LAKE MANITOBA AND LAKE ST. MARTIN OUTLET CHANNELS PROJECT EIS

Manitoba





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7.0 - Aquatic Environment
8.0 - Terrestrial Environment

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LAKE MANITOBA AND LAKE ST. MARTIN OUTLET CHANNELS PROJECT
Environmental Impact Statement

CHAPTER 7

BIOPHYSICAL EFFECTS ASSESSMENT ON AQUATIC ENVIRONMENT

March 2020

Table of Contents

7.0 ASSESSMENT OF POTENTIAL EFFECTS ON AQUATIC ENVIRONMENT 7.1
7.1 OVERVIEW OF CHAPTER 7.1
7.2 FISH AND FISH HABITAT 7.1
7.2.1 Scope of the Assessment 7.1
7.2.1.1 Regulatory and Policy Setting 7.3
7.2.1.2 Influence of Engagement on the Identification of Issues and the Assessment Process 7.5
7.2.1.3 Consideration of Indigenous Information and Traditional Knowledge 7.8
7.2.1.4 Potential Effects, Pathways and Measurable Parameters 7.11
7.2.1.5 Boundaries 7.13
7.2.1.6 Residual Effects Characterization 7.15
7.2.1.7 Significance Definition 7.17
7.2.2 Existing Conditions for Fish and Fish Habitat 7.17
7.2.2.1 Methods 7.17
7.2.2.2 Overview of Fish and Fish Habitat 7.19
7.2.3 Project Interactions with Fish and Fish Habitat 7.48
7.2.4 Assessment of Residual Environmental Effects on Fish and Fish Habitat 7.49
7.2.4.1 Analytical Assessment Techniques 7.49
7.2.4.2 Permanent Alteration or Destruction of Fish Habitat 7.50
7.2.4.3 Change in Fish Passage 7.68
7.2.4.4 Change in Fish Health and Mortality 7.74
7.2.4.5 Summary of Project Residual Effects 7.82
7.2.5 Determination of Significance 7.84
7.2.5.1 Significance of Residual Environmental Effects from the Project 7.84
7.2.6 Potential Effects on Federal Lands 7.85
7.2.7 Prediction Confidence 7.85
7.2.8 Follow-Up and Monitoring 7.86
7.2.9 Conclusions 7.87
7.2.9.1 Permanent Alteration or Destruction of Fish Habitat 7.87
7.2.9.2 Change in Fish Passage 7.88
7.2.9.3 Change in Fish Health and Mortality 7.88
7.2.10 References 7.89
7.2.10.1 Literature Cited 7.89
7.2.10.2 Personal Communication 7.94

LIST OF TABLES

Table 7.2-1 Issues of Concern Identified in Traditional Knowledge 7.9
Table 7.2-2 Potential Effects, Effect Pathways and Measurable Parameters for Fish and Fish Habitat Valued Component 7.12
Table 7.2-3 Characterization of Residual Effects on Fish and Fish Habitat 7.15
Table 7.2-4 Distribution of Fish Species in the RAA 7.24

Table 7.2-5 Potential Project Interactions with Fish and Fish Habitat During Construction and Operations 7.48
Table 7.2-6 Measures to Avoid or Mitigate Potential Permanent Alteration or Destruction of Fish Habitat 7.59
Table 7.2-7 Measures to Avoid or Mitigate Potential Change in Fish Passage 7.70
Table 7.2-8 Measures to Avoid or Mitigate Potential Change in Fish Health and Mortality 7.77
Table 7.2-9 Summary of Project Residual Effects on Fish and Fish Habitat 7.82

LIST OF APPENDICES

APPENDIX 7A TABLES 7A.1

APPENDIX 7B FIGURES 7B.1

APPENDIX 7C PHOTOS 7C.1

7.0 ASSESSMENT OF POTENTIAL EFFECTS ON AQUATIC ENVIRONMENT

7.1 OVERVIEW OF CHAPTER

This chapter discusses the aquatic environment setting and the potential effects that the Project will have on the aquatic environment. Section 7.1 of the Canadian Environmental Assessment Agency (CEAA) Environmental Impact Statement (EIS) Guidelines for the Project (CEAA 2018) and Section 3.2 of the Environmental Assessment Scoping Document (Manitoba Infrastructure 2018) submitted to Manitoba Sustainable Development) indicate that baseline conditions should be documented for fish and fish habitat, including species at risk, with the federal Guidelines also requesting information on aquatic invasive species. Section 7.2 of the EIS Guidelines indicates that predicted changes to the physical environment should be determined for aquatic invasive species, and Section 7.3 indicates that predicted effects on valued components should be determined for fish and fish habitat and species at risk. To characterize these changes and effects in a structured way, fish and fish habitat was established as the valued component (VC) for aquatic environment, with the following associated sub-components:

- fish habitat
- fish community
- commercial, recreational and Aboriginal fisheries
- aquatic invasive species
- aquatic species at risk

Focal topics of discussion include potential changes in fish habitat, fish passage, and fish health and mortality. Information is provided on the scope of assessment, existing conditions, potential Project interactions with fish and fish habitat, assessment of potential residual environmental effects, determination of significance, cumulative effects, effects to federal lands, and any follow up and monitoring requirements.

7.2 FISH AND FISH HABITAT

7.2.1 Scope of the Assessment

This fish and fish habitat assessment is written in accordance with the requirements described in both federal and provincial guidance documents for the Project. Concordance tables, demonstrating where EIS Guidelines are addressed, are provided in at the beginning of this EIS.

Section 3 of the Environmental Assessment Scoping Document for the Project (Manitoba Infrastructure 2018) submitted to Manitoba Sustainable Development discusses aquatic environment issues in the following subsections:

- Section 3.2.1 indicates that the EIS will describe fish and fish habitat, including fish populations (species, life stage, abundance, distribution, and movements), fish habitat preferences, primary and secondary productivity, fish passage issues and species of interest identified by local and/or Indigenous people through TK studies and the Public Engagement Program (PEP).
- Section 3.2.2 indicates that the EIS will consider aquatic species identified as being of conservation concern.

Section 7 of the CEAA EIS Guidelines for the Project discusses aquatic environment issues in the following subsections:

- Section 7.1.5 indicates that the EIS will present information on fish and fish habitat for potentially affected surface waters, including fish populations (species, life stage), primary and secondary productivity, fish or invertebrate species at risk, fish habitat, fish passage issues and species of cultural and/or commercial importance to Indigenous peoples that are found or are likely to be found in the study area.
- Section 7.1.6 indicates that the EIS will include information on existing or potential aquatic invasive species, including residences, seasonal movements, movement corridors, habitat requirements, key habitat areas, and general life history.
- Section 7.2.4. requires information on potential changes to the above, including to species at risk.
- Section 7.1.9 requires information on species at risk, including residences, seasonal movements, movement corridors, habitat requirements, key habitat areas, identified critical habitat and/or recovery habitat and general life history.
- Section 7.3.1 requires the identification of any potential direct and indirect adverse effects to fish and fish habitat as defined in subsection 2(1) of the *Fisheries Act*, including riparian areas, water/sediment quality and methylmercury, and section 35 of the *Fisheries Act* regarding fish mortality, as well as potential effects on fish movements and invasive species.
- Section 7.3.5 requires discussion on the potential effects of the Project on species at risk and their critical habitat, including the direct and indirect effects on their survival or recovery.

Fish and fish habitat is a VC for the Project because fish and fish habitat are a component of a healthy aquatic ecosystem, they provide the basis for valuable commercial and recreational fisheries in Lake Manitoba, Lake St. Martin, and Lake Winnipeg, are important for traditional and cultural purposes for local Indigenous groups, and are the end-point receptors for any potential changes in water quality or water quantity caused by the Project. Additionally, fish and fish habitat are protected by the *Fisheries Act*. As a result, the Project must comply with the provisions of the *Fisheries Act* that protect fish and fish habitat in Canada.

Fish and fish habitat is the only VC used for assessing potential effects in the aquatic environment. Potential effects from the Project on surface water quantity and quality (a key aspect of fish habitat) and groundwater are predicted in Chapter 6, Section 6.4 and are used as input for assessing the effects of potential changes in lake levels, stream flows, and water quality on fish and fish habitat.

7.2.1.1 Regulatory and Policy Setting

Various legislation, regulations, policies, and guidelines govern how fish and fish habitat are managed in Canada and in the Province of Manitoba. These regulatory instruments provide the framework for how potential impacts to fish and fish habitat are identified, how they can be avoided or mitigated, and, as a last resort, if and how unavoidable impacts can be counterbalanced with offsetting. Federal and provincial regulations also govern how commercial, recreational, and Aboriginal fisheries are managed. Descriptions of the various regulatory instruments applicable to fish and fish habitat in Canada and Manitoba and to the Project in general are provided below.

Federal Regulations and Policy

Fisheries Act

Section 35(1) of the *Fisheries Act* prohibits "any work, undertaking, or activity that results in serious harm to fish that are part of a commercial, recreational, or Aboriginal fishery, or to fish that support such a fishery." Serious harm to fish is defined in the Act as "the death of fish or permanent alteration or destruction of fish habitat". However, a person does not contravene Section 35(1) of the *Fisheries Act* if the work, undertaking, or activity is conducted in accordance with prescribed conditions, regulations, or is authorized by the Minister of Fisheries and Oceans Canada (DFO). When considering a paragraph 35(2)(b) *Fisheries Act* authorization application to cause "serious harm to fish", the Minister must consider the following factors:

- the contribution of the relevant fish to the ongoing productivity of commercial, recreational, or Aboriginal (CRA) fisheries
- fisheries management objectives
- whether there are measures and standards to avoid, mitigate, or offset serious harm to fish that are part of a CRA fishery, or that support such a fishery
- the public interest

Section 36(3) of the *Fisheries Act* prohibits the "deposit of a deleterious substance of any type in water frequented by fish or in any place under any conditions where the deleterious substance may enter any such water." A deleterious substance is any substance that, if added to water, degrades or alters its quality so that it is likely to be rendered deleterious to fish or fish habitat or to people or fish that frequent that water. For example, a deleterious substance could include sediment, hydrocarbons such as diesel fuel, oil, and grease, heavy metals such as mercury, or other potentially toxic chemicals.

Section 43(1) of the *Fisheries Act* provides DFO with the ability to develop regulations to control and prevent the introduction of aquatic invasive species (AIS). The objectives of the AIS regulations are to prevent new introductions and manage the spread of AIS. The current regulations prohibit the import, transport, possession, and/or release of species listed in Part 2 of the regulation, in specific geographic areas and under specific conditions. There are currently 88 species in Part 2 of the Aquatic Invasive Species Regulation that are prohibited from possession, transportation, and release in Manitoba. Section 7.2.2.2 provides details on the aquatic invasive species most relevant to the Project.

Species at Risk Act

The *Species at Risk Act* (SARA) protects wildlife species at risk in Canada to prevent the extirpation or extinction of wildlife species (including fish), to provide recovery strategies for species that are extirpated, endangered, and threatened because of human activity, and to manage species of special concern so they do not become threatened or endangered. The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses and designates the status of species and recommends designation for legal protection under SARA. Species listed under COSEWIC only are not afforded legal protection under SARA until they are formally listed on Schedule 1 of the SARA by the Parliament of Canada.

Under SARA, it is prohibited to kill, harm, harass, capture or take individual species at risk (Section32(1)), or damage or destroy their residences (Section 33). Critical habitat may be identified and designated as such for species at risk. Section 58 of SARA prohibits the destruction of critical habitat for all species at risk on federally regulated lands and on all lands if it is an aquatic species protected under the *Fisheries Act*.

SARA is relevant to the Project because of the presence of several “at-risk” aquatic species in Lake Manitoba, Lake St. Martin, and Lake Winnipeg as identified in Section 7.2.2.2.

Provincial Regulations and Policy

Manitoba Fisheries Act and Manitoba Fishery Regulations

The Manitoba Fisheries Act regulates who can fish on provincial Crown land, what conditions may be included in a license, and what fees are paid for a license. It also regulates the property rights in fish on those individuals who fish commercially or recreationally in waters within Manitoba’s Crown land. The Manitoba Fishery Regulations dictate the close times, quotas, and gear types for Manitoba’s commercial and recreational fisheries.

Manitoba Water Rights Act

The Manitoba Water Rights Act regulates the use or diversion of water in Manitoba and is administered by Manitoba Sustainable Development (MSD). Section 9.1(1) of the *Water Rights Act* requires the

Minister to consider scientific or other information relating to the groundwater and water body levels and the instream flows that are necessary to ensure that aquatic ecosystems are protected and maintained. Sections 9.1(2), 9.2, and 14(1) allows the Minister to refuse to issue a water use license, to suspend an existing water use license, or cancel an existing water use license, respectively if, in the opinion of the Minister, the action authorized by the license would negatively affect an aquatic ecosystem. Section 14.1 allows the Minister to undertake scientific investigations into groundwater, waterbody levels, or instream flows anywhere in Manitoba to determine whether aquatic ecosystems are being negatively affected by insufficient levels or flows.

Manitoba Water Resources Conservation Act

The Manitoba Water Resources Conservation Act prohibits the diversion, extraction, taking, storage, or transport of water for removal from a water basin or sub-water basin in Manitoba that could, individually or collectively, have significant adverse effects on the ecological integrity of Manitoba's water resources or their associated ecosystems.

Manitoba Water Protection Act

The Manitoba Water Protection Act provides for the protection and stewardship of Manitoba's water resources and aquatic ecosystems. It does so by establishing the Manitoba Water Quality Standards, Objectives, and Guidelines (MWQSOG) which lists water quality standards (Tier I), objectives (Tier II), and guidelines (Tier III) for drinking water, agricultural use, and protection of aquatic resources. Additionally, the MWQSOG lists fish tissue residue guidelines for wildlife and/or human consumers for arsenic, fluoride, lead, mercury, methylmercury, and four organic compounds.

Manitoba Water Protection Amendment Act (Aquatic Invasive Species)

This amendment to *The Manitoba Water Protection Act* provides for the official designation of AIS and prohibits the transport and/or release or possession of AIS into and within Manitoba. The Act outlines the powers of AIS inspectors to inspect water equipment and require cleaning and decontamination prior to use. Additional requirements may be outlined in a control order and specific AIS control zones as designated by the Act.

7.2.1.2 Influence of Engagement on the Identification of Issues and the Assessment Process

Manitoba Infrastructure has undertaken engagement prior to and throughout preparation of the EIS, and will continue to consult with Indigenous groups, government agencies, and stakeholders throughout the are summarized under the following topics and are described with reference to the Indigenous group providing the comment in the sections below:

- introduction of invasive species (e.g., zebra mussels)
- impacts on commercial fisheries
- fish mortality due to stranding in the channels
- impacts to spawning areas
- changes in fish migration patterns
- change in water quality
- change in sediment and debris
- changes in fish health and quality
- need for monitoring of fish populations
- need for hatchery stocking programs and improved fish ladders
- loss of habitat/change in shoreline morphology

Engagement efforts with regulatory agencies have included meetings with Manitoba Sustainable Development (MSD) (March 14 and May 2, 2018) to solicit concerns regarding construction and operation of the LMOC and LSMOC on surface water, groundwater, and aquatic biota. In addition to many of the concerns raised by the public and Indigenous groups, the following additional concerns about potential effects to fish and fish habitat were raised by MSD staff during these meetings:

- change in mercury accumulation in aquatic biota
- effects on headwater lakes and streams
- change in groundwater/surface water interactions important to fish

Each of these key concerns is discussed in the assessment.

Introduction of Invasive Species

The potential for the channels to lead to further introduction of invasive species, such as zebra mussels was raised as a concern by multiple Indigenous groups: Interlake Reserves Tribal Council, Keewatinook Fishers of Lake Winnipeg, Black River First Nation, Little Saskatchewan First Nation, Manitoba Metis Federation, Fisher River Cree Nation, Lake St. Martin First Nation and Little Saskatchewan First Nation. Manitoba Metis Federation commented that diverting considerable amounts of water will allow the spread of aquatic species faster and farther than would typical occur and that the preventing zebra mussels (currently in Lake Winnipeg) from entering Lake St. Martin and Lake Manitoba should be paramount. Potential effects of the Project on the spread of invasive species is addressed in Section 7.2.4.2.

Impacts on Commercial Fisheries

The wider effects of the Project on commercial fisheries and how compensation for impacts to commercial fisheries would be managed was expressed as a concern by multiple Indigenous groups: Black River First Nation, Lake St. Martin First Nation, Dauphin River First Nation, Seymourville Community Council, Ebb and Flow First Nation, Norway House First Nation, Black River First Nation, Pinaymootang First Nation, O-Chi-Chak-Ko-Sipi First Nation, Manitoba Metis Federation, Lake Manitoba First Nation and Keewahtinook Fishers of Lake Winnipeg. Black River First Nation commented that commercial fishing on Lake St. Martin is an important economic activity and must be protected.

Potential effects of the Project on CRA fisheries are addressed in all aspects of the fish and fish habitat effects assessment; specifically, in Section 7.2.2.2.

Change in Water Quality

Effects of the Project on water quality were expressed as a concern by Dauphin River First Nation, Norway House Cree Nation, Pinaymootang First Nation, Peguis First Nation and Little Saskatchewan First Nation. Potential changes to water quality due to the Project are predicted in Chapter 6, Section 6.4.8.2 but the potential effects on fish and fish habitat from these changes are assessed in Sections 7.2.4.2 and 7.2.4.4.

Changes in Fish Migration

Potential effects on fish migrations and movements caused by the presence of permanent Project infrastructure was expressed as a concern by Interlake Reserves Tribal Council, Dauphin River First Nation and Fisher River First Nation. The Interlake Reserves Tribal Council commented that they were concerned that the channels could result in changes to the distribution of fish and fish populations. Potential changes to fish migrations due to the Project are addressed in Section 7.2.4.3.

Fish Mortality due to Stranding

Stranding of fish in the outlet channels and how this could lead to fish mortality was raised as a concern by a number of Indigenous groups, including Manitoba Metis Federation, Ebb and Flow First Nation and Interlake Reserves Tribal Council. Manitoba Metis Federation expressed concern about how large numbers of small-bodied bait fish and benthic species could remain in the channels after their use. Potential effects of the Project on fish standing are addressed in Section 7.2.4.4.

Impacts to Spawning Areas

Potential impacts on spawning areas and how the long-term health and viability of fish populations important to commercial and Aboriginal fisheries will be affected by the Project was expressed as a concern by Lake Manitoba First Nation, Manitoba Metis Federation, Dauphin River Nation and Interlake Reserves Tribal Council. Potential effects of the Project on fish habitat and spawning areas are addressed in Section 7.2.4.2.

Change in Sediment and Debris

Multiple Indigenous groups expressed concern that the channels would lead to an increase in sediment, debris in surface waters downstream of the Project. These concerns were expressed by Dauphin River First Nation, Fisher River Cree First Nation, Lake St. Martin First Nation, Ebb and Flow First Nation, Norway House Cree Nation, Seymourville Northern Affairs Community, Interlake Reserves Tribal Council, Fisher River First Nation and Kinonjeoshtegon First Nation. Dauphin River First Nation expressed specific concern about the possibility of increased sediment and debris in the Dauphin River while the Lake St. Martin First Nation expressed similar concern for Bear Creek. Potential effects of sediment and debris on fish habitat are addressed in Section 7.2.4.2 and the potential direct effects of sediment and debris on fish health and mortality are addressed in Section 7.2.4.4.

Changes in Fish Health and Quality

Concern about potential changes to fish health and quality due to the Project was expressed by multiple Indigenous groups including: the Interlake Reserves Tribal Council, Manitoba Metis Federation, Dauphin River First Nation, Fisher River Nation and Hollow Water First Nation. The health of fish in Lake Winnipeg as a result of potential contamination was expressed as a concern by Dauphin River First Nation and Keewahtinook Fishers of Lake Winnipeg. Potential effects of the Project on fish health and quality are addressed in Section 7.2.4.4.

Need for Monitoring, Stocking and Fish Ladders

The need for monitoring and follow-up is discussed in Section 7.2.8. The potential need for measures to offset residual Project effects will be addressed in the *Fisheries Act* Authorization for the Project.

Loss of Habitat/Change in Shoreline Morphology

Fisher River First Nation and Manitoba Metis Federation expressed concern about potential effects of the Project on aquatic habitat. Manitoba Metis Federation commented that it was not clear if the aquatic habitat will be impacted positively or negatively due to the fluctuating nature of flows in the channel. Potential effects of the Project on fish habitat are addressed in Section 7.2.4.2.

7.2.1.3 Consideration of Indigenous Information and Traditional Knowledge

Traditional knowledge (TK), including information about existing conditions, potential effects, and mitigation measures, has been provided by Indigenous groups through Project specific studies. A summary of recommended Project-related effects/issues of concern related to fish and fish habitat in these studies is provided in Table 7.2-1 and the text that follows.

Table 7.2-1 Issues of Concern Identified in Traditional Knowledge

Indigenous Group	Project-related Effect/Issue of Concern	EIS Consideration
Manitoba Metis Federation	• Spawning studies should be carried out and continued throughout the affected waterbodies. • Assessment should consider fish stranding, specifically small body baitfish and benthic invertebrate species and how large numbers of small-bodied fish could be stranded in the channel • Assessment should consider spawning throughout the affected waterbodies and how changes will affect spawning behavior including, the long-term health and viability of important fish populations • Monitor for and take measures (steps) to control the spread of invasive species	Potential effects of the Project on fish stranding is addressed in Section 7.2.4.4. Potential effects of the Project on spawning habitat and the spread of invasive species are addressed in Section 7.2.4.2. Potential effects of the Project on fish behavior are addressed in Section 7.2.4.3. Follow-up and monitoring is discussed in Section 7.2.9.
Dauphin River First Nation	• Potential for the Project to affect Whitefish spawning grounds, located near the proposed Lake St. Martin channel outlet • Potential for the Project to affect fish movement • Whitefish now use the emergency outlet channel and Buffalo Creek rather than Dauphin River. This is evidenced by the congregation of pelicans at the outlet of Buffalo Creek, where they prey upon the Whitefish that gather in that area • Potential for the Lake Manitoba channel to increase the oxygen in the water, which could positively benefit Pickerel populations	Potential effects of the Project on spawning habitat are addressed in Section 7.2.4.2. Potential effects of the Project on fish movement are addressed in Section 7.2.4.3. The EOC will not be used once the Project is complete. Potential benefits of the Project on fish populations are discussed in Section 7.2.4.2
Interlake Reserves Tribal Council	• Potential for the channels to result in changes to the distribution of fish, fish populations, and the potential for fish to be trapped in the channel • Potential for the spread of zebra mussels • Potential for and effect on fish spawning grounds, including in Lake St. Martin and Whitefish spawning grounds, located near the Lake St. Martin channel outlet • Potential for fish to move through the Lake Manitoba channel. Indigenous groups noted that following construction of the emergency channel fish species (e.g., bullhead) which had never been seen in the area were being caught.	Potential for Project effects on fish movement are addressed in Section 7.2.4.3. Potential effects of the Project on the spread of AIS are addressed in Section 7.2.4.2. Potential effects of the Project on spawning habitat are addressed in Section 7.2.4.2.
Lake Manitoba First Nation	• Pickerel spawning locations are located on the south end of Lake Winnipeg	The Project is not expected to have any effects on the south basin of Lake Winnipeg.
Multiple Indigenous groups[1]	• Changes in water flows within Dauphin River and Buffalo Creek will affect whitefish spawning and movement in Lake St. Martin • Spawning areas at Johnson Beach would be affected if water is discharged into that area	Potential effects of the Project on fish movement are addressed in Section 7.2.4.3. Potential effects of the Project on spawning habitat are addressed in Section 7.2.4.2.

Table 7.2-1 Issues of Concern Identified in Traditional Knowledge

Indigenous Group	Project-related Effect/Issue of Concern	EIS Consideration
	• The Project will change fish movement and result in fish stranding when the channel is in use • Bear Creek on the south east side of Lake St. Martin is important spawning area that could be affected by the Project	Potential effects of the Project on fish stranding is addressed in Section 7.2.4.4. Bear Creek will not be directly affected by the Project. The potential effects to fish behavior and movement are addressed in Section 7.2.4.3.
Fisher River First Nation	• Deterioration of fish movement and/or migration due to Project construction and operation, presence of permanent infrastructure • Increased fish mortality through the stranding of fish during Project operation and potential reduction in fish quality and increased mortality due to changes in water quality • Loss or alteration of fish habitat due to Project construction and operation, presence of permanent infrastructure	Potential effects of the Project on fish movement are addressed in Section 7.2.4.3. Potential effects of the Project on fish health and mortality are addressed in Section 7.2.4.4. Potential effects of the Project on fish habitat are addressed in Section 7.2.4.2.
[1] Multiple Indigenous groups including; Fisher River First Nation, Ebb and Flow First Nation ,Lake Manitoba First Nation, O-Chi-Chak-Ko-Sipi First Nation, Manitoba Metis Federation, Little Saskatchewan First Nation, Peguis First Nation, Berens River First Nation, Berens River Northern Affairs Community (NAC), Bloodvein First Nation, Dauphin River First Nation, Fisher Bay NAC, Hollow Water First Nation, Interlake Reserves Tribal Council, Pinaymootang First Nation, Pine Dock NAC, Princess Harbour NAC, Sagkeeng First Nation, Seymourville NAC		

Through information sharing, Indigenous groups have also recommended mitigation measures that, if implemented, may limit or reduce potential Project effects to the aquatic environment. Recommended mitigation proposed by the Manitoba Metis Federation includes:

- Manitoba Infrastructure must monitor for and take measures to control the spread of invasive species wherever possible, especially into new waterbodies.
- There should be some consideration for the natural variability in the flow regime to limit the impact to the aquatic life in the downstream environment and the peoples that rely on these water bodies as fishing grounds for personal and commercial fishing.
- Manitoba Infrastructure should also consider ways to allow for a slower release of water through a slower ‘ramp up period’ to lessen the impact on the downstream habitat and to have a fish salvage mitigation measure to protect important fish species.
- It is recommended that a detailed benthic invertebrate study be completed and be on-going in order to monitor long-term changes in nutrients and benthic environments, as an important indicator of prey availability for resident fish.

In addition, Manitoba Infrastructure is discussing alternative mitigation measures with Indigenous groups other than those listed above. Mitigation measures identified by Indigenous groups that have been incorporated into the assessment include:

- Measures to monitor for and reduce the spread of invasive species.
- The Project has been designed to only pass flows through the LMOC and LSMOC during high water events (excepting a small baseflow in LSMOC) reducing effects to water levels and flows outside these periods.
- Ramping rates (gradual increase in water flows in the channels) will be incorporated into the Project operation to reduce effects to fish. The outlet channels have been designed to create permanent fish habitat and sustain fish throughout the year.
- Benthic invertebrate surveys have been conducted in relation to the inlets and outlets of the channels. It is expected that monitoring of benthic invertebrates in these areas will continue during operation.

These mitigation measures are considered in Section 7.2.4.

7.2.1.4 Potential Effects, Pathways and Measurable Parameters

The focus of this fish and fish habitat assessment is on Project activities or components that have the potential to adversely affect fish and fish habitat that are part of, or that support, commercial, recreational, or Aboriginal fisheries as defined by the federal *Fisheries Act*. Commercial, recreational, and Aboriginal (CRA) fisheries in the Project area are described in Section 7.2.2.2 and include up to 12 different fish species. However, instead of assessing potential effects on all 12 species, four focal fish species (listed below) have been selected to focus the assessment. These four species provide, or support, important CRA fisheries in the Project area and have unique life history (e.g., spring spawning) and habitat requirements that cover the range of life histories and habitat requirements for other CRA fish species in the LAA and RAA. As a result, these four focal species provide the means to identify all potential interactions between the Project and fish and fish habitat and the ability to identify avoidance and mitigation measures to protect these focal fish species and other fish species that could be directly or indirectly affected by the Project. These focal species are:

- Lake whitefish (*Coregonous clupeaformis*) is a large-bodied, invertebrate-feeding, fall spawning species known to be an important component of commercial, recreational, and Aboriginal fisheries in the north basin of Lake Winnipeg, Lake St. Martin and Lake Manitoba. Lake whitefish are known to spawn in rivers or lakes with sandy to rocky substrates.
- Walleye (*Sander vitreus*) is a large-bodied, piscivorous (i.e., fish-eating), spring spawning species known to be an important component of commercial, recreational, and Aboriginal fisheries in Lake Winnipeg, Lake St. Martin and Lake Manitoba. Walleye, known locally as pickerel, are known to spawn along lake shorelines and in rivers and streams with rocky substrates and are found in deeper, offshore areas of lakes during the day due to light sensitivity.

- Northern pike (*Esox lucius*) is a large-bodied, piscivorous, spring spawning species known to be an important component of commercial, recreational, and Aboriginal fisheries in Lake Winnipeg, Lake St. Martin and Lake Manitoba. Pike spawn in quiet bays of lakes and ponds with aquatic vegetation.
- Forage fish is a collective group of small-bodied, spring or summer spawning fish species (e.g., fathead minnow, emerald shiner) that are prey for the large-bodied focal fish species listed above. As such, forage fish provide a link between potential affects to plankton and benthic invertebrates and piscivorous species such as walleye and northern pike.

Potential effects on fish and fish habitat include potential changes in the quantity or quality of fish habitat due to changes in lake level elevations, stream flows, groundwater inflows, and bottom sediments, and introduction of aquatic invasive species. They also include potential changes in fish passage due to changes in flow patterns and potential changes in fish health or mortality due to changes in water quality including sediment and accidental releases of deleterious substances. Potential effects, the effect pathways, and the measurable parameters used to characterize potential residual effects of the Project, and potentially to monitor potential effects and the effectiveness of avoidance and mitigation measures, on the fish and fish habitat VC are provided in Table 7.2-2.

Table 7.2-2 Potential Effects, Effect Pathways and Measurable Parameters for Fish and Fish Habitat Valued Component

Potential Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Permanent alteration or destruction of fish habitat	Change in habitat in Watchorn Bay, Birch Bay, the north basin of Lake St. Martin, and Sturgeon Bay due to excavation of bottom substrates	Areal extent of altered or destroyed fish habitat (m^2)
	Change in groundwater inflows to lakes and streams along or adjacent to the channels	Water temperature (°C), total dissolved solid (TDS) concentrations (mg/L)
	Introduction of aquatic invasive species	Presence of aquatic invasive species in the LMOC and LSMOC
	Change in habitat due to realignment, isolation, or dewatering of drains and headwater streams	Areal extent of altered or destroyed fish habitat (m^2)
	Change in habitat due to movement and deposition of sediment	Substrate depth (m), relative composition (%), and change in areal distribution, and/or areal extent of altered or destroyed fish habitat (m^2)
	Change in riparian area inundation along lake and river shorelines	Areal extent (m^2), duration of inundation (days)
	Change in flow patterns in rivers and streams	Water depth (m), channel width (m), and water velocity (m/s)
Change in Fish Passage	Change in fish passage due to replacement or installation of new road crossing structures	Maximum water velocity (m/s) in culvert, culvert slope (%), drop height (m)

Table 7.2-2 Potential Effects, Effect Pathways and Measurable Parameters for Fish and Fish Habitat Valued Component

Potential Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
	Change in passive or active movement of fish out of Lake Manitoba and Lake St. Martin	Numbers of fish moving in existing rivers and in the channels
	Changes in attraction flows in Fairford and Dauphin Rivers	Numbers of fish in rivers and channels during spawning periods
Change in Fish Health or Mortality	Accidental release of deleterious substances	Numbers of potentially affected fish, pH, polycyclic aromatic hydrocarbon concentrations in water (mg/L) and fish tissue (mg/kg)
	Introduction of sediment	Total suspended solid (TSS) concentrations (mg/L) or turbidity units (NTU)
	Stranding of fish and fish eggs	Numbers of potentially affected fish or fish eggs
	Increased fish mortality due to increased angling pressure and access	Increase in fishing license sales in Interlake region; Numbers of harvested and/or dead “caught and released” fish
	Bioaccumulation of methylmercury due to change in terrestrial habitat inundation	Areal extent (m^2), duration of inundation (days), methylmercury concentration in fish tissue (mg/kg)

7.2.1.5 Boundaries

Spatial Boundaries

Spatial boundaries for the fish and fish habitat assessment are the same as those used by the surface water subcomponent of groundwater and surface water VC. This is because all potential direct or indirect effects on fish and fish habitat from the Project result from potential changes to lake levels, stream flows, groundwater–surface water interactions or water quality. Federal lands within these boundaries consist of reserve lands associated with the Indigenous communities.

The Project development area (PDA), local assessment area (LAA) and regional assessment area (RAA) for the assessment of effects on fish and fish habitat are shown in Appendix 7B, Figure 7.2B-1.

Project Development Area

The PDA is an area of 2,099 ha and is the area in which the Project components and activities are located. The PDA includes the Lake Manitoba Outlet Channel (LMOC), the realignment of highway PR 239, and the Lake St. Martin Outlet Channel (LSMOC).

Local Assessment Area

The LAA for the assessment of effects on fish and fish habitat includes the PDA and the lakes, embayments, drainages, rivers and streams where measurable changes in water levels, stream flows, groundwater/surface water interactions, sediment distribution and composition, and water quality due to the Project are expected to occur. The LAA includes (from south to north):

- Watchorn Bay (Lake Manitoba)
- Watchorn Creek and its headwater lakes and drains (Reed and Long lakes and Spearhill Drain)
- Birch Creek and its headwater lakes and drains (Clear, Water, and Goodison lakes and Woodale Drain)
- Fairford River
- Pineimuta Lake
- Lake St. Martin (including Birch Bay, the Narrows, and the Northeast Basin) and tributaries
- Buffalo Creek and Big Buffalo Lake
- Dauphin River
- Sturgeon Bay (Lake Winnipeg)

The LAA excludes the entirety of Lake Manitoba, with the exception of Watchorn Bay, because Project effects on fish and fish habitat in this area are expected to be unmeasurable. The north basin of Lake Winnipeg, with the exception of Sturgeon Bay, has also been excluded from the LAA because Project effects on water levels are not expected to be discernible in the context of existing water level variations (see Chapter 6, Section 6.4.7.2). In addition, Project effects on water quality are not expected to be measurable outside Sturgeon Bay. This is consistent with the vegetation assessment, which does not expect measurable effects on aquatic vegetation around the shorelines of Lake Manitoba or the north basin of Lake Winnipeg due to changes in water levels (see Chapter 6, Section 6.4.7.2). The LAA area is illustrated in Appendix 7B, Figure 7.2B-2.

Regional Assessment Area

The RAA for the assessment of effects on fish and fish habitat includes the PDA and LAA and extends to include the entirety of Lake Manitoba and the entirety of the north basin of Lake Winnipeg (Appendix 7B, Figure 7.2B-1). It also includes the mouth of the Mantagao River, a tributary of Sturgeon Bay near the LSMOC outlet.

This RAA was selected because it includes the spatial area used by fish populations important to commercial, recreational, or Aboriginal fisheries in the area and by known aquatic species at risk (ASAR) and AIS with the greatest potential to increase or decrease their distribution due to the Project. This RAA is used to provide regional context for potential direct and indirect effects on fish and fish habitat from the Project and to assess potential cumulative effects of the Project with other past, present, or reasonably foreseeable projects relevant to the aquatic environment.

The RAA does not extend downstream into Playgreen Lake or the Nelson River because it is assumed that Manitoba Hydro will continue to manage water levels and flows in the Nelson River in accordance with the Lake Winnipeg Regulation (LWR) operating criteria. Manitoba Hydro completed an analysis of the differences in water levels on Lake Winnipeg and waterways downstream of Lake Winnipeg in relation to the changes in flows due to the Project. This analysis concluded that any potential changes in water levels are not expected to be discernible in the context of existing water level variations. Details of the analysis are provided in Chapter 6, Appendix 6I, which is a copy of Manitoba Hydro (2019). As such, there is no pathway of effects to surface water hydrology in the north basin of Lake Winnipeg and Nelson River, and this effect is not considered further in the analysis of potential effects of the Project on fish and fish habitat.

The RAA does not extend upstream to include the Portage Diversion or the Assiniboine River because the inlet control structure precludes fish passage to the Assiniboine River from Lake Manitoba. Further, Manitoba Infrastructure will continue to operate the Portage Diversion and other flood protection infrastructure throughout the province in accordance with their applicable existing operation guidelines. As outlined in Appendix 3D, separate operating guidelines have been developed for the Project.

Temporal Boundaries

The temporal boundary for the assessment of effects on the fish and fish habitat covers the duration of the construction and operation and maintenance phases of the Project. Construction is tentatively expected to occur over a period of approximately 2.5 to 3.0 years with approximately 1 to 2 years for post-construction works, such as site clean-up, survey, and reclamation. It is currently estimated that construction would occur from fall 2020 to spring/summer 2023, with operation and maintenance starting in fall 2022. The overall schedule is contingent largely on receipt of the final regulatory approvals in 2020. Once construction is complete, the Project would be ready for operational usage on an as-required basis. The operation and maintenance phase of the Project is expected to be indefinite.

7.2.1.6 Residual Effects Characterization

Table 7.2-3 presents definitions for the characterization of residual environmental effects on fish and fish habitat. The criteria describe the potential residual effects that remain after mitigation measures have been implemented.

Table 7.2-3 Characterization of Residual Effects on Fish and Fish Habitat

Characterization	Range of Criteria	Level of Effect and Definition
Direction of Change	Neutral	No measurable change on the VC.
	Adverse	Net loss (adverse or undesirable change) on the VC.

Table 7.2-3 Characterization of Residual Effects on Fish and Fish Habitat

Characterization	Range of Criteria	Level of Effect and Definition
	Positive	Net benefit (or desirable change) on the VC.
Duration	Short-Term	The potential effect results from short-term events or activities such as the time required to complete a discrete component during construction, maintenance, or rehabilitation activities (i.e., several months to one year).
	Medium-Term	The potential effect is likely to persist until the completion of construction and rehabilitation activities (i.e., > 1 year to 10 years).
	Long-Term	The potential effect is likely to persist beyond the completion of construction and rehabilitation activities into the operations and maintenance phase of the Project (i.e., >10 years).
Magnitude	Negligible or Low	A measurable change in habitat quantity or quality, fish passage, or fish health or mortality but that is <10% different from pre-Project baseline conditions.
	Moderate	A measurable change in habitat quantity or quality, fish passage, or fish health or mortality that is >10% but <20% different from pre-Project baseline conditions.
	High	A measurable change in habitat quantity or quality, fish passage, or fish health or mortality that is >20% different from pre-Project baseline conditions
Timing	No Sensitivity	Effect does not occur during a critical life stage (e.g., spawning and egg incubation periods).
	High Sensitivity	Effect occurs during a critical life stage (e.g., fish spawning and egg incubation periods).
Extent	PDA	The physical space or directly affected area on which Project components or activities are located or the immediately adjacent area, including designated ROWs, and permanent and temporary facilities
	LAA	Area within which potential Project effects are measurable and extending beyond the PDA to, but not beyond, the LAA.
	RAA	The regional extent of potential direct, indirect and cumulative effects that may extend beyond the LAA.
Frequency	Infrequent	The potential effect occurs once or seldom during the life of the Project
	Sporadic/Intermittent	The potential effect occurs only occasionally and without any predictable pattern during the life of the Project
	Regular/Continuous	The potential effect occurs at regular and frequent intervals during the Project phase in which they occur or over the life of the Project
Reversibility	Reversible (short-term)	Potential effect is readily reversible over a relatively short period (< than five years).
	Reversible (long-term)	Potential effect is potentially reversible but over a long period (> than five years).
	Irreversible	Project-specific potential effects are permanent and irreversible.

Table 7.2-3 Characterization of Residual Effects on Fish and Fish Habitat

Characterization	Range of Criteria	Level of Effect and Definition
Ecological Context	Undisturbed	Habitat or fish population is relatively undisturbed or not previously affected by human activity.
	Disturbed	Habitat or fish population has been substantially disturbed or harvested by humans.

7.2.1.7 Significance Definition

For the purpose of this assessment, a significant effect on fish and fish habitat is one that results in any one of the following:

- a permanent alteration or destruction of fish habitat that is likely to result in an irreversible, measurable reduction in the annual production of CRA fish species in the RAA
- a permanent alteration of fish passage that is likely to result in an irreversible, measurable reduction of critical upstream or downstream movements (i.e., spawning runs) of CRA fish species and/or an irreversible, measurable increase in the distribution of AIS that is likely to reduce the annual production of CRA fish species in the RAA
- a change in fish health or mortality that is likely to result in a measurable change in the abundance of any CRA fish population in the RAA

These thresholds for significance of residual effects on fish and fish habitat have been defined in consideration of prohibitions outlined in the *Fisheries Act* (i.e., subsections 35(1), 20(2), and 36(3)), guidance provided by the Fisheries Protection Policy Statement (DFO 2013), and fish species designated under Schedule 1 of SARA (i.e., section 79). In consideration of the *Fisheries Act*, a net loss of fish habitat would be assessed as a significant adverse effect (i.e., permanent alteration to or destruction of CRA fish habitat that cannot be offset).

7.2.2 Existing Conditions for Fish and Fish Habitat

7.2.2.1 Methods

Existing conditions for fish and fish habitat in the RAA and LAA were developed from a combination of desktop research and field surveys. Desktop research included review of provincial fisheries reports, commercial fishery production data and publicly available grey and primary literature. Information is organized into:

- field surveys (fish inventories, habitat use surveys, and fish habitat assessments)
- commercial, recreational and Aboriginal fisheries
- aquatic invasive species

- aquatic species a risk

Fish Inventories, Habitat Use Surveys, and Fish Habitat Assessments

Field surveys included those conducted specifically to monitor the effects of operation of the Lake St. Martin Emergency Outlet Channel (EOC) between 2011 and 2015: fish and benthic invertebrate inventories, fish habitat assessments, and bathymetry and suspended sediment surveys in the north basin of Lake St. Martin, streams and lakes in the Buffalo Creek watershed, Dauphin River, and south Sturgeon Bay (NSC 2016b, 2016c; KGS 2016). They also included field surveys conducted between 2015 and 2018 specifically for assessing potential effects of the LSMOC and the LMOC; fish and benthic invertebrate inventories and fish habitat assessments (AAE Technical Services 2016a; 2016b); spring fish use surveys (NSC 2019a) in the small lakes, streams, and constructed drains along the proposed LMOC; bathymetry and substrate surveys in the Fairford River and Pineimuta Lake; benthic invertebrate surveys (NSC 2019b); fisheries investigations in Lake St. Martin and Sturgeon Bay (NSC 2019b; 2019c); and an index gillnetting survey of Lake St. Martin (NSC 2019d).

Descriptions of the methods used to conduct the fish habitat assessments, bathymetric and substrate surveys, benthic invertebrate surveys, and fish community inventories are provided in the technical reports identified above and listed in the reference section of this assessment.

Commercial, Recreational, and Aboriginal Fisheries

Annual commercial fishing harvest statistics for Lake Manitoba, Lake St. Martin, and Lake Winnipeg were compiled from records provided by Manitoba Sustainable Development. Fish species targeted by the recreational fisheries in all three lakes were identified using professional experience and from the Manitoba Sustainable Development's "Lake Information for Anglers" online tool (https://www.gov.mb.ca/waterstewardship/fisheries/fish_stocking_gMap_MVC_V2/index.html).

Although limited, information on traditional and subsistence fisheries conducted by local Indigenous groups living on or near Lake Manitoba, Lake St. Martin, and the north basin of Lake Winnipeg was provided by communities during engagement by Manitoba Infrastructure for the Project.

Aquatic Invasive Species

Aquatic invasive species (AIS) located within or with the potential to colonize the LAA or RAA in the reasonably foreseeable future were identified from the following sources:

- Invasive Species Council of Manitoba: https://invasivespeciesmanitoba.com/site/index.php?page=aquatic-species
- Cary Institute: https://www.caryinstitute.org/educators/teaching-materials/changing-hudson-project/zebra-mussel-fact-sheet
- Manitoba Water Stewardship: http://www.gov.mb.ca/waterstewardship/stopais/

- Ontario's Invading Species Awareness Program: http://www.invading species.com/rusty-crayfish/
- The Freshwater Fishes of Manitoba (Stewart and Watkinson 2004)

Aquatic Species at Risk

Aquatic species at risk currently or historically present in the LAA and/or RAA were identified from:

- DFO's "Aquatic Species at Risk Map" on-line tool (https://www.dfo-mpo.gc.ca/species-especes/sara-lep/map-carte/index-eng.html)
- Environment Canada's "Species At Risk Public Registry" (https://wildlife-species.canada.ca/species-risk-registry/search/SpeciesSearch_e.cfm)
- Manitoba's "Fish Species at Risk in Manitoba" website (https://www.gov.mb.ca/waterstewardship/fisheries/habitat/sare.pdf)

7.2.2.2 Overview of Fish and Fish Habitat

Fish Habitat in the RAA

Lake Manitoba

Lake Manitoba has an area of approximately 4,600 km^2, making it the second largest lake in Manitoba (LMRRAC 2003). The lake has an average depth of 5 m and a maximum depth of 7 m. Due to its shallow depth, waters warm quickly in summer and are well mixed from wave action.

Lake Manitoba can be roughly divided into two basins separated by the Lake Manitoba Narrows: a northern basin and a southern basin. Together, the two basins have a straight-line length of 225 km and an approximate shoreline length of 915 km. In the south basin, shorelines are primarily granular in composition (LMRRAC 2003) and, consequently, migrate through erosion and accretion in relation to water level and wave action. Shorelines in the north basin are more irregular and are characterized by more rock and aquatic vegetation. There are approximately 246,700 ha of wetlands surrounding the shoreline of the lake.

Offshore substrates in the southern basin consist mainly of silt and clay sediments (Last 1983). In addition, there are several areas where relict fluvial-shoreline sand and till deposits occur. The north basin is generally shallower than the south basin and has a higher proportion of sand substrates and a larger number of shoals.

The natural watershed of Lake Manitoba encompasses Waterhen Lake, Lake Winnipegosis and Dauphin Lake and is approximately 79,000 km^2 (LMRRAC 2003). Primary inflows to the north basin are from Lake Winnipegosis and Waterhen Lake by the Waterhen River, which contributes approximately 42% of the total annual inflow to the lake. Primary inflows to the south basin are from the Whitemud River and local overland flow, which contributes approximately 18% of the total annual inflow. The remainder of inflows is from precipitation. Lake Manitoba drains northeast into Lake St. Martin through Fairford River.

The Portage Diversion was completed in 1970 and, when in use, diverts flow from the Assiniboine River into Lake Manitoba. From 1970 to 2003, the Portage Diversion contributed an average annual volume of 304,400,000 m^3 from the Assiniboine River to Lake Manitoba (LMRRAC 2003).

The lacustrine processes presently operating in Lake Manitoba reflect the influence of 1) the extreme shallow depth of the lake, 2) the basin morphology, and 3) the water chemistry (Last 1983). In addition, land clearing and increased watershed drainage have resulted in increased rates of sedimentation in the South Basin during the past century. Lake Manitoba water is alkaline and brackish with the salinity dominated by sodium and chloride ions (Last 1983).

Sediment cores from the south basin of Lake Manitoba show that Lake Manitoba has undergone substantial eutrophication since at least 1890 (Leavitt et al. 2015). This has included a rapid degradation of water quality and a two- to three-fold increase in the late summer abundance of cyanobacteria and chlorophyte algae compared to pre-1890 levels. Eutrophication was generally most rapid from 1890-1930, although the abundance of chlorophytes, cyanobacteria and total algae continued to increase throughout the 20th century in direct proportion to the growth of the human population in western Canada.

Recent data on primary productivity in Lake Manitoba are limited. However, mean chlorophyll *a* concentration in the north basin ranged from less than 9 µg/L to 13 µg/L and were determined to be driven by nutrient availability rather than light limitation (Page 2011). In particular, the north basin of Lake Manitoba was found to be phosphorus limited with an average total phosphorus concentration of 0.055 mg/L (Page 2011), which would classify it as meso-trophic to eutrophic (OECD 1982).

Due to its trophic status, Lake Manitoba is extremely productive. Tuorancea et al. (1979) identified 47 benthic invertebrate taxa from the lake, although 90% of individuals were represented by just seven taxa: *Candona rawsoni* (Ostracod; seed shrimp), *Cytheromorpha fuscata* (Ostracod); *Pisidium* spp. (fingernail clam); *Amnicola limosa* (Gastropod; snail); and *Harnischia curtilamellata* (Chironomid; midge fly larvae), *Procladius freemani* (Chironomid) and *Chironomus* spp. (Chironomid). *Amnicola limosa* and *Chironomus* spp. were the most important contributors to the total biomass and net production of the benthic invertebrate community of Lake Manitoba (Tuorancea et al. 1979).

Fish habitat in Lake Manitoba is characteristically shallow, turbid, and pelagic and provides ideal habitat for open-water fish species such as cisco, walleye, sauger, and suckers. Species adapted to deeper, cold-water environments do not do as well in the lake (e.g., lake trout; *Salvelinus namaycush*). The marshlands surrounding the lake are considered important spawning and nursery areas for fish. Several tributaries (Whitemud River, Swan Creek, Basket Creek, and Waterhen River) also provide important spawning habitats for Lake Manitoba fish populations.

Lake Winnipeg

Lake Winnipeg is the largest lake in Manitoba with a surface area of 23,750 km^2 (EC/MWS 2011). Like Lake Manitoba, Lake Winnipeg has a distinct north and south basin separated by a narrows (Appendix 7B, Figure 7.2B-1). The lake has a maximum depth of approximately 60 m, located just south of the narrows but most of the lake is less than 20 m deep (Appendix 7B, Figure 7.2B-3). Because of its generally shallow depth, the lake's bottom sediments are routinely re-suspended by wave action, creating turbid conditions. The north basin is less turbid than the south basin because it is deeper (maximum depth 19 m) and has lower suspended sediment inputs.

The Lake Winnipeg watershed extends from the Canadian Rockies in the west to within 19 km of Lake Superior in the east and south into Minnesota and South Dakota. This watershed is dominated by agricultural land use and includes many densely populated urban centers that contribute to the eutrophic status of the lake. Approximately 75% of the inflow to Lake Winnipeg comes from Winnipeg and Saskatchewan Rivers (EC/MWS 2011). Numerous other tributaries, including Red River (9%) and Dauphin River (3%), contribute most of the remaining inflow (McCullough 2015). Outflow from the lake occurs into Nelson River at the northeastern side of the northern basin.

Lake Winnipeg and its main tributaries are regulated by numerous dams and diversions. These include the Grand Rapids Generating Station (completed in 1968) on Saskatchewan River and the Pine Fall Generating Station (completed in 1952) on Winnipeg River. Since 1976, outflow from Lake Winnipeg has been regulated by a control structure at Jenpeg Generating Station located on Nelson River approximately 125 km downstream of Lake Winnipeg. The Lake Winnipeg Regulation (LWR) Project included channel works at the north end of the lake to increase the maximum outflow capacity by up to 50%. The increased outflow capacity has reduced the occurrence of extreme high and low lake levels when compared to pre-LWR lake levels.

Lake Winnipeg's north basin eastern shoreline consists of Precambrian granite bedrock, while the western shoreline consists of Palaeozoic shales and dolomite (Todd et al. 1998). Bottom sediments consist almost entirely of Lake Agassiz clays, which reach thicknesses of over 100 m in the north basin. Till and other gravel bearing glacial sediments are not extensive but are present as major moraines at George Island and Pearson Reef (Thorliefson et al. 2000). These glacial sediments rarely exceed 10 m in thickness but are furrowed up to 2 m deep, 200 m wide and several km long in a generally NNW to SSE direction by lake ice (Thorliefson et al. 2000). These furrows are most prevalent in the northwestern portion of north basin where ice accumulation and shallower depths favour scouring.

The shallow, wind-swept waters of the lake are typically uniformly mixed in temperature and dissolved oxygen throughout the water column during the open-water season. However, recent observations have recorded brief periods of thermal stratification in the northern basin during the open-water (e.g., 2003) and under-ice (e.g., 2007) seasons and complex spatial and temporal variation in dissolved oxygen concentrations throughout the lake in recent years. Mean summer water temperatures and dissolved oxygen concentrations in the north basin between 1999 and 2007 were 19.7˚C and 8.8 mg/L, respectively (Environment Canada/Manitoba Water Stewardship 2011); dissolved oxygen concentrations were, for the most part, above the water quality objectives for the protection of aquatic life (greater than 6 mg/L; CCME 1999; MWS 2011). Recent periods of under-saturation have occurred in association with thermal stratification events in the north basin, highlighting the potential for oxygen depletion in bottom waters.

Lake Winnipeg waters are alkaline and well buffered with bicarbonate, sulphate, and calcium (EC/MWS 2011). Nutrient concentrations are strongly associated with inflowing waters from tributaries and total suspended solids concentrations, primarily due to agricultural run-off. Nutrient concentrations are typically lower in the north basin than in the south. However, algal blooms are generally more extensive in the north basin because of lower suspended solids concentrations that permit greater light penetration through the water column.

A total of 146 genera of phytoplankton were identified in Lake Winnipeg from samples collected from 1999 to 2007 (EC/MWS 2011). A large proportion (greater than 80 %) of the total phytoplankton biomass in the lake was represented by only three genera of cyanobacteria (*Aphanizomenon*, *Anabaena*, *Microcystis*) and two genera of diatoms (*Aulacoseira*, *Stephanodiscus*), taxa that are characteristic of large, shallow, eutrophic lakes (Wetzel 2001; Reynolds 1998). The greatest occurrences of cyanobacteria (i.e., *Aphanizomenon*) have corresponded with warm summers. Diatoms, on the other hand, are most prevalent in wet, cool years owing to their low light and temperature requirements for growth. Although blooms of non-nitrogen-fixing cyanobacteria (e.g., *Microcystis*), which favour turbid conditions, are common in the south basin of the lake, they are not common in the north basin (EC/MWS 2011).

Phytoplankton biomass (as chlorophyll *a*) varies annually in Lake Winnipeg, ranging from 4 µg/L to 34 µg/L between 1999 and 2007, with a mean of 14.4 µg/L (EC/MWS 2011). Chlorophyll *a* concentrations under-ice can be 3.5 times lower than open-water concentration, but the average under-ice phytoplankton biomass is approximately six times higher in the north basin than in the south basin.

In 1928-1929 the benthos in the north basin of Lake Winnipeg was largely crustaceans (80%), with the remaining 20% of the community composed of molluscs (10%) and oligochaetes, chironomidae, ephemeroptera, trichoptera, and hirudinea (10% combined) (Bajkov 1930). In 1969, a more diverse benthic assemblage was found in the north basin comprising largely four main groups: crustaceans (44%), molluscs (19%), oligochaets (18%) and chironomidae (17%) (Flannagan et al. 1994).

In both 1929 and 1969, crustaceans were dominated by one amphipod species, *Diporeia brevicornis*, which was considered a vital food source for fish populations in Lake Winnipeg at the time (Bajkov 1930; Flannagan and Cobb 1994). Molluscs were the second most abundant group in the north basin in both years and were largely (greater than 50%) represented by *Pisidium casertanum*, *P. lilljeborgi*, and *Probythinella lascustris* in 1969 (Flannagan et al. 1994). Midge fly larvae (Diptera: Chironomidae) were the most species diverse group with 222 different species identified (Chang et al. 1993,1994).

The benthic community in Lake Winnipeg has shown a substantial increase in density in recent decades (EC/MWS 2011). Mean invertebrate density in the lake more than tripled between the summers of 1969 and 2002, due primarily to substantial increases in round worm (Oligochaeta; Tubificinae), clam (Mollusca: Sphaeriidae), and midge fly larvae (Diptera; Chironomidae) densities in the north basin (Hann et al. 2017). The benthic community may be responding both directly and indirectly to the increased nutrient enrichment in the lake (EC/MWS 2011).

The depths, clear water and productive benthic invertebrate community in the north basin of Lake Winnipeg provides near ideal habitat for lake whitefish. The abundant zooplankton community supports large populations of pelagic cyprinids (minnows) and coregonines, such as cisco. These in turn support large populations of piscivorous fish species such as walleye and northern pike. Because the lake does not typically stratify, water temperatures are too high for cold water species such as lake trout.

Fish Community of the RAA

As many as 54 species of fish have the potential to occur in the RAA (Appendix 7A, Table 7.2A-1). This number includes several species that, while not recorded in the RAA, occur in the south basin of Lake Winnipeg and, therefore, could also occur in the RAA (e.g., bigmouth buffalo, chestnut lamprey, black crappie). There are several other species that occur in tributaries to Lake Winnipeg and Lake Manitoba that could, but are highly unlikely, to occur in the RAA (e.g., smallmouth bass, river shiner, golden redhorse).

The most abundant large-bodied species in the RAA are, in no particular order of abundance: common carp, goldeye, mooneye, white sucker, shorthead redhorse, northern pike, cisco, lake whitefish, yellow perch, walleye, sauger, freshwater drum, longnose sucker, silver redhorse, burbot, and white bass. Abundant forage (small-bodied) fish species in the RAA are northern pearl dace, golden shiner, emerald shiner, blacknose shiner, spottail shiner, fathead minnow, trout-perch, brook stickleback, ninespine stickleback, mottled sculpin, johnny darter, log perch, central mudminnow, longnose dace, rainbow smelt, and slimy sculpin.

Lake Manitoba

A total of 37 species are known to occur in Lake Manitoba (Table 7.2-3) and there is potential for an approximately 10 species that may gain access to the lake from the Assiniboine River through the Portage Diversion. The most common large-bodied fish species in Lake Manitoba are white sucker, shorthead redhorse, common carp, freshwater drum, walleye, northern pike, and yellow perch.

Species that do well in shallow open-water pelagic environments do well in Lake Manitoba. Little is known of use of specific habitats in the lake, but most species are widespread. Tributaries are important for walleye, suckers and northern pike for spawning in spring and for rearing in early summer. Nearshore wetlands are important spawning and rearing areas for northern pike, carp, walleye and yellow perch.

Lake St. Martin

A total of 37 species are known to occur in the Lake St. Martin/Dauphin River system (Table 7.2-4). A more detailed description of the fish community of Lake St. Martin is provided in Section 7.2.2.2 (Fish Community of the LAA)

Lake Winnipeg

More than 65 species are known to occur in or have been introduced to Lake Winnipeg or in the lower portions of its tributaries. Most fish species in the lake prefer nearshore habitat (e.g., redhorse, bullheads, northern pike, sculpin, and freshwater drum) (Franzin et al. 2003). The species that occur primarily in offshore areas include lake whitefish, goldeye, mooneye, lake sturgeon, flathead chub, and shortjaw cisco (Franzin et al. 2003). The smaller-bodied fish species that dominate in offshore waters include emerald shiner, rainbow smelt and cisco (EC and MWS 2011). The most abundant species in the lake (i.e., walleye, sauger, yellow perch, white sucker, and burbot) are found in both nearshore and offshore waters as adults (Franzin et al. 2003).

Non-native rainbow smelt first appeared in Lake Winnipeg in 1990 (Campbell et al. 1991) and are now an important part of the offshore prey fish community in the north basin. However, recent Coordinated Aquatic Monitoring Program (CAMP) data from Sturgeon Bay suggests that abundance of rainbow smelt has decreased substantially in the lake in the last few years (Appendix 7A, Table 7.2A-2). Walleye abundance in Lake Winnipeg has increased in concert with rainbow smelt, which have become one of the principal prey items for walleye in the lake.

There appears to be a strong positive relationship between walleye abundance and total phosphorous concentration, chlorophyll *a* concentration, and zooplankton density in Lake Winnipeg. Similar relationships have been observed elsewhere in large, shallow lakes in central Ontario (EC and MWS 2011).

Table 7.2-4 Distribution of Fish Species in the RAA

Fish Species	Scientific Name	Fish Species Presence		
		Lake Manitoba	Lake St. Martin	Lake Winnipeg
Chestnut lamprey	*Ichthyomyzon castaneus*	O	O	N
Silver lamprey	*Ichthyomyzon unicuspis*	O	O	N
Lake sturgeon	*Acipenser fulvescens*	I	O	N
Goldeye	*Hiodon alosoides*	N	N	N
Mooneye	*Hiodon tergisus*	N	O	N
Blacknose shiner	*Notropis heterlepis*	N	N	NT
Common carp	*Cyprinus carpio*	I	I	I
Emerald shiner	*Notorpis atheroides*	N	N	N
Fathead minnow	*Pimephales promelus*	N	N	NT
Flathead chub	*Platygobio gracilis*	O	O	N
Golden shiner	*Notemigonus crysoleucas*	N	N	NT
Lake chub	*Couesius plumbeus*	O	O	N
Longnose dace	*Rhnichthys cataractae*	O	N	N
Northern pearl dace	*Margariscus nachtriebi*	N	N	NT

Table 7.2-4 Distribution of Fish Species in the RAA

Fish Species	Scientific Name	Fish Species Presence		
		Lake Manitoba	Lake St. Martin	Lake Winnipeg
Spottail shiner	*Notropis hudsonius*	N	N	N
Western blacknose dace	*Rhinichthys obtusus*	O	O	N
Longnose sucker	*Catostomus catostomus*	O	N	N
Quillback	*Carpoides cyprinis*	N	N	N
Shorthead redhorse	*Moxostoma macrolepidotum*	N	N	N
Silver redhorse	*Moxostoma anisurum*	O	N	N
White sucker	*Catostomus commersonii*	N	N	N
Black bullhead	*Ameiurus melas*	N	N	N
Brown bullhead	*Ameiurus nebulosus*	N	O	N
Channel catfish	*Ictalurus punctatus*	N	O	N
Tadpole madtom	*Noturus gyrinus*	N	O	NT
Northern pike	*Esox lucius*	N	N	N
Central mudminnow	*Umbra limi*	N	NT	NT
Rainbow smelt	*Osmerus mordax*	O	O	I
Cisco	*Coregouns artedi*	N	N	N
Lake whitefish	*Coregonus clupeaformis*	N	N	N
Shortjaw cisco	*Coregonus zenithicus*	O	O	N
Trout perch	*Percopsis omiscomaycus*	N	N	N
Burbot	*Lota lota*	N	N	N
Brook stickleback	*Culea inconstans*	N	N	NT
Ninespine stickleback	*Pungitius pungitius*	N	N	N
Mottled sculpin	*Cottus bairdi*	N	N	N
Slimy sculpin	*Cottus cognatus*	O	N	N
Spoonhead sculpin	*Cottus ricei*	O	O	N
White bass	*Morone chrysops*	O	I	I
Iowa darter	*Etheostoma exile*	N	N	NT
Johnny darter	*Etheostoma nigrum*	N	N	N
Logperch	*Percina caprodes*	N	N	NT
River darter	*Percina shumardi*	N	N	N
Sauger	*Sander canadensis*	N	N	N
Walleye	*Sander vitreus*	N	N	N
Yellow perch	*Perca flavescens*	N	N	N
Freshwater drum	*Aplodinotus grunniens*	N	N	N

Table 7.2-4 Distribution of Fish Species in the RAA

Fish Species	Scientific Name	Fish Species Presence		
		Lake Manitoba	Lake St. Martin	Lake Winnipeg
Note: N=native; O=unknown from watershed; I=introduced; NT=native in tributaries; NTS=native in tributaries of south basin; T=transplanted Information derived from Appendix 7A, Table 7.2A-1.				

Fish Habitat in the LAA

Watchorn Bay

The northeastern portion of Watchorn Bay has a relatively uniform gently sloping bottom reaching a depth of 2.7 m approximately 750 m from shore (AAE Tech Services 2016). Substrate along the shoreline and within approximately 1.0 m of the water's edge are primarily (greater than 80%) gravel and cobble. Most (90%) of the substrates at depths greater than 0.5 m and within 1 km of shore are sand, with areas of scattered boulders, particularly in proximity to Mercer Creek (Appendix 7B, Figure 7.2B-4). Where depths exceed 1.5 m, substrates consist of gravel, sand, and silt. Pockets of substrate consisting of coarser sand and gravel occur at depths greater than 2.0 m. The shallow depths (Watchorn Bay Bathymetry shown in Chapter 6, Appendix 6F, Figure 6F-7) and wave action in Watchorn Bay create conditions that mobilize sediments, which likely makes the habitat suboptimal for spawning for most large bodies fish species in Lake Manitoba (M. Forester Enterprises et al. 2017).

Aquatic vegetation was sparse in Watchorn Bay during spring and fall surveys in 2015 and 2016 (AAE Tech Services 2016). However, isolated patches were present where water depths exceeded 2.0 m and in localized areas near the mouths of Watchorn and Mercer creeks.

A total of 16 taxa from eight groups of benthic macroinvertebrates (BMI) were collected in Watchorn Bay in 2015 (AAE Tech Services 2016). The most common group (55.50 individuals/m^2) was mayfly larvae (Ephemeroptera), followed by true fly larvae (Diptera; 36.75 individuals/m^2), water mites (Trombidiformes; 26.70/m^2) and scuds (Amphipoda; 21.90/m^2). Round worms (Nematoda), caddisfly larvae (Trichoptera), beetle larvae (Coleoptera) and true bugs (Hemiptera) were also present. The mean taxa richness was 5.30/sample with a mean density of 144 ± 199 individuals/m^2 and a Simpson's Diversity Index of 0.62. Invertebrate density in Watchorn Bay in fall 2015 was lower than in Lake St. Martin in the falls of 2015 and 2018 and substantially lower than in Sturgeon Bay in fall 2018.

Watchorn Creek

Watchorn Creek flows into the south side Watchorn Bay at Watchorn Provincial Park (Appendix 7B, Figure 7.2B-2). Its headwaters are a low-lying area west of Moosehorn, Manitoba. The creek can be diverted into Spearhill Drain by closing a set of culverts located approximately 9 km upstream of the bay. Spearhill Drain re-enters the Watchorn Creek approximately 4.5 km farther downstream where another set of operable culverts are located. When operated, these culverts isolate 4.0 km of Watchorn Creek to the north of the road.

Riparian vegetation along the lower 5.0 km of Watchorn Creek is mixed grasses and cattails. During a 2015 survey, channel widths in Watchorn Creek ranged between 8.0 m and 11.0 m with thalweg depths ranging between 0.5 m and 1.0 m (AAE Tech Services 2016). Water velocities ranged from stagnant to 0.14 m/s. Substrate composition was clay and silt, with some sand, gravel and cobble.

Long Lake and Reed Lake

Long Lake and Reed Lake have surface areas of 30 ha and 180 ha, respectively, and are situated north of Spearhill Drain (Appendix 7B, Figure 7.2B-2). Both lakes are shallow with abundant aquatic vegetation and marshy shorelines, Outflow direction from both lakes appears to be dependent on water levels, with water draining north into Birch Creek during high water and south into the Spearhill Drain at all water levels.

