November 2016

Lake St. Martin Outlet Channel Proposed All Season Access Road - Summary of the Existing Environment - Final Report

Submitted to:

Manitoba Infrastructure, Water Management and Structures
600 - 215 Garry Street, Winnipeg MB R3C 3P3

Prepared by:

M. Forster Enterprises

AAE Tech Services Inc.

Ecologic Environmental Inc.

SG Environmental Services Inc.

Northern Lights Heritage Services Inc.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PHOTOS

LIST OF APPENDICES

ABBREVIATIONS	
%	Percent
≤	Less Than or Equal To
°C	Degrees Celsius
AC	Alternating Current
AQHI	Air Quality Health Index
ASI	Areas of Special Interest
ATK	Aboriginal Traditional Knowledge
CH_4	Methane
CIZ	Community Interest Zone
CO	Carbon Monoxide
CO_2	Carbon Dioxide
COSEWIC	Committee On the Status of Endangered Wildlife In Canada
CPUE	Catch Per Unit Effort
CRA	Commercial, Recreational or Aboriginal (Fisheries)
dB	Decibel
dBA	A-Weighted Decibel
DO	Dissolved Oxygen
FMU	Forest Management Unit
FN	First Nation
FRI	Forest Resource Inventory
GHA	Game Hunting Area
GHG	Greenhouse Gas
ha	Hectare
IR	Indian Reserve
IWSA	Integrated Wood Supply Area
km	Kilometre
km/hr	Kilometres Per Hour
km^2	Square Kilometre
kV	Kilovolt
LCA	Life Cycle Analysis
LCC	Land Cover Classification
LSA	Local Study Area
m	Metre
m/s	Metres Per Second

ABBREVIATIONS	
masl	Metres Above Sea Level
MBCDC	Manitoba Conservation Data Centre
MESEA	Manitoba *Endangered Species and Ecosystems Act*
MI	Manitoba Infrastructure
mm	Millimetre
NO	Nitric Oxide
NO_2	Nitrogen Dioxide
NO_2	Nitrous Oxide
NO_x	Nitrogen Oxides
NTU	Nephelometric Turbidity Unit
NWA	Noxious Weed Act
O_3	Ozone
PM_{10}	Particulate Matter ≤ 10 Microns
$PM_{2.5}$	Particulate Matter ≤ 2.5 Microns
PR	Provincial Road
PSL	Permissible Sound Levels
PTH	Provincial Trunk Highway
RHA	Regional Health Authority
RM	Rural Municipality
RoW	Right of Way
RSA	Regional Study Area
RTL	Registered Trap Line
SARA	Species At Risk Act
SH_6	Sulphur Hexafluoride
SO_2	Sulphur Dioxide
US	United States
VOCs	Volatile Organic Compounds
WMAs	Wildlife Management Areas

1 INTRODUCTION

Manitoba Infrastructure (MI) is currently developing options to address ongoing flood issues in the Assiniboine River and Lake Manitoba watershed basins. As part of this endeavour, MI initiated the *Assiniboine River & Lake Manitoba Basins Flood Mitigation Study*. This study, which was completed in 2011, included several components. In particular, the "*Assiniboine River & Lake Manitoba Basins Flood Mitigation Study Lake Manitoba & Lake St. Martin Outlet Channels Conceptual Design - Stage 1 - Deliverable No: LMB-01*" (KGS Group 2014) and the "*Assiniboine River & Lake Manitoba Basins - Flood Mitigation Study LMB & LSM Outlet Channels Conceptual Design - Stage 2*" (KGS Group 2016) were key to identifying future flood protection initiatives for the Assiniboine River and Lake Manitoba watershed basins.

The Stage 1 and Stage 2 Conceptual Designs prepared by KGS and MI included the three following components:

- further development of the Lake St. Martin Outlet Channel (LSMOC), which involves development of a channel in the area referred to as Reach 2 and completion of the channel referred to as Reach 3;
- construction and operation of a new channel from Lake Manitoba (LM) to Lake St. Martin (LSM) to increase flow capacity and expedite movement of flood waters between these waterbodies; and
- construction and operation of an All Season Road (ASR) in the area of the Lake St. Martin Outlet Channels to facilitate year-round vehicle, crew and equipment access to the Lake St. Martin Outlet Channels.

These three main components formed the overall MI Lake Manitoba and Lake St. Martin Access Road and Outlet Channels Project (the Project) at the time of this writing.

MI later engaged M. Forster Enterprises (MFE) and a team of professional consultants to conduct desktop and field investigations at varying spatial scales near the Project to provide information on the existing environmental conditions for each of the three Project components listed above. The intent of these investigations was to describe the baseline conditions in vicinity of the Project to support a future Environmental Impact Assessment (EIA). While the overall Project will require approval and licensing under the federal *Canadian Environmental Assessment Act* (CEAA) and the Manitoba *Environment Act*, the realignment and construction of an ASR for construction access will require regulatory approval and licensing from the Province of Manitoba.

This report provides a summary of the existing environmental conditions for the ASR component of the Project, as identified through desktop, field studies and associated analysis, to provide the required baseline data for the environmental assessment and support the preparation of the provincial Environmental Impact Statement (EIS) for the ASR component of the Project.

2 BACKGROUND

As noted above, further development of a Lake St. Martin Outlet Channel (LSMOC) includes the requirement for an ASR in the area of the LSMOC to facilitate year-round vehicle, crew and equipment access. During previous construction and operation of the LSMOC, access to the area was restricted to winter roads extending from the end of Idylwild Road. The Idylwild road is an existing forestry road that runs north from Birch Lake Drive, which is a municipal road located east of the communities of Grahamdale and Spearhill and connects to Dewald Road. In an effort to improve area access, MI plans to construct an ASR on the existing municipal, resource and winter road alignments. The provision of an ASR to access the LSMOC will also require the upgrading and expansion of sections of the municipal road and the Idylwild forestry road. As such, the ASR component of the Project (ASR Project) was defined as the works associated with the upgrading, construction and operation of the affected areas of the municipal road, the Idylwild forestry road, the LSMOC Reach 3 Winter Road Access and the LSMOC Reach 1 proposed ASR Alignment, to an ASR. Figure 1 provides a map of the proposed ASR Project study area. Information on the boundaries selected for the Project area is provided below in Section 4.

3 ABORIGINAL TRADITIONAL KNOWLEDGE

It is recognized that there are many plant species, wildlife species, fish species and areas of cultural significance to many First Nations peoples, and that these plants, wildlife, fish and areas of significance will vary by the practices of each First Nation, and their gathering locations. It is recognized that First Nations people have a special relationship with the earth and all living things in it. This relationship is based on a profound spiritual connection to the environment that guided indigenous peoples to practice reverence, humility and reciprocity. First Nations people have relied on many species of plants, wildlife and fish for subsistence needs and cultural values that extend back thousands of years. In regard to the collection and use of Aboriginal Traditional Knowledge (ATK) for the baseline investigations, MI and First Nations consultations were ongoing at the time of this writing, and ATK for plants, wildlife, fish and areas of cultural significance in the Project Study Area had yet to be compiled.

4 PROJECT SCOPE

As noted above, the proposed ASR Project is defined as the works associated with the upgrading, construction and operation of the affected areas of the municipal road, the Idylwild forestry road, the LSMOC Reach 3 Winter Road Access and the LSMOC Reach 1 proposed ASR Alignment, to an ASR. These works include, but may not be limited to: clearing of vegetation and overburden; culvert installations and replacements; construction and operation of the gravel road surface; and reclamation of areas within the ASR Right of Way (RoW) not used for the road surface.

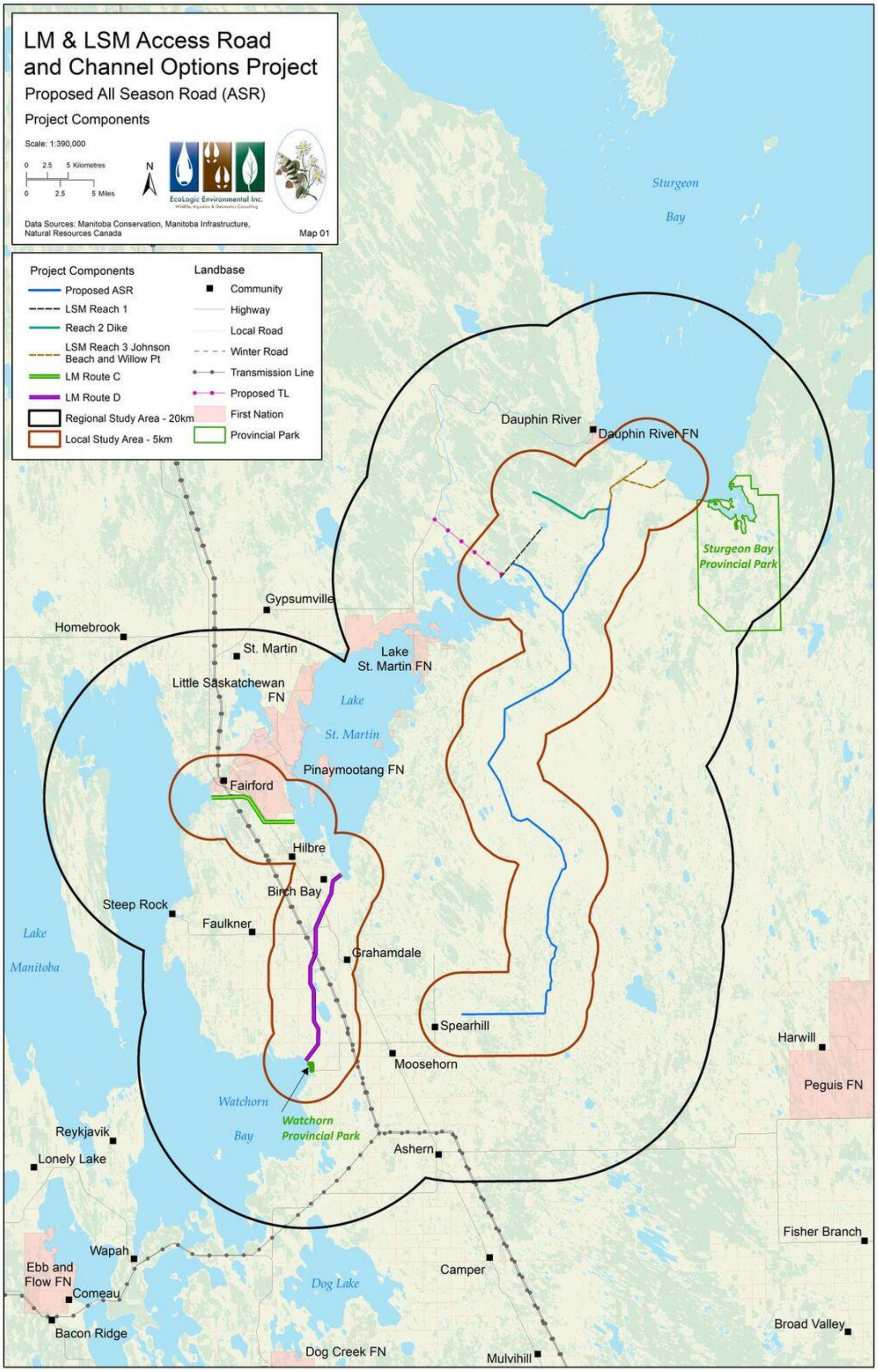


Figure 1: Lake St. Martin Outlet Channels Proposed All Season Road Project Study Area

The scope of this work also includes any ancillary activities such as development and/or use of borrow and/or quarry areas; crew, materials and equipment staging and/or storage areas; water and work site management; waste disposal and management; and the decommissioning and reclamation of areas used for the ancillary activities.

4.1 Spatial Boundaries

For the purposes of environmental assessment, the spatial boundaries of a project are typically described at three spatial scales: a Project Footprint area, a Local Study Area and a Regional Study Area. The Project Footprint (PF) is the physical space or directly affected area on which the Project components or activities are located; the Local Study Area (LSA) is the area beyond the Project footprint in which Project effects are measurable; and the Regional Study Area (RSA) is the area beyond the LSA within which most indirect and cumulative effects would occur (CEAA 2015).

These three spatial scales may vary depending on the environmental component. For example, for the aquatic environment, the PF is the area of the watercourses directly affected by the construction and operation of the road crossings, including the riparian zone areas (i.e., areas of vegetation adjacent to watercourses) and RoW associated with the watercourse crossing. The LSA would include areas upstream or downstream of the road crossings where aquatic organisms and/or their habitat may be affected by the ASR crossings (e.g., by changes in flow patterns), and the RSA would include aquatic areas upstream or downstream of the LSA that are connected to watercourse reaches within the PF. For wildlife, the spatial boundaries are selected based on the type and extent of the proposed project activities that may affect wildlife and their habitat, and the need to include the seasonal movements and spatial range of the animals of interest.

Given that the information collected for the baseline studies will be used in the environmental assessment for the Project, the study design for the baseline studies included the establishment of appropriate study area spatial boundaries.

As noted above, the overall Project was presented by MI as having three components and included: 1) further development of the LSMOC; 2) construction and operation of the LMOC; and 3) construction and operation of an ASR in the area of the LSMOC. The ASR and LSMOC components are linked as the ASR needs to be in place before the LSMOC works can be undertaken, and sections of the ASR and LSMOC options are contiguous or in close proximity on the landscape. As noted in Section 1, the overall Project will require both federal and provincial approval and licensing, whereas the construction and operation of the ASR will require provincial regulatory approval and licensing. In addition, MI requires the ASR to be in place to provide access for construction and operation of the LSMOC options. As such, MI required the baseline information for the ASR in advance of the baseline information for the LSMOC options, to allow

MI to secure approval and licensing from the Province of Manitoba for the ASR component of the Project.

This need for the ASR baseline information prior to the LSMOC and LMOC baseline information was met by preparing three separate reports for MI: one report for the ASR, one report for the LMOC, and one report for the LSMOC. This approach was used to resolve the timing needs for the Project, but because some sections of the ASR and LSMOC occupy the same area on the landscape, and the LMOC is in proximity to the LSMOC and ASR, it also resulted in a spatial overlap when the LSA and RSA boundaries were determined for each of the three components. The rationale and determination for the study area boundaries are further described below. Note that the spatial boundaries selected for the EIA can be modified as desired from the spatial boundaries selected for the baseline investigations; however, the data provided for the three Project components were collected using the spatial boundaries indicated below.

4.1.1 Project Footprint

The proposed ASR will have a gravel road base width of 7 metres (m) and a RoW width of 20 m (Lovie 2015 pers.omm.). As such, the PF area was designated as the total length of the ASR, i.e., the length from the start point of the affected areas of the municipal road to the end points of the LSMOC Reach 3 Winter Road Access and the LSMOC Reach 1 proposed ASR Alignment, times the total width of 20 m. Information provided by MI indicated that the lengths of the existing road segments are 20.6 kilometres (km) of municipal road, 48 km of existing forestry road (Idlywild Road) and 48 km of winter road (Lovie 2015 pers. comm.).

4.1.2 Local Study Area

The LSA was designated as the total length of the proposed ASR with a width of 5 km from either side of the centreline of the proposed ASR for all environmental components except vegetation. This 5 km width on either side of the proposed ASR alignment was selected based on:

- Published guidance documents and environmental assessment criteria for air quality, greenhouse gas (GHG) emissions, noise, vibration and human health (e.g., Health Canada 2011);
- The need to include areas upstream or downstream of proposed ASR watercourse crossings where aquatic organisms and/or their habitat may be affected by the works associated with the ASR crossings (e.g., by changes in flow patterns);
- Published literature on the potential local disturbance effects of roads on moose (*Alces alces*) (Laurian et al., 2008; Silverberg et al., 2003; Wasser et al., 2011; Yost and Wright 2001);
- The need to encompass wildlife movements, including Species At Risk (SAR), within the area of the proposed ASR;
- The need to provide an understanding of the existing socio-economic features of the area surrounding the proposed ASR; and

- The need to provide quantitative and qualitative information on the Heritage Resources within and surrounding the area of the proposed ASR as required under existing legislation and in accordance with environmental assessment requirements.

For vegetation, the LSA was designated as the total length of the ASR with a width of 1 km from either side of the centreline of the ASR to reflect the mostly sessile nature of plants, but also include areas of potential seed dispersal, new growth or colonization.

As noted above, the baseline data for the ASR were required separately and in advance of the baseline data for the LSMOC, which was resolved by preparing a separate report for each component. If the ASR data had not been required in advance of the LSMOC, it is expected that these two separate components could have been combined into one component (i.e., as the LSMOC and ASR component) as the application of a 5 km LSA boundary for each component resulted in some spatial overlap for the LSMOC and ASR components.

4.1.3 Regional Study Area

The RSA was designated as the total length of the ASR with a width of 20 km from either side of the centreline of the ASR for all environmental components except vegetation. This 20 km width on either side of the proposed ASR alignment was selected based on the guidelines, criteria and legislation described above, and to capture the area of a typical moose home range of 40 km^2 (Hundertmark 1997). For vegetation, the RSA was designated as the total length of the ASR with a width of 5 km from either side of the centreline of the ASR to allow for the assessment of vegetation at a community level, if required.

The need to include the movements and spatial range of moose resulted in the 5 km LSA and 20 km RSA described above. The use of a 5 km LSA and 20 km RSA resulted in some overlap with the areas potentially affected by the proposed LM Outlet Channels, and the existing and planned LSMOC. Figure 2 provides a map of the designated PF, LSA and RSA for the ASR component of the Project, and illustrates the overlap that occurred due to the proximity of the other two Project components. As such, information presented for the RSA in each of the three report assignments (ASR report, LMOC report, LSMOC report) was similar for many of the environmental components, e.g., climate, air quality, GHGs, noise and vibration, socio-economic setting.

4.2 Temporal Boundaries

The framework for an environmental assessment also includes the establishment of temporal boundaries to allow for the comparison of the existing environmental conditions in the Project area to the conditions that will exist with the Project in place, and where a cumulative effects assessment is required, to allow for the examination of the environmental conditions in the Project area in combination with past, present and future activities and projects in the Project area.

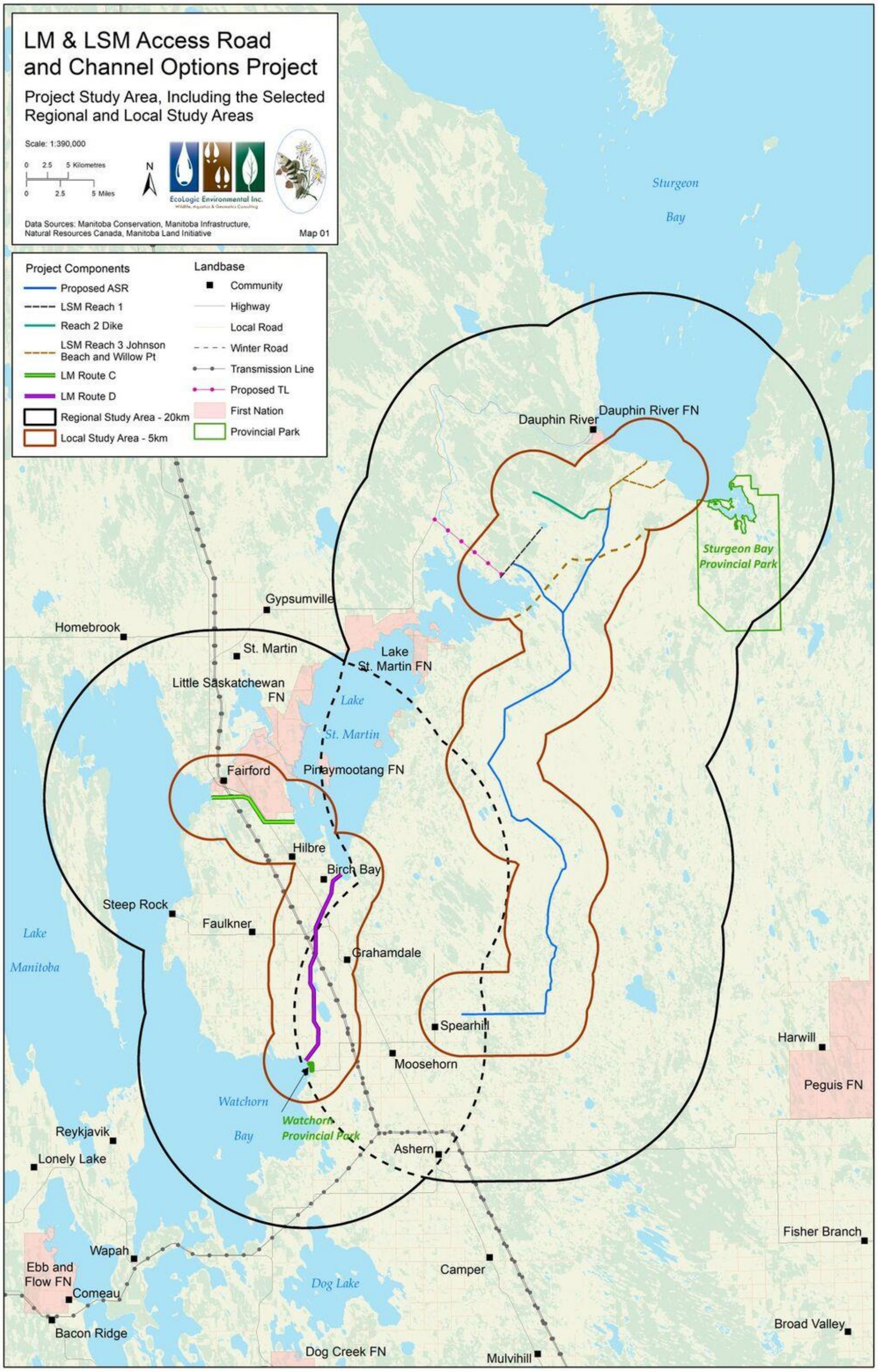


Figure 2: Project Study Area, including the selected Regional and Local Study Areas

Temporal boundaries are also defined for the time required for clearing, construction and operational activities to aid in the determination of the effects of these activities on the environmental receptors, i.e., the biophysical and socio-economic components of the environment. Table 1 provides a summary of the temporal boundaries defined for the Project based on information provided by MI (Lovie 2015, pers.comm.).

Table 1: Summary of Project Temporal Boundaries*

Activity	Estimated Start Date	Estimated End Date
Baseline environmental field and desktop studies	September 2015	January 2017
Road and culvert upgrading on the municipal road	October 2017	April 2018
Road and culvert upgrading on Idlywild Road	October 2017	April 2018
Clearing and construction of the road surface on the LSMOC Reach 3 Winter Road Access	October 2017	June 2018
Clearing and construction of the road surface on the LSMOC Reach 1 proposed ASR Alignment.	October 2017	June 2018
Completion of construction and start of operational phase for the ASR	June 2018	August 2018
Decommissioning and reclamation of areas within the ASR RoW and areas used for ancillary activities	June 2018	Not Applicable

*Temporal boundaries as of the time of this writing

5 PROJECT DESCRIPTION

5.1 Project Work Activities

The works will be completed in phases as shown in Table 1 above. Further information for the project description was provided by MI (Lovie 2015, pers.comm.) and is described below.

Initial work consists of replacing failing culverts and building up the existing road in low areas to prevent flooding, washouts and to provide a safe and solid travelling surface. This work is scheduled to commence in late fall/early winter of 2017 during low flow/frozen conditions and be completed before spring of 2018. Culvert replacements are planned for 22 locations along the municipal road section and Idlywild Road. The culvert sizing is based on the natural seasonal flows at each site to maintain the existing natural drainage patterns. If water is present, site isolation (e.g., using cofferdams) and dewatering methods such as pumping water away from the site into a well vegetated area, will be utilized as required.

For the proposed road spot grade improvements, construction will consist of surface preparation, grade repairs using quarried rock, and the application of traffic gravel. Works will be limited to areas within the toes of the existing grade slopes. Material for the grade repairs will be hauled from a quarry chosen by the contractor. Embankments will be constructed of limestone rock;

therefore, no seeding or placement of erosion control blanket will occur following construction. This method is used to reduce the potential of animals grazing along the roadside, which can enhance the safety of both public and wildlife.

The road will be designed with a minimum 7 m finished top. As noted above, quarried limestone rock will be used for grade repairs and embankments, and borrow will be used as fill and other road building materials. The borrow material is anticipated to be granular to clay to silty till materials, depending on the location and depth of cut. Some of the sections of the proposed ASR that pass over wet areas on the existing road will be spot graded with 125 millimetre (mm) or 50 mm minus shot rock. Once it is built, the entire road will have an approximate depth of 125 mm of traffic gravel.

The design speed was selected as 70 km/hr, which dictates a minimum radius curve of 200 m. The road will be gated to minimize public access.

After completion of the Phase 1 works, construction will commence on the LSMOC Reach 3 Winter Road Access and the LSMOC Reach 1 proposed ASR Alignment sections for the ASR.

5.2 Project Schedule

The works will be constructed in phases from the fall of 2017 to the summer of 2018 as shown in Table 1.

6 STUDY METHODS

The characterization of the existing environmental conditions in the ASR Project area was carried out using a number of desktop and field methods. The methods used for each component of the study are provided below.

6.1 Desktop Methods

Desktop study methods were used for all of the environmental components discussed in this report. Table 2 provides a summary of the desktop methods used by each component. Further details on the desktop methods used for the wildlife, vegetation, fish and fish habitat and Heritage Resources components are provided in the technical reports included as appendices 1 to 4 of this report.

Table 2: Summary of Desktop Methods Used for Each Environmental Component

Environmental Component	Desktop Methods
Climate, Climate Change, GHGs, Air	• Review of Project related reports and information provided by MI; • collection and review of other published and unpublished literature relevant to the Project area and Project activities; and

Table 2: Summary of Desktop Methods Used for Each Environmental Component

Environmental Component	Desktop Methods
Quality, Noise and Vibration	• collection and review of guidance documents, policies, environmental assessment criteria and methods, regulations and relevant legislation.
Terrain and Topography	• Review of Project related reports and information provided by MI; • collection and review of other published and unpublished literature relevant to the Project area and Project activities; and • review of elevation data relevant to the Project area.
Geology and Soils	• Review of Project related reports and information provided by MI; • collection and review of other published and unpublished literature relevant to the Project area and Project activities; and • review of geotechnical, geological and soils reports relevant to the Project area.
Vegetation	• Review of Project related reports and information provided by MI; • collection and review of other published and unpublished literature relevant to the Project area and Project activities; • submission of information requests to relevant government agencies, e.g., Manitoba Conservation Data Centre (MBCDC); • review of species listings under the federal *Species At Risk Act* (SARA), Committee on the Status of Endangered Wildlife In Canada (COSEWIC), Manitoba *Endangered Species and Ecosystems Act* (MESEA), the Invasive Species Council of Manitoba (ISCM), and the MBCDC listing of species of conservation concern; • review of other relevant legislation, e.g., *Noxious Weed Act*; • use of Ducks Unlimited Canada's Enhanced Wetland Classification System (Ducks Unlimited Canada 2014); • use of the Earth Observation for Sustainable Development of Forests (EOSD) Land Cover Classification (LCC) spatial database to create vegetation maps, characterize the vegetation types present in the Project area, and identify study plot locations for field studies; and • analysis and qualification of existing habitat, including SAR, using Geographic Information System (GIS) based technology.
Wildlife and Wildlife Habitat	• Review of Project related reports and information provided by MI; collection and review of other published and unpublished literature relevant to the Project area and Project activities; • submission of information requests to relevant government agencies, e.g., Manitoba Sustainable Development (MBSD), MBCDC; • the selection of spatial boundaries and selection of key species;

Table 2: Summary of Desktop Methods Used for Each Environmental Component

Environmental Component	Desktop Methods
	• detailed listing of all mammal, avian, reptile and amphibian species within the Project area using available provincial databases, i.e., MBCDC, Manitoba Breeding Bird Atlas (MBBA), Canada Important Bird Areas (IBA), Manitoba Herps Atlas (MHA); • detailed literature reviews of life history and habitat requirements for key species; • review of species listings under MESEA, SARA, COSEWIC and the MBCDC listing of species of conservation concern; acquisition of spatial database of known locations of species at risk or of conservation concern; • historical fire analysis; habitat mapping and spatial analysis using the LCC and Forest Resource Inventory (FRI) to assess for high quality habitat for key focal species; • habitat modelling to identify potential habitat availability for key species and to guide field methods; linear density analysis for moose; review of provincial historical records of mammal, avian, reptile and amphibian distribution within the Project area; • interviews with Resource Managers, Species Specialists, and other information holders for important presence and absence information on key species; and • analysis and quantification of existing habitat and potential habitat loss for wildlife, including SAR, using GIS based technology; data collation with the development of a GIS database in ArcGIS 10.1 through acquisition of existing and available information.
Groundwater	• Review of Project related reports and information provided by MI; • collection and review of other published and unpublished literature relevant to the Project area and Project activities; review of groundwater, hydrogeological, geotechnical and geochemical reports relevant to the Project area; and • collection and review of guidance documents, policies, environmental assessment criteria and methods, standards, regulations and relevant legislation.
Surface Water	• Review of Project related reports and information provided by MI; • collection and review of other published and unpublished literature relevant to the Project area and Project activities; review of surface water and hydrological reports relevant to the Project area; and • collection and review of guidance documents, policies, environmental assessment criteria and methods, standards, regulations and relevant legislation.

Table 2: Summary of Desktop Methods Used for Each Environmental Component

Environmental Component	Desktop Methods
Fish and Fish Habitat	• Review of Project related reports and information provided by MI; • collection and review of other published and unpublished literature relevant to the Project area and Project activities; • review of Manitoba fish species zoogeographical distribution information; review of Manitoba fish species life history and habitat requirements, including SAR; review and application of Fisheries and Oceans (DFO) guidelines, policies and legislation for fish and fish habitat, including the DFO habitat classification system (Milani 2013); and • review of aerial photography, provincial watershed maps and topographic maps to determine location, morphology and connectivity of the proposed ASR Project area watercourses and waterbodies.
Species At Risk	• Identification of floral and faunal species and/or ecosystems in the Project area classified as SAR and/or species of conservation concern through review of federal and provincial databases (SARA, COSEWIC, MESEA, MBBA, MHA, MBCDC); and • review of federally legislated species Management and/or Recovery plans and other applicable guidance or policies; identification of required habitat types or Critical Habitats for floral and faunal species and/or ecosystems in the Project area classified as species at risk or species of conservation concern, including the identification of Critical Habitat areas for the two bat species listed as Endangered on Schedule 1 of SARA that may be present in the Project area.
Socio - Economic Environment	• Review of Project related reports and information provided by MI; • collection and review of other published and unpublished literature relevant to the Project area and Project activities; • review of available information and reports on demographics, local services, infrastructure, land use, resource use, and protected areas relevant to the Project area; • collection and collation of mapping information and production of a series of maps, e.g., fire history in the Project area, infrastructure in the Project area; and • collection and review of guidance documents, policies, environmental assessment criteria and methods, standards, regulations and relevant legislation, e.g., Health Canada *Guidance for Evaluating Human Health Impacts in Environmental Assessment: Noise (Draft)* (Health Canada 2011).
Culture and Heritage Resources	• Review of Project related reports and information provided by MI; • submission of information requests to relevant government agencies, e.g., Manitoba Historic Resources Branch (MHRB);

Table 2: Summary of Desktop Methods Used for Each Environmental Component

Environmental Component	Desktop Methods
	• review and application of documentation on the cultural history, archaeological records and historical records relevant to the Project area; and • Project area mapping of known information for the area to guide field studies.

