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P&R 8.257 JRCC

D-206.05

Dauphin River First Nation

Environment Act Proposal for Wastewater Treatment Lagoon Construction

APEGM
Certificate of Authorization
J. R. Cousin Consultants Ltd.
No. 234 Date: 15/04/23

PROVINCE OF MANITOBA
J.R.L. COUSIN
Member
22391
REGISTERED PROFESSIONAL ENGINEER
15/04/23

Prepared by:

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Senior Municipal Engineer

April 2015

ENGINEERING CONSULTANTS

REMARKS

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

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Environment Act Proposal Form

Manitoba
Conservation and Water Stewardship

Name of the development: Dauphin River First Nation Facutative Lagoon			
Type of development per Classes of Development Regulation (Manitoba Regulation 164/88): Class 2			
Legal name of the applicant: Dauphin River First Nation			
Mailing address of the applicant: PO Box 58			
Contact Person: Chief John Stagg			
City: Gypsumville	Province: Manitoba	Postal Code: R0C 1J0	
Phone Number: (204) 659-5370	Fax: (204) 659-4458	email:	
Location of the development: 1.5 km southwest of the DRFN community center			
Contact Person: Chief John Stagg			
Street Address:			
Legal Description: NE 27-34-05-WPM			
City/Town: Gypsumville	Province: Manitoba	Postal Code: R0C 1J0	
Phone Number: (204) 659-5370	Fax: (204) 659-4458	email:	
Name of proponent contact person for purposes of the environmental assessment: Jason Cousin, JR Cousin Consultants Ltd.			
Phone: 204-489-0474 Fax: 204-489-0487	Mailing address: 91 A Scurfield Blvd Winnipeg, Manitoba R3Y1G4		
Email address: jrcousin@jrcc.ca			
Webpage address: www.jrcc.ca			
Date: 2015/04/23	Signature of proponent, or corporate principal of corporate proponent: Printed name: Jason Cousin		

EXECUTIVE SUMMARY

General

Dauphin River First Nation (DRFN) is proposing to construct a new wastewater treatment lagoon for the residents of their community and the community of Dauphin River (CDR). An Environment Act License will be required from Manitoba Conservation for the construction and operation of the proposed lagoon. JR Cousin Consultants Ltd. (JRCC) was retained for the engineering services.

Description

A new facultative wastewater treatment lagoon is being proposed by DRFN to service residents in the community and the CDR. The site selected for the lagoon is located at NE 27-34-05-WPM. The treated effluent will be discharged to the ditch alongside Provincial Road (PR) 513 where it will flow to the Dauphin River and, eventually, into Lake Winnipeg. The new lagoon construction would include constructing earthen primary and secondary cells with a spillway, truck turnaround, perimeter fencing and ditching.

The proposed development site is located approximately 1.5 km southwest of the DRFN Community Centre, with the CDR and PR 513 bordering the site to the southeast and provincial land surrounding the site to the south, west and north.

Population Contributing Effluent

The on-reserve growth rate was estimated to be 3.19% per annum (assuming an exponential distribution). This growth rate, and the 2014 on-reserve base population of 247, led to a projected Year 20 (2034) on-reserve population of 493 people. Applying the assumed growth rate of 3.19% per annum to the 2014 CDR population of 25 people results in a projected 2036 design population of 50 people.

Combining the projected year 20 DRFN population of 493 people and the projected year 20 CDR population of 50 people, results in a year 20 (2036) design population of 543 people.

Lagoon Loading

The total projected year 20 organic loading to the lagoon primary cell would be approximately 41.8 kg BOD_5/day. Based on a per capita hydraulic loading rate of 288 L/person/day for a piped population of 463 people and a process water loading of 42.5 L/person/day for a combined community population of 543 people, the projected year 20 hydraulic load to the lagoon would be 156.4 m^3/day. The lagoon would require a total hydraulic capacity of 57,179 m^3 in design year 20, for 365 days of storage.

Topographical Survey and Geotechnical Investigation

The site for the proposed wastewater treatment lagoon is located on the northwest bank of the Dauphin River, close to its estuary into Lake Winnipeg. This area is currently provincial land, approximately 1.5 km southwest of DRFN. Surrounding land towards the north, west, and south consists mainly of undeveloped, forested area. It is relatively flat, sloping gently east toward the Dauphin River and west toward forested area.

Survey points at the proposed lagoon location show the existing ground at 223.5 m above msl. The 100 year flood level for Lake Winnipeg at the outlet for the Dauphin River is estimated to be 220.1 m above msl. Therefore, the proposed lagoon site is approximately 3.4 m above the 100 year flood level for Lake Winnipeg at the outlet for the Dauphin River.

A dark, saturated, organic peat layer with an average thickness of 1.37 m was found on the site, over a brown, firm, fissured clay layer with an average thickness of 3.20 m. Heavy seepage and caving was observed from the superficial peat layer in the two test pits. No other seepage or caving conditions were encountered. Based on the laboratory analysis, the underlying clay layer still contains a mixture of clay (46%), silt (31%) and sand (22%), with an average Plasticity Index of 49 (Atterberg Limits). Hydraulic conductivity tests were completed on one reworked soil sample. The samples were chosen to be reworked based on a visual analysis that determined the soils would not pass Manitoba Conservation guidelines undisturbed. The result of the reworked clay hydraulic conductivity test was 5.2×10^{-7} cm/s. To be in compliance with Manitoba Conservation guidelines, a hydraulic conductivity of less than 1.0×10^{-7} cm/s is required. Based on soil properties, the site should be suitable for a reworked liner despite the test results not meeting the hydraulic conductivity requirements. Additional geotechnical testing is currently underway. It is assumed that the additional will confirm the soil suitability for a remolded soil liner.

Lagoon Liner

Based on the onsite geotechnical investigation and results of the laboratory analysis, it is recommended that the lagoon horizontal liner and the vertical cut-off walls be constructed of reworked and recompacted soil material from the site excavation.

Nutrient Management Plan

Based on the 2011 *Manitoba Water Quality Standards, Objectives and Guidelines*, the Municipal wastewater effluent discharge requirement is a limit of 1.0 mg/L of phosphorus. The exception being small wastewater treatment facilities that 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. For this project, the phosphorus reduction strategy will be through chemical precipitation with an alum based coagulant.

1.0 INTRODUCTION AND BACKGROUND

The development described herein is for construction of a new facultative wastewater treatment lagoon in Dauphin River First Nation (DRFN), Manitoba.

1.1 Introduction

Dauphin River First Nation retained JR Cousin Consultants Ltd. (JRCC) to provide engineering services to construct a facultative wastewater treatment lagoon for the DRFN and the Community of Dauphin River (CDR). An Environment Act License is required from Manitoba Conservation for the construction and operation of the proposed lagoon.

1.2 Contact Information

Mr. Jason Cousin, P.Eng.
JR Cousin Consultants Ltd.
91A Scurfield Blvd.
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R3Y 1G4
Phone (204) 489-0474, Fax (204) 489-0487

Chief John Stagg
Dauphin River First Nation
PO Box 58
Gypsumville, Manitoba
ROC 1JO
Phone (204) 659-5370, Fax (204) 659-4458

1.3 Background Information

DRFN 48A Reserve is located adjacent to the mouth of the Dauphin River, on the west shore of Lake Winnipeg, approximately 240 km north of Winnipeg, Manitoba. DRFN is accessible by all-weather Provincial Road (PR) 513. The DRFN Townsite is located on the north bank of the Dauphin River and includes a band office/community health center, school, and church. There are approximately 50 housing units within the community, the majority of which are located in the Townsite or along the north bank of the Dauphin River. Additional housing units are located on the south bank and are only accessible by boat (summer) or ice road (winter).

The Community of Dauphin River is located adjacent to DRFN. JRCC has been advised that the estimated current population of the CDR is 25 people and that there are eight houses in the Community.

There is currently no centralized wastewater treatment facility in the community. The majority of homes and public facilities have private septic systems with raised field beds for wastewater disposal. Some septic systems are shared between homes. In 2015 all of the buildings on the north shore are planned to be serviced with a gravity sewage collection system.

1.4 Description of Previous Studies

The report entitled *Dauphin River First Nation Water and Wastewater Feasibility Study*, by JRCC in October 2014 was reviewed to obtain background information on the three proposed treatment options: septic systems, a facultative sewage lagoon, and an aerated sewage lagoon. For the facultative sewage lagoon, three lagoon siting options were considered and evaluated, including the proposed lagoon development site. The study included an onsite geotechnical investigation for all three proposed lagoon sites and evaluated the soils to determine their suitability for use as a lagoon liner as well as any potential difficulties associated with construction.

1.5 Project Description

The development is proposed to be a facultative lagoon with one primary cell and one secondary cell constructed with a reworked horizontal soil liner and vertical cut-off wall. The lagoon is to be located at NE 27-34-05-WPM, southwest of the DRFN, along PR 513 and north of the CDR. The lagoon discharge will be directed to the PR ditch, flow into the Dauphin River and eventually into Lake Winnipeg.

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 development site is located at NE 27-34-05-WPM, approximately 1.5 km southwest of the DRFN community Centre. The land is undisturbed forest land (spare Birch and Poplar trees are found in the area), relatively flat, sloping gently east toward the Dauphin River and west towards the forested area. The land is currently owned by the Province, as stated in the email correspondence with Manitoba Crown Lands and Property Agency (included in Appendix A). A permit of use application has been submitted for the construction and operation of this lagoon on the site.

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 ownership of the mines and minerals at the proposed development location (email correspondence has been included in Appendix A). It was indicated in the email that the owner of the lands and minerals as well as sand and gravel is currently the Province of Manitoba. An application has been submitted to the Manitoba Crown Lands & Property Agency for a permit to be issued to use the site for the construction and operation of the lagoon.

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 development site is native forest land, characterized by deciduous boreal forest, swamps, marshes and bogs due to its location close to the banks of Dauphin River and the shores of Lake Winnipeg. PR 315 borders the site to the southeast. The nearest existing residence is located approximately 500 m to the southeast on the community of Dauphin River. The DRFN Community Centre is located approximately 1.5 km to the northeast of the proposed lagoon development (see Plan L1 in Appendix D).

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 Crown Lands & Property Agency was contacted regarding the Zoning Designation at the proposed development location (email correspondence has been included in Appendix A). The Agency indicated that the NE 27-34-05 WPM is coded M1 – Marsh/Swamp/Bog – No Agricultural Use. It is considered an Integrated Wood Supply Area and it is also part of the Water Power Storage Reserve.

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

The lagoon design is proposed to begin upon receipt of an Environment Act Licence. Lagoon construction works are proposed to begin in fall 2015. Commissioning and operation of the lagoon is proposed to begin upon completion of lagoon construction and after approval for use is obtained from Manitoba Conservation. No date for decommissioning has been set for the lagoon, however the lagoon is being designed for a projected year 20 (2036) service population, and a lagoon assessment should be conducted when the lagoon approaches this year 20 design life.

2.5.2 Basis for Proposed Lagoon Site Selection

The proposed location for the lagoon construction was chosen based on a Feasibility Study conducted by JRCC in 2014, which takes into account the proximity to the existing community, rural residents, drainage routes and property boundaries. There were three areas identified as possible locations for a new facultative lagoon. The locations, along with their respective advantages and disadvantages, are as follows:

- Location 1:
- Approximately 3 km north of the existing town site
    - Advantages
        - Located on land that is in the process of being acquired by DRFN from the Province
        - Discharges to a swamp or bog along the shores of Lake Winnipeg
        - Has all year round access
    - Disadvantages
        - A 3 km access road is required to be developed
        - Located on land not currently part of DRFN
- Location 2: Southwest of the town site, north of PR 513
    - Advantages
        - Closest to the DRFN

        - Has year round access
        - South of the proposed community well Location
    - Disadvantages
        - Located on Crown Land
        - Would discharge into the Dauphin River
- Location 3: South Reserve Parcel (South Bank of Dauphin River)
    - Advantages
        - Located on land currently owned by DRFN
        - Could provide piped sewer services to residents living south of the Dauphin River
        - Could discharge to swamp or bog adjacent to Dauphin River
    - Disadvantages
        - No road access or year round access
        - Requires a forcemain to cross the Dauphin River
        - Could not receive truck hauled sewage.

When locating a facultative lagoon, the Manitoba Provincial Guidelines recommend a minimum 300 m buffer zone to a single resident and a 460 m buffer zone to a residential centre. All three proposed locations are capable of satisfying Provincial buffer zone requirements.

Location 2 was selected as the site for the proposed facultative lagoon site. Refer to Plan L1 in Appendix D for a map of the proposed location.

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 lagoon development site in relation to each of the guidelines is also provided in the table.

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

Manitoba Conservation Guideline	Proposed Relation to Site
Lagoons must be located a minimum of 460 m from any community centre.	The proposed lagoon site is located approximately 1.5 km from the community centre.
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).	The proposed lagoon site is located approximately 500 m from the nearest residence.
Consideration should be given to sites in which prevailing winds are in the direction of uninhabited areas.	The prevailing winds typically blow from the north and west. The proposed lagoon expansion site is located southeast (downwind) of the Dauphin River First Nation.

Manitoba Conservation Guideline	Proposed Relation to Site
Sites with an unobstructed wind sweep across the lagoon are preferred.	The land surrounding the proposed lagoon is native forest land, for this reason the site has a treed windbreak along the north, west and south boundaries.
Areas that are habitually flooded shall be avoided.	The elevation of the existing ground is 223.5 m above msl. The proposed lagoon site is approximately 3.4 m above the 100 year flood level (220.1 m above msl) for Lake Winnipeg at the outlet for Dauphin River.
Areas of porous soils and fissured rock formations should be critically evaluated to avoid creation of health hazards or other undesirable conditions.	Area does not contain porous soils or fissured rock formations. A reworked soil liner will be utilized in the lagoon cell construction according to Provincial guidelines, thus reducing the possibility of groundwater contamination.

The proposed lagoon construction area is located beyond all setback distances required by Manitoba Conservation; therefore there are no expected siting concerns for the location of the lagoon cells. Plan L1 in Appendix D, shows the minimum setback distance requirements for the proposed lagoon to the local residents and the DRFN.

2.5.3 Lagoon Drainage Route

The proposed lagoon effluent would flow into the existing drainage ditch of the provincial road (PR 513) to the south of the site, which flows west to east towards Dauphin River, approximately 1.5 km away. The river discharges into Lake Winnipeg approximately 1.5 km east of this point (see Plan L1 in Appendix D).

2.5.3.1 Fish Species Information

The following fish species have been identified in Dauphin River according to the Fisheries Inventory Habitat and Classification System (FIHCS): lake whitefish, logperch, longnose dace, mottled sculpin, ninespine stickleback, northern pike, rainbow trout (stocked in), sauger, shorthead redhorse, spottail shiner, walleye, white sucker, yellow perch, Johnny darter, brook stickleback, burbot, central mudminnow, cisco, emerald shiner, fathead minnow, freshwater drum, iowa darter.

According to the FIHCS, Dauphin River is rated as a Class 1 water body that has high capability for the production of fish. Email correspondence with Manitoba Conservation and Water Stewardship – Fisheries Branch (included in Appendix B), indicates that general use on Dauphin River include bait, commercial sport (lodges), and domestic and recreational angling.

Information on Lake Winnipeg has been included as well, as many species can access Dauphin River for spawning, nursery and foraging purposes. The following fish species have been identified for Lake Winnipeg: creek chub, emerald shiner, fathead minnow, flathead chub, freshwater drum, golden shiner, goldeye, iowa darter, Johnny darter, lake chub, lake sturgeon, lake whitefish, logperch, longnose dace, longnose sucker, mimic shiner, mooneye, mottled sculpin, ninespine stickleback, northern pike, pearl dace, quillback, rainbow smelt, river darter, river shiner, rock bass, sand shiner, sauger, shortjaw cisco, silver chub, silver lamprey, silver redhorse, slimy sculpin, spoonhead sculpin, spottail shiner, tadpole madtom, trout perch, walleye, white bass, white sucker, yellow perch, cisco, black bullhead, black crappie, blacknose dace, blacknose shiner, blacksided darter, brook stickleback, brown bullhead, burbot, carp, central mudminnow, channel catfish, chestnut lamprey.

General fishing limits and regulations apply for angling and the different fisheries uses include: bait, commercial net, domestic and recreational angling.

2.5.3.2 Water Quality Information

Manitoba Conservation and Water Stewardship were contacted for water quality data in Dauphin River close to the estuary into Lake Winnipeg. The samples were recorded between February 2012 and Jan 2015. The water parameters were averaged over this time period for all samples obtained.

Table B: Average Water Quality in Dauphin River

Parameter	Average Concentration	Unit
Ammonia – N	0.09	mg/L
Biochemical Oxygen Demand	1.79	mg/L
Dissolved Oxygen	9.90	mg/L
Nitrate/ Nitrite	0.02	mg/L
Nitrogen Total Kjeldahl (TKN)	1.13	mg/L
pH	8.38	-
Total Dissolved Solids	590.88	mg/L
Total Organic Carbon	16.02	mg/L
Total Phosphorus (TP)	0.13	mg/L
Total Suspended Solids	62.00	mg/L
Aluminum (Al)	0.33	mg/L
Calcium (Ca)	49.74	mg/L
Iron Total (Fe)	0.43	mg/L
Magnesium (Mg)	36.33	mg/L
Manganese Total (Mn)	0.04	mg/L
Potassium (K)	9.49	mg/L
Sodium (Na)	113.13	mg/L

2.5.4 Access Road

The proposed lagoon development site would require an access road (approach) off of PR 513, to the northwest. This access road would be gated, and provide all weather access from PR 513 to the lagoon truck turnaround. This lagoon access road would be constructed of a compacted granular base.

2.5.5 Population Contributing Effluent

Based on information provided by AANDC's Indian Registry System (INSTAT), the population for DRFN between 1994 and 2014 was as follows:

Table C: DRFN Population between 1994 and 2014

Year	Reserve & Crown Land	Off-Reserve	Total
1992	125	33	158
1993	128	34	162
1994	131	36	167
1995	136	35	171
1996	95	78	173
1997	109	76	185
1998	117	79	196
1999	131	88	219
2000	146	85	231
2001	153	90	243
2002	155	93	248
2003	138	118	256
2004	142	119	261
2005	141	123	264
2006	194	78	272
2007	200	84	284
2008	202	84	286
2009	211	88	299
2010	212	91	303
2011	208	96	304
2012	223	102	325
2013	234	105	340
2014	247	109	356

The 2014 on-reserve population was 247 people, which is approximately 69.4% of the total registered population. Between 1994 and 2014, the on-reserve population decreased from 78.4% of the total registered population in 1994 to 69.4% in 2014. According to information provided by INSTAT, the 2014 off-reserve registered population was 109 people. This number accounts for 31% of the total registered Reserve population. For design, it will be assumed that there are no non members living on-reserve.

Based on the historical data in Table C, the total reserve population has shown continual growth over the last 23 years. The on-reserve population has grown as well, but with some year to year fluctuations. The cause of the fluctuations is due to population migration on and off the reserve.

Of particular note is the sudden drop in on-reserve population between 1995 and 1996 and the sudden increase in on-reserve population between 2005 and 2006. In both cases however, there is a corresponding drop or increase in off-reserve populations to counter balance the on-reserve population fluctuations. The increase in on-reserve population between 2005 and 2006 was due to a Canada Mortgage and Housing Corporation (CMHC) project that involved significant house construction on the reserve.

The 20 year (1995 to 2014) on-reserve historical growth rate is estimated at 3.19% per annum, assuming an exponential distribution. If calculated based on the period after the sudden population increase between 2005 and 2006, the historical on-reserve growth rate is estimated at 3.07% per annum, assuming an exponential distribution over the 9 year period. Both the 20 year and 9 year historical growth rates are similar to each other; however the 20 year historical growth rate is considered a more accurate reflection of on-reserve growth as its estimation is based on a longer period of historical population data. Therefore, the 20 year historical growth rate of 3.19% per annum will be utilized to project future populations.

The facultative lagoon design will be designed to meet a 20 year life span. For design purposes, the life span will be from 2016 (Year 0) to 2036 (Year 20). Applying the historical growth rate of 3.19% per annum to the 2014 on-reserve population of 247 people, results in a projected 2036 on-reserve design population of 493 people. Projected on-reserve populations for years between 2016 and 2036 are available in Table 1 in Appendix B.

There are six private residences on the South Reserve Parcel. Based on a housing density of 5.0 people/residence, the population of the South Reserve Parcel is estimated to be 30 people. Due to the lack of year round road access to the South Reserve Parcel, it will be assumed that the population of the South Reserve Parcel will remain constant over the 20 year design period. This implies that all growth on DRFN will occur in the North Reserve Parcel.

Note the South Reserve Parcel population was included in the population projections calculated in Table 1 (Appendix B), so the assumption of a constant population on the South Reserve Parcel does not affect the overall 20 year design population. The assumption of a constant population on the South Reserve Parcel has negligible effect on 20 year design capacities for the proposed facultative lagoon.

The community of Dauphin River is located adjacent to DRFN. Manitoba Infrastructure and Transportation (MIT) provided a population of 25 people for the CDR in a February 19, 2015 email to JRCC. JRCC was advised that there are eight houses in the CDR. Therefore, the CDR housing density is 3.1 people/residence.

For design, the following will be assumed regarding the CDR:

- They will utilize the proposed DRFN facultative lagoon
- They will have the same growth rate as the DRFN population.

Applying the assumed growth rate of 3.19% per annum to the 2014 CDR population of 25 people results in a projected 2036 design population of 50 people.

Combining the projected 20 year DRFN population of 493 people and the projected year 20 CDR population of 50 people, results in a Year 20 (2036) design population of 543 people.

2.5.6 Wastewater Production

The proposed wastewater treatment lagoon is to service the projected year 20 populations as stated above.

2.5.6.1 Organic Loading

The per capita organic load will be 0.076 kg BOD_5/person/day for residents connected to the proposed gravity sewer system. All buildings located in the North Reserve Parcel of DRFN are assumed to be connected to the proposed gravity sewer collection system. The year 20 population in this area is estimated at 463 people.

Both the South Reserve Parcel and CDR populations were assumed to be serviced by septic tanks with yearly haulage to the proposed DRFN lagoon. Typically, septage from a septic tank has a larger organic load than wastewater discharged to a gravity sewer system. An average organic strength of 1.80 kg BOD_5/m^3 was utilized to calculate the organic loading from residents serviced by septic tanks. The organic strength was calculated based on 1,000 L of septage at a concentration of 7.0 kg BOD_5/m^3 and 3,500 L of domestic sewage at a concentration of 0.304 kg BOD_5/m^3, per pump out. Based on a septic tank pump out of 4,500 L, each household would produce 6.6 kg BOD_5/year.

In design year 20, there will be a total of 23 houses on septic tanks (six in the South Reserve Parcel and 17 in the CDR). Based on an assumed allowable haulage period of 135 days, this corresponds to approximately 0.17 tanks/day being hauled to the proposed lagoon. For design, it will be assumed one tank per day will be hauled to the proposed DRFN lagoon. Therefore the organic loading from one daily septic tank pump out would be 6.6 kg BOD_5/day.

The year 20 daily organic loading from residents in the North Reserve Parcel is projected to be 35.2 kg BOD_5/day. The year 20 daily organic loading from residents in the South Reserve Parcel and CDR is estimated to be 6.6 kg BOD_5/day. Combined, the total Year 20 daily organic loading design capacity is 41.8 kg BOD_5/day.

2.5.6.2 Hydraulic Loading

A water consumption of 250 L/person/day is adopted for design purposes by the Manitoba Region AANDC Technical Services Office. As DRFN currently uses individual private wells, no historical water usage information is available to calculate a per capita water demand. Therefore, a per capita water usage of 250 L/person/day will

be utilized for design. Additionally, a 15% infiltration allowance was utilized to account for infiltration in the new system. In total, the hydraulic loading production for residents serviced by the proposed gravity sewer system is estimated to be 288 L/person/day. This hydraulic loading rate multiplied by the population to be serviced by the gravity sewer system (463 people) is equal to 133.3 m^3/day (288*463/1000).

An additional volume typically included in wastewater projection estimates is process wastewater generated by the community's water treatment facility. The recommended treatment process for the proposed WTP is nanofiltration (NF), which generates a reject stream of approximately 17% of the daily per capita water demand. This percentage applied to the water consumption of 250 L/person/day is equal to 42.5 L/person/day. Multiplied by the population to be serviced by the WTP (i.e. the total DRFN and community of Dauphin River populations combined, 543 people) provides a hydraulic loading of 23.08 m^3/day (42.5*543/1000).

Typically, septage from a septic tank has a smaller hydraulic load than wastewater discharged to a gravity sewer system. The hydraulic loading from the residents serviced by septic tanks was based on the typical septage generation rate of 200 L/person/year. The average septic tank volume was assumed to be 4,500 L (1,000 Imp. gal.). When septic tanks are pumped out, the highly concentrated septage and domestic sewage present in the tank at the time of the pump out are pumped out together. Therefore the average hydraulic loading per pump out is equal to the tank size. Septic tanks are pumped out on average once per year, so the hydraulic load per household would be 4,500 L/year. This value corresponds to 103.5 m^3/year (4.5*(6+17)) when the population and housing density for the South Reserve Parcel (30/5=6 homes) and the CDR (50/3.1=17 homes) are considered.

In summary, The Year 20 daily hydraulic loading for the gravity sewer system is projected to be 156.4 m^3/day. The Year 20 yearly hydraulic loading from residents in the South Reserve Parcel and CDR is estimated to be 103.5 m^3/year.

2.5.6.3 Wastewater Production Summary Table

Table 1 in Appendix B summarizes the population growth and related sewage production for the DRFN over a 20 year period. The table indicates the following:

- The Year 20 (2036) estimated design population is 543 people.
    - 463 people are serviced by the proposed gravity sewer collection system.
    - 80 people are serviced by septic tanks and fields. (23 homes)
- The Year 20 (2036) estimated daily organic loading is 41.8 kg BOD_5/day.
- The Year 20 (2036) estimated daily hydraulic loading through the gravity sewer system is 156.4 m^3/day.

- The Year 20 (2036) estimated yearly hydraulic loading for residents serviced by the septic tanks and fields is 103.5 m^3/year.

2.5.7 Lagoon Sizing Requirements

The proposed lagoon would consist of one primary cell and one storage cell. Sizing of the cells was based on 4H:1V inner dike slopes, an operating depth of 1.5 m, a freeboard height of 1.0 m and a discharge invert of 0.3 m.

2.5.7.1 Primary Cell

The Manitoba provincial guidelines, *Design Objectives for Wastewater Treatment Lagoons*, set the maximum acceptable organic loading at 56 kg BOD_5/ha/day. However, since the lagoon is servicing the DRFN, AANDC has requested their organic loading standards to be followed. AANDC guidelines suggest that the organic loading rate of a lagoon should not exceed 22 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 to determine the treatment surface area. For design sizing purposes, the more stringent 22 kg BOD_5/ha/day is utilized.

Based on the estimated organic loading rate discussed above, the minimum surface area required at 0.75 m depth (at 22 kg BOD_5/ha/day) in the primary cell is 19,716 m^2. This corresponds to a cell with an approximate flat bottom width and length of 100 m by 180 m.