Both lakes likely support forage fish populations and possibly could support some large-bodied fish species periodically depending on their connectivity to the Spearhill Drain. Data collected in 2011 and 2015 suggest there is a low possibility for groundwater inflows to both lakes, although some seepage may occur (KGS 2016). Regardless of groundwater input, it is likely both lakes become anoxic during some winters due to their shallow depth and abundant aquatic vegetation.

Fairford River

Fairford River upstream of the Fairford River Water Control Structure (FRWCS) is approximately 750 m long and 330 m wide at the mouth tapering to 150 m wide at the control structure. At a water surface elevation of 247.51m (CVGD28), depths in the river reach a maximum of 3.5 m within 20 m of the control structure (see Fairford River bathymetry in Chapter 6, Appendix 6F, Figure 6F-1).

Fairford River downstream of the FRWCS is 15 km long (Appendix 7B, Figure 7.2B-2) and up to 5 m deep immediately below the control structure, rising to 2.5 m deep approximately 200 m downstream. Substrates in the river are characterized by limestone cobble in high velocity areas and organic material and fine sediments in depositional areas (NSC 2003).

In response to concerns from local commercial and recreational fishers that fish could not pass upstream through the FRWCS, a Denil fishway was installed during the winter of 1983-84. An attraction flume, with a discharge capacity of 3 m^3/s, was located beside the fishway entrance. The fishway has three flumes with baffles, two resting pools and two vertical lift control gates. Studies conducted in the spring of 1987 (Derksen 1988) and in the fall of 2007 (Gillespie and Remnant 2008) showed that the Denil fishway can pass several species of fish upstream to Lake Manitoba (e.g., white sucker, walleye and sauger).

Pineimuta Lake

The north end of Pineimuta Lake consists mainly of meadow and potholes with emergent vegetation, while the south end consists largely of an alluvial delta of Fairford River. The east shoreline is relatively steep, gravelly and fringed with willow. Numerous embayments characterize the western shore.

The lake lies in the transition zone between sedge peat and deep moss-covered peat bogs in the Interlake Till Plain. The productivity of the lake is dependent on the nutrients and sediments brought into the lake by Fairford River, Partridge Creek and Homebrook Drain, which enters the lake at the northwest end (DU 1978). Emergent aquatic vegetation is abundant in the lake and dominated by bulrush, phragmites, lagreed, spangletop and cattail.

Only 15% of the lake could be surveyed in 2017 due to dense aquatic vegetation. Mean depth on the east side the lake was approximately 2.0 m (at a water surface elevation of 244.92 m [CGVD28]). (Pineimuta Lake bathymetry figure in Chapter 6, Appendix 6F-2). Substrates were predominantly mud (Appendix 7B, Figure 7.2B-5). Chlorophyll *a* concentrations ranged from less than 0.50 µg/L to 19.5 µg/L with a mean of 5.84 µg/L, indicating that primary productivity in Lake Pineimuta was moderate (NSC 2016a).

Lake St. Martin

Lake St. Martin has two main basins separated by a narrows: a southwest basin and a northeast basin. The total surface area of the lake is 34,900 ha. The southwest basin has a mean depth of 3.8 m and a maximum depth of 6.4 m. Substrates in the central portion of the southwest basin are soft mud, silt and clay with sand, gravel and boulders more prevalent in the southern end near the mouth of Fairford River, in Birch Bay and along the northeastern shoreline. The smaller northeast basin has a mean depth of 1.8 m and a maximum depth of 3.7 m. Most substrates in the northeast basin are a mixture of silt, sand, gravel and clay. Boulders and cobbles are present toward the eastern end. Areas of bare bedrock and extensive gravel bars and boulders are present near the narrows.

Nearshore substrates where the proposed LSMOC will be located were not surveyed in 2017 (as can be seen in Lake St. Martin bathymetry figure in Chapter 6, Appendix 6F-4) due to depth (less than 1 m). Substrates in the nearshore area where the inlet of the proposed LSMOC would be located are comprised of gravel and cobbles with occasional boulders (Appendix 7B, Figure 7.2B-6). Aquatic vegetation in this area of the lake is limited due to these coarse substrates.

Due to its large surface area to volume ratio and its exposure to prevailing winds, Lake St. Martin does not thermally stratify in summer. A solid ice cover occurs on the lake from November until April or May (NSC and KGS 2015a). Dissolved oxygen concentrations in the main basins of the lake are generally suitable for fish and other aquatic biota in winter. However, periods of reduced dissolved oxygen concentrations have been known to occur, particularly in the shallow northeast end of the lake (Stone 1963). Areas near the outlet and in the narrows typically become ice free earliest in the spring.

Similar to Lake Manitoba, Lake St. Martin is phosphorus limited and mesotrophic (NSC 2016a). The annual mean open-water chlorophyll *a* concentrations ranged from 3.5 µg/L to 7.0 µg/L (NSC 2016a). As is typical of Manitoba lakes (CAMP 2017), primary productivity is low in Lake St. Martin during the ice-cover season (NSC 2016a).

Benthic macroinvertebrates have been sampled from three areas in Lake St. Martin due to their proximity to the proposed inlet or outlet of the LMOC or LSMOC: Birch Bay, Harrison Bay, and the northeast basin of Lake St. Martin. Birch Bay and Harrison Bay were sampled in fall 2015 (AAE Tech Services 2016), while the northeast basin of Lake St. Martin was sampled in fall 2018 (NSC 2019b). Although there were subtle differences in between areas, the benthic invertebrate community in all three locations was largely of midge fly (Diptera: Chironomidae), phantom fly larvae (Diptera: Chaobroidae), mayfly larvae (Ephemeridae), and amphipods. Less abundant taxonomic groups included aquatic worms (Oligochaeta), water mites (Trombidiformes), caddisfly lavae (Tricoptera), dragonfly larvae (Odonata), true bugs (Hemiptera) and leeches (Hirudinea). The mean taxonomic richness was higher in Birch Bay (9.25 taxa/sample) and Harrison Bay (8.50 taxa/sample) than in the northeast basin of Lake St. Martin (6.0 taxa/sample) but the mean density was higher in the northeast basin (897 individuals/m^2) than in Birch Bay (409 individuals/m^2) and Harrison Bay (195 individuals/m^2).

Birch Bay

Birch Bay is the southern-most embayment of Lake St. Martin and the location where the proposed outlet of the LMOC would enter the lake. Maximum depth in the middle of the Bay is 5.0 m. A prominent gravel reef extends across Birch Bay at the mouth of Birch Creek, rising to a depth of less than 1.0 m (AAE Tech Services 2016). Depths in the marshy area near the mouth of Birch Creek are less than 1.0 m (AAE Tech Services 2016) (Watchorn Bay Bathymetry figure in Chapter 6, Appendix 6F-7).

Substrates in Birch Bay are gravel and sand to a depth less than 2.5 m (AAE Tech Services 2016; Appendix 7B, Figure 7.2B-6). At depths greater than 2.5 m, substrates transition to greater than 90% sand. At depths greater than 3.0 m, gravel patches exist amongst the sand. Boulders are intermittently present at depths less than 1.0 m and within 20 m of shore and along the reef that crosses the mouth of Birch Creek. Aquatic vegetation was present in Birch Bay almost exclusively at depths less than 2.0 m and was present in the highest density along the west and east shores and across the mouth of Birch Creek (AAE Tech Services 2016).

Birch Creek and Headwater Lakes

Birch Creek is approximately 7 km long and drains a series of shallow, intermittent lakes (Goodison Lake, Water Lake, and Clear Lake) north to Lake St. Martin at the southern end of Birch Bay. Apart from the lowest 1 km of Birch Creek, which flows through a dense, grass and cattail marsh before entering Birch Bay, much of the watercourse has been channelized. The creek has a consistent U-shaped cross-sectional profile upstream of the marshy area and has an average width of 9.5 m and a maximum depth of 0.95 m (AAE Tech Services 2016). Substrate composition is variable and included patches of silt, sand, gravel, and cobble with some boulders. Riparian habitat is grasses and cattails. The adjacent land use is almost exclusively livestock grazing and hay land.

Woodale Drain flows into Birch Creek from the west approximately 3 km upstream from Lake St. Martin. Flow is intermittent and the drain likely provides fish habitat only during high flow periods. Riparian vegetation along the drain was terrestrial grasses (NSC 2019a).

The size and depth of Goodison Lake (260 ha), Water Lake (100 ha) and Clear Lake (25 ha) varies annually and seasonally depending on local precipitation. Passage of large-bodied fish from Lake St. Martin into these lakes would occur only during high flow events in Birch Creek. Data collected in 2011 and 2015 suggest there is a low possibility for groundwater inflows to these lakes, although some seepage may occur (KGS 2016). Regardless of groundwater input, these lakes likely become anoxic during winter due to their shallow depth and abundance of aquatic vegetation.

Clarks Lake (25 ha) drains into Birch Creek approximately 5.5 km upstream from Lake St. Martin through a series of constructed drains.

Bear Creek

Bear Creek is a small Lake St. Martin tributary that enters the northeast basin, south of the proposed Lake St. Martin Outlet Channel (Appendix 7B, Figure 7.2B-2). It was identified during the public consultation process as an important spawning ground that could be affected by the Project. The creek is approximately 4 km long with accessibility to fish depending on stream discharge. The lower 1 km of the creek is characterized by slow-moving water that is less than 1 m deep with fine sediments and organic material.

Dauphin River

Dauphin River is the natural outflow from Lake St. Martin. It is approximately 50 km long, originating at the northern extent of Lake St. Martin and flowing into the north basin of Lake Winnipeg at Sturgeon Bay. Most of the river is relatively shallow and swiftly flowing. The river is situated in Palaeozoic formations and substrate is typical of the region consisting of sand, gravels and cobbles.

Detailed bathymetry of the lower reaches of Dauphin River collected from fall 2011 to 2014 generally showed similar overall depths among years and seasons (NSC and KGS 2015a) (Dauphin R. Bathymetry figure in Chapter 6, Appendix 6F-5). The shallowest depths (less than 2 m) were generally located in the vicinity of the confluence with Buffalo Creek and along the south shore. Depths were higher along the north shore and increased up to 6 m towards the river mouth. Small-scale differences in bed elevation caused by erosion and deposition were noted between years, reflecting the naturally occurring and dynamic sediment transportation processes occurring in the river (NSC and KGS 2015a).

Substrates in the lower Dauphin River in 2011, 2013, and 2014 were consistently characterized by hard compacted, large-grained materials regardless of construction or operation of the EOC (NSC 2016b). Gravels and cobbles were particularly abundant, being approximately 50% of the total substrate in all surveys. Less than 0.1% of the substrates in the total mapped area of the river were sand. Substrates near the confluence of Buffalo Creek and Dauphin River were limestone shelves and cobbles and boulders. Only in the final lower kilometer of the river are gravel and sand substrates dominant (NSC 2016b).

At discharges between 58 m^3/s and 527 m^3/s in 2011, average water velocity in the lower Dauphin River ranged from 0.5 m/s to 1.6 m/s (NSC and KGS 2015a). Within this velocity range, sand and smaller substrates are transported in suspension into Sturgeon Bay. At the higher end of this range, gravels and cobbles are transported to Sturgeon Bay as bed load (NSC and KGS 2015a).

Big Buffalo Lake and Buffalo Creek

Big Buffalo Lake (55 ha), Little Buffalo Lake (5 ha), several unnamed ponds, and three intermittent creeks form the headwaters of Buffalo Creek, a tributary of the Dauphin River. Prior to operation of the EOC in 2011, water depth in Big Buffalo Lake ranged between 1.0 and 2.0 m, with a mean depth of 1.7 m (NSC 2016a). Aquatic vegetation (*Potamogeton* sp.) occurs throughout the lake but is considerably less dense in the central portion compared to nearshore areas. Shoreline vegetation consists largely of shrub wetlands comprised of sedges (*Carex* sp.), cattails (*Typha* sp.), and bulrushes (*Scirpus* sp.). Trees are rare.

Natural inflow to Big Buffalo Lake consists of local run off from surrounding wetlands and, possibly, groundwater. Water temperature and dissolved oxygen concentrations in August 2011 were 19°C and 8 mg/L, respectively, both of which are suitable for fish. However, the lake becomes anoxic in winter due to oxygen demand from decomposition of dead vegetation; dissolved oxygen concentrations were less than 0.5 mg/L in the winters of 2012/2013 and 2013/2014 (NSC 2015a). Substrates in the lake have a deep layer of loosely compacted organic sediments. Access to the lake by large bodied fish is likely periodic and dependent on flows and beaver activity in Buffalo Creek.

Buffalo Creek flows for approximately 15 km from Big Buffalo Lake to its confluence with Dauphin River. For the first 4 km downstream from Big Buffalo Lake, Buffalo Creek flows through a sparsely treed wetland/bog complex that includes Little Buffalo Lake. Downstream of Little Buffalo Lake, the creek flows in a defined channel with channel widths between 7 m and 12 m with water depths typically less than 1 m. Two small intermittent creeks converge with Buffalo Creek as it exits Little Buffalo Lake. These watercourses drain a peat bog and are not well defined. Downstream of these watercourses, the properties of gradient, flow, and habitat diversity in Buffalo Creek increases.

A wide variety of habitat types (i.e., run, pool, and riffle), as well as numerous beaver dams, exist in Buffalo Creek. Prior to operation of the EOC, the average wetted width was 13 m, average depth was 0.65 m and average water velocity was 0.74 m/s. The beaver dams create pools with soft substrates and impede fish passage at low flows. Instream vegetation exists throughout Buffalo Creek and riparian vegetation is dense and composed of grasses immediately adjacent to the creek and shrubs and trees further up both banks.

Operation of the EOC in 2011/2012 increased the wetted area of Big Buffalo Lake and the surrounding bog complex by 97% (NSC 2015a). Wetted widths, depths, and water velocities in Buffalo Creek also increased. Increased flow through Big Buffalo Lake eroded the organic substrates from much of the lake bottom, exposing underlying coarser aggregates in some areas. Some of this eroded material was deposited in Little Buffalo Lake, surrounding bog, and Buffalo Creek, while the smallest and lightest material was transported downstream to Dauphin River and Sturgeon Bay.

Following operation of the EOC in 2011, the extent of fish habitat in Big Buffalo Lake, Little Buffalo Lake, and the bog complex was similar to that which was available prior to operation of the channel (NSC 2015a). However, many of the trees and shrubs surrounding the lake had died and substrate composition in Big Buffalo Lake changed from loosely compacted organic sediments to coarser gravels and fine mineral sediments at most sites surveyed in August 2014 (NSC 2015a).

Habitat in Buffalo Creek was altered by operation of the EOC in 2011. This included a widening of the channel and the addition of approximately 3 ha of new run habitat and 2 ha of new pool habitat and the loss of approximately 1 ha of beaver pond habitat downstream of the bog complex. Channel width increased to between 6 m and 20 m within 3 km of the bog and up to 12 m wide closer to Dauphin River. Areas of channel erosion and bank slumping were observed (NSC 2015a) and fine substrates in the creek were largely removed, leaving gravels in much of the run/pool habitats. However, these coarser substrates are covered by fines over time. Additionally, grasses and sedges have since re-established in the riparian area adjacent to Buffalo Creek.

Sturgeon Bay

Sturgeon Bay is located on the southwest side of the north basin of Lake Winnipeg. It is a shallow bay with a maximum depth of approximately 11 m (EC/MWS 2011). Turbidity in the bay is often high due to wind-driven sediment re-suspension (McCullough et al. 2001).

Bottom substrates in a band along the southwest shore of Sturgeon Bay between Dauphin River outflow and Willow Point are generally gravel and cobble or a mixture of gravel, cobble and fines (Appendix 7B, Figure 7.2B-7). Areas farther offshore were composed entirely of clay, silt, and sand, with gravel and cobble substrates occurring infrequently in small isolated locations. In general, the abundance of sand decreased with increasing distance from shore, while the reverse was true for silt and clay (NSC 2015a).

Operation of the EOC between 2011 and 2015 introduced large volumes of suspended sediment into Sturgeon Bay. While repeated sampling between 2011 and 2015 showed that the distribution of major substrate classes over most of Sturgeon Bay did not substantially change, particle size analyses indicated that the silt component increased throughout the bay due to operation of the EOC (NSC 2016b). In particular, substrate composition near the Dauphin River outlet underwent the largest changes since operation of the EOC in 2011 (NSC 2016b). Between 2011 and 2013, fine clay and silt were deposited over much of the coarser substrate that occurred north of the river mouth. However, gravel, cobble, and boulders persisted northeast of the river mouth, albeit with a higher proportion of gravel. Substrate conditions near the river mouth have remained relatively consistent since 2013 (NSC 2016b).

The water quality in Sturgeon Bay is moderately nutrient rich, low to moderately turbid, slightly alkaline, hard to very hard, and well oxygenated (NSC and KGS 2015b). Sturgeon Bay is phosphorus limited and chlorophyll *a* concentrations measured in 2011 (7.0 ry productivity in the bay is moderate (NSC 2016a). Conductivity in the bay varies depending on proximity to the Dauphin River outlet.

A total of 11 taxa from six groups were collected in Sturgeon Bay in fall 2018 (NSC 2019b). The most common group captured was aquatic worms (Oligochaeta; 7,122 individuals/m^2), followed by finger clams (Pisidiidae; 3,695/m^2) and midge fly larvae (Chironomidae; 2,355/m^2). The remaining groups included aquatic snails (Gastropoda; 807/m^2), caddisfly larvae (Tricoptera; 242/m^2) and mayfly larvae (Ephemeroptera; 96/m^2). Taxonomic richness at the family level was 8.7 ± 1 .3 with a mean total density of 14,411 individuals/m^2 (± 5991) and a Simpson's Diversity Index of 0.65. The benthic invertebrate community of Sturgeon Bay in 2018 was similar, albeit lower density than the benthic invertebrate community observed in 2011 and 2013 (NSC 2016b).

Fish Community of the LAA

Of the 54 species that could occur within the RAA, 38 have been captured within the LAA during studies related to the EOC or the Project. The following sections present a summary of the current knowledge of the fish community in waterbodies and watercourses in the LAA. Sections are ordered geographically from upstream to downstream (i.e., Watchorn Bay in Lake Manitoba to Sturgeon Bay in Lake Winnipeg).

Watchorn Bay and Tributaries

Yellow perch were the most abundant species captured during a boat electrofishing survey conducted in Watchorn Bay in spring 2016. The survey yielded 2.37 fish/min with yellow perch accounting for almost half of the catch (AAE Tech Services 2016; Appendix 7A, Table 7.2A-3). It is likely that yellow perch use Watchorn Bay for spawning.

Index gill nets set in Watchorn Bay in fall 2015 yielded 13.6 fish/100 m/hour with lake whitefish comprising 92% of the total catch (AAE Tech Services 2016). Approximately 50% of these lake whitefish were sexually mature suggesting that lake whitefish spawn in the area (AAE Tech Services 2016). It is likely that lake whitefish spawning occurs offshore in areas where eggs would be protected from ice scouring, substrate resuspension and oxygen depletion.

Index gill nets set in spring 2016 yielded 18.24 fish/100m/hour with catches dominated by white sucker (80%) and, to a lesser extent, northern pike (14%) and walleye (2%) (AAE Tech Services 2016). Many of these fish were sexually mature (Appendix 7A, Table 7.2A-3) and, because larval walleye and white sucker were also captured in neuston tows during early June (AAE Tech Services 2016), it is likely that northern pike, walleye, and white sucker species spawn in Watchorn Bay or in tributaries flowing into Watchorn Bay.

White sucker, walleye and northern pike are known to migrate into Watchorn Creek in spring to spawn. In fact, the number of white suckers moving up Watchorn Creek is large enough to support a commercial trapping operation approximately 4 km upstream from the mouth (AAE Tech Services 2016).

Walleye, yellow perch, northern pike, and white suckers also use Mercer Creek, another Watchorn Bay tributary located west of Watchorn Creek, to spawn. White suckers will use at least the lower 13.5 km of Mercer Creek to spawn (AAE Tech Services 2016). However, use of Mercer Creek by spawning white sucker is dependent on spring run-off conditions. Low runoff during spring 2018 restricted use of the creek for spawning to the lower 2 km (NSC 2019a). In most years, Mercer Creek supports a commercial trapping operation approximately 600 m upstream from the mouth.

Although specific data are lacking, other large bodied species such as shorthead redhorse, quillback and several forage species may also spawn in Watchorn Bay during spring and summer. Suitable habitat exists in the wetlands adjacent to and between Watchorn and Mercer creeks for carp, northern pike, and yellow perch spawning.

Mercer and Watchorn creeks and the nearshore habitat and shallow bays of Watchorn Bay likely provide rearing habitat for juvenile northern pike, white sucker, yellow perch, and walleye and for many forage species throughout the year. Large-bodied species use of these areas is likely transitory because fish can access habitats throughout the lake for foraging and overwintering.

Fairford River and Inlet Area

Upstream movement of fish from Lake St. Martin to Lake Manitoba through Fairford River is facilitated by a Denil fishway located in the FRWCS. This fishway provides upstream movement at all flows. A study conducted by Katapodis et al. (1991) in spring 1987 captured 8,871 fish moving upstream through the Denil fishway in the FRWCS (Appendix 7.2A-4). White sucker (57%), walleye (26%) and sauger (10%) made up 93% of the fish captured. Cisco, shorthead redhorse and carp were most of the remaining fish. Sexually mature white sucker accounted for 28% of the fish moving upstream in May. Large numbers of walleye and sauger also moved upstream in May and June, but not for spawning because water temperatures were already above preferred spawning temperatures (approximately 6°C) and few were in spawning condition. Approximately 8% of all upstream migrants captured in spring 1987 returned downstream later in the year (Katapodis et al. 1991).

Twenty-two percent of the 2,313 walleye tagged moving through the fishway in 1987 were later recaptured in Lake Manitoba, primarily from the north end of Portage Bay and near Steeprock (Derksen 1988). Some walleye moved into Basket Creek at the north end of the lake and Swan Creek at the south end of the lake to spawn. Less than 2% were recaptured in the northwest portion of Lake Manitoba and in Waterhen Lake.

Use of Fairford River by fish in fall is relatively unknown. However, a hoopnetting survey conducted below the dam from October 2-11, 2007 yielded 87 upstream migrating fish comprised of nine species (Gillespie and Remnant 2008). Cisco were most abundant fish species comprising 42.5% of the catch. Small numbers of yellow perch, freshwater drum, northern pike, burbot, walleye, white sucker, black bullhead and quillback were also captured. Large mesh index gillnet catches yielded northern pike (54%), carp (16%), walleye (15%), shorthead redhorse (9%), white sucker (4%) and single cisco and freshwater drum (Gillespie and Remnant 2008). Small mesh index gill nets yielded emerald shiner, spottail shiner, yellow perch and northern pike.

Index gillnetting surveys conducted above the FRWCS in fall 2007 had a catch-per-unit-effort (CPUE) of 0.96 fish/100 m/hour and yielded 72 fish comprised of walleye (32%), yellow perch (26%), white sucker (19%) and spottail shiner (7%). Small numbers of shorthead redhorse, lake whitefish, northern pike, freshwater drum, cisco and carp were also captured (Gillespie and Remnant 2008; Appendix 7A, Table 7.2A-4).

Spring boat electrofishing in the bay south of the Fairford River inlet in 2016 yielded 2.02 fish/minute, with yellow perch accounting for more than half the catch (AAE Tech Services 2016) (Appendix 7A, Table 7.2A-4). Index gillnetting in this area in spring 2016 yielded 12.78 fish/100 m/hour (AAE Tech Services 2016) with white sucker comprising the majority (80%) of the catch, followed by northern pike (14%). Index gillnetting in fall yielded 7.8 fish/100 m/hour with northern pike (52%) comprising most of the catch, followed by white sucker (30%) and lake white fish (17%). Most northern pike, white sucker and walleye captured in spring 2016 and all lake whitefish captured in fall 2016 were in spawning condition, suggesting that spawning occurs in the area.

Downstream movement of fish from Lake Manitoba into Fairford River and over the Fairford Dam is likely highest during high flows. However, the magnitude of these downstream movements is unknown. According to Katapodis et al. (1991), commercial fishers on Lake Manitoba expressed concerns as early as 1963 that walleye were leaving Lake Manitoba through the Fairford River and were unable to return because of inadequate fish passage. However, evidence to support this assertion is not strong as commercial catches of walleye in Lake Manitoba had been declining since 1950, 10 years prior to construction of the FRWCS.

Pineimuta Lake

Little is known about fish use of Pineimuta Lake. It is expected that many of the fish species known to occur in Fairford River and Lake St. Martin would also use the lake, particularly those species that prefer shallow, soft bottom habitats with an abundance of aquatic vegetation. The lake would be expected to provide abundant foraging habitat for species such as suckers, carp, northern pike, stickleback, central mudminnow, bullheads, and fathead minnow. Carp, northern pike, stickleback, fathead minnow, and central mudminnows likely spawn in the lake as well. Use of the lake for overwintering is probably limited by shallow depth and low oxygen levels, particularly in low water years.

Lake St. Martin and Tributaries

Current knowledge of the Lake St. Martin fish community is based on boat electrofishing, gillnetting, and hoopnetting surveys conducted between 2012 and 2018 (AAE Tech Services 2016; NSC 2016c, 2019c). A total of 4,466 fish, from 20 species, were captured by large- and small-mesh experimental index gillnetting and boat electrofishing in Lake St. Martin from 2012-2018 (Appendix 7A, Table 7.2A-5).

White sucker (31%) were the most abundant species captured, followed by yellow perch (16%), northern pike (12%), and spottail shiner (10%). Lake whitefish and cisco were seasonally abundant, comprising over half of fall gillnet catches near the Narrows in 2014 (NSC 2016c), more than 70% of gillnet catches in Harrison and Birch bays in fall 2015 (AAE Tech Services 2016; Appendix 7A, Table 7.2A-5), and 79% of the gillnet catch in the north basin during fall 2018 (NSC 2019c).

During spring, sexually mature white sucker, northern pike, shorthead redhorse and yellow perch have been captured throughout the lake. Catches of larvae in neuston tows in Harrison and Birch bays in spring 2016 were comprised almost exclusively of white sucker (93%) and walleye (less than 7%) (AAE Tech Services 2016) suggesting these species spawned nearby. Large numbers of larval yellow perch drifted out of Lake St. Martin into the EOC in 2012, indicating that yellow perch spawning occurs in the lake.

White sucker have been observed spawning in Bear Creek in spring (NSC 2016c), a tributary which enters the north basin of Lake St. Martin across from the inlet to the proposed LSMOC (Appendix 7A, Table 7.2A-5). Northern pike and white sucker are known to use Harrison Creek for spawning and northern pike, white sucker and walleye are known to use Birch Creek for spawning (AAE Tech Services 2016). The number of white sucker using Birch Creek in spring is sufficient to support a commercial trapping operation (AAE Tech Services 2016).

Lake whitefish are known to spawn on gravel bars in the northeast basin of Lake St. Martin and in the narrows between basins in fall (Stone 1965; Cook and MacKenzie 1979; Kristofferson and Clayton 1990). However, captures of sexually mature lake whitefish in Harrison and Birch bays during the fall of 2015 (AAE Tech Services 2016) suggest that spawning areas may be more widespread than just the northeast basin. Lake St. Martin is reported to have an abundance of groundwater upwellings (Einarson 2018, pers. comm.), which may be a key attribute of lake whitefish spawning habitat in the lake.

Spring neuston tows conducted annually in the north basin of Lake St. Martin from mid-April to early July in 2012 to 2018 captured larval fish, which positively confirmed the successful spawning of the following species in Lake St. Martin: catostomids (white and longnose sucker and shorthead redhorse), percids (yellow perch, darters and walleye), cyprinids, coreonines (lake whitefish and cisco), gasterosteids (stickleback) and trout perch (NSC 2016c; NSC 2019c; Appendix 7A, Table 7.2A-6). Coregonine larvae were most abundant just after ice break up with increasing abundance of percids, catostomids and cyprinids as the season progressed (NSC 2016c; NSC 2019b).

It was noted by Interlake Reserves Tribal Council during the Indigenous engagement process that the species composition of Lake St. Martin has changed since the channels and water control structures were constructed (see Section 7.2.1.2). Species that were not previously encountered, such as bullhead, are now being captured in Lake St. Martin.

Dauphin River

Historically, walleye, lake whitefish, sauger, northern pike, burbot, suckers, yellow perch, cisco, and freshwater drum have been recorded as occurring in Dauphin River (Doan 1961). Fish species known to occur in the river as of 2016 are listed in Appendix 7A, Table 7.2A-1.

During recent surveys, white sucker and shorthead redhorse have been the most abundant species captured in the spring (NSC 2016c; Appendix 7A, Table 7.2A-7) and these species are known to use the river for spawning. Evidence includes the capture of sucker eggs on egg mats set near its confluence with Buffalo Creek (NSC 2016c) and the capture of larval suckers in drift nets set in the river in spring (NSC 2016c) (Appendix 7A, Table 7.2A-8).

Carp, freshwater drum, northern pike, percids (walleye, sauger, yellow perch), and white bass were also relatively abundant in the river in spring. The capture of larval minnows, sculpins and percids (walleye, sauger, yellow perch, and darters) in drift nets NSC 2016c) indicates that these species spawn in the Dauphin River or in Lake St. Martin (Appendix 7A, Table 7.2A-8). Species such as white bass, carp and freshwater drum become more prevalent in the river as water temperatures warm and suckers, percids and pike move back downstream to Sturgeon Bay.

Historically, a large spawning run of walleye occurred in Dauphin River at spring break-up (Doan 1945; Pollard 1975). These fish were known to gather in the lower part of the river during late winter and remain there until ice-off, presumably in preparation for spawning in spring. However, more recently, walleye have never comprised more than 1% of the catch in the river in any season (NSC 2016c; Appendix 7A, Table 7.2A-7); walleye eggs have not been recovered in egg mats and only 1% of all larval fish captured in drift nets set in the river in spring between 2012 and 2015 were percids (NSC 2016c; Appendix 7A, Table 7.2A-8). These data suggest that, at present, there is no significant walleye spawning run in the river.

Lake whitefish from Lake Winnipeg have long been reported to migrate up Dauphin River each fall to spawn in Lake St. Martin. Cook and MacKenzie (1979) suggested that lake whitefish return to Lake St. Martin in successive years. It has also been reported that some of these fish may spawn in the river itself (Stone 1965; Cook and MacKenzie 1979; Kristofferson and Clayton 1990; Traverse 1999). More recent studies have confirmed that lake whitefish use Dauphin River for spawning and as a migration route to Lake St. Martin in fall. This includes the capture of lake whitefish eggs on egg mats during operation of the EOC each fall between 2011 and 2015 (NSC 2016c), the capture of larval coregonines in drift traps in spring, and the capture of adult lake whitefish in the river at rates between 5 to 42 fish/minute during fall surveys conducted between 2011 and 2014 (Appendix 7A, Table 7.2A-7). These high capture rates indicate very high fall densities of adult whitefish in Dauphin River each year.

Kristofferson and Clayton (1990) noted that the lake whitefish population using Dauphin River exhibits differences in morphological characteristics and allelic frequencies compared to other lake whitefish stocks in Lake Winnipeg. Mark-recapture studies suggest that the range of Dauphin River/Lake St. Martin subpopulation may be localized (Cook and MacKenzie 1979).

Low abundance of carp, freshwater drum and white bass in the river in fall suggests that these species return to Lake Winnipeg to overwinter.

Big Buffalo Lake and Buffalo Creek

Yellow perch, northern pike, white sucker, and golden shiner were captured in Big Buffalo Lake during an index gillnetting survey conducted in spring 2011 (Appendix 7A, Table 7.2A-9; NSC 2016c). Yellow perch were by far the most abundant species present, accounting for 87% of the catch. Most were young juveniles (1+ years) suggesting that perch spawning occurs in the lake. Young-of-the-the-year (YOY) minnows (i.e., forage fish) were also observed in large numbers in areas with abundant aquatic vegetation but could not be captured for species identification.

While densities of fish were similar or higher in follow-up spring surveys of Big Buffalo Lake conducted in 2012, 2013, 2014 and 2015 (NSC 2016c), yellow perch numbers were substantially reduced or absent following operation of the EOC in 2011 (Appendix 7A, Table 7.2A-9). Catches in these years were instead dominated by white sucker and northern pike. Other fish species captured in Big Buffalo Lake in the spring or fall of 2012, 2014, and 2015 when the EOC was operational included adult lake whitefish, cisco, freshwater drum, longnose sucker, shorthead redhorse, and carp in spring 2015 (NSC 2016c).

Nine species of fish and large numbers of YOY minnows were observed and captured while backpack electrofishing in Buffalo Creek in August 2011, prior to the operation of the EOC (NSC 2016c; Appendix 7A, Table 7.2A-10). The most abundant species were central mudminnow, northern pearl dace, and juvenile white sucker. Catches in upper Buffalo Creek near the bog complex and downstream at the confluence with the Dauphin River, where backwater effects occurred, were dominated by central mudminnow and northern pearl dace. In the free-flowing lower portion of the creek, where habitat was more typically riffle, longnose dace and slimy sculpin were more abundant. Similar species diversity was observed in spring 2014, but fish densities were lower than in 2011, primarily due to a reduction in the number of central mudminnow and northern pearl dace captured in backwater habitats.

Besides yellow perch, spawning by coregonines (i.e., lake whitefish, cisco), suckers, minnows, sticklebacks, and northern pike has been confirmed in Buffalo Creek and/or Big Buffalo Lake by the capture of eggs on egg mats or larval fish in drift nets set in Buffalo Creek. Coregonine eggs were captured on egg mats set in the lowest reach of Buffalo Creek in fall 2011, either just before or while the EOC was operating (NSC 2016c). However, no eggs were captured in spring 2013 or 2014. The larval fish catch in spring 2012 was large numbers of suckers and minnows, as well as sticklebacks, coregonines, yellow perch, sculpins, and northern pike (Appendix 7A, Appendix 7.2A-8). Substantially fewer larvae were captured in the creek in the springs of 2013, 2014 and 2015.

Densities of larval coregonines did not vary from the EOC downstream through Buffalo Creek in 2015 (NSC 2016c). In contrast, densities of larval minnows and suckers were much higher in the lower portion of Buffalo Creek. These data suggest that the coregoine larvae originated in the EOC or in Lake St. Martin, while the minnow and sucker larvae originated throughout the system.

Sturgeon Bay

All fish species found in the RAA and Lake Winnipeg have the potential to inhabit Sturgeon Bay. However, there are several species that have only been found in the south basin or on the east side of

Lake Winnipeg and are unlikely to occur in the LAA. Fish species with distributional ranges that are known to include Sturgeon Bay are listed in Appendix 7A, Table 7.2A-1.

Walleye, yellow perch, white sucker, shorthead redhorse, and northern pike were consistently captured during standard index gillnetting conducted annually each summer between 2008 and 2016 in Sturgeon Bay (Appendix 7A, Table 7.2A-11). Other species captured during at least one year of sampling included sauger, white bass, rainbow smelt, lake whitefish, cisco, mooneye and black bullhead. Yellow perch, spottail shiner, troutperch, rainbow smelt and log perch were the most abundant species captured in small mesh index gill nets during this same period. Walleye, white sucker, northern pike, shorthead redhorse, cisco, lake whitefish and emerald shiner comprised the remainder of the catch. The annual CPUE for large mesh nets averaged 2.49 fish/100m/hour. The annual small mesh CPUE averaged 22.43 fish/100 m/hour. Of note is a decrease in abundance of rainbow smelt during this period; rainbow smelt were not captured in small mesh gill nets in 2016 and have not been captured in large mesh nets since 2013.

Spring index gillnetting conducted in Sturgeon Bay from the Dauphin River mouth south to Willow Point between 2012 and 2018 yielded between 259 and 873 fish annually and CPUEs of 10.0 to 68.5 fish/100 m/hour (Appendix 7A, Table 7.2A-11). The most abundant fish species captured in spring in this area of Sturgeon Bay were yellow perch (up to 83% of the total catch in some years) followed by northern pike, walleye and white sucker (each comprising up to 39% of the catch in some years), and shorthead redhorse (comprising up to 10% of the catch in 2018). Coregonines comprised 12% of the catch in 2012 but no more than 1% in other years.

Spring neuston tows in Sturgeon Bay yielded larval goldeye/mooneye, suckers, minnows, northern pike, lake whitefish/cisco, trout-perch, sticklebacks, white bass and walleye/sauger/perch (NSC 2016c NSC 2019d; Appendix 7.2A, Table 7.2A-6). Abundance of each taxa varied with water temperature and date, with coregonines being more abundant earlier in spring and goldeye/mooneye and white bass being more abundant later in June. The presence of larvae of these species suggests that spawning occurs nearby, either in Sturgeon Bay itself or in local tributaries.

Fall index gillnetting was conducted in this same area of Sturgeon Bay between 2011 and 2018 (Appendix 7A, Table 7.2A-11). Coregonines were generally the most abundant species, comprising between 34% and 62% of the total catch, with yields of between 46 and 333 fish annually and CPUEs of 4.2 fish/100 m/hour to 10.4 fish/100 m/hour (NSC 2016c; NSC 2019d). Northern pike and white sucker were the next most abundant species, each comprising between 9% and 39% of the catch. Shorthead redhorse comprised up to 10% of the catch depending on the year.

The proportion of lake whitefish captured in fall gillnets set near the Dauphin River mouth was higher than those set near Willow Point in all years. Most lake whitefish captured were adult fish in a pre-spawn condition, including those fish captured near Willow Point. Captures of small numbers of coregonine eggs on egg mats set between the Dauphin River mouth and Willow Point in the fall of 2012, 2013 and 2014 (NSC 2016c) suggest that spawning occurred nearby.

Traditional Knowledge

Chapter 9 (Section 9.6) provides information on traditional land and resource use. Although primary sources of Traditional Knowledge for the Project area are limited to those Indigenous groups that have been engaged by Manitoba Infrastructure to date (see Section 7.2.1.2) and, therefore, do not necessary include all potentially affected groups or specific information from the LAA, a preliminary list of fish species that are traditionally important for local Indigenous groups has been compiled. This list, in no order of importance, includes sturgeon, white sucker, whitefish, carp, northern pike, channel catfish, burbot, perch, sauger, walleye, and trout (species not specified).

Habitat Use and Life History Characteristics of Focal Species

Walleye

Walleye are widely distributed throughout the RAA and LAA.

Walleye spawn during spring shortly after ice-out when water temperatures approach 6°C. Spawning can occur in streams and lakes and preferred spawning habitats include gravel bottomed pools above riffles in streams or along wind exposed rocky/gravel shoreline and shoals in lakes. Spawning in tributaries generally occurs earlier than in lakes because of the higher water temperatures associated with spring run-off. Eggs are broadcast and fall into crevices in the substrate (Scott and Crossman 1973).

Important known or suspected walleye spawning locations in the RAA include Basket and Swan creeks, the Whitemud and Waterhen rivers, and other tributaries of Lake Manitoba and Mantagao River, Limestone Bay, and tributaries of the north basin of Lake Winnipeg. Specific spawning locations in the LAA are Watchorn and Birch creeks. Historically, Dauphin River was thought to be an important spawning area, although recent data suggests numbers of fish using the river for spawning are low.

After hatching, larval walleye emerge from the gravels and drift downstream with currents. When their yolk sac is depleted, they become planktivorous, eventually shifting to larger insects and then to small fish (Stewart and Watkinson 2004). They are primarily piscivorous after their first year. By the latter part of the summer, young walleye move towards the bottom and are generally found in 6 m to 9 m of water (Scott and Crossman 1973). They actively seek the shelter of dim light during periods of strong light intensities in clear waters (Scherer 1971; Ryder 1977 in McMahon et al. 1984) and, by day, are often found in deep or turbid water or in contact with substrates under cover of boulders, log piles, or dense beds of submerged vegetation.

There is abundant walleye rearing habitat in near shore and open-water areas throughout the RAA and LAA. The turbid waters of Lake Manitoba and Lake Winnipeg provide ideal cover for juvenile walleye. Although not specifically targeted, no walleye less than 195 mm in length were captured in the LAA during fisheries investigations conducted from 2011-2016 (AAE Tech Services 2016; NSC 2016c; NSC 2019 c, d). However, approximately 6% of the 2018 index gillnetting catch from Lake St. Martin was walleye less than 200 mm in length (NSC 2019c), indicating that it is a rearing area for walleye.

In the turbid waters of the RAA and Lake St. Martin, walleye are generally open-water foragers, often travelling in schools at depths between 3 m and 10 m and feeding on whatever fish are available. As abundance has increased over the past 20 years, rainbow smelt have become increasingly important in the diet of Lake Winnipeg walleye, particularly in the north basin. Emerald shiner, spottail shiner, yellow perch and cisco also are an important portion of the diet.

Walleye overwinter in lakes and rivers where water velocities are relatively low and oxygen levels are sufficient to sustain them until spring. Lake Manitoba and Lake Winnipeg provide ideal overwintering habitat for walleye. Lake St. Martin provides good overwintering habitat in most years, except during extremely low water levels when ice thickness and low oxygen levels may become limiting (Cober 1967). Adult walleye will often move to spawning locations under the ice.

Walleye in the RAA generally do not undertake extensive migrations but will move into local tributaries to spawn. For example, some fish marked in Lake St. Martin and Dauphin River moved upstream as far as the Waterhen and Fairford rivers and downstream as far as Sturgeon Bay (NSC 2016c). Fish marked in Sturgeon Bay moved throughout Lake Winnipeg (NSC 2016c). Derksen (1988) reported 2,313 adult (greater than 300 mm in length) walleye moving through the Fairford Dam fishway from May 6 to June 12, 1987. A total of 216 were recaptured, of which the largest proportion (78%) were recaptured locally either a second time in the fishway or from Fairford River below the dam. The remaining walleye were recaptured in Lake Manitoba, mostly from the Portage Bay, Steeprock and the Narrows.

Lake Whitefish

Lake whitefish are abundant in the RAA, and particularly in the north basin of Lake Winnipeg. The species is somewhat less abundant in the shallower waters of the Lake Manitoba. In the north basin of Lake Winnipeg, there are six genetically distinct lake whitefish populations (Mavros 1992). This suggests that these populations home to their respective spawning areas, with limited interbreeding, and they also have distinct feeding areas (Stewart and Watkinson 2004).

Lake whitefish are fall spawners, but do not necessarily spawn every year. Pre-spawning aggregations in the north basin of Lake Winnipeg begin in mid-September (Green and Derksen 1987). Fish in spawning condition first appear at in early October at temperatures between 10°C and 5°C. Spawning occurs in lakes or rivers, typically over gravel substrates. However, spawning can also occur over sand or mud/clay/detritus. Eggs are broadcast over the substrate and hatch five to six months later in April or May (Scott and Crossman 1973). Larvae emerge at ice out and move up in water column. After the yolk sac is absorbed, they become demersal (Scott and Crossman 1973).

A large spawning migration of lake whitefish occurs up Dauphin River and into Lake St. Martin during fall. Adults are thought to move back downstream under the ice after spawning or in very early spring. There is little evidence of movement up Fairford River during fall or through the Denil fishway into Lake Manitoba. However, this may also be an artifact of low sampling effort as some local fishers have reported substantive movements into Lake Manitoba, particularly in the fall of 2017 (Benson pers. comm. 2018). There is no evidence of significant post-spawning downstream movements of adult lake whitefish from Lake Manitoba. However, this also may be due to lack of fishing effort.

Known lake whitefish spawning areas in the LAA include the Dauphin River, Watchorn Bay, and Lake St. Martin, as far south as Birch Bay (NSC 2016c, 2019d; AAE Tech Services 2016b). Lake St. Martin is reported to have an abundance of ground water upwellings (Einarson, 2018 pers. comm.) which, although unproven, may be a key attribute of lake whitefish spawning success in the lake by providing thermal regulation over the winter incubation period and reducing mortality due to ice forming to the bottom. Local knowledge suggests that spawning may also occur in Sturgeon Bay. However, lake whitefish in post-spawn condition have not been captured in Sturgeon Bay during late fall experimental gillnetting programs to support this.

Juvenile whitefish generally leave shallow inshore waters by early summer and move into deeper water. This is supported by the relatively few juvenile lake whitefish captured in the LAA during baseline studies or studies associated with the EOC and the absence of juvenile lake whitefish from the Lake St. Martin catch during the 2018 index gillnetting program (NSC 2019c). Howard (1980) found that young lake whitefish were abundant in warm protected bays of Lake Winnipeg during June, but by July had dispersed, likely to deeper offshore areas.

Adult whitefish are bottom feeders but can also be planktivorous when benthic invertebrate densities are low (Stewart and Watkinson 2004). Small fish can also form a proportion of their diet. Lake whitefish are typically associated with open-water foraging and are known to school (Scott and Crossman 1973). In general, subpopulations of lake whitefish in Lake Winnipeg tend to forage local to their spawning locations (Cook and MacKenzie 1979), an observation supported by the presence of distinct populations in the northern basin (Mavros 1992). Juvenile whitefish are initially planktivorous for their first spring but increasingly depend on benthic invertebrates later in summer (Reckahn 1970 in Scott and Crossman 1973).

Lake whitefish overwinter in lakes and rivers where water velocities are relatively low and dissolved oxygen levels are sufficient (i.e., greater than 4 mg/L) to sustain them until spring. Within the LAA, lake whitefish are known to overwinter in Lake St. Martin and Sturgeon Bay. Lake St. Martin provides good overwintering habitat in most years, except during extremely low water levels when ice thickness and low oxygen levels may become limiting (Cober 1967). It is thought that post-spawning adult lake whitefish move downstream from spawning grounds in early winter under the ice. In the LAA, this would entail movement of whitefish from Lake St. Martin to Lake Winnipeg.

Populations of lake whitefish in Lake Winnipeg do not appear to make extensive foraging movements (Cook and MacKenzie 1979). For example, only 2% (17 of 778 fish) of lake whitefish tagged near the Dauphin River in 1938 were recovered on the east side of Lake Winnipeg while another two were recaptured in Playgreen Lake and one was recapture in Lake St. Martin (Kennedy 1950). Further evidence of the limited movement was provided by mark/recapture of tagged lake whitefish in the LAA between 2011 and 2014 when less than 1% of lake whitefish (23 of 3,017 fish) tagged in the Dauphin River were recaptured in a different location (NSC 2016c): 21 moved into Sturgeon Bay; one moved to Long Point in Lake Winnipeg; and one moved into Lake St. Martin. However, the low recapture rate in Lake St. Martin is likely an artifact of low sampling effort.

Northern Pike

Northern pike are one of the most widely distributed fish in Manitoba and are found in almost all permanent waters that support fish populations (Stewart and Watkinson 2004). They are typically in the top four most abundant large bodied species in all waterbodies sampled within the LAA and RAA.

Northern pike spawn in spring just prior to or at ice-off. They move into vegetated areas where they pair up and randomly deposit eggs (Scott and Crossman 1973). Optimal pike spawning habitat is flooded vegetation in shallow, sheltered areas (Casselman and Lewis 1996). The eggs readily stick to the vegetation where they incubate for approximately two weeks.

Spawning habitat for northern pike is widespread throughout the LAA and RAA. Within the LAA, northern pike are known to spawn in numerous tributaries (e.g., Mercer, Birch, Watchorn, and Bear creeks) and likely in Pineimuta Lake, throughout the nearshore environments of Lake St. Martin, the peripheral areas of Dauphin River and near the mouth of Mantagao River.

At hatching, young pike remain inactive for 6-10 days feeding on the yolk sac. Once exogenous feeding commences, growth is rapid. Feeding initially focuses on small invertebrates and then shifts to fish (Scott and Crossman 1973). Young tend to stay in less than 5 m of water and remain associated with patches of aquatic vegetation. Rearing habitat for northern pike is found throughout the RAA in close association with spawning areas.

Adult pike are typically associated with weed beds but are also prolific foragers in open-water environments (Scott and Crossman 1973). They are opportunistic feeders that rely on surprise and a burst of speed to capture prey. While fish comprise 90% of their diet, they will also feed on frogs and crayfish, and almost any living vertebrate up to one-half their size that is available to them (Scott and Crossman 1973). The productive habitats of Lake Manitoba, Lake St. Martin and Lake Winnipeg provide ideal pike foraging habitat.

Northern pike overwinter in lakes and rivers where water velocities are relatively low and oxygen levels are sufficient to sustain them until spring (>3 mg/L; Casselman and Lewis 1996). Pike generally move into deeper waters as temperatures cool. Feeding continues through winter, albeit at a slower pace than in summer. Northern pike overwintering habitat is abundant throughout the LAA wherever water and oxygen levels do not become limiting.

In general, northern pike are sedentary, establishing vague territories where food and cover are adequate (Scott and Crossman 1973). Migrations to nearby streams or marshes occur in spring for spawning. During the remainder of the open-water season, local movements occur on and offshore in relation to water temperature and light. No northern pike were captured moving upstream through the Denil fishway at the FRWCS in spring 1987 (Derksen 1988).

Forage fish

Forage fish are fish species below the top of the aquatic food chain. As a result, they are an important source of food for predatory species, such as northern pike and walleye, at the top of the aquatic food chain. Forage fish are typically small (i.e., less than 100 mm in length) and include members of the minnow family (Cyprinidae), darters (Percidae), sculpin (Cottidae), trout perch, rainbow smelt, and stickleback (Gasterosteidae) as well as juvenile whitefish and cisco (Coregonines), and juvenile yellow perch, suckers, and other large-bodied species.

Forage species are found throughout the LAA and RAA. However, the species mix, and their abundance are dependent on the habitat present. Species such as fathead minnows and stickleback are tolerant of high-water temperatures and low oxygen concentrations and, therefore, are found in marginal fish habitats or habitats that are periodically isolated. These species tend to have high reproduction rates and can quickly re-establish in waters that periodically winterkill. Juveniles of large-bodied species, such as whitefish and cisco, are more restricted in their habitat preferences than fathead minnows and stickleback, and therefore, are only found in larger lakes. Other forage fish species, such as longnose dace and sculpin, are found in riffle and run habitats that are well oxygenated and with hard substrates (e.g., gravel and cobble). Still other forage fish species, such as pearl dace and central mudminnow, are found in backwater habitats with little or no water velocity and mud/detritus bottoms.

Spawning, rearing, foraging and overwintering habitats for forage fish species vary greatly depending on the species. However, home ranges for most forage fish species are small and habitats for each of these life history requirements are generally near each other. Most forage fish species spawn in late spring or early summer. Many species do not live more than three years. Densities can vary greatly on an annual basis.

Due their poorer swimming performance than adult large-bodied fish, forage fish species are particularly vulnerable to entrainment in currents and involuntary downstream movements.

Commercial, Recreational, and Aboriginal Fisheries

Lake Winnipeg, Lake St. Martin, Dauphin River, and Lake Manitoba have supported subsistence fisheries since time immemorial. The principle fish species harvested from these lakes by local Indigenous groups are white sucker, lake whitefish, cisco, carp, northern pike, channel catfish, burbot, perch, sauger, walleye, and trout (species not specified). Lake sturgeon were previously harvested from Lake Winnipeg when they were more abundant.

Lake Manitoba

Approximately 1.4 million kg (round) of fish were commercially harvested from Lake Manitoba annually from 1997-2017 (Appendix 7A, Table 7.2A-12). This included an average annual harvest of 606,443 kg of suckers, 246,878 kg of carp, 231,334 kg of walleye, and 165,860 kg of yellow perch. Of note are a recent decline in the harvest of yellow perch (2012-2017), an increase in harvest of lake whitefish (2012-2017), and the 2017 catch of walleye (496,494 kg), which was the highest in 21 years. Some of the variability in harvest is related to markets, particularly for rough species such as suckers.

The Lake Manitoba recreational fishery focuses on yellow perch, walleye, sauger, northern pike and freshwater drum. Popular recreational fishing locations include the Whitemud River and Delta Beach areas, the Narrows and Steeprock.

Lake St. Martin/Dauphin River

Lake St. Martin has been fished commercially since 1922 (Stone 1963) and currently supports a winter fishery, primarily for lake whitefish, northern pike and walleye, and a spring fishery for carp and suckers (Appendix 7.2A-13). Lake whitefish harvests from the lake were as high as 114,105 kg in the winter of 1976/77 (Cook and MacKenzie 1979) but have averaged only 1,000 kg annually since 2007. Between 1997 and 2017, approximately 13,750 kg (round) of fish were harvested annually from Lake St. Martin (Appendix 7A, Table 7.2A-13). This included an average annual harvest of 4,762 kg of lake whitefish, 3,843 kg of carp, 2,667 kg of suckers, 2,233 kg of northern pike, and 227 kg of walleye. However, these statistics are biased by the much larger harvests that occurred in the lake between 1997 and 2007; since 2007, annual harvests have been sporadic and substantially lower than the earlier decade of record. For example, the fishery was closed in 2010, and in total, only 8 kg of lake whitefish and 44 kg of suckers were harvested in 2013 and 2014, respectively. Similar to Lake Manitoba, some of the variability is related to markets, particularly for rough species such as sucker and carp.

Recreational fishing pressure on Lake St. Martin has traditionally been less than on Lake Manitoba or Sturgeon Bay (Pollard 1973; Valliant and Smith 1979). Dauphin River supports a small recreational fishery. While more recent data are unavailable, an estimated 15,500 kg of walleye was harvested by recreational anglers from Dauphin River in 1972 (Pollard 1975) while an estimated 28,863 kg of walleye, 8,100 individual northern pike and 300 individual yellow perch were harvested from the river by recreational anglers in 1977 (Valiant and Smith 1979).

Lake Winnipeg

The Lake Winnipeg commercial fishery was established in the mid-1800s and its importance increased substantially when the province was connected by railway to the United States in 1877 and eastern Canada in 1881. The lake whitefish harvest, upon which the Lake Winnipeg commercial fishery was originally based, decreased in the 1930s when percids (sauger and walleye) began to dominate.

There are two open-water fisheries (summer and fall) and a winter fishery in Lake Winnipeg; the summer fishery remains the most productive (MSD 2017). Since 1997, an average of 3.9 million kg of fish has been harvested annually by the commercial fishery in the north basin of Lake Winnipeg (Appendix 7A, Table 7.2A-14). Walleye and sauger have comprised almost 60% of the harvest, while lake whitefish have comprised most of the remaining 40%. After 15 years of walleye and sauger harvests totaling over 2 million kg annually, harvests have decreased over the last three years to approximately 1.55 million kg in 2017. Concurrently, lake whitefish harvests have increased from an average of 1.22 million kg annually from 2000-2014 to 1.98 million kg annually from 2015-2017. Lake whitefish roe is sometimes sold as part of the fall fishery. Suckers, northern pike, and eight other species combined currently comprise less than 8% of the harvest.

Sturgeon Bay supports a commercial fishery primarily conducted by fishers from the community of Dauphin River. Average annual production at Dauphin River from 1997 to 2017 was 462,508 kg (Appendix 7A, Table 7.2A-15); this statistic includes the reduced fishing effort and harvest in 2012 when only 20,027 kg of fish were harvested due to a partial fishing closure. Unlike the rest of the north basin where walleye and sauger dominate the fishery, lake whitefish is half of the catch at Dauphin River. The relative importance of lake whitefish has grown recently as walleye and sauger catches have declined over the past five years (2013-2017). After a declining trend from 2012-2014, lake whitefish harvests have averaged 267,000 kg over the past three years, which approximates the long-term average from 1997-2010 of 271,000 kg (Appendix 7A, Table 7.2A-15).

Historically, the recreational fishery of Lake Winnipeg was focused around tributaries and resort towns. With the increase in walleye stocks in the lake over the last 20 years, the fishery has expanded throughout the south basin and is particularly popular in winter. Recreational fishing also occurs on Mantagao River, Sturgeon Bay, and in Sturgeon Bay tributaries to the north of the Dauphin River (Pollard 1975). A bait fishery is also prominent on the lake.

Aquatic Invasive Species

Based on a list generated by the Invasive Species Council of Manitoba, (https://invasivespeciesmanitoba.com/site - accessed March 27, 2019) there are 15 aquatic invasive species (AIS) with direct routes of dispersal to potentially colonize the LAA and RAA. These include eight species of plants (curly leaf pondweed, Eurasian water milfoil, salt cedar, yellow flag iris, flowering rush, Himalayan balsam, invasive phragmites, and purple loosestrife), three species of invertebrates (spiny water flea, zebra mussel, rusty crayfish), and four species of fish (common carp, rainbow smelt, mosquito fish, round goby).

The preferred habitats, Manitoba distribution, and primary modes of dispersal for each AIS of concern are provided in Appendix 7A, Table 7.2A-16. There are other aquatic invasive species that occur outside of Manitoba, but within North America, that pose an ongoing threat to the province if inadvertently introduced (e.g., Asian carp). However, these species are not listed here for brevity and because they are unlikely to colonize the LAA or RAA in the reasonably foreseeable future.

Aquatic Species at Risk

There are seven aquatic species at risk that have a potential to occur within the LAA or RAA that have been identified by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), or are currently listed on one of the three schedules of the *SARA* (Appendix 7A, Table 7.2A-17): mapleleaf mussel (*Quadrula quadrula*), lake sturgeon (*Acipenser fluvescens*), bigmouth buffalo (*Ictiobus cyprinellus*), silver chub (*Macrhybopsis storeriana*), bigmouth shiner (*Notropis dorsalis*), chestnut lamprey (*Ichthyomyzon castaneus*), and shortjaw cisco (*Coregonus zenithicus*).

Mapleleaf mussel is the only species in the RAA listed on Schedule 1 of SARA. While there are historical records of mapleleaf mussel occurring as far north as the mouth of Dauphin River, there are no records of mapleleaf mussel occurring within the LAA or the west side of Lake Winnipeg since 1992 (COSEWIC 2016). This includes an absence of mapleleaf mussel from macroinvertebrate samples collected in Sturgeon Bay and Lake St. Martin during monitoring of the EOC conducted since 2011. However, mapleleaf mussel have been recorded from most major tributaries on the east side of Lake Winnipeg as far north as Berens River (COSEWIC 2016; North/South Consultants 2015).

Mapleleaf mussel occur in medium to large rivers with slow to moderate current with firmly packed coarse gravel and sand to firmly packed clay/mud bottom substrates and lakes and reservoirs with mud, sand, or gravel bottoms. This type of habitat does not generally exist in Dauphin River, where substrates are generally hard or composed of non-compacted sand, or in Sturgeon Bay where substrates are generally composed of non-compacted sand in water depths that would make them highly susceptible to ice scour.

Mapleleaf mussel larvae are parasitic on channel catfish and their absence in the Sturgeon Bay area may also be attributable to low densities of the host species. Although not particularly susceptible to gillnets, no channel catfish have been captured in Sturgeon Bay by the provincial Coordinated Aquatic Monitoring Program (CAMP 2017) and only one channel catfish has been recorded from the Dauphin River/Lake St. Martin/Fairford River system (Derksen 1988) in the last 32 years.

Lake sturgeon are a bottom-dwelling fish found in large rivers and lakes, at depths generally over 5 m. Spawning occurs in the spring in fast-flowing water at depths between 0.6 m and 5 m over hard-pan clay, sand, gravel or boulders. Historically, lake sturgeon did not occur within the Lake Manitoba system. However, a recent capture of a juvenile sturgeon in Lake Manitoba in 2015 likely gained access through the Portage Diversion and originated from fish stocked into the Assiniboine River. There have been anecdotal reports of lake sturgeon captured in Lake St. Martin but there are no official records of the species occurring within the Dauphin River/Lake St. Martin system.

Lake sturgeon were historically abundant in Lake Winnipeg. However, the species was severely reduced by the commercial fishery in the late 1800s and have not recovered. Lake sturgeon are still captured occasionally within Sturgeon Bay, although rarely, but are more commonly found near the mouth of the Winnipeg River and tributaries on the east side of the lake.

Although both the above species were historically found within the LAA, there are no recent records of mapleleaf in the LAA and natural occurrences of Lake Sturgeon are rare and transient and restricted to Sturgeon Bay. Consequently, neither species have been assessed further.

No other aquatic species at risk have been found to occur within the LAA to date. Bigmouth buffalo, silver chub, bigmouth shiner, and chestnut lamprey occur in the Red and Assiniboine river systems and south basin of Lake Winnipeg but not in Lake Manitoba, Lake St. Martin, or Sturgeon Bay. Shortjaw cisco are restricted to deep areas (usually greater than 50 m) of larger lakes and, therefore, are likely restricted to the pelagic areas of the north basin of Lake Winnipeg and the narrows separating the north and south basins.

A list of habitat preferences and nearest known occurrence of each the species at risk identified is provided in Appendix 7A, Table 7.2A-17.

7.2.3 Project Interactions with Fish and Fish Habitat

Table 7.2-5 identifies for each potential effect, the Project components and physical activities that have the potential to affect fish and fish habitat during construction and dry operation of the LMOC and LSMOC. These interactions are identified by check marks and are discussed in detail in Section 7.2.4 in the context of effects pathways, standard and Project-specific mitigation and residual effects. A justification for no effect is provided following the table.

Table 7.2-5 Potential Project Interactions with Fish and Fish Habitat During Construction and Operations

Project Components and Physical Activities	Environmental Effects		
	Permanent alteration or destruction of fish habitat	Change in fish passage	Change in fish health or mortality
Construction			
Site preparation of Project components[1] (development of the PDA prior to construction activities [e.g., removal of existing infrastructure, vegetation clearing and initial earthworks, development of temporary construction camp and staging areas])	-	-	
Project-related transportation within the LAA (movement of trucks, equipment, bulk materials, supplies, and personnel within the LAA)	-	-	
Construction of Project components[1] (physical construction of utilities, infrastructure, and other facilities)			
Quarry development (blasting and aggregate extraction used for the construction of Project components[1])	-	-	
Water development and control (dewatering and realignment of existing water works)		-	
Reclamation	-	-	
Operations			
Operation and maintenance of the outlet channels (normal operational conditions when the outlet channels and associated infrastructure [e.g., water control structures] are either actively conveying water or are non-operational)			
Operation and maintenance of other Project components[1] ((normal operations conditions associated with PR 239 and municipal road realignments, distribution line and bridges and culverts)	-	-	
Project-related transportation within the LAA	-	-	

Project Components and Physical Activities	Environmental Effects		
	Permanent alteration or destruction of fish habitat	Change in fish passage	Change in fish health or mortality
(movement of trucks, equipment, bulk materials, supplies, and personnel within the LAA)			
Operation, maintenance, and reclamation of quarries	-	-	-

Notes:
indicates a potential interaction.
– indicates no potential interactions are expected.
[1] components include: outlet channels, water control structures, distribution line, bridges and culverts, PR 239 and municipal road realignments, temporary construction camps and staging areas, and quarries.

Potential changes in fish health or mortality largely occur due to the potential release of fine sediments during construction and operation of the outlet channels, an effect that may occur during almost every activity. Other potential sources of fish mortality are stranding of fish in the channels after their use, accidental release of hydrocarbons from heavy machinery, and increased angling due to the presence of the construction workforce and any new access to previously inaccessible lakes or streams.

Potential changes in fish passage occur during construction of the outlet channels, when existing streams and drains are diverted or dewatered; during operation (WCS gates open) of the outlet channels and lake discharge is shared by the Project and Fairford River and Dauphin River; and during maintenance of the bridges and culverts along the highways and roads crossing the channels. Changes in fish passage from drainage realignment (i.e., non-channel culvert and ditch crossings) are addressed on a site-specific design basis that employs typical standard mitigations as managed by DFO’s existing review and approval process.

Potential permanent alteration or destruction of fish habitat may occur during construction when excavation of the inlet and outlets will occur in Watchorn Bay, Lake St. Martin, and Sturgeon Bay and when excavation of the channels themselves will require diversion, dewatering, or filling in of existing creeks or drains and may cause a change in groundwater/surface water interactions in lakes and streams along or adjacent to the channels. In contrast, construction of the channels will create new fish habitat during operations, a potential benefit to fisheries in the LAA.

7.2.4 Assessment of Residual Environmental Effects on Fish and Fish Habitat

7.2.4.1 Analytical Assessment Techniques

Potential effects of the Project on fish and fish habitat were assessed qualitatively and quantitatively, where possible. Qualitative assessments were conducted using a weight of evidence approach. This entailed using professional judgement based on an understanding of the potential effect, the habitat use and life history of the focal fish species, and the likely effectiveness of mitigation measures, supported by scientific literature, secondary literature, industry best management practices and regulatory guidelines, as available. Avoidance and mitigation measures included those identified in DFO's "Measures to avoid causing harm to fish and fish habitat" https://www.dfo-mpo.gc.ca/pnw-ppe/measures-mesures/measures-mesures-eng.html, accessed June 22, 2019) and Project-specific mitigation measures included in the Project Environmental Requirements (PERs). Quantitative assessments were conducted whenever model predictions (e.g., lake levels and stream flows), guidelines (e.g., Canadian Water Quality Guidelines for the Protection of Aquatic Life), and geographic information system (GIS) calculations of potentially affected habitat areas where available.

Measures that avoid permanent alteration or destruction of fish habitat, changes in fish passage, or changes in fish health and mortality are those that eliminate a potential linkage between the Project component or activities and fish and fish habitat. Such measures effectively relocate Project components or activities away from fish and fish habitat or by rescheduling Project activities to occur when fish are not present. No residual effect remains for those potential effects where avoidance measures will be used during design, construction, or operation of the Project and these potential effects are not further assessed.

Measures that mitigate potential permanent alteration or destruction of fish habitat are those that limit, but do not eliminate, the potential effect. As a result, a potential residual effect remains. However, pathways of effects that are likely to result in residual effects on fish or fish habitat may not cause significant adverse effects. That depends on the sensitivity of individual fish and the resiliency of the affected fish populations to the effect, and the importance of the affected fish habitat to the sustainability of commercial, recreational, or Aboriginal fisheries in the RAA.

Only the potential effects for which mitigation is determined to have a low or medium likelihood of effectiveness are further assessed; potential effects for which mitigation measures are determined to have a high likelihood of effectiveness are not further assessed because the risk to fish habitat is considered to be low.

7.2.4.2 Permanent Alteration or Destruction of Fish Habitat

Project Pathways

Fish habitat may be permanently altered or destroyed during construction and operation of the LMOC and LSMOC. During construction, fish habitat may be affected by construction of the channels and water control structures and by dewatering or realigning existing drains and creeks. During operations, fish habitat may be affected when the water control structures are open and when they are closed. The following pathways of effects on fish habitat may result from construction and operation of the LMOC and LSMOC:

- change in habitat in Watchorn Bay, Birch Bay, Lake St. Martin, and Sturgeon Bay due to excavation of bottom substrates

- change in groundwater inflows to lakes and streams along or adjacent to the channels
- introduction of aquatic invasive species
- change in habitat due to realignment, isolation, or dewatering of drains and headwater streams
- change in habitat due to movement and deposition of sediment
- change in riparian area inundation along lake and river shorelines
- change in flow patterns in rivers and channel inlets and outlets

Descriptions of each of these potential pathways of effects, prior to mitigation, are provided below.