6.2 Field Studies

Field studies were conducted for the vegetation, wildlife, fish and fish habitat, SAR and Heritage Resources components of the ASR Project. Table 3 provides a summary of the methods used by each component. Further details on the field methods used for vegetation, wildlife, fish and fish habitat, SAR and Heritage Resources components are provided in the technical reports included as appendices 1 to 4 of this report.

Table 3: Summary of Field Study Methods Used for Each Environmental Component

Environmental Component	Field Study Methods
Vegetation	• An initial ground-based reconnaissance survey of the area was completed by 4x4 truck and on foot in October 2015; • an aerial reconnaissance survey was conducted in October 2015 by helicopter to observe the Project area and collect georeferenced photographs and observational notes on the existing vegetation cover and wetlands; • vegetation field surveys were conducted in spring (June 07, 2016 to June 10, 2016) and summer (August 02, 2016 to August 05,2016) to capture species with different emergence periods; • qualitative vegetation surveys were conducted along the existing municipal road, forestry road and winter road sections of the proposed ASR; • sample sites were pre-selected and stratified based on habitat-type encountered along the proposed ASR using the LCC data and information gathered during the 2015 aerial survey; • a handheld Garmin Oregon 450 GPS pre-loaded with the tracks of the proposed ASR and each sample site were used to navigate to the survey locations; • sample sites along the municipal and forestry road portions of the proposed ASR were access by 4x4 pick-up truck;

Table 3: Summary of Field Study Methods Used for Each Environmental Component

Environmental Component	Field Study Methods
	• due to wetland habitats posing constraints to ground access, the sample sites along the winter roads were accessed by helicopter; • a total of 18 sample plots were selected and completed during the spring and summer surveys to provide a sufficient number of plots within different habitat types; • at each plot site, two 100 m transects were placed perpendicular on either side of the centreline of the proposed ASR; transects were walked and all vascular plants observed (within a 5 m visual radius) were recorded and identified to species; immature plants or plants missing structures (e.g., fruiting bodies, etc.) that could not be identified to species were identified to genus or family; • additional data collected at each sample site included: soil type, site location and description of the vegetation community; • no voucher specimens were collected; • photographs of the plant and identifying characteristics were taken of any species not identifiable in the field; • the relative location of each sample site, as with any observations of invasive species, plant species of significance to Aboriginal peoples, and/or species of conservation concern (S1, S2, S3) were recorded with a handheld Garmin Oregon 450 GPS and incorporated into the data collected for the ASR component of the Project; and • incidental observations of plant species along the proposed ASR that occurred outside of the sample sites, were also documented.

Wildlife and Wildlife Habitat	• An initial ground-based reconnaissance survey of the area was completed by 4x4 truck and on foot in October 2015;
	• an aerial reconnaissance survey was conducted in October 2015 by helicopter to observe the Project area and collect georeferenced photographs and observational notes on the existing habitat;
	• field studies were conducted in the winter of 2015-16, spring 2016, summer 2016 and fall 2016; the types of field surveys conducted included:
	  o winter aerial moose, elk, and white-tailed deer survey; winter aerial multispecies survey;
	  o spring aerial shoreline survey, including a Piping Plover survey; spring avian Point Count survey; spring bird nest (egg) searches; spring raptor nest and heron rookery survey; spring amphibian Point Count survey; spring reptile hibernacula survey;
	  o winter, spring, summer and fall Ecologically Sensitive Site (ESS) investigations for mammal dens, mineral licks, hibernacula,

Table 3: Summary of Field Study Methods Used for Each Environmental Component

Environmental Component	Field Study Methods
	rookeries, nests; winter, spring, summer and fall bat hibernacula surveys; and • the detailed methodologies and equipment used for the wildlife field surveys are provided in Appendix 1 in the Lake St. Martin Outlet Channel proposed ASR Terrestrial Wildlife Technical Report.
Fish and Fish Habitat	• On October 6, 2015, an initial site inspection was completed to assess the roadway prior to field investigations; an aerial survey was conducted by helicopter on October 9, 2015 to examine the extent of the roadway to be upgraded and to delineate the sampling reaches prior to the commencement of fieldwork, which was to include all creek crossings along the roadway area (municipal, forestry and winter road segments) • field surveys were conducted in the fall of 2015 and spring of 2016 and included the use of backpack electrofishing, trap netting, and gill netting; sampling methods were adapted from Newbury and Gaboury (1993) and Harrelson et al. (1994); all methods were performed to minimize harm to captured fish; captured fish were identified to species, enumerated, measured for fork length and released unharmed; • field surveys included the collection and documentation of a number of aquatic habitat parameters including: cover type (i.e., presence/absence of submerged or emergent vegetation, presence of large boulders, undercut banks, woody debris); substrate composition of the creek bed (clay, silt, sand, gravel, cobble, boulder), based on a simplified Wentworth Scale for substrate classification (Wentworth 1922); channel sinuosity and habitat type (run, riffle, pool); a Swoffer 2100 current velocity meter was used to measure water velocities; in situ water chemistry measurements for turbidity (Nephelometric Turbidity Units [NTU]), temperature (°C), conductivity (μS/cm), pH, and dissolved oxygen (DO, mg/L); instream cover (rock, undercut banks, turbidity, woody debris) and riparian zone/ streamside vegetation and cover (overhanging trees, shrubs, grasses); • additional field surveys were conducted at Mantagao Lake in summer 2016 to study fish species composition within the headwaters of the Project area creeks (e.g., Winthers Creek), and investigate fish species composition within the larger watershed system; and • boat electrofishing using a Smith-Root 2.5 GPP was conducted along the shoreline at depths of approximately 1.3 m; captured fish were identified to species, enumerated, measured for fork length and released unharmed.

Table 3: Summary of Field Study Methods Used for Each Environmental Component

Environmental Component	Field Study Methods
Species At Risk	• All the field surveys outlined for the vegetation, wildlife and fish and fish habitat components included identification and documentation of SAR and/or species of conservation concern.
Culture and Heritage Resources	• An initial ground-based reconnaissance survey of the area was completed by 4x4 truck and on foot in October 2015; • An aerial reconnaissance survey was conducted in October 2015 by helicopter to observe the Project area and collect georeferenced photographs and observational notes on the existing land base; and • A field survey of the ASR Project area was conducted in August 2016 to conduct ground surveys of selected areas based on the collated desktop information; site locations were surveyed on foot with access by 4x4 truck or helicopter.

7 EXISTING ENVIRONMENT

7.1 Biophysical Environment

7.1.1 Climate

Climate can be defined as the generally prevailing weather conditions of a region throughout the year, and is typically described by variables such as air pressure, cloud cover, humidity, precipitation, hours of sunshine, temperature, wind speed and wind direction. Environment and Climate Change Canada (ECCC) has collected climate normals data for several areas within Canada from 1961 to 1990, 1971 to 2000 and 1981 to 2010. The ECCC weather station closest to the RSA with the most recent climate normals data, i.e., from 1981 to 2010, is located in Lundar, Manitoba. Table 2 summarizes the climate normals data for the Lundar weather station, which is located at Latitude 50°45' N and Longitude 97°56' W at an elevation of 266.7 m.

The 30 year climate normals report an average annual temperature of 1.9 degrees Celsius (°C), with a maximum of 18.3°C in July, and a minimum of -18.1°C in January (Government of Canada 2016a). Mean annual precipitation is 480.2 millimetres (mm), of which 385.5 mm falls as rain with the remainder 94.7 mm as snow (approximately 20 percent [%]). Precipitation falls primarily as snow during the winter months, with the greatest snowfalls occurring in November, December and January. Precipitation occurs mainly as rain during the spring, summer and fall seasons, with overall levels of precipitation peaking in June, July and August.

Table 4: Climate Normals Summary for Lundar, Manitoba (1981-2010)

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Daily Average Temperature (ºC)	-18.1	-13.5	-6.6	3.3	10.9	16.4	18.3	17.7	11.3	4.4	-6.5	-14.6	1.9
Daily Max (ºC)	-12.7	-8.0	-1.3	9.4	17.7	22.8	24.7	24.7	17.7	9.7	-2.1	-9.8	7.7
Daily Min (ºC)	-23.6	-18.8	-11.9	-2.9	4.1	9.9	11.9	10.6	4.9	-1.1	-10.8	-19.4	-3.9
Rainfall (mm)	0.0	0.2	5.9	14.8	55.2	80.1	74.8	68.9	45.8	35.7	3.0	1.2	385.5
Snowfall (cm)	16.1	13.5	13.4	11.9	0.4	0.0	0.0	0.0	0.0	5.3	16.3	17.7	94.7
Precipitation (mm)	16.1	13.7	19.3	26.7	55.6	80.1	74.8	68.9	45.8	41.0	19.4	18.9	480.2

Source : Government of Canada 2016a.

There were no wind data found for locations within the RSA; as such, wind data for the area was based on information collected at the station closest to the RSA, which is located at Dauphin, Manitoba. Average wind speeds recorded at Dauphin, Manitoba are fairly constant throughout the year, ranging from approximately 14 kilometres per hour (km/hr) to 17 km/hr. There is an average of approximately 13 days per year when wind speeds exceed 50 km/hr, with maximum hourly wind speeds of between 71 km/hr and 89 km/hr and maximum gust speeds between 85 km/hr and 122 km/hr (Weather Network 2016).

The large lakes within and around the RSA have an influence on the climate and weather. The basin size and position of Lake Manitoba, Lake Winnipegosis and Lake Winnipeg result in the creation of lake and land breeze circulations that can cause highly variable winds in the area (Environment and Climate Change Canada [ECCC] 2016a). The presence of the lakes also influence temperature and precipitation patterns in the area, with sudden storms and snow squalls that can produce strong winds over the land and water (ECCC 2016a). Manitoba's "big three" lakes are known for their rough waters and choppy waves, a feature of the large surface area but shallow depths of these lakes (ECCC 2016a).

The Development Plan for the RM of Grahamdale (2016) states that the climate of Grahamdale can be generalized from weather data collected at Gypsumville and Ashern in the RM of Siglunes. At these locations, the mean annual temperature was cited as 1.1 °C, with a mean annual precipitation of 483 mm and average frost-free period of 101 days (RM of Grahamdale 2016).

7.1.2 Climate Change

The effects of climate change in Manitoba have been reported to include warmer temperatures, changes in rainfall and water availability, declining snow and ice cover, and extreme weather events that can lead to increased risk of flooding and erosion in spring, and increased risk of droughts in summer (Government of Manitoba 2012a). These climate change effects could lead to declines in agricultural and ecological productivity, and warmer temperatures may cause permafrost thawing and erosion, which will put northern roads, railways and other community infrastructure at risk and result in a shorter winter road season (Government of Manitoba 2012a).

To address climate change issues, the government of Manitoba enacted *The Climate Change and Emissions Reductions Act* in 2008, which set a target of reducing greenhouse gas (GHG) emissions to six per cent below 1990 levels by 2012, and required the province to report on whether emissions in 2010 were less than they were in 2000 (Government of Manitoba 2012a). Manitoba also released *Beyond Kyoto* in 2008, an action plan on climate change that outlined over 60 actions to reduce GHG emissions and adapt to the impacts of climate change across multiple sectors including energy, transportation, agriculture, municipalities, businesses and government operations.

The Government of Manitoba is responding to the effects of climate change using three main areas of focus:

- reducing Manitoba's GHG emissions
- adapting to the anticipated impacts of climate change
- collaborating and sharing best practices with other jurisdictions

Further information on climate change effects and initiatives in Manitoba is provided in *Manitoba's Report on Climate Change For 2012* (Government of Manitoba 2012a).

Other means of offsetting the potential effects of climate change include the maintenance, creation or expansion of 'carbon sinks'. Carbon sinks are processes that remove greenhouse gases from the atmosphere and store them long-term in another form, for example the storage of CO_2 (carbon dioxide) in perennial vegetation such as shelterbelts and woodlots and in soils as organic matter (Government of Manitoba 2016a). Hundreds of billions of tonnes of carbon are also sequestered in wetlands as peat or soil in the expanses of swamps, marshes, fens and bogs that cover many areas of Manitoba (Manitoba Water Caucus 2016), including sections of the LSA and RSA in the Project area.

7.1.3 Greenhouse Gas Emissions

Climate change has been linked to GHG emissions that contribute to atmospheric increases in levels of CO_2 and other gases (e.g., methane [CH_4], nitrous oxide [N_2O]) that increase global temperatures, change climate and precipitation patterns, and increase the frequency of extreme weather events. Environment and Climate Change Canada (ECCC) currently tracks six GHG substances as part of Canada's efforts to identify, quantify and reduce sources of GHGs. The six substances are CO_2, CH_4, N_2O, sulphur hexafluoride (SH_6), perfluorocarbons and hydrofluorocarbons (ECCC 2016b). Each GHG has a different global warming potential (GWP) and persists for a different length of time in the atmosphere; as such, GHG emissions from different types of gaseous compounds are converted into CO_2 equivalents to be compared and tracked over time (Climate Change Connection 2016). Table 5 provides a summary of GHG emissions by Canadian province and territory for 1990, 2005 and 2014.

Table 5: GHG Emissions by Province and Territory for 1990, 2005 and 2014

Province or Territory	1990 Greenhouse Gas Emissions (Mt of CO_2 Equivalent)	2005 Greenhouse Gas Emissions (Mt of CO_2 Equivalent)	2014 Greenhouse Gas Emissions (Mt of CO_2 Equivalent)
Newfoundland and Labrador (NL)	9.6	10.2	10.6
Prince Edward Island (PE)	2.0	2.1	1.8
Nova Scotia (NS)	20.0	23.5	16.6
New Brunswick (NB)	16.4	20.5	14.9
Quebec (QC)	89.1	89.7	82.7
Ontario (ON)	181.8	210.6	170.2
Manitoba (MB)	18.7	20.7	21.5
Saskatchewan (SK)	45.1	69.6	75.5
Alberta (AB)	175.2	233.0	273.8
British Columbia (BC)	52.9	65.2	62.9
Yukon (YT)	0.5	0.5	0.3
Northwest Territories (NT)	1.6[A]	1.7	1.5
Nunavut (NU)	n/a	0.3	0.3

Notes: [A] 1990 emissions data for the Northwest Territories include emissions for Nunavut, which was part of the Northwest Territories until 1999; Mt = megatonnes; n/a = not applicable; Emission levels for some years have been revised in light of improvements to estimation methods and availability of new data.
Source: Environment and Climate Change Canada (2016c) *National Inventory Report 1990–2014: Greenhouse Gas Sources and Sinks in Canada.*

Based on the data in Table 5, Manitoba was the 7th largest emitter of GHGs in 1990 and 2005, and the 8th largest emitter of GHGs in 2014, in comparison to all other provinces and territories. Additional information on the relative amounts of each tracked substance for different GHG categories (i.e., energy, industrial processes, solvent and other product use, agriculture and waste) can be found in the annual National Inventory Reports (ECCC 2016c).

ECCC also monitors GHGs under the Greenhouse Gas Emissions Reporting Program (GHGRP), which is Canada's legislated, publicly accessible inventory of facility-reported GHG data and information. The most current data available at the time of this writing was the summary for the year 2014, provided in Table 5 (ECCC 2016d). In 2014, there were 12 facilities in Manitoba reporting under the GHGRP. These facilities are located about 200 to 600 km from the ASR Project area, with the exception of the Graymont limestone and gypsum processing plant, which is located on Provincial Trunk Highway (PTH) 239 between the towns of Steep Rock and Faulkner (Figure 2; Figure 8 in Section 6.2.4). The Graymont plant is located about 43 km west of where the municipal road ends and the forestry road begins. This facility reported the 4th highest level of overall GHG emissions in Manitoba in 2014 (Table 6).

Other sources of GHGs in the RSA are likely from agricultural and recreational activities; vehicles travelling PTH 6, which is the main highway in the area and an important route to Thompson, Manitoba; and vehicle use on the other municipal roads and trails throughout the area. Pollutants emitted from motor vehicles include NOx (nitric oxide and nitrogen dioxide), CO (carbon monoxide), volatile organic compounds, and to a lesser extent SO_2 (sulphur dioxide) and particulate matter. These compounds are monitored under provincial and federal air quality guidelines and legislation, which are discussed in Section 6.14.

Within the LSA for the proposed ASR, infrastructure is limited to the existing municipal road, forestry road, winter roads, the LSMOC Reach 1 and LSMOC Reach 3 (Figure 1). The town of Spearhill and a portion of the Dauphin River FN are the only human settlements within the LSA. Human activities within the LSA are limited to access by truck, All Terrain Vehicle (ATV) or snowmobile for hunting, fishing or other recreational use. Based on the low population and limited use of the area, the existing environment for GHG emissions in the LSA is considered to be low. Land use conversion from vegetation cover to permanent gravelled road surface could contribute to GHG emissions for the ASR Project due to loss of carbon sequestration. However, this land use conversion will only occur in limited sections of the PF area, and additional areas of vegetation, including wetland areas, are present throughout the PF, LSA and RSA.

The construction and operation of the proposed ASR to the LSMOC will contribute temporary GHG emissions from intermittent use of construction equipment and vehicles, and there will be a change in carbon storage along the proposed ASR RoW where sections of the proposed ASR and roadside vegetation will be converted from its current vegetated state to a permanent gravelled road surface. As such, the construction and operation of the ASR is expected to be a small contributor to GHG emissions in the LSA and RSA.

Table 6: Summary of GHG Emissions Reported by Facilities in Manitoba in 2014 (ECCC 2016d)

Facility Name	City/Town	Greenhouse Gas (tonnes CO_2 eq)						
		CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Total
Brady Road Resource Management Facility – City of Winnipeg, Water & Waste Department	Winnipeg	48,530	332,500	-	-	-	-	381,030
Brandon Generating Station – Manitoba Hydro	Brandon	71,963	34	316	-	-	90	72,404
Faulkner Plant – Graymont Western Canada Inc.	Faulkner	143,454	18	161	-	-	-	143,632
General Scrap - Winnipeg – General Scrap Partnership	Winnipeg	1,659	2	15	-	-	-	1,676
HBMS Metallurgical Complex – Hudson Bay Mining and Smelting Co., Limited	Flin Flon	34,147	20	677	-	-	-	34,844
Kilcona Landfill – City of Winnipeg, Water & Waste Department	Winnipeg	6,125	55,825	-	-	-	-	61,950

Table 6: Summary of GHG Emissions Reported by Facilities in Manitoba in 2014 (ECCC 2016d)

Facility Name	City/Town	Greenhouse Gas (tonnes CO_2 eq)						
		CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Total
Koch Fertilizer Canada, ULC – Koch Fertilizer Canada, ULC	Brandon	568,772	52,033	44,986	-	-	-	665,791
Manitoba Kraft Papers Division – Tolko Industries Ltd.	The Pas	57,350	6,676	4,828	-	-	-	68,854
Minnedosa Ethanol Plant – Husky Oil Operations Limited	Minnedosa	77,514	38	339	-	-	-	77,891
Summit Road Landfill – City of Winnipeg, Water & Waste Department	Winnipeg	10,509	95,775	-	-	-	-	106,284
Thompson Operations – Vale Canada Limited	Thompson	78,049	24	796	14	-	-	78,883
TransCanada Pipeline, Manitoba – TransCanada PipeLines Ltd.	Winnipeg	252,907	11,806	3,487	-	-	-	268,200
Totals		**1,350,979**	**554,751**	**55,604**	**14**	**0**	**90**	**1,961,438**

7.1.4 Air Quality

In Manitoba, air quality issues are mostly local in nature and are primarily related to odour and other pollutants such as wind-blown dust released from specific local sources or activities. Emissions from the metal smelters in Flin Flon and Thompson and smoke from forest fires tend to be the most significant sources of air pollution in northern Manitoba (Government of Manitoba 2009). Southern Manitoba has also experienced poor air quality on occasion due to smoke from forest fires or crop residue burning. Air quality within the RSA is affected by the commercial, agricultural, recreational, rural, transportation and urban activities that occur in the region, as well as from naturally occurring forest fires.

The Province of Manitoba and Environment Canada operate air quality monitoring stations in the cities of Brandon, Flin Flon, Thompson, and Winnipeg, Manitoba. The air quality monitoring stations closest to the Project area are located in the City of Winnipeg at 65 Ellen Street and at 299 Scotia Street. Air quality parameters that are monitored include: carbon monoxide (CO); particulate matter less than or equal to (≤) 10 microns (PM_{10t}); particulate matter ≤ 2.5 microns ($PM_{2.5}$), nitric oxide (NO); nitrogen dioxide (NO_2); nitrogen oxides (NO_x); ground level ozone (O_3); sulphur dioxide (SO_2); wind direction; and wind speed (Government of Manitoba 2016b).

Table 7 provides a summary of the air quality parameters for Winnipeg, Manitoba on November 1, 2016 as an example of the available information.

Table 7: Air Quality Parameters for Winnipeg, Manitoba, November 01, 2016

Station	Date	Time	PM10t	PM	CO	O3	NO	NO2	NOX	SO2	Wind Dir	Wind Speed
			µg/m3	2.5s	ppm	ppb	ppb	ppb	ppb	ppb		
Winnipeg Ellen St.	11/1/2016	7:00 AM	6.5	2.2	0.237	2.8	9.8	11.7	21.5	0	308	8
Winnipeg Scotia St.	11/1/2016	7:00 AM	-	2.5	-	1.8	10	3.8	13.9	-	-	-

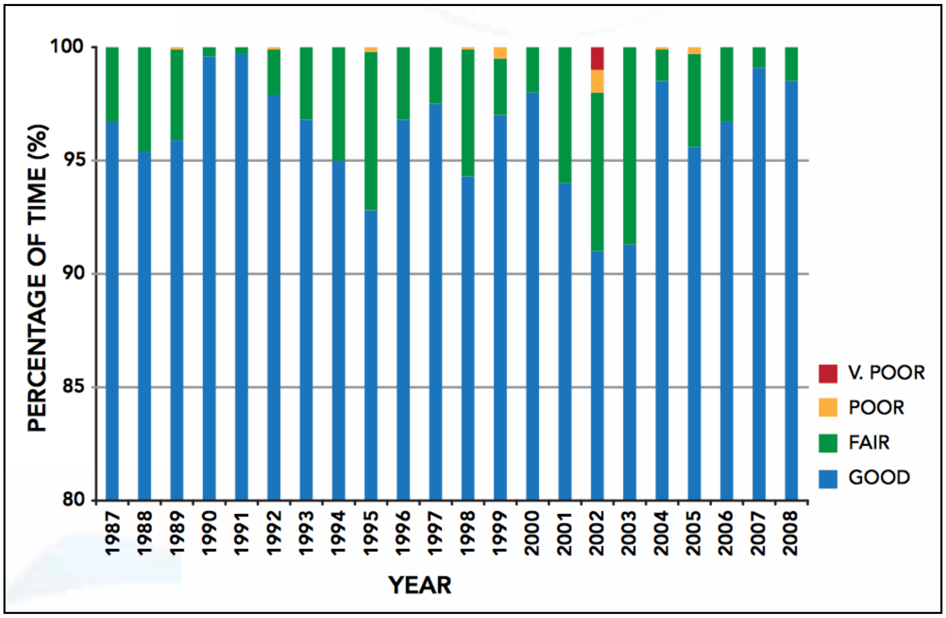
Source: Government of Manitoba 2016b.

PM_{10t} = particulate matter ≤10 microns; µg/m3 = micrograms per cubic meter; $PM_{2.5s}$ = particulate matter ≤2.5 microns; ppm = parts per million; ppb= parts per billion; Wind Dir = wind direction in degrees; Wind Speed = wind speed in kilometers per hour.

The Manitoba Ambient Air Quality Criteria (Government of Manitoba 2016c) provides the maximum tolerable, maximum acceptable and maximum desirable concentrations of air pollutants required to protect and preserve air quality for human health. Comparison of the air quality parameters for November 01, 2016 in Table 7 to the Manitoba Ambient Air Quality Criteria indicates that the measured parameters do not exceed the maximum acceptable level and meet the “maximum desirable” concentrations for parameters that have this value defined.

Environment and Climate Change Canada has also developed the “Air Quality Health Index” (AQHI), an index that is based on the relative risk to human health that can be caused by a combination of common air pollutants (ECCC 2016d). These pollutants include ground-level O_3, $PM_{2.5}$ and NO_2. The AQHI is measured on a colour-coded scale from 1 to 10+ and the values are also grouped into risk categories (low, moderate, high, very high) to identify the level of risk. The higher the number, the greater the health risk associated with local air quality (ECCC 2016e). The Province of Manitoba states that “recent monitoring has shown that the health risks associated with air quality for the cities of Brandon and Winnipeg are generally low, with an average AQHI rating of around three or lower in both locations” (Government of Manitoba 2016d). Manitoba’s Sustainability Report 2009 indicates air quality as being stable in Manitoba based on the data from three reporting stations in Winnipeg, Flin Flon, and Brandon (Government of Manitoba 2009). The AQHI data summarized for Winnipeg for the period from 1987 to 2008 indicates good air quality for the majority of the time, with one episode of very poor air quality that occurred during 2002 that was likely due to smoke from burning crop residue in surrounding agricultural land (Figure 3) (Government of Manitoba, 2009).

The RSA is located approximately 200 km northwest of the City of Winnipeg and has a much lower density of population and development than the City of Winnipeg and surrounding areas. As such, it is expected that the ambient air quality within the RSA is of similar or higher quality than the ambient air quality for the City of Winnipeg. The RSA for the project is in a more forested landscape than the City of Winnipeg, and therefore may experience greater frequency of smoke from forest fires. The RSA includes and is adjacent to agricultural areas, which may also result in air quality effects due to the burning of crop residues.



Source: Government of Manitoba 2009.

Figure 3: Winnipeg (Downtown) Air Quality Index, 1987-2008

Within the LSA for the proposed ASR, the level of human activities and development are very low, with air quality effects limited to intermittent use of the municipal, forestry and winter roads by trucks, ATVs or snowmobiles, and naturally occurring or human induced forest fires. The construction and operation of the proposed ASR to the LSMOCs will contribute temporary emissions from interim use of construction equipment and vehicles. The use of the proposed ASR is expected to be higher than current levels during construction activities, but is expected to return to a lower level of use once construction is completed and the Project enters the operational phase. As such, the construction and operation of the ASR is not expected to have a significant effect on air quality in the LSA and RSA.

7.1.5 Noise and Vibration

Existing noise and vibration levels in the RSA are expected to be typical of an area that consists mainly of forest, wetland and grassland areas with a transportation corridor and small urban and rural centers, cottage areas, and the presence of commercial, recreational and transportation activities. Existing sources of noise and vibration in the RSA include use of light and heavy vehicles; processing activities at the Graymont plant; farming activities; recreational vehicles and activities (e.g., hunting, snowmobiling, use of ATVs); occasional air traffic; and bird migration, nesting and breeding activities. The Canadian National (CN) rail line that runs adjacent to PTH 6 and the spurs to Spearhill and Steeprock have been abandoned since 1997 (Transport Canada 2015) and are no longer a source of noise in the RSA. Planned upgrades to sections of PTH 6 have the potential to contribute to noise and vibrations in the RSA. The upgrades to PTH 6 are part of a five-year plan by the Manitoba Government and include paving of 19.5 km of asphalt from 1.6 km south of Moosehorn to the Steep Rock Junction at PTH 239 in the RSA (Figure 2) (Government of Manitoba 2013). The PF and LSA and are located away from the majority of the sources of noise and vibration in the RSA, which is expected to result in an existing environment of low ambient noise and vibration in the PF and LSA.

Traffic noise objectives have not been established in Manitoba for provincial highways; however, highway traffic noise is indirectly controlled by Transport Canada under the Motor Vehicle Safety Regulations (C.R.C., c. 1038) Schedule V.1 – Noise Emissions (Standard 1106), which defines maximum permissible sound levels (PSL) for individual categories of vehicles (Government of Canada 2016b). Common noise levels and typical human reactions are summarized in Table 8.

Table 8: Common Noise Levels and Typical Human Reactions

Source	Decibels (dB)	Effect
Quarry production blast at 500 m	128	-
Car horn/propeller aircraft/air raid siren	120	Threshold of pain
Amplified rock band	110	Maximum vocal effort
Rockbreaker breaking at 7 m	100	
Running train	100	Discomfort
Reversing alarm at 4 m	92	
Heavy truck at 15 metres (m)/ Busy city street	90	Very annoying - Hearing damage (8 hr)
Paver at 15 m	89	-
Jackhammer at 15 m	88	-
Concrete mixer at 15 m	85	-
Bulldozer, Grader or Loader at 15 m	85	-
Pneumatic tool at 15 m	85	-
Generator at 15 m	81	-
Backhoe at 15 m	80	-
Factory floor	80	Annoying
Concrete vibrator at 15 m	76	-
Pump at 15 m	76	-
Passenger car at 65 miles per hour at 8 m	70	Telephone use difficult
Normal conversation	60	Intrusive
Noisy office	50	Speech interference
Light automobile traffic at 30 m	50	-
Public library	40	Quiet
Soft whisper at 5 m	30	Very quiet
Rustle of leaves	10	Just audible
Threshold of hearing	0	-

Sources: Beranek 1988; CMHC 1981; Explosives and Rockwork Technologies Ltd. 2002; HMMH 2014.

As shown in Table 8, noise levels in the vicinity of a highway can be in the range of 50 to 70 decibels (dB), although actual noise levels would be dependent on the volume of traffic, speed of the traffic and distance from the roadway. Road construction equipment noise ranges between about 76 dB and 89 dB at 15 m from the equipment.

