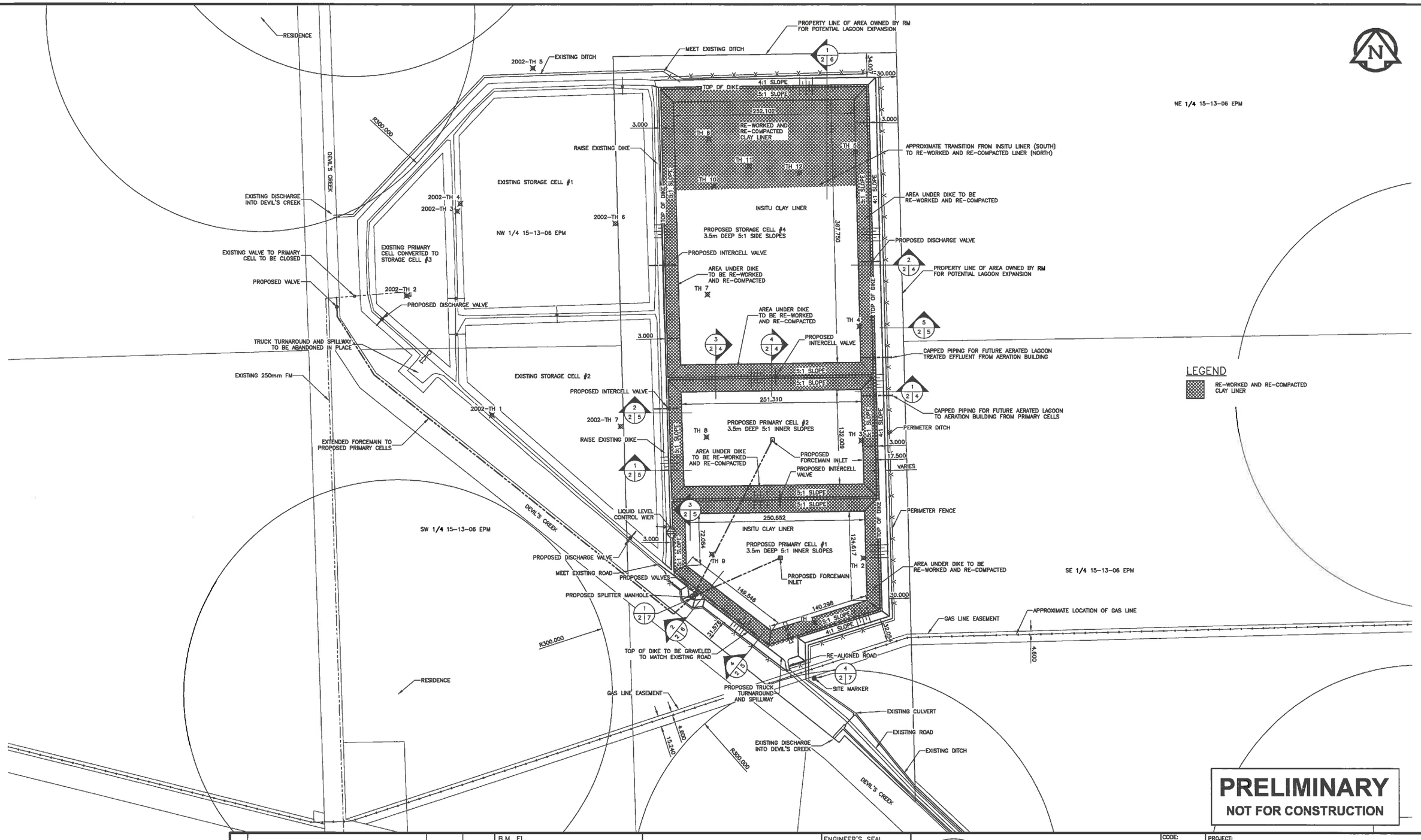
Engineering Excellence since 1981

CODE:	B-246.10
DESIGNED BY:	JC
DRAWN BY:	BM
REVIEWED BY:	JC

PROJECT:
RM OF BROKENHEAD
ENVIRONMENT ACT PROPOSAL

TITLE:
PROPOSED LAGOON LOCATION PLAN WITH SETBACKS

SCALE:	DATE:	PLAN:	SHEET:
1:7500	13/05/23	L1	1 of 8



SCALE BAR
(IN METRES)
50 0 25 50 100 150 200 250
1:2500

No.	REVISIONS	DATE	INITIALS

B.M. EL.