Change in Habitat in Watchorn Bay, Birch Bay, Lake St. Martin, and Sturgeon Bay due to Excavation of Bottom Substrates

Construction of the LMOC and LSMOC will require excavation of substrates in Watchorn Bay, Birch Bay, Lake St. Martin, and Sturgeon Bay to construct the channel inlets and outlets. Final decisions about what type of machinery is used and whether the excavations will be conducted in-the-wet or in-the-dry has not been made. Regardless of method, spoil material will be transported to inland locations away from shore. Fisher River First Nation raised the issue that Project construction and infrastructure could affect fish habitat (see Section 7.2.2).

Rock-filled jetties and cofferdams may be built around the excavation areas to protect the work areas from excessive sedimentation and to allow the excavations to be conducted in-the-dry. Alternatively, temporary groins may be built using rock-fill and/or spoil from the excavation to provide the machinery with access to the excavation area if work is to be conducted “in-the-wet”.

Excavations will flare out over short distances (less than 500 m) from the shoreline to meet natural lake-bed elevations at all four locations. Based on preliminary design, the total estimated areas of fish habitat to be permanently altered or destroyed by the excavations are:

- LMOC inlet in Watchorn Bay is estimated to be 377,515 m^2
- LMOC outlet in Birch Bay is estimated to be 433,887 m^2
- LSMOC inlet in Lake St. Martin is estimated to be 521,217 m^2
- LSMOC outlet in Sturgeon Bay is estimated to be 434,195 m^2

Additional fish habitat may be temporarily disturbed at each location if jetties and cofferdams are required. While the need for these structures and their dimensions are currently unknown, the increase in disturbed habitat area will be less than 10% of excavation areas at each location and that the habitat would be restored within two months to two years once the jetties and cofferdams are removed. Because of their relatively small dimensions, the jetties and coffer dams would affect similar habitats as those that will be affected by the excavations.

Existing fish habitat within the proposed LMOC inlet area in Watchorn Bay is largely sand and gravel substrates at depths greater than 0.5 m (Appendix 7B, Figure 7.2B-4) with little aquatic vegetation (AAE Tech Services 2016). Overall, habitat in the excavation area is not diverse (Appendix 7C, Photos 7.2C-1 and 7.2C-2) and wave action and sediment movement in the bay likely makes the area sub-optimal as spawning habitat for most large-bodied species in Lake Manitoba (Forester Enterprises et al. 2017).

Existing fish habitat within the proposed excavation area in Birch Bay at the outlet of the LMOC is primarily gravel and sand substrates (Appendix 7B, Figure 7.2B-6), with abundant aquatic vegetation at depths less than 2.0 m (AAE Tech Services 2016). This habitat likely provides spawning habitat for northern pike and rearing habitat for juvenile walleye, pike, and forage fish species (Appendix 7C, Photos 7.2C-3 to 7.2C-4).

Existing fish habitat within the proposed LSMOC inlet area in the northeastern basin of Lake St. Martin is largely gravel and cobbles with interspersed boulders (Appendix 7B, Figure 7.2B-6; Appendix 7C, Photos 7.2C-5, 7.2C-6, 7.2C-7, 7.2C-8). Aquatic vegetation is sparse in the area due to the paucity of fine substrates. This area is likely suboptimal for northern pike spawning but may be utilized to a very limited degree by lake whitefish for spawning and by walleye for rearing (shallow depths preclude use by large-bodied species).

Existing fish habitat with the proposed LSMOC outlet area in Sturgeon Bay is sand and silt nearest the shoreline, graduating to sand and gravel further offshore (Appendix 7B, Figure 7.2B-7; Appendix 7C, Photos 7.2C-9 and 7.2C-10). There is no aquatic vegetation within the proposed excavation area. Sediments within this area are highly mobile and turbidity in Sturgeon Bay is high due to wave action created by the shallow local bathymetry and exposure to northeast winds. This makes this area sub-optimal for spawning by most large-bodied fish species, although local knowledge (commercial fishers) suggests that lake whitefish spawn in offshore areas of Sturgeon Bay. This area of Sturgeon Bay is likely used by walleye for rearing. Juvenile lake whitefish occupy deeper offshore waters while northern pike typically rear near aquatic vegetation which is not present within the proposed excavation area.

Change in Groundwater Inflows to Lakes and Streams Along or Adjacent to the Channels

The LMOC will be constructed entirely in till deposits. While this will likely limit effects on groundwater inputs to surface waterbodies and watercourses (see Chapter 6, Section 6.4.4.3), there is potential for groundwater discharges into the channel during excavation. Although it is unlikely that there is a connection between the confined carbonate aquifer and the lakes (i.e., Reed Lake, Clear Lake, Water Lake, Goodison Lake), wetlands, and drains to the east of the channel, over time, groundwater may seep upwards, providing an artesian discharge to these waterbodies. This seepage could be affected during construction dewatering (see Chapter 6, Section 6.4.4.3).

In addition to possibly reducing lake areas and stream flows to some limited extent, any reduction in groundwater input to the lakes, wetlands, and drains to the east of the LMOC could increase summer water temperatures and reduce dissolved oxygen concentrations for fish. These lakes, wetlands, and drains provide habitat primarily for forage fish, but in years of high water, may also be used by northern pike and yellow perch.

Construction of the LMOC may affect local groundwater pressures under Lake Manitoba and Lake St. Martin within 3 km to 5 km of the LMOC inlet or outlet (see Chapter 6, Section 6.4.4.2). Currently, groundwater in this carbonate aquifer near the proposed LMOC radiates out from an uplands area to the east of Lake St. Martin with flow paths toward Watchorn Bay and Birch Bay (Chapter 6, Appendix 6B, Figure 6.4B-3). Any pressure reduction in the confined carbonate aquifer would be expected to continue after construction but be smaller than during construction and limited to less than 200 m from the channel. The most likely area for this type of passive, long-term depressurization is in the north section of the LMOC, downstream of the water control structure near Birch Bay. This is because water levels in the LMOC will be at the same elevation as Lake St. Martin and, therefore, lower than upstream of the water control structure which will be at the same elevation as Lake Manitoba. Therefore, while the potential exists that local groundwater inflows to Watchorn Bay and Birch Bay may be affected by construction of the LMOC, no change in regional groundwater inflows to Lake Manitoba, Lake St. Martin, or Lake Winnipeg is expected to occur (see Chapter 6, Section 6.4.4.2).

Maintenance of groundwater inflows to Lake St. Martin during construction of the channels is potentially important to the sustainability of the lake whitefish population using Lake St. Martin for spawning. While the size of this spawning run has not been determined, fall migrations of lake whitefish up Dauphin River into Lake St. Martin are known to be one of the largest in Lake Winnipeg. Therefore, spawning habitat in Lake St. Martin is likely critical to the annual production of lake whitefish population(s) in the northern basin of Lake Winnipeg; these populations of lake whitefish are highly valued by commercial, recreational, and Aboriginal fisheries.

Little is known about the importance of groundwater for lake whitefish spawning site selection and egg survival. For example, in a study conducted in the Experimental Lakes Area (ELA) in northern Ontario, Begout-Anras et al (1999) determined that lake whitefish selected shallow, nearshore habitats with specific substrate and slope characteristics, but did not note groundwater upwelling at selected spawning sites. However, other salmonid species, such as brook trout and Arctic char, require groundwater for spawning. This suggests that regional groundwater inflows to Lake St. Martin could be a reason why Lake St. Martin is such an important spawning area for lake whitefish. A precautionary approach has been taken in this assessment by assessing the potential effects on lake whitefish spawning in Lake St. Martin as a result of groundwater effects. Monitoring will be conducted during operation of the LMOC and LSMOC to determine the validity of this potential pathway to lake whitefish spawning habitat in Lake St. Martin.

Natural surface and shallow,
length of the LSMOC. However, due to the complexity of the system, the nature of the effect on groundwater is uncertain. Should reductions in groundwater inputs to the bog complex occur, it may affect

overwintering habitat for juvenile and forage fish. Lake whitefish do not naturally spawn in the Buffalo Lake bog complex. However, lake whitefish spawning was documented during operation of the EOC when flows in Buffalo Creek were higher.

Introduction of Aquatic Invasive Species

Aquatic invasive species of immediate risk to fish and fish habitat in the LAA are discussed in Section 7.2.2.2. The Project may facilitate the spread of AIS by:

- construction of additional, and potentially easier, connections between Lake Manitoba and Lake St. Martin and between Lake St. Martin and Lake Winnipeg than the existing Fairford and Dauphin rivers
- attachment to and transfer from movement of heavy machinery between waterbodies
- transfer in bait buckets, live wells, and on fish catches due to the presence of additional recreational anglers in the workforce required to build the channels and from improved access to previously inaccessible waterbodies

The effect of individual AIS species on fish and fish habitat in the LAA depends on their unique life history, habitat requirements, and reproductive rates. Generally, AIS species are successful because they are better able to exploit available habitats and resources than native species. This is typically due to their broader habitat requirements and higher reproductive rates. As a result, they eventually out-compete native species for space and food and, in extreme cases, can extirpate native species from their overlapping ranges. This in turn can affect the physical habitat available to fish (e.g., zebra mussels covering hard substrates used by fish for spawning) and alter the food web upon which fish depend for growth and survival (e.g., spiny water flea replacing native *Daphnia* as the dominant zooplankton species; spiny water flea are too long to be eaten by some larval fish).

Spiny water flea and zebra mussel were identified in Sturgeon Bay for the first-time during fall sampling in 2018. While these species generally do not disperse in an upstream direction by themselves, movement of water or vehicles from Sturgeon Bay into Lake St. Martin and Lake Manitoba during the Project poses a risk for expanding the distribution of these species, with potential adverse implications for fish habitat, and the fish species that use this habitat, in Lake St. Martin and Lake Manitoba. Of importance, is the potential effect that zebra mussels could have on the availability and quality of spawning habitat for walleye and lake whitefish in Lake St. Martin.

Rainbow smelt (*Osmerus mordax*) are the only other AIS that pose an immediate threat of increasing their distribution due to the Project. Rainbow smelt are currently found in Lake Winnipeg but have not been reported in Lake St. Martin or Lake Manitoba. Therefore, rainbow smelt could become established in Lake St. Martin and Lake Manitoba more readily if the LMOC and LSMOC provide improved hydraulic conditions (i.e., greater water depths, lower water velocities) for their upstream dispersal compared to the existing conditions in the Fairford (including Denil fishway at the FRWCS) and Dauphin rivers.

Potential linkages between Project related increases in AIS and effects on Aquatic Species at Risk (ASR) are weak. While there are seven Aquatic Species at Risk (ASR) that may occur in the Local Assessment Area (LAA) that have been identified by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) or are currently listed on one of the three schedules of the Species at Risk Act (SARA) (Appendix 7A ,Table 7.2A-17), only one (the Lake Sturgeon) is currently known to occur in the LAA. The risk of increasing the spread of AIS to ASR is generally in relation to potential introductions to Lake St. Martin where no ASR are known to occur. In addition, the majority of ASR that may occur in the LAA already occur with the AIS of primary concern (i.e., zebra mussels, spiny water flea) in Lake Winnipeg.

Change in Habitat due to Realignment, Isolation, or Dewatering of Drains and Headwater Streams

Construction of the LMOC will isolate approximately 27% of the Birch Creek watershed and 4% of the Watchorn Creek watershed on the west side of the channel (see Chapter 6, Section 6.4.7.4). Drains flowing in an easterly direction in this area eventually will be re-routed to the channel or an adjacent drain and into Lake St. Martin and Lake Manitoba. Fish habitat in these drains is marginal for large-bodied focal species due to shallow depths (less than 0.5 m), intermittent flow, muddy bottom, and lack of diversity. Use by forage species would be intermittent and depend on seasonal flows. However, runoff from these drains currently discharges to Birch Creek and Watchorn Creek, which are known to be used by white sucker and walleye for spawning in spring.

Construction of the LSMOC will redirect headwater streams in the Buffalo Creek watershed into or along the channel and affect the natural hydrology within the Big Buffalo Lake bog complex. A culvert and gate system will be constructed on Creek C approximately 1 km upstream of its confluence with Buffalo Creek and similar culvert and gate systems will be constructed on two unnamed headwater tributaries of Buffalo Creek with confluences just downstream of Big Buffalo Lake. These culvert and gate systems will allow runoff from the southeast side of the LSMOC into the channel, while minimizing backwater from the channel into the adjacent land during periods of operation. The design criteria for the culverts will be to pass 1:10 year runoff events with flows exceeding these design criteria flowing over the channel dike through rock-lined overflows. In general, surface runoff from these tributaries will flow naturally above and/or through the peat until the discharge point at the drainage control structure.

Operation of the LSMOC and these water management structures will result in a reduction of inflow to Big Buffalo Lake and Buffalo Creek. Reduced water levels and inflows may affect the ability of habitat within these waterbodies to produce fish by reducing flooded littoral areas in Buffalo Lake and wetted widths, depths and water velocities in Buffalo Creek used by yellow perch, northern pike, and forage fish, such as shiners and dace, for spawning in spring. These reductions in habitat availability and suitability may result in reduced spawning success and annual recruitment of local yellow perch, northern pike, sucker, and forage species populations in the Big Buffalo Lake system.

Construction of the culvert and gate system on Creek C and the two unnamed tributaries will isolate upstream habitat from fish in Buffalo Creek. In Creek C, isolation of habitat upstream of the culvert will result in loss of rearing habitat for northern pike. However, this is not expected to result in a measurable effect on the northern pike population due to the abundance of northern pike rearing habitat in the Buffalo Creek watershed. No effect on forage fish species will occur because it is expected that forage fish species, such as brook stickleback will continue to be able to conduct all their life history requirements in the isolated habitat. These potential effects on Creek C are not further assessed for these reasons, but effects on other identified waterbodies are assessed.

Change in Habitat due to Movement and Deposition of Sediment

Excavation of the channel inlets and outlets, along with the potential installation and removal of rock jetties and cofferdams, are the principle means by which sediments may be mobilized, introduced and/or deposited in fish habitats in Lake Manitoba, Lake St. Martin and Lake Winnipeg during construction. Additional pathways by which sediment may be introduced to waterbodies during construction of the channels include activities associated with redirection of drains intersected by the LMOC and LSMOC, groundwater discharges into the channels that are pumped to surface waters, and runoff from spoil piles adjacent to the channels.

Sediment will be mobilized and deposited in Birch Bay in Lake St. Martin and in Sturgeon Bay in Lake Winnipeg during initial operation of the channels. The channel bottoms will not be armoured with rip-rap, and although compacted during construction, some finer substrates in the channel bottoms will be scoured and entrained in the outflow. Additional scour of sediments will also occur within the inlet and outlet areas during operations. Sediments deposited during construction (i.e., during cofferdam installation and removal) are expected to be particularly vulnerable to movement at this time.

The amount of sediment mobilized from the channels and deposited in Birch Bay and Sturgeon Bay is expected to decrease over time as the amount of fine, erodible substrates diminishes with each successive use of the channels. However, sediment erosion and deposition will never completely stop when the channels are in use and spikes in suspended and deposited sediment are expected whenever a high flood event occurs, and the channels are conveying water at maximum capacity.

Any increase in the amount of fine sediment deposited in Watchorn Bay, Birch Bay, the northeast basin of Lake St. Martin, and Sturgeon Bay during construction of the inlets and outlets of the LMOC and LSMOC or in Birch Bay and Sturgeon Bay during operation of the LMOC and LSMOC has the potential to decrease the suitability of habitat in these waterbodies for fish. This includes potentially decreasing the suitability of nearshore habitats with gravel and cobble substrates used by walleye and lake whitefish for spawning in Watchorn Bay, Birch Bay and the northeast basin of Lake St. Martin. It also includes the potential to decrease benthic invertebrate production in these same areas. This can occur if sediment deposition over hard substrates is sufficient to reduce production of periphyton (i.e., attached algae) that is food for many benthic invertebrate species. This in turn can affect prey availability for forage fish and benthivores such as suckers and lake whitefish.

Change in Riparian Area Inundation Along Lake and River Shorelines

Riparian areas that are flooded during extreme high-water events are generally not considered important to fish in terms of providing direct habitat, due to the very infrequent occurrence of these events.

However, inputs from riparian areas that are flooded do contribute to fish productivity by providing a source of nutrients and supplementary food items (i.e., terrestrial insects and detritus) to the adjacent waterbodies.

Operation of the LMOC will decrease the flooded riparian areas on Lake Manitoba and along Fairford River during periods of high water. For example, the decrease in peak water level on Lake Manitoba with operation of the LMOC during the 2011 flood would have been 0.46 m (Manitoba Infrastructure 2019b). This would have resulted in a decrease in flooded riparian area of 754.1 km^2 surrounding Lake Manitoba during the flood. In addition, once built, use of the LMOC will decrease, by 5.6%, the duration that water levels in Lake Manitoba exceed the desired maximum elevation of 247.65 m asl. Operation of the LMOC will also slightly increase, by 1.5%, the amount of time that the lake is below the desired minimum elevation of 247.05 m asl.

Operation of the LSMOC, in tandem with the LMOC, will reduce peak flood levels and reduce the duration of riparian area inundation around Lake St. Martin (see Chapter 6, Section 6.4.7.2). For example, the decrease in peak water level on Lake St. Martin with operation of the LSMOC and LMOC during the 2011 flood event would have been approximately 0.76 m (Manitoba Infrastructure 2019b), which would have resulted in a decrease in flooded riparian area of 27.5 km^2. In a smaller flood year, the average decrease in water level in Lake St. Martin is predicted to be 0.52 m, a decrease in flooded area of 21.4 km^2. Operation of the channels is also predicted to decrease, by 19.2%, the duration that Lake St. Martin is above the desired operation range of between 242.93 m asl and 243.84 m asl while also increasing, by 1.3%, the amount of time the lake is below 242.93 m (Manitoba Infrastructure 2019b).

Operation of the LMOC and LSMOC is expected to have a negligible effect on Lake Winnipeg water levels. As noted in Chapter 6, Manitoba Hydro completed an analysis of the differences in water levels on Lake Winnipeg and waterways downstream of Lake Winnipeg in relation to the changes in flows due to the Project and concluded that any potential changes in water levels are not expected to be discernible in the context of existing water level variations. Details of the analysis are provided in Section 6, Appendix 6I (Manitoba Hydro 2019). As such, there is no pathway of effects on surface water hydrology and ultimately to fish and fish habitat in the north basin of Lake Winnipeg and Nelson River.

For these reasons, potential effects of operation of the LMOC and LSMOC on inundation of riparian areas and fish habitat in the north basin of Lake Winnipeg are not assessed further, but effects on other identified waterbodies are assessed.

Change in Flow Patterns in Rivers and Channel Inlets and Outlets

Diversion of flows down the LMOC and LSMOC during high flood events will change flow patterns within the LAA. This will include movement of water between Watchorn Bay in Lake Manitoba and Birch Bay in Lake St. Martin and between the northeast basin of Lake St. Martin and Sturgeon Bay in Lake Winnipeg, where such movements did not previously exist. These diversions will transfer water that would otherwise be conveyed between the lakes by the Fairford and Dauphin rivers.

These diversions have the potential to decrease discharges in the rivers (see Chapter 6, Section 6.4.7.2), with subsequent changes in their hydraulic conditions (i.e., widths, depths, and water velocities). Both rivers are known to be used as migratory routes by focal fish species in the LAA and, in the case of Dauphin River, are known to be used by walleye, northern pike, and potentially lake whitefish, for spawning. Therefore, the potential exists that diversion of water from the rivers to the channels during high flood events may reduce the availability and suitability of the rivers as migratory corridors and spawning areas for focal fish species.

Operation of the LMOC and LSMOC will also alter localized flow patterns near the inlets and outlets of the channels in Watchorn Bay, Birch Bay, the northeastern basin of Lake St. Martin, and Sturgeon Bay. This will cause previously lacustrine habitats (i.e., only wind-generated currents) at the inlets and outlets to be transformed into more riverine habitats (i.e., gravity-generated currents). While it is currently unknown how large the potentially affected areas at the inlets and outlets will be, this change in local hydraulics at the inlet and outlet locations may affect the availability and suitability of habitat in these locations for spawning, rearing, foraging, or overwintering of focal fish species.

Mitigation

Manitoba Infrastructure has incorporated avoidance and mitigation measures to eliminate or reduce potential permanent alteration or destruction of fish habitat during construction and operation of the LMOC and LSMOC. These measures, and their likely effectiveness, are summarized in Table 7.2-6. The mitigation measures presented are not intended to replace future requirements for Authorization under Paragraph 35(2) (b) of the Fisheries Act. Requirements for future Authorizations will be addressed separately from the environmental assessment process.

The Project inherently mitigates effects on fish habitat by creating new fish habitat in the LMOC and LSMOC. When completed, the LMOC will be 24.1 km long, and have a trapezoid cross-section with a base width of 8 m to 13 m, and 5H:1V to 6H:1V side-slopes (see Figure 3B-5 in Chapter 3, Appendix B) Water depths in the channel will range between 5 m and 8 m upstream of the control structure and 4 m to 5 m downstream of the control structure. The wetted width of the channel will vary between 30 m and 60 m (see Chapter 6, Section 6.4.7.4). Water levels in the channel upstream of the control structure will be the same as water levels in Lake Manitoba and water levels downstream of the control structure will be the same as water levels in Lake St. Martin. Substrate composition in the LMOC will be primarily till. Over time, aquatic vegetation may become established along the margins of the channel. Otherwise, the channel will provide relatively homogenous, low diversity habitat for fish.

When completed, the LSMOC will be 23 km long and have a trapezoidal cross-section with a base width of 44 m and 4H:1V side slopes. The channel will have an average slope of approximately 0.12%. However, steeper gradients will occur locally. To limit water velocities at these locations, the LSMOC will have 12 drop structures constructed of rockfill with a sheet pile cut-off at the upstream crest. Pool depths upstream of the drop structures will be sufficient to maintain a wetted channel upstream to the next drop structure. Together with the channel geometry and drop structures, baseflows in the LSMOC will limit variations in water levels in the LSMOC when not in use and allow a stationary, lake-type ice cover to form on the channel without freezing to the bottom. Groundwater seepage is also expected to augment these baseflows along the channel length. Substrates in the channel will be primarily till.

The LMOC and LSMOC will provide at least 172 ha of new fish habitat when completed and filled with water; approximately 72 ha in the LMOC (based on a length of 24 km and a width of 30 m) and approximately 100 ha in the LSMOC (based on a length of 23 km and a base of 44 m). When the water control structures are closed, there will be no flow in the LMOC channel. A small baseflow in the LSMOC will maintain some low velocity flow in the LSMOC when the when the WCS gates are closed and the channel is not being used to mitigate lake levels. When the WCS gates are open, habitat areas in the channels will increase and flow conditions will be much more riverine compared to when the water control structures are closed. For example, average water velocities in the LMOC are expected to be approximately 1.3 m/s at maximum capacity, while average water velocities in the LSMOC are expected to approach 1.2 m/s at maximum capacity with velocities up to 4 m/s at the drop structures (KGS Group 2017a).

A variety of fish species are expected to use the habitat provided by the channels year-round. This may include spawning, rearing, and overwintering for forage fish and for large-bodied fish such as walleye, suckers, northern pike, and lake whitefish. When control structures are open, flow conditions below the water control structure in the LMOC and below the downstream-most drop structure in the LSMOC are expected to be fast (greater than 1 m/s) and turbulent and this may provide conditions suitable for spawning, particularly for walleye. During periods when gates are closed, both channels are likely to support large numbers of forage fish as well as YOY and juveniles of many large-bodied fish species in the LAA. Adult northern pike are also likely to reside in the channels year-round.

Fish in the LMOC will be have unrestricted access to Lake Manitoba or Lake St. Martin year-round. This is because water levels upstream and downstream of the water control structure will be the same as the water levels in the lakes. In contrast, fish will only be able to move downstream in the LSMOC. This is because fish will not be able to ascend the channel from Sturgeon Bay due to the hydraulic jump and high water velocities at the downstream-most drop structure when the water control structure gates are open and because of the height of the vertical drop at the downstream-most drop structure when the water control structure gates are closed.

Table 7.2-6 Measures to Avoid or Mitigate Potential Permanent Alteration or Destruction of Fish Habitat

Potential Effect	Avoidance or Mitigation Measure	Likely Effectiveness of Avoidance or Mitigation Measure
Change in habitat in Watchorn Bay, Birch Bay, the north basin of Lake St. Martin, and Sturgeon Bay due to excavation of bottom substrates	• Limiting excavations to the minimum areas required to efficiently convey water into and out of the channels • Construction of outlet channels will fully, or partially offset habitat lost or altered by excavation of the inlets and outlets	Moderate: change in habitat within the excavation areas cannot be avoided but this alteration will be offset by habitat created in the channels, albeit different habitat than in the lakes within the excavation areas

Table 7.2-6 Measures to Avoid or Mitigate Potential Permanent Alteration or Destruction of Fish Habitat

Potential Effect	Avoidance or Mitigation Measure	Likely Effectiveness of Avoidance or Mitigation Measure
	• Follow DFO timing windows for instream work (https://www.dfo-mpo.gc.ca/pnw-ppe/timing-periodes/index-eng.htm)l	
Change in groundwater inflows to lakes and streams along or adjacent to the channels	• Selection of Route D for the LMOC reduces the risk of changing groundwater inflows compared to other assessed options because it maintains the hydraulic head above the channel invert elevation • Grout injection of the carbonate aquifer near the LSMOC to maintain artisanal groundwater pressures in the carbonate aquifer if deemed warranted during detailed design and further groundwater testing • Discharge groundwater from aquifer depressurization during construction of the LMOC to Birch Creek, Watchorn Creek, or to the lakes, wetlands, and drains to the east of the LMOC if required	Moderate: the proposed measures will reduce the potential magnitude of groundwater losses to the drains and lakes on the eastern side of the LMOC, but potential reductions in groundwater contributions to these waterbodies may still occur
Introduction of aquatic invasive species	• Comply with provincial AIS regulations • Implement Access Management Plan • Require all heavy machinery to be cleaned and decontaminated prior to arriving on site and before moving between work areas at different lakes and drainages	Moderate: taken together, the proposed measures are likely to reduce the potential introduction of AIS to Lake St. Martin and Lake Manitoba from Lake Winnipeg, but no mitigation measure can eliminate this risk
Change in habitat due to realignment, isolation, or dewatering of drains and headwater streams	• Selection of Route D (see Section 2.4.2.1) for the LMOC limits the number of watersheds affected and the % change in watershed areas affected in Birch and Watchorn creeks compared to the other route options assessed • Any temporary diversions shall be designed to provide fish passage, even during low flow conditions, constructed "in-the-dry", sized to accommodate the expected diversion flow from	Moderate: the proposed measures will reduce the amount of headwater drains and streams that are realigned, isolated, or dewatered by the Project but this effect is unavoidable given the nature of the Project

Table 7.2-6 Measures to Avoid or Mitigate Potential Permanent Alteration or Destruction of Fish Habitat

Potential Effect	Avoidance or Mitigation Measure	Likely Effectiveness of Avoidance or Mitigation Measure
	storm, run-off, or spring melt events, and routinely inspected to identify potential erosion sites (see PERs) • Incorporate habitat enhancements, where possible, including potential consideration of repurposing of the EOC to convey additional flow to the Big Buffalo Lake bog complex • Follow DFO timing windows for instream work	
Change in habitat due to movement and deposition of sediment	• Following mitigations outlined for erosion and sediment control in the PERs • Provide 100 m set-back from work areas and waterbodies or a buffer zone of undisturbed vegetation between the work area and waterbody of at least 10 m plus 1.5 times the slope gradient or 30 m, whichever is greater • Limit machine fording to one-time events, if necessary • Limit any instream work to low flow periods when waterbodies or watercourses are dry or frozen • Installing silt curtains around excavation areas • Conducting excavations within dewatering cofferdams so that excavations can be conducted “in-the-dry” • Transfer excavation spoil to upland areas away from streams and waterbodies • Follow DFO timing windows for instream work • Rip-rap sides of the channels where necessary and compact bottom sediments to the maximum extent possible • Vegetate channel slopes with native vegetation • Implement Sediment Management Plan	Moderate: Taken together, these mitigation measures will substantially reduce the amount of fine sediment mobilized, entrained, and deposited in fish-bearing waterbodies and watercourses. However, it is not possible to eliminate the potential release of sediment to the aquatic environment, particularly fine clay and silt, when working in and around water with heavy machinery and when installing structures in water such as cofferdams and jetties.

Table 7.2-6 Measures to Avoid or Mitigate Potential Permanent Alteration or Destruction of Fish Habitat

Potential Effect	Avoidance or Mitigation Measure	Likely Effectiveness of Avoidance or Mitigation Measure
	• Monitor water quality to manage construction activities in relation to TSS guidelines	
Change in riparian area inundation along lake and river shorelines	• Use LMOC and LSMOC only during high flood events • Maintain, as practical, lake levels within desired operating ranges	Low: The proposed measures are unlikely to reduce the change in riparian habitat inundation around Lake St. Martin given that the purpose of the Project is to reduce peak lake levels and the duration that upland areas are flooded in spring during high water events
Change in flow patterns in rivers and channel inlets and outlets	• Design and operate LMOC and LSMOC such that hydraulic conditions in Fairford River and Dauphin River during spring and fall spawning periods are suitable for upstream fish passage and walleye and lake whitefish spawning and egg incubation • Design channel inlets and outlets to limit sediment scour and entrainment of fish, eggs, and sediments in the outflow • Develop ramping rates for implementation during opening and closing WCS gates	Moderate: The LMOC and LSMOC will only be used during high flow events and, consequently, flows in Fairford and Dauphin rivers during spring and fall will remain relatively normal during these periods. However, given that the intent of the Project is to divert flows some effects on fish behaviour will be unavoidable. Operational procedures will mitigate any negative effects that may result from a modification in fish behavior associated with flow change

All seven potential effects on fish habitat identified are assessed. This is because there are no avoidance or mitigation measures available that would eliminate the effects or reduce the likelihood of the effect occurring such that the risk to fish habitat is reduced to a point where a residual effect would be unlikely to occur.

Project Residual Effects

Change in Habitat in Watchorn Bay, Birch Bay, Lake St. Martin, and Sturgeon Bay due to Excavation of Bottom Substrates

The habitats that will be made temporarily unavailable by the rock jetties and cofferdams and permanently altered by excavation of the inlets and outlets in Watchorn Bay, Birch Bay, the northeastern basin of Lake St. Martin and Sturgeon Bay are not unique and are abundant within each of the affected waterbodies. Therefore, fish will have access to similar habitat very close by or immediately adjacent to the affected habitats during construction of the channels.

Once construction is complete, rock jetty and cofferdam remnants are expected to diversify substrates and should have no permanent adverse effects on productivity of periphyton, benthic invertebrates, and fish populations in Lake Manitoba, Lake St. Martin, or Lake Winnipeg. Although there will be an initial loss of productive capacity until substrate conditions within the excavation areas and rock jetty and cofferdam footprints stabilize, it is expected that, over the long-term, the substrates in these areas will be just as productive as those existing before the Project.

Overall, habitat changes in Watchorn Bay, Birch Bay, Lake St. Martin, and Sturgeon Bay caused by excavation of bottom substrates at the inlets and outlets of the LMOC and LSMOC are not expected to have a measurable effect on the any of the focal fish populations in the LAA or RAA. This is because:

- None of the substrates or habitats at the location of the proposed channel inlets and outlets are unique and, instead, are widely distributed and abundant in Lake Manitoba, Lake St. Martin, and Lake Winnipeg; therefore, these types of substrates and habitats will continue to be used by focal fish species without a measurable change in productivity.
- The nearshore areas that will be disturbed by the excavations are a small fraction of the total nearshore areas of the lakes.
- Excavated habitat at the channel inlets and the outlets will be deeper than prior to excavation, providing greater cover for fish.
- Any temporary or permanent loss or alteration of habitat in the lakes will be more than offset by the permanent new habitat created by the channels.

For these reasons, the potential residual effect on fish habitat in Lake Manitoba, Lake St. Martin, and Lake Winnipeg is predicted to be negligible in magnitude and neutral in direction. The effect will occur through construction and operation, be long-term in duration, have high sensitivity, limited to the PDA, and be continuous and irreversible. The area where the effect will occur is currently undisturbed.

Change in Groundwater Inflows to Lakes and Streams Along or Adjacent to the Channels

Reductions in groundwater discharge to the lakes, wetlands, and drains to the east of the LMOC may reduce the suitability of these lakes for overwintering fish during the construction period. This effect may be at least partially mitigated by pumping or diverting any groundwater entering the channel into the lakes and wetlands or directly to Birch Creek or Watchorn Creek.

Construction of the LMOC has the potential to affect local groundwater discharges within 3 km to 5 km of the channel (see Chapter 6, Section 6.4.4.2). This effect is expected to substantially diminish in magnitude and geographic extent during operations but may persist to some degree within 200 m of the channel below the water control structure. However, any such reduction in groundwater discharge to Birch Bay could reduce the suitability of Birch Bay for lake whitefish spawning if groundwater upwellings are one of the factors influencing lake whitefish spawning habitat suitability, spawning success, and egg survival in Lake St. Martin.

Although potential effects on Buffalo Creek and the Big Buffalo Lake bog complex are uncertain, at most, reductions in groundwater inputs to Buffalo Creek and Creek C may have a small effect on the ability of these habitats to overwinter juvenile and forage fish. Such an effect is considered negative, long-term, low in magnitude, and restricted to the LAA.

Overall the potential effects to fish habitat as a result of the Project affecting groundwater will be adverse and occur through operation over the long term. The magnitude of the effect will be low during construction and diminish further during operation, but will occur during highly sensitive periods, be continuous, irreversible and could extend into the LAA. The habitats affected are currently undisturbed.

Introduction of Aquatic Invasive Species

Operation of the LMOC and LSMOC will unavoidably provide additional dispersion routes for AIS to colonize Lake Manitoba, Lake St. Martin, and/or Lake Winnipeg. Of the AIS present in the RAA, increased dispersal of spiny water flea, zebra mussels, and rainbow smelt are of greatest concern. However, the increased risk of dispersal of these AIS is not expected to substantially increase due to the Project because:

- Spiny water flea and zebra mussel veligers cannot disperse upstream because they are poor swimmers or only passively drift downstream or in lake currents. Because spiny water flea and zebra mussels are currently known only to reside in Lake Winnipeg, operation of the LMOC and LSMOC will not provide new or additional conduits for these species to colonize Lake St. Martin or Lake Manitoba.
- Rainbow smelt typically disperse in a downstream direction and, because they are currently known to only occur in Lake Winnipeg, the likelihood that the channels will provide an additional conduit for their upstream dispersal is low.
- The LMOC and LSMOC will not provide any new connections between waterbodies that are not already naturally connected by Fairford and Dauphin rivers.

Increased access and the presence of the construction workforce will also increase the risk for AIS transfers. However, these vectors of AIS transfer already exists when boaters, anglers, and commercial fishers move between the lakes.

Based on the evidence above, the likelihood that the Project will notably increase the risk of AIS dispersal in the LAA and RAA is low. However, the potential magnitude of this effect is high due to the substantial alteration of physical habitat and disruption of aquatic food webs that spiny water flea and zebra mussels can cause. This potential effect is adverse, long-term in duration and continuous in frequency as it will exist throughout the duration that the Project operates. The potential effect is not sensitive, is irreversible, and would occur in an undisturbed area extending through the RAA. Incremental effects to ASR are expected to be low given that the majority of ASR that may occur in the LAA already occur with the AIS of primary concern (i.e., zebra mussels, spiny water flea) in Lake Winnipeg,

Change in Habitat due to Realignment, Isolation, or Dewatering of Drains and Headwater Streams

Redirection of the drains to the west of the LMOC is expected to cut off access to a small amount of fish habitat in the headwaters of the Birch and Watchorn Creek watersheds; up to 27% of the Birch Creek watershed and no more than 4% of the Watchorn Creek watershed. Habitat in these headwater drains are primarily suitable only for forage fish species such as brook stickleback and minnows. This is because these drains have measurable flow only in spring and, for the remainder of the year are nearly stagnant or dry. In channels that have water year-round, water temperatures are high while dissolved oxygen concentrations in summer and winter are typically below (less than 3 mg/L) those that can be tolerated by any fish besides fathead minnow or brook stickleback (Klinger et al. 1982).

Diversion of these drains into the LMOC, and their isolation from Birch and Watchorn creeks, is not expected to have any measurable effect on any of the large-bodied focal fish populations in the LAA or RAA. This is because, except for Woodale Drain, none of the headwater drains that would be diverted and isolated are used by any large-bodied focal species for any part of their life history. Woodale Drain, which is a tributary to Birch Creek, located 3 km upstream from Lake St. Martin is likely only used by large-bodied species in high water years and only for a short distance upstream (it was not used in 2018; NSC 2019a). Any reduction of forage fish production in Birch and Watchorn Creek watersheds from diversion and isolation of these drains is expected to have no measurable effect on their population and, therefore, no measurable effect on large-bodied focal species (i.e., northern pike, and walleye) that eat these forage fish as prey.

Realignment of the drains is also expected to decrease annual flow volumes in Birch and Watchorn creeks by the same amount the watershed areas that will be diverted and isolated: 27% in Birch Creek and 4% in Watchorn Creek (assuming mean annual discharge is in proportion to watershed area). These reductions are not expected to substantially decrease the availability and suitability of Birch Creek for white sucker, walleye, or northern pike spawning as these species are spring spawners and would use the creek during a period when flows are highest and, therefore, least sensitive to flow reductions. There is no known use of Birch Creek by fall spawning lake whitefish. Predicted flow reductions in Watchorn Creek are too small to have any measurable effect on fish habitat or fish use.

Construction of the LSMOC will divert and isolate spawning and nursery habitat used by northern pike in Creek C. This loss of habitat is expected to have a negligible effect on the northern pike population in the LAA because there is abundant northern pike spawning and nursery habitat in the LAA, including extensive areas suitable for spawning and nursery habitat in the Big Buffalo Lake bog complex downstream of Creek C.

Overall, the net effect of realignment, isolation, and diversion of drains and headwater streams on fish habitat and, therefore, fish production of focal fish species, is expected to be adverse, but negligible in magnitude and restricted to the LAA. The effects will be irreversible, begin in construction and continue over the long-term, and will occur in previously disturbed fish habitat.

Change in Habitat due to Movement and Deposition of Sediment

Sediment mobilization and deposition during operation of the channels is expected to be measurable during the first few periods of use. However, the amount of sediment released and deposited in Birch Bay and Sturgeon Bay is expected to decrease with each successive operation because the amount of fine sediment available to be eroded decreases over time.

Sediments transported down the LMOC are expected to settle in Birch Bay, while finer sediments will be likely transported further into Lake St. Martin. Substrate composition in Birch Bay is largely sand and gravels (AAE Tech Services 2016), while substrates in the main basin of Lake St. Martin are largely comprised of silt and clay. This suggests that finer substrates such as silt and clay do not generally accumulate in Birch Bay (likely due to its shallower depth and greater turbulence than in the deeper main basin) and are eventually deposited in the main basin of the lake. This suggests that any fine silt of clay conveyed by the LMOC into Birch Bay will also be eventually transported, likely in suspension, out of Birch Bay and into the main basin of the lake. Therefore, in the long-term, the effect on habitat in Birch Bay, and its use by fish, is not expected to measurably change. Short-term, highly localized deposition of silt and clay may occur periodically in nearshore habitats in Birch Bay. However, this effect is expected to be too brief and too small to have a measurable effect on production of periphyton, benthic invertebrates, or fish using this habitat.

Sediments transported down the LSMOC into Sturgeon Bay are expected to eventually be transported into the main basin of Lake Winnipeg. This is because wind- and wave-driven sediment re-suspension is generally higher in Sturgeon Bay than in deeper areas of Lake Winnipeg (McCullough et al. 2001). Sediments in Sturgeon Bay are well sorted on a continual basis because of these wind- and wave-generated currents. Therefore, because these currents will continue to occur with the Project, it is expected that existing coarse substrates in Sturgeon Bay, which may be important for lake whitefish and walleye spawning, will not be affected over the long-term. Additionally, sediment inputs to Sturgeon Bay from the LSMOC are expected only to be a small proportion of the annual inputs to the lake.

Sediment introductions to Lake St. Martin and Lake Winnipeg will be unavoidable anytime the water control structure gates are open. These will likely include highly localized sediment introductions at the channel outlets when they are in use. These would be sporadic and the effect to fish and fish habitat is expected to be short in duration because any sediment accumulations would be resuspended and removed during the next high wind event on Birch and Sturgeon bays.

While sediment inputs from the Project will commence during construction and continue through operation, overall sediment inputs to Lake St. Martin and Lake Winnipeg are expected to remain unchanged over the long-term in relation to pre-Project conditions due to reduced duration of high flows in Fairford and Dauphin rivers (see Chapter 6, Section 6.4.7.5) and the reduced extent of erosion of upland areas around Lake Manitoba and Lake St. Martin. Therefore, the residual effects of sediment deposition on fish and fish habitat are expected to be negligible. The effects will occur sporadically over the long-term and, while focused to the LAA, the effect is expected to extend into the RAA (i.e., northern basin of Lake Winnipeg). The effects would be irreversible, could have high sensitivity and occur in undisturbed areas.

Change in Flow Patterns in Rivers and Channel Inlets and Outlets

Use of the outlet channels to mitigate lake levels during floods is expected to have minimal effects on flows in Fairford and Dauphin rivers in the spring (see Chapter 6, Section 6.4.7.2). This is because flows in the river will continue to be at or near maximum capacity even when the water control structures for the channels are open; the channels will only convey the surplus flow that the rivers cannot pass without flooding. As a result, no notable change in the habitat availability or suitability for spring-spawning species, in terms of widths, depths and water velocities, is expected to occur.

Similarly, use of the outlet channels is expected to have a minimal effect on flows, and therefore habitat, in the Fairford and Dauphin rivers in fall. Use of the channels in fall would only occur in high-water years when it would be necessary to continue discharging water through the channels to reduce upstream lake levels enough to prepare for potential high-water conditions the following spring. Although use of the channels would reduce wetted widths, depths, and water velocities in the rivers in fall, this effect would only reduce these hydraulic conditions in comparison those that would occur during high flow conditions. Therefore, the resulting hydraulic conditions in the rivers would remain closer to those that occur during more normal flow conditions; conditions that occur more frequently than extreme conditions. There is no evidence of lake whitefish use of Fairford River during the fall.

It was noted in the engagement process that operation of the EOC affected spawning areas at the mouth of Dauphin River and in Lake St. Martin. While the reason for such changes is uncertain, the effects were likely due to changes in local hydraulics. Fish were likely relocating spawning effort in relation to the new conditions. It is expected that a similar shift may also occur during operation of the LMOC and LSMOC where walleye and/or lake whitefish take advantage of turbulent conditions and coarse substrates created downstream of the LMOC control structure and the most downstream drop structure of the LSMOC.

Once the Project becomes operational, changes in fish habitat will occur due to changes in flow patterns in Fairford and Dauphin rivers and at the inlet and outlet to the LMOC in Watchorn Bay and Birch Bay and at the inlet and outlet to the LSMOC in the northeast basin of Lake St. Martin and Sturgeon Bay. While unavoidable and adverse, the potential effect on fish habitat in these rivers and lake areas is expected to be negligible in magnitude, long-term in duration, sporadic in frequency, and confined to the LAA. The effects could be highly sensitive, are reversible when the water control structure gates are closed, and are occurring in undisturbed habitats. Any negative effects on habitat associated with redirection of flows are expected to be offset by the habitats created in the new channels.

7.2.4.3 Change in Fish Passage

Project Pathways

Changes in fish passage will occur as a result of construction and operation of the LMOC and LSMOC. During construction, changes in fish passage could occur during replacement or installation of new stream crossings along the PR 239 and road realignments and along the construction access roads. During operations, a change in fish passage will occur when the water control structures are open. This includes potential changes in the upstream and downstream movement of adult, juvenile, and larval fish between Lake Manitoba, Lake St. Martin, and Lake Winnipeg. The following pathways of effects on fish passage may result from construction and operation of the LMOC and LSMOC:

- change in fish passage due to replacement or installation of new road crossing structures
- change in passive or active movement of fish out of Lake Manitoba and Lake St. Martin
- changes in attraction flows in Fairford and Dauphin rivers

Descriptions of each of these potential pathways of effects, prior to mitigation, are provided below.

Change in Fish Passage due to Replacement or Installation of New Road Crossing Structures

Construction of the LMOC will require realignment of PR 239 and reconstruction, realignment, or extension of various smaller municipal roads. The crossing at PR 239 will be across the LMOC itself and will be a new clear-span bridge. Similarly, the new crossing of the LMOC on the Township Line Road will be a new clear-span bridge. Therefore, no potential barrier to fish passage within the channel will be created. Any new crossing at any of the municipal roads that require reconstruction, realignment, or extension to accommodate the LMOC will be closed-bottomed culverts.

Construction of the LSMOC will require use and upgrade of an existing 19.5 km long winter road that extends from Idylwild Road to the LSMOC channel inlet. Permanent access to the LSMOC will be along the top of the containment dykes on either side of the excavated channel. Upgrade and extension of the access road required for construction of the LSMOC may include the need for new stream crossings. These would likely be closed or open-bottom culverts, which if sized or installed incorrectly, could become barriers to fish passage.

Change in Passive or Active Movement of Fish Out of Lake Manitoba and Lake St. Martin

Concern was expressed during the IPEP process about the potential loss of fish from Lake Manitoba to Lake St. Martin and Lake Winnipeg due to operation of the LMOC and LSMOC. This concern was specifically for those commercially important species in Lake Manitoba, such as walleye and lake whitefish, that could be lost to the fishery because these fish could not, or were unlikely to, return to Lake Manitoba once they left the lake.

Larval fish in Watchorn Bay and in the northeastern basin of Lake St. Martin may be passively entrained in the inflows to the LMOC and LSMOC when the water control structures are open. In 2012 for example, large numbers of yellow perch larvae were entrained in the EOC during spring operation (NSC 2016c). This could have adverse effects on fish populations in Lake Manitoba and Lake St. Martin if there are large concentrations of larval fish in the immediate vicinity of the channel inlets when the water control structures are opened. Most larval fish are poor swimmers due to their small size and, therefore, are susceptible to entrainment.

Additionally, adult fish may be attracted to actively move down the channels. In the LMOC, this may include fish already residing in the channel while the water control structure gates are closed and fish in Watchorn Bay that are attracted to the current in the channel when the water control structure gates are open. In the LSMOC, this would only include fish in Lake St. Martin that may be attracted to the current in the channel because few adult fish are expected to reside in the channel when the water control structure gates are closed. This is because of the short distance between the water control structure and the lake.

Change in Attraction Flows in the Fairford and Dauphin Rivers

Flow reductions in Fairford River due to operation of the LMOC will reduce the extent of the outflow plume entering Lake Pineimuta and potentially, Lake St. Martin. Similarly, flow reductions in the Dauphin River due to operation of the LSMOC will reduce the extent of the outflow plume entering Sturgeon Bay. These reductions, combined with new outflow plumes entering Birch Bay and Sturgeon Bay through the LMOC and LSMOC, have the potential to decrease the number of spawning fish moving up Fairford and Dauphin rivers in spring or fall by diverting some of these fish into the LMOC and LSMOC or other nearby tributaries (e.g., Mantagao River).

This concern was raised through the engagement process; specifically, how changes in Dauphin River flows would affect lake whitefish movements and spawning. Substantial migrations of lake whitefish from Lake Winnipeg are known to move upstream through Dauphin River in fall to spawn in Lake St. Martin. Therefore, because the downstream-most drop structure (closest to Lake Winnipeg) in the LSMOC will not allow upstream movement of fish, lake whitefish may become attracted to flowing water that they will not be able to ascend. This could delay or prevent these fish from spawning if they do not move out of the LSMOC outflow to find and ascend the Dauphin River. Similar effects could happen to spring spawning species such as walleye, suckers, and northern pike, all species known to migrate up the Dauphin River in spring.

Similar effects could occur at the outlet of the LMOC because it is known that walleye, suckers, sauger, and northern pike move up Fairford River in spring while cisco are known to move up Fairford River in fall.

Mitigation

Manitoba Infrastructure has incorporated avoidance and mitigation measures to eliminate or reduce potential changes in fish passage during construction and operation of the LMOC and LSMOC. These measures, and their likely effectiveness, are summarized in Table 7.2-7.

Table 7.2-7 Measures to Avoid or Mitigate Potential Change in Fish Passage

Potential Effect	Avoidance or Mitigation Measure	Likely Effectiveness of Avoidance or Mitigation Measure
Change in fish passage due to replacement or installation of new off-channel stream crossing structures	• Design and installation of clear-span bridges or properly sized and installed closed-bottom or open-bottom culverts that provide hydraulic conditions suitable for fish passage • Adhere to Manitoba's "Stream Crossing guidelines for the Protection of Fish and Fish Habitat" (DFO and Manitoba Natural Resources 1996) • Maintain natural alignment of streams • When feasible, construct stream crossings during low flow or frozen conditions • Maintain flows at all times to permit the safe and uninterrupted passage of fish (see PERs) • Installation of stream crossings only by experienced contractors	High**:** design and installation of stream crossing structures that prevent creation of fish barriers is well known and effective
Change in passive or active movement of fish out of Lake Manitoba or Lake St. Martin	• Channel designs will allow fish to egress from the channel during the entire open-water season • Develop and implement ramping rates for implementation during opening and closing of WCS gates to provide fish with cues that flow velocities in the channels are increasing or decreasing • Decrease outflow discharges through the FRWCS in concordance with Lake Manitoba operational guidelines and corresponding discharges in the LMOC	Low**:** Taken together, the proposed measures may reduce entrainment of larval fish in the channels, but it is unlikely that this potential effect can be eliminated. While the proposed measures will allow adult fish to leave the channels if they desire, there is little that can be done, besides closing the water control structures, to reduce or eliminate adult fish from actively moving downstream through the channels when the WCS gates are open.
Change in attraction flows in Fairford and Dauphin rivers	• Develop and implement ramping rates for implementation during opening and closing of WCS gates to provide fish with cues that flows in the channels are increasing or decreasing • Maintain adequate flows in the Denil fish-way in the FRWCS to	Moderate: Taken together, the proposed measures are expected to reduce the risk of attracting fish away from the Fairford and Dauphin rivers; however, it is not possible to prevent fish from entering the channels and using them for all of part of their life histories.

Table 7.2-7 Measures to Avoid or Mitigate Potential Change in Fish Passage

Potential Effect	Avoidance or Mitigation Measure	Likely Effectiveness of Avoidance or Mitigation Measure
	maintain upstream fish passage in spring • downstream-most drop structure on LSMOC designed to prevent upstream fish passage	

Of the three potential effects on fish passage identified in Section 7.2.4.3, only the potential effect of replacement or installation of new stream crossings is not further assessed. This is because the proposed measures to mitigate potential restriction or impediment of fish passage at new or replaced stream crossings are well understood and entirely applicable and effective in the environmental setting of the Project. Potential effects on fish passage from passive or active movement of fish out of the lakes and from potential changes to attraction flows in the rivers are further assessed because there are no mitigation measures available to eliminate or significantly reduce these effects and residual effects are likely to occur.

Project Residual Effects

Change in Passive or Active Movement of Fish out of Lake Manitoba and Lake St. Martin

Operation of the LMOC will provide a conduit for fish to move out of Watchorn Bay, a conduit that did not exist prior to the Project. These movements could include passive drift of larval yellow perch, walleye, suckers, northern pike, and lake whitefish, all of which are believed to spawn in Watchorn Bay or in tributaries to Watchorn Bay north (Mercer Creek) or south (Watchorn Creek) of the proposed LMOC inlet. These movements could also include active movement of juveniles and adults of these species from Watchorn Bay in Lake Manitoba to Birch Bay in Lake St. Martin when the water control structure gates are open.

The LSMOC will provide a new conduit, year-round, for fish to move from the northeast basin of Lake St Martin to Sturgeon Bay in Lake Winnipeg, in addition to the Dauphin River. These movements could include the passive drift of larval lake whitefish, cisco, suckers, yellow perch, walleye, and small-bodied forage fish such as brook stickleback and trout-perch. Spawning habitat for all these species exists in the northeast basin of Lake St. Martin and adult lake whitefish in spawning condition have been captured in this basin in fall. Movements into the channel could also consist of juvenile and adult fish of these species actively moving downstream.

Movement of fish out of Lake Manitoba to Lake St. Martin and out of Lake St. Martin to Lake Winnipeg through the outlet channels is unavoidable and cannot be completely mitigated. However, the potential residual effect of these movements is not expected to have a long-term measurable effect on the populations of focal fish species in any of the lakes. This assessment is based on the following:

- The effect to the lake whitefish population using Lake St. Martin for spawning is expected to be negligible because most larval whitefish leave the lake for Lake Winnipeg within their first year, regardless of whether there is one (i.e., Dauphin River) or multiple conduits (i.e., EOC or LSMOC). For example, overall CPUE of lake whitefish larvae in Dauphin River and in Reach 1 of the EOC in 2012 was similar to the overall CPUE in the Dauphin River in the spring of 2013 when the EOC was not in operation (see Appendix 7A, Table 7.2A-8). Therefore, operation of the LSMOC is likely only to facilitate an outward migration of larval whitefish that would otherwise continue to occur without the channel.

- Northern pike larvae are generally not susceptible to entrainment unless they hatch in the immediate vicinity of the outlets. This is because northern pike larvae typically remain close to their natal vegetated areas for protection and early access to prey once they become large enough to consume small fish. They are generally not found in open water environments.

- The duration that larval fish would be susceptible to entrainment in channel outflows would be restricted to the period between when larval fish first emerge from shoreline substrates or vegetation beds and when they are able to first achieve burst (i.e., less than 20 seconds; Katapodis and Gervais 2016) or prolonged (i.e., greater than 20 seconds, less than 30 minutes; Katapodis and Gervais 2016) swimming speeds that will enable them to swim against and out of inflow currents at the channel inlets. This period will differ among species due to differences in growth rates and swimming performance but it likely to be limited to one or two months for most species.

- Use of the LMOC and LSMOC will likely result in some moderate level of redistribution of larval yellow perch and walleye in Watchorn Bay and Lake St. Martin. However, because both channels will be operated at the same time, it is likely that any loss of larval yellow perch or walleye from Lake St. Martin through the LSMOC would be, at least partially, offset by the movement of larval yellow perch and walleye from Watchorn Bay.

- The number of larval, juvenile, or adult fish moving between the lakes is expected to be small in comparison to the number of larval, juvenile and adult fish present in Lake Manitoba and Lake St. Martin. Spawning habitat exists for lake whitefish, walleye, northern pike, and forage fish species throughout both lakes. Therefore, because the lakes are large, any loss of fish from Watchorn Bay and the northeastern basin of Lake St. Martin is not expected to have a measurable effect on the population sizes in either lake.

- Fish will only be susceptible to increased risk of movement in one year out of every three to five years (based frequency of water control structure gates being opened).

Although fish may be redistributed to some degree, the effect on focal fish population in the LAA and RAA from passive or active movement of fish in the channels is expected to be neutral. The effect will occur sporadically over the long-term during operation and is expected to be low in magnitude. The effect could have high sensitivity, depending on life stage, is reversible over the short term, and is only expected to be detectable within the LAA. The fish affected are already disturbed by passage over the FRWCS.

Change in Attraction Flows in the Fairford and Dauphin Rivers

Diversion of flow from Dauphin River to the LSMOC and from Fairford River to the LMOC in spring is not expected to have a measurable effect on the number of walleye, suckers, or northern pike ascending these rivers to access spawning habitat. This is primarily because flows in the rivers will continue to be near maximum capacity, despite water control gates of the channels being opened; the channels will only convey the discharge that would otherwise be backwatered and cause the flooding in Lake Manitoba and Lake St. Martin. Because of this, the rivers are expected to continue to provide nearly the same attraction flows for spring spawning fish as they would have without the channels.

Outflows from the LMOC in spring will unavoidably attract some walleye, suckers, and northern pike. While some of these fish may choose to spawn in the channel, others may be temporarily delayed moving to traditional spawning sites in Fairford River or in Lake Manitoba. This effect is expected to have a negligible effect on focal fish populations in the LAA. This is because use of Fairford River by spawning walleye and northern pike is low and fish will still be attracted and able to use the Denil fish-way in the FRWCS during spring. Similarly, no effect to the movement of northern pike into Lake Pineimuta is expected to occur because northern pike make only localized migrations and spawn in low flow areas with abundant vegetation. Therefore, northern pike are less reliant on attraction flows than species such as walleye and suckers, which actively seek out flowing water for spawning.

A similarly small effect is expected for focal fish populations normally using Dauphin River and Lake St. Martin for spawning in spring. Species that would be most affected are white and longnose suckers because recent studies have shown that there is currently no substantive migration into or use of the Dauphin River by walleye (see Section 7.2.2.2).

The change in attraction flows in Fairford and Dauphin rivers may continue throughout the summer and into the fall because the channels are likely to be required to continue conveying flood waters stored in Lake Manitoba and Lake St. Martin over many months during high floods. This is particularly relevant for Dauphin River because of the large lake whitefish spawning migration known to occur there in the fall. Potential residual effects on fall spawning in Fairford River are expected to be low because lake whitefish are not known to use this river; however, spawning movements of cisco were documented in Fairford River in fall 2007 (Gillespie and Remnant 2008).

While attraction of some lake whitefish to the outlet of the LSMOC is unavoidable when the water control structure gates are open, the potential residual effect on the lake whitefish population using the Dauphin River and Lake St. Martin for spawning is expected to be negligible. This is because:

- Fall discharges in Dauphin River in high flood years would be similar to discharges in non-high flood years because the LSMOC would be conveying only the additional run-off needed to reduce Lake St. Martin water levels to where they will limit potential flooding the following spring.
- Diversion of flows from Dauphin River into the LSMOC is expected to occur only once every three to five years; no change in attraction flows or effects on the Dauphin River lake whitefish spawning run would occur in years when the water control gates are closed.

- Fish attracted to alternate spawning locations would be expected to successfully reproduce, resulting in no net loss to fish productivity.

Potential residual adverse effects on focal fish species populations in the LAA and RAA are expected to occur during operation and will be low in magnitude (for reasons explained above), long-term in duration, reversible and sporadic in frequency given that the effect will occur every time the channels are operated. The fish movements that could be affected are highly sensitive and undisturbed.

7.2.4.4 Change in Fish Health and Mortality

Project Pathways

Fish health and mortality have the potential to be affected by most activities required for construction and operation of the channels. This is primarily because most construction activities will occur in or near water and could potentially release deleterious substances to streams and lakes adjacent to or downstream of the LMOC and LSMOC. Such releases may directly affect respiration of fish and gas exchange of fish eggs or indirectly affect plankton or benthic invertebrates which are food for many fish species. The following pathways of effects on fish health and mortality may result from construction and operation of the LMOC and LSMOC:

- accidental release of deleterious substances (e.g., grease, fuel, oil, and/or hydraulic fluids from heavy machinery or concrete washout)
- mortality of fish and fish eggs due to blasting in borrow-pits and quarries
- introduction of sediment
- stranding of fish and fish eggs
- increased fish mortality due to increased angling pressure and access
- bioaccumulation of methylmercury due to change in terrestrial habitat inundation

Accidental Release of Deleterious Substances

When heavy equipment is operated in the vicinity of waterbodies there is always a risk of introduction of hydrocarbons, such as oil, diesel fuel, grease, and hydraulic fluids, to the aquatic environment. Such accidental releases could adversely affect fish health and mortality by suffocating incubating fish eggs, decreasing growth and survival of periphyton, plankton, and benthic invertebrate communities that form the basis for the aquatic food web and by causing direct acute or chronic toxicological effects on fish themselves if concentrations are high enough and exposures long enough.

Concrete washouts during construction or maintenance of the water control structures could increase pH levels in water. This could have similar negative effects on fish health, growth, and survival as accidental hydrocarbon releases by causing direct acute or chronic toxicological effects on fish or indirect effects on growth and survival of periphyton, plankton, and benthic invertebrates. Changes in pH can also alter the solubility and toxicity of various water quality parameters (e.g., ammonia).

Blasting in Borrow-Pits and Quarries

Mortalities of fish and fish eggs could occur due to any blasting required to produce rock and fill material in the borrow-pits and quarries if the borrow-pits and quarries are located in close proximity to fish-bearing waterbodies and if the charge sizes are large enough to create sound overpressures or peak particle velocities high enough to destroy the eggs or damage the internal organs of juvenile or adult fish. Additionally, the health and mortality of fish could be affected by any blast residues entering any fish-bearing waterbody or watercourse. Depending on the type of explosives used, this could include residual ammonia, a compound known to be toxic to fish and other aquatic biota in certain concentrations.

Introduction of Sediment

Mobilization of sediments during construction and operation of the LMOC and LSMOC could result in indirect or direct effects on fish health and mortality. Indirect effects include reduction of periphyton and benthic invertebrate production in streams and rivers and reduction of plankton and benthic invertebrate production in lakes due to increased turbidity and sedimentation. Direct effects on fish include respiratory stress, reduced prey and predator detection, reduced gas exchange across egg membranes and avoidance of spawning, foraging or overwintering areas. Regardless of pathway, the effect of sediment on fish depends on the amount of sediment mobilized, suspended, or deposited, the duration of exposure to the sediment and/or elevated suspended sediment concentrations, and the sensitivity of the fish species and life stage. Concerns were expressed during the Indigenous engagement process that inputs of sediment due to the Project will increase the turbidity levels and algal blooms that are currently being observed in Lake Winnipeg.

Initial use of the LMOC and LSMOC is expected to result in a pulse of sediment from the newly constructed channel and from scour of areas in proximity to the inlet and outlets. Sediments deposited during construction, such as cofferdam installation and removal, excavation of the channels, and installation of rip-rap in the channels, will be particularly vulnerable to re-suspension at this time. Sediments from the LMOC will be transported out into the main basin of Lake St. Martin. Finer sediments will move into the north basin and down Dauphin River or LSMOC and into Lake Winnipeg. Sediments in the LSMOC will be transported out into Sturgeon Bay.

Other potential sources of sediment to lakes and streams within the LAA during construction and operation of the outlet channels include:

- installation and removal of rock jetties and cofferdams
- redirection of drains intersected by the channels
- channel groundwater discharges pumped to surface waters

- runoff from spoil piles adjacent to the channels
- channel maintenance activities

Depending on the magnitude and duration, these introductions of sediment could result in guideline exceedances for total suspended sediment (TSS) concentrations in the water column.

Stranding of Fish

Fish may be attracted to the LMOC and LSMOC when the WCS gates are open. This will likely result in adult fish using the channels for foraging or spawning, juvenile fish using the channels for rearing, and the presence of fish eggs and larvae. Consequently, the potential exists for fish and fish eggs to be stranded, or for eggs to be subject to suboptimal incubation conditions in the channels when the water control structures are closed, resulting in unintended mortality. Large numbers of lake whitefish (greater than 1,700) attracted into the Buffalo Creek watershed during operation of the EOC during 2011/12 perished in Reach 1 following flow termination in the winter of 2012/2013 (NSC 2016c). Given that there is no evidence that Lake Whitefish spawn below the FRWCS (see Fairford River and Inlet Area in Section 7.2.2.2), the risk that Lake Whitefish will spawn below either the LMOC water control structure or the most downstream drop structure (closest to Lake Winnipeg) on the LSMOC is low.

Fish will not be susceptible to stranding in the LMOC because water levels above and below the control structure will be maintained at the same elevation as water levels on Lake Manitoba and Lake St. Martin respectively, allowing fish to move out of the channel regardless of flow.

Fish will be unable to enter the LSMOC from Lake Winnipeg because the most downstream drop structure will be designed to prevent upstream fish movement. Fish entering the channel from Lake St. Martin may be able to move back upstream past the control structure when it is open, but not when the control structure gates are closed. At this time, fish will only be able to exit the channel in a downstream direction. Although drop structures in the LSMOC have been designed to enable downstream movement of fish during the open-water season, there remains the potential that fish may have difficulty leaving the channel when flows are reduced.

In addition, fish and fish eggs may be stranded within the excavation areas if cofferdams are used and work areas are dewatered to enable construction. Although unlikely, endangered mapleleaf mussels may also be stranded within any isolated excavation area in Sturgeon Bay at the outlet of the LSMOC.

Increased Mortality due to Increased Fishing Pressure and Access

Construction of the channels will require the presence of a large workforce, many of which can be expected to be recreational anglers. Additionally, construction of the outlet channels will require construction of new roads that may provide new or improved access to previously inaccessible lakes and streams. Together, these two factors could contribute to an increase in fish harvesting and/or hooking mortality in the LAA. This potential effect is expected to pose the greatest risk to fish during construction when the size of the workforce would be greatest. However, increased fish mortality could continue throughout operations because the access roads will be required for maintenance of the channels and because the channels may attract concentrations of spawning fish, such as walleye and northern pike, in spring and lake whitefish in fall.

Bioaccumulation of Methylmercury due to Change in Terrestrial Habitat Inundation

Flooding of terrestrial habitats is a pathway for the potential bioaccumulation of methyl mercury in fish tissues (Bodaly and Hecky 1979; Bodaly et al. 1984). This occurs through the bacterial decomposition of flooded organic matter containing naturally occurring mercury.

This potential effect was raised during consultation of the Project with provincial regulators and is particularly relevant where extensive areas of terrestrial habitat are flooded. However, operation of the LMOC and LSMOC will result in a net reduction in flooded terrestrial habitat in Lake Manitoba and Lake St. Martin during high-water periods. Consequently, the Project has the potential to reduce, not increase, the uptake of methylmercury in fish. However, the magnitude of this potential benefit is expected to be negligible. Fish within the LAA and RAA currently have methylmercury concentrations lower than the Health Canada standard for commercial marketing of freshwater fish in Canada (0.5 mg/kg) and these concentrations are not expected to measurably change because of the Project (Appendix 7.2A-18). This potential effect is not further assessed assessment.

Mitigation

Manitoba Infrastructure has incorporated avoidance and mitigation measures to eliminate or reduce potential changes in fish health and mortality during construction and operation of the LMOC and LSMOC. These measures, and their likely effectiveness, are summarized in Table 7.2-8.