2.5.7.2 Storage Cell

Provincial guidelines stipulate that the hydraulic storage capacity of a lagoon is determined from the volume of the top half of the primary cell and the secondary (storage) cell volume, between the discharge pipe invert and the maximum liquid level (1.5 m depth).

Due to the proximity with Lake Winnipeg and in following with AANDC storage guidelines a 365 day storage period has been utilized for cell sizing, instead of the typical 230 day provincial storage requirements.

Based on the estimated year 20 hydraulic loading rate discussed above, the lagoon requires a total storage volume of 57,179 m^3 over a 365 day winter storage period.

2.5.8 Topography and Geotechnical Review

2.5.8.1 Geotechnical Investigation

The proposed site was tested to determine whether the soils were suitable for use as a clay lagoon liner in an undisturbed state (in situ) or after reworking, and whether soils could be used for potential borrow material. Test hole locations are shown on Plan L1, attached in Appendix D.

The geotechnical data was obtained from the *Preliminary Geotechnical Assessment – Candidate Lagoon Sites & Water Treatment Plant – Dauphin River First Nation* by Aski Geosciences Ltd. (attached in Appendix C). There were two test pits and two test holes excavated at the proposed location for the new lagoon. A review of the test hole data in this report indicated the proposed lagoon construction site consisted of an average of 1.37 m of black-brown peat over an average of 3.2 m of slightly plastic clay with silt inclusions. Excavation of hole/pit was stopped due to refusal on suspected boulders in glacial till, bedrock, or heavy seepage and caving.

The site contains a substantial depth of peat (1.0 to 1.5 m) that would require removal prior to lagoon construction.

Details of the soil profile in each test hole can be found in the test hole logs included in the previously mentioned Geotechnical report, attached in Appendix C.

Soil Particle Analysis

Soil particle size analyses were completed on representative soil samples from the proposed lagoon site. The samples were from the clay material. The results of the analyses are as follows:

Table D: Soil Particle Size Analysis

Location	% Gravel	% Sand	% Silt	% Clay	Classification*
Lagoon Site 2	1	22	31	46	Clay

* *As per the Soil Texture Classification Triangle in the Supplementary Information for Onsite Wastewater Management System Installations.*

Atterberg Limits

Atterberg limits were determined from two representative samples from the proposed lagoon site as follows:

Table E: Atterberg Limits

Location	Sample	Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index
Lagoon Site 2	1	35.4	75	25	50
	2	34.0	72	24	48

A general rule is that soils of 50% clay or greater can generally be used for an in situ clay liner if the Atterberg limits are above 25. The soil samples tested had soil particle size analysis with a clay content close 50% and a plastic well above 25.

Hydraulic Conductivities

Hydraulic conductivities were completed on one reworked soil sample from Lagoon Site 2. The samples were chosen to be reworked based on a visual analysis that determined the soils would not pass Manitoba Conservation guidelines undisturbed. The results of the hydraulic conductivity analysis are as follows:

Table F: Hydraulic Conductivities

Location	Soil Sample	Hydraulic Conductivity (cm/s)
Lagoon Site 2	Reworked	5.2×10^{-7}

To be in compliance with Manitoba Conservation guidelines, a hydraulic conductivity of less than 1.0×10^{-7} cm/s is required. As identified in the *Preliminary Geotechnical Assessment – Candidate Lagoon Sites & Water Treatment Plant – Dauphin River First Nation* by Aski Geosciences Ltd. (attached in Appendix C), based on soil properties, Site 2 should be suitable for a reworked liner despite the test results not meeting the hydraulic conductivity requirements. Additional geotechnical testing is currently underway to confirm the use of a reworked liner. Additional geotechnical testing is currently underway. It is assumed that the additional will confirm the soil suitability for a remolded soil liner.

Other soil samples from the community were tested at alternate lagoon sites during the investigation in 2014. The soils tested had less clay content, and higher sand and gravel content, with similar a similar plastic index. Hydraulic conductivity testing was completed on those samples and found to meet the 1.0×10^{-7} cm/s requirement.

For further details regarding the geotechnical parameters, refer to the *Preliminary Geotechnical Assessment – Candidate Lagoon Sites & Water Treatment Plant – Dauphin River First Nation* by Aski Geosciences Ltd. (Appendix C).

2.5.8.2 Topography

The proposed site consists mainly of undeveloped forested area. It is relatively flat, sloping gently east toward the Dauphin River and west toward forested area. Lowlying, swampy areas are also prevalent across the site, along with the areas of poorly drained, saturated, peaty soil.

Survey points at the proposed lagoon location show the existing ground at 223.5 m above msl. The 100 year flood level for Lake Winnipeg at the outlet for the Dauphin River is estimated to be 220.1 m above msl. Therefore, the proposed lagoon site is approximately 3.4 m above the 100 year flood level for Lake Winnipeg at the outlet for the Dauphin River.

2.5.9 Lagoon Regulatory Requirements

2.5.9.1 Province of Manitoba Design Objectives

The Province of Manitoba *Design Objectives for Standard Sewage Lagoons (1985)* were used as a guideline in the layout and design of the lagoon expansion.

Organic Loading

Although a facultative lagoon operates at various organic efficiencies throughout the year, an average organic treatment capacity of 56 kg BOD_5/ha/day at a depth of 0.75 m in the primary cell has been established by Manitoba Conservation for facultative lagoon design purposes.

Hydraulic Loading

According to current guidelines a facultative lagoon cannot be discharged between November 1 and June 15 (230 day winter storage period). 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(s) volume from the invert of the discharge pipe to the maximum liquid level.

Lagoon Liner

Sewage lagoons are to be designed and constructed such that the interior surface of the proposed lagoon is underlain by soil with a thickness of at least 1.0 m and having a hydraulic conductivity of 1×10^{-7} cm/sec or less.

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, along with the Federal *Wastewater Systems Effluent Regulations*, for discharged effluent. The effluent requirements for the Dauphin River wastewater treatment lagoon, at a minimum, would be:

- fecal coliforms of 200/100 ml or less, or E. coli of 200/100 ml or less
- BOD of 25 mg/L or less
- CBOD of 25 mg/L or less
- TSS of 25 mg/L or less
- total residual chlorine of 0.02 mg/L or less
- un-ionized ammonia (as N) of 1.25 mg/L or less, at 15°C
- a demonstrated nutrient reduction strategy.

2.5.9.2 Nutrient Management Plan

Phosphorus Reduction by Chemical Precipitation

This option involves application of chemicals such as alum to wastewater in the storage cell to reduce the level of phosphorus in the treated effluent. 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. The effluent can then be discharged from the storage cells with a reduced level of phosphorus. The alum will be added in the last lift station before reaching the lagoon.

Public Awareness

In conjunction with the nutrient reduction methods described above, preventative measures can also be taken to reduce nutrients in the wastewater influent. As the majority of the influent to the DRFN lagoon would be residential in nature, it is encouraged to inform residents and school personnel in the community of nutrient reducing strategies, such as using non-phosphate based soap and cleaning products for domestic use. This would reduce the amount of phosphorus being released into the lagoon and reduce the level of treatment required.

2.5.10 Conceptual Lagoon Design and Construction Details

2.5.10.1 Conceptual Liner Design and Construction Details

The proposed lagoon would consist of one primary cell and one storage cell. The proposed lagoon layout is shown on Plan L2 in Appendix D. Conceptual design plans and details for the lagoon construction are provided in Appendix D (Plans L1 to L4).

The primary cell floor horizontal liner will be constructed of reworked and re-compacted clay to a depth of 1.0 m, including the inner slopes of the primary cell. In this way, if unsuitable soils are encountered during construction and excavation and the floor of the primary cell needed to be reworked, then the inner slopes would not have to be excavated after construction. Any unsuitable soil material (silt or sand) excavated will be stockpiled and not utilized in the construction of the lagoon liner.

The primary cell would have a flat bottom area of approximately 18,000 m^2 and the storage cell would have a flat bottom area of approximately 32,400 m^2. The lagoon cells would be constructed with a total height of 2.5 m from the cell floor to the top of dike. The two cells would share an intercell dike, which would have an intercell pipe extending through the dike, with a valve box at the top of dike to allow equalization of liquid in the cells. A discharge pipe would be installed through the north perimeter dike of the storage cell to allow for lagoon effluent discharge. A valve box would be located on the top of the dike to open and close the discharge pipe, when required. The forcemain will be extended into the primary cell with an isolation valve located in the dike to allow the forcemain to be shut off when requried.

A 1.2 m high barbed wire fence would be constructed around the perimeter of the lagoon and a lockable gate would be installed at the entrance to the lagoon site to limit access. A concrete spillway with bollards would be installed along the interior slope of the primary cell to allow for truck hauled septage dumping into the lagoon. A compacted granular access road would be constructed from PR 513 to the lagoon truck turnaround. The truck turnaround area would also be constructed using a compacted granular material and would allow for septic hauling trucks to dump effluent into the primary cell. A perimeter ditch will be constructed along the outside toe of the lagoon dikes to direct surface water flow around the lagoon cells to the discharge route. Rip rap stone would be placed around the pipe ends to prevent erosion.

2.5.10.2 Construction Techniques

On the site there is a layer of peat approximately 1.5 m thick that must be removed from the lagoon cell construction area, including the lagoon cell floor area. The vertical cell liner will be constructed of reworked and re-compacted clay soils from the site excavation to a width of 3.0 m. The liner is to be compacted to a minimum Standard Proctor Density of 98% in lifts of 150 mm. The dike and liner material should be compacted with a minimum of eight passes of a sheepsfoot roller on each 150 mm compacted lift. The cell bottom will be graded to a tolerance of ± 50 mm. The inner and outer dikes would be constructed with clay material at slopes of 4H: 1V.

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 should not be less than 1,200 mm. Each roller should 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 feet should be at least 200 mm long and should have a minimum area of at least 4,500 mm^2.

A limited range of moisture content should be permitted in the liner soils. 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.

The granular access road and truck turnaround material will consist of C base and A base, with a geotextile material over the compacted subgrade. The spillway located on the inner slope of the primary cell will be constructed of concrete.

2.5.11 Summarized Selected Design Criteria

The following selected criteria will be used for design purposes:

- A 20 year design period
- A total design population of 543 people, 463 being serviced from the future piped collection system and 80 serviced by septic tanks and fields.
- A storage period of 365 days
- The primary cell organic treatment capacity is 22 kg BOD_5/ha/day
- A total projected daily organic loading rate of 41.8 kg BOD_5/day
- The primary cell to have a surface area of 19,716 m^2 at a height of 0.75 m from the cell floor
- The secondary cell to have a flat bottom area of 32,400 m^2
- A total usable hydraulic storage capacity of 57,179 m^3
- A height of 2.5 m from the cell floor to the top of dike in the primary and storage cells
- A maximum operating depth of 1.5 m in the primary and storage cells
- A discharge pipe invert of 0.3 m above the cell floor elevation in the storage cell
- A discharge pipe installed through the north perimeter dike of the storage cell
- A 3.0 m wide vertical cell liner of reworked clay material that ties into the horizontal liner on the perimeter dikes
- A horizontal liner of reworked and recompacted clay material at the cell floor elevation of the primary cell
- A horizontal liner of reworked and recompacted clay material under the inner slopes of the primary cell
- A horizontal liner of reworked and recompacted clay material at the cell floor elevation in the storage cell
- A horizontal liner of reworked and recompacted clay material under the inner slopes of the storage cell
- A 4H:1V slope will be used for the inner and outer dike slopes
- A compacted granular access road and truck turnaround
- A concrete spillway installed in the primary cell
- An intercell pipe with valve box installed in the intercell dike
- A forcemain installed into the primary cell with an isolation gate valve and capped outside of the perimeter dike
- Chemical dosing system (Alum) in lift station for Phosphorus precipitation in the primary cell
- A 1.2 m high barbed wire fence installed around the perimeter of the lagoon cells
- A lockable gate installed at the entrance to the site on the access road

- Rip rap stone installed around the end of the pipes to control erosion
- A perimeter ditch constructed around the toe of the lagoon cells
- Discharge from the lagoon to follow existing drainage route along PR 513 drainage ditch and provincial drain towards Dauphin River
- Warning signs will be placed on each side of the lagoon fencing
- A lagoon entrace sign and valve markers will be installed.

2.5.12 Decommissioning

The proposed lagoon cells will have a design life of 20 years, after which time a lagoon assessment should be conducted to determine the state of the lagoon and whether expansion or decommissioning are required.

Decommissioning would typically require a decommissioning plan submitted to Manitoba Conservation, discussing the removal of liquid and sludge, backfilling of lagoon cells (possible), site grading and seeding, and discussion on future use of the lands.

2.5.13 Lagoon Maintenance and Operation

The lagoon site will have a designated and trained operator from the DRFN public works department.

Maintenance of the lagoon will include:

- Maintaining the fencing, gate and lock
- Ensuring the gate is locked at all times and only the local septic haulers and community public works department have access to the site
- Restricting truck hauling to the lagoon primary cell to 1 truck load per day, as specified in Section 2.5.6.1 above
- Monitoring liquid level of lagoon
- Closing the intercell valve prior to sampling effluent in storage cell
- Sampling lagoon effluent prior to and during discharge period, in accordance with the lagoon effluent monitoring plan
- Opening and closing the intercell and discharge piping valves
- Operating the Alum dosing pump
- Maintaining records of discharge events and water quality testing
- Maintaining the intercell and discharge piping and valves in working condition
- Maintaining rip rap stone at location of lagoon discharge to prevent erosion of soils
- Maintaining grass cover on dikes to a height of no more than 0.3 m
- Maintaining a program to prevent and remove burrowing animals

- Maintaining surface of access road and truck turnaround area
- Clearing of snow from the lagoon access and truck turnaround.

Typical operation of the storage cell in a facultative lagoon will allow for two discharges per year at the peak design loading. During operation, the intercell valve would be opened after the fall discharge of the lagoon and allowed to fill up from winter and spring loadings. Prior to June 15, the intercell valve would be closed and the storage cell effluent would be tested for the discharge criteria. If the test results are acceptable, the storage cell volume from the discharge pipe invert elevation to the maximum operating level would be discharged starting on June 15.

Once the storage cell is fully discharged, the discharge valve would be closed and the intercell valve would be opened to allow the lagoon cells to equalize. The intercell valve would remain open and all of the lagoon cells would be allowed to fill up from the summer hydraulic loadings. The intercell valve would again be closed and the storage cell effluent would be tested for the discharge criteria. If test results are acceptable, the storage cell could be discharged while the primary cell would accept hydraulic loadings to the lagoon during the discharge period. This final discharge would need to be completed prior to the end of the discharge period (before October 31). This discharge procedure would be repeated each year.

Due to the storage sizing design accommodating 365 days of storage, under normal operation, the lagoon will only need to be discharged once per year between January 15 and October 31. With the discharge flexibility the operator has the ability to check the effluent quality and monitor it for best effluent results prior to discharge.

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, which are common at the bottom of facultative lagoons. During the summer, the lagoon would be aerobic near the surface, facultative at the centre and anaerobic near the bottom. Minimal to no treatment would occur in the winter due to the ice cover on the surface and water temperatures near 0°C. The treatment process would predominantly be anaerobic during winter and would also include solids settling. 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. These odours have the potential to be a nuisance to nearby residents. However, due to the dense tree cover around the lagoon and the proposed set back distances, it is expected that the odours will not be a problem.

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 to be significant as the construction area will meet the minimal setback distances from residences, and a treed windbreak exists all around the site.

3.1.2 Water

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

Pollutants that have a potential to be released into the surface water or groundwater during the lagoon 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 existing drainage ditch of the provincial road (PR 513) to the south of the site that runs west to east towards the Dauphin River, 1.5 km away. The river meets Lake Winnipeg approximately 1.5 km to the east. There is also potential to impact surface water via sedimentation from soil erosion in the discharge route during construction.

The discharge from the lagoon should not cause or contribute to flooding in or along the drainage route, therefore the lagoon would not be discharged during flooding conditions.

Groundwater

There is a potential for groundwater to be impacted 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 and/or fuel spills during construction.

3.1.3 Land

The landscape would be altered by construction of the lagoon dikes and perimeter ditching. Fencing would also be installed around the perimeter of the lagoon. Disturbed areas can be impacted through soil erosion if not covered or re-vegetated.

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

3.2 Wildlife

The proposed lagoon site is located in the "Mid-Boreal Lowland" Ecoregion of Canada. Characteristic wildlife includes moose, black bear, wolf, lynx, snowshoe hare. Bird species include duck, goose, pelican, sandhill crane, ruffed grouse and other birds.

The typical concern on any construction project is that wildlife species would be displaced through the construction works.

The Manitoba Conservation Data Centre and Wildlife and Ecosystem Protection Branch was contacted regarding occurrences of rare or endangered wildlife and bird species in their database at the proposed lagoon site. The response indicated there were no occurrences of rare species identified in the area of the proposed development, based on information in the provincial database (see Email correspondence with Manitoba Data Centre, February 11, 2015, attached in Appendix B).

3.3 Fisheries

Fish species identified in Dauphin River and Lake Winnipeg according to correspondence with Manitoba Conservation and Water Stewardship Fisheries Branch were described in Section 2.5.3.1.

The typical concerns with impacts to fish and fish habitat are from sediments released during construction and the lagoon effluent discharges into a body of surface water utilized by fish species. These impacts could include the reduction of water quality or physical disturbances that would create an unfavourable environment for fish or fish eggs.

To avoid this negative effect, lagoon discharge would only occur after the spring fish spawning period has occurred and only when the treated effluent meets the water quality requirements of the Environment Act Licence for lagoon discharges.

3.4 Forestry

The area of the proposed lagoon is unaltered, native forest land with sparse Birch and Poplar trees. Tree removal will be minimal and the area is not commercially forested.

3.5 Vegetation

The "Mid-Boreal Lowland" Ecoregion is classified as having a subhumid mid-boreal ecoclimate. It is part of the boreal mixed coniferous and deciduous forest, characterized by medium to tall, closed stands of trembling aspen and balsam poplar with white and black spruce, and balsam fir occurring in late successional stages.

Manitoba Conservation Wildlife and Ecosystem Protection Branch was contacted regarding occurrences of rare or endangered vegetative species in their database at the proposed lagoon site. The response indicated that there were no occurrences of rare species identified at the proposed development site (see Email correspondence with Manitoba Data Centre, February 11, 2015, attached in Appendix B).

3.6 Noise Impacts

There is a potential for noise impacts in the immediate area of lagoon construction due to the heavy equipment utilized during construction. Other than maintenance vehicles (for lagoon maintenance or mowing grass) or wastewater 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, as heavy equipment will be utilized on site. The potential for public trespassing during lagoon operation will be minimal.

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 (see correspondence with Manitoba Historic Resources Branch, February 27, 2015 in Appendix B).

While impacts to historic or heritage resources are not expected at the site, there is always potential for an unexpected discovery when excavating an area that has not recently been excavated.

3.9 Socio-Economic Implications

The lagoon construction 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 Dauphin River First Nation and the community of Dauphin River as there will be employment opportunities during construction. In addition, the community would have increased wastewater capacity upon completion of the project, which will encourage continued growth in the communities. With the combination of the lagoon and sewage collection system, most residents will no longer need to deal with septic tank operation and pump outs.

Traffic along PR 513 will increase from heavy construction equipment and transportation vehicles traveling to the construction site, and there is potential for delays.

3.10 Aesthetics

The lagoon construction will have a minimal impact on the general aesthetics of the area, although some tree removal will be required. The works would primarily occur 500 m north to PR 513 and a tree line would be maintained between PR 513 and the proposed lagoon site that would limit the impacts to aesthetics.

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 DRFN, the primary cell has been sized for the projected year 20 organic loadings, from the service population. This takes into consideration the maximum allowable organic loading rate of 56 kg BOD_5/ha/day. To further improve odour potential, the primary cell has been designed to reduce the loading to 22 kg BOD_5/ha/day.

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 significant impacts to the DRFN or the CDR from drifting odours, as the DRFN is located northwest and the CDR is due south of the proposed lagoon site, which will have a dense tree covered all around. Furthermore, the proposed lagoon would be located beyond the minimum setback requirements of 300 metres from the nearest resident and 460 metres from the nearest centre of a community, as required by Manitoba Conservation.

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

4.2 Mitigation of Impacts to Water

4.2.1 Surface Water

Impacts to surface waters from the discharge of lagoon effluent are not expected, as the lagoon effluent would not be discharged until the requirements of Tier I *Manitoba Water Quality Standards, Objectives and Guidelines*, and the Federal Wastewater Systems Regulations are met, as described in Section 2.5.9.1 above.

Impacts to nearby surface waters due to discharge of the lagoon are not expected, as treatment will occur in the lagoon cells and measures such as chemical precipitation for phosphorus removal and extended storage period for enhanced treatment would be utilized to further reduce nutrient loading to downstream surface waters.

Erosion from any excess material stockpiles would be prevented by the use of silt fencing at drainage locations and by either covering any bare soil stockpiles temporarily or seeding with grass if stockpile is to remain after construction is complete. Clean rock material from an appropriate land-based source would be utilized as rip rap to reduce occurrence of erosion at the lagoon discharge outlet. Silt fencing would be installed in the perimeter ditching and in the PR 513 drainage ditch during construction, and should remain in place until grass growth is

established in disturbed areas. 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 construction specifications 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 mm 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 or drainage route.
- 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 (Manitoba Conservation at (204) 944-4888).

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 or drainage route.

If flooding occurs along the drainage route, the community must not discharge the lagoon. The discharge should not cause or contribute to flooding in or along the drainage route. Even though Dauphin River is prone to flooding, the proposed lagoon site is approximately 3.4 m above the 100 year flood level for Lake Winnipeg at the outlet for the Dauphin River and the lagoon dikes will be built above ground.

4.2.2 Groundwater

Seepage of effluent from the lagoon is unlikely to affect groundwater as the lagoon cell construction would utilize a reworked clay liner, having a minimum thickness of 1.0 m and a hydraulic conductivity of 1 x 10^{-7} cm/sec or less, as required by Manitoba Conservation.

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 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 newly constructed dikes would be constructed at 4H:1V. In addition, the dike tops, outside slopes and permanent soil stockpiles would be seeded with grass. The location of the discharge pipe outlet would be covered with rip rap stone to minimize potential soil erosion into the ditch during discharge events.

4.4 Mitigation of Impacts to Vegetation

The removal of vegetation will be limited to the construction area by clearly marking the site boundaries prior to construction. Vegetation outside of this construction area will not be damaged and the tree windbreak around the site will remain intact.

4.5 Mitigation of Noise Impacts

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

4.6 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. The lagoon will be surrounded with a barbed wire fence and a lockable gate to prevent public access during lagoon operation, and warning signs will be placed around the perimeter of the lagoon fencing.

4.7 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 DRFN Elders, Manitoba Historic Resources Branch and any other provincial or federal authority as may be required.

4.8 Socio-Economic Implications

If traffic from the construction activities limits access to PR 513, the contractor will place warning signs on the road and provide flagmen to direct traffic around the areas of construction or delay. Any impacts to traffic or access will only be temporary and will only take place during daylight hours, during the construction schedule.

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 proposed wastewater treatment lagoon, due to the mitigation measures described above. Positive residual effects to DFRN and the CDR are expected from the wastewater treatment lagoon, which will allow for expansion of the service area in the future and the reduction of septic filed sewage disposal in the residential area. No other construction projects in the area are expected to create cumulative effects on the service area.

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.)

The lagoon clay liner will be inspected and tested in the presence of Manitoba Conservation upon completion of lagoon construction. The liner will be tested for hydraulic conductivity to ensure that the Environment Act Licence requirements are met. 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 and during discharge; and is to ensure water quality guidelines as described in the Environment Act Licence are met. The operator is also to maintain records of discharge events and water quality monitoring. If there are any concerns with the operation of the lagoon, the owner is to contact the local environment officer to discuss options. 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, licensse, permits, authorizations, etc. known to be required for the proposed development, and the status of the project's application or approval.

Funding is jointly provided by the Province of Manitoba and AANDC as part of Operation Return Home following the 2011 flooding of the area.

The lagoon construction project will require a permit for the use of the land from the Province of Manitoba as well as licensing under the *Water Rights Act* for the installation of a new effluent discharge outlet. Approval will also be required from Manitoba Infrastructure and Transportation for the lagoon access road approach from PR 315. During the construction works, Manitoba Hydro and MTS will need to be contacted to notify of the proposed works and to locate any buried utility lines. No additional approvals, licenses or permits are required for the lagoon construction and operation. The DRFN will also be responsible for registering the lagoon with Environment Canada and providing annual monitoring reports to Environment Canada under the Federal *Wastewater Systems Effluent Regulations*.

8.0 PUBLIC CONSULTATION

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

Public consultation by the Dauphin River First Nation through a designated public forum has not been conducted to date for the residents in the community. Dauphin River First Nation Council will be advising their local membership about the project. The community of Dauphin River has been advised of the project through discussions with their Manitoba Aboriginal and Northern Affairs Environmental Consultant, North Central Region. Public comments received by Manitoba Conservation through the public registry during the Environmental Act Proposal review period will be addressed prior to lagoon construction.

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 design and construction can begin in a timely manner.

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

APPENDICES

Appendix A

Crown Lands & Property Agency - Lands Branch February 5, 2015 Email Correspondence

Crown Lands & Property Agency - Lands Branch March 19, 2015 Email Correspondence

Appendix B

Table 1: Dauphin River First Nation – Population, Organic, and Hydraulic Loading Projections to Design Year 20

Manitoba Conservation and Water Stewardship - Fisheries Branch March 9, 2015 Email Correspondence

Manitoba Conservation and Water Stewardship - Wildlife and Ecosystem Protection Branch, February 11, 2015 Email Correspondence

Manitoba Tourism, Culture, Heritage and Consumer Protection - Historic Resources Branch, February 27, 2015 Email Correspondence

Appendix C

Preliminary Geotechnical Assessment – Candidate Lagoon Sites & Water Treatment Plant – Dauphin River First Nation, Aski Geosciences Ltd., April 2014

Appendix D

Title Page

Plan L1: Proposed Lagoon with Test Hole Location, Drainage Route and Setback Plan

Plan L2: Proposed Lagoon Layout Plan

Plan L3: Dike Details

Plan L4: Miscellaneous Details

Plan L5: Miscellaneous Details (cont.)

Appendix A

Crown Lands & Property Agency - Lands Branch February 5, 2015 Email Correspondence

Crown Lands & Property Agency - Lands Branch March 19, 2015 Email Correspondence

Crown Lands & Property Agency - Lands Branch February 5, 2015 Email Correspondence

From: Little, Karen (CLPA)
To: "Mario Poveda"
Cc: Bannerman, Jill (CLPA)
Subject: RE: Dauphin River FN Facultative Lagoon - Mines and Minerals NE 27-34-5 WPM
Date: Thursday, February 05, 2015 12:01:06 PM
Attachments: Application for Permit-Lease-Purchase.pdf

Good morning Mario.... According to The Crown Land Registry System this date, NE 27-34-5 WPM excluding area taken for Plan 13885 WLTO is owned the Her Majesty The Queen in Right of the Province of Manitoba (HMQ Manitoba) including the mines & minerals and sand & gravel.

