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March 29, 2016 Ref.: 3315449-000-EAP

Ms. Tracey Braun, Director
Manitoba Conservation and Water Stewardship
Environmental Approvals
Suite 160, 123 Main Street
Winnipeg MB R3C 1A5

Dear Ms. Braun:

Re: Environment Act Proposal, Municipality of WestLake – Gladstone Land Application of Lagoon Sludge

MMM Group Limited, a WSP Global Company (MMM) has been retained by the Municipality of WestLake – Gladstone to submit a comprehensive Environment Act Proposal for the Land Application of Lagoon Biosolids from Cells 1, 2 and 3, located on Section 29-14-11WPM.

The objective of this Environment Act Proposal is to provide documentation in support of attainment of an Environment Act Licence for the land application of biosolid materials in an environmentally sustainable and agronomically suitable manner. Biosolid loading limits have been and will be determined to target available nitrogen and phosphorus levels for a barley crop and set metal loading limits for the agricultural field in the application program.

The Municipality's schedule is to complete the land application by November 10, 2017 at the latest, and therefore it would be greatly appreciated to have a final Environment Act Licence active by early October, 2017 as this will ensure the schedule for the land application program.

For your consideration, please find enclosed an electronic (USB drive) copy and four printed copies of the Environmental Act Proposal, the application form and application fee for $7,500.00 made out to the Minister of Finance. If you have any questions or concerns about this submission, please contact the undersigned at 204-272-2020.

Yours truly,

MMM Group Limited

Darren Keam, M.Sc., P.Ag.
Senior Project Manager
Environmental Management

DK/tc

MMM Group Limited

ENVIRONMENT ACT PROPOSAL RURAL MUNICIPALITY OF WESTLAKE - GLADSTONE LAND APPLICATION OF LAGOON BIOSOLIDS

FINAL

PREPARED FOR:

Manitoba Conservation and Water Stewardship
Environmental Approvals Branch

SUBMITTED BY:

WSP | MMM GROUP

COMMUNITIES
TRANSPORTATION
BUILDINGS
INFRASTRUCTURE

March 2016 | 3315449-000-EAP

ENVIRONMENT ACT PROPOSAL
MUNICIPALITY OF WESTLAKE - GLADSTONE
LAND APPLICATION OF LAGOON BIOSOLIDS

3315449-000-EAP

Prepared for:

Manitoba Conservation and Water Stewardship Environmental Approvals Branch

On Behalf Of:

Municipality of WestLake - Gladstone

Prepared by:

MMM Group Limited

March 29, 2016

Prepared by:

Brian Moons, B.Sc., EPt
Biologist
Dated: March 29, 2016

Reviewed by:

MANITOBA
Darren D. Keam, P.Ag.
MIA #1160
AGROLOGIST

Darren Keam, M.Sc., P.Ag.
Project Manager
Dated: March 29, 2016

EXECUTIVE SUMMARY

Introduction

This Environment Act Proposal (EAP) is submitted to the Manitoba Conservation and Water Stewardship (MCWS) Environmental Approvals Branch (EAB), as required under *The Environment Act* for the purpose of obtaining a Class 2 Environment Act Licence (EAL) for land application of biosolid material from the Municipality of WestLake - Gladstone wastewater treatment lagoon Cells 1, 2 and 3.

The Municipality of WestLake - Gladstone is proposing to initiate a land application program for biosolid materials from the Gladstone wastewater treatment lagoon Cells 1, 2 and 3 located on Section 29, Township 14, Range 11WPM (**Figure 3**, **Appendix A**). In 2017 it is planned that biosolid materials will be excavated from the bottom of lagoon Cells 1, 2 and 3 and included in a land application program. Sampling for biosolid material from the lagoon cells for nutrient and metal analysis was conducted in October 2015. The biosolid materials will be applied onto privately owned agricultural fields located in the Municipality of WestLake - Gladstone within a distance of 3 kilometres (km) from the lagoon site.

There is approximately 20,000 cubic metres of biosolid material from lagoon Cells 1, 2 and 3 that will be land applied onto approximately 233 hectares of agricultural land.

Objective

The objective of this EAP is to provide documentation in support of attainment of an EAL for the land application of biosolid materials in an environmentally sustainable and agronomically suitable manner. Biosolid loading limits have been/will be determined to target optimum available nitrogen and phosphorous levels for grain and oil seed crops and set metal loading limits for each agricultural field in the application program. If EAL approval is granted in early October 2017 by the EAB, it is anticipated that the biosolid application to the land base for stockpiled biosolid material from lagoon Cells 1, 2 and 3 will begin in late October and be completed by November 10, 2017.

Biosolid Application Rates

A hypothetical application rate was developed based on residual nitrogen and phosphorous concentrations and P_2O_5 crop removal. The hypothetical application rate is based on nutrient concentrations of the biosolid samples collected from Cells 1, 2 and 3. The hypothetical application rated is based on 134 kg ha^{-1} of required nitrogen and one (42 kg ha^{-1}) and two time (84 kg ha^{-1}) crop removal of a permitted crop (**Table 5.2**, **5.3** and **5.4**, **Appendix B**).

Cell 1 hypothetical application rates outlined in **Table 5.2**, **Appendix B**, the nitrogen application rate of 34.5 tonnes per hectare (dry) provides an estimated 304 percent of the required P_2O_5, which is not suitable. Therefore the preferred application rate is based on two times crop removal (84 kg ha^{-1}) of a permitted crop. This would provide approximately 82 kg ha^{-1} of required nitrogen and allowing for a top up of approximately 52 kg ha^{-1}. The total land area required is then anticipated to be approximately 63 hectares for a two times crop removal application rate for phosphorous. For risk management purposes 233 hectares has been reserved for land application program.

Based on interviews with the cooperating farm producer managing the land base, it is anticipated that each selected parcel will be suitable for a two times crop removal of phosphorous application rate. Detailed soil sample analysis will be obtained for each field and a detailed prescription rate will be provided to MCSW as promptly as possible for a timely approval prior to land application.

Summary

When applied at balanced rates, the land application of biosolids is a sustainable means to reuse nutrients within an agriculture system. The application of biosolid organic material enhances the water holding capacity, structure and tilth of soils thereby providing benefits to land utilized for agricultural production. The objective of this project is for the Municipality of West-lake - Gladstone to complete a land application of biosolid materials collected from wastewater treatment lagoon Cells 1, 2 and 3 in an agronomically and environmentally sustainable manner. There are no negative, long-term environmental or socioeconomic impacts associated with this project.

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APPENDICES

1.0 INTRODUCTION

This Environment Act Proposal (EAP) is submitted to the Manitoba Conservation and Water Stewardship (CWS) Environmental Approvals Branch (EAB), as required under *The Environment Act* for the purpose of obtaining a Class 2 Environment Act Licence (EAL) for land application of biosolid material from the Municipality of WestLake - Gladstone wastewater treatment lagoon Cells 1, 2 and 3.

1.1 Background

The Municipality of WestLake - Gladstone is proposing to initiate a land application program for biosolid materials from the Gladstone wastewater treatment lagoon Cells 1, 2 and 3 located on Section 29, Township 14, Range 11WPM (**Figure 3**, **Appendix A**). In 2017 it is planned that biosolid materials will be excavated from the bottom of lagoon Cells 1, 2 and 3 and included in a land application program. Sampling for biosolid material from the lagoon cells for nutrient and metal analysis was conducted in October 2015. The biosolid materials will be applied onto privately owned agricultural fields located in the Municipality of WestLake - Gladstone within a distance of 3 kilometres (km) from the lagoon site.

Cells 1 and 2 of Gladstone's wastewater lagoons were constructed in 1966. Release of effluent was via 5" aluminum pipe from the lagoons, north underneath the CN and CP rail tracks and discharged directly into the Whitemud River until 1982. Cell 3 was constructed in 1985, in which an outflow was installed to release wastewater into the pre-existing drain located on the west side of the adjacent Gladstone landfill.

Currently, the three lagoon cells are operated under The Clean Environment Commission (Order No. 1060) dated March 25, 1985, where the Town of Gladstone is considered to be the Applicant.

There are 419 accounts connected to the Gladstone sewer system which is directly pumped via forced main into the lagoons. It was reported by the Municipality of WestLake - Gladstone that in 2014 approximately 2.4 million liters of wastewater and septic effluent was released into the lagoons by licensed septic haulers.

1.2 Objective

The objective of this EAP is to provide documentation in support of attainment of an EAL for the land application of biosolid materials in an environmentally sustainable and agronomically suitable manner. Biosolid loading limits have been/will be determined to target optimum

available nitrogen and phosphorous levels for grain and oil seed crops and set metal loading limits for each agricultural field in the application program.

If the EAL approval is granted in a timely manner (October 2017) by the EAB, it is anticipated that the biosolid application of biosolid material from lagoon Cells 1, 2 and 3 will begin in early October and end by November 10, 2017.

1.3 Proponent

The proponent for this project is the Municipality of WestLake - Gladstone; Chief Administrative Officer, Ms. Eileen Peters. Project work has been approved by the Mayor, City Councillors and the Waterworks Department Head.

1.4 Description of Regulatory Requirements

The following Acts and Regulations apply to the project and will be adhered to throughout the completion of the project:

1. *The Environment Act C.C.S.M. c. E125 (1987)*
    a. Licensing Procedures Regulations 163/88
    b. Classes of Development Regulation 164/88
    c. Environment Act Fees Regulation 168/96
    d. Livestock Manure and Mortalities Management Regulation 42/98
    e. Environmental Regulations for Treatment and Disposal of Biosolids in Manitoba, Mike Van Den Bosch, P.Eng., Municipalities & Industrial Approvals, Manitoba Environment
2. *The Water Protection Act C.C.S.M. c. W65 (2005)*
    a. Nutrient Management Regulation 62/2008

2.0 DESCRIPTION OF PROPOSED PROJECT

The proposed project involves:

- The removal and land application in the fall of 2017 of approximately 20,000 (+15% contingency factor) cubic metres of biosolid material dredged from the Municipality of WestLake - Gladstone wastewater treatment lagoon Cells 1, 2 and 3.

- The biosolid material from Cells 1, 2 and 3 will be land applied based on appropriate agronomic rates calculated for each of the agricultural fields participating in the application program. All of the agricultural fields are located within 3 km of the lagoons. The main components and activities of the project are described in the sections below.

2.1 Components and Activities

2.1.1 Program Components

- Biosolid quality (nutrient levels, salts and metals) and physical properties (conductivity, pH, solids) was assessed through laboratory analytical testing conducted in October 2015 for Cells 1, 2 and 3.

- MMM identified potentially suitable receiving agricultural lands for the complete biosolid application program in 2017.
  - Land use agreements have been acquired from the participating farm producers (**Appendix C**).
  - A review of the environmental considerations for these lands was conducted through a desktop review including: agricultural capability, nutrient management requirements, and distance from sensitive features.
  - Based on anticipated residual soil fertility levels and phosphorous crop uptake and removal, it is estimated that approximately 233 hectares (ha) (576 acres) of agricultural land will be required. Lands in the program consist of annual croplands utilized to produce small grain and oil seeds.
  - Soil physical (texture) and chemical (pH, electrical conductivity, nutrients and metals) parameters will be assessed through a field sampling program and laboratory analytical testing, immediately after harvest or approximately three weeks prior to land application of biosolid materials.

- Based on the biosolid analytical results, agronomically appropriate application rates for each parcel of land receiving these materials will be calculated.

- Appropriate record keeping for load application by parcel and on-site monitoring of the application program will be completed.

2.1.2 Program Activities

- The biosolid materials will be dredged using a floating dredge (IMS Dredge 4010) which pumps the slurry directly from the lagoon bottom through pipes to a nurse tank at the receiving land location.

- These materials will then be directly injected to the parcels of land in the program in October/November of 2017 at the calculated prescribed agronomic rates for the biosolid materials from Cells 1, 2 and 3.

- The applied biosolid materials will be directly injected into the soil sub-surface for each parcel of land.

2.2 Crossing Agreements

One of the parcels of agricultural land (SW28-14-11WPM) that is to receive the biosolid materials is located east of the wastewater treatment lagoon site, across a municipal road, while the other land parcels are located to the south (NW, SW and SE21-14-11WPM), across Provincial Trunk Highway (PTH) #16 (**Figure 2**). In order to direct pump the biosolid slurry material to the receiving lands and eliminate the need for tanker trucks to transport the materials, a review of available culvert locations was conducted during a site visit to the area. Two culvert crossings were identified as the optimum means that would accommodate a hose to pass under the rail bed and the Provincial Trunk Highway (PTH) 16 to connect with the applicator's equipment.

2.2.1 Canadian National Railway (CNR)

Cells 1 and 2 are both located on the west side of the Canadian National Railway, a steel culvert in the rail bed is located on the northeast corner of cell two to permit drainage going to the east to the Gladstone Drain.

CNR was contacted in November 2015 in order to inquire about permissions regarding running a pipe underneath a CNR owned rail bed through an existing drainage culvert. The response received on January 15, 2016, from the Design and Construction Department at CNR indicated that a work permit would need to be completed two months prior to the land application program.

2.2.2 Manitoba Infrastructure and Transportation (MIT)

MMM has been in contact with the MIT Regional Office in Portage la Prairie and understand that there are means to obtain a permit to allow crossing of PTH 16 through an existing box culvert of the Gladstone Drain between field quarter-sections SW-28-14-11WPM and NW-21-14-11WPM.

2.3 Project Tasks and Schedule of Events

The project tasks and schedule of events for the proposed project are outlined below in **Table 2.1.**

Table 2.1 - Project Tasks and Schedule

Task	Timeline
Biosolid and sludge quality sample collection for laboratory analysis of physical and chemical parameters.	October 2015
Consultation with Local Study Area (LSA) farm producers for land use agreement formalization.	January 2016
Desktop review of land suitability in the LSA.	January 2016
Submission of EAP for the project.	February 2016
EAP approval and granting of EAL by CWS[1].	Winter 2016
Soil sample collection for laboratory analysis of physical and chemical parameters for biosolid application.	September - October 2017
Land application of biosolid materials from Cells 1, 2 and 3.	October (Post Harvest) – Early November 2017[2]
Project completion and closure with client.	November 30, 2017

NOTES:

[1]Based on current estimated review by the MCWS Technical Advisory Committee (TAC) and public review timeframe of 6 months

[2]Applicaiton will occur no later than November 10.

2.4 Regional and Local Study Areas

The Regional Study Area (RSA) is located approximately 125 km northwest of the City of Winnipeg and approximately 40 km east of the Town of Neepawa, Manitoba within the Municipality of WestLake - Gladstone (**Figure 1**, **Appendix A**). The Town of Gladstone is located within the RSA. The Local Study Area (LSA) includes parts of four quarter sections of land available for biosolid application (**Figure 2**, **Appendix A**). These parcels of land are located within 1 to 3 km southeast of the Town of Gladstone. Lands in this area are primarily used for agricultural production of small grain and forage crops.

2.4.1 Land Ownership and Management

Agricultural land owned by a farm producer within the LSA will be utilized for biosolid application for this project. Consultation with the land owner interested in having biosolid materials applied to their land was held in January 2016 in which a land use agreement was formalized and access to lands for soil sampling for assessment of land suitability for sludge application was granted. Certificates of Title and the landowner agreement for the proposed receiving lands are

available in **Appendix C**. **Table 2.2** provides a list of agricultural fields available for biosolid application and landowner name. **Figure 2** (**Appendix A**) provides an overview of agricultural fields put forward for land application.

Table 2.2 - Fields Available for Biosolid Application

Legal Land Location	Cooperating Farm Producer	Field Area (ha)	Manitoba Land Title #	Registered Owner
SW-28-14-11WPM	Gerald Cavat	56	1498397/3	G. Cavat Enterprises Ltee
NW-21-14-11WPM	Gerald Cavat	177	1499830/3	G. Cavat Enterprises Ltee
SW-21-14-11WPM				
SE-21-14-11WPM				

2.4.2 Current Land Use Development Controls

The fields SE21-14-1WPM, SW21-14-11WPM, NW21-14-11WPM and SW28-14-11WPM of the LSA are zoned as Restricted Agricultural Zone – Urban Fringe (AR-1) under the Municipality of Westbourne Zoning By-Law No. 1937 (June 14, 2005 - the former rural municipality that existed prior to the amalgamation of rural municipalities of Lakeview and Westbourne and the Town of Gladstone). Under the Zoning By-law, AR-1 Zone is defined as: “non-intensive agricultural activities in proximity to the Town of Gladstone, L.U.D.s and Settlements. It restricts agricultural activities in areas where it is not possible to permit a full range of agricultural uses where it is necessary to avoid land use conflicts. Some smaller holding and non-agricultural uses, such as farmsteads and supporting agricultural industries, which are compatible in the agricultural area, may be accommodated in this zone”.

Neighbouring land use zoning to the east of the LSA is zoned as Agricultural General Zone (AG) and is defined as: “a wide range of agricultural activities on large parcels of land in a fairly unrestricted manner. Special and intensive agricultural uses may be permitted on smaller parcels of land. Some small holding and non-agricultural uses, such as farmsteads and supporting agricultural industries, which are compatible in the agricultural area, may be accommodated in the zone”.

Personal communication with Ms. Coralie Smith, Assistant CAO with the Municipality of WestLake - Gladstone on January 11, 2016, indicated that no restrictions to biosolid application exist within the Municipality of WestLake - Gladstone’s By-laws for AR-1 zoned land.

2.4.3 Gladstone Wastewater Treatment Lagoon

The Gladstone wastewater treatment lagoon is located at Section 29-14-11WPM, on the southeast side of the Town of Gladstone (Figure 3, Appendix A). The lagoon is comprised of three cells: one primary cell (Cell 1), one secondary cell (Cell 2) and one polishing cell (Cell 3). Biosolid material will be dredged from Cells 1, 2 and 3 in 2017 for land application under this EAP.

3.0 DESCRIPTION OF EXISITING ENVIRONMENT IN THE LOCAL STUDY AREA

3.1 Biophysical Environment

The proposed project is located within the Gladstone Ecodistrict of the Lake Manitoba Plain Ecoregion which is covered by the broader Prairies Ecozone (Smith et al., 1998).

3.1.1 Climate

The Gladstone Ecodistrict is found within the most humid subdivision of the Grassland Transition Ecoclimatic Region. The ecodistrict is characterised by short, warm summers and cold winters with a mean average temperature of 2.2°C (Smith et al., 1998). The average crop growing season is 179 days with approximately 1630 growing degree-days. Mean annual precipitation is 490 mm, one quarter of which is in the form of snowfall. The Gladstone Ecodistrict has a moderately cold, subhumid to humid, Cryoboreal soil climate with an average annual soil moisture deficit of approximately 170 mm (Smith et al., 1998).

3.1.2 Physiography and Drainage

The general project area is located east of the sandy Lower Assiniboine Delta. The physiography ranges from smooth, level glaciolacustrine plain to gently sloping. The mean area elevation is 267 m above sea level (masl). The overall slope for the ecodistrict is northeasterly from the western edge of the district towards Lake Manitoba to the east (Smith et al., 1998).

The main drainage pathway for the area and within the RSA is the Whitemud River that drains into Lake Manitoba. The Whitemud River is located to the north and east of the Gladstone lagoons approximately 0.5 km and 1.8 km respectively and is classified as an Order 6 Stream. The Dead Lake Drain and Gladstone Drain, both second order drains, provides drainage within the southwest corner of the RSA (refer to **Figure 4**, **Appendix A**).

3.1.3 Surficial and Bedrock Geology

Deposits overlaying bedrock within the RSA are unconsolidated and up to 91 m thick (Langman, 1984). Surficial deposits are primarily fine deltaic sands with depths between 1 and 12 m and its reported that alluvial loams and sands can be found adjacent to the Whitemud River (Langman, 1984). These surficial deposits are underlain by the Amaranth, Reston and Melota Formations which are composed primarily of shales, sandstone and limestone with gypsum, anhydrite and red beds in the Amaranth Formation. These formations are from the Jurassic Period (Klassen et al., 1970).

3.1.4 Groundwater and Hydrological Description

Bedrock aquifers of limestone, sandstone and shale of the Jurassic Formations are considered to be saline and are an unlikely and insignificant source of domestic groundwater use in the area. These aquifer zones, however, may have significant flow zones. The saline water in the area may contain dissolved solids concentrations between 5,000 and 100,000 mg/L (Rutulis, 1986).

The aquifers overlaying bedrock within the RSA are within lenses of sand and gravel of the surficial deposits. The depth to these aquifers can range from only a few meters to greater than 100 m. It is reported that well yields in these aquifers can range from 0.1 L/s to greater than 100 L/s. However, within the RSA, water quality is reported to be very poor to slightly saline water to salty to very salt water. The total dissolved solids range from 2,500 to greater than 25,000 mg/L. In some areas where water is not considered potable, it may be acceptable for some livestock (Rutulis, 1986).

A search of the Manitoba GWDrill (2012) logs for groundwater wells within the LSA found no (zero) registered groundwater wells. A search for groundwater wells within the RSA including the number and recorded use of the wells identified is listed in **Table 3.1**. The groundwater well search results are included in **Appendix D**.

Table 3.1 - Groundwater Use Well Records within the RSA

Legal Land Location	GWdrill Results (GWDrill, 2012)	Groundwater Use
NW17-14-11W	1	Domestic, Livestock
SW20-14-11W	1	-
NE22-14-11W	3	Domestic (2); Test Well (1)
NW22-14-11W	1	Test Well
SE22-14-11W	2	Domestic (1); Test Well (1)
SW22-14-11W	3	Domestic (1); Test Well (2)
SE27-14-11W	1	Domestic

3.1.5 Soils

Soils in the ecodistrict consist primarily of imperfectly drained Gleyed Rego Black Chernozems that have been developed on slightly to strongly calcareous, shallow, glaciolacustrine sediment of loam to clay. Drainage of these soils internally is slowed due to clay surface textures in the south and clay substrate to the north thus producing a high water table (Smith et al., 1998). The occurrence of poorly drained Gleysolic and imperfectly drained, variably saline Black Solonetzic soils may also be present in the area (Smith et al., 1998). Specific soil characteristics of the LSA are discussed in the Land Suitability, Section 4.0.

3.1.6 Vegetation

The native vegetation of the Gladstone Ecodistrict originally consisted of trembling aspen groves separated by grasses, forbs and shrubs. As a result of cultivation, much of the native vegetation in the district has been replaced by agricultural crops (Smith et al., 1998).

3.1.7 Wildlife Species

Habitat for wildlife species is limited within the RSA due to the predominance of agricultural production. Species which persist in the region and have adapted to the agricultural landscape include white-tailed deer, jack rabbit, racoon, skunks, red fox, voles and mice and various bird species such as crows, blackbirds and songbirds.

3.1.8 Surface Water Bodies

There are no natural lakes within the RSA and wetlands have been reduced to small ephemeral depressions and small dugouts. Historic drainage patterns in the region have been altered over time to accommodate agricultural production. The Whitemud River is located to the east and north of the RSA and is defined as an Order 6 Stream. The Gladstone Drain and Dead Lake Drain both occur within the RSA and are both classified as Order 2 Streams.

3.1.9 Aquatic Life

Aquatic life in the RSA is restricted to the narrow vegetated buffer strips immediately adjacent to the Whitemud River and its tributaries and may include species such as frogs, dragonflies, turtles and garter snakes, as well as various waterfowl species.

A fish community and fish habitat inventory of streams and drains conducted between 2002 and 2006 by the Department of Fisheries and Oceans Canada (DFO) Central and Arctic Region in agricultural areas of Manitoba identified several minnow and fish species within the RSA. (Milani, 2013). The species that were inventoried through backpack electrofishing techniques include: Black Bullhead (*Ameiurus melas*), Blackside Darter (*Percina maculate*), Brook Stickleback (*Culaea inconstans*), Common Carp (*Cyprinus carpio*), Creek Chub (*Semotilus atromaculatus*), Emerald Shiner (*Notropis atherinoides*), Fathead Minnow (*Pimephales promelas*), Freshwater Drum (*Aplodinotus grunniens*), Johnny Darter (*Etheostoma nigrum*), Pearl Dace (*Margariscus margarita*), Sand Shiner (*Notropis stramineus*), Spottail Shiner (*Notropis hudsonius*), Tadpole Madtom (*Noturus gyrinus*), Western Blacknose Dace (*Rhinichthys obtusus*), White Sucker (*Catostomus commersonii*) and Yellow Perch (*Perca flavescens*). All species were caught in the Whitemud River and surrounding unnamed tributaries between 2002 and 2006 (Milani, 2013).

3.2 Potential Species of Concern

An online request was made to the Manitoba Conservation and Water Stewardship Wildlife and Ecosystems Protection Branch, Manitoba Conservation Data Centre (MBCDC) on November 19, 2015, with respect to species of conservation concern within the RSA including Sections 14-23, 26-35 within Township 14, Range 11WPM. Mr. Chris Friesen, Biodiversity Information Manager of the MBCDC examined database records and found two occurrences of species of conservation concern within the RSA boundaries; the Northern Prairie Skink with occurrence at SE 20-14-11WPM and the Eastern Wood-pewee with occurrences at NW 19-14-11WPM and SW 20-14-11WPM.

The Northern Prairie Skink (*Plestiodon septentrionalis*), a small, slender lizard is listed as S1 in Manitoba and therefore is defined as being very rare throughout its range or province (5 or fewer occurrences or few individuals) and may be vulnerable to extirpation. It is protected under

Manitoba's *Endangered Species and Ecosystems Act*, listed as Endangered under Schedule 1 of the *Species at Risk Act* (SARA), and listed as Endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). In Manitoba, the habitat of the Northern Prairie Skink Habitat is limited to areas of mixed-grass prairie in sandy soils.

The Eastern Wood-pewee (*Contopus virens*), a small forest songbird is listed as S4B in Manitoba. This rank is defined as the breeding status of the Eastern Wood-pewee is widespread, abundant and apparently secure throughout its range or in the province, with many occurrences, but may be of long-term concern. It is listed as Special Concern under COSEWIC due to the fact that the population of the Eastern Wood-pewee has been observed to be declining over the past 40 years likely due to habitat loss (Government of Canada, 2016).

3.3 Parks and Protected Areas

Several community green space and sports parks are located within the Gladstone town limits. No protected areas or wildlife management areas were identified within the RSA.

3.4 Socioeconomic Environment

3.4.1 Population

The settled populations within and adjacent to the RSA include the town of Gladstone with a population of 879 individuals (Statistics Canada, 2011), and with a total population in the Municipality of WestLake - Gladstone of approximately 3000 individuals (Municipality of WestLake-Gladstone, www.westlake-gladstone.ca).

3.4.2 Existing Land and Resource Uses

The parcels of land that are to receive the biosolid materials are classified as agricultural and are used for the production of annual crops such as cereals and oilseeds. Several rural residences adjoin some of these lands and one, second order level drain bisects the land parcels (refer to **Figure 4**, **Appendix A**). Other activities in the area surrounding the LSA include grazing for cattle. All appropriate set back distances will be applied as required for adjacent and neighbouring land use and for the second order drain.

3.4.3 Heritage Resources

A request was made to the Manitoba Historic Resources Branch (MHRB) on January 4, 2016 with respect to the location of heritage resources within the RSA including Sections 15-17, 20-22 and 27-28 within Township 14, Range 11WPM. Ms. Christina Nesbitt, Impact Assessment Archaeologist with the MHRB examined branch records and found that there were no concerns with the RSA (**Appendix C**).

3.4.4 First Nation Communities

No First Nation communities are located within the RSA and no lands owned by First Nations are included in the LSA.

4.0 LAND SUITABILITY

In order to assess whether lands within the LSA are suitable to receive biosolid materials, a desktop assessment of the LSA soils was completed that included a review of the dominant soil series, agricultural capability, nutrient management zone classes and agronomic practices of the participating landowner as outlined below.

4.1 Dominant Soil Series

Within the LSA there are a limited number of dominate soil series. Single soil series or compound map series and the applicable number of hectares are outlined in **Table 4.1** and characteristics of the soil series are outlined in **Table 4.2** and shown in **Figure 6** (**Appendix A**).

Table 4.1 – Soil series and the Aerial Extent within the LSA

Soil Series / Map Unit (percent area of polygon)	Aerial Extent (ha)
Fortier	7.03
Gervais	29.64
Gervais (50%) Graysville (50%)	6.72
Gnadenthal	21.20
Neuhorst (60%) Gnadenthal (40%)	129.32
Neuhorst (70%) Newton Siding (30%)	4.41
Osborne	7.09
Reinland	19.20
Willowbend	8.69

Table 4.2 - Classification of Soils and the Aerial Extent within the LSA

Order	Great Group	Subgroup	Soil Series, Family Description
Gleysolic – Poorly drained soils which may have an organic and/or an A horizon. The subsoils show gleying and are dull coloured, but may have brighter colored prominent mottles. Soils associated with wetness.[1]	**Humic Gleysol** – Contain at least 2% organic C and its rubbed colour varies from 3.5 or less.[1]	**Rego Humic Gleysol**	**Osborne** (OBO) developed on moderately to strongly calcareous lacustrine sediments, poorly drained.[2]
			Willowbend (WWB) developed on loamy, moderately to strongly calcareous, recent fluvial sediments, poorly drained.[2]
Chernozemic – Soils with chernozemic Ah horizon more than 10 cm thick and with B or C horizons of high base saturation divalent cations, calcium usually common. Well to imperfectly drained soil.[1]	**Black** – A horizon with dry colour Munsell values darker than 3.5[1]	**Gleyed Rego Black**	**Gnadenthal** (GDH) developed on loamy, stratified, moderately to strongly calcareous, fluvial and lacustrine sediments, imperfectly drained.[2]
			Graysville (GYV) developed on loamy, moderately to strongly calcareous, fluvial and lacustrine sediments overlying calcareous, clayey, lacustrine deposits at 70 to 100 cm in depth, imperfectly drained.[2]
			Neuhorst (NUH) developed on fine loamy, moderately to strongly calcareous fluvial and lacustrine sediments, imperfectly drained.[2]
			Newton Siding (NWN) developed on imperfectly drained, moderately to strongly calcareous fine loamy, fluvial and lacustrine sediments overlying stratified sandy sediments.[2]
			Reinland (RLD) developed on coarse loamy, calcareous, fluvial and lacustrine sediments, imperfectly drained.[2]
Regosolic – Soil with a weak horizon development.[1]	**Regosol** – A soil without an Ah horizon at least 10 cm thick and no B horizon at least 5 cm thick.[1]	**Gleyed Cumulic Regosol**	**Fortier** (FTE) developed on clayey, moderately to strongly calcareous, recent fluvial sediments, imperfectly drained.[2]
			Gervais (GVS) developed on loamy, moderately to strongly calcareous, recent fluvial sediments, imperfectly drained.[2]

[1]Agriculture Canada Expert Committee, 1987.

[2]Langman, 1984

4.2 Canada Land Inventory – Soil Capability for Agriculture

The Water Protection Act (C.C.sMc W65, 2005) Nutrient Management Regulation (62/2008) outlines nutrient application restrictions based on Canada Land Inventory Soil Capability Classification for agriculture ratings (Government of Manitoba, 2008). The Canada Land Inventory (CLI) is a dry-land agriculture capability inventory for rural Canada. The CLI limitations are based on climate, geology, soil chemical and physical characteristics (salinity and structure), droughtiness, inundation, erosion, stoniness and landscape topography of the soils.

The CLI groups mineral soils into seven classes with the same relative degree of limitation and then delineates subclasses within each class based on type of limitation (Fraser et al. 2001). Classes one to seven are based on increasing degree of limitation, the first three classes are capable of sustained cultivated crop production, class four is marginal for sustained arable cropping and class five is capable of pasture or hay, class six is capable of permanent pasture and class seven has no capability for arable crop or permanent pasture. There are thirteen different subclasses or limitations. Soils series within the LSA are identified as being of Class 2 with subclass designations of W. The class descriptions are as follows:

- Class 2 - Soils in this class have moderate limitations that restrict the range of crops or require moderate conservation practices. The soils are deep and hold moisture well. The limitations are moderate and the soils can be managed and cropped with little difficulty. Under good management they are moderately high to high in productivity for a fairly wide range of crops.