Table 7.2-8 Measures to Avoid or Mitigate Potential Change in Fish Health and Mortality

Potential Effect	Avoidance or Mitigation Measure	Likely Effectiveness of Avoidance or Mitigation Measure
Accidental release of deleterious substances	• Prohibit re-fueling of machinery and storage of hydrocarbon products within 100 m from the high-water mark of waterbodies and watercourses • Store hydrocarbon products in secondary containment and approved storage tanks • Maintain and have readily accessible spill control and clean-up equipment • Prepare and educate workforce about Spill Response and Remediation Plan (see PERs), including	High: these measures are well understood and widely applied in industrial settings and include methods to avoid impacts by spatially separating deleterious substances from waterbodies and watercourses

Table 7.2-8 Measures to Avoid or Mitigate Potential Change in Fish Health and Mortality

Potential Effect	Avoidance or Mitigation Measure	Likely Effectiveness of Avoidance or Mitigation Measure
	spill containment and clean-up procedures • Implement Hazardous Materials Management Plan (see PERs) • Implement Cement Washout Plan (see PERs) • Equipment and vehicles will be clean of oil, grease, and hydraulic fluids and free of leaks upon arrival to site and kept in good working order • Follow DFO timing windows for instream work to the extent possible	
Blasting in borrow pits and quarries	• Locate borrow-pits and quarries at least 100 m away from watercourses and waterbodies • Adhere to set-back and charge sizes that comply with Guidelines for the Use of Explosives in or Near Canadian Fisheries Waters (Wright and Hopky 1998) • Prohibition of ammonium nitrate-fuel oil (ANFO) mixtures as explosives • Where necessary, when blasting near water, minimize blast charge weights and subdivide each charge into a series of smaller charges with a minimum 25 millisecond delay between charge detonations • Where necessary, back-fill blast holes with sand or gravel to grade to confine the blast • Where necessary, place blasting mats over top of blast holes to minimize blast debris	High**:** taken together, these mitigation measures will virtually eliminate the potential mortality risk to fish and fish eggs from blasting in the borrow-pits and quarries
Introduction of sediment	• Following mitigations outlined for erosion and sediment control in the PERs • Provide 100 m set-back from work areas and waterbodies or a buffer zone of undisturbed vegetation between the work	Moderate**:** Taken together, these mitigation measures will substantially reduce the amount of fine sediment mobilized, entrained, and deposited in fish-bearing waterbodies and watercourses and the duration that fish and other aquatic biota are

Table 7.2-8 Measures to Avoid or Mitigate Potential Change in Fish Health and Mortality

Potential Effect	Avoidance or Mitigation Measure	Likely Effectiveness of Avoidance or Mitigation Measure
	area and waterbody of at least 10 m plus 1.5 times the slope gradient or 30 m, whichever is greater • Limit machine fording to one-time events, if necessary • Limit any instream work to low flow periods when waterbodies or watercourses are dry or frozen • Install silt curtains around excavation areas • Conducting excavations within dewatering cofferdams so that excavations can be conducted “in-the-dry” (if required). Some work may not be done "in the dry" (e.g. inlet/outlet excavation); if so, these will be isolated outside the fish window. • Transfer excavation spoils to upland areas away from streams and waterbodies • Construct the channels “in-the-dry” and only connect them to upstream and downstream lakes once all in-channel erosion and sediment control measures are in place. Any work not done “in-the-dry” will be isolated if conducted outside the fish window • Direct groundwater pumped from channels through settling ponds • Rip-rap sides of the channels where necessary and compact bottom sediments to the maximum extent possible • Vegetate channel slopes with native or non-invasive vegetation • Implement Construction and Operations Sediment Management Plans • Monitor water quality to manage construction activities in relation to TSS guidelines and to trigger additional	exposed to sediment. However, it is not possible to eliminate the potential release of sediment to the aquatic environment, particularly fine clay and silt, when working in and around water with heavy machinery and when installing structures in water such as cofferdams and jetties.

Table 7.2-8 Measures to Avoid or Mitigate Potential Change in Fish Health and Mortality

Potential Effect	Avoidance or Mitigation Measure	Likely Effectiveness of Avoidance or Mitigation Measure
	mitigation measures if necessary • Follow DFO timing windows for instream work to the extent possible	
Stranding of fish and fish eggs	• Isolate in-water work areas and conduct fish and mussel salvages prior to construction or maintenance (see PERs) • Provide year-round baseflow in the LSMOC when the WCS gates are closed • Design and construct channels with minimum residual pool depths to sustain small and large-bodied fish through the winter • Design and locate downstream-most drop structure in the LSMOC to prevent fish access from Lake Winnipeg • Design and construct drop structures in LSMOC to enable downstream movement of fish during most open-water flow conditions • During operation, monitor potential egg deposition below the LMOC WCS and the most downstream drop structure on the LSMOC. If eggs are found, develop an appropriate water management plan for the duration of egg incubation in consultation with DFO	High**:** Taken together, these mitigation measures are expected to substantially reduce the potential stranding of fish and fish eggs in the channels because they provide cues for fish to leave, provide egress from the channels under most flow conditions, and/or provide conditions suitable for fish to remain in the channels if they desire
Increased fishing pressure	• Implement Access Management Plan • Implement "no fishing" policy for workers and subcontractors in the LAA during shifts • Implement "no fishing" policy for workers and the public in the channels at all times	Moderate**:** mitigation will limit but not eliminate increased fishing pressure because it is not possible to restrict anglers when they are on their own time and ATVs and snowmobiles are difficult to stop from using access roads

Of the six potential effects on fish heath and mortality identified, only the potential effects of introduction of sediment, stranding of fish, and increased fishing pressure are assessed further. Potential effects on fish health and mortality from accidental releases of deleterious substances and blasting in the borrow-pit and quarries are assessed further because the likelihood of such releases and effects from blasting occurring is low and because the proposed mitigation measures are considered to be highly effective at reducing the risks and containing the releases should, in the unlikely case, they occur. Potential effects on fish health and mortality due to methylmercury bioaccumulation are considered positive and are therefore not assessed further in this assessment.

Project Residual Effects

Introduction of Sediment

Elevated and measurable TSS levels are expected to occur sporadically over the duration of channel construction. However, the direct effect of sediment releases on fish health and mortality and the indirect effect on periphyton, plankton, and benthic invertebrate communities that are their prey, are expected to be low in magnitude and restricted to the LAA. Therefore, no measurable effect on focal fish populations in the LAA or RAA is expected to occur. This assessment is based on the expectation that:

- The mitigation measures that will be implemented will limit the amount of sediment that will enter the lakes and streams adjacent to and downstream of construction areas.
- Sediment loads introduced during construction will be only a small proportion of the annual inputs to Lake St. Martin and Lake Winnipeg.
- Any sediment plumes will be highly localized and quickly dispersed by waves and currents in the lakes.
- Individual fish can move out of any plume that occurs.
- Fish species living in Lake Manitoba, Lake St. Martin, and Lake Winnipeg are adapted to living in turbid conditions.

Sediment introductions will commence during construction, and elevated and measurable TSS levels in lakes downstream of the channels are expected to occur when the water control gates are open. However, these sediment pulses are expected to decrease with each successive use of the channels. Overall, effects on fish health and mortality due to sediment introductions from the Project are expected to be adverse, but low in magnitude. The introductions will occur sporadically and over the long term, be irreversible and could occur at highly sensitive times in an undisturbed environment. The effects would be restricted to the LAA.

Stranding of Fish

Fish will not be susceptible to stranding in the LMOC. This is because water levels in the channel upstream and downstream of the water control structure will always be at the same level as Lake Manitoba and Lake St. Martin, respectively, and because there will be no physical barriers in the channel, fish will always have unrestricted egress to the lakes.

The LSMOC has been designed to allow downstream movement of fish throughout the open-water season. With a baseflow and pool depths sufficient to prevent freezing to the bottom, it is expected that the LSMOC will be able to sustain fish throughout the winter, even during periods when its water control gates are open. Because of the capacity to overwinter fish, large numbers of forage species are expected to become established in the channel during periods of when the gates are closed. Therefore, although stranding of individual fish or fish eggs along the margins of the channels may be unavoidable, effects of stranding to the populations of focal fish species in the LAA and RAA are expected to be low in magnitude and will only occur sporadically over the duration of the Project. The effect is reversible over the long term and the fish that could be affected are currently highly disturbed by commercial fisheries. No measurable effect on the productivity of any fish populations in the LAA or RAA is expected.

Increased Mortality due to Increased Fishing Pressure and Access

Increased access, the presence of a large workforce, and the potential concentration of fish below control structure will result in an increased risk of fish mortality from fishing. The potential residual effect to large-bodied focal fish species is expected to be adverse, occur during construction and operation, medium-term, low in magnitude, have no sensitivity, continuous, reversible and be restricted to the LAA. The low magnitude rating of this potential residual effect is based on the contention that the construction work force will only be present for a maximum of three years, only a small proportion of this work force will be active anglers, and all anglers will need to abide by provincial fishing regulations. Any potential increase in subsistence fishing would be mitigated by the fishers. The fish affected are currently highly disturbed by commercial, subsistence and recreational fisheries.

7.2.4.5 Summary of Project Residual Effects

Table 7.2-9 summarizes the potential residual effects on fish and fish habitat during construction and operation of the LMOC and LSMOC.

Table 7.2-9 Summary of Project Residual Effects on Fish and Fish Habitat

Residual Effect	Residual Effects Characterization								
	Project Phase	Direction	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Ecological Context
Permanent Alteration or Destruction of Fish Habitat									
Change in habitat in Watchorn Bay, Birch Bay, Lake St. Martin, and Sturgeon Bay due to Excavation of Bottom Substrates	C, O	N	LT	NL	HS	PDA	RC	I	U

Table 7.2-9 Summary of Project Residual Effects on Fish and Fish Habitat

Residual Effect	Residual Effects Characterization								
	Project Phase	Direction	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Ecological Context
Change in Groundwater Inflows to Lakes and Streams Along or Adjacent to the Channels	C, O	A	LT	NL	HS	LAA	RC	I	U
Introduction of Aquatic Invasive Species	C,O	A	LT	NL	NS	RAA	RC	I	U
Change in Habitat due to Realignment, Isolation, or Dewatering of Drains and Headwater streams	C, O	A	LT	NL	HS	LAA	RC	I	D
Change in Habitat due to Movement and Deposition of Sediment	C, O	A	LT	NL	HS	RAA	SI	I	U
Change in Flow Patterns in Rivers and Channel Inlets and Outlets	O	A	LT	NL	HS	LAA	SI	R	U
Change in Fish Passage									
Change in Passive or Active Movement of Fish Out of Lake Manitoba and Lake St. Martin	O	N	LT	NL	HS	LAA	SI	RS	D
Change in Attraction Flow in the Fairford and Dauphin rivers	O	A	LT	NL	HS	LAA	SI	RS	U
Change in Fish Health and Mortality									
Introduction of Sediment	C, O	A	LT	NL	HS	LAA	SI	I	U
Stranding of Fish	O	A	LT	NL	HS	RAA	SI	R	D
Increased Mortality due to Increased Fishing Pressure and Access	C, O	A	MT	NL	NS	LAA	RC	RL	D

Table 7.2-9 Summary of Project Residual Effects on Fish and Fish Habitat

Residual Effect	Residual Effects Characterization								
	Project Phase	Direction	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Ecological Context

KEY See Table 7.2-3 for detailed definitions ***Project Phase*** *C: Construction* *O: Operation* ***Direction:*** *P: Positive* *A: Adverse* *N: Neutral* ***Duration:*** *ST: Short-term* *MT: Medium-term* *LT: Long-term*	***Magnitude:*** *NL: Negligible or Low* *M: Moderate* *H: High* ***Timing*** *NS: No sensitivity* *HS: High sensitivity* ***Geographic Extent:*** *PDA: Project development area* *LAA: local assessment area* *RAA: regional assessment area* *N/A: Not applicable*	***Frequency:*** *IF: Infrequent* *SI: Sporadic/Intermittent* *RC: Regular/Continuous* ***Reversibility:*** *RS: Reversible (short-term)* *RL: Reversible (long-term)* *I: Irreversible* ***Ecological Context:*** *U: Undisturbed* *D: Disturbed*

7.2.5 Determination of Significance

7.2.5.1 Significance of Residual Environmental Effects from the Project

A significant effect on fish and fish habitat is one that results in either of:

- a permanent alteration or destruction of fish habitat that is likely to result in an irreversible, measurable reduction in the annual production of CRA fish species in the RAA
- a permanent alteration or disruption of fish passage that is likely to result in an irreversible, measurable reduction of critical upstream or downstream movements (i.e., spawning runs) of CRA fish species and/or an irreversible, measurable increase in the distribution of Aquatic Invasive Species that is likely to reduce the annual production of CRA fish species in the RAA
- a change in fish health or mortality that is likely to result in a measurable change in the abundance of any CRA fish population in the RAA

The Project will have a long-term, continuous, positive effect on fish habitat by creating a minimum of 172 ha of habitat for CRA fish. Ultimately, however, the Project entails the alteration of stream flows and lake levels to alleviate flooding of communities along Lake Manitoba and Lake St. Martin and, therefore, cannot be built or operated without some negative effects on fish and fish habitat.

Potential negative effects of the Project on fish and fish habitat can be eliminated or reduced to a level that substantially reduces risks to the long-term sustainability and production of focal fish populations in the LAA and RAA, populations that are important to commercial, recreational, and Aboriginal fisheries in Lake Manitoba, Lake St. Martin, and Lake Winnipeg. All residual effects are expected to be negligible or low in magnitude, but they will be medium-term to long-term in duration because they are likely to occur each time the water control structure gates are opened. Any fish habitat altered or destroyed by the Project will be offset by the creation of new habitat in the outlet channels or by habitats that have been changed at the inlets and outlets of the channels. While fish passage will be altered, the Project is not expected to measurably affect critical movements (i.e., lake whitefish spawning movements to and from Dauphin Lake) or substantially increase the risk of aquatic invasive species dispersal. Although the LSMOC may cause some low level of fish and fish egg mortality (e.g., from stranding), the risk and potential magnitude have been limited through Project design (e.g., deep pools) and how it will be operated (e.g., provision of year-round baseflows).

Based on the assessment of the proposed effects of the Project on fish and fish habitat, and the proposed avoidance and mitigation measures, the residual effects are predicted to be not significant.

7.2.6 Potential Effects on Federal Lands

Fish habitat in lakes and streams potentially affected by the Project fall under the protection and auspices of the federal *Fisheries Act*. Because this assessment has been conducted in accordance with the Fish Habitat Protection provisions of the *Fisheries Act*, potential effects to federal lands and waters have been addressed.

7.2.7 Prediction Confidence

This assessment has been based on an understanding of the potential interactions between Project activities and components and fish and fish habitat using baseline data collected between 2011 and 2018 to monitor the effects of the EOC. Project-specific baseline data were collected in the small lakes, streams, and drains along the proposed outlet channel routing options and in the immediate vicinity of the channel inlets and outlets in Lake Manitoba, Lake St. Martin, and Lake Winnipeg. One baseline assessment of the overall fish population in Lake St Martin was conducted in 2018. Similar data collection in other lakes and rivers in the LAA was not conducted.

Despite the gaps, data were available from most waterbodies in the LAA and are considered adequate for describing the existing aquatic environment, identifying potential interactions and identifying the avoidance and mitigation measures that would be necessary to limit potential effects on fish and fish habitat. However, additional data will be required, prior to construction, to address potential changes to the Project coming out of detailed design and to ensure that the baseline is adequate for an effective aquatic effects monitoring program.

This assessment on fish and fish habitat has relied on predictions made about how the Project will affect stream flows, lake levels, and local and regional groundwater inputs. Changes in lake levels due to the

Project have been predicted by using water balance models and are considered sufficiently accurate for the assessment of these changes on fish and fish habitat. Hydraulic modeling to predict the potential change in hydraulic conditions in Fairford River, the FRWCS Denil fish-way, and the Dauphin River have not been conducted. Hydraulic conditions in the LMOC and LSMOC under different discharges also have not been modeled nor have hydraulic conditions at, and downstream of, the water control structures and drop structures. Therefore, assessment of the potential effects of changes to the hydraulic conditions in the rivers and in the channels on fish habitat, fish passage, and fish and fish egg stranding are qualitative, based on professional judgment using the information available.

Similarly, modeling of groundwater flow pathways and conductivity has not been conducted. Predictions of potential effects of the Project on groundwater/surface water interactions are instead based on field data collected from groundwater wells located in the expected zone of groundwater influence, an understanding of the topography and surficial geology of the area, an understanding of the conceptual dimensions, locations and depths of the proposed outlet channels, and professional judgment. The assessment of potential changes to groundwater/surface water interactions on fish and fish habitat is dependent on the accuracy of the groundwater assessment. Although the linkage is uncertain, a conservative approach has been undertaken in relation to assessing the potential importance of groundwater to lake whitefish in Lake St Martin in that there is no scientific evidence for use of groundwater upwellings by spawning lake whitefish.

7.2.8 Follow-Up and Monitoring

Follow-up and monitoring for fish and fish habitat will include measures outlined in the Project Environmental Management Program (EMP), as discussed in Chapter 3, Section 3.7, which consists of a Construction Environmental Management Program (CEMP) and an Operation Environmental Management Program (OEMP). The EMP describes targeted programs that will guide construction of the Project while also protecting the aquatic environment, including the following plans relevant to fish and fish habitat:

- Environmental Protection Plans
- PERs
- Access Management Plan
- Sediment Management Plan
- Water Management Plan (including Surface Water and Groundwater management plans)
- Revegetation Plan
- Waste Management Plan
- Hazardous Waste Management Plan

- Emergency Response Plan

Measures identified in these plans will mitigate, manage and monitor most of the potential environmental effects on fish and fish habitat during the construction and operation phases of the Project.

An Aquatic Effects Monitoring Plan (AEMP) will be developed as a component of the SWMP in both the CEMP and the OEMP. The intent of the AEMP will be to monitor the measurable parameters identified in Section 7.2.1.4 for each potential pathway of effect with the greatest likelihood of occurrence and/or greatest potential consequence to fish and fish habitat.

Monitoring conducted under the AEMP will focus on the primary effects on key components of fish and fish habitat, rather than addressing all potential changes. Components monitored as part of the AEMP will include, but not necessary be limited to:

- water quality, particularly TSS concentrations
- the quality and quantity of fish habitat (including lower trophic levels)
- abundance, distribution and reproductive success of focal fish populations

Monitoring conducted under the AEMP will focus on the primary effects on key components of fish and fish habitat, rather than addressing all potential changes.

Monitoring results will be reported in compliance with provincial and federal legislation and any Environment Certificate or permit conditions issued to the Project.

7.2.9 Conclusions

7.2.9.1 Permanent Alteration or Destruction of Fish Habitat

The LMOC and LSMOC will permanently alter some fish habitat. However, none of the potentially altered habitat is unique or limiting in the Lake Manitoba, Lake St. Martin, Lake Winnipeg, Fairford River, or Dauphin River.

Effects on habitat from sediment mobilization and deposition, groundwater depressurization, and realignment of drains are expected to be small in magnitude and have little effect on fish populations in the LAA. The channels have been designed to remain permanently wetted and therefore, will provide permanent fish habitat. This habitat is expected to provide spawning, rearing, foraging, and overwintering habitat for large numbers of forage fish, fish that will be a food source for CRA fish, such as walleye and northern pike.

It is expected that the Project will result in a net gain in fish habitat. The habitat in the LMOC will have water depths between 5 m and 8 m upstream of the control structure and 4 m to 5 m downstream of the control structure. The wetted width of the channel will vary between 30 m and 60 m. Substrate composition will be primarily till. Over time, aquatic vegetation may become established along the margins of the channel. Habitat in the LSMOC will have a trapezoidal cross-section with a base width of 44 m. It will be characterized by a series of pools formed by 12 drop structures constructed of rockfill with a sheet pile cut-off at the upstream crest. Pool depths upstream of the drop structures will be sufficient to maintain a wetted channel upstream to the next drop structure. Together with the channel geometry and drop structures, baseflows in the LSMOC will limit variations in water levels in the LSMOC when not in use and allow a stationary, lake-type ice cover to form on the channel without freezing to the bottom. Groundwater seepage is also expected will augment flows along the channel. Substrates will be primarily till. Together the LMOC and LSMOC will create approximately 172 ha of permanently wetted fish habitat. Despite the net gain in habitat, effects to CRA fish productivity in the LAA and RAA are not expected to be measurable.

7.2.9.2 Change in Fish Passage

The LMOC and the LSMOC will provide a new conduit for fish to move from Lake Manitoba to Lake St. Martin and from Lake St. Martin to Lake Winnipeg. It is expected that this will result in a small net increase in fish movement in a downstream direction between these waterbodies in the long-term. However, the magnitude of this movement is expected to be small in comparison to the size of focal fish populations in the lakes and is not expected to affect fish population sizes or productivity in any lake.

Small, localized changes in the abundance of schooling fish species (e.g., minnows) or life stages (e.g., larval perch) may occur intermittently when the water control structure gates are open. However, any affect is expected to be short-term and low in magnitude because any fish lost to the system are expected to be replaced by recruitment the following year such that there is no measurable effect on fish population size or productivity.

Flow changes may also alter cues that attract fish. However, it is expected that these changes will not be sufficiently large to affect fish migrations and, if some fish do alter their behaviour, the effects are not expected to cause a decrease in fish population sizes or productivity.

7.2.9.3 Change in Fish Health and Mortality

There are several pathways by which the Project could affect fish health and mortality. These include potential introductions of deleterious substances (including sediment), potential mortality from blasting in the borrow-pits and quarries, potential increases in fish pressure, and potential stranding of fish in the channels. It is expected that Project design (including operational guidelines) and implementation of mitigation measures in the Project environmental requirements will sufficiently mitigate these potential effects such that there will be low risk of fish and fish egg mortalities and that the number of unintended mortalities will be insufficient to have a measurable effect on fish populations or fish productivity in the LAA or RAA.

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Appendix 7A TABLES

Appendix 7A TABLES

LIST OF TABLES

Table 7.2A-1 Fish Species Occurring in the LAA and RAA 7A.2
Table 7.2A-2 Commercial Fish Harvest (in kg round weight) from Lake Manitoba, by Year and Species, from 1997-2017 ....7A.3
Table 7.2A-3 Fish Catches during the CAMP Program on Sturgeon Bay, 2008-2016 ....7A.4
Table 7.2A-4 Commercial Fish Harvest (in kg round weight) from the North Basin of Lake Winnipeg, by Year and Species, 1997-2017 ....7A.5
Table 7.2A-5 Lake Manitoba and Tributaries Index Gill Net, Hoop Net and Electrofishing Catches, 2015-2016 ....7A.6
Table 7.2A-6 Catches of Fish from the FRWCS Fishway and Index Gillnet Catches from the Fairford River, 1987 and 2007 ....7A.7
Table 7.2A-7 Index Gillnet, Boat Electrofishing and Hoopnet Catches from Lake St. Martin and Tributaries 2012-2018 ....7A.8
Table 7.2A-8 Fish Catches in Neuston and Wisconsin Net Tows Conducted on Lake Manitoba, Lake St. Martin, Big Buffalo Lake, and Sturgeon Bay, 2012-2018 ....7A.9
Table 7.2A-8 Fish Catches in Neuston and Wisconsin Net Tows Conducted on Lake Manitoba, Lake St. Martin, Big Buffalo Lake, and Sturgeon Bay, 2012-2018 ....7A.10
Table 7.2A-9 Larval Drift Catches in Lake St. Martin, the Dauphin River and the Buffalo Creek Watershed, 2012-2015 ....7A.11
Table 7.2A-10 Commercial Fish Harvests (in kg round weight) from Lake St. Martin, by Year and Species in 1997-2017 as recorded at Lake St. Martin Junction and Lake St. Martin First Nation 7A.12
Table 7.2A-11 Dauphin River Boat Electrofishing Catches by Season, 2011-2015 ....7A.13
Table 7.2A-12 Index Gill Net and Boat Electrofishing Catches from Big Buffalo Lake and Reach 1 during each Phase of the LSMEOC Project, 2011-2015 ....7A.14
Table 7.2A-13 Backpack Electrofishing Catches in Mercer Creek and Buffalo Creek 7A.15
Table 7.2A-14 Index Gillnet Catches from Sturgeon Bay, 2011-2018 ....7A.16
Table 7.2A-15 Commercial Deliveries of Fish (in kg round weight) to the Dauphin River Fish Plant, by Year and Species, 1997-2017 ....7A.17
Table 7.2A-16 Mean Arithmetic and Standardized Mercury (Hg) Concentrations in Lake Whitefish and Northern Pike sampled from Lake St. Martin, the Dauphin River and Sturgeon Bay in 2011 and 2014 and in walleye sampled from Sturgeon Bay in 2011 ....7A.18
Table 7.2A-17 Aquatic Invasive Species near or in Manitoba that may be of concern for the LMBLSMOC Project 7A.19
Table 7.2A-18 Species at Risk that Occur, or have the Potential to Occur, in the Aquatic Environment RAA, and have the Potential to Occur in the Aquatic Environment LAA 7A.20

Table 7.2A-1 Fish Species Occurring in the LAA and RAA

Family	Common Name	Scientific Name	ID Code	Recorded in LAA	Lake Manitoba			Lake St Martin			Buffalo Creek	Dauphin River		Lake Winnipeg		Winnipeg River	Red River	Assiniboine River
					(Stewart and Watkinson 2007)	LMOC Route Options[4]	LMOC Route Options (Watchorn Creek)	(Stewart and Watkinson 2007)[1]	NSC Monitoring[2]	LMOC Route Options[4]	NSC Monitoring[2]	(Stewart and Watkinson 2007)[1]	NSC Monitoring[2]	(Stewart and Watkinson 2007)[1]	NSC Monitoring[2]	(Stewart and Watkinson 2007)	(Stewart and Watkinson 2007)	(Stewart and Watkinson 2007)
Petromyzontidae	Chestnut Lamprey	*Ichthyomyzon castaneus*	CHLM	No	O			O				O		N		N	N	N
Petromyzontidae	Northern Brook Lamprey	*Ichthyomyzon fossor*	NRLM	No	O			O				O		O		N Whitemouth and Winnipeg Rivers	O	O
Petromyzontidae	Silver Lamprey	*Ichthyomyzon unicuspis*	SLLM	No	O			O				O		N		N	N	N rare
Acipenseridae	Lake Sturgeon	*Acipenser fulvescens*	LKST	Yes [5]	O			N				N		N		N	N rare	N extirpated RI recent
Hiodontidae	Goldeye	*Hiodon alosoides*	GOLD	Yes	N			N	ü			N		N		N	N	N
Hiodontidae	Mooneye	*Hiodon tergisus*	MOON	Yes	N			O				N		N	ü [3]	N to Pine Falls	N	N
Cyprinidae	Goldfish	*Carassius auratus*	GLFS	No	O			O				O		O		O	I	I urban
Cyprinidae	Lake Chub	*Couesius plumbeus*	LKCH	Yes	O			O				O		N		N	O	O
Cyprinidae	Spotfin Shiner	*Cyprinella spiloptera*	SFSH	No	O			O				O		O		O	N	N lower
Cyprinidae	Carp	*Cyprinus carpio*	CARP	Yes	I	ü		I	ü	ü	ü	I	ü	I		I	I	I
Cyprinidae	Brassy Minnow	*Hybognathus hankinsoni*	BRMN	No	O			O				O		O		O	N Pembina River	N Duck Mtn Prov Park
Cyprinidae	Common Shiner	*Luxilus cornutus*	CMSH	No	O			O				O		N Tributaries		N	N Tributaries	N mostly Tributaries
Cyprinidae	Silver Chub	*Macrhybopsis storeriana*	SLCH	No	O			O				O		N South Basin		O	N	N
Cyprinidae	Northern Pearl Dace	*Margariscus nachtriebi*	PRDC	Yes	N			N			ü	N		N Tributaries		N	N Pembina and Rat rivers	N Tributaries
Cyprinidae	Hornyhead Chub	*Nocomis biguttatus*	HRCH	No	O			O				O		N Brokenhead River		N Whitemouth River	N Erroneus record?	O
Cyprinidae	Golden Shiner	*Notemigonus chrysoleucas*	GLSH	Yes	N			N		ü	ü	N		N Tributaries		N	N rare	N Oxbow lakes
Cyprinidae	Emerald Shiner	*Notropis atherinoides*	EMSH	Yes	N	ü		N		ü		N		N		N	N	N
Cyprinidae	River Shiner	*Notropis blennius*	RVSH	No	O			O				O		N South Basin		O	N	N lower
Cyprinidae	Bigmouth Shiner	*Notropis dorsalis*	BGSH	No	O			O				O		O		O	N Roseau and Pembina rivers	N mostly Tributaries
Cyprinidae	Blackchin Shiner	*Notropis heterodon*	BCSH	No	O			O				O		O		N	O	N Oxbow lakes
Cyprinidae	Blacknose Shiner	*Notropis heterolepis*	BLSH	Yes	N			N		ü	ü	N		N Tributaries		N	O	N Oxbow lakes
Cyprinidae	Spottail Shiner	*Notropis hudsonius*	SPSH	Yes	N	ü		N		ü	ü	N	ü	N	ü [3]	N	N	N
Cyprinidae	Carmine Shiner	*Notropis percobromus*	CRSH	No	O			O				O		O		N	O	O
Cyprinidae	Sand Shiner	*Notropis stramineus*	SNSH	No	O			O				O		O		O	N mostly Tributaries	N
Cyprinidae	Weed Shiner	*Notropis texanus*	WDSH	No	O			O				O		N Tributaries		N	O	N Oxbow lakes
Cyprinidae	Mimic shiner	*Notropis volucellus*	MMSH	No	O			O				O		N Tributaries		N	O	O
Cyprinidae	Northern Redbelly Dace	*Chrosomus eos*	NRDC	No	N rare, Tributaries			N ?			ü	N		N Tributaries		N	N Rat River	N Tributaries
Cyprinidae	Finescale Dace	*Chrosomus neogaeus*	FNDC	No	N Whitemud and Big Grassy rivers			O				O		N Tributaries		N	N Rat River	N Upper Tributaries

Table 7.2A-1 Fish Species Occurring in the LAA and RAA

Family	Common Name	Scientific Name	ID Code	Recorded in LAA	Lake Manitoba			Lake St Martin			Buffalo Creek	Dauphin River		Lake Winnipeg		Winnipeg River	Red River	Assiniboine River
					(Stewart and Watkinson 2007)	LMOC Route Options[4]	LMOC Route Options (Watchorn Creek)	(Stewart and Watkinson 2007)[1]	NSC Monitoring[2]	LMOC Route Options[4]	NSC Monitoring[2]	(Stewart and Watkinson 2007)[1]	NSC Monitoring[2]	(Stewart and Watkinson 2007)[1]	NSC Monitoring[2]	(Stewart and Watkinson 2007)	(Stewart and Watkinson 2007)	(Stewart and Watkinson 2007)
Cyprinidae	Bluntnose Minnow	*Pimephales notatus*	BLMN	No	O			O				O		O		N above McArthur Falls	N 1 record	O
Cyprinidae	Fathead Minnow	*Pimephales promelas*	FTMN	Yes	N	ü		N		ü	ü	N		N Tributaries		N	N	N mostly Tributaries
Cyprinidae	Flathead Chub	*Platygobio gracilis*	FLCH	No	O			O				O		N		O	N lower	N
Cyprinidae	Longnose Dace	*Rhinichthys cataractae*	LNDC	Yes	O			N			ü	N		N		N	N	N
Cyprinidae	Western Blacknose Dace	*Rhinichthys obtusus*	BLDC	No	O			O				O		N		O	N	N
Cyprinidae	Creek Chub	*Semotilus atromaculatus*	CRCH	No	O			O				O		N Tributaries		N 1 Record	N	N mostly Tributaries
Catostomidae	Quillback	*Carpiodes cyprinus*	QUIL	Yes	N	ü		N				N		N	ü	N Lower	N	N
Catostomidae	Longnose Sucker	*Catostomus catostomus*	LNSC	Yes	O			N	ü		ü	N	ü	N	ü	N	O	O
Catostomidae	White Sucker	*Catostomus commersonii*	WHSC	Yes	N	ü	ü	N	ü	ü	ü	N	ü	N	ü	N	N	N
Catostomidae	Bigmouth Buffalo	*Ictiobus cyprinellus*	BGBF	No	N Rare, Delta Marsh			O				O		N South Basin		O	N	N rare, mostly lower
Catostomidae	Silver Redhorse	*Moxostoma anisurum*	SLRD	Yes	O			N	ü			N	ü	N	ü	N	N	N
Catostomidae	Golden Redhorse	*Moxostoma erythrurum*	GLRD	No	O			O				0		N South Basin		N Lower	N	N lower
Catostomidae	Shorthead Redhorse	*Moxostoma macrolepidotum*	SHRD	Yes	N			N	ü	ü	ü	N	ü	N	ü	N	N	N
Ictaluridae	Black Bullhead	*Ameiurus melas*	BLBL	Yes	N recent			O	ü	ü		O		N	ü [3]	N	N	N
Ictaluridae	Brown Bullhead	*Ameiurus nebulosus*	BRBL	No	N recent			O				O		N		N	N	N
Ictaluridae	Channel Cat	*Ictalurus punctatus*	CHCT	No	N recent			O				O		N		N to Pine Falls T in Lac Du Bonnet	N	N
Ictaluridae	Stonecat	*Noturus flavus*	STON	No	O			O				O		N Tributaries		O	N	N
Ictaluridae	Tadpole Madtom	*Noturus gyrinus*	TDMD	No	N recent			O				O		N Tributaries		N	N	N Tributaries and oxbow lakes
Esocidae	Northern Pike	*Esox lucius*	NRPK	Yes	N	ü	ü	N	ü	ü	ü	N	ü	N	ü	N	N	N
Esocidae	Muskellunge	*Esox masquinongy*	MUSK	No	T							O		O		N rare	O	T Duck Mtn. Prov. Park
Umbridae	Central Mudminnow	*Umbra limi*	CNMD	Yes	N recent			N Tributaries			ü	N		N Tributaries		N	N	N Tributaries and oxbow lakes
Osmeridae	Rainbow Smelt	*Osmerus mordax*	RNSM	Yes	O			O				I recent ?		I recent	ü [3]	I recent	I lower, 1 record	O
Salmonidae	Cisco	*Coregonus artedi*	CISC	Yes	N			N	ü	ü	ü	N	ü	N	ü	N	N lower	N Riding Mtn Nat. Park
Salmonidae	Lake Whitefish	*Coregonus clupeaformis*	LKWH	Yes	N	ü		N	ü	ü	ü	N	ü	N	ü	N	N recent	N
Salmonidae	Shortjaw Cisco	*Coregonus zenithicus*	SHCS	No	O			O				O		N		N George Lake	O	O
Salmonidae	Rainbow Trout	*Onchorynchus mykiss*	RNTR	No	I			O				O		I		I	I	I
Salmonidae	Kokanee Salmon	*Onchorynchus nerka*	KKSL	No	O			O				O		I		I	O	O
Salmonidae	Brown Trout	*Salmo trutta*	BWTR	No	I			O				O		O		I	I	I

Table 7.2A-1 Fish Species Occurring in the LAA and RAA

Family	Common Name	Scientific Name	ID Code	Recorded in LAA	Lake Manitoba			Lake St Martin			Buffalo Creek	Dauphin River		Lake Winnipeg		Winnipeg River	Red River	Assiniboine River
					(Stewart and Watkinson 2007)	LMOC Route Options[4]	LMOC Route Options (Watchorn Creek)	(Stewart and Watkinson 2007)[1]	NSC Monitoring[2]	LMOC Route Options[4]	NSC Monitoring[2]	(Stewart and Watkinson 2007)[1]	NSC Monitoring[2]	(Stewart and Watkinson 2007)[1]	NSC Monitoring[2]	(Stewart and Watkinson 2007)	(Stewart and Watkinson 2007)	(Stewart and Watkinson 2007)
Salmonidae	Brook Trout	*Salvelinus fontinalis*	BRTR	No	T			O				T		T		T	T	T Riding Mtn Nat. Park and Duck Mtn. Prov. Park
Salmonidae	Splake	*(brook and lake trout hybrid)*	SPLK	No	O			O				I		I		I	O	I Riding Mtn Nat. Park
Salmonidae	Lake Trout	*Salvelinus namaycush*	LKTR	No	O			O				O		N		N	O	T Riding Mtn Nat. Park and Duck Mtn. Prov. Park
Percopsidae	Trout-perch	*Percopsis omiscomaycus*	TRPR	Yes	N	ü		N	ü	ü	ü	N	ü	N	ü	N	N	N
Gadidae	Burbot	*Lota lota*	BURB	Yes	N			N				N		N	ü	N	N	N
Fundulidae	Banded Killifish	*Fundulus diaphanus*	BNKL	No	O			O				O		O		N 1 Record Crowduck Lake	N 1record	O
Gasterosteidae	Brook Stickleback	*Culea inconstans*	BRST	Yes	N			N			ü	N		N Tributaries		N	N	N
Gasterosteidae	Threespine Stickleback	*Gasterosteus aculeatus*	THST	No	O			O				O		O		O	O	O
Gasterosteidae	Ninespine Stickleback	*Pungitius pungitius*	NNST	Yes	N			N				N		N	ü	N	O	N
Cottidae	Mottled Sculpin	*Cottus bairdi*	MTSC	Yes	N			N		ü		N		N		N	O	O
Cottidae	Slimy Sculpin	*Cottus cognatus*	SLSC	Yes	O			N			ü	N		N		N	O	N
Cottidae	Spoonhead Sculpin	*Cottus ricei*	SPSC	No	O			O				O		N		O	O	O
Cottidae	Deepwater Sculpin	*Myoxocephalus thompsoni*	DPSC	No	O			O				O		O		N West Hawk Lake; George Lake	O	O
Moronidae	White Bass	*Morone chrysops*	WHBS	Yes	O			I			ü	I		I	ü	I	I	O
Centrarchidae	Rock Bass	*Ambloplites rupestris*	RCBS	No	O			O				O		N Tributaries		N	N	N
Centrarchidae	Smallmouth Bass	*Micropterus dolomieu*	SMBS	No	O			O				O		N South Basin		I	I recent	O
Centrarchidae	Largemouth Bass	*Micropterus salmoides*	LRBS	No	O			O				O		I		I Lake of the Woods	I	I failed?
Centrarchidae	White Crappie	*Pomoxis annularis*	WHCR	No	O			O				O		O		O	N rare	O
Centrarchidae	Black Crappie	*Pomoxis nigromaculatus*	BLCR	No	O			O				O		N Tributaries		N	N	O
Percidae	Iowa Darter	*Etheostoma exile*	IWDR	Yes	N			N				N		N Tributaries		N	N mostly Tributaries	N Tributaries and oxbow lakes
Percidae	Johnny Darter	*Etheostoma nigrum*	JHDR	Yes	N	ü		N			ü	N		N		N	N	N
Percidae	Yellow Perch	*Perca flavescens*	YLPR	Yes	N	ü		N	ü	ü	ü	N	ü	N		N	N	N
Percidae	Logperch	*Percina caprodes*	LGPR	Yes	N	ü		N			ü	N		N Tributaries	ü [3]	N	N	N mostly Tributaries
Percidae	Blackside Darter	*Percina maculata*	BLDR	No	O			O				O		N Tributaries		N	N	N Tributaries
Percidae	River Darter	*Percina shumardi*	RVDR	Yes	N			N				N		N		N	N	N
Percidae	Sauger	*Sander canadensis*	SAUG	Yes	N			N				N		N	ü	N	N	N
Percidae	Walleye	*Sander vitreus*	WALL	Yes	N	ü	ü	N	ü	ü	ü	N	ü	N	ü	N	N	N

Table 7.2A-1 Fish Species Occurring in the LAA and RAA

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Sciaenidae	Freshwater Drum	*Aplodinotus grunniens*	FRDR	Yes	N	ü		N	ü	ü	ü	N	ü	N	ü	N to Pine Falls	N	N

N = native
O = unknown from watershed
I = introduced
N Tributaries = native in tributaries
N South Basin = Native to South Basin
T = transplanted

1 - inferred from distributional maps in Stewart and Watkinson (2007)
2 - captured during fisheries investigations in 2012-2018 as part of Lake St. Martin Emergency Outlet Channel monitoring (2012-2015) and LMBLSMOCP baseline data collections (2015-2018)
3 - captured during CAMP monitoring
4 - LMOC Route Options - AAE Tech Services (2016)
5 - single specimen captured in commercial fishery at St. Laurent, December 2015 (M. Gillespie, *pers comm.* 2018)
6 - under review

Table 7.2A-2 Commercial Fish Harvest (in kg round weight) from Lake Manitoba, by Year and Species, from 1997-2017 [1]

Year	BURB	CISC	CARP	FRDR	GOLD	LKWH	NRPK	SAUG	SUCK	TROUT	WALL	WHBS	YLPR	Total
1997	-	-	245053	-	-	4008	104566	64833	841692	-	264311	-	177830	1702293
1998	4749	-	236437	-	-	4275	95461	82310	921023	79	174605	-	177104	1696045
1999	-	-	398689	-	-	2903	89719	58127	1964936	-	302576	-	83651	2900601
2000	25	-	264781	-	-	9211	80992	27271	1140060	1	414865	-	85788	2022995
2001	46	-	115732	-	-	9744	71730	14621	1138236	-	261307	-	444277	2055693
2002	1696	-	433575	-	-	5186	165678	20683	1294801	47	243508	-	304125	2469298
2003	2182	-	194557	-	-	5977	134329	21838	948349	-	358789	-	136088	1802109
2004	-	1467	344885	-	-	4345	42819	4530	362873	-	150414	640	110658	1022630
2005	-	-	196938	-	-	3587	70947	7879	459480	-	145866	-	133055	1017753
2006	-	-	300317	-	2	3789	151649	2920	308619	-	199126	-	181926	1148347
2007	-	-	79080	-	-	3363	97177	1247	404470	-	100767	-	241052	927156
2008	-	-	123976	-	3	9516	98114	2484	313290	2	285135	-	81758	914278
2009	-	-	12428	-	4	6574	89496	4441	330082	-	243836	-	106743	793604
2010	-	-	896	-	4	5396	93892	5598	48665	-	97596	-	142261	394308
2011	-	104	2283	-	1	7230	165610	3502	275500	-	218361	3	248370	920964
2012	-	153	249	-	6	17480	245739	1514	129161	-	103429	-	40761	538493
2013	-	-	193605	3	6	17814	306424	994	206658	-	124371	-	16180	866055
2014	-	5	483784	7767	2	16878	365708	1646	470292	-	191998	254	26810	1565142
2015	-	353	519205	-	-	32199	387376	2469	610545	9	217649	-	3241	1773046
2016	-	-	481472	977	1	12509	289121	4381	292310	-	263021	1	110	1343902
2017	-	661	556488	191	-	60538	336515	7124	274273	-	496,494	45	315	1732644
Total	**8699**	**2742**	**5184428**	**8938**	**28**	**242523**	**3483065**	**340412**	**12735313**	**137**	**4858023**	**943**	**2742104**	**29607355**
Avg. Annual	**414**	**131**	**246878**	**426**	**1**	**11549**	**165860**	**16210**	**606443**	**7**	**231334**	**45**	**130576**	**1409874**
% Composition	**0.0**	**0.0**	**17.5**	**0.0**	**0.0**	**0.8**	**11.8**	**1.1**	**43.0**	**0.0**	**16.4**	**0.0**	**9.3**	**100.0**

1 - commercial catch data provided by Manitoba Sustainable Development

Table 7.2A-3 Fish Catches during the CAMP Program on Sturgeon Bay, 2008-2016

Index gill net catches (2, 3, 3.75, 4.25, 5 " panels)

Location	**Sturgeon Bay**																							
Year	2008			2009			2010			2012			2013			2014			2015			2016		
Season	Summer			Summer			Summer			Summer			Summer			Summer			Summer			Summer		
Dates	25-28 Aug			13-14 Jul			25-27 Jun			25-27 Jun			8-10 Jul			8-10 Jul			23-25 Jun			5-7 Jul		
Survey Type	Index Gill Nets			Index Gill Nets			Index Gill Nets			Index Gill Nets			Index Gill Nets			Index Gill Nets			Index Gill Nets			Index Gill Nets		
Effort	11 sites, 215.91 hours			7 sites, 130.25 hours			10 sites, 189.77 hours			9 sites, 165.89 hours			11 sites, 200.50 hours			11 sites, 192 hours			11 sites, 205.82 hours			10 sites, 175.67 hours		
CPUE	**54.47**			**45.71**			**47.46**			**99.93**			**51.98**			**52.77**			**49.14**			**75.9**		
Species	**#**	**%**	**CPUE**	**#**	**%**	**CPUE**	**#**	**%**	**CPUE**	**#**	**%**	**CPUE**	**#**	**%**	**CPUE**	**#**	**%**	**CPUE**	**#**	**%**	**CPUE**	**#**	**%**	**CPUE**
Black Bullhead	-	-	-	-	-	-	-	-	-	-	-	-	1	0.2	0.10	-	-	-	-	-	-	-	-	-
Cisco	7	1.3	0.75	-	-	-	1	0.2	0.11	3	0.4	0.43	-	-	-	-	-	-	1	0.2	0.09	1	0.2	0.12
Freshwater Drum	10	1.8	0.94	2	0.7	0.34	6	1.3	0.69	5	0.6	0.66	7	1.4	0.78	22	4.7	2.03	4	0.8	0.45	11	1.7	1.31
Lake Whitefish	23	4.1	2.08	-	-	-	1	0.2	0.13	-	-	-	-	-	-	1	0.2	0.09	1	0.2	0.10	1	0.2	0.12
Mooneye	-	-	-	-	-	-				-	-	-	1	0.2	0.12	-	-	-	-	-	-	-	-	-
Northern Pike	36	6.5	3.44	25	8.9	4.21	63	13.6	7.17	48	6.2	5.61	35	7.0	3.56	36	7.6	3.77	24	4.9	2.33	26	4.1	3.13
Rainbow Smelt	10	1.8	1.05	2	0.7	0.38	7	1.5	0.65	7	0.9	0.77	3	0.6	0.29	-	-	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	6	1.3	0.61	5	0.6	0.62	10	2.0	1.14	31	6.6	3.62	9	1.8	0.97	23	3.6	2.78
Shorthead Redhorse	39	7.0	3.81	38	13.5	6.54	6	1.3	0.65	18	2.3	2.47	29	5.8	3.56	49	10.4	5.50	38	7.7	4.13	81	12.7	9.80
Walleye	8	1.4	0.73	135	48.0	22.29	200	43.2	19.81	290	37.2	38.24	221	44.0	22.64	246	52.1	28.12	259	52.3	25.91	320	50.2	38.01
White Sucker	142	25.5	13.62	7	2.5	1.07	70	15.1	7.21	160	20.5	20.68	39	7.8	4.18	20	4.2	2.25	65	13.1	6.19	52	8.2	6.14
White Bass	7	1.3	0.67	1	0.4	0.19	-	-	-	3	0.4	0.43	14	2.8	1.46	11	2.3	1.08	11	2.2	1.13	21	3.3	2.54
Yellow Perch	276	49.5	27.39	71	25.3	10.69	103	22.3	10.44	241	30.9	30.01	142	28.3	14.15	56	11.9	6.31	83	16.8	7.84	101	15.9	11.95
TOTAL	**558**	**100**	**54.48**	**281**	**100**	**45.71**	**463**	**100**	**47.47**	**780**	**100**	**99.92**	**502**	**100**	**51.98**	**472**	**100**	**52.77**	**495**	**100**	**49.14**	**637**	**100**	**75.90**

Small mesh gill net catches

Location	**Sturgeon Bay**																				
Year	2009			2010			2012			2013			2014			2015			2016		
Season	Summer			Summer			Summer			Summer			Summer			Summer			Summer		
Dates	13-14 July			25-27 June			25-27 June			8-10 July			8-10 July			23-25 June			5-7 July		
Survey Type	Index Gill Nets			Index Gill Nets			Index Gill Nets			Index Gill Nets			Index Gill Nets			Index Gill Nets			Index Gill Nets		
Effort	2 sites, 36.82 hours			2 sites, 35.10 hours			3 sites, 53.24 hours			3 sites, 52.50 hours			3 sites, 51.25 hours			3 sites, 56.08 hours			3 sites, 51.58 hours		
CPUE	**342.07**			**485.2**			**245.82**			**810.03**			**948.43**			**305.97**			**435.07**		
Species	**#**	**%**	**CPUE**	**#**	**%**	**CPUE**	**#**	**%**	**CPUE**	**#**	**%**	**CPUE**	**#**	**%**	**CPUE**	**#**	**%**	**CPUE**	**#**	**%**	**CPUE**
Cisco	-	-	-	1	0.1	0.64	1	0.2	0.52	-	-	-	1	0.1	0.51	-	-	-	-	-	-
Emerald Shiner	-	-	-	1	0.1	0.64	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lake Whitefish	-	-	-	-	-	-	1	0.2	0.52	-	-	-	-	-	-	-	-	-	-	-	-
Logperch	30	5.4	18.44	63	9.0	45.05	22	4.0	10.67	34	2.0	14.13	35	1.9	13.93	36	5.2	14.48	13	1.4	5.88
Northern Pike	-	-	-	-	-	-	2	0.4	0.89	-	-	-	2	0.1	0.73	-	-	-	1	0.1	0.47
Rainbow Smelt	1	0.2	0.57	145	20.7	93.18	7	1.3	3.35	177	10.2	81.90	24	1.3	12.62	5	0.7	1.87	-	-	-
Shorthead Redhorse	-	-	-	-	-	-	-	-	-	-	-	-	1	0.1	0.51	-	-	-	2	0.2	0.90
Spottail Shiner	36	6.5	22.63	37	5.3	24.99	26	4.7	12.85	727	41.9	313.64	76	4.1	45.04	145	21.0	70.68	273	29.4	129.39
Unid. Shiner spp.	-	-	-	-	-	-	-	-	-	-	-	-	174	9.3	77.27	-	-	-	-	-	-
Troutperch	29	5.2	17.68	102	14.5	71.52	56	10.2	27.38	30	1.7	15.28	154	8.2	69.58	139	20.1	62.38	126	13.6	59.16
Walleye	5	0.9	3.04	6	0.9	3.93	17	3.1	8.09	2	0.1	0.97	13	0.7	7.08	14	2.0	5.73	7	0.8	3.29
White Sucker	-	-	-	1	0.1	0.73	-	-	-	1	0.1	0.44	4	0.2	1.60	-	-	-	9	1.0	4.23
Yellow Perch	453	81.8	279.70	346	49.3	244.51	417	76.0	181.55	763	44.0	383.66	1388	74.2	719.58	353	51.0	150.82	499	53.7	231.73
TOTAL	**554**	**100**	**342.06**	**702**	**100**	**485.19**	**549**	**100**	**245.82**	**1734**	**100**	**810.02**	**1872**	**100**	**948.45**	**692**	**100**	**305.96**	**930**	**100**	**435.05**

Table 7.2A-4 Commercial Fish Harvest (in kg round weight) from the North Basin of Lake Winnipeg, by Year and Species, 1997-2017 [1]

Year	BURB	CHCT	CISC	CARP	FRDR	GOLD	LKWH	NRPK	SAUG	SUCK	TROUT	WALL	WHBS	YLPR	TOTAL
1997	-	-	20	275	1559	115	919815	105760	559442	244141	108	607971	9701	24544	2473452
1998	43323	-	332	2029	0	34	882440	165131	660665	269293	219	939559	7691	18131	2988847
1999	1795	9	47	4290	0	61	728350	183785	602227	260860	855	1458650	22454	40944	3304328
2000	2584	-	-	9264	6	3	1036025	106892	364662	204423	307	2039296	13999	28192	3805654
2001	1518	-	8	12762	0	8	1321473	98785	416636	204037	193	2029221	20028	30019	4134689
2002	4905	-	246	5028	2	26	1252540	80823	446889	210623	2	1861675	14733	47591	3925084
2003	2083	63	67	2010	33	189	1588552	88263	440035	196929	62	1745265	9049	49073	4121674
2004	-	-	374	453	720	1484	1376604	119622	295046	139210	21	2019978	6209	41919	4001641
2005	-	55	2	394	87	57	1102815	51762	140491	104340	5	2459350	2423	23196	3884975
2006	-	165	4	734	325	721	1054235	47646	58699	90644	30	2705231	8423	9480	3976337
2007	-	47	619	1298	1324	2546	842193	44900	49399	50662	-	2927464	2671	16549	3939672
2008	-	42	26	1524	126	1982	1392017	86252	132973	89469	1	2757702	1865	13389	4477367
2009	-	125	9	1413	412	309	1400458	91418	435960	104488	-	2470796	2724	27709	4535821
2010	-	85	194	215	1654	42	1303838	48048	149410	51792	30	2701971	2145	7239	4266662
2011	-	108	260	578	283	240	1035888	40359	105913	44863	-	2714739	6112	5775	3955117
2012	-	17	1048	142	152	736	982181	83232	101993	58897	-	2514898	3288	7375	3753960
2013	-	-	512	414	1247	374	1164756	150164	130761	135737	-	2620171	6000	10586	4220723
2014	-	-	9115	1400	3135	191	1526509	185099	189531	146658	-	1988361	25285	18863	4094147
2015	-	-	15479	601	14	299	2063576	168485	163621	160409	36	1545920	30852	29665	4178956
2016	-	43	85586	953	1868	467	1979612	137880	132782	118337	-	1518086	22045	45736	4043394
2017	-	44	80738	11788	4227	453	1897851	118321	65997	101073	-	1484204	12896	67666	3845259
Total	**56209**	**804**	**194687**	**57565**	**17173**	**10340**	**26851727**	**2202627**	**5643130**	**2986886**	**1870**	**43110508**	**230594**	**563641**	**81927760**
Avg. Annual	**2677**	**38**	**9271**	**2741**	**818**	**492**	**1278654**	**104887**	**268720**	**142233**	**89**	**2052881**	**10981**	**26840**	**3901322**
% Composition	**0.1**	**0.0**	**0.2**	**0.1**	**0.0**	**0.0**	**32.8**	**2.7**	**6.9**	**3.6**	**0.0**	**52.6**	**0.3**	**0.7**	**100**

1 - commercial catch data provided by Manitoba Sustainable Development

Table 7.2A-5 Lake Manitoba and Tributaries Index Gill Net, Hoop Net and Electrofishing Catches, 2015-2016 '

Location	South of Fairford River Mouth						Watchorn Bay						Watchhorn Creek		Mercer Creek				Lake MB Combined		Lake MB Combined	
Year	**2015**		**2016**				**2015**		**2016**				**2016**		**2016**				**All Years**		**All Years**	
Season	Fall		Spring		Spring		Fall		Spring		Spring		Spring		Spring		Spring		Spring/Fall		Spring	
Dates	Oct / Nov		Jun 2-10		May 4-19		Oct/Nov		Jun 2-10		May 4-19		Apr 27-May 8		Apr 27-May 8		May 8/12					
Survey Type	Index Gill Nets		Boat Electrofishing		Index Gill Nets		Index Gill Nets		Boat Electrofishing		Index Gill Nets		Hoopnetting		Hoopnetting		Backpack Electrofishing		Index Gill Nets		Boat Electrofishing	
Effort	2.0 h		54.9 min		5.8 h		1.0 h		33.8 min		5.9 h		2.2 h		11.4 h		17.9 min					
CPUE	**7.80 fish/100m/hr**		**2.02 fish/min**		**12.78 fish/100m/hr**		**18.24 fish/100m/hr**		**2.37/min**		**13.56 fish/100m/hr**		**0.01 fish/min**		**0.19 fish/min**		**10.46 fish/min**					
Species	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**
Carp	-	-	1	0.9	-	-	-	-	10	12.5	2	1.8							2	0.8	11	5.8
Cisco	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Emerald Shiner	-	-	4	3.6	-	-	-	-	-	-	-	-	-	-	-	-	23	12.3	-	-	4	2.1
Fathead Minnow	-	-	1	0.9	-	-	-	-	4	5.0	-	-	-	-	-	-	54	28.9	-	-	5	2.6
Freshwater Drum	-	-	3	2.7	-	-	-	-	-	-	1	0.9	-	-	-	-	-	-	1	0.4	3	1.6
Iowa Darter	-	-			-	-	-	-	-	-	-	-	-	-	-	-	5	2.7	-	-	-	-
Johnny Darter	-	-	1	0.9	-	-	-	-	1	1.3	-	-	-	-	-	-	-	-	-	-	2	1.0
Lake Whitefish	4	17.4			-	-	23	92.0	-	-	-	-	-	-	-	-	-	-	27	10.7	-	-
Logperch	-	-	1	0.9	-	-	-	-	3	3.8	-	-	-	-	-	-	-	-	-	-	4	2.1
Northern Pike	12	52.2	2	1.8	13	14.1	1	4.0	3	3.8	8	7.1	-	-	-	-	-	-	34	13.4	5	2.6
Quillback	-	-	-	-	1	1.1	-	-	-	-	-	-	-	-	-	-	-	-	1	0.4	-	-
Shorthead Redhorse	-	-	-	-	2	2.2	-	-	-	-	-	-	-	-	-	-	-	-	2	0.8	-	-
Spottail Shiner	-	-	11	9.9	-	-	-	-	19	23.8	-	-	-	-	7	10.3	53	28.3	-	-	30	15.7
Trout Perch	-	-	-	-	-	-	-	-	1	1.3	-	-	-	-	-	-	-	-	-	-	1	0.5
Walleye	-	-	19	17.1	2	2.2	-	-	-	-	3	2.7	-	-	-	-	-	-	5	2.0	19	9.9
White Sucker	7	30.4	5	4.5	74	80.4	1	4.0	-	-	99	87.6	1	100.0	60	88.2	4	2.1	181	71.5	5	2.6
Yellow Perch	-	-	63	56.8	-	-	-	-	39	48.8	-	-	-	-	1	1.5	48	25.7	-	-	102	53.4
Total	**23**	**100**	**111**	**100**	**92**	**100**	**25**	**100**	**80**	**100**	**113**	**100**	**1**	**100**	**68**	**100**	**187**	**100**	**253**	**100**	**191**	**100**

1 - captured during fisheries investigations in 2015-2016 as part of LMBLSMOCP data collections ((AEE Tech Services 2016).
Note: AEE Boat efisher uses 2.5 GPP unit and NSC uses 5.0 GPP unit. The smaller unit would be expected to capture a greater number of small-bodied fish, which is observed in the catch totals.
Note: Watchorn Creek hoopnet was set US of a commercial trap net

Table 7.2A-6 Catches of Fish from the FRWCS Fishway and Index Gillnet Catches from the Fairford River, 1987 and 2007

Location	Fairford River[1]		Fairford River[2]		Upstream of FRWCS[2]				Downstream of FRWCS[2]					
Year	**1987**		**2007**		**2007**		**2007**		**2007**		**2007**		**2007**	
Season	Spring		Fall		Fall		Fall		Fall		Fall		Fall	
Dates	May 6-June 12		Oct 3-10		Oct 5-10		Oct 5-6		Oct 1-11		Oct 3-8		Oct 7-9	
Survey Type	Fishway		Fishway		Index Gill Nets		Small Mesh Gill Nets		Hoop nets		Index Gill Nets		Small Mesh Gill Nets	
Effort	Continual		Continual		27.9 h		24.5 h		788.8 h		78.4 h		32.9 h	
CPUE					**0.96/100 m/hour**		**3.27/100 m/hour**		**0.08/hour**		**1.44/100 m/hour**		**103.5/100 m/hour**	
Species	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**
Black Bullhead	-	-	-	-	-	-	-	-	1	1.4	-	-	-	-
Burbot	4	0.0	1	25.0	-	-	-	-	4	5.7	-	-	-	-
Carp	79	0.9	-	-	1	2.2	-	-	-	-	12	15.8	-	-
Channel Catfish	1	0.0	-	-	-	-	-	-	-	-	-	-	-	-
Cisco	352	4.0	2	50.0	1	2.2	-	-	37	52.9	1	1.3	-	-
Emerald Shiner	-	-	-	-	-	-	-	-	-	-	-	-	242	44.2
Freshwater Drum	2	0.0	-	-	1	2.2	-	-	12	17.1	1	1.3	-	-
Lake Whitefish	3	0.0	-	-	2	4.3	-	-	-	-	-	-	-	-
Longnose Sucker	1	0.0	-	-			-	-	-	-	-	-	-	-
Northern Pike	-	-	-	-	1	2.2	-	-	6	8.6	41	53.9	2	0.4
Quillback	1	0.0	-	-	-	-	-	-	1	1.4	-	-	-	-
Sauger	907	10.2	-	-	-	-	-	-	-	-	-	-	-	-
Shorthead Redhorse	175	2.0	-	-	3	6.5	-	-	-	-	7	9.2	-	-
Silver Redhorse	1	0.0	-	-	-	-	-	-	-	-	-	-	-	-
Spottail Shiner	-	-	-	-	-	-	5	20.8	-	-	-	-	77	14.1
Walleye	2313	26.1	1	25.0	23	50.0	-	-	4	5.7	11	14.5	-	-
White Sucker	5032	56.7	-	-	14	30.4	-	-	4	5.7	3	3.9	-	-
Yellow Perch	-	-	-	-	-	-	19	79.2	1	1.4	-	-	226	41.3
Total	**8871**	**100**	**4**	**100**	**46**	**100**	**24**	**100**	**70**	**100**	**76**	**100**	**547**	**100**

1 - data from Derksen (1988)
2 - data from Gillespie and Remnant (2008)

Table 7.2A-7 Index Gillnet, Boat Electrofishing and Hoopnet Catches from Lake St. Martin and Tributaries 2012-2018 [1]

Location	North and South Basins				North Basin and Narrows													
Year	2018		2018		2012		2013		2014		2014		2015		2018		2018	
Season	Summer		Summer		Spring		Spring		Spring		Fall		Spring		Spring		Fall	
Dates	Sep 5 - Sep 10		Sep 5- Sep 10		16 Apr-29 May		17 May - 18 Jun		22 May-27 Jun		31-Oct		5 May - 5 Jun		14 May - 8 Jun		Oct 25-26	
Survey Type	Index Gill Nets		Small Mesh GN		Index Gill Nets		Index Gill Nets		Index Gill Nets		Index Gill Nets		Index Gill Nets		Index Gill Nets		Index Gill Nets	
Effort	254.0 h		85.6 h		51.9 h		42.7 h		30.0 h		3.8 h		14.9 h		20.9 hr		13.3	
CPUE	**1.74/100m/h**		**13.80/100m/hr**		**8.49/100 m/hr**		**11.06/100 m/hr**		**8.62/100 m/hr**		**3.36/100 m/hr**		**9.74/100 m/hr**		**15.23/100 m/hr**		**15.23/100 m/hr**	
Species	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**
Black Bullhead	3	0.5	5	0.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Blacknose Shiner	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Carp	1	0.2	-	-	-	-	3	0.4	-	-	-	-	-	-	1	0.3	-	-
Cisco	37	6.1	3	0.3	-	-	7	1.0	18	4.8	4	25.0	8	3.9	2	0.5	29	16.1
Emerald Shiner	-	-	226	19.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fathead Minnow	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Freshwater Drum	18	3.0	3	0.3	1	0.2	9	1.3	24	6.4	-	-	1	0.5	-	-	-	-
Golden Shiner	-	-	1	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Goldeye	1	0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lake Whitefish	86	14.2	1	0.1	21	4.2	33	4.9	19	5.1	5	31.3	12	5.9	21	5.5	114	63.3
Longnose Sucker	-	-	-	-	16	3.2	34	5.1	20	5.3	-	-	16	7.8	30	7.8	-	-
Mottled Sculpin	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Northern Pike	97	16.1	7	0.6	147	29.6	104	15.6	27	7.2	6	37.5	18	8.8	46	12.0	10	5.6
Shorthead Redhorse	39	6.5	-	-	4	0.8	66	9.9	42	11.2	-	-	6	2.9	32	8.3	-	-
Silver Redhorse	-	-	-	-	-	-	-	-	2	0.5	-	-	1	0.5	-	-	-	-
Spottail Shiner	-	-	439	37.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trout-perch	-	-	7	0.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Walleye	172	28.5	5	0.4	4	0.8	6	0.9	3	0.8	-	-	-	-	5	1.3	3	1.7
White Sucker	103	17.1	18	1.5	246	49.5	385	57.7	216	57.6	1	6.3	138	67.6	180	46.9	15	8.3
Yellow Perch	47	7.8	464	39.4	58	11.7	20	3.0	4	1.1	-	-	4	2.0	67	17.4	9	5.0
TOTAL	**604**	**100**	**1179**	**100.1**	**497**	**100**	**667**	**100**	**375**	**100**	**16**	**100**	**204**	**100**	**384**	**100**	**180**	**100**

1 - captured during fisheries investigations conducted as part of Lake St. Martin Emergency Outlet Channel monitoring (2011-2015) and LMBLSMOCP baseline data collections (2016-2018)

Table 7.1A-7 Index Gillnet, Boat Electrofishing and Hoopnet Catches from Lake St. Martin and Tributaries 2012-2018 [1]

Location	Harrison Bay								Birch Bay						Birch Creek		Harrison Creek		Bear Creek	
Year	2015		2016		2015		2016		2016		2015		2016		2016		2016		2018	
Season	Fall		Spring		Fall		Spring		Spring		Fall		Spring		Spring		Spring		Spring	
Dates	Nov-01		Jun 2-10		Oct/Nov		May 4-19		Jun 2-10		Oct/Nov		May 4-19		Apr 27-May 8		Apr 27-May 8		May 15-17	
Survey Type	Electrofishing		Electrofishing		Index Gill Nets		Index Gill Nets		Electrofishing		Index Gill Nets		Index Gill Nets		Hoop nets		Hoop nets		Hoop nets	
Effort	41.6 min		64.7 min		0.75 h		6.1 h		32.2 min		1.0 h		2.1 h		10.8 h		6.1 h		46.8 h	
CPUE	**1.00/min**		**1.33/min**		**12.42/100 m/hr**		**16.44/100 m/hr**		**0.59/min**		**13.86/100m/hr**		**18.3/100m/hour**		**0.80/min**		**0.14/min**			
Species	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	#	%	#	%	#	%	#	%
Black Bullhead	-	-	-	-	-	-	2	1.5	-	-	-	-	-	-	-	-	-	-	-	-
Blacknose Shiner	-	-	20	23.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Carp	-	-	4	4.7	-	-	-	-	11	57.9	-	-	-	-	-	-	-	-	-	-
Cisco	-	-	-	-	-	-	-	-	-	-	3	15.8	4	7.8	-	-	-	-	-	-
Emerald Shiner	1	2.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fathead Minnow	-	-	8	9.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Freshwater Drum	-	-	-	-	-	-	6	4.4	-	-	-	-	-	-	-	-	-	-	-	-
Golden Shiner	-	-	2	2.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Goldeye	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lake Whitefish	-	-	-	-	8	72.7	-	-	-	-	11	57.9	1	2.0	-	-	-	-	-	-
Longnose Sucker	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mottled Sculpin	-	-	5	5.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Northern Pike	15	38.5	9	10.5	2	18.2	25	18.5	2	10.5	1	5.3	19	37.3	6	1.8	-	-	1	50.0
Shorthead Redhorse	-	-	-	-	-	-	36	26.7	-	-	-	-	10	19.6	-	-	-	-	0	0
Silver Redhorse	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spottail Shiner	4	10.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trout-perch	-	-	8	9.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Walleye	-	-	-	-	-	-	7	5.2	-	-	-	-	1	2.0	-	-	-	-	-	-
White Sucker	6	15.4	-	-	1	9.1	59	43.7	-	-	4	21.1	14	27.5	332	98.2	1	100.0	1	50.0
Yellow Perch	13	33.3	30	34.9	-	-	-	-	6	31.6	-	-	2	3.9	-	-	-	-	-	-
TOTAL	**39**	**100**	**86**	**100**	**11**	**100**	**135**	**100**	**19**	**100**	**19**	**100**	**51**	**100**	**338**	**100**	**1**	**100**	**2**	**100**