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No. 234 Date: 13/05/23

ENGINEER'S SEAL
PROVINCE OF MANITOBA
J.R. COUSIN
13/05/23
REGISTERED PROFESSIONAL ENGINEER

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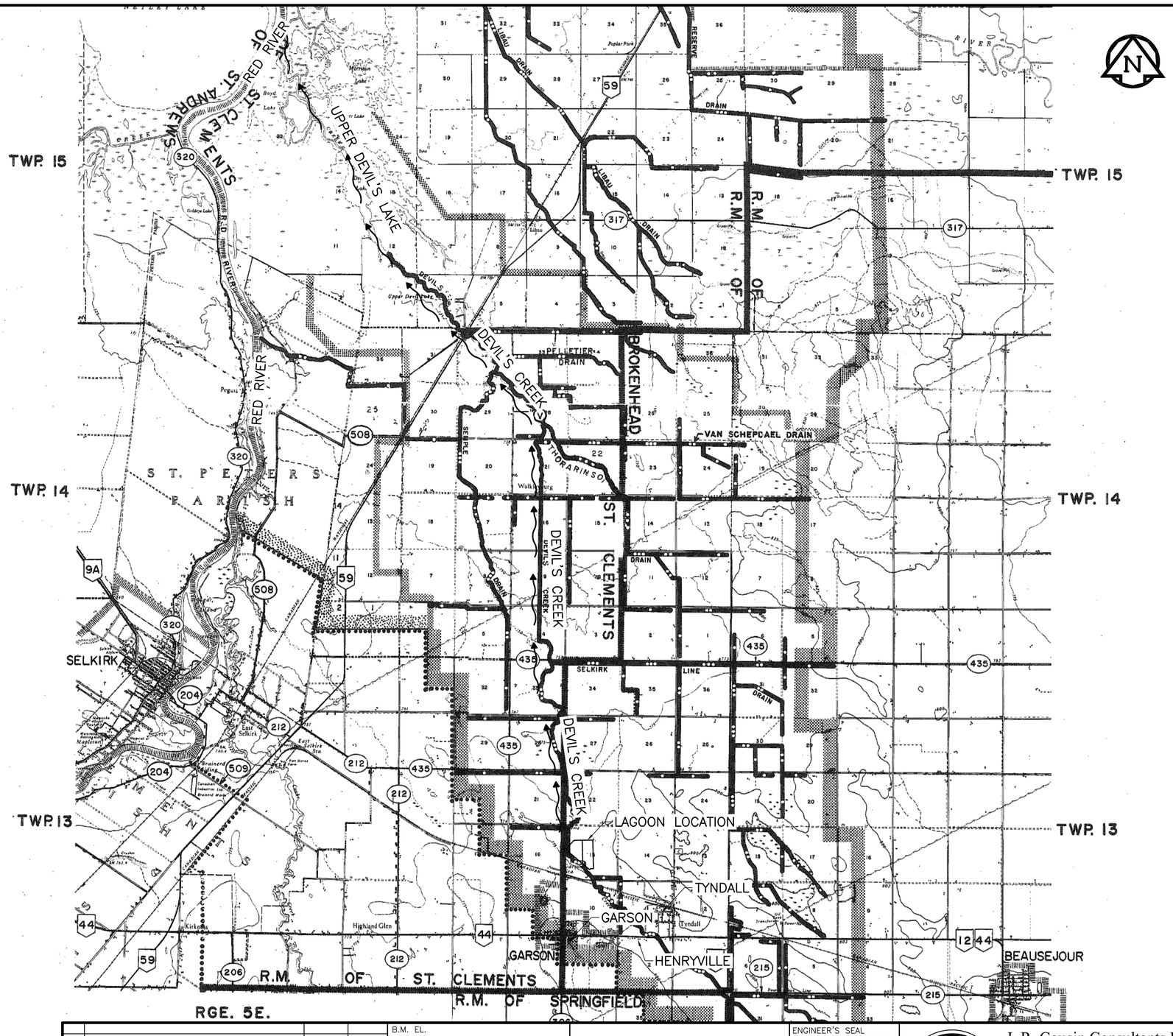
CODE:	B-246.10
DESIGNED BY:	JC
DRAWN BY:	BM
REVIEWED BY:	JC

PROJECT: RM OF BROKENHEAD
ENVIRONMENT ACT PROPOSAL

TITLE: PROPOSED LAGOON EXPANSION LAYOUT WITH TEST HOLE LOCATIONS

SCALE:	DATE:	PLAN:	SHEET:
1:2500	13/05/23	L2	2 of 8



LEGEND:

EXISTING DRAINAGE

PRELIMINARY
NOT FOR CONSTRUCTION

No.	REVISIONS	DATE	INITIALS

B.M. EL.

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CODE:	B–246.10
DESIGNED BY:	JC
DRAWN BY:	BM
REVIEWED BY:	JC

PROJECT: RM OF BROKENHEAD
ENVIRONMENT ACT PROPOSAL

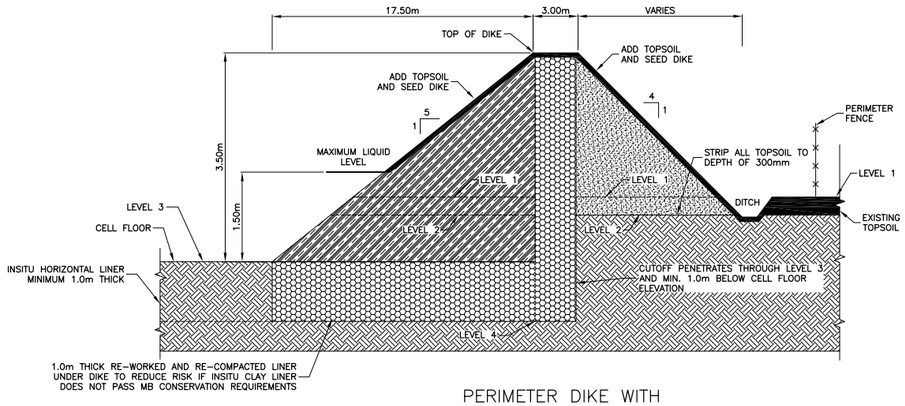
TITLE: LAGOON DISCHARGE ROUTE

SCALE:	DATE:	PLAN:	SHEET:
NTS	13/01/16	L3	3 of 8

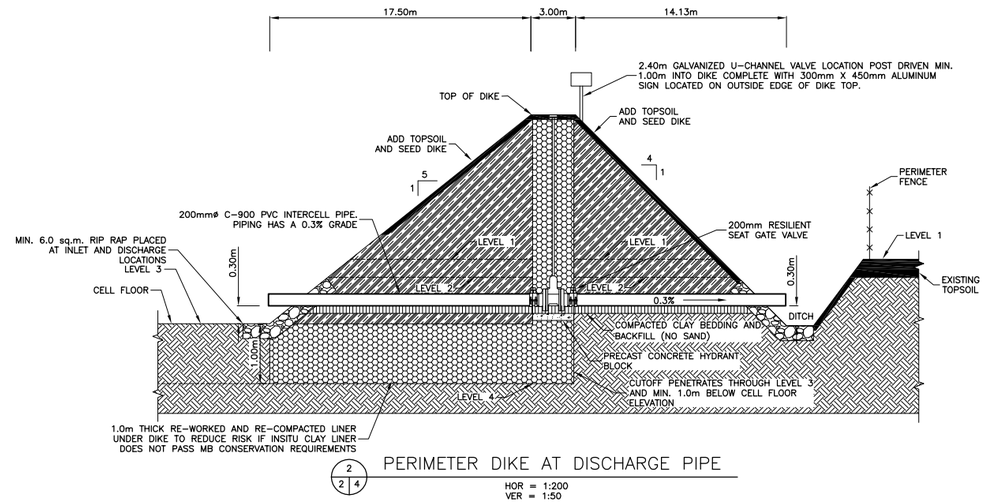
LEGEND:

