MMM Group Limited
111 - 93 Lombard Avenue
Winnipeg, MB Canada R3B 3B1
t: 204.943.3178 | f: 204.943.4948

www.mmm.ca

July 5, 2013 Ref.: 5513035-000.300.710

Ms. Tracy Braun, Director
Manitoba Conservation
Environmental Approvals
123 Main Street, Suite 160
Winnipeg MB R3C 1A5

Dear Ms. Braun:

Re: Environment Act Proposal, City of Steinbach Land Application of Lagoon Biosolids

MMM Group Limited (MMM) has been retained by the City of Steinbach to submit a comprehensive Environment Act Proposal for the Land Application of Lagoon Biosolids from Cells 1 and 2, located on section 8-7-6EPM. On June 25, 2012, the City of Steinbach Waterworks Department was presented with an Environment Act Order by Manitoba Conservation for the unauthorized release of wastewater and biosolids from the City of Steinbach wastewater treatment lagoon. To address Manitoba Conservation's Order, the City of Steinbach is seeking an EAL to apply the stockpiled biosolid material from Cell #1 in the fall of 2013. To achieve the requirements of the Order, time is of the essence.

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 phosphorus levels for grain, oil seed, corn and soybean crops and set metal loading limits for each agricultural field in the application program.

For your consideration, please find enclosed electronic (compact disc) copies and printed copies of the EAP document, the application form and application fee for $5000.00. 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 Soil Scientist, Associate
Environmental Management Services

Enclosures

DK/ac

MMM Group Limited

ENVIRONMENT ACT PROPOSAL
CITY OF STEINBACH LAND APPLICATION OF LAGOON BIOSOLIDS

Prepared for:

Manitoba Conservation & Water Stewardship
Environmental Assessment and Licensing Branch

On Behalf of:

City of Steinbach, Waterworks Department

Submitted by:

MMM GROUP

June 2013 | 5513035-000.300

ENVIRONMENT ACT PROPOSAL
CITY OF STEINBACH LAND APPLICATION OF LAGOON BIOSOLIDS

5513035-000.300

Prepared for:

Manitoba Conservation and Water Stewardship Environmental Assessment and Licensing Branch

On Behalf Of:

City of Steinbach
Waterworks Department

Prepared by:

MMM Group Limited

June 2013

Prepared by:

Danette Sahulka,MSc., P.Ag.
Senior Ecologist
Dated: June 28, 2013

Reviewed by:

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

Darren Keam, M.Sc., P.Ag.
Senior Soil Scientist
Dated: June 28, 2013

EXECUTIVE SUMMARY

Introduction

This Environment Act Proposal (EAP) is submitted to the Manitoba Conservation and Water Stewardship (CWS) Environmental Assessment and Licencing Branch (EALB), 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 City of Steinbach wastewater treatment lagoon Cells 1 and 2.

The City of Steinbach is proposing to initiate a land application program of biosolid materials from the Steinbach wastewater treatment lagoon Cells 1 and 2 located on Section 8-7-6EPM. Biosolids were previously removed from lagoon Cell 1 and are presently stockpiled along the western edge of lagoon Cells 1 and 2. In addition, biosolid materials will be excavated from the bottom or lagoon Cell 2 and included in a land application program in approximately two years. The biosolid materials will be applied onto privately and City of Steinbach owned agricultural fields located in the R.M. of Hanover a radial distance within 4 km from the lagoon site.

There is approximately 8,000 cubic metres of biosolid material from lagoon Cell 1 that will be land applied in 2013 onto approximately 312 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 phosphorus 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 2013 by the EALB, it is anticipated that the biosolid application to the land base for stockpiled biosolid material from lagoon Cell 1 will begin in late October to early November of 2013. Biosolid material from lagoon Cell 2 is anticipated to be applied in 2014-2015.

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 sample collected from the Cell #1 stockpile. The hypothetical application rate is based on 100 kg ha^{-1} of required nitrogen and one (39 kg ha^{-1}) and two time (70 kg ha^{-1}) crop removal of a permitted crop.

Based on the hypothetical application rates outlined in Table 5.6, the nitrogen application rate of 13.5 tonnes per hectare (dry) provides an estimated 438 percent of the required P_2O_5, which is not suitable. Therefore the preferred application rate is based on two times crop removal (70 kg ha^{-1}) of a permitted crop. This would provide approximately 41 kg ha^{-1} of required nitrogen allowing for a top up of approximately 30 kg ha^{-1}. The total land area required is then anticipated to be approximately 283 hectares for a two times crop removal application rate for phosphorous.

Based on interviews with the farm producers managing each parcel of land and soil sample reports produced by some of the producers, 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 City of Steinbach to complete a land application of biosolid materials collected from wastewater treatment lagoon Cells 1 and 2 in an agronomically and environmentally sustainable manner. There are no negative, long-term environmental or socioeconomic impacts associated with this project.

TABLE OF CONTENTS

APPENDICES

1.0 INTRODUCTION

This Environment Act Proposal (EAP) is submitted to the Manitoba Conservation and Water Stewardship (CWS) Environmental Assessment and Licencing Branch (EALB), 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 City of Steinbach wastewater treatment lagoon Cells 1 and 2.

1.1 Background

The City of Steinbach is proposing to initiate a land application program for biosolid materials from the Steinbach wastewater treatment lagoon Cells 1 and 2 located on southeast quarter of Section 8, Township 7, Range 6 EPM (Figure 1, Appendix A). In June 2012, biosolids were removed from lagoon Cell 1 and are presently stockpiled along the southern edge of lagoon Cells 1 and 2 in a confined cell. On June 25, 2012, the City of Steinbach Waterworks Department was presented with an Environment Act Order by Manitoba Conservation for the unauthorized release of wastewater and biosolids from the City of Steinbach wastewater treatment lagoon. To address Manitoba Conservation's Order, the City of Steinbach is seeking an EAL to apply the stockpiled biosolid material from Cell #1 in the fall of 2013.

In 2014 it is planned that biosolid materials will be excavated from the bottom or lagoon Cell 2 and included in a land application program. Sampling for biosolid material from both lagoon Cells 1 and 2 for nutrient and metal analysis will be conducted prior to land application. The biosolid materials will be applied onto privately and City of Steinbach owned agricultural fields located in the R.M. of Hanover within a distance of 4 kilometres (km) from the lagoon site.

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 phosphorus levels for grain, oil seed, corn and soybean crops and set metal loading limits for each agricultural field in the application program.

Time is of the essence to meet the requirements of the Environment Order. If the EAL approval is granted in a timely manner (October, 2013) by the EALB, it is anticipated that the biosolid application to the land base for stockpiled biosolid material from lagoon Cell 1 will begin in early October to end by November of 2013. Biosolid material from lagoon Cell 2 is anticipated to be applied in 2014-2015.

1.3 Proponent

The proponent for this project is the City of Steinbach Waterworks Division; Department Head Mr. Mike Heppner. Project work has been approved by the City Manager, City Corporate Manager, 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. 14.1 Designation of Red River Valley Special Management Area
    f. 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:

1. The removal and land application in the fall of 2013 of approximately 8,000 (+10% safety factor) cubic metres of biosolid material previously excavated from the City of Steinbach wastewater treatment lagoon Cell 1, currently stockpiled along the southern edge of cells one and two in a confined area.

2. The removal and land application in 2014-2015 of biosolid material currently within lagoon Cell 2. Cell 2 is estimated to contain a similar amount of biosolid material to that excavated from Cell 1 – 8,000 cubic meters (+ 10% safety factor). A more complete assessment of biosolid volume and quality from Cell 2 will be completed prior to application in 2014-2015.

3. The biosolid material from Cells 1 and 2 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 4 km of the lagoon. 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 April, 2013 for Cell 1. Testing for Cell 2 will be completed prior to the land application program for that cell.

- The City of Steinbach has identified potentially suitable receiving agricultural lands for Cell 1 biosolid application. The same fields are being considered for the application program for Cell 2.
  - Land use agreements have been acquired from participating farm producers (Appendix B).
  - 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 229 hectares (ha) (563 acres) of agricultural land will be required. Lands in the program consist of annual croplands utilized to produce small grain, oil seed, corn and soybean.
  - 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 soil and 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 collected or dredged using heavy equipment and then placed into tanker trucks and/or TerraGator® trucks and transported to the receiving land locations.
- These materials will then be surfaced applied to the parcels of land in the program at the prescribed agronomic rates in October/November of 2013 for biosolid material from Cell 1 and in 2014-2015 for biosolid material from Cell 2.
- The applied biosolid materials will be incorporated into the soil sub-surface for each parcel of land through cultivation within one to four days of application.

2.2 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.	Early to mid-April 2013
Consultation with Local Study Area (LSA) farm producers for land use agreement formalization.	Mid to late April 2013
Desktop review of land suitability in the LSA.	May 2013
Submission of EAP for the project.	June 2013
EAP approval and granting of EAL by CWS.[1]	Early-October 2013
Soil sample collection for laboratory analysis of physical and chemical parameters for Cell 1biosolids.	Mid-October 2013
Land application of biosolid materials from Cell1.	Late October – Early November 2013
Soil sample collection for lab analysis of physical & chemical parameters for application of Cell 2 biosolids.	September 2015
Land application of biosolid material from Cell 2.	Late October – Early November 2015
Project completion and closure with client.	November 30, 2015

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

2.3 Regional and Local Study Areas

The Regional Study Area (RSA) is located approximately 40 km southwest of the City of Winnipeg, Manitoba within the R.M. of Hanover (Figure 1, Appendix A). Two towns including Blumenort and Randolph as well as land owned by the City of Steinbach are located within the RSA. The Local Study Area (LSA) includes parts of eight quarter sections of land available for biosolid application (Figure 2, Appendix A). These parcels of land are located within 2 to 8 km northwest of the City of Steinbach. The RSA and LSA fall within the Red River Valley of Manitoba and are included in the Red River Valley Special Management Area (RRVSMA) as defined in section 14.1 of *The Livestock Manure and Mortalities Management Regulation* of the *Environment Act*. Lands in this area are primarily used for agricultural production of small grain and forage crops.

2.3.1 Land Ownership and Management

Agricultural land owned by farm producers within the LSA will be utilized for biosolid application for this project. Consultation with land owners and/or land lessees interested in having biosolid materials applied to their land was held in April-May 2013 at which time land use agreements were formalized and access to lands for soil sampling for assessment of land suitability for sludge application was granted. Certificates of Title and landowner agreements for the proposed receiving lands are available in Appendix B. Table 2.2 provides a list of landowners and agricultural fields available for biosolid application. 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	Manitoba Land Title #	Registered Owner
SE 08-7-6EPM	Lorne Reimer	32 ha (80 ac)	2513551 2513552	City of Steinbach
N1/2 NW 15-7-6EPM	Mark Reimer	33 ha (82 ac)	1011186	Mark Reimer
NW 10-7-6EPM	Leonard Penner	20 ha (50 ac)	1464688	Steinbach Community Development Corporation
SE 9-7-6EPM	Bob Brandt & Ray Landspring	56 ha (140 ac)	1801694	Steinbach Community Development Corporation
NW11-7-6E	Ray Lang	28 ha (70 ac)	2286206 2121716 2225244 133823	R&M Penner Holdings Limited 5074399 Manitoba Inc. 5468877 Manitoba Ltd. Town of Steinbach
SE22-7-6EPM	Mark Reimer	52 ha (128 ac)	1477129 2515333	Eileen Reimer Reimark Farms
NE22-7-6EPM	Mark Reimer	24 ha (59 ac)	2516718	Reimmark Farms

At this time, it is anticipated that the same fields will be used also for the land application of Cell 2 biosolids.

2.3.2 Current Land Use Development Controls

The fields SE08-7-6EPM, SE9-7-6EPM, E1/2 15-7-6EPM, of the LSA are zoned as Rural Zone under the Rural Municipality of Hanover Zoning By-Law No. 2171 (Figure 3, Appendix A). Under the Zoning By-law, Rural Zone is defined as: **"**this zone provides for general agricultural uses similar to the Agricultural Zone however, due to the proximity to urban centres, rural residential development areas and environmentally sensitive areas, certain uses that may conflict with these areas, such as livestock operations, are more restricted."

Fields NW10-7-6EPM and W1/2 11-7-6EPM are zoned Agriculture and Open Space under the City of Steinbach Zoning By-Law No. 1882 (Figure 3, Appendix A). Agriculture is defined as a district intended for general agriculture activities and Open Space is defined as providing for conservation of: Publicly-owned lands to be retained in an undeveloped state for the foreseeable future due to their scenic character, physical limitations and need; Privately-owned lands used for golf courses and major trunk utility rights-of-way which have an open space character; Slough areas, brush and shrub land, ravines, and other similar areas deemed to be unsuitable for development; Land used as buffers separating different types of land use; Lands which are intended to be used as future road allowances; and Lands which are to be retained in proximity to natural waterways.

Neighbouring land use zoning for fields SW10 and NW10-7-6EPM and W1/2 11-7-6EPM are Light Industrial (M1), Commercial Corridor (C3), and Commercial Regional.

The identified land use zoning districts under the two by-laws established by the Rural Municipality of Hanover and City of Steinbach for identified LSA and neighbouring properties do not prohibit the use of the land for spreading of biosolids.

2.3.3 City of Steinbach Wastewater Treatment Lagoon

The City of Steinbach wastewater treatment lagoon is located at Section 8-7-6EPM and S1/2 17-7-6EPM, approximately 3.8 km northwest of the City of Steinbach (Figure 2, Appendix A). The lagoon is comprised of nine cells: one primary cell, two aeration cells (1 and 2) and seven holding cells (cells 3 through 6). Currently the biosolid material previously collected from Cell 1 that is to be land applied is stockpiled along the southern edge of lagoon Cells 1 and 2 (Figure 2, Appendix A). Biosolid material will also be excavated from Cell 2 in 2014-2015 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 Steinbach Ecodistrict of the Interlake Plain Ecoregion which is covered by the broader Boreal Plains Ecozone (Smith, Veldhuis, Mils, Eilers, Fraser and Lelyk 1998).

3.1.1 Climate

The Steinbach Ecodistrict lies in a more humid and cooler subdivision of the Subhumid Low Boreal Ecoclimatic Region. The ecodistrict is characterised by short, warm summers and cold winters with a mean average temperature of 2.4^{0}C (Smith, et al. 1998). The average crop growing season is 184 days with approximately 1700 growing degree-days. Mean annual precipitation is 510 mm, one fifth of which is in the form of snowfall. The Steinbach Ecodistrict has a moderately cold, humid, Cryoboreal to cool, subhumid Boreal soil climate with an average annual soil moisture deficit of approximately 200-250 mm (Smith, et al. 1998).

3.1.2 Physiography and Drainage

The general project area is situated within the southeastern lake terrace section of the Manitoba Plain. The physiography ranges from smooth, level glaciolacustrine plain to gently undulating, terraced plain with water-worked glacial till and glaciofluvial materials. The mean area elevation is 297 metres above sea level (masl). The overall slope for the ecodistrict is northwestward from the eastern edge of the district towards the Red River in the west (Smith, et al. 1998).

The main drainage pathways for the area include the Seine and Rat Rivers that drain into the Red River. Within the RSA itself, the Manning Canal, a fifth order drain, provides the main drainage system in the area. This canal provides an outlet for Blind Creek northwest of Steinbach and connects to the Seine River Diversion along Provincial Highway #210 approximately 26 km northwest of the City of Steinbach. Several second order and third order drains including the North Arm Upper Manning Canal and the South Arm Upper Manning Canal are also found in the area around Steinbach and contribute water into the Manning Canal (refer to Figure 4, Appendix A).