1 - captured during fisheries investigations conducted as part of Lake St. Martin Emergency Outlet Channel monitoring (2011-2015) and LMBLSMOCP baseline data collections (2016-2018)

Table 7.2A-8 Fish Catches in Neuston and Wisconsin Net Tows Conducted on Lake Manitoba, Lake St. Martin, Big Buffalo Lake, and Sturgeon Bay, 2012-2018 [1]

Location	**Lake St. Martin Northeast Basin and Narrows**												**Big Buffalo Lake**		**Sturgeon Bay**									
Year	2012		2013		2014		2014		2015		2018		2015		2012		2012		2013		2013		2014	
Season	Spring		Spring		Spring		Summer		Spring		Spring		Spring		Spring		Summer		Spring		Summer		Spring	
Dates	16 Apr - 29 May		18 May - 18 Jun		23 May - 27 Jun		9 Jul		5 May - 5 Jun		16 May- June 7		3 Jun		18 Apr - 27 Jun		3 Jul - 5 Jul		2 Jun - 22 Jun		10 Jul - 12 Jul		27 May, 17 Jun	
Survey Type	Neuston Tow		Neuston Tow		Neuston Tow		Neuston Tow		Neuston Tow		Neuston Tow		Neuston Tow		Neuston Tow		Neuston Tow		Neuston Tow		Neuston Tow		Neuston Tow	
Effort	10,052 m^3		4,557 m^3		4,507 m^3		604 m^3		4,974 m^3		2907 m^3		871 m^3		10,987 m^3		902 m^3		3,977 m^3		6,546 m^3		2,950 m^3	
CPUE	**6.91/100 m^3**		**187.15/100m^3**		**28.77/100m^3**		**28.34/100m^3**		**16.67/100m^3**		**54.68/100m^3**		**7.25/100m^3**		**4.25/100m^3**		**1.78/100m^3**		**22.64/100m^3**		**22.98/100m^3**		**716.61/100m^3**	
Species	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.1	-	-
Catostomidae	7	1.2	5579	65.1	89	4.5	-	-	6	0.7	5	0.3	60	89.6	62	13.4	9	28.1	275	31.3	21	1.2	17960	82.8
Cisco	54	9.1	168	2.0	14	0.7	-	-	210	24.4	37	2.3	-	-	87	18.8	-	-	164	18.7	-	-	217	1.0
Coregoninae	-	-	-	-	-	-	-	-	-	-	1	0.1	-	-	-	-	-	-	-	-	-	-	-	-
Cyprinidae	55	9.3	492	5.7	675	34.4	139	84.2	-	-	6	0.4	-	-	2	0.4	11	34.4	138	15.7	14	0.8	1780	8.2
Darters	57	9.6	266	3.1	52	2.6	2	1.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gasterosteidae	-	-	-	-	4	0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hiodontidae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14	1.6	-	-	-	-
Lake Whitefish	259	43.6	400	4.7	114	5.8	-	-	398	46.3	165	10.2	6	9.0	90	19.5	-	-	56	6.4	-	-	940	4.3
Ninespine Stickleback	-	-	-	-	1	0.1	3	1.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Northern Pike	-	-	2	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0.2	-	-	-	-
Percidae	49	8.2	213	2.5	203	10.3	-	-	4	0.5	32	2.0	1	1.5	26	5.6	-	-	1	0.1	-	-	645	3.0
Troutperch	-	-	-	-	7	0.4	-	-	-	-			-	-	-	-	-	-	-	-	3	0.2	-	-
Unidentified Larvae	-	-	-	-	1	0.1	14	8.5	-	-	22	1.4	-	-	-	-	-	-	-	-	6	0.3	-	-
White Sucker	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.1	-	-
White Bass	-	-	-	-	-	-	-	-	-	-	-	-	-	-	22	4.8	12	37.5	-	-	-	-	-	-
Yellow Perch	113	19.0	1447	16.9	805	41.0	7	4.2	241	28.1	1344	83.4	-	-	173	37.4	-	-	229	26.1	1702	97.4	158	0.7
TOTAL	**594**	**100**	**8567**	**100**	**1965**	**100**	**165**	**100**	**859**	**100**	**1612**	**100**	**67**	**100**	**462**	**100**	**32**	**100**	**879**	**100**	**1748**	**100**	**21700**	**100**

1 - captured during fisheries investigations cpnducted as part of Lake St. Martin Emergency Outlet Channel monitoring (2011-2015) and LMBLSMOCP baseline data collections (2016-2018)

Table 7.2A-8 Fish Catches in Neuston and Wisconsin Net Tows Conducted on Lake Manitoba, Lake St. Martin, Big Buffalo Lake, and Sturgeon Bay, 2012-2018 [1]

Location	Sturgeon Bay				Willow Point		Dauphin River mouth		Mantagao River	
Year	2014		2015		2018		2018		2018	
Season	Summer		Spring		Spring		Spring		Spring	
Dates	5 Jul		3 May - 4 Jun		23 May, 8 Jun		23 May		23 May - 24 May	
Survey Type	Neuston Tow		Neuston Tow		Neuston Tow		Neuston Tow		Neuston Tow	
Effort	938 m^3		4,284 m^3		1093 m^3		293 m^3		2449 m^3	
CPUE	**0.86/100m^3**		**104.64/100m^3**		**874.41/100m^3**		**23.56/100m^3**		**12.52/100m^3**	
Species	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Catostomidae	9	60.0	3624	83.0	7136	74.0	8	11.6	-	-
Cisco	-	-	156	3.6	18	0.2	12	17.4	13	4.2
Coregoninae	-	-	-	-	-	-	-	-	-	-
Cyprinidae	3	20.0	-	-	-	-	-	-	-	-
Darters	2	13.3	-	-	-	-	-	-	-	-
Gasterosteidae	-	-	-	-	-	-	-	-	-	-
Hiodontidae	-	-	-	-	-	-	-	-	-	-
Lake Whitefish	-	-	581	13.3	265	2.7	49	71.0	269	87.3
Ninespine Stickleback	1	6.7	-	-	-	-	-	-	-	-
Northern Pike	-	-	-	-	-	-	-	-	-	-
Percidae	-	-	7	0.2	2220	23.0	-	-	-	-
Troutperch	-	-	-	-	-	-	-	-	-	-
Unidentified Larvae	-	-	-	-	1	-	-	-	6	1.9
White Sucker	-	-	-	-	-	-	-	-	-	-
White Bass	-	-	-	-	-	-	-	-	-	-
Yellow Perch	-	-	-	-	-	-	-	-	20	6.5
TOTAL	**15**	**100**	**4368**	**100**	**9640**	**100**	**69**	**100**	**308**	**100**

1 - captured during fisheries investigations cpnducted as part of Lake St. Martin Emergency Outlet Channel monitoring (2011-2015) and LMBLSMOCP baseline data collections (2016-2018)

Table 7.2A-9 Larval Drift Catches in Lake St. Martin, the Dauphin River and the Buffalo Creek Watershed, 2012-2015 [1]

Location	Lake St. Martin Reach 1 and Dauphin River										Lower Dauphin River									
Year	2012		2013		2014		2014		2015		2012		2013		2014		2015		All Years	
Season	Spring		Spring		Spring		Summer		Spring		Spring		Spring		Spring		Spring		Spring	
Dates	14 Apr - 30 May		16 May - 19 Jun		22 May - 28 Jun		8 Jul - 11 Jul		4 May - 6 Jun		17 Apr - 1 Jun		13 May - 19 Jun		11 May - 25 Jun		1 May - 4 Jun			
Survey Type	Drift Traps		Drift Traps		Drift Traps		Drift Traps		Drift Traps		Drift Traps		Drift Traps		Drift Traps		Drift Traps		Drift Traps	
Effort	354,449 m^3		111,297 m^3		17,254 m^3		9,456 m^3		22,223 m^3		563,209 m^3		398,243 m^3		75,354 m^3		57,963 m^3		1,094,770 m^3	
CPUE	**2.13/100 m^3**		**1.33/100 m^3**		**0.26/100 m^3**		**0.15/100 m^3**		**0.29/100 m^3**		**11.30/100 m^3**		**77.91/100 m^3**		**5.44/100 m^3**		**5.41/100 m^3**		**25.02/100 m^3**	
Species	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**
Burbot	-	-	-	-	-	-	-	-	-	-	-	-	1	0.0	-	-	-	-	1	0.0
Catostomidae	22	0.2	222	14.4	-	-	-	-	2	3.5	72122	96.5	50392	89.4	2594	60.5	2075	62.6	127183	91.7
Cisco	50	0.4	73	4.7	13	27.7	-	-	6	10.5	51	0.1	46	0.1	60	1.4	143	4.3	300	0.2
Coregonine	-	-	7	0.5	-	-	-	-	2	3.5	-	-	271	0.5	-	-	-	-	271	0.2
Cottidae	-	-	1	0.1	-	-	2	18.2	12	21.1	839	1.1	352	0.6	476	11.1	169	5.1	1836	1.3
Cyprinidae	4	0.0	-	-	-	-	-	-	4	7.0	65	0.1	1862	3.3	54	1.3	47	1.4	2028	1.5
Darters	-	-	27	1.8	1	2.1	4	36.4	-	-	-	-	20	0.0	150	3.5	-	-	170	0.1
Gasterosteidae	4	0.0	-	-	-	-	1	9.1	3	5.3	-	-	-	-	1	0.0	-	-	1	0.0
Lake Whitefish	745	5.2	718	46.7	9	19.1	-	-	12	21.1	1477	2.0	1812	3.2	637	14.9	838	25.3	4764	3.4
Logperch	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Northern Pike	-	-	20	1.3	-	-	-	-	-	-	1	0.0	626	1.1	4	0.1	-	-	631	0.5
Percidae	45	0.3	412	26.8	-	-	-	-	8	14.0	141	0.2	965	1.7	111	2.6	27	0.8	1244	0.9
Rainbow Smelt	-	-	-	-	-	-	-	-	-	-	4	0.0	-	-	-	-	-	-	4	0.0
Troutperch	-	-	-	-	24	51.1	-	-	-	-	-	-	-	-	4	0.1	-	-	4	0.0
Unidentified Larvae	-	-	1	0.1	-	-	1	9.1	4	7.0	-	-	-	-	-	-	15	0.5	15	0.0
White Bass	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Yellow Perch	13372	93.9	58	3.8	-	-	3	27.3	4	7.0	19	0.0	37	0.1	195	4.5	-	-	251	0.2
TOTAL	**14242**	**100**	**1539**	**100**	**47**	**100**	**11**	**100**	**57**	**100**	**74719**	**100**	**56384**	**100**	**4286**	**100**	**3314**	**100**	**138703**	**100**

1 - captured during fisheries investigations conducted as part of Lake St. Martin Emergency Outlet Channel monitoring (2011-2015).

Note: Water velocity was not measured for two sampling sessions in spring 2014 Buffalo Creek and Dauphin River; insufficient velocity data to obtain accurate mean value for estimating missing information; drift

Table 7.2A-9 Larval Drift Catches in Lake St. Martin, the Dauphin River and the Buffalo Creek Watershed, 2012-2015 [1]

Location	Buffalo Creek											
Year	2012		2013		2014		2015 - D/S		2015 - U/S		2015 - Reach 1	
Season	Spring		Spring		Spring		Spring		Spring		Spring	
Dates	16 Apr - 15 Jun		13 May - 19 Jun		11 May - 24 Jun		1 May - 4 Jun		1 May - 4 Jun		4 May - 6 Jun	
Survey Type	Drift Traps		Drift Traps		Drift Traps		Drift Traps		Drift Traps		Drift Traps	
Effort	41,489 m^3		6,752 m^3		10,989 m^3		26,571 m^3		27,681 m^3		16,707 m^3	
CPUE	**47.52/100 m^3**		**0.62/100 m^3**		**0.14/100 m^3**		**2.31/100 m^3**		**0.28/100 m^3**		**0.21/100 m^3**	
Species	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**
Burbot	-	-	-	-		-	-	-	-	-	-	-
Catostomidae	17901	91.0	7	70.0	144	79.6	477	80.0	38	43.2	7	20.0
Cisco	38	0.2	-	-	-	-	-	-	-	-	-	-
Coregonine	-	-	-	-	-	-	2	0.3	3	3.4	5	14.3
Cottidae	37	0.2	1	10.0	2	1.1	25	4.2	-	-	-	-
Cyprinidae	604	3.1	1	10.0	17	9.4	82	13.8	21	23.9	6	17.1
Darters	-	-	-	-	-	-	-	-	-	-	-	-
Gasterosteidae	348	1.8	-	-	3	1.7	-	-	-	-	-	-
Lake Whitefish	163	0.8	-	-	-	-	10	1.7	25	28.4	12	34.3
Logperch	-	-	-	-	2	1.1	-	-	-	-	-	-
Northern Pike	4	0.0	-	-	2	1.1	-	-	-	-	-	-
Percidae	96	0.5	-	-	-	-	-	-	-	-	5	14.3
Rainbow Smelt	-	-	-	-	-	-	-	-	-	-	-	-
Troutperch	-	-	-	-	11	6.1	-	-	-	-	-	-
Unidentified Larvae	-	-	1	10.0	-	-	-	-	1	1.1	-	-
White Bass	421	2.1	-	-	-	-	-	-	-	-	-	-
Yellow Perch	61	0.3	-	-	-	-	-	-	-	-	-	-
TOTAL	**19673**	**100**	**10**	**100**	**181**	**100**	**596**	**100**	**88**	**100**	**35**	**100**

1 - captured during fisheries investigations conducted as part of Lake St. Martin Emergency Outlet Channel monitoring (2011-2015).
Note: Water velocity was not measured for two sampling sessions in spring 2014 Buffalo Creek and Dauphin River; insufficient velocity data to obtain accurate mean value for estimating missing information; drift

Table 7.2A-10 Commercial Fish Harvests (in kg round weight) from Lake St. Martin, by Year and Species, 1997-2017 as recorded at Lake St. Martin Junction and Lake St. Martin First Nation [1]

Year	BURB	CISC	CARP	FRDR	LKWH	NRPK	SAUG	SUCK	TROUT	WALL	WHBS	YLPR	TOTAL
1997	-	-	7	-	13486	11862	18	3125	-	1291	-	7	29795
1998	-	-	-	-	6314	2126	1	1123	-	543	-	-	10107
1999	-	-	94	-	4215	7394	14	15166	-	1211	-	52	28147
2000	-	-	189	-	15953	3947	44	7151	91	295	-	1	27671
2001	-	-	8804	-	8732	5513	11	9054	-	387	-	3	32505
2002	4	-	25547	-	17362	6523	3	7204	-	537	-	2	57182
2003	-	-	4090	-	8245	1193	1	572	-	52	-	-	14153
2004	-	-	959	-	671	2	-	2471	-	-	-	-	4102
2005	-	-	20553	-	3628	117	-	558	-	2	-	-	24859
2006	-	-	7982	-	7277	483	-	1974	-	57	-	0	17774
2007	-	-	4454	-	651	445	-	64	-	3	-	-	5617
2008	-	-	-	-	624	976	-	563	-	29	-	-	2191
2009	-	-	-	-	111	553	-	70	-	12	-	-	745
2010	-	-	-	-	-	-	-	-	-	-	-	-	-
2012	-	-	-	-	3535	1930	-	2527	-	8	-	-	8000
2013	-	-	-	-	8	-	-	-	-	-	-	-	8
2014	-	-	-	-	-	-	-	44	-	-	-	-	44
2015	-	-	4181	-	600	520	6	328	-	24	-	-	5660
2016	-	-	-	-	371	-	-	-	-	3	-	-	374
2017	-	122	-	-	3467	1068	-	1339	-	88	-	-	6084
TOTAL	**4**	**122**	**76861**	**0**	**95251**	**44652**	**97**	**53332**	**91**	**4543**	**0**	**65**	**275019**
Avg. Annual	**0.2**	**6.1**	**3843.0**	**0**	**4762.6**	**2232.6**	**4.9**	**2666.6**	**4.6**	**227.1**	**0**	**3.3**	**13751.0**
% Composition	**0**	**0**	**27.9**	**0**	**34.6**	**16.2**	**0.0**	**19.4**	**0.0**	**1.7**	**0**	**0.0**	**100**

1 - commercial catch data provided by Manitoba Sustainable Development

Table 7.2A-11 Dauphin River Boat Electrofishing Catches by Season, 2011-2015 [1]

Season	Spring								Summer				Fall											
Year	2012		2013		2014		2015		All		2014		2011		2011		2012		2013		2014		All	
Dates	17 Apr - 31 May		13 May - 20 Jun		12 May -16 Jun		1 May - 2 Jun		Spring		5 Jul - 6 Jul		14 Oct - 21 Oct		5 Nov		14 Oct - 8 Nov		26 Sept - 7 Nov		15 Sept - 5 Nov		Fall	
Effort (min)	424.1		330.5		283.9		172.3		1210.8		52.3		51.3		10.5		105.0		191.1		129.8		487.7	
CPUE (#fish/min)	**7.8**		**15.3**		**10.9**		**14.5**		**12.1**		**3.9**		**43.1**		**26.6**		**29.0**		**8.4**		**30.0**		**27.4**	
Species	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**
Carp	416	19.0	671	21.0	560	28.5	537	25.6	2184	23.1	23	11.6	-	-	-	-	-	-	-	-	-	-	-	-
Cisco	3	0.1	5	0.2	-	-	-	-	8	0.1	-	-	16	3.1	10	4.1	153	20.4	404	34.1	200	9.6	783	16.4
Coregonine	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100	13.3	-	-	-	-	100	2.1
Emerald Shiner	-	-	-	-	2	0.1	-	-	2	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Freshwater Drum	182	8.3	34	1.1	241	12.3	23	1.1	480	5.1	99	49.7	3	0.6	-	-	-	-	24	2.0	25	1.2	52	1.1
Lake Whitefish	51	2.3	29	0.9	59	3.0	44	2.1	183	1.9	1	0.5	481	92.7	234	95.1	496	66.0	615	51.9	1743	84.0	3569	74.7
Longnose Sucker	21	1.0	12	0.4	10	0.5	18	0.9	61	0.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ninespine Stickleback	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.0	1	0.0
Northern Pike	53	2.4	64	2.0	91	4.6	91	4.3	299	3.2	-	-	2	0.4	-	-	-	-	1	0.1	4	0.2	7	0.1
Quillback	1	0.0	1	0.0	-	-	-	-	2	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Shorthead Redhorse	164	7.5	520	16.3	43	2.2	136	6.5	863	9.1	22	11.1	-	-	-	-	-	-	1	0.1	4	0.2	5	0.1
Silver Redhorse	-	-	1	0.0	1	0.1	-	-	2	0.0	1	0.5	-	-	-	-	-	-	-	-	-	-	-	-
Spottail Shiner	11	0.5	79	2.5	9	0.5	402	19.2	501	5.3	-	-	-	-	-	-	1	0.1	60	5.1	-	-	61	1.3
Stickleback	-	-	-	-	1	0.1	-	-	1	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Walleye	2	0.1	28	0.9	5	0.3	-	-	35	0.4	1	0.5	1	0.2	-	-	-	-	8	0.7	1	0.0	10	0.2
White Bass	-	-	33	1.0	68	3.5	-	-	101	1.1	50	25.1	-	-	-	-	-	-	-	-	-	-	-	-
White Sucker	1267	57.9	1712	53.6	795	40.5	843	40.3	4617	48.9	1	0.5	14	2.7	2	0.8	1	0.1	71	6.0	96	4.6	184	3.9
Yellow Perch	19	0.9	6	0.2	77	3.9	-	-	102	1.1	1	0.5	2	0.4	-	-	-	-	1	0.1	-	-	3	0.1
Total	**2190**	**100**	**3195**	**100**	**1962**	**100**	**2094**	**100**	**9441**	**100**	**199**	**100**	**519**	**100**	**246**	**100**	**751**	**100**	**1185**	**100**	**2074**	**100**	**4775**	**100**

1 - captured during fisheries investigations conducted as part of Lake St. Martin Emergency Outlet Channel monitoring (2011-2015).

Table 7.2A-12 Index Gill Net and Boat Electrofishing Catches from Big Buffalo Lake and Reach 1 during each Phase of the LSMEOC Project, 2011-2015

LSMEOC Project Phase	Pre Operation				Operation				Closure							
Location	Big Buffalo Lake		Big Buffalo Lake		Big Buffalo Lake		Big Buffalo Lake		Big Buffalo Lake		Big Buffalo Lake		Big Buffalo Lake		Big Buffalo Lake	
Year	2011		2011		2012		2012		2013		2013		2014		2014	
Season	Summer		Summer		Fall		Fall		Summer		Summer		Spring		Spring	
Dates	15-Aug		15-17 Aug		25-Oct		24-26 Oct		5-Jul		4-5 Jul		18-Jun		18-19 Jun	
Survey Type	Small Mesh Gill Nets		Index Gill Nets		Small Mesh Gill Nets		Index Gill Nets		Small Mesh Gill Nets		Index Gill Nets		Small Mesh Gill Nets		Index Gill Nets	
Effort	21.2 h		94.2 h		3.7 h		5.4 h		3.7 h		47.9 h		2.4 h		47.7 h	
CPUE	**38.6/100 m/hr**		**0.8/100 m/hr**		**0.0/100 m/hr**		**4.0/100 m/hr**		**28.2/100 m/hr**		**1.8/100 m/hr**		**259.3/100 m/hr**		**0.1/100 m/hr**	
Species	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**
Carp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cisco	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cyprinidae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Freshwater Drum	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
Golden Shiner	12	4.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lake Whitefish	-	-	-	-	-	-	8	16.3	-	-	-	-	-	-	-	-
Longnose Sucker	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Northern Pike	4	1.6	16	23.2	-	-	27	55.1	8	25.8	32	25.4	-	-	4	66.7
Shorthead Redhorse	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spottail Shiner	-	-	-	-	-	-	-	-	3	9.7	-	-	187	99.5	1	16.7
White Sucker	3	1.2	7	10.1	-	-	10	20.4	14	45.2	93	73.8	-	-	1	16.7
Yellow Perch	227	92.3	46	66.7	-	-	4	8.2	6	19.4	1	0.8	1	0.5	-	-
Total	**246**	**100**	**69**	**100**	**0**	**0**	**49**	**100**	**31**	**100**	**126**	**100**	**188**	**100**	**6**	**100**

Table 7.2A-12 Index Gill Net and Boat Electrofishing Catches from Big Buffalo Lake and Reach 1 during each Phase of the LSMEOC Project, 2011-2015

LSMEOC Project Phase	Operation											
Location	Big Buffalo Lake		Big Buffalo Lake + Creek		Reach 1		Big Buffalo Lake		Big Buffalo Lake + Creek		Reach 1	
Year	2014		2014		2014		2015		2015		2015	
Season	Fall		Fall		Fall		Spring		Spring		Spring	
Dates	27-Oct		16 Sep, 26 Oct		10 Sep, 27 Oct		16 May, 3 Jun		15-16 May		16-May	
Survey Type	Index Gill Nets		Boat Electrofishing		Boat Electrofishing		Index Gill Nets		Boat Electrofishing		Boat Electrofishing	
Effort	8.3 h		220.2 min		92.7 min		8.6 h		138.1 min		67.2 min	
CPUE	**2.4/100 m/hr**		**0.3/min**		**26.7/min**		**3.9/100 m/hr**		**1.9/min**		**1.3/min**	
Species	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**
Carp	-	-	-	-	6	0.6	-	-	-	-	4	5.3
Cisco	-	-	2	3.6	1	0.1	3	7.7	-	-	-	-
Cyprinidae	-	-	1	1.8	2	0.2	-	-	-	-	-	-
Freshwater Drum	1	3.7	-	-	101	10.7	2	5.1	-	-	-	-
Golden Shiner	-	-	-	-	-	-	-	-	-	-	-	-
Lake Whitefish	19	70.4	-	-	814	86.2	5	12.8	-	-	8	10.5
Longnose Sucker	-	-	1	1.8	-	-	1	2.6	-	-		-
Northern Pike	6	22.2	17	30.9	8	0.8	4	10.3	19	7.7	6	7.9
Shorthead Redhorse	-	-	1	1.8	2	0.2	1	2.6	-	-	-	-
Spottail Shiner	-	-	2	3.6	5	0.5	-	-	-	-	-	-
White Sucker	1	3.7	25	45.5	5	0.5	23	59.0	228	92.3	51	67.1
Yellow Perch	-	-	6	11	-	-	-	-	-	-	7	9
Total	**27**	**100**	**55**	**100**	**944**	**100**	**39**	**100**	**247**	**100**	**76**	**100**

1 - captured during fisheries investigations conducted as part of Lake St. Martin Emergency Outlet Channel monitoring (2011-2015) [1].

Table 7.2A-13 Backpack Electrofishing Catches in Mercer Creek and Buffalo Creek

	Mercer Creek		Buffalo Creek					
Year	2016		2011		2013		2014	
Season	Spring		Summer		Summer		Spring	
Dates	Apr - May		15-17 Aug		6 Jul		19-21 Jun	
Effort	17.9 min		58.5 min		62.9 min		55.3 min	
CPUE	**10.46 fish/min**		**5.78 fish/60 min**		**1.59 fish/60 min**		**1.97 fish/60 min**	
Species	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**
Blacknose Shiner	-	-	-	-	-	-	6	5.5
Brook Stickleback	-	-	2	0.6	-	-	-	-
Catostomidae	-	-	-	-	-	-	1	0.9
Central Mudminnow	-	-	180	53.3	37	37.0	53	48.6
Cyprinidae	-	-	100	29.6	-	-	-	-
Emerald Shiner	23	12.3	-	-	-	-	-	-
Fathead Minnow	54	28.9	-	-	-	-	13	11.9
Iowa Darter	5	2.7	-	-	-	-	-	-
Johnny Darter	-	-	-	-	3	3.0	1	0.9
Logperch	-	-	6	1.8	-	-	-	-
Longnose Dace	-	-	4	1.2	57	57.0	19	17.4
Longnose Sucker	-	-	-	0	-	-	-	-
Northern Pike	-	-	4	1.2	-	-	2	1.8
Northern Redbelly Dace	-	-	-	-	-	-	2	1.8
Pearl Dace	-	-	21	6.2	-	-	-	-
Shorthead Redhorse	-	-	-	-	-	-	1	0.9
Slimy Sculpin	-	-	9	2.7	-	-	1	0.9
Spottail Shiner	53	28.3	-	-	2	2.0	9	8.3
White Sucker	4	2.1	11	3.3	-	-	1	0.9
Yellow Perch	48	25.7	1	0.3	1	1.0	-	-
Total	**187**	**100**	**338**	**100**	**100**	**100**	**109**	**100**

1 - captured during fisheries investigations conducted as part of Lake St. Martin Emergency Outlet Channel monitoring (2011-2015) and LMBLSMOCP baseline data collections (2016-2018)

Table 7.2A-14 Index Gillnet Catches from Sturgeon Bay, 2011-2018 [1]

Location	Sturgeon Bay																	
Year	2011		2012		2012		2013		2013		2014		2014		2018		2018	
Season	Fall		Spring		Fall		Spring		Fall		Spring		Fall		Spring		Fall	
Dates	14-21 Oct		17 Apr - 2 Jun		17 Oct - 7 Nov		2-22 Jun		16 Oct - 6 Nov		27 May - 17 Jun		29-Oct		23 May-June 8		12-27 Oct	
Survey Type	Index Gill Nets		Index Gill Nets		Index Gill Nets		Index Gill Nets		Index Gill Nets		Index Gill Nets		Index Gill Nets		Index Gill Nets		Index Gill Nets	
Effort	62.3 h		60.3 h		11.1 h		12.8 h		17.9 h		12.2 h		7.8 h		16.9 h		62.97	
CPUE	**4.5 fish/100m/hr**		**27.3 fish/100m/hr**		**10.4 fish/100m/hr**		**68.5 fish/100m/hr**		**7.1 fish/100m/hr**		**18.8 fish/100m/hr**		**4.2 fish/100m/hr**		**10.0 fish/100m/hr**		**6.6 fish/100m/hr**	
Species	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**
Burbot	1	0.3		-		-		-		-		-		-		-	2	0.6
Cisco	121	36.3	34	4.4	78	51.7	5	0.6	43	25.0		-	17	37.0		-	203	57.2
Freshwater Drum	1	0.3	2	0.3		-		-		-	1	0.3		-	1	0.4		-
Lake Whitefish	34	10.2	56	7.3	16	10.6	2	0.2	15	8.7	3	1.0	2	4.3	1	0.4	23	6.5
Longnose Sucker		-	5	0.7		-		-		-		-		-	2	0.8		-
Northern Pike	45	13.5	139	18.1	43	28.5	42	4.8	23	13.4	53	18.5	18	39.1	62	23.9	81	22.8
Quillback		-		-		-		-		-		-		-	1	0.0		-
Sauger		-	4	0.5		-	3	0.3	1	0.6	1	0.3		-	3	1.2	1	0.3
Shorthead Redhorse	9	2.7	11	1.4		-	2	0.2	17	9.9	11	3.8	2	4.3	28	10.8	3	0.8
Silver Redhorse		-		-		-		-		-	1	0.3		-		-		-
Trout Perch		-	1	0.1		-		-		-	1	0.3		-		-		-
Walleye	19	5.7	62	8.1		-	43	4.9	9	5.2	28	9.8		-	50	19.3	11	3.1
White Bass		-	8	1.0		-	4	0.5		-	2	0.7		-		-		-
White Sucker	76	22.8	59	7.7	13	8.6	45	5.2	59	34.3	35	12.2	7	15.2	101	39.0	28	7.9
Yellow Perch	27	8.1	385	50.3	1	0.7	727	83.3	5	2.9	150	52.4		-	10	3.9	3	0.8
Total	**333**	**100**	**766**	**100**	**151**	**100**	**873**	**100**	**172**	**100**	**286**	**100**	**46**	**100**	**259**	**100**	**355**	**100**

1 - captured during fisheries investigations cpnducted as part of Lake St. Martin Emergency Outlet Channel monitoring (2011-2015) and LMBLSMOCP baseline data collections (2016-2018)

Table 7.2A-15 Commercial Deliveries of Fish (in kg round weight) to the Dauphin River Fish Plant, by Year and Species, 1997-2017 [1]

Year	BURB	CHCT	CISC	CARP	FRDR	GOLD	LKWH	NRPK	SAUG	SUCK	TROUT	WALL	WHBS	YLPR	TOTAL
1997	-	-	-	46	-	-	114867	10522	4534	64221	1	22891	-	121	217202
1998	12500	-	-	1043	-	-	130005	27271	20853	95718	1	61324	-	57	348771
1999	1788	-	-	1253	-	-	84546	29842	32045	92452	-	101783	-	110	343820
2000	104	-	-	174	-	-	209715	23202	12636	92469	-	131628	-	105	470032
2001	1518	-	-	293	-	-	204531	20107	59322	83238	-	144810	3	84	513904
2002	1715	-	-	589	-	-	308712	19198	4756	89987	-	151168	3	143	576270
2003	785	-	-	1789	-	-	425616	14386	1054	92499	-	114774	1	183	651086
2004	-	-	-	2	-	-	373289	14176	11908	65695	-	124323	-	611	590003
2005	-	-	-	10	-	-	338178	11386	2393	67129	-	148051	5	183	567334
2006	-	-	-	54	-	-	336652	14895	2598	54959	-	207203	6	128	616495
2007	-	-	-	959	-	-	249991	10535	7573	33531	-	262471	-	302	565361
2008	-	-	-	46	-	-	390738	15547	4646	58725	-	213222	890	190	684005
2009	-	-	-	343	-	-	379823	28523	7013	60963	-	195018	1171	750	673602
2010	-	-	-	8	-	-	259389	11121	3758	27296	-	210942	878	166	513557
2012	-	3	-	-	-	4	12394	5286	1	1461	-	877	-	2	20027
2013	-	-	-	22	6	-	200131	23947	2502	35535	-	132124	1333	42	395641
2014	-	-	229	80	371	-	104198	23472	24	30061	-	105064	1231	5	264735
2015	-	-	-	50	-	-	244126	45621	151	45338	-	78067	4911	85	418348
2016	-	-	385	-	-	-	289871	42886	87	29247	-	64774	4515	2	431767
2017	-	-	2075	27	235	-	266877	35830	542	29943	-	50223	2455	2	388208
TOTAL	**18410**	**3**	**2689**	**6787**	**611**	**4**	**4923645**	**427750**	**178396**	**1150465**	**2**	**2520735**	**17401**	**3269**	**9250167**
Avg. Annual	**920**	**0**	**134**	**339**	**31**	**0**	**246182**	**21387**	**8920**	**57523**	**0**	**126037**	**870**	**163**	**462508**
% Composition	**0.2**	**0.0**	**0.0**	**0.1**	**0.0**	**0.0**	**53.2**	**4.6**	**1.9**	**12.4**	**0.0**	**27.3**	**0.2**	**0.0**	**100.0**

1 - commercial catch data provided by Manitoba Sustainable Development

Table 7.2A-16 Mean Arithmetic and Standardized Mercury (Hg) Concentrations in Lake Whitefish and Northern Pike sampled from Lake St. Martin, the Dauphin River and Sturgeon Bay in 2011 and 2014 and in walleye sampled from Sturgeon Bay in 2011 [1]

Species	Water Body	Year	n	Mean Length	Mean Weight	Mean K	Mean Age	Arithmetic Mean Hg	Standardized Mean Hg
Lake Whitefish									
	Lake St. Martin	2014	4	399	800	1.25		0.049	
	Dauphin River	2014	24	383	904	1.59		0.032	
	Sturgeon Bay	2011	33	392	823	1.48	7.6	0.039	0.039
	Sturgeon Bay	2014	2	424	1200	1.57		0.04	
Northern Pike									
	Lake St. Martin	2014	6	533	1376	0.78		0.232	
	Dauphin River	2014	1	555	975	0.57		0.077	
	Sturgeon Bay	2011	45	551	1574	0.77	5.4	0.17	0.170
	Sturgeon Bay	2014	16	587	1709	0.8		0.234	
Walleye									
	Sturgeon Bay	2011	18	392	823	1.22	3.9	0.2	0.188

1 - samples collected from fish captured during fisheries investigations conducted as part of Lake St. Martin Emergency Outlet Channel monitoring (2011-2015) [1].

Table 7.2A-17 Aquatic Invasive Species near or in Manitoba that may be of concern for the LMBLSMOC Project[1]

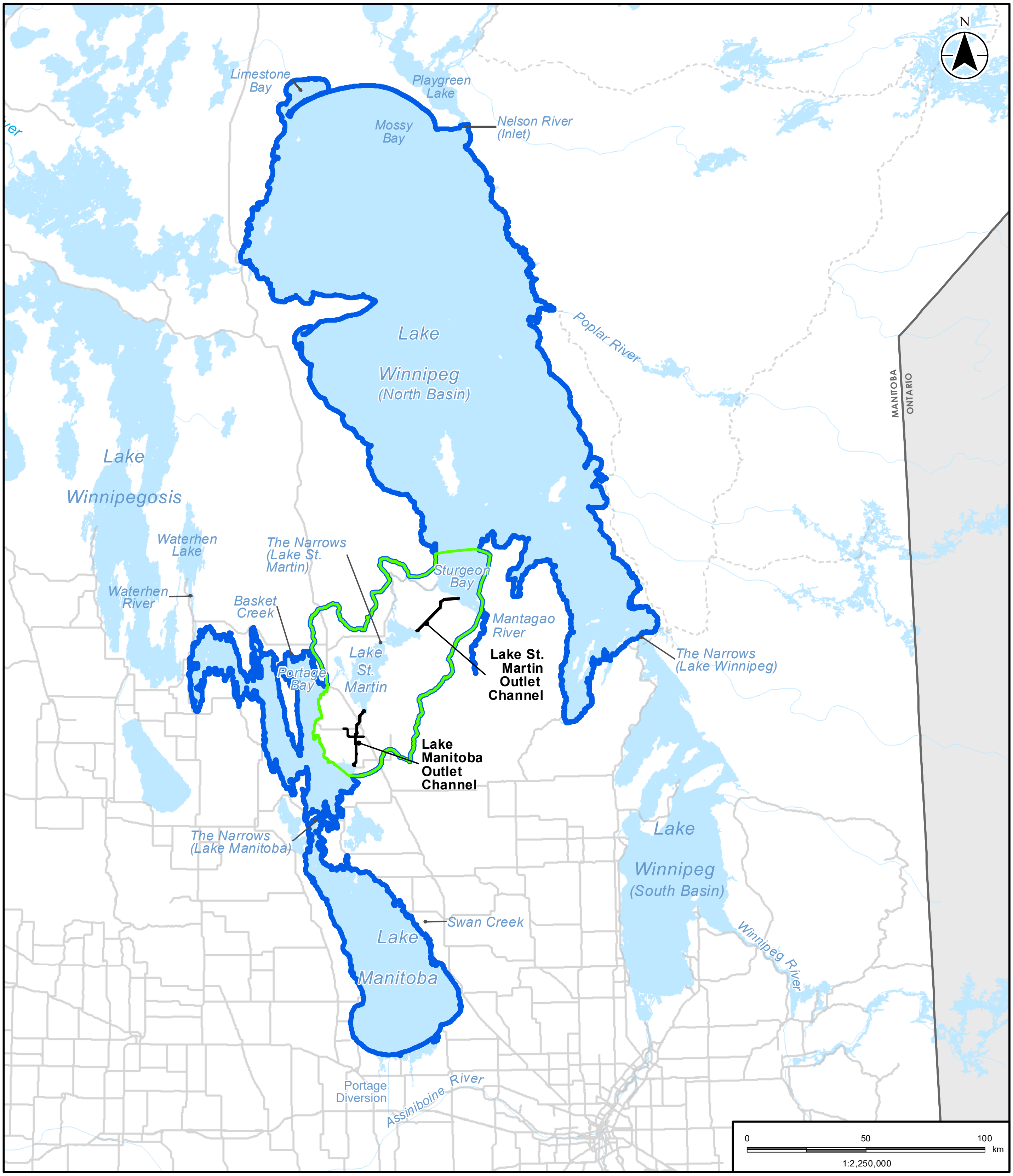
Group	Species	Scientific Name	Present in Manitoba	Preferred Habitat	Distribution in Manitoba	Primary Modes of Dispersal
Fish	Common Carp	*Cyprinus carpio*	Y	Found in slow moving or still waters ranging from streams and ponds to large rivers and lakes. Found over all substrates but prefer shallow water with soft substrates for feeding.[5]	First introduced to Manitoba in 1886, and by 1954 was common. Found in the Red and Assinboine rivers and tributaries, Lake Manitoba, Lake Winnipegosis, Lake Winnipeg and down the Nelson River to Hudson Bay.[5]	Diversions and inadvertent or intentional introductions
	Rainbow Smelt	*Osmerus mordax*	Y	Schooling, midwater fish that prefers cool lakes, reservoirs or lake-like expansions of large rivers with water temperatures up to 15oC. Become increasingly benthic as they approach maturity.[5] Spawning in streams or along beaches.	First found in southern Manitoba in 1991. Found in the Winnipeg River, Lake Winnipeg and Nelson River to Hudson Bay, and Churchill River mouth.[5]	Dispersal is generally in a downstream direction. Introductions through disposal of bait fish.
	MosquitoFish	*Gambusia affinis* or *Gambusia holbrooki*	N	Shallow areas in streams, ponds and ditches, with and without vegetation. The mosquitofish can tolerate low levels of dissolved oxygen and high temperatures. It may thrive in degraded and artificial habitats.[1]	In the United States, established widely in the west, midwest and northeast, including several states bordering the Great Lakes and much of the Mississippi River drainage as far north as Indiana and Illinois. Not yet in Manitoba.[1]	Intentionally introduced in other parts of the world as an agent of Mosquito control; subsequent spread resulted through population growth and dispersal. The aquarium and ornamental pond industries are potential vectors of accidental or unlawful release into open waters, particularly given ongoing public concern about Mosquito-borne disease.[1]
	Round Goby	*Neogobius melanostomus*	N	Usually abundant near shore. Prefer rocky, sandy substrate.[1]	Found in all the Great Lakes and some inland lakes in Ontario and Michigan. Not yet in Manitoba.[1]	On or in watercraft and though inadvertent or intentional introductions.[1]
Invertebrates	Zebra Mussel	*Dreissena polymorpha*	Y	Typically found attached to objects, surfaces, or each other by threads underneath the shells. Thrive in nutrient-rich water that supports healthy populations of plankton. [1] Substantial levels of calcium are required for shell production as are firm surfaces to which the mussels can attach. Prefer slightly alkaline water with temperatures between 68-77˚ F, but can survive more extreme ranges. [2] Along with quagga mussels are the only freshwater mussels that attach firmly to surfaces, including rocks, watercraft hulls etc. [1]	Zebra Mussels have been expanding their range into Manitoba, moving northwards from Minnesota First reported in 2010 in the United States portion of the Red River watershed in Wahpeton, North Dakota. In October, 2013, zebra mussel adults were confirmed in the southwest section of Lake Winnipeg in Manitoba. [1] Currently found in the Red River, Lake Winnipeg and Cedar Lake.	Zebra mussels are often unknowingly transported by boaters or other water users who don't realize mussels or veligers have attached to their equipment. They can also spread via water currents and diversions.[2]
	Spiny Water Flea	*Bythotrephes longimanus*	Y	Commonly found clumped together in lakes, rivers and streams.[1]	Confirmed in the Laurentian Great Lakes and in some inland lakes in Ontario and Minnesota including Lake of the Woods.[1] Found in the Winnipeg River and Lake Winnipeg in Manitoba.[3]	Can be moved from one waterbody to another un-noticed in bait buckets, totes, livewells, bilge or on any fishing equipment, nets, and water-based gear.[1]
	Rusty Crayfish	*Orconectes rusticus*	Y	Found in lakes, rivers, ponds and streams with clay, silt and gravel bottoms that contain rocks, logs or debris. Eat large amounts of aquatic vegetation and their aggressive nature helps protect them from being eaten by native fish.[4]	Rusty Crayfish are a relatively new invader to Manitoba, being first spotted in Falcon Lake in 2007.[3]	Often intentionally introduced into lakes from a bait bucket release, a mercy release, or from an unintentional release such as a boat transfer. Also spread via inter-connecting waterways. It is now illegal to possess any crayfish in Manitoba.[3]
Plants	Flowering Rush	*Butomus umbellatus*	Y	Aquatic and wetland areas including streams, rivers, lakes, stormwater retention ponds, marshes and gravel pits as well as road side ditches.[1]	In Manitoba, it has been seen at Patricia Beach, near Lockport, and along the Assiniboine River in Winnipeg.[1]	Introduced into North America via ballast of trans-Atlantic ships and intentional plantings by gardeners. Thought to be spread over large distances by intentional plantings in water gardens. Further spread is by rhizomes and root pieces. Animals, boaters, water, and ice transport plant materials into novel areas. Wild animals and waterfowl are also dispersal modes.[1]
	Himalayan Balsam	*Impatiens glandulifera*	Y	Invades agricultural areas, natural forests, disturbed areas, rangelands, riverbanks, wetlands and gardens.[1]	It is found in eight provinces including Manitoba, and locally in some gardens and one or two river bank areas within Winnipeg.[1]	Initial spread is mainly from ornamental. Seed can be spread by movement of riparian soil and in the sediment from the bottoms of water courses of infested areas. [1]
	Invasive Phragmites	*Phragmites australis spp. australis*	Y	Common in freshwater marshes, swamps, potholes, roadside ditches, retention ponds, riverbanks, brackish and alkaline wetlands as well as in some tropical wetlands. Usually found in the marsh-upland interface.[1]	Found in several localized concentrations in Winnipeg, Headingley and the capitol region.[1]	Seeds are dispersed over the fall and winter months mostly via wind, water and perhaps by birds. Once established, further spread is primarily through vegetative reproduction. Rhizomes and rhizome fragments are dispersed by water currents, animals and construction equipment such as road maintenance equipment.[1]
	Purple Loosetrife	*Lythrum salicaria L.*	Y	Plants can grow in a variety of habitats including wetlands, ditches, lakes, rivers, railway lines, rock crevasses, on gravel, sand, clay and organic soils. In wet areas including marshes, bogs, prairie potholes, river/stream banks, lakeshores, and roadside ditches.[1]	Eurasian perennial accidentally introduced into North America in the early 1800's. In Manitoba, it has spread as far north as Snow Lake.[1]	Primarily through use as an ornamental. Spreads primarily by seed but can also spread by laterally branching root stocks.[1]
	Curly Leaf Pondweed	*Potomogeton crispus*	N	Generally found in ponds, rivers, lakes, wetlands, streams and brackish waters. Tolerates low light and temperatures and prefers nutrient-rich habitats.[1]	Has not yet been reported or confirmed in Manitoba. Found throughout most of the United States, including areas of North Dakota and Minnesota along the Manitoba border.[1]	Most likely spread overland by recreational boating as the plant wraps around propellers.[1]
	Eurasian Water Milfoil	*Myriophyllum spicatum*	N	Grows in depths of up to 7 metres of water, in any type of aquatic substrate including silt, sand, or rocks.[1]	Reported but not confirmed in Manitoba. It was reported in 1998 and again in 2001 in a channel portion of the Souris River in southwestern Manitoba. Of concern to Manitoba is the general northward spread of the plant and established populations in Minnesota and Wisconsin. The species has been confirmed in the Red River Watershed in North Dakota southwest of Fargo.[1]	Recreational activities are thought to be the major source of introduction. Plant materials caught on boat motors, trailers, nets, boat propellers, and fishing gear can cause introduction to new waterbodies. Dispersal is also linked to the aquarium and aquatic nursery trade. Eurasian Watermilfoil is a popular aquarium plant and unwanted aquarium contents discarded into various water sources including wetlands, lakes, streams and rivers can cause new introductions. Storms, and flood events can further contribute to dispersal.[1]
	Salt Cedar	*Tamarix spp.*	N	Has become established in flood plains, riparian areas, wetlands and lake margins in the western United States. Has also been found growing in dirt stock tanks, railroad rights-of-way, parks, and upland situations.[1]	Present in almost all US States, including North Dakota. In Canada, can be found in nurseries, but has not yet been seen in natural areas.[1]	Dispersal occurs via wind and down river rafting of seeds. Accidental transport can occur with recreational vehicles, tractors, recreational boating and anglers. Ornamental plantings also serve as a dispersal mechanism. [1]
	Yellow Flag Iris	*Iris pseudacorus*	N	Found in wet areas at low- to mid-elevations, growing in ditches, irrigation canals, marshes, stream and lake shorelines and shallow ponds.[1]	Has been widely planted in North America, including Manitoba, as a water garden ornamental and has escaped cultivation.[1]	Yellow Flag-Iris is widely sold in nurseries and on the Internet for wet areas and well-mulched soil. While seeds disperse in the wind and water, popularity of the plant in the market worsen efforts to contain new infestations.[1]

[1] Invasive Species Council of Manitoba https://invasivespeciesmanitoba.com/site/index.php?page=aquatic-species
[2] Cary Institute https://www.caryinstitute.org/sites/default/files/public/downloads/curriculum-project/zebra_mussel_fact_sheet.pdf
[3] https://www.gov.mb.ca/sd/environment_and_biodiversity/invasive_species/fish_and_wildlife/index.html
[4] Ontario's Invading Species Awareness Program http://www.invadingspecies.com/rusty-crayfish/
[5] Stewart and Watkinson 2004

Table 7.2A-18 Species at Risk that Occur, or have the Potential to Occur, in the Aquatic Environment RAA, and have the Potential to Occur in the Aquatic Environment LAA

Species	Scientific Name	COSEWIC Status	*SARA* Schedule	*SARA* Status	Distribution in Manitoba	Preferred Habitat
Mapleleaf Mussel	*Quadrula quadrula*	Threatened	1	Endangered	Red River and in lower reaches of tributaries, Assiniboine River, and lower reaches of some tributaries draining into Lake Winnipeg	Occurs in a variety of habitats ranging from medium to large rivers with slow to moderate current, to lakes and reservoirs in mud, sand, or gravel bottoms. Most typically recovered from medium to large rivers in firmly packed coarse gravel and sand to firmly packed clay/mud bottom
Bigmouth Buffalo	*Ictiobus cyprinellus*	Special Concern	1	Special Concern	Red River and lower Assiniboine River, Assiniboine River diversion, Delta Marsh, south basins of Lake Manitoba and Lake Winnipeg	Near the bottom of shallow lakes, ponds, pools of large streams and man-made impoundments. Inhabit areas where current is slow; tolerates high turbidity. Prefer waters that are warm and highly eutrophic; found in areas where bottom fauna and plankton are abundant.
Silver Chub	*Macrhybopsis storeriana*	Non active	1	Special Concern	Red and Assiniboine river systems, and has expanded northward into lower Lake Winnipeg.	Occurs in large, moderate flow rivers with a substrate of silt or sand, but sometimes gravel, rubble, boulder or bedrock.
Lake Sturgeon	*Acipenser fulvescens*	2007 Endangered 2017 Non-active	Not listed	No Status	Nelson, Saskatchewan, Churchill, Winnipeg, Red and Assiniboine rivers, eastern tributaries to Lake Winnipeg, rare in Lake Winnipeg, extremely rate in Lake Manitoba	Bottom-dwelling fish found in large rivers and lakes, at depths generally over 5 m. Spawning occurs in the spring in fast-flowing water at depths between 0.6 and 5 m over hard-pan clay, sand, gravel and boulders.
Shortjaw Cisco	*Coregonus zenithicus*	Threatened	2	Threatened	Lake Winnipeg, Athapapusko, Reindeer, and George lakes	Found in the deeper waters of large lakes. It has been found at depths of between 55 to 114 m in lakes Superior, Michigan, and Huron. In Lake Superior, has been found to move seasonally. It was found at depths of 110 to 114 m in spring, 55 to 71 m in summer, and at 73 to 90 m in winter. Little is known about habitat preferences in smaller lakes.
Bigmouth Shiner	*Notropis dorsalis*	Not at Risk	3	Special Concern	Assiniboine River and tributaries, Pembina, Roseau, Roaring and Woody rivers	Inhabit small creeks and prairie-like streams, where the bottom is composed mainly of sand and where the flow is constant. Prefer shallow water.
Chestnut Lamprey	*Ichthyomyzon castaneus*	Non-active	3	Special Concern	Red and Assiniboine River and south basin of Lake Winnipeg north to Dog Head Point	Inhabit moderate-sized rivers and large creeks. Spawning occurs from mid-June to late July, in areas of coarse gravel.

Appendix 7B FIGURES



Legend

- Project Development Area (PDA)
- Fish & Fish Habitat Local Assessment Area (LAA)
- Fish & Fish Habitat Regional Assessment Area (RAA)
- Waterbody
- Major Highway
- Winter Road

Manitoba

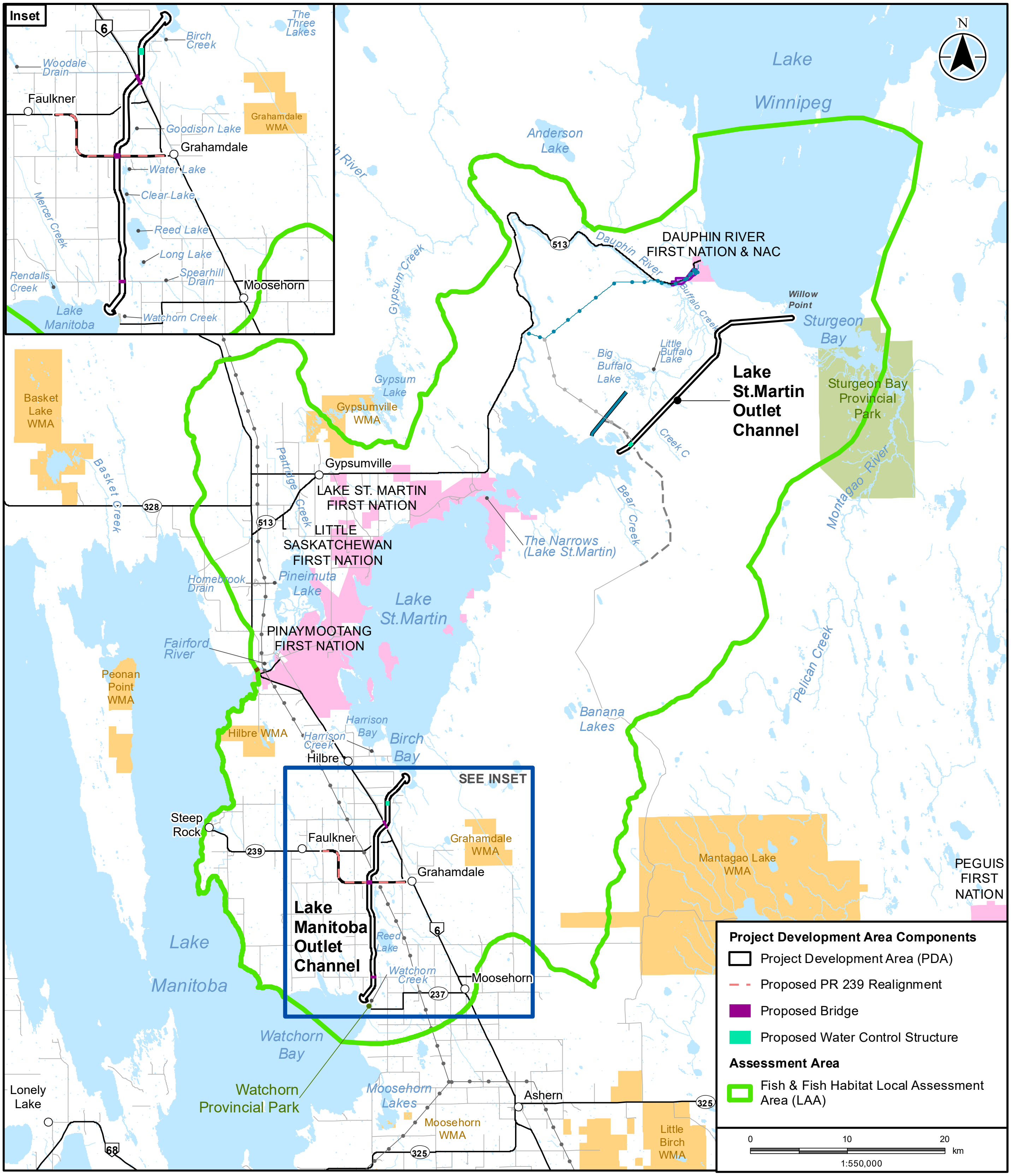
MANITOBA INFRASTRUCTURE
Lake Manitoba & Lake St.Martin Outlet Channels Project
Environmental Impact Statement

Fish and Fish Habitat Spatial Boundaries

Figure 7.2B-1

Notes
1. Coordinate System: NAD 1983 UTM Zone 14N
2. Data Sources: Governments of Manitoba and Canada, Manitoba Infrastructure
3. Last Update: 8/14/2019 2:52:35 PM

G:_GIS_Project_Folder\1114751201\figures\Ch7_Aquatic_Environment\Final\Fig 7.2B-1 AQ Fish and Fish Habitat Spatial Boundaries.mxd



Legend

- Fairford Water Control Structure
- Lake St.Martin Emergency Outlet Channel (Reach 1)
- Lake St. Martin Access Road
- Existing Transmission Line
- Existing Distribution Line
- Planned Distribution Line
- Provincial Highway (PTH/PR)
- Municipal Road
- Northern Affairs Community (NAC)
- First Nation
- Provincial Park
- Wildlife Management Area

Manitoba

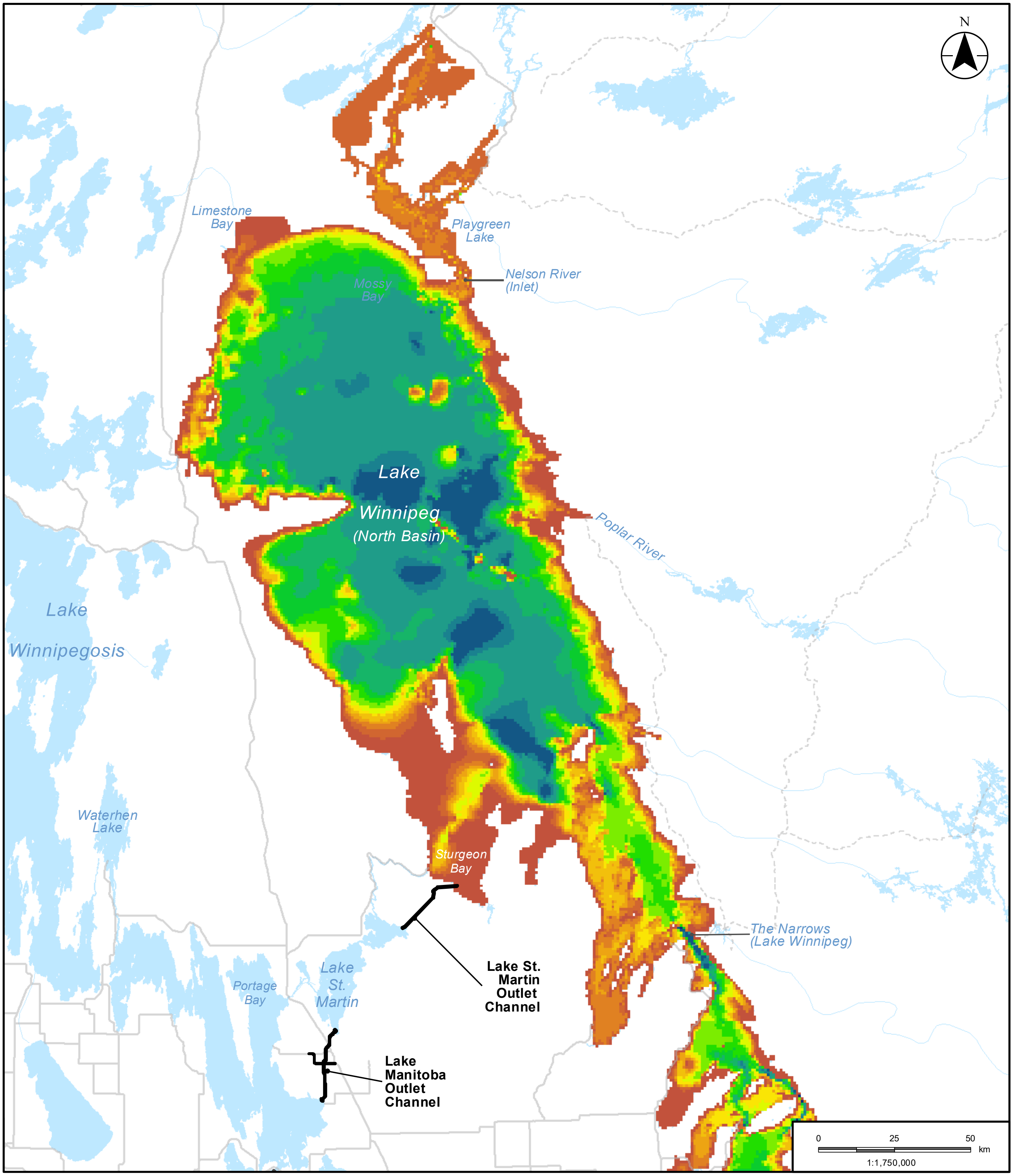
MANITOBA INFRASTRUCTURE
Lake Manitoba & Lake St.Martin Outlet Channels Project
Environmental Impact Statement

Fish and Fish Habitat Local Assessment Area

Figure 7.2B-2

Notes
1. Coordinate System: NAD 1983 UTM Zone 14N
2. Data Sources: Governments of Manitoba and Canada, Manitoba Infrastructure
3. Last Update: 8/14/2019 2:17:23 PM

G:_GIS_Project_Folder\1114751\20\figures\Ch7_Aquatic_Environment\Final\Fig 7.2B-2 AQ Fish and Fish Habitat LAA.mxd



Legend

Project Development Area (PDA)

Depth (m)

2.2 - 3.0	8.8 - 10.1	15.4 - 16.8
3.0 - 4.4	10.1 - 11.5	16.8 - 17.9
4.4 - 6.0	11.5 - 12.9	17.9 - 18.8
6.0 - 7.4	12.9 - 14.2	18.8 - 25.1
7.4 - 8.8	14.2 - 15.4	25.1 - 37.7

Notes
1. Coordinate System: NAD 1983 UTM Zone 14N
2. Data Sources: Governments of Manitoba and Canada, Manitoba Infrastructure, RM of Grahamdale
3. Last Update: 8/14/2019 2:16:19 PM

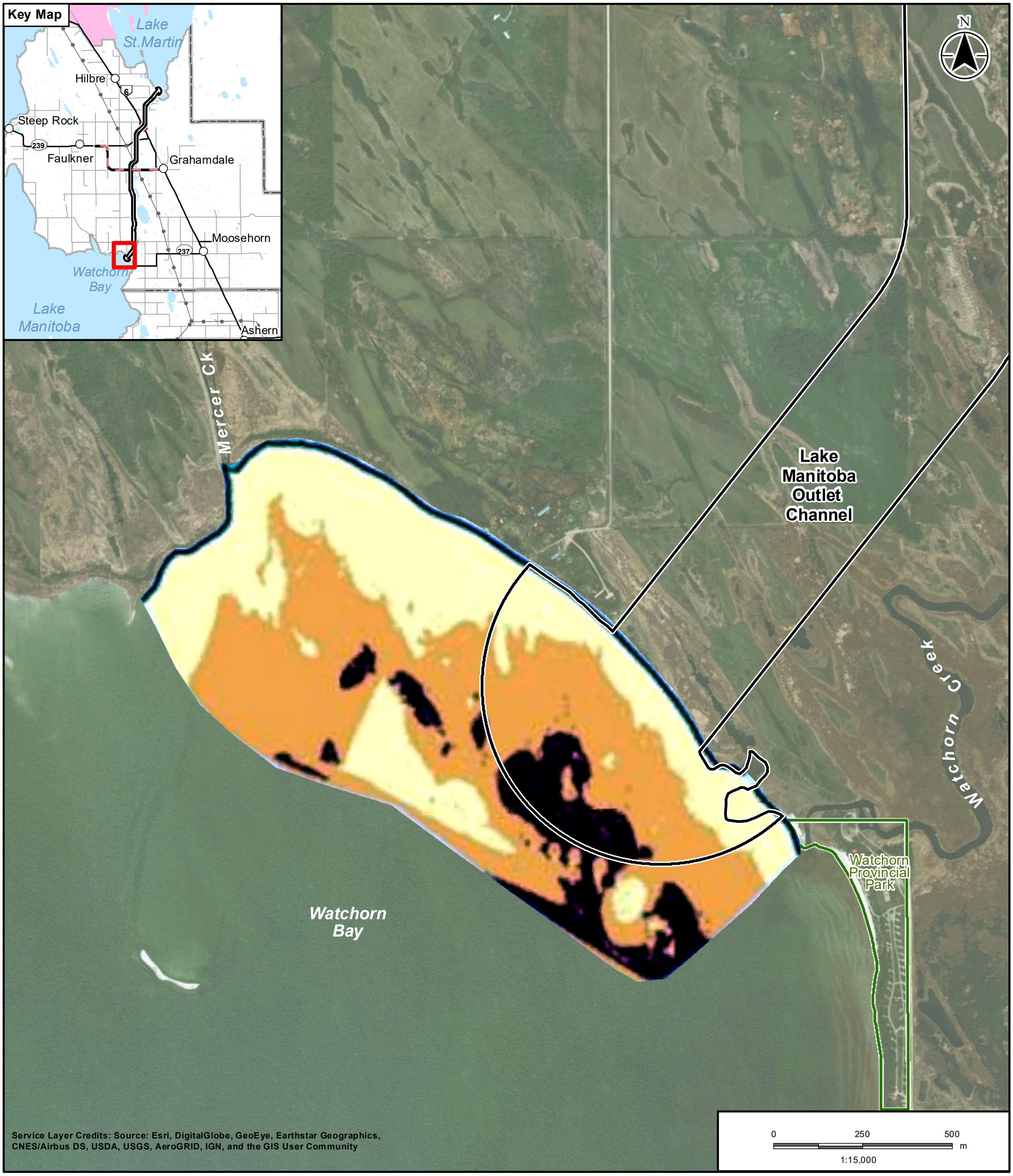
G:_GIS_Project_Folder\1114751200\figures\Ch7_Aquatic_Environment\Final\Fig 7.2B-3 AQ Bathymetry of North Basin of Lake Winnipeg.mxd

Manitoba

MANITOBA INFRASTRUCTURE
Lake Manitoba & Lake St.Martin Outlet Channels Project
Environmental Impact Statement

Bathymetry of North Basin of Lake Winnipeg

Figure 7.2B-3



Legend

Project Development Area (PDA)

Substrate

- Sand
- Gravel with Sand & Silt
- Sand & Gravel

Manitoba

MANITOBA INFRASTRUCTURE
Lake Manitoba & Lake St.Martin Outlet Channels Project
Environmental Impact Statement

Substrate Composition in Watchorn Bay

Figure 7.2B-4

Notes
1. Coordinate System: NAD 1983 UTM Zone 14N
2. Data Sources: Governments of Manitoba and Canada, Manitoba Infrastructure, AAE Tech Services 2016
3. Last Update: 8/14/2019 2:44:38 PM

G:_GIS_Project_Folder\1114751200\figures\Ch7_Aquatic_Environment\Final\Fig 7.2B-4 AQ Watchorn Bay Substrate.mxd

Legend

Substrate Classes

Gravel/Cobble

Gravel/Sand

Silt/Clay

First Nation

Notes
1. Coordinate System: NAD 1983 UTM Zone 14N
2. Data Sources: Governments of Manitoba and Canada, Manitoba Infrastructure
3. Last Update: 8/14/2019 2:46:12 PM