The subclass descriptions are as follows:

- 'W' - Excess Water - this subclass includes soils where excess water other than brought about by inundation is a limitation to agricultural use. Excess water may result from inadequate soil drainage, a high water table, seepage or from runoff from surrounding areas.

4.3 Nutrient Management and Buffer Zones

The Water Protection Act (C.C.sMc W65, 2005) Nutrient Management Regulation (NMR) (62/2008) outlines criteria for the application of nutrients (nitrogen and phosphorous) to agricultural land. The purpose of the NMR is to protect water quality by encouraging responsible nutrient planning. The objective to regulate the application of substances containing nitrogen or phosphorous to land is a protective measure for sensitive water bodies and/or groundwater.

Table 4.3 outlines the identified soil series, the associated CLI – soil capability for agriculture classes and subclasses, and the water quality management zone within the LSA and associated

limitations for nutrient application. **Figure 7** outlines the CLI-Agricultural Capability within the LSA for each soil polygon.

Table 4.3 - Soil Series, CLI Rating and Water Quality Management Zone within LSA.

Soils Series	CLI Rating Agricultural Capability Class and subclass	Water Quality Management Zone
Fortier	2W	N1
Gervais	2W	N1
Graysville	2W	N1
Gnadenthal	2W	N1
Neuhorst	2W	N1
Osborne	2W	N1
Reinland	2W	N1
Willowbend	2W	N1

Within the LSA there are approximately 233 ha of Class 2W land (**Figure 7**, **Appendix A**). The Water Quality Management Zone nitrogen application limits within Zone N1 is summarized as a rate of application that results in a residual concentration of nitrate nitrogen within the top 0.6 m of soil at the end of the growing season, at any place within the application area no greater than:

- Zone N1: 157.1 kg/ha (140 lbs/acre)

The Water Quality Management Zone phosphorous application limits within Zone N1 where soil test phosphorous levels (i.e., Olsen procedure) for any place in the application area is 60 ppm or more except at a rate of application that does not exceed:

- Two times the applicable phosphorous removal rate, if the soil test phosphorous levels are less than 120 ppm.
- The applicable phosphorous removal rate if the soil test phosphorous levels are 120 ppm or more but less than 180 ppm.

In order to minimize risk to human and environmental health and safety from the land application of biosolid materials, buffer zones will be established as outlined in the *Nutrient Management Regulation* (62/2008) under *The Water Protection Act (C.C.S.M. c. W65)* and the Farm Practices Guidelines for Pig Producers in Manitoba (April 2007). Buffer zones around residential areas, residences, groundwater wells and surface water drainage systems will be established as outlined in **Table 4.4.**

Table 4.4 - Nutrient Buffer Zones to be Established for Biosolid Application

Description	Recommended Buffer Zone Distance (m)
A lake or reservoir designated as vulnerable	30 m (98 ft) if area is covered with permanent vegetation at the water body's high water mark **OR** 35 m (115 ft) if area is not covered with permanent vegetation the top of the outermost bank on that side of the water body
A roadside ditch of an Order 1 or 2 drain	No direct application to ditches and Order 1 and 2 drains
A river, creek or stream not designated as vulnerable An Order 3, 4, 5 or 6 drain A major wetland, bog, marsh or swamp A constructed stormwater retention pond.	3 m (10 ft) if area is covered with permanent vegetation **OR** 8 m (26 ft) if area is not covered with permanent vegetation
A groundwater feature, a lake or reservoir (not including a constructed storm water retention pond) not designated as vulnerable a river, creek or stream designated as vulnerable.	15 m (49 ft) if area is covered with permanent vegetation **OR** 20 m (66 ft) if area is not covered with permanent vegetation

4.4 Agronomy

Crops grown on lands receiving biosolid materials include cereals and oils seeds. Application of biosolid materials will increase soil health (water-holding capacity, tilth) and provide beneficial macro (nitrogen, phosphorous, potassium, sulfur) and micro nutrients (boron, copper, zinc, magnesium) to the soil for crop production. The farm producer participating in the project has been advised of the benefits of biosolid application and understands that the application of commercial fertilizers should only be completed to supplement nutrient levels from the biosolids at agronomically sustainable rates.

5.0 PROPOSED BIOSOLID APPLICATION RATES

It is anticipated that the biosolids will be applied in a liquid state as it will be dredged from the bottom of each cell. This means that the material will be injected directly into the soil and no further incorporation will be required.

5.1 Biosolid Sampling Procedure

MMM collected composite sludge samples from the lagoon Cells 1 and 2 on October 14, 2015, and Cell 3 on October 26, 2015, using a telescoping pole and scoop via electric powered aluminum boat. Lagoon sludge was collected from approximately ten different locations in each cell, sites were selected at random, and sludge was placed in a bucket for compositing. The samples were placed on ice and submitted for analysis to ALS Laboratory Group (ALS), an accredited laboratory by the Canadian Association for Laboratory Accreditation Inc. (CALA). The following analysis was completed on each sample to assess the biosolid quality:

- Physical characteristics: moisture content, total and volatile solids, organic matter content, total carbon, mineral content and specific gravity.
- Detailed salinity (chloride, calcium, potassium, magnesium, sodium, sulfur, SAR, E.C, and pH.
- Nutrient characteristics: nitrogen profile (Total Kjeldahl Nitrogen, nitrate-nitrogen, ammonium-nitrogen), total and bi-carbonate phosphorous, potassium and sulfate-sulfur.
- Metals profile (20 metals, refer to Certificate of Analysis in **Appendix E** for a complete list).

5.2 Biosolid Quantity

Biosolid quantity was assessed in lagoon Cells 1, 2 and 3 by MMM in October 2015. The method of quantification is as follows:

- The top of the lagoon berms were staked at approximately 20 m intervals.
- A survey of the exterior toe of the berm, top of berm and water's edge of lagoons was completed at each stake using a Trimble R8 GPS unit and Trimble controller to get a georeferenced point and elevation.
- An aluminum boat was launched on the lagoons and a grid system was established by estimating the intersection of north-south oriented stakes with east-west oriented stakes.
- At each intersection point on the lagoon surface, a survey rod was used to measure the depth to the bottom of the lagoon using the lagoons surface water level as a bench mark elevation.
- At the same intersection point as above, a second survey rod, with a plate installed on the bottom, was used to measure the top of the lagoon sludge using the lagoons surface water level as a bench mark elevation.

- An MMM AutoCAD technician used this field data to create a lagoon sludge thickness drawing to estimate the total volume of sludge in each cell (SK-01, 02 and 03, **Appendix A**).

Cell 1 has a surface area of 2.5 ha (6.2 acres), Cell 2 has a surface area of 3.1 ha (7.7 acres) and Cell 2 has a surface area of 2.1 ha (5.2 acres). The wastewater travels from Cell 1 to Cell 2 to Cell 3 and no aeration is used in the cells. The anticipated volume of biosolid material that will be collected from lagoon Cells 1, 2 and 3 and land applied is 7,224 cubic metres, 6,745 cubic meters and 5,522 cubic meters, respectively.

Table 5.1 - Estimated Biosolid Quantity from Cells 1, 2 and 3

Description	Unit	Biosolid Quantity Cell 1	Biosolid Quantity Cell 2	Biosolid Quantity Cell 3
Reported Volume	m^3	7,224	6,745	5,522
15% Contingency Factor	m^3	1,084	1,012	828
Volume with Safety	m^3	8,308	7,757	6,350
Specific Gravity	Kg/l	1.01	1.03	1.02
Mass	t	8,391	7,990	6,477

5.3 Biosolid Quality

Biosolid analytical Certificate of Analysis is presented in **Appendix E**.

5.3.1 Nutrient Content of Biosolid Material

To determine environmentally sustainable and agronomically appropriate biosolid prescription rates, it is important to determine nutrient quality for the biosolid material and then tailor the application rate based on targeted crop uptake and removal rates and soil fertility concentrations. The nutrient values currently determined will be utilized to evaluate the prescription rates and are outlined in **Table 5.2**, **5.3** and **5.4** in **Appendix B**.

When utilizing an organic source as a fertilizer, only a portion of the total nitrogen is immediately available. A portion of the total nitrogen is in the organic form and goes through a mineralization process. Mineralization is the conversion of organic nitrogen to ammonium nitrogen. Like hog manure, the anticipated mineralization rate for year one is 25 percent, for year two 12 percent and for year three 6 percent.

At a Carbon to Nitrogen (C:N) ratio that exceeds 30:1, N becomes a limiting nutrient for decomposer organisms, and this can reduce the rate of decomposition and results in N immobilization. The C:N ratio for the Cell 1, 2 and 3 biosolid material is approximately 14:1, 14:1 and 23:1, respectively, thus mineralization will continue at anticipated rates.

With a Carbon to Phosphorous (C:P) ratio between 200:1 and 300:1, mineralization and immobilization balance each other to result in no net release of P from the decomposing manure. When C:P is below this range, P is released and when above this range P will be tied up and not released for crop use. The Cell 1, 2 and 3 biosolid material C:P ratios are below this range and therefore P is anticipated to be released.

When animal and municipal wastes have N:P ratios ranging from 1:1 to 1:2 and are applied based on N rates on soils, over time P will accumulate. The Cell 1, 2 and 3 biosolid material N:P ratios are approximately 4:1, 4:1 and 2:1, thus it is anticipated that P will not accumulate.

5.3.2 Salinity

The biosolid material from Cell 1, 2 and 3 has an electrical conductivity (E.C.) value of 3.00, 2.11 and 6.2 dS m^{-1}, and a Sodium Absorption Ratio (SAR) of 2.54, 2.43 and 3.82, respectively. The biosolid material may be considered as “slightly-saline” and as such does pose a slight environmental risk for soil salinization, as soil E.C., soluble ions (e.g., sodium, potassium, chloride and sulfate) and SAR increase directly with rate application. Comparatively, the reported salinity is less than or similar to hog manure as reported by Racz and Fitzgerald (2001), where it was found that the mean E.C of 145 Manitoba hog manure samples had a value of 16.0 dS m^{-1} and a SAR of 5.1. It is reported by Sullivan et al (2007) that repeated biosolid applications in soil did not result in detrimental salt accumulations in soil even at locations with low precipitation and no irrigation. Sulivan et al (2007) reported that annual applications of dewatered cake biosolids (80 percent moisture) that have been made for over 10 years has not increased soil salinity above 1 mmho cm^{-1}.

Salinity analysis results for Cells 1, 2 and 3 biosolids are found in **Table 5.5** and **5.6**, in **Appendix B**.

5.3.3 Trace Metals

In “The Effect of Biosolids on Crops, Soil and Environmental Quality, A Summary of the Research” conducted by the Department of Soil Science at the University of Manitoba, Fitzgerald and Racz (1999) reported that loading rates for City of Winnipeg biosolids (i.e., 0, 50, 100 and 200 tonnes per hectare) found that biosolid cadmium was not mobile and was not plant available and that very little of the cadmium was taken up by wheat plants. It was also reported that for concentrations of other heavy metals (e.g., copper, zinc, nickel and lead) no consistent effect on the heavy metal content of wheat grain due to increasing rates of added biosolids was

observed. Fitzgerald and Racz concluded that heavy metals in the biosolids-treated soils was similar to that of wheat produced in the Canadian Prairies and that loading rates as high as 200 t ha^{-1} did not affect grain quality.

In Cell 1, 2 and 3 biosolid materials, the metals of principal concern to agriculture include: arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc. MCWS has established cumulative loading rates for each of these metals. The cumulative weight per hectare of each heavy metal in the soil is calculated by adding the amount of each metal in the biosolid at the prescription rate to the background soil level of the same metal. As the EAP has not determined actual soil metal concentrations at this time, mean trace element concentrations were obtained from the Haluschak et al. (1998), study for selected trace elements in agricultural soils of southern Manitoba. Actual metal loading rates to the soil within the LSA will be determined based on infield soil results and prescription application rates as discussed in Section 5.3.2. Based on an application rate of 21, 40 and 46 t ha^{-1} for Cells 1, 2 and 3, respectively, and the mean concentrations of trace elements, the metal loading rates will be below the limit criteria. Table 5.7 in Appendix B reports the trace element concentrations for Cells 1, 2 and 3 biosolids and the soil loading rates and guidelines.

5.4 Receiving Land Soil Quality

To determine environmentally sustainable and agronomically appropriate biosolid loading limits, it is important to determine nutrient requirements for each agricultural field based on targeted crop uptake rates and residual soil fertility levels. The objective of determining application rates is to target the optimum available nitrogen and phosphorous removal for small grains, oil seeds and forage crops without exceeding nutrient management zone criteria (N1) for both nitrogen and phosphorous.

A benchmark soil sampling program will be conducted immediately after harvest, anticipated to be in late September of 2016 by MMM for lands within the LSA. For each quarter section or management parcel of land within the LSA one composite sample will be collected from the soil surface layer (0-15 cm) and submitted to ALS for analysis of nitrate-nitrogen, bicarbonate phosphorous, potassium, sulfate-sulphur, pH, E.C. and heavy metals. One composite sample will also be collected from the rooting soil zone (15-60 cm) and analyzed for nitrate-nitrogen and sulfate-sulfur. Based on the soil analytical results, gross application rates, and prescriptive, and nutrient budgets will be determined for the biosolid material. These proposed biosolid application rates will be forwarded to MCWS for review to fulfill the requirements of this EAP.

5.5 Proposed Biosolid Application Rates

5.5.1 Prescriptive Rates and Nutrient Budgets

A hypothetical application rate was developed based on residual nitrogen and phosphorous concentrations from a fall 2015 soil test (**Appendix C**) and anticipated P_2O_5 crop removal based on crop rotation for 2017. The hypothetical application rate is based on nutrient concentrations of the biosolid samples collected from Cells 1, 2 and 3. The hypothetical application rated is based on 134 kg ha^{-1} of required nitrogen and one (42 kg ha^{-1}) and two time (84 kg ha^{-1}) crop removal of a permitted crop (**Table 5.2**, **5.3** and **5.4**, **Appendix B**).

Cell 1 hypothetical application rates outlined in **Table 5.2**, **Appendix B**, the nitrogen application rate of 34.5 tonnes per hectare (dry) provides an estimated 304 percent of the required P_2O_5, which is not suitable. Therefore the preferred application rate is based on two times crop removal (84 kg ha^{-1}) of a permitted crop. This would provide approximately 82 kg ha^{-1} of required nitrogen and allowing for a top up of approximately 52 kg ha^{-1}. The total land area required is then anticipated to be approximately 63 hectares for a two times crop removal application rate for phosphorous. For risk management purposes 233 hectares has been reserved for land application program.

Based on interviews with the cooperating farm producer, it is anticipated that both of the selected parcels of land will be suitable for a two times crop removal of phosphorous application rate. Detailed soil sample analysis will be obtained for each field and a detailed prescription rate will be provided to MCWS as promptly as possible for a timely approval prior to land application.

6.0 DESCRIPTION OF ENVIRONMENTAL EFFECTS AND MITIGATION MEASURES OF THE PROPOSED PROJECT

6.1 Potential Soil Impacts

6.1.1 Management of Nitrogen and Phosphorous

Of primary concern associated with the land application of biosolid materials is the leaching and/or surface runoff of nitrogen and phosphorous into ground or surface water if application rates exceed crop removal rates and soil storing capacity.

When applied at balanced rates, the land application of biosolids is a sustainable means to reuse nutrients within an agriculture system as the application of biosolid organic material enhances the water holding capacity, structure and tilth of soils thereby providing benefits to

land utilized for agricultural production. The objective of the proposed project is to manage nitrogen and phosphorous based on beneficial farm management practices and applicable regulations. Biosolids will be applied based on nutrient requirements for each agricultural field as outlined in Sections 5.5.1 and 5.5.2. Prescribed nitrogen and phosphorous rates will target uptake ability of small grains and oil seed. to a maximum of 100 kg ha^{-1} nitrogen without exceeding the nutrient management regulatory criteria in zone N1.

Leaching to groundwater is not a significant concern (refer to Section 4.1) within the LSA as the soils are primarily imperfectly drained or poorly drained. In addition, by applying the biosolids at prescribed rates that optimize crop uptake and by establishing buffer zones around sensitive features, the risk of surface runoff into the Whitemud River drainage system will be minimized.

6.1.2 Metals

To prevent overloading of heavy metals into soils, the prescribed application rates provide cumulative weight criteria for metals that are below the permitted concentrations. The loading rates for heavy metals in the biosolids from lagoon Cells 1, 2 and 3 has been determined based on the theoretical maximum application of 21, 40 and 46 dry tonnes per hectare, respectively, as presented in **Table 5.7** in **Appendix B**. These calculated heavy metal loading rates to the soil in the LSA are all below the cumulative weight criteria.

6.1.3 Salinity and Sodicity

The biosolid material may be considered as “slightly-saline” and as such does pose a slight environmental risk for soil salinization, as soil E.C., soluble ions (e.g., sodium, potassium, chloride and sulfate) and SAR increase directly with rate application. The biosolid salinity is considered to be less than hog manure (Racz and Fitzgerald, 2001). It is reported by Sullivan et al (2007) that repeated biosolid applications in soil have not resulted in detrimental salt accumulations in soil even at locations with low precipitation and no irrigation.

The majority of the land base within the LSA is non-saline and only the Osborne soil series is identified as slightly saline (4 - 8 dS m^{-1}) (Langman, 1984). The Osborne soil series is limited in extent (7 ha) (**Figure 6**, **Appendix A**), and with the Osborne soil series included, the cumulative effect of salinity is not considered significant with the limited application of biosolids.

6.1.4 Soil Compaction

Soil compaction is the clasping together of soil particles, reducing the space available for air and water thus increasing the density of the soil. Soil compaction impacts water and air movement, seedling emergence, root growth and may reduce yield potential of a field. The soil series identified within the LSA may be susceptible to physical compaction due to the clay texture.

Soil compaction may occur at entrances to the fields within the LSA due to heavy equipment traffic entering fields for biosolid application. As these entrances are typically utilized by farm producers with heavy farm equipment for crop production activities, soil compaction in these areas is likely not of great concern. In addition, winter frost action also aids in the mitigation of soil compaction. However, should the farm producer have a concern with the potential compaction, field entrances may be deep ripped in order to mitigate compaction.

It should also be noted that the field equipment utilized to complete the land application of the biosolid material is equipped with large floatation tires to minimize the compaction potential.

6.2 Potential Wildlife Impacts

Potential impacts to wildlife include habitat disruption and vehicle/wildlife collisions. However the impact to wildlife habitat is considered to be low as land within the LSA primarily consists of cultivated land with minimal natural vegetative cover available as habitat. In addition, the timing of biosolid application will occur in the fall, outside of the breeding bird window.

The occurrences of the Northern Prairie Skink and Eastern Wood-pewee do not occur in the LSA. Due to the application process occurring on agricultural land that is regularly disturbed, the use of farm access roads for equipment travel and the maintenance of setback distances for natural areas, the biosolid application process is unlikely to impact the Northern Prairie Skink or Eastern Wood-pewee.

6.3 Potential Surface Water and Fisheries Impacts

Potential impacts to surface water and fish within the Whitemud River drainage system include nutrient loading from surface runoff. However the impact to surface water and fish is considered low as biosolid material will be applied at agronomically appropriate rates and will be injected directly into the soil, thereby minimizing the potential of overland flow to the drainage system. In addition, appropriate setback distances of 8 m will be established around all Order 3 or higher drains (**Figure 4**, **Appendix A**).

6.4 Potential Groundwater Impacts

Groundwater pollution within the Municipality of WestLake - Gladstone is possible in areas where sand and gravel deposits are at or near the ground surface. However, the LSA is located in an area of minimal to low potential impact according to Land Resource Unit (2000) report map for Potential Environmental Impact Under Irrigation for the former Rural Municipality of Westbourne.

Application of the biosolid materials at agronomically appropriate rates for nitrogen and phosphorous will ensure plant uptake of these nutrients over the growing season, thereby

further minimizing the potential of leaching to the groundwater. In addition, appropriate setback distances will be established around all residences and domestic wells as outlined in **Table 6.3** in **Section 6.8.3**.

6.5 Potential Heritage Resource Impacts

The project will have no impact on the heritage resources in the area, as land application of the biosolid materials will occur on agricultural land that does not contain any of these resources.

6.6 Greenhouse Gas Considerations

Greenhouse gas (GHG) emissions within the context of this biosolid land application program are carbon dioxide, methane and nitrous oxide. The activities related to GHG contributions are limited to the equipment emissions that will be used to transport, land apply and incorporate the biosolid material and natural decomposition of land applied organic matter in the soil. Land application of biosolids provides significant benefits through the reduction of GHG production that occurs with landfill disposal, carbon sequestration in soil organic matter and reduced use of inorganic commercial fertilizers from petroleum based sources within the LSA. These three benefits are reported to counter balance the potential emissions due to mechanical needs for the land application program (CCME, 2012).

6.7 Socioeconomic Effects

The application of biosolids to agricultural land provides a positive economic benefit to both the farm producer and the Municipality of WestLake - Gladstone itself. The objective of providing prescription application rates for biosolids to crops is to provide an organic source for nutrient management. As outlined, biosolids provide macro nutrients (nitrogen, phosphorous, potassium, and sulfur) and micro-nutrients (boron, copper, iron, chloride, manganese, molybdenum and zinc), all of which provide economic value to the farm producer. For example, based on fertilizer commodity price as of February 2016 for Urea (82-0-0) and Triple Super Phosphate (11-52-0-1.5), the following economic value as presented in Table 6.1 can be recognized from the prescribed biosolid land application of two times crop removal of P_2O_5.

Table 6.1 - Economic value for Nitrogen and Phosphorous in Applied Biosolids

Nutrient (Year 1)	Market Price (February 2016)	Hypothetical Application Rate	Value of Applied Biosolids
Available Nitrogen	\$1.056 kg^{-1}	Cell 1: 82.5 kg ha^{-1} Cell 2: 79.0 kg ha-1 Cell 3: 45 hg ha-1	\$87.12 ha^{-1} \$83.42 ha-1 \$47.52 ha-1

Total Available P_2O_5 (2x Crop removal Rate estimated at 84 kg ha-1	$1.23 kg^{-1}	Cell 1: 84 kg ha^{-1} Cell 2: 84 kg ha-1 Cell 3: 84 kg ha-1	$103.32 ha^{-1} $103.32 ha^{-1} $103.32 ha^{-1}

The biosolid material is being provided at no charge to the farm producer, thus reducing his fertilizer bill between $151 and $190 per hectare depending upon the source of biosolids (Cell 1, 2 or 3) (**Table 6.1**). Based on the anticipated 63 hectares required for the land application, this equates to approximately $11,680 for total available nitrogen and total available P_2O_5 in year one and does not account for multiple years of available nitrogen and phosphorous. It also does not account for the added benefit of potassium, sulfur and additional micro-nutrients in year one or for multiple years. Hence the economic benefit to the farm producer is substantial based on the savings the farm producer will incur for crop fertilizer amendments in year one and subsequent years. It should also be noted that the economic benefit to the Municipality of WestLake - Gladstone is recognized from no land use fees being paid to the farm producer for the application of the biosolids; whereas, if the biosolids were disposed of in the local landfill the tipping fee would represent a significant cost to the Municipality of WestLake - Gladstone.

6.8 Public Safety and Health Risks

6.8.1 Biological Pathogens and Odour Management

Biological pathogens such as *E. coli* and fecal coliforms as well as nuisance odour associated with land application of biosolids may be considered to pose a public health and safety risk. However these human health and safety risks will be managed through the application of the biosolid materials onto private lands that have restricted public access. In addition, the direct injection methods of application will minimize odour and eliminate human exposure to pathogens. Pathogens from biosolids are often killed by exposure to sunlight, drying conditions, unfavorable pH and other macro and micro environmental conditions. Lands that receive biosolid material will also be managed on a crop rotation system for three years that includes non-root/vegetable crops.

6.8.2 Metal Accumulation in Crops

Heavy metal bioaccumulation in agricultural crops consumed by humans poses a minimal human health risk as uptake, removal and accumulation of metals by the harvested portions of crops is minimal. Harb (1999) concluded that the health risk to humans from the consumption of heavy metals in wheat and oats grown on land treated with biosolids is negligible and that there are environmental and economic benefits.

6.8.3 Additional Applicable Buffer Zones

In order to minimize risk to humans, environmental health and safety and control odour from the land application of biosolid materials, buffer zones will be established as outlined in the *Nutrient Management Regulation* (62/2008) under *The Water Protection Act (C.C.S.M. c. W65)* and the Farm Practices Guidelines for Pig Producers in Manitoba (April 2007). Buffer zones around residential areas, residences, groundwater wells and surface water drainage systems will be established as outlined in **Table 6.2**.

Table 6.2 - Buffer Zones to be Established for Biosolid Application

Description	Recommended Buffer Zone Distance
Identified groundwater well	50 m
Presence of clay and clay till to a depth of 1.5 metres.	n/a
Residential areas	400 m[1] (1312 ft)
Occupied Residence (other than the residence occupied by the owner of the land on which the biosolids are to be applied)	75 m[1] (246 ft)
Property line with residence	10 m[1] (33 ft)
Property line without residence	1.0 m[1] (3.3 ft)

Notes:

[1] *Farm Practices Guidelines for Pig Producers in Manitoba (April 2007)* if surface applied and incorporated within 48 hours

7.0 MONITORING AND REPORTING

This project is of limited duration (three years) and therefore limited monitoring and reporting are recommended including:

1. Completion of an on-site project start up meeting between MMM, the Municipality of WestLake - Gladstone and the Applicator to review the requirements of the EAL and procedure for the land application of the biosolids.
2. Recording of percent solids and volumes during land application process.
3. Completion of weekly on-site inspections and monitoring of biosolid application including:

a. Monitoring adherence by the Applicator to buffer zones.

b. Monitoring of application rates.

4. Three year post harvest monitoring for Nitrate – N and phosphorous (Olsen-P) for each field that land application occurred on based on georeferenced benchmark soil sampling procedure.

5. Providing a summary report to MCWS EAB on behalf of the Municipality of WestLake - Gladstone that summarizes soil fertility analytical results, prescribed biosolid application rates, and application activities completed for the project.

8.0 SUMMARY

When applied at balanced agronomic rates, the land application of biosolids use is a sustainable means to reuse nutrients within an agriculture system. The application of biosolid organic material enhances the water holding capacity, structure and tilth of soils thereby providing benefits to land utilized for agricultural production. The objective of this project is for the Municipality of WestLake - Gladstone to complete a land application of biosolid materials collected from wastewater treatment lagoon Cells 1, 2 and 3 in an agronomically and environmentally sustainable manner. There are no negative, long-term environmental or socioeconomic impacts associated with this project.

9.0 CLOSURE

This report has been prepared for use by the Municipality of WestLake - Gladstone, in accordance with generally accepted agricultural and environmental investigation practices by qualified professional and technical staff. The Standard Limitations pertaining to the use of this report are presented in **Appendix G**.

10.0 REFERENCES

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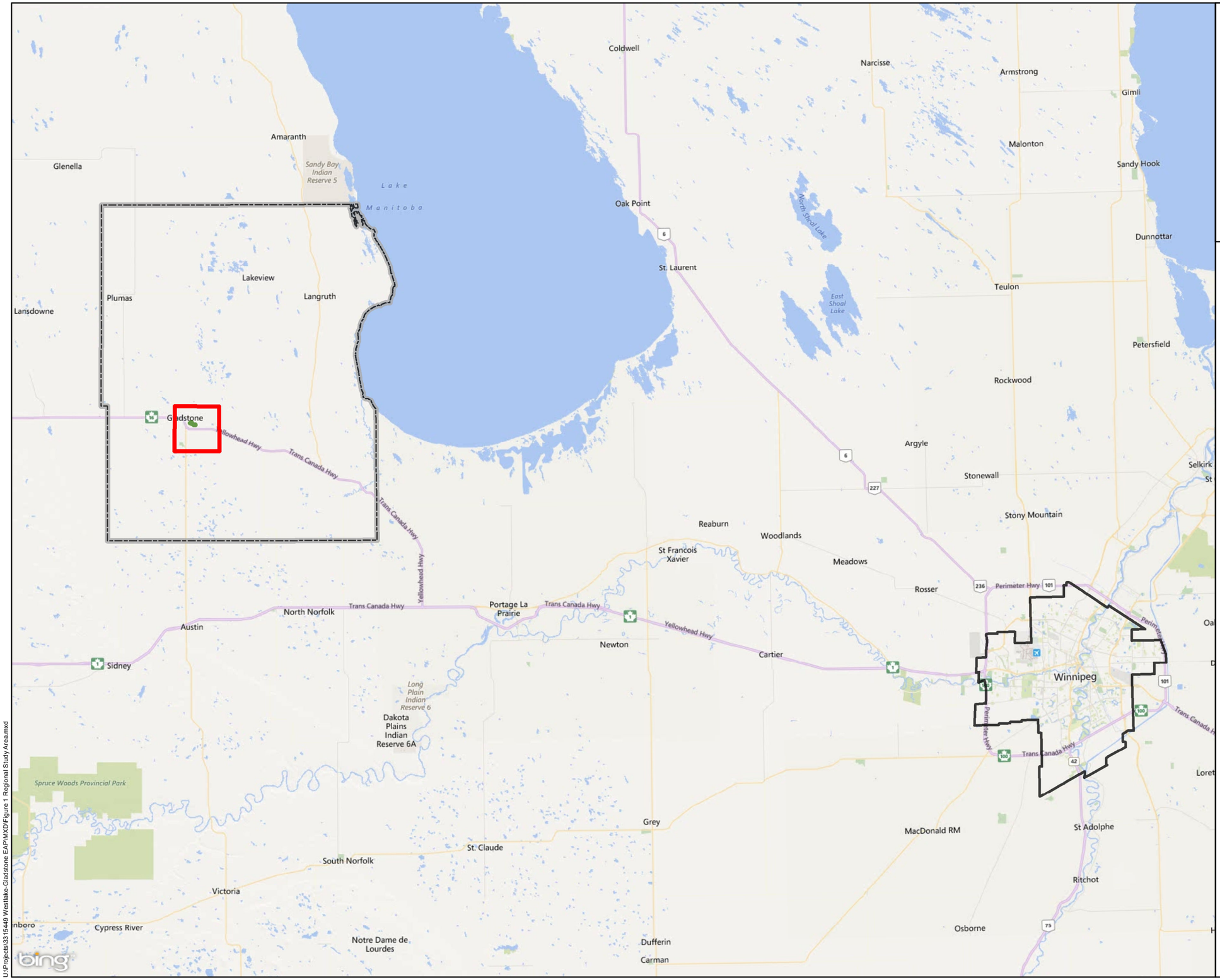
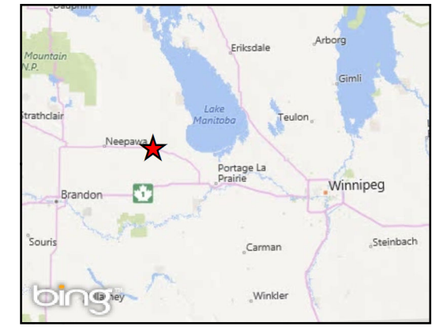
APPENDIX A – Figures and Drawings





WESTLAKE-GLADSTONE EAP

Legend

- Regional Study Area
- Rural Municipality of WestLake - Gladstone
- City
- Wastewater Treatment Lagoon Site

Coordinate System: NAD 83, UTM Zone 14 N
Data Source: MLI, MMM, Bing
Date Created: December 17, 2015
Revision Date: February 23, 2016