3.1.3 Surficial and Bedrock Geology

Surficial deposits within the RSA consist of clay beds up to 24 m thick, underlain by glacial till. These surficial deposits are underlain by carbonate rock (limestone and dolostone) bedrock. Beneath the carbonate bedrock layer are sandstone and shale beds which occur at a depth of approximately 79 m near the City of Steinbach. These sandstone and shale beds are in turn underlain by granitic rock (Rutulis 1973).

3.1.4 Groundwater and Hydrological Description

Extensive aquifers underlie the R.M. of Hanover, including the RSA. Near Steinbach, the carbonate aquifer that underlies the surficial deposits ranges in depth from 24 to 45 m with the static water level (flowing well area) occurring at up to 9 m above ground level (Rutulis 1973). This aquifer is formed by thick and extensive carbonate rock beds with minor shale beds (Rutulis 1986[1]). Most domestic wells in the R.M. draw their water from the carbonate aquifer and have been developed into the carbonate rock to a depth of 9 m or less (Rutulis 1973). Domestic wells in the carbonate aquifer yield more than 1.0 L/s (Rutulis 1986_1). Water quality in the carbonate aquifer is of good to excellent quality and can be used as a domestic supply without treatment. Total dissolved solids concentration and hardness is less than 500 parts per million (ppm) and 400 ppm respectively (Rutulis 1973).

Within the R.M., beneath the carbonate rock formation lays the sandstone aquifer. Near Steinbach, this extensive aquifer is found at a depth of approximately 79 m. Static water levels in wells drilled into the sandstone aquifer are similar to those of the carbonate aquifer. Water quality in the sandstone aquifer contains higher levels of dissolved solids and hardness is several times lower compared to the carbonate aquifer (Rutulis 1973).

In the area around the town of Blumenort as well as south of provincial highway #52, discontinuous sand and gravel aquifers also occur above the carbonate aquifer (Rutulis 1973). These aquifers range in size from less than a hectare to several square kilometres in size. These sand and gravel aquifers may occur at less than 15 m up to a depth of more than 30 m and average thicknesses may range from a few metres to greater than 30 m (Rutulis 1986[2]). These aquifers are common throughout most of the R.M. but are not continuous; thus, some wells in the area may be developed into these aquifers, but most have been developed into the carbonate aquifer. Water quality is generally better in the sand and gravel aquifers compared to the carbonate aquifer (Rutulis 1973). Well yield ranges from less than 0.1 to more than 10 L/s (Rutulis 1986[2]).

A search of the Manitoba GWDrill (2012) logs for groundwater wells within the LSA found a total of 37 groundwater wells in the LSA. For each field in the LSA the number of groundwater wells and recorded use 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 LSA

Legal Land Location	GWdrill Results (GWDrill, 2010)	Groundwater Use
SE 08-7-6EPM	1	Observation
NW 15-7-6EPM	0	-
NW 10-7-6EPM	1	Domestic
SE 9-7-6EPM	0	-
NW11-7-6EPM	1	Geothermal
SE22-7-6EPM	1	Domestic
NE22-7-6EPM	2	Domestic

3.1.5 Soils

Soils in the ecodistrict consist of well to imperfectly drained Dark Gray and Black Chernozems developed on thin, variably calcareous, discontinuous, sandy to loamy glaciolacustrine veneers. These veneers overlay extremely calcareous water–worked glacial till that are loamy to clayey in texture (Smith, et al. 1998). Sandy deposits and till ridges in the eastern area of the ecodistrict contain imperfectly and well drained Luvisol and some Eutric Brunisol soils (Smith, et al. 1998). Depressional lowland areas in the ecodistrict contain poorly drained peaty Gleysols and organic Mesisols (Smith, et al. 1998). Specific soil characteristics of the LSA are discussed in Land Suitability, Section 4.0.

3.1.6 Vegetation

The native vegetation of the Steinbach Ecodistrict originally consisted of trembling aspen and balsam poplar tree bluffs and tall grass prairie, with creeks and low-lying areas supporting willow and red-oiser dogwood shrubs and a variety of sedges. As a result of settlement, much of the native vegetation in the district has been replaced by agricultural crops (Smith, et al. 1998). Local pockets of natural vegetation can still be found in areas of unbroken land.

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 dugouts that are used for livestock watering. Historic drainage patterns in the region have been altered over time to accommodate agricultural production with the result of several “blind” creeks being established and the development of the Manning Canal in the late 1950s. The Manning Canal provides the main drainage system in the area with drainage water being collected from various “arms” and tributaries (refer to section 3.1.2) of the canal in the local area surrounding Steinbach.

3.1.9 Aquatic Life

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

A survey conducted in 2006 by the City of Winnipeg Naturalists Services Branch for the presence of fish within certain upstream regions of Winnipeg creeks and streams identified that several minnow and fish species were observed to be entering Winnipeg drains and channels from the Seine River and tributaries including black bullhead and fathead minnows, common carp and white sucker (Penner, 2007). Based on these findings it is possible for the Manning Canal and its tributaries to contain transient minnow and fish species.

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 April 1, 2013 with respect to species of conservation concern within the RSA including all Sections (1 to 36) within Township 7, Range 6 EPM and Sections 1 to 4, 9 to 12, 13 to 16, 21 to 24, 25 to 28 and 33 to 36 within Township 7, Range 5 EPM. Mr. Chris Friesen, Biodiversity Information Manager of the MBCDC examined database records and found no occurrences of species of conservation concern within the RSA boundaries (Appendix C).

3.3 Parks and Protected Areas

Several community green space and sports parks are located within the Steinbach city 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 Blumenort with a population of 1,133 individuals, the hamlet of Randolph with an unreported population number, the town of Mitchell with a population of 1,136 individuals and the City of Steinbach with a population of 13,524 individuals (Statistics Canada 2011).

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, oilseeds, corn and soybean. Several rural residences adjoin some of these lands and three, third order level drains bisect some of the land parcels (refer to Figure 4, Appendix A). Other activities in the area surrounding the LSA include poultry, dairy and hog farms. All appropriate set back distances will be applied as required for adjacent and neighbouring land use and for third order drains.

3.4.3 Heritage Resources

A request was made to the Manitoba Historic Resources Branch (MHRB) on April 1, 2013 with respect to the location of heritage resources within the RSA including all Sections (1 to 36) within Township 7, Range 6 EPM and Sections 1 to 4, 9 to 12, 13 to 16, 21 to 24, 25 to 28 and 33 to 36 within Township 7, Range 5 EPM. Ms. Heather Docking, Heritage Resources Registrar with the MHRB examined branch records and found that there are no known archaeological sites or designated heritage sites within 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 landowners as outlined below.

4.1.1 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 hecares are outlined in Talbe 4.1 and characteristics of the soil series are outlined in Table 4.2and 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)
Glenella (50%) Osborne (50%)	<0.5
Glenella (70%) Plum Ridge (30%)	27
Niverville (100%, saline phase)	1
Osborne (100%, drained phase)	78
Osborne (70%) Red River (30%)	36
Scanterbury (80%) Red River (20%)	140

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

Order	Great Group	Subgroup	Soil Series, Family Description
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.	Black A horizon with dry colour Munsell values darker than 3.5	Gleyed Black	**Scanterbury** (SCY) developed on moderately to strongly calcareous lacustrine clay, Imperfectly drained
		Gleyed Rego Black	**Glenella** (GNL) developed on moderately to strongly calcareous stratified, loamy textured alluvial and lacustrine deposits, underlain by moderately to strongly calcareous, lacustrine clay. Imperfectly drained.
			Plum Ridge (PMG) coarse loamy mixed, strongly calcareous, cold to moderately cold, subhumid
			Niverville (NIV) fine loamy over clayey, mixed strongly calcareous, Imperfectly drained, Modifier: weakly saline (4 – 8 mS/cm)

Order	Great Group	Subgroup	Soil Series, Family Description
			Red River (RIV) developed on moderately to strongly calcareous lacustrine clay, Imperfectly drained
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.	Humic Gleysol	Rego Humic	**Osborne** (OBO) developed on moderately to strongly calcareous lacustrine clay, poorly drained. Drained phase

Source: Hopkins, L.A., et al. 1993

4.1.2 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 (Manitoba Water Stewardship, 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 (Frazer 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, 3, and 5 with subclass designations of W, N and M. 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.

- Class 3 - Soils in this class have moderately severe limitations that restrict the range of crops or require special conservation practices. The limitations are more severe than for class 2 soils. They affect one or more of the following practices: timing and ease of tillage, planting and harvesting, choice of crops, and methods of conservation. Under good management, they are fair to moderately high in productivity for a fair range of crops.

- Class 5 - Soils in this class have very severe limitations that restrict their capability to producing perennial forage crops, and improvement practices are feasible. The limitations are so severe that soils are not capable of use for sustained production of annual field crops. The soils are capable of producing native or tame species of perennial forage plants. The improvement practices may include clearing of bush, cultivation, seeding, fertilizing, or water control.

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.

- 'N' – Salinity - soils of this subclass possess excessive soluble salts which adversely affect crop growth or restrict the range of crops that may be grown.

- 'M' - Moisture Limitations – this subclass consists of soil where crops are affected by drought owing to inherent soil characteristics. These soils usually have a low water-holding capacity.

4.1.3 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 (Manitoba Water Stewardship, 2008).

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
Scanterbury	2W	N1
Glenella	2W	N1
Plum Ridge	2W	N1
Niverville	3N	N1
Red River	2W	N1
Osborne	3W	N1

Within the LSA there are approximately 167 ha of Class 2W land, 1 ha of 3N land and 114 ha of 3W land (Figure 7, Appendix A). The Water Quality Management Zone nitrogen application limits within Zones N1 to N3 are 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)
- Zone N2: 101 kg/ha (90 lbs/acre)
- Zone N3: 33.6 kg/ha (90 lbs/acre)

The Water Quality Management Zone phosphorous application limits within zones N1 to N3 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

4.1.4 Agronomy

Crops grown on lands receiving biosolid materials include cereals, oils seeds, corn and soybeans. Application of biosolid materials will increase soil health (water-holding capacity, tilth) and provide beneficial macro (nitrogen, phosphorus, potassium, sulfur) and micro nutrients (boron, copper, zinc, magnesium) to the soil for crop production. Farm producers participating in the project have been advised of the benefits of biosolid application and understand 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 semi-dry state with continued dewatering as the material is in a drying bed location. This means that the material will be surface spread and incorporated.

MMM completed a comprehensive sampling program on April 10, 2013 of the biosolid stockpile from Cell 1. Cell 2 will be sampled prior to the land application program for that cell.

5.1 Biosolid Sampling Procedure

The City of Steinbach arranged to have heavy equipment (rubber tire hoe) to break open the biosolid stockpile from Cell 1 at three locations in order to collect bucket samples of the biosolid material. One composite sample from the three bucket samples was collected 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

The biosolid stockpile consisted of material dredged from lagoon Cell 1 in 2012. The volume of stockpiled biosolid material from Cell 1 is approximately 8,000 cubic metres (Table 5.1).

Cell 2 has a surface area of 2.1 ha (5.2 acres) and a holding capacity of 90,800,000 litres. The wastewater in Cell 2 has received similar treatment and aeration as Cell 1. The anticipated volume of biosolid material that will be collected from lagoon Cell 2 and land applied is 8,000+ cubic metres. Biosolid material from Cell 2 will be sampled in 2014 prior to land application to confirm the consistency of material. Due to the parallel treatment of the biosolid it is anticipated that the quality of Cell 2 biosolid will be similar.

Table 5.1 - Estimated Biosolid Quantity Cell 1

Description	Unit	Biosolid Quantity
Reported Volume	m^3	8,000
10% Safety Factor	m^3	800
Volume with Safety	m^3	8,800
Specific Gravity	Kg/l	1.0
Mass	t	8,800

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.

Table 5.2 - Physical Characteristics, Nitrogen and Phosphorous Profiles for Biosolids from Cell 1

Parameter Name	Parameter Description	Unit	Cell 1 Results
Reported Volume (plus 10% safety volume)	In-field	m^3	8,800
Specific Gravity	As Received	kg L^{-1}	1.00
Dry tonnes biosolid available (= wet tonnes x %solids)	Dried Basis	tonnes	1,267
Moisture	As Received	%	86.40
Total Solids	As Received	%	14.40
Total Volatile Solids	Dry Basis	%	1,960
Organic Matter	Dry Basis	%	34.50
Mineral Content	Dry Basis	%	65.50
Nitrogen Profile			
Total Kjeldahl N	% Dried Basis	%	2.76
Total Kjeldahl N	Dried Basis	mg kg^{-1}	27,600
Total Kjeldahl N	Dried Basis	kg $Tonne^{-1}$	27.60
Ammonium - N	Dried Basis	mg kg^{-1}	876.00
Ammonium - N	Dried Basis	kg $Tonne^{-1}$	0.8760
Available Nitrate	Dried Basis	mg kg^{-1}	0
Available Nitrate-N	Dried Basis	mg kg^{-1}	0
Organic N (= TKN – Ammonium-N)	Dried Basis	mg kg^{-1}	26,724
Organic N	Dried Basis	kg $Tonne^{-1}$	26.72
Method of Application:			Injection
Anticipated Weather			Cool/wet
Anticipated Volatilization (Incorporation within 4 days)			17%
Available Organic N	Dried Basis	kg $Tonne^{-1}$	2.67
Ammonium nitrogen available	Dried Basis	kg $Tonne^{-2}$	0.73

Parameter Name	Parameter Description	Unit	Cell 1 Results
Total available nitrogen (Year 1)	Dried Basis	kg Tonne^{-1}	3.40
Mineralization N (Year 2)	Dried Basis	kg Tonne^{-1}	3.21
Mineralization N (Year 3)	Dried Basis	kg Tonne^{-1}	1.60
Phosphorous Profile			
Total Phosphorous (Acid digestion)	Dried Basis	mg kg^{-1}	11,000
Phosphorus	Dried Basis	kg Tonne^{-1}	11.00
P_2O_5 equivalent	Dried Basis	kg Tonne^{-1}	25.30
Total Available P_2O_5	Dried Basis	kg Tonne^{-1}	12.65
Phosphorous (Olsen)	Dried Basis	mg kg^{-1}	76.80
Phosphorus	Dried Basis	kg Tonne^{-1}	0.08
P_2O_5 equivalent	Dried Basis	kg Tonne^{-1}	0.18
Total Available P_2O_5 (50% available)	Dried Basis	kg Tonne^{-1}	0.09
Confirmation Characteristics			
Total Organic Carbon	Dry Basis	%	27.20
C:N Ratio	Dry Basis	x:1	9.86
C:P Ratio	Dry Basis	x:1	24.73
N:P Ratio	Dry Basis	x:1	2.51
pH	Saturated Paste		6.87

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 biosolid material is approximately 10:1, 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 biosolid material C:P ratio is below this range and 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 biosolid material N:P ratio is 2.5:1, thus it is anticipated that P will not accumulate.

5.3.2 Salinity

The biosolid material from Cell #1 has an electrical conductivity (E.C.) value of 3.02 dS m^{-1} and a Sodium Absorption Ratio (SAR) of 4.60. 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 Cell 1 biosolids are found in Table 5.3.

Table 5.3 - Detailed Salinity of Biosolids Cell 1

Parameter Name (Saturated Paste)	Unit	Analytical Results Cell 1	Mean values from Racz and Fitzgerald (2001)*
Electrical Conductivity (Dry)	dS m^{-1}	3.02	16.1
Sodium Absorption Ratio		4.60	5.1
% Saturation	mg kg^{-1}	856.00	
Calcium (Wet)	mg kg^{-1}	128.00	
Magnesium (Wet)	mg kg^{-1}	83.00	
Sodium (Wet)	mg kg^{-1}	272.00	
Chloride (Wet)	mg kg^{-1}	297.00	
Potassium (Wet)	mg kg^{-1}	28.30	
Sulfate-S (Wet)	mg kg^{-1}	210.00	

* Mean values from 145 Manitoba Hog manure samples.