Manitoba

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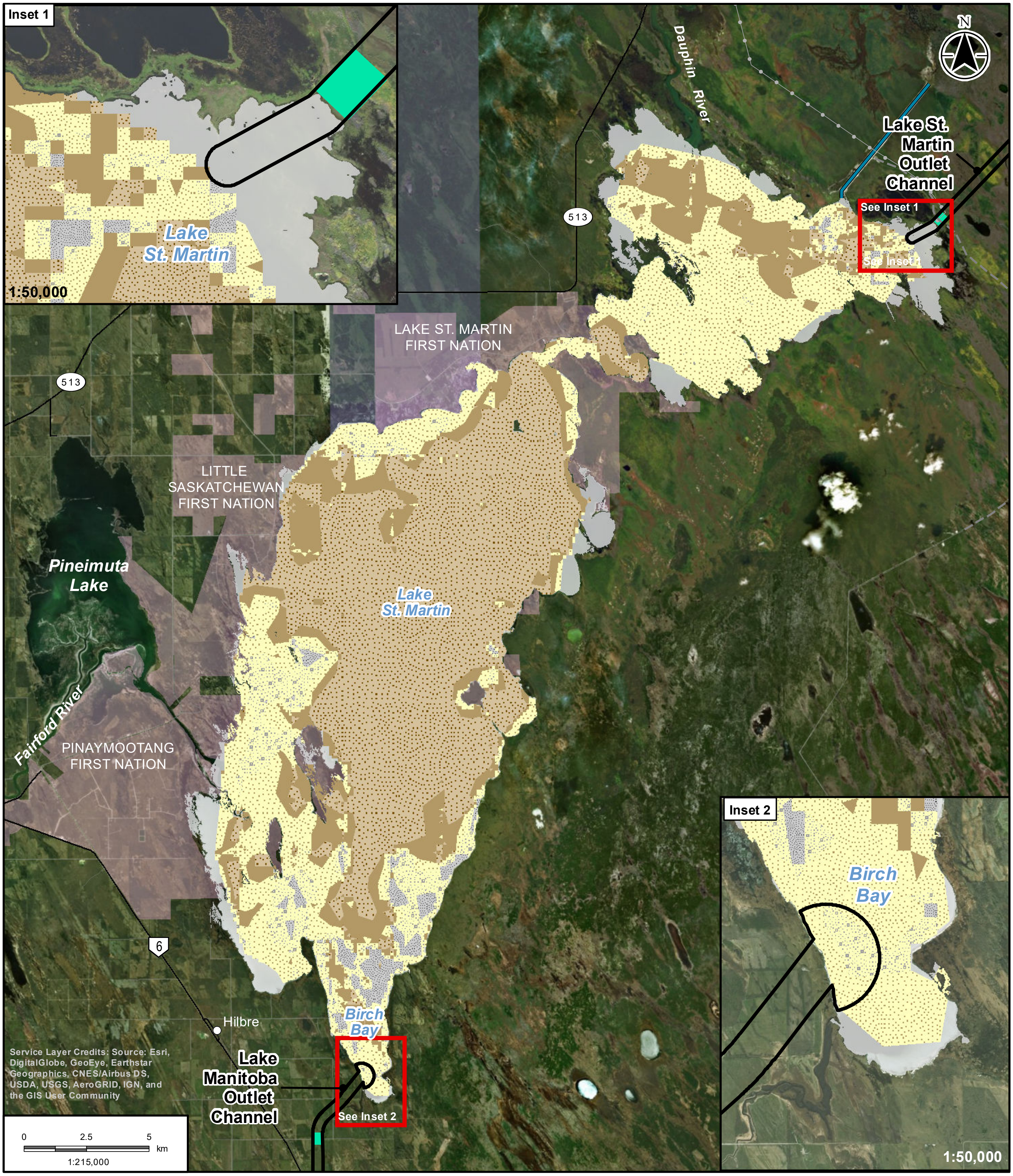
Lake Manitoba & Lake St.Martin Outlet Channels Project
Environmental Impact Statement

Substrate Composition in Pineimuta Lake

Figure 7.2B-5

G:_GIS_Project_Folder\1114751\20\figures\Ch7_Aquatic_Environment\Final\Fig 7.2B-5 AQ Pineimuta Lake Substrate.mxd



Legend

- Project Development Area
- Proposed Water Control Structure
- Lake St.Martin Emergency Outlet Channel (Reach 1)
- Lake St.Martin Access Road
- Planned Distribution Line

Substrate Class

- Cobble/Gravel/Boulder
- Sand/Gravel
- Clay
- Silt/Sand/Gravel/Clay
- Silt/Clay

- Unclassified Substrate
- Provincial Highway (PTH/PR)
- Municipal Road
- First Nation

Notes

1. Coordinate System: NAD 1983 UTM Zone 14N
2. Data Sources: Governments of Manitoba and Canada, Manitoba Infrastructure
3. Last Update: 8/14/2019 2:51:41 PM

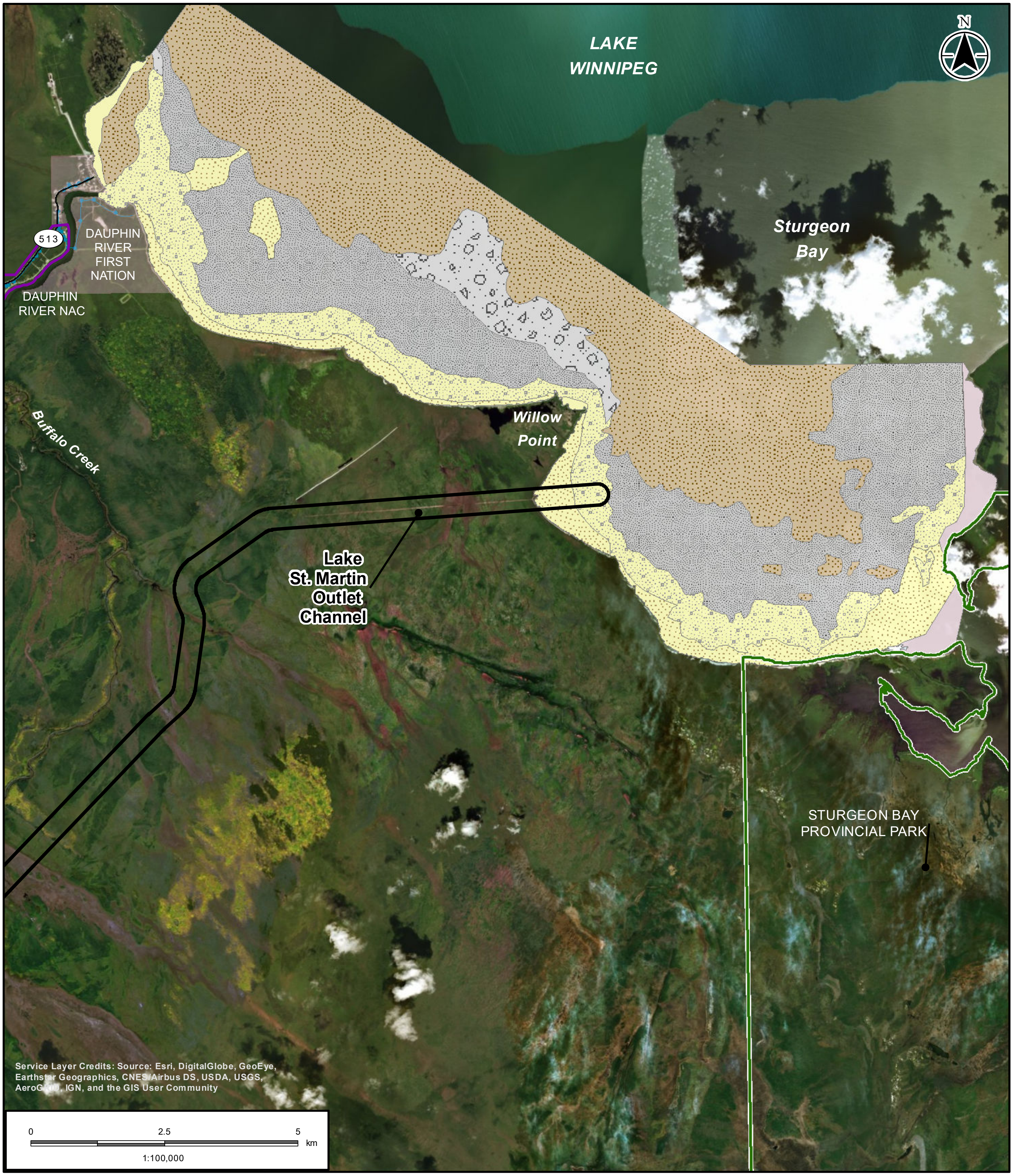
Manitoba

MANITOBA INFRASTRUCTURE
Lake Manitoba & Lake St.Martin Outlet Channels Project
Environmental Impact Statement

Substrate Composition of Lake St. Martin

Figure 7.2B-6

G:_GIS_Project_Folder\1114751201\figures\Ch7_Aquatic_Environment\Final\Fig 7.2B-6 AQ Lake St.Martin Substrate.mxd



Legend

- Project Development Area (PDA)
- Existing Distribution Line

Substrate Classes

- Cobble/Boulder
- Cobble/Gravel
- Gravel/Sand
- Sand
- Sand/Silt
- Silt/Clay
- Not Surveyed
- Provincial Highway (PTH/PR)
- Northern Affairs Community (NAC)
- First Nation
- Provincial Park

Manitoba

MANITOBA INFRASTRUCTURE
Lake Manitoba & Lake St.Martin Outlet Channels Project
Environmental Impact Statement

Substrate Composition in Sturgeon Bay

Figure 7.2B-7

Notes

1. Coordinate System: NAD 1983 UTM Zone 14N
2. Data Sources: Governments of Manitoba and Canada, Manitoba Infrastructure
3. Last Update: 8/14/2019 2:55:28 PM

Appendix 7C PHOTOS

Appendix 7C PHOTOS

Photo 7.2C-1 LMBOC-LM Inlet Digital Globe WV 50 cm Oblique Overview

Photo 7.2C-2 LMBOC-LM Inlet Digital Globe WV 50 cm 2016 Oblique Zoom

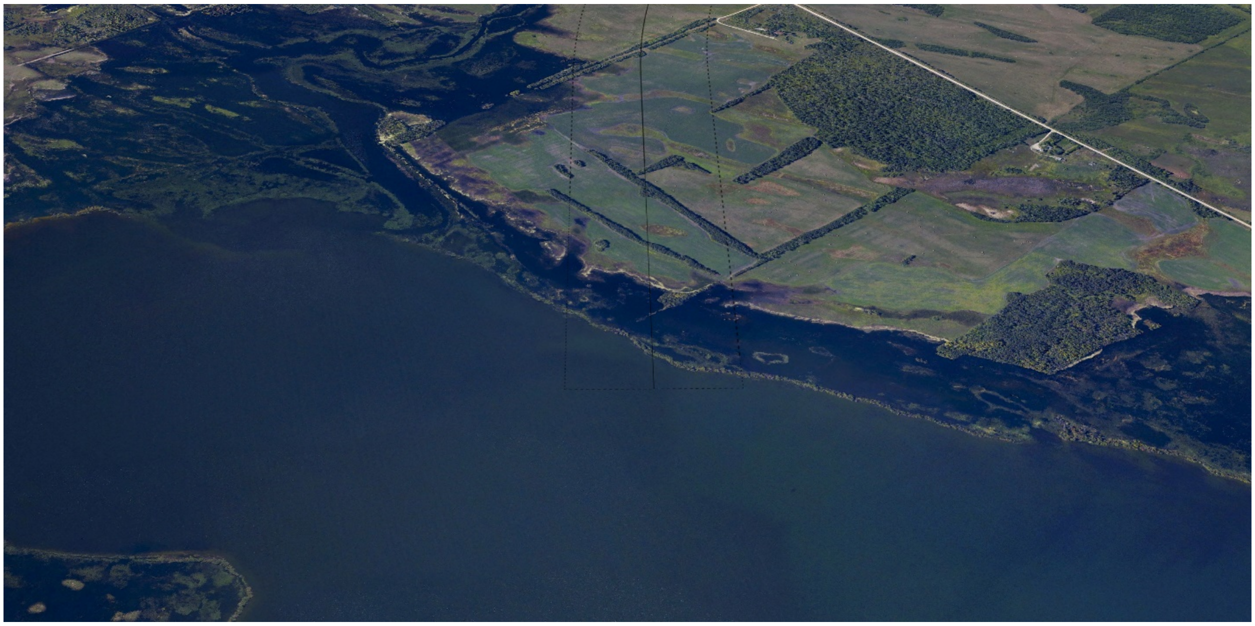


Photo 7.2C-3 LMBOC-LSM Outlet MB Ortho 30 cm 2011 Oblique Overview

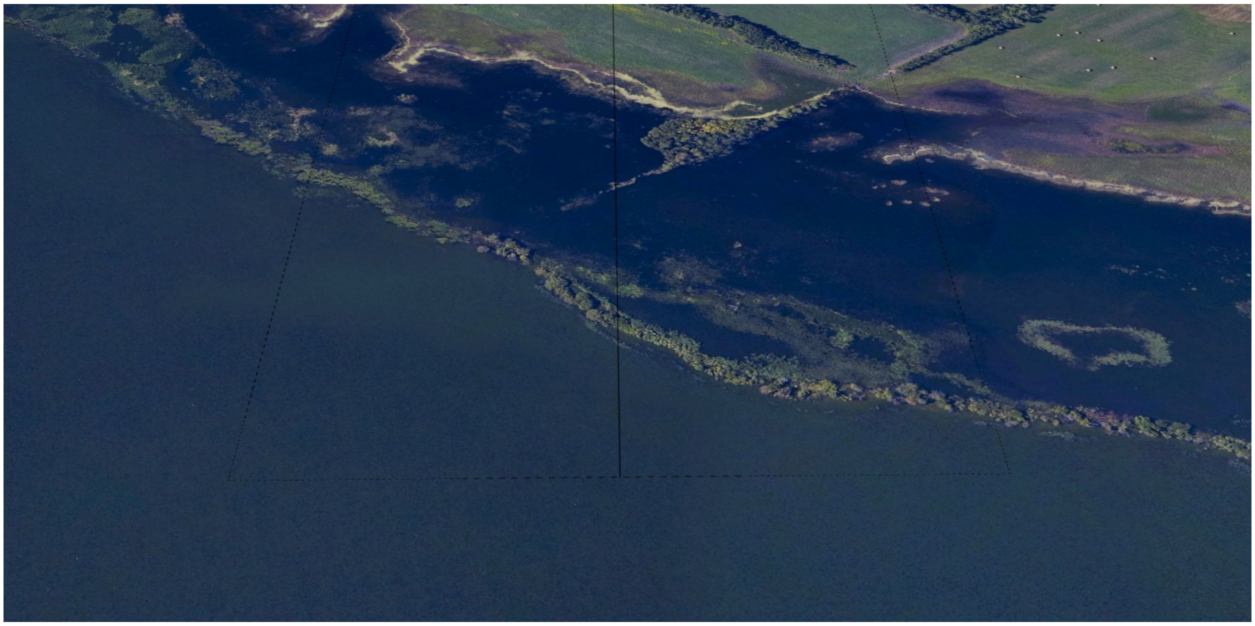


Photo 7.2C-4 LMBOC-LSM Outlet MB Ortho 30 cm 2011 Oblique Zoom

Photo 7.2C-5 LMBOC-LSM Outlet Inlet Habitat

Photo 7.2C-6 LMBOC-LSM Inlet Substrate

Photo 7.2C-7 LMBOC-LSM Inlet MB Ortho 30 cm 2011 Oblique Overview

Photo 7.2C-8 LMBOC-LSM Inlet MB Ortho 30 cm 2011 Oblique Zoom

Photo 7.2C-9 LMBOC-LSM SB Inlet MB Ortho 30 cm 2011 Oblique Overview Large

Photo 7.2C-10 LMBOC-LSM SB Inlet MB Ortho 30 cm 2011 Oblique Zoom

LAKE MANITOBA AND LAKE ST. MARTIN OUTLET CHANNELS PROJECT
Environmental Impact Statement

CHAPTER 8

BIOPHYSICAL EFFECTS ASSESSMENT ON TERRESTRIAL ENVIRONMENT

March 2020

Table of Contents

8.0 ASSESSMENT OF POTENTIAL EFFECTS ON TERRESTRIAL ENVIRONMENT 8.1
8.1 OVERVIEW OF CHAPTER 8.1
8.2 VEGETATION 8.2
8.2.1 Scope of the Assessment 8.2
8.2.1.1 Regulatory and Policy Setting 8.3
8.2.1.2 Influence of Engagement on the Identification of Issues and the Assessment Process 8.6
8.2.1.3 Potential Effects, Pathways and Measurable Parameters 8.7
8.2.1.4 Boundaries 8.9
8.2.1.5 Residual Effects Characterization 8.10
8.2.1.6 Significance Definition 8.12
8.2.2 Existing Conditions for Vegetation 8.12
8.2.2.1 Methods 8.12
8.2.2.2 Overview 8.17
8.2.3 Project Interactions with Vegetation 8.32
8.2.4 Assessment of Residual Environmental Effects on Vegetation 8.35
8.2.4.1 Analytical Assessment Techniques 8.35
8.2.4.2 Change in Landscape Diversity 8.36
8.2.4.3 Change in Community Diversity 8.39
8.2.4.4 Change in Species Diversity 8.49
8.2.4.5 Change in Wetland Functions 8.55
8.2.4.6 Summary of Project Residual Effects 8.62
8.2.5 Determination of Significance 8.63
8.2.5.1 Significance of Residual Environmental Effects from the Project 8.63
8.2.6 Potential Effects on Federal Lands 8.64
8.2.7 Prediction Confidence 8.64
8.2.8 Follow-Up and Monitoring 8.64
8.2.9 Conclusions 8.65
8.2.9.1 Change in Landscape Diversity 8.65
8.2.9.2 Change in Community Diversity 8.65
8.2.9.3 Change in Species Diversity 8.65
8.2.9.4 Change in Wetland Functions 8.65
8.3 WILDLIFE 8.66
8.3.1 Scope of the Assessment 8.66
8.3.1.1 Regulatory and Policy Setting 8.68
8.3.1.2 Engagement and Key Concerns 8.69
8.3.1.3 Potential Effects, Pathways and Measurable Parameters 8.71
8.3.1.4 Boundaries 8.73
8.3.1.5 Residual Effects Characterization 8.74
8.3.1.6 Significance Definition 8.76
8.3.2 Existing Conditions for Wildlife 8.76
8.3.2.1 Methods 8.76
8.3.2.2 Overview 8.78
8.3.3 Migratory Birds 8.86

8.3.3.1 Wetlands....8.86
8.3.3.2 Grasslands....8.88
8.3.3.3 Forests....8.88
8.3.4 Species at Risk and Species of Conservation Concern....8.89
8.3.4.1 Mammals....8.89
8.3.4.2 Birds....8.90
8.3.4.3 Amphibians and Reptiles....8.95
8.3.4.4 Invertebrates....8.96
8.3.5 Project Interactions with Wildlife....8.96
8.3.6 Assessment of Residual Environmental Effects on Wildlife....8.97
8.3.6.1 Analytical Assessment Techniques....8.97
8.3.6.2 Change in Habitat....8.98
8.3.6.3 Change in Mortality Risk....8.109
8.3.6.4 Change in Movement....8.115
8.3.6.5 Summary of Project Residual Effects....8.121
8.3.7 Determination of Significance....8.121
8.3.7.1 Significance of Residual Environmental Effects from the Project....8.121
8.3.8 Potential Effects on Federal Lands....8.122
8.3.9 Prediction Confidence....8.122
8.3.10 Follow-Up and Monitoring....8.122
8.3.11 Conclusions....8.123
8.3.11.1 Change in Habitat....8.123
8.3.11.2 Change in Mortality Risk....8.124
8.3.11.3 Change in Movement....8.124
8.3.12 References....8.124
8.3.12.1 Vegetation....8.124
8.3.12.2 Wildlife....8.131

LIST OF TABLES

Table 8.2-1 Potential Effects, Effect Pathways and Measurable Parameters for Vegetation....8.8
Table 8.2-2 Characterization of Residual Effects on Vegetation....8.10
Table 8.2-3 Native Vegetation Patch Metrics for the RAA....8.18
Table 8.2-4 Land Cover Classes in the PDA, LAA, and RAA based on the Desktop Mapping and LCC Data....8.20
Table 8.2-5 Land Cover Classes in the PDA, LAA, and RAA based on the LCC Data....8.22
Table 8.2-6 Average Age in Years of Forested Cover Classes in the PDA, LAA, and RAA....8.23
Table 8.2-7 Plant SOCC within the PDA, LAA and RAA....8.28
Table 8.2-8 Non-Native Invasive Species within the PDA, LAA, and RAA....8.29
Table 8.2-9 Project-Environment Interactions with Vegetation During Construction and Operations....8.33
Table 8.2-10 Change in Native Upland Vegetation Cover Classes in the LAA....8.43
Table 8.2-11 Change in Area of Forest Age Classes....8.47
Table 8.2-12 Area of Native Upland Vegetation Communities Affected by the 2011 Flood and Change with the Project....8.48
Table 8.2-13 Change in Wetland Abundance in the RAA following Project Construction....8.59

Table 8.2-14 Summary of Project Residual Effects on Vegetation 8.62
Table 8.3-1 Potential Effects, Effect Pathways and Measurable Parameters for Wildlife 8.72
Table 8.3-2 Characterization of Residual Effects on Wildlife 8.74
Table 8.3-3 Furbearers with Potential to Occur in RAA[1] 8.83
Table 8.3-4 Project-Environment Interactions with Wildlife During Construction and Operation 8.96
Table 8.3-5 Summary of Project Residual Effects on Wildlife 8.121

LIST OF FIGURES

Figure 8.2-1 Changes in Area of Forest Age Classes 8.46

LIST OF APPENDICES

APPENDIX 8A TABLES 8A.1

APPENDIX 8B FIGURES 8B.1

APPENDIX 8C PHOTOS 8C.1

APPENDIX 8D SUMMARY OF FIELD STUDIES 8D.1

8.0 ASSESSMENT OF POTENTIAL EFFECTS ON TERRESTRIAL ENVIRONMENT

8.1 OVERVIEW OF CHAPTER

This chapter discusses the terrestrial environment setting and the potential effects that the Project will have on the terrestrial environment. Section 7.1 of the Canadian Environmental Assessment Agency Environmental Impact Statement (EIS) Guidelines for the Project (CEAA 2018) indicate that baseline conditions should be documented for riparian, wetland and terrestrial environments, migratory birds and their habitat, and species at risk. Section 3.3 of the Environmental Assessment Scoping Document for the Project (MI 2018) submitted to Manitoba Sustainable Development indicates that the terrestrial environmental setting will include discussion on ecosystems and vegetative communities, ecosystems and vegetative communities at risk, and wildlife and wildlife habitat. Section 7.2 of the EIS Guidelines indicates that predicted changes to the physical environment should be determined for riparian, wetland and terrestrial environments, and Section 7.3 indicates that predicted effects on valued components should be determined for migratory birds and species at risk. To characterize these changes and effects in a structured way, the following terrestrial environment valued components (VCs) and associated sub-components/focal species are assessed:

- Vegetation:
  - plant species of conservation concern
  - native vegetation communities (upland, wetland and riparian), including ecological communities of conservation concern
  - wetland functions
- Wildlife and Wildlife Habitat:
  - moose
  - American elk
  - furbearers
  - bats
  - migratory birds
  - species at risk

Information is provided on the scope of assessment, existing conditions, Project interactions, assessment of residual environmental effects, determination of significance, cumulative effects, effects to federal lands, and any follow up and monitoring requirements.

8.2 VEGETATION

8.2.1 Scope of the Assessment

This environment assessment for vegetation is in accordance with the requirements described in both federal and provincial guidance documents for the Project. Concordance tables, demonstrating where EIS Guidelines are addressed, are provided at the beginning of this EIS.

Section 3.3 of the Environmental Assessment Scoping Document discusses terrestrial environment in the following subsections:

- Section 3.3.1 indicates that the EIS will describe attributes such as ecological land classification, identification and quantification of broad vegetation classes, description of vegetation communities (based on species composition, site conditions, and topography), description of natural disturbance cycles, invasive species, species of interest identified by local and/or Indigenous peoples (through TK studies and the IPEP).
- Section 3.3.2 indicates that the EIS will also consider ecosystems and vegetative species of conservation concern.

Section 7.1 of the CEAA EIS Guidelines for the Project discusses vegetation issues in the following subsections:

- Section 7.1.7 indicates that the EIS will present information on riparian, wetland and terrestrial environments, including characterization of the shoreline, banks, flooded areas, and wetlands, the ecological function and species composition of each of the riparian and wetland environments, and plant species and their habitats, with a focus on species at risk or with special status, as well as invasive alien species.
- Section 7.2.3 of the EIS Guidelines indicate that the EIS will present information on the changes to riparian, wetland and terrestrial environments, including changes related to landscape disturbance, losses, structural changes and fragmentation of riparian habitat of terrestrial environments and wetlands frequented by birds (types of cover, ecological unit of the area in terms of quality, quantity, diversity, distribution and functions), and changes to shorelines and riparian areas.
- Section 7.3.5 requires an assessment of the potential effects of the Project on species at risk and their critical habitat, including the direct and indirect effects on their survival or recovery.

Chapter 4 (Section 4.4.1) describes VCs as features that may be affected by the Project as related to the role of the VC in the ecosystem and the value people place on it. Vegetation is a VC because it directly supports ecosystem functions, such as carbon sequestration and wildlife habitat, environmental cycles (e.g., nutrient cycling) and is valued for cultural, spiritual and aesthetic benefits.

Project activities have the potential to affect the distribution and abundance of:

- plant species of conservation concern (SOCC)
- native vegetation communities (upland, wetland and riparian), including ecological communities of conservation concern (COCC)
- wetland functions

The Project may also divide patches of native vegetation potentially increasing landscape fragmentation.

8.2.1.1 Regulatory and Policy Setting

A list of various regulatory requirements that were considered in developing this environmental impact statement (EIS) can be found in the Introduction (Chapter 1, Section 1.5 and Appendix 1A). Particular consideration was given to the following federal and provincial legislation, policies and guidelines in the preparation of this environmental assessment.

Federal Regulations and Policy

Relevant legislation includes the *Species at Risk Act* (SARA) and the Federal Policy on Wetland Conservation (Government of Canada 1991).

Species at Risk Act

SARA was implemented to protect species at risk in Canada and their critical habitat. The Committee on the Status of Endangered Wildlife Species in Canada (COSEWIC) was established by the SARA to assess and designate the status of wildlife species, including plants, in Canada. Species listed as extinct, extirpated, endangered or threatened, and designated critical habitat, are protected on federally regulated land and SARA goals are typically reflected in provincial legislation and policies.

Federal Policy on Wetland Conservation

The objective of the Federal Policy on Wetland Conservation (Government of Canada 1991) is to conserve wetlands to sustain ecological and socio-economic functions through enhancement and rehabilitation, securement, maintenance and utilization. Ecological functions include water filtration and storage, habitat, carbon sequestration, nutrient cycling, and socio-economic functions include hunting and trapping, recreation and tourism, natural heritage areas and agriculture. The Federal Policy on Wetland Conservation applies to wetlands on federal lands and waters and those that receive federal funding (lands under federal jurisdiction).

Provincial Regulations and Policies

In addition to federal regulations and policies, several provincial regulations and policies may influence the Project and are considered in the assessment of effects on vegetation.

The Conservation Agreements Act

The Conservation Agreements Act allows landowners and conservation groups to voluntarily protect natural areas, wildlife or fish habitat or plant and animal species on private lands. Conservation agreements can be established between landowners and conservation agencies such as Manitoba Habitat Heritage Corporation (MHHC), Ducks Unlimited Canada or Nature Conservancy of Canada. Limitations on development activities are based on the features to be protected. Specifically, drainage of wetlands, conversion of grasslands and clearing of wooded areas may be restricted.

The Endangered Species and Ecosystem Act

In Manitoba, plant SOCC with legislated protection include species listed federally under SARA as well as species listed as endangered, threatened or extirpated under *The Endangered Species and Ecosystem Act* (MBESEA). It is prohibited to kill, injure, possess or disturb endangered and threatened species or re-introduced extirpated species, and destroy, disturb or interfere with the habitat of endangered and threatened species or locations where previously extirpated species have been reintroduced. Alvars (areas of sparse vegetation on limestone or dolomite bedrock with 10 cm or less soil) and tall grass prairie are also protected under the *Act.* Ecosystem preservation zones may also be designated under the *Act* and activities in these areas may be restricted.

Other SOCC in Manitoba are ranked for rarity by the Manitoba Conservation Data Centre (MBCDC 2018). SOCC ranked S1, S2, and S3 by the MBCDC not listed under the *Manitoba Endangered Species and Ecosystems Act* are not protected; however, they are important contributors to biodiversity in Manitoba and are considered rare or uncommon.

Ecological Reserves Act

Unique, rare and representative natural features, including habitats, geological features and ecosystems, and modified ecosystems offering opportunities for research may be designated as ecological reserves under the *Manitoba Ecological Reserves Act*. Areas are designated as ecological reserve by the Government of Manitoba and access and use of these areas requires prior approval.

Water Rights Act

The construction of water control works that temporarily or permanently alter the level or flow of water in a waterbody, including wetlands is regulated by *The Water Rights Act*. It was amended in 2018 to include wetland offsetting requirements for wetland loss (Government of Manitoba n.d.). Alteration or loss of class 3 (seasonal), class 4 (semi-permanent) or class 5 (permanent) wetlands will require a license and a restoration or enhancement plan prior to disturbance.

The Noxious Weeds Act

Non-native invasive plants are regulated under *The Noxious Weeds Act.* Ninety noxious weeds are listed in the Noxious Weeds Regulations including those that are a threat to agricultural and natural areas. *The Noxious Weeds Act* designates three tiers of noxious weeds. Tier 1 species are those that are considered to have the most potential for negative effects though they may not yet be present in Manitoba. Under the Act, Tier 1 species must be destroyed or eradicated immediately upon discovery. Tier 2 species are already established in Manitoba and have been observed to spread easily. Tier 2 species infestations under five acres are must be eradicated; whereas, infestations larger than five acres must be controlled and kept from spreading. Tier 3 species are all other designated species that do not require immediate control unless the spread of the occurrence poses a threat to the economy, environment, or the well-being of residents. It should be noted that Tier 3 lists common and showy milkweed (*Asclepias syriaca* and *A. speciosa*) that are native plant species and are not considered weeds in this assessment.

The Invasive Species Council of Manitoba (ISCM) has created an early detection and rapid response (EDRR) list and placed invasive species into two categories: Category 1 and Category 2 (ISCM 2016). Category 1 species are those that are not yet known to be present in Manitoba or if so, only in cultivation, and are listed as a Manitoba Noxious Weed with the capability of establishing in Manitoba with a pathway of introduction (e.g., spotted knapweed *[Centaurea stoebe*]). The criteria for Category 2 invasive plants are species that occur in Manitoba and are capable of further invasive spread (e.g., invasive phragmites [*Phragmites australis* subsp. *australis*]). Observations of these species are to be reported to the ISCM and uploaded to the early detection and distribution mapping system (EDDMapS) for the Prairie Region (Manitoba and Saskatchewan). Eradication, if feasible, is the first management option if a Category 1 or 2 species is detected. Otherwise, containment and control programs are recommended.

The Forest Health Protection Act

Forest threats including insects, diseases, and organisms set out in Schedule A and invasive forest threats (set out in Schedule B) are regulated through The *Forest Health Protection Act.* Schedule A includes Dutch elm disease, dwarf mistletoe, and emerald ash borer. Schedule 2 includes oak wilt, sudden oak death, and mountain pine beetle. Programs to protect and promote the health of trees and forests in Manitoba, such as the Dutch Elm Disease Management Program, are administered under the Act. The Forestry and Peatlands Branch of the Manitoba Ministry of Sustainable Development monitors for forest insects and diseases such as Dutch elm disease and emerald ash borer.

The Wildfires Act

The burning of land, timber and debris is regulated under the *Manitoba Wildfires Act*. A burning permit is required for outdoor fires in certain areas of Manitoba. Fires must not be started if conditions could lead to the fire burning out of control and controls must be in place prior to burning material, including a minimum 6 m wide strip of land free of inflammable material or covered by snow or water. Burning material also cannot be placed where it could cause a fire to spread and burning must be supervised until the fire is out.

The Forest Act

Timber and forestry related matters are regulated under *The Forest Act*. The management use and conservation of forest on Crown land as well as afforestation (establishing forest on land with no previous forest cover), reforestation and tree preservation and tree improvement are regulated under the *Act*. In addition, the gathering of wild plants and cutting of hay on Crown lands is administered under the *Act*.

8.2.1.2 Influence of Engagement on the Identification of Issues and the Assessment Process

Manitoba Infrastructure has undertaken engagement prior to and throughout preparation of the EIS, and will continue to engage with Indigenous groups, government agencies, and stakeholders throughout the operation of the Project. A discussion of the engagement process is provided in Chapter 5: Indigenous and Public Engagement with additional details provided in Appendix 5C. Engagement feedback from Indigenous groups, has been an important consideration in identifying issues of concern, framing the scope of the EIS baseline and effects assessments, and in identification of specific mitigation measures, where provided. Engagement feedback specifically related to vegetation was provided by Manitoba Metis Federation, Interlake Reserves Tribal Council and Fisher River Nation. In summary, comments were related to the following:

- concern that channel banks will be devoid of vegetation creating a linear habitat gap were natural re-growth of vegetation does not occur
- increased flows in channels may lead to a reduction in vegetation
- requirement for ongoing monitoring of vegetation
- impacts on vegetation for harvesting from changes in water levels
- protection of existing wetlands from drainage

Potential effects on vegetation are discussed in sections 8.2.4.2 (landscape diversity), 8.2.4.3 (community diversity), 8.2.4.4 (species diversity) and 8.2.4.5 (wetland functions).

Consideration of Indigenous Information and Traditional Knowledge

Traditional knowledge (TK) has also been provided by Indigenous groups through Project-specific studies. Indigenous groups have recommended mitigation measures that when implemented may limit or reduce potential Project effects to the vegetation. Mitigation measures identified by Indigenous groups that have been incorporated into the assessment include the following:

- Manitoba Metis Federation
  - Manitoba infrastructure should prioritize active restoration and rehabilitation of the emergency channel banks to the extent in which heightened flood conditions and damage is no longer

expected. Embankment and riparian areas provide unique habitats for vegetation and stand structural diversity preferred by many wildlife species that are important to the Community. The MMF requests the use of native seed mixes and tree species that mimic pre-disturbance habitat types for the restoration of these areas.

  - Ongoing monitoring of natural revegetation success in Buffalo Creek in engagement with MMF. Adaptive management thresholds should be identified, for which active restoration will be implemented to improve recovery of the area if needed.

- Fisher River First Nation:

  - Implement necessary controls to protect existing wetlands from drainage as a result of drainage plans and construction of the channel and other Project components.

Indigenous input and community concerns contributed to selecting the channel routes for the Project, including avoiding areas described as important, such as the Johnson Beach area and Buffalo Lake. Key issues regarding vegetation identified through the engagement process and the sections of the EIS where they are addressed are summarized in the following sub-sections.

Public Engagement Process

Manitoba Infrastructure received comments about vegetation during four rounds of the (Indigenous and Public Engagement Process (IPEP) as described in Chapter 5. Vegetation related comments from public engagement (and the EIS sections where they are discussed) are grouped into the following categories:

- impacts to existing vegetation (trees and shorelines) of not proceeding with the Project (Section 8.2.2.2)
- impacts to wetlands and their value in flood protection (Section 8.2.4.5)
- potential for invasive species (Section 8.2.4.4)

8.2.1.3 Potential Effects, Pathways and Measurable Parameters

The focus of this assessment is on effects that have the potential to affect the vegetation VC. Potential environmental effects, the effect pathway and measurable parameters used to assess potential effects on vegetation are provided in Table 8.2-1. The assessment uses a diversity approach, assessing changes in landscape, community and species diversity. The abundance of different landcover features and species along with the number or area are assessed at each level. In addition, wetland function is assessed by evaluating changes in the area of wetland classes and indirect effects on hydrology, structure and nutrients. Effects on vegetation may reduce community and species abundance or alter community composition and functions.

Table 8.2-1 Potential Effects, Effect Pathways and Measurable Parameters for Vegetation

Potential Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in landscape diversity	Fragmentation of native plant community patches arising from native vegetation clearing	Number of native plant community cover type patches Number of large "intact" patches of native vegetation cover type patches Mean patch area (ha) of native plant community cover types Mean perimeter (edge) length (km) of native plant community cover type patches
Change in community diversity	Direct loss or alteration of native vegetation communities, including riparian lands and ecological communities of management concern from native vegetation clearing Indirect alteration of native communities, including riparian lands and ecological communities of management concern from the introduction or establishment of regulated weeds and invasive species or deposition of dust	Area (ha) of native upland and wetland plant communities lost or altered and change in spatial distribution Area (ha) of ecological communities of conservation concern lost or altered Number of occurrences of weeds and other non-native invasive plant species that are aggressive competitors to native species
Change in species diversity	Direct loss of plant SOCC or plant species of interest for Indigenous groups due to vegetation clearing Indirect effects on plant SOCC or plant species of interest for Indigenous groups from herbicide application to control the spread of regulated weeds	Number of SOCC occurrences affected by the Project and change in spatial distribution Occurrences of traditional plant resources affected by the Project and change in spatial distribution Area (ha) of Species at Risk critical habitat lost or altered (Government of Canada 2016a) Number of occurrences of weeds and other non-native invasive plant species that are aggressive competitors to native species and rare plants
Change in wetland functions	Direct loss or alteration of wetland area, change in wetland type, or reduced quality from vegetation clearing Indirect loss or alteration of wetland area, change in wetland type or reduced quality because of changes in surface and groundwater	Area (ha) or type of wetland lost or altered and change in spatial distribution Area (ha) of human disturbance

8.2.1.4 Boundaries

Spatial Boundaries

The Project development area (PDA), local assessment area (LAA) and regional assessment area (RAA) for the assessment of effects on vegetation are shown in Appendix 8B, Figure 8.2B-1 and described below. Federal lands within these boundaries consist of reserve lands associated with the Indigenous communities.

Project Development Area

The PDA is the area in which the Project components and activities are located, covering 2,099 ha and including the area of physical disturbance associated with the construction and operation of the Project. The PDA includes the Lake Manitoba Outlet Channel (LMOC), the realignment of highway PR 239, and the Lake St. Martin Outlet Channel (LSMOC).

Local Assessment Area

The LAA for the assessment of effects on vegetation includes the PDA and a 1 km buffer around the PDA including along the shore of Lake St. Martin (Appendix 8B, Figure 8.2B-1). The LAA is used to evaluate measurable effects from the Project on upland vegetation and species of conservation concern (SOCC) and inform changes in wildlife habitat. A 1 km buffer around the PDA was selected so that it is large enough to be representative of the spatial distribution of native vegetation communities observed from air photo review and capture measurable effects on upland vegetation.

Indirect effects on wetlands may extend beyond the LAA and are, therefore, assessed at the RAA level in conjunction with the assessment of effects on wetland functions. The Lake St. Martin shoreline was buffered as water levels in the lake are predicted to decrease with the Project (see Section 6.4), which could measurably alter surrounding vegetation, particularly in wetlands. Lake water levels are above the desired operating level 24.4% of the time currently and levels are expected to be above the desired operating range 5.2% of the time with the Project. Water levels are expected to decrease by 0.06 m during non-flood conditions, 0.46 m during minor flood conditions and 0.74 m during high flood conditions.

Changes in water levels are also predicted for Lake Manitoba and Lake Winnipeg, but the changes are predicted to be small (2.4 cm or less on Lake Manitoba and undiscernible on Lake Winnipeg) and measurable changes in surrounding vegetation are not expected. Changes to Lake Pineimuta water levels may also occur; however, only changes to flood levels are expected and therefore the lake is not included in the LAA.

Regional Assessment Area

The RAA for the assessment of effects on vegetation includes the PDA and LAA and a 12 km buffer either side of the PDA (Appendix 8B, Figure 8.2B-1). The RAA is used to assess Project effects on landscape diversity and wetland functions, and contributions to cumulative effects, including the effects of past, present and reasonably foreseeable future activities, on vegetation. The 12 km buffer was selected because it includes the contributing sub-watersheds in which changes in hydrology may occur and is large enough to characterize regional vegetation and land use patterns. The buffer is the same as is used in the wildlife assessment (Section 8.3).

Temporal Boundary

The temporal boundary for the assessment of effects on vegetation covers the duration of the construction and operation and maintenance phases of the Project. Construction is tentatively expected to occur over a period of approximately 2.5 to 3 years with approximately 1-2 years for post-construction works, such as site clean-up, survey, and environmental offset works. It is currently estimated that construction would occur from fall 2020 to spring/summer 2023, with operation and maintenance starting in fall 2022. The overall schedule is contingent largely on receipt of the final regulatory approvals in 2020. Once construction is complete, the Project would be ready for operational usage on an as-required basis. The operation and maintenance phase of the Project is expected to be ongoing for an indefinite future.

8.2.1.5 Residual Effects Characterization

Table 8.2-2 presents definitions for the characterization of residual environmental effects on vegetation. The criteria describe the potential residual effects that remain after mitigation measures have been implemented.

Table 8.2-2 Characterization of Residual Effects on Vegetation

Characterization	Range of Criteria	Level of Effect and Definition
Direction of Change (type of effect)	Neutral	No measurable change on the VC.
	Adverse	Net loss (adverse or undesirable change) on the VC.
	Positive	Net benefit (or desirable change) on the VC.
Duration (period of time the effect occurs)	Short-Term	The potential effect likely only persists for the time required to complete a discrete component during construction, maintenance, or reclamation activities (i.e., a timeframe of several months up to one year).
	Medium-Term	The potential effect is likely to persist until the completion of construction and reclamation activities (i.e., > 1 year to 10 years).
	Long-Term	The potential effect is likely to persist beyond the completion of construction and rehabilitation activities into the operations and maintenance phase of the Project (i.e., a timeframe of greater than 10 years).
Magnitude (degree or intensity of the change)	Negligible or Low	Negligible – no measurable change from existing conditions Low – a measurable change in vegetation conditions, but unlikely to affect sustainability in the LAA or RAA and no effect on species or communities of management concern

Table 8.2-2 Characterization of Residual Effects on Vegetation

Characterization	Range of Criteria	Level of Effect and Definition
	Moderate	Measurable change affecting the sustainability of vegetation, including species and communities of management concern in the LAA, but unlikely to affect sustainability in the RAA
	High	Measurable change affecting the sustainability of vegetation in the RAA
Timing[1]	Moderate Sensitivity	Effect may occur during a lower sensitive period of a critical life stage; for vegetation and wetlands this is summer, fall or winter when the ground is dry or frozen and many plant species have flowered and set seed, or are dormant.
	High Sensitivity	Effect occurs during a critical life stage (e.g., plant germination, flowering) or during spring when soils are wet, and areas are more subject to erosion from rainfall.
	Not Applicable	Residual effect of Project activities will have the same effect on the VC, regardless of timing
Extent (Spatial Boundary)	PDA	The physical space or directly affected area on which Project components or activities are located and/or immediately the adjacent area, including designated ROWs, and permanent and temporary facilities (e.g., borrow pits and quarries)
	LAA	Area within which potential direct and indirect Project effects are measurable and extending beyond the Project Footprint to, but not beyond, the LAA.
	RAA	The regional extent of potential direct, indirect and cumulative effects that may extend beyond the LAA.
Frequency (how often the effect occurs)	Infrequent	The potential effect occurs once or seldom during the life of the Project (e.g., initial clearing and grubbing).
	Sporadic/Intermittent	The potential effect occurs only occasionally and without any predictable pattern during the life of the Project (e.g., blasting at quarries; site-specific construction equipment noise; potential wildlife-vehicle collisions).
	Regular/Continuous	The potential effect occurs at regular and frequent intervals during the Project phase in which they occur or over the life of the Project (e.g., noise associated with vehicle traffic along the realigned portions of PR 239).
Reversibility (the degree of permanence)	Reversible (short-term)	Potential effect is readily reversible over a relatively short period (< than five years).
	Reversible (long-term)	Potential effect is potentially reversible but over a long period (> than five years).
	Irreversible	Project-specific potential effects are permanent and irreversible.

[1] In terms of Timing, the critical life stages include things such as nesting, breeding, spawning and calving which will vary by VC and will vary annually depending on seasonal conditions. For example, it is clear that winter is outside of bird nesting and breeding period and that spring is fully within this critical time period, whereas early spring and late fall is a transitional period that depending on the seasonal conditions may or may not affect the life stage.

Table 8.2-2 Characterization of Residual Effects on Vegetation

Characterization	Range of Criteria	Level of Effect and Definition
Ecological Context	Undisturbed	Ecological: Area is relatively undisturbed or not adversely affected by human activity.
	Disturbed	Ecological: Area has been substantially previously disturbed by human development or human development is still present.

8.2.1.6 Significance Definition

A significant effect on vegetation is one that after the application of mitigation:

- threatens the long-term persistence or viability of a plant species or community in the RAA, including effects that are contrary to or inconsistent with the goals, objectives or activities of recovery strategies, action plans and management plans, published conservation targets, or
- results in uncompensated loss of wetland function, or
- threatens the long-term availability of traditional-use plants within the RAA

8.2.2 Existing Conditions for Vegetation

8.2.2.1 Methods

Published literature, vegetation databases, maps and aerial photographs were reviewed for information on existing conditions for vegetation in the PDA, LAA and RAA and Project field surveys were conducted. Reviewed information sources included information on species abundance and distribution, plant community composition and traditional use of plants. Field surveys of the PDA, LAA, and RAA were conducted with surveys focusing on SOCCs.

Existing Data and Analysis

Existing data on vegetation is organized into the following:

- vegetation mapping
- species and communities of conservation concern
- plant species of interest to Indigenous groups
- wetland functions

The following information sources were used to gather background information on the LAA and RAA for vegetation:

- AltaLis aerial imagery (2017)
- Google Earth® (2019, 2014, 2011)
- Government databases that included information on provincially-listed SOCC (Manitoba Conservation Data Centre [MBCDC 2018]), federally-listed species at risk (Species at Risk Public Registry), and non-native invasive species and regulated weeds (Early Detection and Distribution Mapping System [EDDMapS 2019])
- Manitoba version of Land Classification Canada for 2005 (Land Sat Thematic Mapper) imagery (30 m resolution) (LCC 2005)
- Manitoba Forest Resource Inventory (FRI 2016)

Vegetation Mapping

Land cover in the PDA and LAA portions of the LMOC and LSMOC were mapped using LCC data (2005), 2017 orthophotos and LiDAR data. Land cover classes in the LAA (Appendix 8A, Table 8.2A-1) were adapted from the LCC (Government of Canada 2003), the Canadian Wetland Classification System (National Wetland Working Group 1997) and the Boreal Wetland Classes in the Boreal Plains Ecozone of Canada (Ducks Unlimited Canada 2018) were mapped to 50 cm resolution using object based image analysis (OBIA). Land cover areas were identified by analyzing spectral, textural, size and shape characteristics of the imagery, checked against available LCC data (2005), Manitoba Habitat Heritage Corporation (MHHC) wetland data (2013) and Manitoba Forest Resource Inventory (FRI) data (FRI 2000). Areas without existing LCC, FRI or MHHC data were classed using a supervised classification approach; identifying training areas and classifying areas with similar image characteristics. Forest and shrubby communities were further separated using AltaLis LiDAR data to evaluate vegetation height and age classes were identified using Manitoba forest fire history data (Manitoba Conservation 2013).

Due to limited coverage of 2017 imagery, land cover mapping could not be updated for the portion of the LAA around Lake St. Martin, the power distribution line, and the RAA. Land cover surrounding Lake St Martin, the power distribution line, and in the RAA was mapped using LCC data (2005) and refined using available FRI data. Mapping in the RAA was completed at a scale of 1:20,000 and land cover classes are provided in Appendix 8A, Table 8.2-2.

Both the desktop mapping data and the LCC data (Table 8.2-5) on land cover are presented for existing conditions. The LCC data was used to make direct comparisons between the PDA, LAA and RAA. The desktop mapping data was used to provide greater detail and to assess both direct and indirect effects on community diversity within the LAA. There are several discrepancies between the desktop mapping data and the LCC data, for example:

- The LCC dataset does not classify the land cover at a scale to discuss the native vegetation communities, in particular wetlands i.e., fen – forested.
- The LCC dataset underestimates the area of forested wetlands. They may be lumped within the shrub dominated wetlands. The desktop mapping was completed at a finer scale to include bog – forested, fen – forested, swamp – forested coniferous, swamp – forested deciduous, and swamp – forested mixedwood.
- The LCC dataset overestimates the amount of native upland vegetation classes, particularly grasslands. The LCC grasslands likely contain tame pasture, hayland, and cultivated land. During field surveys conducted in 2016, most of the grasslands surveyed within the PDA for the LMOC were identified as tame hayland and pasture. The desktop mapping was completed at a finer scale and, therefore, detects wetlands that are not captured in the LCC dataset.
- The LCC dataset underestimates the areas of agricultural land. The desktop mapping captured areas that have been converted to hayland, tame pasture, or cultivated that the LCC data classified as wetlands.
- The LCC dataset overestimates the areas of developed land, particularly in the LAA. This is likely due to the coarser scale of the dataset.

Aquatic vegetation was also mapped for the portions of Lake Manitoba, Lake St. Martin and Lake Winnipeg in the LAA. The publicly available Sentinel-2 multispectral 10 m resolution satellite imagery was used to identify, map and quantify aquatic vegetation in LAA portions. Imagery obtained from AltaLis (dated August 22, 2018) was used for mapping aquatic vegetation, and vegetation was near annual peak growth and water levels were relatively low. The imagery channels coastal (432 µm to 443 µm), blue (459 µm to 525 µm), green (541 µm to 577 µm) and red (649 µm to 680 µm) were clipped to the LAA.

An adaptive image enhancement was applied to each water body to expose details in the darker water pixels and spectral, texture, shape and size attributes were used to identify aquatic vegetation. Aerial photos (Google Earth and Bing imagery) were used to identify aquatic vegetation near shorelines and train the mapping classification. No accuracy assessment could be performed because field data of submerged vegetation for the LAA were not available.

Landscape diversity metrics of native vegetation cover were calculated in the RAA for forest, shrubland, grassland and wetlands. The calculated metrics included number of patches, patch size and patch perimeter length. Adjacent individual polygons of same top level landcover class (e.g., forest) were merged into a single polygon and the number of patches, patch size and perimeter length were then calculated. The number and patch size of forested patches of 200 ha or greater, minus a 100 m wide internal strip, was also calculated following recommended methods of Environment Canada (2013). Patches larger than 200 ha, minus a 100 m internal strip, are important for wildlife species and ecological function. Retention of grassland patches 50 ha or larger, with at least one patch 100 ha or larger, is also recommended by Environment Canada (2013). Conservation targets are not available for shrub and wetland patches, and 50 ha is used because these areas may be affected similarly to grasslands.

Species and Communities of Conservation Concern

The Species at Risk Public Registry (Government of Canada 2019) was searched for federally listed species at risk within Manitoba. The Government of Manitoba Wildlife and Fisheries Branch lists the species protected under the *Endangered Species and Ecosystems Act.* A literature review was conducted to find the habitat preferences of each species at risk to determine if they have potential to occur within the RAA. The MBCDC was searched in 2015 for a list of SOCC that have historically been present within 20 km of the PDA (Friesen 2015, pers. comm.) prior to field surveys in order to determine the potential for SOCC within the RAA. The MBCDC was searched again in 2019 to determine if there are any recently identified occurrences of SOCC within the PDA, LAA, and RAA (Murray 2019, pers. comm.). The University of Manitoba Herbarium (WIN) online database was also searched for historical occurrences of plant SOCC with in the PDA, LAA, and RAA (Ford 2017).

Communities of conservation concern (COCC) are native upland vegetation communities listed as at risk by MBESEA including alvars and tall grass prairie. COCC also include sensitive sites with unique landform features that can support uncommon vegetation communities defined in Chapter 6, Section 6.3.2.4 as shallow (within 1 m) soils exposed bedrock (i.e., limestone and dolomite), saline soils, and sandy soils (see Chapter 6, Appendix 6B, Figure 6.3B-15).

Alvars are characterized by the presence of a thin or absent layer of soil (less than 10 cm) overlying limestone or dolomite bedrock pavement and are globally uncommon habitats (Reschke et al. 1999). The presence of bedrock can restrict the drainage and retention of water, which can result in flooding or drought conditions in these habitats, which can result in vegetation composition different from other habitat types in the RAA and including provincially, nationally and globally rare species (Reschke et al. 1999).

Plant Species of Interest for Indigenous Groups

The following documents were reviewed to identify plant species of interest to Indigenous groups potentially affected by the Project:

- Metis Land Use and Occupancy Study: Assessment of Potential Effects Prior to Mitigation, Manitoba-Minnesota Transmission Project: Prepared for Manitoba Hydro and Manitoba Conservation and Water Stewardship. (Manitoba Metis Federation [MMF] 2016)
- Bipole III Transmission Project: Aboriginal Traditional Knowledge Technical Report: A Summary of the Self-Directed Studies Report #2. (Manitoba Hydro 2011)
- Keeyask Transmission Technical Report. Heritage Resources. (Manitoba Hydro 2012)

- An Ecosystem Service Assessment of Peatlands in the Eastern Interlake Regions of Manitoba (International Institute for Sustainable Development 2013)
- Interlake Reserves Tribal Council October Phase 1 Traditional Land Use and Traditional Knowledge Report (Interlake Reserves Tribal Council 2018)
- Interlake Reserves Tribal Council October 2017 Meeting Summary Report - Draft for Comment (Interlake Reserves Tribal Council 2017)
- Manitoba-Minnesota Transmission Project. Environmental Assessment (Manitoba Hydro 2015)

During rare plant surveys, all observed vascular plant species were recorded at each survey transect. Observed species lists for each site were cross-referenced with the documents to determine presence of plant species in the PDA, LAA and RAA that are of interest to Indigenous peoples.

Non-Native Invasive Species and Regulated Weeds

The EDDMapS Prairie Region was searched for historical occurrences of non-native invasive species listed under *The Noxious Weeds Act* within the PDA, LAA, and RAA (EDDMapS 2019).

Wetland Functions

Wetland functions are natural processes associated with the regulation of wetland hydrology, biogeochemical cycling, habitat and carbon sequestration (Hanson et al. 2008; Keddy 2000). Various assessment techniques have been developed to assess wetland functions (Hanson et al. 2008) and include landscape and watershed scale approaches, rapid field methods and intensive field studies. Wetland functions for this EIS were assessed using a hydrogeomorphic, landscape scale assessment of wetland abundance following methods of Brinson (1993). The hydrogeomorphic approach was selected because it uses readily available desktop information and is focused on essential wetland processes. A standard field-based assessment approach has not been developed for Manitoba and data on wetland conditions in the PDA, LAA and RAA are primarily desktop.

The abundance of wetland classes (e.g., bog, fen, swamp) and types (forested, shrub, graminoid), along with information on hydrology (e.g., source of water, type of water loss) was used to determine the functions performed by wetlands in the RAA and sub-watersheds intersected by the Project. The relative abundance of human disturbance in the RAA and Project intersected sub-watershed was used to evaluate how well wetland functions are performed. Available published literature and professional judgement is used to evaluate existing wetland function conditions from land use and potential project effects. Assessment of wetland abundance and human disturbance at the sub-watershed level is provided in addition to the RAA because the Project may alter water inputs to wetlands in these areas by intersecting surface and shallow groundwater flows.

Field Surveys

The government of Manitoba has no requirements or protocols for rare plant surveys (Friesen 2019, pers. comm.).

Vegetation field surveys were conducted in 2016 at 68 sites within the RAA (Manitoba Infrastructure 2016a; 2017a, b). These surveys were conducted to identify occurrences of SOCC, weed species, and traditional-use plant species. Survey sites were located in the following areas:

- 22 in the LMOC PDA
- 5 in the LSMOC PDA
- 2 in the LAA on the north shore of Lake St. Martin
- 4 in the LAA on the west shore of Lake St. Martin
- 35 in the RAA outside the LAA

The vegetation surveys were completed from June 5 to 11 and August 2 to 5, 2016 to capture both early- and late-blooming species. Transects 500 m^2 (100 m long, 5 m wide) were surveyed perpendicular to the PDA. A vascular plant species inventory was completed on each transect along with soil type and a description of the vegetation community. The vegetation community was assessed using the forest ecosystem classification system for Manitoba (Zoladeski et al. 1995). Vegetation communities were visually assessed and classed to vegetation type (V-Type) based on the dominant tree species in the stand and the dominant vascular plant species in the understorey (Zoladeski et al. 1995).

8.2.2.2 Overview

The Project is in the Sturgeon Ecodistrict of the Mid-Boreal Lowland Ecoregion and Ashern and Gypsumville Ecodistricts of the Interlake Plain Ecoregion. A portion of the RAA is also located in the Waterhen Ecodistrict; however, it occupies a very minor portion (2.6%) of the northwest portion of the RAA and is inconsequential on the assessment and, therefore, is not characterized.

The Sturgeon Ecodistrict has a mean elevation of 259 m above sea level (m asl) and is located along the west side of Lake Winnipeg from Wicked Point in the north to Fisher Bay in the south, encompassing most of the north basin of Lake Winnipeg (Smith et al. 1998). Upland areas are characterized by mixed forest stands of black spruce (*Picea mariana*), jack pine (*Pinus banksiana*), trembling aspen (*Populus tremuloides*) and balsam poplar (*Populus balsamifera*). Bog wetlands are dominated by black spruce and ericaceous shrubs (e.g., Labrador tea [*Rhododendron groenlandicum*]), and fens are dominated by sedges (*Carex* spp.), brown mosses (e.g., *Drepanocladus aduncus*, *Tomentypnum nitens*), swamp birch (*Betula pumila*) and tamarack (*Larix laricina*). The average annual growing season is 166 days and annual precipitation is approximately 510 mm.

The Ashern Ecodistrict is located between Lake Manitoba on the west and Lake Winnipeg on the east. The Ecodistrict slopes very gently toward Lake Winnipeg and westward toward Lake Manitoba with a mean elevation of approximately 274 m asl. Upland forested areas are dominated by trembling aspen and white spruce (*Picea glauca*) interspersed. Wet areas on mineral soil are composed of willow (*Salix* spp.), sedges (*Carex* spp.) and meadow grasses, and peatlands are dominated by black spruce, along with a lower abundance of tamarack, and swamp birch, ericaceous shrubs and mosses. A large amount of land in the ecodistrict has been converted to agriculture. The average annual growing season is 175 days and annual precipitation is approximately 510 mm.

The Gypsumville Ecodistrict is located along the north and west sides of Lake St. Martin in the RAA and LAA. This ecodistrict is characterized as having elevations ranging from 410 m asl to 218 m asl near Lake Winnipeg and vegetation is forest stands of trembling aspen, balsam poplar and white spruce, with jack pine found on drier sites (Smith et al. 1998). The average annual growing season is 173 to 184 days and annual precipitation ranges from 500 mm to 525 mm.

Landscape Diversity

Native vegetation patches in the RAA are mainly smaller than 10 ha. However, patch size is highly variable for forested, grassland and wetland areas and mean patch size is generally greater than 10 ha due to the area of a small number of large patches (Table 8.2-3). Shrubland patch size is much less variable and all patches are 20 ha or smaller.

Table 8.2-3 Native Vegetation Patch Metrics for the RAA

Land Cover	Number of Large[1] Patches	Patch Area (ha)				Patch Perimeter (km)			
		Mean	Minimum[3]	Maximum	SD	Mean	Minimum	Maximum	SD
Forest	15	8.53	0.01	7,493.28	115.19	1.29	0.06	409.90	7.39
Shrubland	0	2.49	0.01	13.35	3.34	3.86	0.07	167.04	12.13
Grassland[2]	157	42.26	0.02	2,505.25	170.33	2.13	0.04	16.02	3.23
Wetland	91	24.22	0.01	87,809.36	1,201.12	1.85	0.07	4,111.29	56.48

Note:

[1] Large forested patches equal 200 ha following the removal of the area in a 100 m strip inside the patch. The area of forested patches is reduced by a 100 m strip to account for potential edge effects. Large grassland, shrubland and wetland patches equal 50 ha.

[2] Grassland areas identified in LCC data are likely tame pasture or hayland.

[3] Minimum map unit equals 0.01 ha.

Although most patches of native vegetation are small, a few large patches, particularly forested and wetland areas, account for most of the native area (Appendix 8B, 8.2B-2 and 8.2B-3). These patches are primarily located east and north of Lake St. Martin (Appendix 8B, Figure 8.2B-2) and the distribution mostly reflects past land use patterns in the RAA. Specifically, areas west and south of Lake St. Martin have largely been converted to agricultural use and remaining native vegetation consist of small remnant patches surrounded by cultivated fields, hayland and tame pasture, or larger wetlands that are less suitable for agriculture (e.g., Reed Lake and Goodison Lake). Differences among areas across the RAA are most evident for forested patches, with 1 ha to 10 ha and greater than 1,000 ha patches occupying the most area. Patches 1 ha to 10 ha in size are common south and west of Lake St. Martin and patches larger than 1,000 ha only occur north of Lake St. Martin. Fifteen forested patches larger than 200 ha (minus a 100 m internal strip) are present in the RAA, with most located north and northwest of Lake St. Martin. Only three large forested patches (greater than or equal to 200 ha minus a 100 m internal strip) occur south of Gypsumville on the west side of Lake St. Martin, including two near Pinaymootang First Nation, and one occurs south of Lake St. Martin east of Grahamdale (Appendix 8B, Figure 8.2B-2). These large patches are important for maintaining wildlife diversity (Environment Canada 2013) and potentially plant diversity. A threshold for wetland patch size is not available; however, 91 wetlands larger than 50 ha occur in the RAA, including south and north of Lake St. Martin. No shrubland patches larger than 13.35 ha occur in the RAA (Table 8.2-3).

A review of recent air photographs (2014 and 2011) indicates areas of native grassland identified in LCC data are more likely tame pasture or hayland. These areas contain remnant tree stands and/or tracks from farm machinery, suggesting the areas were historically forested and are actively managed. Areas surveyed for the Project were hayland or tame pasture. The mean patch size of LCC mapped grasslands is 42.26 ha, but the distribution is skewed and most patches are smaller than the mean (Table 8.2-3). A total of 156 grassland patches are 50 ha or larger and all are located west and south of Lake St. Martin. Some native grassland patches may occur in the PDA or LAA of the LMOC, LSMOC or proposed PR 239 realignment route; however, large patches of native grassland are likely not present. Although upland grassland areas may be present in the LAA of the LSMOC, grasslands are not a dominant cover type of the Boreal Plains Ecozone (Smith et al. 1998) and documented grassland areas of the boreal forest are small (less than 3 ha) (Schwarz and Wein 1997), or occur on slopes ranging from 45% to 75% (Strong 2015) or on solonetzic soils in a transition area between parkland and boreal forest (Wilkinson and Johnson 1983). Available soils information indicates solonetzic soils do not occur in the LAA (see Chapter 6.2.2.2).

Patch perimeter also varies greatly (Table 8.2-3). Shrublands have the greatest average length of edge, 3.86 km. Many large native forest patches have complex shapes with a high degree of edge in relation to area (Appendix 8B, Figure 8.2B- 2). Mapped wetland area is extensive around Lake St. Martin and the LSMOC and there is a greater amount of patch area to edge perimeter as a result.

Patch size, perimeter length and associated vegetation structure and species composition have been affected by the fire regime throughout the Boreal Plains Ecozone (Smith et al. 1998). Fire has resulted in a mosaic of forest stand ages and patchiness (Weber and Flannigan 1997) and the area burned is highly variable between years (Brandt et al. 2013). Land use north and south of Lake St. Martin has also affected patch size, perimeter length, and potentially woody vegetation cover and species composition of the remaining patches. Smaller patches and those with greater perimeter length generally contain more light tolerant plant species, including non-native annuals (Sumners and Archibold 2007; Harper et al. 2005), smaller stemmed trees more tolerant of wind (Zeng et al. 2009) and a lower abundance of bryophytes (Barbe et al. 2017). In addition, Gignac and Dale (2007) recorded increased shrub cover, up to 20 m, and increased weed abundance, between 5 m and 15 m but present up to 40 m, in aspen stands surrounded by agriculture. Annual plant abundance may also increase, and shade tolerant plant abundance decrease near edges in response to altered forest canopy structure as changes have been observed in response to altered tree and shrub cover with forest age (Aubin et al. 2007).

Community Diversity

The LAA is a diverse matrix of plant communities dominated by Lake St. Martin (water), wetlands (both shrub and herb wetlands identified from LCC data and marsh wetlands identified from Project mapping), deciduous forests, hayland, and grassland (Table 8.2-4; Appendix 8A, Table 8.2A-3; Appendix 8B, Figure 8.2B-3).

Table 8.2-4 Land Cover Classes in the PDA, LAA, and RAA based on the Desktop Mapping and LCC Data

Land Cover Category	Land Cover Class[1]	PDA		LAA		RAA	
		ha	%	ha	%	ha	%
Agriculture	Cultivated	122.3	5.8	747.1	1.2	3,362.9	1.0
	Hayland	368.2	17.5	2,994.0	4.7	2,994.0	0.9
	Hayland and Pasture[2]	n/a	n/a	51.4	0.1	6,075.1	1.8
	Tame Pasture	34.0	1.6	238.2	0.4	238.2	0.1
	Total	**524.4**	**24.9**	**4,030.7**	**6.3**	**1,2670.3**	**3.7**
Bare Ground	Bare ground[2]	0.0	0.0	66.8	0.1	1,031.2	0.3
	Rock/Sand	1.0	<0.1	9.9	<0.1	9.9	<0.1
	Total	**1.0**	**<0.1**	**76.7**	**0.1**	**1,041.1**	**0.3**
Developed	Developed[2]	n/a	n/a	74.7	0.1	2,802.3	0.8
	Industrial	38.1	1.8	50.1	0.1	50.1	<0.1
	Residential	5.0	0.2	79.4	0.1	79.4	<0.1
	Roads	19.4	0.9	83.3	0.1	83.3	<0.1
	Total	**62.5**	**3.0**	**287.5**	**0.5**	**3,015.1**	**0.9**
Native Upland Vegetation	Coniferous Forest - Dense	58.1	2.8	571.7	0.9	17,265.9	5.1
	Coniferous Forest - Open	4.4	0.2	387.8	0.6	5,001.2	1.5
	Deciduous Forest - Dense	123.8	5.9	3,877.9	6.1	16,528.9	4.9
	Deciduous Forest - Open	51.7	2.5	1,060.4	1.7	8,704.8	2.6
	Grassland	7.8	0.4	2,531.1	4.0	54,303.3	16.0
	Mixedwood Forest - Dense	30.0	1.4	382.3	0.6	13,947.9	4.1
	Mixedwood Forest - Open	0.4	<0.1	23.1	<0.1	23.1	<0.1

Table 8.2-4 Land Cover Classes in the PDA, LAA, and RAA based on the Desktop Mapping and LCC Data

Land Cover Category	Land Cover Class[1]	PDA		LAA		RAA	
		ha	%	ha	%	ha	%
	Shrubland	30.2	1.4	74.4	0.1	146.7	<0.1
	Total	**306.3**	**14.6**	**8,908.6**	**14.0**	**115,921.8**	**34.2**
Water	Channel	5.4	0.3	14.8	<0.1	14.8	<0.1
	Lakes	52.6	2.5	35,342.8	55.4	75,083.6	22.1
	River/Streams/Creeks	0.5	<0.1	37.7	0.1	37.7	<0.1
	Total	**190.9**	**9.1**	**35,395.2**	**55.4**	**75,136.0**	**22.1**
Wetland	Bog - Forested	1.4	0.1	8.2	<0.1	8.2	<0.1
	Bog – Shrub	3.8	0.2	20.2	<0.1	20.2	<0.1
	Dugout	0.8	<0.1	7.5	<0.1	7.5	<0.1
	Fen - Forested	157.7	7.5	922.3	1.4	922.3	0.3
	Fen - Graminoid	196.7	9.4	1,186.8	1.9	1,186.8	0.3
	Fen - Shrub	122.1	5.8	698.8	1.1	698.8	0.2
	Marsh	281.7	13.4	1,659.8	2.6	1,659.8	0.5
	Shallow Open Water	38.7	1.8	510.7	0.8	510.7	0.2
	Swamp – Forested Coniferous	111.7	5.3	1,127.2	1.8	1,127.2	0.3
	Swamp – Forested Deciduous	12.6	0.6	24.8	<0.1	24.8	<0.1
	Swamp – Forested Mixedwood	42.7	2.0	244.0	0.4	244.0	0.1
	Swamp - Shrub	43.8	2.1	321.4	0.5	321.4	0.1
	Wetland – herb[2]	n/a	n/a	3,968.6	6.2	36,109.2	10.6
	Wetland – shrub[2]	n/a	n/a	4,426.5	6.9	82,619.6	24.4
	Wetland – treed[2]	n/a	n/a	26.6	<0.1	6,019.1	1.8
	Total	**1,013.6**	**48.2**	**15,153.3**	**23.7**	**131,479.7**	**38.8**
Grand Totals[3]		**2,100.7**	**100.0**	**63,852.3**	**100.0**	**339,264.0**	**100.0**

[1] Based on desktop mapping data.
[2] Based on LCC and FRI data.
[3] Totals may not equal sum of individual values due to rounding.