N

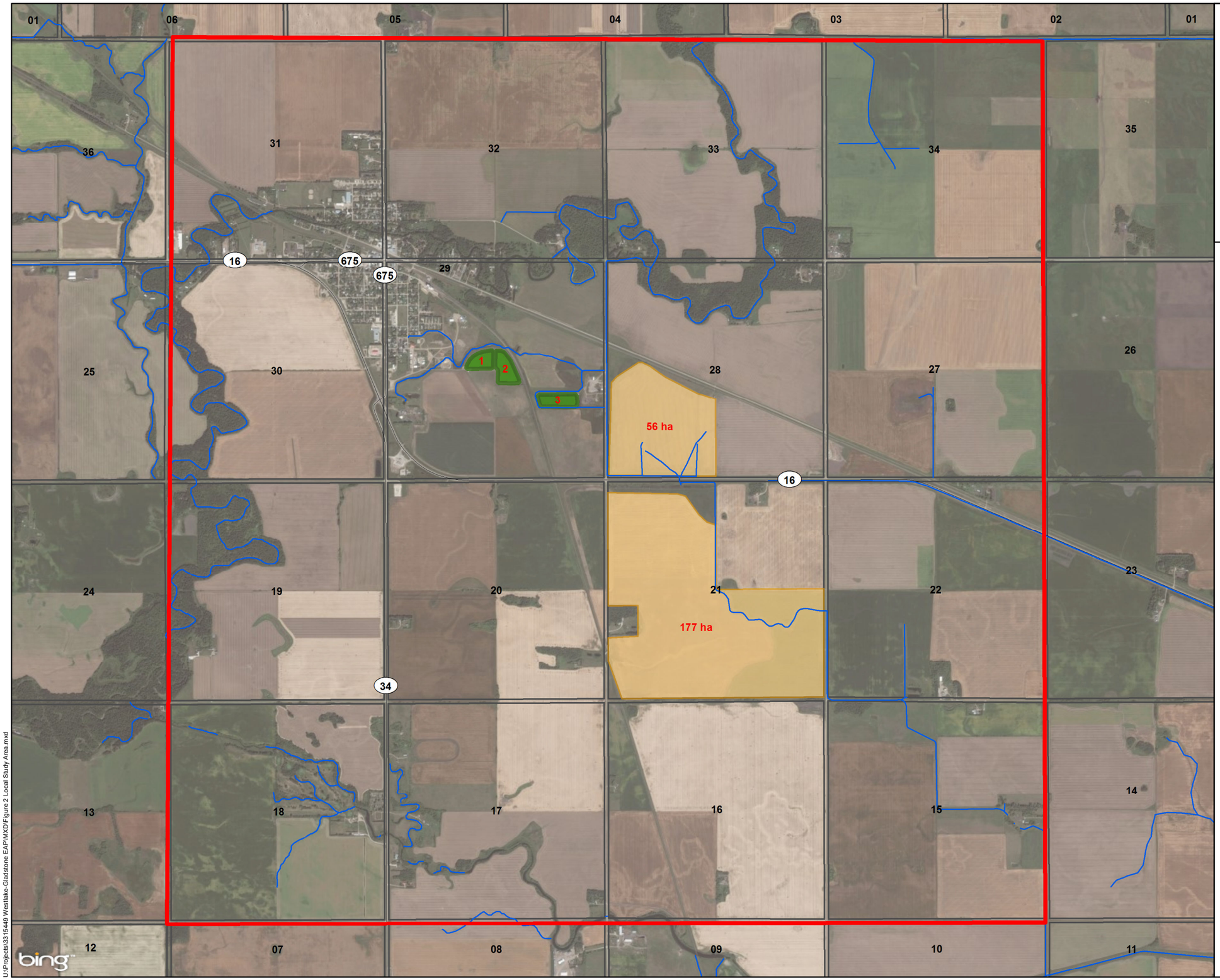
0 50 100 200 300
Kilometres

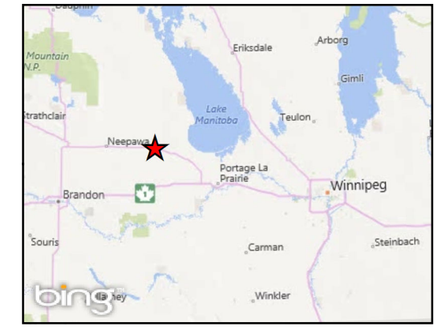
FIGURE 1

Regional Study Area

WSP | MMM GROUP

U:\Projects\33154449 Westlake-Gladstone EAP\MXD\Figure 1 Regional Study Area.mxd





WESTLAKE-GLADSTONE EAP

Legend

- Regional Study Area
- Local Study Area
- Township Section
- Wastewater Treatment Lagoon Site
- Watercourses

Coordinate System: NAD 83, UTM Zone 14 N
Data Source: MLI, MMM, Bing
Date Created: December 17, 2015
Revision Date: February 08, 2016

N

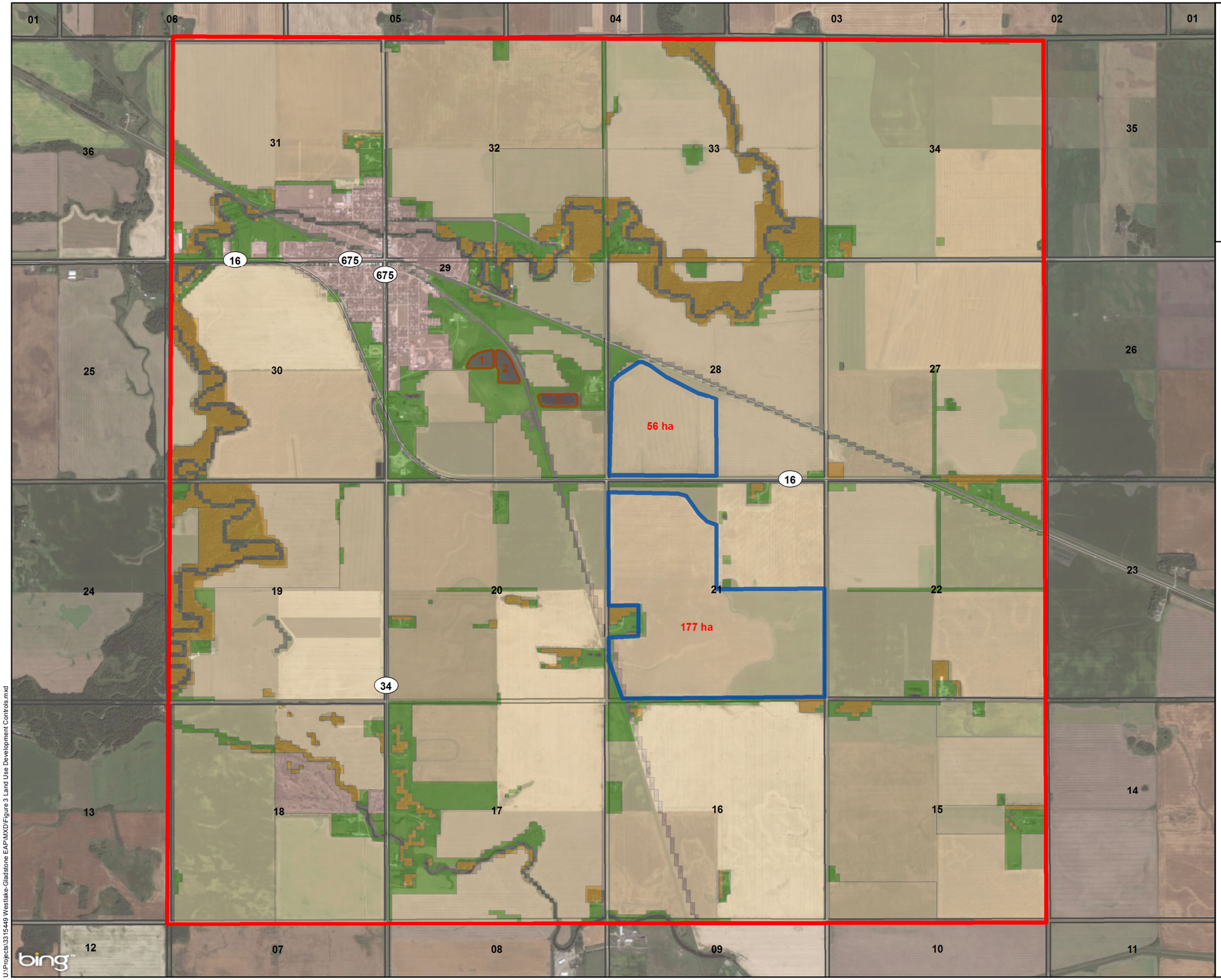
0 0.5 1 2
Kilometres

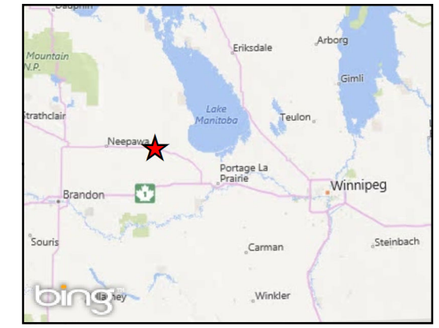
FIGURE 2

Local Study Area

WSP | MMM GROUP

U:\Projects\33\15449 Westlake-Gladstone EAP\MXD\Figure 2 Local Study Area.mxd





WESTLAKE-GLADSTONE EAP

Legend

- Regional Study Area
- Local Study Area
- Wastewater Treatment Lagoon Site
- Township Section

Land Use

- Agricultural
- Cultural Features
- Decidious Forest
- Open Space

Coordinate System: NAD 83, UTM Zone 14 N
Data Source: MLI, MMM, Bing
Date Created: January 06, 2016
Revision Date: February 08, 2016

N

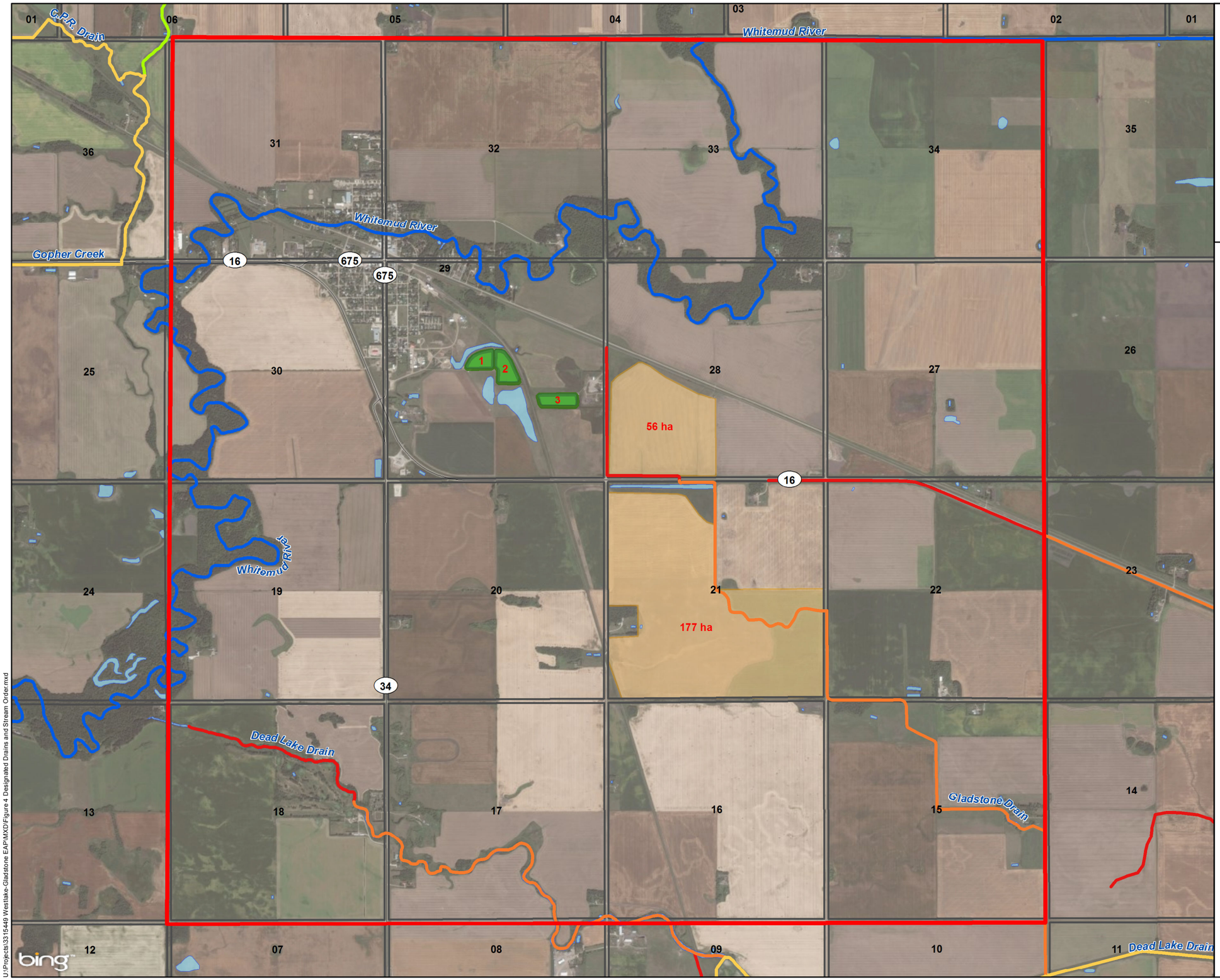
0 0.25 0.5 1 1.5 2
Kilometres

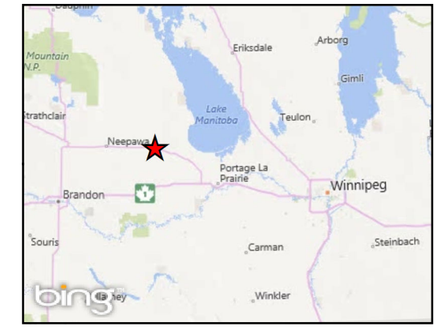
FIGURE 3

Land Use Development Controls

WSP | MMM GROUP

U:\Projects\33\15449 Westlake-Gladstone EAP\MXD\Figure 3 Land Use Development Controls.mxd





WESTLAKE-GLADSTONE EAP

Legend

- Regional Study Area
- Local Study Area
- Wastewater Treatment Lagoon Site
- Township Section
- Waterbodies

Stream Order

- 1
- 2
- 3
- 4
- 5
- 6

Coordinate System: NAD 83, UTM Zone 14 N
Data Source: MLI, MMM, Bing
Date Created: December 17, 2015
Revision Date: February 08, 2016

N

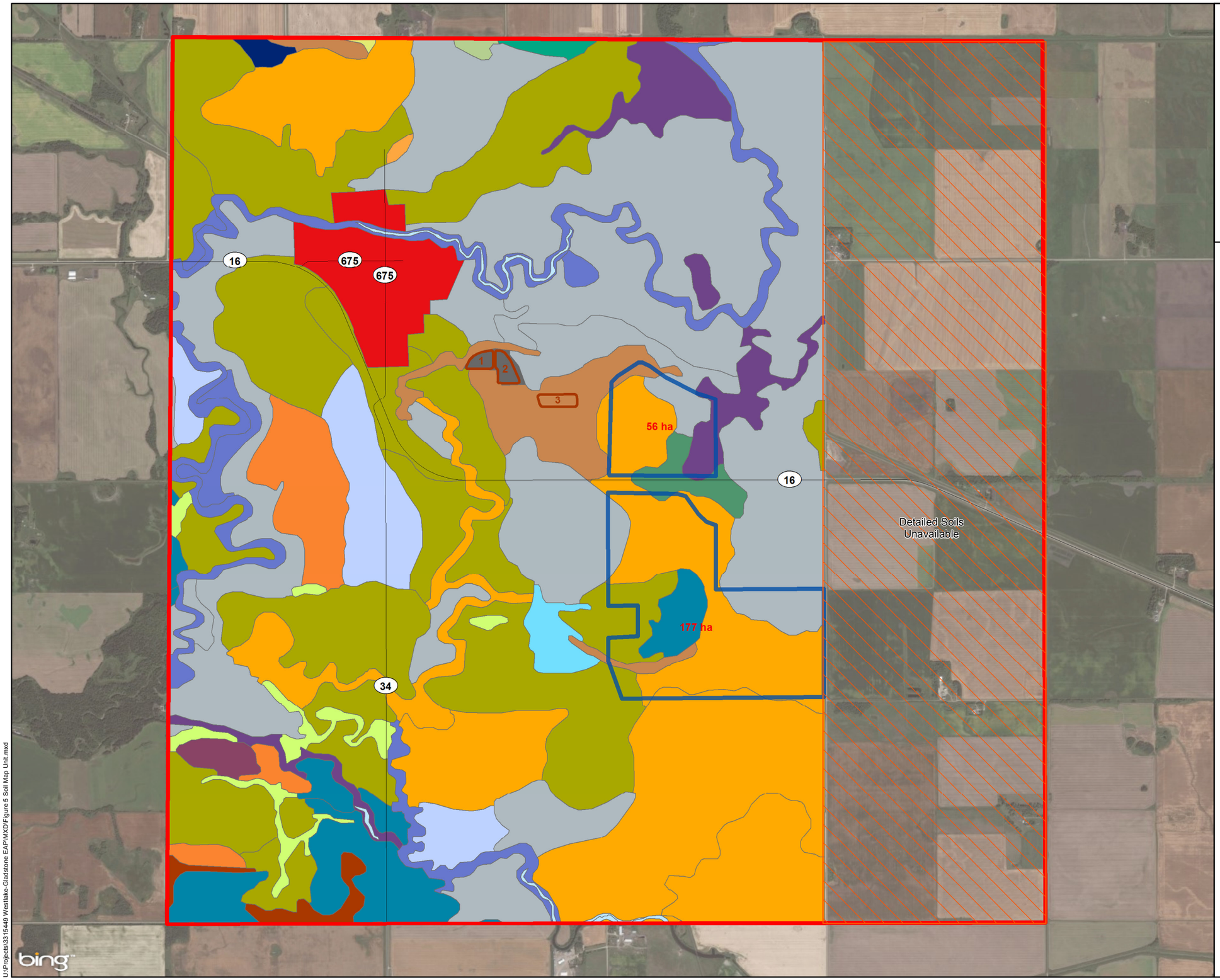
0 0.25 0.5 1 1.5
Kilometres

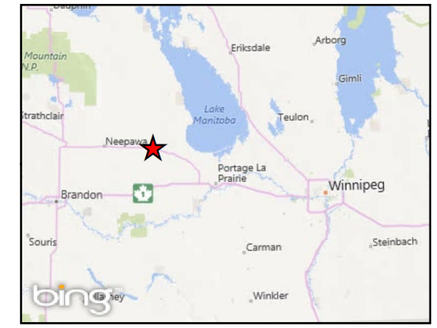
FIGURE 4

Designated Drains and Stream Order

WSP | MMM GROUP

U:\Projects\33\15449 Westlake-Gladstone EAP\MXD\Figure 4 Designated Drains and Stream Order.mxd





WESTLAKE-GLADSTONE EAP

Legend

- Regional Study Area
- Local Study Area
- Wastewater Treatment Lagoon Site

Soil Description

- Unclassified Land
- Urban Land
- Water
- Almasippi
- Blumenfeld
- Dufresne
- Fortier
- Gnandenthal
- Gervais
- Graysville
- Lakeland
- La Salle
- McCreary
- Magnet
- Neuenberg
- Neuhorst
- Newton Siding
- Osborne
- Osterwick
- Red River
- Reinland
- St. Claude
- Willowbend
- Willowcrest

Coordinate System: NAD 83, UTM Zone 14 N
Data Source: MLI, MMM, Bing
Date Created: December 17, 2015
Revision Date: February 08, 2016

N

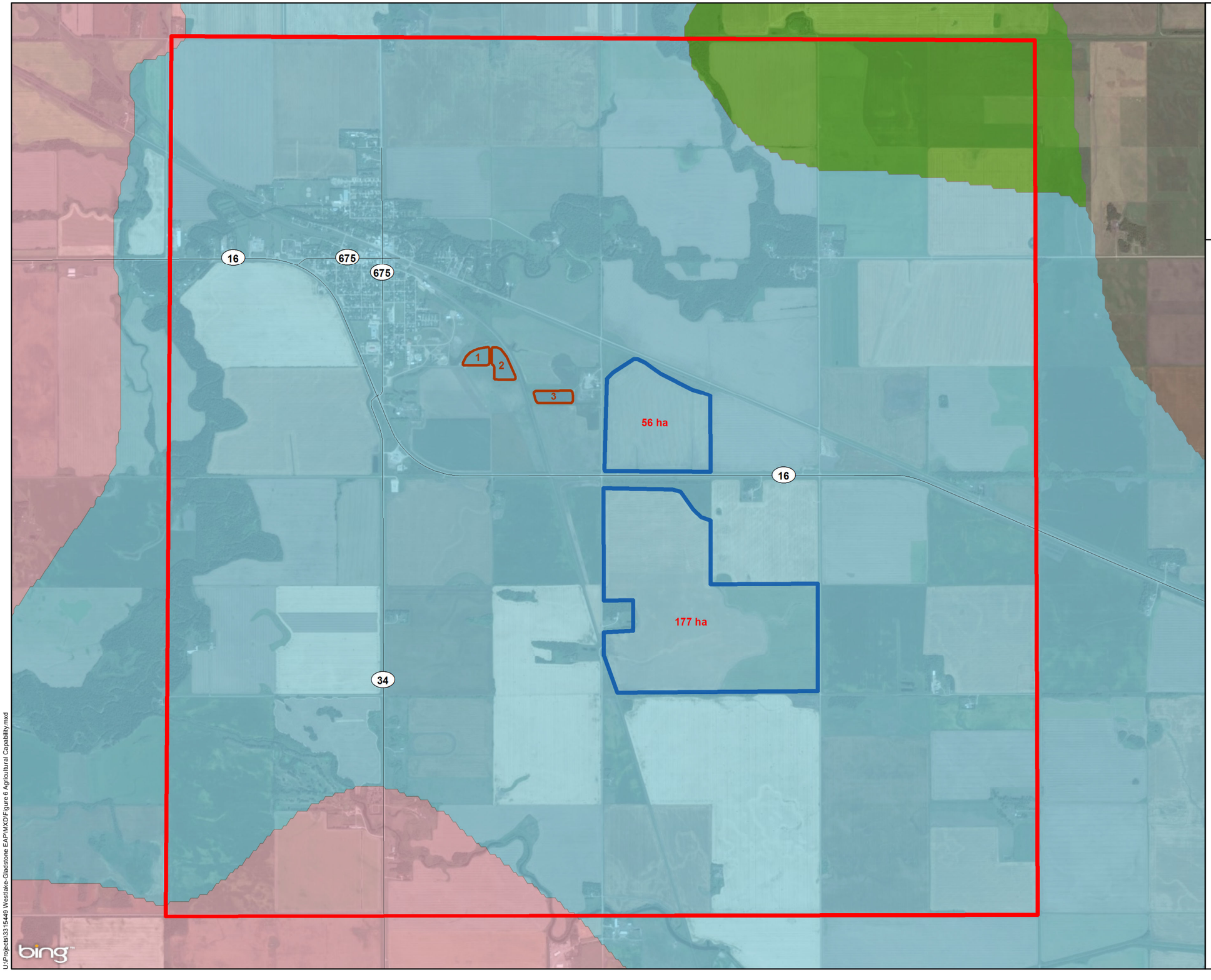
0 0.25 0.5 1 1.5
Kilometres

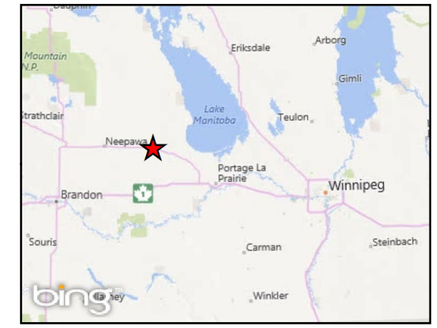
FIGURE 5

Soil Map Unit within Local Study Area

WSP | MMM GROUP

U:\Projects\3315449 Westlake-Gladstone EAP\MXD\Figure 5 Soil Map Unit.mxd





WESTLAKE-GLADSTONE EAP

Legend

- Regional Study Area
- Local Study Area
- Wastewater Treatment Lagoon Site

Agricultural Capability

Class, Subclass

- 2 - Moderate Limitations, W - Excess Water
- 3 - Moderately Devere Limitations, S - Combination of subclasses
- 3 - Moderately Devere Limitations, W - Excess Water

Coordinate System: NAD 83, UTM Zone 14 N
Data Source: MLI, MMM, Bing
Date Created: December 17, 2015
Revision Date: February 08, 2016

N

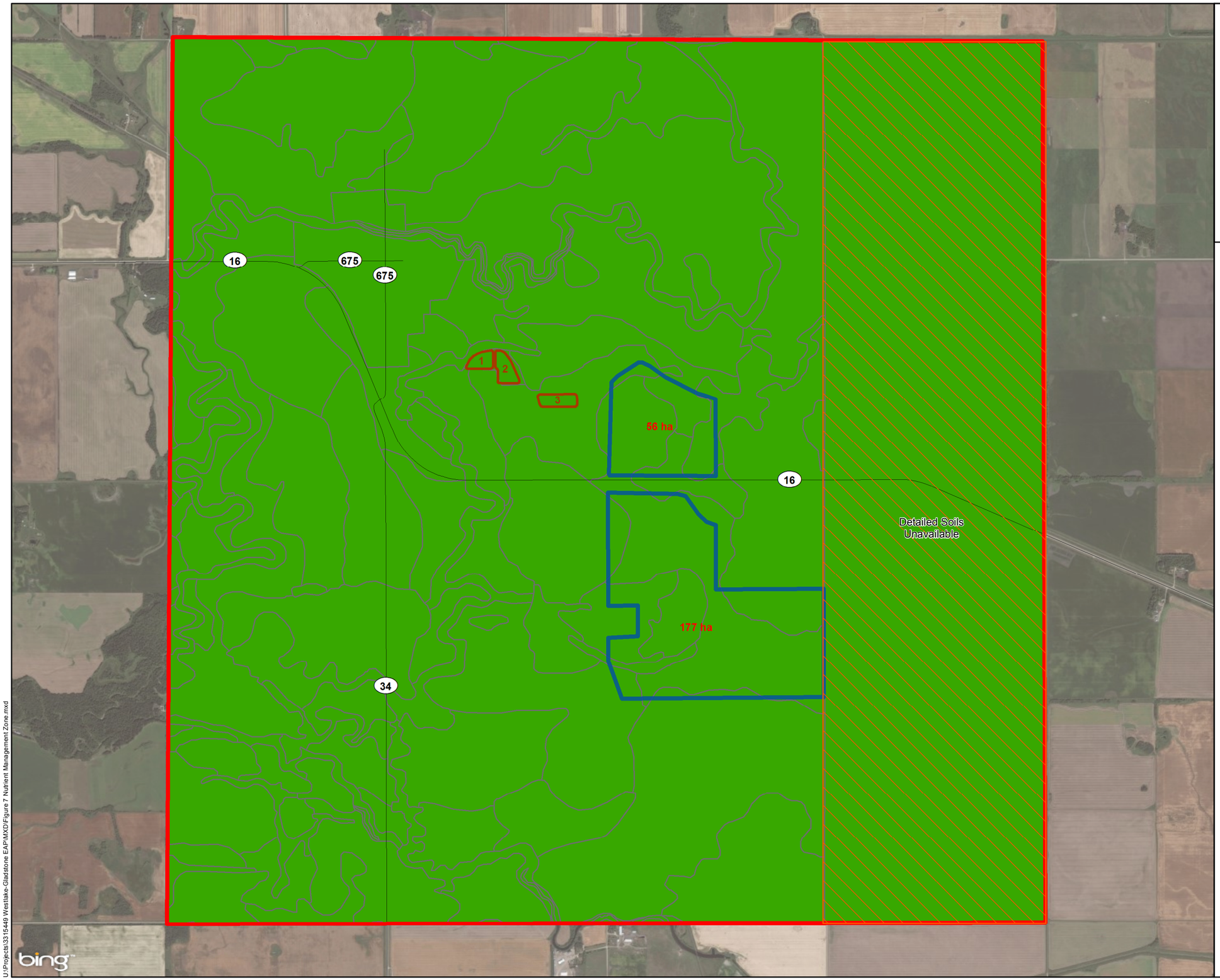
0 0.25 0.5 1 1.5 2
Kilometres

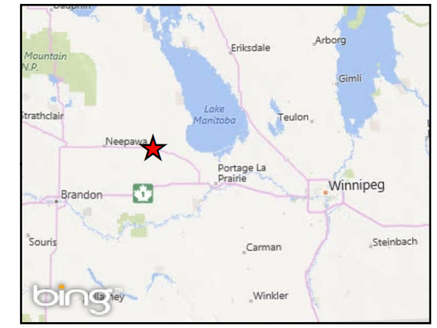
FIGURE 6

Canada Land Inventory Soil Agricultural Capability within Local Study Area

WSP | MMM GROUP

U:\Projects\3315449 Westlake-Gladstone EAP\MXD\Figure 6 Agricultural Capability.mxd





WESTLAKE-GLADSTONE EAP

Legend

- Regional Study Area
- Local Study Area
- Wastewater Treatment Lagoon Site

Nutrient Management Zone

- N1
- N2
- N3
- N4
- N5

Note:
Nutrient Management Zone displayed are representative for the most limiting Agricultural Capability rating for the soil series.