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 biosolid material, the metals of principal concern to agriculture include: Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel and Zinc. Manitoba Conservation Water Stewardship 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 proposal has not determined actual soil metal concentrations, 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 5.5 t ha^{-1} and the mean concentrations of trace elements, the metal loading rates will be below the limit criteria. Table 5.6 reports the trace element concentrations for Cell 1 biosolids and the soil loading rates and guidelines. It is anticipated that Cell 2 trace element concentrations will be similar to Cell 1 due to similar treatment and management.

Table 5.6 - Trace Elements for Cell 1 Biosolids

Trace Element	Laboratory Detection Limit	Steinbach Lagoon Cell 1		Typical Soil Concentrations		Loading Rate at 5.5 T ha^{-1} (dry)	Cumulative Metal Concentration	Cumulative Weight Allowed by Guideline[1]
	mg kg^{-1}	mg kg^{-1}	kg $tonne^{-1}$	mg kg^{-1}	kg ha^{-1}	kg ha^{-1}	kg ha^{-1}	kg ha^{-1}
Cadmium (Cd)	0.1	2.42	0.002	0.10	0.00	0.013	0.02	2.5
Mercury (Hg)-Total	1	3.9	0.004	75.00	3.11	0.021	3.13	11.9
Arsenic (As)	0.1	6.03	0.006	5.00	0.21	0.033	0.24	21.6
Nickel (Ni)	1	19.7	0.020	41.00	1.70	0.108	1.81	90
Copper (Cu)*	10	1350	1.350	38.00	1.57	7.425	9.00	113.4
Chromium (Cr)	0.5	36.3	0.036		0.00	0.200	0.20	115.2
Lead (Pb)	1	52.8	0.053	26.00	1.08	0.290	1.37	126
Zinc (Zn)	50	913	0.913	107.00	4.43	5.022	9.45	360
Barium (Ba)*	10	1240	1.240		0.00	6.820	6.82	-
Beryllium (Be)	0.5	<0.5	0.000		0.00	0.000	0.00	-
Cobalt (Co)	1	4.8	0.005	24.00	0.99	0.026	1.02	-
Molybdenum (Mo)	1	51.9	0.052	4.00	0.17	0.285	0.45	-
Selenium (Se)	0.2	6.98	0.007	0.40	0.02	0.038	0.05	-
Silver (Ag)	0.2	31.3	0.031	0.20	0.01	0.172	0.18	-
Thallium (Tl)	0.1	0.18	0.000		0.00	0.001	0.00	-

Trace Element	Laboratory Detection Limit	Steinbach Lagoon Cell 1		Typical Soil Concentrations		Loading Rate at 5.5 T ha^{-1} (dry)	Cumulative Metal Concentration	Cumulative Weight Allowed by Guideline[1]
Tin (Sn)	2	25.9	0.026		0.00	0.142	0.14	-
Uranium (U)	0.1	16.9	0.017		0.00	0.093	0.09	-
Vanadium (V)	1	17.4	0.017	141.00	5.84	0.096	5.93	-
Aluminum (Al)	50	11900	11.900					
Antimony (Sb)	0.1	2.63	0.003		0.00	0.014	0.01	
Bismuth (Bi)	1	29.1	0.029		0.00	0.160	0.16	
Boron (Bo)	0.2	7.6	0.008		0.00	0.042	0.04	
Iron (Fe)	50	18100	18.100		0.00	99.550	99.55	
Lithium	2	6.6	0.007		0.00	0.036	0.04	
Strontium	100	208.0	0.208		0.00	1.144	1.14	
Titanium (Ti)	5	28.3	0.028		0.00	0.156	0.16	

Notes:

1. Cumulative Weight allowed by guideline includes the metals in biosolids and soil.
   *Detection Limit adjusted for required dilution.

Mean trace element for an Osborne soil series

Mean trace element for an Plume Ridge soil series

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

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 and N3) for both nitrogen and phosphorous.

A benchmark soil sampling program will be conducted immediately after harvest, anticipated to be in late September of 2013 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 phosphorus, 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 stockpiled biosolid material from Cell 1. 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 and P_2O_5 crop removal. The hypothetical application rate is based on nutrient concentrations of the biosolid sample collected from the Cell #1 stockpile. The hypothetical application rated is based on 100 kg ha^{-1} of required nitrogen and one (39 kg ha^{-1}) and two time (70 kg ha^{-1}) crop removal of a permitted crop (Table 5.7).

Table 5.7 - Hypothetical Application Rate based on Nitrogen requirement or P_2O_5 Crop Removal

Parameter	Units	Rates
Nitrogen based application rate (dry)	tonnes ha^{-1}	13.5
Amount of Available P_2O_5 applied (dry)	kg ha^{-1}	171
P_2O_5 Application check	%	438
Area of land required	hectares	94
	acres	231
Wet Tonnes per hectare:	tonnes ha^{-1}	93.7
Application Rate based on Phosphorous (1x Crop Removal)		
Total Phosphorus Based Application Rate (dry)	tonnes ha^{-1}	3.08
Amount of Nitrogen applied (dry)	kg ha^{-1}	22.8
Additional Nitrogen required	kg ha^{-1}	77.2
Selected Application rate based on:		**P_2O_5**
Selected Application Rate (tonnes ha^{-1}):		**3.08**
Area of land required:	hectares	411
	acres	1,011
Wet Tonnes per hectare:	tonnes ha^{-1}	21
Application Rate based on Phosphorous (2x Crop Removal)		
Total Phosphorus Based Application Rate (dry)	tonnes ha^{-1}	5.5
Amount of Nitrogen applied (dry)	kg ha^{-1}	41
Additional Nitrogen required	kg ha^{-1}	29
Selected Application Rate Based on:		**P_2O_5**
Selected Application Rate (tonnes ha^{-1}):		**5.5**
Area of land required:	hectares	229
	acres	563
Wet Tonnes per hectare	tonnes ha^{-1}	38

Based on the hypothetical application rates outlined in Table 5.6, the nitrogen application rate of 13.5 tonnes per hectare (dry) provides an estimated 438 percent of the required P_2O_5, which is not suitable. Therefore the preferred application rate is based on two times crop removal (70 kg ha^{-1}) of a permitted crop. This would provide approximately 41 kg ha^{-1} of required nitrogen and allowing for a top up of approximately 30 kg ha^{-1}. The total land area required is then anticipated to be approximately 229 hectares for a two times crop removal application rate for phosphorous.

Based on interviews with the farm producers managing each parcel of land and soil sample reports produced by some of the producers 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 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 Phosphorus

Of primary concern associated with the land application of biosolid materials is the leaching and/or surface runoff of nitrogen and phosphorus 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 phosphorus based on beneficial farm management practices and following prescription rates for the Red River Valley Management Area 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 phosphorus rates will target uptake ability of small grains, oil seed, corn, and soybean crops to a maximum of 100 kg ha^{-1} without exceeding the nutrient management regulatory criteria in zones N1 and N3.

Leaching to groundwater is not a significant concern (refer to Section 4.4) within the LSA as the soil texture is a clay. 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 Manning Canal 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 Cell 1 has been determined based on the theoretical maximum application of 5.5 dry tonnes per hectare as presented in Tables 5.5. 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 Niverville soil series is identified as slightly to weakly saline (4 - 8 dS m^{-1}). The Niverville soil series is limited in extent (1 ha) (Figure 6, Appendix A), and with the Niverville 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 are highly susceptible to physical compaction due to the clay texture and small pore spaces.

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 a farm producer(s) 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 spreading 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. Equipment traffic associated with the transfer of biosolids from the lagoons to the receiving fields will be below posted speed limits thus reducing the possibility of wildlife collisions.

6.3 Potential Surface Water and Fisheries Impacts

Potential impacts to surface water and fish within the Manning Canal 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 incorporated into the soil within 48 hours of application 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 R.M. of Hanover is possible in areas where sand and gravel deposits are at or near the ground surface and where sand and gravel aquifers are used as a domestic water supply (Rutulis 1973). However, based on the groundwater pollution hazard map developed by Rutulis (1973) for the R.M. of Hanover, the LSA has a zero to minimal pollution hazard risk as most domestic wells in the area draw water from the carbonate aquifer which is overlain by thick clay and/or till deposits that act as barriers to movement of contaminates to the aquifer.

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. If surface applied, incorporation of the biosolid material within 48 hours of application will minimize the potential of overland flow to groundwater wells. In addition appropriate setback distances will be established around all residences and domestic wells as outlined in Table 6.4.

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 producers and the City of Steinbach itself. The objective of providing prescription application rates for biosolids to crop specifics 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 April 2013 for Urea (46-0-0) and Triple Super Phosphate (0-45-0), the following economic value as presented in Table 6.1 can be recognized from the prescribed biosolid land application of 5.5 tonnes ha^{-1}.

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

Nutrient	Market Price (April 2013)	Hypothetical Application Rate	Value of Applied Biosolids
Available Nitrogen	\$0.81 kg^{-1}	41 kg ha^{-1}	\$32.80 ha^{-1}
Total Available P_2O_5	\$0.98 kg^{-1}	70 kg ha^{-1}	\$68.60 ha^{-1}

The biosolid material is being provided at no charge to the farm producer, thus reducing his fertilizer bill by approximately \$101.40 per hectare (Table 6.1). Based on the anticipated 229 hectares required for the land application this equates to approximately \$23,220 for just nitrogen and phosphorous fertilizer and does not account for the added benefit of potassium, sulfur and micro-nutrients. Hence the economic benefit to the farm producer is substantial based on the savings the farm producer will incur for crop fertilizer amendments. It should also be noted that the economic benefit to the City of Steinbach 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 City of Steinbach.

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, incorporation of the biosolid material within 48 hours or less of surface 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 the Table 6.3.

Table 6.3 - Buffer Zones to be Established for Biosolid Application

Description	Recommended Buffer Zone Distance
Identified groundwater well	50 m
No application where there is less 1.5	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 City of Steinbach and the Applicator to review the requirements of the EAL and procedure for the land application of the biosolids.

2. Determination of the moisture and dry tonnes of the stockpiled biosolid material to ensure consistant application at prescribed rates.

3. Recording of each scaled truck load and net biosolid weight.

4. 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.

5. Providing a summary report to MCWS EALB on behalf of the City of Steinbach 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 City of Steinbach to complete a land application of biosolid materials collected from wastewater treatment lagoon Cells 1 and 2 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 City of Steinbach, 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 F.

10.0 REFERENCES

Canadian Council of Ministers of the Enviornment, 2009. The Biosolids Emissions Assessment Model (BEAM): A Method for Determining Greenhouse Gas Emissions from Canadian Biosolids Management Practices , PN 1432.

Fraser. W.R., Cyr.P., Eilers.R.G., & Lelyk, G.W., 2001) Technical Manual for Manitoba RM Soils and Terrain Information Bulletins. Winnipeg; Agriculture and Agri-Food Canada.

Penner, R. 2007. City of Winnipeg Naturalist Services Branch, Fish Sampling Report 2007.

Haluschak, P., R.G. Eilers, G.F.Mills, and S.Grift, 1998. Status of Selected Trace Elements in Agriculture Soils of Southern Manitoba. Soil Resources Section, Soils and Crops Branch, Manitoba Agriculture.

Harb, J. 1999. A Health Risk Assessment on the Consumption of Trace Metals Found in Crops Grown on Biosolids Amended Soil. Master of Science Thesis. Faculty of Medicine, Department of Community Health Sciences, University of Manitoba.

Hopkins, L.A., E.St.Jacques and G.F. Mills. 1993. Soils of the Rural Municipality of Hanover, Soil Report No. D82. Agriculture Canada, Manitoba Department of Agriculture and Department of Soil Science, University of Manitoba.

Racz, G.J. and M.M. Fitzgerald. 2001. Nutrient and heavy metal contents of hog manure – effect on soil quality and productivity. In *Livestock Options for the Future Conference*. Winnipeg, Manitoba, June 25-27.

Rutulis, M. September 23, 1973. Province of Manitoba Inter-departmental Memo – Groundwater Availability in the Municipality of Hanover.

Rutulis, M. (1986)[1]. Aquifer Maps of Southern Manitoba Map 1 of 2 Sand and Gravel Aquifers. Winnipeg, MB: Department of Water Resources, Water Resources Branch.

Rutulis, M. (1986)[2]. Aquifer Maps of Southern Manitoba Map 2 of 2 Bedrock Aquifers. Winnipeg, MB: Department of Water Resources, Water Resources Branch.

Smith, R., Veldhuis, H., Mils, G., Eilers, R., Fraser, W., & Lelyk, G. (1998). Terrestrial Ecozones, Ecoregions and Ecodistrics of Manitoba, An Ecological Stratification of Manitoba's Natural Landscapes. Winnipeg, MB: Agriculture and Agri-Food Canada, Research Branch, Brandon Research Centre, Land Resources Unit.

Statistics Canada. 2011. Census Profile. Available online at: http://www12.statcan.gc.ca/census-recensement/2011/dp-pd/prof/index.cfm?Lang=E. Accessed on April 2, 2013.

Sullivan, D.M., C.G. Cogger, A.I. Bary, 2007. Fertilizing with Biosolids. A Pacific Northwest Extension Publication (PNW 508-E). Oregon State University, University of Idaho, Washington State University.