- EXCAVATED AND COMPACTED MEDIUM–HIGH PLASTIC CLAY TYPE SOIL
- EXCAVATED AND COMPACTED MIXTURE OF SOILS
- INSITU HIGH PLASTIC CLAY TYPE SOIL
- INSITU LOW PLASTIC SILTY CLAY TYPE SOIL
- RIP RAP
- TOPSOIL
- EXCAVATED AND COMPACTED MEDIUM–HIGH PLASTIC CLAY TYPE SOIL

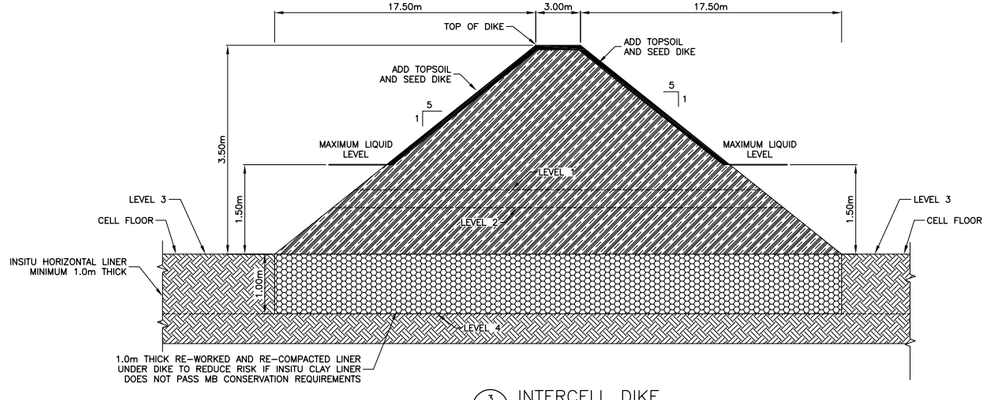
LEVEL 1 – PRE–CONSTRUCTION EXISTING GROUND ELEVATION
LEVEL 2 – ELEVATION FOLLOWING TOPSOIL REMOVAL
LEVEL 3 – FINISHED CELL BOTTOM ELEVATION
LEVEL 4 – BOTTOM OF HORIZONTAL LINER AND CUTOFF WALL



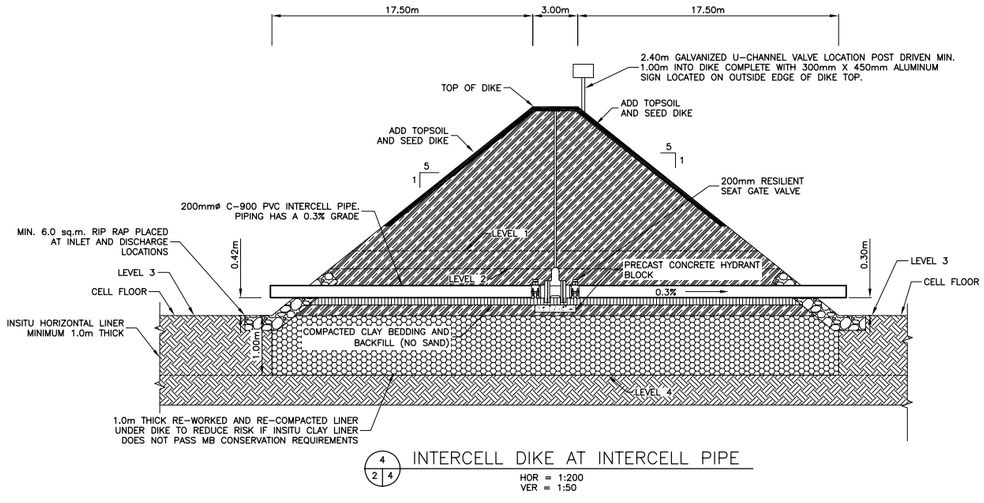
1 / 2 4 PERIMETER DIKE WITH RE–WORKED LINER UNDER DIKE
HOR = 1:200
VER = 1:50



2 / 2 4 PERIMETER DIKE AT DISCHARGE PIPE
HOR = 1:200
VER = 1:50



3 / 2 4 INTERCELL DIKE
HOR = 1:200
VER = 1:50



4 / 2 4 INTERCELL DIKE AT INTERCELL PIPE
HOR = 1:200
VER = 1:50

PRELIMINARY
NOT FOR CONSTRUCTION

No.	REVISIONS	DATE	INITIALS

B.M. EL.

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REGISTERED PROFESSIONAL ENGINEER

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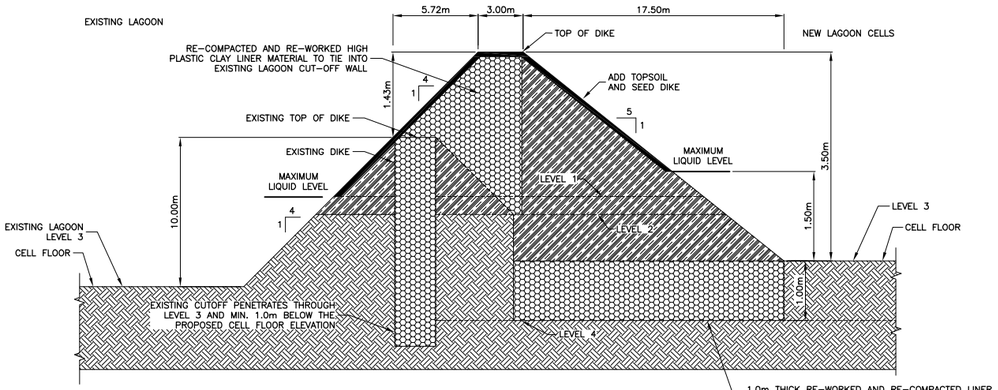
Engineering Excellence since 1981