Coordinate System: NAD 83, UTM Zone 14 N
Data Source: MLI, MMM, Bing
Date Created: December 17, 2015
Revision Date: February 08, 2016

N

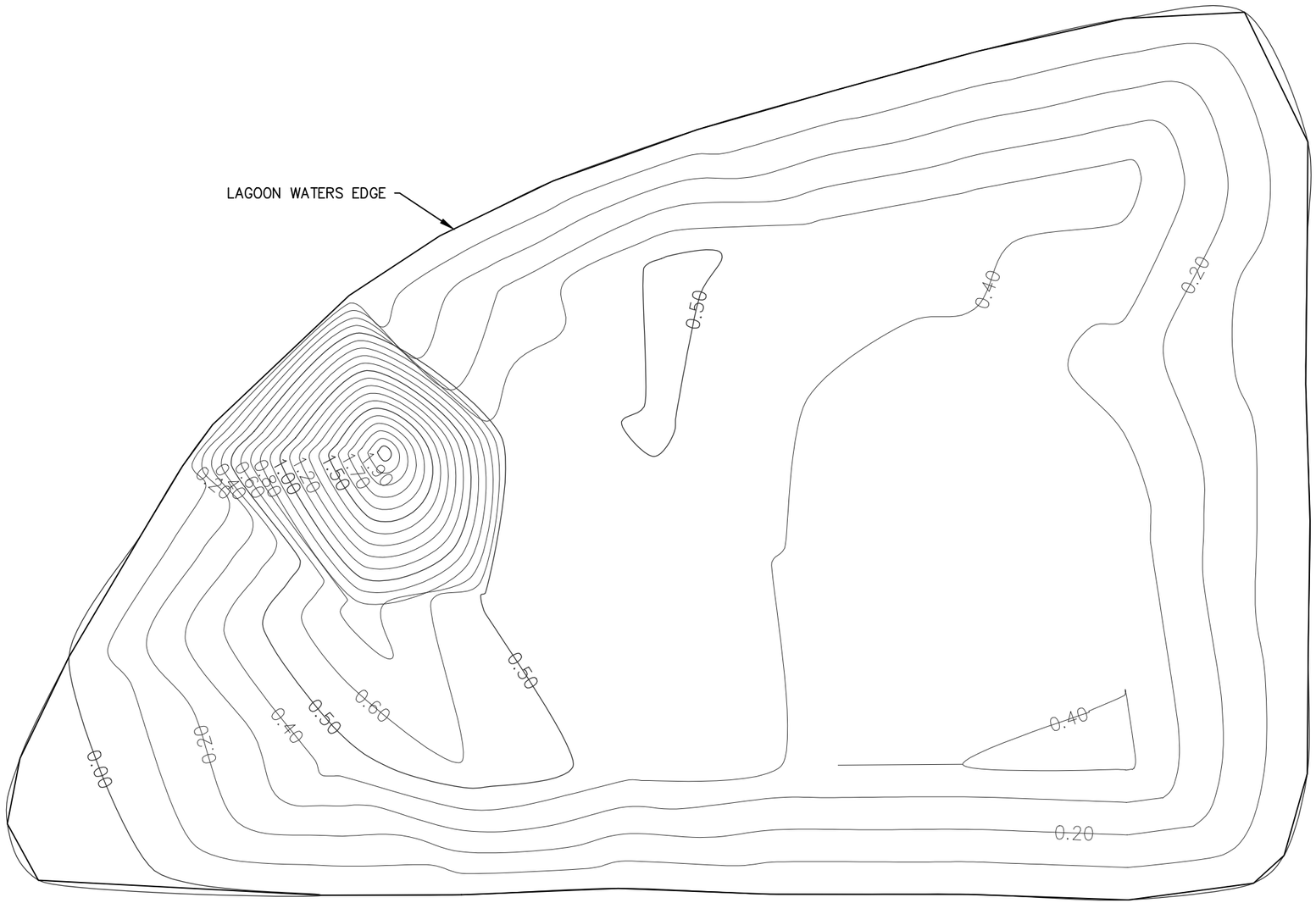
0 0.25 0.5 1 1.5 2
Kilometres

FIGURE 7

Canada Land Inventory Nutrient Management Zones within Local Study Area

WSP | MMM GROUP

U:\Projects\3315449 Westlake-Gladstone EAP\MXD\Figure 7 Nutrient Management Zone.mxd



ESTIMATED VOLUME OF SLUDGE = 7224 m^3

METRIC

WHOLE NUMBERS INDICATE MILLIMETRES
DECIMALIZED NUMBERS INDICATE METRES

NOTE:

1. BENCH MARK ELEVATION 269.112m – WATER LEVEL – OCT.14,2015
2. ELEVATION ERROR +/– 2cm (Trimble R8 GPS)
3. CONTOURS ARE DELINEATION OF SLUDGE THICKNESS
4. MEASURE OF CELL 1 = 25078 m^2

MMM GROUP

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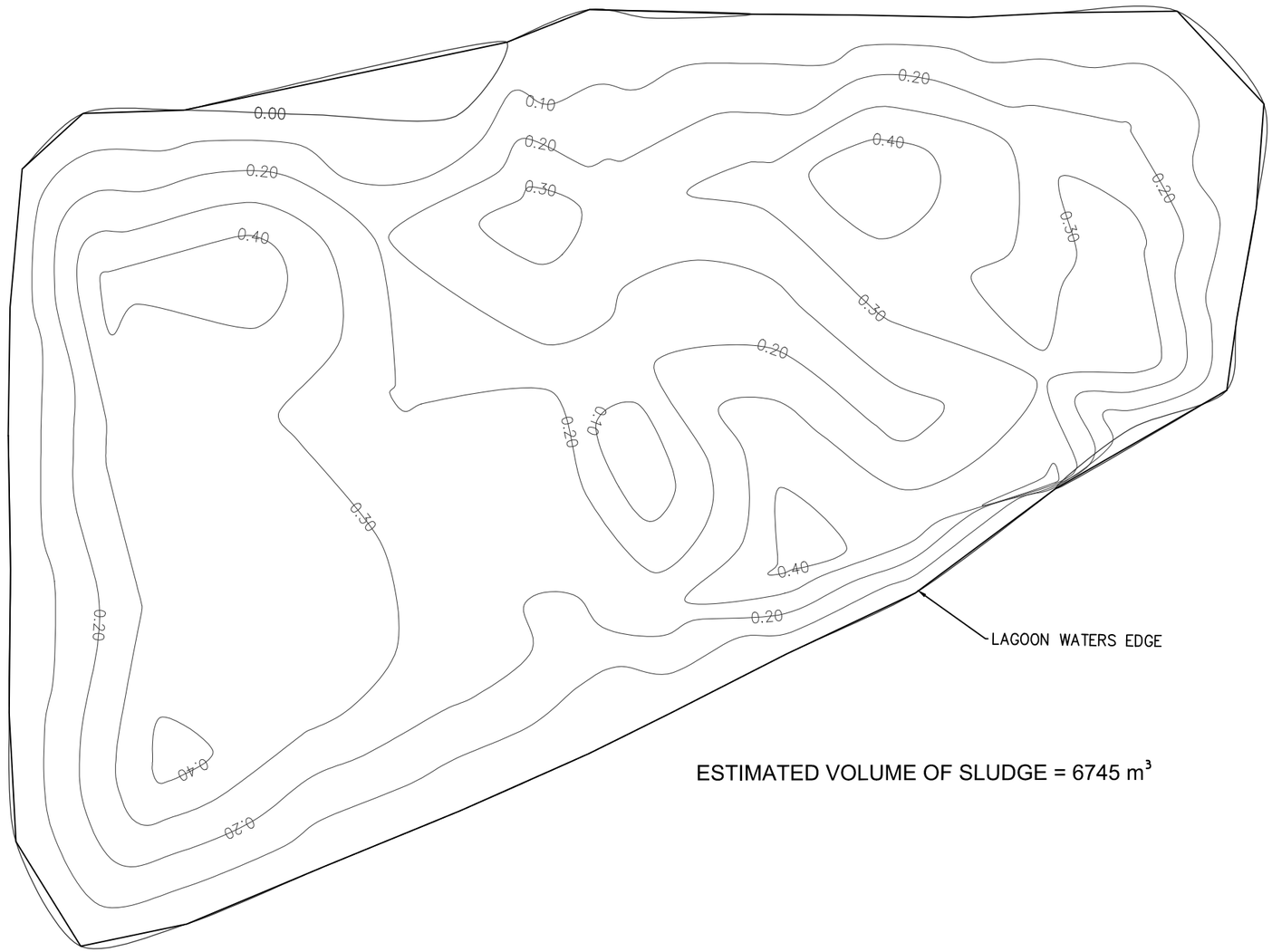
f. 204.943.4948
www.mmm.ca

GLADSTONE LAGOON

CELL 1
VOLUME

SCALE:	DATE:	DWG. No.
NTS	03 NOV 2015	SK 01



N

ESTIMATED VOLUME OF SLUDGE = 6745 m^3

NOTE:
1. BENCH MARK ELEVATION 269.119m – WATER LEVEL – OCT.14,2015
2. ELEVATION ERROR +/– 2cm (Trimble R8 GPS)
3. CONTOURS ARE DELINEATION OF SLUDGE THICKNESS
4. MEASURE OF CELL 2 = 30763 M^2

METRIC

WHOLE NUMBERS INDICATE MILLIMETRES
DECIMALIZED NUMBERS INDICATE METRES

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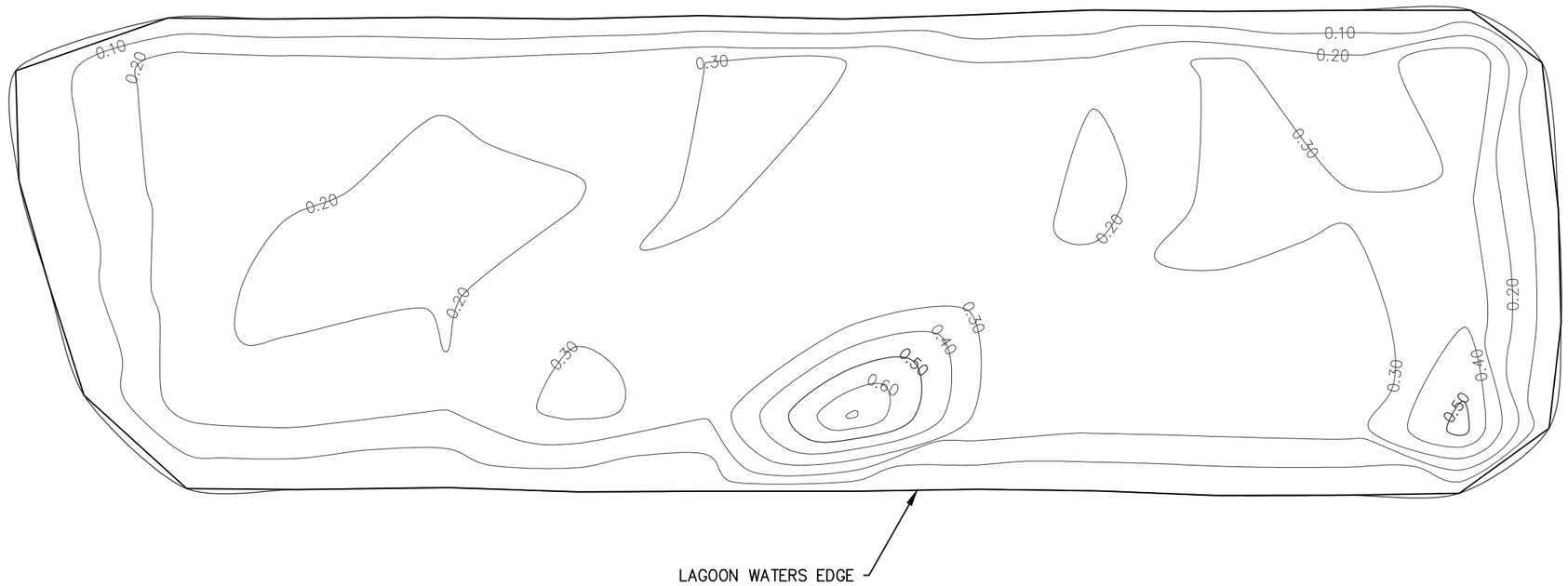
GLADSTONE LAGOON

CELL 2
VOLUME

SCALE:	DATE:	DWG. No.
NTS	03 NOV 2015	SK 02

Nov 04, 2015 – 10:17am
C:\Users\Farrowd\appdata\local\temp\AcPublish_5068\GladstoneLagoonSurvey 20151027.dwg – tab:Cell 2



ESTIMATED VOLUME OF SLUDGE = 5522 m^3

NOTE:
1. BENCH MARK ELEVATION 268.084m – WATER LEVEL – OCT.26,2015
2. ELEVATION ERROR +/– 2cm (Trimble R8 GPS)
3. CONTOURS ARE DELINEATION OF SLUDGE THICKNESS
4. MEASURE OF CELL 3 = 21343 M^2

METRIC
WHOLE NUMBERS INDICATE MILLIMETRES
DECIMALIZED NUMBERS INDICATE METRES

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Winnipeg, MB R3B 3B1
t. 204.943.3178
f. 204.943.4948
www.mmm.ca

GLADSTONE LAGOON
CELL 3
VOLUME

SCALE:	DATE:	DWG. No.
NTS	03 NOV 2015	SK 03

APPENDIX B – Tables

Table 5.2 Hypothetical Field Prescription Application Rates for Cell 1, Westlake/Gladstone, MB October 2, 2015

Field ID:	NW/SW 21-14-11WPM	
Land Area Available (ha):		177
2017 Crop	Canola	
2016 Target Yield:	40	
	lb/ac	kg/ha
Target Nitrogen recommended :	120	134.4
Fertilizer Phosphate (P2O5) Recommended:	45	50.4
1 x P2O5 Crop Removal @ target Yield:	42	47.04
2 x P2O5 Crop Removal @ target Yield:	84	94.08

Plant Available Nutrients Soil Test Data			
Sample ID	**21-14-11W**	**2015 Soil Sample**	
Sample Depth	0-15 cm	15-60 cm	Total Available
Units	mg kg^{-1}		kg ha-1
Available Nitrate-N	10.0	0	20
Available Phosphate-P (Olsen)	06.0		12
Available Potassium	151		302
Available Sulfate-S	060		120

Steinbach Biosolids Characteristics and Analysis

Parameter Name	**Parameter Description**	**Unit**	**Biosolid Analysis (Cell 1)**
Estimated Biosolid Volume (+ 15% safety volume)	In-field	m^3	8,308
Specific Gravity	As Received	kg L^{-1}	1.01
Estimated Biosolids		tonnes	8,391
Dry tonnes biosolids available (=wet tonnes x %solids)	Dried Basis	tonnes	556
Moisture	As Received	**%**	93.40
Total Solids	As Received	**%**	6.69
Total Volatile Solids	Dry Basis	%	31
Organic Matter	Dry Basis	%	20.80
Mineral Content	Dry Basis	%	79.20
Total Organic Carbon	Dry Basis	%	18.70
C:N Ratio	Dry Basis	x:1	13.65
C:P Ratio	Dry Basis	x:1	48.45
N:P Ratio	Dry Basis	x:1	3.55
pH	Saturated Paste		8.07
Total Kjeldahl N	% Dried Basis	%	1.37
Total Kjeldahl N	Dried Basis	mg kg^{-1}	13,700
Total Kjeldahl N	Dried Basis	kg $Tonne^{-1}$	13.70
Ammonium - N	Dried Basis	mg kg^{-1}	622.00
Ammonium - N	Dried Basis	kg $Tonne^{-1}$	0.6220
Available Nitrate	Dried Basis	mg kg^{-1}	-
Available Nitrate-N	Dried Basis	mg kg^{-1}	-
Available Nitrate-N		kg $Tonne^{-1}$	-
Total Phosphorous	Dried Basis	mg kg^{-1}	3,860

Measured Volume

7,224

Amount of Biosolids Nutrient Available to Crop

Organic N (=TKN-ammonium N)	Dried Basis	mg kg^{-1}	13,078.00
Organic N	Dried Basis	kg $Tonne^{-1}$	13.08
Method of Application:			Injected
Anticipated Weather			Cool/dry
Anticipated Volatilization (%)			-
Available Organic N	Dried Basis	kg $Tonne^{-1}$	3.27
Ammonium nitrogen available	Dried Basis	kg $Tonne^{-2}$	0.62
Total available nitrogen (Year 1) (@25%)	Dried Basis	kg $Tonne^{-1}$	3.89
Mineralization N Year 2 (@12%)	Dried Basis	kg $Tonne^{-1}$	1.57
Mineralization N Year 3 (@6%)	Dried Basis	kg $Tonne^{-1}$	0.78
Total Phosphorus	Dried Basis	kg $Tonne^{-1}$	3.86
$P_2O_{5\ equivalent}$	Dried Basis	kg $Tonne^{-1}$	8.88
Total Available P2O5 (@ 50%)	Dried Basis	kg $Tonne^{-1}$	4.44

Application Rate based on Nitrogen				**Land Area Required (Ha)**
Nitrogen Based Application Rate	Dried Basis	tonnes ha^{-1}	34.54	**16**
Amount of Available P2O5 applied	Dried Basis	kg ha^{-1}	153.31	
P2O5 Application check		%	304.18	

Application Rate based on Phosphorous (1xCR)				**Land Area Required (Ha)**
Total Phosphorus Based Application Rate	Dried Basis	tonnes ha^{-1}	10.60	**52**
Amount of Nitrogen applied	Dried Basis	kg ha^{-1}	41.24	
Additional Nitrogen required		kg ha^{-1}	93.16	

Application Rate based on Phosphorous (2xCR)				**Land Area Required (Ha)**
Total Phosphorus Based Application Rate	Dried Basis	tonnes ha^{-1}	**21.19**	**26**
Amount of Nitrogen applied	Dried Basis	kg ha^{-1}	82.48	
Additional Nitrogen required		kg ha^{-1}	51.92	

Selected Application rate based on:		**2xCR**	**P2O5**
Selected Application rate based on P2O5	Dried Basis	tonnes ha^{-1}	**21.19**
		tons ac^{-1}	**9.54**
	Wet	tonnes ha^{-1}	316.80
		tons ac^{-1}	142.56
		L ha^{-1}	146,837
		igal ac^{-1}	**13,069**
Estimated Biosolids Volume Applied	Wet	Tonnnes	56,074
Estimated Biosolids Volume Remaining	Wet	Tonnes	- 47,683

Notes

Available Ammonium N - Volatilization loss associated with different application methods (0% with Injection)

Organic N - TKN - Ammonium N

Available Organic N - Organic N x 0.25year 1

Mineralization of Year 2 = 12%, Year 3 = 6%

Plant Available Nitrogen= (NO3-N)+Volatilization factor (NH4-N)+Organic N Mineralization

Phosphorous Total and Olsen methods.

* See Estimates of Ammonium-N Retained After Biosolids application

C:N exceeds 30:1, N becomes a limiting nutrient for decomposer organisms, and this can reduce the rate of decomposition and results in N immobilization

C:P ratio between 200:1 and 300:1, mineralization and immobilization balance each other to result in no net release of P from the decomposing manure. When C:P is below this range, P is released.

When animal and municipal wastes have N:P ratios ranging from 1:1 to 1:2 are applied based on N rates on soils, over time P will accumulate

Table 5.3 Hypothetical Field Prescription Application Rates for Cell 2, Westlake/Gladstone, MB

October 2, 2015

Field ID:	NW/SW21-14-11WPM	
Land Area Available (ha):		177
2016 Crop	Canola	
2016 Target Yield:	40	
	lb/ac	kg/ha
Target Nitrogen recommended :	120	134.4
Fertilizer Phosphate (P2O5) Recommended:	45	50.4
1 x P2O5 Crop Removal @ target Yield:	42	47.04
2 x P2O5 Crop Removal @ target Yield:	84	94.08

Plant Available Nutrients Soil Test Data			
Sample ID	**21-14-11W**	**2015 Soil Sample**	
Sample Depth	0-15 cm	15-60 cm	Total Available
Units	mg kg^{-1}		kg ha-1
Available Nitrate-N	10.0		20
Available Phosphate-P (Olsen)	06.0		12
Available Potassium	151		302
Available Sulfate-S	060		120

Steinbach Biosolids Characteristics and Analysis

Parameter Name	Parameter Description	Unit	Biosolid Analysis (Cell 2)
Estimated Biosolid Volume (+ 15% safety volume)	In-field	m^3	7,757
Specific Gravity	As Received	kg L^{-1}	1.03
Estimated Biosolids		tonnes	7,989
Dry tonnes biosolids available (=wet tonnes x %solids)	Dried Basis	tonnes	1,280
Moisture	As Received	**%**	84.20
Total Solids	As Received	**%**	16.50
Total Volatile Solids	Dry Basis	%	16.7
Organic Matter	Dry Basis	%	10.10
Mineral Content	Dry Basis	%	89.90
Total Organic Carbon	Dry Basis	%	10.80
C:N Ratio	Dry Basis	x:1	14.40
C:P Ratio	Dry Basis	x:1	52.94
N:P Ratio	Dry Basis	x:1	3.68
pH	Saturated Paste		8.29
Total Kjeldahl N	% Dried Basis	%	0.75
Total Kjeldahl N	Dried Basis	mg kg^{-1}	7,500
Total Kjeldahl N	Dried Basis	kg $Tonne^{-1}$	7.50
Ammonium - N	Dried Basis	mg kg^{-1}	131.00
Ammonium - N	Dried Basis	kg $Tonne^{-1}$	0.1310
Available Nitrate	Dried Basis	mg kg^{-1}	-
Available Nitrate-N	Dried Basis	mg kg^{-1}	-
Available Nitrate-N		kg $Tonne^{-1}$	-
Total Phosphorous	Dried Basis	mg kg^{-1}	2,040

Measured Volume

6,745

Amount of Biosolids Nutrient Available to Crop

Organic N (=TKN-ammonium N)	Dried Basis	mg kg^{-1}	7,369.00
Organic N	Dried Basis	kg $Tonne^{-1}$	7.37
Method of Application:			Injected
Anticipated Weather			Cool/dry
Anticipated Volatilization (%)			
Available Organic N	Dried Basis	kg $Tonne^{-1}$	1.84
Ammonium nitrogen available	Dried Basis	kg $Tonne^{-2}$	0.13
Total available nitrogen (Year 1) (@25%)	Dried Basis	kg $Tonne^{-1}$	1.97
Mineralization N Year 2 (@12%)	Dried Basis	kg $Tonne^{-1}$	0.88
Mineralization N Year 3 (@6%)	Dried Basis	kg $Tonne^{-1}$	0.44
Total Phosphorus	Dried Basis	kg $Tonne^{-1}$	2.04
$P_2O_{5\ equivalent}$	Dried Basis	kg $Tonne^{-1}$	4.69
Total Available P_2O_5 (@50%)	Dried Basis	kg $Tonne^{-1}$	2.35

Application Rate based on Nitrogen				**Land Area Required (Ha)**
Nitrogen Based Application Rate	Dried Basis	tonnes ha^{-1}	68.11	**19**
Amount of Available P2O5 applied	Dried Basis	kg ha^{-1}	159.79	
P2O5 Application check		%	317.04	

Application Rate based on Phosphorous (1xCR)				**Land Area Required (Ha)**
Total Phosphorus Based Application Rate	Dried Basis	tonnes ha^{-1}	20.05	**64**
Amount of Nitrogen applied	Dried Basis	kg ha^{-1}	39.57	
Additional Nitrogen required		kg ha^{-1}	94.83	

Application Rate based on Phosphorous (2xCR)				**Land Area Required (Ha)**
Total Phosphorus Based Application Rate	Dried Basis	tonnes ha^{-1}	**40.10**	**32**
Amount of Nitrogen applied	Dried Basis	kg ha^{-1}	79.13	
Additional Nitrogen required		kg ha^{-1}	55.27	

Selected Application rate based on:		**2xCR**	**P2O5**
Selected Application rate based on P2O5	Dried Basis	tonnes ha^{-1}	**40.10**
		tons ac^{-1}	**18.05**
	Wet	tonnes ha^{-1}	243.04
		tons ac^{-1}	109.37
		L ha^{-1}	112,651
		igal ac^{-1}	**10,026**
Estimated Biosolids Volume Applied	Wet	Tonnnes	43,019
Estimated Biosolids Volume Remaining	Wet	Tonnes	- 35,029

Notes

Available Ammonium N - Volatilization loss associated with different application methods (0% with Injection)

Organic N - TKN - Ammonium N

Available Organic N - Organic N x 0.25year 1

Mineralization of Year 2 = 12%, Year 3 = 6%

Plant Available Nitrogen= (NO3-N)+Volatilization factor (NH4-N)+Organic N Mineralization

Phosphorous Total and Olsen methods.

* See Estimates of Ammonium-N Retained After Biosolids application

C:N exceeds 30:1, N becomes a limiting nutrient for decomposer organisms, and this can reduce the rate of decomposition and results in N immobilization

C:P ratio between 200:1 and 300:1, mineralization and immobilization balance each other to result in no net release of P from the decomposing manure. When C:P is below this range, P is released.

When animal and municipal wastes have N:P ratios ranging from 1:1 to 1:2 are applied based on N rates on soils, over time P will accumulate

Table 5.4 Hypothetical Field Prescription Application Rates for Cell 3, Westlake/Gladstone, MB

October 2, 2015

Field ID:	SW28-14-11WPM	
Land Area Available (ha):		56
2016 Crop	Canola	
2016 Target Yield:	40	
	lb/ac	kg/ha
Target Nitrogen recommended :	120	134.4
Fertilizer Phosphate (P2O5) Recommended:	40	44.8
1 x P2O5 Crop Removal @ target Yield:	42	47.04
2 x P2O5 Crop Removal @ target Yield:	84	94.08

Plant Available Nutrients Soil Test Data			
Sample ID	**28-14-11W**	**2015 Soil Sample**	
Sample Depth	0-15 cm	15-60 cm	Total Available
Units	mg kg^{-1}		kg ha-1
Available Nitrate-N	14.5	0	29
Available Phosphate-P (Olsen)	05.0		10
Available Potassium	153		306
Available Sulfate-S	060	0	120

Steinbach Biosolids Characteristics and Analysis

Parameter Name	Parameter Description	Unit	Biosolid Analysis (Cell 3)
Estimated Biosolid Volume (+ 15% safety volume)	In-field	m^3	6,350
Specific Gravity	As Received	kg L^{-1}	1.02
Estimated Biosolids		tonnes	6,477
Dry tonnes biosolids available (=wet tonnes x %solids)	Dried Basis	tonnes	213
Moisture	As Received	**%**	98.50
Total Solids	As Received	**%**	3.35
Total Volatile Solids	Dry Basis	%	20.9
Organic Matter	Dry Basis	%	6.10
Mineral Content	Dry Basis	%	93.90
Total Organic Carbon	Dry Basis	%	8.00
C:N Ratio	Dry Basis	x:1	22.86
C:P Ratio	Dry Basis	x:1	44.94
N:P Ratio	Dry Basis	x:1	1.97
pH	Saturated Paste		7.69
Total Kjeldahl N	% Dried Basis	%	0.35
Total Kjeldahl N	Dried Basis	mg kg^{-1}	3,500
Total Kjeldahl N	Dried Basis	kg $Tonne^{-1}$	3.50
Ammonium - N	Dried Basis	mg kg^{-1}	135.00
Ammonium - N	Dried Basis	kg $Tonne^{-1}$	0.1350
Available Nitrate	Dried Basis	mg kg^{-1}	2.60
Available Nitrate-N	Dried Basis	mg kg^{-1}	0.0026
Available Nitrate-N		kg $Tonne^{-1}$	0.0000026
Total Phosphorous	Dried Basis	mg kg^{-1}	1,780

Amount of Biosolids Nutrient Available to Crop

Organic N (=TKN-ammonium N)	Dried Basis	mg kg^{-1}	3,365.00
Organic N	Dried Basis	kg $Tonne^{-1}$	3.37
Method of Application:			Injections
Anticipated Weather			Cool/dry
Anticipated Volatilization (%)			
Available Organic N	Dried Basis	kg $Tonne^{-1}$	0.84
Ammonium nitrogen available	Dried Basis	kg $Tonne^{-2}$	0.14
Total available nitrogen (Year 1) (@25%)	Dried Basis	kg $Tonne^{-1}$	0.98
Mineralization N Year 2 (@12%)	Dried Basis	kg $Tonne^{-1}$	0.40
Mineralization N Year 3 (@6%)	Dried Basis	kg $Tonne^{-1}$	0.20
Total Phosphorus	Dried Basis	kg $Tonne^{-1}$	1.78
$P_2O_{5\ equivalent}$	Dried Basis	kg $Tonne^{-1}$	4.09
Total Available P_2O_5 (@50%)	Dried Basis	kg $Tonne^{-1}$	2.05

Mesured Volume

5,522

Application Rate based on Nitrogen				Land Area Required (Ha)
Nitrogen Based Application Rate	Dried Basis	tonnes ha^{-1}	137.67	**2**
Amount of Available P2O5 applied	Dried Basis	kg ha^{-1}	281.81	
P2O5 Application check		%	629.04	

Application Rate based on Phosphorous (1xCR)				Land Area Required (Ha)
Total Phosphorus Based Application Rate	Dried Basis	tonnes ha^{-1}	22.98	**9**
Amount of Nitrogen applied	Dried Basis	kg ha^{-1}	22.43	
Additional Nitrogen required		kg ha^{-1}	111.97	

Application Rate based on Phosphorous (2xCR)				Land Area Required (Ha)
Total Phosphorus Based Application Rate	Dried Basis	tonnes ha^{-1}	**45.96**	**5**
Amount of Nitrogen applied	Dried Basis	kg ha^{-1}	44.87	
Additional Nitrogen required		kg ha^{-1}	89.53	

Selected Application rate based on:		**2xCR**	**P2O5**
Selected Application rate based on P2O5	Dried Basis	tonnes ha^{-1}	**45.96**
		tons ac^{-1}	**20.68**
	Wet	tonnes ha^{-1}	1,371.94
		tons ac^{-1}	617.37
		L ha^{-1}	635,894
		igal ac^{-1}	**56,595**
Estimated Biosolids Volume Applied	Wet	Tonnnes	76,829
Estimated Biosolids Volume Remaining	Wet	Tonnes	- 70,351

Notes

Available Ammonium N - Volatilization loss associated with different application methods (0% with Injection)

Organic N - TKN - Ammonium N

Available Organic N - Organic N x 0.25year 1

Mineralization of Year 2 = 12%, Year 3 = 6%

Plant Available Nitrogen= (NO3-N)+Volatilization factor (NH4-N)+Organic N Mineralization

Phosphorous Total and Olsen methods.

* See Estimates of Ammonium-N Retained After Biosolids application

C:N exceeds 30:1, N becomes a limiting nutrient for decomposer organisms, and this can reduce the rate of decomposition and results in N immobilization

C:P ratio between 200:1 and 300:1, mineralization and immobilization balance each other to result in no net release of P from the decomposing manure. When C:P is below this range, P is released.

When animal and municipal wastes have N:P ratios ranging from 1:1 to 1:2 are applied based on N rates on soils, over time P will accumulate

Table 5.5 Results of Detailed Salinity Analysis for Cells 1 and 2 of the RM of WestLake - Gladstone lagoons.

Analyte	Units	Sample ID	Cell 1	Cell 2
		Detection Limit	Soil	Soil
Conductivity (EC)	dS m^{-1}	0.01	3	2.11
SAR	SAR	0.1	2.54	2.43
Calcium (Ca) - calculated	mg L^{-1}	10	114 [1]	109 [1]
Chloride (Cl) - calculated		1	1690 [2]	159
Magnesium (Mg) - calculated		10	118 [1]	127 [1]
Potassium (K) - calculated		10	23 [1]	24 [1]
Sodium (Na) - calculated		10	162 [1]	157 [1]
Sulfur (as SO4) - calculated		10	217 [1]	345 [1]
Calcium (Ca) - dry weight	mg kg^{-1}	53	1610	582
Chloride (Cl) - dry weight		5.3	23800	847
Magnesium (Mg) - dry weight		53	1670	675
Potassium (K) - dry weight		53	330	127
Sodium (Na) - dry weight		53	2290	838
Sulfur (as SO4) - dry weight		53	3070	1840
Calcium (Ca) - wet weight	mg kg^{-1}	8.4	106	91.9
Chloride (Cl) - wet weight		0.84	1570	134
Magnesium (Mg) - wet weight		8.4	110	107
Potassium (K) - wet weight		8.4	21.6	20.1
Sodium (Na) - wet weight		8.4	151	132
Sulfur (as SO4) - wet weight		8.4	203	291

[1]Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.

[2]Detection Limit Raised: Dilution required due to high concentration of test analyte(s).

Table 5.6 Results of Detailed Salinity Analysis for Cell 3 of the RM of WestLake - Gladstone lagoons.

Analyte	Units	Sample ID	Cell 3
		Detection Limit	Soil
Conductivity Saturated Paste (EC)	dS m^{-1}	0.1	6.2
SAR	SAR	0.1	3.82
Calcium (Ca) - saturated soil	mg L^{-1}	25	399 [1]
Chloride (Cl) - saturated soil		60	1460 [1]
Magnesium (Mg) - saturated soil		25	487 [1]
Potassium (K) - saturated soil		25	90 [1]
Sodium (Na) - saturated soil		25	480 [1]
Sulfur (as SO4) - saturated soil		25	2980 [1]
Calcium (Ca)	mg kg^{-1}	21	341 [1]
Chloride (Cl)		51	1240 [1]
Magnesium (Mg)		21	415 [1]
Potassium (K)		21	76 [1]
Sodium (Na)		21	410 [1]
Sulfur (as SO4)		21	2540 [1]

[1]Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.