APPENDIX A – Figures

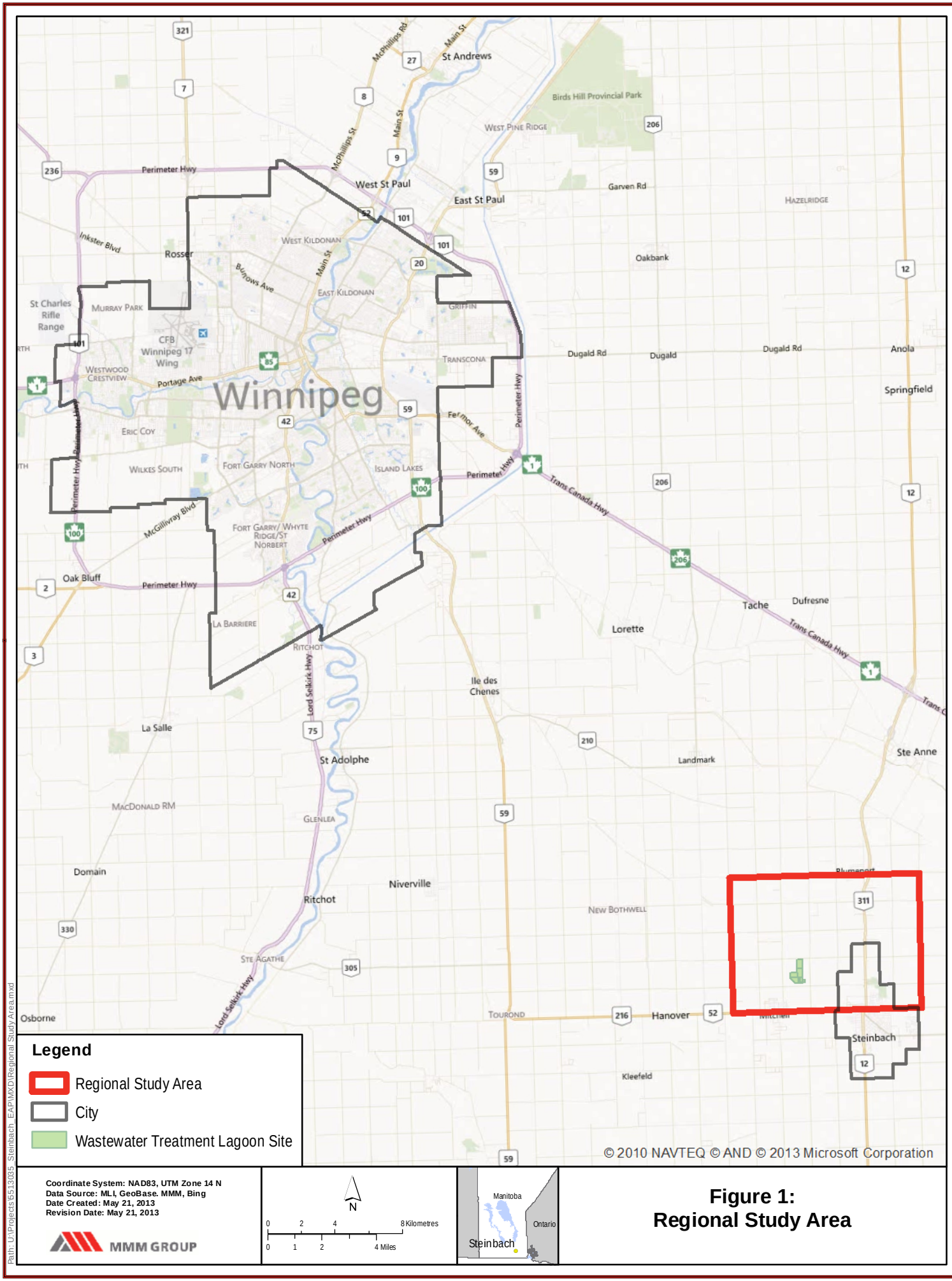
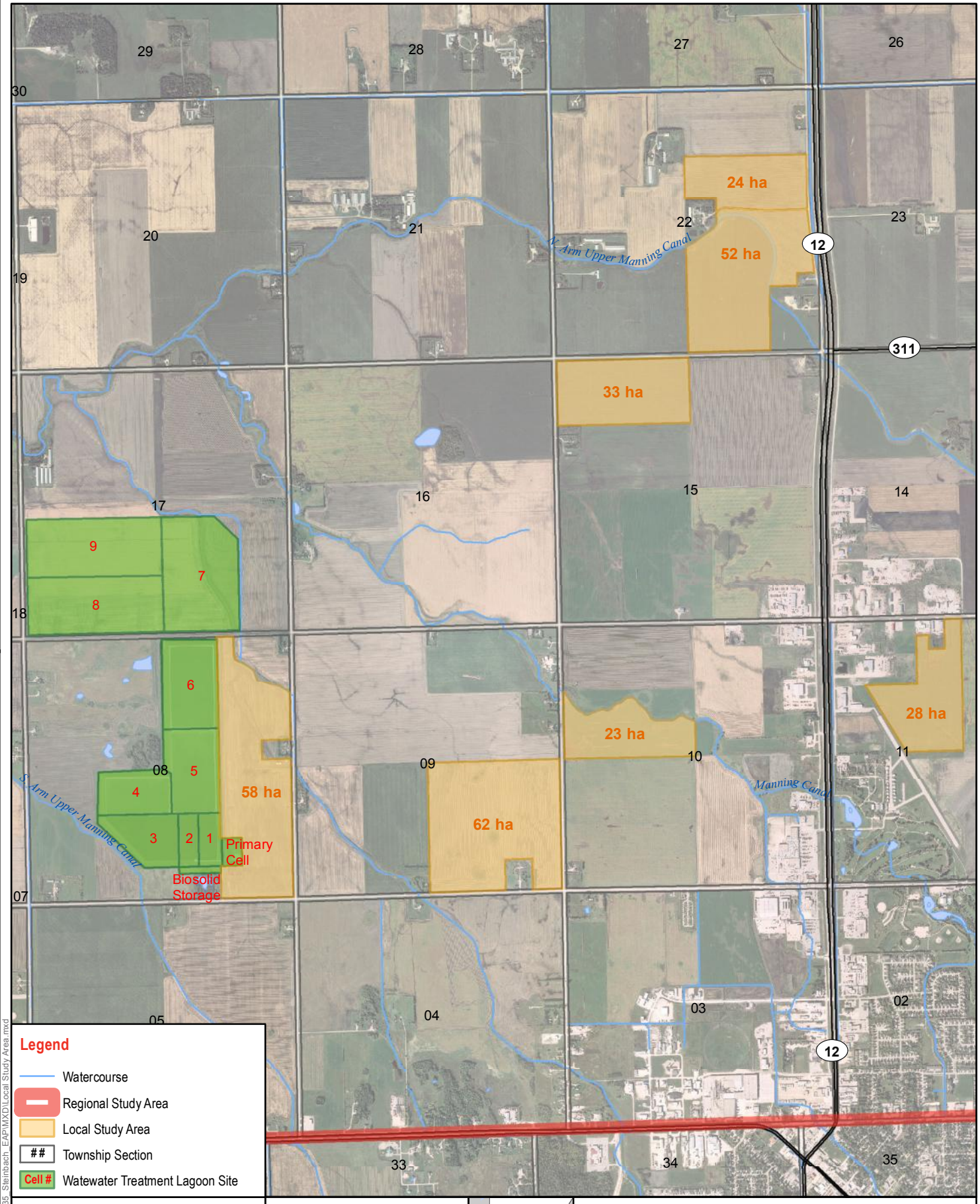
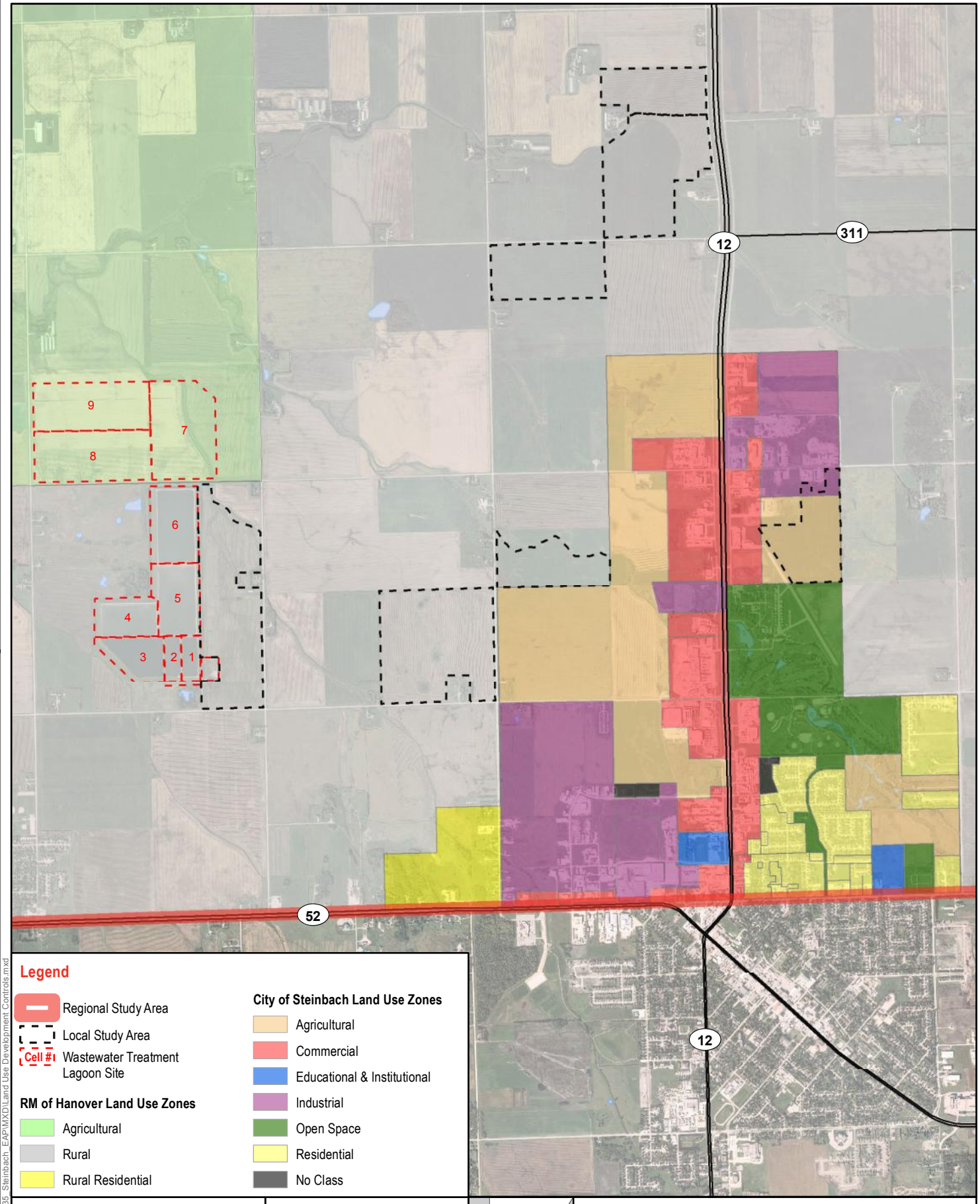


Figure 1:
Regional Study Area


29
28
27
26
30
20
21
22
23
19
24 ha
52 ha
S Arm Upper Manning Canal
12
311
33 ha
16
15
14
17
9
7
8
18
6
28 ha
23 ha
10
11
08
5
4
58 ha
09
62 ha
Manning Canal
S Arm Upper Manning Canal
3
2
1
Primary Cell
Biosolid Storage
07
05
04
03
02
12
33
34
35
Legend
Watercourse
Regional Study Area
Local Study Area
Township Section
Cell # Watewater Treatment Lagoon Site
Coordinate System: NAD83, UTM Zone 14 N
Data Source: MLI, GeoBase. MMM
Date Created: May 21, 2013
Revision Date: June 14, 2013
MMM GROUP
N
0 200 400 800 Metres
0 500 1,000 2,000 Feet
Manitoba
Ontario
Steinbach
Figure 2:
Local Study Area
Path: U:\Projects\5513035 Steinbach EAP\MXD\Local Study Area.mxd



Legend

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

RM of Hanover Land Use Zones

- Agricultural
- Rural
- Rural Residential

City of Steinbach Land Use Zones

- Agricultural
- Commercial
- Educational & Institutional
- Industrial
- Open Space
- Residential
- No Class

Coordinate System: NAD83, UTM Zone 14 N
Data Source: MLI, GeoBase, RM of Hanover, MMM
Date Created: June 14, 2013
Revision Date: June 17, 2013

MMM GROUP

N

0 200 400 800 Metres

0 500 1,000 2,000 Feet

Figure 3: Land Use Development Controls

Path: U:\Projects\5513035 Steinbach EAP\MXD\Land Use Development Controls.mxd

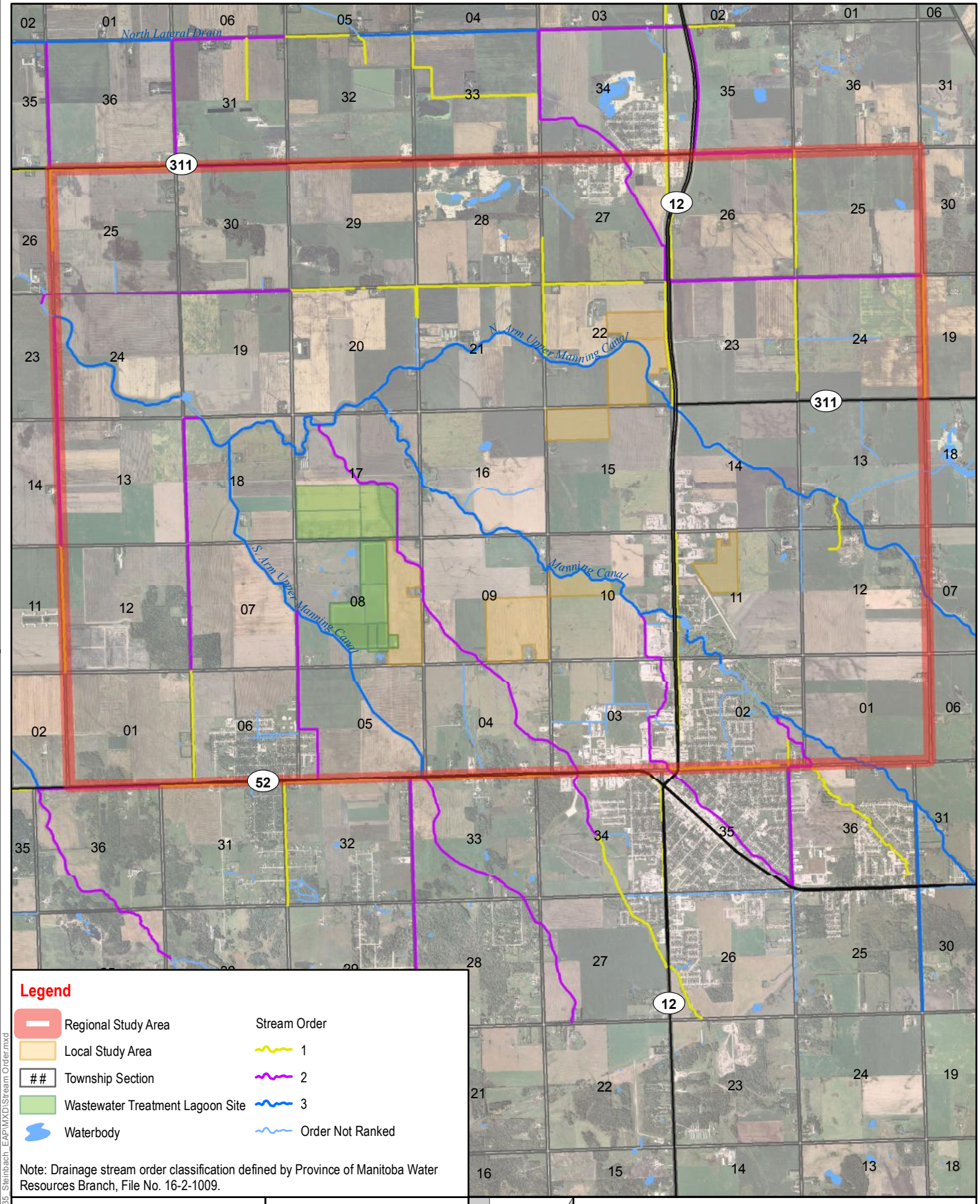
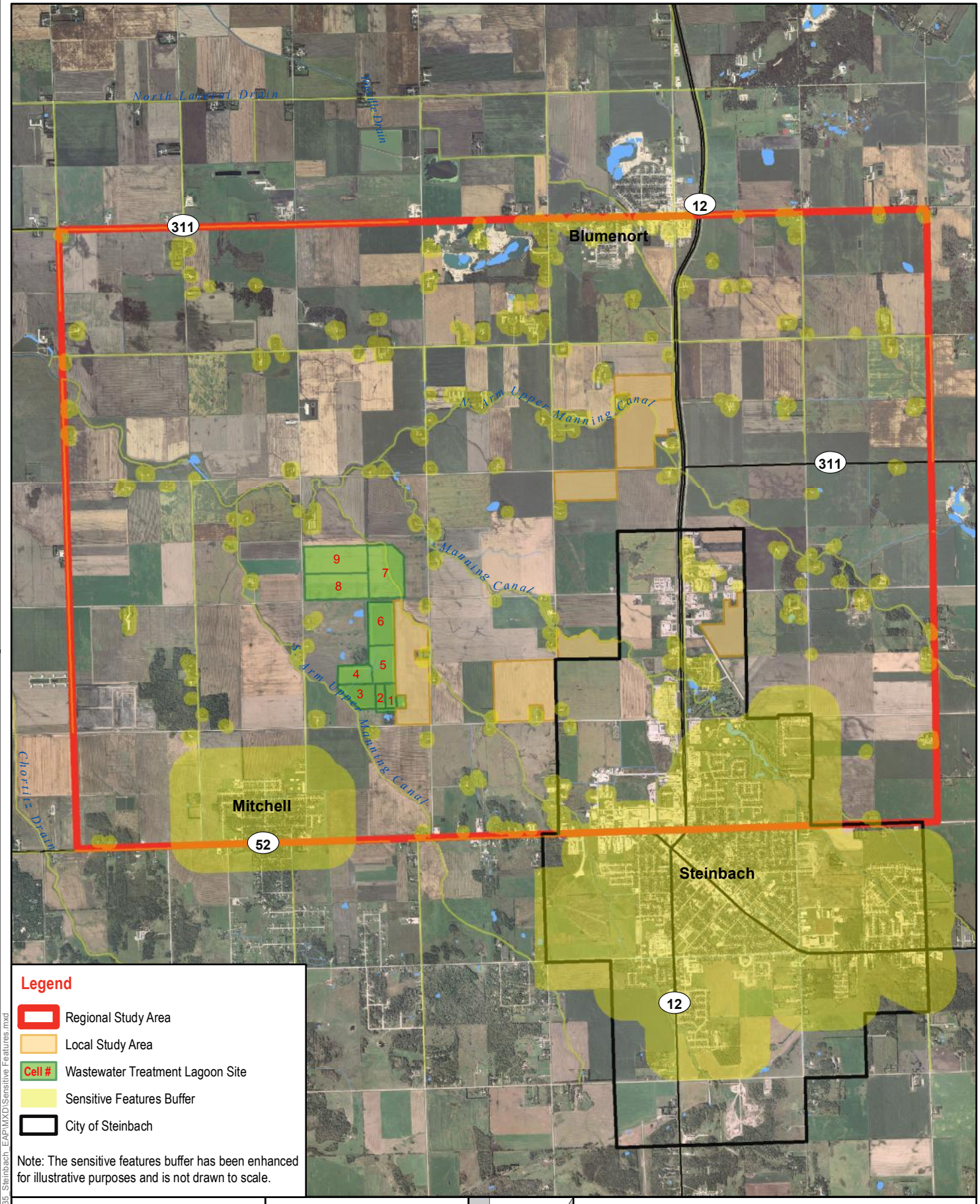