Regulation of noise in Manitoba is intended for management of worker exposure to noise levels in occupational environments, and local municipal bylaws established for noise nuisance management in the acoustic environment. Noise control guidelines for land use planning are provided through Manitoba's published *Guidelines for Sound Pollution* for daytime and nighttime acceptable and desirable noise levels in residential areas (MCWS 1992). For residential areas, the maximum desirable level is 55 dB during the day and 45 dB at night. For road construction, the industrial maximum desirable level would be used, which is 70 dB day or night.

Based on the above information, it is expected that there will be temporary increases in noise levels during construction and operation of the ASR from periodic vehicle and equipment use in the PF and portions of the LSA, but this increased noise level is not expected to extend to the entire LSA or to the RSA.

D. J. Martin (1977) conducted a study on ground vibrations due to construction noise generated by different types of equipment on different types of soils and surfaces. Martin (1977) classified the construction equipment as follows:

- Tracked plant, such as dozers and tractor shovels;
- Rubber-tired plant, such as motorized scrapers and dump trucks; and
- Continuous or intermittent impacting plant, such as pile drivers and vibratory rollers.

The study found that vibration levels at 10 m from equipment such as an earth-moving plant and sheet-piling rig were above the threshold of human perception and could cause disturbance to people. However, the levels were much lower than the levels that could likely cause architectural damage to buildings. The results showed that the major sources of vibration in road construction were the tracked earthmoving plant, compaction plant and intermittent impacting plant. Rubber-tired equipment did not generate ground surface vibration levels high enough to be detected by human subjects. At distances greater than 10 m, ground attenuation effects may reduce the vibration levels to values below human sensitivity.

Vibration assessments typically measure vibration in terms of the Peak Particle Velocity (PPV), which is the maximum speed at which the ground particle moves due to the vibration, and is expressed as either millimeters or inches per second (Explosives and Rockwork Technologies Ltd. 2002). The PPV threshold for the perception of ground vibration is about 0.51 mm/s (0.02 in/s) for most people (The World of Explosives 2016). Ground vibration limits may be expressed as a single value; however, it is more likely that the limits will vary based on frequency as the limits are typically designed for the protection of property and structures.

The construction and operation of the proposed ASR requires the need for quarried rock (Section 4.1). The noise and vibration from a production blast has been estimated as 128 dBa at 500 m, with a PPV of 1.3 mm/s at 500 m and an air blast (i.e., the wave of highly compressed air spreading outward from an explosion) of 119.4 dBa at 500 m (Explosives and Rockwork Technologies Ltd. 2002).

As such, there will be instances during the construction of the proposed ASR where noise and vibration levels may temporarily increase for short periods of time within the PF and sections of the LSA that are in proximity to the PF. Based on data on the attenuation of noise and vibration over distance, this increased noise and vibration level is not expected to extend to the entire LSA or to the RSA. Noise and vibration levels may also increase temporarily and locally during the operational phase of the proposed ASR due to vehicle or equipment use in the PF.

7.1.6 Terrain and Topography

The RSA traverses three ecodistricts; Sturgeon Bay (676), Gypsumville (720), and Ashern (723). The Gypsumville (720) Ecodistrict is located within the RSA, but falls outside of the LSA. This ecodistrict occupies a small area surrounding Lake St. Martin between Lake Winnipeg and Lake Manitoba (Smith et al. 1998). The physiography of the region is mostly level to ridge till plain, partly covered with thin, glaciolacustrine clay deposits. Vegetation is dominated by forest stand mixtures of trembling aspen (*Populus tremuloides*), balsam poplar (*Populus balsamifera*), and white spruce (*Picea glauca*), while Jack pine (*Pinus banksiana*) prevails on drier sites (Smith et al. 1998). The principal sources of water in the ecodistrict are groundwater, and surface water from Lake St. Martin.

The Ashern (723) Ecodistrict is located within both the RSA and the LSA. The ecodistrict is between Lake Manitoba to the west and Lake Winnipeg to the east in the Interlake region (Smith et al. 1998). The ecodistrict slopes very gently toward Lake Winnipeg and westward toward Lake Manitoba (Smith et al. 1998). The physiography is the outcome of Glacial Lake Agassiz's retreat; wave action and iceberg scouring resulted in ridges of coarse-textured small rock (cobble and gravel) and finer-textured depressions (Smith et al. 1998). Forest stand vegetation is dominated by trembling aspen in the ridge areas, but often associated with balsam poplar and white spruce whose distribution is much affected by forest fires (Smith et al. 1998). Willow, sedge, and meadow grass occur in the poorly-drained depressions. Groundwater, the principal source of water in the ecodistrict, is from shallow sand and gravel aquifers associated with the glacial till deposits (Smith et al. 1998).

The Sturgeon Bay (676) Ecodistrict is located within both the RSA and the LSA. The ecodistrict encompasses most of the North Basin of Lake Winnipeg (Smith et al., 1998). The ecodistrict slopes gently northeastward toward Lake Winnipeg (Smith et al. 1998). The physiography is the outcome of Glacial Lake Agassiz's retreat; wave action and iceberg scouring resulted in ridges of coarse-textured small rock (cobble and gravel) and finer-textured depressions (Smith et al. 1998). Black spruce *(Picea mariana*) dominates forest stands due to extensive bogs/fens (peatlands) and poorly-drained mineral soils (transitional areas) (Smith et al. 1998). Associated vegetation varies from mosses, ericaceous shrubs, swamp birch (*Betula pumila*), sedge, willow, and tamarack (*Larix laricina*), depending if the area is characterized as a peatland or transitional area. Groundwater, the principal source of water in the ecodistrict, is from shallow sand and gravel aquifers associated with the glacial till deposits (Smith et al. 1998).

The elevation in the LSA for the proposed ASR is about 218 metres above sea level (masl) in the area of the proposed LSMOC Reach 3 Johnson Beach/Willow Point outlet, rising to an elevation of about 295 masl along the ridge that encompasses a section of the forestry road, and lowering to about 282 masl at the end of the municipal road. Table 75 and Map 44 in Appendix 1 provide a summary of the elevation data for a number of features in the LSA, which are portrayed on Map 44.

7.1.7 Geology and Soils

The RSA is located in an area of Manitoba referred to as the “Interlake” region as it lies between Lakes Manitoba and Lake Winnipeg. The geology of the RSA is composed of layers of Devonian, Silurian and Ordovician carbonates and sandstone formed during the Paleozoic era that overly or onlap with Precambrian granites or gneisses (Figure 4) (Leybourne et al 2007). The LSM area is a region of great geological interest as it was struck by a meteor during the Jurassic, Triassic or Permian period (Lapenskie and Bamburak 2015; Leybourne et al 2007; McCabe 1971). The LSM meteorite impacted dolomitic Ordovician to Devonian carbonates, basal sandstones and underlying Precambrian rock formations (Lapenskie and Bamburak 2015; Leybourne et al 2007; McCabe 1971). The LSM impact structure was described by McCabe (1971) as a crypto-explosion crater consisting of a crater or hole 14 miles (22.4 km) in diameter and more than 1,000 feet (about 350 m) deep, with a central core 2 to 3 miles (3.2 to 4.8 km) in diameter, consisting of highly shock-metamorphosed Precambrian gneiss that was uplifted by at least 700 feet (about 213 m), and is exposed in the centre of the crater. At the crater rim, lower Paleozoic and Precambrian rocks have been uplifted by 700 feet (about 213 m) or more and are exposed in outcrop near The Narrows of Lake St. Martin; beyond the crater rim is a structurally uplifted belt extending for about 14 miles (22.4 km) (McCabe 1971). The geological history of the area also resulted in large deposits of limestone, dolomite and gypsum, many of which have been mined for use as foundations and building structures, aggregate materials, cement, wallboard and Plaster of Paris (Government of Manitoba 2016e).

Over time, areas within the limestone, dolomite and gypsum deposits become dissolved, forming what is referred to as karst topography, which produces a variety of features such as underground drainage systems, sinkholes and caves (Bilecki 2003). These sinkholes and caves can provide wildlife habitat for a variety of species as dens, hibernacula and resting areas (Bilecki 2003). The Paleozoic boundaries mainly encompass the Interlake Plain (155), Mid-Boreal Lowlands (148), and a small portion of the Lake Manitoba Plain (162) Ecoregions, as defined by Smith et al. (1998). The RSA is located just south of the localized permafrost zone (Lockery 1984). The surficial geology can be described as very calcareous, stony (cobble or gravel), water-worked glacial till that is deep to shallow (20-30 m) over limestone bedrock (Smith et al. 1998). Additional information on the regional surficial and bedrock geology is provided in the “Assiniboine River & Lake Manitoba Basins Flood Mitigation Study LMB & LSM Outlet Channels Conceptual Design - Stage 2” prepared by KGS Group (2016).

Soils within the RSA are heavily influenced by the geology of the area. Chernozemic dark grey surface horizons result, as well as soils composed of luvisol, brunisol and organic matter (Mills 1984). The soils in the Gypsumville (720) Ecodistrict are typically imperfectly-drained, dark grey chernozems developed on strongly calcareous, loamy to clay glacial till; poorly-drained gleysol and black chernozem soils occur on shallower areas (Smith et al. 1998). The Ashern (723)

Ecodistrict is comprised of dominant soils in the higher ridges that are imperfectly-drained, dark chernozems developed on strongly calcareous, loamy to clay loam glacial till, while the low areas are dominated by poorly-drained gleysols to shallow, slightly decomposed organic soils (Smith et al. 1998). The soils associated with the Sturgeon Bay (676) Ecodistrict are very poorly-drained shallow to deep moderately-decomposed mesisols dominate soils, but local areas of very poorly-drained spaghnum fibrosols and imperfectly-drained brunisols on glacial till ridges also occur (Smith et al. 1998). Map 3 in the Wildlife Technical Report (Appendix 1) presents the soil landscapes of the RSA.

In 2011, KGS Group drilled soil data cores in specified areas surrounding LSMOC Reach 1 and LSMOC Reach 3 (KGS Group 2013). Results from the drilling identified that the surface soils were typically 0.75 to 0.9 m of organic peat underlain by silty clay till layers. The silty clay layers ranged from light grey, wet, soft with medium to low plasticity. There were some traces of sand and gravel to light brown, wet, low plasticity (KGS Group 2013). In some of the cores, the soil represented a silt till comprised of grey/tan, moist to wet, firm low plasticity soil with fine to coarse grain sand. Some gravel and clay was encountered followed by limestone granite bedrock at approximately 9.75 m (KGS Group, 2013). Additional soil surveys were completed in 2015 by KGS Group on the proposed ASR along the alignment of the existing winter roads to LSMOC Reach 1 and LSMOC Reach 3 (KGS Group 2016). Soils were found to be composed of a peat layer underlain by silty clay and silt till over boulders or dense silt till. The layers ranged from 0 to about 1.5 m of peat, 0.5 m to 1.5 m of silty clay, 1.5 m to 3.0 m of silt till, with boulders or dense silt till found at depths of about 3.8 m to 5.2 m (KGS Group 2016; Test Pits 15-32 to 15-71).

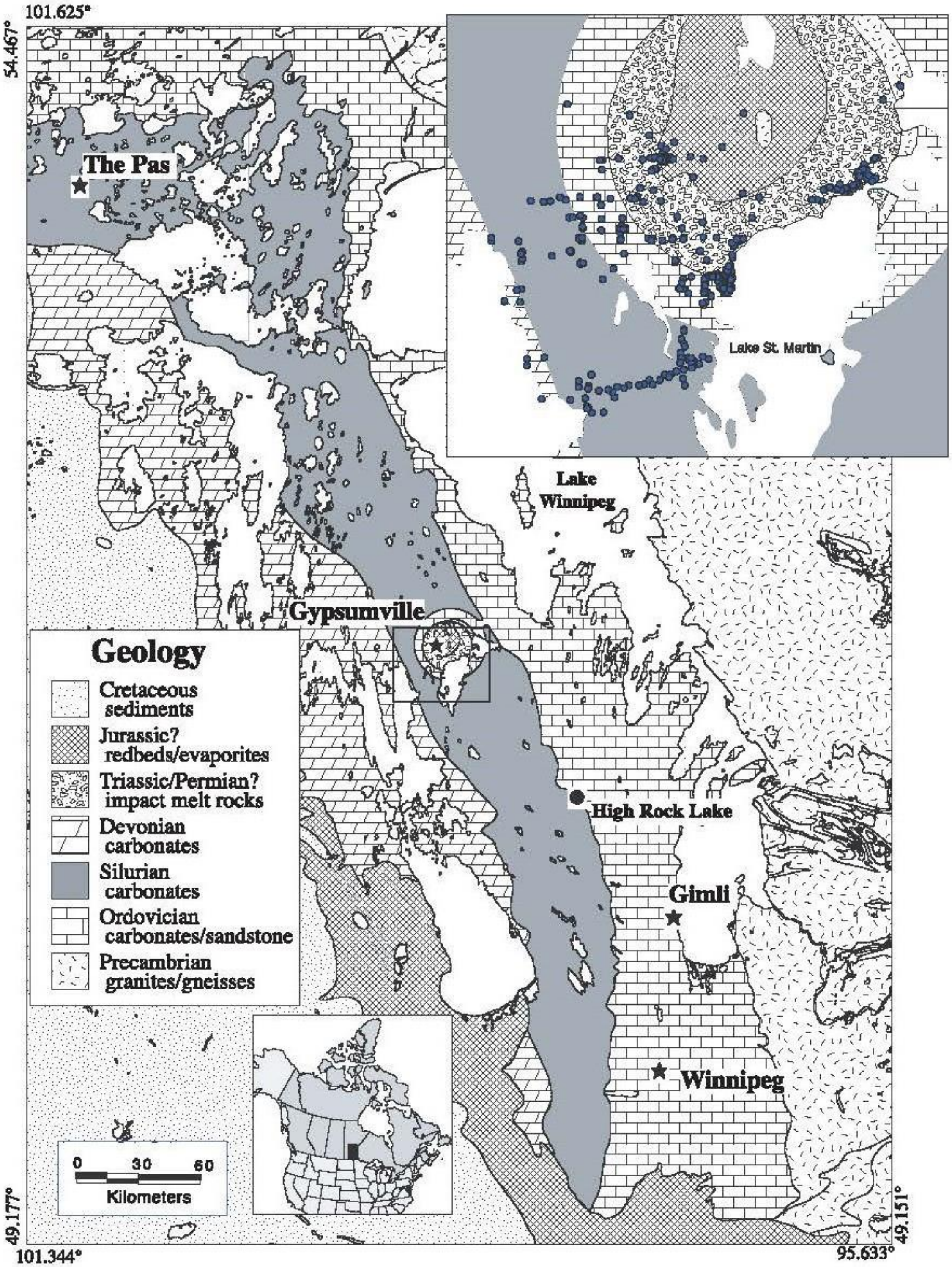


Figure 4: Geological information for the RSA and LSM meteor impact area (from Leybourne et al 2007)

7.1.8 Vegetation

The following information was obtained from the “Lake St. Martin Outlet Channel Proposed All Season Access Road – Vegetation Technical Report” prepared by S. Gray Environmental Services Inc. (2016) and provided as Appendix 2 to this report. Additional information on the vegetation studies for the ASR Project, including site photographs, is provided in Appendix 2.

7.1.8.1 Ecological Land Classification

The RSA is located within the Boreal Plains Ecozone. In Manitoba, the ecozone extends from the central portion of the Manitoba-Saskatchewan border east to Lake Winnipeg, and then south in a narrow band along the Red River (Smith et al. 1998). Balsam poplar, black spruce, jack pine, tamarack, trembling aspen, white birch (*Betula papyrifera*) and white spruce and are the most common tree species in the ecozone (Smith et al. 1998). Within the Boreal Plains Ecozone, the RSA is situated in the Gypsumville and Ashern Ecodistricts of the Interlake Plain Ecoregion and the southwest portion of the Sturgeon Bay Ecodistrict within the Mid-Boreal Lowland Ecoregion, which straddles the west side of Lake Winnipeg (Smith et al. 1998).

The Ashern Ecodistrict occupies a major portion of the area generally referred to as the “Interlake”. Trembling aspen dominates the forest stands in the ecodistrict, while balsam poplar and white spruce occur to a lesser extent (Smith et al. 1998). Poorly drained areas have willow (*Salix* spp.), sedge (*Carex* spp.) and meadow grass (e.g., *Poa* spp.) vegetation. Black spruce and tamarack dominate the vegetative cover in the bogs in association with swamp birch, ericaceous shrubs (e.g. Labrador tea [*Rhododendron groenlandicum*]) and sphagnum (*Sphagnum* spp.) and other mosses. Willows and sedges, and to a lesser extent tamarack, and various herbs and forbs, are dominant in fen peatlands (Smith et al. 1998).

The Gypsumville Ecodistrict occupies a small area in the north-central part of the Interlake Plain Ecoregion and encompasses Lake St. Martin (Smith et al. 1998). Nearly all of the soils are imperfectly drained, and the vegetation varies based on moisture content of the soils (Smith et al. 1998). The forest stands in the ecodistrict are a mixture of trembling aspen, balsam poplar and white spruce in varying quantities. Jack pine is prevalent on drier sites (Smith et al. 1998).

The Sturgeon Bay ecodistrict has poor drainage due to surface topography (Smith et al. 1998). Peatlands are extensive in the area; most being flat bogs and peat plateau bogs, but also consisting of horizontal and water track fens (Smith et al. 1998). Due to the extensive amounts of peatlands and poorly drained mineral soils, the majority of the Sturgeon Bay Ecodistrict consists of black spruce dominant bogs, transitional bogs and areas of poorly drained mineral soils. The associated vegetation in these stands varies from sphagnum and feather (e.g., *Ptilium crista-castrensis*) mosses, swamp birch and ericaceous shrubs such as Labrador tea, leatherleaf (*Chamaedaphne calyculata*) and bog rosemary (*Andromeda polifolia*) on bogs, to sedges, mosses, tamarack and willow on transitional bogs (Smith et al. 1998). Fens have vegetation dominated by tamarack, sedges, brown mosses, willow and swamp birch shrub, and occasionally some black spruce (Smith et al. 1998). The uplands have a varied vegetation dependent on drainage, soil texture and fire history. Stands are generally mixed with black spruce, jack pine, trembling aspen and white spruce (Smith et al. 1998). Shrubs include willow and red-osier dogwood (*Cornus sericea*) on wetter sites and ericaceous shrubs on dry sites. Feather mosses are common as groundcover in coniferous stands, whereas deciduous stands have a forb dominant ground cover, with a hazel (*Corylus* spp.) shrub layer (Smith et al. 1998).

7.1.8.2 Vegetation Cover Classification

Vegetative cover classes used to represent the communities and habitats within the RSA and LSA were obtained from the LCC. The LCC provides vegetated and non-vegetated land cover classes that identify the primary ecological and vegetation/habitat conditions of an area. The LCC for the vegetation RSA and LSA are provided in Figure 2 of Appendix 2, and a summary of the LCC information for the RSA and LSA is provided in Table 2 of Appendix 2. The primary land cover types in the RSA and within the LSA were shrub and herb dominant wetlands, with small areas of upland coniferous and mixedwood forests (Figure 2 in Appendix 2).

7.1.8.3 Wetland Classification

The wetland classifications used to identify the wetland habitats within the LSA were obtained from the Ducks Unlimited Canada's Enhanced Wetland Classification and conform to the Canadian Wetland Classification System (Ducks Unlimited Canada 2014). This classification system identifies five major wetland classes (Bogs, Fen, Swamps, Marshes, and Shallow Open Water) and 19 minor wetland classes. Bogs are organic peatlands that are stagnant, non-flowing systems and receive water only through precipitation. All bogs have a thick sphagnum moss layer and have a low diversity of plants due to the low nutrient availability. Fens are peatlands that receive water from a combination of precipitation, surface runoff and groundwater. Fens have a complex hydrology and can transport large volumes of water and nutrients across the landscape, often connecting wetland systems over large distances. Fens are more nutrient-rich than bogs and have greater plant diversity. Swamps are mineral wetlands that receive water from runoff, precipitation and groundwater. Swamps have fluctuating water tables and are seasonally flooded. Marshes are often a transition between open water and shoreline. They can be heavily influenced by stream inflow and fluctuate seasonally. Shallow Open Water wetlands have a water depth of less than two meters, yet deep enough to prevent the establishment of emergent plants such as cattails and rushes. Shallow Open Water wetlands have a water depth of less than two meters, yet are deep enough to prevent the establishment of emergent plants such as cattails (*Typha* spp.) and rushes (*Scirpus* spp.). They look like shallow lakes with pond lily and other floating leaf, free-floating and submergent aquatic vegetation present and are generally permanently flooded (Ducks Unlimited Canada 2014). This wetland classification system was used in combination with the LCC data to identify and classify the wetland areas in the PF and LSA, as well as identify potential habitat for rare species.

7.1.8.4 Summary of Field Investigations

A total of 142 plant species were identified during the spring and summer field surveys, including: four non-vascular species, 25 graminoids (sedges, grass, rushes), 31 shrubs, seven trees and 75 herbaceous species. Complete species lists are provided in Appendix C of Appendix 2.

Much of the RSA lies within a wet depression zone that is dominated by vast interconnecting areas of tree-less graminoid rich fens with scattered black spruce (*Picea mariana*)/tamarack (*Larix laricina*) sphagnum bogs and tamarack dominant transitional bog peatlands. Scattered glacial moraine ridges in the area have created strips of upland habitat dominated by coniferous jack pine stands and mixedwood forests comprised of tamarack, trembling aspen (*Populus tremuloides*), balsam poplar (*Populus balsamifera*) and white spruce (*Picea glauca*).

The proposed ASR consists of four sections: the municipal road section; the forestry road section (Idlywild Road); and two winter road sections, one to LSMOC Reach 1 and one to LSMOC Reach 3 (Figure 1). The proposed ASR started off passing by some tame hay pasture fields and trembling aspen stands (Figure 3: Plot 1 and 2; Photo 1 in Appendix 2). The timothy (*Phleum pratense*) and smooth brome (*Bromus inermis*) dominant pastures contained several invasive species such as common dandelion (*Taraxacum officinale)*, scentless chamomile (*Tripleurospermum perforate*) and yellow sweet clover (*Melilotus officinalis*), all of which were also found along the roadside. The understory within the aspen stand was dominated by shrubs such as willows (*Salix* spp.) and red osier dogwood (*Cornus stolonifera*), and herbaceous species adapted to damp woodlands, such as wild lily-of-the-valley (*Maianthemum canadense*), star flowered false Solomon's seal (*Maianthemum stellatum*) and yellow lady slipper (*Cypripedium parviflorum*). Seneca root (*Polygala senega*) was found within drier areas along the roadside and edge of the pasture within Plot 2. As the municipal road transitioned into the forestry road, the proposed ASR crossed several marshes and large graminoid rich fens dominated by sedges, common reed grass (*Phragmities australis*), bulrush (*Scirpus* spp.) and horsetail (*Equisetum* spp.), as well as species such as marsh marigold (*Caltha palustris*) and buck bean (*Menyanthes trifoliate*). Shrub species such as willows, red osier and bog birch (*Betula glandulosa*) were present along the edge of the wetland (Figure 3: Plot 3 in Appendix 2).

As the existing forestry road travels north, it followed a moraine ridge of upland white spruce, and aspen dominated the mixedwood forest habitat (Figure 3: Plot 4; Photo 2 in Appendix 2). A beaked hazel (*Corylus cornuta*) and green alder (*Alnus virdis*) shrub layer dominated the understory with moist woodland herbaceous species such as woodland strawberry (*Fragaria vesca*), wild sarsaparilla (*Aralia nudicaulis*) and black snakeroot (*Sanicula marilandica*) common throughout. Several invasive plant species were found along the roadside, including Canada thistle, dandelion and bird's foot trefoil (*Lotus corniculatus*). As the proposed ASR continued north along the moraine ridge, it crossed a creek with associated marsh and fen habitat dominated by graminoids and aquatic plant species (Photo 3 in Appendix 2). Dry sandier soils become more prevalent further north as the aspen dominant mixedwood forest transitioned to a jackpine (*Pinus* *banksiana*) dominating coniferous forest with some aspen remnants (Figure 3: Plot 5; Photo 4 in Appendix 2). This upland habitat was characterized by dry, open woodlands with a sparse low shrub layer dominated by creeping juniper (*Juniperus horizontalis*) and bearberry (*Arctostaphylos uva-ursi*). Invasive species such as absinthe (*Artemisia absinthium*), field chickweed (*Cerastium arvense*), and bird's foot trefoil were found within disturbed areas along the roadside.

As the proposed ASR continued north, it followed a sandy upland ridge surrounded by large fen and bog wetlands. Jackpine continued to dominate the surrounding coniferous forest (Figure 3: Plot 6 to 10; Photo 5 in Appendix 2). Seneca root was quite prevalent in this area, occurring frequently along the roadside and within dry open areas along the road. The proposed ASR in this area also started to encounter some transitional black spruce and tamarack bog habitats (Figure 3: Plot 7; Photo 6 in Appendix 2).

Where the forestry road ends and the winter road begins, the upland dry habitat gave way to low-lying wetland habitats characterized by a large expansive graminoid rich fen, with scattered 'islands' of black spruce and tamarack dominant sphagnum bogs (Photo 7 in Appendix 2). The large interconnected network of rich fen habitats consisted mainly of floating sedge and buckbean mats with areas of common reed grass, bog birch, willow, coltsfoots (*Petasites* spp.) and marsh marigold (Figure 3: Plot 11 and 15; Photo 8 in Appendix 2).

The 'islands' of treed and shrubby sphagnum bog habitats consisted of typical bog vegetation such as Labrador tea, pitcher plant (*Sarracenia purpurea*), bog laurel *(Kalmia polifolia*), bog rosemary, bog cranberry (*Vaccinium oxycoccos*), and three-leaved false Solomon's seal (*Maianthemum trifolium*) (Figure 3: Plot 13; Photo 9 in Appendix 2). A community of six dragon's mouth orchids (*Arethusa bulbosa*) was found within a shrubby bog growing in a bed of sphagnum moss.

As the proposed ASR continued towards the LSMOC Reach 3 access point, transitional upland mixedwood forests of tamarack, white spruce, aspen and jackpine were still present along the proposed ASR in between the large areas of fen and bog wetlands. These transitional upland forests contained a mixture of shrub species such as willow, hazel, sweet bayberry (*Myrica gale*) and speckled alder (*Alnus incana*); and herbaceous cover consisting of green bog-orchid, fringed milkwort (*Polygaloides paucifolia*), bedstraw (*Galium* spp.) and fringed gentian (*Gentiana crinita*) (Figure 3: Plot 14 and 16 in Appendix 2).

The LSMOC Reach 1 winter road branches off the main winter access road and heads northwest, passing through large areas of shrubby and graminoid rich fen habitat, before following a mainly dry ridge of mixedwood upland habitat dominated by trembling aspen, balsam poplar and white spruce as it approaches the LSMOC (Photo 2 in Appendix 2). This mixedwood forest contained a mixture of shrub species such as willow, speckled alder, and low-bush cranberry *(Viburnum edule*); and herbaceous cover consisting of common fireweed (*Chamaenerion angustifolium*), bedstraw and bunchberry (*Cornus canadensis*) (Figure 3: Plot 17 and 18; Photo 11 in Appendix 2).

7.1.8.5 Plant Species of Conservation Concern

Based on the desktop review, there are seven vascular plant species at risk that occur in the Interlake Plain Ecoregion and none in the Mid-Boreal Lowland Ecoregion. However, no plant listed under MESEA, SARA, or that having a special designation by COSEWIC are known or expected to occur in the RSA (Government of Canada [GC] 2015; Manitoba Conservation [MC] 2015). The small white lady's-slipper (*Cypripedium candidum*) and the rough agalinis (*Agalinis aspera*), are both Federally and Provincially Endangered, and have known distributions 100 km south of the RSA, close to St. Laurent, Manitoba (MC 2015; Environment Canada [EC] 2015a). Based on the known distribution and specialized habitat requirements of these species, there is an extremely low probability of these species' occurrence in the RSA (Manitoba Conservation 2015; EC 2015a).

The MBCDC lists 108 vascular plant species of conservation concern within the Interlake Plain Ecoregion (Appendix A in Appendix 2) and 55 species within the Mid-Boreal Lowland Ecoregion (Appendix B in Appendix 2) that have a provincial status of S1, S2 or S3. A search of the MBCDC database for recorded occurrences of rare species in the RSA and LSA found occurrences of one species of conservation concern in both the RSA and LSA, the ram's-head lady's-slipper (*Cypripedium arietinum*), which has a S2S3 designation (Friesen 2015, pers. comm.). The ram's-head lady's-slipper can be found in black spruce and tamarack sphagnum bogs and less so in drier upland coniferous forests (Foster and Reimer 2007).

A vegetation survey conducted by KGS Group in 2011 in the RSA, found two species listed by MBCDC to be of conservation concern (S2) that were identified during the field survey (KGS Group 2013). Three occurrences of green adder's mouth orchid (*Malaxis unifolia*) (S2) were encountered within damp black spruce sphagnum bogs. Two occurrences were located approximately 1.5 km and 2 km north of the Reach 1 Outlet Channel inlet, while one was encountered near the confluence of Buffalo Creek and the Dauphin River (KGS 2013). Habitat for this species was cited as common throughout the study (KGS Group 2013). The second species of conservation concern identified during the KGS Group field survey was eelgrass (*Zostera marina*) (S2), which was encountered at one location along Buffalo Creek beside a fen habitat (KGS Group 2013).

Black spruce and tamarack sphagnum bogs are common throughout the RSA and LSA and there is a high potential to encounter green adder's mouth orchid, ram's-head lady's-slipper, or other species of conservation concern that have similar habitat preferences (Foster and Reimer 2007). Eelgrass is an aquatic plant native to marine environments growing in the intertidal and subtidal zones of shallow bays, coves and estuaries (Hanson 2004). The known distribution of eelgrass in Manitoba is restricted to the Hudson Bay coastline and it is unlikely that this species is present within the RSA. It is possible that the eelgrass encountered during the KGS survey was misidentified as *Zostera marina* and is actually *Vallisneria americana*, the freshwater eelgrass, which is not a listed species.