CODE:	B–246.10
DESIGNED BY:	JC
DRAWN BY:	BM
REVIEWED BY:	JC
PROJECT:	RM OF BROKENHEAD ENVIRONMENT ACT PROPOSAL
TITLE:	PERIMETER DIKE AND INTERCELL DIKE DETAILS
SCALE:	AS NOTED
DATE:	13/01/15
PLAN:	L4
SHEET:	4 of 8

LEGEND:

- EXCAVATED AND COMPACTED MEDIUM–HIGH PLASTIC CLAY TYPE SOIL
- EXCAVATED AND COMPACTED MIXTURE OF SOILS
- INSITU HIGH PLASTIC CLAY TYPE SOIL
- INSITU LOW PLASTIC SILTY CLAY TYPE SOIL
- RIP RAP
- TOPSOIL
- EXCAVATED AND COMPACTED MEDIUM–HIGH PLASTIC CLAY TYPE SOIL

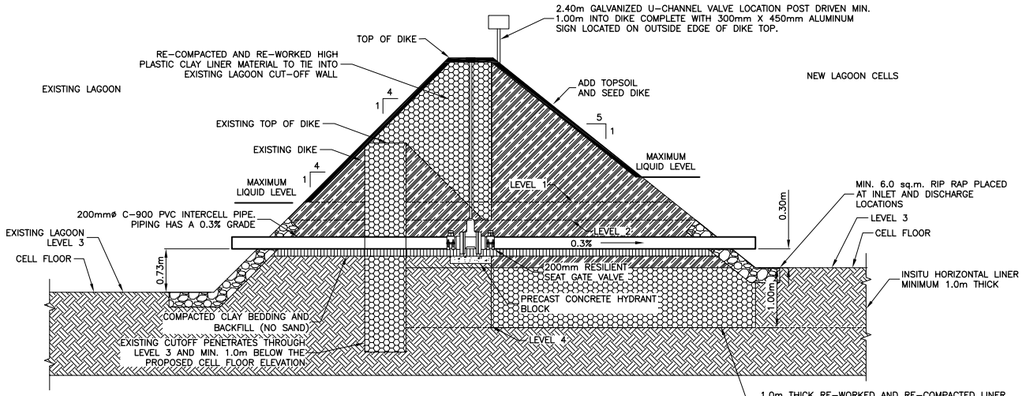
LEVEL 1 – PRE–CONSTRUCTION EXISTING GROUND ELEVATION
LEVEL 2 – ELEVATION FOLLOWING TOPSOIL REMOVAL
LEVEL 3 – FINISHED CELL BOTTOM ELEVATION
LEVEL 4 – BOTTOM OF HORIZONTAL LINER AND CUTOFF WALL



EXISTING LAGOON PERIMETER DIKE UPGRADE TO BECOME NEW INTERCELL DIKE

1/2 5

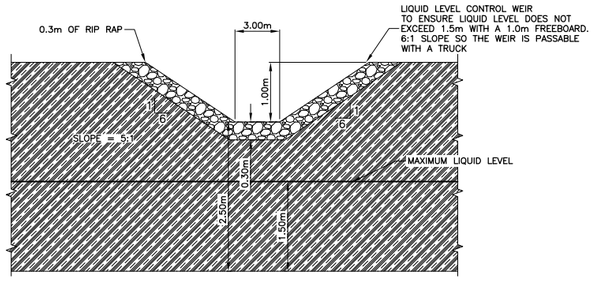
HOR = 1:200
VER = 1:50



EXISTING LAGOON PERIMETER DIKE UPGRADE TO BECOME NEW INTERCELL DIKE AT INTERCELL PIPE

2/2 5

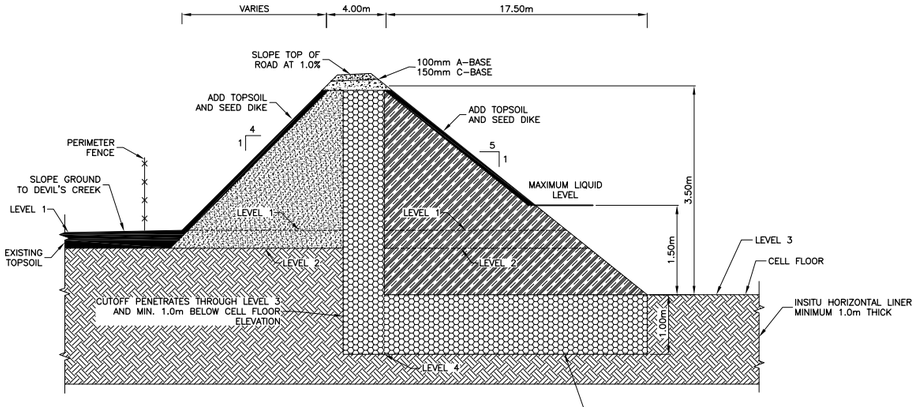
HOR = 1:200
VER = 1:50



FRONT VIEW OF LIQUID LEVEL CONTROL WEIR

3/2 5

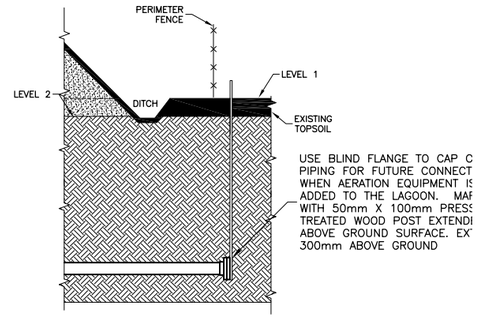
HOR = 1:200
VER = 1:50



PERIMETER DIKE WITH ROAD

4/2 5

HOR = 1:200
VER = 1:50



PIPING FLANGE AND MARKER DETAIL

5/2 5

HOR = 1:200
VER = 1:50

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			B.M. EL.