Figure 4:
Designated Drains and Stream Order



Legend

- Regional Study Area
- Local Study Area
- Cell # — Wastewater Treatment Lagoon Site
- Sensitive Features Buffer
- City of Steinbach

Note: The sensitive features buffer has been enhanced for illustrative purposes and is not drawn to scale.

Coordinate System: NAD83, UTM Zone 14 N
Data Source: MLI, GeoBase. MMM
Date Created: May 21, 2013
Revision Date: June 17, 2013

MMM GROUP

N

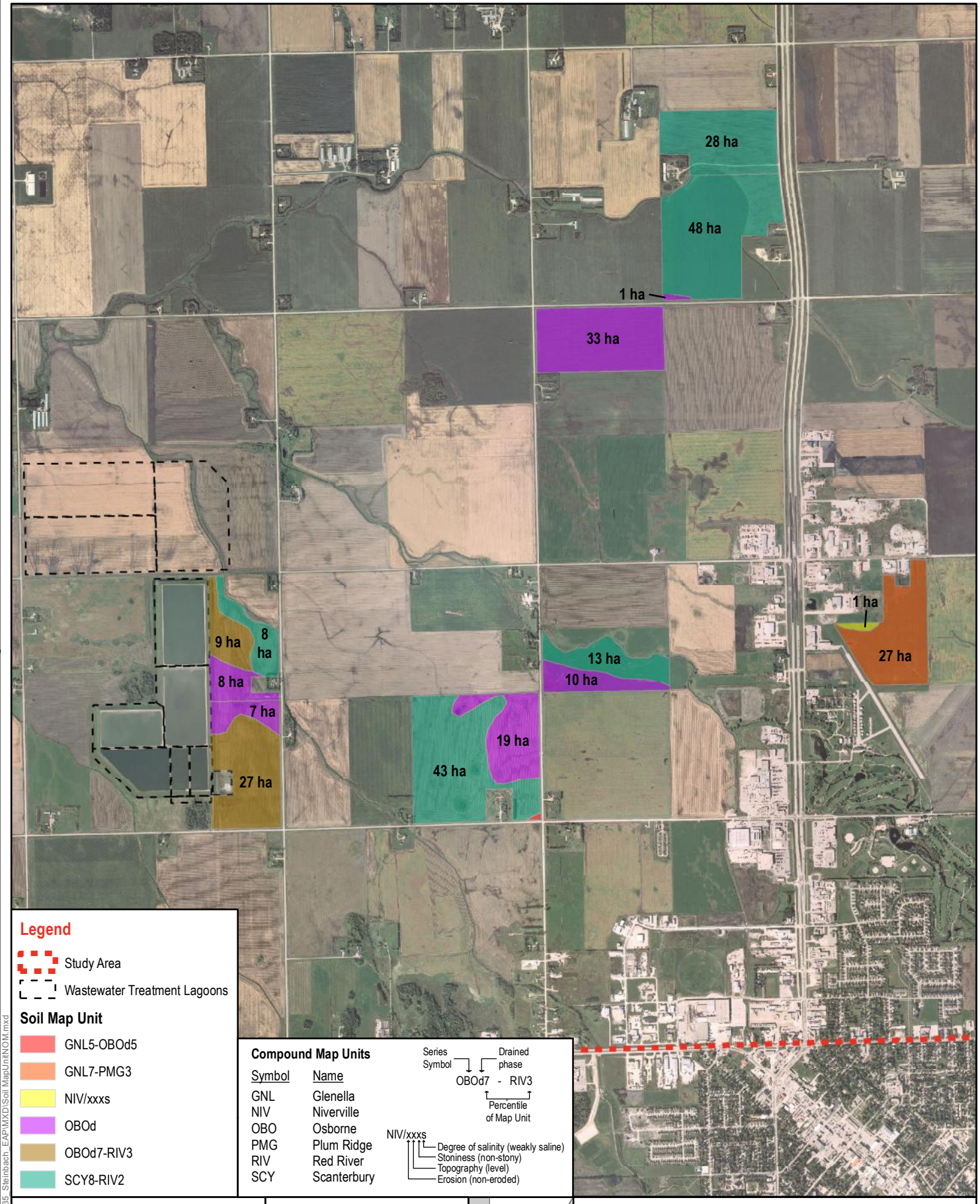
0 0.5 1 2 Kilometres

0 0.25 0.5 1 Mile

Manitoba
Ontario
Steinbach

Figure 5: Sensitive Features Setback Distances

Path: U:\Projects\5513035 Steinbach EAP\MXD\Sensitive Features.mxd



Legend

- Study Area
- Wastewater Treatment Lagoons

Soil Map Unit

- GNL5-OBOd5
- GNL7-PMG3
- NIV/xxxs
- OBOd
- OBOd7-RIV3
- SCY8-RIV2

Compound Map Units

Symbol	Name
GNL	Glenella
NIV	Niverville
OBO	Osborne
PMG	Plum Ridge
RIV	Red River
SCY	Scanterbury

Series Symbol — Drained phase: OBOd7 - RIV3 (Percentile of Map Unit)

NIV/xxxs
- Degree of salinity (weakly saline)
- Stoniness (non-stony)
- Topography (level)
- Erosion (non-eroded)

Coordinate System: NAD83, UTM Zone 14 N
Data Source: CLI, GeoBase. MMM
Date Created: April 2, 2013
Revision Date: June 14, 2013

MMM GROUP

N

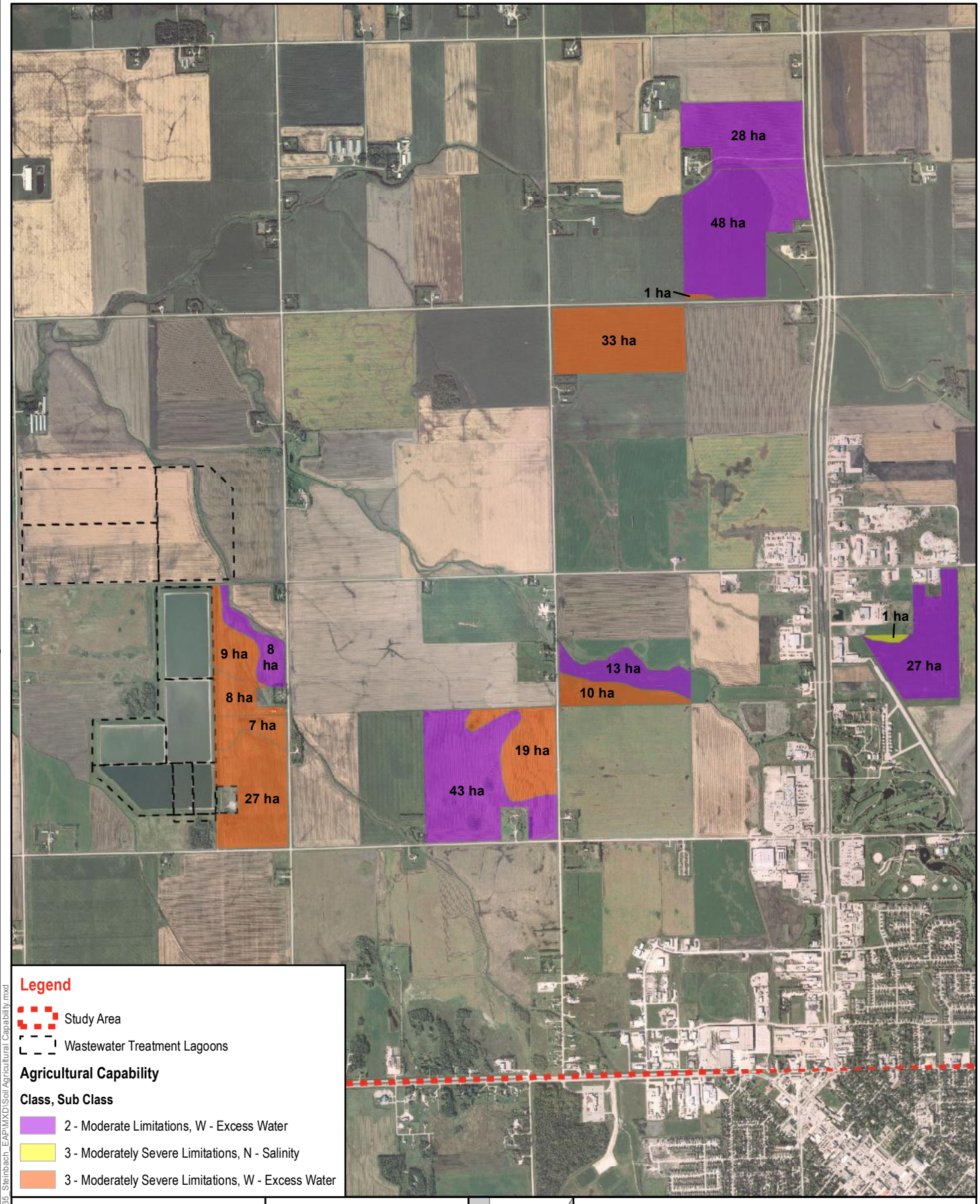
0 200 400 800 Meters

0 500 1000 2000 Feet

Manitoba
Ontario
Steinbach

Figure 6: Soil Map Unit within Local Study Area

Path: U:\Projects\5513035_Steinbach_EAP\MXD\Soil MapUnitNOM.mxd



Legend

- Study Area
- Wastewater Treatment Lagoons

Agricultural Capability

Class, Sub Class

- 2 - Moderate Limitations, W - Excess Water
- 3 - Moderately Severe Limitations, N - Salinity
- 3 - Moderately Severe Limitations, W - Excess Water

Coordinate System: NAD83, UTM Zone 14 N
Data Source: CLI, GeoBase. MMM
Date Created: April 2, 2013
Revision Date: June 14, 2013

MMM GROUP

N

0 200 400 800 Meters

0 500 1000 2000 Feet

Manitoba
Ontario
Steinbach

Figure 7:
Canadian Land Inventory Soil Agricultural Capability within Local Study Area

Path: U:\Projects\5513035 Steinbach EAP\MXD\Soil Agricultural Capability.mxd

APPENDIX B – Landowner Agreements and Land Titles

CITY OF STEINBACH

225 Reimer Avenue, Steinbach MB R5G 2J1 Phone 204.326.9877 Fax 204.346.6235

Dear Farm Producer

The City of Steinbach requires agricultural land to apply bio solids from the aeration cells at the City Wastewater Treatment facility. Applying bio solids 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 bio solids 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. Bio solids will be applied at agronomic prescribed rates.
6. Bio solids / sludge may require tillage incorporation shortly after application depending upon the application method.
7. There are no fees to be paid from City of Steinbach to the landowner or lessee for:
    a. Bio solids/sludge or nutrients
    b. Use of land
    c. Application process
    d. Tillage requirements
8. Volume of bio solids 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 (2 weeks).
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 10 - 7 - 6 EPM~~	NW 15 - 7 - 6 E PM.
E 1/2 ~~22~~ - 7 - 6 E PM Keep SW	

Signature: _____ Date: June 7 / 2013

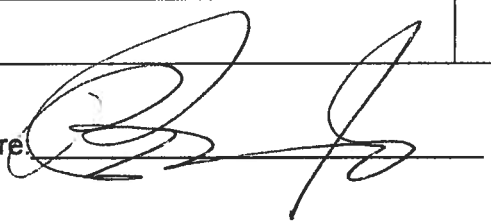
Legal land location (quarter/section/township/range) for each parcel:

SE 8-7-6E	

Signature: _____ Date: April 29, 2013

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

SE9-7-6E	

Signature: 

Date: April 16, 2013

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

NW 10-8-6 E	

Signature: Leonard A. Penner Date: Apr. 16 2013

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

NW11-7-6E.	

Signature: Ray Laing

Date: May 3, 2013.

APPENDIX C – Supporting Documents

Danette Sahulka

From: Friesen, Chris (CON) <Chris.Friesen@gov.mb.ca>
Sent: April-09-13 9:43 AM
To: Danette Sahulka
Subject: Steinbach Biosolids EAP

Follow Up Flag: Follow up
Flag Status: Flagged

Categories: High Priority

Danette

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

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

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

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

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

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

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

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

From:
Sent: Monday, April 01, 2013 2:20:03 PM
To: +WPG1212 - CDC_Wildlife (CON)
Subject: WWW Form Submission
Auto forwarded by a Rule

Below is the result of your feedback form. It was submitted by WWW Information Request () on Monday, April 1, 2013 at 14:20:03

DocumentID: Manitoba_Conservation

Project Title: Steinbach Biosolids EAP

Date Needed: 2013/04/17

Name: Danette Sahulka

Company/Organization: MMM Group Limited

Address: 111-93 Lombard Ave.

City: Winnipeg

Province/State: Manitoba

Phone: 204-943-3178 ext. 3890

Fax: 204-943-4948

Email: sahulkad@mmm.ca

Project Description: On behalf of the proponent (City of Steinbach), MMM Group is completing an environment act proposal (EAP) for the land application of biosolids from the City's wastewater treatment lagoon (proposed project) on agricultural lands within the RM of Hanover.

Information Requested: Would like a search of MBCDC's databases to determine if there are any potential species of conservation concern within the project study area that may be impacted by the proposed project.

Format Requested: ArcView shapefile sent by email.