No federally or provincially listed species were observed during the vegetation surveys. One species listed by the MBCDC having conservation concern was identified, Dragon's mouth orchid, which is ranked S2 by the MBCDC, meaning it is considered rare throughout its range or in the province (6 to 20 occurrences) and may be vulnerable to extirpation. A community of six individuals was observed within a small shrubby sphagnum bog surrounded by a large expansive rich fen. The orchids were growing on a raised mound of sphagnum moss surrounded by bog birch, Labrador tea, bog rosemary, bog laurel, and young tamaracks (Photograph 1).

Photograph 1: Dragon's mouth orchid observed along the proposed ASR within shrubby bog habitat at Plot 13 (taken on August 10, 2016)

7.1.8.6 Plant Species of Significance to First Nations

MI and First Nations consultations were ongoing at the time of this writing, and a list of species important to the local First Nation communities had yet to be compiled. However, it is known that Seneca root is gathered in the area and is an important plant used for medicinal and ceremonial purposes (NLHS 2015). The First Nations also used to gather various species of edible berries such as gooseberries (*Ribes uva-crispa*), as well as medicinal plants such as sweet flag (*Acorus calamus*), which is chewed for sore throats and to prevent colds, and found along riverbanks and wetland habitats (Traverse 1999).

During the field investigations, Seneca root was found along the municipal road and along the edge of the pasture located within Plot 2. It was also found in abundance at multiple locations along the proposed ASR within the jack pine dominating forests (Plots 6, 7, 9, and 10). The species was mainly found within the dry open areas adjacent to the road.

7.1.8.7 Invasive Plant Species

There was no available historical information on invasive species within the LSA or RSA. However, due to the level of human disturbance and activity along the proposed ASR, it is expected that invasives have been introduced and are present within the LSA. Invasive phragmites (*Phragmites australis* sub. *australis*) is a wetland invader that spreads quickly and outcompetes native species for water and nutrients. Invasive phragmites is commonly found in disturbed wet roadside ditches and can quickly crowd out native wetland vegetation resulting in decreased plant diversity. Much of the RSA is located in low-lying wet habitats that could be vulnerable to invasive phragmites establishment. Other invasive species expected to occur within the LSA are common dandelion, perennial sow thistle (*Sonchus* spp.) and Canada thistle (*Cirseum arvense*), as they commonly occur along disturbed roadsides and heavy traffic areas.

There were 12 species that are invasive to Manitoba that were identified within the LSA during the spring and summer surveys (Table 4 in Appendix 2). Scentless chamomile, which is a Tier 2 Noxious Weed under the Manitoba *Noxious Weed Act* (NWA) and an Early Detection and Rapid Response (EDRR) category 2 listed species by the Invasive Species Council of Manitoba (ISCM), was identified along the roadside and in the pasture north of the road located within Plot 2. Scentless chamomile is well adapted to wet, moist soils and periodic flooding, as well as drier areas and perennial forage fields. All efforts should be made to eradicate and control the spread of this species during construction. No Category 1 listed species were identified during the field surveys.

Canada thistle and yellow sweet clover, identified as moderate invasives by Environment Canada (EC 1999) and as Tier 3 noxious weeds under the NWA, were found at several locations within the LSA. Other Tier 3 noxious weeds and minor invasive plant species such as Kentucky bluegrass (*Poa pratenses*), absinthe and common dandelion were also observed within the LSA. These minor and moderate invasives were found predominantly along the roadside and previously disturbed areas along the ASR. These species vary in aggressiveness and are well adapted to a variety of habitats. They can quickly establish in disturbed areas and propagate by seed, and therefore can be easily spread. Preventing seed production and spreading using an integrated approach of combining herbicide and/or mechanical treatment with competition from desirable native plants is an effective way of controlling these species. Another important method to prevent the spread of invasive species is the use of clean native seeds in seeding rights-of-way (Parks 2010).

7.1.8.8 Vegetation Study Summary

The vegetation study was conducted to determine the existing vegetation, including wetlands, and delineate the vegetation habitat types within the proposed ASR Project area. The 5 km vegetation RSA for the proposed ASR lies within a large depression area that is widely covered by an expansive graminoid dominant rich fen characterized by floating sedge and buckbean mats with patches of common reed grass, bog birch and willows. Scattered throughout the large fen network are 'islands' of treed and shrubby sphagnum bogs dominated by Labrador tea, pitcher plant, bog laurel, bog cranberry, bog cranberry, and three-leaved false Solomon's seal. Some scattered upland mixedwood and coniferous forests are present on sandy moraine ridges. The majority of the proposed ASR followed the upland moraine ridge, which ranged from moist aspen and white spruce dominating mixedwood forests with a heavy willow and hazel shrub layer, to dry, open jack pine stands with creeping juniper and herbaceous dominant understory.

An additional focus of the study was the identification of any species at risk or species of conservation concern, species significant to First Nations, and/or invasive species within the Study Area. One species of conservation concern listed by the MBCDC was identified during the vegetation surveys, dragon's mouth orchid (S2). This species was found within a shrubby sphagnum bog, which is a common habitat type throughout the vegetation LSA. Although not encountered during the 2016 field surveys, there is a potential to encounter green adder's mouth orchid, ram's-head lady's-slipper, and/or other species of conservation concern that have similar habitat preferences. Seneca root was a species of significance to First Nations found during the field surveys. This species was mainly found along the proposed ASR within dry upland jack pine dominating forest and along the edge of open pastures. Twelve invasive species were identified during the field surveys. One species identified as a category 2 species by the ISCM and Tier 2 noxious weed under the NWA, scentless chamomile, was observed in a fairly isolated location along the municipal road and within the tame pasture to the north of the road.

7.1.9 Wildlife and Wildlife Habitat

The following information was obtained from the "Lake St. Martin Outlet Channel Proposed All Season Access Road: Wildlife Technical Report" prepared by EcoLogic Environmental Inc. (EcoLogic 2016) and provided as Appendix 1 to this report. Additional information on the wildlife studies for the ASR Project is provided in Appendix 1.

7.1.9.1 Mammals

The RSA, which occurs within the Manitoba Lowlands of the Boreal Forest, consists of flat, poorly drained land with forested patches of various deciduous and coniferous tree species, intermixed with swamps, meadows, and arable areas cleared for agriculture (Rowe 1972). Based on this diversity of habitat types, typical mammal species in the area include American marten (*Martes americana*), American beaver (*Castor canadensis*), black bear (*Ursus americanus*), coyote (*Canis latrans*), elk (Manitoba subspecies *Cervus elaphus manitobensis*), ermine (*Mustela erminea*), fisher (*Pekania pennanti*), grey wolf (*Canis lupus*), least chipmunk (*Neotamias minimus*), lynx (*Lynx canadensis*), mink (*Neovison vison*), moose (*Alces alces*), muskrat (*Ondatra zibethicus*), otter (*Lontra canadensis*), red squirrel (*Tamiasciurus hudsonicus*), snowshoe hare (*Lepus americanus*), and white-tailed deer (*Odocoileus virginianus*).

Moose are distributed across much of forested Canada (Banfield 1974) and are common within many areas of Manitoba including the Project Study Area. Moose are found particularly in forest, shrub and wetland habitats occupying much of the northern extent of Manitoba and increasingly are more common in the southern prairie region of Manitoba where they were previously absent, including Spruce Woods and Turtle Mountain Provincial Parks. Their home range is typically 40 km^2 where they are associated with riparian habitat, predominantly featuring willow, a key forage species, and other habitats that feature areas of aquatic feeding, coniferous cover, and mineral licks (Gillingham and Parker 2008). Such successional (newly emergent or young growth) vegetation frequently exists after disturbance, both natural (i.e. wildfire) and anthropogenic (i.e. forest removal).

Moose are most commonly found in swampy areas with aquatic plants and willows, which make up the majority of their diet (Renecker and Schwartz 1998). Cover is critical in winter to reduce snow depths and provide relief from heat stress in the summer. Moose are an integral component of the ecosystem in their predator/prey relationships. Moose population sustainability is a specific concern in several areas in western Manitoba.

Elk inhabit young coniferous tree stands and dense woodlands as well as meadows and valleys, including plains areas such as those found in the larger RSA. Elk are commonly found in early successional areas after disturbances such as fires where they find good foraging vegetation (Reid 2006). This foraging preference correlates with the fire history described previously, where a number of fires have occurred in the area since the 1980s.

White-tailed deer are also present in the RSA. White-tailed deer tend to inhabit both woodland and open areas, which are used for cover and forage (Reid 2006). The occurrence of higher ungulate populations in an area (increased prey) may result in increased predator populations. As a result, deer occurrence in areas near to moose may result in higher wolf populations in the area, and subsequent increases in predation.

Black bears are found across most wooded habitats in North America and are relatively common through northern mixed and eastern deciduous forests (Kolenosky and Strathearn 1987; Reid 2006). Black bear densities are highest in diverse forests at relatively early stages of development and lowest where soils are thinner and plant growth generally poorer (Kolenosky and Strathearn 1987). Black bears can take advantage of anthropogenic landscape change such as agricultural lands and woodlots. Agricultural crops provide a variety of vegetation and insects to feed on, as do woodlots, given many small prey reside in woodlots, and they are typically comprised of a variety of tree seeds, new successional vegetation, and insects. Black bears are found in the RSA in some areas, but due to habitat needs, they tend to stay away from the wetter lowland areas and select the denser areas of forest stands.

Coyote are a highly adaptable species found most commonly in mixed habitats rather than dense unbroken forests (Reid 2006). Coyotes are found throughout the RSA and feed upon small mammals and rodents, as well as scavenging on deer and larger ungulates. Coyotes, when banding together, can also take down these large animals (Caras 1967).

Grey wolves are also plentiful in most of Manitoba and in the RSA. They tend to inhabit forested areas with sufficient prey species such as moose, American beaver, and snowshoe hare.

The RSA offers suitable habitat to many furbearers. American beaver and muskrat provide valuable furs and, along with hares, good meat for eating. Ermine, fisher, American marten, mink, otters, red fox (*Vulpes vulpes*), and red squirrel are furbearers that are known to be present in the RSA.

Ermine habitat includes coniferous or mixedwood forests, fields, areas of dense vegetation and areas near wetlands, and can be found in most of these habitats in Manitoba, including the RSA (Reid 2006). Both fisher and American marten can be found in most of Manitoba with American marten being limited to primarily boreal areas of the province. They generally inhabit mature coniferous or mixedwood forests and will feed on small mammals such as hares, some birds, fruit, nuts, and carrion (Reid 2006). They also feed on rodents, shrews, and insects. Mink inhabit areas along streams, lakes, and wooded cover. They can be found in all of Manitoba and will primarily feed on small to medium mammals, crayfish, frogs, snakes, and birds (Reid 2006). Otters can be found in most of central/northern Manitoba and within the RSA near or in lakes, streams, rivers, or swamps. They feed on fish, frogs, crayfish, and shellfish (Reid 2006).

There are several species of small mammals that can be considered to be within or at the edge of their natural range. These include the least weasel (*Mustela nivalis*), masked shrew (*Sorex cinereus*), meadow jumping mouse (*Zapus hudsonius*), Northern bog lemming (*Synaptomys borealis*), pygmy shrew (*Sorex hoyi*), raccoon (*Procyon lotor*), short-tailed shrew (*Blarina brevicauda*), striped skunk (*Mephitis mephitis*), and woodchuck (*Marmota monax).*

There are six species of bats that may be found within the RSA. These include the big brown bat (*Eptesicus fuscus*), eastern-red bat (*Lasiurus borealis*), hoary bat (*Lasiurus cinereus*), little brown bat (or little brown myotis) (*Myotis lucifugus*), northern long-eared bat (or northern myotis) (*Myotis septentionalis*), and silver-haired bat (*Lasionycteris noctivagans*). The eastern-red, hoary and silver-haired bat species migrate south for the winter, while the big brown, little brown and northern long-eared bat species overwinter in hibernacula such as caves. The little brown bat and northern long-eared bat are listed as Endangered on Schedule 1 of SARA and MESEA (SARA 2015; MC 2015). SARA currently has a proposed Recovery Strategy for the little brown bat and northern long-eared bat, with three Critical Habitat areas for these species identified in the Interlake area of Manitoba (EC 2015b; Norquay et al. 2013). Additional information on Species At Risk (SAR) in the ASR Project area is provided in Section 7.1.13.

A list of known mammals that can be found in the Interlake Plain and Mid- Boreal Lowlands ecoregions and their conservation classification is presented in Appendix 1. Information on hunting and trapping of mammal species is provided in Section 7.2.5.

7.1.9.2 Birds

There are a number of types of birds and bird species present in the Mid-Boreal Lowland and Interlake Plain Ecoregions. These birds include raptor species such as bald eagles (*Haliaeetus leucocephalus*) and osprey (*Pandion haliaetus*). Bald eagles nest in tall shoreline trees along lakes, rivers, and open areas and primarily feed on water birds, small mammals, fish, and carrion (Bezener and De Smet 2000). Osprey can be found in most of Manitoba, in habitat located along slow flowing rivers, streams as well as lakes, where they nest in tall trees or on artificial platforms. Their diet consists mostly of fish, though they will also take rodents, birds, and small vertebrates (Bezener and De Smet 2000).

A variety of owl species can also be found within the RSA including but not limited to: the great grey owl (*Strix nebulosi*), great horned owl (*Bubo virginianus*), northern hawk owl (*Surnia ulula*), and short-eared owl (*Asio flammeus*).

Some of the forest birds that can be found within the RSA include: the bobolink (*Dolichonyx oryzivorus*), Canada warbler (*Cardellina canadensis*), common nighthawk (*Chordeiles minor*), eastern whip-poor-will (*Astrotomus vociferous*), eastern wood-pewee (*Contopus virens*), golden-winged warbler (*Vermivora chrysoptera*), grey jay (*Perisoreus canadensis*), olive-sided flycatcher (*Contopus cooperi*), ovenbird (*Seiurus aurocapilla*), red-headed woodpecker (*Melanerpes erythrocephalus*), and rusty blackbird (*Euphagus carolinus*), among others (Bezener and De Smet 2000; Peterson and Peterson 2002; Manitoba Avian Research Committee 2003; MBBA 2015).

Geese, ducks, and other waterfowl are also plentiful in the RSA. The RSA supports a variety of waterbirds and waterfowl such as the American white pelican (*Pelecanus erythrorhynchos*), black-crowned night heron (*Nycticorax nycticorax*), great blue heron (*Ardea herodias*), horned grebe (*Podiceps auritus*), least bittern (*Ixobrychus exilis*), trumpeter swan (*Cygnus buccinators*), and yellow rail (*Coturnicops noveboracensis*), among others (Bezener and De Smet 2000; Peterson and Peterson 2002; Manitoba Avian Research Committee 2003; MBBA 2015).

Shorebirds and gulls are found along the shores and on the islands of Lake Manitoba, Lake St. Martin, and Lake Winnipeg, including species such as the Caspian tern (*Hydroprogne capsica*), herring gull (*Larus argentatus*), and the piping plover (*Charadrius melodus*). The piping plover is very rare in Manitoba (MBCDC 2015) and is listed as endangered by SARA and MESEA. The piping plover uses low-gradient, un-vegetated, and wide shorelines with patchy gravel substrates (AESRD 2013). Additional information on SAR in the ASR Project area is provided in Section 7.1.13.

Within the RSA, there is a Canada Important Bird Area (IBA), referred to as the Lake St. Martin islands (IBA 2016). The IBA website states that "*the islands of Lake St. Martin support significant numbers of several colonial waterbird species: terns, cormorants, and pelicans. A total of 3,400 Common Tern nests were recorded at this site, representing about 3% of the estimated North*

American population of this species. In 1986, 1,500 Caspian Tern nests were recorded on a reef in Lake St. Martin. This number of nests is roughly equivalent to 4.5% of the North American Caspian Tern population. Double-crested Cormorants also occur in large numbers at this site. In 1991, 2,414 cormorant nests, or about 1.6% of the Interior cormorant population, were observed at this site. Hundreds of American White Pelicans nest here too, although a recent estimate is not available. In 1969, 670 nests were counted and if increases in the overall population of pelicans also occurred here, then the population on these islands may equal about 1% of the Canadian population of the species. Small numbers of Great Blue Herons and Black- crowned Night-Herons breed on islands within the lake. Twenty Great Blue Heron nests were recorded on an unnamed island in 1979, and another 20 nests were recorded on Big Fisher Island in 1991. Moderate numbers of ducks and geese breed and migrate amongst the Lake St. Martin Islands, and small numbers of Forster's Terns have nested in the past in the marshes bordering Lake St. Martin. Bald Eagles have been recorded as both a breeding and a staging species - it is thought that they are attracted to the fish that spawn at the mouth of the Dauphin River" (IBA 2016).

A listing of known birds that can be found in the Interlake Plain and Mid-Boreal Lowland ecoregions and their conservation classification is presented in Appendix 1.

7.1.9.3 Reptiles and Amphibians

The RSA provides habitat for a number of reptile and amphibian species. The red-sided garter snake (*Thamnophis sirtalis*) has the northernmost distribution of any species of snake in North America and, along with the smooth green snake (*Opheodrys vernalis)* and the western plains garter snake (*Thamnophis radix*), are the only snake species to inhabit this area (Cook 1984; Conant and Collins 1991; Nature North 2014; Preston 1982). The red-sided garter snake prefers mesic woodlands where they can be often found at the margins of ponds (Preston 1982). They will often hibernate within crevices in upland areas. The range of the red-sided garter snake extends throughout much of the RSA (Conant and Collins 1991). The limestone substrate found within the LSA is characterized by crevices and cavernous formations that make for suitable habitat for snake hibernacula.

The species of frogs and toads that may occur within the area include: boreal chorus frog (*Pseudacris maculata*), Canadian toad (*Anaxyrus hemiophrys*), grey tree frog (*Hyla versicolor*), northern leopard frog (*Lithobates pipiens*), and wood frog (*Lithobates sylvaticus*) (Conant and Collins 1991). With the exception of the northern leopard frog, these species generally require shallow ponds and puddles for breeding and moist environments in shrubby and wooded areas for the rest of the year. The northern leopard frog requires several habitat types to meet its needs throughout the year, using different sites for overwintering, breeding, and foraging. The overwintering sites for northern leopard frogs need to be well-oxygenated bodies of water that do not freeze to the bottom (SARA 2015). A typical breeding pond is 30 m to 60 m in diameter and 1.5 m to 2.0 m deep, located in an open area with abundant vegetation and no fish (SARA 2015). The eastern tiger salamander (*Ambystoma tigrinum*) and the blue-spotted salamander (*Ambystoma laterale*) are two other amphibian species also found within the RSA (MBCDC

2015a,b). Both the eastern tiger salamander and the blue-spotted salamander prefer moist woodlots and wetland edge habitats (Nature North 2014).

A list of known amphibians and reptiles that can be found in the Interlake Plain and Mid- Boreal Lowlands ecoregions is presented in Appendix 1.

7.1.9.4 Key Species for Analysis

The federal environmental assessment process typically includes the need for the identification of Valued Ecosystem Components (VECs) in the area of interest to focus the environmental assessment on key species or key components of the environment. The Canadian Environmental Assessment Agency (CEAA) defines a Valued Ecosystem Component as "the environmental element of an ecosystem that is identified as having scientific, social, cultural, economic, historical, archaeological or aesthetic importance" (CEAA 2012).

The selection of VECs is used to identify key species in the study area of interest that can represent a trophic level or guild of species (e.g., selection of a key ungulate species that is also important for human consumption), rather than conducting an assessment of all individual species in an area. Key species are selected based on their biological and socio-economic role in the ecosystem, their ability to represent the habitat and/or life history requirements of similar species, and may include SAR or species of conservation concern to ensure that protected and rare species are accounted for in an environmental assessment.

As such, the desktop and field studies for wildlife and wildlife habitat included the collection of baseline data for the wildlife species found in the Project Study Area, followed by the identification of a number of key wildlife species of interest and/or importance in the Project Study Area, to focus the analysis of potential habitat changes or other effects of the Project activities, and provide context for the future environmental assessment.

Key species of interest in the Project Study Area were identified to focus the analysis of potential habitat changes and/or other effects of the Project activities, and provide context for the future EIA. Key species were selected using the process for VEC selection defined by CEAA, information collected during the desktop studies, and previous knowledge of the area.

Table 9 provides a list and rationale for the key wildlife species in the ASR Project RSA that were selected for analysis. The key wildlife groups and species included:

- Moose;
- Elk;
- American marten;
- American beaver;
- Bats;

- Migratory birds (forest birds and water birds);
- Reptiles and amphibians; and
- Ecologically Sensitive Sites (mammal dens, rookeries, large stick nests, mineral licks, bat and snake hibernacula).

Table 9: Summary of Key Species Selection and Rationale

Group	Key Species	Rationale
Ungulates	Moose	• Demonstrate large home ranges (~40km²) • Important prey species for large carnivores e.g. wolves • Hunted by rights-based and licensed hunters
	Elk	• Demonstrate large home ranges (50-400 km²) • Important prey species for large carnivores e.g. wolves • Hunted by rights-based and licensed hunters
Furbearers	American marten	• Commonly trapped furbearer • Important species for predatory/prey dynamics • Representative of mature forest habitat
	American beaver	• Ecosystem engineer • Representative furbearer for aquatic habitat
Bats	Little brown bat (little brown myotis) Northern long-eared bat (northern myotis)	• Listed as "endangered" under SARA and MESEA • Critical habitat for these species already identified in the Interlake region • Geology within the RSA is conducive to support these species – representative of karst habitat
Migratory Birds	Forest Bird Species (including Barn Swallow, Bank Swallow, Bobolink, Canada Warbler, Common Nighthawk, Eastern Whip-Poor-Will, Eastern Wood-Pewee, Golden-winged Warbler, Olive-sided Flycatcher,	• Some species listed as "endangered", "threatened" or "special concern" under COSEWIC, SARA and/or MESEA • Key species selected as representative of forest habitat types

Table 9: Summary of Key Species Selection and Rationale

Group	Key Species	Rationale
	Peregrine Falcon, Red-headed Woodpecker, Short-eared Owl)	
	Water Bird Species (including American White Pelican, black-crowned night heron, Caspian tern, horned grebe, least bittern, piping plover, trumpeter swan, yellow rail, ducks and geese)	• Some species listed as “endangered”, "threatened" or "special concern" under COSEWIC, SARA and/or MESEA • Some species hunted by rights-based and licensed hunters
Reptiles and Amphibians	Northern leopard frog, red-sided garter snake	• Northern leopard frog listed under SARA and MESEA • Red-sided garter snake species most commonly found snake within RSA
Ecologically Sensitive Sites	Bat and snake hibernacula, terrestrial mammal dens (e.g. bears, wolves), rookeries large stick nests, mineral licks	• Critical wintering habitat • Critical breeding habitat • Species fidelity to dens and nests • Culturally significant sites

7.1.9.5 Data Collection and Analysis

7.1.9.5.1 Habitat Evaluation

The dynamic ecosystem where the RoW is located will be undergoing continuous change from both natural (e.g. flood, fire) and human disturbance (e.g. logging, landscape change). To establish the baseline habitat conditions prior to construction, an evaluation of existing habitat conditions was conducted using the Land Cover Classification (LCC) spatial data base developed by the federal government. The LCC analysis was used to determine the type of habitat currently available within and adjacent to the proposed ASR works. The LCC covertype analysis provides a quantitative assessment into the amount of habitat available within the LSA and RSA. Additional information on the LCC and methods for analysis are provided in Appendix 1.

Table 10 provides the results of the LCC analysis by area (km^2) and percentage of cover types. The LCC habitat analysis results showed water, wetland shrub, and grasslands as the most commonly occurring habitat covertypes within the LSA and RSA. There were very little (<1%) low shrub, tall shrub, developed or exposed land covertypes located within the LSA and RSA. The LCC of the RSA is provided in Map 4 in Appendix 1.

Table 10: LCC Covertypes within the RSA and LSA

LCC-Cover Type	RSA		LSA (Proposed ASR)	
	Area km^2	Percent (%)	Area km^2	Percent (%)
100-Herb	118.26	1.74%	1.97	0.17%
110-Grassland	691.64	10.16%	6.06	0.52%
121-Annual crops	28.21	0.41%	0.06	0.01%
122-Perennial crops and Pasture	70.02	1.03%	0.56	0.05%
20-Water	1500.20	22.04%	97.25	8.33%
211-Coniferous - Dense	415.19	6.10%	83.55	7.16%
212-Coniferous - Open	82.87	1.22%	20.10	1.72%
221-BroadLeaf - Dense	376.68	5.53%	21.91	1.88%
222-BroadLeaf - Open	205.63	3.02%	33.15	2.84%
231-MixedWood - Dense	264.79	3.89%	45.90	3.93%
33-Exposed Land	17.74	0.26%	2.22	0.19%
34-Developed	43.20	0.63%	1.52	0.13%
51-Shrub -Tall	7.37	0.11%	0.91	0.08%
52-Shrub - Low	1.87	0.03%	0.00	0.00%
81-Wetland Treed	117.04	1.72%	22.29	1.91%
82-Wetland Shrub	1997.31	29.35%	611.24	52.38%
83-Wetland Herb	867.84	12.75%	218.34	18.71%
Total Area	6805.85	100.00%	1167.03	100.00%

7.1.9.5.2 Fire History

The evaluation of the type and amount of habitat available to wildlife species is influenced by natural disturbances such as forest fires. Forest fires are important for the health, regeneration and succession of the boreal forest. Boreal forest fires play an important role in characterizing forest composition, energy cycles, and biochemical processes.

The spatial fire history data for the RSA were mapped and assessed for the timeframe between 1928 and 2013. This timeframe was used as it provided a set of consistent data that were collected by the province and available for analysis. Spatial fire data obtained from the Manitoba Land Initiative (MLI) website were clipped (constrained) to the RSA. Burn years were classified into 5 year periods (1930-34, 1935-39 etc.) with the total area burned calculated and expressed in km^2, thus providing a 5-year fire trend for the RSA over the majority of the last century. Map 5 in Appendix 1 illustrates the fire activity within the RSA over the last 84 years.

Within the RSA, based on the fire history collected between 1928-2013, it would appear that a major burn cycle occurs every 20-25 years with approximately 1500-3000 km^2 (32-55% of total area) of mature habitat being burnt. Smaller burns are occurring during that time; however, large landscape burns appear to be on a 20-25 year cycle. As a result, within 5 to 10 years following a major fire event, the growth of successional vegetation would offer good quality habitat for moose on the landscape. Given the last major burn event occurred in 1985-89, if the 20-25-year cycle occurs again, another major burn event should occur in 2015-2019 within the RSA. However, given that the only available spatial fire history data were from 1928 onward, there is limited information available to determine burn cycle events beyond the last 90-year period.

The data collection from the 1950s onward is more accurate in comparison to the fire data collected prior to the 1950s as data collection, technological advances and reporting techniques had improved in the 1950s and onward. Moose populations thrive in areas of frequent fire (Gillingham and Parker 2008). Given small burns occur on the landscape frequently, habitat is regenerated. However, based on the 90-year data, major large-scale burns are relatively infrequent within the RSA. In addition to fire suppression efforts in recent years, the combination of these two factors may influence the future availability of moose habitat within these areas.

7.1.9.5.3 Linear Density Analysis for Moose

Although moose have been extensively studied, little research has focused on the effects of habitat fragmentation and the habitat or landscape thresholds (boundary beyond which change occurs) in the management of the species. Salmo et al. (2004) compiled a table of management indicators and guidelines for moose based on studies across Canada and recommended that access density and stream crossing indices be used as land-use indicators, and that core areas and patch/corridor size be used as habitat indicators when conducting cumulative effects assessments. In summary, the authors identified a target threshold for linear disturbance for moose on a landscape scale at a density of 0.4 km/km^2 (i.e., linear disturbance features divided by the total area of interest) and a critical threshold density of 0.9 km/km^2. As such, analyses were conducted to identify the density of linear features in the LSA and RSA in comparison to the published Salmo et al. (2004) thresholds for moose.

The current linear density for moose was found to be 0.10 km^2 within the LSA and 0.22 km^2 within the RSA, which are below the published Salmo et al. (2004) thresholds. The linear density analysis of Project-related linear developments within the LSA and RSA identified that, regardless of which channel or reach option is selected for the overall Project, the linear density of the LSA and RSA will remain below the published Salmo et al. (2004) linear density thresholds for moose.

7.1.9.6 Wildlife Study Summary

7.1.9.6.1 Desktop Studies and Key Species for Analysis

The "Lake St. Martin Outlet Channel Proposed All Season Access Road: Wildlife Technical Report" (EcoLogic 2016) was developed for the ASR component of the Project to provide a detailed summary of the wildlife data collection activities, methods, analyses, and results that were conducted to date within the RSA and LSA. The desktop and field studies for wildlife and wildlife habitat included the collection of baseline data for the wildlife species found in the ASR Project RSA, followed by the identification of a number of key wildlife species of interest and/or importance in the ASR Project RSA, to focus the analysis of potential habitat changes or other effects of the Project activities, and provide context for the future EIA.

Data were gathered from various agencies and sources to provide historical context to mammal, avian reptile and amphibian presence and distribution within the RSA. Habitat modelling was conducted for moose, elk, white-tailed deer, beaver, marten, and a number of bird species listed as Species At Risk or species of special concern. The fire history for the area was collated and reviewed to examine changes in vegetation on the landscape over time due to fire activity, which can influence the quality and availability of browse and other habitat conditions for moose and other wildlife. The desktop studies also included a linear density analysis for moose to establish the existing presence, size and type of linear features on the landscape that may affect moose and their habitat.

7.1.9.6.2 Moose

A total of 14 moose were observed to be present in the overall Project RSA during the winter 2016 winter aerial survey. Moose were observed to be present in the area of the LSMOC Reach 1, Reach 2, and Reach 3 options; along the east side of the forestry road in the LSA for the proposed ASR; and along the west side of the LMOC Route C LSA. Habitat modelling for moose showed the presence of summer habitat throughout the RSA and LSA, with winter habitat more prevalent in the areas north, east and west of the existing winter roads (Appendix 1).

There were a number of existing paved, gravel and dirt roads and trails located throughout the RSA and LSA, as well as snowmobile trails. The presence of these roadways and trails suggests that current access for hunting and recreation is widely available in the LSA and RSA.

7.1.9.6.3 Elk

Based on habitat characterization and modelling conducted prior to field investigations, habitat for elk was shown to be present in the southern and western portions of the RSA, with very little elk habitat present near the existing LSMOC and winter roads. A total of 16 elk were observed to be present in the overall Project RSA during the winter 2016 aerial survey; these observations were located along the east side of the LMOC Route D LSA and near the community of Spearhill in the LSMOC/ASR LSA. During the June 2016 ground surveys, there were no signs of elk presence observed in the LSA for the proposed ASR. As noted above, there were a number of existing paved, gravel and dirt roads and trails located throughout the RSA and LSA, as well as snowmobile trails. The presence of these roadways and trails suggests that current access for hunting and recreation is widely available in the LSA and RSA.