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No. 234 Date: 13/01/24

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G. R. COUSIN
13/01/24
REGISTERED PROFESSIONAL ENGINEER

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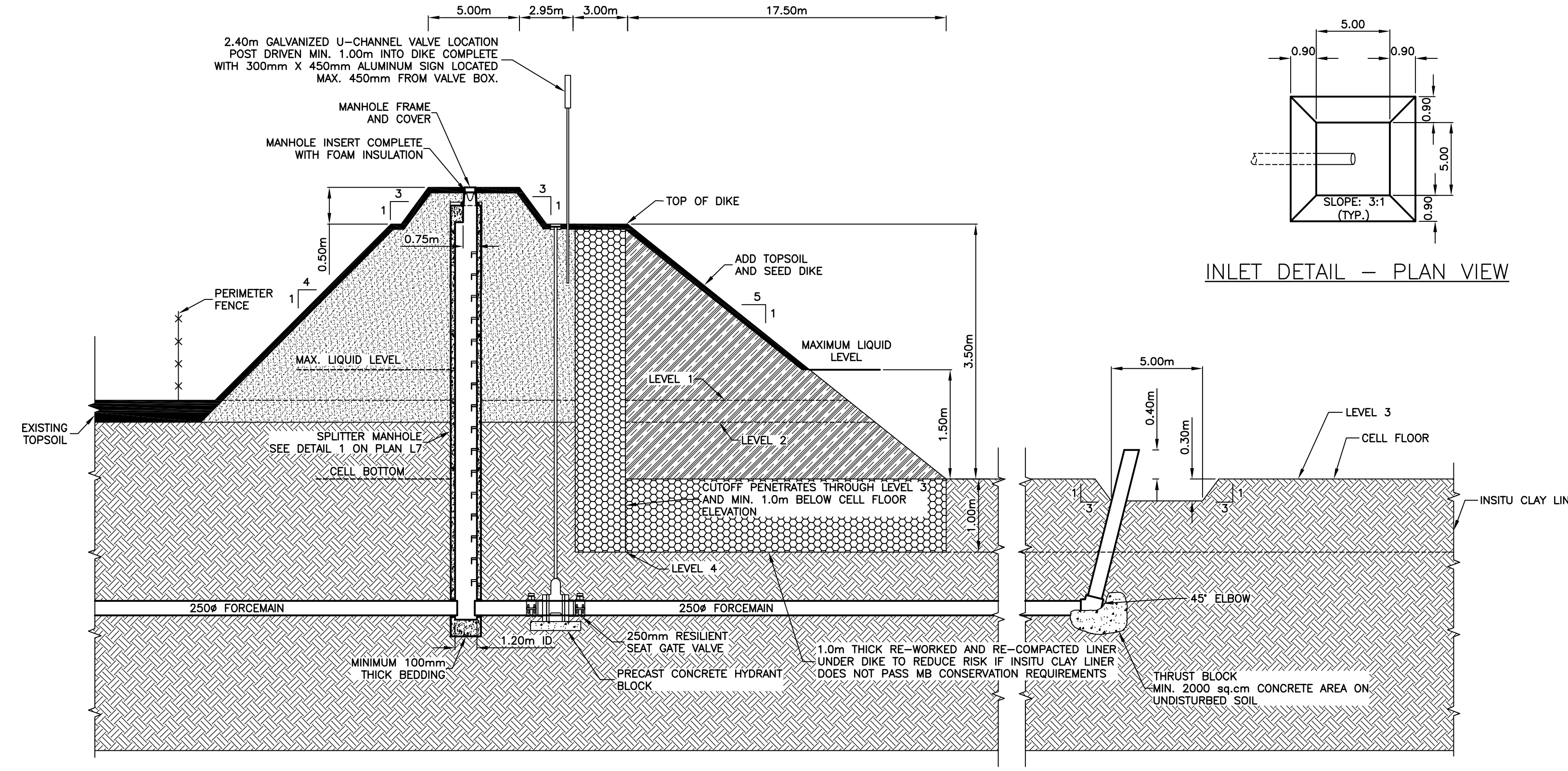
Engineering Excellence since 1981

CODE:	B–246.10
DESIGNED BY:	JC
DRAWN BY:	BM
REVIEWED BY:	JC
PROJECT:	RM OF BROKENHEAD ENVIRONMENT ACT PROPOSAL
TITLE:	EXISTING LAGOON DIKE UPGRADE, LIQUID LEVEL CONTROL WEIR, PERIMETER DIKE AND PIPING FLANGE AND MARKER DETAILS
SCALE:	AS NOTED
DATE:	13/01/15
PLAN:	L5
SHEET:	5 of 8

LEGEND:

- EXCAVATED AND COMPACTED MEDIUM-HIGH PLASTIC CLAY TYPE SOIL
- EXCAVATED AND COMPACTED MIXTURE OF SOILS
- INSITU HIGH PLASTIC CLAY TYPE SOIL
- INSITU LOW PLASTIC SILTY CLAY TYPE SOIL
- RIP RAP
- TOPSOIL
- EXCAVATED AND COMPACTED MEDIUM-HIGH PLASTIC CLAY TYPE SOIL

LEVEL 1 – PRE-CONSTRUCTION EXISTING GROUND ELEVATION
LEVEL 2 – ELEVATION FOLLOWING TOPSOIL REMOVAL
LEVEL 3 – FINISHED CELL BOTTOM ELEVATION
LEVEL 4 – BOTTOM OF HORIZONTAL LINER AND CUTOFF WALL