Table 5.7 Biosolid Trace Element (Metal) Sample Results for Cells 1, 2 and 3, Typical Soil Metal Concentrations and Cumulative Metal Concentrations

Trace Element	Units	Sample ID	Cell 1		Cell 2		Cell 3		Typical Soil Concentrations		Cell 1 Loading Rate		Cell 2 Loading Rate		Cell 3 Loading Rate		Cumulative Weight Allowed by Guideline[1]
											Application Rate 21.0 T ha-1 (dry)	Cumulative Metal Concentration	Application Rate 40.0 T ha-1 (dry)	Cumulative Metal Concentration	Application Rate 46.0 T ha-1 (dry)	Cumulative Metal Concentration	
		Detection Limit	mg kg^{-1}	kg tonne^{-1}	mg kg^{-1}	kg tonne^{-1}	mg kg^{-1}	kg tonne^{-1}	mg kg^{-1}	kg ha^{-1}	kg ha^{-1}	kg ha^{-1}	kg ha^{-1}	kg ha^{-1}	kg ha^{-1}	kg ha^{-1}	kg ha^{-1}
Antimony (Sb)		0.1	1.14	0.001	0.34	0.000	0.2	0.000			0.024	0.02	0.014	0.04	0.009	0.05	-
Arsenic (As)		0.1	7.56	0.008	3.1	0.003	3.2	0.003	9.00	0.37	0.159	0.53	0.123	0.65	0.148	0.80	21.6
Barium (Ba)		0.5	288	0.288	159	0.159	161	0.161			6.048	6.05	6.360	12.41	7.406	19.81	-
Beryllium (Be)		0.1	0.35	0.000	00.5	0.000	00.4	0.000			0.007	0.01	0.019	0.03	0.019	0.05	-
Boron (B), Hot Water Ext. Available		1.4 (1), 0.6 (2)	11.1 (1)*	0.011	9.0 (1)*	0.009	7.54 (2)*	0.008			0.233	0.23	0.360	0.59	0.347	0.94	-
Cadmium (Cd)		0.02	1.69	0.002	0.396	0.000	0.335	0.000	0.10	0.00	0.035	0.04	0.016	0.06	0.015	0.07	2.5
Chromium (Cr)		1	19.9	0.020	16.4	0.016	14.3	0.014	70.00	2.90	0.418	3.32	0.656	3.97	0.658	4.63	115.2
Cobalt (Co)		0.02	4.59	0.005	5.62	0.006	5.29	0.005	19.00	0.79	0.096	0.88	0.225	1.11	0.243	1.35	-
Copper (Cu)		1	538	0.538	103	0.103	48.4	0.048	27.00	1.12	11.298	12.42	4.120	16.54	2.226	18.76	113.4
Lead (Pb)		0.2	51.7	0.052	12	0.012	6.3	0.006	26.00	1.08	1.086	2.16	0.480	2.64	0.290	2.93	126
Mercury (Hg)	mg kg^{-1}	0.05	2.12	0.002	0.125	0.000	<0.050		0.07		0.045	0.04	0.005	0.05			11.9
Molybdenum (Mo)		0.02	12.3	0.012	3.22	0.003	1	0.001	4.00	0.17	0.258	0.42	0.129	0.55	0.046	0.60	-
Nickel (Ni)		0.5	19.8	0.020	17.1	0.017	15.9	0.016	35.00	1.45	0.416	1.86	0.684	2.55	0.731	3.28	90
Phosphorus (P)		100	3860	3.860	2040.0	2.040	1780.0	1.780			81.060	81.06	81.600	162.66	81.880	244.54	-
Selenium (Se)		0.5	5.52	0.006	2.38	0.002	0.92	0.001	0.50	0.02	0.116	0.14	0.095	0.23	0.042	0.27	-
Silver (Ag)		0.1	11	0.011	01.0	0.001	00.2	0.000	0.20	0.01	0.231	0.24	0.040	0.28	0.010	0.29	-
Thallium (Tl)		0.1	0.19	0.000	0.2	0.000	0.15	0.000			0.004	0.00	0.008	0.01	0.007	0.02	-
Tin (Sn)		5	26.6	0.027	<5.0		<5.0				0.559	0.56					-
Uranium (U)		0.02	36.5	0.037	23.6	0.024	9.95	0.010			0.767	0.77	0.944	1.71	0.458	2.17	-
Vanadium (V)		0.5	23.4	0.023	27.9	0.028	25.1	0.025	82.00	3.39	0.491	3.89	1.116	5.00	1.155	6.16	-
Zinc (Zn)		10	351	0.351	103	0.103	49	0.049	96.00	3.97	7.371	11.35	4.120	15.47	2.254	17.72	360

Notes:
[1] Cumulative Weight Allowed by Guideline includes the metals in soils.

* Detection Limit adjusted due to sample matrix effects.

Mean trace element for a Neuhorst soil series

Source: Haluschak, P. R.G. Eilers, G.F. Mills, and S. Grift. 1998. Status of Selected Trace Elements in Agricultural Soils of Southern Manitoba

APPENDIX C – Landowner Agreements, Land Titles and Soil Tests

Municipality of WestLake-Gladstone

Box 150 Gladstone MB R0J 0T0
Phone: 204-385-2332 Fax 204-385-2391
info@westlake-gladstone.ca

Dear Mr. Gerald Cavat,

The Municipality of WestLake-Gladstone requires agricultural land to apply biosolids from the Wastewater Treatment facility lagoons. Applying biosolids to agricultural land is a beneficial and sustainable means to manage this organic material. This is a letter agreement to allow land application to occur on the land parcels outlined below. The following outlines the points of this agreement.

1. Each quarter section will need to be soil sampled for nutrients, metals and salts. Soil sampling will be completed by truck and required for prescription rates.
2. Soil sampling may need to occur more than one occasion and will occur prior to spring seeding or post-harvest.
3. Land application of biosolids will be completed with heavy field equipment and will need good access to the land parcel(s) after crop harvest or prior to spring seeding.
4. If applicable, buffer zones may be left with no biosolid application near property lines, homes, groundwater wells and surface water features as required by the Manitoba Environment Act.
5. Biosolids will be applied at agronomic prescribed rates.
6. Biosolids / sludge may require tillage incorporation shortly after application depending upon the application method.
7. There are no fees to be paid from the Municipality to the landowner or lessee for:
    a. Biosolids/sludge or nutrients
    b. Use of land
    c. Application process
    d. Tillage requirements
8. Volume of biosolids is not exact, not all the land may be required for application.

9. The landowner has the right to pull out of the program, with sufficient notice (ie. 2 months).
10. Manitoba Conservation imposes cropping restrictions, the following crops can only be grown; cereal crops, oil seed crop, forage, field peas or lentils.

Legal land location (quarter/section/township/range) for each parcel:

SW-28-14-11 W1	G Cavat Enterprises Ltd.
NW-21-14-11 W1	G Cavat Enterprises Ltd.
SW-21-14-11 W1	G Cavat Enterprises Ltd.
SE-21-14-11 W1	G Cavat Enterprises Ltd.

Signature: G. Cavat Date: 22 Jan / 2016

For further information please contact:

Darren Keam, M.Sc., P.Ag.

Senior Soil Scientist

Environmental Management

MMM Group Limited, a WSP Company

111 – 93 Lombard Avenue

Winnipeg, MB R3B 3B1

T +1 204-272-2020

O +1 204-943-3178 #3891

F +1 204-943-4948

C +1 204-250-4010

keamd@mmm.ca

www.mmmgrouplimited.com | www.wspgroup.ca

STATUS OF TITLE

Title Number **1499830/3**
Title Status **Accepted**
Client File 3315449.000.exp

The Property Registry
A Service Provider for the Province of Manitoba

1. REGISTERED OWNERS, TENANCY AND LAND DESCRIPTION

G. CAVAT ENTERPRISES LTEE.

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

PARCEL 1: SW 1/4 21-14-11 WPM, EXC
FIRSTLY: THE NLY 750 FEET PERP OF THE SLY 2270 FEET PERP
OF THE WLY 745 FEET PERP
SECONDLY: RLY RIGHT-OF-WAY PLAN 317 PLTO

PARCEL 2: NW 1/4 21-14-11 WPM EXC ROAD PLAN 1830 PLTO

PARCEL 3: SE 1/4 21-14-11 WPM

The land in this title is, unless the contrary is expressly declared, deemed to be subject to the reservations and restrictions set out in section 58 of *The Real Property Act.*

2. ACTIVE INSTRUMENTS

Instrument Type:	**Caveat**
Registration Number:	**96-1852/3**
Instrument Status:	**Accepted**
Registration Date:	1996-03-25
From/By:	GLADSTONE AUSTIN NATURAL GAS CO-OP LTD.
To:	
Amount:	
Notes:	AFFECTS PARCELS 1 & 2
Description:	No description

INSTRUMENTS THAT AFFECT THIS INSTRUMENT

Registration Number	Instrument Type	Status
1072679/3	Assignment Of Caveat	Accepted

Instrument Type:	**Assignment Of Caveat**
Registration Number:	**1072679/3**
Instrument Status:	**Accepted**
Registration Date:	2004-03-23
From/By:	GLADSTONE AUSTIN NATURAL GAS CO-OP LTD.
To:	CENTRA GAS MANITOBA INC.
Amount:	
Notes:	No notes
Description:	No description

3. ADDRESSES FOR SERVICE

G. CAVAT ENTERPRISES LTEE
P.O. BOX 446
GLADSTONE MB
R0J 0T0

4. TITLE NOTES

No title notes

5. LAND TITLES DISTRICT

Portage la Prairie

6. DUPLICATE TITLE INFORMATION

Duplicate not produced

7. FROM TITLE NUMBERS

E20309/3 All

8. REAL PROPERTY APPLICATION / CROWN GRANT NUMBERS

No real property application or grant information

9. ORIGINATING INSTRUMENTS

Instrument Type:	**Transfer Of Land**
Registration Number:	**1003711/3**
Registration Date:	1997-04-14
From/By:	YELLOW QUILL FARMS LTD.
To:	G. CAVAT ENTERPRISES LTEE
Consideration:	$330,000.00

10. LAND INDEX

NW 21-14-11W
EXC ROAD PLAN 1830

SE 21-14-11W

SW 21-14-11W
EXC N 750'P OF S 2270'P OF W 745'P & RLY PLAN 317

CERTIFIED TRUE EXTRACT PRODUCED FROM THE LAND TITLES DATA STORAGE SYSTEM OF TITLE NUMBER 1499830/3

STATUS OF TITLE

Title Number **1498397/3**
Title Status **Accepted**
Client File 3315449.000.exp

The Property Registry
A Service Provider for the Province of Manitoba

1. REGISTERED OWNERS, TENANCY AND LAND DESCRIPTION

G. CAVAT ENTERPRISES LTEE

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

THAT PORTION OF W 1/2 28-14-11 WPM WHICH LIES SOUTH OF
RLY RIGHT-OF-WAY PLAN 608 PLTO, EXC
FIRSTLY: THE NELY 20 FEET PERP OF THAT PORTION LYING WEST OF A LINE
DRAWN SLY AT RIGHT ANGLES TO THE CENTRE LINE OF SAID RLY RIGHT-OF-WAY
PLAN 608 PLTO FROM A POINT THEREIN DISTANT SELY 2621.95 FEET FROM THE
WEST LIMIT OF SAID SECTION
SECONDLY: OUT OF THE SW 1/4, ROAD PLAN 1830 PLTO

The land in this title is, unless the contrary is expressly declared, deemed to be subject to the reservations and restrictions set out in section 58 of *The Real Property Act.*

2. ACTIVE INSTRUMENTS

No active instruments

3. ADDRESSES FOR SERVICE

G. CAVAT ENTERPRISES LTEE
P.O. BOX 446
GLADSTONE MB
R0J 0T0

4. TITLE NOTES

No title notes

5. LAND TITLES DISTRICT

Portage la Prairie

6. DUPLICATE TITLE INFORMATION

Duplicate not produced

7. FROM TITLE NUMBERS

E23829/3 All

8. REAL PROPERTY APPLICATION / CROWN GRANT NUMBERS

No real property application or grant information

9. ORIGINATING INSTRUMENTS

Instrument Type:	**Request To Issue Title - Internal**
Registration Number:	**1003435/3**
Registration Date:	1997-04-03
From/By:	G. CAVAT ENTERPRISES LTEE
To:	
Amount:	

10. LAND INDEX

NW 28-14-11W
EXC OUT OF PT A 20'STRIP SOUTH OF RLY

SW 28-14-11W
EXC OUT OF PT A 20'STRIP S OF RLY EXC ROAD PLAN 1830

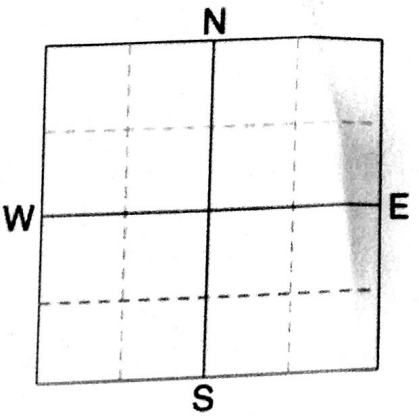
CERTIFIED TRUE EXTRACT PRODUCED FROM THE LAND TITLES DATA STORAGE SYSTEM OF TITLE NUMBER 1498397/3

SOIL TEST REPORT

AGVISE LABORATORIES

Soil Analysis by Agvise Laboratories
(http://www.agvise.com)
Northwood: (701) 587-6010
Benson: (320) 843-4109

FIELD ID **N OF HIGHWAY**
SAMPLE ID
FIELD NAME
COUNTY **11W**
TWP **14** RANGE
SECTION **28** QTR **SW** ACRES **170**
PREV. CROP **Canola-bu**



SUBMITTED FOR:
GERALD CAVAT

GLADSTONE, MB

SUBMITTED BY: **MU1712**
MUNRO FARM SUPPLIES, LTD.
620 6TH AVE
BOX 92
WESTBOURNE, MB **R0H 1P0**

REF # **14212293** BOX # **0**
LAB # **NW125045**

Date Sampled **10/06/2015** Date Received **10/08/2015** Date Reported **10/21/2015**

Nutrient In The Soil			Interpretation (VLow / Low / Med / High)
Nitrate	0-6"	29 lb/ac	**********
Phosphorus	Olsen	5 ppm	********
Potassium		153 ppm	**********
Chloride	0-6"	122 lb/ac	**********
Sulfur	0-6"	120 +lb/ac	**********
Boron		3.0 ppm	**********
Zinc		0.70 ppm	**********
Iron		19.8 ppm	**********
Manganese		2.1 ppm	**********
Copper		1.36 ppm	**********
Magnesium		1835 ppm	**********
Calcium		7282 ppm	**********
Sodium		263 ppm	**********
Org.Matter		4.8 %	**********
Carbonate(CCE)		10.5 %	**********
Sol. Salts	0-6"	2.87 mmho/cm	**********

1st Crop Choice		
Oats		
YIELD GOAL		
110 BU		
SUGGESTED GUIDELINES		
Band/Maint.		
LB/ACRE		APPLICATION
N	52	
P_2O_5	33	Band *
K_2O	26	Band *
Cl	0	
S	0	
B	0	
Zn	3	Band (Trial)
Fe	0	
Mn	0	
Cu	0	
Mg	0	
Lime		

2nd Crop Choice		
YIELD GOAL		
0		
SUGGESTED GUIDELINES		
LB/ACRE		APPLICATION
N		
P_2O_5		
K_2O		
Cl		
S		
B		
Zn		
Fe		
Mn		
Cu		
Mg		
Lime		

3rd Crop Choice		
YIELD GOAL		
0		
SUGGESTED GUIDELINES		
LB/ACRE		APPLICATION
N		
P_2O_5		
K_2O		
Cl		
S		
B		
Zn		
Fe		
Mn		
Cu		
Mg		
Lime		

Soil pH	Buffer pH	Cation Exchange Capacity	% Base Saturation (Typical Range)				
			% Ca	% Mg	% K	% Na	% H
0-6" **8.2**		**53.2 meq**	(65-75) **68.4**	(15-20) **28.7**	(1-7) **0.7**	(0-5) **2.1**	(0-5)

General Comments: Texture is not estimated on high pH soils.

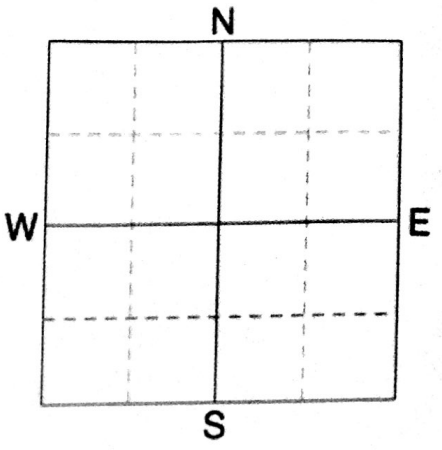
Crop 1: Soil Nitrogen level is estimated at 58 lbs/acre. * Caution: Seed Placed Fertilizer Can Cause Injury * Many crops may respond to a starter application of P & K even on high soil tests. High salt levels may decrease yields in portions of this field. Crop Removal: P2O5 = 28 K2O = 21 AGVISE Band/Maintenance guidelines will build P & K

AGVISE LABORATORIES

Soil Analysis by Agvise Laboratories
(http://www.agvise.com)
Northwood: (701) 587-6010
Benson: (320) 843-4109

SOIL TEST REPORT

FIELD ID **S OF HIGHWAY**
SAMPLE ID
FIELD NAME
COUNTY **11W**
TWP **14** RANGE
SECTION **21** QTR ACRES **460**
PREV. CROP **Oats**



SUBMITTED FOR:
GERALD CAVAT

GLADSTONE, MB

SUBMITTED BY: **MU1712**
MUNRO FARM SUPPLIES, LTD.
620 6TH AVE
BOX 92
WESTBOURNE, MB **R0H 1P0**

REF # **14212294** BOX # **0**
LAB # **NW125047**

Date Sampled **10/06/2015** Date Received **10/08/2015** Date Reported **10/21/2015**

Nutrient In The Soil		Interpretation			
		VLow	Low	Med	High
0-6" Nitrate	20 lb/ac	**********			
Olsen Phosphorus	6 ppm	**********			
Potassium	151 ppm			**********	**********
0-6" Chloride	33 lb/ac	**********			
0-6" Sulfur	120 +lb/ac				**********
Boron	2.5 ppm				**********
Zinc	0.55 ppm	**********			
Iron	14.1 ppm				**********
Manganese	1.7 ppm		**********		
Copper	0.77 ppm		**********		
Magnesium	1079 ppm				**********
Calcium	6117 ppm				**********
Sodium	57 ppm	********			
Org.Matter	4.6 %			**********	
Carbonate(CCE)	8.6 %				**********
0-6" Sol. Salts	1.18 mmho/cm			**********	

1st Crop Choice		
Canola-bu		
YIELD GOAL		
50 BU		
SUGGESTED GUIDELINES		
Band/Maint.		
LB/ACRE		APPLICATION
N	135	
P_2O_5	48	Band *
K_2O	23	Band *
Cl		Not Available
S	10	Band
B	0	
Zn	3	Band (Trail)
Fe	0	
Mn	0	
Cu	0	
Mg	0	
Lime		

2nd Crop Choice		
YIELD GOAL		
0		
SUGGESTED GUIDELINES		
LB/ACRE		APPLICATION
N		
P_2O_5		
K_2O		
Cl		
S		
B		
Zn		
Fe		
Mn		
Cu		
Mg		
Lime		

3rd Crop Choice		
YIELD GOAL		
0		
SUGGESTED GUIDELINES		
LB/ACRE		APPLICATION
N		
P_2O_5		
K_2O		
Cl		
S		
B		
Zn		
Fe		
Mn		
Cu		
Mg		
Lime		

Soil pH	Buffer pH	Cation Exchange Capacity	% Base Saturation (Typical Range)				
			% Ca	% Mg	% K	% Na	% H
0-6" **8.2**		**40.2 meq**	(65-75) **76.1**	(15-20) **22.4**	(1-7) **1.0**	(0-5) **0.6**	(0-5)

General Comments: Texture is not estimated on high pH soils.

Crop 1: ** Chloride yield data is limited for this crop. Soil Nitrogen level is estimated at 40 lbs/acre. * Caution: Seed Placed Fertilizer Can Cause Injury * Many crops may respond to a starter application of P & K even on high soil tests. Crop Removal: P2O5 = 45 K2O = 23 AGVISE Band/Maintenance guidelines will build P & K test levels to the medium range over many years and then maintain them.

APPENDIX D – Supporting Documents

From: Nesbitt, Christina (TCHSCP) <Christina.Nesbitt@gov.mb.ca>
Sent: February-09-16 3:31 PM
To: Brian Moons
Subject: RE: Heritage Resources Search Request - biosolid land application program

Hi Brian,

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

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

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

Christina Nesbitt
Impact Assessment Archaeologist
Historic Resources Branch
Main Floor - 213 Notre Dame Avenue, Winnipeg, MB R3B 1N3
Phone (204) 945-8145; Fax (204) 948-2384
E-mail: Christina.Nesbitt@gov.mb.ca

Manitoba
Tourism, Culture, Heritage, Sport and Consumer Protection

From: Brian Moons [mailto:MoonsB@mmm.ca]
Sent: January-26-16 2:40 PM
To: Nesbitt, Christina (TCHSCP)
Subject: RE: Heritage Resources Search Request

Hi Christina,

Thanks for the response. We will be conducting a biosolid land application program on agricultural land within the project area. The purpose of this request is to include it in our Environment Act Proposal for MB Conservation. There is no development for this project, it is merely utilizing previously identified agricultural land.

Will this provide enough clarification? Please let me know.

Regards,

WSP | MMM GROUP

Brian Moons, B.Sc., EPt
Biologist
Environmental Management

MMM Group Limited
T +1 204-943-3178 #3849
F +1 204-943-4948
C +1 204-803-9488
MoonsB@mmm.ca

From: Nesbitt, Christina (TCHSCP) [mailto:Christina.Nesbitt@gov.mb.ca]
Sent: January-26-16 2:01 PM
To: Brian Moons
Subject: RE: Heritage Resources Search Request

Good afternoon Brian,

There is potential to impact significant heritage resources in some of the project study areas.

To further assist you I will require more context to process your request. For example, if you are requesting a Heritage Screening in advance of development, submissions should include as much detail about the project study area as possible such as development extent – this will aid in identifying the potential impact to heritage resources.

Thank you in advance.

Christina Nesbitt
Impact Assessment Archaeologist
Historic Resources Branch
Main Floor - 213 Notre Dame Avenue, Winnipeg, MB R3B 1N3
Phone (204) 945-8145; Fax (204) 948-2384
E-mail: Christina.Nesbitt@gov.mb.ca

Manitoba
Tourism, Culture, Heritage, Sport and Consumer Protection

From: Brian Moons [mailto:MoonsB@mmm.ca]
Sent: January-04-16 10:01 AM
To: +WPG574 - HRB Archaeology (TCHSCP)
Subject: Heritage Resources Search Request

Good morning,

I am looking to have a search conducted for any potential heritage resources that may be located in a project study area in the Gladstone area. The area of interest includes Sections 15, 16, 17, 20, 21, 22, 27 and 28 of Township 14, Range 11, Meridian W1.

Regards,

Brian Moons, B.Sc., EPt
Biologist
Environmental Management

MMM Group
111 - 93 Lombard Avenue
Winnipeg, Manitoba R3B 3B1 Canada
T +1 204-943-3178 x3849
F +1 204-943-4948
C +1 204-803-9488
MoonsB@mmm.ca

www.mmmgrouplimited.com | http://mmmgrouplimited.com/offices/winnipeg/ | www.wspgroup.ca

From: Friesen, Chris (CWS) <Chris.Friesen@gov.mb.ca>
Sent: November-27-15 10:04 AM
To: Brian Moons
Subject: Westlake Gladstone Biosolids

Brian

Thank you for your information request. I completed a search of the MB Conservation Data Centre rare species database which resulted in the following occurrence:

SE 20-14-11W
Northern Prairie Skink (Plestiodon septentrionalis), S1, ESEA: Endangered, SARA: Endangered, COSEWIC: Endangered

Further information on this ranking system can be found on our website at http://www.gov.mb.ca/conservation/cdc/consranks.html and these designations can be found at http://web2.gov.mb.ca/laws/statutes/ccsm/e111e.php, http://www.cosewic.gc.ca/ and http://www.sararegistry.gc.ca/default_e.cfm.

The information provided in this letter is based on existing data known to the Manitoba CDC of the Wildlife and Ecosystem Protection Branch at the time of the request. These data are dependent on the research and observations of our scientists and reflects our current state of knowledge. An absence of data does not confirm the absence of any rare or endangered species. Many areas of the province have never been thoroughly surveyed, however, and the absence of data in any particular geographic area does not necessarily mean that species or ecological communities of concern are not present. The information should, therefore, not be regarded as a final statement on the occurrence of any species of concern nor should it substitute for on-site surveys for species or environmental assessments. Also, because our 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 passes before it is utilised.

Third party requests for products wholly or partially derived from the Biotics database 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 data from our database, as 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 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/

-----Original Message-----
From:
Sent: November-19-15 2:02 PM
To: Friesen, Chris (CWS)
Subject: WWW Form Submission

Below is the result of your feedback form. It was submitted by WWW Information Request () on Thursday, November 19, 2015 at 14:01:55

DocumentID: Manitoba_Conservation

Project Title: Westlake Gladstone Biosolids

Date Needed: 2015-12-10

Name: Brian Moons

Company/Organization: MMM Group

Address: 111 - 93 Lombard Avenue

City: Winnipeg

Province/State: Manitoba

Phone: 2049433178

Fax: 2049434948

Email: moonsb@mmm.ca

Project Description: Being used to develop an Environment Act Proposal for the Municipality of Westlake-Gladstone for biosolid land application of their wastewater lagoons.

Information Requested: Rare and at-risk species within the study area.

Format Requested: Microsoft Word and map

Location: Land surrounding the town of Gladstone to the south and east within the Municipality of Westlake - Gladstone. Sections 20, 21, 28, 29 of Township 14, Range 11, Meridian W1.

action: Submit

From: Friesen, Chris (CWS) <Chris.Friesen@gov.mb.ca>
Sent: December-08-15 9:01 AM
To: Brian Moons
Subject: Westlake Gladstone Biosolids

Brian

Thank you for you information request. I completed a search of the Manitoba Conservation Data Centre database for your area of interest and found the following occurrence associated with the riparian area of NW 19 and SW 20-14-11W:

Eastern Wood-pewee (Contopus virens), S4B, COSEWIC: Special Concern

Further information on this ranking system can be found on our website at http://www.gov.mb.ca/conservation/cdc/consranks.html and these designations can be found at http://web2.gov.mb.ca/laws/statutes/ccsm/e111e.php, http://www.cosewic.gc.ca/ and http://www.sararegistry.gc.ca/default_e.cfm.

The information provided in this letter is based on existing data known to the Manitoba Conservation Data Centre of the Wildlife and Ecosystem Protection Branch at the time of the request. These data are dependent on the research and observations of our scientists and reflects our current state of knowledge. An absence of data does not confirm the absence of any rare or endangered species. Many areas of the province have never been thoroughly surveyed, therefore, the absence of data in any particular geographic area does not necessarily mean that species or ecological communities of concern are not present. The information should not be regarded as a final statement on the occurrence of any species of concern, nor should it substitute for on-site surveys for species or environmental assessments. Also, because our 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 passes before it is utilized.

Third party requests for products wholly or partially derived from our Biotics database 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 data from our database, as 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 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/

-----Original Message-----
From:
Sent: December-02-15 3:58 PM
To: Friesen, Chris (CWS)
Subject: WWW Form Submission

Below is the result of your feedback form. It was submitted by WWW Information Request () on Wednesday, December 2, 2015 at 15:58:27

DocumentID: Manitoba_Conservation

Project Title: Westlake Gladstone Biosolids

Date Needed: 2016/01

Name: Brian Moons

Company/Organization: MMM Group

Address: 111 - 93 Lombard Avenue

City: Winnipeg

Province/State: Manitoba

Phone: 2049323178

Fax: 2049434948

Email: MoonsB@mmm.ca

Project Description: Being used to develop an Environment Act Proposal for the Municipality of Westlake-Gladstone for biosolid land application of their wastewater lagoons.

Information Requested: Rare and at-risk species within the study area.

Format Requested: Microsoft Word and map

Location: Land surrounding the town of Gladstone to the south and east within the Municipality of Westlake - Gladstone. Sections 14, 15, 16, 17, 18, 19, 22, 23, 26, 27, 30, 31, 32, 33, 34, 35 of Township 14, Range 11, Meridian W1.

action: Submit

APPENDIX E – GWDrill Search Results

LOCATION: NW17-14-11W

Well_PID: 57552
Owner: A G KARAZ
Driller: Paddock Drilling Ltd.
Well Name:
Well Use: PRODUCTION
Water Use: Domestic,Livestock
UTMX: 503960.052
UTMY: 5560080.97
Accuracy XY: UNKNOWN
UTMZ:
Accuracy Z:
Date Completed: 1986 Sep 17

WELL LOG

From (ft.)	To (ft.)	Log
0	5.0	SAND; SILTY, BROWN, FINE
5.0	9.0	CLAYEY SAND; BROWN
9.0	13.0	SAND; BROWN FINE
13.0	17.5	SAND; GREY, FINE
17.5	18.0	SAND; GREY, MEDIUM
18.0	28.0	CLAY; SOFT, GREY

WELL CONSTRUCTION

From (ft.)	To (ft.)	Casing Type	Inside Dia.(in)	Outside Dia.(in)	Slot Size(in)	Type	Material
0	8.0	casing	30.00			CORRUGATED	FIBERGLASS
8.0	28.0	perforations	30.00		0.040	SAW CUT	FIBERGLASS
0	28.0	gravel pack				WASHED S.	

Top of Casing: 1.5 ft. below ground

PUMPING TEST

Date: 1986 Sep 17
Pumping Rate: 10.0 Imp. gallons/minute
Water level before pumping: 10.0 ft. below ground
Pumping level at end of test: 26.0 ft. below ground
Test duration: 1 hours, 30 minutes
Water temperature: ?? degrees F

REMARKS

PUMP TEST IS RECOVERY

LOCATION: SW20-14-11W

Well_PID: 109257
Owner: EARL STEWART
Driller: UNKNOWN
Well Name: MRGQI SW20-14-11W
Well Use: PRODUCTION
Water Use:
UTMX: 503957.061
UTMY: 5560919.84
Accuracy XY:
UTMZ:
Accuracy Z:
Date Completed: 1999 Sep 24

No well log data for this well.

No construction data for this well.

Top of Casing: 0.0

No pump test data for this well.

REMARKS

MRGQI - DRILLER'S LOG N/A

LOCATION: NE22-14-11W

Well_PID: 1713
Owner: R CLAYTON
Driller: MANITOBA GOVERNMENT
Well Name:
Well Use: PRODUCTION
Water Use: Domestic
UTMX: 508035.341
UTMY: 5561712.52
Accuracy XY: UNKNOWN
UTMZ:
Accuracy Z:
Date Completed: 1916 Jul 19

WELL LOG

From (ft.)	To (ft.)	Log
0	50.0	CLAY, SAND AND HARDPAN
50.0	104.9	HARDPAN, WATER AT 40 FEET

No construction data for this well.

Top of Casing: ft. below ground

PUMPING TEST

Date:
Pumping Rate: Imp. gallons/minute
Water level before pumping: 10.0 ft. below ground
Pumping level at end of test: ?? ft. below ground
Test duration: ??? hours, ?? minutes
Water temperature: ?? degrees F

LOCATION: NE22-14-11W

Well_PID: 52824
Owner: B DOELL
Driller: Watkins & Argue Construction Co.
Well Name:
Well Use: PRODUCTION
Water Use: Domestic
UTMX: 508035.341
UTMY: 5561712.52
Accuracy XY: UNKNOWN
UTMZ:
Accuracy Z:
Date Completed: 1985 Aug 21

WELL LOG

From (ft.)	To (ft.)	Log
0	10.0	CLAY
10.0	12.0	CLAY; SANDY, YELLOW
12.0	21.0	CLAY; YELLOW
21.0	38.0	CLAY; BLUE
38.0	47.0	CLAY AND SAND LAYER
47.0	59.0	GRAVEL CLAY AND SAND
59.0	62.0	CLAY; BLUE
62.0	68.0	GRAVELLY SANDY CLAY

WELL CONSTRUCTION

From (ft.)	To (ft.)	Casing Type	Inside Dia.(in)	Outside Dia.(in)	Slot Size(in)	Type	Material
0	8.0	casing	24.00				CORRUGATED GALVANIZED
8.0	68.0	perforations	24.00				PERF. PIPE GALVANIZED

Top of Casing: ft. below ground

No pump test data for this well.

REMARKS

110M. SW. OF HOUSE

LOCATION: NE22-14-11W

Well_PID: 52825
Owner: B DOELL
Driller: Watkins & Argue Construction Co.
Well Name:
Well Use: TEST WELL
Water Use:
UTMX: 508035.341
UTMY: 5561712.52
Accuracy XY: UNKNOWN
UTMZ:
Accuracy Z:
Date Completed: 1985 Aug 16

WELL LOG

From (ft.)	To (ft.)	Log
0	10.0	CLAY; SANDY, YELLOW
10.0	11.0	SAND
11.0	21.0	CLAY; YELLOW
21.0	38.0	CLAY, BLUE
38.0	45.0	CLAY AND SAND LAYERS
45.0	104.9	CLAY; BLUE

No construction data for this well.