Location: Parcels of land within the RM of Hanover including:
- All sections (1 to 36) within Township 7, Range 6 EPM.
- Sections 1 to 4, 9 to 12, 13 to 16, 21 to 24, 25 to 28 and 33 to 36 within Township 7, Range 5 EPM.

action: Submit

Danette Sahulka

From: McClean, Heather <Heather.McClean@gov.mb.ca>
Sent: April-03-13 1:46 PM
To: Danette Sahulka
Cc: Smith, Brian (CHT); Butterfield, David (CHT)
Subject: RE: Heritage Resources Database Search Request
Attachments: Centennial_Farms_Steinbach_Area.dbf; Centennial_Farms_Steinbach_Area.prj; Centennial_Farms_Steinbach_Area.sbn; Centennial_Farms_Steinbach_Area.sbx; Centennial_Farms_Steinbach_Area.shp; Centennial_Farms_Steinbach_Area.shp.xml; Centennial_Farms_Steinbach_Area.shx; Plaques_Steinbach_Area.dbf; Plaques_Steinbach_Area.prj; Plaques_Steinbach_Area.sbn; Plaques_Steinbach_Area.sbx; Plaques_Steinbach_Area.shp; Plaques_Steinbach_Area.shp.xml; Plaques_Steinbach_Area.shx

Follow Up Flag: Follow up
Flag Status: Flagged

Categories: High Priority

Hi Danette – Thank you for your acknowledgement. Attached are shapefiles of all known heritage resources within the requested Township/Range areas. The shapefiles are of Centennial Farms and plaques within the area, there are no known archaeological sites or designated heritage sites.

Heather McClean
Heritage Resources Registrar
Historical Assessment Services
Historic Resources Branch
MB Culture, Heritage and Tourism
Main Floor, 213 Notre Dame Avenue
Winnipeg MB R3B 1N3
Heather.McClean@gov.mb.ca
Phone: (204) 945-7146
Fax: (204) 948-2384

From: Danette Sahulka [mailto:SahulkaD@mmm.ca]
Sent: April-03-13 12:55 PM
To: McClean, Heather
Subject: RE: Heritage Resources Database Search Request

Hi Heather,

This email is to acknowledge that I have reviewed and agree to the terms and conditions outlined in the attached disclaimer you sent.

Thank you,

Danette Sahulka, M.Sc., B.Ed., P.Ag.
Senior Ecologist
MMM Group Limited
t: 204.943.3178 ext. 3890| f: 204.943.4948 | c: 204.330.6078

sahulkad@mmm.ca |

From: McClean, Heather [mailto:Heather.McClean@gov.mb.ca]
Sent: April-03-13 10:54 AM
To: Danette Sahulka
Cc: Smith, Brian (CHT); Butterfield, David (CHT)
Subject: RE: Heritage Resources Database Search Request

Hi Danette - Thank you for your data request. Please find attached our disclaimer statement for use of the data we have prepared for you. Please review and acknowledge the terms and conditions of its use by return e-mail to:Heather.McClean@gov.mb.ca. Your requested data will be sent once your agreement to these terms has been received by our office.

Please note: the information to follow only pertains to currently known and recorded heritage resources within the area of your request. This does not necessarily indicate the potential of the area to contain additional heritage sites. Therefore this data set cannot be used to obtain heritage clearance for development projects and the user should be aware that all development proposals must be approved directly by the Historic Resources Branch Archaeological Assessment Services Unit (Contact at hrb@gov.mb.ca)

The information provided is to be considered as confidential and with the specific intent to assist in heritage resource protection. Under no circumstances is the information provided to be used, passed on, or shared with other parties for public consumption (for example, but not limited to: Websites, PowerPoint Presentations or Poster Displays), unless prior approval for such use has been obtained in writing from the Historic Resources Branch. The unapproved use of data may result in future requests being denied to the applicant.

Please also note that requests for scanned sites forms of 5 or less will be considered (if time and resources allow), anything above that number will be provided in the form of an Excel spreadsheet.

If you require any clarification or additional information, please do not hesitate to contact me.

Thank you.

Heather McClean
Heritage Resources Registrar
Historical Assessment Services
Historic Resources Branch
MB Culture, Heritage and Tourism
Main Floor, 213 Notre Dame Avenue
Winnipeg MB R3B 1N3
Heather.McClean@gov.mb.ca
Phone: (204) 945-7146
Fax: (204) 948-2384

From: Danette Sahulka [mailto:SahulkaD@mmm.ca]
Sent: April-01-13 2:30 PM
To: McClean, Heather
Subject: Heritage Resources Database Search Request

Hello Heather,

I am requesting any heritage or archaeological information from your database for the following location:

All Sections (1 to 36) of Township 7, Range 6 EPM and Sections 1 to 4, 9 to 12, 13 to 16, 21to 24, 25 to 28 and 33 to 36 of Township 7, Range 5 EPM. I have attached a map of the area (outlined in red).

This information will be included in an Environment Act Proposal that MMM is completing for the City of Steinbach.

If you would supply me with a summary of your findings by April 17, that would be much appreciated.

Please contact me if you have any questions regarding this request.

Thank you,

Danette Sahulka, M.Sc., B.Ed., P.Ag.
Senior Ecologist
Environmental Management
MMM Group Limited
111-93 Lombard Avenue
Winnipeg, Manitoba, Canada R3B 3B1
t: 204.943.3178 ext. 3890 | f: 204.943.4948 | c: 204.330.6078
sahulkad@mmm.ca | www.mmm.ca

APPENDIX D – GWDrill Search Results

SE09-7-6E: (0)
None.

E15-7-6E: (0)
None.

SE08-7-6E: (1)
LOCATION: SE8-7-6E
Well_PID: 160659
Owner: CITY OF STEINBACH
Driller: UNKNOWN
Well Name: MW-1A
Well Use: OBSERVATION
Water Use:
UTMX: 663523
UTMY: 5490960
Accuracy XY: 3 ACCURATE [50-350M] [WITHIN 1/4-SECTION]
UTMZ: 251
Accuracy Z: 4 FAIR - Shuttle at Centroid
Date Completed: 1993 Jan 01
No well log data for this well. No construction data for this well. No pump test data for this well.
Top of Casing: 0.0
REMARKS
SPECIFIC DRILL DATE UNKNOWN, ONLY DRILL YEAR. NO LOG. STEINBACH, MB.

NW10-7-6E: (1)

LOCATION: NW10-7-6E
Well_PID: 69028
Owner: B CHORNOBOY
Driller: Echo Drilling Ltd.
Well Name:
Well Use: PRODUCTION
Water Use: Domestic
UTMX: 665986.764
UTMY: 5491835.91
Accuracy XY: UNKNOWN
UTMZ:
Accuracy Z:
Date Completed: 1990 Dec 06

WELL LOG

From (ft.)	To (ft.)	Log
0	1.0	BLACK LOAM
1.0	6.0	BROWN TILL WITH GRANITE BOULDERS
6.0	12.0	MEDIUM BROWN SAND
12.0	33.0	BROWN TILL WITH STRINGERS OF SAND
33.0	57.0	GREY SILTY TILL
57.0	73.0	GREY TILL WITH GRANITE BOULDERS
73.0	81.9	MEDIUM GRAVEL
81.9	84.9	GREY CLAY

WELL CONSTRUCTION

From (ft.)	To (ft.)	Casing Type	Inside Dia.(in)	Outside Dia.(in)	Slot Size(in)	Type	Material
0	76.0	casing	4.20			INSERT	BLACK IRON
76.0	80.9	perforations	4.00		0.015	WIRE WOUND S. S.	
76.0	82.9	gravel pack				NO. 10-30	SILICA S.

Top of Casing: 2.5 ft. below ground

PUMPING TEST

Date: 1990 Dec 06
Pumping Rate: 20.0 Imp. gallons/minute
Water level before pumping: 10.0 ft. below ground
Pumping level at end of test: 14.0 ft. below ground
Test duration: 2 hours, minutes
Water temperature: ?? degrees F

E22-7-6E (3)

LOCATION: NE22-7-6E
Well_PID: 30948
Owner: C P PENNER
Driller: EMIL MANKEY & SON
Well Name:
Well Use: PRODUCTION
Water Use: Domestic

UTMX: 666733.642
UTMY: 5495134.9
Accuracy XY: UNKNOWN
UTMZ:
Accuracy Z:
Date Completed: 1977 Jun 14

WELL LOG

From (ft.)	To (ft.)	Log
0	12.0	YELLOW CLAY
12.0	84.9	SANDY GREY CLAY
84.9	88.9	SANDY BROWN CLAY
88.9	176.9	LIMESTONE

WELL CONSTRUCTION

From (ft.)	To (ft.)	Casing Type	Inside Dia.(in)	Outside Dia.(in)	Slot Size(in)	Type	Material
0	88.9	casing	4.25			INSERT	GALVANIZED
88.9	176.9	open hole	4.00				

Top of Casing: ft. below ground

PUMPING TEST
Date:
Pumping Rate: 15.0 Imp. gallons/minute
Water level before pumping: 14.0 ft. below ground
Pumping level at end of test: 28.0 ft. below ground
Test duration: hours, minutes
Water temperature: ?? degrees F

LOCATION: NE22-7-6E
Well_PID: 161898
Owner: EILEEN REIMER
Driller: Friesen Drillers Ltd.
Well Name:
Well Use: PRODUCTION
Water Use:

UTMX: 667883
UTMY: 5494794
Accuracy XY: 1 EXACT [<5M] [GPS]
UTMZ: 251
Accuracy Z: 4 FAIR - Shuttle at Centroid
Date Completed: 1900 Jan 01

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
SEINE RAT RIVER CD WELL INVENTORY 2009. NO LOG. UNKNOWN DRILL DATE.

LOCATION: SE22-7-6E
Well_PID: 69037
Owner: M REIMER
Driller: Echo Drilling Ltd.
Well Name:
Well Use: PRODUCTION
Water Use: Domestic

UTMX: 666748.169
UTMY: 5494333.97
Accuracy XY: UNKNOWN
UTMZ:
Accuracy Z:
Date Completed: 1990 Aug 02

WELL LOG

From (ft.)	To (ft.)	Log
0	18.0	CLAY
18.0	50.0	BROWN TILL
50.0	74.0	SANDY TILL GREY
74.0	79.9	HARD BLUE CLAY
79.9	85.9	BROWN TILL
85.9	206.9	LIMESTONE
206.9	217.9	RED SHALE
217.9	239.8	SANDSTONE

WELL CONSTRUCTION

From (ft.)	To (ft.)	Casing Type	Inside Dia.(in)	Outside Dia.(in)	Slot Size(in)	Type Material
0	86.9	casing	5.00			INSERT PVC
86.9	239.8	open hole	4.80			

Top of Casing: 2.0 ft. above ground

PUMPING TEST
Date: 1990 Aug 02
Pumping Rate: 50.0 Imp. gallons/minute
Water level before pumping: 15.0 ft. below ground
Pumping level at end of test: ?? ft. below ground
Test duration: hours, minutes
Water temperature: ?? degrees F

NW11-7-6E: (35)

LOCATION: NW11-7-6E
Well_PID: 147940
Owner: JOHN DYCK
Driller: Echo Drilling Ltd.
Well Name:
Well Use: PRODUCTION
Water Use: Air conditioning

UTMX: 667878
UTMY: 5491677
Accuracy XY: 1 EXACT [<5M] [GPS]
UTMZ: 257
Accuracy Z: 4 FAIR - Shuttle at Centroid
Date Completed: 2007 Mar 27

WELL LOG

From (ft.)	To (ft.)	Log
0	15.0	CLAY
15.0	50.0	TILL
50.0	75.0	CLAY
75.0	85.0	TILL
85.0	200.0	LIMESTONE

WELL CONSTRUCTION

From (ft.)	To (ft.)	Casing Type	Inside Dia.(in)	Outside Dia.(in)	Slot Size(in)	Type Material
0	88.0	CASING	5.00			INSERT PVC
88.0	200.0	OPEN HOLE	4.80			
40.0	85.0	CASING GROUT				CEMENT

Top of Casing: 2.0 ft. above ground

PUMPING TEST
Date: 2008 Mar 27
Flowing Rate: 70.0 Imp. gallons/minute
Water level before pumping: 5.0 ft. above ground
Pumping level at end of test: ?? ft. below ground
Test duration: ??? hours, ?? minutes
Water temperature: ?? degrees F
REMARKS

BOX 23 KLEEFELD

APPENDIX E – Certificates of Analysis

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

Date Received: 11-APR-13
Report Date: 26-APR-13 11:57 (MT)
Version: FINAL

Client Phone: 204-272-2020

Certificate of Analysis

Lab Work Order #: L1288422

Project P.O. #: 5513035
Job Reference: 5513035
C of C Numbers:
Legal Site Desc:

Craig Riddell
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1288422-1 STEINBACH LAGOON #1							
Sampled By: LY on 10-APR-13 @ 12:00							
Matrix: SEDIMENT (GRAB)							
Miscellaneous Parameters							
Ammonium (as N)	876		1.0	mg/kg	23-APR-13	23-APR-13	R2585628
Boron (B), Hot Water Ext.	7.60		0.20	mg/kg	18-APR-13	18-APR-13	R2581211
Available Phosphate-P	76.8		1.0	mg/kg	24-APR-13	24-APR-13	R2587190
Available Potassium	451		20	mg/kg	17-APR-13	17-APR-13	R2580860
Available Sulfate-S	923		3.0	mg/kg	17-APR-13	17-APR-13	R2580466
Mercury (Hg)	3.9		1.0	mg/kg	17-APR-13	19-APR-13	R2582374
Nitrate-N	<20		20	mg/kg	23-APR-13	23-APR-13	R2587248
Special Request	See Attached					25-APR-13	R2588808
Specific Gravity	1.00		0.010	kg/L		15-APR-13	R2578664
Total Carbon by Combustion	27.2		0.1	%	17-APR-13	17-APR-13	R2580404
Total Kjeldahl Nitrogen	0.376		0.020	%	17-APR-13	18-APR-13	R2581290
Note: Sample analyzed as received.							
Organic Matter by LOI at 375 deg C.							
Organic Matter	34.5		1.0	%	24-APR-13	25-APR-13	R2588829
Loss on Ignition @ 375 C	43.9		1.0	%	24-APR-13	25-APR-13	R2588829
Total Solids and Moisture at 70C							
Moisture	86.4		0.10	%	16-APR-13	16-APR-13	R2579888
Total Solids	13.6		0.10	%	16-APR-13	16-APR-13	R2579888
Total Solids and Total Volatile Solids							
Total Solids	14.4		0.10	%	18-APR-13	18-APR-13	R2581202
Total Volatile Solids (dry basis)	1960		0.10	%	18-APR-13	18-APR-13	R2581202
Detail Salinity in mg/kg							
Chloride (Cl)	2540	DLA	86	mg/kg		19-APR-13	
Calcium (Ca)	1100	DLA	86	mg/kg		19-APR-13	
Magnesium (Mg)	710	DLA	86	mg/kg		19-APR-13	
Potassium (K)	242	DLA	43	mg/kg		19-APR-13	
Sodium (Na)	2330	DLA	170	mg/kg		19-APR-13	
Sulfur (as SO4)	1800	DLA	210	mg/kg		19-APR-13	
Metals in Soil by CRC ICPMS							
Aluminum (Al)	11900		50	mg/kg	17-APR-13	18-APR-13	R2580951
Antimony (Sb)	2.63		0.10	mg/kg	17-APR-13	18-APR-13	R2580951
Arsenic (As)	6.03		0.10	mg/kg	17-APR-13	18-APR-13	R2580951
Barium (Ba)	1240	DLA	10	mg/kg	17-APR-13	18-APR-13	R2580951
Beryllium (Be)	<0.50		0.50	mg/kg	17-APR-13	18-APR-13	R2580951
Bismuth (Bi)	29.1		1.0	mg/kg	17-APR-13	18-APR-13	R2580951
Cadmium (Cd)	2.42		0.10	mg/kg	17-APR-13	18-APR-13	R2580951
Calcium (Ca)	45000		100	mg/kg	17-APR-13	18-APR-13	R2580951
Chromium (Cr)	36.3		0.50	mg/kg	17-APR-13	18-APR-13	R2580951
Cobalt (Co)	4.8		1.0	mg/kg	17-APR-13	18-APR-13	R2580951
Copper (Cu)	1350	DLA	10	mg/kg	17-APR-13	18-APR-13	R2580951
Iron (Fe)	18100		50	mg/kg	17-APR-13	18-APR-13	R2580951
Lead (Pb)	52.8		1.0	mg/kg	17-APR-13	18-APR-13	R2580951
Lithium (Li)	6.6		2.0	mg/kg	17-APR-13	18-APR-13	R2580951
Magnesium (Mg)	16000		100	mg/kg	17-APR-13	18-APR-13	R2580951
Manganese (Mn)	158		1.0	mg/kg	17-APR-13	18-APR-13	R2580951
Molybdenum (Mo)	51.9		1.0	mg/kg	17-APR-13	18-APR-13	R2580951
Nickel (Ni)	19.7		1.0	mg/kg	17-APR-13	18-APR-13	R2580951
Phosphorus (P)	11000		50	mg/kg	17-APR-13	18-APR-13	R2580951
Potassium (K)	1060		100	mg/kg	17-APR-13	18-APR-13	R2580951
Selenium (Se)	6.98		0.20	mg/kg	17-APR-13	18-APR-13	R2580951
Silver (Ag)	31.3		0.20	mg/kg	17-APR-13	18-APR-13	R2580951