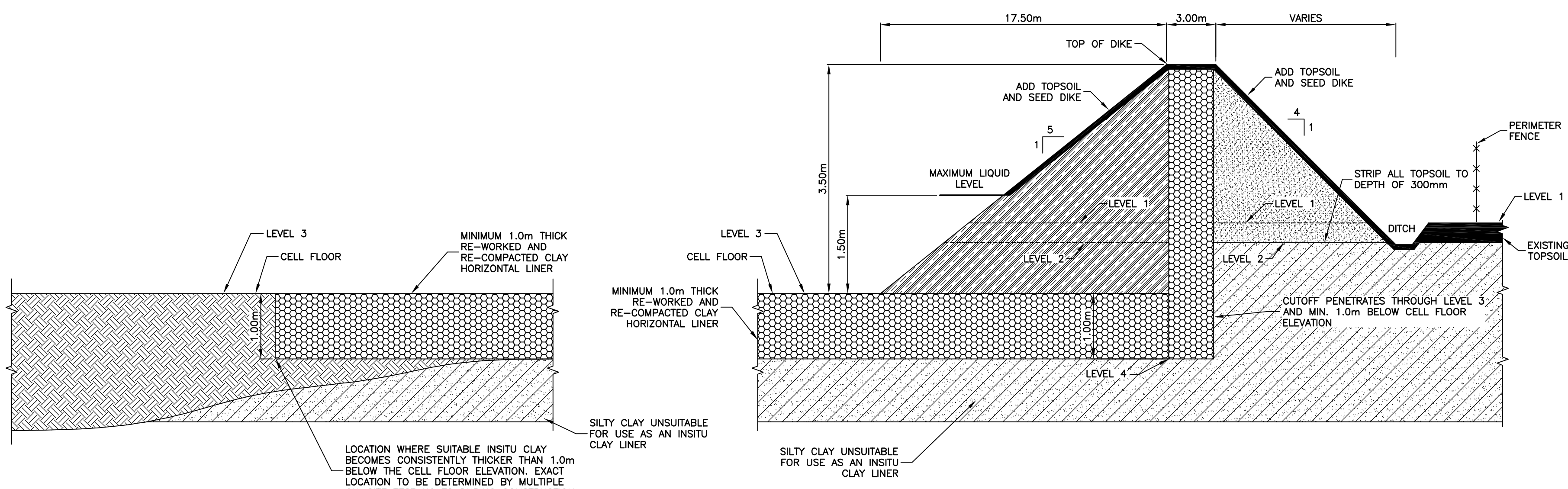


PERIMETER DIKE AT SPLITTER MANHOLE AND FORCEMAIN INLET

2 / 2 6

HOR = 1:200
VER = 1:50

INLET DETAIL – PLAN VIEW



PERIMETER DIKE AT TRANSITION BETWEEN RE-WORKED AND INSITU LINER

1 / 2 6

HOR = 1:200
VER = 1:50

PRELIMINARY
NOT FOR CONSTRUCTION

No.	REVISIONS	DATE	INITIALS

B.M. EL.

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13/01/24
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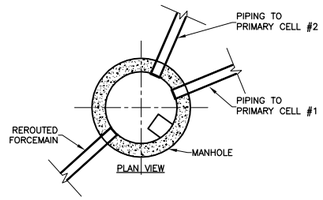
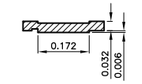
CODE: B-246.10
DESIGNED BY: JC
DRAWN BY: BM
REVIEWED BY: JC

PROJECT: RM OF BROKENHEAD ENVIRONMENT ACT PROPOSAL

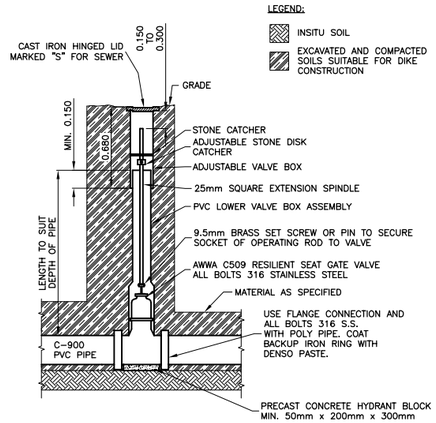
TITLE: PERIMETER DIKE AT TRANSITION BETWEEN RE-WORKED AND INSITU LINER AND AT SPLITTER MANHOLE DETAILS

SCALE: AS NOTED
DATE: 13/01/15
PLAN: L6
SHEET: 6 of 8

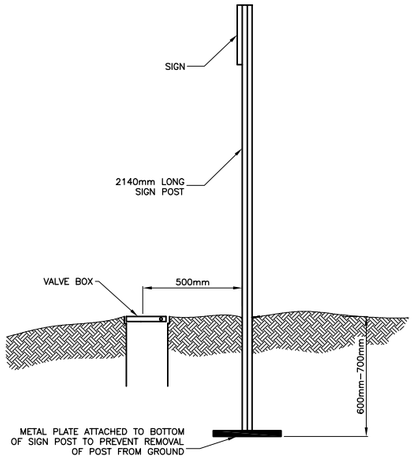




COVER DETAIL
SCALE = 1:10



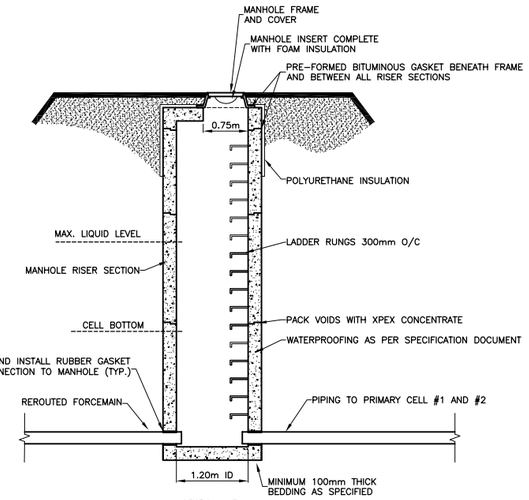
2/7 TYPICAL VALVE DETAIL
SCALE = 1:25



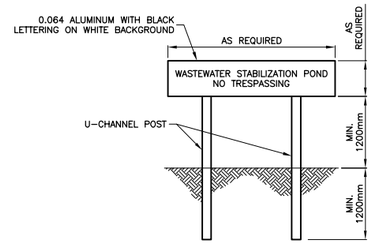
NOTES:

- MINIMUM SIGN SIZE: 300mm X 450mm
- MINIMUM POST LENGTH: 2140mm
- CROSSING MARKERS TO BE SET IN 200mmø X 1.0m CONCRETE AS PER SPECIFICATIONS