7.1.9.6.4 Furbearers

The winter 2016 aerial multispecies survey identified the presence and/or tracks of beaver, marten, otter, hare, lynx and coyote in the RSA (Appendix 1). Maps 29 to Map 34 in Appendix 1 show the core use areas (i.e., spatial distribution) for beaver, marten, otter, hare, lynx, and coyote in the RSA as created from the winter 2016 aerial multispecies survey data.

American beaver activity in the LSA was found in the areas around the existing Reach 1 winter roads and along the east side of the lower (i.e., southern) section of the existing forestry road. All of the observed American marten activity in the RSA was located throughout the LSA, with higher activity in the area of Reach 2 and the upper (i.e., northern) section of the forestry road. Otter activity was observed in the area of the Reach 1, Reach 2 and Reach 3 options, as well as in a section along the east side of the lower section of the forestry road. Hare activity was observed throughout the LSA, and three lynx were identified within the LSA along the east side of the lower section of the forestry road. There were a number of coyote observations and tracks identified in the LSA in the area of the Reach 1, Reach 2 and Reach 3 alignments, and along the east side of the lower section of the forestry road. Three wolves were also observed during the winter 2016 aerial surveys about 2 km north of the northern section of the forestry road, and one wolf was sighted by the aquatics field crew on April 29, 2016 on the forestry road, about 9 km south of where the three wolves were sighted during the winter 2016 aerial survey (M. Lowdon pers.comm., 2016). During the aerial survey conducted in October 2015, a large adult black bear was observed in the LSMOC and ASR LSA.

Tables 19 and 20 in Appendix 1 provides a summary of the furbearer activity and presence identified during the spring 2016 ground surveys, and Table 21 in Appendix 1 provides a summary of the predator activity and presence identified during the spring 2016 ground surveys.

7.1.9.6.5 Birds

Key bird species of interest in the LSA and RSA were identified through review of information from the Manitoba Breeding Bird Atlas (MBBA 2015), Manitoba Conservation Data Centre (MBCDC 2015a,b), Manitoba Conservation (MC 2015), Important Bird Areas of Canada (IBA 2015) and the federal Species At Risk Act (SARA 2015). Habitat modelling was conducted for the 20 bird species identified in Table 9 to examine the available habitat for these bird species within the LSA and RSA. Four of the 20 modelled species (bank swallow, common nighthawk, least bittern and trumpeter swan) were confirmed to be present within the LSA. As of September 2015, the bank swallow was listed as threatened under COSEWIC; the common nighthawk was listed as threatened under COSEWIC, SARA and MESEA; the least bittern was listed as threatened under COSEWIC and endangered under SARA and MESEA; and the trumpeter swan was listed as endangered under MESEA. Additional information on these species is provided in Appendix 1, as well as a list of all bird species confirmed to be present in the LSA.

In addition to the habitat modelling, pedestrian bird and nest searches, and point count surveys, the avian field studies included a raptor nest and heron rookery search. A total of three eagle nests, a goose nest, a small stick nest and two nesting snags were observed in the LSA (Table 71, Map 44 in Appendix 1). A number of nesting islands, some of them being used by cormorants, pelicans and terns, were observed within the RSA, but these areas were located outside of the proposed ASR LSA. There was a significant heron rookery observed on one of the Lake St. Martin islands south of the Narrows within the RSA, but outside of the proposed ASR LSA.

7.1.9.6.6 Reptiles and Amphibians

The reptile and amphibian surveys recorded observations and vocalizations of three amphibian species in the LSA: boreal chorus frog, grey tree frog and wood frog; and observation of one reptile species in the LSA, the red-sided garter snake. There were no other reptiles or amphibians observed or heard during the spring and summer 2016 field surveys.

7.1.9.6.7 Bat Species

During winter 2016 aerial surveys, potential areas containing bat (and snake) hibernacula and large mammal dens were observed in the RSA. These sightings were way-pointed within the RSA during the winter 2016 aerial survey and further investigated on foot during the spring 2016 and summer 2016 field work.

The spring 2016 and summer 2016 ground surveys identified potential areas of previously and/or currently active bat hibernacula within the LSA for the proposed ASR. To determine the presence/absence and species of bats within the LSA, an Acoustic Recording Unit (ARU) was deployed within the LSA and along the proposed ASR in 2016 during the months of August, September, and October. During the time the ARU was deployed, there were four bat species that were identified: big brown bat, hoary bat, little brown bat and silver-haired bat. The acoustic data collected from September 26, 2016 to October 17, 2016 included a small number of recordings that also indicated the potential presence of the northern long-eared bat. To determine if there were any areas within the LSA for the proposed ASR being used by bats for hibernation, further investigations were conducted in March and April of 2017. These investigations included a FLIR aerial study to locate potential heat signatures or ‘hotspots’ on the landscape that could indicate the presence of hibernacula, followed by pedestrian searches of the hotspot areas. There were 12 hotspot locations identified during the FLIR aerial survey that were investigated by pedestrian surveys. The pedestrian investigations determined that the hotspot locations identified during the winter aerial FLIR survey were false positives. Further ground-based investigation was also conducted of the potential hibernaculum that was identified during the 2016 baseline field studies; this investigation showed that the area was not being actively used by bats. As such, the bat Species at Risk field studies conducted during March and April of 2017 did not identify the presence of active bat hibernacula within the LSA for the proposed ASR (EcoLogic 2017).

7.1.9.6.8 Ecologically Sensitive Sites

The Ecologically Sensitive Sites identified within the ASR LSA and RSA included areas of rock outcrops and sinkholes that could potentially provide winter hibernacula for overwintering snake and bat species in the area. As noted above, further investigations of these areas did not identify the presence of active bat hibernacula in the LSA or RSA. There were two sinkhole areas identified that could serve as potential snake hibernacula; these sites were located approximately 4 km from the centreline of the proposed ASR on the west side of the upper section of the existing forestry road (Map 49 in Appendix 1). There were no mineral licks identified during any field studies conducted within the ASR LSA or RSA.

As noted above, a number of nesting islands, some of them being used by cormorants, pelicans and terns, were observed within the RSA, but these areas were located outside of the LSA for the proposed ASR. There was also a significant heron rookery observed on one of the Lake St. Martin islands south of the Narrows within the RSA, but outside of the proposed ASR LSA.

7.1.10 Groundwater

The RSA is located within the Manitoba Lowland physiographic region, which is described as an area of gentle relief lying to the east of the Manitoba Escarpment (Betcher et al. 1995). This area is underlain by gently southwestwardly dipping Paleozoic and Mesozoic sediments consisting mainly of carbonate rocks with some clastic and argillaceous units, with bedrock overlain by glacial tills and proglacial lacustrine sediments (Betcher et al. 1995). The major lakes of Manitoba occupy portions of this lowland area.

The surficial deposits within the RSA consist mainly of glacial till and sand and gravel deposits, with fairly extensive sand and gravel deposits at the surface being common in the area (Rutulis 1973). The availability and quality of groundwater is dependent upon the presence of shallow aquifers, which are generally sand or sand and gravel lenses (Rutulis 1973). The depth to these aquifers may range from less than 6 m where the sand and gravel deposits are at ground surface, to more than 60 m in low-lying areas where thick clay beds cover the aquifer (Rutulis 1973). Water quality in the sand and gravel aquifers ranges from fair to excellent (Betcher et al. 1995; Rutulis, 1973). Areas where the sand and gravel deposits are at or close to the ground surface and that are probable or existing groundwater sources are susceptible to contamination from surface activities (Rutulis 1973). Flowing artesian well conditions are somewhat common in the study area, in particular along Birch Creek, and in the vicinity of Lake St. Martin (KGS Group 2016). Flowing artesian well conditions also occur in the Dauphin River area and are consistent with the 2011 and 2015 field investigation results where artesian flow conditions were encountered up to 1 m above ground surface (KGS Group 2016).

KGS Group (2016) reported that the regional groundwater flow is easterly towards Lake Winnipeg, as well as westerly toward Lake Manitoba and Lake St. Martin (and Lake Winnipegosis). Discharge from the aquifer occurs as seepage and flow into streams, marshes, and lakes found throughout the Interlake, with piezometric pressures in the aquifer between approximately El 250 m to El 260 m (820 feet [ft] to 853 ft) in the Birch Creek (Route D) area, and between approximately El 240 m to El 250 m (787 ft to 820 ft) in the Fairford River area (KGS Group 2016). KGS Group (2016) also reported that sparse data available in the northeast, near Dauphin River, show regional piezometric levels in the order of El 220 m to El 230 m (721 ft to 755 ft).

Well yields are highly variable in the region, which is a direct result of the fractured rock conditions, with water yields dependent on the number of fractures intersected by a well and the aperture size, extent, and interconnection to other fractures (KGS Group 2016). East of Lake Manitoba, the water quality is generally fresh, with Total Dissolved Solids (TDS) <1,000 mg/L, and water quality generally of the Mg-Ca-HCO3 type, with TDS in the order of 400 mg/L to 650 mg/L (KGS Group 2016). KGS Group (2016) noted that this water quality is reflective of the effects of the meteor impact described in Section 6.1.7 and aquifer recharge zone noted within the Interlake area. Due to more complex geology and evaporate mineralogy in the Gypsumville area, water quality varies and is locally poorer with TDS concentrations up to 4,550 mg/L (Betcher 1987).

There were no groundwater data found specific to the proposed ASR PF or LSA. The majority of the area within the LSA for the proposed ASR is undeveloped and uninhabited, with the exception of seasonal trailers and other small dwellings used for hunting and recreation. As such, there were no recent or local data available for groundwater use, groundwater quality or well yields in the proposed ASR PF or LSA. It is expected that the construction and operation of the ASR will not affect groundwater resources in the PF or LSA; however, given that groundwater resources in the area are close to the ground surface or artesian, precautions should be taken to prevent contamination of groundwater and surface water in the area in keeping with *The Ground Water and Water Well Act* (C.C.S.M. c. G110) and the *Well Drilling Regulation* (Manitoba Regulation 28/88 R) (Manitoba Water Stewardship 2011).

7.1.11 Surface Water

The LSA for the proposed ASR encompasses portions of the north basin of Lake St. Martin; Bear Creek; Winthers Creek and other unnamed and named creeks that flow to Mantagao Lake; and Sturgeon Bay in Lake Winnipeg. An unnamed creek that flows to Little Buffalo Lake, the headwaters of Bear Creek, and a portion of Winthers Creek are located within the PF area of the proposed ASR. Figure 5 provides a map of the watercourses and waterbodies located within the LSA that are connected to the proposed ASR. The proposed ASR includes a series of culverts, including where it intersects the three above mentioned watercourses. Further information on the culvert locations and crossing identification is provided in the "Lake St. Martin proposed ASR Fisheries and Aquatic Habitat Assessment" prepared by AAE Tech Services Inc. (AAE) (2016) included as Appendix 3 to this report.

There were no historical hydrological or surface water chemistry data found for the watercourses located within the LSA and PF. Water velocity and water chemistry parameters for the three creeks that cross the proposed ASR were collected by AAE as part of aquatic field investigations in 2015 and 2016 (Appendix 3). The aquatic field studies for the proposed ASR focused on watercourses and waterbodies within the LSA that could provide habitat for fish, specifically species that support a Commercial, Recreational or Aboriginal (CRA) fishery and/or Species At Risk; as such, the collection of water velocity and water chemistry data was limited to the one section of Bear Creek and two sections of Winthers Creek that cross the proposed ASR. These crossings were referred as Crossing 1 - Winthers Creek, Crossing 2 - Winthers Creek and Crossing 3 - Bear Creek (Appendix 3).

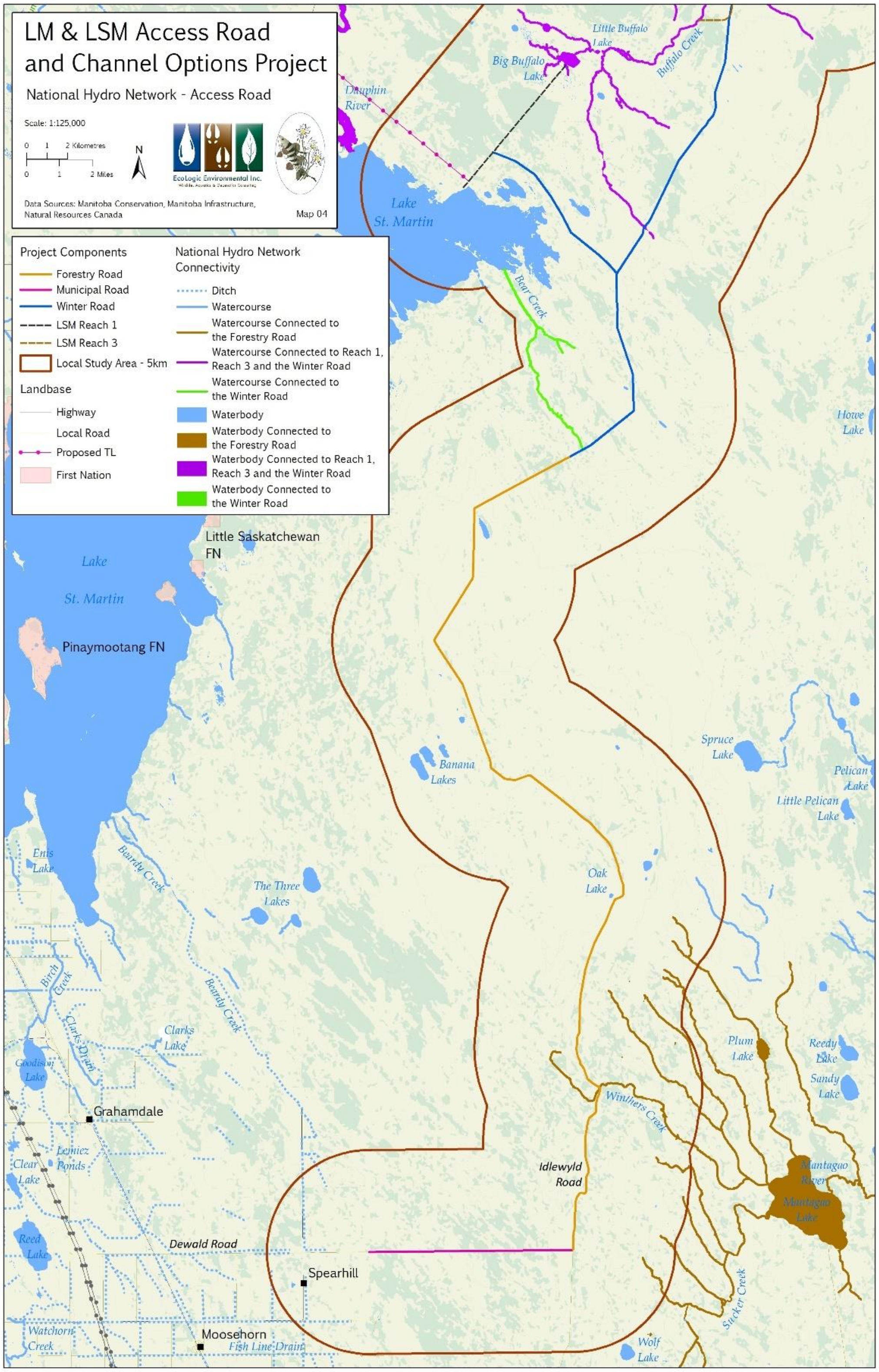


Figure 5: Watercourses and Waterbodies in the LSA and Connectivity with the Proposed ASR

7.1.11.1 Water Velocity

During the 2015 fall study period, water velocity measurements were only obtained at Crossing 2 due to the no-flow conditions observed at Crossings 1 and 3 (Table 1 in Appendix 3). The study took place during a period when routine maintenance of the culverts crossings was being conducted by MI. Grubbing and clearing of the culvert at Crossings 1 and 2 took place October 22, 2015. Average water velocities at Crossing 2 were measured on October 22, 2015 and again on October 23, 2015 to document changes in response to the culvert clearing.

Water velocity was measured as 0.28 metres/second (m/s) on October 22, 2015 very shortly after grubbing, and was measured as 0.18 m/s the following day once upstream water levels had dropped. Despite cleaning, no observable flow was present at Crossing 1, likely due to beaver activity immediately upstream of the crossing site. All three crossing sites saw zero flow conditions in the spring of 2016, as advanced beaver activity had resulted in the complete blockage of all culverts at all sites.

It did not appear as if further grubbing and clearing of any culverts along the proposed ASR had occurred following the noted clearing of Crossing 2. A cross-sectional profile of the distal downstream reach of Crossing 2 showed a maximum average velocity of 0.34 m/s within the center of the channel (Figure 5 in Appendix 3). Substrates within the measured cross-section included silt, sand, cobble, and boulder, and the maximum observed water depth was 18 cm.

7.1.11.2 Water Quality

Water turbidity (Nephelometric Turbidity Units [NTU] measured in-situ), temperature (°C), conductivity (μS/cm), pH and dissolved oxygen (DO, mg/L) were measured immediately upstream of each crossing during fall 2015 and spring 2016 sampling. Additional sampling was conducted at Mantagao Lake, the headwaters of Winthers Creek, located approximately 9 km east of Crossing 2, in the summer of 2016. Water quality results are presented in Table 3 of Appendix 3.

Water temperatures at the creek crossings ranged between 6.5°C and 7.0°C for the fall 2015 assessment and between 10.0°C and 12.8°C for the spring 2016 assessment. Additional sampling at Mantagao Lake was carried out in the summer of 2016, which had a higher average water temperature of 24.0°C.

Turbidity measurements taken during the fall of 2015 showed Crossing 2 as markedly less turbid than Crossings 1 or 3, likely due to culvert clearing and increased flow rates at this site. Subsequent turbidity measurements in the spring showed similar turbidity levels at all three sites.

Similar values were observed at Mantagao Lake (Figure 2 in Appendix 3). Turbidity values ranged from 0.63 NTUs to 3.07 NTUs at the creek crossings, and was measured as 1.7 NTUs at the off-shore Mantagao Lake sampling area, and as 3.8 NTUs at the Mantagao Lake near-shore sampling area.

Conductivity and pH levels were similar at all three crossing sites in both the fall and spring field seasons. Conductivity values ranged from 201 µS/cm to 231 µS/cm at the creek crossings, and was measured as 388 µS/cm in Mantagao Lake. Measured pH ranged from 6.12 to 6.65 at the creek crossings, and was 8.82 at the Mantagao Lake sampling site.

DO levels ranged from 8.98 mg/l to 9.77 mg/l at the creek crossings, and was 8.79 mg/l at the Mantagao sampling site. DO levels were slightly higher at the Crossing 3 site in both fall 2015 and spring 2016 seasons, likely due to the large volume of water retained at this site and the associated wave action observed along the roadway where measurements were taken. Wave action at the water surface provides mixing and can increase DO levels (AAE 2016).

All of the measured water quality parameters were within the Manitoba *Tier II Water Quality Objectives* and *Tier III Water Quality Guidelines*, with the exception of pH (Manitoba Water Stewardship 2011). The *Tier III Water Quality Guideline* for Surface Water for the Protection of Freshwater Aquatic Life for pH is 6.5 to 9.0 (Manitoba Water Stewardship 2011). The pH measurements at Crossing 1 and Crossing 2 on Winthers Creek ranged from 6.09 to 6.31. The pH of natural waters is influenced by the geology, soils and vegetation that the water flows over, through or around. The lower pH level in Winthers Creek could be a result of lower alkalinity that occurs in the absence of carbonate sources such as limestone or dolomite; or could reflect the presence of peat or Sphagnum moss, as water in peat bogs typically have a pH range of 3.3 - 5.5, and transitional bog waters have a pH in the range of 4.5 - 6.0 (Upper Thames River Conservation Authority 2016).

7.1.12 Fish and Fish Habitat

The following information was obtained from the “Lake St. Martin Outlet Channel Proposed All Season Access Road Fisheries and Aquatic Habitat Assessment” (AAE 2016) provided as Appendix 3 to this report. Additional information on the aquatic studies for the Project is provided in Appendix 3.

7.1.12.1 Fish Habitat

7.1.12.1.1 Overview

As noted in Section 6.1.11, field investigations were carried out at three creek crossings in the proposed ASR LSA in the fall of 2015 and spring of 2016 by AAE. Upstream habitat was similar at all three crossing sites and marked by extensive beaver activity. As a result, woody debris and soil had accumulated upstream of all culverts resulting in significant water retention and road washout at all three sites, with little to no flow through the crossings. These watercourses were lined uniformly with silt substrate, which ranged from very soft to firm and was scattered in some areas with woody debris, which provided a low level of instream cover for fish. Emergent vegetation and, within shallower regions (usually < 1 m), submerged vegetation, was generally dense along shorelines and provided a moderate degree of cover. Submerged aquatic vegetation was less abundant immediately alongside the proposed ASR at the crossing due to the steeplysloping banks. Floating aquatic vegetation was abundant upstream of Crossing 1 and provided a high level of in-stream cover for fish.

Downstream habitat was more variable among sites and often differed from the upstream habitat. At Crossing 1, a very narrow creek extending a short distance (~10m) opened into a large beaver pond. Both the creek and pond were steep sided with no-flow and a silt substrate. Creek depth reached approximately 1 m, while pond depth extended beyond 2 m. The downstream bank was undercut, preventing upstream species passage. Most cover was provided by woody debris and, along shorelines, densely-packed emergent vegetation, grasses and light to moderate tree cover. Unlike upstream, floating vegetation was minimal and was restricted to the pond beyond the narrow creek.

Aquatic habitat downstream of Crossing 2 was different from the large, deep pond observed upstream. Within the proximal downstream reach, water travelled through a narrow, shallow stream (usually < 0.5 m depth) which branched through dense areas of grasses and woody debris, providing moderate to heavy in-stream and overhanging cover. Substrate was more complex, consisting mainly of silt and sand, transitioning intermittently into gravel/cobble riffles. The upstream boundary of the distal downstream reach was marked by a large beaver dam. Within the distal downstream reach, the creek was shallower and unbranched. Although cover was reduced, with woody debris and submerged vegetation becoming less abundant, substrate was highly complex, including silt, sand, gravel, cobble, and boulder. Riffle habitat was also commonly observed over gravel and cobble substrates within this region.

In the absence of any flow, downstream habitat at Crossing 3 consisted of a small, stagnant pool. The pond, which reached a maximum depth of approximately 1 m, had a very soft silt substrate and very dense submerged aquatic vegetation, providing excellent cover for fish species, especially Central Mudminnow (*Umbra limi*).

7.1.12.1.2 Habitat Connectivity

Although the existing NHN data for the area showed flow connectivity within the PF and LSA of the proposed ASR (Figure 5), the actual habitat connectivity was found to be limited at all three Crossing sites, as well as across the entire LSA. Culvert crossings at all three sites were found to be blocked and/or damaged. While grubbing and cleaning were noted at Crossing 2 in October of 2015 (Section 6.1.11), the culvert was again blocked the following spring, and continued beaver activity had resulted in numerous road washouts and extensive culvert blockage/damage along the extent of the access road. Blockages at Crossings 2 and 3 resulted in extensive damage and washout of the forestry road in the spring of 2016 (figures 6 and 7 in Appendix 3).

Culverts were assessed for any perching, blockages or the presence of any wildlife gates or blockage prevention methods (Table 4 in Appendix 3). Wildlife gating was observed on some culverts along the forestry road, though none were present at the surveyed crossing sites.

Photographic documentation of all culverts at each crossing are presented in Appendix B of Appendix 3.

7.1.12.1.3 Habitat Classification

Fish habitat was classified for each sampling reach using the DFO classification flowchart for streams and constructed drains through agricultural areas (Milani 2013) (Figure 3 in Appendix 3). The presence of forage fish and absence of CRA or SARA listed species within all upstream and downstream reaches indicated that all aquatic habitat assessed was classified as either Type C or Type D habitat, depending on habitat complexity. Simple habitat is defined as habitat with low to moderate cover coupled with uniform substrate type and flow, whereas complex habitat is characterized by increased diversity of either substrate type or flow regime and/or heavy cover. Therefore, habitat with at least one of these characteristics of increased complexity is defined as complex, or Type C habitat. Habitat lacking these characteristics is defined as simple, or Type D habitat. Photographic documentation of all aquatic and riparian habitat immediately upstream and downstream of each crossing site is presented in Appendix C of Appendix 3.

Aquatic habitat was similar upstream of all three creek crossings, with a similar uniform silt substrate and no-flow conditions. Crossings 2 and 3 were found to have little to no emergent or submerged aquatic vegetation and minimal woody debris concentrated at beaver lodges located upstream of the crossing sites. Extensive water retention resulted in significant retention ponds at Crossings 2 and 3, with primarily open water. Riparian habitat was simple at both sites, with predominantly simple grasses and low shrubs. Thus, upstream habitat at Crossings 2 and 3 were classified as Type D (Table 5 in Appendix 3).

Upstream habitat at Crossing 1 was markedly different, with abundant floating aquatic vegetation, likely due to lack of flow from beaver activity further upstream. Riparian habitat at this site was also more complex, with tall grass, shrub and trees present providing increased cover. Therefore, upstream habitat at Crossing 1 was defined as complex and classified as Type C habitat, whereas upstream habitat at Crossings 2 and 3 was defined as simple and both were classified as Type D habitat (Table 5 in Appendix 3).

Downstream habitat was more variable among sites than upstream habitat. At Crossing 1, downstream habitat was defined as Type D due to its uniform silt substrate, lack of flow, and simple riparian habitat of low grasses. Downstream of Crossing 2, substrate complexity was significantly higher within both the proximal and distal reaches. Riparian habitat along the proximal reach consists of complex grass, shrub and trees, providing a high level of overhanging cover. Therefore, habitat within both downstream reaches at Crossing 2 was defined as complex and classified as Type C habitat (Table 5 in Appendix 3). Crossing 3 was determined to have no flow and uniform silt substrate. However, very dense submerged aquatic vegetation was present at this site, likely due to the lack of flow downstream of all culverts. Grass and tall shrubs dominate the riparian habitat downstream providing excellent overhanging cover for fish. This habitat was defined as complex, and classified as Type C habitat (Table 5 in Appendix 3).

7.1.12.2 Fish Community

7.1.12.2.1 Backpack Electrofishing

During fall 2015 field investigations, a total of 1,012 fish representing four species and one species hybrid were collected from all creek crossings (Table 6, Table 7, Figure 8 and Figure 10 in Appendix 3). Seventy-one percent (n = 720) of the total catch was identified as *Phoxinus* spp. Within this genus, Northern Redbelly Dace (*Phoxinus eos*) and Finescale Dace (*Phoxinus neogaeus*), as well as a small number of hybrids of these two species, were captured. Seventeen percent (n = 167) of the total catch was identified as Brook Stickleback (*Culaea inconstans*). The remaining 12% (n = 125) of the total catch was identified as Central Mudminnow. Visual surveys conducted during the study identified no large-bodied fish at any of the three crossings.

Note that it was not possible to identify each *Phoxinus* spp. specimen captured to species level because Northern Redbelly Dace, Finescale Dace, and hybrids of these two species are difficult to distinguish based on external morphology; identification is typically accomplished by examination of internal organs (e.g. intestine looping direction). To minimize harm to fish while enabling identification to species level, a small number (n = 12) of *Phoxinus* spp. voucher specimens were preserved in formalin and identified in the lab as the species listed above.

Although only four fish species (including hybrids) were determined to be present, distributions varied among crossings. Catch rates were low at Crossing 1, especially upstream, and species distributions appeared segregated; exclusively Central Mudminnow were captured upstream and exclusively Brook Stickleback were captured downstream. Blockage and only minimal flow through the culvert likely contributed to this disparity and separation of the species. All four species were captured at Crossing 2: *Phoxinus* spp. represented the majority of the catch (79%), Brook Stickleback was also common (21%), and a single Central Mudminnow was captured within the distal downstream reach. Catch per unit effort (CPUE) varied at Crossing 2, the highest rate (distal downstream) being nearly 95 times greater than the lowest (proximal downstream). Species distribution at Crossing 3 also differed between the upstream and downstream reaches. Upstream, the majority of fish collected were *Phoxinus* spp. (79%), followed by Brook Stickleback (18%), and a small number of Central Mudminnow (3%). However, downstream CPUE was significantly higher than the upstream CPUE, with exclusively Central Mudminnow captured.

Representative photographs of all fish species captured during the study are presented in Appendix D of Appendix 3.

7.1.12.2.2 Trap Netting

Although visual observations confirmed the presence of small bodied fish during the spring, no large-bodied fish or otherwise were captured at either crossing. Trap net coordinates and set lengths are presented in Appendix A of Appendix 3.

7.1.12.2.3 Gill Netting

No large-bodied fish were captured at any of the three crossings. When coupled with the lack of fish captured by trap netting, this result indicates an absence of large bodied fish within Winthers Creek or Bear Creek at the road crossing sites. Gill net coordinates and set lengths are presented in Appendix A of Appendix 3.

7.1.12.3 Mantagao Lake

To study fish species composition within the headwaters of Winthers Creek (referred to as "Sucker Creek" in KGS 2016), and thus establish a more complete assessment of fish species composition within the watershed system as a whole, boat electrofishing using a Smith-Root 2.5 GPP was performed on Mantagao Lake in the summer of 2016. Sampling was performed along the shoreline at depths of approximately 1.3 m. Fish captured were identified to species, enumerated, fork length measured, and released unharmed. Start and end points of each transect are presented in Appendix A of Appendix 3.

A total of sixty-nine fish representing seven species were captured during two transects (combined effort of 2197 seconds) of boat electrofishing on Mantagao Lake (Table 8 and Table 9 in Appendix 3). The most abundant species captured was Yellow Perch (*Perca flavascens*), which accounted for 44.9% of the total catch (n = 31). The second most abundant species captured was Blacknose Shiner (*Notropis heterolepis*), which accounted for 29.0% of the total catch (n = 20). The remaining 26.1% of the catch was comprised of Walleye (*Sander vitreus*, n = 6), Fathead Minnow (*Pimephales promelas*, n = 4), Golden Shiner (*Notemigonus crysoleucas*, n = 4), Northern Pike (*Esox lucius*, n = 3), and Emerald Shiner (*Notropis athineroides*, n = 1). It was observed that most species were distributed relatively evenly throughout the sampling area, and CPUE was very similar between the two transects. However, all six Walleye were captured within the eastern half of Transect 2, suggesting that Walleye distribution may be selective within the lake.