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1288422-1 STEINBACH LAGOON #1							
Sampled By: LY on 10-APR-13 @ 12:00							
Matrix: SEDIMENT (GRAB)							
Metals in Soil by CRC ICPMS							
Sodium (Na)	2200		100	mg/kg	17-APR-13	18-APR-13	R2580951
Strontium (Sr)	208		1.0	mg/kg	17-APR-13	18-APR-13	R2580951
Thallium (Tl)	0.18		0.10	mg/kg	17-APR-13	18-APR-13	R2580951
Tin (Sn)	25.9		2.0	mg/kg	17-APR-13	18-APR-13	R2580951
Titanium (Ti)	28.3		5.0	mg/kg	17-APR-13	18-APR-13	R2580951
Uranium (U)	16.9		0.10	mg/kg	17-APR-13	18-APR-13	R2580951
Vanadium (V)	17.4		1.0	mg/kg	17-APR-13	18-APR-13	R2580951
Zinc (Zn)	913	DLA	50	mg/kg	17-APR-13	18-APR-13	R2580951
Detailed Salinity							
Chloride (Cl) (Saturated Paste)							
Chloride (Cl)	297	DLA	10	mg/L	19-APR-13	19-APR-13	R2582075
SAR, Cations and SO4 in saturated soil							
Calcium (Ca)	128	DLA	10	mg/L	19-APR-13	19-APR-13	R2582232
Potassium (K)	28.3	DLA	5.0	mg/L	19-APR-13	19-APR-13	R2582232
Magnesium (Mg)	83	DLA	10	mg/L	19-APR-13	19-APR-13	R2582232
Sodium (Na)	272	DLA	20	mg/L	19-APR-13	19-APR-13	R2582232
SAR	4.60		0.10	SAR	19-APR-13	19-APR-13	R2582232
Sulfur (as SO4)	210	DLA	25	mg/L	19-APR-13	19-APR-13	R2582232
pH and EC (Saturated Paste)							
% Saturation	856		1.0	%	18-APR-13	19-APR-13	R2581771
pH in Saturated Paste	6.87		0.10	pH	18-APR-13	19-APR-13	R2581771
Conductivity Sat. Paste	3.02		0.10	dS m-1	18-APR-13	19-APR-13	R2581771

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

Reference Information

Sample Parameter Qualifier Key:

Qualifier	Description
DLA	Detection Limit Adjusted For required dilution

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
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-SAR-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.			
HG-200.2-CVAF-SK	Soil	Mercury on Soil by CVAFS	EPA 200.2/EPA 245.7
A representative portion of dry < 2mm soil is digested with concentrated nitric and hydrochloric acids for 2 hours in an open vessel digestor at 95 degrees. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometer.			
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-CCMS-SK	Soil	Metals in Soil by CRC ICPMS	EPA 200.2/6020A
This analysis is carried out using procedures from CSR Analytical Method: "Strong Acid Leachable Metals (SALM) in Soil", BC Ministry of Environment, 26 June 2009, and procedures adapted from EPA Method 200.2. The sample is dried at 40 C, then ground to < 2 mm particle size using a stainless steel flail grinder. A representative portion is digested with concentrated nitric and hydrochloric acids for 2 hours in an open vessel digestor at 95 degrees. Instrumental analysis of the digested extract is by collision cell inductively coupled plasma - mass spectrometry (modifed from EPA Method 6020A).			
MOIST-70-SK	Biocompost	Total Solids and Moisture at 70C	TMECC 3.09-A
MOIST-DRY-70-SK	Biocompost	Moisture at 70C from air dry	TMECC 3.09-A
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.			
NH4-1:5-SK	Biocompost	Ammonia-N (1:5) - calc to 70C	TMECC 4.02-C
NO3-1:5-KCL-SK	Biocompost	Nitrate-N in biocompost - calc to 70C	TMECC 4.02-B
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.			
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.			
SO4-AVAIL-SK	Soil	Available Sulfate-S	REC METH SOIL ANAL - AB. AG(1988)
Plant available sulfur in the soil is extracted with a weak calcium chloride solution. Total S in the extract is then 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,			

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
while the weight lost on ignition represents the Total Volatile Solids.			
SPECGRAV-ED	Soil	Specific Gravity	-
SPECIAL REQUEST-SK	Misc.	Special Request Sask Lab	SEE SUBLET LAB RESULTS

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

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

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

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

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

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

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 R2581211								
WG1655109-2 IRM		**SAL814**						
Boron (B), Hot Water Ext.			92.2		%		70-130	18-APR-13
WG1655109-1 MB								
Boron (B), Hot Water Ext.			<0.20		mg/kg		0.2	18-APR-13
C-TOT-LECO-SK	**Soil**							
Batch R2580404								
WG1655747-7 DUP		**L1288422-1**						
Total Carbon by Combustion		27.2	26.5		%	2.4	20	17-APR-13
WG1655747-8 IRM		**08-109_SOIL**						
Total Carbon by Combustion			102.5		%		80-120	17-APR-13
WG1655747-9 MB								
Total Carbon by Combustion			<0.1		%		0.1	17-APR-13
CL-SAR-SK	**Soil**							
Batch R2582075								
WG1656590-2 IRM		**ED-SAL_NAT1**						
Chloride (Cl)			91.9		%		70-130	19-APR-13
WG1656590-1 MB								
Chloride (Cl)			<2.0		mg/L		2	19-APR-13
HG-200.2-CVAF-SK	**Soil**							
Batch R2582374								
WG1655192-4 CRM		**TILL-1**						
Mercury (Hg)			100.8		%		70-130	19-APR-13
WG1655192-2 DUP		**L1288422-1**						
Mercury (Hg)		3.9	3.9		mg/kg	0.4	40	19-APR-13
WG1655192-1 MB								
Mercury (Hg)			<0.0050		mg/kg		0.005	19-APR-13
K-AVAIL-SK	**Soil**							
Batch R2580860								
WG1655110-2 IRM		**FARM2005**						
Available Potassium			93.2		%		70-130	17-APR-13
WG1655110-1 MB								
Available Potassium			<20		mg/kg		20	17-APR-13
MET-200.2-CCMS-SK	**Soil**							
Batch R2580951								
WG1655192-3 CRM		**PACS-2**						
Aluminum (Al)			90.9		%		70-130	18-APR-13
Antimony (Sb)			83.1		%		70-130	18-APR-13

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-SK	**Soil**							
Batch R2580951								
WG1655192-3 CRM		**PACS-2**						
Arsenic (As)			104.9		%		70-130	18-APR-13
Barium (Ba)			88.3		%		70-130	18-APR-13
Beryllium (Be)			85.7		%		50-150	18-APR-13
Bismuth (Bi)			78.4		%		50-150	18-APR-13
Cadmium (Cd)			106.0		%		70-130	18-APR-13
Calcium (Ca)			95.5		%		70-130	18-APR-13
Chromium (Cr)			98.3		%		70-130	18-APR-13
Cobalt (Co)			94.9		%		70-130	18-APR-13
Copper (Cu)			93.5		%		70-130	18-APR-13
Iron (Fe)			94.3		%		70-130	18-APR-13
Lead (Pb)			81.1		%		70-130	18-APR-13
Lithium (Li)			106.5		%		70-130	18-APR-13
Magnesium (Mg)			90.1		%		70-130	18-APR-13
Manganese (Mn)			94.3		%		70-130	18-APR-13
Molybdenum (Mo)			96.1		%		70-130	18-APR-13
Nickel (Ni)			94.8		%		70-130	18-APR-13
Phosphorus (P)			102.5		%		70-130	18-APR-13
Potassium (K)			86.8		%		70-130	18-APR-13
Selenium (Se)			98.2		%		70-130	18-APR-13
Silver (Ag)			81.5		%		70-130	18-APR-13
Sodium (Na)			93.8		%		70-130	18-APR-13
Strontium (Sr)			91.0		%		70-130	18-APR-13
Thallium (Tl)			81.2		%		50-150	18-APR-13
Tin (Sn)			88.4		%		70-130	18-APR-13
Titanium (Ti)			90.5		%		70-130	18-APR-13
Uranium (U)			75.7		%		70-130	18-APR-13
Vanadium (V)			97.3		%		70-130	18-APR-13
Zinc (Zn)			96.2		%		70-130	18-APR-13
WG1655192-4 CRM		**TILL-1**						
Aluminum (Al)			93.0		%		70-130	18-APR-13
Antimony (Sb)			105.2		%		70-130	18-APR-13
Arsenic (As)			106.4		%		70-130	18-APR-13
Barium (Ba)			106.7		%		70-130	18-APR-13
Beryllium (Be)			98.9		%		50-150	18-APR-13

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-SK	**Soil**							
Batch R2580951								
WG1655192-4 CRM		**TILL-1**						
Bismuth (Bi)			95.9		%		70-130	18-APR-13
Cadmium (Cd)			84.7		%		50-150	18-APR-13
Calcium (Ca)			100.2		%		70-130	18-APR-13
Chromium (Cr)			103.4		%		70-130	18-APR-13
Cobalt (Co)			99.6		%		70-130	18-APR-13
Copper (Cu)			96.9		%		70-130	18-APR-13
Iron (Fe)			91.6		%		70-130	18-APR-13
Lead (Pb)			92.4		%		70-130	18-APR-13
Lithium (Li)			100.3		%		70-130	18-APR-13
Magnesium (Mg)			95.9		%		70-130	18-APR-13
Manganese (Mn)			97.0		%		70-130	18-APR-13
Molybdenum (Mo)			105.0		%		70-130	18-APR-13
Nickel (Ni)			102.4		%		70-130	18-APR-13
Phosphorus (P)			107.1		%		70-130	18-APR-13
Potassium (K)			89.8		%		70-130	18-APR-13
Selenium (Se)			100.0		%		70-130	18-APR-13
Silver (Ag)			109.7		%		70-130	18-APR-13
Sodium (Na)			100.6		%		50-150	18-APR-13
Strontium (Sr)			111.9		%		70-130	18-APR-13
Thallium (Tl)			96.0		%		70-130	18-APR-13
Tin (Sn)			92.1		%		70-130	18-APR-13
Titanium (Ti)			90.7		%		70-130	18-APR-13
Uranium (U)			105.0		%		70-130	18-APR-13
Vanadium (V)			101.8		%		70-130	18-APR-13
Zinc (Zn)			95.2		%		70-130	18-APR-13
WG1655192-2 DUP		**L1288422-1**						
Aluminum (Al)		11900	13600		mg/kg	13	30	18-APR-13
Antimony (Sb)		2.63	2.86		mg/kg	8.3	30	18-APR-13
Arsenic (As)		6.03	6.65		mg/kg	9.9	30	18-APR-13
Barium (Ba)		1240	1250		mg/kg	0.9	30	18-APR-13
Beryllium (Be)		<0.50	<0.50	RPD-NA	mg/kg	N/A	30	18-APR-13
Bismuth (Bi)		29.1	32.0		mg/kg	9.5	30	18-APR-13
Cadmium (Cd)		2.42	2.82		mg/kg	15	30	18-APR-13
Calcium (Ca)		45000	45400		mg/kg	0.7	30	18-APR-13

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-SK	**Soil**							
Batch R2580951								
WG1655192-2 DUP		**L1288422-1**						
Chromium (Cr)		36.3	39.6		mg/kg	8.6	30	18-APR-13
Cobalt (Co)		4.8	5.1		mg/kg	6.5	30	18-APR-13
Copper (Cu)		1350	1390		mg/kg	3.4	30	18-APR-13
Iron (Fe)		18100	19900		mg/kg	9.5	30	18-APR-13
Lead (Pb)		52.8	56.8		mg/kg	7.2	40	18-APR-13
Lithium (Li)		6.6	7.8		mg/kg	17	30	18-APR-13
Magnesium (Mg)		16000	17700		mg/kg	10	30	18-APR-13
Manganese (Mn)		158	177		mg/kg	11	30	18-APR-13
Molybdenum (Mo)		51.9	59.8		mg/kg	14	30	18-APR-13
Nickel (Ni)		19.7	21.4		mg/kg	8.4	30	18-APR-13
Phosphorus (P)		11000	12400		mg/kg	11	30	18-APR-13
Potassium (K)		1060	1200		mg/kg	12	30	18-APR-13
Selenium (Se)		6.98	6.89		mg/kg	1.4	30	18-APR-13
Silver (Ag)		31.3	38.3		mg/kg	20	30	18-APR-13
Sodium (Na)		2200	2280		mg/kg	3.7	30	18-APR-13
Strontium (Sr)		208	239		mg/kg	14	30	18-APR-13
Thallium (Tl)		0.18	0.18		mg/kg	2.7	30	18-APR-13
Tin (Sn)		25.9	30.6		mg/kg	17	30	18-APR-13
Titanium (Ti)		28.3	34.0		mg/kg	18	30	18-APR-13
Uranium (U)		16.9	18.2		mg/kg	7.4	30	18-APR-13
Vanadium (V)		17.4	19.1		mg/kg	9.1	30	18-APR-13
Zinc (Zn)		913	945		mg/kg	3.4	30	18-APR-13
WG1655192-1 MB								
Aluminum (Al)			<50		mg/kg		50	18-APR-13
Antimony (Sb)			<0.10		mg/kg		0.1	18-APR-13
Arsenic (As)			<0.10		mg/kg		0.1	18-APR-13
Barium (Ba)			<1.0		mg/kg		1	18-APR-13
Beryllium (Be)			<0.50		mg/kg		0.5	18-APR-13
Bismuth (Bi)			<1.0		mg/kg		1	18-APR-13
Cadmium (Cd)			<0.10		mg/kg		0.1	18-APR-13
Calcium (Ca)			<100		mg/kg		100	18-APR-13
Chromium (Cr)			<0.50		mg/kg		0.5	18-APR-13
Cobalt (Co)			<1.0		mg/kg		1	18-APR-13
Copper (Cu)			<1.0		mg/kg		1	18-APR-13