We have no record of the First Nation applying to permit, lease or purchase this land for wastewater treatment lagoon on this land. Prior to any development, the First Nation (under a registered Corporation's name) will be required to apply for the land required for this lagoon. (application attached)....upon receipt the application will be circulated to all departments/agencies for comments/approval. For more information regarding the application circular process please contact Jill Bannerman.

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

An Agency of the Manitoba Government

From: Mario Poveda [mailto:mpoveda@jrcc.ca]
Sent: February-02-15 4:39 PM
To: Little, Karen (CLPA)
Subject: Dauphin River FN Facultative Lagoon - Mines and Minerals

Good afternoon Karen,

J.R. Cousin Consultants Ltd. (JRCC) is preparing an Environmental Act Proposal for the construction of a facultative wastewater treatment lagoon at Dauphin River First Nation Community. The lagoon

would be constructed within NE 27-34-05-W.

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

Thank you for your time,

Mario Poveda, E.I.T.
Environmental Engineer-in-Training

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

Crown Lands & Property Agency - Lands Branch March 19, 2015 Email Correspondence

From: Fowler, Heather (CLPA)
To: "Mario Poveda"
Cc: Bannerman, Jill (CLPA)
Subject: RE: Dauphin River FN proposed lagoon site questions - NE 27-34-05 W
Date: Thursday, March 19, 2015 3:38:29 PM

Good Afternoon Mario,

Thank you for 1:50000 mapping, and the previous information. As Jill Bannerman is soon to retire, she has passed your inquiry on to me.

I believe that Karen Little has provided you with an application, and indicated that prior to any development that the First Nation (under a registered Corporation's name) must apply for the required land. The corporation's current "Certificate of Status" will be required for our file, and also please indicate on the site diagram of the application, the area that would be required for any future expansion that may be considered. I would advise that you provide dimensions and distances on the plan if an application is being submitted. The application will be circulated to all relevant parties, who will have the opportunity to provide their comments and conditions of approval or disapproval of the proposed development. Please note that a survey may be a requirement.

The NE 27-34-05 WPM is coded M1 – Marsh/Swamp/Bog – No Agricultural Use. Our records indicate it to be an Integrated Wood Supply Area, and it is also part of the Water Power Storage Reserve. I believe that both will be dealt with during the circulation process.

Please submit the application along with the appropriate fee to this office.

If you require any assistance, please contact me.

Heather Fowler
Land Administrator

Crown Lands Act Dispositions
308 - 25 Tupper Street North
Portage la Prairie MB R1N 3K1
P 204-239-3812 F 204-239-3560
Toll Free 1-866-210-9589
www.clp.gov.mb.ca

From: Mario Poveda [mailto:mpoveda@jrcc.ca]
Sent: March-19-15 10:05 AM
To: Fowler, Heather (CLPA)
Cc: Bannerman, Jill (CLPA)
Subject: Dauphin River FN proposed lagoon site questions

Good morning Heather.

For the proposed lagoon site for the Dauphin River FN, is there any land use designation or zoning designation for this particular quarter section (NE 27-34-05-W)? The area is currently native forest, as can be seen in the plans sent before.

On that subject, do you have any comments or suggestions on the two plans submitted? We would like to proceed with the official submission as soon as possible.

Thank you again for your time and understanding.

Best regards,

Mario Poveda, M.Sc., E.I.T.
Environmental Engineer-in-Training

J.R. Cousin Consultants Ltd.
Phone: (204) 489-0474
Fax: (204) 489-0487
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Appendix B

Table 1: Dauphin River First Nation – Population, Organic, and Hydraulic Loading Projections to Design Year 20

Manitoba Conservation and Water Stewardship - Fisheries Branch March 9, 2015 Email Correspondence

Manitoba Conservation and Water Stewardship - Wildlife and Ecosystem Protection Branch, February 11, 2015 Email Correspondence

Manitoba Tourism, Culture, Heritage and Consumer Protection - Historic Resources Branch, February 27, 2015 Email Correspondence

Table 1: Dauphin River First Nation – Population, Organic, and Hydraulic Loading Projections to Design Year 20

TABLE 1

DAUPHIN RIVER FIRST NATION

POPULATION, ORGANIC, AND HYDRAULIC LOADING PROJECTIONS TO DESIGN YEAR 20

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8	Column 9	Column 10	Column 11	Column 12	Column 13	Column 14	Column 15	Column 16	Column 17
TIMELINE		CONTRIBUTING POPULATION						ORGANIC LOADING				HYDRAULIC LOADING				
CALENDAR YEAR	DESIGN YEAR	ON-RESERVE FIRST NATION POPULATION NORTH RESERVE PARCEL (gravity sewer service) 3.19% annual growth (minus 20 people for the South Reserve Parcel) (people)	ON-RESERVE FIRST NATION POPULATION SOUTH RESERVE PARCEL (septic tank service) 0.00% annual growth (people)	TOTAL DRFN POPULATION (gravity sewer and septic tank service) 3.19% annual growth (people)	COMMUNITY OF DAUPHIN RIVER (CDR) POPULATION (septic tank service) 3.19% annual growth (people)	TOTAL DRFN AND CDR POPULATION (gravity sewer and septic tank service) 3.19% annual growth (people)	TOTAL SEPTIC TANK PUMP OUTS PER DAY South Reserve Parcel 5.0 residents/house CDR 3.1 residents/house (pump outs/day)	DAILY PER CAPITA BOD (kg BOD/person/day)	DAILY SEPTIC TANK PUMP OUT 6.6 kg BOD/pump out (kg BOD/pump out)	DAILY BOD PRODUCTION (kg BOD/day)	PRIMARY CELL AREA AT 0.75 M DEPTH (@22kg BOD/ha/day) (m^2)	WASTEWATER PRODUCTION NORTH RESERVE PARCEL (gravity sewer service) Includes 15% for Infiltration (L/person/day)	PROCESS WASTEWATER PRODUCTION DRFN AND MANA POPULATION 17% of per capita wastewater production (L/person/day)	TOTAL DAILY PIPED WASTEWATER VOLUME (m^3/day)	DAILY SEPTIC TANK PUMP OUT 4500 L/pump out (m^3/year)	TOTAL WASTEWATER VOLUME PER STORAGE PERIOD For 365 day storage period (m^3/365 days)
2014	0	217	30	247	25	272	1	0.076	6.6	23.1	10,496	288	42.5	74.1	67.5	27,098
2015	0	225	30	255	26	281	1	0.076	6.6	23.7	10,769	288	42.5	76.7	67.5	28,061
2016	0	233	30	263	27	290	1	0.076	6.6	24.3	11,049	288	42.5	79.4	67.5	29,054
2017	1	241	30	271	27	299	1	0.076	6.6	24.9	11,339	288	42.5	82.2	67.5	30,080
2018	2	250	30	280	28	308	1	0.076	6.6	25.6	11,638	288	42.5	85.1	72.0	31,142
2019	3	259	30	289	29	318	1	0.076	6.6	26.3	11,947	288	42.5	88.1	72.0	32,234
2020	4	268	30	298	30	328	1	0.076	6.6	27.0	12,265	288	42.5	91.2	72.0	33,360
2021	5	278	30	308	31	339	1	0.076	6.6	27.7	12,594	288	42.5	94.4	76.5	34,527
2022	6	288	30	318	32	350	1	0.076	6.6	28.5	12,933	288	42.5	97.7	76.5	35,727
2023	7	298	30	328	33	361	1	0.076	6.6	29.2	13,283	288	42.5	101.1	76.5	36,965
2024	8	308	30	338	34	372	1	0.076	6.6	30.0	13,644	288	42.5	104.6	81.0	38,247
2025	9	319	30	349	35	384	1	0.076	6.6	30.8	14,017	288	42.5	108.2	81.0	39,565
2026	10	330	30	360	36	396	1	0.076	6.6	31.7	14,401	288	42.5	111.9	81.0	40,925
2027	11	342	30	372	38	409	1	0.076	6.6	32.6	14,798	288	42.5	115.7	85.5	42,333
2028	12	353	30	383	39	422	1	0.076	6.6	33.5	15,207	288	42.5	119.7	85.5	43,781
2029	13	366	30	396	40	436	1	0.076	6.6	34.4	15,630	288	42.5	123.8	85.5	45,276
2030	14	378	30	408	41	450	1	0.076	6.6	35.3	16,066	288	42.5	128.0	90.0	46,822
2031	15	391	30	421	43	464	1	0.076	6.6	36.3	16,516	288	42.5	132.4	90.0	48,414
2032	16	405	30	435	44	479	1	0.076	6.6	37.4	16,980	288	42.5	136.9	94.5	50,060
2033	17	419	30	449	45	494	1	0.076	6.6	38.4	17,459	288	42.5	141.5	94.5	51,755
2034	18	433	30	463	47	510	1	0.076	6.6	39.5	17,953	288	42.5	146.3	99.0	53,508
2035	19	448	30	478	48	526	1	0.076	6.6	40.6	18,463	288	42.5	151.3	99.0	55,312
2036	20	463	30	493	50	543	1	0.076	6.6	41.8	18,990	288	42.5	156.4	103.5	57,179

Manitoba Conservation and Water Stewardship - Fisheries Branch March 9, 2015 Email Correspondence

From: Janusz, Laureen R (CWS)
To: "Mario Poveda"
Cc: Klein, Geoff (CWS)
Subject: Fish Species Info Dauphin River FN lagoon - Fisheries
Date: Monday, March 09, 2015 9:30:49 AM

Hi Mario,

I'm not sure why I didn't think of this sooner but I've looked back in my email and there was a request for information on Dauphin River/Lake Winnipeg (Sturgeon Bay) in 2012. So the following is what I provided from the FIHCS and files. I left the Lake Winnipeg information, as many species can access Dauphin River for spawning, nursery and foraging purposes. There has also been some work done associated with the drainage channel (Lake Manitoba to Lake Winnipeg). I'm checking to see what fish species have been collected and if there are any additions/corrections, I'll let you know. My apologies for the delay.

By way of this email I am sending to the Regional Fisheries Manager should he have any additional information or corrections to the information below. 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 lake.

FHICS Dauphin River: lake whitefish, logperch, longnose dace, mottled sculpin, ninespine stickleback, northern pike, rainbow trout (stocked in), sauger, shorthead redhorse, spottail shiner, walleye, white sucker, yellow perch, Johnny darter, brook stickleback, burbot, central mudminnow, cisco, emerald shiner, fathead minnow, freshwater drum, iowa darter.

Dauphin River provides year round habitat and is rated as a Class 1 waterbody (has high capability for the production of fish).

Fisheries uses include bait, commercial sport (lodges), domestic and recreational angling.

The Dauphin River Hatchery opened in 1936 operating as a whitefish hatchery – not continuously – until 1982 (1981 last operating season). From 1983-1986 walleye were also reared there.

FHICS Lake Winnipeg: creek chub, emerald shiner, fathead minnow, flathead chub, freshwater drum, golden shiner, goldeye, iowa darter, Johnny darter, lake chub, lake sturgeon, lake whitefish, logperch, longnose dace, longnose sucker, mimic shiner, mooneye, mottled sculpin, ninespine stickleback, northern pike, pearl dace, quillback, rainbow smelt, river darter, river shiner, rock bass, sand shiner, sauger, shortjaw cisco, silver chub, silver lamprey, silver redhorse, slimy sculpin, spoonhead sculpin, spottail shiner, tadpole madtom, trout perch, walleye, white bass, white sucker, yellow perch, cisco, black bullhead, black crappie, blacknose dace, blacknose shiner, blacksided darter, brook stickleback, brown bullhead, burbot, carp, central mudminnow, channel catfish, chestnut lamprey.

Note the aquatic invasive species, spiny waterflea, is now in Lake Winnipeg and Playgreen Lake and,

Zebra Mussels are in the south basin of Lake Winnipeg. There may be restrictions/conditions to limit the potential to spread this species, particularly if using machinery in or near the lake that could be used elsewhere.

Angling Regulations: general fishing limits and regulations apply.

Fisheries Uses: bait, commercial net, domestic and recreational angling. This lake supports a tremendous commercial (walleye, sauger, lake whitefish quota species; northern pike and yellow perch non quota species) and recreational fishery.

Fish Habitat Information for Lake Winnipeg (Sturgeon Bay) and Dauphin River:
Information from Branch Files indicate Sturgeon Bay was used by whitefish for spawning (including a run up the Dauphin River to spawn in Lake St. Martin) and as nursery/forage habitat for whitefish fry. And Dauphin River/Sturgeon Bay is also utilized by walleye.

The following information is an accounting of fish habitat provided to Department of Fisheries and Oceans by a commercial fisherman: In Lake Winnipeg, Johnson's Beach which is three miles south of the mouth of Dauphin River, has a natural sandbar running parallel to the beach. This area is utilized in the spring by pickerel and yellow perch. In the fall whitefish also use this area as a spawning ground. In the spring the walleye, mullet and carp travel upstream on the Dauphin River to spawn in the river, in the small creeks and other areas around Lake St. Martin. Historically walleye, mullet, carp, yellow perch and northern pike have always been in the Sturgeon Bay area in spring and summer, using the areas mentioned. Long ago Sturgeon were plentiful here, hence the name "Sturgeon Bay".

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: Mario Poveda [mailto:mpoveda@jrcc.ca]
Sent: March-09-15 8:48 AM
To: Janusz, Laureen R (CWS)
Subject: RE: Dauphin River FN lagoon - Fisheries

Thanks Laureen! I will be waiting for your email.

Mario Poveda, E.I.T.
Environmental Engineer-in-Training

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

From: Janusz, Laureen R (CWS) [mailto:Laureen.Janusz@gov.mb.ca]
Sent: Monday, March 09, 2015 8:35 AM
To: 'Mario Poveda'
Subject: RE: Dauphin River FN lagoon - Fisheries

Hi Mario,

I hope to have something to you today. I'm not getting access to our database and sent in a request on Friday to look into it. I hope to hear today.

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: Mario Poveda [mailto:mpoveda@jrcc.ca]
Sent: March-05-15 8:38 AM
To: Janusz, Laureen R (CWS)
Cc: Kroeker, Derek (CWS)
Subject: FW: Dauphin River FN lagoon - Fisheries

Good morning Ms. Janusz.

I am not sure if you received my previous email, so please find it below. I would appreciate your comments so I can proceed with the EAP report.

Thank you for your time,

Mario Poveda, E.I.T.

Environmental Engineer-in-Training

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

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From: Mario Poveda [mailto:mpoveda@jrcc.ca]
Sent: Tuesday, February 17, 2015 11:39 AM
To: 'Laureen.Janusz@gov.mb.ca'
Subject: Dauphin River FN lagoon - Fisheries

Good morning Ms. Janusz,

J.R. Cousin Consultants Ltd. is preparing an Environmental Act Proposal for the proposed facultative lagoon of the Dauphin River FN. The new cells would be constructed within the NE 27-34-05-W.

The facultative lagoon will have highly treated effluent with phosphorus reduction and UV disinfection. The effluent would flow into the existing drainage ditch of the provincial road (PR 513) to the south of the site, which flows west to east towards Dauphin River, approximately 1.5 km away. The river then discharges into Lake Winnipeg approximately 1.5 km east. Please find attached a plan of the proposed site.

Could you please respond with any comments or concerns you have with the proposed project.

Thank you for your time,

Mario Poveda, 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 and Water Stewardship - Wildlife and Ecosystem Protection Branch, February 11, 2015
Email Correspondence

From: Friesen, Chris (CWS)
To: "Mario Poveda"
Subject: RE: Dauphin River FN Facultative Lagoon - Species at risk
Date: Wednesday, February 11, 2015 9:49:21 AM

Mario

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

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

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

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

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

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

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

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

From: Mario Poveda [mailto:mpoveda@jrcc.ca]
Sent: February-02-15 4:44 PM
To: Friesen, Chris (CWS)
Subject: Dauphin River FN Facultative Lagoon - Species at risk

Good afternoon Chris,

J.R. Cousin Consultants Ltd. (JRCC) is preparing an Environmental Act Proposal for the construction

of a facultative wastewater treatment lagoon at Dauphin River First Nation Community. The lagoon would be constructed within NE 27-34-05-W.

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

Thank you for your time,

Mario Poveda, E.I.T.
Environmental Engineer-in-Training

J.R. Cousin Consultants Ltd.
Phone: (204) 489-0474
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Manitoba Tourism, Culture, Heritage and Consumer Protection - Historic Resources Branch, February 27, 2015
Email Correspondence

From:	Sitchon, Myra (TCHSCP)
To:	"Mario Poveda"
Cc:	Smith, Brian (TCHSCP)
Subject:	RE: Dauphin River FN Facultative Lagoon - Heritage Resources
Date:	Friday, February 27, 2015 2:33:03 PM

Hi Mario,
Thanks for sending the layout plans. I have examined the area further and have determined that 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 effects of development on the heritage resources.

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

Thanks kindly,
Myra

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

Phone: (204) 945-6539
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Fax: (204) 948-2384
Website: http://www.manitoba.ca/heritage

Manitoba
Tourism, Culture, Heritage, Sport and Consumer Protection

From: Mario Poveda [mailto:mpoveda@jrcc.ca]
Sent: February-27-15 2:25 PM
To: Sitchon, Myra (TCHSCP)
Subject: RE: Dauphin River FN Facultative Lagoon - Heritage Resources

Hello Myra,

Please find attached a layout plan of the proposed lagoon site. Let me know if you require additional information.

Thanks,

Mario Poveda, E.I.T.
Environmental Engineer-in-Training

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

***

From: Sitchon, Myra (TCHSCP) [mailto:Myra.Sitchon@gov.mb.ca]
Sent: Thursday, February 26, 2015 2:53 PM
To: 'Mario Poveda'
Cc: Smith, Brian (TCHSCP)
Subject: RE: Dauphin River FN Facultative Lagoon - Heritage Resources

Hello Mario,
I've reviewed the project location you provided and have determined that there is a heritage site in the vicinity of this quarter section. Could you provide me with further details on this project such as site plans? With this information I can determine if a heritage resources impact assessment is required. Please feel free to contact me if you have any questions.
Thanks,
Myra

Myra L. Sitchon, *Ph.D.*
Impact Assessment Archaeologist,
Archaeological Assessment Services Unit,
Historic Resources Branch
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Website: http://www.manitoba.ca/heritage

Manitoba
Tourism, Culture, Heritage, Sport and Consumer Protection

From: Mario Poveda [mailto:mpoveda@jrcc.ca]
Sent: February-02-15 4:55 PM
To: Nesbitt, Christina (TCHSCP)
Subject: Dauphin River FN Facultative Lagoon - Heritage Resources

Good afternoon Christina,

J.R. Cousin Consultants Ltd. (JRCC) is preparing an Environmental Act Proposal for the construction

of a facultative wastewater treatment lagoon at Dauphin River First Nation. The lagoon would be constructed within NE 27-34-05-W.

Could you please confirm the impact to heritage resources?

Thank you for your time,

Mario Poveda, E.I.T.
Environmental Engineer-in-Training

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

Appendix C

Preliminary Geotechnical Assessment – Candidate Lagoon Sites & Water Treatment Plant – Dauphin River First Nation, Aski Geosciences Ltd., April 2014

PRELIMINARY GEOTECHNICAL ASSESSMENT

CANDIDATE LAGOON SITES AND WATER TREATMENT PLANT

DAUPHIN RIVER FIRST NATION
DAUPHIN RIVER, MANITOBA

Dauphin River First Nation
April 7, 2014

PREPARED FOR: Dauphin River First Nation
c/o JR Cousin Consultants Ltd.

PREPARED BY: Aski Geosciences Ltd.
207-1555 St. James St.
Winnipeg, Manitoba
R3H 1B5

May 2014
DR807

aski geosciences ltd
environmental & geotechnical services

ASKI GEOSCIENCES LTD.

Environmental & Geotechnical Services

May 21, 2014
Aski File: DR807

Dauphin River First Nation
c/o JR Cousin Consultants Ltd.
91 Scurfield Boulevard
Winnipeg, Manitoba
R3Y 1G4

Attention: **Mr. Jason Cousin, P. Eng.**

Dear Sir:

Reference: **Preliminary Geotechnical Assessment – Proposed Lagoon Sites & WTP Dauphin River First Nation, Dauphin River, Manitoba**

Aski Geosciences Ltd. (Aski) is pleased to provide three (3) copies of the report entitled "Preliminary Geotechnical Assessment – Proposed Lagoon Sites & WTP, Dauphin River First Nation, Dauphin River, Manitoba".

The report summarizes the findings of a geotechnical assessment completed at three (3) candidate sites (identified as Site 1, Site 2, and Site 3) for the proposed lagoon facility and one (1) candidate site for the new water treatment plant located near the community of Dauphin River First Nation. A total of eight (8) testholes and seven (7) testpits were advanced across the three (3) candidate lagoon facility sites and at the water treatment plant site to evaluate soil and groundwater conditions.

In order to finalize the geotechnical recommendations for the design and construction of the proposed lagoon facility and water treatment plant, additional field and laboratory testing will be required.

Should you have any questions regarding the findings or recommendations presented in this report, please do not hesitate to contact the undersigned at your convenience.

Yours truly,

Colin Ledger, C.E.T.
Principal

PROVINCE OF MANITOBA
R. P. KUPCHAK
Member
7670
May 23/14
REGISTERED PROFESSIONAL ENGINEER

Distribution: 2 copies – JR Cousin Consultants
1 copy – PM Associates

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1.0 INTRODUCTION

Aski Geosciences Ltd. (Aski) was retained by JR Cousin Consultants Ltd. (JRC) on behalf of Dauphin River First Nation (DRFN) to conduct a geotechnical assessment at three (3) candidate sites for the development of a new wastewater lagoon facility, and one (1) candidate site for a proposed new water treatment plant (WTP) in Dauphin River First Nation. The site work was initiated from March 14 to March 16, 2014 and completed between April 7 and April 8, 2014.

Aski's scope of work was developed from reference information provided by JRC and submitted in proposal format to Mr. Phil Cesario, P. Eng. of P.M. Associates Ltd. on February 21, 2014. The sites were pre-selected by the project team and the locations for assessment were provided to Aski by JRC. Three (3) candidate sites for the new wastewater lagoon facility (herein referred to as Site 1, Site 2, and Site 3) and one (1) candidate site the new WTP were investigated. During site investigation, Aski advanced eight (8) testholes (one (1) additional testhole at Site 1) and seven (7) testpits at the proposed sites. The scope of the assessment was undertaken to address soil and groundwater at the feasibility stage.

1.1 Objective

The purpose of the geotechnical investigation was to determine the suitability of the soil and groundwater at the candidate sites for the proposed wastewater lagoon facility, and to develop preliminary foundation recommendations for the new water treatment plant, based on the findings of the intrusive soils investigation and physical characteristics of the soils and groundwater.

1.2 Community Description

Dauphin River First Nation is located approximately 240 km north of Winnipeg along the junction of Dauphin River and Lake Winnipeg. The reserve has a total land base of 326 hectares and is accessible by road all year round. The on-reserve population of DRFN is approximately 251 members, based on the regional population statistics (AANDC 2014). For community location, refer to Figure 1.

The First Nation is located within the Interlake Plain Ecoregion, where the landscape presents a mosaic of farmland and forest, marking the southern limit of closed boreal forest and northern extent of arable agriculture. Its native vegetative cover consists of a closed cover of tall to low trembling aspen with secondary quantities of balsam poplar, an understory of tall shrubs, and a ground cover of mixed herbs. White spruce and balsam fir are the climax species but are not well represented. Open stands of tall jack pine occur on dry, sandy sites. Depressions are water-filled or are covered with sedges, willow, some black spruce, and tamarack. Underlain by low relief, flat-lying Palaeozoic

limestone, the region is covered by broadly ridged, extremely calcareous, glacial till and by shallow, level lacustrine sands, silts, and clays. Predominant soils are Dark Gray Chernozems. Peaty Gleysols and Mesisols are usually associated with poorly drained depressions.

1.3 Site Description

A site description of each individual candidate site for the new proposed wastewater lagoon facility and the new WTP building is provided in the following sub-sections. Refer to Figure 1 for a site location plan. Photos taken across the investigated areas are depicted in Appendix C.

1.3.1 Candidate Site 1 – Proposed Lagoon Facility

Site 1 is located on crown land, approximately 2.4 km north of the DRFN main community and 1.5 km west of Sturgeon Bay (Lake Winnipeg) within the future DRFN community development area. Based on the previous survey data, Site 1 is relatively flat, sloping gently east toward Lake Winnipeg and west towards ephemeral wetlands. Site 1 consists of an undeveloped land, sparsely forested with Spruce, Birch, and Poplar trees. Surrounding land consists mainly of undeveloped, forested area. A borrow pit is located approximately 1.2 km south of the Site.

According to the aerial photographs of the area reviewed by Aski, a single stream, partially ephemeral and related drainage course is evident to the west of Site 1. The stream loops to the north, around moderately elevated lands, draining the areas to the west of the site to Lake Winnipeg. Isolated, low-lying, swampy areas are prevalent across the Site. Significant areas of poorly drained, saturated, peaty soil are evident across Site 1. Exposed bedrock was not observed across the cut-lines or at the borehole locations within Site 1.

1.3.2 Candidate Site 2 – Proposed Lagoon Facility

Site 2 is located on provincial land, approximately 1.2 km southwest of the DRFN community. Provincial Road 513 (gravel) is located approximately 0.2 km east of Site 2, followed by moderate to sparse residential housing and Dauphin River. Surrounding land towards the north, west, and south consists mainly of undeveloped, forested area (sparsely forested with Birch and Poplar trees). Similar to Site 1, Site 2 is relatively flat, sloping gently east toward the Dauphin River and west towards the forested area. Low-lying, swampy areas are also prevalent across Site 2, along with the areas of poorly drained, saturated, peaty soil. Exposed bedrock was not observed within the cut-lines or the borehole locations across Site 2.

1.3.3 Candidate Site 3 – Proposed Lagoon Facility

Site 3 is located on crown land, approximately 1.3 km southeast from the second parcel of the DRFN community, across the Dauphin River. A community beach/greenspace area is located approximately 1.2 km north of Site 3. Surrounding land consists mainly of undeveloped, forested area. The land is fairly flat across the Site, with a gentle slope towards the lakeshore. Site 3 consists mainly of an undeveloped land, moderately forested with Birch and Poplar trees. Access to Site 3 is provided by a trail that runs in a north-south direction across the Site. Compared to Site 1 and Site 2, there was significantly better drainage noted at Site 3.

1.3.4 Proposed Water Treatment Plant Site

The proposed new WTP Site is located within the northern portion of the DRFN main community near a newly developed residential area. Lake Winnipeg is located approximately 0.3 km east of the proposed Site. Surrounding land consists of undeveloped, forested area to the west, a residential area towards the southeast, and a community band garage to the south of the proposed WTP Site. A newly installed drainage ditch runs along the north side of the Site. Vegetation across the proposed WTP Site consists mainly of Birch and Poplar trees.