7.1.12.4 Fish and Fish Habitat Study Summary

The overall risk to fisheries resources associated with upgrading the current road network to the proposed ASR was considered to be low. The fish species identified at each crossing were not part of a Commercial, Recreational or Aboriginal fishery, and there appeared to be no connectivity within the system to allow passage of large-bodied fish. Fish habitat immediately adjacent to each crossing was considered Type C or D habitat, and was dominated by forage fish species. Lack of connectivity, resulting from a combination of beaver activity and damaged, failing or blocked culverts, is at present preventing the migration of large-bodied species into this system, although Type C habitat present at all three crossing sites could provide suitable habitat for these species if connectivity between upstream and downstream areas was improved.

While at present no large-bodied CRA fish species are expected to be found at these crossings, efforts should be made to limit impacts to the very productive forage fish communities currently present at all three crossing sites, which contribute to the diversity and health of this ecosystem.

It is recommended that, in any instance where isolation and de-watering of an area is required for construction, a fish salvage be completed to remove the potentially large volume of small-bodied fish present, as required by DFO regulations/reviews pertaining to construction projects. Spawning windows and habitat/behavior preferences for all fish species identified in this study are presented in Appendix E of Appendix 3.

Grubbing and clearing of the culvert at Crossing 2 was noted on October 22, 2015 and resulted in significant drops in upstream water levels (approximately 0.25 m within 24 hours). However, this effect on water flows and levels was short lived, and complete blockage of all three creek crossings resulted in the retention of a significant amount of water during the spring sampling period. Additional beaver activity noted in the spring of 2016 created additional barriers within the creek system, as well as several washouts along the forestry road (Figure 9 in Appendix 3). Future drainage of these sites, while not expected to impact the fish communities identified, could alter the aquatic and riparian habitat upstream of these culvert crossings, at least temporarily. Changes could include alterations to standing water surface area, increase in flow rates, and improvements to system connectivity. At Crossing 3 where water retention is greatest, increased connectivity could enable fish passage from Bear Creek to the north, which flows into Lake St. Martin. This connectivity could have implications to fish utilization and species composition at the Crossing 3 site, especially if drainage and connectivity are maintained with the proposed road upgrades.

The extensive beaver activity observed upstream and downstream of all three sites provided insight into the absence of large-bodied fish within the crossings. Beaver dams and lodges, and associated culvert blockages along Winthers Creek and Bear Creek, currently act as barriers to fish passage, completely excluding the entry of large-bodied fish into the region of the crossings.

Although the prevalence of beaver dams throughout the area disrupts connectivity among the creek headwaters and the crossings along the proposed ASR, dam removal may be sufficient to enable fish passage. Preliminary conversations with local stakeholders and land users confirmed that one such headwater source, Mantagao Lake, located approximately 9 km east of the access road (Figure 2 in Appendix 3), is actively used as a recreational and commercial fishery. The results of the examination of Mantagao Lake demonstrated that CRA fish species such as Walleye, Yellow Perch and Northern Pike were present in the headwaters of the creeks crossing the proposed ASR. If removal of or modification to beaver dams along the creeks is required for the proposed ASR construction, a re-evaluation of fish species and fish habitat would be necessary. As the dams currently act as a barrier to large-bodied fish passage, changes to these dams may enable passage of additional fish species, including those that are part of CRA fisheries.

To address the issue of potential blockage of water flow and fish passage, following the clearing/maintenance of culverts along the forestry road, wildlife deterrents such as culvert grates, beaver deceivers, or similar devices could be installed, especially at the three watercourse crossings identified in this study, to reduce the likelihood of blockage and help to maintain water levels at these sites.

7.1.13 Species at Risk

The examination of Species at Risk in the ASR RSA was accomplished by:

- Reviewing the regulatory parameters and terminology for Species at Risk and species of conservation concern;
- Reviewing provincial and federal databases for information on Project area species;
- Identification of Species At Risk and species of conservation concern potentially present or known to be present in the ASR RSA;
- Habitat modelling to evaluate potential habitat in the RSA suitable for selected bird Species At Risk and/or species of conservation concern; and
- Conducting field studies that included investigations for the identified Species at Risk and/or species of conservation concern.

Based on the review of regulatory parameters and terminology, the Species At Risk for the Project area were defined as:

- Species currently designated by COSEWIC for listing on Schedule 1 of the federal SARA, including species in the risk categories of extirpated, endangered, threatened and special concern;
- Provincial species currently listed as endangered or threatened under MESEA; and
- Species of conservation concern in the RSA that are currently listed as very rare (provincial status of S1), rare (provincial status of S2) or uncommon (provincial status of S3) throughout their range by the MBCDC.

7.1.13.1 Flora

Information on and discussion of the floral Species At Risk and plant species of conservation concern is provided in Section 7.1.8.5 of this report. No federally or provincially listed species were observed during the vegetation surveys. One species listed by the MBCDC having conservation concern was identified, Dragon's mouth orchid, which is ranked S2 by the MBCDC, meaning it is considered rare throughout its range or in the province (6 to 20 occurrences) and may be vulnerable to extirpation. A community of six individuals was observed along the proposed ASR within a small shrubby sphagnum bog surrounded by a large expansive rich fen. The orchids were growing on a raised mound of sphagnum moss surrounded by bog birch, Labrador tea, bog rosemary, bog laurel, and young tamaracks (Photograph 1).

7.1.13.2 Fauna

As noted in Section 7.1.9.2, there are two bat Species At Risk with known ranges in the RSA, the little brown myotis and the northern long-eared myotis. Both of these species are listed as endangered under Schedule 1 of SARA and under MESEA, and proposed Recovery Plans have been released by SARA for these species.

A number of bird species of conservation concern listed by COSEWIC, SARA and/or MESEA, have ranges that overlap with the RSA (MC 2015; SARA 2015). These species include bank swallow, barn swallow, bobolink, Canada warbler, common nighthawk, eastern whip-poor-will, eastern wood-pewee, golden-winged warbler, horned grebe, least bittern, olive-sided flycatcher, peregrine falcon, piping plover, red-headed woodpecker, rusty blackbird, short-eared owl, trumpeter swan and yellow rail (MBBA 2015).

There is one amphibian species of conservation concern with distribution ranges in the RSA. The northern leopard frog is listed as special concern under Schedule 1 of SARA and has a MBCDC rank of S4.

The MBCDC provided a list of known locations of species of concern and special interest that had been identified within the RSA; the information on the known locations of species of concern as provided by MBCDC is presented on Map 8 in Appendix 1 (MBCDC 2015; C. Friesen pers. comm. 2015).

7.1.13.2.1 Habitat Modelling

Habitat modelling was conducted for all avian SAR potentially located in the RSA and the LSA. In all cases, the habitat for the listed avian species modelled was not limiting within the RSA and the LSA and the degree of habitat loss/alteration associated with the proposed ASR represented a very small percentage of the overall avian species habitat available. A summary of the parameters selected for the model for each species; quantification of the habitat within the RSA and the LSA; and the amount of potential habitat for each species lost with the proposed ASR, as well as with each proposed linear feature of the overall Project, are provided in Appendix 1.

7.1.13.2.2 Summary of Field Investigations

The field surveys conducted in 2015 and 2016 documented the presence of the following SAR or species of conservation concern within the LSA of the proposed ASR:

- Little brown bat;
- Northern long-eared bat;
- Bank swallow;
- Common nighthawk;
- Least bittern; and
- Trumpeter swan.

Additional information for these species and observations is provided in Section 7.1.9 of this report and in Appendix 1.

7.2 Socio-Economic Environment

7.2.1 Regional Communities and Population

Within the RSA there are two rural municipalities, the RM of Grahamdale and the RM of Siglunes (Figure 6). Communities within the RM of Grahamdale include Mulvihill, Camper, Moosehorn, Spearhill, Grahamdale, Faulkner, Steep Rock, Fairford, St. Martin and Gypsumville, and communities within the RM of Siglunes include the town of Ashern (Figure 6). The largest concentrated population in the RM of Grahamdale is located in the community of Moosehorn (RM of Grahamdale 2016). As of January 01, 2015, the RM of Siglunes was incorporated with the RM of Eriksdale to form the new RM of West Interlake in accordance with the Province of Manitoba's 2013 *Municipal Amalgamations Act* (Government of Manitoba 2016f). A small portion of the RM of Alonsa and the RM of Fisher are part of the RSA boundary based on the study area designation, but these RMs were not included as part of the proposed ASR study.

The 2011 census data for the RM of Grahamdale showed a population of 1364 people in the 2384.62 km^2 area of the RM, or a population density of 0.6 people/km^2 (Statistics Canada 2016), and the 2011 census data for the RM of Siglunes showed a population of 1360 people in the 837.42 km^2 area of the RM, or a population density of 1.6 people/km^2 (Statistics Canada 2016). In comparison, the population density in the City of Winnipeg in 2011 was reported as 137.7 people/km^2 (Statistics Canada 2016).

The communities in the area are typically small hubs providing local services to the regional population, travellers and tourists. Occupations in the area include farming, ranching, fishing and operation of the businesses found in the region, such as gas stations, hotels/motels, grocery stores, building materials stores, agricultural equipment stores, vehicle sales and repairs, credit unions, government and municipal services, restaurants, beach resorts, hunting and fishing outfitters, and campgrounds. The major economic sector in the region continues to be agriculture, which is focused mainly on ranching and feedlots for cattle (RM of Grahamdale 2016).

The only community present within the LSA for the proposed ASR project is Spearhill (Figure 6). Limestone was historically quarried from sites near Spearhill, and the Winnipeg Supply and Fuel Company operated a limestone processing plant from 1969-1972 in Spearhill (Government of Manitoba 2016g).

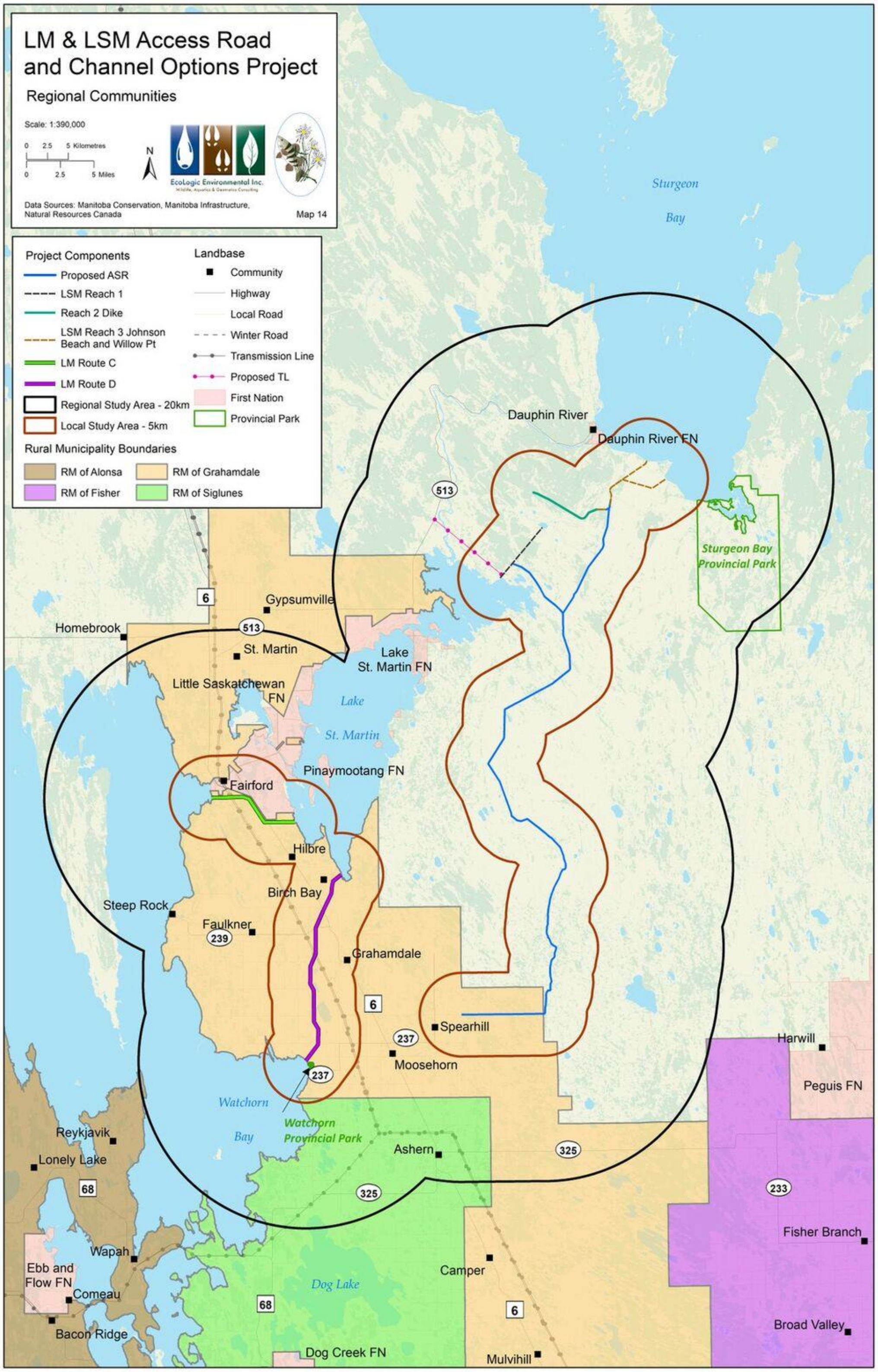


Figure 6: Regional Communities

7.2.2 Aboriginal Population

There are four First Nations located within the RSA: Dauphin River, Lake St. Martin, Pinaymootang, and Little Saskatchewan. The Peguis First Nation has a Community Interest Zone (CIZ) that includes a portion of the RSA and LSA. There are also a number of people of Métis descent whom reside in the area. Figure 7 shows the location of the four First Nations and the CIZ. Information on these communities was gathered from the 2006 and 2011 Census data prepared by Statistics Canada (2016). At the time of this writing, MI was in the process of meetings and consultations with the regional First Nations and Métis people who have interest in the Project; as such, Aboriginal Traditional Knowledge (ATK) for the area was not available for the baseline investigation studies. MI will collect and collate the ATK as part of the EIA process.

7.2.2.1 Dauphin River First Nation

Dauphin River First Nation is located along the north shore of Dauphin River where it enters Sturgeon Bay on Lake Winnipeg (Figure 7). Access is by gravel road on PR 513 running east from Gypsumville to Dauphin River. The Dauphin River First Nation is composed of two adjacent communities: one section is located on the Dauphin River Indian Reserve and the other section is located on Crown land formerly called Anama Bay (INAC 2017). The First Nation has a land area of 325.8 ha (INAC 2017).

The community of Dauphin River is not part of the Dauphin River First Nation but is a Manitoba Northern Affairs Community under provincial administration provided by the Aboriginal and Northern Affairs department (INAC 2017). The Census Profile for 2006 indicated a population of 84 for the Dauphin River FN and a population of 25 for the Northern community of Dauphin River (Statistics Canada 2016). The Community of Dauphin River website indicated a population of 30 people (Community of Dauphin River 2017). The Total Registered Population as of December 2016 was 374 people (INAC 2017).

7.2.2.2 Lake St. Martin First Nation

Lake St. Martin First Nation is located on the north shore of LSM west of The Narrows (Figure 7). Access to the First Nation is by PR 513 east from Gypsumville. Lake St. Martin First Nation has two parcels, The Narrows 49 and The Narrows 49A. The First Nation has a land area of 2613.30 ha in the Narrows 49 and 982 ha in the Narrows 49a with a total of 3595.3 ha. The population was recorded as 505 in the 2006 census (Statistics Canada 2016) and the Total Registered Population as of December 2016 was 2689 people (INAC 2017).

7.2.2.3 Pinaymootang First Nation

Pinaymootang First Nation (also referred to as Fairford First Nation), is located on the Fairford River at PTH 6 (Figure 7). Access to the first Nation is via PTH 6. The First Nation includes Dunsekikan Island in LSM, and has a land area of 7412.60 ha (INAC 2017). The population was recorded as 975 people in 2011 (Statistics Canada 2016) and the Total Registered Population as of December 2016 was 3257 people (INAC 2017).

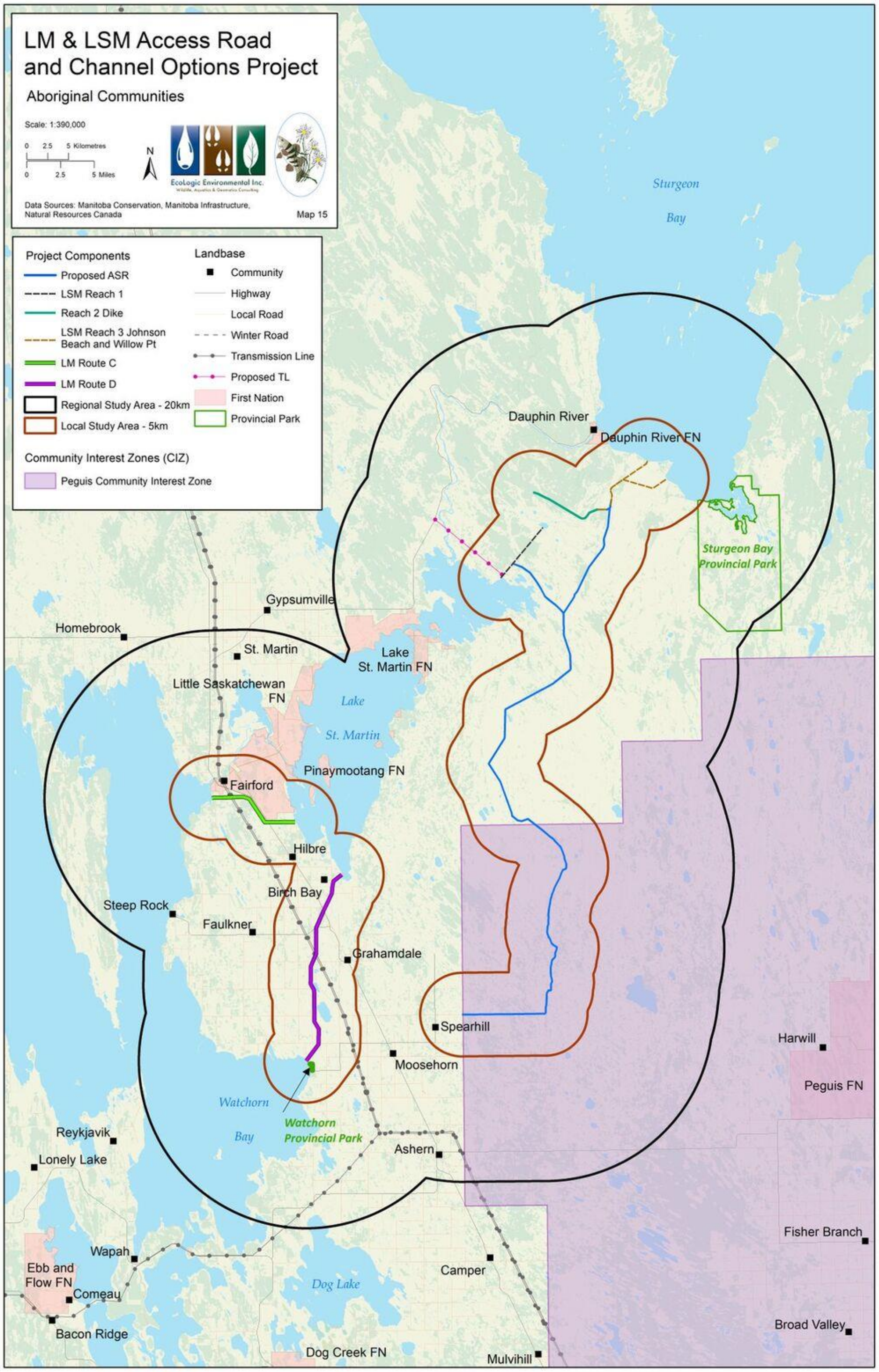


Figure 7: Aboriginal Communities and Community Interest Zones

7.2.2.4 Little Saskatchewan First Nation

Little Saskatchewan First Nation is located along the shoreline of LSM (Figure 7). The community is accessible from the north by PR 513 or from the south through the Pinaymootang First Nation. The First Nation is composed of two land parcels, Little Saskatchewan 48, which has an area of 1310.80 ha, and Little Saskatchewan 48B, which has an area of 97.50 ha (INAC 2017). The Little Saskatchewan First Nation population was recorded as 410 people in 2011 (Statistics Canada 2016) and the Total Registered Population as of December 2016 was 1245 people (INAC 2017).

7.2.2.5 Peguis First Nation

Peguis First Nation does not have a community in the RSA, but the First Nation has a large Community Interest Zone (CIZ) in the region. Part of the CIZ falls within the RSA and LSA for the proposed ASR (Figure 7). CIZs are areas of land selected by First Nations as part of Treaty Land Entitlement negotiations and processes with the Province of Manitoba (Treaty Land Entitlement Committee 2016). The process of Treaty Land Entitlement has several steps and requires time for selection, assessment and acquisition of the land; as such, the 1997 *Treaty Land Entitlement Framework Agreement* stipulates that the province must provide notification to the community if there are any other interests or proposed changes to the lands within a CIZ (Treaty Land Entitlement Committee 2016).

7.2.2.6 Métis

The 2011 Statistics Canada Census showed that Métis people made up 6.7% of the population of Manitoba (Statistics Canada 2016). The 2006 Manitoba Bureau of Statistics Census data for the RM of Grahamdale indicated that 285 of the 1415 residents identified as Métis, which represented 20% of the total population of the RM (Manitoba Bureau of Statistics 2008a). The 2006 Manitoba Bureau of Statistics Census data for the RM of Siglunes indicated that 200 of the 1460 residents identified as Métis, which represented 14% of the total population of the RM (Manitoba Bureau of Statistics 2008b).

Based on rulings in 2012 by the Supreme Court of Canada involving Aboriginal rights for Métis people, the government of Manitoba partnered with the Manitoba Métis Federation (MMF) to recognize Métis rights to harvest natural resources for food and domestic use in Manitoba, and allocated Métis Natural Resource Harvesting Zones based on the established Game Hunting Areas (GHAs) for the province (Government of Manitoba 2012b, MMF 2015). Game Hunting Areas (GHAs) are areas of land in Manitoba designated, regulated and managed by the Province for the hunting of deer, moose, elk and other animals. Map 12 in Appendix 1 provides an overview of the GHAs located within the RSA and LSA.

These Natural Resource Harvesting Zones include GHAs 16, 20, and 25, but do not include GHA 21 (Government of Manitoba 2012b; Map 12 in Appendix 1). However, personal communications with MI in 2016 suggested that GHA 21 is also included as a Métis Natural Resource Harvesting Zone (M. Allard pers. comm. 2016).

7.2.3 Land Use

The RM of Grahamdale Development Plan (RM of Grahamdale 2016) categorized the land base within the RM as Agriculture Restricted Areas, Agriculture Rural Areas, General Development Areas, Recreation Areas, Rural Residential Areas, and Wildlife Management Areas (WMAs). The WMAs are designated and managed by the province of Manitoba. There are six WMAs in the RSA: Grahamdale WMA, located northeast of Grahamdale; Hilbre WMA, located west of Hilbre; Little Birch WMA, located southeast of Ashern; Mantagao Lake WMA, located north and east of Spearhill; Moosehorn WMA, located southwest of Moosehorn; and Peonan Point WMA, located northwest of Steep Rock. The name, location and size of the WMAs in the RSA and LSA are shown on Map 7 in Appendix 1. The lower section of the forestry road is located within the Mantagao Lake WMA; the WMA border parallels the west side of the existing forestry road for several kilometres and extends eastward and southward beyond the LSA to Mantagao Lake.

A large portion of the land in the RSA is designated for agricultural use. However, about 61% of the soils are rated as Class 3 due to their level of stoniness; 11% of the area is rated as Class 5 and Class 7 due to excessive stoniness and rockiness; 12% of the soils are rated as Class 6, due to wetness where soil landscapes are poorly drained and/or are more than 50% wetlands; and a further 10% of the soils are organic, and have very limited capability for agriculture (RM of Grahamdale 2016). These land and soil characteristics, coupled with the poor drainage and surface water pooling found in several areas, results in moderate to severe limitations for agriculture in the area (RM of Grahamdale 2016). As such, the majority of agricultural activities are related to cattle production, with some areas used for pastures and forage crops where the land is suitable for these practices. The RM of West Interlake cites the major products produced in the region as agricultural products, specifically grain, hay, forage seed, livestock and Pregnant Mares Urine (PMU) (RM of West Interlake 2016).

Limestone, dolomite and gypsum quarrying and processing are also important economic land use activities that take place in the RSA and LSA and are described in Section 7.2.4 of this report. As noted in Section 7.1.8, Seneca root is gathered in the area and is an important plant used for medicinal and ceremonious purposes (NLHS 2015). The majority of Seneca root for manufacture of pharmaceutical cold and cough remedies is produced in the Interlake region (V. Petch, pers. comm., 2016).

Figure 8 shows the land ownership in the LSA and RSA. The majority of the area is Crown Lands, with the remaining areas composed of a mix of private and municipal ownership. Within the LSA, land use activities consist mainly of hunting, fishing, snowmobiling and other recreational activities, as well as some quarry activity.

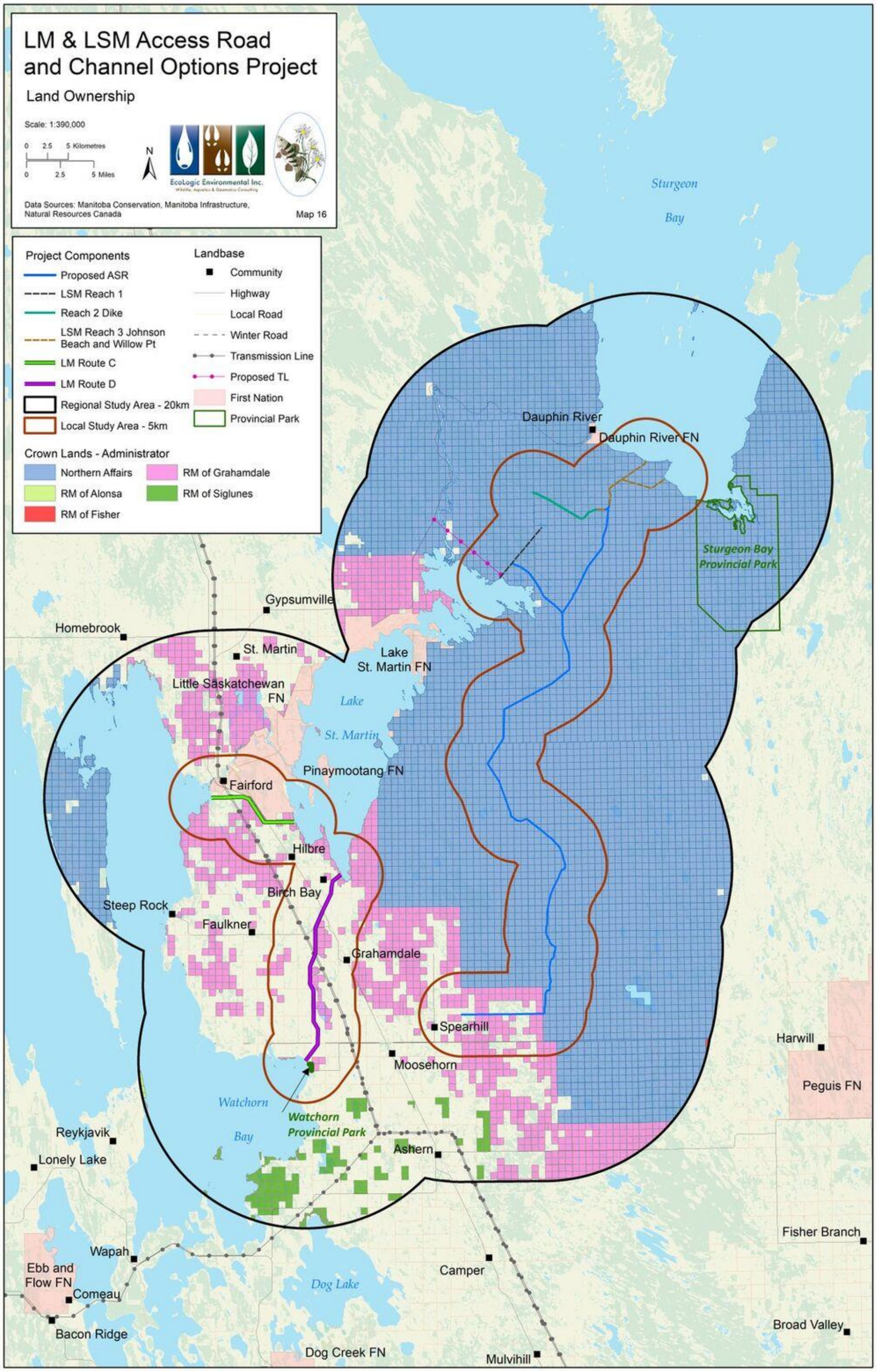


Figure 8: Land Ownership

7.2.4 Infrastructure and Services

Figure 9 provides the location of infrastructure and services in the RSA and LSA. Information on the infrastructure and services is provided below.

7.2.4.1 Roads and Highways

PTH 6 is a major road artery in the region that is located in the western part of the RSA and is the principal access to the proposed LSMOC area (Figure 9). PTH 6 crosses the Fairford River east of Lake Manitoba and is the connecting road for the four Provincial Roads in the RSA: PR 325 from Ashern to Hodgson; PR 237 from Watchorn Provincial Park to Spearhill; PR 239 from PTH 6 to Steeprock; and PR 513, which is a paved road from PTH 6 to Gypsumville, and a gravel surface to the community of Dauphin River on the shore of Lake Winnipeg. Within the LSA, the existing road network consists of a section of municipal road, the forestry road and the winter road sections (Figure 9). There are also a number of access trails, dirt roads and snowmobile trails located within the LSA (Map 11 in Appendix 1).

7.2.4.2 Railways

There is one rail line in the RSA that parallels PTH 6 in the RSA (Figure 9). The 104 km long line segment for the Warren to Steep Rock Junction route was operated by the CN Railway but was abandoned in 1997 (Transport Canada 2016). Several spur lines connected to the route were also abandoned, including the spurs to Spearhill and Steep Rock (Transport Canada 2016).