In contrast, the RAA is dominated by native upland vegetation including shrubby wetlands, bare ground, grasslands, herbaceous wetlands, and dense coniferous, deciduous and mixedwood forests (Table 8.2-5; Appendix 8B, Figure 8.2B-4). Grassland areas are likely hayland and tame pasture as remnant tree stands and/or tracks from farm machinery are visible in air photos, suggesting the areas were historically forested and are actively managed.

Table 8.2-5 Land Cover Classes in the PDA, LAA, and RAA based on the LCC Data

Land Cover Category	LCC Land Cover	PDA		LAA		RAA	
		ha	%	ha	%	ha	%
Agriculture	Cultivated	36.2	1.7	310.2	0.5	2,926.0	0.9
	Hayland and Pasture	131.4	6.3	692.4	1.1	6,716.1	2.0
	Total	**167.6**	**8.0**	**1,002.6**	**1.6**	**9,642.1**	**2.8**
Bare Ground	Bare ground	8.7	0.4	120.5	0.2	1084.8	0.3
Developed	Developed	43.7	2.1	345.5	0.5	3,073.1	0.9
Native Upland Vegetation	Coniferous Forest - Dense	57.8	2.8	564.2	0.9	17,258.4	5.1
	Coniferous Forest - Open	7.2	0.3	393.4	0.6	5,006.8	1.5
	Deciduous Forest - Dense	74.3	3.5	3,339.7	5.2	15,990.8	4.7
	Deciduous Forest - Open	6.4	0.3	747.3	1.2	8,391.7	2.5
	Grassland	616.3	29.3	7,115.1	11.1	58,887.2	17.4
	Mixedwood Forest - Dense	52.9	2.5	472.1	0.7	1,4037.8	4.1
	Shrubland	0.0	0.0	2.5	<0.1	74.9	<0.1
	Total	**815.0**	**38.8**	**12,634.4**	**19.8**	**119,647.6**	**35.3**
Water	Water	186.0	8.9	35,489.1	55.6	75,229.9	22.2
Wetland	Wetland-herb	309.0	14.7	6,050.9	9.5	38,191.6	11.3
	Wetland-shrub	535.0	25.5	8,012.3	12.5	86,205.5	25.4
	Wetland-treed	33.9	1.6	196.9	0.3	6,189.4	1.8
	Total	**877.8**	**41.8**	**14,260.1**	**22.3**	**130,586.4**	**38.5**
Grand Total		**2,100.7**	**100.0**	**63,852.2**	**100.0**	**339,264.0**	**100.0**

Native upland vegetation makes up 8,908.6 ha (14.6%) of the LAA. If the area of Lake St. Martin is removed from the calculations, native upland vegetation makes up 31% of the terrestrial land cover in the LAA. Forested land dominates the LSMOC and makes up 6,303.1 ha (9.9%) of the LAA. The most common forest type in the LAA is dense deciduous forest (3,877.9 ha) followed by open deciduous forest (1,060.4 ha), dense coniferous forest (571.7 ha), open coniferous forest (387.8 ha), and dense mixedwood forest (382.3 ha). Deciduous forests are dominated by trembling aspen (*Populus tremuloides*) with an understorey of herbaceous species, including common yarrow (*Achillea millefolium*), red baneberry (*Actaea rubra*), tall meadow rue (*Thalictrum dasycarpum*), and leafy arnica (*Arnica chamissonis*), and shrubs such as hazel (*Corylus cornuta*). Coniferous forests are dominated either by black spruce (*Picea mariana*) with an understory of feather mosses, or on drier sites they are dominated by jack pine (*Pinus banksiana*). Mixedwood forests include a mixture of both coniferous and deciduous species such as tamarack (*Larix laricina*), trembling aspen, balsam poplar (*Populus balsamifera*), and white spruce (*Picea glauca*).

In the boreal forest, fire is an important natural disturbance that drives vegetation dynamics at the landscape, stand and species levels (Natural Resources Canada 2019). The average forest stand age in the LAA is 29.9 years, which corresponds to a fire in 1989 that burned in the LSMOC (Table 8.2-6). This corresponds to the young forest stage (less than 40 years old) as described in Whelan Enns Associates Inc. (2012). The oldest stand in the LAA is a 70-year old deciduous forest, which is defined as mature forest (40 years to 80 years old). The youngest forest in the LAA is a regenerating two-year old deciduous forest, or the pole/sapling stage. Structurally complex, old growth forests (>80 years) do not occur within the LAA.

Table 8.2-6 Average Age in Years of Forested Cover Classes in the PDA, LAA, and RAA

Forested Cover Classes	PDA		LAA (year)	RAA (year)
	LSMOC	PR 239		
Bog - Forested	-	-	30.0	30.0
Bog - Shrub	30.0	-	30.0	30.0
Coniferous Forest	30.0	-	30.3	34.1
Deciduous Forest	30.0	55.0	29.5	35.3
Fen - Forested	30.0	-	30.0	30.0
Mixedwood Forest	30.0	-	30.8	36.2
Swamp - Forested Coniferous	30.0	-	30.0	30.0
Swamp – Forested Deciduous	30.0	-	30.0	30.0
Swamp – Forested Mixedwood	30.0	-	30.0	30.0
Swamp - Shrub	30.0	-	30.0	30.0
Grand Total	**30.0**	**55.0**	**29.9**	**34.8**

Grasslands make up 2,531.1 ha (4.0%) of the LAA; however, only 7.8 ha of grassland was located within the PDA (Table 8.2-4). Most of the grassland land cover data comes from the LCC data set, which has been found to overestimate the area of grassland in the LAA. Based on the field surveys, the grassland is likely agricultural land classes. There are few intact areas of grassland remaining in Manitoba due to agricultural conversion. Remaining grasslands are important habitat for plant and animal SOCC and are mixed and fescue prairie, which historically covered a large part of the prairie provinces and the southern portion of the Boreal Plains ecozone in Canada (Joyce and Morgan 1989). It is estimated that 99.5% of tall grass prairie has been lost in Manitoba and what remains is invaded by non-native invasive species (Henderson and Koper 2014). However, there is no way to know the true historical extent of the tall grass prairie in Manitoba. As such, tall grass prairie is a SOCC.

Shrublands make up 74.4 ha (0.1%) of the LAA. Most of the shrubland is located along the LSMOC PDA (27.7 ha).

Wetlands make up 15,153.3 ha (23.7%) of the LAA. The dominant wetland class is wetland – shrub (6.9%) followed by wetland – herb (6.2%), and marshes (2.6%). Based on the refined desktop mapping data, marsh wetlands, particularly located within agricultural lands, are underrepresented. Both the LMOC and LSMOC bisect wetlands. The wetlands along the LSMOC are dominated by fens (476.5 ha) and swamps (210.7 ha). Wetlands along the LMOC are predominately marshes (269.5 ha) with some shallow open water wetlands (21.5 ha). Threats to wetlands include agricultural runoff, drainage, forestry activities, off-road vehicles, peat extraction, and right-of-way activities (Foster et al. 2004).

Realignment of the existing non-functioning portion of the EOC (known as Reach 3) is approximately 6 km in length. Prior to construction of Reach 3, the vegetation community was dominated by a bog wetland, but due to the change in drainage the area is now flooded and is transitioning to a marsh wetland.

The LAA is dominated by areas of open water 34,995.0 ha (54.8%). Lake St. Martin occupies a large portion of the water in the LAA. Constructed channels (14.8 ha) from large wetlands or lakes occur along the LMOC. Lakes (347.8 ha) follow the east side of the LMOC including Long Lake, Reed Lake, Clear Lake, Water Lake, and Goodison Lake. Both Little Buffalo and Big Buffalo Lakes are in the LSMOC. There are several areas of moving water in the LAA including Birch Creek in the LMOC and Buffalo Creek and Dauphin River in the LSMOC (37.7 ha).

There is one provincial park within the LAA, Watchorn Lake near the inlet to the LMOC, which is predominantly classed as residential with some open deciduous forest. Sturgeon Bay Provincial Park is in the RAA near the outlet to the LSMOC and is predominantly wetland-shrub with some wetland-herb (Appendix 8B, Figure 8.2B-4). The Federal land includes three First Nations within the LAA: Pinaymootang First Nation, Little Saskatchewan First Nation, and Lake St. Martin First Nation (Appendix 8B, Figure 8.2B-3). Pinaymootang First Nation is predominantly grassland with some wetland herb and dense deciduous forest. Lake St. Martin Fist Nation is predominantly grassland on the west side of Lake St. Martin and dense deciduous forest on the east side of the lake. Little Saskatchewan First Nation is predominantly grassland.

The native upland and wetland vegetation communities predominantly along the west side of the LMOC and the west side of Lake St. Martin of the LAA are surrounded by anthropogenic disturbances. These native vegetation communities have been fragmented over time and are now smaller patches that likely have a different species composition than similar native vegetation communities along the LAA of the LSMOC. These smaller patches typically have increased sun-tolerant species, non-native annuals, smaller stemmed trees, and lower abundance of bryophytes (Harper et al. 2005; Sumners and Archibold 2007; Zeng et al. 2009; Barbe et al. 2017).

Aquatic vegetation also occurs in the LAA portions that include Lake Manitoba, Lake Winnipeg and Lake St. Martin (Chapter 7, Section 7.2.2). A total of 4,606.0 ha were identified based on baseline mapping sources (Appendix 8B, Figure 8.2B-4). Little information on species of aquatic vegetation occurring in the

LAA was found. Three species, duck weed (*Lemna* sp.), water milfoil (*Myriophyllum* sp.) and greater bladderwort (*Utricularia vulgaris* sub sp. *microrhiza*), have been observed in Lake Winnipeg (Ross and Rose 2012; Ford 2017) and sago pondweed (*Potamogeton pectinatus*) has been documented in Delta Marsh of Lake Manitoba (Anderson and Low 1976). Other common species could include water lilies (*Nymphaea* spp.) and other pondweed species (*Potamogeton* spp.).

LCC Mapping

In comparison to the LAA Project mapping, native vegetation is more common in the LCC data set (Table 8.2-5), occupying 38.8% of the PDA versus 14.6%. This is largely due to a greater abundance of grassland identified in the LCC data. Wetland abundance is similar, 41.8% of the PDA in LCC data, and 48.2% of the PDA in the Project mapping.

Ecological Communities of Conservation Concern

No COCC were identified during the 2016 field surveys. No uncommon communities associated with soil types (shallow soils, exposed bedrock, saline soils, and sandy soils) were mapped, surveyed, or quantified.

Based on a literature review there is potential for COCC such as unique vegetation communities on saline soils, exposed bedrock, or sandy soils within the LAA and RAA. The potential for alvars within the PDA or LAA is low to none (Friesen pers. comm, 2018; Manitoba Alvar Initiative 2012). In addition, no limestone or bedrock was mapped within the PDA (see Chapter 6, Section 6.3.2). Limestone bedrock occurs in up to 262 ha of the LAA. In 2012, Manitoba Conservation and Water Stewardship and the Nature Conservancy of Canada (Winnipeg Region) initiated a study, called the Manitoba Alvar Initiative, whose objectives were to systematically map and describe potential alvar sites in the Interlake Plain region of the province between Lake Winnipeg and Lake St. Martin (Manitoba Alvar Initiative 2012). Results of the study identified four confirmed alvar communities (grassland, shrubland, savannah and wetland) approximately 70 km east of the PDA in the Interlake Plain region. The study also identified 13 species (including six vascular and seven non-vascular plants) that may be indicators of alvars: wild white onion (*Allium textile*), Porter's chess (*Bromus porter*), rough fescue (*Festuca hallii*), Gastony's cliffbrake (*Pellaea gastonyi*), dwarf western cliffbrake (*Pellaea glabella* subsp. *occidentalis*), dense spikemoss (*Selaginella densa*), Grimmia dry rock moss (*Grimmia teretinervis*), moss (*Schistidium frigidum*), Donn's small limestone moss (*Seligeria donniana*), hyaline liverwort (*Athalamia hyaline*), inflated scalewort (*Frullania inflata*), fragrant macewort (*Mannia fragrans*), and liverwort (*Mannia sibirica*).

Based on the literature review, there is no known remnant tall grass prairie patches within the PDA, LAA, and RAA. However, Henderson and Koper (2014) argue that remnant patches may exist in areas beyond the historical extent of tall grass prairie because it may have been underestimated. Tall grass prairie is named after the codominant grass species, big bluestem (*Andropogon gerardii*) and little bluestem (*Schizachyrium scoparium*). Indicator species for tall grass prairie include the following: big bluestem S5, yellow indiangrass (*Sorghastrum nutans*) S3S4, old switch panicgrass (*Panicum virgatum*) S4, prairie dropseed (*Sporobolus heterolepis*) S3S5, and Jerusalem artichoke (*Helianthus tuberosus*) S3S4. Tall grass prairie occurs in both upland and lowland communities (Henderson and Koper 2014). Today, the largest remnant of tall grass prairie is a 2,200 ha preserve located outside of the RAA in southern Manitoba near Tolstoi (Manitoba Conservation 2018). Tall grass prairie is habitat for SOCC that are protected under both MBESEA and SARA including the western prairie fringed orchid (*Platanthera praeclara* - endangered), whose only Canadian location is in the tall grass prairie preserve and the small white lady's-slipper (*Cypripedium candidum* - threatened). Both plant species can be found in wet meadows (Manitoba Conservation 2018).

Species Diversity

A total of 202 vascular plant species were observed during the 2016 field surveys (Appendix A, Table 8.2A-5). The species observed include 5 ericaceous shrubs, 25 graminoids, 129 herbaceous species, 27 shrubs, and 15 trees.

Plant Species of Conservation Concern

Based on desktop review, nine vascular plant species at risk have potential to occur in the Interlake Plain and Mid-boreal lowland ecoregions: rough agalinis (*Agalinis aspera*), small white lady's slipper (*Cypripedium candidum*), black ash (*Fraxinus nigra*), Gastony's cliffbrake (*Pellaea gastonyi*), western prairie fringed orchid (*Platanthera praeclara*), Riddell's goldenrod (*Solidago riddellii*), Great Plains ladies'-tresses (*Spiranthes magnicamporum*), western silvery aster (*Symphyotrichum sericeum*), and culver's-root (*Veronicastrum virginicum*) (Appendix 8A, Table 8.2A-4). Of these species, five are listed as *endangered* and three are listed as *threatened* by the MESEA, but only four of them are federally listed under SARA and COSEWIC. In 2018, the COSEWIC status of black ash (*Fraxinus nigra*) changed to *threatened* due to the devastation of the invasive emerald ash borer on the population (Government of Canada 2018). Black ash currently is not under a SARA schedule and has no status under SARA. Black ash is ranked as S2S3 by the MBCDC.

Rough agalinis and small white lady's-slipper have known distributions approximately 112 km south of the PDA, close to St. Laurent, MB (Manitoba Conservation 2015; Government of Canada 2014). Black ash is found on poorly drained sites, peatlands, fine sands, loams in bogs, streambanks and other low spots (USDA 2019). Gastony's cliffbrake is a globally rare fern that is associated with dolomite and limestone cliffs and outcroppings typical of alvars (Friesen and Murray 2015). The known occurrences of Gastony's cliffbrake include a population approximately 60 km west of the PDA in an area known locally as Marble Ridge near Hodgson, Manitoba (Friesen and Murray 2015). The Western prairie fringed orchid critical habitat is west of Vita, Manitoba, which is over 250 km south of the PDA. Based on the Management Plan for Riddell's goldenrod, its known distribution in Manitoba is south of Steinbach, which is approximately 230 km from the PDA (Government of Canada 2015b). Great Plain's ladies'-tresses populations occur near the Gardenton-Vita area (Government of Manitoba n.d.), approximately 250 km south of the PDA. The Recovery Strategy for the Western silvery aster describes the known populations occurring south of Lake Winnipeg, 200 km southeast of the PDA (Government of Canada 2017). Culver's-root has known occurrences within the Tall Grass Prairie Preserve, over 250 km south of the PDA (Government of

Manitoba n.d.). Based on the known occurrences of these species, there is a low probability for these species occurring in the LAA, or PDA.

Prior to fieldwork, the MBCDC database search revealed three occurrences of SOCC in the RAA and LAA including ram's-head lady's-slipper (*Cypripedium arietinum*) (S2S3), long-fruited parsley (*Lomatium macrocarpum*) (S2S3), and hairy-fruited parsley (*L. foeniculaceum*) (S3). Narrow-leaved milkvetch (*Astragalus pectinatus*) (S2) also was historically observed within 20 km of the LAA (Friesen 2015, pers. comm.). The ram's-head lady's-slipper habitat includes black spruce (*Picea mariana*) and tamarack (*Larix laricina*) sphagnum (*Sphagnum* spp.) bogs and drier upland coniferous forests (Foster and Reimer 2006). The long-fruited parsley, hairy-fruited parsley and narrow-leaved milkvetch occur on dry upland prairie habitats, often along hillsides (Jennings 2007). The long-fruited parsley and hairy-fruited parsley have been previously found along the Lake Manitoba shoreline near the town of Steeprock (Friesen and Murray 2010).

The updated MBCDC database search in 2019 revealed no additional historical records for plant SOCC within the RAA (Murray 2019, pers. comm.).

In addition to the database search, the MBCDC lists 99 vascular plant SOCC expected to occur within the Interlake Plain ecoregion and 44 within the Mid-Boreal Lowland ecoregion (Appendix 8A, Table 8.2A-5). Of these species, 51 are wetland species, 63 are upland species, and 9 can occur in both upland and wetland habitats. Foster et al. (2004) noted the importance of calcareous wetlands (e.g., fens) and their potential to support SOCC. Due to the abundance of wetlands (including fens) in the PDA, wetland dependent SOCC have the potential to occur within the PDA, LAA, and RAA. In addition, nine aquatic vascular plant SOCC have the potential to occur in the marshes, shallow open water wetlands, lakes, rivers and/or streams within the PDA, LAA, and RAA.

Based on a search of the University of Manitoba Herbarium (WIN) dataset (Forb 2017), there is one historical occurrence of river bulrush (*Bolboshoenus fluviatilis*) S3 (Appendix 8B, Figure 8.2B-6). River bulrush was observed 1.1 km north of Lake St. Martin (Appendix 8B, Figure 8.2B-6). Habitat for river bulrush includes freshwater marshes, wet shores, and shallow water of streams (Harms et al. 2018).

Six plant SOCC were observed during the 2016 field surveys (Table 8.2-7). Three occurrences of dragon's mouth orchid (*Arethusa bulbosa*) (Appendix 8C, Photo 8.2C-1) and one occurrence of yellow willow (*Salix lutea*) were found along the LSMOC. Four additional occurrences of yellow willow were observed along the LMOC. Common sweet grass (*Anthoxanthum monticola* ssp. *alpinum*), saline shooting star (*Dodecatheon pulchellum*), annual sunflower (*Helianthus annuus*), and early yellow locoweed (*Oxytropis sericea*) were all observed once along the LMOC. None of these species are listed by SARA, COSEWIC or MBESA, but are provincially ranked as critically imperiled (S1), imperiled (S2) or vulnerable (S3) to extirpation. No occurrences of eelgrass (*Zostera marina*) were observed or have been documented in available datasets.

Table 8.2-7 Plant SOCC within the PDA, LAA and RAA

Scientific Name[1]	Common Name	Provincial Rank	Number of Occurrences		
			PDA	LAA	RAA
Anthoxanthum monticola ssp. *alpinum*	common sweet grass	S1S2	1	-	-
Arethusa bulbosa[2]	dragon's mouth orchid	S2	2	5	-
Dodecatheon pulchellum	saline shooting star	S3	1	-	-
Helianthus annuus	annual sunflower	S3	1	-	2
Oxytropis sericea	early yellow locoweed	S1	1	-	2
Salix lutea	yellow willow	S2S3	4	1	3

[1] SG Environmental Services Inc..2016. Lake Manitoba Outlet Channel Route Options Vegetation Technical Report. Prepared for: M. Forster Enterprises and Manitoba Infrastructure.

SG Environmental Services Inc. 2017. Lake St. Martin Outlet Channels

Plant Species of Interest to Indigenous Groups

A total of 89 plant species of interest to Indigenous groups were identified based on the document review (see Methods 8.2.2.1). Of these 89 plant species of interest for Indigenous groups, 23 of them may be harvested for their berries. During the 2016 field surveys, 45 plant species of interest for Indigenous groups were observed (Appendix 8A, Table 8.2A-6). Plant abundance was not recorded during field surveys and it is not known if the plant species of interest to Indigenous groups are locally or regionally abundant.

Out of the 89 listed plant species of interest for Indigenous groups, half are ranked as provincially secure, including many berry species. Species ranked S5 are ranked as secure, which means that they are at very low or no risk of extirpation in Manitoba (NatureServe, date unknown). The 45 plant species of interest to Indigenous groups observed within the PDA are provincially ranked as secure. Two of the important plant species of interest to Indigenous species are also SOCC: sweet grass (S1S2) and dwarf blueberry (*Vaccinium caespitosum*) (S3). Sweet grass was observed at one location within the PDA during the 2016 field surveys.

Some plant species of interest to Indigenous groups may not have been documented because traditional-use species names did not correspond to recognized common names used in Manitoba.

The Lake Manitoba First Nation has indicated that seneca is picked within the PDA. During the 2016 field surveys, seneca was noted in the field surveys as widespread throughout the hayfields adjacent to wetlands near Goodison Lake wetland in the LMOC.

Non-Native Invasive Species and Weeds

Desktop search of the EDDMapS database revealed eight non-native invasive species within the PDA, LAA, or RAA. Leafy spurge (*Euphorbia esula*), a tier 2 invasive species, historically occurred in five locations along highway 239 between Highway 6 and Steep Rock. Ox-eyed daisy (*Leucanthemum vulgare*), tier 2, historically occurred in 12 locations north of Grahamdale along Railway avenue. Dalmation toadflax (*Linaria dalmatica*), tier 2, historically occurred in four locations east of Newman Lake in the LAA. Bladder campion (*Silene vulgaris*), tier 2, historically occurred at four locations along Highway 6 south of Moosehorn. Scentless chamomile (*Tripleurospermum inodorum*), tier 2, historically occurred at three locations near the Steep Rock junction. Forty historical occurrences of yellow toadflax (*Linaria vulgaris*), tier 3, were located within the LMOC LAA. Red bartsia (*Odontites vernus*) historically occurred in three patches on the shore of Pineimuta Lake in the RAA. Common tansy (*Tanacetum vulgare*), tier 2, historically occurred at 38 locations east of Grahamdale.

During the vegetation field surveys, ten non-native invasive species were observed within the PDA (Table 8.2-8). No non-native invasive species were designated tier 1 species. Three species, nodding thistle (*Carduus nutans*), ox-eyed daisy, and scentless chamomile (*Triplospermum perforata*) are designated Tier 2 species.

Table 8.2-8 Non-Native Invasive Species within the PDA, LAA, and RAA

Scientific Name	Common Name	Noxious Weed Act Designation[1]	Number of Occurrences		
			PDA	LAA	RAA
Arctium lappa	great burdock	Tier 3	2	1	2
Artemisia absinthium	absinthe	Tier 3	5	2	0
Asclepias syriaca[2]	common milkweed	Tier 3	0	0	2
Carduus nutans	nodding thistle	Tier 2	2	0	0
Cicuta maculata[2]	water hemlock	Tier 3	2	0	4
Cirsium arvense	Canada thistle	Tier 3	4	4	6
Galeopsis tetrahit	hemp nettle	Tier 3	2	0	2
Leucanthemum vulgare	ox-eyed daisy	Tier 2	4	1	1
Pastinaca sativa	wild parsnip	Tier 3	4	1	6
Sonchus arvensis	perennial sow thistle	Tier 3	3	1	2
Taraxacum officinale	common dandelion	Tier 3	13	2	7
Tripleurospermum inodorum	scentless chamomile	Tier 2	2	1	1
Total			43	13	33

[1] Government of Manitoba. 2017. Noxious Weeds Regulation. C.C.S.M.c.N110. Registered April 13, 2017. Available at: https://web2.gov.mb.ca/laws/regs/current/_pdf-regs.php?reg=42/2017. Accessed June 28, 2019.
[2] This is a native plant species and therefore not considered non-native invasive for the purposes of this assessment.

Common reedgrass (*Phragmites australis*) was observed in 12 plots in the LSMOC including Plot 7 surrounding Buffalo Lake in a graminoid poor fen, in plot 1 on the shores of Lake St. Martin, and along the shore of Lake Winnipeg in Plots 23 and 24. It was also observed in the LMOC PDA on Plot 12 and Plot 20. However, it was not identified to subspecies. Invasive phragmites (*P. australis* subsp. *australis*) is morphologically distinct from common reedgrass, but the features are somewhat ambiguous. Further information is required to identify the presence of invasive phragmites in the PDA.

Wetland Functions

Wetlands are common in the vegetation RAA, occupying 38.8% (131,479.7 ha) based on Project mapping and LCC data (Table 8.2-4) and 38.5% (130,586.4 ha) based on LCC data alone (Table 8.2-5). Fen, bog, swamp, marsh and shallow open water wetland classes, as well as dugouts, occur in the intersected sub-watersheds, with shrub dominated areas the most common (Appendix 8B, Figure 8.2B-11 and Figure 8.2B-12). Herb and shrub dominated wetlands identified by LCC data south of Lake St. Martin are likely marsh and swamp wetlands due to the expected moisture deficit of the southern portion of the Ashern Ecodistrict. The Ashern Ecodistrict has an average moisture deficit of 100 mm (Smith et al 1998), and this is likely higher in southern portions of the ecodistrict. Peatlands generally occur where there is an excess of moisture (Mitch and Gosselink 1993). However, Halsey et al. (1997) estimate from 0.1% to 20% of the terrestrial land cover between Lake Winnipeg and Lake Manitoba consists of open fens and 0.1% to 10% consists of wooded non-patterned fens, and therefore herb and shrub dominated map units may include peatlands.

Swamp and marsh wetlands have high decomposition rates and fluctuating water levels, with swamps being drier (National Wetlands Working Group 1997). Swamps can be treed or shrubby and drier treed swamps tend to grade into upland forests and wetter treed and shrubby swamps grade into fens. Swamps occur on clays to sand with deciduous treed and shrubby swamps generally occurring in richer nutrient conditions and coniferous dominated swamps occurring on poor to rich sites (National Wetlands Working Group 1997). Although typically occurring on mineral soil, swamps on peat have been documented in Manitoba near Duck Mountain (Locky et al. 2005). Swamps on peat soils have taller trees, a denser bryophyte layer and denser overstory then fens. Swamps in Manitoba are found along lakes, streams, broad depressional areas and adjacent to peatlands (Halsey et al. 1997). Swamps occupy 0.4% (1,396.0 ha) to 26.6% (90,356.1 ha) of the RAA, depending on how wetland –shrub and wetland – treed land units are classified (i.e., swamps or fens) (Table 8.2-4), and are most common north of Lake St. Martin, including in the LSMOC intersected sub-watersheds (Appendix 8B, Figure 8.2B-12). Swamps are widely dispersed in the Project intersected LSMOC sub-watersheds and are located on the edge of fens or as small islands surrounded by fen (Appendix 8B, Figure 8.2B-12). In the LMOC and PR 239 sub-watersheds, it is noted that swamps, including wetland – shrub wetland classes occur in riparian areas bordering portions of Birch Creek and near the south side of Clear Lake (Appendix 8B, Figure 8.2B-11).

Water levels of marshes are highly variable, varying from days, to seasons to years, and are dominated by graminoid and herbaceous plants, with shrubs occupying 25% or less of the cover (National Wetlands Working Group 1997). Vegetation is dominated by grasses and herbs and composition varies with changing water levels, often forming distinct zones of differing water depths and permanence (Stewart and Kantrud 1971). Due to varying water depths and periodically exposed soils, decomposition rates and nutrient levels tend to be high (National Wetlands Working Group 1997; Bayley and Mewhort 2004). Marshes can occur as isolated ponds lacking inlets and outlets, bordering streams and lakes or adjacent to peatlands. In Manitoba, marshes are most common south of Lake Winnipeg and particularly west of Lake Manitoba (Halsey et al. 1997). Marshes occupy 0.5% (1,659.8 ha) to 11.1% (37,769.0 ha) of the vegetation RAA (Table 8.2-5), depending on how the wetland - herb category of LCC data is classed, and are most common in the Project intersected LSMOC sub-watersheds (Appendix 8B, Figure 8.2B-12), although herb dominated wetlands identified by LCC data in this portion of the RAA are more likely fens based on LAA mapping and climatic conditions. Surveyed marsh areas were dominated by cattails (*Typha latifolia*), rushes (*Bolboshoenus* spp. and *Schoenoplectus* spp.), mint (*Mentha* sp.) and sedge species (*Carex* spp.). For the LMOC and PR 239 sub-watersheds, marshes are widely distributed and occur as small isolated ponds or as part of large wetland complexes adjacent to areas of more permanent open water, and near the northern portion of Birch Creek (Appendix 8B, Figure 8.2B-11). In the Project intersected LSMOC sub-watersheds, marshes occur adjacent to larger fen, swamp and bog complexes and potentially as isolated wetlands surrounded by upland forest (Appendix 8B, Figure 8.2B-12). Shallow open water wetlands are seasonally to permanently flooded areas with water depths less than 2 m mid-summer (National Wetlands Working Group 1997). They typically occur as transitional areas between more infrequently wet marsh, fen, bog and swamp areas, and areas of deeper water, or as central deeper areas of surrounding shallower wetlands. Sediment may accumulate in low energy areas not connected to larger water bodies or lakes and nutrient levels vary depending on the surficial geology, water source, surrounding land use and plant composition. Shallow open water wetlands occupy 0.2% (510.7 ha) of the RAA and are most common in the Project intersected LSMOC sub-watersheds (Appendix 8B, Figure 8.2B-12).

Fens also have fluctuating water levels, but with soils typically continuously wetted, and surface run-off and ground water are primary sources of water. Decomposition is slow leading to a buildup of peat and nutrient levels are generally low. Depending on the amount of time water is in contact with buried minerals and the type of buried material, water in fens can rage mineral poor to rich (National Wetlands Working Group 1997). Wetter fens are dominated by sedges and scattered shrubs, while drier areas have increased shrub cover; the driest areas are dominated by trees. In Manitoba, fens have been shown to be associated with calcareous bedrock and are most common north of Lake Winnipeg, with permafrost areas occurring north of the Project RAA (Halsey, et al. 1997). In the RAA, fens occur as a large complex associated with Buffalo Lake and smaller areas closer to Lake Winnipeg, and potentially extensive areas east of Lake St. Martin (Appendix 8B, Figure 8.2B-12). Fens are not suspected to occur south of Lake St. Martin, including the Project intersected LMOC sub-watersheds.

Bogs are typically isolated from surface run-off and ground water, receiving most of their water from direct precipitation (National Wetlands Working Group 1997). Water levels are generally at or slightly above the ground surface and like fens, decomposition is slow, leading to the accumulation of peat and low nutrient levels. Bogs can be treed, shrubby or dominated by grasses. In Manitoba, bogs are restricted to north of Lake Winnipeg (Halsey et al. 1997) and in the LAA bogs occur as small tree and shrub areas on the edge of fens, likely in backwater areas isolated from ground water and surface water flows. Bogs are uncommon in the LAA 28.4 ha (less than 0.1%) and suspected to be uncommon in the RAA. Bogs were only mapped north of Lake St. Martin in the LAA (Appendix 8B, Figure 8.2B-3). Areas of bog wetland likely occur elsewhere in the RAA, but the abundance and distribution cannot be determined with available Project information. Surveyed bogs were dominated by bog birch and bog willow. Labrador tea and three-leaved false Solomon's seal (*Maianthemum Trifolium*) provided ground cover along with sphagnum moss.

The LMOC and PR 239 sub-watersheds have largely been converted to agricultural use (Appendix 8B, Figure 8.2B-4). Only isolated areas of native upland vegetation remain in the LAA and vegetation of remaining wetlands in the sub-watersheds has likely been altered. Marsh wetlands may have originally been shrubby or forested swamps, and marshes and remaining swamps may contain non-native plant species. In addition, hydrology and biogeochemistry functions of wetlands in the LMOC and PR 239 sub-watersheds may have been altered due to increased surface run-off and nutrient inputs from surrounding cultivation. Nitrogen fertilizers are highly mobile (Winter et al. 1998) and cultivation has been shown to affect surrounding wetland conditions (Olker et al. 2016; Bayley et al. 2013; Houlahan et al. 2006). Increased run-off may also occur to wetlands near industrial developments due to pavement and buildings. Road salts and oils from vehicles may discharge to some wetlands.

Functions of the wetlands in the Project LSMOC intersected sub-watersheds are likely largely unaltered due to the low abundance of human disturbance (Appendix 8B, Figure 8.2B-8). Wetland area in the LAA around Lake St. Martin equals 8,231.6 ha and accounts for 16.8% of the LAA around the lake (Appendix 8A, Table 8.2A-3). Wetland - shrub, likely shrubby swamp, is the most common wetland class occupying 4,340.0 ha, followed by wetland – herb (3,865.7 ha), likely marsh wetlands, and wetland – treed, likely treed swamp (25.5 ha). Wetlands are most abundant along the east and north side of Lake St. Martin, and small areas occur on islands in the lake (Appendix 8B, Figure 8.2B-4). Human disturbance consists mainly of hayland and tame pasture (2,574.0 ha).

8.2.3 Project Interactions with Vegetation

Table 8.2-9 identifies for each potential effect, the Project components and physical activities that might interact with vegetation during construction and dry operations and result in the identified environmental effect. These interactions are identified by check marks and are discussed in detail in Section 8.2.4 in the context of effects pathways, standard and project-specific mitigation and residual effects. A justification for no effect is provided following the table.

Table 8.2-9 Project-Environment Interactions with Vegetation During Construction and Operations

Project Components and Physical Activities	Environmental Effects			
	Change in landscape diversity	Change in community diversity	Change in species diversity	Change in wetland functions
Construction				
Site preparation of Project components[1] (development of the PDA prior to construction activities [e.g., removal of existing infrastructure, vegetation clearing and initial earthworks, development of temporary construction camp and staging areas])	✓	✓	✓	✓
Project-related transportation within the LAA (movement of trucks, equipment, bulk materials, supplies, and personnel within the LAA)	-	✓	✓	✓
Construction of Project components[1] (physical construction of utilities, infrastructure, and other facilities)	✓	✓	✓	✓
Quarry development (blasting and aggregate extraction used for the construction of Project components[1])	✓	✓	✓	✓
Water development and control (dewatering and realignment of existing water works)	-	-	✓	✓
Reclamation	✓	✓	✓	✓
Operations				
Operation and maintenance of the outlet channels (normal operational conditions when the outlet channels and associated infrastructure [e.g., water control structures] are either open and actively conveying water or are closed)	-	✓	✓	✓
Operation and maintenance of other Project components[1] (normal operations conditions associated with PR 239 and municipal road realignments, the distribution line, and bridges and culverts)	-	-	✓	✓
Project-related transportation within the LAA (movement of trucks, equipment, bulk materials, supplies, and personnel within the LAA)	-	✓	✓	-

NOTES:
✓ indicates a potential interaction.
– indicates no potential interactions are expected.
[1] Components include: outlet channels, water control structures, distribution line, bridges and culverts, PR 239 and municipal road realignments, temporary construction camps and staging areas, and quarries.

Most effects on vegetation will occur during clearing with the direct removal of vegetation and excavation of soils. All vegetation along the ROW will be removed prior to construction of the channels, water control structures, bridges and culverts and along the proposed PR 239 realignment. Altered surface drainage and subsurface flows from excavation of the LMOC and LSMOC may also alter surrounding vegetation conditions, leading to increased flooding in some areas and drier conditions in others. Altered water flow paths from water development and control may occur due to intersected drainages. Effects are expected to occur primarily in wetlands and riparian areas where water collects. Effects may occur in isolated upland areas, but outside drainage channels, combined with monitoring and adaptive management, should result in limited temporary effects to upland areas. Construction reclamation is expected to be positive as native plants will be used and activities will be restricted to the ROW.

Measurable effects from operation-related transportation in the LAA are not expected on landscape diversity and wetland function as vehicles will be restricted to existing roads and trails. Vehicles, equipment and personnel clothing will be inspected for plant and soil material prior to use in the LAA and material removed; however, weeds and non-native invasive plants may be accidently transported to the LAA. No measurable effects are expected from construction or operation emissions, discharges and wastes as emissions will be temporary and restricted to construction and maintenance traffic, waste will be controlled and removed from site, spill control measures will be in place and no waste will be released to the surrounding environment. Water collected during construction de-watering will be discharged to the surrounding environment. Effects on vegetation are not expected because ground water meets the Canadian Council of Ministers of the Environment (CCME) water quality guidelines (Section 6.4.2). Water collected during construction de-watering will however be tested prior to releasing to the environment. Localized changes in vegetation may occur due to the volume of water released during construction; however, expected volumes are not known.

Discharges and wastes generated during construction and operation will be handled, stored and disposed of according to Manitoba legislation and regulations and Project-specific plans outlined in the Environmental Management Program (e.g., Water Management and Waste Management plans). As such, discharges and wastes as a result of Project activities will not affect soil and terrain.

Effects from Project operations are expected from use of PR 239. Road salts and other chemicals from vehicle use may discharge into adjacent wetlands thereby potentially affecting water quality and plant composition. Erosion and changes in plant communities near the Project inlets and outlets is expected to be managed with use of either rock groins or other engineered structures. The project-specific revegetation plan, to be developed as part of the Project detailed design, will further mitigate erosion in the inlets and outlets and elsewhere in the PDA.

No effects on landscape diversity are expected from operations and maintenance of the outlet channels as changes in patch metrics (e.g., patch size and number of patches) from vegetation clearing will be restricted to construction. Changes to landscape and community diversity are also not expected from operation and maintenance of Project components other than PR 239 because no vegetation clearing will occur beyond construction. Weed and non-native invasive species introductions and spread are possible with the use of PR 239.

8.2.4 Assessment of Residual Environmental Effects on Vegetation

8.2.4.1 Analytical Assessment Techniques

Construction and operations phases are assessed for potential effects, compared to existing conditions. Effects on landscape diversity are assessed by evaluating changes to the number of native vegetation community patches, patch area and length of patch edge in the RAA.

Changes in community diversity (change in area of vegetation and wetland cover types) are estimated by comparing changes in the area of vegetation cover types and COCC in the LAA. Changes to species diversity are assessed by evaluating potential changes to SOCC occurrences in the LAA from vegetation clearing and competition from potential weed spread and introduction. Historical SOCC data and field observations, combined with available literature on SOCC biology are used to evaluate potential effects to known SOCC occurrences and potentially undocumented occurrences. Guidelines on desirable landscape and community conditions are obtained from Environment Canada's *How Much Habitat is Enough* (2013) and available scientific literature (e.g., Harper et al. 2005; Henderson 2011). Environment Canada's *How Much Habitat is Enough* (2013) provides recommendations for wildlife conservation and is used to assess vegetation effects as vegetation provides the supporting habitat and thresholds for vegetation diversity were not located in available literature.

Conditions near the EOC are used to help identify and understand potential changes that may occur from construction of the LSMOC. The EOC was constructed in 2011 approximately 4 km northwest of the proposed LSMOC and intersects similar wetland classes to those intersected by the LSMOC. Landsat-5 satellite imagery from July 25, 2010, prior to EOC construction, and Landsat-8 satellite imagery from July 18, 2018 were examined for changes in vegetation. A normalized difference vegetation index (NDVI) analysis was carried out on each satellite image and compared differences in light reflectance. The NDVI is a measure of vegetation health and provides a quantitative health value for each individual image pixel (Carlson and Ripley 1997). NDVI is calculated using the red and near infrared (NIR) channels in the following formula:

$$(NIR - Red) / (NIR + Red)$$

Healthy vegetation strongly reflects NIR energy and strongly absorbs red energy. As vegetation becomes stressed, including from flooding or less frequent natural flooding, vegetation will reflect less NIR energy and absorb less red energy.

A change detection analysis was performed by subtracting the 2018 NDVI image from the 2010 NDVI image to determine the environmental impact area of the EOC over the past eight years. Any areas near the constructed channel where the NDVI change was positive or equal indicates no impact from outlet construction. Areas where the NDVI change was negative nay be due to the emergency outlet.

8.2.4.2 Change in Landscape Diversity

Project Pathways

Landscape diversity of native vegetation will likely be altered by clearing during Project construction. Vegetation will be removed for channel construction, realignment of PR 239 and construction of the power distribution line. The LMOC and LSMOC ROW's will be reclaimed following construction; however, vegetation will consist of different species and may be maintained in a different state than prior to construction, with graminoid or shrub landcover instead of forested. Tree and shrub cover will likewise be removed from the power distribution line ROW. The distribution line will extend from an existing power line near PR 513 and intersect similar land cover classes as the LSMOC. Vegetation will be permanently removed along the PR 239 re-route alignment. The fragmentation of native vegetation patches could reduce or alter plant diversity (e.g., decrease shade tolerant species abundance and increased light tolerant species abundance), alter patch structure (e.g., increase shrub abundance), or alter ecosystem functions, such as nutrient cycling and carbon sequestration (e.g., fewer larger trees sequestering carbon for long periods).

The locations of quarries and borrow material sites for aggregate and limestone material have not been determined and material could be supplied from existing or undeveloped quarry sites. Potential aggregate locations include south of Grahamdale, west of Faulkner, west of Hilbre and near the start of the LSMOC access road upgrade in Township 30, Range 6, West of 1. All but the quarry location near the start of the LSMOC access road upgrade are predominately located in areas of agricultural land cover, although patches of remnant native vegetation may be cleared for expansion of existing quarries or development of new quarries. The potential quarry site near the start of the LSMOC access road upgrade has not been developed and development may fragment existing native upland and wetland patches.

Effects on landscape diversity are not expected during operations and maintenance as additional vegetation clearing is not planned. Effects on remaining patches of native vegetation from non-native invasive plant species and weeds are assessed in the community diversity and species diversity sections (sections 8.2.4.3 and 8.2.4.4 respectively).

Mitigation

Project effects on landscape diversity cannot be fully avoided given the abundance of native vegetation in the PDA and in adjacent areas of the RAA. Potential Project effects have been reduced by selecting a direct route for the LMOC while avoiding large wetland complexes where possible and following an existing road for the PR 239 realignment. This approach reduces the overall Project footprint. Effects cannot be avoided on the LSMOC due to the abundance of native vegetation in the RAA. A portion of the non-functioning EOC (Reach 3) will be used as part of the LSMOC though, reducing the need to clear native vegetation. Potential Project effects will be further reduced on the LMOC, PR 239 realignment and LSMOC by implementing standard Manitoba Infrastructure management plans (e.g., Manitoba

Infrastructure 2016b) and Project environmental requirements. Mitigation measures to reduce potential effects on landscape diversity will include the following:

- Prior to clearing or grubbing, the work area will be clearly staked or marked.
- Clearing, grubbing and burning operations will be conducted in accordance with the applicable Provincial and Municipal regulations and Acts.
- Clearing and grubbing will be limited to the construction or contract limits unless otherwise approved.
- Temporary staging areas will be located in the ROW wherever feasible and leaving short shrubs and herbaceous, graminoid and non-vascular cover in place to promote recovery of native vegetation.
- Wetland water level monitoring along the LMOC and LSMOC will be conducted as part of the groundwater management plan following construction, in areas where shallow ground water is intersected, and mitigated by either re-directing drainage into affected wetlands or by modifying the outside drainage ditch design to reduce changes in wetland hydrology.
- Rock, aggregate and limestone will be obtained from existing quarries where possible.
- Wood and brush piled for burning will be located at least 15 m from other wood and brush piles or standing timber. If piles are windrowed for burning a 15 m break in the windrow should occur for every 100 m of length. Slash will be piled in a manner that allows for clean, efficient burning of all material.
- The contractor will obtain a burning permit for open fires between April 1 and November 15 and must adhere to all permit conditions. Burn permits may not be issued in dry conditions. Burning between November 16 and March 31 does not require a burning permit; however, the supervising officer shall be advised prior to any burning. All fires will be completely extinguished by March 31.
- All occurrences of fire spreading beyond burn piles will be reported.
- All designated areas will be leveled to natural or pre-existing grade and slope as part of decommissioning. Stockpiled topsoil and other organic matter that had been removed from the site will be spread to promote natural re-establishment of vegetation.
- Where seeding is not required, temporary site locations will be left in a manner which promotes natural re-vegetation of the site.
- In cases where seeding is required, and when conditions permit, it will commence immediately upon completion of grading, capping and trimming operations.
- Feathering the ROW edge during operations vegetation management will maintain taller trees and shrubs along the edge of the ROW and reduce the extent of edge effects.

Project Residual Effects

Project construction of the LMOC, LSMOC and PR 239 will alter the mean vegetation patch size and mean patch perimeter length (Appendix 8A, Table 8.2A-7). Mean patch size increases for forested, grassland and wetland patches and decreases for shrub patches following site clearing. Mean patch perimeter length decreases for forested patches and shrubland patches, remains unchanged for grasslands and increases for wetlands. The changes, however, are small: less than 1% of the existing condition mean and the maximum patch size is only decreased for wetlands (87,809.36 ha at existing conditions to 87,109.30 ha following site clearing).

Increased mean patch size of forested, grassland and wetland patches are due to a decrease in the number of smaller patches, particularly less than 1 ha and 1 ha to 10 ha size classes (Appendix 8B, Figure 8.2B-7, Figure 8.2B-9, and Figure 8.2B-10). The mean patch size of shrublands decreases due to a decrease in the number of patches in the 1 ha to 10 ha and 10 ha to 20 ha size classes (Appendix 8B, Figure 8.2B-8). The total area in each patch size class is only slightly affected for land cover classes and the distribution of area amongst size classes is unchanged from baseline. Most of the area has patches larger than 500 ha for forested, grassland and wetland areas, and most shrubland patch areas consist of patches 1 ha to 10 ha in size. Forested patches of 1 ha to 10 ha also contain the second most area of forested patch size classes. No large forested patches (greater than 200 ha with an internal 100 m buffer) are intersected by the PDA and no size class, including larger classes of shrubland, grassland or wetlands, are lost from the RAA as a result of the Project.

Patch perimeter length decreases for most of the patch size classes of forested, shrubland and grassland cover classes (Appendix 8B, Figure 8.2B-7, Figure 8.2B-8, and Figure 8.2B-9). Patch perimeter length increases for six of the eleven wetland size classes with the largest increase to the 500 ha to 1,000 ha size class (Appendix 8B, Figure 8.2B-10).

The planned distribution line crosses an area composed mainly of wetlands, predominantly fens and swamps, and native forest. Vegetation clearing required for the construction of the distribution line is expected to increase fragmentation north of Lake St. Martin as existing intact wetland and forested patches will be intersected, including several large wetland patches (

classes are maintained. Smaller patches surrounded by human land uses likely have altered plant species composition and altered plant structure, with forested areas having denser shrub layers and changes in coarse woody debris (Harper et al. 2005).

A review of available literature by Harper et al. (2005) found edge effects extended from 40 m to 125 m from the edge of patches in boreal forests, depending on surrounding land use and stand age and, therefore, forested patches less than 1 ha to 5 ha (and potentially larger patches with a high degree of edge) are likely considerably different than larger patches. Reductions in the area of larger patches will likely reduce native plant abundance, including non-vascular plants, in the RAA due to changes in patch size and associated edge effects. Structural features are also expected to be naturally maintained in larger patches of the RAA. Effects duration will be long-term as upland and wetland forested and shrubland areas of the PDA may be maintained in a herbaceous or grassland form, or shrub cover and height reduced. Effects will extend into the RAA. Effects timing is not applicable because patch metrics and resulting patch conditions will be unaffected by the timing of construction.

8.2.4.3 Change in Community Diversity

Project Pathways

Community diversity of native vegetation including both uplands and wetlands will likely be altered by clearing during Project construction. Vegetation will be removed for channel construction and realignment of PR 239, and construction of the power distribution line. The loss of vegetation will have a direct effect on the area of native vegetation communities. Indirect effects from fragmentation on native vegetation communities, including a change in species diversity and composition, i.e., reduced species diversity, increase in light tolerant species, are assessed in Section 8.2.4.2 Landscape Diversity. A study of historic changes in water levels of Lake Manitoba following the installation of the Fairford dam showed an increase in cattail abundance and a reduction in the abundance of other native grasses (Shay et al. 1999). The change in water levels associated with the diversion of water through the channels will likely have an indirect effect on community diversity. This will likely result in the loss or alteration of wetlands along the channels. Indirect effects on wetlands are assessed in Section 8.2.4.5, Wetland Functions.

The change in drainage patterns and hydrology will likely cause indirect effects to community diversity including drawdown and drying of wetlands, or back-up of water and flooding. Natural surface and subsurface drainage flow may be affected along the LSMOC up to 500 m (see Chapter 6, Section 6.4). Unmitigated, this effect would be expected to affect drainage over an area of up to approximately 1,200 ha on either side of the channel.

Vehicle and heavy equipment use during construction could also cause indirect effects to native vegetation communities through edge effects, including the introduction or spread of non-native invasive species and dust deposition. Hollow Water First Nation expressed concerns regarding the effects of invasive species. These non-native invasive species may also be spread by recreational vehicle use during operations through increased access. Edge effects from non-native invasive plant species may extend up to 1 km (Henderson 2009). Dust deposition can alter plant productivity and change vegetation community structure (Farmer 1993). Some plant species are more sensitive to dust particularly *Sphagnum* dominated communities (Farmer 1993).

The locations of quarries and borrow material sites for aggregate and limestone material have not been determined and material could be supplied from existing or undeveloped quarry sites. Quarry sites may cause direct effects from native vegetation removal and indirect effects from dust deposition.

The LMOC and LSMOC ROWs will be reclaimed following construction; however, native vegetation communities may be maintained in a different state than prior to construction, with graminoid or shrub land cover instead of forested.

Manitoba Infrastructure may transfer Crown land to private ownership to compensate for the loss of impacted privately-owned cultivated land. The transferred Crown land could subsequently be converted to agricultural use, which would result in the loss of native upland vegetation communities within the LAA and RAA. Conversion to agriculture may also result in the drainage of wetlands, particularly marshes. The conversion to agriculture will also have an indirect effect such as an increased introduction and spread of non-native invasive species.

Further changes to community diversity during Project operations and maintenance include indirect edge effects from non-native invasive species introduction and spread. Areas disturbed during construction will be reclaimed using native plant species, and the PDA will be inspected for areas of water impoundment adjacent to the ROW and drying of wetlands. Outside drainages will be constructed to help maintain surrounding drainage, one on the west side of the LMOC and one on the east side of the LSMOC. Drainage design will be altered, or other mitigation options implemented if drainage problems are identified during Project operations.

Mitigation

Standard industry practices and Project-specific mitigation measures will be followed during construction and operation. Project effects on community diversity cannot be fully avoided given the abundance of native vegetation along the LAA and in adjacent areas of the RAA. Potential Project effects have been reduced by selecting a direct route for the LMOC while avoiding large wetland complexes, which reduces the overall Project footprint. Effects cannot be avoided on the LSMOC due to the abundance of native vegetation in the RAA. Potential Project effects will be further reduced on the LMOC, PR 239 realignment and LSMOC by implementing the Project specific environmental requirements (PER). The following mitigation measures will be included:

- Clearing and grubbing will be limited to the construction or contract limits unless otherwise approved.
- Clearing and excavating in wetlands will occur during dry or frozen conditions whenever possible.
- Construction-related traffic to the Project ROW and associated access routes during Project construction and maintenance will be restricted. Where access routes are accessible by the public, access will be blocked when not in use.

- Clearing and grubbing for the Project is expected to primarily occur in the winter months. Grubbing will not occur within 2 m of standing timber in order to prevent damaging root systems of adjacent standing trees and to reduce the potential of future blow down.
- Harvested merchantable timber will be cleared of limbs and neatly stockpiled piled within the work limits.
- Disposing of cleared trees and brush will be conducted in a manner approved by Manitoba Infrastructure according the Manitoba Infrastructure's Clearing Guidelines. Disposal may involve burning, compacting, piling, burying, windrowing and compacting, limbing and chipping.
- Restricting or prohibiting disposal of cleared vegetation in wetlands, riparian areas, important traditional collection areas or known SOCC and COCC locations will be implemented.
- Removal of riparian vegetation will be minimized, to help maintain the stability of waterbody banks. The area over which vegetation in riparian vegetation areas is removed will affect no more than one third (1/3) of the total woody vegetation in the right-of-way within 30 m of the ordinary high-water mark of a waterbody. Vegetative root masses found within the waterbody banks will remain undisturbed unless specified.
- Trees will be felled towards the center of the area to be cleared. Any brush falling outside the area to be cleared will be moved back into the work area immediately.
- Use of pesticides/herbicides will be restricted in areas of known SOCC and COCC.
- Dust control measures will follow Manitoba Infrastructure's Specification for Dust Control (Manitoba Infrastructure 2000a).
- Cleared vegetation stockpiles will be dispersed to limit available fuel sources for wildfire ignition and spread. A burning permit will be obtained where required and burning will not be conducted if conditions could lead to fires burning out of control. Controls will be in place for all burning.
- Temporary staging areas will be located in the ROW wherever feasible and short shrubs and herbaceous, graminoid and non-vascular cover will be left in place to promote recovery of native vegetation.
- Temporary camp sites and staging areas will be located in currently disturbed areas and/or using existing facilities wherever possible.
- Vegetation removal and restricting construction access will be limited to existing roads and trails when possible. New access will be constructed through previously disturbed areas when possible and grading and compacting will be limited to access needed for heavy equipment.

- Erosion control measures will be implemented, including matting if working within wetlands unless the work is in dry or frozen conditions. If working during wet conditions, an Environmental monitor will be on site to monitor effects to wetlands including rutting.
- The topsoil (i.e., the organic layer) will be salvaged and temporarily stored to be used as a seed bed to spread over the containment dikes.
- Natural revegetation will be encouraged. Disturbed lands such as in areas vulnerable to erosion and sedimentation will be seeded and/or planted in accordance to the Revegetation Plan. The Revegetation Plan will be completed as part of the Construction Environmental Management Program (CEMP) for Manitoba Infrastructure. The Revegetation Plan will identify locations and methods for restoration of vegetation cover in disturbed areas.
- A drainage ditch will be installed on the east side of the LSMOC to intercept any water flowing from the Lake Manitoba and Lake Winnipeg drainage basins from the east. Similarly, on the LMOC, an outside drain will be constructed along the west side of the channel to intercept any water flowing from the drainage basins from the west.
- Consideration may be given to discharge water via Reach 1 of the EOC to mitigate for the loss of flows to Buffalo Creek in the LSMOC in future.
- An integrated pest management approach will follow Manitoba Infrastructure (2016b) for controlling weeds, invasive non-native species and pests. Control methods may include mowing, controlled burns and pesticide application. Pesticides may be considered for areas with dangerous noxious weeds or invasive species not resolvable by other control methods. Only pesticides approved for use by provincial legislation will be used and application will be by licensed personnel.

Project Residual Effects

Vegetation clearing will remove 306.3 ha (-3.4%) of native upland vegetation within the LAA (Table 8.2-10). All native upland vegetation cover classes within the LAA will be maintained. However, clearing the LMOC, LSMOC ROW will change reclaimed forested and shrubland areas into grassland communities, and these restored vegetation communities may not have the same species composition or structure as native vegetation communities and are therefore not directly comparable. During operation, taller shrub and tree cover will likely be cleared from parts the ROW to maintain access roads.

Vegetation clearing includes 165.7 ha of native upland vegetation in the LAA of the LMOC, which is predominantly dense and open deciduous forest. Along PR 239, 12.7 ha of native upland vegetation will be removed in the LAA, including predominantly dense and open deciduous forest. In the LAA of the LSMOC, 127.9 ha of native upland vegetation including primarily dense coniferous and mixedwood forest will be removed.

The power distribution line for the LSMOC water control structure will also affect native uplands and wetlands, with 11.3 ha of native upland and 30.3 ha of wetland altered. Loss of native vegetation, however, will likely be limited to structure locations. Native vegetation will be modified along the length of the ROW due to tree and tall shrub removal; however, low shrubs, herbs, grasses and potentially non-vascular cover will be retained. Forested areas will be converted to shrublands as a result. Removal of trees and tall shrubs may also alter species composition due to changes in light and moisture conditions.

Vegetation clearing will result in the loss of 40.6% (30.2 ha) of shrubland within the LAA. In the LAA, this represents a loss of 2.5 ha in the LMOC and 27.7 ha in the LSMOC.

Grassland will be lost in 0.3% (7.8 ha) of the LAA, which includes 1.1 ha in the LMOC and 6.7 ha in LSMOC. The area of grassland has the potential to increase after construction as parts of the ROW is restored to grassland. No known areas of tall grass prairie COCC will be disturbed by the Project. Effects on COCC will be limited to vegetation communities on seven locations of sandy soil within the PDA (see Chapter 6, Section 6.3.2.4, Table 6.3-10). Effects on unidentified alvar COCC are not expected as no areas of shallow soils and exposed bedrock were identified within the PDA.

Vegetation clearing will remove 1,013.6 ha (6.7%) of wetland vegetation in the LAA (Table 8.2-10). In the LAA of the LSMOC, 717.6 ha of wetlands will be lost including 476.5 ha of fens, 210.7 ha of swamps, 17.3 ha of shallow open water, 7.9 ha of marshes, and 5.2 ha of bogs. All wetland land cover classes will be affected by the Project.

Marsh will be lost in 281.6 ha of the LAA including 269.5 ha in the LMOC, 4.2 ha in PR 239, and 7.9 ha in LSMOC. The desktop mapping underestimated marsh polygons, particularly in agricultural lands so the area covered by marsh is likely larger. In PR 239, 4.2 ha of marsh will be lost. See Section 8.2.4.5 for an assessment of effects on wetland functions. Indirect effects from changes in water levels due to channel operation may change species composition in marshes from native grass species to cattails (Shay et al. 1999).

Shallow open water wetlands will be lost in 7.6% (38.7 ha) of the LAA including 21.5 ha within the LMOC and 17.3 ha within the LSMOC.

See Appendix 8A, Table 8.2A-3 for details on the area of land cover classes intersected by the LMOC, LSMOC, PR 239 realignment and around Lake St. Martin in the LAA.

Table 8.2-10 Change in Native Upland Vegetation Cover Classes in the LAA

Land Cover Category	Land Cover Class[1]	LAA		
		Existing	Construction	Construction
		ha	ha	% Change
Agriculture	Cultivated	747.1	624.7	-16.4
	Hayland	2,994.0	2,625.6	-12.3
	Hayland and Pasture[2]	51.4	51.4	n/a
	Tame Pasture	238.2	204.3	-14.3
	Total[3]	**4,030.7**	**3,505.9**	**-13.0**

Table 8.2-10 Change in Native Upland Vegetation Cover Classes in the LAA

Land Cover Category	Land Cover Class[1]	LAA		
		Existing	Construction	Construction
		ha	ha	% Change
Bare Ground	Bare ground[2]	66.8	66.8	n/a
	Rock/Sand	9.9	8.9	-9.9
	Total[3]	**76.7**	**75.7**	**-1.3**
Developed	Developed[2]	74.7	74.7	n/a
	Industrial	50.1	11.9	-76.2
	Residential	79.4	74.5	-6.2
	Roads	83.3	63.5	-23.7
	Total[3]	**287.5**	**224.7**	**-21.9**
Native Upland Vegetation	Coniferous Forest - Dense	571.7	513.6	-10.2
	Coniferous Forest – Open	387.8	383.4	-1.1
	Deciduous Forest – Dense	3,877.9	3,754.1	-3.2
	Deciduous Forest – Open	1,060.4	1,008.7	-4.9
	Grassland	2,531.1	2,523.4	-0.3
	Mixedwood Forest - Dense	382.3	352.2	-7.9
	Mixedwood Forest - Open	23.1	22.7	-1.8
	Shrubland	74.4	44.2	-40.6
	Total[3]	**8,908.6**	**8,602.3**	**-3.4**
Water	Channel	14.8	9.3	-36.7
	Lakes	35,342.8	35,157.8	-0.5
Water	River/Streams/Creeks	37.7	37.2	-1.4
	Total[3]	**35,395.2**	**35,204.3**	**-0.5**
Wetland	Bog - Forested	8.2	6.8	-17.5
	Bog - Shrub	20.2	16.4	-18.6
	Dugout	7.5	6.7	-10.9
	Fen - Forested	922.3	764.6	-17.1
	Fen - Graminoid	1,186.8	990.1	-16.6
	Fen - Shrub	698.8	576.7	-17.5
	Marsh	1,659.8	1,376.8	-17.0
	Shallow Open Water	510.7	472.0	-7.6
	Swamp - Forested Coniferous	1,127.2	1,015.5	-9.9
	Swamp – Forested Deciduous	24.8	12.2	-50.6
	Swamp – Forested Mixedwood	244.0	201.3	-17.5

Table 8.2-10 Change in Native Upland Vegetation Cover Classes in the LAA

Land Cover Category	Land Cover Class[1]	LAA		
		Existing	Construction	Construction
		ha	ha	% Change
	Swamp - Shrub	321.4	277.7	-13.6
	Wetland-herb[2]	3,968.6	3,968.6	n/a
	Wetland-shrub[2]	4,426.5	4,426.4	n/a
	Wetland-treed[2]	26.6	26.6	n/a
	Total[3]	**15,153.3**	**14,138.4**	**-6.7**

[1] Based on desktop mapping data.
[2] Based on LCC data
[3] Totals may not equal sum of individual values due to rounding.

Stand-destroying crown fires occur at approximately 50 to 200 year intervals and can reach 500 years on very moist sites. The coniferous forests (e.g., spruce, pine) experience more frequent crown fires than deciduous dominated forests (Perry 1994). Vegetation clearing will change the abundance of forest age classes in the LAA; however, no age class of any upland or wetland forest type will be lost and changes in the relative abundance of age classes are small (Figure 8.2-1 and Table 8.2-11).

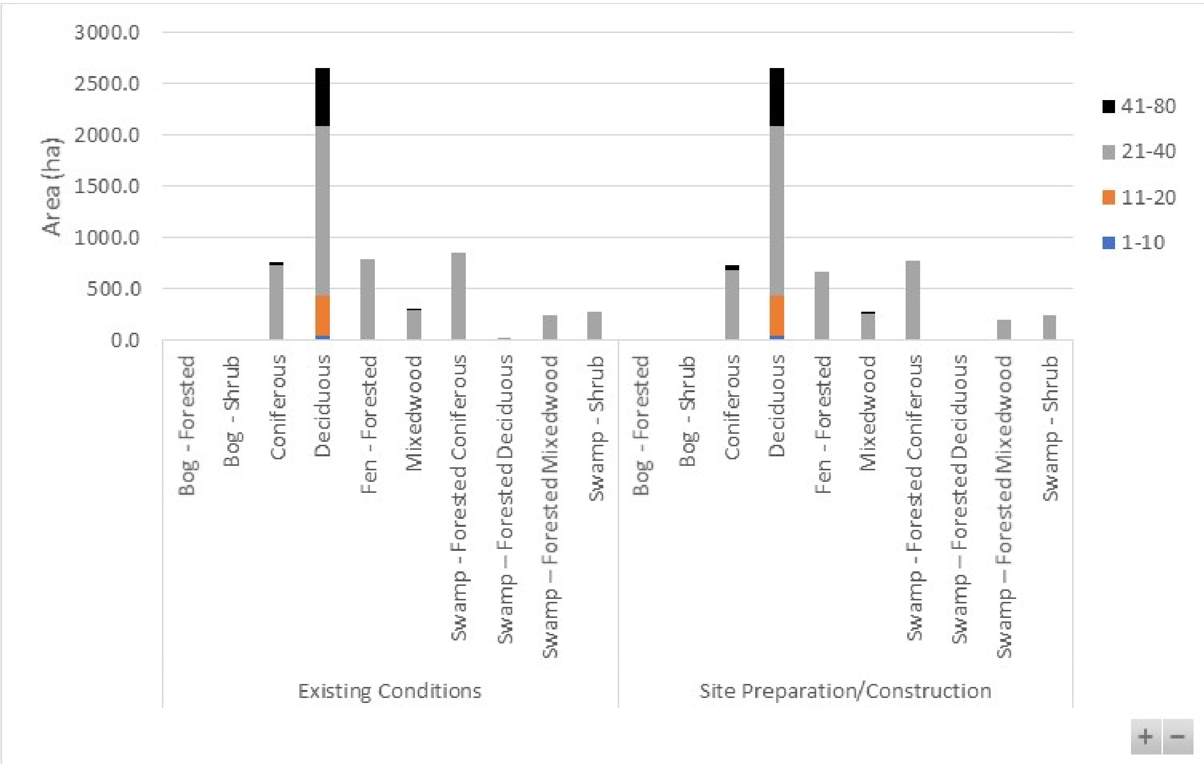


Figure 8.2-1 Changes in Area of Forest Age Classes

Table 8.2-11 Change in Area of Forest Age Classes

Project Phase	Forest Cover Class	Forest Age Class Area (ha)				Total Area (ha)
		1-10	11-20	21-40	41-80	
Existing Conditions	Bog - Forested	0.0	0.0	0.1	0.0	0.1
	Bog - Shrub	0.0	0.0	12.5	0.0	12.5
	Coniferous	0.0	0.7	727.3	37.6	765.6
	Deciduous	33.6	394.8	1,663.6	565.5	2,657.6
	Fen - Forested	0.0	0.0	793.2	0.0	793.2
	Mixedwood	0.0	2.7	289.6	12.0	304.3
	Swamp - Forested Coniferous	0.0	0.0	854.7	0.0	854.7
	Swamp – Forested Deciduous	0.0	0.0	23.8	0.0	23.8
	Swamp – Forested Mixedwood	0.0	0.0	244.0	0.0	244.0
	Swamp - Shrub	0.0	0.0	268.7	0.0	268.7
	Total	**33.6**	**398.3**	**4,877.4**	**615.2**	**5,924.4**
Construction	Bog - Forested	0.0	0.0	0.1	0.0	0.1
	Bog - Shrub	0.0	0.0	10.6	0.0	10.6
	Coniferous	0.0	0.7	687.9	37.6	726.2
	Deciduous	33.6	394.8	1,662.6	563.8	2,654.8
	Fen - Forested	0.0	0.0	669.2	0.0	669.2
	Mixedwood	0.0	2.7	260.0	12.0	274.7
	Swamp - Forested Coniferous	0.0	0.0	780.2	0.0	780.2
	Swamp – Forested Deciduous	0.0	0.0	11.5	0.0	11.5
	Swamp – Forested Mixedwood	0.0	0.0	201.3	0.0	201.3
	Swamp - Shrub	0.0	0.0	239.4	0.0	239.4
	Total	**33.6**	**398.3**	**4522.7**	**613.4**	**5568.1**
	Grand Total	**67.3**	**796.5**	**9400.1**	**1228.6**	**11492.5**

For a low flood event (i.e., 801.93 ft lake level), it is estimated that the operation of the outlet channels will decrease the lake level by 0.52 m, on average, in Lake St. Martin (see Chapter 6, Section 6.3.2.4). This ^{2} (2,140 ha) in the amount of area that would have been inundated by flood waters (see Section 6.3 groundwater and surface water; Manitoba Infrastructure 2019b). Changes in the extent of aquatic vegetation may also occur in Lake St. Martin due to changes in lake water levels.