1.4 Methodology

In accordance with the terms of reference and proposal, Aski performed the following tasks in conducting the geotechnical investigation at the Sites:

- Undertake an intrusive investigation at the proposed three (3) lagoon facility sites including seven (7) testholes and six (6) testpits to a maximum depth of 6.1 metres to obtain soil samples and visually inspect soil and groundwater conditions at the sites;
- Undertake an intrusive investigation at the proposed new water treatment plant site including one (1) testhole and one (1) testpit to a maximum depth of 6.1 metres to determine bedrock depth, and visually inspect soil and groundwater conditions at the site;
- Obtain soil samples at regular intervals for soil characterization analysis including moisture content and/or pocket pen readings;
- Submit two (2) representative soil samples for Atterberg Limits and one (1) soil sample for particle size analysis (hydrometer) from each candidate lagoon site;
- Submit one (1) representative re-molded soil sample from candidate lagoon Site 1 and Site 2 for permeability testing;

- Submit one (1) representative undisturbed soil sample from candidate lagoon Site 3 for permeability testing;
- Obtain GPS coordinates of all testhole and testpit locations using a Garmin handheld GPS unit; and,
- Provide three (3) copies of the final report complete with a site plan, site photos, laboratory results, and lithologic logs.

2.0 FIELD INVESTIGATION

2.1 Testhole and Testpit Program

Aski initiated the site work on March 14, 2014. Prior to the commencement of the intrusive investigation, snow and cut-lines were cleared by Arnason Industries Ltd. to provide access to the candidate lagoon sites and the proposed water treatment plant site. A 750J Dozer was used to clear cut-lines and snow, while a Komatsu 160LC backhoe was used to advance testpits across the Sites.

Two (2) boreholes were initially advanced on March 16, 2014 at Site 3 with a DR150 drill rig owned and operated by Maple Leaf Drilling. However, due to delays by Maple Leaf on a previous project, Paddock Drilling Ltd. was subsequently retained to complete the drilling program. On April 7, 2014, an Acker XS drill rig was mobilized to the site to advance the remaining boreholes. A total of seven (7) testholes and six (6) testpits were advanced across the proposed wastewater lagoon sites to a maximum depth of 4.6 metres below ground level (mBGL). One (1) testhole and one (1) testpit were also advanced at the WTP Site to the apparent bedrock surface. Directly adjacent each borehole, an additional testhole was advanced to collect undisturbed soil samples with the use of Shelby Tubes.

The subsoils were visually classified to the full extent of each testhole/testpit and any soil caving or seepage conditions encountered during the intrusive program were noted. Soil samples were obtained at regular intervals and placed in plastic bags for further analysis. Soil lithologies at each testpit and testhole were logged in accordance with the Modified Unified Soil Classification (MUSC) system. Lithologic logs indicating the surficial geology and other observations, such as odour, staining, and composition are presented in Appendix A.

The locations of the testholes and testpits were surveyed using a handheld GPS unit. The testholes and testpit locations at each candidate site are depicted on Figure 1.

2.2 Soil and Groundwater Conditions

2.2.1 Candidate Site 1 – Proposed Lagoon Facility

The general soil stratigraphy encountered within Site 1 consisted of a dark, wet, organic peat layer, ranging in thickness from 0.2 m to 1.3 m, underlain by brown, firm, silty clay with slight to moderate plasticity. Glacial till was encountered in testholes TH3 and TH5 and testpit TP2. The glacial till varied in composition but mainly consisted of tan, clayey, silty glacial till to auger refusal and end of testpit. The tan glacial till was gravelly and contained some cobbles and boulders. Seepage and caving conditions were primarily observed from the peat layer, which was saturated in the localized low-lying areas. Refer to the lithologic logs in Appendix A for the soil and groundwater conditions observed at each testhole and testpit location.

2.2.2 Candidate Site 2 – Proposed Lagoon Facility

Soil conditions encountered at Site 2 consisted of a variable thickness of dark, saturated, organic peat ranging in thickness from 1.0 m to 1.5 m. The peat was underlain by brown, firm, fissured, clay with some silt inclusions and slight to moderate plasticity. In general, the clay material became soft with increasing depth in testholes TH6 and TH7. Clay became firm to stiff near end of testpits TP4 and TP5. Auger refusal at each testhole was encountered on suspected bedrock at depths ranging from 4.6 to 6.1 mBGL.

Heavy seepage and caving was observed from the surficial peat layer in testpits TP4 and TP5. No other seepage or caving conditions were encountered across Site 2. Refer to the lithologic logs in Appendix A for the soil and groundwater conditions observed at each testhole and testpit location.

2.2.3 Candidate Site 3 – Proposed Lagoon Facility

The general soil stratigraphy encountered within Site 3 consisted of a 0.2 m, dark, organic peat layer, underlain by brown, silty, clayey glacial till with some cobbles and boulders. The glacial till became dense to hard near end of testpit and auger refusal. Limestone bedrock was encountered at testpit TP7 underlying the hard glacial till. Relatively shallow auger refusal was also encountered in the testholes.

No seepage or caving was observed in the testholes or testpits advanced at Site 3. Refer to the lithologic logs in Appendix A for the soil and groundwater conditions observed at each testhole and testpit location.

2.2.4 Proposed Water Treatment Plant Site

The general soil profile encountered at the proposed WTP Site consisted of a dark,

organic peat layer, underlain by brown, firm, silty, slightly plastic clay with some gravel. Tan, hard, gravelly, clayey glacial till with some cobbles and boulders was encountered in the testhole and the testpit advanced at the site. Auger refusal was encountered at 3.2 m on suspected bedrock in the testhole, and fractured limestone bedrock was encountered at 4.3 m in the testpit advanced at the Site.

Heavy seepage was observed at testhole TH5 from the base of the surficial peat layer, below the frost. No other seepage or caving conditions were observed at the proposed WTP Site. Refer to the lithologic logs in Appendix A for the soil and groundwater conditions observed at each testhole and testpit location.

3.0 LABORATORY RESULTS

Select soil samples collected from the three (3) candidate lagoon sites were submitted for Atterberg Limits, particle size analysis (hydrometer), and hydraulic conductivity testing. In addition, moisture contents were determined on select soil samples collected from the three (3) candidate sites and the proposed WTP Site. The results of the laboratory testing are presented alongside the lithologic logs enclosed in Appendix A, and laboratory results in Appendix B.

3.1 Candidate Site 1 – Proposed Lagoon Facility

Moisture contents were determined on fifteen (15) soil samples collected at regular intervals from testholes and testpits advanced at Site 1. Moisture levels in the brown, silty clay soils ranged from 15.9% to 42%. The tan, silty glacial till beneath the clay unit exhibited moisture contents ranging from 9.6% to 30.9%.

Three (3) representative soil samples were submitted to Trek Geotechnical Inc. (Trek) for Atterberg limits. The laboratory results are presented in Table 1.

Table 1: Atterberg Limits (Lagoon Site 1)

Sample Identification	Moisture Content	Liquid Limit	Plastic Limit	Plasticity Index	Classification
TP2-LAG @ 2.3 m (7.5 ft)	18%	36%	15%	21	CI Clay - silty, medium plasticity
TH3-LAG @ 1.5 m (5.0 ft)	15.9%	41%	15%	26	CI Clay - silty, medium plasticity
TH5-LAG @ 2.3m (7.5 ft)	33.8%	66%	19%	47	CH Clay - high plasticity, fat clay

Atterberg limits define the liquid and plastic limits of a fine-grained soil, which are then used to determine the moisture limits at which clay transforms from a plastic to liquid state. The limits help define the soil characteristics under different moisture conditions and also classify the soil according to soil classification standards.

As shown in Table 1, the clay soil sample taken at 1.5 mBGL from testhole TH3 was found to exhibit a liquid limit of 41% and a plasticity index of 26. This sample is classified as medium plastic, inorganic silty clay (CI). The clay soil sample taken at 2.3 mBGL from testhole TH5 was found to exhibit a liquid limit of 66% and a plasticity index of 47. This sample is classified as high plastic, inorganic clay (CH). The clay soil sample taken at 2.3 mBGL from testpit TP2 was found to exhibit a liquid limit of 36% and a plasticity index of 21. This sample is classified as medium plastic, inorganic silty clay (CI). In general, the moisture content of the tested soil samples were between the liquid and plastic limits and should be workable without augmentation with water or drying of the soils. However, clay soils directly below the peat may require drying.

One (1) selected soil sample from testhole TH4 at 2.3 mBGL was submitted to H. Manalo Consulting Limited (H. Manalo) in Winnipeg for particle size analysis (hydrometer).

Table 2: Gradation Limits (Lagoon Site 1)

Sample Identification	% Gravel	% Sand	% Silt	% Clay	Classification
TH4 @ 7.5' (2.3 m)	12%	16%	40%	32%	CL – Inorganic silt and clay of low plasticity with some sand and gravel

Under the MUCS for soil, the clay material encountered within testhole TH4 at 2.3 mBGL is categorized as inorganic clay and silt (CL) of low plasticity with some sand and gravel material.

A representative composite soil sample (TP1@10', TP2@5', and TP2@7.5') was forwarded to Trek for hydraulic conductivity analysis in order to determine the permeability of a remolded, clay material, recompacted to 95% standard proctor density. An undisturbed (Shelby tube) sample of the clay/clayey till soils was also retrieved from the site, but was not tested. The calculated hydraulic conductivity (k) of the combined, remolded sample is presented in Table 3.

Table 3: Hydraulic Conductivity (cm/s) (Lagoon Site 1)

Sample Identification	Hydraulic Conductivity (k_{20}), cm/s[1]
Composite TP1@10', TP2@5', and TP2@7.5'	3.3×10^{-8}

1 – Hydraulic conductivity corrected to 20°C.

Hydraulic conductivity is a measure of the rate that water flows through a soil. The result of the remolded composite soil sample collected from TP1 and TP2 indicated a hydraulic conductivity value of $k = 3.3 \times 10^{-8}$ cm/s, which is satisfactory for the construction of an earthen liner.

3.2 Candidate Site 2 – Proposed Lagoon Facility

Moisture contents were determined on seventeen (17) soil samples collected at regular intervals from testholes and testpits advanced at Site 2. Moisture levels in the brown, fissured clay soils ranged from 12% to 48.4%.

Two (2) representative soil samples were submitted to Eng-Tech Consulting Ltd. (Eng-Tech) for Atterberg limits. The laboratory results are presented in Table 4.

Table 4: Atterberg Limits (Lagoon Site 2)

Sample Identification	Moisture Content	Liquid Limit	Plastic Limit	Plasticity Index	Classification
TP4-LAG @ 2.3 m (7.5 ft)	35.4%	75%	25%	50	CH Clay – high plasticity, fat clay
TP5-LAG @ 1.8 m (6 ft)	34%	72%	24%	48	CH Clay – high plasticity, fat clay

As shown in Table 4, the clay soil sample taken at 2.3 mBGL from testpit TP4 was found to exhibit a liquid limit of 75% and a plasticity index of 50. This sample is classified as highly plastic, inorganic fat clay (CH). The clay soil sample taken at 1.8 mBGL from testpit TP5 was found to exhibit a liquid limit of 72% and a plasticity index of 48. This sample is classified as high plastic, inorganic clay (CH).

One (1) selected soil sample from testhole TH6 at 1.5 mBGL was submitted to H. Manalo in Winnipeg for particle size analysis (hydrometer).

Table 5: Gradation Limits (Lagoon Site 2)

Sample Identification	% Gravel	% Sand	% Silt	% Clay	Classification
TH6 @ 5.0' (1.5 m)	1%	22%	31%	46%	CI – Inorganic silty, sandy clay of medium plasticity

Under the MUCS for soil, the clay material encountered within testhole TH6 at 1.5 mBGL is categorized as inorganic, silty, sandy clay (CI) of medium plasticity with trace gravel.

A representative composite soil sample (TP4@6', TP4@7.5', TP5@6', and TP5@9') was forwarded to Eng-Tech for hydraulic conductivity analysis in order to determine the permeability of the remolded, clay material, recompacted to 95% standard proctor density. The calculated hydraulic conductivity (k) is presented in Table 6.

Table 6: Hydraulic Conductivity (cm/s) (Lagoon Site 2)

Sample Identification	Hydraulic Conductivity (k_{20}), cm/s[1]
Composite TP4@6', TP4@7.5', TP5@6', and TP5@9'	5.2×10^{-7}

1 – Hydraulic conductivity corrected to 20°C.

The result of the remolded soil sample collected from TP4 and TP5 indicates a hydraulic conductivity value of $k = 5.2 \times 10^{-7}$ cm/s and is slightly greater than 1×10^{-7}, which is required for an earthen liner. However, the soil classification (CH and CI) and particle size composition of the soil are indicative of soil that may be suitable for use as a liner. Additional testing for hydraulic conductivity, on undisturbed and/or remolded samples may be required to confirm the suitability of the material for use as a liner. An undisturbed (Shelby tube) sample of the clay/clayey till soils was retrieved from the site but was not tested.

3.3 Candidate Site 3 – Proposed Lagoon Facility

Moisture contents were determined on eight (8) soil samples collected at regular intervals from testpits TP6 and TP7 advanced at Site 3. The glacial till material exhibited moisture contents ranging from 9.6% to 30.2%.

Two (2) representative soil samples were submitted to Eng-Tech for Atterberg limits. The laboratory results are presented in Table 7.

Table 7: Atterberg Limits (Lagoon Site 3)

Sample Identification	Moisture Content	Liquid Limit	Plastic Limit	Plasticity Index	Classification
TP6-LAG @ 2.3 m (7.5 ft)	16.1%	39%	15%	24	CI Clay - silty, medium plasticity
TP7-LAG @ 1.5 m (5 ft)	16.1%	34%	15%	19	CI Clay - silty, medium plasticity

The clay soil sample retrieved at 2.3 mBGL from testpit TP6 exhibited a liquid limit of 39% and a plasticity index of 24. This sample is classified as medium plastic, inorganic silty clay (CI). The clay soil sample taken at 1.5 mBGL from testpit TP7 exhibited a liquid limit of 34% and a plasticity index of 19. This sample is classified as medium plastic, inorganic silty clay (CI). The moisture content of each sample was identified slightly above the plastic limit, suggesting additional moisture may be required during compaction.

One (1) selected soil sample from testpit TP6 at 1.5 mBGL was submitted to H. Manalo for particle size analysis (hydrometer).

Table 8: Gradation Limits (Lagoon Site 3)

Sample Identification	% Gravel	% Sand	% Silt	% Clay	Classification
TP6 @ 5.0' (1.5 m)	12%	39%	33%	16%	ML – Inorganic silt of slight plasticity

Under the MUCS for soil, the dense glacial till material encountered within testpit TP6 at 1.5 mBGL is categorized as inorganic, sand and silt (ML) of slight plasticity with some clay and gravel. It should be noted that the cobble content from the glacial till sample is not represented in the particle size analysis due to their physical size and frequency, but is documented in the testpit log.

A single undisturbed soil sample (TH1 – 3’ to 4’) was retrieved from candidate Site 3 by advancing a Shelby Tube at the transition from clay to silty till soils. The tube was forwarded to Stantec Consulting Ltd. (Stantec), and a sample was selected from the dense, clayey till, above the silty transition. The sample was analyzed for hydraulic conductivity analysis in order to determine the in-situ permeability. The calculated hydraulic conductivity (k) is presented in Table 9.

Table 9: Hydraulic Conductivity (cm/s) (Lagoon Site 3)

Sample Identification	Hydraulic Conductivity (k_{20}), cm/s[1]
TH1 – 3' to 4' (undisturbed sample)	1.0×10^{-8}

1 – Hydraulic conductivity corrected to 20°C.

The result of the undisturbed soil sample collected from testhole TH1 indicates a hydraulic conductivity value of $k = 1.0 \times 10^{-8}$ cm/s, which suggests that the shallow in-situ soils may be suitable as a liner. However, additional testing would be required on composite, remolded clay samples to determine if the shallow soil is suitable for use as a recompacted earthen liner.

3.4 Proposed Water Treatment Plant Site

Moisture contents were determined on two (2) soil samples collected from testpit TP3 advanced at the WTP Site. The clay material exhibited a moisture content of 37% and the glacial till material exhibited a moisture content of 14.8%.

4.0 FINDINGS & RECOMMENDATIONS

The feasibility level findings and recommendations are based on the soils information gathered from the three (3) candidate lagoon facility sites and the proposed WTP Site identified by the project team, and laboratory information presented by Eng-Tech, Stantec, Trek Geotechnical, and H. Manalo. Soils information gathered from the candidate sites is limited to the tested areas and should only be considered as general conditions for the subject areas. Any deviation from the tested areas may exhibit different soil and groundwater conditions from those presented.

4.1 Proposed Wastewater Lagoon Sites

Lagoon Site 1

The results of physical soil testing at Site 1 indicate that the shallow clay soils are medium to high plastic, CI to CH, and the moisture content is between the liquid and plastic limits, suggesting the soils are workable without augmentation with water or drying of the soils.

Local jurisdictions generally require that the inside dykes and bottom of lagoons have a relative impervious layer consisting of at least one (1) metre of soil having a maximum permeability of $k = 1 \times 10^{-7}$ cm/s. The hydraulic conductivity of the combined remolded sample, $k = 3.3 \times 10^{-8}$ cm/s, suggests that a recompacted earthen clay liner may be applicable for the site, utilizing the clay and clayey till soils identified from approximately

1.5 m and below. Although an undisturbed sample was not tested for hydraulic conductivity, fissures and silt inclusions were identified in the shallow clays and use of the in-situ material as an earthen liner is not recommended at Site 1 without substantial additional testing. An underlying unit of tan glacial till, which varies in depth, was identified at the site. Caution and diligent inspection would be required to ensure that material from the underlying unit of tan glacial till is not incorporated into an earthen liner.

Although the underlying clay soils identified at Site 1 may represent a suitable source for an earthen clay liner, a substantial unit of saturated peat cover (1.2 metres) was identified, and considerable effort would be required to clear and grub the site during warm temperatures. In addition, obtaining drainage at the site may require considerable evaluation, as the site is located in a relatively low-lying area (±727 ft, ASL) adjacent an ephemeral marshy zone that drains around an elevated area to the north and subsequently back to the northeast of the proposed site adjacent the discharge to Lake Winnipeg (±717 ft, ASL). Careful attention should be given to elevations at the design stage if this site is selected.

If Site 1 is selected as the preferred site for the proposed wastewater lagoon, a detailed geotechnical investigation, encompassing the footprint of the site, would be required to confirm the depth to the tan, silty glacial till and related soil characteristics at the site.

Lagoon Site 2

The results of physical soil testing at Site 2 indicate that the shallow soils are comprised of medium to high plastic clays. The moisture content is between the liquid and plastic limits, indicating that the soils at Site 2 may also be workable without augmentation, with water or drying of the soils. However, the hydraulic conductivity of the combined remolded sample was evaluated at $k = 5.2 \times 10^{-7}$ cm/s, slightly greater than 1×10^{-7} cm/s, which is required for an earthen liner. As the composition of the soil (inorganic silty, sandy clay of medium to high plasticity) is indicative of soils suitable for use as a liner, Aski suggests that additional hydraulic conductivity testing be considered to confirm if the clay soil material is suitable for use as an earthen liner.

Although an undisturbed sample of the clay/clayey till soils was retrieved from the site, and is available for testing, fissures and silt inclusions were identified in the clays and use of the in-situ material as an earthen liner should only be considered with substantial additional testing.

A substantial unit of saturated peat cover (±1.5 metres) was identified at the site and considerable effort would also be required to clear and grub Site 2 in summer conditions. Although the site is in a relatively flat area, obtaining site drainage towards the south may be achievable with less effort than at Site 1. However, careful attention should also be given to elevations at Site 2, if the site is selected.

If Site 2 is selected as the preferred site for the proposed wastewater lagoon, a detailed geotechnical investigation, encompassing the footprint of the site, would be required to confirm the soil stratigraphy, hydraulic conductivity and related soil characteristics at the site. Alternatively, a geosynthetic liner should be considered for this site.

Lagoon Site 3

A relatively limited depth of medium plastic CI clay till was identified at Lagoon Site 3 which transitions to tan, silty till at a depth of approximately 1.2 mBGL. Although testing of an undisturbed sample indicates the hydraulic conductivity of the in-situ clay till is in the range of $k=1.0x10^{-8}$ cm/s, there is likely insufficient clay at the site to construct an earthen liner without substantial borrow. Testing of remolded samples would be required to determine if the available soil is suitable for use as a recompacted earthen liner.

Cobbles and boulders were identified in the dense, silty till unit underlying the clay. This may restrict the efficiency of sub cuts into the till unit using conventional excavation equipment.

Lagoon Site 3 is relatively flat, and slightly elevated (±732 ft ASL), with gentle relief towards Lake Winnipeg. No significant drainage issues were noted at the site.

Should Site 3 be selected as the preferred site for the proposed wastewater lagoon, a detailed geotechnical investigation would be required to confirm the soil stratigraphy over the footprint of the site in more detail. A suitable local source for clay borrow material would also need to be identified.

4.2 Proposed Water Treatment Plant

4.2.1 Foundation Recommendation

Limestone bedrock was identified at the proposed water treatment plant at 2.4 mBGL in testpit TP3. The testpit revealed that the top 0.2 m of the bedrock surface was fractured, with relatively solid limestone below. Suspected bedrock was encountered in testhole TH2 at 3.2 mBGL, suggesting undulating bedrock.

To confirm the condition of the bedrock and assess for voids, soundness and groundwater seepage, coring of the bedrock is recommended to a minimum of 1.5 m below the design depth of the bearing surface. Design bearing pressures cannot be defined without coring and a Limit States Design assessment, but may range from 250 kPa to 1000 kPa, depending on the condition and compressive strength of the bedrock.

4.2.2 Lateral Earth Pressure

Permanent walls that are constructed below ground level must be designed to resist lateral earth pressure. The active horizontal soil pressure "p" (kPa) acting on subsurface walls at any depth "h" (m) is calculated with the following equation:

$$p = K_0 (\gamma h + q)$$

where: p = lateral earth pressure (kPa)
K_0 = earth pressure coefficient; 0.7 (rigid wall)
γ = 22 kN/m^3 estimated unit weight backfill (compacted, drained sand/gravel) backfill); 20 kN/m^3 (unit weigh of clay till)
h = depth from grade to point of interest (m)
q = surcharge live load acting adjacent to wall (kPa)

Drainage must be provided at the base of the wall to prevent a buildup of hydrostatic pressure. Lateral earth pressures due to compaction and surcharge loading should also be calculated at final design.

Excavation of the overlying soils must be undertaken using safe slopes in accordance with Manitoba Workplace Safety and Health. Therefore, excavations greater than 1.2 metres shall have slopes not greater than 45 degrees.

4.3 Frost Protection

Based on the freezing index for the community, the expected depth of frost penetration is approximately 2.6 metres. Sufficient insulation or alternative frost protection should be incorporated into any frost susceptible components installed above 2.6 m.

4.4 Concrete

Based on our previous experience in the Dauphin River area, it is recommended that all concrete in contact with the soils shall be manufactured with sulphate resistant cement (CSA Type HS). Therefore, high sulphate resistant concrete may be used for all concrete work. The concrete mix should be air entrained to improve freeze-thaw durability and manufactured with a water to cement ratio of 0.50 and a minimum 56-day compressive strength of 32 MPa for long term durability.

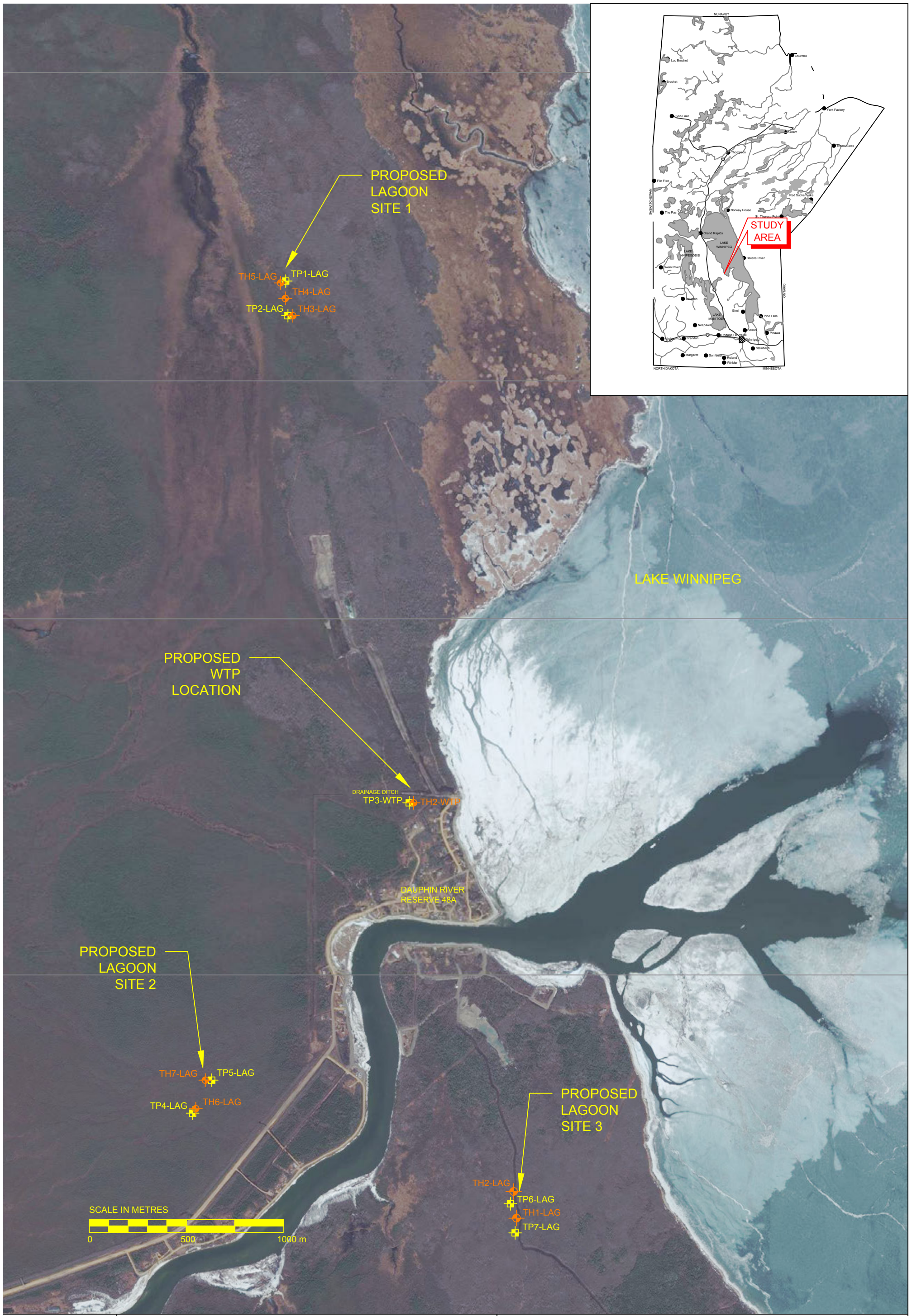
5.0 CLOSURE

The findings and recommendations of this report were prepared in accordance with generally accepted professional engineering principles and practices for geotechnical investigations of this nature. The findings and discussions were based on discussions with the project team and the results of the field observations by Aski. Soil characterization undertaken by Eng-Tech Consulting Ltd., Stantec Consulting Ltd., Trek Geotechnical Inc., and H. Manalo Consulting Limited also assisted in the recommendations presented in this report. Although the testpits and testholes are location specific, they reflect the general conditions observed across the tested areas.