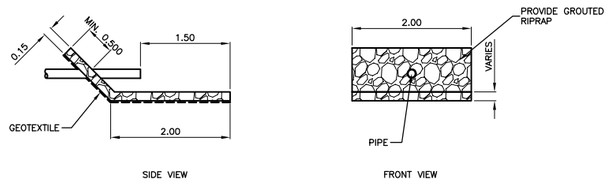
3/7 VALVE MARKER DETAIL
SCALE = 1:15



1/2/7 SPLITTER MANHOLE
SCALE = 1:200



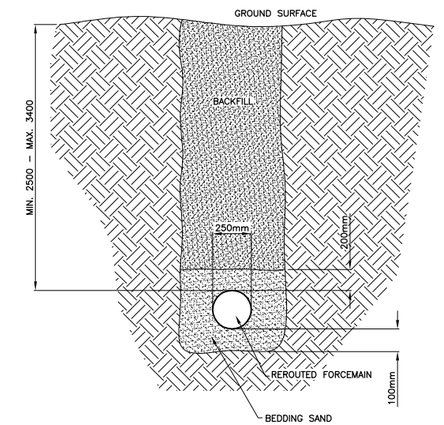
4/2/7 LAGOON SITE MARKER DETAIL
SCALE = 1:50



NOTE:

-RIPRAP MATERIAL SHALL BE WELL GRADED 125mm TO 150mm HARD, DENSE, ROUNDED & DURABLE FIELD STONE.

5/7 RIPRAP DETAIL
SCALE = 1:50



6/7 REROUTED FORCEMAIN TRENCH PIPING DETAIL
TYPICAL EXCAVATION AND CLASS "B" BEDDING
SCALE = NTS

PRELIMINARY
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No.	REVISIONS	DATE	INITIALS
	B.M. EL.		

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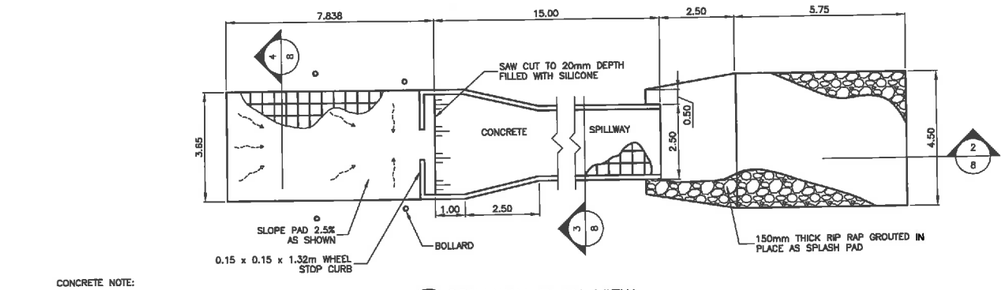
CODE:	B-246.10
DESIGNED BY:	JC
DRAWN BY:	BM
REVIEWED BY:	JC
PROJECT:	RM OF BROKENHEAD ENVIRONMENT ACT PROPOSAL
TITLE:	SPLITTER MANHOLE, VALVE, VALVE MARKER, SITE MARKER, RIP RAP AND FORCEMAIN TRENCH DETAILS
SCALE:	AS NOTED
DATE:	13/01/15
PLAN:	L7
SHEET:	7 of 8



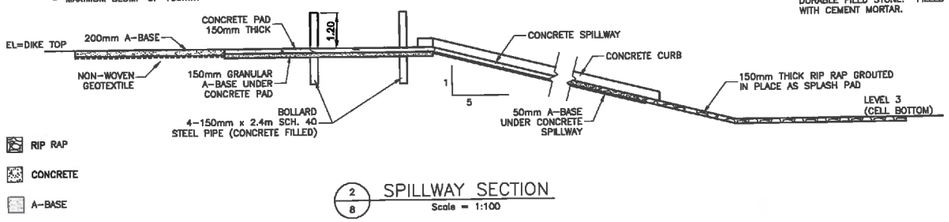
1/8 SPILLWAY PLAN VIEW
Scale = 1:100

CONCRETE NOTE:

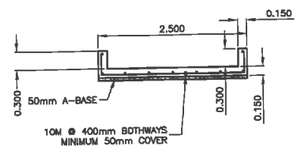
CONCRETE IS:
- TYPE HS PORTLAND CEMENT MINIMUM 28 DAY COMPRESSION OF 20 MPa
- 5–7% AIR CONTENT
- MAXIMUM AGGREGATE SIZE OF 20mm
- MAXIMUM SLUMP OF 100mm

RIP RAP NOTE:

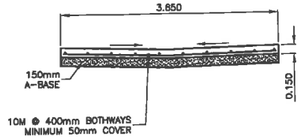
RIP RAP MATERIAL WELL GRADED 125mm TO 150mm HARD, DENSE, ROUNDED & DURABLE FIELD STONE. FILLED JOINTS WITH CEMENT MORTAR.



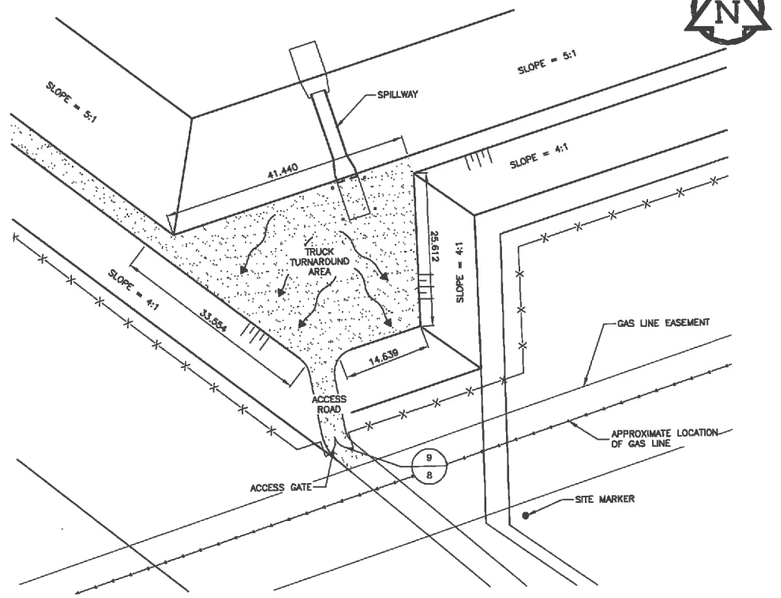
2/8 SPILLWAY SECTION
Scale = 1:100



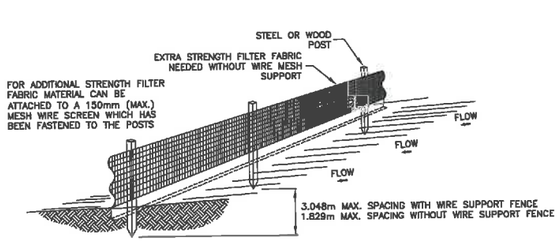
3/8 CONCRETE SPILLWAY SECTION
Scale = 1:50