Top of Casing: ft. below ground

No pump test data for this well.

REMARKS

61M. W. OF HOUSE ZONE 38-45 0.5 TO 1.0 IGPM

LOCATION: NW22-14-11W

Well_PID: 1719
Owner: A CLAYTON
Driller: MANITOBA GOVERNMENT
Well Name:
Well Use: TEST WELL
Water Use:
UTMX: 507227.961
UTMY: 5561720.52
Accuracy XY: UNKNOWN
UTMZ:
Accuracy Z:
Date Completed: 1916 Aug 11

WELL LOG

From (ft.)	To (ft.)	Log
0	35.0	CLAY
35.0	45.0	HARDPAN

No construction data for this well.

Top of Casing: ft. below ground

No pump test data for this well.

LOCATION: SE22-14-11W

Well_PID: 8297
Owner: W FEHR
Driller: D.C.L. DRILLING
Well Name:
Well Use: TEST WELL
Water Use:
UTMX: 508041.323
UTMY: 5560914.82
Accuracy XY: UNKNOWN
UTMZ:
Accuracy Z:
Date Completed: 1966 Jun 06

WELL LOG

From (ft.)	To (ft.)	Log
0	34.0	BROWN SANDY CLAY
34.0	149.9	TILL WITH SAND LAYERS

No construction data for this well.

Top of Casing: ft. below ground

No pump test data for this well.

LOCATION: SE22-14-11W

Well_PID: 1710
Owner: R CLAYTON
Driller: MANITOBA GOVERNMENT
Well Name:
Well Use: PRODUCTION
Water Use: Domestic
UTMX: 508041.323
UTMY: 5560914.82
Accuracy XY: UNKNOWN
UTMZ:
Accuracy Z:
Date Completed: 1916 Jul 24

WELL LOG

From (ft.)	To (ft.)	Log
0	40.0	CLAY
40.0	70.0	HARDPAN
70.0	79.9	QUICKSAND
79.9	119.9	HARDPAN, WATER AT 75 FEET

No construction data for this well.

Top of Casing: ft. below ground

PUMPING TEST

Date:
Pumping Rate: Imp. gallons/minute
Water level before pumping: 45.0 ft. below ground
Pumping level at end of test: ?? ft. below ground
Test duration: ??? hours, ?? minutes
Water temperature: ?? degrees F

LOCATION: SW22-14-11W

Well_PID: 26417
Owner: W FEHR
Driller: NORAL SERVICES
Well Name:
Well Use: TEST WELL
Water Use:
UTMX: 507229.952
UTMY: 5560906.83
Accuracy XY: UNKNOWN
UTMZ:
Accuracy Z:
Date Completed: 1976 Sep 23

WELL LOG

From (ft.)	To (ft.)	Log
0	5.0	TILL
5.0	18.0	LIGHT BROWN CLAY
18.0	28.0	DARK BROWN CLAY

No construction data for this well.

Top of Casing: ft. below ground

No pump test data for this well.

LOCATION: SW22-14-11W

Well_PID: 2505
Owner: M F MCKENZIE
Driller: MANITOBA GOVERNMENT
Well Name:
Well Use: TEST WELL
Water Use:
UTMX: 507229.952
UTMY: 5560906.83
Accuracy XY: UNKNOWN
UTMZ:
Accuracy Z:
Date Completed: 1920 Oct 12

WELL LOG

From (ft.)	To (ft.)	Log
0	37.0	CLAY
37.0	79.9	HARDPAN
79.9	119.9	HARDPAN AND SAND
119.9	136.9	SAND

No construction data for this well.

Top of Casing: ft. below ground

No pump test data for this well.

REMARKS

HOLE ABANDONDED BECAUSE OF HEAVING SAND

LOCATION: SW22-14-11W

Well_PID: 2502
Owner: M F MCKENZIE
Driller: MANITOBA GOVERNMENT
Well Name:
Well Use: PRODUCTION
Water Use: Domestic
UTMX: 507229.952
UTMY: 5560906.83
Accuracy XY: UNKNOWN
UTMZ:
Accuracy Z:
Date Completed: 1920 Oct 04

WELL LOG

From (ft.)	To (ft.)	Log
0	70.0	BLUE CLAY
70.0	119.9	HARDPAN, SALTY WATER

No construction data for this well.

Top of Casing: ft. below ground

No pump test data for this well.

LOCATION: SE27-14-11W

Well_PID: 1712
Owner: UNKNOWN
Driller: MANITOBA GOVERNMENT
Well Name:
Well Use: PRODUCTION
Water Use: Domestic
UTMX: 508031.36
UTMY: 5562554.38
Accuracy XY: UNKNOWN
UTMZ:
Accuracy Z:
Date Completed: 1916 Aug 07

WELL LOG

From (ft.)	To (ft.)	Log
0	45.0	CLAY
45.0	60.0	HARDPAN

No construction data for this well.

Top of Casing: ft. below ground

PUMPING TEST

Date:
Pumping Rate: Imp. gallons/minute
Water level before pumping: 9.0 ft. below ground
Pumping level at end of test: ?? ft. below ground
Test duration: ??? hours, ?? minutes
Water temperature: ?? degrees F

APPENDIX F – Certificates of Analysis

MMM Group Ltd.
ATTN: DARREN KEAM
111-93 Lombard Ave
Winnipeg MB R3B 3B1

Date Received: 15-OCT-15
Report Date: 24-NOV-15 07:18 (MT)
Version: FINAL REV. 2

Client Phone: 204-272-2020

Certificate of Analysis

Lab Work Order #: L1688313

Project P.O. #: NOT SUBMITTED
Job Reference: 3315449
C of C Numbers:
Legal Site Desc:

Brian Morgan, B.Sc. Hons.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	MU	Qualifier*	D.L.	Units	Bias	Extracted	Analyzed	Batch
L1688313-1 CELL 1									
Sampled By: CLIENT on 14-OCT-15 @ 13:30									
Matrix: grab									
CCME Metals									
Mercury in Soil by CVAFS									
Mercury (Hg)	2.12	-		0.40	mg/kg	-	22-OCT-15	23-OCT-15	R3295433
Metals									
Antimony (Sb)	1.14	+/-0.25		0.10	mg/kg	0	22-OCT-15	22-OCT-15	R3295004
Arsenic (As)	7.56	+/-0.96		0.10	mg/kg	0	22-OCT-15	22-OCT-15	R3295004
Barium (Ba)	288	+/-79		0.50	mg/kg	0	22-OCT-15	22-OCT-15	R3295004
Beryllium (Be)	0.35	+/-0.11		0.10	mg/kg	0	22-OCT-15	22-OCT-15	R3295004
Cadmium (Cd)	1.69	+/-0.30		0.020	mg/kg	0	22-OCT-15	22-OCT-15	R3295004
Chromium (Cr)	19.9	+/-3.6		1.0	mg/kg	0	22-OCT-15	22-OCT-15	R3295004
Cobalt (Co)	4.59	+/-0.64		0.020	mg/kg	0	22-OCT-15	22-OCT-15	R3295004
Copper (Cu)	538	+/-81		1.0	mg/kg	0	22-OCT-15	22-OCT-15	R3295004
Lead (Pb)	51.7	+/-10		0.20	mg/kg	0	22-OCT-15	22-OCT-15	R3295004
Molybdenum (Mo)	12.3	+/-2.2		0.020	mg/kg	0	22-OCT-15	22-OCT-15	R3295004
Nickel (Ni)	19.8	+/-2.5		0.50	mg/kg	0	22-OCT-15	22-OCT-15	R3295004
Phosphorus (P)	3860	+/-670		100	mg/kg	0	22-OCT-15	22-OCT-15	R3295004
Selenium (Se)	5.52	+/-0.99		0.50	mg/kg	0	22-OCT-15	22-OCT-15	R3295004
Silver (Ag)	11.0	+/-2.6		0.10	mg/kg	0	22-OCT-15	22-OCT-15	R3295004
Thallium (Tl)	0.19	+/-0.08		0.10	mg/kg	0	22-OCT-15	22-OCT-15	R3295004
Tin (Sn)	26.6	+/-5.2		5.0	mg/kg	0	22-OCT-15	22-OCT-15	R3295004
Uranium (U)	36.5	+/-7.4		0.020	mg/kg	0	22-OCT-15	22-OCT-15	R3295004
Vanadium (V)	23.4	+/-5.3		0.50	mg/kg	0	22-OCT-15	22-OCT-15	R3295004
Zinc (Zn)	351	+/-44		10	mg/kg	0	22-OCT-15	22-OCT-15	R3295004
Miscellaneous Parameters									
Boron (B), Hot Water Ext.	11.1	+/-1.9	DLM	3.4	mg/kg	0	20-OCT-15	20-OCT-15	R3291473
Note: Done as Rec'd, back calculated to dry									
Available Phosphate-P	208	-		1.0	mg/kg	-	20-OCT-15	20-OCT-15	R3293081
Note: Done As Received and Back Calculated To Dry.									
Available Potassium	602	+/-73		50	mg/kg	-11.8%	20-OCT-15	20-OCT-15	R3293104
Note: Done As Received and Back Calculated To Dry									
Available Sulfate-S	570	+/-99	DLM	72	mg/kg	0	20-OCT-15	20-OCT-15	R3293062
Note: Done as Rec'd, back calculated to dry									
% Moisture	93.4	+/-11		0.10	%	0		20-OCT-15	R3293007
% Saturation	Oversat	-		1.0	%	-	20-OCT-15	20-OCT-15	R3292934
Special Request	See Attached	-				-		27-OCT-15	R3297798
Specific Gravity	1.01	-		0.010	kg/L	-		26-OCT-15	R3296575
Total Carbon by Combustion	18.7	+/-1.6		0.1	%	0	20-OCT-15	20-OCT-15	R3293879
Total Kjeldahl Nitrogen	1.37	+/-0.27	DLHC	0.20	%	0	22-OCT-15	23-OCT-15	R3295607
Organic Matter by LOI at 375 deg C.									
Organic Matter	20.8	+/-4.2		1.0	%	0	20-OCT-15	21-OCT-15	R3293837
Loss on Ignition @ 375 C	26.4	+/-4.3		1.0	%	0	20-OCT-15	21-OCT-15	R3293837
Total Solids and Total Volatile Solids									
Total Solids	6.69	-		0.10	%	-	23-OCT-15	23-OCT-15	R3295614
Total Volatile Solids (dry basis)	31.4	-		0.10	%	-	23-OCT-15	23-OCT-15	R3295614
pH and EC (1:2 Soil:Water Extraction)									
Conductivity (1:2)	2.60	-		0.050	dS m-1	-	22-OCT-15	22-OCT-15	R3294803
pH (1:2 soil:water)	8.07	-		0.10	pH	-	22-OCT-15	22-OCT-15	R3294803
Detailed Salinity in dry-weight mg/kg									
Chloride (Cl)	23800	-		1400	mg/kg dwt	-		20-OCT-15	
Calcium (Ca)	1610	-		140	mg/kg dwt	-		20-OCT-15	
Magnesium (Mg)	1670	-		140	mg/kg dwt	-		20-OCT-15	

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	MU	Qualifier*	D.L.	Units	Bias	Extracted	Analyzed	Batch
L1688313-1 CELL 1									
Sampled By: CLIENT on 14-OCT-15 @ 13:30									
Matrix: grab									
Detailed Salinity in dry-weight mg/kg									
Potassium (K)	330	-		140	mg/kg dwt	-		20-OCT-15	
Sodium (Na)	2290	-		140	mg/kg dwt	-		20-OCT-15	
Sulfur (as SO4)	3070	-		140	mg/kg dwt	-		20-OCT-15	
Detailed Salinity in wet-weight mg/kg									
Chloride (Cl)	1570	-		93	mg/kg wwt	-		20-OCT-15	
Calcium (Ca)	106	-		9.3	mg/kg wwt	-		20-OCT-15	
Magnesium (Mg)	110	-		9.3	mg/kg wwt	-		20-OCT-15	
Potassium (K)	21.6	-		9.3	mg/kg wwt	-		20-OCT-15	
Sodium (Na)	151	-		9.3	mg/kg wwt	-		20-OCT-15	
Sulfur (as SO4)	203	-		9.3	mg/kg wwt	-		20-OCT-15	
Total Available N & NO3-N, NO2-N & NH4									
Available Ammonium-N									
Available Ammonium-N	622	+/-88	DLHC	14	mg/kg	0	20-OCT-15	20-OCT-15	R3295295
Note: Done as received and cacluated to dry.									
Available Ammonium-N - Calculation									
Total Available Nitrogen	622	-		37	mg/kg	-		23-OCT-15	
Nitrate, Nitrite & Nitrate+Nitrite-N(KCL									
Nitrite-N	<6.8	-	DLM	6.8	mg/kg	-	20-OCT-15	20-OCT-15	R3293084
Nitrate+Nitrite-N	<34	-	DLM	34	mg/kg	-	20-OCT-15	20-OCT-15	R3293084
Nitrate-N	<34	-	DLM	34	mg/kg	-	20-OCT-15	20-OCT-15	R3293084
Note: Done As Rec'd And Back Calculated To Dry									
Detailed Salinity -over sat'd waste									
Chloride (Cl)									
Chloride (Cl)	1690	-	DLHC	100	mg/L	-	20-OCT-15	20-OCT-15	R3293085
SAR and Cations (over sat'd)									
Calcium (Ca)	114	-	DLDS	10	mg/L	-	20-OCT-15	20-OCT-15	R3293034
Potassium (K)	23	-	DLDS	10	mg/L	-	20-OCT-15	20-OCT-15	R3293034
Magnesium (Mg)	118	-	DLDS	10	mg/L	-	20-OCT-15	20-OCT-15	R3293034
Sodium (Na)	162	-	DLDS	10	mg/L	-	20-OCT-15	20-OCT-15	R3293034
Sulfur (as SO4)	217	-	DLDS	10	mg/L	-	20-OCT-15	20-OCT-15	R3293034
SAR	2.54	-		0.10	SAR	-	20-OCT-15	20-OCT-15	R3293034
pH and Conductivity									
pH	7.41	-		0.10	pH	-	20-OCT-15	20-OCT-15	R3292934
Conductivity (EC)	3.00	-		0.010	dS m-1	-	20-OCT-15	20-OCT-15	R3292934
L1688313-2 CELL 2									
Sampled By: CLIENT on 14-OCT-15 @ 14:30									
Matrix: grab									
CCME Metals									
Mercury in Soil by CVAFS									
Mercury (Hg)	0.125	-		0.050	mg/kg	-	22-OCT-15	23-OCT-15	R3295433
Metals									
Antimony (Sb)	0.34	+/-0.08		0.10	mg/kg	0	22-OCT-15	22-OCT-15	R3295004
Arsenic (As)	3.08	+/-0.39		0.10	mg/kg	0	22-OCT-15	22-OCT-15	R3295004
Barium (Ba)	159	+/-43		0.50	mg/kg	0	22-OCT-15	22-OCT-15	R3295004
Beryllium (Be)	0.47	+/-0.14		0.10	mg/kg	0	22-OCT-15	22-OCT-15	R3295004
Cadmium (Cd)	0.396	+/-0.071		0.020	mg/kg	0	22-OCT-15	22-OCT-15	R3295004
Chromium (Cr)	16.4	+/-3.0		1.0	mg/kg	0	22-OCT-15	22-OCT-15	R3295004
Cobalt (Co)	5.62	+/-0.78		0.020	mg/kg	0	22-OCT-15	22-OCT-15	R3295004
Copper (Cu)	103	+/-15		1.0	mg/kg	0	22-OCT-15	22-OCT-15	R3295004
Lead (Pb)	12.0	+/-2.3		0.20	mg/kg	0	22-OCT-15	22-OCT-15	R3295004
Molybdenum (Mo)	3.22	+/-0.59		0.020	mg/kg	0	22-OCT-15	22-OCT-15	R3295004

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	MU	Qualifier*	D.L.	Units	Bias	Extracted	Analyzed	Batch
L1688313-2 CELL 2									
Sampled By: CLIENT on 14-OCT-15 @ 14:30									
Matrix: grab									
Metals									
Nickel (Ni)	17.1	+/-2.1		0.50	mg/kg	0	22-OCT-15	22-OCT-15	R3295004
Phosphorus (P)	2040	+/-360		100	mg/kg	0	22-OCT-15	22-OCT-15	R3295004
Selenium (Se)	2.38	+/-0.43		0.50	mg/kg	0	22-OCT-15	22-OCT-15	R3295004
Silver (Ag)	1.00	+/-0.23		0.10	mg/kg	0	22-OCT-15	22-OCT-15	R3295004
Thallium (Tl)	0.20	+/-0.08		0.10	mg/kg	0	22-OCT-15	22-OCT-15	R3295004
Tin (Sn)	<5.0	-		5.0	mg/kg	-	22-OCT-15	22-OCT-15	R3295004
Uranium (U)	23.6	+/-4.8		0.020	mg/kg	0	22-OCT-15	22-OCT-15	R3295004
Vanadium (V)	27.9	+/-6.3		0.50	mg/kg	0	22-OCT-15	22-OCT-15	R3295004
Zinc (Zn)	103	+/-13		10	mg/kg	0	22-OCT-15	22-OCT-15	R3295004
Miscellaneous Parameters									
Boron (B), Hot Water Ext.	9.0	+/-1.6	DLM	1.4	mg/kg	0	20-OCT-15	20-OCT-15	R3291473
Note: Done as Rec'd, back calculated to dry									
Available Phosphate-P	70.8	-		1.0	mg/kg	-	20-OCT-15	20-OCT-15	R3293081
Note: Done As Received and Back Calculated To Dry.									
Available Potassium	408	+/-51		20	mg/kg	-11.8%	20-OCT-15	20-OCT-15	R3293104
Note: Done As Received and Back Calculated To Dry									
Available Sulfate-S	462	+/-80	DLM	32	mg/kg	0	20-OCT-15	20-OCT-15	R3293062
Note: Done as Rec'd, back calculated to dry									
% Moisture	84.2	+/-9.7		0.10	%	0		20-OCT-15	R3293007
% Saturation	Oversat	-		1.0	%	-	20-OCT-15	20-OCT-15	R3292934
Special Request	See Attached	-				-		27-OCT-15	R3297798
Specific Gravity	1.04	-		0.010	kg/L	-		26-OCT-15	R3296575
Total Carbon by Combustion	10.8	+/-0.9		0.1	%	0	20-OCT-15	20-OCT-15	R3293879
Total Kjeldahl Nitrogen	0.75	+/-0.15	DLHC	0.10	%	0	22-OCT-15	23-OCT-15	R3295607
Organic Matter by LOI at 375 deg C.									
Organic Matter	10.1	+/-2.2		1.0	%	0	20-OCT-15	21-OCT-15	R3293837
Loss on Ignition @ 375 C	12.6	+/-2.1		1.0	%	0	20-OCT-15	21-OCT-15	R3293837
Total Solids and Total Volatile Solids									
Total Solids	16.5	-		0.10	%	-	23-OCT-15	23-OCT-15	R3295614
Total Volatile Solids (dry basis)	16.7	-		0.10	%	-	23-OCT-15	23-OCT-15	R3295614
pH and EC (1:2 Soil:Water Extraction)									
Conductivity (1:2)	2.78	-		0.050	dS m-1	-	22-OCT-15	22-OCT-15	R3294803
pH (1:2 soil:water)	8.29	-		0.10	pH	-	22-OCT-15	22-OCT-15	R3294803
Detailed Salinity in dry-weight mg/kg									
Chloride (Cl)	847	-		5.3	mg/kg dwt	-		20-OCT-15	
Calcium (Ca)	582	-		53	mg/kg dwt	-		20-OCT-15	
Magnesium (Mg)	675	-		53	mg/kg dwt	-		20-OCT-15	
Potassium (K)	127	-		53	mg/kg dwt	-		20-OCT-15	
Sodium (Na)	838	-		53	mg/kg dwt	-		20-OCT-15	
Sulfur (as SO4)	1840	-		53	mg/kg dwt	-		20-OCT-15	
Detailed Salinity in wet-weight mg/kg									
Chloride (Cl)	134	-		0.84	mg/kg wwt	-		20-OCT-15	
Calcium (Ca)	91.9	-		8.4	mg/kg wwt	-		20-OCT-15	
Magnesium (Mg)	107	-		8.4	mg/kg wwt	-		20-OCT-15	
Potassium (K)	20.1	-		8.4	mg/kg wwt	-		20-OCT-15	
Sodium (Na)	132	-		8.4	mg/kg wwt	-		20-OCT-15	
Sulfur (as SO4)	291	-		8.4	mg/kg wwt	-		20-OCT-15	
Total Available N & NO3-N, NO2-N & NH4 Available Ammonium-N									
Available Ammonium-N	131	+/-19	DLM	4.8	mg/kg	0	20-OCT-15	20-OCT-15	R3295295

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	MU	Qualifier*	D.L.	Units	Bias	Extracted	Analyzed	Batch
L1688313-2 CELL 2									
Sampled By: CLIENT on 14-OCT-15 @ 14:30									
Matrix: grab									
Note: Done as received and cacluated to dry.									
Available Ammonium-N - Calculation									
Total Available Nitrogen	131	-		13	mg/kg	-		23-OCT-15	
Nitrate, Nitrite & Nitrate+Nitrite-N(KCL									
Nitrite-N	<2.4	-	DLM	2.4	mg/kg	-	20-OCT-15	20-OCT-15	R3293084
Nitrate+Nitrite-N	<12	-	DLM	12	mg/kg	-	20-OCT-15	20-OCT-15	R3293084
Nitrate-N	<12	-	DLM	12	mg/kg	-	20-OCT-15	20-OCT-15	R3293084
Note: Done As Rec'd And Back Calculated To Dry									
Detailed Salinity -over sat'd waste									
Chloride (Cl)									
Chloride (Cl)	159	-		1.0	mg/L	-	20-OCT-15	20-OCT-15	R3293085
SAR and Cations (over sat'd)									
Calcium (Ca)	109	-	DLDS	10	mg/L	-	20-OCT-15	20-OCT-15	R3293034
Potassium (K)	24	-	DLDS	10	mg/L	-	20-OCT-15	20-OCT-15	R3293034
Magnesium (Mg)	127	-	DLDS	10	mg/L	-	20-OCT-15	20-OCT-15	R3293034
Sodium (Na)	157	-	DLDS	10	mg/L	-	20-OCT-15	20-OCT-15	R3293034
Sulfur (as SO4)	345	-	DLDS	10	mg/L	-	20-OCT-15	20-OCT-15	R3293034
SAR	2.43	-		0.10	SAR	-	20-OCT-15	20-OCT-15	R3293034
pH and Conductivity									
pH	7.69	-		0.10	pH	-	20-OCT-15	20-OCT-15	R3292934
Conductivity (EC)	2.11	-		0.010	dS m-1	-	20-OCT-15	20-OCT-15	R3292934

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

Reference Information

Sample Parameter Qualifier Key:

Qualifier	Description
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).
DLM	Detection Limit Adjusted due to sample matrix effects.

Test Method References:

ALS Test Code	Matrix	Test Description	Preparation Method Reference	Method Reference**
B-HOTW-SK	Soil	Available Boron, Hot Water		SSSA (1996) P. 610-611
Hot water is used to extract the plant-available and potentially plant-available boron from soil. Boron in the extract is determined by ICP-OES.				
C-TOT-LECO-SK	Soil	Total Carbon by combustion method		SSSA (1996) P. 973-974
The sample is ignited in a combustion analyzer where carbon in the reduced CO2 gas is determined using a thermal conductivity detector.				
CL-COL-SK	Waste	Chloride (Cl)		APHA 4110B
ETL-N-TOT-AVAIL-SK	Soil	Available Ammonium-N - Calculation		Soil Methods of Analysis (1993) CSSS
HG-200.2-CVAF-WP	Soil	Mercury in Soil by CVAFS		EPA 200.2/1631E (mod)
Soil samples are digested with nitric and hydrochloric acids, followed by analysis by CVAFS.				
K-AVAIL-SK	Soil	Available Potassium		Comm. Soil Sci. Plant, 25 (5&6)
Plant available potassium is extracted from the soil using Modified Kelowna solution. Potassium in the soil extract is determined by flame emission at 770 nm.				
MET-200.2-MS-WP	Soil	Metals		EPA 200.2/6020A
Samples for analysis are homogenized, dried at 60 degrees Celsius, sieved through a 2 mm (10 mesh) sieve, and a representative subsample of the dry material is weighed. The sample is then digested by block digester (EPA 200.2). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A). Method Limitation: This method is not a total digestion technique. It is a very strong acid digestion that is intended to dissolve those metals that may become "environmentally available." By design, elements bound in silicate structures are not normally dissolved by this procedure as they are not usually mobile in the environment.				
MOIST-SK	Soil	Moisture Content		ASTM D2216-80
The weighed portion of soil is placed in a 105°C oven overnight. The dried soil is allowed to cooled to room temperature, weighed and the % moisture is calculated. Reference: ASTM D2216-80				
N-TOTKJ-COL-SK	Soil	Total Kjeldahl Nitrogen		CSSS (1993) 22.2.3
The soil is digested with sulfuric acid in the presence of CuSO4 and K2SO4 catalysts. Ammonia in the soil extract is determined colrimetrically at 660 nm.				
N2/N3-AVAIL-KCL-SK	Soil	Nitrate, Nitrite & Nitrate+Nitrite-N(KCL		CSSS (1993) p. 26-28
Plant available nitrate and nitrite are extracted from the sample with 2N KCl. Nitrate and Nitrite in the filtered extract are determined colorimetrically by Technicon auto-analyzer or flow injection analyzer at 520 nm.				
NH4-AVAIL-SK	Soil	Available Ammonium-N		CSSS(1993) 4.2/COMM SOIL SCI 19(6)
Ammonium (NH4-N) is extracted from the soil using 2 N KCl. Ammonium in the extract is mixed with hypochlorite and salicylate to form indophenol blue, which is determined colorimetrically by auto analysis at 660 nm.				
OM-LOI-SK	Soil	Organic Matter by LOI at 375 deg C.		CSSS (1978) p. 160
The dry-ash method involves the removal of organic matter by combustion at 375 degrees C for a minimum of 16 hours. Samples are dried prior to combustion. Reference: McKeague, J.A. Soil Sampling and Methods of Analysis. Can. Soc. Soil Sci.(1978) method 4.23				
PH,EC-1:2-SK	Soil	pH and EC (1:2 Soil:Water Extraction)		CSSC 3.13/CSSS 18.3.1

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Preparation Method Reference	Method Reference**
1 part dry soil and 2 parts de-ionized water (by volume) is mixed. The slurry is allowed to stand with occasional stirring for 30 - 60 minutes. After equilibration, pH of the slurry is measured using a pH meter. Conductivity of the filtered extract is measured by a conductivity meter.				
PH/EC-SK	Waste	pH and Conductivity		APHA 4500-H,2510
PO4-AVAIL-OLSEN-SK	Soil	Available Phosphate-P by Olsen		CSSS (1993) 7.2,7.3.1
Plant available phosphorus is extracted from the sample with sodium bicarbonate. PO4-P in the filtered extract is determined colorimetrically at 880 nm.				
SAL-D50-DRYCALC-SK	Waste	Detailed Salinity in dry-weight mg/kg		Calculation
Conversion of Saturation Extract soluble ions from units of mg/L to dry-weight mg/kg. For over-saturated wastes: mg/kg dwt = mg/L * % Moisture / (100% - % Moisture) For under-saturated wastes: mg/kg dwt = mg/L * (% Saturation / 100%)				
SAL-D50-WETCALC-SK	Waste	Detailed Salinity in wet-weight mg/kg		Calculation
Conversion of Saturation Extract soluble ions from units of mg/L to wet-weight mg/kg. For over-saturated wastes: mg/kg wwt = mg/L * % Moisture / 100% For under-saturated wastes: mg/kg wwt = mg/L * (% Saturation / 100%) * (100% - % Moisture) / 100%				
SALINITY-INTCHECK-SK	Soil			CSSS 18.4-Calculation
SAR-CALC-SK	Waste	SAR and Cations (over sat'd)		APHA 3120B
SAT-PCNT-SK	Soil	Saturated Paste		CSSS (1993) 18.2.2
SO4-AVAIL-SK	Soil	Available Sulfate-S		REC METH SOIL ANAL - AB. AG(1988)
Plant available sulfate in the soil is extracted using a weak calcium chloride solution. Sulfate in the extract is determined by ICP-OES.				
SOLIDS-TOT/TOTVOL-SK	Manure	Total Solids and Total Volatile Solids		APHA 2540G
A well-mixed sample is evaporated in a weighed dish and dried to constant weight in an oven at 103-105"C. The increase in weight over that of the empty dish represents the Total Solids. The crucible is then ignited at 550"–10"C for 1 hour. The remaining solids represent the Total Fixed Solids, while the weight lost on ignition represents the Total Volatile Solids.				
SPECGRAV-CL	Soil	Specific Gravity		ASTM D 5057 - 90
A portion of sample is weighed in a container that is calibrated for volume. Specific Gravity is reported as the mass of sample per mass of an equal volume of pure water, where the density of pure water is taken to be 1.00 g/mL.				
SPECIAL REQUEST-SK	Misc.	Special Request Sask Lab		SEE SUBLET LAB RESULTS

** The indicated Method Reference is the closest nationally or internationally recognized reference for the applicable ALS test method. ALS methods may incorporate modifications from the specified reference to improve performance.

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

Laboratory Definition Code	Laboratory Location
SK	ALS ENVIRONMENTAL - SASKATOON, SASKATCHEWAN, CANADA
WP	ALS ENVIRONMENTAL - WINNIPEG, MANITOBA, CANADA
CL	ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA

Chain of Custody Numbers:

Reference Information

GLOSSARY OF REPORT TERMS

Surr - Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.
MU: Measurement Uncertainty. The reported uncertainty is an expanded uncertainty calculated using a coverage factor of 2 which gives a level of confidence of approximately 95%.
Bias: The reported method bias is the average long term deviation from the target value for a long term reference or control sample, measured in percent. Zero values indicate no detectable method bias.