This report was prepared for the exclusive use of Dauphin River First Nation. Any use or reliance by a third party is the responsibility of such third parties. Aski Geosciences Ltd. accepts no responsibility for damages, if any, incurred by any third party as a result of the information documented in this report. Any questions arising from this report should be directed to Colin Ledger, C.E.T.

MAPS AND FIGURES

- **Figure 1:** Testpit & Testhole Location Plan



LEGEND

TP1 TESTPIT LOCATION (MAR 16, 2014)

TH1 TESTHOLE LOCATION (APR 7, 2014)

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TESTPIT AND TESTHOLE LOCATION PLAN

PROJECT:
GEOTECHINCAL ASSESSMENT - PROPOSED LAGOON AND WTP SITES
DAUPHIN RIVER FIRST NATION
DAUPHIN RIVER, MANITOBA

DRAWN BY: JP	DESIGNED BY: JP	PROJECT NO: DR807
DATE: 03/18/14	CHECKED BY: RK	FIGURE: 1

APPENDIX A - LITHOLOGIC LOGS

Lagoon Site 1:

- Testpits: TP1 and TP2
- Testholes: TH3 – TH5

Lagoon Site 2:

- Testpits: TP4 and TP5
- Testhole: TH6 and TH7

Lagoon Site 3:

- Testpits: TP6 and TP7
- Testholes: TH1 and TH2

Proposed Water Treatment Plant Site:

- Testpit: TP3
- Testhole: TH5

Project: Geotechnical Investigation

Project No: DR807

Site: Proposed Lagoon - Site 1

Location: Dauphin River First Nation, Manitoba

Testpit No: TP1

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SUBSURFACE PROFILE / SAMPLE

Depth (ft / m)	USC	Symbol	Description	Elev. (m)	Sample No.	Type	Pocket Pen kPa (100 – 300)	Moistures % (10 30 50 70 90)	Lab Analysis/ Remarks
0 / 0			Ground Surface	0.00					
0 – 4 / 0 – 1	Pt		**PEAT** - brown-black, fibrous, tree roots - saturated - frozen to 0.3 mBGL - heavy seepage below 0.3 mBGL - moderate caving	-1.22					
4 / 1					TP1-1	G	•		
4 – 10 / 1 – 3	Cl		**CLAY** - brown, firm, moderately plastic - silty - trace sand - very silty and grey-brown below 2.4 mBGL - soft, slightly plastic						
10 / 3					TP1-2	G			
10 – 14 / 3 – 4			- clay till structure below 3.6 mBGL - very stiff to hard - some gravely and sand	-4.27					
14 / 4					TP1-3	G			
14 – 16 / 4 – 5			End testpit at 4.3 mBGL due to heavy seepage and caving. GPS 14U 0563490 E, 5760412 N. Water level at 2.1 mBGL upon completion of testpit.						

Drilling Contractor: Arnason Industries

Drill Method: Komatsu 160LC

Elevation: 0

Field Personnel: RL, CL, JP

Hole Size: Testpit

Drill Date: March 14, 2014

Checked by: RK

Page: S1-1

Project: Geotechnical Investigation

Project No: DR807

Site: Proposed Lagoon - Site 1

Location: Dauphin River First Nation, Manitoba

Testpit No: TP2

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SUBSURFACE PROFILE					SAMPLE				
Depth (ft / m)	USC	Symbol	Description	Elev. (m)	Sample No.	Type	Pocket Pen kPa (100 – 300)	Moistures % (10 30 50 70 90)	Lab Analysis/ Remarks
0 / 0			Ground Surface	0.00					
0 – 3 / 0 – 1	Pt		**PEAT** - brown-black, tree roots, saturated - heavy seepage - frozen to 0.4 mBGL	-1.22					
4 – 9 / 1 – 2	Cl		**CLAY** - brown, firm, slightly plastic - some silt inclusions - some gravel and sand - moderate caving	-2.74	TP2-1 TP2-2 TP2-3 TP2-4 TP2-5	G			
9 – 13 / 3 – 4	ML		**GLACIAL TILL** - tan, silty, some gravel - some boulders - some cobbles and gravel - dense - hard below 3.3 mBGL	-3.96	TP2-6	G			
13 / 4			End testpit at 4.0 mBGL in hard glacial till. Heavy seepage and caving noted. GPS 14U 0563500 E, 5760223 N.						
17 / 5 – 18									

Drilling Contractor: Arnason Industries

Drill Method: Komatsu 160LC

Elevation: 0

Field Personnel: RL, CL, JP

Hole Size: Testpit

Drill Date: March 14, 2014

Checked by: RK

Page: S1-2

Project: Geotechnical Investigation

Project No: DR807

Site: Proposed Lagoon - Site 1

Location: Dauphin River, Manitoba

Testhole No: TH3

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SUBSURFACE PROFILE					SAMPLE				
Depth (ft / m)	USC	Symbol	Description	Elev. (m)	Sample No.	Type	Pocket Pen kPa (100 300)	Moistures % (10 30 50 70 90)	Lab Analysis/ Remarks
0 / 0			Ground Surface	0.00					
0 – 3.3 / 0 – 1	Pt		**PEAT** - brown-black, tree roots, saturated - heavy seepage - frozen to 0.5 mBGL	-1.22					
4 – 9 / 1 – 2	Cl		**CLAY** - brown, firm, slightly plastic - some silt inclusions - some gravel and sand - advanced Shelby Tube 1.5 to 1.9 mBGL	-2.74					
9 – 15 / 3 – 4.6	ML		**GLACIAL TILL** - tan, silty - some boulders - some cobbles and gravel - dense - hard below 3.3 mBGL	-4.57					
16 / 5			End testhole at 4.6 mBGL in tan till. Seepage noted from peat layer. No caving noted. GPS 14U 0563513 E, 5760220 N.						

Drilling Contractor: Paddock Drilling

Drill Method: Acker XS

Elevation: 0

Field Personnel: CL, JP

Hole Size: 125 mm

Drill Date: April 7, 2014

Checked by: RK

Page: S1-3

Project: Geotechnical Investigation

Project No: DR807

Site: Proposed Lagoon - Site 1

Location: Dauphin River, Manitoba

Testhole No: TH4

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SUBSURFACE PROFILE					SAMPLE				
Depth (ft / m)	USC	Symbol	Description	Elev. (m)	Sample No.	Type	Pocket Pen kPa (100 300)	Moistures % (10 30 50 70 90)	Lab Analysis/ Remarks
0 / 0			Ground Surface	0.00					
0 – 4	Pt		**PEAT** - brown-black, fibrous, tree roots - saturated - frozen to 0.3 mBGL - heavy seepage below 0.3 mBGL - moderate caving	-1.22					
4 – 14	Cl		**CLAY** - brown, firm, moderately plastic - silty, trace sand - soft at 3.0 m - clay till structure at 3.0 mBGL - sandy, some gravel, hard	-4.27					
14 – 19			Auger refusal at 4.2 mBGL on suspected bedrock. No seepage or caving noted. GPS 14U 0563494 E, 5760313 N.						

Drilling Contractor: Paddock Drilling

Drill Method: Acker XS

Elevation: 0

Field Personnel: CL, JP

Hole Size: 125 mm

Drill Date: April 7, 2014

Checked by: RK

Page: S1-4

Project: Geotechnical Investigation

Project No: DR807

Site: Proposed Lagoon - Site 1

Location: Dauphin River, Manitoba

Testhole No: TH5

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SUBSURFACE PROFILE					SAMPLE				
Depth (ft / m)	USC	Symbol	Description	Elev. (m)	Sample No.	Type	Pocket Pen kPa (100 – 300)	Moistures % (10 30 50 70 90)	Lab Analysis/ Remarks
0 / 0			Ground Surface	0.00					
0 – 4 / 0 – 1	Pt		**PEAT** - brown, fibrous, tree roots, moist - frozen	-1.37					
4 – 13 / 1 – 4	Cl		**CLAY** - brown, firm, slightly plastic - some silt, some gravel	-3.96					
13 – 14 / 4 – 4.27	ML		**GLACIAL TILL** - tan, stiff, clayey - some gravel	-4.27					
15 / 4.6			Auger refusal at 4.3 mBGL in dense till.						
16 – 17 / 5			Heavy seepage noted in the peat layer. No caving noted.						
17 / 5.2			GPS 14U 0563487 E, 5760401 N.						

Drilling Contractor: Paddock Drilling

Drill Method: Acker XS

Elevation: 0

Field Personnel: CL, JP

Hole Size: 125 mm

Drill Date: April 7, 2014

Checked by: RK

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Project: Geotechnical Investigation

Project No: DR807

Site: Proposed Lagoon - Site 2

Location: Dauphin River First Nation, Manitoba

Testpit No: TP4

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SUBSURFACE PROFILE					SAMPLE				
Depth (ft / m)	USC	Symbol	Description	Elev. (m)	Sample No.	Type	Pocket Pen kPa (100 – 300)	Moistures % (10 30 50 70 90)	Lab Analysis/ Remarks
0 / 0			Ground Surface	0.00					
0 – 4 / 0 – 1	Pt		**PEAT** - black-brown, fibrous, wet - tree roots - frozen to 0.8 mBGL - heavy seepage below 0.6 mBGL	-1.37					
4 – 12 / 1 – 3.7	Cl		**CLAY** - brown, slightly plastic, firm - fissured, silt inclusions - moderate caving below 1.5 mBGL - firm to stiff below 2.3 mBGL	-3.66	TP4-1 TP4-2 TP4-3	G G G			- atterberg limits
12 / 3.7			End testpit at 3.7 mBGL due to heavy seepage and caving. GPS 14U 0563048 E, 5756215 N.						

Drilling Contractor: Arnason Industries

Drill Method: Komatsu 160LC

Elevation: 0

Field Personnel: RL, CL, JP

Hole Size: Testpit

Drill Date: March 15, 2014

Checked by: RK

Page: S2-1

Project: Geotechnical Investigation

Project No: DR807

Site: Proposed Lagoon - Site 2

Location: Dauphin River First Nation, Manitoba

Testpit No: TP5

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SUBSURFACE PROFILE					SAMPLE				
Depth (ft / m)	USC	Symbol	Description	Elev. (m)	Sample No.	Type	Pocket Pen kPa (100 – 300)	Moistures % (10 30 50 70 90)	Lab Analysis/ Remarks
0 / 0			Ground Surface	0.00					
0 – 3 / 0 – 1	Pt		**PEAT** - black-brown, fiberous, wet - tree roots - frozen to 0.8 mBGL - heavy seepage below 0.9 mBGL	-1.07					
3 – 13 / 1 – 4	CI		**CLAY** - brown, silty, fissured - slightly plastic - firm to stiff - glacial till structure below 3.0 mBGL - very stiff - silt inclusions - some gravel	-3.96	TP5-1 TP5-2 TP5-3 TP5-4 TP5-5	G			- atterberg - remolded hydraulic conductivity (combined) $K=10^{-7}$ - remolded hydraulic conductivity (combined) $K=10^{-7}$
13 – 18 / 4 – 5			End testpit at 4.0 mBGL due to heavy seepage and caving. GPS 14U 0563145 E, 5756336 N.						

Drilling Contractor: Arnason Industries

Drill Method: Komatsu 160LC

Elevation: 0

Field Personnel: RL, CL, JP

Hole Size: Testpit

Drill Date: March 15, 2014

Checked by: RK

Page: S2-2

Project: Geotechnical Investigation

Project No: DR807

Site: Proposed Lagoon - Site 2

Location: Dauphin River, Manitoba

Testhole No: TH6

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SUBSURFACE PROFILE					SAMPLE				
Depth (ft / m)	USC	Symbol	Description	Elev. (m)	Sample No.	Type	Pocket Pen kPa (100 300)	Moistures % (10 30 50 70 90)	Lab Analysis/ Remarks
0 / 0			Ground Surface	0.00					
0 – 4 / 0 – 1	Pt		**PEAT** - black-brown, fibrous, wet - tree roots and rootlets - frozen to 1.0 mBGL	-1.52					
5 – 20 / 2 – 6	Cl		**CLAY** - brown, slightly plastic, firm - fissured, silt inclusions - stiff to 2.1 m - advanced Shelby Tube 1.8 to 2.2 mBGL - very soft at 4.6 mBGL	-6.10					
21 / 6			Auger refusal at 6.1 mBGL on suspected bedrock. No seepage or caving noted. GPS 14U 0563058 E, 5756228 N.						

Drilling Contractor: Paddock Drilling

Drill Method: Acker XS

Elevation: 0

Field Personnel: CL, JP

Hole Size: 125 mm

Drill Date: April 7, 2014

Checked by: RK

Page: S2-3

Project: Geotechnical Investigation

Project No: DR807

Site: Proposed Lagoon - Site 2

Location: Dauphin River, Manitoba

Testhole No: TH7

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SUBSURFACE PROFILE					SAMPLE				
Depth (ft / m)	USC	Symbol	Description	Elev. (m)	Sample No.	Type	Pocket Pen kPa (100 300)	Moistures % (10 30 50 70 90)	Lab Analysis/ Remarks
0 / 0			Ground Surface	0.00					
0 – 5 / 0 – 1	Pt		**PEAT** - black-brown, fibrous, wet - tree roots - frozen to 0.9 mBGL	-1.52					
5 – 15 / 1 – 4.6	Cl		**CLAY** - brown, silty, fissured - slightly plastic - stiff at 1.8 mBGL - advanced Shelby Tube 1.8 to 2.3 mBGL - soft at 4.4 mBGL	-4.57					
15 – 20 / 4.6 – 6			Auger refusal at 4.6 mBGL on suspected bedrock. No seepage or caving noted. GPS 14U 0563133 E, 5756337 N.						

Drilling Contractor: Paddock Drilling

Drill Method: Acker XS

Elevation: 0

Field Personnel: CL, JP

Hole Size: 125 mm

Drill Date: April 7, 2014

Checked by: RK

Page: S2-4

Project: Geotechnical Investigation

Project No: DR807

Site: Proposed Lagoon - Site 3

Location: Dauphin River First Nation, Manitoba

Testpit No: TP6

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SUBSURFACE PROFILE / SAMPLE

Depth (ft / m)	USC	Symbol	Description	Elev. (m)	Sample No.	Type	Pocket Pen kPa (100 – 300)	Moistures % (10 30 50 70 90)	Lab Analysis/ Remarks
0 / 0			Ground Surface	0.00					
0	Pt		**PEAT** - brown, fibrous, tree roots, moist - frozen	-0.24					
1	Cl		**GLACIAL TILL** - tan-brown, silty, clayey - frozen to 0.5 mBGL - moist, medium dense - some gravel and sand - medium dense to dense - trace cobbles		TP6-1	G			
2 / 1									
3									
4					TP6-2	G			
5									
6									
7 / 2					TP6-3	G			- atterberg limits
8									
9	ML		- less clay below 2.9 mBGL - gravelly, very dense to hard						
10 / 3					TP6-4	G			
11									
12				-3.66					
13 / 4			End testpit in hard glacial till at 3.6 mBGL. Tough digging. No caving or seepage noted. GPS 14U 0564788 E, 5755711 N.						
14									
15									
16									
17 / 5									

Drilling Contractor: Arnason Industries

Drill Method: Komatsu 160LC

Elevation: 0

Field Personnel: RL, CL, JP

Hole Size: Testpit

Drill Date: March 15, 2014

Checked by: RK

Page: S3-1

Project: Geotechnical Investigation

Project No: DR807

Site: Proposed Lagoon - Site 3

Location: Dauphin River First Nation, Manitoba

Testpit No: TP7

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SUBSURFACE PROFILE / SAMPLE

Depth (ft / m)	USC	Symbol	Description	Elev. (m)	Sample No.	Type	Pocket Pen kPa (100 – 300)	Moistures % (10 30 50 70 90)	Lab Analysis/ Remarks
0 / 0			Ground Surface	0.00					
	Pt		**PEAT** - brown, fiberous, tree roots, moist - frozen	-0.24					
1	Cl		**GLACIAL TILL** - brown, silty, clayey, varved - gravelly - frozen to 0.9 mBGL						
2					TP7-1	G			
3 / 1			- tan below 1.0 mBGL - some boulders and cobbles						
4	ML								
5					TP7-2	G			
6 / 2									
7			- hard below 2.1 mBGL - tough digging						
					TP7-3	G			
8									
9				-2.74					
	BR		**BEDROCK** - flat, solid, limestone	-2.90					
10 / 3					TP7-4	G			
			Bucket refusal at 2.7 mBGL on solid bedrock.						
11			No caving or seepage noted.						
12			GPS 14U 0564800 E, 5755501 N.						
13									

Drilling Contractor: Arnason Industries

Field Personnel: RL, CL, JP

Checked by: RK

Drill Method: Komatsu 160LC

Hole Size: Testpit

Page: S3-2

Elevation: 0

Drill Date: March 15, 2014

Project: Geotechnical Investigation

Project No: DR807

Site: Proposed Lagoon - Site 3

Location: Dauphin River First Nation, Manitoba

Testhole No: TH1

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SUBSURFACE PROFILE					SAMPLE				
Depth (ft / m)	USC	Symbol	Description	Elev. (m)	Sample No.	Type	Pocket Pen kPa (100 300)	Moistures % (10 30 50 70 90)	Lab Analysis/ Remarks
0 / 0			Ground Surface	0.00					
	Pt		**PEAT** - brown, fiberous, tree roots, moist - frozen	-0.24					
1	Cl		**GLACIAL TILL** - brown, stiff, clayey, silty - frozen to 0.6 mBGL - medium dense						
2									
3 / 1									
4	ML		- tan at 1.2 mBGL - silty, some cobbles, dense						
5									- undisturbed hydraulic conductivity $k=1.0 \times 10^{-8}$ cu/s
6 / 2									
7				-2.44					
8			Auger refusal at 2.4 mBGL on suspected boulder in glacial till. Additional testhole drilled nearby with refusal at 1.2 mBGL. No caving or seepage noted. GPS 14U 0564784 E, 5755534 N.						
9 / 3									
10									
11									
12									

Drilling Contractor: Maple Leaf Drilling

Field Personnel: RL, CL, JP

Checked by: RK

Drill Method: DR150

Hole Size: 125 mm

Page: S3-3

Elevation: 0

Drill Date: March 16, 2014

Project: Geotechnical Investigation

Project No: DR807

Site: Proposed Lagoon - Site 3

Location: Dauphin River First Nation, Manitoba

Testhole No: TH2

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SUBSURFACE PROFILE					SAMPLE				
Depth (ft / m)	USC	Symbol	Description	Elev. (m)	Sample No.	Type	Pocket Pen kPa (100 300)	Moistures % (10 30 50 70 90)	Lab Analysis/ Remarks
0 / 0			Ground Surface	0.00					
	Pt		**PEAT** - brown, fiberous, tree roots, moist - frozen	-0.24					
1	Cl		**GLACIAL TILL** - brown, stiff, clayey, silty - frozen to 0.6 mBGL - medium dense						
2									
3 / 1									
4									
5									
6	ML								
7 / 2									
8				-2.44					
9			Auger refusal at 2.4 mBGL on suspected boulder in glacial till. Additional testhole drilled nearby with refusal at 1.2 mBGL. No caving or seepage noted. GPS 14U 0564774 E, 5755723 N.						
10 / 3									
11									
12									

Drilling Contractor: Maple Leaf Drilling

Field Personnel: RL, CL, JP

Checked by: RK

Drill Method: DR150

Hole Size: 125 mm

Page: S3-4

Elevation: 0

Drill Date: March 16, 2014

Project: Geotechnical Investigation

Project No: DR807

Site: Proposed Water Treatment Plant

Location: Dauphin River First Nation, Manitoba

Testpit No: TP3

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SUBSURFACE PROFILE					SAMPLE				
Depth (ft / m)	USC	Symbol	Description	Elev. (m)	Sample No.	Type	Pocket Pen kPa (100 – 300)	Moistures % (10 30 50 70 90)	Lab Analysis/ Remarks
0 / 0			Ground Surface	0.00					
	Pt		**PEAT** - brown-black, moist to wet - numerous tree roots (thick) - frozen to 0.6 mBGL	-0.85					
3 / 1	CI		**CLAY** - brown, fissured, slightly plastic - silty, firm, trace gravel	-2.13					
7 / 2	ML		**GLACIAL TILL** - tan, hard, gravelly, silty - trace clay and sand - trace cobbles and boulders	-2.44					
8	BR		**BEDROCK** - fractured limestone, undulating, solid	-2.62					
9 / 3			Bucket refusal at 2.5 mBGL on weathered bedrock. No caving or seepage noted. Testhole relocated due to new drainage ditch for community. GPS 14U 0564227 E, 5757788 N.						
13									

Drilling Contractor: Arnason Industries

Field Personnel: RL, CL, JP

Checked by: RK

Drill Method: Komatsu 160LC

Hole Size: Testpit

Page: S4-1

Elevation: 0

Drill Date: March 15, 2014

Project: Geotechnical Investigation

Project No: DR807

Site: Proposed Water Treatment Plant

Location: Dauphin River First Nation, Manitoba

Testhole No: TH2

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SUBSURFACE PROFILE					SAMPLE				
Depth (ft / m)	USC	Symbol	Description	Elev. (m)	Sample No.	Type	Pocket Pen kPa (100 300)	Moistures % (10 30 50 70 90)	Lab Analysis/ Remarks
0 / 0			Ground Surface	0.00					
0 – 2 / 0 – 1	Pt		**PEAT** - brown, fiberous, wet, tree roots - frozen to 0.4 mBGL	-0.76					
3 – 6 / 1 – 2	Cl		**CLAY** - brown, fissured, slightly plastic, silty - firm, trace gravel	-1.83					
6 – 10 / 2 – 3	ML		**GLACIAL TILL** - tan, hard, gravelly, silty - trace clay and sand - trace cobbles and boulders	-3.20					
11 – 15 / 3 – 4			Auger refusal at 3.2 mBGL on suspected bedrock. No seepage or caving noted. GPS 14U 0564244 E, 5757788 N.						

Drilling Contractor: Maple Leaf Drilling

Field Personnel: RL, CL, JP

Checked by: RK

Drill Method: DR150

Hole Size: 125 mm

Page: S4-2

Elevation: 0

Drill Date: March 16, 2014

APPENDIX B - LABORATORY RESULTS

Candidate Lagoon Site # 1

Moisture Content – Aski Geosciences Ltd:

- TH3 @ 1.5 m, 2.3 m, 3.6 m
- TH4 @ 2.3 m, 3.0 m, 3.8 m
- TH5 @ 2.3 m, 3.0 m, 3.8 m
- TP1 @ 3.1 m, 4.3 m
- TP2 @ 1.5 m, 2.3 m, 3.0 m, 3.8 m

Atterberg Limits – Trek Geotechnical Inc:

- TP2 - LAG @ 7.5' (2.3 m)
- TH3 - LAG @ 5' (1.5 m)
- TH5 - LAG @ 7.5’ (2.3 m)

Particle Size Analysis – H. Manalo Consulting Ltd:

- TH4 @ 7.5’ (2.3 m)

Hydraulic Conductivity – Trek Geotechnical Inc:

- Composite TP1 @ 10’, TP2 @ 5’, TP2 @ 7.5’

Candidate Lagoon Site # 2

Moisture Content – Aski Geosciences Ltd:

- TH6 @ 1.5 m, 2.3 m, 3.0 m, 3.8 m, 4.6 m, 5.3 m, 6.1 m
- TH7 @ 1.5 m, 2.3 m, 3.0 m, 3.8 m
- TP4 @ 1.8 m, 2.3 m, 3.3 m
- TP5 @ 1.8 m, 2.7 m, 3.4 m

Atterberg Limits – Eng-Tech Consulting Ltd:

- TP4 - LAG @ 7.5' (2.3 m)
- TP5 - LAG @ 6' (1.8 m)

APPENDIX B - LABORATORY RESULTS (cont'd)

Particle Size Analysis – H. Manalo Consulting Ltd:

- TH6 @ 5' (1.5 m)

Hydraulic Conductivity – Eng-Tech Consulting Ltd:

- Composite TP4 @ 6', TP4 @ 7.5', TP5 @ 6', TP5 @ 9'

Candidate Lagoon Site # 3

Moisture Content – Aski Geosciences Ltd:

- TP6 @ 0.8 m, 1.5 m, 2.3 m, 3.0 m
- TP7 @ 0.8 m, 1.5 m, 2.3 m, 3.8 m

Atterberg Limits – Eng-Tech Consulting Ltd:

- TP6 - LAG @ 7.5' (2.3 m)
- TP7 - LAG @ 5' (1.5 m)

Particle Size Analysis – H. Manalo Consulting Ltd:

- TP6 @ 5' (1.5 m)

Hydraulic Conductivity – Stantec Consulting Ltd:

- TH1 – 3' to 4' (undisturbed sample)

Proposed WTP Site

Moisture Content – Aski Geosciences Ltd:

- TP3 @ 1.5 m, 2.3 m

MOISTURE ANALYSIS

Proposed Lagoon and Water Treatment Plant

DR807

Dauphin River First Nation, Dauphin River, Manitoba

BOREHOLE NO.	TH3	TH3	TH3				
Tare No.	19	66	41				
Depth (m)	1.5	2.3	3.6				
Wt. Wet Soil + Tare (g)	91.1	31.0	74.5				
Wt. Dry Soil + Tare (g)	78.8	23.9	57.3				
Wt. Water (g)	12.3	7.1	17.2				
Tare Container (g)	1.3	1.4	1.6				
Wt. Dry Soil (g)	77.5	22.5	55.7				
Moisture Content (%)	**15.9%**	**31.6%**	**30.9%**				

BOREHOLE NO.	TH4	TH4	TH4				
Tare No.	75	14	4				
Depth (m)	2.3	3.0	3.7				
Wt. Wet Soil + Tare (g)	73.3	85.0	92.5				
Wt. Dry Soil + Tare (g)	55.5	64.5	76.8				
Wt. Water (g)	17.8	20.5	15.7				
Tare Container (g)	1.4	1.3	1.4				
Wt. Dry Soil (g)	54.1	63.2	75.4				
Moisture Content (%)	**32.9%**	**32.4%**	**20.8%**				

BOREHOLE NO.	TH5	TH5	TH5				
Tare No.	36	69	8				
Depth (m)	2.3	3.0	3.8				
Wt. Wet Soil + Tare (g)	69.5	76.9	92.5				
Wt. Dry Soil + Tare (g)	52.3	60.3	76.8				
Wt. Water (g)	17.2	16.6	15.7				
Tare Container (g)	1.4	1.4	1.4				
Wt. Dry Soil (g)	50.9	58.9	75.4				
Moisture Content (%)	**33.8%**	**28.2%**	**20.8%**				