4/8 CONCRETE PAD SECTION
Scale = 1:50



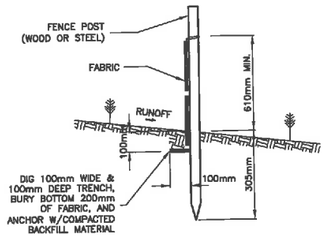
5/8 TRUCK TURNAROUND DETAIL
SCALE = 1:500



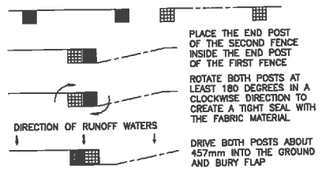
NOTES:

1. THE HEIGHT OF A SILT FENCE SHALL NOT EXCEED 914mm.
2. THE FILTER FABRIC SHALL BE PURCHASED IN A CONTINUOUS ROLL CUT TO THE LENGTH OF THE BARRIER TO AVOID THE USE OF JOINTS.
3. POSTS SHALL BE SPACED A MAXIMUM OF 3.048m APART AT THE BARRIER LOCATION AND DRIVEN SECURELY INTO THE GROUND A MINIMUM OF 300mm. WHEN EXTRA STRENGTH FABRIC IS USED WITHOUT THE WIRE SUPPORT FENCE, POST SPACING SHALL NOT EXCEED 1.829m.
4. A TRENCH SHALL BE EXCAVATED APPROXIMATELY 100mm WIDE AND 100mm DEEP ALONG THE LINE OF POSTS AND UPSLOPE FROM THE BARRIER.
5. WHEN STANDARD STRENGTH FILTER FABRIC IS USED, A WIRE MESH SUPPORT FENCE SHALL BE FASTENED SECURELY TO THE UPSLOPE SIDE OF THE POSTS USING HEAVY DUTY WIRE STAPLES AT LEAST 25mm LONG, TIE WIRES, OR HOG RINGS. THE WIRE SHALL EXTEND INTO THE TRENCH A MINIMUM OF 50mm AND SHALL NOT EXTEND MORE THAN 914mm ABOVE THE ORIGINAL GROUND SURFACE.
6. THE STANDARD STRENGTH FILTER FABRIC SHALL BE STAPLED OR WIRED TO THE FENCE, AND 200mm OF THE FABRIC SHALL BE EXTENDED INTO THE TRENCH. THE FABRIC SHALL NOT EXTEND MORE THAN 914mm ABOVE THE ORIGINAL GROUND SURFACE.
7. THE TRENCH SHALL BE BACKFILLED AND THE SOIL COMPACTED OVER THE FILTER FABRIC.
8. SILT FENCING TO BE POLYPROPYLENE SYNTHETIC FIBRE WITH ULTRAVIOLET STABILIZERS. AMOCO 1198 OR APPROVED EQUAL.
9. WOOD POSTS TO BE 38mm X 89mm (2" X 4"), POINTED AT ONE END AND FABRICATED.
10. INSTALL ALL SUPPORTING POSTS ON THE DOWN SLOPE SIDE OF THE FENCING.
11. MAINTAIN SILT FENCE THROUGHOUT CONSTRUCTION AND UNTIL REVEGETATION OCCURS.

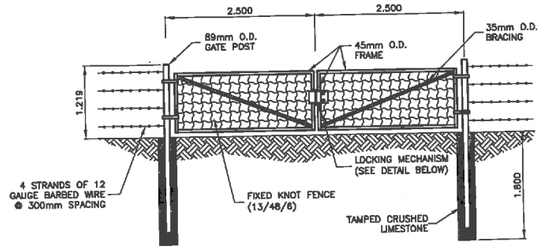
6/8 SILT FENCE DETAIL
SCALE = NTS



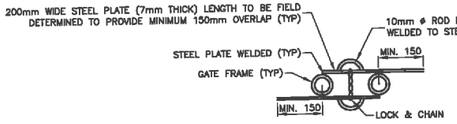
7/8 SILT FENCE SECTION
SCALE = NTS



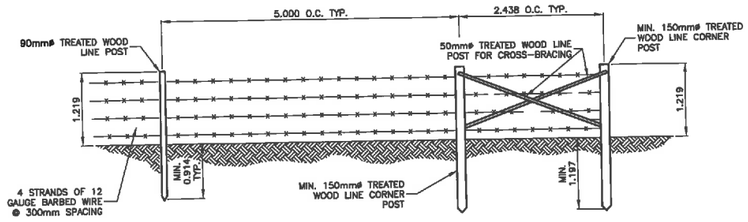
8/8 ATTACHING TWO SILT FENCES
SCALE = NTS



9/8 GATE DETAIL
Scale = 1:50



10/8 LOCK DETAIL
SCALE = 1:10



NOTE:
- PROVIDE CROSS BRACING AT CORNERS POSTS IN BOTH DIRECTIONS.
- SHOWN DIAMETER REFERS TO SMALLEST END OF POST.

11/8 FENCE DETAIL
SCALE = 1:50

PRELIMINARY
NOT FOR CONSTRUCTION

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: 13/05/23

ENGINEER'S SEAL
PROVINCE OF MANITOBA — J.R. COUSIN — 13/05/23 — REGISTERED PROFESSIONAL ENGINEER

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CODE:	B-246.10
DESIGNED BY:	JC
DRAWN BY:	BM
REVIEWED BY:	JC
PROJECT:	RM OF BROKENHEAD ENVIRONMENT ACT PROPOSAL
TITLE:	SPILLWAY, SILT FENCE, TRUCK TURNAROUND, GATE, FENCE AND LOCK DETAILS
SCALE:	AS NOTED
DATE:	13/05/23
PLAN:	LB
SHEET:	8 of 8