7.2.4.3 Airports

There are three airports located within the RSA at Ashern, Anama Bay-Dauphin River and Pineimuta (Figure 9). The Anama Bay-Dauphin River and Pineimuta airports are no longer active (Canadian Owners and Pilots Association 2016). The Ashern airport was active at the time of this writing but was not operated for nighttime flying (Canadian Owners and Pilots Association 2016).

7.2.4.4 Waste Disposal

At the time of this writing, there were four waste disposal grounds located within the RSA that were in operation (RM of Grahamdale 2016; RM of West Interlake 2016). These waste disposal grounds are located in proximity to the communities of Ashern, Faulkner, Moosehorn and Pineimuta (RM of Grahamdale 2016; RM of West Interlake 2016) (Figure 9). There were no waste disposal grounds identified within the LSA (Figure 9).

Personal communications with MBSD indicated that a waste disposal ground is being constructed in the community of Dauphin River, but was not yet operational as of December 15, 2016 (K. Dorward pers. comm. 2016).

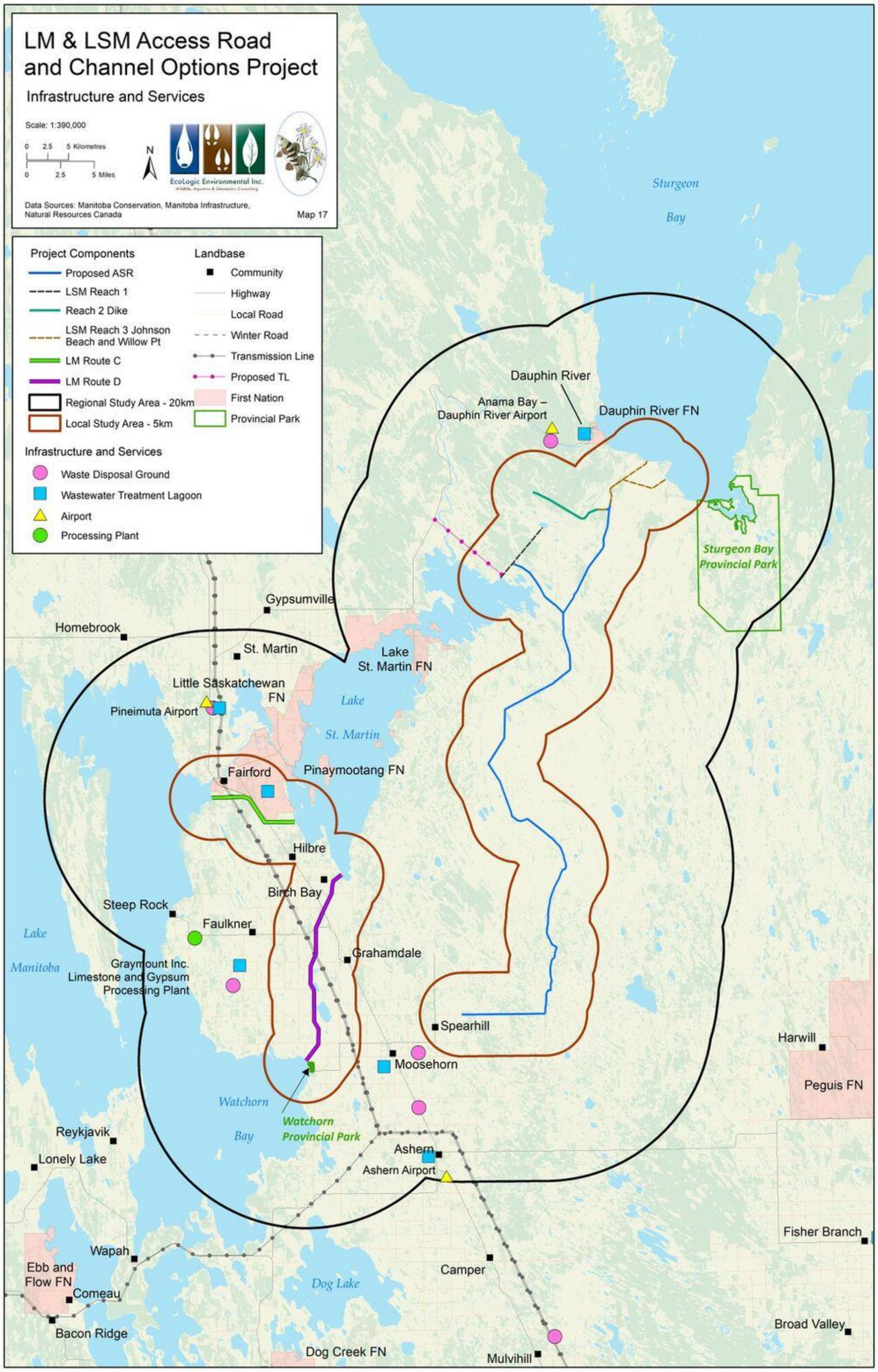


Figure 9: **Infrastructure and Services**

7.2.4.5 Wastewater Treatment Lagoons

At the time of this writing, there were five wastewater treatment lagoons in operation in the RSA (RM of Grahamdale 2016; RM of West Interlake 2016) (Figure 9). These wastewater treatment lagoons are located in proximity to the communities of Ashern, Fairford, Faulkner, Moosehorn, and Pineimuta (Figure 9). The wastewater treatment lagoon within the Pinaymootang FN southeast of the community of Fairford was the only wastewater treatment lagoon identified within the LSA (Figure 9). Personal communications with MBSD indicated that a wastewater treatment lagoon is being constructed in the community of Dauphin River, but was not yet operational as of December 15, 2016 (K. Dorward pers. comm. 2016). There are no wastewater treatment plants in the RSA (K. Dorward pers. comm. 2016).

7.2.4.6 Hydroelectric Power Transmission

Electrical services are provided to communities in the RSA by Manitoba Hydro. Transmission lines located within the RSA include a section of the Bipole I and BiPole II 500 kV lines that pass through the RSA in a RoW adjacent to PTH 6, and sections of 230 kV lines that connect the communities (Manitoba Hydro 2016) (Figure 9). The overall Project plans also include the potential need for a new 24 kV transmission line in the LSA, shown as a ‘proposed TL’ that connects on the west side of Reach 1 on Figure 8 (KGS Group 2016).

7.2.4.7 Pipelines

There were no natural gas, oil, water or other pipelines identified within the RSA or LSA.

7.2.5 Resource Use

7.2.5.1 Agriculture

As noted in Section 6.2.3, a large portion of the land in the RSA is designated for agricultural use, but much of these lands have soil and moisture conditions that restrict some agricultural activities. The predominant vegetation cover in the RSA is wetland at 43%, followed by water at 22.3% and grassland at 10.3% (Table 10; Map 4 in Appendix 1). Less than 2% of the land area within the RM of Grahamdale has Agricultural Suitability in Classes 1-3, i.e., the Classes that are most suited to annual crop production (Agriculture and Agri-Food Canada 1999). Agricultural classifications of annual crop, perennial crop and pasture in the LCC data only account for 1.44% of the lands within the RSA and 0.06% of the lands in the LSA (Table 10; Map 4 in Appendix 1).

7.2.5.2 Forestry

The province of Manitoba manages and regulates forestry activities in Manitoba through the establishment of administrative boundaries such as Forest Management Units (FMUs) and Integrated Wood Supply Areas (IWSAs), which are used to delineate and manage harvestable timber areas and wood supply areas. FMUs within the RSA include units 41, 43, and 45, and IWSAs in the RSA includes IWSA #2 (MCWS 2013) (Map 7 in Appendix 1). The majority of the LSA for the proposed ASR is in FMU 41, and IWSA #2, which covers much of the RSA except the southwest corner (Map 7 in Appendix 1). Within IWSA #2, the Pine Falls Paper Company has previously been given the first right of refusal for timber that is not allocated to quota holders of the IWSA and is still under the annual allowable cut levels for the area (Forest Resource Management 2000).

7.2.5.3 Lodges and Outfitters

Map 9 in Appendix 1 shows the location of lodges and outfitters in the RSA and LSA. There were four lodges or outfitters identified: Einarsson's Guide Service, near Dauphin River; Bear Track Outfitters, northeast of Gypsumville; Steep Rock Canoe and Kayak, at Steep Rock; and Wildwood Outfitters near Moosehorn (Map 9 in Appendix 1). None of these lodges or outfitters are located within the LSA for the proposed ASR. Map 9 in Appendix 1 also presents hunting stands and hunting shacks that were identified in the LSA for the proposed ASR during field studies in 2016. There were six hunting shacks and a hunting camp observed in the LSA in the area of the municipal road and lower section of the forestry road (Map 9 in Appendix 1).

7.2.5.4 Industry

As noted above, the major economic sector in the region continues to be agriculture, which is focused mainly on ranching and feedlots for cattle (RM of Grahamdale 2016). Other notable industry in the RSA includes the Graymont Western Canada Inc. limestone and gypsum quarries and processing plant, which is located on PR 239 between the towns of Steep Rock and Faulkner, Manitoba (Figure 9), and provides employment for a number of local residents (Groom 2004). As noted in Section 6.2.3, within the LSA, limestone was historically quarried from sites near Spearhill, and the Winnipeg Supply and Fuel Company operated a limestone processing plant from 1969-1972 in Spearhill (Government of Manitoba 2016h).

7.2.5.5 Quarries and Mining

Map 10 in Appendix 1 shows the locations of quarry and mining activity in the RSA and LSA at the time of this writing. The map shows that there are many existing quarrying sites in the RSA, with the majority being quarry withdrawal activity and the remainder are quarry lease, private quarry permit, mining claims and casual quarry permits. Within the LSA there are two quarry withdrawals, one quarry lease and one casual quarry permit.

Limestone, dolomite and gypsum have been mined in the RSA since the early 1900s (RM of Grahamdale 2016; Government of Manitoba 2016e, 2016g). Materials produced from these mineral resources include building foundations and building structures, aggregate materials, cement, wallboard and Plaster of Paris (Government of Manitoba 2016e).

The Graymont Western Canada Inc. limestone and gypsum quarries and processing plant are located on PTH 239 between the towns of Steep Rock and Faulkner (Figure 9). In the LSA, as noted in Section 6.2.1, limestone was historically quarried from sites near Spearhill, and the Winnipeg Supply and Fuel Company operated a limestone processing plant from 1969-1972 in Spearhill (Government of Manitoba (2016g).

7.2.5.6 Recreational Trails and Campgrounds

Map 11 in Appendix 1 provides an overview of the recreational trails and campgrounds identified in the RSA and LSA. There were five campgrounds identified within the RSA: Benson's Big Rock Camp and Campground on the north shore of Lake St. Martin near the entrance to the Dauphin River; the Roviera resort and Campsite at Fairford; the Steep Rock Beach Park Campsite at Steep Rock; the Elm Point Campground south of Faulkner on the east shore of Lake Manitoba; and the Watchorn Bay Provincial Park Campground located west of Moosehorn (Map 11 in Appendix 1).

The Sturgeon Bay Provincial Park was established in 2015 and lies within the northeast section of the RSA on the western shore of Lake Winnipeg. The park is designated as a wilderness camping area with no road accesses or facilities located on park land, and there are no plans for development (MBSD 2016d).

There are many recreational and snowmobile trails located within the RSA. A spatial data layer for the known and available recreational trails was acquired from the Natural Resources of Canada, Earth and Sciences Sector, and the available snowmobile trail data were digitized from the Manitoba Provincial Snowmobile Trail Guide, 2015-2016 (www.snoman.mb.ca). In addition to the publicly available data, the trail network in the RSA and LSA was further enhanced with the digitization of access trails recorded by GPS during the 2016 winter aerial survey work. These additional access trails have been included on Map 11 in Appendix 1.

7.2.5.7 Hunting

Map 12 in Appendix 1 provides an overview of the GHAs located within the RSA and LSA. The GHAs located within the RSA include GHAs 16, 20, 21 and 25. The LSA is located within GHA 21 on the west side of Lake Winnipeg and is adjacent to GHA 25 to the west, and GHA 16 to the north.

Boreal woodland caribou (*Rangifer tarandus*) were not found to be present in the RSA or LSA; however, Manitoba Sustainable Development (MBSD) indicates that hunting of boreal woodland caribou is not permitted in GHA 16, 21, or 25 (MBSD 2016a).

Moose are important big game animals for hunting within the RSA and LSA. Moose are valued for licensed hunting and rights-based subsistence hunting. Currently, licensed moose hunting is closed in all of areas of GHA 16 and GHA 25.

Elk are valued for rights-based subsistence harvesting and licenses for recreational hunters can be purchased from MBSD during certain times of year for GHA 21 and GHA 25 (MBSD 2016a). GHA 21 and GHA 25 season dates are late-September to mid-October for one bull elk in the general rifle draw and early- October to mid-October for one bull elk by general (rifle) draw. The archery draw is active in GHA 21 from early-September to mid-September, and GHA 25 is open for archery draw early-September to late-September for one elk.

White-tailed deer are valued for rights-based subsistence harvesting and licenses for recreational hunters can be purchased from the MBSD for Zone B, which is open to deer harvest during certain times of year for GHA 16, GHA 21, and GHA 25 (MBSD 2016a). An archery season for resident, non-resident, and foreign resident hunters is open for parts of September and again in late October to early November (MBSD 2016a). A general rifle season for white-tailed deer in Zone B for resident, non-resident, and foreign resident hunters is open from early-November to mid-November (MBSD 2016a). Zone C (GHA 16) is also open to deer harvest; archery season is open to resident, non-resident, and foreign resident hunters from early-September to early November. General rifle is open for Zone C from early November to mid-November.

MBSD licenses hunters for resident, and non-resident bear hunting, along with registered outfitters for foreign resident bear hunting in GHA 16, GHA 21, and GHA 25 (MBSD 2016a). GHA 16 and GHA 21 are part of black bear hunting Zone B, where licensed hunting is allowed between late April to end of June and late August to early October for one adult black bear (not female with cubs). GHA 25 is a part of Zone C where licensed hunting is allowed between late April to mid-June and then again in the beginning of September until mid-October.

MBSD licenses hunters for resident, non-resident, and foreign resident wolf hunting in GHA 16, GHA 21, and GHA 25 (MBSD 2016a). GHA 16 and GHA 21 are part of grey wolf and coyote Zone B for licensed-based hunting between late August and late March for one wolf. GHA 25 is a part of Zone C for grey wolf and coyote season between the same dates. Coyotes have been designated for recreational hunting by MBSD and licenses for hunters can be purchased for certain dates in GHA 16, GHA 21 and GHA 25 (MBSD 2016a).

GHA 16, GHA 21 and GHA 25 are a part of Game Bird hunting zone 3 (GBHZ3), which has a grouse (ruffed grouse [*Bonasa umbellus*], spruce grouse, and sharp-tailed grouse [*Tympanuchus phasianellus*]) hunting season between the beginning of September and mid-December with a possession limit of 12 (MBSD 2016a).

Other birds that can be hunted within GBHZ3 include ducks such as mallard (*Anas platyrhynchos*), coots such as American coot (*Fulica americana*), snipe, such as the common snipe (*Gallinago gallinago*), geese such as the Canada goose (*Branta canadensis*), and sandhill crane (*Grus canadensis*).

MBSD also enforces vehicle restrictions to increase the quality of the hunting experience, decrease illegal hunting from vehicles, and provide undisturbed areas for big game animals (MBSD 2016a). Vehicles may not be used while hunting elk, moose or WTD, except to travel to or from a hunting area, or to retrieve a kill by the most direct route (MBSD 2016a). GHA 16 lies within the 'Northern Zone', and therefore the use of off-road vehicles (ORVs) as transportation from one hunting site to another is allowed. GHAs 20, 21, and 25 lie within the 'Roads, Trails and Waterways Zone', where all vehicles operated by elk, moose or WTD hunters are restricted to roads, established trails and waterways. For example, an ORV may be used to access a hunting area along an established trail, but hunters may not establish their own trails or venture off existing trails (MBSD 2016a).

7.2.5.8 Trapping

Commercial trapping of furbearers is administered by MBSD through the Registered Trap Line (RTL) system (MBSD 2016c). The RSA lies within the Interlake RTL district (Trapping Area 7), and intersects a portion of the Crane River RTL on the west side of the RSA, and a portion of the Gypsumville RTL in the north-central area of the RSA (Map 13 in Appendix 1). The remainder of the RSA, including the majority of the LSA, is part of Open Trap Area #3 (MBSD 2016f).

Animals trapped within the RSA include badger (*Taxidea taxus*), beaver, coyote, cross fox, fisher, lynx, marten, mink, muskrat, otter, raccoon, red fox, squirrel, weasel, and wolf (Appendix 1). MBSD tracks trapping production in the RTLs, but does not track production within an open block (Appendix 1). Additional information on trapping within the RSA and LSA is provided in Appendix 1.

7.2.6 Protected Areas

Manitoba's Protected Areas Initiative is a government program developing and managing land to protect Manitoba's enduring features and biodiversity, in terrestrial, marine and freshwater environments (MBSD 2016b). Protected areas fall under several designations and levels of protection including Areas of Special Interest (ASIs), Ecological Reserves, Parks and Park Reserves, and Wildlife Management Areas (WMAs) (MBSD 2016b). Map 7 in Appendix 1 provides the location and size of the ASIs, Ecological Reserves, Parks and Park Reserves, and WMAs in the RSA and LSA.

Within the area of the RSA, there are six land areas designated as ASIs: Lynx Bay ASI, Sturgeon Bay ASI, Gypsum Lake ASI, and Idylwild ASI. The Sturgeon Bay ASI is composed of three parcels (Map 7 in Appendix 1).

The Reindeer Island Ecological Reserve is located north of Sturgeon Bay in Lake Winnipeg, but is not part of the RSA.

There are two Provincial Parks located within the overall Project RSA, the Sturgeon Bay Provincial Park and the Watchorn Bay Provincial Park.

There are six WMAs in the RSA: Grahamdale WMA, located northeast of Grahamdale; Hilbre WMA, located west of Hilbre; Little Birch WMA, located southeast of Ashern; Mantagao Lake WMA, located east of Spearhill; Moosehorn WMA, located southwest of Moosehorn; and Peonan Point WMA, located northwest of Steep Rock (Map 7 in Appendix 1).

The LSA includes parts of the Sturgeon Bay ASI areas, the Idylwild ASI, and the Mantagao Lake WMA (Map 7 in Appendix 1).

7.2.7 Culture and Heritage Resources

The following information was obtained from the "Heritage Resources Characterization Study: Lake St. Martin Outlet Channels and Proposed All Season Access Road" (NLHS 2016) provided as Appendix 4 to this report. Additional information on the Heritage Resources studies for the Project is provided in Appendix 4.

A baseline overview of the culture history of the RSA and the LSA was undertaken to provide the background heritage resources information for the ASR Project in preparation for a Heritage Resources Impact Assessment (HRIA). Attention was given to heritage resources protected under The *Manitoba Heritage Resources Act* (Government of Manitoba 1986) (The Act) as well as human remains, which are further protected by Manitoba's Policy Concerning the Reporting, Exhumation and Reburial of Found Human Remains (Government of Manitoba 1987). The Policy refers to burials and found human remains that occur outside of registered cemeteries.

Existing data for the region were reviewed prior to field studies to gain an understanding of the area and provide information to focus the field studies on sites and/or areas in need of investigation. Three main sources of information were reviewed: the archaeological and historical records and, where possible, accessible sources of Aboriginal Traditional Knowledge (ATK).

7.2.7.1 Archaeological Record

The archaeological record of Manitoba contains evidence of First Peoples dating to 10,000 years ago in southwestern Manitoba, with gradual movement into the interior following deglaciation and dewatering of glacial Lake Agassiz. The overall archaeological record for the RSA is not well documented, mainly due to lack of research. However, the record of the surrounding area indicates that ancient people could have been present in the vicinity probably by 7,000 years ago. The earliest occupation in this area appears to be associated with the Archaic cultural period circa (ca.) 5,000 to 4,000 years ago, although there is the possibility of earlier occupation by Plano culture.

The Provincial Archaeological Site Inventory for the RSA noted that only six registered archaeological sites were documented. Four of the sites were identified as historic period and included fur trade and homestead influence; the two remaining sites were identified as Middle to Late Woodland Period (ca. 2,000 to 350 years ago), based on the stone tools and Native ceramics. A review of the Provincial designated sites and commemorative plaques indicated that there were no Provincial commemorations within the RSA. However, a private plaque was noted to have been erected commemorating Spear Hill at some time in the past (pers. comm. Historic Resources Branch 2015). The location of the plaque requires verification since it is noted by the Heritage Resources Branch records to be on the southwest shore of Lake St. Martin; Spear Hill is located some 30km to the southeast.

In 1984 and 1985, an archaeological field study was carried out by the Historic Resources Branch for the Western Interlake Planning District (Siglunes, St. Laurent, Coldwell and Eriksdale) (Riddle, 1985; Riddle and Pettipas 1992). Throughout the course of the study, 46 archaeological sites were identified. Thirteen of these sites were found inland away from water and consisted of stone tools and tool- making stone waste, indicating hunting in the interior regions; the remaining sites were located on the Lake Manitoba shore. The majority of the sites were associated with the Middle and Late Woodland periods (ca. 2,000 to 350 years ago) when native pottery was a signature part of the artifact assemblage.

Later, under the supervision of Petch (1994), an analysis of the ceramics recovered from the Bensa Tanki Site (EfLq-04) in 1984 was completed by Moravetz and Jezik (1994). This analysis provided interesting Pre-European contact connections between the east side of Lake Winnipeg and Lakes Manitoba and Winnipegosis based on comparison of selected metric and non-metric attributes. Ceramics related to a tradition called Blackduck appear to have spread across north-central Manitoba from the Lake of the Woods area. According to Moravetz and Jezik (1994), 35 unique motifs representing 49 separate vessels were present in the Bensa Tanki collection. Attributes of lip/rim shape, design elements and presence/absence of punctates contributed to the overall motif.

In 2000, Northern Lights Heritage Services (NLHS) conducted a field study of the Fairford River between Lake Manitoba and the bridge crossing at the Fairford Reserve. Four new archaeological sites were registered and one formerly recorded site was revisited. These sites are noted in Table 1 of Appendix 4 as EjLq-2,3 & 4 and EjLp-1. One site, ElLm-1, was not visited as it was outside the study area of the project.

During HRIA and monitoring of installation of fibre-optic cable between Ashern, Manitoba and Dauphin, Manitoba at The Narrows, approximately 32 km southwest of Ashern, three archaeological sites were identified by NLHS (NLHS 2006). Ceramics representing Middle and Late Woodland periods were recovered. Further, several kilometres west of The Narrows, a Thunderbird Nest is located near the north-west shore of Lake Manitoba. This area is actively used by the local First Nations (Petch, personal observation).

As noted, no archaeological record of the Lake St. Martin Outlet Channel proposed ASR exists. The only reported site was recorded on the north side of the Dauphin River at Lake Winnipeg. Areas of archaeological potential usually occur within 100 m of a water body, on a <2˚ slope with minimum of 180˚ vista and a southeast aspect. Since most of these variables have not changed significantly in the past 5,000 years they are considered relatively stable. Other considerations such soil type, drainage and resources may have changed due to climatic conditions and isostacy. There may be heritage resources from an earlier time that are deeply buried beneath soils.

7.2.7.2 Historical Record

The Interlake was not habitable until at least 8,000 BP[1] or at the time that glacial Lake Agassiz had diminished to the extent that successional vegetation and wildlife were established. Immediately following the drainage of glacial Lake Agassiz, other processes were also taking

[1] BP is Before Present. The year 1950 marks the beginning of this time scale, which was established at the time of C-14 dating.

place. The retreat of the glaciers caused rebound of the land that had been hard pressed for thousands of years. This process, plus the slope/tilt of the land, played havoc with early drainage patterns. The Manitoba Great Lakes changed in size and shape until today's present configuration. These processes had great bearing on the movement of early human inhabitants, as noted on the series of Holocene evolution of the lakes. It is worth noting the large mesa-like feature that has persisted from the first post glacial Lake Agassiz phase (7,700 BP) to the present (Mataille et al. 1996). Known locally as "Big Ridge" (Richtik 1964), the feature rises 62 m above Lake St. Martin with the highest point of the post-glacial ridge recorded as 306 masl. This prominent attribute may have been an important landscape feature. Hind (1971) noted occasional spring flooding at Lake St. Martin that occasionally forced people to seek temporary relief on higher lands. This relief may have included refuge along the most dominant landscape feature in the area. Ancient and recent traditional camps may have been established in some of the interior pockets such as the limestone "Big Ridge" and other outcrops, and may contain important cultural and heritage information regarding former land use patterns.

Given that the altithermal warming some 7500-5000 years ago would have elicited a much different environment, and given that two lakes called Big and Little Buffalo drain into Buffalo Creek, there is a strong possibility that bison hunting occurred in this area. One could expect to find former "ancient bison" *(Bison antiquus*), American bison (*Bison bison*) and more recent Plains bison *(Bison bison bison)* faunal remains and perhaps bison kill and butchering sites in and around the ridge and lakes.

Small pockets of Seneca root may be found in some of the drier areas. Seneca root is a ubiquitous plant found throughout the Interlake. Seneca root grows profusely in dry areas and is a source of traditional medicines and cash economy for local First Nation and Métis. In the past, it was most likely an item traded at the Mandan and Shoshone Rendezvous, in which much of pre-European Native Americans participated. The Interlake produces the majority of Seneca root for manufacture of pharmaceutical cold and cough remedies. Other herbs and plants contribute to a small, local medicinal practice.

7.2.7.3 Available Traditional Knowledge

The sources found for available Traditional Knowledge within the RSA included Ballard's [Traverse] MA Thesis (1999) and PhD Dissertation (2012), which provide important traditional knowledge from the Lake St. Martin First Nation that is relevant to the regional and local study area. Ballard speaks to certain general areas where resource use occurs. Both her studies were related to the changing water regimes caused by the Fairford Dam and the 2011 flooding of Lake St. Martin. This, plus anecdotes such as from Warms (2001), Russenholt (n.d.) and Hind's descriptive narration (1971) provide evidence of an active and varied resource base and local First Nations had a seasonal round (i.e., travel to places for hunting, fishing, medicinal and edible plants and other resources and during the different seasons of the year) that would span distances of over 160 km. Anecdotal information was provided by John Warms (2001) regarding the history of local hideouts of the escaped convict Percy Moggey in 1960. Areas of Seneca root digging by local First Nations were identified to have occurred in the Spearhill area. This location is verified by Turcotte's 1997 thesis *Towards Sustainable Harvesting of Seneca Snakeroot (Polygala senega L.) on Manitoba Hydro Rights-of-Way* where the area in the vicinity of Spear Hill is also identified as an area of distribution (Turcotte 1997).

The vulnerable ram's head lady's slipper (*Cypripedium arietinum* R. Br), a member of the Orchidae family, is known to grow within the RSA. Roots of various orchids are known to have been used in "…North America both by indigenous and immigrant peoples for their sedative and antispasmodic properties and to counter insomnia and nervous tension. …" (Wilson 2007). Densmore (1928) also noted that the Anishinaabeg of the Rainy River area used *Cypripedium* spp. roots both as an infusion and mixed with food, depending on the nature of the illness. Hutchens (1991) also noted the medicinal properties of *Cypripedium* spp. in combination with other plants. The ram's head lady's slipper may have been used locally for these medicinal purposes.

Cranberries were noted by Hind (1971) to occur at the mouth of Big Buffalo Creek. Other inland areas with similar properties may exist in the area around the northeast portion of the forestry road and the access roads. Cranberries were an important emergency winter food; the twig tips were also chewed to treat sore throat, cold sores and teething. The tea is also used as a blood purifier, to reduce urinary tract infections and a variety of female ailments (Marles et al. 2000). Fishing appears to have been mainly associated with the large lakes and main rivers; however, if inland spawning areas were known, there is a potential for stone weirs to be present.

7.2.7.4 Culture and Heritage Resources Summary

The general archaeologic and historic records for the study area indicate human occupation over the past 8-7000 years. Within the regional and local study areas, minimal archaeological field research has occurred only along a portion of the Fairford River, leaving the impression that the land was never used. However, the archaeological record to the immediate south in the Siglunes and The Narrows area confirms occupation by First People at least by 5000 years ago. Increased seasonal occupation is apparent by the presence of numerous Middle and Late Woodland Sites (ca. 2000-350 BP) found around the regional study area. The Woodland traditions are considered to be the ancestors of today's Cree and Anishinaabeg (Ojibwa).

The history of the general study area, as recorded in archival and other documents reviewed, is concerned mainly with the chronology of facts such as European exploration, the historic First Nations and early European settlement. The record does not take into account the details of interactions among the cultural groups, nor does it offer much in the way of land use and occupancy by historic First Nations or immigrants to the region. The available oral history is found in the thesis and dissertation of Ballard (nee Traverse) for the Lake St. Martin First Nation, which suggests traditional use of areas within the RSA and LSA.

With the exception of the ridge areas described above, the study area was considered to be of low potential for archaeological sites. The existing LSMOC, access road and winter roads are surrounded by low and swampy lands, which do not rate as having high or medium potential for archaeological sites. Ground and aerial surveys conducted in the proposed LSMOC LSA during the summer of 2016 did not reveal any further archaeological evidence or heritage resources in the area, with the exception of one site on Lake Winnipeg northeast of the proposed Reach 3 Willow Point outlet. Here, several secondary grey chert flakes and preforms were recovered. Chert is a common rock type that occurs most often in carbonate rocks as nodes or layers (Sand Atlas 2017). Chert is described as a hard and compact sedimentary rock that consists mainly of small quartz crystals (Sand Atlas 2017). It was used by ancient peoples for the manufacture of tools where flint, which is of higher quality than chert, was not available (Archaeology Wordsmith 2017). A preform is a bifacially flaked piece of stone that exhibits both percussion (i.e., being struck) and pressure flaking, usually triangular in shape, indicating it was intended to be shaped into a projectile point or knife (Archaeology Wordsmith 2017). The term preform refers to various flint (or chert) objects that may be unfinished tools or discarded unsuccessful attempts at creating a tool (Oklahoma Archaeological Survey 2017). They are a common artifact and may be plentiful at lithic workshops or locations where flint knapping was done (Oklahoma Archaeological Survey 2017).