BOREHOLE NO.	TH6	TH6	TH6	TH6	TH6	TH6	TH6
Tare No.	38	10	43	44	78	77	12
Depth (m)	1.5	2.3	3.0	3.8	4.6	5.3	6.1
Wt. Wet Soil + Tare (g)	61.7	63.3	67.6	74.2	95.3	116.2	87
Wt. Dry Soil + Tare (g)	44.6	49.6	49.6	62.7	74.3	100.7	77.8
Wt. Water (g)	17.1	13.7	18.0	11.5	21.0	15.5	9.2
Tare Container (g)	1.3	1.4	1.5	1.3	1.4	1.4	1.4
Wt. Dry Soil (g)	43.3	48.2	48.1	61.4	72.9	99.3	76.4
Moisture Content (%)	**39.5%**	**28.4%**	**37.4%**	**18.7%**	**28.8%**	**15.6%**	**12.0%**

BOREHOLE NO.	TH7	TH7	TH7	TH7			
Tare No.	12	2	79	3			
Depth (m)	1.5	2.3	3.0	3.8			
Wt. Wet Soil + Tare (g)	75.4	72.4	80.8	77.7			
Wt. Dry Soil + Tare (g)	46.4	53.6	59.9	52.8			
Wt. Water (g)	29.0	18.8	20.9	24.9			
Tare Container (g)	1.3	1.4	1.4	1.4			
Wt. Dry Soil (g)	45.1	52.2	58.5	51.4			
Moisture Content (%)	**64.3%**	**36.0%**	**35.7%**	**48.4%**			

MOISTURE ANALYSIS

Proposed Lagoon and Water Treatment Plant

DR807

Dauphin River First Nation, Dauphin River, Manitoba

BOREHOLE NO.	TP1	TP1					
Tare No.	3	72					
Depth (m)	3.0	4.3					
Wt. Wet Soil + Tare (g)	44.0	31.0					
Wt. Dry Soil + Tare (g)	31.4	23.9					
Wt. Water (g)	12.6	7.1					
Tare Container (g)	1.4	1.4					
Wt. Dry Soil (g)	30.0	22.5					
Moisture Content (%)	**42.0%**	**31.6%**					

BOREHOLE NO.	TP2	TP2	TP2	TP2			
Tare No.	8	66	37	69			
Depth (m)	1.5	2.3	2.7	3.8			
Wt. Wet Soil + Tare (g)	66.3	66.7	52.4	60.8			
Wt. Dry Soil + Tare (g)	51.6	56.7	45.2	55.6			
Wt. Water (g)	14.7	10.0	7.2	5.2			
Tare Container (g)	1.5	1.2	1.2	1.4			
Wt. Dry Soil (g)	50.1	55.5	44.0	54.2			
Moisture Content (%)	**29.3%**	**18.0%**	**16.4%**	**9.6%**			

BOREHOLE NO.	TP3	TP3					
Tare No.	10	19					
Depth (m)	1.5	2.3					
Wt. Wet Soil + Tare (g)	64.4	63.4					
Wt. Dry Soil + Tare (g)	47.4	55.4					
Wt. Water (g)	17.0	8.0					
Tare Container (g)	1.4	1.3					
Wt. Dry Soil (g)	46.0	54.1					
Moisture Content (%)	**37.0%**	**14.8%**					

BOREHOLE NO.	TP4	TP4	TP4				
Tare No.	12	43	38				
Depth (m)	6.0	2.3	3.3				
Wt. Wet Soil + Tare (g)	60.4	51.3	55.5				
Wt. Dry Soil + Tare (g)	44.6	38.3	40.6				
Wt. Water (g)	15.8	13.0	14.9				
Tare Container (g)	1.4	1.6	1.4				
Wt. Dry Soil (g)	43.2	36.7	39.2				
Moisture Content (%)	**36.6%**	**35.4%**	**38.0%**				

BOREHOLE NO.	TP5	TP5	TP5				
Tare No.	6	39	78				
Depth (m)	1.8	2.7	3.4				
Wt. Wet Soil + Tare (g)	54.2	52.8	58.2				
Wt. Dry Soil + Tare (g)	40.8	40.3	41.1				
Wt. Water (g)	13.4	12.5	17.1				
Tare Container (g)	1.4	1.3	1.3				
Wt. Dry Soil (g)	39.4	39.0	39.8				
Moisture Content (%)	**34.0%**	**32.1%**	**43.0%**				

MOISTURE ANALYSIS

Proposed Lagoon and Water Treatment Plant

DR807

Dauphin River First Nation, Dauphin River, Manitoba

BOREHOLE NO.	TP6	TP6	TP6	TP6			
Tare No.	4	75	77	36			
Depth (m)	0.8	1.5	2.3	3.0			
Wt. Wet Soil + Tare (g)	44.9	66.3	70.6	75.4			
Wt. Dry Soil + Tare (g)	37.7	56.6	61.0	62.7			
Wt. Water (g)	7.2	9.7	9.6	12.7			
Tare Container (g)	1.7	1.3	1.4	1.5			
Wt. Dry Soil (g)	36.0	55.3	59.6	61.2			
Moisture Content (%)	**20.0%**	**17.5%**	**16.1%**	**20.8%**			

BOREHOLE NO.	TP7	TP7	TP7	TP7			
Tare No.	17	45	40	69			
Depth (m)	0.8	1.5	2.3	3.8			
Wt. Wet Soil + Tare (g)	69.9	72.8	56.3	60.8			
Wt. Dry Soil + Tare (g)	60.0	62.9	43.6	55.6			
Wt. Water (g)	9.9	9.9	12.7	5.2			
Tare Container (g)	1.3	1.3	1.5	1.4			
Wt. Dry Soil (g)	58.7	61.6	42.1	54.2			
Moisture Content (%)	**16.9%**	**16.1%**	**30.2%**	**9.6%**			

BOREHOLE NO.							
Tare No.							
Depth (m)							
Wt. Wet Soil + Tare (g)							
Wt. Dry Soil + Tare (g)							
Wt. Water (g)							
Tare Container (g)							
Wt. Dry Soil (g)							
Moisture Content (%)							

BOREHOLE NO.							
Tare No.							
Depth (m)							
Wt. Wet Soil + Tare (g)							
Wt. Dry Soil + Tare (g)							
Wt. Water (g)							
Tare Container (g)							
Wt. Dry Soil (g)							
Moisture Content (%)							

BOREHOLE NO.							
Tare No.							
Depth (m)							
Wt. Wet Soil + Tare (g)							
Wt. Dry Soil + Tare (g)							
Wt. Water (g)							
Tare Container (g)							
Wt. Dry Soil (g)							
Moisture Content (%)							

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Winnipeg, MB R3H 0L3
Tel: 204.975.9433 Fax: 204.975.9435

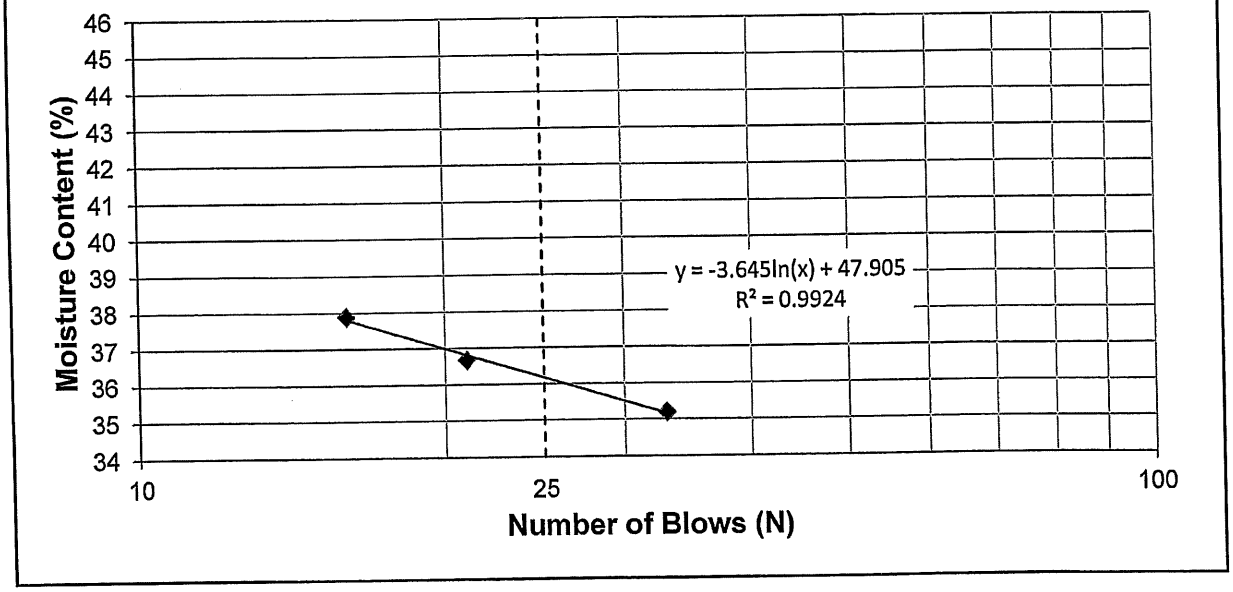
Atterberg Limits
ASTM D4318

Project No.	1000 002 13
Client	Aski Geosciences Ltd.
Project	2014 General Services & Testing
Test Hole	TP2
Sample #	-
Depth (ft)	7.5
Sample Date	
Test Date	26-Mar-14
Technician	Daniel Mroz

Liquid Limit	36
Plastic Limit	15
Plasticity Index	21

Liquid Limit

Trial #	1	2	3	4	5
Number of Blows (N)	33	21	16		
Mass Wet Soil + Tare (g)	24.905	24.787	26.170		
Mass Dry Soil + Tare (g)	22.048	21.900	22.853		
Mass Tare (g)	13.934	14.028	14.097		
Mass Water (g)	2.857	2.887	3.317		
Mass Dry Soil (g)	8.114	7.872	8.756		
Moisture Content (%)	35.211	36.674	37.883		



Plastic Limit

Trial #	1	2	3	4	5
Mass Wet Soil + Tare (g)	20.668	20.347			
Mass Dry Soil + Tare (g)	19.795	19.521			
Mass Tare (g)	14.071	13.954			
Mass Water (g)	0.873	0.826			
Mass Dry Soil (g)	5.724	5.567			
Moisture Content (%)	15.252	14.837			

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Atterberg Limits
ASTM D4318

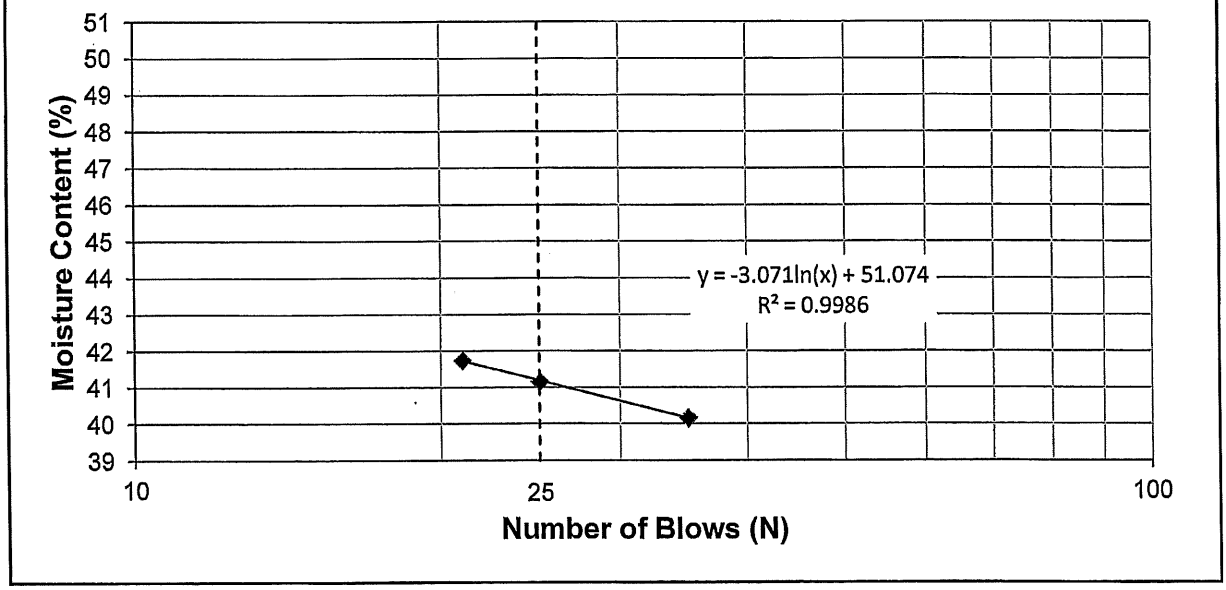
Project No.	1000 002 13
Client	Aski Geosciences Ltd.
Project	DR 807
Test Hole	TH3-LAG
Sample #	-
Depth (m)	1.5
Sample Date	-
Test Date	14-Apr-14
Technician	Daniel Mroz

Liquid Limit	41
Plastic Limit	15
Plasticity Index	26

CI

Liquid Limit

Trial #	1	2	3	4	5
Number of Blows (N)	35	25	21		
Mass Wet Soil + Tare (g)	24.945	22.725	24.728		
Mass Dry Soil + Tare (g)	21.810	20.238	21.481		
Mass Tare (g)	14.005	14.195	13.703		
Mass Water (g)	3.135	2.487	3.247		
Mass Dry Soil (g)	7.805	6.043	7.778		
Moisture Content (%)	40.167	41.155	41.746		



Plastic Limit

Trial #	1	2	3	4	5
Mass Wet Soil + Tare (g)	20.197	19.964			
Mass Dry Soil + Tare (g)	19.410	19.184			
Mass Tare (g)	14.128	13.892			
Mass Water (g)	0.787	0.780			
Mass Dry Soil (g)	5.282	5.292			
Moisture Content (%)	14.900	14.739			

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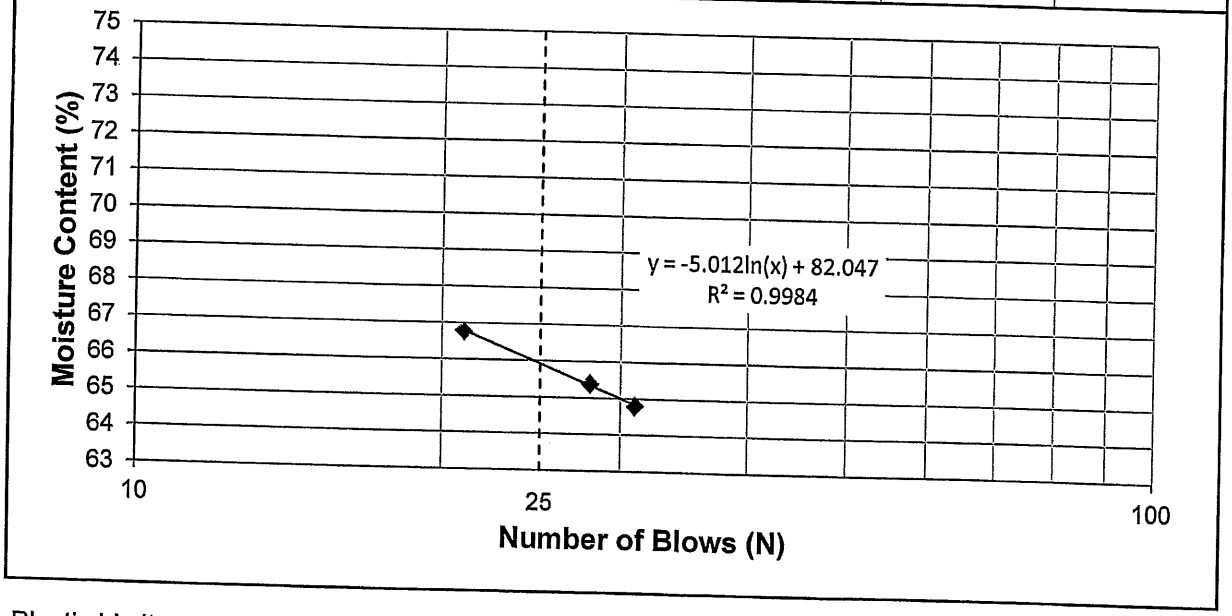
Atterberg Limits
ASTM D4318

Project No.	1000 002 13
Client	Aski Geosciences Ltd.
Project	DR 807
Test Hole	TH5-LAG
Sample #	-
Depth (m)	2.3
Sample Date	-
Test Date	14-Apr-14
Technician	Daniel Mroz

Liquid Limit	66
Plastic Limit	19
Plasticity Index	47

Liquid Limit

Trial #	1	2	3	4	5
Number of Blows (N)	31	28	21		
Mass Wet Soil + Tare (g)	20.436	21.678	20.818		
Mass Dry Soil + Tare (g)	17.807	18.672	18.155		
Mass Tare (g)	13.750	14.075	14.167		
Mass Water (g)	2.629	3.006	2.663		
Mass Dry Soil (g)	4.057	4.597	3.988		
Moisture Content (%)	64.802	65.390	66.775		



Plastic Limit

Trial #	1	2	3	4	5
Mass Wet Soil + Tare (g)	20.185	20.066			
Mass Dry Soil + Tare (g)	19.189	19.081			
Mass Tare (g)	14.067	13.976			
Mass Water (g)	0.996	0.985			
Mass Dry Soil (g)	5.122	5.105			
Moisture Content (%)	19.446	19.295			

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Winnipeg, MB R3E 2R1
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Hydraulic Conductivity Determination (Flexible Wall) ASTM D5084-10

Project No.	1000 002 13
Client	Aski Geosciences Ltd.
Project	2014 General Services & Testing

Test Hole	Combined Sample, Remolded	**Cell Pressure**	206.9 (kPa)
Sample #	(TP1@10', TP2@5', TP2@7.5')	**Back Pressure**	151.7 (kPa)
Depth (m)	-	**Differential Pressure, h**	13.8 (kPa)
Sample Date	-	**Gradient,**	13.75
Test Date	April 4, 2014 to April 17, 2014	**K (20°C)**	3.30E-10 (m/sec)
Technician	PB	**K (20°C)**	3.30E-08 (cm/sec)

Visual Classification

Description Combined and remolded sample: CLAY AND SILT - some fine sand, trace gravel (<10mm diam.) Proctor density 1700 @ 19.9%, remolded at 1642 @ 22.3%

Atterberg Limits

Liquid Limit	N/A
Plastic Limit	N/A
Plasticity Index	N/A

Initial Specimen Data		Final Specimen Data	
Moisture %	22.3 (%)	**Moisture %**	23.6 (%)
Avg. Length	0.102 (m)	**Avg. Length**	0.102 (m)
Avg. Diameter	0.073 (m)	**Avg. Diameter**	0.072 (m)
Area	4.13E-03 (m^2)	**Area**	4.12E-03 (m^2)
Volume	4.23E-04 (m^3)	**Volume**	4.21E-04 (m^3)
Bulk Unit Weight	19.70 (kN/m^3)	**Bulk Unit Weight**	20.1 (kN/m^3)
Dry Unit Weight	16.11 (kN/m^3)	**Dry Unit Weight**	16.2 (kN/m^3)
Sp. Gravity, G_s	2.70	**Sp. Gravity, G_s**	2.70
Void Ratio, e	0.644	**Void Ratio, e**	0.631
Saturation, S	93.5 (%)	**Saturation, S**	101.0 (%)
Porosity, n	0.392	**Porosity, n**	0.387

Start	End	Time	Influent (ml)	Effluent (ml)	Corrected Hydraulic Conductivity, k (cm/s)
4/11/14 5:15 PM	4/14/14 7:30 AM	224100	4.2	4.3	3.20E-08
4/14/14 7:30 AM	4/15/14 7:30 AM	86400	1.5	1.5	2.93E-08
4/15/14 7:30 AM	4/15/14 5:30 PM	36000	0.7	0.8	3.52E-08
4/15/14 5:30 PM	4/16/14 8:05 AM	52500	1.1	1.1	3.54E-08

ENG-TECH
CONSULTING LIMITED

Unit 6 - 854 Marion Street, Winnipeg, Manitoba, R2J 0K4
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E-mail: eng_tech@mts.net
www.eng-tech.ca

April 10, 2014

File No.: 14-067-01

Aski Geosciences Ltd.
Suite 207-1555 St. James Street
Winnipeg, Manitoba
R3H 1B5

ATTENTION: Rob Kupchak/Colin Ledger

RE: DAUPHIN RIVER DR808 SOIL ANALYSIS

ENG-TECH Consulting Limited (ENG-TECH) has completed the requested analyses on the soil samples from the above project. The laboratory soil analyses consisted of the following:

- Particle Size Analysis (1)
- Atterberg Limits (2)
- Moisture Content (2)

The above tests were conducted in accordance with the current ASTM Standard Test Methods D 422, D 4318 and D 2216. The Atterberg limits were conducted using the Multipoint Liquid Limit – Method A.

The results of the Atterberg Limits and insitu moisture contents are shown on Table 1. The grain size distribution results are shown on the attached Particle Size Analysis Report (Ref. No. 14-67-1-7).

ENG-TECH trusts this is all the information you require. If you have any questions, please contact the undersigned.

Sincerely,
ENG-TECH Consulting Limited

Danny Holfeld, Principal
Manager of Operations

DH/cah

Attachments: Table 1
Particle Size Analysis Report (Ref. No. 14-67-1-7)

TABLE 1
SOIL SAMPLE ANALYSIS
DAUPHIN RIVER DR808

Test Hole	Sample No.	Ref. No.	Depth (ft.)	Classification	Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index
TP 3 SCH	-	14-67-1-5	5'	CH, clay, high plastic, brown, trace oxides	26.4	62	21	41
TP 6 SCH	-	14-67-1-6	10'	CH, clay, high plastic, dark brown	37.2	76	22	54

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PARTICLE SIZE ANALYSIS REPORT

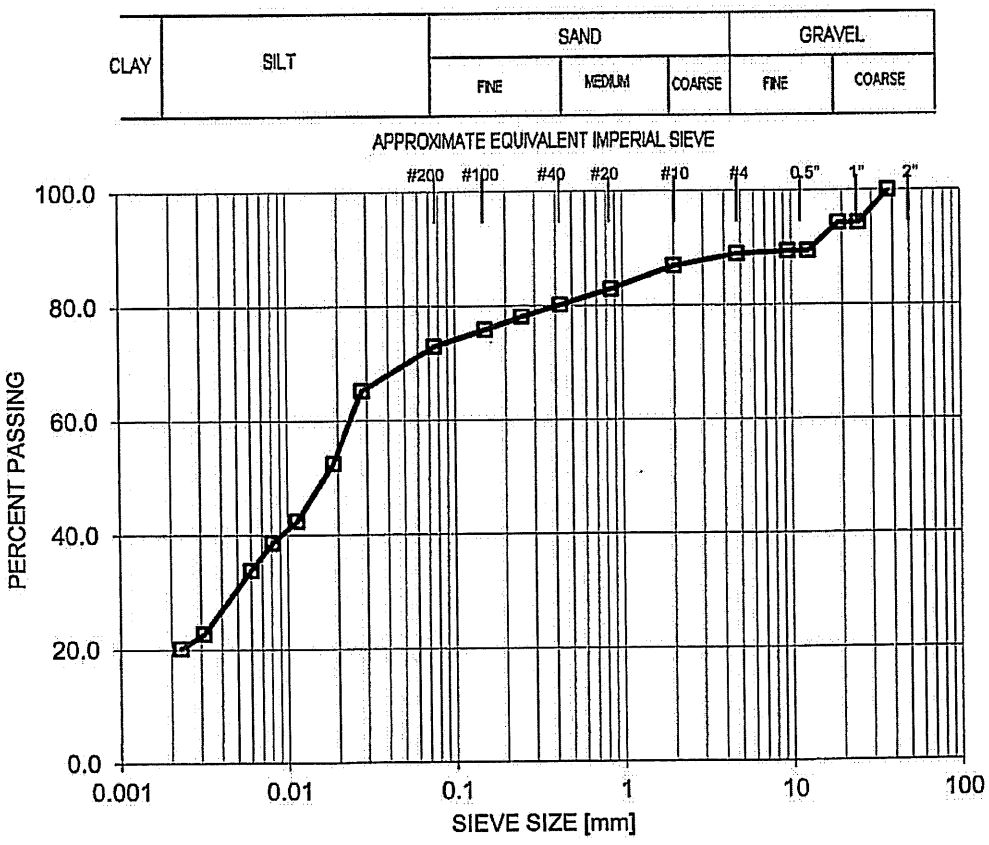
Aski Geosciences Ltd.
Suite 207-1555 St. James Street
Winnipeg, Manitoba
R3H 1B5

File No.: 14-67-01
Ref. No.: 14-67-1-7

ATTENTION: Rob Kupchak/Colin Ledger

PROJECT: DAUPHIN RIVER DR808 SOIL ANALYSIS

Test Hole No.	TP1 SCH	**Sample No.**	-	**Depth:**	8'
Sampled By:	Client	**Type of Sample:**	Grab	**Source:**	Project Site
Date Sampled:	-	**Date Received:**	Mar 24/14	**Date Tested:**	Mar 27/14



SIEVE SIZE (mm)	PERCENT PASSING
37.500	100.0
25.000	94.3
19.000	94.3
12.500	89.4
9.500	89.4
4.750	88.9
2.000	86.9
0.850	82.9
0.425	80.2
0.250	78.1
0.1500	75.8
0.0750	72.9
0.0278	65.2
0.0187	52.6
0.0114	42.4
0.0081	38.7
0.0060	33.9
0.0031	22.7
0.0023	20.2

Percent of: GRAVEL (11.1 %), SAND (16.0 %), SILT (54.0 %), CLAY (19.0 %)
Sample Description:

COMMENTS: Insitu Moisture content is 9.4%.