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

Quality Control Report

Workorder: L1688313 Report Date: 24-NOV-15

Client: MMM Group Ltd.
111-93 Lombard Ave
Winnipeg MB R3B 3B1
Contact: DARREN KEAM

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
B-HOTW-SK	**Soil**							
Batch R3291473								
WG2193559-2 IRM		**SAL814**						
Boron (B), Hot Water Ext.			92.5		%		70-130	20-OCT-15
WG2193559-1 MB								
Boron (B), Hot Water Ext.			<0.20		mg/kg		0.2	20-OCT-15
C-TOT-LECO-SK	**Soil**							
Batch R3293879								
WG2195913-2 DUP		**L1689722-2**						
Total Carbon by Combustion		21.4	21.6		%	1.0	20	20-OCT-15
WG2195913-7 IRM		**08-109_SOIL**						
Total Carbon by Combustion			100.6		%		80-120	20-OCT-15
WG2195913-9 MB								
Total Carbon by Combustion			<0.1		%		0.1	20-OCT-15
HG-200.2-CVAF-WP	**Soil**							
Batch R3295433								
WG2199671-3 CRM		**CANMET TILL-1**						
Mercury (Hg)			0.107		mg/kg		0.048-0.148	23-OCT-15
WG2199671-4 CRM		**PACS-3**						
Mercury (Hg)			119.0		%		70-130	23-OCT-15
WG2199671-5 DUP		**L1688313-1**						
Mercury (Hg)		2.12	2.27		mg/kg	7.1	40	23-OCT-15
WG2199671-6 DUP		**L1676535-69**						
Mercury (Hg)		<0.050	<0.050	RPD-NA	mg/kg	N/A	40	23-OCT-15
WG2199671-2 LCS								
Mercury (Hg)			110.5		%		80-120	23-OCT-15
WG2199671-1 MB								
Mercury (Hg)			<0.050		mg/kg		0.05	23-OCT-15
K-AVAIL-SK	**Soil**							
Batch R3293104								
WG2195836-2 IRM		**FARM2005**						
Available Potassium			91.0		%		70-130	20-OCT-15
WG2195836-1 MB								
Available Potassium			<20		mg/kg		20	20-OCT-15
MET-200.2-MS-WP	**Soil**							
Batch R3295004								
WG2198403-3 CRM		**CANMET TILL-1**						
Antimony (Sb)			107.0		%		70-130	22-OCT-15
Arsenic (As)			96.1		%		70-130	22-OCT-15

Quality Control Report

Client: MMM Group Ltd.
111-93 Lombard Ave
Winnipeg MB R3B 3B1
Contact: DARREN KEAM

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-MS-WP	**Soil**							
Batch R3295004								
WG2198403-3 CRM		**CANMET TILL-1**						
Barium (Ba)			83.7		%		70-130	22-OCT-15
Beryllium (Be)			86.1		%		70-130	22-OCT-15
Cadmium (Cd)			85.9		%		70-130	22-OCT-15
Chromium (Cr)			92.6		%		70-130	22-OCT-15
Cobalt (Co)			89.9		%		70-130	22-OCT-15
Copper (Cu)			88.4		%		70-130	22-OCT-15
Lead (Pb)			93.6		%		70-130	22-OCT-15
Molybdenum (Mo)			95.1		%		70-130	22-OCT-15
Nickel (Ni)			91.9		%		70-130	22-OCT-15
Phosphorus (P)			98.3		%		70-130	22-OCT-15
Selenium (Se)			84.1		%		70-130	22-OCT-15
Silver (Ag)			101.9		%		70-130	22-OCT-15
Thallium (Tl)			0.13		mg/kg		0.03-0.23	22-OCT-15
Tin (Sn)			83.3		%		70-130	22-OCT-15
Uranium (U)			103.8		%		70-130	22-OCT-15
Vanadium (V)			94.3		%		70-130	22-OCT-15
Zinc (Zn)			89.0		%		70-130	22-OCT-15
WG2198403-4 CRM		**PACS-3**						
Antimony (Sb)			102.2		%		70-130	22-OCT-15
Arsenic (As)			91.8		%		70-130	22-OCT-15
Barium (Ba)			94.1		%		70-130	22-OCT-15
Beryllium (Be)			106.1		%		70-130	22-OCT-15
Cadmium (Cd)			88.8		%		70-130	22-OCT-15
Chromium (Cr)			92.8		%		70-130	22-OCT-15
Cobalt (Co)			94.5		%		70-130	22-OCT-15
Copper (Cu)			95.5		%		70-130	22-OCT-15
Lead (Pb)			98.2		%		70-130	22-OCT-15
Molybdenum (Mo)			97.6		%		70-130	22-OCT-15
Nickel (Ni)			94.3		%		70-130	22-OCT-15
Phosphorus (P)			88.9		%		70-130	22-OCT-15
Selenium (Se)			0.84		mg/kg		0.51-1.51	22-OCT-15
Silver (Ag)			103.7		%		70-130	22-OCT-15
Thallium (Tl)			0.41		mg/kg		0.23-0.43	22-OCT-15
Tin (Sn)			92.1		%		70-130	22-OCT-15

Quality Control Report

Client: MMM Group Ltd.
111-93 Lombard Ave
Winnipeg MB R3B 3B1
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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-MS-WP	**Soil**							
Batch R3295004								
WG2198403-4 CRM		**PACS-3**						
Uranium (U)			104.8		%		70-130	22-OCT-15
Vanadium (V)			95.4		%		70-130	22-OCT-15
Zinc (Zn)			94.2		%		70-130	22-OCT-15
WG2198403-6 DUP		**WG2198403-5**						
Antimony (Sb)		1.14	1.09		mg/kg	4.3	30	22-OCT-15
Arsenic (As)		7.56	7.55		mg/kg	0.2	30	22-OCT-15
Barium (Ba)		288	273		mg/kg	5.6	40	22-OCT-15
Beryllium (Be)		0.35	0.34		mg/kg	3.8	30	22-OCT-15
Cadmium (Cd)		1.98	1.90		mg/kg	4.0	30	22-OCT-15
Chromium (Cr)		19.9	19.6		mg/kg	1.8	30	22-OCT-15
Cobalt (Co)		4.59	4.46		mg/kg	2.9	30	22-OCT-15
Copper (Cu)		538	532		mg/kg	1.2	30	22-OCT-15
Lead (Pb)		51.7	49.7		mg/kg	3.9	40	22-OCT-15
Molybdenum (Mo)		12.3	12.1		mg/kg	1.9	40	22-OCT-15
Nickel (Ni)		19.8	19.9		mg/kg	0.8	30	22-OCT-15
Phosphorus (P)		3860	4000		mg/kg	3.5	30	22-OCT-15
Selenium (Se)		5.52	5.27		mg/kg	4.5	30	22-OCT-15
Silver (Ag)		11.0	10.7		mg/kg	3.1	40	22-OCT-15
Thallium (Tl)		0.19	0.18		mg/kg	6.4	30	22-OCT-15
Tin (Sn)		26.6	26.2		mg/kg	1.8	40	22-OCT-15
Uranium (U)		36.5	35.7		mg/kg	2.0	30	22-OCT-15
Vanadium (V)		23.4	22.6		mg/kg	3.7	30	22-OCT-15
Zinc (Zn)		351	341		mg/kg	2.9	30	22-OCT-15
WG2198403-2 LCS								
Antimony (Sb)			101.0		%		80-120	22-OCT-15
Arsenic (As)			97.0		%		80-120	22-OCT-15
Barium (Ba)			96.8		%		80-120	22-OCT-15
Beryllium (Be)			96.4		%		80-120	22-OCT-15
Cadmium (Cd)			103.0		%		80-120	22-OCT-15
Chromium (Cr)			96.9		%		80-120	22-OCT-15
Cobalt (Co)			96.8		%		80-120	22-OCT-15
Copper (Cu)			96.7		%		80-120	22-OCT-15
Lead (Pb)			100.3		%		80-120	22-OCT-15

Quality Control Report

Client: MMM Group Ltd.
111-93 Lombard Ave
Winnipeg MB R3B 3B1
Contact: DARREN KEAM

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-MS-WP	**Soil**							
Batch R3295004								
WG2198403-2 LCS								
Molybdenum (Mo)			98.4		%		80-120	22-OCT-15
Nickel (Ni)			96.8		%		80-120	22-OCT-15
Phosphorus (P)			103.4		%		80-120	22-OCT-15
Selenium (Se)			96.0		%		80-120	22-OCT-15
Silver (Ag)			99.7		%		80-120	22-OCT-15
Thallium (Tl)			95.1		%		80-120	22-OCT-15
Tin (Sn)			102.8		%		80-120	22-OCT-15
Uranium (U)			101.6		%		80-120	22-OCT-15
Vanadium (V)			92.1		%		80-120	22-OCT-15
Zinc (Zn)			90.6		%		80-120	22-OCT-15
WG2198403-1 MB								
Antimony (Sb)			<0.10		mg/kg		0.1	22-OCT-15
Arsenic (As)			<0.10		mg/kg		0.1	22-OCT-15
Barium (Ba)			<0.50		mg/kg		0.5	22-OCT-15
Beryllium (Be)			<0.10		mg/kg		0.1	22-OCT-15
Cadmium (Cd)			<0.020		mg/kg		0.02	22-OCT-15
Chromium (Cr)			<1.0		mg/kg		1	22-OCT-15
Cobalt (Co)			<0.020		mg/kg		0.02	22-OCT-15
Copper (Cu)			<1.0		mg/kg		1	22-OCT-15
Lead (Pb)			<0.20		mg/kg		0.2	22-OCT-15
Molybdenum (Mo)			<0.020		mg/kg		0.02	22-OCT-15
Nickel (Ni)			<0.50		mg/kg		0.5	22-OCT-15
Phosphorus (P)			<100		mg/kg		100	22-OCT-15
Selenium (Se)			<0.50		mg/kg		0.5	22-OCT-15
Silver (Ag)			<0.10		mg/kg		0.1	22-OCT-15
Thallium (Tl)			<0.10		mg/kg		0.1	22-OCT-15
Tin (Sn)			<5.0		mg/kg		5	22-OCT-15
Uranium (U)			<0.020		mg/kg		0.02	22-OCT-15
Vanadium (V)			<0.50		mg/kg		0.5	22-OCT-15
Zinc (Zn)			<10		mg/kg		10	22-OCT-15
MOIST-SK	**Soil**							

Quality Control Report

Client: MMM Group Ltd.
111-93 Lombard Ave
Winnipeg MB R3B 3B1
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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MOIST-SK	**Soil**							
Batch R3293007								
WG2196316-1 DUP		**L1688313-2**						
% Moisture		84.2	83.3		%	1.0	20	20-OCT-15
N-TOTKJ-COL-SK	**Soil**							
Batch R3295607								
WG2198683-2 DUP		**L1688924-2**						
Total Kjeldahl Nitrogen		0.059	0.067		%	13	20	23-OCT-15
WG2198683-3 IRM		**08-109_SOIL**						
Total Kjeldahl Nitrogen			97.2		%		80-120	23-OCT-15
WG2198683-4 MB								
Total Kjeldahl Nitrogen			<0.020		%		0.02	23-OCT-15
WG2198683-5 RB								
Total Kjeldahl Nitrogen			<0.020		%			23-OCT-15
N2/N3-AVAIL-KCL-SK	**Soil**							
Batch R3293084								
WG2195428-3 IRM		**SAL814**						
Nitrate+Nitrite-N			97.1		%		70-130	20-OCT-15
WG2195428-2 MB								
Nitrite-N			<0.50		mg/kg		0.5	20-OCT-15
Nitrate+Nitrite-N			<2.0		mg/kg		2	20-OCT-15
NH4-AVAIL-SK	**Soil**							
Batch R3295295								
WG2195430-3 IRM		**SAL814**						
Available Ammonium-N			85.6		%		70-130	20-OCT-15
WG2195430-2 MB								
Available Ammonium-N			<1.0		mg/kg		1	20-OCT-15
OM-LOI-SK	**Soil**							
Batch R3293837								
WG2196873-1 DUP		**L1688313-2**						
Organic Matter		10.1	9.9		%	1.8	20	21-OCT-15
Loss on Ignition @ 375 C		12.6	12.4		%	1.8	25	21-OCT-15
WG2196873-3 IRM		**SAL2001**						
Organic Matter			96.7		%		80-120	21-OCT-15
Loss on Ignition @ 375 C			96.1		%		80-120	21-OCT-15
WG2196873-2 MB								
Organic Matter			<1.0		%		1	21-OCT-15
Loss on Ignition @ 375 C			<1.0		%		1	21-OCT-15

Quality Control Report

Client: MMM Group Ltd.
111-93 Lombard Ave
Winnipeg MB R3B 3B1
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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PH,EC-1:2-SK	**Soil**							
Batch R3294803								
WG2195432-1 DUP		**L1688313-2**						
Conductivity (1:2)		2.78	2.85		dS m-1	2.3	20	22-OCT-15
pH (1:2 soil:water)		8.29	8.37	J	pH	0.08	0.3	22-OCT-15
WG2195432-3 IRM		**SAL814**						
Conductivity (1:2)			95.3		%		80-120	22-OCT-15
pH (1:2 soil:water)			8.13		pH		7.65-8.25	22-OCT-15
WG2195432-2 MB								
Conductivity (1:2)			<0.050		dS m-1		0.05	22-OCT-15
PO4-AVAIL-OLSEN-SK	**Soil**							
Batch R3293081								
WG2195433-3 IRM		**FARM2005**						
Available Phosphate-P			92.9		%		70-130	20-OCT-15
WG2195433-2 MB								
Available Phosphate-P			<1.0		mg/kg		1	20-OCT-15
SO4-AVAIL-SK	**Soil**							
Batch R3293062								
WG2195838-2 IRM		**SAL814**						
Available Sulfate-S			98.6		%		70-130	20-OCT-15
WG2195838-1 MB								
Available Sulfate-S			<4.0		mg/kg		4	20-OCT-15
SPECGRAV-CL	**Soil**							
Batch R3296575								
WG2200965-2 DUP		**L1688313-2**						
Specific Gravity		1.04	1.05		kg/L	1.0	20	26-OCT-15
WG2200965-1 IRM		**DI_H2O**						
Specific Gravity			102.0		%		90-110	26-OCT-15
CL-COL-SK	**Waste**							
Batch R3293085								
WG2195406-4 MB								
Chloride (Cl)			<1.0		mg/L		1	20-OCT-15
PH/EC-SK	**Waste**							
Batch R3292934								
WG2195406-4 MB								
Conductivity (EC)			0.010		dS m-1		0.01	20-OCT-15
SAR-CALC-SK	**Waste**							

Quality Control Report

Client: MMM Group Ltd.
111-93 Lombard Ave
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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
SAR-CALC-SK	**Waste**							
Batch R3293034								
WG2195406-4 MB								
Calcium (Ca)			<5.0		mg/L		5	20-OCT-15
Potassium (K)			<5.0		mg/L		5	20-OCT-15
Magnesium (Mg)			<5.0		mg/L		5	20-OCT-15
Sodium (Na)			<5.0		mg/L		5	20-OCT-15
Sulfur (as SO4)			<5.0		mg/L		5	20-OCT-15
SOLIDS-TOT/TOTVOL-SK	**Manure**							
Batch R3295614								
WG2196279-2 DUP		**L1688313-1**						
Total Solids		6.69	6.68		%	0.1	25	23-OCT-15
Total Volatile Solids (dry basis)		31.4	32.2		%	2.5	25	23-OCT-15

Quality Control Report

Workorder: L1688313 Report Date: 24-NOV-15

Client: MMM Group Ltd.
111-93 Lombard Ave
Winnipeg MB R3B 3B1
Contact: DARREN KEAM

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

Product	Sample	Client ID	Matrix	Analyte	Result (Dry)	Result (Wet)	Units	LOR (dry)	LOR (wet)	Qualifier
PH/EC-SK	L1688313-1	CELL 1	Waste	Conductivity (EC)		3.00	dS m-1		0.01	
PH,EC-1:2-SK	L1688313-1	CELL 1	Soil	Conductivity (1:2)	2.60		dS m-1	0.050		
PH/EC-SK	L1688313-1	CELL 1	Waste	pH		7.41	pH		0.1	
PH,EC-1:2-SK	L1688313-1	CELL 1	Soil	pH (1:2 soil:water)	8.07		pH	0.10		
MOIST-SK	L1688313-1	CELL 1	Soil	% Moisture		93.4	%		0.1	
OM-LOI-SK	L1688313-1	CELL 1	Soil	Loss on Ignition @ 375 C	26.4		%	1.0		
OM-LOI-SK	L1688313-1	CELL 1	Soil	Organic Matter	20.8		%	1.0		
SOLIDS-TOT/TOTVOL-SK	L1688313-1	CELL 1	Manure	Total Volatile Solids (dry basis)	31.4	1.11	%	0.10	0.01	
SOLIDS-TOT/TOTVOL-SK	L1688313-1	CELL 1	Manure	Total Solids		6.69	%	0.10		
N-TOTKJ-COL-SK	L1688313-1	CELL 1	Soil	Total Kjeldahl Nitrogen	1.37	0.09	%	0.20	0.01	DLHC
ETL-N-TOT-AVAIL-SK	L1688313-1	CELL 1	Soil	Total Available Nitrogen	622	41.05	mg/kg	37	2.5	
C-TOT-LECO-SK	L1688313-1	CELL 1	Soil	Total Carbon by Combustion	18.7	1.23	%	0.1	0.01	
NH4-AVAIL-SK	L1688313-1	CELL 1	Soil	Available Ammonium-N	622	41.05	mg/kg	14	1.0	DLHC
N2/N3-AVAIL-KCL-SK	L1688313-1	CELL 1	Soil	Nitrate+Nitrite-N	<34	<2.5	mg/kg	34	2.5	DLM
N2/N3-AVAIL-KCL-SK	L1688313-1	CELL 1	Soil	Nitrate-N	<34	<2.5	mg/kg	34	2.5	DLM
N2/N3-AVAIL-KCL-SK	L1688313-1	CELL 1	Soil	Nitrite-N	<6.8	<0.5	mg/kg	6.8	0.5	DLM
PO4-AVAIL-OLSEN-SK	L1688313-1	CELL 1	Soil	Available Phosphate-P	208	13.73	mg/kg	1.0	0.1	
K-AVAIL-SK	L1688313-1	CELL 1	Soil	Available Potassium	602	39.73	mg/kg	50	3.5	
SO4-AVAIL-SK	L1688313-1	CELL 1	Soil	Available Sulfate-S	570	37.62	mg/kg	72	5.0	DLM
SAR-CALC-SK	L1688313-1	CELL 1	Waste	SAR	NA	2.54	SAR		0.1	
SAR-CALC-SK	L1688313-1	CELL 1	Waste	Calcium (Ca)	1610	106	mg/kg	10	0.1	DLDS
CL-COL-SK	L1688313-1	CELL 1	Waste	Chloride (Cl)	23800	1570	mg/kg	100	6.75	DLHC
SAR-CALC-SK	L1688313-1	CELL 1	Waste	Magnesium (Mg)	1670	110	mg/kg	10	1.0	DLDS
SAR-CALC-SK	L1688313-1	CELL 1	Waste	Potassium (K)	330	21.6	mg/kg	10	1.0	DLDS
SAT-PCNT-SK	L1688313-1	CELL 1	Soil	% Saturation	Oversat	Oversat	%	1.0	1.0	
SAR-CALC-SK	L1688313-1	CELL 1	Waste	Sodium (Na)	2290	151	mg/kg	10	1.0	DLDS
SAR-CALC-SK	L1688313-1	CELL 1	Waste	Sulfur (as SO4)	3070	203	mg/kg	10	1.0	DLDS
B-HOTW-SK	L1688313-1	CELL 1	Soil	Boron (B), Hot Water Ext.	11.1	0.73	mg/kg	3.4	0.25	DLM

DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).
DLM	Detection Limit Adjusted due to sample matrix effects.
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.

Product	Sample	Client ID	Matrix	Analyte	Result (Dry)	Result (Wet)	Units	LOR (dry)	LOR (wet)	Qualifier
PH/EC-SK	L1688313-2	CELL 2	Waste	Conductivity (EC)		2.11	dS m-1		0.01	
PH,EC-1:2-SK	L1688313-2	CELL 2	Soil	Conductivity (1:2)	2.78		dS m-1	0.050		
PH/EC-SK	L1688313-2	CELL 2	Waste	pH		7.69	pH		0.1	
PH,EC-1:2-SK	L1688313-2	CELL 2	Soil	pH (1:2 soil:water)	8.29		pH	0.10		
MOIST-SK	L1688313-2	CELL 2	Soil	% Moisture		84.2	%		0.1	
OM-LOI-SK	L1688313-2	CELL 2	Soil	Loss on Ignition @ 375 C	12.6		%	1.0		
OM-LOI-SK	L1688313-2	CELL 2	Soil	Organic Matter	10.1		%	1.0		
SOLIDS-TOT/TOTVOL-SK	L1688313-2	CELL 2	Manure	Total Volatile Solids (dry basis)	16.7		%	0.10	0.01	
SOLIDS-TOT/TOTVOL-SK	L1688313-2	CELL 2	Manure	Total Solids		16.5	%	0.10		
N-TOTKJ-COL-SK	L1688313-2	CELL 2	Soil	Total Kjeldahl Nitrogen	0.75	0.12	%	0.20	0.03	DLHC
ETL-N-TOT-AVAIL-SK	L1688313-2	CELL 2	Soil	Total Available Nitrogen	131	20.70	mg/kg	37	2.5	
C-TOT-LECO-SK	L1688313-2	CELL 2	Soil	Total Carbon by Combustion	10.8	1.71	%	0.1	0.01	
NH4-AVAIL-SK	L1688313-2	CELL 2	Soil	Available Ammonium-N	131	20.70	mg/kg	14	1.0	DLM
N2/N3-AVAIL-KCL-SK	L1688313-2	CELL 2	Soil	Nitrate+Nitrite-N	<12	<2	mg/kg	12	2.0	DLM
N2/N3-AVAIL-KCL-SK	L1688313-2	CELL 2	Soil	Nitrate-N	<12	<2	mg/kg	12	2.0	DLM
N2/N3-AVAIL-KCL-SK	L1688313-2	CELL 2	Soil	Nitrite-N	<2.4	<0.5	mg/kg	2.4	0.5	DLM
PO4-AVAIL-OLSEN-SK	L1688313-2	CELL 2	Soil	Available Phosphate-P	70.8	11.19	mg/kg	1.0	0.1	
K-AVAIL-SK	L1688313-2	CELL 2	Soil	Available Potassium	408	64.46	mg/kg	50	3.5	
SO4-AVAIL-SK	L1688313-2	CELL 2	Soil	Available Sulfate-S	462	73.00	mg/kg	72	5.0	DLM
SAR-CALC-SK	L1688313-2	CELL 2	Waste	SAR	NA	2.43	SAR		0.1	
SAR-CALC-SK	L1688313-2	CELL 2	Waste	Calcium (Ca)	582	91.9	mg/L	10	0.1	DLDS
CL-COL-SK	L1688313-2	CELL 2	Waste	Chloride (Cl)	847	134	mg/L	100	6.75	
SAR-CALC-SK	L1688313-2	CELL 2	Waste	Magnesium (Mg)	675	107	mg/L	10	1.0	DLDS
SAR-CALC-SK	L1688313-2	CELL 2	Waste	Potassium (K)	127	20.1	mg/L	10	1.0	DLDS
SAT-PCNT-SK	L1688313-2	CELL 2	Soil	% Saturation	Oversat	Oversat	%	1.0	1.0	
SAR-CALC-SK	L1688313-2	CELL 2	Waste	Sodium (Na)	838	132	mg/L	10	1.0	DLDS
SAR-CALC-SK	L1688313-2	CELL 2	Waste	Sulfur (as SO4)	1840	291	mg/L	10	1.0	DLDS
B-HOTW-SK	L1688313-2	CELL 2	Soil	Boron (B), Hot Water Ext.	9.0	1.42	mg/kg	3.4	0.25	DLM

DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).
DLM	Detection Limit Adjusted due to sample matrix effects.
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

L1688313-COFC

COC Number: 14 -

Page 1 of 1

Report To		Report Format / Dis		Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)
Company:	MMM Group	Select Report Format:	☑ PDF ☑ [illegible] ☐ EDD (DIGITAL)	R ☑ Regular (Standard TAT if received by 3 pm - business days)
Contact:	Darren Keam	Quality Control (QC) Report with Report	☑ Yes ☐ No	P ☐ Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT
Address:	111 - 93 Lombard Ave., Wpg	☐ Criteria on Report - provide details below if box checked		E ☐ Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT
		Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX	E2 ☐ Same day or weekend emergency - contact ALS to confirm TAT and surcharge
Phone:	1204-296-5368 1 204 943 3178	Email 1 or Fax	keamd@mmm.ca	Specify Date Required for E2,E or P:
		Email 2	moonsb@mmm.ca	
Invoice To	Same as Report To ☐ Yes ☐ No	Invoice Distribution		
	Copy of Invoice with Report ☐ Yes ☐ No	Select Invoice Distribution:	☑ EMAIL ☐ MAIL ☐ FAX	
Company:		Email 1 or Fax	accountspayable@mmm.ca	
Contact:		Email 2		

Project Information		Oil and Gas Required Fields (client use)	
ALS Quote #:	Q37455	Approver ID:	Cost Center:
Job #:	3315449	GL Account:	Routing Code:
PO / AFE:		Activity Code:	
LSD:		Location:	
ALS Lab Work Order # (lab use only)		ALS Contact:	Sampler:

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	TKN	Available Ammonia-N & Nitrate, Nitrite-N	CCME Metals, HotWater Boron, Mercury	Total Phosphorous	Total and Volitile Solids	Moisture	Total Carbon	Available Potassium	Available Suphur	Detailed Salinity	Specific Gravity	Organic Matter		Number of Containers
	Cell 1	14-Oct-15	13:30	Grab	R	R	R	R	R	R	R	R	R	R	R	R		3
	Cell 2	1	14:30	1	R	R	R	R	R	R	R	R	R	R	R	R		3
	[illegible]	[illegible]		1	~~R~~	~~R~~	~~R~~	~~R~~	~~R~~	~~R~~	~~R~~	~~R~~	~~R~~	~~R~~	~~R~~	~~R~~		~~3~~

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report (client Use)
Are samples taken from a Regulated DW System? ☐ Yes ☐ No	3c
Are samples for human drinking water use? ☐ Yes ☐ No	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen	☐		SIF Observations	Yes ☐	No ☐	
Ice packs	Yes ☐	No ☐	Custody seal intact	Yes ☐	No ☐	
Cooling Initiated	☐					

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by:	Date:	Time:
[illegible]	2015-10-15	13:30	[illegible]	10-15-15	1:30			

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

NA-[illegible] v08 Front/04 January 2014

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

MMM Group Ltd.
ATTN: DARREN KEAM
111-93 Lombard Ave
Winnipeg MB R3B 3B1

Date Received: 27-OCT-15
Report Date: 24-NOV-15 12:04 (MT)
Version: FINAL REV. 2

Client Phone: 204-272-2020

Certificate of Analysis

Lab Work Order #: L1693663

Project P.O. #: NOT SUBMITTED
Job Reference: 3315449
C of C Numbers:
Legal Site Desc:

Judy Dalmaijer
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	MU	Qualifier*	D.L.	Units	Bias	Extracted	Analyzed	Batch
L1693663-1 CELL 3									
Sampled By: B MOONS on 26-OCT-15 @ 12:00									
Matrix: GRAB									
CCME Metals									
Mercury in Soil by CVAFS									
Mercury (Hg)	<0.050	-		0.050	mg/kg	-	29-OCT-15	02-NOV-15	R3303867
Metals									
Antimony (Sb)	0.20	+/-0.05		0.10	mg/kg	0	29-OCT-15	29-OCT-15	R3299652
Arsenic (As)	3.22	+/-0.41		0.10	mg/kg	0	29-OCT-15	29-OCT-15	R3299652
Barium (Ba)	161	+/-44		0.50	mg/kg	0	29-OCT-15	29-OCT-15	R3299652
Beryllium (Be)	0.42	+/-0.13		0.10	mg/kg	0	29-OCT-15	29-OCT-15	R3299652
Cadmium (Cd)	0.335	+/-0.060		0.020	mg/kg	0	29-OCT-15	29-OCT-15	R3299652
Chromium (Cr)	14.3	+/-2.6		1.0	mg/kg	0	29-OCT-15	29-OCT-15	R3299652
Cobalt (Co)	5.29	+/-0.73		0.020	mg/kg	0	29-OCT-15	29-OCT-15	R3299652
Copper (Cu)	48.4	+/-7.3		1.0	mg/kg	0	29-OCT-15	29-OCT-15	R3299652
Lead (Pb)	6.30	+/-1.2		0.20	mg/kg	0	29-OCT-15	29-OCT-15	R3299652
Molybdenum (Mo)	1.00	+/-0.18		0.020	mg/kg	0	29-OCT-15	29-OCT-15	R3299652
Nickel (Ni)	15.9	+/-2.0		0.50	mg/kg	0	29-OCT-15	29-OCT-15	R3299652
Phosphorus (P)	1780	+/-310		100	mg/kg	0	29-OCT-15	29-OCT-15	R3299652
Selenium (Se)	0.92	+/-0.17		0.50	mg/kg	0	29-OCT-15	29-OCT-15	R3299652
Silver (Ag)	0.21	+/-0.05		0.10	mg/kg	0	29-OCT-15	29-OCT-15	R3299652
Thallium (Tl)	0.15	+/-0.06		0.10	mg/kg	0	29-OCT-15	29-OCT-15	R3299652
Tin (Sn)	<5.0	-		5.0	mg/kg	-	29-OCT-15	29-OCT-15	R3299652
Uranium (U)	9.95	+/-2.0		0.020	mg/kg	0	29-OCT-15	29-OCT-15	R3299652
Vanadium (V)	25.1	+/-5.6		0.50	mg/kg	0	29-OCT-15	29-OCT-15	R3299652
Zinc (Zn)	49	+/-6		10	mg/kg	0	29-OCT-15	29-OCT-15	R3299652
Miscellaneous Parameters									
Boron (B), Hot Water Ext.	7.54	+/-1.3	DLM	0.60	mg/kg	0	30-OCT-15	30-OCT-15	R3300172
Available Phosphate-P	124	-		1.0	mg/kg	-	03-NOV-15	03-NOV-15	R3304575
Available Potassium	410	+/-50	DLHC	100	mg/kg	-11.8%	30-OCT-15	30-OCT-15	R3304375
% Moisture	98.5	+/-11		0.10	%	0	31-OCT-15	31-OCT-15	R3300425
Specific Gravity	1.02	-		0.010	kg/L	-		05-NOV-15	R3306030
Total Carbon by Combustion	8.0	+/-0.7		0.1	%	0	30-OCT-15	30-OCT-15	R3300322
Total Kjeldahl Nitrogen	0.35	+/-0.07	DLHC	0.20	%	0	04-NOV-15	04-NOV-15	R3305203
Sulfur (S)-Total	3000	+/-1000		500	mg/kg	-6.4%	30-OCT-15	30-OCT-15	R3300322
Organic Matter by LOI at 375 deg C.									
Organic Matter	6.1	+/-1.4		1.0	%	0	02-NOV-15	03-NOV-15	R3304357
Loss on Ignition @ 375 C	7.5	+/-1.2		1.0	%	0	02-NOV-15	03-NOV-15	R3304357
Total Solids and Total Volatile Solids									
Total Solids	3.35	-		0.10	%	-	30-OCT-15	30-OCT-15	R3300158
Total Volatile Solids (dry basis)	20.9	-		0.10	%	-	30-OCT-15	30-OCT-15	R3300158
Total Available N & NO3-N, NO2-N & NH4									
Available Ammonium-N - Calculation									
Total Available Nitrogen	138	-		55	mg/kg	-		31-OCT-15	
Nitrate, Nitrite & Nitrate+Nitrite-N(KCL									
Nitrite-N	0.80	+/-0.29		0.50	mg/kg	0	03-NOV-15	03-NOV-15	R3304599
Nitrate+Nitrite-N	2.6	+/-0.6		2.0	mg/kg	0	03-NOV-15	03-NOV-15	R3304599
Nitrate-N	<2.0	-		2.0	mg/kg	-	03-NOV-15	03-NOV-15	R3304599
Available Ammonia-N & Nitrate-N (2N KCl)									
Available Ammonium-N									
Available Ammonium-N	135	+/-19	DLM	55	mg/kg	0	30-OCT-15	30-OCT-15	R3300711
Note: Done as received and cacluated to dry.									
Available Nitrate-N (2N KCl)									
Available Nitrate-N	2.6	-		2.0	mg/kg	-	03-NOV-15	03-NOV-15	R3304957
Detailed Salinity									

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	MU	Qualifier*	D.L.	Units	Bias	Extracted	Analyzed	Batch
L1693663-1 CELL 3									
Sampled By: B MOONS on 26-OCT-15 @ 12:00									
Matrix: GRAB									
Chloride (Cl) (Saturated Paste)									
Chloride (Cl)	1460	-	DLDS	60	mg/L	-	03-NOV-15	03-NOV-15	R3304467
Detail Salinity in mg/kg									
Chloride (Cl)	1240	-	DLDS	51	mg/kg	-		03-NOV-15	
Calcium (Ca)	341	-	DLDS	21	mg/kg	-		03-NOV-15	
Magnesium (Mg)	415	-	DLDS	21	mg/kg	-		03-NOV-15	
Potassium (K)	76	-	DLDS	21	mg/kg	-		03-NOV-15	
Sodium (Na)	410	-	DLDS	21	mg/kg	-		03-NOV-15	
Sulfur (as SO4)	2540	-	DLDS	21	mg/kg	-		03-NOV-15	
SAR, Cations and SO4 in saturated soil									
Calcium (Ca)	399	+/-65	DLDS	25	mg/L	0	03-NOV-15	03-NOV-15	R3304490
Potassium (K)	90	+/-15	DLDS	25	mg/L	0	03-NOV-15	03-NOV-15	R3304490
Magnesium (Mg)	487	+/-84	DLDS	25	mg/L	+10%	03-NOV-15	03-NOV-15	R3304490
Sodium (Na)	480	+/-72	DLDS	25	mg/L	0	03-NOV-15	03-NOV-15	R3304490
SAR	3.82	-		0.10	SAR	-	03-NOV-15	03-NOV-15	R3304490
Sulfur (as SO4)	2980	+/-480	DLDS	25	mg/L	+7%	03-NOV-15	03-NOV-15	R3304490
Theoretical Gypsum Requirement									
TGR(brine)	<0.10	-		0.10	t/ha	-		03-NOV-15	
TGR(sodic)	<0.10	-		0.10	t/ha	-		03-NOV-15	
pH and EC (Saturated Paste)									
% Saturation	85.3	+/-0.8		1.0	%	0	02-NOV-15	03-NOV-15	R3304424
pH in Saturated Paste	7.69	+/-0.06		0.10	pH	0	02-NOV-15	03-NOV-15	R3304424
Conductivity Sat. Paste	6.20	+/-0.78		0.10	dS m-1	0	02-NOV-15	03-NOV-15	R3304424

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

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Internal Reference Material	Chloride (Cl)	DLA	L1693663-1
Internal Reference Material	Calcium (Ca)	DLDS	L1693663-1
Internal Reference Material	Magnesium (Mg)	DLDS	L1693663-1
Internal Reference Material	Potassium (K)	DLDS	L1693663-1
Internal Reference Material	Sodium (Na)	DLDS	L1693663-1
Internal Reference Material	Sulfur (as SO4)	DLDS	L1693663-1
Duplicate	Available Potassium	DLHC	L1693663-1

Sample Parameter Qualifier Key:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).
DLM	Detection Limit Adjusted due to sample matrix effects.