Sites related to seasonal harvesting were expected to be identified in and around the municipal road near the former Spearhill quarry since this was noted by Warms (2001) as a Seneca root gathering place of the local First Nations; however, as noted above, there were no archaeological sites found during the summer 2016 field studies. The presence of recently constructed bear platforms and hunting cabins in the vicinity of the forestry road indicated ongoing resource harvesting by local residents. ATK data to be collected and collated by MI for the EIA can be integrated with the existing information on Culture and Heritage Resources in the RSA and LSA and provide further context for the study and future EIA process.

Heritage resources are often buried beneath the ground surface. It is important to understand that there is potential for heritage resources to be discovered during construction activities. Therefore, a Heritage Resources Protection Plan should be prepared that will provide guidance to contractors and equipment operators should artifacts or human remains be unearthed. If heritage resources are found during construction, activity at that location must stop immediately and the project archaeologist contacted. If human remains are exposed during construction, activity at that location must stop immediately and the RCMP and Historic Resource Branch contacted immediately (Manitoba's Policy Concerning the Reporting, Exhumation and Reburial of Found Human Remains 1987), and the Project archaeologist will also be informed.

7.2.8 Human Health and Safety

The EIA process includes the assessment of potential project activities that could be linked to potential effects on human health and safety. For the proposed ASR project, the potential project activities that could be linked to effects on human health and safety include:

- GHG emissions;
- Vehicle and equipment emissions;
- Vehicle and equipment noise and vibration;
- Changes to soil, vegetation, groundwater or surface water quality or quantity;
- Changes to the quality and/or contaminant uptake of trapped, captured or hunted fish and wildlife consumed by local residents and tourists;
- Changes to traffic patterns and/or access to homes, services or recreational areas;
- Alteration or loss of natural areas, recreational areas, or Protected Areas; and
- Alteration or loss of archaeological, historical or Heritage Resources.

The data collected, collated, analyzed and summarized for this report will provide information on the existing conditions in the LSA and RSA prior to construction and operation of the proposed ASR, and other components of the overall Project.

With proper planning and informed design, the majority of potential effects related to the construction and operation of the proposed ASR can most likely be mitigated through the use of existing Best Management Practices, knowledge of previous environmental protection and environmental management plans, and application of these practices and plans to the execution of the Project.

8 CLOSURE

We trust that the above information meets your present requirements. If you have any questions or require additional details, please contact the undersigned.

Sincerely,

Maureen Forster, MSc., EP – Fisheries and Wildlife
M. Forster Enterprises

9 REFERENCES

AAE Tech Services Inc. (AAE). 2016. Lake St. Martin Outlet Channel Proposed All Season Access Road Fisheries and Aquatic Habitat Assessment. Prepared for M. Forster Enterprises for Submission to Manitoba Infrastructure. Winnipeg, Manitoba.

AESRD (Alberta Environment and Sustainable Resource Development). 2013. Sensitive Species Inventory Guidelines. http://srd.alberta.ca/FishWildlife/WildlifeManagement/documents/SensitiveSpeciesInventoryGuidelines-Apr18-2013.pdf

Agriculture and Agri-Food Canada. 1999. Land Resource Unit. *Soils and Terrain. RM of Grahamdale.* Information Bulletin 99-21. Brandon, Manitoba.

Ballard (nee Traverse), M.J. 1999. Analyzing the Effects of the Fairford Dam on Lake St. Martin First Nation. M.Sc. Thesis, Department of Native Studies, University of Manitoba, Winnipeg, MB.

Ballard (nee Traverse), M.J. 2012. Flooding Sustainable Livelihoods of the Lake St. Martin First Nation: The Need to Enhance the Role of Gender and Language in Anishinaabe Knowledge Systems. Dissertation, Natural Resources Institute, University of Manitoba, Winnipeg, MB.

Banfield, A.W.F. 1974. The Mammals of Canada. University of Toronto Press. Toronto, Ontario.

Bannatyne, B.B. and J.T. Teller. 1984. Geology of Manitoba Before the Ice Age; in Teller J.T. (ed). Natural Heritage of Manitoba: Legacy of the Ice Age. ISBN 0-920704-14-X. Manitoba Museum of Man and Nature, and Manitoba Nature Magazine. Winnipeg, Manitoba.

Beranek, L.L. 1988. Book Review: Noise and Vibration Control. 1988 edited by L. L. Beranek (revised edition). Washington, D.C.: Institute of Noise Control Engineering.

Betcher, R.N., 1987. Groundwater AVADL Ability Map Series – Dauphin Lake (620), Manitoba Natural Resources, Water Resources.

Betcher, R., G. Grove and C. Pupp. 1995. Groundwater In Manitoba: Hydrogeology, Quality Concerns, Management. NHRI Contribution No. CS-93017. March, 1995

Bezener. K. and A. De Smet. 2000. Manitoba Birds. Lone Pine Publishing, Edmonton, AB.

Bilecki, L. C. 2003. Bat Hibernacula in the Karst Landscape of Central Manitoba: Protecting Critical Wildlife Habitat While Managing for Resource Development. Natural Resources Institute, University of Manitoba. Winnipeg, Manitoba. August 25, 2003.

CEAA (Canadian Environmental Assessment Agency). 2012. Glossary – terms commonly used in federal environmental assessments. Public Works and Government Services Canada. Available at: http://publications.gc.ca/collections/collection_2008/ec/En106-58- 2006E.pdf. Accessed October 2015.

CEAA (Canadian Environmental Assessment Agency) 2015. Technical Guidance for Assessing Cumulative Environmental Effects under the Canadian Environmental Assessment Act, 2012.

Canadian Environmental Assessment Agency. December 2014. DRAFT. Available at: http://www.ceaa-acee.gc.ca/default.asp?lang=en&n=B82352FF-1&offset=&toc=hide.

CMHC (Canadian Mortgage and Housing Corporation). 1981. Road and Rail Noise: Effects on Housing. Available at: ftp://ftp.cmhc-schl.gc.ca/chic-ccdh/Research_Reports-Rapports_de_recherche/Older13/CA1%20MH110%2081R56_w.pdf.

Caras, R.A. 1967. North American Mammals- Fur-bearing Animals of the United States and Canada. Meredith Press. University of Minnesota, MN.

Climate Change Connection. 2016. CO_2 Equivalents. Available at: http://climatechangeconnection.org/emissions/co2-equivalents/. Accessed October 31, 2016.

Conant, R. and J.T. Collins. 1991. A Field Guide to Reptiles and Amphibians of Eastern and Central North America. Houghton Mifflin Co. Boston, MA.

Cook, F.R. 1984. Introduction to Canadian Amphibians and Reptiles. National Museums of Canada. Ottawa, Ontario.

Canadian Owners and Pilots Association. 2015. Places to Fly. Available at https://www.copanational.org/Placestofly.cfm. Accessed November 05, 2016.

Densmore, F. 1928. Indian Use of Wild Plants for Crafts, Food, Medicine and Charms. Forty-Fourth Annual Report of the Bureau of American Ethnology, 1926-1927. United States Government Printing Office, Washington D.C.

Ducks Unlimited Canada. 2014. Field Guide: Boreal Wetland Classes in the Boreal Plains Ecozone of Canada. Ducks Unlimited Canada.

EcoLogic Environmental Inc. 2016. Lake St. Martin Outlet Channel Proposed All Season Access Road: Wildlife Technical Report. Prepared by Ecologic Environmental Inc., Winnipeg, Manitoba.

EcoLogic Environmental Inc. 2017. Lake Manitoba and Lake St. Martin Access Road and Outlet Channels Project - Bat Species at Risk Field Study Report. April 2017.

Environment and Climate Change Canada. 2016a. Marine Topics: Prairies Regional Guide: Part 4 Manitoba. Available at: https://www.ec.gc.ca/meteo-weather/default.asp?lang=En&n=779FD5BA-1&offset=5&toc=show#sec7.1. Accessed November 3, 2016.

Environment and Climate Change Canada. 2016b. Facility Greenhouse Gas Reporting. Greenhouse Gas Emissions Reporting Program. Available at: http://www.ec.gc.ca/ges-ghg/default.asp?lang=En&n=040E378D-1. Accessed October 31, 2016.

Environment and Climate Change Canada. 2016c. National Inventory Report 1990–2014: Greenhouse Gas Sources and Sinks in Canada.

Environment and Climate Change Canada. 2016d. Reported Facility Greenhouse Gas Data. Available at: https://www.ec.gc.ca/ges-ghg/default.asp?lang=En&n=8044859A-1. Accessed October 31, 2016.

Environment and Climate Change Canada. 2016e. Air Quality Health Index: Winnipeg, Manitoba. Available at: http://weather.gc.ca/airquality/pages/mbaq-001_e.html. Accessed November 01, 2016.

Environment Canada (EC). 1999. Invasive Plants of Natural Habitats in Canada. An Integrated Review of Wetland and Upland Species and Legislation Governing their Control. Wildlife Habitat Conversation, Canadian Wildlife Service. Available at: https://www.ec.gc.ca/eee-ias/78D62AA2-55A4-4E2F-AA08-538E1051A893/invasives.pdf. Accessed May 2016.

Environment Canada (EC). 2015a. Recovery Strategy for the Rough Agalinis (*Agalinis aspera*) in Canada [Proposed]. Species at Risk Act Recovery Strategy Series. Environment Canada, Ottawa. iv + 31 pp.

Environment Canada (EC). 2015b. Recovery Strategy for Little Brown Myotis (*Myotis lucifugus)*, Northern Myotis (*Myotis septentrionalis*), and Tri-colored Bat (*Perimyotis subflavus*) in Canada [Proposed]. Species at Risk Act Recovery Strategy Series. Environment Canada, Ottawa. ix + 110 pp.

Explosives and Rockwork Technologies Ltd. 2002. Vibration Assessment Eagle Rock Quarry Project. Prepared for Polaris Minerals Corporation, Vancouver, BC.

Forest Resources Management. June 6, 2000. "Integrated Wood Supply Area (I.W.S.A.)." Manitoba Conservation, Forest Resources Management.

Foster, C. and Reimer, E. 2007. Rare Plant Surveys by the Manitoba Conservation Data Centre, 2006. MS Report 07-01. Manitoba Conservation Data Centre, Winnipeg, Manitoba. 53 pp.

Government of Canada. 2016a. Canadian Climate Normals 1981-2010 Station Data. Available at:http://climate.weather.gc.ca/climate_normals/results_1981_2010_e.html?searchType=stnName&txtStationName=lundar&searchMethod=contains&txtCentralLatMin=0&txtCentralLatSec=0&txtCentralLongMin=0&txtCentralLongSec=0&stnID=3815&dispBack=1. Accessed October 31, 2016.

Government of Canada. 2016b. Justice Laws Website. Available at: http://laws-lois.justice.gc.ca/eng/regulations/C.R.C.,_c._1038/index.html. Accessed November 01, 2016.

Government of Manitoba. 1986. The Heritage Resources Act. Queen's Printer, Winnipeg, MB.

Government of Manitoba. 1987. Policy for the Reporting, Exhumation and Reburial of Found Human Remains. Manitoba Historic Resources Branch, Culture, Heritage and Tourism. Winnipeg, MB.

Government of Manitoba. 2009. Provincial Sustainability Report for Manitoba 2009. http://www.gov.mb.ca/conservation/pdf/sustainabilty_report_2009.pdf Accessed December 5, 2015.

Government of Manitoba 2012a. Manitoba's Report on Climate Change For 2012. Progress Update on Manitoba's Emission Reductions.

Government of Manitoba 2012b. News Release September 29, 2012. http://news.gov.mb.ca/news/?archive=&item=15364

Government of Manitoba 2013. News Release December 5, 2013. http://news.gov.mb.ca/news/index.html?item=19836

Government of Manitoba. 2016a. Soil Management Guide. Available at: https://www.gov.mb.ca/agriculture/environment/soil-management/soil-management-guide/print,greenhouse-gases-in-agriculture.html. Accessed October 31, 2016.

Government of Manitoba. 2016b. Manitoba Air Quality. https://web31.gov.mb.ca/EnvistaWeb/Default.ltr.aspx. Accessed November 01, 2016.

Government of Manitoba. 2016c. Ambient Air Quality Criteria. Updated July 2005. Available at: http://www.gov.mb.ca/conservation/envprograms/airquality/aq-criteria/ambientair_e.html. Accessed November 01, 2016.

Government of Manitoba. 2016d. Air Quality Health Index. Available at: http://www.gov.mb.ca/conservation/envprograms/airquality/aq-health/. Accessed November 01, 2016.

Government of Manitoba. 2016e. Mineral Resources. Mineral Inventory Cards. Mineral Inventory File No. 924. Gypsumville. Available at: https://www.gov.mb.ca/iem/min-ed/mbhistory/mininv/924.htm. Accessed November 02, 2016.

Government of Manitoba. 2016f.The Municipal Modernization Act (Municipal Amalgamations). Available at: https://web2.gov.mb.ca/bills/40-2/b033e.php. Accessed November 04, 2016.

Government of Manitoba. 2016g. Mineral Resources. Mineral Inventory Cards. Mineral Inventory File No. 937. Faulkner. Available at: https://www.gov.mb.ca/iem/min-ed/mbhistory/mininv/937.htm. Accessed November 02, 2016.

Gray, S. 2016. Lake St. Martin Outlet Channel Proposed All Season Access Road – Vegetation Technical Report. Prepared by S. Gray Environmental Services Inc. Winnipeg, Manitoba.

Hanson, A.R. (ed.) 2004. Status and conservation of eelgrass (*Zostera marina*) in Eastern Canada. Technical Report Series No. 412. Canadian Wildlife Service, Atlantic Region. viii. + 40 pp.

Harrelson, C. C., C. L. Rawlins and J. P. Potyondy. 1994. Stream channel reference sites: an illustrated guide to field technique. Gen. Tech. Rep. RM-245. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 61 p.

HMMH (Harris, Miller, Miller and Hanson Inc.). 2014. Noise and Vibration during Construction. Available at: http://www.hmmh.com/cmsdocuments/FTA_Ch_12.pdf. Accessed January 24, 2014.

Health Canada. 2011. Guidance for Evaluating Human Health Impacts in Environmental Assessment: Noise. DRAFT. January 2011.

Hind, H.Y. 1971. Narrative of the Canadian Red River Exploring Expedition of 1857 and of the Assiniboine and Saskatchewan Exploring Expedition of 1858. Charles E. Tuttle Company, Vermont.

Hundertmark, K.J. 1997. Ecology and management of the North American moose. Edited by A.W. Franzmann and C.C. Shwartz. Wildlife Management Institute, Washington, DC. 733 pp.

Hutchens, A.R. 1991. Indian Herbology of North America. Shambhala. Boston Massachusetts.

Important Bird Areas. 2016. Available at: http://www.ibacanada.com. Accessed October 2015.

Invasive Species Council of Manitoba (ISCM). 2016. Website: Alien plant and animal species that threaten Manitoba's ecological balance. Available at: http://invasivespeciesmanitoba.com/site/index.php?page=terrestrial-species. Accessed May 2016.

KGS Group. 2013. Emergency Reduction of Lake Manitoba And Lake St. Martin Water Levels Environmental Scoping Report. Final Report. Prepared for Manitoba Infrastructure and Transportation. January 2013.

KGS Group. 2014. Assiniboine River & Lake Manitoba Basins Flood Mitigation Study Lake Manitoba & Lake St. Martin Outlet Channels Conceptual Design - Stage 1 - Deliverable No: LMB-01. Prepared for Manitoba Infrastructure and Transportation. KGS Group Report 12-0300-011. February 2014.

KGS Group. 2016. Assiniboine River & Lake Manitoba Basins - Flood Mitigation Study LMB & LSM Outlet Channels Conceptual Design - Stage 2. KGS Group Project 12-0300-011. Final Report. January 2016.

Kolenosky, G.B. and S.M. Strathearn. 1987. Black Bear; in Novak, M., J.A. Baker, M.E. Obbard and B. Malloch. (eds.). Wild Furbearer Management and Conservation in North America. Ontario Ministry of Natural Resources. Toronto, Ontario. 443-454 pp.

Lapenskie, K. and Bamburak, J.D. 2015: Preliminary results from geological investigations into gypsum, Harcus area, southwestern Manitoba (NTS 62J10); in Report of Activities 2015, Manitoba Mineral Resources, Manitoba Geological Survey, p. 106–114.

Laurian, C., C. Dussault, J.-P. Ouellet, R. Courtois, M. Poulin, and L. Breton. 2008. Behavior of moose relative to a road network. Journal of Wildlife Management 72: 1550.

Leybourne, M. I, R.E. Denison, B.L. Cousens, R.K. Bezys, D. C. Gregoire, D. R. Boyle and E. Dobrzanski. 2007. Geochemistry, geology, and isotopic (Sr, S, and B) composition of evaporites in the Lake St. Martin impact structure: New constraints on the age of melt rock formation. G3 Geochemistry, Geophysics, Geosystems. An Electronic Journal of the Earth Sciences. Published by American Geophysical Union and the Geochemical Society. Volume 8, Number 3. 3 March 2007.

Lockery, A.R. 1984. The Post-Glacial Period: Manitoba's Present Landscape; in Teller J. T. (ed.). Natural Heritage of Manitoba: Legacy of the Ice Age. ISBN 0-920704-14-X. Manitoba Museum of Man and Nature, and Manitoba Nature Magazine. Winnipeg, Manitoba.

Manitoba Avian Research Committee. 2003. The Birds of Manitoba. Manitoba Naturalists Society, 401-63 Albert Street, Winnipeg, Manitoba. Friesens Printers. Winnipeg, Manitoba.

MBBA (Manitoba Breeding Bird Atlas). 2015. Manitoba Species at Risk. Available at http://www.birdatlas.mb.ca/speciesatrisk/master.htm. Accessed October 10, 2015.

Manitoba Bureau of Statistics. 2008a. 2006 Census Profile Grahamdale, RM. September 2008.

Manitoba Bureau of Statistics. 2008b. 2006 Census Profile Siglunes, RM. September 2008.

Manitoba Conservation (MC). 2015. Species Listed Under the Manitoba Endangered Species and Ecosystems Act. Wildlife and Ecosystem Protection Branch. Winnipeg. URL: http://www.gov.mb.ca/conservation/wildlife/sar/sarlist.html. Accessed October 2015.

MC. 2015. Manitoba Species at Risk Fact Sheet: Small White Lady's-Slipper (*Cypripedium candidum*). Wildlife and Ecosystem Protection Branch. Winnipeg. URL: http://www.gov.mb.ca/conservation/wildlife/sar/pdf/ladyslipper.pdf . Accessed October 2015.

MCWS (Manitoba Conservation and Water Stewardship). 1992. Guidelines for Sound Pollution. Environmental Approvals Branch. Winnipeg, Manitoba.

MCWS. 2013. Manitoba Forest Management Units. Manitoba Conservation and Water Stewardship, Forestry Branch. Winnipeg, Manitoba.

MCWS. 2014. 2013-2014 Trapping Guide. Manitoba Conservation and Water Stewardship, Wildlife and Ecosystem Protection Branch. Winnipeg, Manitoba.

MBCDC (Manitoba Conservation Data Centre). 2015. Interlake Plain Ecoregion list of species of conservation concern. Available at: http://www.gov.mb.ca/conservation/cdc/ecoreg/interlake.html. Accessed October 2015.

Manitoba Hydro. 2016. Facilities and Operations. Available at: https://www.hydro.mb.ca/corporate/facilities_operations.shtml Accessed November 05, 2016.

Manitoba Sustainable Development (MBSD). 2016a. 2016 Manitoba Hunting Guide. Manitoba Conservation and Water Stewardship, Wildlife and Ecosystem Protection Branch. Winnipeg, Manitoba.

Manitoba Sustainable Development (MBSD). 2016b. Protected Areas Initiative. Available at: http://www.gov.mb.ca/conservation/pai/. Accessed November 07, 2016.

MBSD. 2016c. 2015-2016 Trapping Guide. Manitoba Conservation and Water Stewardship, Wildlife and Ecosystem Protection Branch. Winnipeg, Manitoba.

Manitoba Water Stewardship. 2011. Manitoba Water Quality Standards, Objectives, And Guidelines. Manitoba Water Stewardship Report 2011-01. November 28, 2011. Winnipeg, Manitoba.

McCabe, H.R. 1971. Stratigraphy of Manitoba, An Introduction and Review. The Geological Association Of Canada, Special Paper Number 9, 1971.

MMF (Manitoba Metis Federation). 2015. Available at: http://www.mmf.mb.ca Accessed December 10, 2015.

Manitoba Water Caucus. 2016. Wetlands in Manitoba. Available at: http://mbwatercaucus.org/support-the-water-caucus/wetlands. Accessed October 31, 2016.

Marles, R. J., C. Clavelle, L. Monteleone, R. Tays, and D. Burns. 2000. Aboriginal Plant Use In Canada's Northwest Boreal Forest. UBC Press, Vancouver, BC.

Martin. D.J. 1977. Ground Vibrations Caused By Road Construction Operations. Environment Division Transport Systems Department. Transport and Road Research Laboratory Crowthorne, Berkshire, UK. Supplementary Report 328.

Mataille, G., C. F. M. Lewis, E. Nielsen, L. H. Thorliefson, and B. J. Todd.1996. Holocene Evolution of the Manitoba Great Lakes Region. Manitoba Energy and Mines, Open File OF96-8.

Milani, D.W. 2013. Fish community and fish habitat inventory of streams and constructed drains throughout agricultural areas of Manitoba (2002-2006). Can. Data Rep. Fish. Aquat. Sci. 1247: xvi + 6,153 p

Mills, G.F. 1984. Soils of Manitoba; in Teller J. T. (ed.). Natural Heritage of Manitoba: Legacy of the Ice Age. ISBN 0-920704-14-X. Manitoba Museum of Man and Nature, and Manitoba Nature Magazine. Winnipeg, Manitoba.

Moravetz, J. and S. Jezik. 1994. Ceramic Analysis of the Bensa Tanki Site (EfLq-4). In Manitoba Archaeological Journal, Vol. 4 No 1 & 2. Winnipeg, MB.

Nature North. 2014. The Manitoba Herptiles Atlas. Available at http://www.naturenorth.com/Herptiles/Manitoba_Herptiles_Atlas.html. Accessed October 8, 2015.

Newbury, R.W., M.N. Gaboury. 1993. Stream Analysis and Fish Habitat Design: A Field Manual. Newbury Hydraulics Ltd. and the Manitoba Habitat Heritage Corporation. 262 p.

Norquay, K.J. O., F. Martinez-Nunez, J. E. Dubois, K.M. Monson, and C. K. R. Willis. 2013. Long-Distance Movements of Little Brown Bats (*Myotis lucifugus*). Journal of Mammology 94(2):000-000, 2013.

Northern Lights Heritage Services Inc (NLHS). 2000. Fairford River Archaeological Project: A Survey for the Former North West and Hudson's Bay Company Posts. Super Six Community Futures Development Corporation. Ashern, MB.

NLHS. 2006. Heritage Resources Impact Assessment Final Report. Ashern-Dauphin Fibre Optic Cable Heritage Permit A50-06. Prepared for Manitoba Hydro, Winnipeg, MB.

NLHS. 2017. Heritage Resources Characterization Study: Lake St. Martin Outlet Channels and Proposed All Season Access Road. Final report prepared for M. Forster Enterprises and Manitoba Infrastructure.

Parks, C. 2010. Best Management Practices for Industry: Top Invasive Plant Concerns for Rights-of-Way. Prepared by the Invasive Species Council of Manitoba.

Peterson, R.T. and V.M. Peterson. 2002. A Field Guide to the Birds of Eastern and Central North America. Houghton Mifflin Harcourt. New York, NY.

Preston, W.B. 1982. The Amphibians and Reptiles of Manitoba. Manitoba Museum of Man and Nature. Winnipeg, Manitoba.

Reid, F.A. 2006. A Field Guide to the Mammals of North America. Houghton Mifflin Harcourt. New York, NY.

Renecker, L.A. and C.C. Schwartz. 1998. Food Habits and Feeding Behaviour in Ecology and Management of the North American Moose. Franzmann and Schwartz (eds.) Smithsonian Institution Press. Washington, U.S.A. p.403-439.

Richtik, J.M. 1964. A Historical Geography of the Interlake Area of Manitoba from 1871 t0 1921. M.A. Thesis, Department of Geography, University of Manitoba, Winnipeg, MB.

Riddle, D.K. 1985. An Initial Archaeological Inventory and Survey of Siglunes Municipality: Western Interlake Planning District. Manuscript on file with the Historic Resources Branch, Manitoba Culture, Heritage and Tourism. Winnipeg, MB.

Riddle, D.K. and L. Pettipas. 1992. An Initial Archaeological Inventory and Survey of Siglunes Municipality, Wester Interlake Planning District. In Manitoba Archaeological Journal Vol. 2, No. 2. Winnipeg, MB.

Rowe, J.S. 1972. Forest Regions of Canada. Canadian Forest Service, Dept. of the Environment, Information Canada. Publication No. 1300. Ottawa, Ontario.

Royal Canadian Mounted Police (RCMP). 2015. Find a detachment. Accessed online at: http://www.rcmp-grc.gc.ca/detach/en/find/MB.

Rural Municipality (RM) of Grahamdale. 2016. Development Plan. Available at: http://cms.grahamdale.ca/_docs/DevPlanOriginalText_954c647325.pdf. Accessed November 05, 2016.

RM of West Interlake. 2016. Available at: http://rmofwestinterlake.com/. Accessed November 05, 2016.

Rutulis, M. 1973. Groundwater Availability in the Municipality of St Clements. In: Water Resources of the Winnipeg Region.

Salmo Consulting Inc., AXYS Environmental Consulting Ltd., Forem Technologies, and Wildlife & Company Ltd. 2004. Deh Cho Cumulative Effects Study Phase 1: Management Indicators and Thresholds.Calgary, AB. Prepared for Deh Cho Land Use Planning Committee. 172 pp.

SARA (Species At Risk Act). 2015. Species At Risk Public Registry. Available at: http://www.sararegistry.gc.ca/default.asp?lang=En&n=24F7211B-1. Accessed October 2015.

Silverberg, J. K., P. J. Pekins, and R. A. Robertson. 2003. Moose responses to wildlife viewing and traffic stimuli. Alces 39:153–160.

Smith R.E., H. Veldhuis, G.F. Mills, R.G. Eilers, W.R. Fraser, and G.W. Lelyk. 1998. Terrestrial Ecozones, Ecoregions, and Ecodistricts of Manitoba, An Ecological Stratification of Manitoba's Natural Landscapes. Technical Bulletin 1998-9E. Land Resource Unit, Brandon Research Centre, Research Branch, Agriculture and Agri-Food Canada. Winnipeg, Manitoba.

Snoman Inc. 2015. Maps and Trails. Available at: http://snoman.mb.ca/section.php?id=maps-trails. Accessed December 11, 2015.

Statistics Canada. 2016. 2011 Census Profiles. Available at: http://www12.statcan.gc.ca/census-recensement/index-eng.cfm?HPA=1. Accessed November 04, 2016.

Stewart, K. and D. Watkinson. 2004. Freshwater Fishes of Manitoba. University of Manitoba Press. 300 pp.

The World of Explosives. 2016. Human Perception. Available at: http://explosives.org/vibration-basics/human-perception/. Accessed November 01, 2016.

Town of Ashern. n.d.a. Local Services – Municipal Services. Accessed online at: http://www.ashern.ca/main.asp?fxoid=FXMenu,3&cat_ID=1&sub_ID=280

Town of Ashern. n.d.b. Resident Info – Health Care – Hospital. Accessed online at: http://www.ashern.ca/main.asp?fxoid=FXMenu,6&cat_ID=3&sub_ID=243&sub2_ID=167

Transport Canada. 2016. Notices of Rail Line Discontinuance. Available at: https://www.otc-cta.gc.ca/eng/notices-discontinuance-received-agency-under-section-146-july-1-1996-table Accessed November 05, 2016.

Treaty Land Entitlement Committee (TLEC). 2016. Treaty Land Entitlement Framework Agreement. http://tlec.ca/wp-content/uploads/2012/01/TLE-Framework-Agreement-_1997__7.pdf. Accessed November 05, 2016.

Turcotte, C.L.1997. Towards Sustainable Harvesting of Seneca Snakeroot (Polygala senega L.) on Manitoba Hydro Rights-of-Way. MSc. Thesis, Department of Botany, University of Manitoba, Winnipeg, MB.

Upper Thames River Conservation Authority. 2016. Sifton Bog ESA Conservation Master Plan 2009 to 2019. Section 4: Raised Bog Water Chemistry (Geochemistry). London, Ontario.

Warms, J. 2001. Over the Prison Wall. The Story of Percy Moggey. Roviera Publishing. Fairford, MB.

Wasser, S. K., J. L. Keim, M. L. Taper, and S. R. Lele. 2011. The influences of wolf predation, habitat loss, and human activity on caribou and moose in the Alberta oil sands. Frontiers in Ecology and the Environment 9:546–551.

Weather Network. 2016. Statistics: Dauphin, Manitoba. Available at: http://www.theweathernetwork.com/forecasts/statistics/wind/cl5040680/camb0046. Accessed October 31, 2016.

Wilson, M. F. 2007. Medicinal Plant Fact Sheet: *Cypripedium*: Lady's slipper orchids. A collaboration of the IUCN Medicinal Plant Specialist Group, PCA-Medicinal Plant Working Group, and North American Pollinator Protection Campaign. Arlington, Virginia.

Yost, A. C., and R. G. Wright. 2001. Moose, Caribou, and Grizzly Bear Distribution in Relation to Road Traffic in Denali National Park, Alaska. Arctic 54:41–48.

Zoladeski C.A., G.M. Wickware, R.J. Delorme, R.A. Sims, and I.G.W. Corns. 1995. Forest ecosystem classification for Manitoba: field guide. Natural Resources Canada, Canadian Forest Service's, Northwest Region, Northern Forestry Centre, Edmonton, Alberta. Special Report 2.

9.1 Personal Communications

Friesen, Chris. 2015. Manitoba Conservation Data Centre, Provincial Biologist. Request for Review of Manitoba Conservation Data Centre Rare Species Database.

Lovie, Mark. 2015. Manitoba Infrastructure and Transportation, Provincial Roads Construction Supervisor.

Petch, Virginia. 2016. Senior Archaeologist. Northern Lights Heritage Services Inc.

Appendix 1: Wildlife Technical Report

Appendix 2: Vegetation Technical Report

Appendix 3: Aquatics Technical Report

Appendix 4: Heritage Resources Technical Report