Email: rkupchak@askigeo.ca
Email: cledger@askigeo.ca

ENG-TECH Consulting Limited

per _____

Contact: Danny Holfeld, Principal
Ph: (204) 233-1694 Fax: (204) 235-1579

P:\2014\Projects\067(Aski)\01(2014 Various Projects)\HYD\14-67-1-7hyd

H. MANALO CONSULTING LTD.
100 MALLARD WAY, WINNIPEG, MB R2R 1Y1
PHONE: 204 632-7519 CELL: 204 997-1355
hmanalo@mts.net

PARTICLE SIZE ANALYSIS OF SOILS TEST REPORT

CLIENT: Aski Geosciences Ltd.
207-1555 St. James Street
Winnipeg, Manitoba
ATTN: Rob Kupchak
PROJECT: Hydrometer Analysis - DR 807

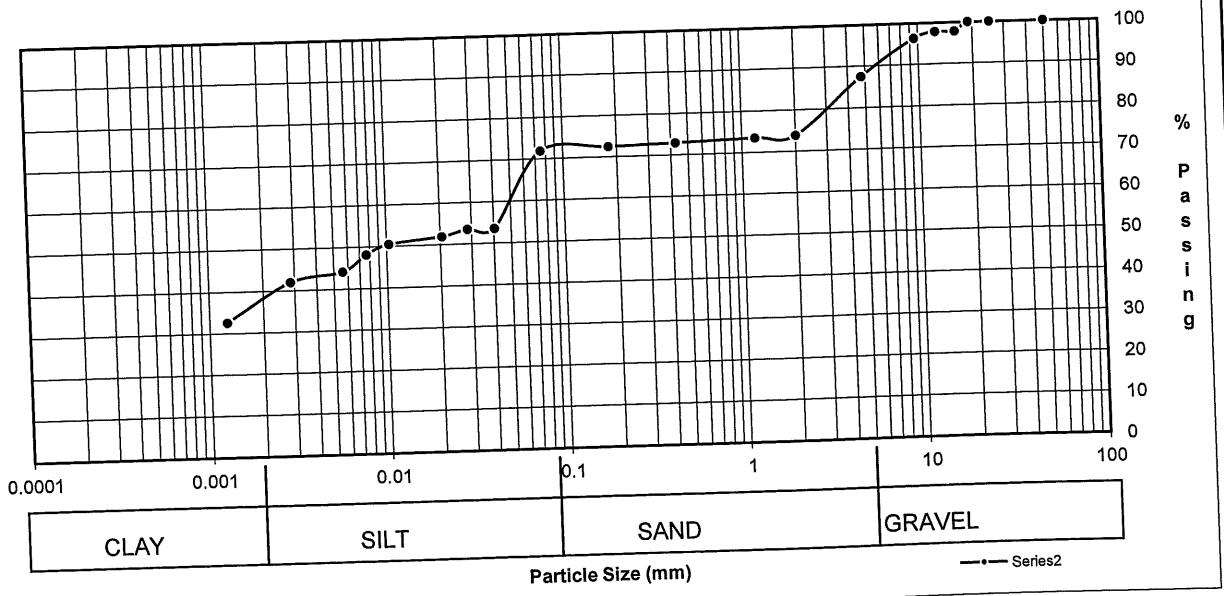
PROJECT NO. HMCL 14-17

Date Sampled: N/A Date Received: 01-May-14
Sampled By: Client Date Tested: 02-May-14

Material Identification
B.H./T.H. No. **TH4 @7.5' (Site 1)**
Sample No. **HM 29**
Sample Source n/a
Specific Gravity of Material: 2.65

Sieve Analysis		Hydrometer Analysis	
Sieve (mm)	% Passing	Diameter	% Finer
50.00	100.0		
25.00	100.0		
19.00	100.0		
16.00	97.8		
12.50	97.8	0.0403	53.6
9.50	96.3	0.0285	53.6
4.75	87.5	0.0204	52.0
2.00	73.8	0.0103	50.5
1.18	73.5	0.0077	48.1
0.425	72.9	0.0056	44.2
0.180	72.5	0.0029	42.0
0.075	71.9	0.0013	32.6

Grain Size Analysis



SOIL DESCRIPTION	% Composition		D10	
	12	Gravel	D30	
	16	Sand	D60	0.40000
	40	Silt	Cu	
	32	Clay	Cc	

Remarks: Test Method: ASTM D422, D2216, D4318

Technician: ECS

REVIEWED BY: Hermie Manalo

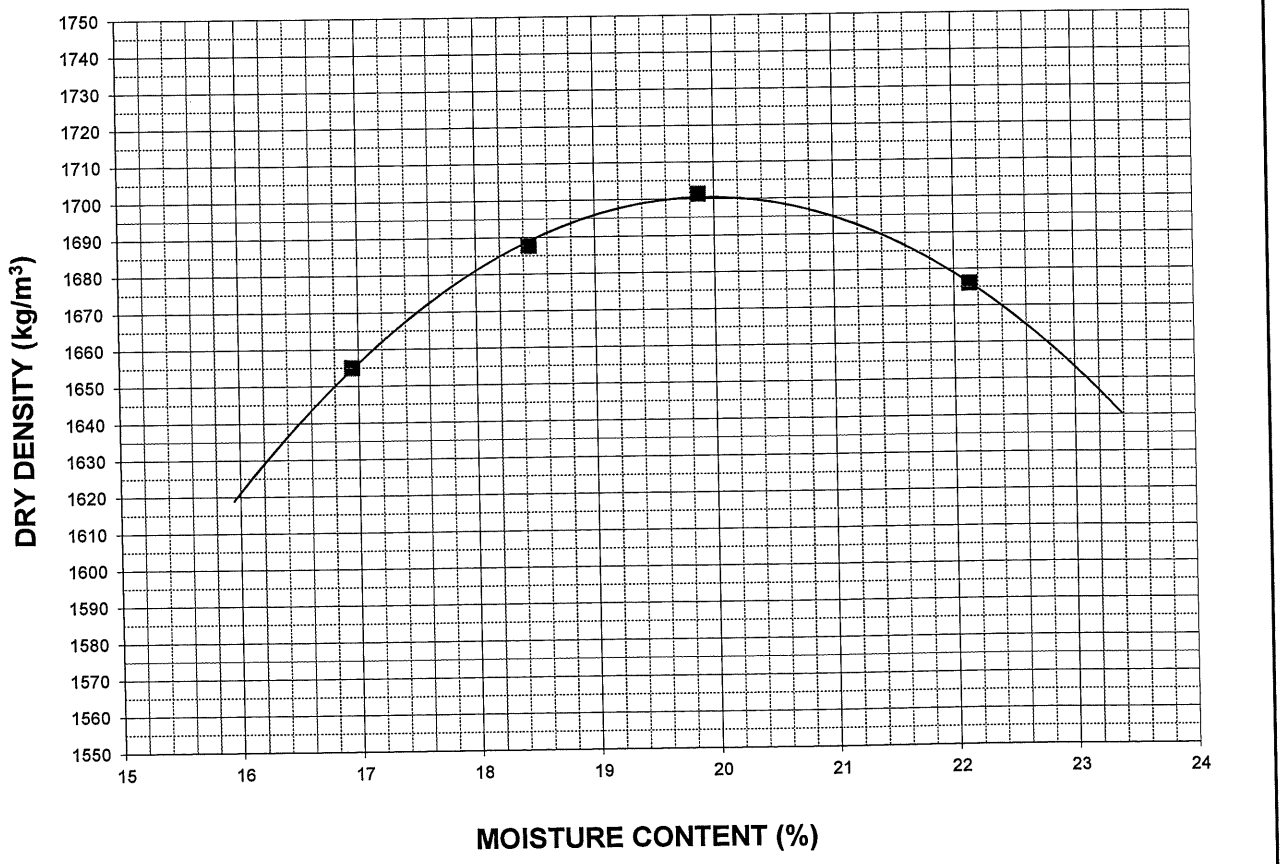
www.trekgeotechnical.ca
1712 St. James Street
Winnipeg, MB R3H 0L3
Tel: 204.975.9433 Fax: 204.975.9435

Standard Proctor Compaction Test
ASTM D698-10

Project No.	1000 002 13
Client	Aski Geosciences Ltd.
Project	2014 General Services & Testing
Sample #	S14010
Source	Combined: TP1@10', TP2@5', TP2@7.5'
Material	Silty Clay
Sample Date	-
Test Date	26-Mar-14
Technician	Paul Bevel

Maximum Dry Density (kg/m3)	1700
Optimum Moisture (%)	19.9

Trial Number	1	2	3	4	
Wet Density (kg/m^3)	1935	1999	2039	2047	
Dry Density (kg/m^3)	1655	1688	1701	1676	
Moisture Content (%)	16.9	18.4	19.9	22.1	



Notes: Total mass of combined samples was approximatly 4kg

H. MANALO CONSULTING LTD.
100 MALLARD WAY, WINNIPEG, MB R2R 1Y1
PHONE: 204 632-7519 CELL: 204 997-1355
hmanalo@mts.net

PARTICLE SIZE ANALYSIS OF SOILS TEST REPORT

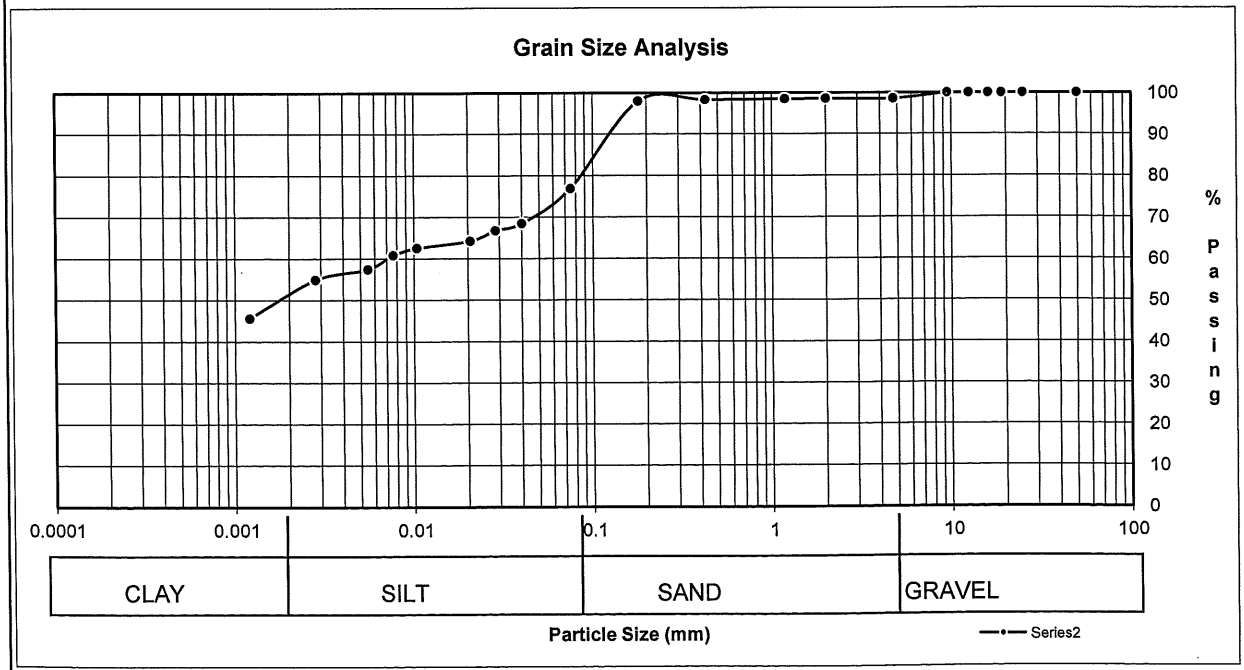
CLIENT: Aski Geosciences Ltd.
207-1555 St. James Street
Winnipeg, Manitoba
ATTN: Rob Kupchak
PROJECT: Hydrometer Analysis - DR 807

PROJECT NO. HMCL 14-17

Date Sampled: N/A Date Received: 01-May-14
Sampled By: Client Date Tested: 02-May-14

Material Identification
B.H./T.H. No. **TH6 @5' (Site 2)**
Sample No. **HM 30**
Sample Source n/a
Specific Gravity of Material: 2.65

Sieve Analysis		Hydrometer Analysis	
Sieve (mm)	% Passing	Diameter	% Finer
50.00	100.0		
25.00	100.0		
19.00	100.0		
16.00	100.0		
12.50	100.0	0.0399	68.5
9.50	100.0	0.0285	66.8
4.75	98.6	0.0206	64.3
2.00	98.6	0.0104	62.6
1.18	98.5	0.0076	60.9
0.425	98.3	0.0055	57.5
0.180	98.0	0.0028	55.0
0.075	76.9	0.0012	45.7



SOIL DESCRIPTION	% Composition		D10	
	1	Gravel	D30	
	22	Sand	D60	0.00800
	31	Silt	Cu	
	46	Clay	Cc	

Remarks: Test Method: ASTM D422, D2216, D4318
Technician: ECS

REVIEWED BY: Hermie Manalo

ENG-TECH
CONSULTING LIMITED

6 - 854 Marion Street, Winnipeg, Manitoba, R2J 0K4
Phone: (204) 233-1694 Fax: (204) 235-1579
E-mail: eng_tech@mts.net
www.eng-tech.ca

April 30, 2014

File No. 14-067-01

Aski Geosciences Ltd.
Suite 207-1555 St. James Street
Winnipeg, Manitoba
R3H 1B5

ATTENTION: Rob Kupchak/Colin Ledger

RE: DAUPHIN RIVER DR807 SOIL ANALYSIS

ENG-TECH Consulting Limited (ENG-TECH) completed the hydraulic conductivity testing service for the above project. ENG-TECH received four (4) samples of which all four samples were combined into one sample and remould to a dry density of 95% of standard proctor. The hydraulic conductivity test data are outlined in Table 1, while the graphical representations of the hydraulic conductivity versus elapsed time are shown in Figure 1.

ENG-TECH prepared the samples for hydraulic conductivity in accordance with ASTM D5084-03, *Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials using a Flexible Wall Permeameter*. A final hydraulic conductivity value (k_{20}) of 5.2×10^{-7} cm/sec was obtained for the combined and remould sample from TP5 LAG @ 6 ft., TP4 LAG @ 7.5 ft., TP5 LAG @9 ft., and TP4 LAG @ 6 ft.

ENG-TECH trusts the above is all the information you require. If you have any questions, please contact the undersigned.

Sincerely,
ENG-TECH Consulting Limited

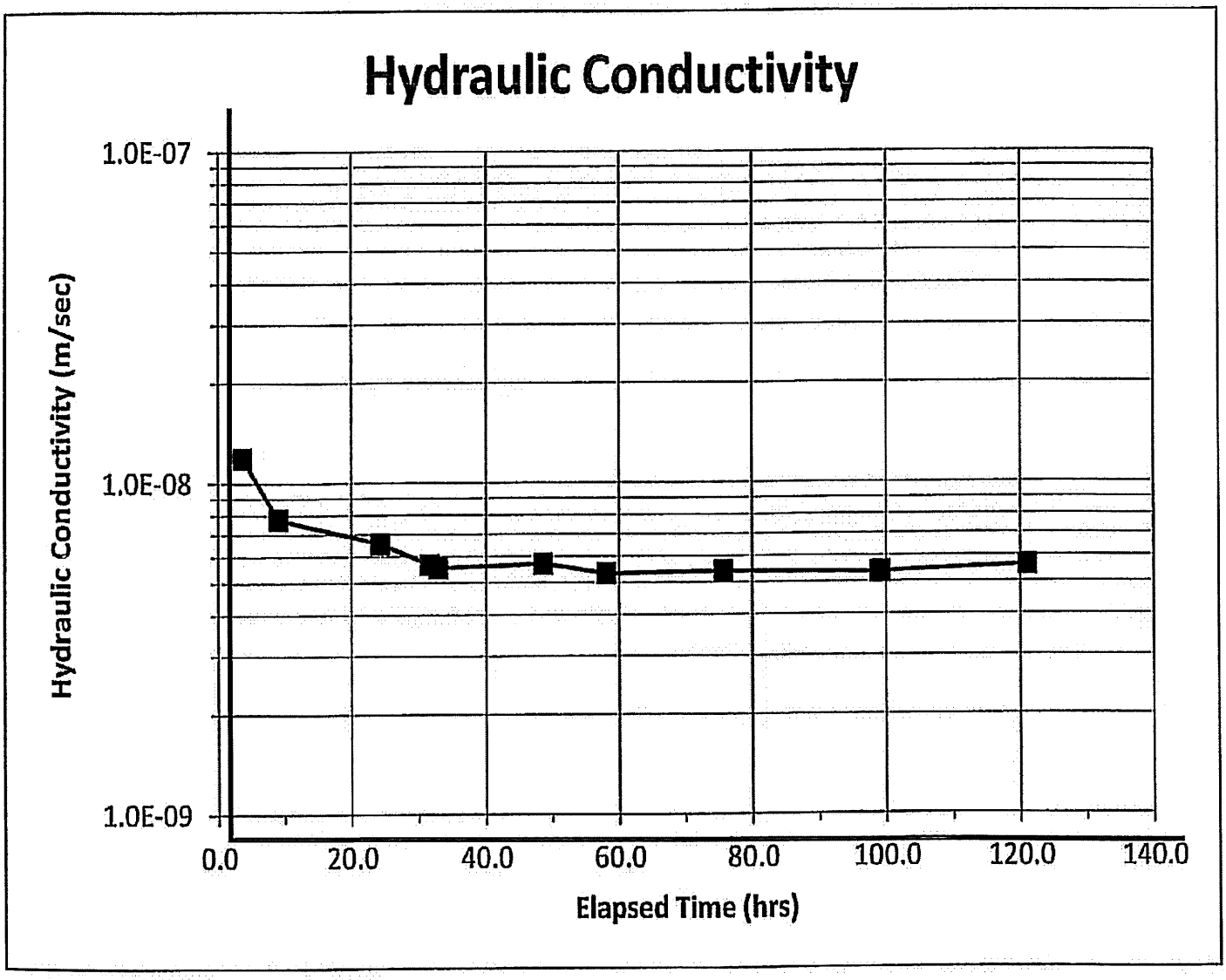
Clark Hryhoruk, M.Sc., P.Eng.
President, Geotechnical Engineer

CDH/tdr

Attachments: Table 1 – Soil Sample Analysis
Figure 1 – Hydraulic Conductivity Versus Elapsed Time

TABLE 1
HYDRAULIC CONDUCTIVITY TEST DATA
Dauphin River

SAMPLE IDENTIFICATION	Combined Sample
ENG-TECH Reference No.	14-067-01-9
Length of Sample in Tube (cm)	N/A
Length (cm)	5.51
Diameter (cm)	6.95
Area (cm^2)	38.0
Volume (cm^3)	209.4
Water Content (%)	25.0
Bulk Dry Density (kg/m^3)	1834
Specific Gravity (G_s) (assumed)	2.70
Void Ratio	0.840
Degree of Saturation (%)	80.4
Length (cm)	5.54
Diameter (cm)	6.95
Area (cm^2)	37.9
Volume (cm^3)	210.1
Water Content (%)	30.0
Bulk Dry Density (kg/m^3)	1931
Specific Gravity (G_s) (assumed)	2.70
Void Ratio	0.817
Degree of Saturation (%)	99.1
Confining Pressure (kPa)	103.4
Pore Water Pressure (kPa)	82.7
Effective Stress (kPa)	20.7
Confining Pressure (kPa)	103.4
Pore Water Pressure (kPa)	82.7
Effective Stress (kPa)	20.7
Hydraulic Gradient	20.3
Permeant Fluid	Distilled Water
HYDRAULIC CONDUCTIVITY at TEST TEMPERATURE OF 22 °C (cm/sec)	5.5×10^{-7}
HYDRAULIC CONDUCTIVITY at TEMPERATURE OF 20 °C (K_{20}) (cm/sec)	5.24×10^{-7}



ENG-TECH Consulting Limited
6 - 854 Marion Street
Winnipeg, MB R2J 0K4
Phone: (204) 233-1694
Fax: (204) 235-1579

ENG. STAMP:

APEGM
Certificate of Authorization
ENG-TECH Consulting Limited
No. 2475 Expiry: April 30, 2014

CLIENT: ASKI GEOSCIENCES LTD.	DWG DESCRIPTION: HYDRAULIC CONDUCTIVITY VERSUS ELAPSED TIME
PROJECT: DR807 SOIL ANALYSIS DAUPHIN RIVER, MANITOBA	SCALE: NTS
	FILE No.: 14-067-01 / CLIENT DWG/FIG. No.:
DRAWN BY: TDR / DATE: APRIL 2014	ENG-TECH DWG/FIG. No.: 1 / NO.:

H. MANALO CONSULTING LTD.

H. MANALO CONSULTING LTD.
100 MALLARD WAY, WINNIPEG, MB R2R 1Y1
PHONE: 204 632-7519 CELL: 204 997-1355
hmanalo@mts.net

PARTICLE SIZE ANALYSIS OF SOILS TEST REPORT

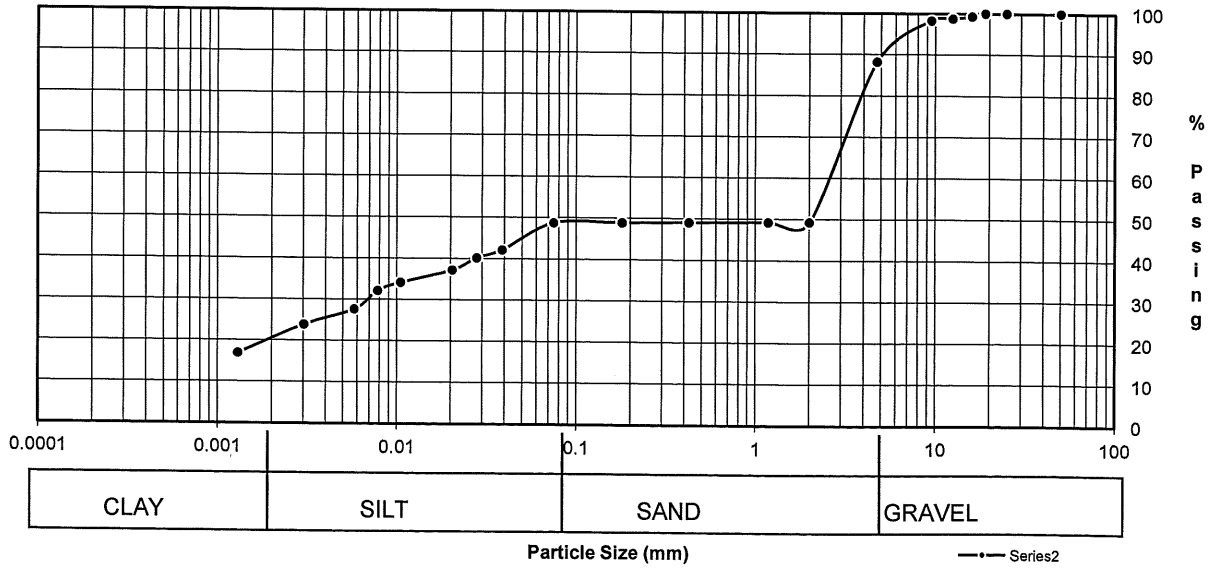
CLIENT: Aski Geosciences Ltd. PROJECT NO. HMCL 14-17
207-1555 St. James Street
Winnipeg, Manitoba
ATTN: Rob Kupchak
PROJECT: Hydrometer Analysis - DR 807

Date Sampled:	N/A	Date Received:	01-May-14
Sampled By:	Client	Date Tested:	02-May-14

Material Identification
B.H./T.H. No. **TP6 @ 5' (Site 3)**
Sample No. **HM 31**
Sample Source n/a
Specific Gravity of Material: 2.65

Sieve Analysis		Hydrometer Analysis	
Sieve (mm)	% Passing	Diameter	% Finer
50.00	100.0		
25.00	100.0		
19.00	100.0		
16.00	99.3		
12.50	98.7	0.0388	42.1
9.50	98.2	0.0280	40.1
4.75	88.2	0.0204	37.2
2.00	49.3	0.0105	34.1
1.18	49.2	0.0078	32.1
0.425	49.1	0.0058	27.6
0.180	48.9	0.0030	23.8
0.075	48.7	0.0013	16.9

Grain Size Analysis



SOIL DESCRIPTION	% Composition		D10	
	12	Gravel	D30	0.00800
	39	Sand	D60	3.00000
	33	Silt	Cu	
	16	Clay	Cc	

Remarks: Test Method: ASTM D422, D2216, D4318
Technician: ECS

REVIEWED BY: Hermie Manalo

Stantec Consulting Ltd.
199 Henlow Bay, Winnipeg MB R3Y 1G4

April 3, 2014
File: 123301415

Attention: Mr. Colin Ledger
Aski Geosciences Ltd.
Suite 207-1555 St. James Street
Winnipeg, MB R3H 1B5

Dear Colin,

Reference: Dauphin River Lagoon Site 3

One soil sample, identified as TH1 (3' to 4') was submitted to our laboratory on March 18, 2014.The sample was tested in accordance with ASTM D5084, Measurement of Hydraulic Conductivity of Saturated Porous Materials using a Flexible Wall Permeameter. The test result is provided in the attached hydraulic conductivity report and is summarized in the following table:

Sample ID	Hydraulic Conductivity, "k_{20}"
TH1 – 3' to 4'	1.0×10^{-8} cm/s

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

Regards,

STANTEC CONSULTING LTD.

Jason Thompson, C.E.T.
Associate - Manager, Materials Testing Services
Phone: (204) 928-4004
Fax: (204) 488-6947
Jason.Thompson@stantec.com

Attachment: Hydraulic conductivity report.

Stantec

LABORATORY
199 Henlow Bay
Winnipeg MB R3Y 1G4
Tel: (204) 488-6999

HYDRAULIC CONDUCTIVITY
ASTM D5084

Aski Geoscience Ltd.
Suite 207 - 1555 St. James Street
Winnipeg, Manitoba
R3H 1B5

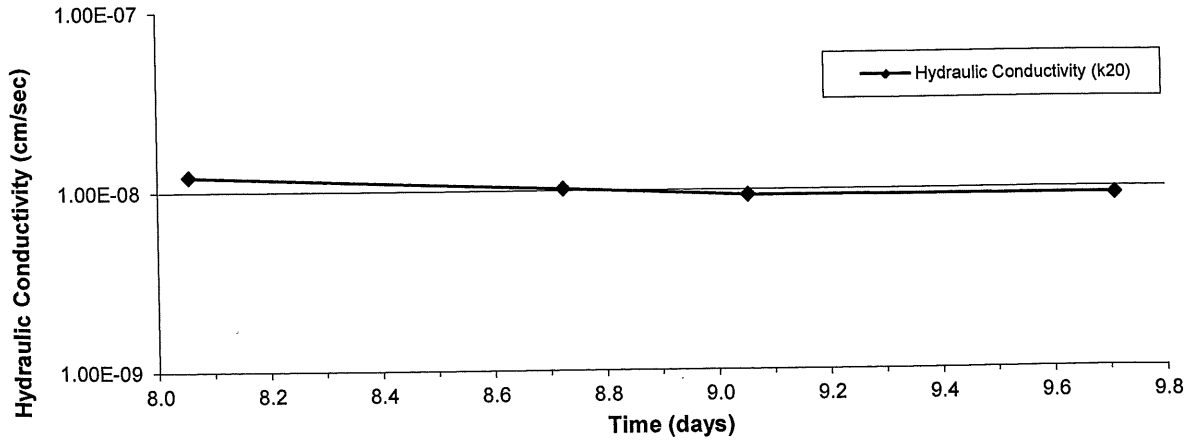
PROJECT: Dauphin River
3 Lagoon Site

Attention: Colin Ledger

PROJECT NO.: 123301415

SAMPLE I.D.:	**TH1 - 3' to 4'**
SOIL DESCRIPTION:	Brown, stiff, moist, high plasticity clay trace silt and trace fine to coarse gravel
DATE TESTED:	March 18 to April 2, 2014
CONFINING PRESSURE (kPa):	137.9
EFFECTIVE SATURATION STRESS (kPa):	34.5
ASSUMED SPECIFIC GRAVITY:	2.71
HYDRAULIC GRADIENT:	19.9
TYPE OF PERMEANT LIQUID:	De-aired Water
HYDRAULIC CONDUCTIVITY, "k" (cm/s):	1.1E-08
HYDRAULIC CONDUCTIVITY, "k_{20}" (cm/s):	**1.0E-08**

	Height (mm)	Diameter (mm)	Wet Mass (g)	Dry Density (g/cm^3)	Water Content (%)	Saturation (%)
Initial Reading	74.1	71.5	629.8	1.771	19.4	99.4
Final Reading	74.4	71.5	636.8	1.770	20.4	104.3



April 3, 2014

REVIEWED BY: Jason Thompson, C.E.T.