Test Method References:

ALS Test Code	Matrix	Test Description	Preparation Method Reference	Method Reference**
B-HOTW-SK	Soil	Available Boron, Hot Water		SSSA (1996) P. 610-611

Hot water is used to extract the plant-available and potentially plant-available boron from soil. Boron in the extract is determined by ICP-OES.

C-TOT-LECO-SK	Soil	Total Carbon by combustion method		SSSA (1996) P. 973-974

The sample is ignited in a combustion analyzer where carbon in the reduced CO2 gas is determined using a thermal conductivity detector.

CL-PASTE-COL-SK	Soil	Chloride (Cl) (Saturated Paste)		CSSS(1993) 18.2.2/APHA 4500-CL E

Chloride in a saturated soil extract is determined colorimetrically by auto-analyzer.

ETL-N-TOT-AVAIL-SK	Soil	Available Ammonium-N - Calculation		Soil Methods of Analysis (1993) CSSS
HG-200.2-CVAF-WP	Soil	Mercury in Soil by CVAFS		EPA 200.2/1631E (mod)

Soil samples are digested with nitric and hydrochloric acids, followed by analysis by CVAFS.

K-AVAIL-SK	Soil	Available Potassium		Comm. Soil Sci. Plant, 25 (5&6)

Plant available potassium is extracted from the soil using Modified Kelowna solution. Potassium in the soil extract is determined by flame emission at 770 nm.

MET-200.2-MS-WP	Soil	Metals		EPA 200.2/6020A

Samples for analysis are homogenized, dried at 60 degrees Celsius, sieved through a 2 mm (10 mesh) sieve, and a representative subsample of the dry material is weighed. The sample is then digested by block digester (EPA 200.2). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

Method Limitation: This method is not a total digestion technique. It is a very strong acid digestion that is intended to dissolve those metals that may become "environmentally available." By design, elements bound in silicate structures are not normally dissolved by this procedure as they are not usually mobile in the environment.

MOIST-SK	Soil	Moisture Content		ASTM D2216-80

The weighed portion of soil is placed in a 105°C oven overnight. The dried soil is allowed to cooled to room temperature, weighed and the % moisture is calculated.

Reference: ASTM D2216-80

N-TOTKJ-COL-SK	Soil	Total Kjeldahl Nitrogen		CSSS (1993) 22.2.3

The soil is digested with sulfuric acid in the presence of CuSO4 and K2SO4 catalysts. Ammonia in the soil extract is determined colrimetrically at 660 nm.

N2/N3-AVAIL-KCL-SK	Soil	Nitrate, Nitrite & Nitrate+Nitrite-N(KCL		CSSS (1993) p. 26-28

Plant available nitrate and nitrite are extracted from the sample with 2N KCl. Nitrate and Nitrite in the filtered extract are determined colorimetrically by

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Preparation Method Reference	Method Reference**
Technicon auto-analyzer or flow injection analyzer at 520 nm.				
NH4-AVAIL-SK	Soil	Available Ammonium-N		CSSS(1993) 4.2/COMM SOIL SCI 19(6)
Ammonium (NH4-N) is extracted from the soil using 2 N KCl. Ammonium in the extract is mixed with hypochlorite and salicylate to form indophenol blue, which is determined colorimetrically by auto analysis at 660 nm.				
NO3-AVAIL-KCL-SK	Soil	Available Nitrate-N (2N KCl)		CSSS (1993) 4.2, 4.3
Available Nitrate and Nitrite are extracted from the soil using a 2N KCl solution. Nitrate is quantitatively reduced to nitrite by passage of the sample through a copperized cadmium column. The nitrite (reduced nitrate plus original nitrite) is then determined by diazotizing with sulfanilamide followed by coupling with N-(1-naphthyl) ethylenediamine dihydrochloride. The resulting water soluble dye has a magenta color which is measured at colorimetrically at 520nm.				
Reference: Carter, Martin. Soil Sampling and Methods of Analysis. Can. Soc. Soil Sci.(1993) methods 4.2, 4.3				
OM-LOI-SK	Soil	Organic Matter by LOI at 375 deg C.		CSSS (1978) p. 160
The dry-ash method involves the removal of organic matter by combustion at 375 degrees C for a minimum of 16 hours. Samples are dried prior to combustion.				
Reference: McKeague, J.A. Soil Sampling and Methods of Analysis. Can. Soc. Soil Sci.(1978) method 4.23				
PO4-AVAIL-OLSEN-SK	Soil	Available Phosphate-P by Olsen		CSSS (1993) 7.2,7.3.1
Plant available phosphorus is extracted from the sample with sodium bicarbonate. PO4-P in the filtered extract is determined colorimetrically at 880 nm.				
S-TOT-LECO-SK	Soil	Total Sulphur by combustion method		ISO 15178:2000
The sample is ignited in a combustion analyzer where sulfur in the reduced SO2 gas is determined using a thermal conductivity detector.				
SAL-MG/KG-CALC-SK	Soil	Detail Salinity in mg/kg		Manual Calculation
SALINITY-INTCHECK-SK	Soil			CSSS 18.4-Calculation
SAR-CALC-SO4-SK	Soil	SAR, Cations and SO4 in saturated soil		APHA 3120B
Ca, Mg, Na, K and SO4 in a saturated soil extract are determined by ICP-OES.				
SAT/PH/EC-SK	Soil	pH and EC (Saturated Paste)		CSSS 18.2.2/CSSC 3.14/CSSS 18.3.1
pH of a saturated soil paste is measured using a pH meter. After equilibration, an extract is obtained by vacuum filtration with conductivity of the extract measured by a conductivity meter.				
SOLIDS-TOT/TOTVOL-SK	Manure	Total Solids and Total Volatile Solids		APHA 2540G
A well-mixed sample is evaporated in a weighed dish and dried to constant weight in an oven at 103-105”C. The increase in weight over that of the empty dish represents the Total Solids. The crucible is then ignited at 550”–10”C for 1 hour. The remaining solids represent the Total Fixed Solids, while the weight lost on ignition represents the Total Volatile Solids.				
SPECGRAV-CL	Soil	Specific Gravity		ASTM D 5057 - 90
A portion of sample is weighed in a container that is calibrated for volume. Specific Gravity is reported as the mass of sample per mass of an equal volume of pure water, where the density of pure water is taken to be 1.00 g/mL.				
TGR2-CALC-SK	Soil	Theoretical Gypsum Requirement		J. Ashworth et al (1999)
Theoretical Gypsum Requirement is an estimate of the gypsum amendment required to remediate brine-contaminated or sodic soils, and is provided in units of tonnes per hectare (t/ha) for a treatment depth of 15cm. TGR(brine), intended for brine-contaminated soils, is calculated using Method A from "A Comparison of Methods for Gypsum Requirement of Brine-Contaminated Soils", by J. Ashworth (Cdn J. of Soil Science, 1999), available at www.alsglobal.com. TGR(sodic), intended for naturally sodic soils, uses the Oster and Frenkel method (Method B) from the same paper. Reported TGR values are capped at 50 t/ha, considered the maximum practical gypsum amendment. To convert TGR from t/ha to tons/acre, multiply by 0.446. To determine a TGR value for an alternate treatment depth, multiply by [desired treatment depth (cm) / 15 cm].				

** The indicated Method Reference is the closest nationally or internationally recognized reference for the applicable ALS test method. ALS methods may incorporate modifications from the specified reference to improve performance.

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

Laboratory Definition Code	Laboratory Location
SK	ALS ENVIRONMENTAL - SASKATOON, SASKATCHEWAN, CANADA

Reference Information

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surr - Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.
MU: Measurement Uncertainty. The reported uncertainty is an expanded uncertainty calculated using a coverage factor of 2 which gives a level of confidence of approximately 95%.
Bias: The reported method bias is the average long term deviation from the target value for a long term reference or control sample, measured in percent. Zero values indicate no detectable method bias.

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

Quality Control Report

Client: MMM Group Ltd.
111-93 Lombard Ave
Winnipeg MB R3B 3B1
Contact: DARREN KEAM

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
B-HOTW-SK	**Soil**							
Batch R3300172								
WG2203083-1 DUP		**L1693741-1**						
Boron (B), Hot Water Ext.		1.08	1.09		mg/kg	1.1	30	30-OCT-15
WG2203083-3 IRM		**SAL814**						
Boron (B), Hot Water Ext.			89.5		%		70-130	30-OCT-15
WG2203083-2 MB								
Boron (B), Hot Water Ext.			<0.20		mg/kg		0.2	30-OCT-15
C-TOT-LECO-SK	**Soil**							
Batch R3300322								
WG2203121-5 DUP		**L1694649-3**						
Total Carbon by Combustion		0.6	0.6		%	5.1	20	30-OCT-15
WG2203121-8 DUP		**L1693663-1**						
Total Carbon by Combustion		8.0	8.1		%	1.7	20	30-OCT-15
WG2203121-6 IRM		**08-109_SOIL**						
Total Carbon by Combustion			105.5		%		80-120	30-OCT-15
WG2203121-7 MB								
Total Carbon by Combustion			<0.1		%		0.1	30-OCT-15
CL-PASTE-COL-SK	**Soil**							
Batch R3304467								
WG2203070-3 IRM		**SAL814**						
Chloride (Cl)			113.1		%		70-130	03-NOV-15
WG2203070-2 MB								
Chloride (Cl)			<5.0		mg/L		5	03-NOV-15
HG-200.2-CVAF-WP	**Soil**							
Batch R3303867								
WG2206210-3 CRM		**CANMET TILL-1**						
Mercury (Hg)			0.106		mg/kg		0.048-0.148	02-NOV-15
WG2206210-4 CRM		**PACS-3**						
Mercury (Hg)			112.2		%		70-130	02-NOV-15
WG2206210-5 DUP		**L1693663-1**						
Mercury (Hg)		<0.050	<0.050	RPD-NA	mg/kg	N/A	40	02-NOV-15
WG2206210-2 LCS								
Mercury (Hg)			107.4		%		80-120	02-NOV-15
WG2206210-1 MB								
Mercury (Hg)			<0.050		mg/kg		0.05	02-NOV-15
K-AVAIL-SK	**Soil**							

Quality Control Report

Client: MMM Group Ltd.
111-93 Lombard Ave
Winnipeg MB R3B 3B1
Contact: DARREN KEAM

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
K-AVAIL-SK	**Soil**							
Batch R3304375								
WG2203089-4 DUP		**L1693663-1**						
Available Potassium		410	390		mg/kg	3.5	30	30-OCT-15
WG2203089-3 IRM		**FARM2005**						
Available Potassium			94.1		%		70-130	30-OCT-15
WG2203089-2 MB								
Available Potassium			<20		mg/kg		20	30-OCT-15
MET-200.2-MS-WP	**Soil**							
Batch R3299652								
WG2203797-3 CRM		**CANMET TILL-1**						
Antimony (Sb)			98.2		%		70-130	29-OCT-15
Arsenic (As)			114.7		%		70-130	29-OCT-15
Barium (Ba)			108.4		%		70-130	29-OCT-15
Beryllium (Be)			92.5		%		70-130	29-OCT-15
Cadmium (Cd)			107.6		%		70-130	29-OCT-15
Chromium (Cr)			108.2		%		70-130	29-OCT-15
Cobalt (Co)			106.9		%		70-130	29-OCT-15
Copper (Cu)			104.4		%		70-130	29-OCT-15
Lead (Pb)			93.5		%		70-130	29-OCT-15
Molybdenum (Mo)			92.5		%		70-130	29-OCT-15
Nickel (Ni)			107.7		%		70-130	29-OCT-15
Phosphorus (P)			113.0		%		70-130	29-OCT-15
Selenium (Se)			96.4		%		70-130	29-OCT-15
Silver (Ag)			102.5		%		70-130	29-OCT-15
Thallium (Tl)			0.13		mg/kg		0.03-0.23	29-OCT-15
Tin (Sn)			93.2		%		70-130	29-OCT-15
Uranium (U)			106.0		%		70-130	29-OCT-15
Vanadium (V)			110.8		%		70-130	29-OCT-15
Zinc (Zn)			104.9		%		70-130	29-OCT-15
WG2203797-4 CRM		**PACS-3**						
Antimony (Sb)			98.4		%		70-130	29-OCT-15
Arsenic (As)			97.3		%		70-130	29-OCT-15
Barium (Ba)			87.8		%		70-130	29-OCT-15
Beryllium (Be)			101.5		%		70-130	29-OCT-15
Cadmium (Cd)			96.3		%		70-130	29-OCT-15
Chromium (Cr)			99.4		%		70-130	29-OCT-15

Quality Control Report

Client: MMM Group Ltd.
111-93 Lombard Ave
Winnipeg MB R3B 3B1
Contact: DARREN KEAM

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-MS-WP	**Soil**							
Batch R3299652								
WG2203797-4 CRM		**PACS-3**						
Cobalt (Co)			100.3		%		70-130	29-OCT-15
Copper (Cu)			101.2		%		70-130	29-OCT-15
Lead (Pb)			93.2		%		70-130	29-OCT-15
Molybdenum (Mo)			89.0		%		70-130	29-OCT-15
Nickel (Ni)			98.3		%		70-130	29-OCT-15
Phosphorus (P)			108.2		%		70-130	29-OCT-15
Selenium (Se)			0.88		mg/kg		0.51-1.51	29-OCT-15
Silver (Ag)			91.2		%		70-130	29-OCT-15
Thallium (Tl)			0.37		mg/kg		0.23-0.43	29-OCT-15
Tin (Sn)			90.9		%		70-130	29-OCT-15
Uranium (U)			99.9		%		70-130	29-OCT-15
Vanadium (V)			103.4		%		70-130	29-OCT-15
Zinc (Zn)			99.2		%		70-130	29-OCT-15
WG2203797-6 DUP		**WG2203797-5**						
Antimony (Sb)		0.20	0.21		mg/kg	3.4	30	29-OCT-15
Arsenic (As)		3.22	3.12		mg/kg	3.1	30	29-OCT-15
Barium (Ba)		161	161		mg/kg	0.0	40	29-OCT-15
Beryllium (Be)		0.42	0.44		mg/kg	5.6	30	29-OCT-15
Cadmium (Cd)		0.335	0.321		mg/kg	4.3	30	29-OCT-15
Chromium (Cr)		14.3	13.8		mg/kg	3.4	30	29-OCT-15
Cobalt (Co)		5.29	5.20		mg/kg	1.8	30	29-OCT-15
Copper (Cu)		48.4	46.2		mg/kg	4.5	30	29-OCT-15
Lead (Pb)		6.30	6.72		mg/kg	6.5	40	29-OCT-15
Molybdenum (Mo)		1.00	1.04		mg/kg	3.1	40	29-OCT-15
Nickel (Ni)		15.9	15.3		mg/kg	3.8	30	29-OCT-15
Phosphorus (P)		1780	1780		mg/kg	0.1	30	29-OCT-15
Selenium (Se)		0.92	0.94		mg/kg	2.8	30	29-OCT-15
Silver (Ag)		0.21	0.21		mg/kg	1.0	40	29-OCT-15
Thallium (Tl)		0.15	0.16		mg/kg	7.7	30	29-OCT-15
Tin (Sn)		<5.0	<5.0	RPD-NA	mg/kg	N/A	40	29-OCT-15
Uranium (U)		9.95	10.6		mg/kg	6.1	30	29-OCT-15
Vanadium (V)		25.1	24.6		mg/kg	1.7	30	29-OCT-15
Zinc (Zn)		49	50		mg/kg	1.0	30	29-OCT-15

Quality Control Report

Client: MMM Group Ltd.
111-93 Lombard Ave
Winnipeg MB R3B 3B1
Contact: DARREN KEAM

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-MS-WP	**Soil**							
Batch R3299652								
WG2203797-2 LCS								
Antimony (Sb)			98.8		%		80-120	29-OCT-15
Arsenic (As)			106.1		%		80-120	29-OCT-15
Barium (Ba)			103.0		%		80-120	29-OCT-15
Beryllium (Be)			94.0		%		80-120	29-OCT-15
Cadmium (Cd)			99.3		%		80-120	29-OCT-15
Chromium (Cr)			104.1		%		80-120	29-OCT-15
Cobalt (Co)			106.1		%		80-120	29-OCT-15
Copper (Cu)			104.1		%		80-120	29-OCT-15
Lead (Pb)			95.4		%		80-120	29-OCT-15
Molybdenum (Mo)			101.1		%		80-120	29-OCT-15
Nickel (Ni)			104.9		%		80-120	29-OCT-15
Phosphorus (P)			105.2		%		80-120	29-OCT-15
Selenium (Se)			97.3		%		80-120	29-OCT-15
Silver (Ag)			99.0		%		80-120	29-OCT-15
Thallium (Tl)			98.4		%		80-120	29-OCT-15
Tin (Sn)			99.1		%		80-120	29-OCT-15
Uranium (U)			97.0		%		80-120	29-OCT-15
Vanadium (V)			105.9		%		80-120	29-OCT-15
Zinc (Zn)			102.6		%		80-120	29-OCT-15
WG2203797-1 MB								
Antimony (Sb)			<0.10		mg/kg		0.1	29-OCT-15
Arsenic (As)			<0.10		mg/kg		0.1	29-OCT-15
Barium (Ba)			<0.50		mg/kg		0.5	29-OCT-15
Beryllium (Be)			<0.10		mg/kg		0.1	29-OCT-15
Cadmium (Cd)			<0.020		mg/kg		0.02	29-OCT-15
Chromium (Cr)			<1.0		mg/kg		1	29-OCT-15
Cobalt (Co)			<0.020		mg/kg		0.02	29-OCT-15
Copper (Cu)			<1.0		mg/kg		1	29-OCT-15
Lead (Pb)			<0.20		mg/kg		0.2	29-OCT-15
Molybdenum (Mo)			<0.020		mg/kg		0.02	29-OCT-15
Nickel (Ni)			<0.50		mg/kg		0.5	29-OCT-15
Phosphorus (P)			<100		mg/kg		100	29-OCT-15
Selenium (Se)			<0.50		mg/kg		0.5	29-OCT-15
Silver (Ag)			<0.10		mg/kg		0.1	29-OCT-15

Quality Control Report

Client: MMM Group Ltd.
111-93 Lombard Ave
Winnipeg MB R3B 3B1
Contact: DARREN KEAM

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-MS-WP	**Soil**							
Batch R3299652								
WG2203797-1 MB								
Thallium (Tl)			<0.10		mg/kg		0.1	29-OCT-15
Tin (Sn)			<5.0		mg/kg		5	29-OCT-15
Uranium (U)			<0.020		mg/kg		0.02	29-OCT-15
Vanadium (V)			<0.50		mg/kg		0.5	29-OCT-15
Zinc (Zn)			<10		mg/kg		10	29-OCT-15
MOIST-SK	**Soil**							
Batch R3300425								
WG2203094-1 DUP		**L1693663-1**						
% Moisture		98.5	98.3		%	0.2	20	31-OCT-15
N-TOTKJ-COL-SK	**Soil**							
Batch R3305203								
WG2206659-1 DUP		**L1694633-5**						
Total Kjeldahl Nitrogen		0.160	0.146		%	9.1	20	04-NOV-15
WG2206659-2 IRM		**08-109_SOIL**						
Total Kjeldahl Nitrogen			90.6		%		80-120	04-NOV-15
WG2206659-3 MB								
Total Kjeldahl Nitrogen			<0.020		%		0.02	04-NOV-15
WG2206659-4 RB								
Total Kjeldahl Nitrogen			<0.020		%			04-NOV-15
N2/N3-AVAIL-KCL-SK	**Soil**							
Batch R3304599								
WG2203086-2 IRM		**SAL814**						
Nitrate+Nitrite-N			100.3		%		70-130	03-NOV-15
WG2203086-1 MB								
Nitrite-N			<0.50		mg/kg		0.5	03-NOV-15
Nitrate+Nitrite-N			<2.0		mg/kg		2	03-NOV-15
NH4-AVAIL-SK	**Soil**							
Batch R3300711								
WG2203076-3 IRM		**SAL814**						
Available Ammonium-N			84.8		%		70-130	30-OCT-15
WG2203076-2 MB								
Available Ammonium-N			<1.0		mg/kg		1	30-OCT-15
NO3-AVAIL-KCL-SK	**Soil**							

Quality Control Report

Client: MMM Group Ltd.
111-93 Lombard Ave
Winnipeg MB R3B 3B1
Contact: DARREN KEAM

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
NO3-AVAIL-KCL-SK	**Soil**							
Batch R3304957								
WG2203085-2 IRM		**SAL814**						
Available Nitrate-N			107.3		%		70-130	03-NOV-15
WG2203085-1 MB								
Available Nitrate-N			<2.0		mg/kg		2	03-NOV-15
OM-LOI-SK	**Soil**							
Batch R3304357								
WG2204596-1 DUP		**L1694240-21**						
Organic Matter		30.8	32.6		%	5.6	20	03-NOV-15
Loss on Ignition @ 375 C		39.1	41.4		%	5.6	25	03-NOV-15
WG2204596-3 IRM		**SAL2001**						
Organic Matter			102.5		%		80-120	03-NOV-15
Loss on Ignition @ 375 C			102.3		%		80-120	03-NOV-15
WG2204596-2 MB								
Organic Matter			<1.0		%		1	03-NOV-15
Loss on Ignition @ 375 C			<1.0		%		1	03-NOV-15
PO4-AVAIL-OLSEN-SK	**Soil**							
Batch R3304575								
WG2203092-1 DUP		**L1694633-5**						
Available Phosphate-P		77.8	76.5		mg/kg	1.7	30	03-NOV-15
WG2203092-3 IRM		**FARM2005**						
Available Phosphate-P			80.6		%		70-130	03-NOV-15
WG2203092-2 MB								
Available Phosphate-P			<1.0		mg/kg		1	03-NOV-15
S-TOT-LECO-SK	**Soil**							
Batch R3300322								
WG2203121-8 DUP		**L1693663-1**						
Sulfur (S)-Total		3000	2800		mg/kg	8.5	30	30-OCT-15
WG2203121-9 IRM		**1646A_SOIL**						
Sulfur (S)-Total			2900		mg/kg		2500-4600	30-OCT-15
WG2203121-7 MB								
Sulfur (S)-Total			<500		mg/kg		500	30-OCT-15
SAR-CALC-SO4-SK	**Soil**							
Batch R3304490								
WG2203070-3 IRM		**SAL814**						
Calcium (Ca)			105.5		%		70-130	03-NOV-15
Potassium (K)			101.4		%		70-130	03-NOV-15

Quality Control Report

Client: MMM Group Ltd.
111-93 Lombard Ave
Winnipeg MB R3B 3B1
Contact: DARREN KEAM

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
SAR-CALC-SO4-SK	**Soil**							
Batch R3304490								
WG2203070-3 IRM		**SAL814**						
Magnesium (Mg)			112.3		%		70-130	03-NOV-15
Sodium (Na)			100.7		%		70-130	03-NOV-15
Sulfur (as SO4)			107.8		%		70-130	03-NOV-15
WG2203070-2 MB								
Calcium (Ca)			<5.0		mg/L		5	03-NOV-15
Potassium (K)			<5.0		mg/L		5	03-NOV-15
Magnesium (Mg)			<5.0		mg/L		5	03-NOV-15
Sodium (Na)			<5.0		mg/L		5	03-NOV-15
Sulfur (as SO4)			<5.0		mg/L		5	03-NOV-15
SAT/PH/EC-SK	**Soil**							
Batch R3304424								
WG2203070-3 IRM		**SAL814**						
% Saturation			44.0		%		37.5-47.5	03-NOV-15
pH in Saturated Paste			7.82		pH		7.4-8	03-NOV-15
Conductivity Sat. Paste			111.0		%		80-120	03-NOV-15
WG2203070-2 MB								
Conductivity Sat. Paste			<0.10		dS m-1		0.1	03-NOV-15
SPECGRAV-CL	**Soil**							
Batch R3306030								
WG2208732-2 DUP		**L1693663-1**						
Specific Gravity		1.02	1.03		kg/L	1.0	20	05-NOV-15
WG2208732-1 IRM		**DI_H2O**						
Specific Gravity			99.0		%		90-110	05-NOV-15
SOLIDS-TOT/TOTVOL-SK	**Manure**							
Batch R3300158								
WG2203160-2 DUP		**L1693663-1**						
Total Solids		3.35	3.33		%	0.6	25	30-OCT-15
Total Volatile Solids (dry basis)		20.9	19.6		%	6.7	25	30-OCT-15

Quality Control Report

Workorder: L1693663 Report Date: 24-NOV-15

Client: MMM Group Ltd.
111-93 Lombard Ave
Winnipeg MB R3B 3B1
Contact: DARREN KEAM

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Quality Control Report

Workorder: L1693663 Report Date: 24-NOV-15

Client: MMM Group Ltd.
111-93 Lombard Ave
Winnipeg MB R3B 3B1
Contact: DARREN KEAM

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Plant Available Nutrients							
Available Nitrate-N (2N KCl)							
	1	26-OCT-15 12:00	03-NOV-15 17:44	3	8	days	EHT

Legend & Qualifier Definitions:

EHTR-FM:	Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR:	Exceeded ALS recommended hold time prior to sample receipt.
EHTL:	Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT:	Exceeded ALS recommended hold time prior to analysis.
Rec. HT:	ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L1693663 were received on 27-OCT-15 08:30.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

ALS Environmental

www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L1693663-COFC

COC Number: 14 -

Page 1 of 1

Report To		Report Format / Di.	Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)
Company:	MMM Group	Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)	R ☑ Regular (Standard TAT if received by 3 pm - business days)
Contact:	Darren Keam	Quality Control (QC) Report with Report ☑ Yes ☐ No	P ☐ Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT
Address:	111 - 93 Lombard Ave., Wpg	☐ Criteria on Report - provide details below if box checked	E ☐ Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT
		Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	E2 ☐ Same day or weekend emergency - contact ALS to confirm TAT and surcharge
Phone:	1204-296-5368	Email 1 or Fax keamd@mmm.ca	Specify Date Required for E2,E or P:
		Email 2 moonsb@mmm.ca	

Invoice To	Same as Report To ☐ Yes ☐ No	Invoice Distribution	Analysis Request
	Copy of Invoice with Report ☐ Yes ☐ No	Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below
Company:		Email 1 or Fax accountspayable@mmm.ca	
Contact:		Email 2	

Project Information		Oil and Gas Required Fields (client use)	
ALS Quote #:	Q37455	Approver ID:	Cost Center:
Job #:	~~AFE~~ 3315449	GL Account:	Routing Code:
PO / AFE:		Activity Code:	
LSD:		Location:	
ALS Lab Work Order # (lab use only)		ALS Contact: Ricky D	Sampler: BMeens

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	TKN	Available Ammonia-N & Nitrate, Nitrite-N	CCME Metals, HotWater Boron, Mercury	Total Phosphorous	Total and Volitile Solids	Moisture	Total Carbon	Available Potassium	Available Suphur	Detailed Salinity	Specific Gravity	Organic Matter		Number of Containers
	Cell 3	26-Oct-15	~~0:00~~ 12:00	Grab	X	X	X	X	X	X	X	X	X	X	X	X		3

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report (client Use)	SAMPLE CONDITION AS RECEIVED (lab use only)
Are samples taken from a Regulated DW System? ☐ Yes ☐ No	Special Request ~~SPR~~ Liquor sludge	Frozen ☐ SIF Observations Yes ☐ No ☐
Are samples for human drinking water use? ☐ Yes ☐ No	1°C	Ice packs Yes ☐ No ☐ Custody seal intact Yes ☐ No ☐
		Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by:	Date:	Time:
	Oct-26-15	8:30		10-27-15	8:30			

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

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Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form.**

APPENDIX G – Standard Limitations

STANDARD LIMITATIONS
ENVIRONMENTAL INVESTIGATIONS and CHARACTERIZATION PROGRAMS

These Standard Limitations form part of the Report to which they are appended and any use of the Report is subject to them.

1. EXCLUSIVE USE BY CLIENT

This Report was prepared for the exclusive use of the client identified as the intended recipient. Any use of the Report by any other party without the written consent of MMM Group Limited is the sole responsibility of such party. MMM Group Limited accepts no responsibility for damages that may be suffered by any third party as a result of decisions made or actions taken based on the Report.

2. SCOPE, TERMS AND CONDITIONS OF CONTRACT

The observations and investigations (hereinafter referred to as the "Work") upon which this Report is based were carried out in accordance with the scope, terms and conditions of the contract or the proposal pursuant to which the Work was commissioned. The conclusions presented in the Report are based solely upon the scope of services described in the contract or the proposal and governed by the time and budgetary constraints imposed by them.

3. STANDARD OF CARE

The principles, procedures and standards relevant to the nature of the services performed are not universally the same. The Work has been carried out in accordance with generally accepted environmental study and/or professional practices, industry standards and environmental regulations, where applicable. No other warranties are either expressed or implied with respect to the professional services provided under the terms of the contract or the proposal and represented in this Report.

4. SCOPE OF THE WORK

This Report may be based in part on information obtained at discrete sampling and/or monitoring locations. The conditions reported herein were those encountered at the subject property at the time the Work was performed and as present at the discrete sampling/monitoring locations, if any. Conditions between sampling/monitoring locations may be different than those encountered at the sampling/monitoring locations and MMM Group Limited is not responsible for such differences.

5. REASONABLE CONCLUSIONS

The conclusions contained in this Report are based on the Work and may also consider a review of information from other sources as identified in the Report. The accuracy of information from other sources was not verified unless specifically noted in the Report, nor was it determined if the reviewed information constituted all information that exists and pertains to the subject property.

The conclusions made are based on reasonable and professional interpretation of the information considered. If additional information concerning conditions of relevance to this Report is obtained during future work at the subject property, MMM Group Limited should be notified in order that we may determine if modifications to the conclusions presented in this Report are necessary.

6. REPORT AS A COMPLETE DOCUMENT

This Report must be read as a whole and sections taken out of context may be misleading. If discrepancies occur between the preliminary (draft) and final versions of the Report, the final version of the report shall take precedence.

7. LIMITS OF LIABILITY

MMM Group Limited's liability with respect to the Work is limited to re-performing, without cost, any part of the Work that is unacceptable solely as a result of failure to comply with industry standards. MMM Group Limited's maximum liability is limited in accordance with terms in the original contract, provided that notice of claim is made within regulated timelines as of the date of delivery of the Report.