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-SK	**Soil**							
Batch R2580951								
WG1655192-1 MB								
Iron (Fe)			<50		mg/kg		50	18-APR-13
Lead (Pb)			<1.0		mg/kg		1	18-APR-13
Lithium (Li)			<2.0		mg/kg		2	18-APR-13
Magnesium (Mg)			<100		mg/kg		100	18-APR-13
Manganese (Mn)			<1.0		mg/kg		1	18-APR-13
Molybdenum (Mo)			<1.0		mg/kg		1	18-APR-13
Nickel (Ni)			<1.0		mg/kg		1	18-APR-13
Phosphorus (P)			<50		mg/kg		50	18-APR-13
Potassium (K)			<100		mg/kg		100	18-APR-13
Selenium (Se)			<0.20		mg/kg		0.2	18-APR-13
Silver (Ag)			<0.20		mg/kg		0.2	18-APR-13
Sodium (Na)			<100		mg/kg		100	18-APR-13
Strontium (Sr)			<1.0		mg/kg		1	18-APR-13
Thallium (Tl)			<0.10		mg/kg		0.1	18-APR-13
Tin (Sn)			<2.0		mg/kg		2	18-APR-13
Titanium (Ti)			<5.0		mg/kg		5	18-APR-13
Uranium (U)			<0.10		mg/kg		0.1	18-APR-13
Vanadium (V)			<1.0		mg/kg		1	18-APR-13
Zinc (Zn)			<5.0		mg/kg		5	18-APR-13
N-TOTKJ-COL-SK	**Soil**							
Batch R2581290								
WG1656247-1 DUP		**L1288422-1**						
Total Kjeldahl Nitrogen		0.376	0.337		%	11	20	18-APR-13
WG1656247-2 IRM		**07-114_SOIL**						
Total Kjeldahl Nitrogen			94.6		%		70-130	18-APR-13
WG1656247-3 MB								
Total Kjeldahl Nitrogen			<0.020		%		0.02	18-APR-13
WG1656247-4 RB								
Total Kjeldahl Nitrogen			<0.020		%			18-APR-13
OM-LOI-SK	**Soil**							
Batch R2588829								
WG1660452-1 DUP		**L1288422-1**						
Organic Matter		34.5	34.1		%	1.2	20	25-APR-13
Loss on Ignition @ 375 C		43.9	43.4		%	1.2	25	25-APR-13
WG1660452-3 IRM		**FARM2009**						

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
OM-LOI-SK	**Soil**							
Batch R2588829								
WG1660452-3 IRM		**FARM2009**						
Organic Matter			4.3		%		3-5	25-APR-13
Loss on Ignition @ 375 C			5.1		%		4.2-6.2	25-APR-13
WG1660452-2 MB								
Organic Matter			<1.0		%		1	25-APR-13
Loss on Ignition @ 375 C			<1.0		%		1	25-APR-13
PO4-AVAIL-OLSEN-SK	**Soil**							
Batch R2587190								
WG1655117-2 IRM		**FARM2005**						
Available Phosphate-P			97.1		%		70-130	24-APR-13
WG1655117-1 MB								
Available Phosphate-P			<1.0		mg/kg		1	24-APR-13
SAR-CALC-SO4-SK	**Soil**							
Batch R2582232								
WG1656590-2 IRM		**ED-SAL_NAT1**						
Calcium (Ca)			119.9		%		70-130	19-APR-13
Potassium (K)			124.8		%		70-130	19-APR-13
Magnesium (Mg)			114.3		%		70-130	19-APR-13
Sodium (Na)			119.6		%		70-130	19-APR-13
Sulfur (as SO4)			112.0		%		70-130	19-APR-13
WG1656590-1 MB								
Calcium (Ca)			<2.0		mg/L		2	19-APR-13
Potassium (K)			<1.0		mg/L		1	19-APR-13
Magnesium (Mg)			<2.0		mg/L		2	19-APR-13
Sodium (Na)			<4.0		mg/L		4	19-APR-13
Sulfur (as SO4)			<5.0		mg/L		5	19-APR-13
SAT/PH/EC-SK	**Soil**							
Batch R2581771								
WG1656590-2 IRM		**ED-SAL_NAT1**						
% Saturation			38.0		%		38-48	19-APR-13
pH in Saturated Paste			6.83		pH		6.5-7.1	19-APR-13
Conductivity Sat. Paste			103.5		%		80-120	19-APR-13
WG1656590-1 MB								
Conductivity Sat. Paste			<0.10		dS m-1		0.1	19-APR-13
SO4-AVAIL-SK	**Soil**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
SO4-AVAIL-SK	**Soil**							
Batch R2580466								
WG1655115-2 IRM		**SAL814**						
Available Sulfate-S			110.6		%		70-130	17-APR-13
WG1655115-1 MB								
Available Sulfate-S			<3.0		mg/kg		3	17-APR-13
SPECGRAV-ED	**Soil**							
Batch R2578664								
WG1655042-2 DUP		**L1288422-1**						
Specific Gravity		1.00	1.00		kg/L	0.1	13	15-APR-13
WG1655042-1 IRM		**DI_H2O**						
Specific Gravity			99.0		%		94.7-104.7	15-APR-13
SOLIDS-TOT/TOTVOL-SK	**Manure**							
Batch R2581202								
WG1655758-1 DUP		**L1288422-1**						
Total Solids		14.4	13.5		%	6.6	25	18-APR-13
Total Volatile Solids (dry basis)		1960	1720		%	13	25	18-APR-13

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
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Quality Control Report

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Plant Available Nutrients							
Ammonia-N (1:5) - calc to 70C							
	1	10-APR-13 12:00	23-APR-13 14:01	7	13	days	EHT
Nitrate-N in biocompost - calc to 70C							
	1	10-APR-13 12:00	23-APR-13 15:20	7	13	days	EHT
Leachable Metals							
Available Boron, Hot Water							
	1	10-APR-13 12:00	18-APR-13	5	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 L1288422 were received on 11-APR-13 08:35.

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.

STEINBACH LAGOON #1 L1288422-1

PRODUCT CODE	ANALYTE	RESULT (Dry)	RESULT (Wet)	QUALIFIER	UNITS	DL
SAR, Cations and SO4 in saturated soil	SAR	4.60			SAR	0.1
pH and EC (Saturated Paste)	% Saturation	856			%	1
pH and EC (Saturated Paste)	pH in Saturated Paste	6.87			pH	0.1
pH and EC (Saturated Paste)	Conductivity Sat. Paste	3.02			dS m-1	0.1
Detail Salinity in mg/kg	Chloride (Cl)	2540	345	DLA	mg/kg	86
Detail Salinity in mg/kg	Calcium (Ca)	1100	150	DLA	mg/kg	86
Detail Salinity in mg/kg	Magnesium (Mg)	710	96.6	DLA	mg/kg	86
Detail Salinity in mg/kg	Potassium (K)	242	32.9	DLA	mg/kg	43
Detail Salinity in mg/kg	Sodium (Na)	2330	317	DLA	mg/kg	170
Detail Salinity in mg/kg	Sulfur (as SO4)	1800	245	DLA	mg/kg	210
Available Boron, Hot Water	Boron (B), Hot Water Ext.	7.60	1.0		mg/kg	0.2
Available Phosphate-P by Olsen	Available Phosphate-P	76.8	10.4		mg/kg	1
Available Potassium	Available Potassium	451	61.3		mg/kg	20
Available Sulfate-S	Available Sulfate-S	923	126		mg/kg	3
Mercury on Soil by CVAFS	Mercury (Hg)	3.9	0.5		mg/kg	1
Metals in Soil by CRC ICPMS	Aluminum (Al)	11900	1618		mg/kg	50
Metals in Soil by CRC ICPMS	Antimony (Sb)	2.63	0.4		mg/kg	0.1
Metals in Soil by CRC ICPMS	Arsenic (As)	6.03	0.8		mg/kg	0.1
Metals in Soil by CRC ICPMS	Barium (Ba)	1240	168.6	DLA	mg/kg	10
Metals in Soil by CRC ICPMS	Beryllium (Be)	<0.50	<0.1		mg/kg	0.5
Metals in Soil by CRC ICPMS	Bismuth (Bi)	29.1	4.0		mg/kg	1
Metals in Soil by CRC ICPMS	Cadmium (Cd)	2.42	0.3		mg/kg	0.1
Metals in Soil by CRC ICPMS	Calcium (Ca)	45000	6120		mg/kg	100
Metals in Soil by CRC ICPMS	Chromium (Cr)	36.3	4.9		mg/kg	0.5
Metals in Soil by CRC ICPMS	Cobalt (Co)	4.8	0.7		mg/kg	1
Metals in Soil by CRC ICPMS	Copper (Cu)	1350	184	DLA	mg/kg	10
Metals in Soil by CRC ICPMS	Iron (Fe)	18100	2462		mg/kg	50
Metals in Soil by CRC ICPMS	Lead (Pb)	52.8	7.2		mg/kg	1
Metals in Soil by CRC ICPMS	Lithium (Li)	6.6	0.9		mg/kg	2
Metals in Soil by CRC ICPMS	Magnesium (Mg)	16000	2176		mg/kg	100
Metals in Soil by CRC ICPMS	Manganese (Mn)	158	21.5		mg/kg	1
Metals in Soil by CRC ICPMS	Molybdenum (Mo)	51.9	7.1		mg/kg	1
Metals in Soil by CRC ICPMS	Nickel (Ni)	19.7	2.7		mg/kg	1
Metals in Soil by CRC ICPMS	Phosphorus (P)	11000	1496		mg/kg	50
Metals in Soil by CRC ICPMS	Potassium (K)	1060	144		mg/kg	100
Metals in Soil by CRC ICPMS	Selenium (Se)	6.98	0.9		mg/kg	0.2

Metals in Soil by CRC ICPMS	Silver (Ag)	31.3	4.3		mg/kg	0.2
Metals in Soil by CRC ICPMS	Sodium (Na)	2200	299		mg/kg	100
Metals in Soil by CRC ICPMS	Strontium (Sr)	208	28.3		mg/kg	1
Metals in Soil by CRC ICPMS	Thallium (Tl)	0.18	0.0		mg/kg	0.1
Metals in Soil by CRC ICPMS	Tin (Sn)	25.9	3.5		mg/kg	2
Metals in Soil by CRC ICPMS	Titanium (Ti)	28.3	3.8		mg/kg	5
Metals in Soil by CRC ICPMS	Uranium (U)	16.9	2.3		mg/kg	0.1
Metals in Soil by CRC ICPMS	Vanadium (V)	17.4	2.4		mg/kg	1
Metals in Soil by CRC ICPMS	Zinc (Zn)	913	124	DLA	mg/kg	50
Total Carbon by combustion method	Total Carbon by Combustion	27.2	3.7		%	0.1
Total Kjeldahl Nitrogen	Total Kjeldahl Nitrogen	2.76	0.376		%	0.02
Nitrate-N in biocompost - calc to 70C	Nitrate-N	<20	<3		mg/kg	20
Ammonia-N (1:5) - calc to 70C	Ammonium (as N)	876	119		mg/kg	1
Total Solids and Moisture at 70C	Moisture	86.4			%	0.1
Total Solids and Moisture at 70C	Total Solids	13.6			%	0.1
Total Solids and Total Volatile Solids	Total Solids	14.4			%	0.1
Total Solids and Total Volatile Solids	Total Volatile Solids (dry basis)	1960			%	0.1
Specific Gravity	Specific Gravity	1.00			kg/L	0.01

ALS Environment

L1288422-COFC

Custody / Analytical Request Form
ada Toll Free: 1 800 668 9878
www.alsglobal.com

L1288422

COC # _____

Page 1 of 2

Report To				t / Distribution				Service Requested (Rush for routine analysis subject to availability)
Company:	MMM Group Limited			☑ Standard	☐ Other			◉ Regular (Standard Turnaround Times - Business Days)
Contact:	Darren Keam			☑ PDF	☑ Excel	☐ Digital	☐ Fax	○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
Address:	111-93 Lombard Avenue			Email 1:	kearnd@mmm.ca			○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
	Winnipeg, MB R3B 3B1			Email 2:	YestrauL@mmm.ca			○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT
Phone:	204-923-3178	Fax:	204-943-4948	Email 3:				
Invoice To	Same as Report ?	☑ Yes	☐ No	Client / Project Information				Analysis Request
Hardcopy of Invoice with Report?		☐ Yes	☑ No	Job #:	5513035			Please indicate below Filtered, Preserved or both (F, P, F/P)
Company:				PO / AFE:	5513035			
Contact:				LSD:				
Address:								
Phone:		Fax:		Quote #:	Q37455			
[redacted] Lab Work Order # (lab use only)				ALS Contact:		Sampler:	LY	

[redacted] Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Total Kjeldahl Nitrogen	Nitrate-N	Nitrite-N	Available Ammonium-N	total available nitrogen	total phosphorous	phosphate-p by olsen	total solids, total volatile solid	moisture	total carbon	available potassium	available sulfate-s	Number of Containers
[redacted]	Steinbach Lagoon #1	April 10/13	12:00pm	Grab	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	5
[redacted]																	
[redacted]																	
[redacted]																	
[redacted]																	
[redacted]																	
[redacted]																	
[redacted]																	
[redacted]																	
[redacted]																	
[redacted]																	
[redacted]																	

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

* Lagoon biosolids.

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 provided on a separate Excel tab.
Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

[redacted] SHIPMENT RELEASE (client use)			[redacted] SHIPMENT RECEPTION (lab use only)				[redacted] SHIPMENT VERIFICATION (lab use only)			
Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
S Keam	11/04/13	830am	SA	Apr 11/13	8:35AM	1.1 °C				

GENF 18.01 Front

ALS Environment

L1288422-COFC

Custody / Analytical Request Form
ada Toll Free: 1 800 668 9878
www.alsglobal.com

COC # _____

Page 2 of 2

Report To				/ Distribution				Service Requested (Rush for routine analysis subject to availability)
Company:	MMM Group Limited			☐ Other				◉ Regular (Standard Turnaround Times - Business Days)
Contact:	Darren Keam			☑ PDF	☑ Excel	☐ Digital	☐ Fax	○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
Address:	111-93 Lombard Avenue			Email 1:	keamd@mmm.ca			○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
	Winnipeg, MB R3B 3B1			Email 2:	YestrauL@mmm.ca			○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT
Phone:	204-923-3178	Fax:	204-943-4948	Email 3:				
Invoice To	Same as Report ?	☑ Yes	☐ No	Client / Project Information				Analysis Request
Hardcopy of Invoice with Report?		☐ Yes	☑ No	Job #:	5513035			Please indicate below Filtered, Preserved or both (F, P, F/P)
Company:				PO / AFE:	5513035			
Contact:				LSD:				
Address:								
Phone:		Fax:		Quote #:	Q37455			
[redacted] Lab Work Order # (lab use only)		[redacted]		ALS Contact:		Sampler:	LY	

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Boron-hotwater	mercury	CCME Metals	Detailed Salinity	pH	Special Request 1	Density?						Number of Containers
[redacted]	Steinbach lagoon #1	10/04/13	12pm.	Grab	✓	✓	✓	✓	✓	✓	✓						5
[redacted]																	
[redacted]																	
[redacted]																	
[redacted]																	
[redacted]																	
[redacted]																	
[redacted]																	
[redacted]																	
[redacted]																	
[redacted]																	
[redacted]																	

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

lagoon biosolids.

Special Request 1 -SK-Analyze samples on As Received Basis. Report dry basis and as received results. Density - if possible?

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 provided on a separate Excel tab.

Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

[redacted] SHIPMENT RELEASE (client use) [redacted]			[redacted] SHIPMENT RECEPTION (lab use only) [redacted]				[redacted] SHIPMENT VERIFICATION (lab use only) [redacted]			
Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
Dkeam.	10/04/13	830am.	SA	Apr 11/13	8:35AM	1.1 °C				

GENF 18.01 Front

APPENDIX F – 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 to the amount of its fee received for the Work, provided that notice of claim is made within one year of the date of delivery of the Report.