APPENDIX C - SITE PHOTOS

- **Photo C1:** Sparse trees and peat cover at Lagoon Site #3 (March 15, 2014).
- **Photo C2:** Clearing snow and brush to Lagoon Site #1 (March 14, 2014).
- **Photo C3:** Snow clearing at Lagoon Site #2 (March 14, 2014).
- **Photo C4:** Advancing testpit at Lagoon Site #1 (March 14, 2014).
- **Photo C5:** Testpit at Lagoon Site #2 (March 14, 2014).
- **Photo C6:** Drainage ditch north of proposed Water Treatment Plant (March 15, 2014).

Photo C1
Sparse trees and peat cover at Lagoon Site #3
(March 15, 2014).

Photo C2
Clearing snow and brush to Lagoon Site #1
(March 14, 2014).

Photo C3
Snow clearing at Lagoon Site #2
(March 14, 2014).

Photo C4
Advancing testpit at Lagoon Site #1
(March 14, 2014).

Photo C5
Testpit at Lagoon Site #2
(March 14, 2014).

Photo C6
Drainage ditch north of proposed Water Treatment Plant (March 15, 2014).

Appendix D

Title Page

Plan L1: Proposed Lagoon with Test Hole Location, Drainage Route and Setback Plan

Plan L2: Proposed Lagoon Layout Plan

Plan L3: Dike Details

Plan L4: Miscellaneous Details

Plan L5: Miscellaneous Details (cont.)

DAUPHIN RIVER FIRST NATION

WASTEWATER LAGOON

ENVIRONMENT ACT PROPOSAL

PRELIMINARY
NOT FOR CONSTRUCTION

REDUCED DRAWING SET
DO NOT SCALE

PLAN INDEX

LAGOON

JR Cousin Consultants Ltd.

91A Scurfield Blvd. Winnipeg MB R3Y 1G4
p. (204) 489-0474
f. (204) 489-0487
www.jrcc.ca

ENGINEERING EXCELLENCE SINCE 1981

PRELIMINARY
NOT FOR CONSTRUCTION

SCALE BAR
(IN METRES)
100 0 50 100 200 300 400 500
1:5000

No.	REVISIONS	DATE	INITIALS

B.M. EL.

LOCATIONS OF UNDERGROUND STRUCTURES/UTILITIES AS SHOWN ARE BASED ON AVAILABLE INFORMATION BUT NO GUARANTEE IS GIVEN OR IMPLIED THAT ALL EXISTING UNDERGROUND STRUCTURES/UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL UNDERGROUND STRUCTURES/UTILITIES MUST BE OBTAINED FROM THE APPROPRIATE AUTHORITY/OWNER, BY THE CONTRACTOR, BEFORE PROCEEDING WITH CONSTRUCTION.

APEGM
Certificate of Authorization
J.R. Cousin Consultants Ltd.
No. 234 **Date:** 15/04/22

ENGINEER'S SEAL
PROVINCE OF MANITOBA
J.R.L. COUSIN
Member
22391
REGISTERED PROFESSIONAL ENGINEER

JR Cousin Consultants Ltd.
91A Scurfield Blvd. Winnipeg MB R3Y 1G4
p. (204) 489-0474
f. (204) 489-0487
www.jrcc.ca
ENGINEERING CONSULTANTS
ENGINEERING EXCELLENCE SINCE 1981

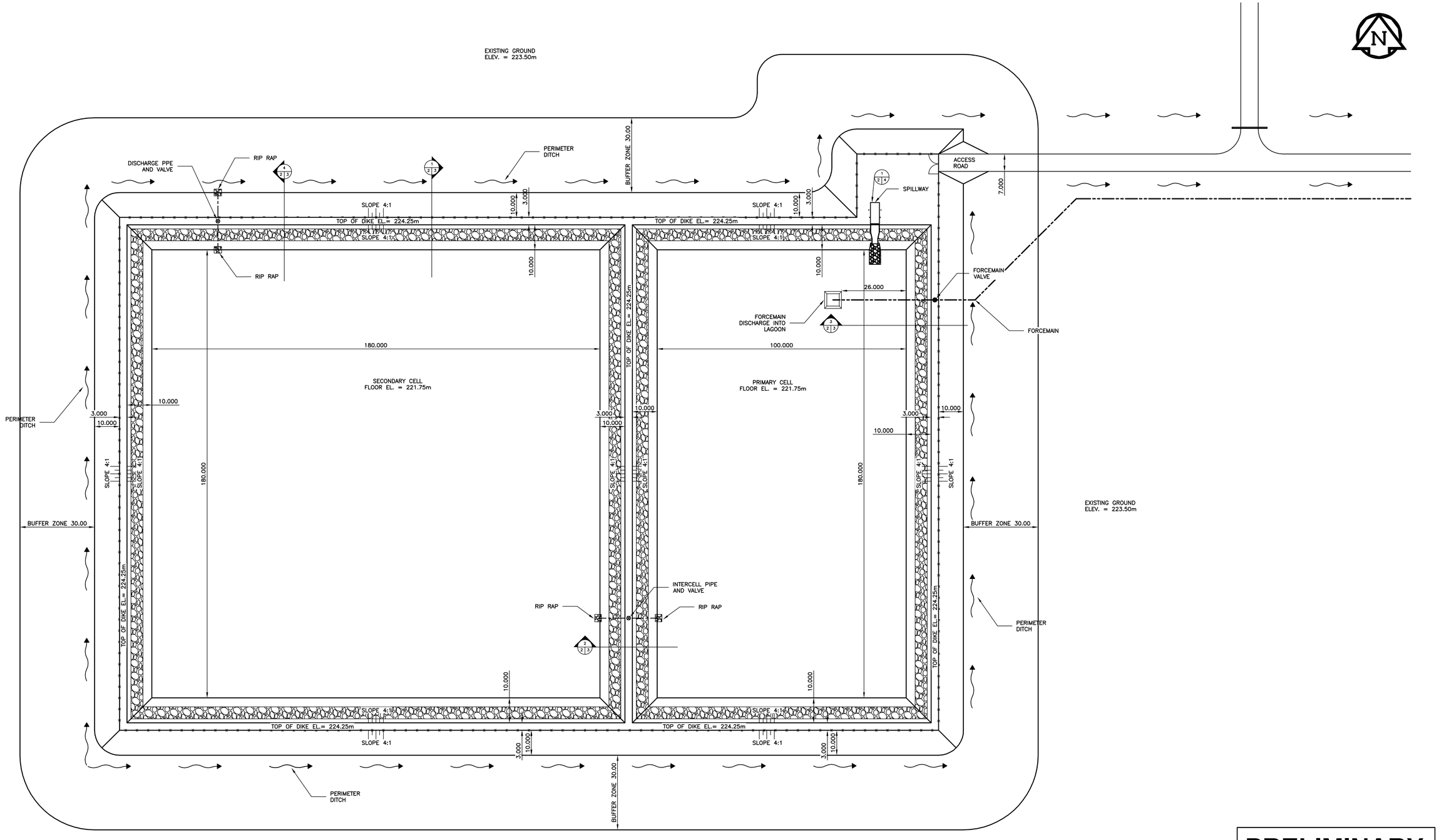
CODE:	D-206.05
DESIGNED BY:	MP
DRAWN BY:	MP
REVIEWED BY:	JRC

PROJECT: DAUPHIN RIVER FIRST NATION WATER AND SEWER PROJECT

TITLE: PROPOSED LAGOON WITH TEST HOLE LOCATION, DRAINAGE ROUTE AND SETBACK PLAN

SCALE:	DATE:	PLAN:	SHEET:
1:5000	15/03/26	L1	1 of 5

Apr 22, 2015 - 3:01pm P:\300\306 Dauphin River Band\306.05 Water and Sewer Project\04 Drawings\Lagoon_EXP.L1 - Proposed Lagoon with Test Hole Locations, Drainage Route and Setback Plan.dwg



SCALE BAR
(IN METRES)

15 0 7.5 15 30 45 60 75

1:750

No.	REVISIONS	DATE	INITIALS

B.M. EL.

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APEGM
Certificate of Authorization
J.R. Cousin Consultants Ltd.
No. 234 **Date:** 15/04/22

ENGINEER'S SEAL
PROVINCE OF MANITOBA
J.R.L. COUSIN
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ENGINEERING CONSULTANTS
ENGINEERING EXCELLENCE SINCE 1981

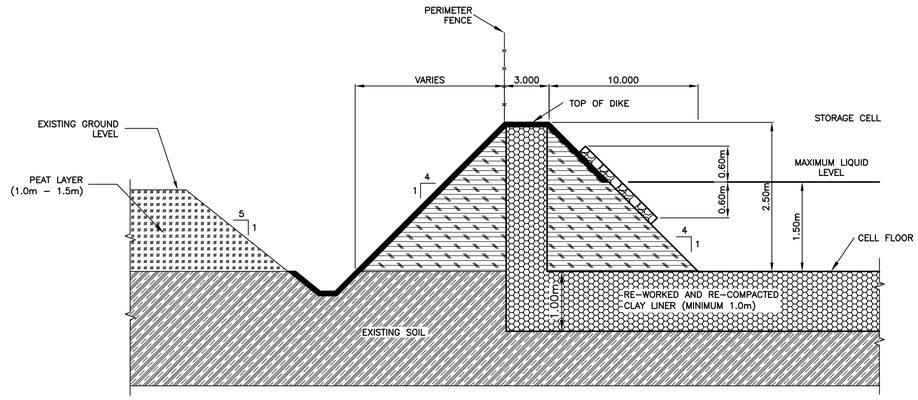
CODE:	D-206.05
DESIGNED BY:	MP
DRAWN BY:	MP
REVIEWED BY:	JRC
PROJECT:	DAUPHIN RIVER FIRST NATION WATER AND SEWER PROJECT
TITLE:	PROPOSED LAGOON LAYOUT PLAN
SCALE:	1:750
DATE:	15/03/26
PLAN:	L2
SHEET:	2 of 5

PRELIMINARY
NOT FOR CONSTRUCTION

Apr 22, 2015 - 3:03pm P:\2015\206 Dauphin River Band\206.05 Water and Sewer Project\04 Drawings\Lagoon EAP\L2 - Proposed Lagoon Layout Plan.dwg

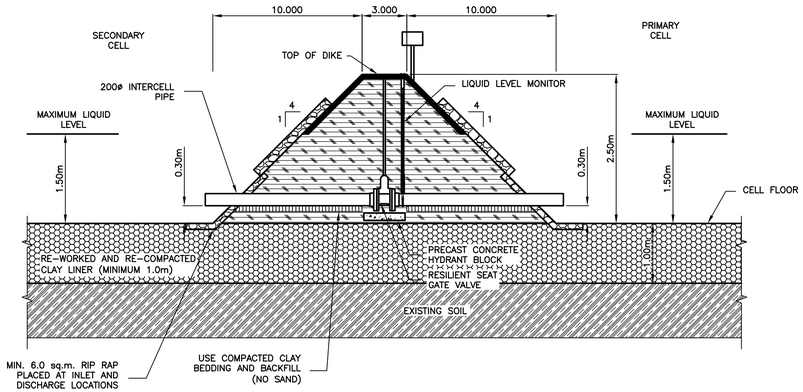
LEGEND:

- EXCAVATED AND COMPACTED CLAY
- EXCAVATED AND COMPACTED MIXTURE OF SOILS
- EXISTING SLIGHTLY PLASTIC, BROWN CLAY
- RIP RAP
- TOPSOIL
- EXISTING PEAT



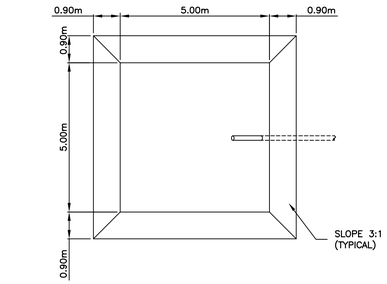
1 / 2 3 PERIMETER DIKE IN STORAGE CELL

HOR = 1:200
VER = 1:50



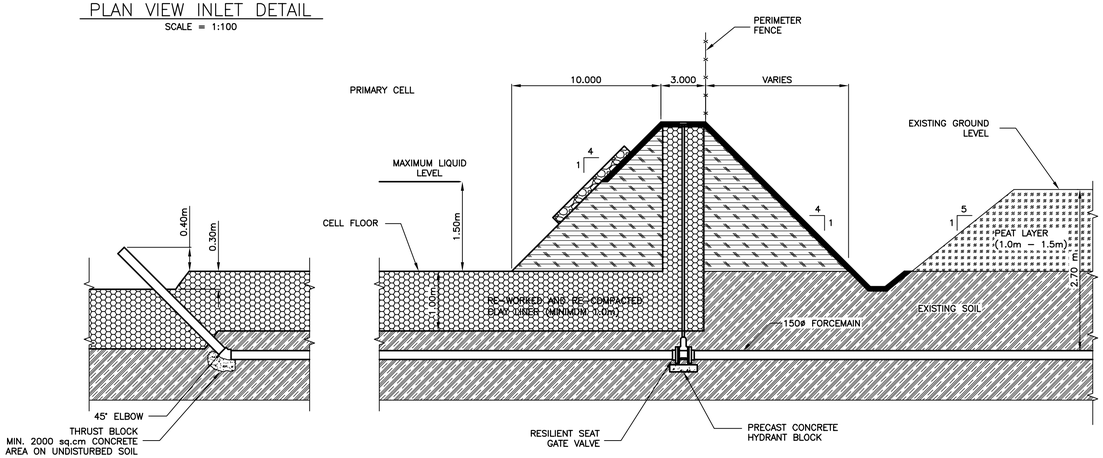
2 / 2 3 INTERCELL DIKE AT INTERCELL PIPE

HOR = 1:200
VER = 1:50



PLAN VIEW INLET DETAIL

SCALE = 1:100



3 / 2 3 PERIMETER DIKE AT FORCEMAIN INLET

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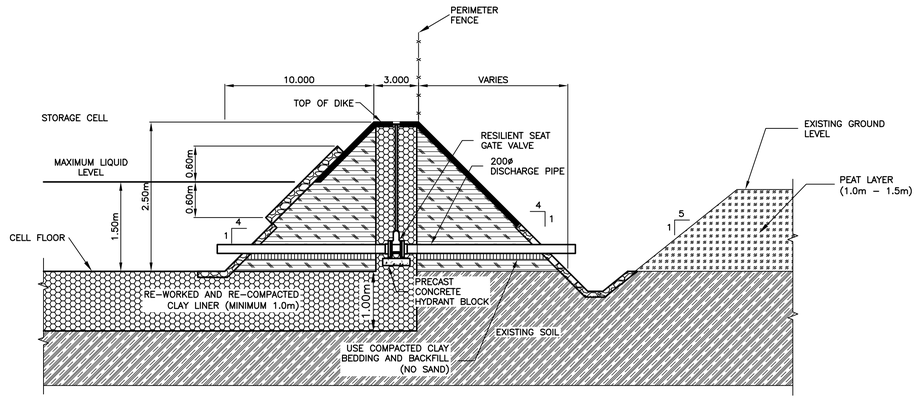

4 / 2 3 PERIMETER DIKE AT DISCHARGE PIPE

HOR = 1:200
VER = 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:** 15/04/22

ENGINEER'S SEAL
PROVINCE OF MANITOBA 15/04/22 J.R.L. COUSIN Member 22391 REGISTERED PROFESSIONAL ENGINEER

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p. (204) 489-0474
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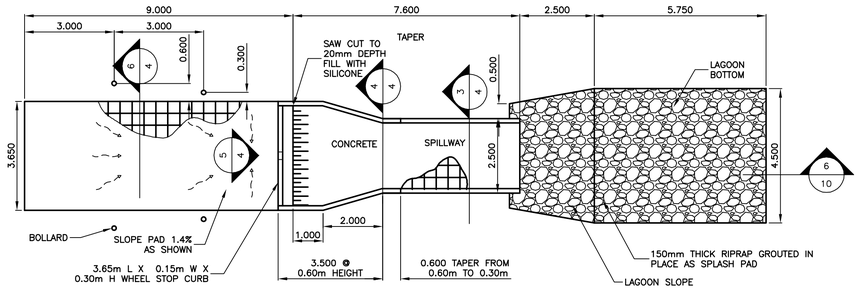
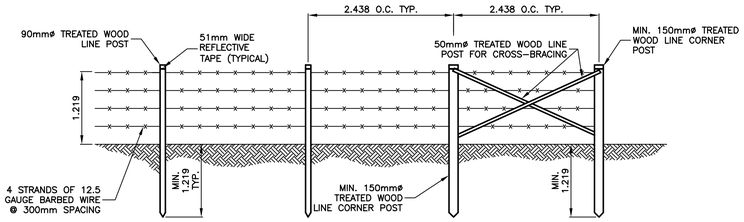
www.jrcc.ca
ENGINEERING CONSULTANTS
ENGINEERING EXCELLENCE SINCE 1981

CODE:	D–206.05
DESIGNED BY:	MP
DRAWN BY:	MP
REVIEWED BY:	JRC
PROJECT:	DAUPHIN RIVER FIRST NATION WATER AND SEWER PROJECT
TITLE:	DIKE DETAILS
SCALE:	AS NOTED
DATE:	15/03/26
PLAN:	L3
SHEET:	3 of 5

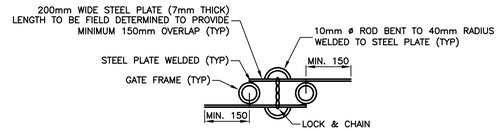


1/2/4 SPILLWAY PLAN VIEW
SCALE = 1:100



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

7/4 CORNER FENCE DETAIL
SCALE = 1:50



8/4 LOCK DETAIL
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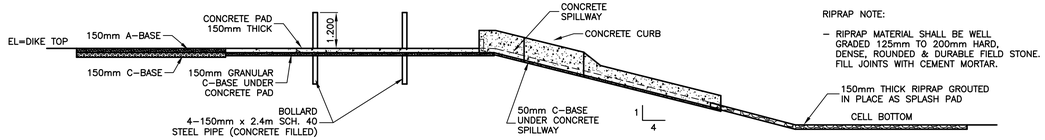
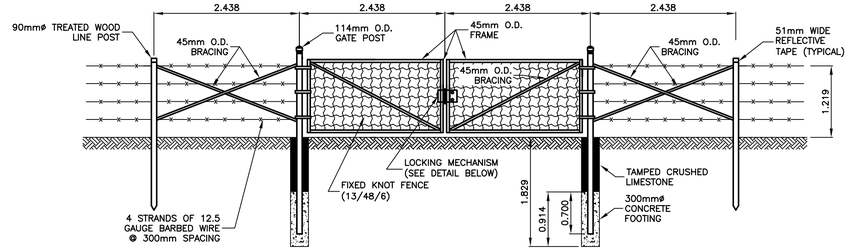
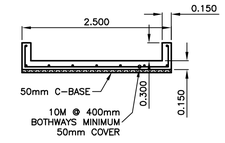


RIPRAP NOTE:
- RIPRAP MATERIAL SHALL BE WELL GRADED 125mm TO 200mm HARD, DENSE, ROUNDED & DURABLE FIELD STONE. FILL JOINTS WITH CEMENT MORTAR.

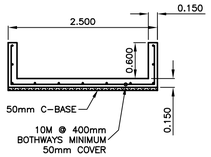
2/4 SPILLWAY SECTION
SCALE = 1:100



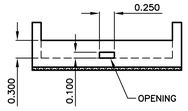
9/4 GATE DETAIL
SCALE = 1:50



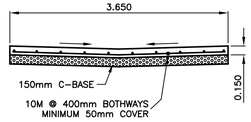
3/4 CONCRETE SPILLWAY SECTION
SCALE = 1:50



4/4 CONCRETE SPILLWAY SECTION
SCALE = 1:50



5/4 CONCRETE SPILLWAY END ELEVATION
SCALE = 1:50



6/4 CONCRETE PAD SECTION
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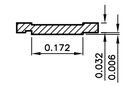
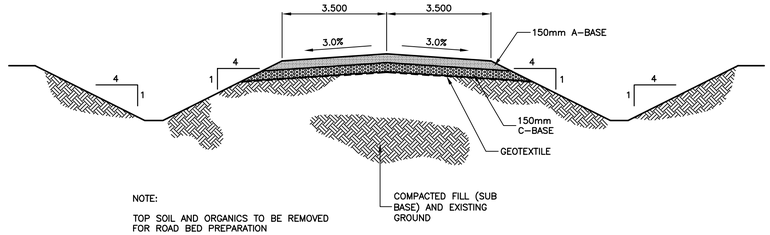
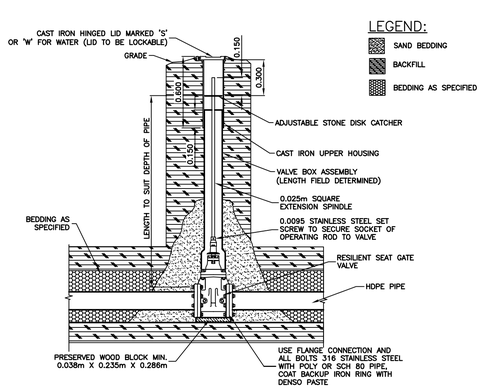


COVER DETAIL
SCALE = 1:10



NOTE:
TOP SOIL AND ORGANICS TO BE REMOVED FOR ROAD BED PREPARATION

10/4 ACCESS ROAD CROSS-SECTION
Horizontal Scale = 1:100
Vertical Scale = 1:50



11/4 LAGOON DIKE VALVE DETAIL
SCALE = 1:25

PRELIMINARY
NOT FOR CONSTRUCTION

No.	REVISIONS	DATE	INITIALS
	B.M. EL.		
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APEGM
Certificate of Authorization
J.R. Cousin Consultants Ltd.
No. 234 Date: 15/04/22

ENGINEER'S SEAL
PROVINCE OF MANITOBA
J.R.L. COUSIN
Member
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REGISTERED PROFESSIONAL ENGINEER
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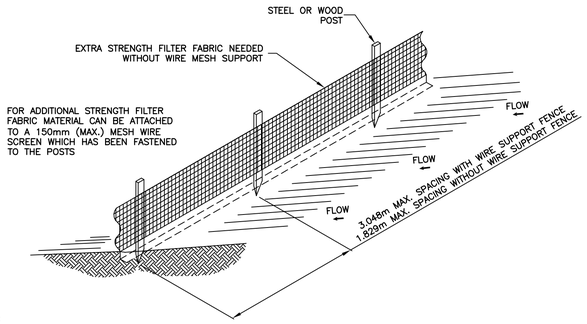
CODE:	D-206.05
DESIGNED BY:	MP
DRAWN BY:	MP
REVIEWED BY:	JRC

PROJECT: DAUPHIN RIVER FIRST NATION WATER AND SEWER PROJECT

TITLE: FENCE, GATE, SPILLWAY, ACCESS ROAD AND LAGOON DIKE VALVE DETAILS

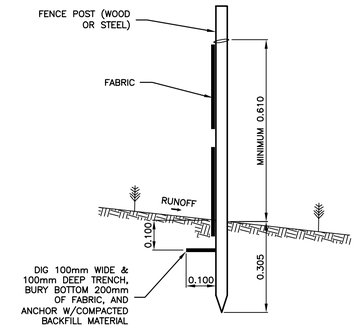
SCALE:	DATE:	PLAN:	SHEET:
AS NOTED	15/03/26	L4	4 of 5



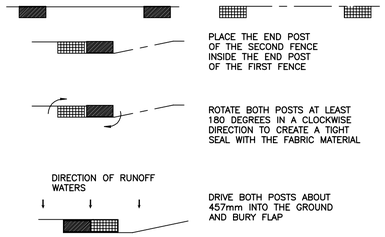
NOTES:

1. THE HEIGHT OF A SILT FENCE SHALL NOT EXCEED 914mm.
2. HE 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.

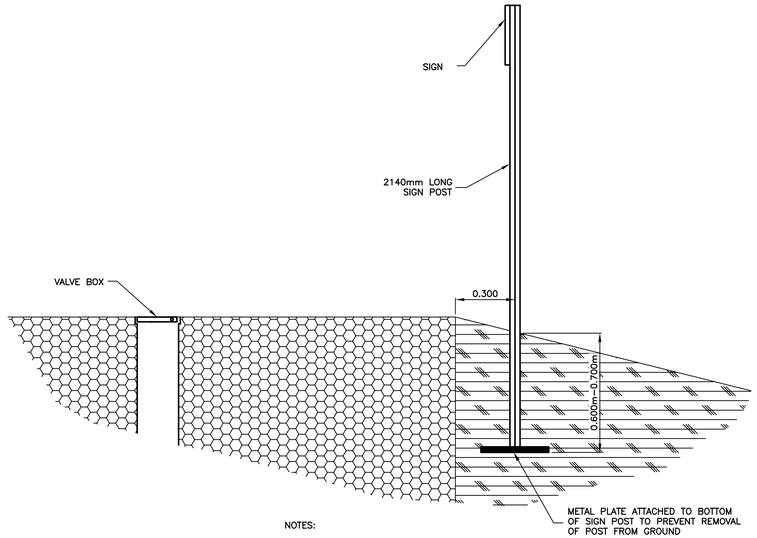
1/5 SILT FENCE DETAIL
SCALE = 1:40



2/5 SILT FENCE SECTION
SCALE = 1:10



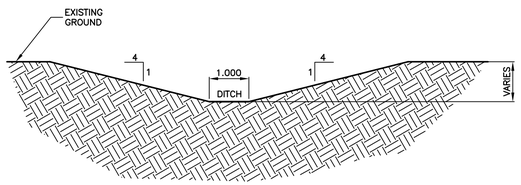
3/5 ATTACHING TWO SILT FENCES
SCALE = 1:10



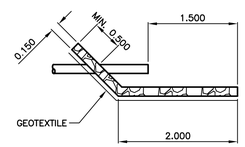
NOTES:

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

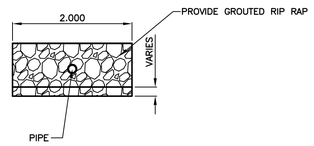
4/5 VALVE MARKER DETAIL
SCALE = 1:15



5/5 TYPICAL DISCHARGE DITCH DETAIL
SCALE = 1:75



SIDE VIEW



FRONT VIEW

NOTE:

–RIP RAP MATERIAL SHALL BE WELL GRADED 125mm TO 200mm HARD, DENSE, ROUNDED & DURABLE FIELD STONE.

6/5 RIP RAP DETAIL
SCALE = 1:50

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	B.M. EL.		

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CODE:	D–206.05
DESIGNED BY:	MP
DRAWN BY:	MP
REVIEWED BY:	JRC
PROJECT:	DAUPHIN RIVER FIRST NATION WATER AND SEWER PROJECT
TITLE:	SILT FENCE, VALVE MARKER, DISCHARGE DITCH AND RIP RAP DETAILS
SCALE:	AS NOTED
DATE:	15/03/26
PLAN:	L5
SHEET:	5 of 5

Apr 22, 2015 - 3:05pm K:\205\206 Dauphin River Band\206.05 Water and Sewer Project\04 Drawings\Layout Files\L4.L5 - Miscellaneous Details.dwg