The extent of change is difficult to estimate as the abundance and extent of aquatic vegetation likely varies with seasons and yearly in response to changes in natural lake levels, water temperature and nutrient levels. However, 22.2 ha of aquatic vegetation in the proposed inlet and outlet excavation locations in Lake Manitoba, Lake St. Martin and Lake Winnipeg, may be removed during construction.

There may be effects on community diversity from the potential quarry site and surrounding area if it is developed in the LSMOC.

Effects on community diversity are adverse and moderate in magnitude because portions of intact native upland vegetation and wetlands cover classes will be lost within the LAA. Sixty per cent of the current landscape of the Lake Winnipeg watershed has been altered by human activity starting in the 1870s (Voora and Veneman 2008) and after Project construction the LAA will consist of 10% forests, 4% grassland, and 23% wetlands.

In addition, some native upland vegetation communities may benefit from reduced flooding including forest or grassland. Comparing the total inundated areas for all land cover types in the LAA during the 2011 flood event to the reduced flood extent predicted with the Project in place, the inundated area would be reduced by a total of 1,682.9 ha around Lake St. Martin LAA and 1,379.6 ha in the Lake Manitoba LAA. This reduced area includes coniferous forests, deciduous forests, mixedwood forest, shrubland, and grassland around Lake St. Martin and deciduous forest, grassland, and shrubland around Lake Manitoba, all of which have been historically inundated by flood waters. The Project will reduce flooding of native vegetation cover classes by 1,118.8 ha around Lake St. Martin and 168.2 ha around Lake Manitoba (Table 8.2-12).

Table 8.2-12 Area of Native Upland Vegetation Communities Affected by the 2011 Flood and Change with the Project

Lake	Native Upland Cover Class	2011 Flood	Expected Flooded Area with Project	Reduction in Flooded Areas	
		Area (ha)	Area (ha)	Area (ha)	%
Lake St. Martin	Coniferous Forest - Dense	65.7	42.5	23.2	35.3
	Coniferous Forest - Open	78.7	34.2	44.5	56.6
	Deciduous Forest - Dense	862.0	482.3	379.7	44.1
	Deciduous Forest - Open	113.5	91.8	21.6	19.1
	Grassland	1,308.4	662.7	645.6	49.4
	Mixedwood Forest - Dense	17.0	12.8	4.3	25.0
	Shrubland	0.8	0.8	0.0	0.0
	Total	**2,445.9**	**1,327.1**	**1,118.8**	**45.7**
Lake Manitoba	Deciduous Forest - Dense	130.4	30.4	100.0	76.7
	Deciduous Forest - Open	92.8	33.3	59.5	64.1

Table 8.2-12 Area of Native Upland Vegetation Communities Affected by the 2011 Flood and Change with the Project

Lake	Native Upland Cover Class	2011 Flood	Expected Flooded Area with Project	Reduction in Flooded Areas	
		Area (ha)	Area (ha)	Area (ha)	%
Lake Manitoba	Grassland	6.8	6.8	0.0	0.0
	Shrubland	11.3	2.6	8.7	77.0
	Total	**241.3**	**73.1**	**168.2**	**69.7**

Indirect effects from dust and non-native invasive species is likely to spread into the LAA (see Section 8.2.4.4 for additional details). The loss in area of native upland vegetation and wetland communities will likely persist beyond completion of construction and restoration activities into the operations and maintenance phase of the Project. Direct effects from changes in drainage (i.e., vegetation stress causing a change in community structure or composition, as shown in the LSMEC) on native upland or wetland communities may extend up to 1,600 m from the PDA, but with mitigation measures such as the addition of a ditch to the channels, effects in the RAA should be reduced. With the application of the mitigation measures, edge effects from the introduction and spread of non-native invasive species would be managed. Construction is scheduled to occur when the ground is dry and many plant species have flowered and set seed. Effects from clearing occurs once during the life of the Project, and as decommissioning is not planned for the Project, the loss or alteration of native upland vegetation and wetland communities is permanent and irreversible.

8.2.4.4 Change in Species Diversity

Project Pathways

Indigenous communities (Dauphin River First Nation and Ebb and Flow First nation) have indicated their concern for the historical loss of plant species of interest for Indigenous groups including berries and other edible plant species due to flooding or other unmentioned factors.

Additional undetected plant SOCC could be present within the PDA because many species numbers fluctuate from year to year in response to environmental conditions. For example, plant SOCC with annual phenology may not germinate or produce seed in dry years. In addition, there are 10 expected plant SOCC within the Interlake Plain ecoregion and three expected plant SOCC within the Mid-boreal Upland ecoregion that are annuals, which may have been undetected during the vegetation surveys in 2016 (Appendix 8A, Table 8.2A-4). There is potential for six of these annual species to occur within the native upland vegetation communities and four to occur within wetland communities within the PDA.

Species diversity of native vegetation will likely be altered by clearing during Project construction. Vegetation will be removed for channel construction and realignment of PR 239. The LMOC and LSMOC ROWs will be reclaimed following construction; however, vegetation may be maintained in a different state than present prior to construction, with graminoid or shrub landcover maintained instead of forest. These changes also have the potential to affect plant species of interest to Indigenous groups. Vegetation will also be altered along the power distribution line ROW with trees and tall shrubs removed. This may alter growing conditions altering the abundance of plant species of interest for Indigenous groups and SOCC. Plant species of interest for Indigenous groups and SOCC may also be removed at structure locations.

The Project could result in direct loss of plant SOCC and plant species of interest for Indigenous groups from vegetation clearing during construction. Vehicle and heavy equipment use during construction and operation could result in the direct loss of plant SOCC and plant species of interest for Indigenous groups through removal or crushing, soil compaction, and rutting. Indirect effects during construction from dust may also effect SOCC and plant species of interest to Indigenous groups. Dust deposition may affect species diversity and plant productivity (e.g., fruit setting, pollen germination) (Farmer 1993). Henderson (2011) states that SOCC require a minimum of 30 m buffer from disturbance to avoid negative effects from construction such as road dust. Vehicle and heavy equipment used during construction could also cause the indirect loss of species diversity, including plant SOCC and plant species of interest for Indigenous groups through the introduction or spread of non-native invasive species. Hollow Water First Nation expressed concerns regarding the effects of invasive species. These non-native invasive species may also be spread by recreational vehicle use during operations through increased access. Furthermore, Henderson (2009) states that edge effects from non-native invasive plant species may extend up to 1 km.

Species diversity may be affected by changes in groundwater during construction dewatering (see Chapter 6, Section 6.4.4.2) as wetlands downstream of the LMOC or LSMOC may become drier. Therefore, undocumented plant SOCC maybe be affected.

Additional vegetation clearing is not planned during operation and maintenance; however, SOCC and plant species of interest to Indigenous groups could be affected by dust from vehicle traffic and weed control and vegetation management (e.g., herbicide application and mowing). The Project could spread plant diseases and pests including jack pine budworm and Eastern larch beetle, which are known to occur within the LAA.

The locations of quarries and borrow material sites for aggregate and limestone material have not been determined and material could be supplied from existing or undeveloped quarry sites. Quarry sites may cause direct effects from native vegetation removal and indirect effects from dust deposition. Reclamation within the PDA after construction will reduce the disturbance footprint and support the establishment of native plant species.

Mitigation

Proven industry practices, standard Manitoba Infrastructure management plans and Project-specific environmental requirements will be followed during construction and operation. Prior to construction, additional rare plant and weed surveys will also be conducted in order to determine sensitive areas that require additional mitigation measures during construction and operation.

Project-specific mitigation measures to avoid or reduce the potential effects of the Project to species diversity includes the following:

- Machinery will arrive on site in a clean condition and shall be kept in good working order and free of fuel, oil or fluid leaks. Machinery that is found to be leaking any fuel, oil or other fluids will be moved off the work site immediately for repair.
- Clearing and grubbing will be limited to the construction or contract limits unless otherwise approved.
- Applicable setbacks will be applied to all known occurrences of federally listed species at risk and their critical habitat following Environment Canada requirements (Henderson 2011). Seed collection or transplanting will be conducted, in consultation with Environment and Climate Change Canada and Manitoba Sustainable Development, if occurrences cannot be avoided.
- Applicable setbacks will be applied to all known occurrences of provincially listed SOCC (Henderson 2011). Seed collection or transplanting will be conducted, in consultation with Manitoba Sustainable Development, if occurrences cannot be avoided.
- Where avoidance of SOCC is not possible, construction in sensitive areas will be restricted to the winter months (outside of the growing season).
- The topsoil (i.e., the organic layer) will be salvaged and temporarily stored to be used as a seed bed to spread over the channel dikes.
- Erosion and Sediment Control Plans will be developed and will include information on revegetation. All upland and side-slope areas must be seeded with a composition of species to reflect the changing moisture conditions (drought or flooding). Revegetation of the channel will include four zones: upland berm, mid-slope, lower slope and wetland (see Chapter 3, Appendix 3E).
- Seeding will follow the Project-specific Revegetation Plan.
- Dust control measures will follow Manitoba Infrastructure (2000).
- Natural revegetation will be encouraged. Disturbed lands such as in areas vulnerable to erosion and sedimentation will be seeded and/or planted in accordance to the Revegetation Plan. The Revegetation Plan will be completed as part of the Construction Environmental Management Program (CEMP) by Manitoba Infrastructure. The Revegetation Plan will identify locations and methods for reclamation of vegetation cover in disturbed areas.
- Contractor(s) will be restricted to established roads, trails, and cleared construction areas in accordance to the Access Management Plan.

- Constructing outside drains on the LMOC (west side) and LSMOC (east side) to capture drainage and manage water level changes in adjacent wetlands. Outside drains will not be required along the east side of the LMOC or west side of the LSMOC because surface runoff slopes away from the east side of the LMOC and west side of the LSMOC.

  An integrated pest management approach will follow Manitoba Infrastructure (2016b) for controlling weeds, invasive non-native species and pests. Control methods may include mowing, controlled burns and pesticide application. Pesticides may be considered for areas with dangerous noxious weeds or invasive species not resolvable by other control methods. Only pesticides approved for use by Provincial legislation will be used and application will be by licensed personnel.

Project Residual Effects

Plant Species of Conservation Concern

The Project will result in the loss of plant SOCC within the PDA. Three SOCC occurred within the LMOC PDA: sweet grass, saline shooting star, and annual sunflower (see Table 8.2-7). One SOCC occurred within the LSMOC portion of the PDA, dragon's mouth orchid. Three SOCC including annual sunflower, early yellow locoweed and yellow willow were also found in the LAA or RAA, and undocumented occurrences may occur in the PDA. Suitable habitat for all six species exists within the RAA. The Project will decrease the abundance of native vegetation communities and increase the fragmentation of large native vegetation patches, which may reduce the area of suitable habitat for SOCC. However, some plant SOCC (e.g., upland-dependent species) that have historically been negatively affected by flooding may be positively affected by the Project because of a reduction in inundated areas when the Project is operating . Undocumented wetland dependent plant SOCC should not be affected by construction dewatering because mitigation measures include pumping the water into wetlands adjacent to the PDA.

Vegetation clearing required for the construction of the power distribution line for the Lake St. Martin water control structure is expected to decrease the area of native upland and wetland vegetation community habitat (Appendix 8B, Figure 8.2B-4). No documented SOCC occurrences are present along the proposed route, but undocumented occurrences may be lost, particularly at proposed power structure locations where ground disturbance and vegetation removal will occur. Undocumented SOCC occurrences may also be lost along the ROW due to removal of trees and tall shrubs and a resulting change in light and moisture levels.

There may be effects on species diversity from the potential quarry site and surrounding area if it is developed in the LSMOC.

Potential residual effects on species diversity are characterized as adverse because known occurrences of SOCC will be lost as they occur within the Project footprint. SOCC may be indirectly affected by construction and operation (i.e., dust, spread of non-native invasive species) within 30 m of the PDA and up to 1,000 m (Henderson 2011). These effects are irreversible because the PDA will be converted from native vegetation communities and disturbance will persist beyond completion of construction and rehabilitation activities for indefinite duration of the Project. The local and regional abundance of SOCC is largely unknown with the exception of the occurrences of SOCC observed during field surveys in the LAA and RAA. Therefore, it is difficult to determine the magnitude of effects from the Project due to the high level of uncertainty regarding potential SOCC occurrences in the non-surveyed areas of the PDA and LAA. This uncertainty has been incorporated into the scope of follow-up in the form of additional rare plant surveys to be completed prior to construction (see Section 8.2.8). In sensitive areas, construction is scheduled to occur when the ground is dry, and many plant species have flowered and set seed. With the mitigation measures to control for indirect effects, the magnitude of the effect on SOCC is considered moderate because there will be a loss of SOCC within the PDA. Because the vegetation LAA is relatively undisturbed along the LSMOC, there will be increased adverse effects to SOCC along this channel.

Plant Species of Interest to Indigenous Groups

The abundance and spatial distribution of plant species of interest to indigenous groups will likely be reduced due to Project clearing. The Project will alter the area of vegetation communities that support plant species of interest to Indigenous groups. The loss of area in native upland vegetation and wetland communities that support these species in the LAA is predominantly located within the LSMOC in deciduous swamps (-50.6%), shrubland (-40.6%), shrub dominated bogs (-18.6%), forested bogs (-17.5%), shrub dominated fens (-17.5%), and mixedwood swamps (-17.5%). These changes in land cover may alter the abundance of upland dependent plant species of interest to Indigenous groups and wetland dependent plant species, particularly berries as many of those species are shrubs (e.g., cranberry [*Viburnum* spp.] and blueberry species [*Vaccinium* spp.]).

The expected effects along the PR 239 in the LAA will be the loss of dense deciduous (7.5 ha) and open deciduous forest (4.3 ha), and marsh (5.6 ha). The loss of native upland vegetation in deciduous forests within the PR 239 could result in the loss of habitat for upland plant species of interest to Indigenous groups.

The expected effects along LMOC include the loss of marsh (269.5 ha) and dense deciduous forest (114.7 ha). The loss of marsh wetland habitat could result in the loss of wetland plant species of interest to Indigenous groups. This may include the loss of seneca observed along Goodison Lake and the loss of sweet grass observed near Reed Lake as they are both wetland species.

Plant species of interest to Indigenous groups will also be reduced due to vegetation clearing of native vegetation communities along the power distribution lone route; however, the local abundance of species of interest to Indigenous groups along the proposed distribution line route is not known.

Plant species of interest for Indigenous groups, including berries, may have a positive residual effect from the Project due to the prevention of flooding in traditional use plant gathering areas.

No land cover classes that support plant species of interest to Indigenous groups will be lost; only portions will be altered in the LAA. Changes in area of native upland vegetation communities could alter the abundance up to 69 upland-dependent plant species of interest to Indigenous groups within the LAA, which are harvested for various uses (see Chapter 10.1).

Undocumented wetland-dependent plant species of interest to Indigenous groups should not be affected by construction dewatering because mitigation measures include pumping the water into the wetlands.

There may be effects on species diversity from the potential quarry site and surrounding area if it is developed in the LSMOC.

Reclamation will reduce the area lost within the PDA because native species will be used, but vegetation communities will be different from the existing conditions. These communities will likely be grassland and shrubland that may support plant species of interest to Indigenous groups.

The local and regional abundance of SOCC and plant species of interest to Indigenous groups is unknown. Therefore, it is difficult to determine the magnitude of effects on the abundance of these species from the Project due to the high level of uncertainty. This uncertainty has been incorporated into the scope of Indigenous engagement. Manitoba Infrastructure has undertaken consultation prior to and throughout preparation of the EIS and the Manitoba Métis Federation (MMF) suggest Manitoba infrastructure reclaim the banks of the channels because embankment and riparian areas provide unique habitats for vegetation and stand structural diversity preferred by many wildlife species that are important to the Community.

There will be a low magnitude effect on plant species of interest to Indigenous groups as some plant species of interest to Indigenous groups (i.e., wetland dependent species) may be adversely affected by the Project. However, some that have historically been negatively affected by flooding (e.g., upland-dependent species) may be positively affected by the Project due to a decrease in flooding and none are expected to be lost from the LAA. The local and regional abundance of plant species of interest to Indigenous groups is uncertain; they may be indirectly affected by edge effects caused by construction and operation within 30 m of the PDA and up to 1,000 m (Henderson 2011), but the edge effects are unlikely to affect the sustainability in the RAA because affected land cover classes are common in the RAA. These effects are largely reversible over the long term after completion of construction and rehabilitation activities and mitigation measures to control dust from road use during operations. Because the vegetation LAA is relatively undisturbed along the LSMOC, there will be increased adverse effects to plant species of interest to Indigenous groups along this channel.

Non-Native Invasive Species and Weeds

Of the 10 non-native invasive species observed at 41 locations within the PDA during the 2016 field surveys, 36 occurred along the LMOC. The most common non-native invasive species were dandelion (*Taraxacum officinale*) and absinthe (*Artemisia absinthium)*. Only three species were observed in the LSMOC and they are all common: hemp nettle, dandelion, and scentless chamomile. Most of the weed species were observed along the LSMOC near the shore of Lake Winnipeg. This suggests that the native upland vegetation and wetlands have largely remained intact and are not heavily invaded by non-native invasive species. All the historical occurrences of non-native invasive species from EDDMapS were from the LMOC area along roads and other anthropogenic disturbances. Sumners and Archibold (2007) report that only common dandelion and Canada bluegrass (*Poa compressa*) were observed within mature mixedwood forests. However, newly created forest edges are susceptible to invasion by non-native invasive species because they are able to establish and out-grow the slow-growing native plant species (Dillon et al. 2018).

The effects of non-native invasive species will be adverse and low in magnitude because construction will cause soil disturbances (i.e., vegetation clearing, compaction) that will create opportunities for the invasive of adjacent native upland vegetation and wetlands. The seeds of these non-native invasive species would likely remain in the seedbank in stockpiled material and will persist following construction. The timing of construction in native upland vegetation and wetlands is highly sensitive as the invasion and spread of weeds increases later in the growing season when they flower and set seed. Operations, particularly vehicle traffic on roads and some vegetation management techniques e.g., mowing, may also spread non-native invasive species. With the application of the mitigation measures, the introduction, spread, and abundance of non-native invasive species would be managed. Edge effects provide recruitment sites and likely result in the spread of non-native invasive species into the vegetation LAA; however, they may be reversible over the long term with adaptive vegetation management such as monitoring reclamation sites and changing vegetation control methods to achieve the desired outcomes. As the PDA and vegetation LAA of the LMOC is largely disturbed, the likelihood of introducing and spreading non-native invasive species is higher. In addition, the creation of a linear disturbance into relatively undisturbed native upland vegetation and wetlands will facilitate non-native invasive species movement.

8.2.4.5 Change in Wetland Functions

Project Pathways

The Project has the potential to alter wetland function from changes in wetland abundance, vegetation cover and structure, and altered water inputs and drainage patterns. These changes have the potential to alter nutrient cycles, decomposition and carbon accumulation rates, water filtration and storage, habitat, and related socio-economic functions such as hunting and trapping. Effects are expected to occur during construction, starting with vegetation clearing, and extend through operations with on-going shallow ground water drainage management and potential permanent alteration of wetland drainage catchment extent and conditions, as well as changes to Lake St. Martin water levels. Indigenous communities (Fisher River Cree Nation, Lake St. Martin First Nation, Black River First Nation) have indicated concerns of effects on wetlands from the Project, including potential effects on the Buffalo Lake bog and creeks intersected by the LMOC and LSMOC, and a need for controls to protect wetlands from drainage.

Wetlands and small wetland lakes and ponds located along the east side of the LMOC alignment (i.e., Goodison Lake, Water Lake, Clear Lake, Reed Lake) are potentially affected during construction. Due to the thick confining layer of till, it is unlikely that there is a connection between the confined carbonate aquifer and the wetlands (Section 6.4.4.3). Because of the long-term artesian pressure from the carbonate aquifer, it is likely that, over time, water does seep upwards towards the wetlands. If this happens to be an undetected artesian discharge into the wetlands, water would flow upwards into the wetlands and then it may be affected during construction dewatering. Although water will likely not drain back through the till towards the limestone, a source of water may be lost for these wetlands when construction dewatering occurs in the region. Water that is being discharged from the dewatering wells can easily be directed to the wetland to mitigate this potential, although unlikely, effect. Water quality monitoring would be required before a discharge occurs to protect vegetation and aquatic life (see Section 6.4.7.7). Another pathway that could affect the wetlands during construction would be a lateral shallow connection between the channel and the wetlands. It is not likely that a continuous lateral connection would occur between adjacent wetlands and the channel because continuous sand lens are unlikely. The current understanding of the till is that there are sand lenses; however, they are infrequently found in boreholes and are likely not continuous for any considerable length.

Natural surface and shallow subsurface drainage flow may be affected along the approximately 24 km length of the LSMOC (Section 6.4.4.3). Based on examination of the effects from the EOC, effects on drainage are not expected to occur beyond 500 m of the channel. Unmitigated, this effect would be expected to affect drainage over an area of up to approximately 1,200 ha on either side of the channel. Therefore, on the east side of the channel, increased potential for inundation and flooding of an area of up to 1,200 ha is expected, while on the west side of the channel a similar area would be expected to dry down and experience reduced surface and near-surface moisture conditions.

Surficial soils are composed of till and organic soils. The distance that changes in water level are transferred through the groundwater are limited in these surficial materials. Changes in groundwater around the channel excavations will be small (less than 1 m), and the effects will transfer only 10 m to 200 m at most. Around Lake St. Martin, Fairford River and Dauphin River, water levels will decrease during high dewatering conditions due to the Project. There will be a decrease in groundwater discharge in the saturated soils along the shoreline due to the water level reduction. The effects will not be noticeable within short distance of the shoreline (Section 6.4.4.2 Changes in Local Groundwater Flows, Levels and Quality). In the region of the LMOC, the channel construction and operation will improve drainage in the PDA (i.e., within the ROW) by lowering the saturation level in the surficial overburden and soils.

Mitigation

Proven best management practices will be used to reduce effects on wetland functions following Project environmental requirements. Key mitigation measures will include:

- Machinery will arrive on site in a clean condition and shall be kept in good working order and free of fuel, oil or fluid leaks. Machinery that is found to be leaking any fuel, oil or other fluids will be moved off the work site immediately for repair.
- Vegetation cover within the work limits will be preserved for as long as possible or left undisturbed if it does not inhibit work. All vegetated areas that are to be preserved or left untouched shall be well staked and identified.
- Effective erosion and sediment control measures will be properly installed before starting any work to prevent undesirable soil movement or the entry of sediment into any waterbody or wetland.

- Erosion and sediment control measures will be inspected by the Engineer, and maintained by the Contractor on a daily basis, as well as during and after every major rain, runoff or spring melt event. Any necessary repairs and adjustments will be made immediately to ensure that measures are effective in controlling erosion and sedimentation.
- Erosion and sediment control measures will be maintained in all disturbed sites until soils have stabilized and complete revegetation of all disturbed areas is achieved as approved by the Engineer.
- Clearing within 30 m of a waterbody will be done by hand.
- Removal of riparian vegetation will be minimized to help maintain the stability of waterbody banks. The area over which vegetation in riparian vegetation areas is removed will affect no more than one third (1/3) of the total woody vegetation in the right-of-way within 30 m of the ordinary high-water mark of a waterbody. Vegetative root masses found within the waterbody banks will remain undisturbed, unless otherwise specified.
- Cleared trees and vegetation will not obstruct waterways during any season and will be kept above the ordinary high-water mark. Stockpiles or windrows of any material are to be kept a minimum of 100 m from any waterbody's ordinary high-water mark.
- Removal of riparian vegetation will be kept to a minimum to help maintain the stability of waterbody banks. The area over which vegetation in riparian vegetation areas is removed will affect no more than one third (1/3) of the total woody vegetation in the right-of-way within 30 m of the ordinary high-water mark of a waterbody. Vegetative root masses found within the waterbody banks will remain undisturbed unless specified in the contract documents.
- Cleared trees and vegetation will not obstruct waterways during any season and shall be kept above the ordinary high-water mark. Stockpiles or windrows of any material are to be kept a minimum of 100 m from any waterbody's ordinary high-water mark.
- Spoil piles, overburden and topsoil will not be placed within 100 m of any waterbody's ordinary high-water mark. Spoil piles shall be positioned and maintained in a manner that prevents direct or indirect sediment releases into a waterbody.
- Designated area(s) will be established for fuel storage, materials handling and storage, equipment cleaning, refueling and servicing. Any designated area will be located at least 100 m away from any waterbody or wetland and will be kept clear of snow and/or miscellaneous materials to allow for clear access and routine inspection and leak detection.
- Outside drains will be constructed on the LMOC (west side) and LSMOC (east side) to capture drainage and manage water level changes in adjacent wetlands. Outside drains will not be required along the east side of the LMOC or west side of the LSMOC because surface runoff slopes away from the east side of the LMOC and west side of the LSMOC.

- All designated areas will be leveled to natural or pre-existing grade and slope as part of decommissioning. Stockpiled topsoil and other organic matter that had been removed from the site will be spread to promote natural re-establishment of vegetation.
- Where seeding is not required, temporary site locations will be left in a manner which promotes natural re-vegetation of the site.
- In cases where seeding is required, and when conditions permit, it will commence immediately upon completion of grading, capping and trimming operations.
- An integrated pest management approach will follow Manitoba Infrastructure ((2016b) for controlling weeds, invasive non-native species and pests. Control methods may include mowing, controlled burns and pesticide application. Pesticides may be considered for areas with dangerous noxious weeds or invasive species not resolvable by other control methods. Only pesticides approved for use by Provincial legislation will be used and application will be by licensed personnel.
- Unmitigated wetland loss will be compensated following provincial wetland offsetting requirements of The Water Rights Act.

Project Residual Effects

Project clearing and channel construction is estimated to result in the loss of 995.9 ha of wetland area in the RAA (Table 8.2-13), including 290.6 ha of wetland area in the LMOC and PR 239 sub-watersheds and 705.3 ha in the LSMOC intersected sub-watersheds. Direct loss of wetland area in the LMOC and PR 239 sub-watersheds is restricted to marsh and shallow open water wetlands (Appendix 8B, Figure 8.2B-11). Bogs, fens and swamps, including treed, shrubby and graminoid forms, as well as marsh and shallow open water wetland classes, will be directly affected by the Project in the LSMOC intersected sub-watersheds, with fens the most affected (Appendix 8B, Figure 8.2B-12).

No wetland class will be lost as a result of the Project and direct losses of individual wetland classes are expected to range from 5.7% (shallow open water) to 17.4% (marsh) in the RAA. Wetlands may be created in the LSMOC and LMOC during Project reclamation; however, reclamation plans have not been finalized and, therefore, they are not subtracted from the area of wetland loss.

The power distribution line may also result in wetland loss, but loss will be restricted to the area around distribution structures and wetland intersects can likely be reduced with careful planning of structure placement. Trees and shrubs will be removed along the distribution line ROW affecting approximately 30.3 ha of wetland (less than 0.1% of existing wetland area), but short shrubs, herbs, grasses and potentially non-vascular cover will be retained. Changes in wetland hydrology will likely not be measurable due to the small footprint of structures and limited change in vegetation cover.

Table 8.2-13 Change in Wetland Abundance in the RAA following Project Construction

Wetland Class	Area (ha)		Change from Existing Condition	
	Existing Condition	Construction	ha	%
Bog – Forested[1]	8.2	6.8	-1.4	-17.1
Bog – Shrub[1]	20.2	16.4	-3.8	-18.8
Fen – Forested[1]	922.3	764.6	-157.7	-17.7
Fen – Shrub[1]	698.8	576.7	-122.1	-18.8
Fen – Graminoid[1]	1186.8	990.1	-196.7	-16.6
Swamp - Forested[1]	1,396.0	1229	-159.3	-11.4
Swamp - Shrub[1]	321.4	277.6	-43.8	-13.6
Marsh[1]	1659.8	1378.1	-273.5	-16.5
Shallow Open Water	510.7	472	-36.8	-7.2
Wetland-treed[2]	6,019.1	6,019.1	n/a	n/a
Wetland-shrub[2]	82,619.60	82,619.60	n/a	n/a
Wetland-herb[2]	36,109.20	36,109.2	n/a	n/a
Dugout[2]	7.5	6.7	-0.8	-10.7
Total	**131,479.7**	**130,483.7**	**-995.9**	**-0.8**

Note:
[1] Based on desktop mapping data.
[2] Based on LCC and FRI data

Project construction will likely result in the full loss of some smaller marsh wetlands and partial loss of larger marsh and shallow open water wetland areas in the LMOC and PR 239 sub-watersheds. Partial wetland loss, including near Watchorn Bay, Reed Lake and Clear Lake, may result in a small increase in runoff per unit area. However, wetland hydrology of wetlands near the PDA will be indirectly affected due to the permanent loss of catchment area (see Section 6.4.7.4) and potential loss of groundwater upwelling during groundwater pumping during construction dewatering (see Section 6.4.4.3). If there is any loss of groundwater upwelling during dewatering, it can be mitigated by pumping the water into the wetlands. Reduced catchment area may permanently reduce wetland water depth, duration of flooding and flood frequency, particularly near Birch Creek (see Section 6.4.7.4). Reduced marsh and shallow open water wetland abundance and altered wetland water levels in the LMOC and PR 239 sub-watersheds will reduce the abundance of wetland dependent plant species and alter the distribution of these plants in the RAA. Most of the smaller wetlands, and potentially some of the larger wetlands, have likely been altered by surrounding agriculture though, and may be cultivated in drier years. The outside drain on the west side of the LMOC should help reduce alterations to wetland levels from changes in sub-watershed water flow paths (Appendix 8B, Figure 8.2B-11) and limit ponding in existing upland areas adjacent to the channel. Changes are not expected in the Watchorn Bay Provincial Park marsh as the marsh is likely hydrologically connected to Lake Manitoba. Full loss of individual wetlands is not expected along the LSMOC due to the size of wetland areas in the PDA (Appendix 8B, Figure 8.2B-12). Partial loss of wetlands may increase flooding on the east side of the LSMOC and decrease flooding on the west side, particularly in sub-watershed 1a. Surface water, and likely shallow groundwater, flows from southeast to northwest in sub-watershed 1 and flows will be intersected by the LSMOC. Riparian wetland adjacent to intersected creeks may also become drier and may not persist. The creeks are intermittent and do not flow at all times.

A review of vegetation conditions along the EOC (Appendix 8B, Figure 8.2B-13) showed stressed vegetation, potentially due to increased flooding, out to 1,600 m east of the channel and out to 600 m west of the channel, potentially due to drier conditions. Changes in flood conditions may have caused tree mortality, reduced non-vascular cover and altered forb and grass species composition. Increased phosphorus levels have also been recorded in wetlands following reductions in tree cover due to flooding (Pinder et al. 2014) with increased levels persisting for several years. Reduction in the abundance of peat accumulating bog, fen and potentially swamps, will also reduce carbon sequestration in the intersected sub-watersheds of the RAA.

The effects to wetlands adjacent to the LSMOC will differ from the effects from the EOC due to the complexity of hydrology within the wetland areas. The LSMOC will include improved drainage to reduce the effects of backwater impacting the wetland to the south and east of the channel. Effects should be reduced and limited compared to the effects of the EOC.

Outside drainage channels are incorporated as part of Project design. Therefore, inundation and flooding due to the presence of the LSMOC is not expected to occur on the southeast side of the LSMOC; however, drier conditions are still expected on the north and west side.

The outside drain on the east side of the LSMOC should help reduce alterations to wetland levels from changes in sub-watershed water flow paths (Appendix 8B, Figure 8.2B-12) and limit ponding on the east side of the channel. Water may also be pumped from the LSMOC to wetlands west of the channel if needed. There is also consideration to repurpose the EOC to replenish water flows into Buffalo bog system that may be lost as a result of channel construction.

Wetlands adjacent to the PR 239 route will also likely be indirectly affected by road salt and potentially oil and other petroleum products during road use. Ditches will be constructed adjacent to the road to channel road run-off, but water will likely still connect to natural adjacent wetlands.

Effects on Delta Marsh are not expected as changes in Lake Manitoba water levels are small (2.4 cm or less).

Changes in water levels of Lake St. Martin will potentially alter wetland areas near the lake shore, potentially increasing in some areas and decreasing in others depending on topography and on islands in the lake or alter plant composition due to changes in water depth and flood frequency. Effects are most likely to occur along the southwest shore and northern area of the lake where water depths are shallower (Appendix 6F, Figure 6F-4). A study of historic changes in water levels of Lake Manitoba following regulation showed an increase in cattail abundance and a reduction in the abundance of other native grasses (Shay et al. 1999). However, historic changes in water levels on Lake Manitoba (2.2 m variation to 0.6 m) are greater than those predicted for Lake St. Martin (0.13 m) because of Project operations during a flood.

The inside of the LMOC and LSMOC will be revegetated to help control weeds and mitigate erosion. Revegetation will be divided into zones reflecting slope positions (e.g., upland berm, mid-slop, lower slope) and plants selected for expected moisture conditions (see Chapter 3); however, plans for the channels have not been finalized, including desired plant species and relative species cover. Native grasses, forbs and potentially shrubs commonly occurring in the Sturgeon, Ashern and Gypsumville Ecodistricts will be used. Changes in water levels under different channel operating scenarios (e.g., non-flood operations, design flood) will alter plant composition. Slender wild rye (*Elymus trachycaulus*) and junegrass (*Koeleria macrantha*), two common native upland grasses recorded during Project field surveys, for example cannot tolerate flooding (USDA 2019) and if used for revegetation would likely be lost following a flood event. Common cattail (*Typha latifolia*), a common wetland plant, can tolerate periodic drought, but has been found to die if soil moisture declines to 1.5% (Asamoah and Bork 2010) and prolonged flooding may also kill the plant (Bansal et al. 2019). Additional seeding may be needed following changes in water levels in the channels as a result.

Because wetland abundance, distribution and associated functions will be reduced or altered following construction of the Project, effects are adverse and considered long-term. Measurable effects will likely be restricted to the vegetation LAA in the LMOC and PR 239 sub-watersheds because the wetlands are not well connected to groundwater (see Section 6.4.4.2) and surface run-off from the immediate area surrounding wetlands likely contributes the majority of surface run-off. Effects around Lake St. Martin are also expected to be restricted to the LAA due to shoreline topography. Effects from the LSMOC may extend to the RAA, given the distance of effects identified along the EOC, although the outside drain on the east side of the LSMOC should help reduce flooding from altered drainage patterns, potentially reducing the extent of effects to the LAA. Construction effects will occur during a moderately sensitive time period if conducted during the summer, fall and winter, and when conditions are dry. Reclamation will offset some wetland loss with areas of marsh potentially re-established in the PDA. Reclamation effects will be positive in direction and restricted to the LAA.

Effects from use of the PR 239 re-route will similarly be adverse and likely limited to the LAA because water quality of wetlands adjacent to the road will be affected by road run-off. Effects timing is not applicable for PR 239 operation because water quality may be affected throughout the year. Effects will be infrequent during construction and continuous during operation. However, most effects should be offset with wetland compensation and are therefore considered low magnitude. Wetland abundance is likely underestimated south of Lake St. Martin and further wetland mapping will be conducted to support *Water Rights Act* regulatory requirements. Additional mitigation may include changing the design of the outside drainage channels to reduce or improve drainage, or actively pumping water from the LMOC and LSMOC to adjacent wetlands. It is expected the electrical distribution tie location can avoid wetland intersects and no effects are predicted on wetland functions.

8.2.4.6 Summary of Project Residual Effects

Table 8.2-14 summarizes the residual environmental effects on vegetation during construction and operations.

Table 8.2-14 Summary of Project Residual Effects on Vegetation

Residual Effect	Residual Effects Characterization								
	Project Phase	Direction	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Ecological and Socio-economic Context
Change in landscape diversity	C	A	LT	M	NA	RAA	RC	I	U and D
Change in community diversity	C	A	LT	M	MS	LAA	RC	I	U and D
Change in species diversity	C	A/P	LT	L/M	MS	LAA	RC	I	U and D
	O	A	LT	L	MS	LAA	RC	I	U and D
Change in wetland functions	C	A	LT	L	MS	LAA/RAA	RC	I	U and D
	O	A	LT	L	NA	LAA/RAA	RC	I	U and D

KEY
See Table 8.2-2 for detailed definitions

C: Construction
O: Operation

P: Positive
A: Adverse
N: Neutral or Negligible

ST: Short-term
MT: Medium-term
LT: Long-term

L: Low
M: Moderate
H: High

NS: No sensitivity
MS: Moderate sensitivity
HS: High sensitivity
NA: Not applicable

PDA: Project development area
LAA: local assessment area
RAA: regional assessment area

N/A: Not applicable

IF: Infrequent
SI: Sporadic
RC: Regular/Continuous

RS: Reversible (short-term)
RL: Reversible (long-term)
I: Irreversible

U: Undisturbed
D: Disturbed
R: Resilient
NR: Not resilient

Project effects, for the most part, will occur during Project construction with the permanent alteration or removal of vegetation. Effects during construction are expected to be low to moderate in magnitude and infrequent, but long-term, and irreversible. The geographic extent of effects on landscape diversity and construction of the LSMOC will extend to the RAA due to a change in the size of native vegetation patch sizes in the RAA and potential alteration of wetland hydrology in Project intersected sub-watersheds. Effects on community diversity, species diversity and wetland function from construction of the LMOC and

PR 239 re-route will be local because 1) no native vegetation cover class will be lost from the LAA, 2) only abundance will be reduced, 3) mitigation should be effective at managing weed and non-native invasive species introductions, and 4) wetlands are not well connected to groundwater in the Project intersected sub-watersheds, which limits the spatial extent of alterations in wetland hydrology. Effects from Project operations will also be adverse and continuous, but low in magnitude. Effects will likely be restricted to the LAA from operation of PR 239. Effects may extend to the RAA from operation of the LSMOC, but mitigation will be implemented to help reduce the extent of effects. Effects from operations will be long-term and irreversible because the Project will be permanent. Reclamation and adaptive weed management should be effective at controlling weed abundance and reducing potential for new introductions during LMOC and LSMOC operations.

The power distribution line will further reduce landscape, community and species diversity, and alter wetland function but is not expected to alter effect magnitude, frequency or duration. Effects will extend to the RAA.

The LSMOC and power distribution line are located in a relatively undisturbed environment, with the exception of some winter roads and the EOC. The LMOC and PR 239 re-route are located in a highly disturbed environment with few large patches of remaining forest that has exceeded recommended thresholds for forest loss (Environment Canada 2013) with more than 50% likely lost in the RAA south of Lake St. Martin. Wetlands are largely surrounded by agriculture and functions have likely been altered as a result.

8.2.5 Determination of Significance

8.2.5.1 Significance of Residual Environmental Effects from the Project

A significant effect on vegetation is one that results in:

- threatens the long-term persistence or viability of a plant species or community in the RAA, including effects that are contrary to or inconsistent with the goals, objectives or activities of recovery strategies, action plans and management plans, published conservation targets, or
- results in uncompensated loss of wetland function, or
- threatens the long-term availability of traditional-use plants within the RAA.

Based on the assessment of the proposed effects of the Project on vegetation and the proposed mitigation measures, the residual effects are considered not significant for landscape diversity, community diversity, species diversity and wetland functions. Although the existing landscape south of Lake St. Martin is highly fragmented, the Project will not result in the loss of any remaining large forest or wetland patches and affects are mainly to smaller patches already altered by surrounding human land use. No native vegetation land cover class is lost from the LAA and reductions in area of upland land cover classes is small, up to a maximum 10.2% of existing conditions. Loss of SOCC and species of interest to Indigenous groups should not occur with further pre-construction surveys and Indigenous engagement. Wetland compensation should off-set affects to wetlands.

8.2.6 Potential Effects on Federal Lands

Effects on federal lands may occur due to alterations in water levels of Lake St. Martin and changes in the area of flooding. The Pinaymootang First Nation, Little Saskatchewan First Nation, and Lake St. Martin First Nation border Lake St. Martin and changes in water levels may alter the abundance and distribution of wetlands bordering the lake. The Project may also be beneficial though because the area of flooding will be reduced, which should improve the function of upland native vegetation areas. Similar effects will occur elsewhere in the LAA.

8.2.7 Prediction Confidence

Prediction confidence is high for landscape diversity and moderate for community diversity and species diversity. Mapping identified remaining large native patches and most existing human disturbances. Effects on native grassland may occur, but large remnant patches are unlikely given the amount of agricultural conversion and review of air photographs. Remaining patches of native grassland, though, may still be present and field survey coverage is insufficient to determine if areas are affected. Effects on areas valued by Indigenous groups are also unknown due to a lack of information on the presence and the areas in relation to the PDA. Most effects on SOCC can likely be avoid with further pre-construction survey, but reasons for SOCC rarity in Manitoba are unknown and mitigation options, such as seed collection and transplanting, for occurrences observed prior to construction are considered experimental and may not be successful.

8.2.8 Follow-Up and Monitoring

Additional pre-construction SOCC surveys will be conducted to further evaluate occurrences in the PDA and identify areas requiring mitigation. Surveys will focus on areas of low sampling density including patches of remnant native vegetation along the LMOC and PR 239 re-route, and areas of higher rare plant potential along the LSMOC PDA (e.g., transition areas from wetland to upland and areas of shallow bedrock).

The environmental inspector (or designate) will follow established industry best management practices and will evaluate effectiveness of mitigation during and following the construction phase. Key monitoring issues will include erosion and sediment control and management of regulated weeds. Follow-up programs on the success of reclamation are anticipated for the operations phase of the Project and will be focused on assessing the rate of establishment of a healthy vegetation cover, and the quick recognition and mitigation of soil erosion.

Additional wetland surveys will be conducted to support *Water Rights Act* regulatory applications, if required. The need for further surveys will be determined following release of regulatory requirements and further regulatory consultation. Wetland compensation will include wetland creation, and wetland enhancement or restoration. Effectiveness of wetland compensation will be conducted as part of post-construction revegetation monitoring.

8.2.9 Conclusions

8.2.9.1 Change in Landscape Diversity

Residual effects on landscape diversity will reduce the size of native vegetation patches, including large forest and wetland patches during construction, but no large native vegetation patches will be lost from the RAA. Vegetation composition, structure and species abundance will likely be altered from increased fragmentation and associated edge effects on the edge of remaining patches, but core areas of large patches will not be lost. Effects are not expected during Project operations.

8.2.9.2 Change in Community Diversity

Residual effects on community diversity will reduce the area of native upland, including shrubland and forests, and wetland vegetation communities during construction, but none will be lost from the LAA. Some native upland vegetation communities may benefit from reduced flooding including forest or grassland. Direct effects from changes in drainage on native upland or wetland communities may extend up to 1,600 m from the PDA. Indirect effects from dust and non-native invasive species is likely to spread into the LAA.

8.2.9.3 Change in Species Diversity

Residual effects on species diversity will remove the known occurrences of SOCC within the Project footprint. Residual effects on plant species of interest to Indigenous groups will alter the area of habitat for species in wetland communities. However, some plant species of interest to Indigenous groups that have historically been negatively affected by flooding may increase in abundance within the LAA. SOCC and plant species of interest to Indigenous groups may be indirectly affected by construction and operation for up to 1,000 m from the PDA. Project operations and management may introduce and spread non-native invasive species into adjacent native upland vegetation and wetlands communities.

8.2.9.4 Change in Wetland Functions

Residual effects on wetland functions will reduce wetland abundance and potentially alter hydrology during construction and operations, and effects could potentially alter water quality and carbon sequestration of remaining wetland areas following construction. The area of changes should be reduced with mitigation and offset with wetland compensation.

8.3 WILDLIFE

8.3.1 Scope of the Assessment

The scope of the wildlife assessment is in accordance with the requirements described in both federal and provincial guidance documents for the Project. Concordance tables, demonstrating where environmental impact statement (EIS) guidelines are addressed, are provided at the beginning of this EIS.

Section 3 of the Environmental Assessment Scoping Document for the Project (Manitoba Infrastructure 2018) submitted to Manitoba Sustainable Development discusses terrestrial environment in the following subsections:

- Section 3.3.3 indicates that the EIS will describe the Project-relevant attributes of amphibians and reptiles, birds (including important areas, migratory birds and habitat), mammals, and terrestrial species at risk (SAR), as well as species of interest identified by local and/or Indigenous peoples.

Section 7 of the CEAA EIS Guidelines for the Project (CEAA 2018) discusses wildlife issues in the following subsections:

- Section 7.1.7 requires information on riparian, wetland and terrestrial environments, including ecological function for wildlife, animal species and their habitats, with a focus on SAR or with special status that are of social, economic, cultural or scientific significance.
- Section 7.1.8 requires information on migratory birds and their habitat, including abundance, distribution, and life stages of migratory and non-migratory birds, characterization of various ecosystems found in the Project area, likely to be affected, and year-round migratory bird use of the area.
- Section 7.1.9 requires information on species at risk, including residences, seasonal movements, movement corridors, habitat requirements, key habitat areas, identified critical habitat and/or recovery habitat (where applicable) and general life history.
- Section 7.3.2 requires identification of any potential direct and indirect adverse effects to migratory birds or their habitat, including staging and nesting areas, foraging grounds, and landing sites.
- Section 7.3.5 requires discussion of the potential effects of the Project on species at risk and their critical habitat, including the direct and indirect effects on their survival or recovery.

In past provincial assessments, the Manitoba Clean Environment Commission (MB CEC) recommended an ecosystem-based approach be followed when selecting VCs for EAs (MB CEC 2013). An ecosystem-based approach allows for all factors to be considered (e.g., overall change to wildlife habitat), while giving focus to those species or wildlife groups (e.g., migratory birds, SAR) that may need more detailed assessment.

Wildlife is a VC because it is an essential component of a functioning ecosystem, plays a vital role in ecological and biological processes, provides a source of income in the region, and facilitates the continued practice of traditional and recreational resource use. Wildlife is also important to regulators because many species, and their habitats, are protected under provincial and federal legislation (Section 8.3.1.1). Further discussion of why wildlife is a VC is provided in Chapter 4.4.1.

Wildlife is a broad group of animals, consisting of birds, amphibians, reptiles, mammals, and invertebrates. It is not practical to assess all species known to inhabit the region; therefore, the discussion of potential Project effects on wildlife focuses on a selection of species or groups identified as important to the public, Indigenous communities and regulators. Selection of focal species and groups considered Project-specific regulatory and public-stakeholder inputs and concerns from potentially affected Indigenous communities. Focal species discussed in the assessment, including rationale, are presented below.

- moose (*Alces alces*)
  - representative ungulate species that utilizes boreal forest in the northern part of the RAA surrounding the LSMOC
  - declining population across much of their range in southern Manitoba
  - important to Indigenous communities (i.e., traditional use) and a species of ecological importance
- American elk (*Cervus canadensis*)
  - representative ungulate species that utilizes forest, grassland, and agriculture habitats of the southern part of the RAA surrounding the LMOC
  - important to Indigenous communities (i.e., traditional use) and a species of ecological and socio-economic importance
- furbearers
  - important to Indigenous communities (i.e., traditional use) and a species of ecological and socio-economic importance
  - several species trapped by local resource users (including Indigenous communities; e.g., American marten [*Martes Americana*; hereafter marten], muskrat [*Ondatra zibethicus*])
- bats
  - little brown myotis (*Myotis lucifugus*) and northern myotis (*Myotis septentrionalis*) are federally and provincially listed as endangered species
  - known to overwinter in the region in formally defined critical habitat

- migratory birds
  - identified as a valued component in the CEA Agency EIS Guidelines (CEA Agency 2018)
  - protected under the *Migratory Birds Convention Act* (MBCA) and the Manitoba *Wildlife Act*
- species at risk (SAR)
  - identified as a valued component in the CEA Agency EIS Guidelines (CEA Agency 2018)
  - protected under the *Species at Risk Act* (SARA) and the Manitoba *Endangered Species and Ecosystems Act*
  - emphasis is placed on species with potential critical habitat in the Project region (i.e., eastern whip-poor-will [*Antrostomus vociferous*], red-headed woodpecker [*Melanerpes erythrocephalus*], piping plover [*Charadrius melodus*], little brown myotis, northern myotis)

For this assessment, SAR that are federally listed on Schedule 1 of the *Species at Risk Act* (*SARA*) as Special Concern, Threatened, or Endangered (Government of Canada 2019a), or provincially listed under Manitoba's *Endangered Species and Ecosystems Act* (MESEA) as threatened or endangered (Government of Manitoba 2019a).

Species of Conservation Concern (SOCC) are defined as species that are listed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC; for listing under *SARA*) as special concern, threatened, or endangered (Government of Canada 2019a) or those listed by the Manitoba Conservation Data Centre (MB CDC) as provincially rare (i.e., S1 or S2 rankings; MB CDC 2018).

A list of SAR and SOCC having potential to occur in the region, including respective conservation rankings, is provided in Appendix 8A, Table 8.3A-2.

8.3.1.1 Regulatory and Policy Setting

A list of various regulatory requirements that were considered in developing this environmental impact statement (EIS) can be found in the Introduction (Chapter 1, Section 1.5 and Appendix 1A). Particular consideration was given to the following federal and provincial legislation, policies and guidelines in the preparation of this environmental assessment.

Federal Regulatory Requirements

The *Species at Risk Act* (SARA) provides protection for SAR in Canada that are listed on Schedule 1. The legislation provides a framework to facilitate recovery of species listed as threatened, endangered, or extirpated and to prevent species listed as special concern from becoming threatened or endangered. SARA provides protection for both SAR and their critical habitat by prohibiting: 1) the killing, harming, or harassing of endangered or threatened SAR (sections 32 and 36); and 2) the destruction of critical habitat of and endangered or threatened SAR (sections 58, 60, and 61; Government of Canada 2002). SARA (section 79) also states that:

1) "Every person who is required by or under an Act of Parliament to ensure that an assessment of the environmental effects of a project is conducted must, without delay, notify the competent minister or ministers in writing of the project if it is likely to affect a listed wildlife species or its critical habitat."

2) "The person must identify the adverse effects of the project on the listed wildlife species and its critical habitat and, if the project is carried out, must ensure that measures are taken to avoid or lessen those effects and to monitor them. The measures must be taken in a way that is consistent with any applicable recovery strategy and action plans."

The *Migratory Birds Convention Act* (MBCA) provides protection for migratory birds, including nests and eggs. Relative to the Project, protection is afforded to all native bird species, except for American white pelican (*Pelecanus erythrorhynchos*), double-crested cormorant (*Phalacrocorax auritus*), upland gamebirds, raptors, belted kingfisher (*Megaceryle alcyon*), owls, corvids, and icterid blackbirds (Government of Canada 1994).

Provincial Regulatory Requirements

Manitoba's *Endangered Species and Ecosystems Act* (MESEA) provides protection to threatened and endangered ecosystems and plant and animal SAR in Manitoba. The Act facilitates the management and development of recovery strategies for threatened, endangered, and extirpated or extinct species to prevent further declines and promote recovery. MESEA-listed species are those that, "are of ecological, educational, aesthetic, historical, medical, recreational and scientific value to Manitoba and the residents of Manitoba" (Government of Manitoba 2015, 2019).

The Wildlife Act provides general provisions for regulating the activities relating to the take and trade of wild animals in Manitoba. A "wild animal" is defined as "an animal or bird of a species or type listed in Schedule A or declared by the regulations to be a wild animal", and includes select amphibian, reptile and mammal species and most bird species (including those not protected under the *Migratory Bird Convention Act*) known to exist in Manitoba (Government of Manitoba 2000). *The Wildlife Act* includes protection for bird species not already afforded protection under the MBCA (Schedule A, Division 6), and as such, all bird species in Manitoba are considered protected by law. Migratory birds, for the purposes of this assessment, includes all bird species, not just those defined and federally protected under the MBCA or those that undergo physical migrations.

8.3.1.2 Engagement and Key Concerns

Manitoba Infrastructure has undertaken engagement prior to and throughout preparation of the EIS, and it will continue to consult with Indigenous groups, government agencies, and stakeholders throughout the life of the Project. A discussion of the Indigenous and Public engagement process (IPEP) is provided in Chapter 5: Indigenous and Public Engagement with additional details presented in Appendix 5C.

Engagement feedback from Indigenous groups, has been an important consideration in identifying issues of concern, framing the scope of the EIS baseline and effects assessments, and in identification of specific mitigation measures, where provided.

Concerns have been raised about how the Project will affect future wildlife populations and habitat (including for SAR and migratory birds), including concerns regarding additional habitat loss (Section 8.3.6.2), increased mortality due to Project-related traffic (Section 8.3.6.3), and linear features bisecting existing habitat and limiting animal movement (Section 8.3.6.4). Additional Indigenous and public engagement is discussed in Chapter 5. Engagement feedback specifically related to wildlife was provided by multiple Indigenous groups. In summary, comments were related to the following:

- disturbance of wildlife and wildlife habitat due to Project construction and operation (Section 8.3.6.2)
- flooding and debris have impacted the numbers of moose, deer, grouse and rabbits in the area (8.3.2.)
- increase in wildlife mortality due to potential vehicle-wildlife collisions from increase vehicle traffic associated with construction and operation (8.3.6.3)
- potential impact on wildlife from increased hunting to the area with increased access (Section 8.3.6.3; also see Chapter 9)
- changes in movement of wildlife as a result of the channels (8.3.6.4.)

Disturbance of wildlife and wildlife habitat due to Project construction and operation and due to the presence of permanent infrastructure were expressed as concerns by the following Indigenous groups: Lake Manitoba First Nation, Fisher River First Nation, Pinaymootang First Nation, Hollow Water First Nation, Peguis First Nation, and Dauphin First Nation. A Dauphin River First Nation member commented that “Wildlife are affected by the loss of their habitat. Moose and deer have left the area. Berries and edibles are gone, not only for our use but for the animals. Bears now come into town scavenging for food, becoming problematic”.

Pinaymootang First Nation and Fisher River First Nation and members of the public expressed concerns in relation to the effects of the Project on particularly big game (e.g., moose and elk), that have declined in response to past flooding and ongoing high-water levels (see Chapter 5). As a result, hunting and trapping opportunities are now limited or non-existent for some species and areas.

The effects of the Project on wildlife corridors and how permanent infrastructure would bisect land was expressed as a concern by Fisher River First Nation, Peguis First Nation, and Pinaymootang First Nation.

Interlake Tribal Council expressed concern that marten populations have been adversely affected because their habitat has been destroyed by flooding from the emergency outlet channel that was built in 2011 to manage extreme water levels in Lake St. Martin. Fisher River First Nation expressed concerns related to the potential impact on wildlife from hunting.

8.3.1.3 Potential Effects, Pathways and Measurable Parameters

The following potential Project-related environmental effects were identified by considering potential interactions between Project components and wildlife:

- change in habitat
- change in mortality risk
- change in movement

Overall, construction and operation of the Project has potential to affect wildlife and wildlife habitat including species at risk through direct habitat loss or alteration (e.g., fragmentation) as well as reduced habitat effectiveness (i.e., sensory disturbance). The Project also has potential to affect wildlife movement by creating physical or sensory barriers as well as increase mortality risk associated with vegetation removal, vehicle collisions, human-wildlife conflicts or indirectly through predation and harvest pressure.

The Project is not expected to affect regional water quality (see Chapter 6.4.7.7); and therefore, a measurable change in wildlife health, including potential changes to water quality that might affect migratory birds is not expected. As such, change in wildlife health is not discussed further in this assessment. Localized effects to sediment transport and suspended sedimentation resulting from construction activities is addressed in change in habitat. The primary pathways by which the potential environmental effects of the Project may affect wildlife include:

- construction
  - direct loss of habitat through vegetation clearing activities and an indirect change in habitat due to sensory disturbance (i.e., noise and artificial light) as well as edge effects from fragmentation
  - increased mortality risk due to vegetation clearing activities and increased Project-related traffic
  - alteration of wildlife movement due to the development of the outlet channels and PR 239 highway realignment
- operation and maintenance
  - alteration of wildlife movement due to the operation of the outlet channels
  - change in mortality risk due to presence of outlet channels and enhanced access by predators and people

Table 8.3-1 summarizes the potential environmental effects of the Project on wildlife, the pathways by which they may affect wildlife, and measurable parameters for evaluating effects. Potential environmental effects and measurable parameters were selected based on professional judgment, recent similar environmental assessments for linear feature projects in Canada, and socio-economic concern for certain species (e.g., rights-based harvesting, regulated hunting, outfitting).

Table 8.3-1 Potential Effects, Effect Pathways and Measurable Parameters for Wildlife

Potential Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in habitat	Direct (e.g., vegetation clearing, surface water management) and/or indirect (e.g., sensory disturbance, edge effects) loss or alteration of wildlife habitat.	Amount (ha) of wildlife habitat directly and/or indirectly lost or altered. Amount (ha) of potential critical habitat directly and indirectly affected for SAR in the LAA. Specifically, for: • Eastern whip-poor-will • Red-headed woodpecker Amount (ha) of suitable habitat directly and indirectly affected for SAR who also have potential critical habitat within the LAA (for the above-mentioned species). Number of environmentally sensitive sites (ESS; e.g., bald eagle nest, waterbird nesting colony,) directly or indirectly affected. • Fragmentation metrics including mean patch size (ha) and mean patch edge (km) of land cover types (see Section 8.2.1.3) • Risk of human-wildlife conflict. Qualitative evaluation of indirect mortality risk: • Predation risk due to change in predator-prey dynamics. • Hunting/trapping harvest pressure.
Change in mortality risk	Direct (e.g., vegetation clearing activities, vehicular collisions, human-wildlife conflicts) and/or indirect (e.g., predation and harvest pressure) change in mortality risk.	Qualitative evaluation of direct mortality risk: • Risk of mortality due to vegetation clearing, site preparation, and maintenance. • Risk of collisions with Project vehicle. • Risk of human-wildlife conflict. Qualitative evaluation of indirect mortality risk: • Predation risk due to change in predator-prey dynamics. • Hunting/trapping harvest pressure.

Table 8.3-1 Potential Effects, Effect Pathways and Measurable Parameters for Wildlife

Potential Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in movement	Project components could result in alteration of daily and/or seasonal wildlife movement patterns or corridors.	Qualitative assessment of wildlife movement across open landscapes including waterbodies. Change in movement (e.g., connectivity) also assessed using results of fragmentation analysis in the RAA (see Section 8.2.1.3)

8.3.1.4 Boundaries

Spatial Boundaries

The Project development area (PDA), local assessment area (LAA) and regional assessment area (RAA) for the assessment of effects on wildlife are shown in Appendix 8B, Figure 8.3B-1 and described below. These spatial boundaries are used to assess Project effects, including residual and cumulative environmental effects, on wildlife in the region surrounding Lake St. Martin and the outlet channels (Appendix 8B, Figure 8.3B-1):

- PDA is the physical footprint of Project components, including the LMOC and LSMOC, PR 239 realignment, and temporary workspaces.
- LAA is a 1 km buffer around the PDA and Lake St. Martin shoreline. The size of the buffer is based on measurable effects on migratory birds (e.g., songbirds and waterbirds; Benitiz-lopez et al. 2010), elk (Storlie 2006) and moose (Laurian et al. 2008). The 1 km buffer also considers recommended setback distances for SOCC (Environment Canada 2009; MB CDC 2014; Government of Saskatchewan 2017; Manitoba Conservation Data Centre 2014).
- RAA is a 12 km buffer around the LAA. The boundary is based on the largest reported home range size for non-migratory moose (97 km^2; Hauge and Keith 1981) and is also large enough to accommodate reported home ranges for elk (e.g., 18-94 km^2; Storlie 2006). Federal lands within the RAA are limited to reserve lands associated with the Indigenous communities.

Temporal Boundaries

The temporal boundary for the assessment of effects on wildlife covers the duration of the construction and operation and maintenance phases of the Project. The construction duration is estimated to occur over 2.5 to 3 years with approximately 1-2 years for post construction-related works (Chapter 3.6). During this time, land clearing activities will occur outside the breeding bird sensitive period (nesting zone B5, including the extended period for SAR [April 22 to August 24]; ECCC 2018a) to minimize disturbance to migratory birds. The operation and maintenance phase of the Project is expected to be indefinite because the Project will not be decommissioned.

8.3.1.5 Residual Effects Characterization

Table 8.3-2 presents definitions for the characterization of residual environmental effects on wildlife. The criteria describe the potential residual effects that remain after mitigation measures have been implemented.

Table 8.3-2 Characterization of Residual Effects on Wildlife

Characterization	Description	Range of Criteria	Level of Effect and Definition
Direction of Change (type of effect)	The trend of the residual effect	Neutral	No measurable change on the VC
		Adverse	Net loss (adverse or undesirable change) on the VC
		Positive	Net benefit (or desirable change) on the VC
Duration (period of time the effect occurs)	The period of time required until the measurable parameter or the VC returns to its existing condition, or the effect can no longer be measured or otherwise perceived	Short-Term	The potential effect results from short-term events or activities such as the time required to complete a discrete component during construction, maintenance, or rehabilitation activities (i.e., a timeframe of several months up to one year)
		Medium-Term	The potential effect is likely to persist until the completion of construction and rehabilitation activities (i.e., > 1 year to 10 years)
		Long-Term	The potential effect is likely to persist beyond the completion of construction and rehabilitation activities into the operations and maintenance phase of the Project (i.e., a timeframe of greater than 10 years)
Magnitude (degree or intensity of the change)	The amount of change in habitat for wildlife, including migratory birds, relative to existing conditions[1]	Low	Project has an effect on less than 10% of wildlife habitat within the LAA
		Medium	Project has an effect on 10-20% of wildlife habitat within the LAA
		High	Project has an effect on greater than 20% of wildlife habitat within the LAA
	The amount of change in habitat for species at risk (i.e., eastern whip-poor-will and red-headed woodpecker) relative to existing conditions[1]	Low	Project has an effect on less than 5% of SAR habitat within the LAA
		Medium	Project has an effect on 5-10% of SAR habitat within the LAA
		High	Project has an effect on greater than 10% of SAR habitat within the LAA

Table 8.3-2 Characterization of Residual Effects on Wildlife

Characterization	Description	Range of Criteria	Level of Effect and Definition
	Change in movement and mortality risk	Low	A measurable change in the abundance of wildlife in the LAA is unlikely, although temporary local shifts in distributions might occur
		Medium	A measurable change in the abundance and distribution of wildlife in the LAA is possible, but a measurable change in the abundance of wildlife in the RAA is unlikely
		High	A measurable change in the abundance of wildlife in the RAA is possible
Timing	Periods of time where residual effects from Project activities could affect the VC	No Sensitivity	Effect does not occur during critical life stage (e.g., outside elk calving periods) or timing does not affect the VC
		Moderate Sensitivity	Effect may occur during a lower sensitive period of a critical life stage; for many species this is the start (e.g., several days prior to nesting for birds) or end (e.g., periods when birds have fledged but remain in proximity to their nest) of the critical period
		High Sensitivity	Effect occurs during a critical life stage (e.g., fish spawning or bird nesting periods)
Extent (Spatial Boundary)	The geographic area in which an environmental effect occurs	PDA	Residual effects are restricted to the PDA
		LAA	Residual effects are restricted to the LAA
		RAA	Residual effects extend into the RAA and/or interact with those of other projects in the RAA
Frequency (how often the effect occurs)	Identifies when the residual effect occurs and how often during the Project	Infrequent	Residual effect occurs once or seldom during the life of the Project (e.g., initial clearing and grubbing)
		Sporadic/intermittent	Residual effect occurs sporadically without any predictable pattern during the life of the Project (e.g., outlet operation; site-specific construction equipment noise; potential wildlife-vehicle collisions)
		Regular/continuous	Residual effect occurs periodically at regular intervals or is continuous over the life of the Project (e.g., noise associated with vehicle traffic along the realigned portions of PR 239)

Table 8.3-2 Characterization of Residual Effects on Wildlife

Characterization	Description	Range of Criteria	Level of Effect and Definition
Reversibility (the degree of permanence)	Pertains to whether a measurable parameter or the VC can return to its existing condition after the Project activity ceases	Reversible (short-term)	Potential effect is readily reversible over a relatively short period (10 years)
		Reversible (long-term)	Potential effect is potentially reversible but over a long period (> 10 years)
		Irreversible	Project-specific potential effects are permanent and irreversible
Ecological Context	Existing condition and trends in the area where environmental effects occur	Undisturbed	Area is relatively undisturbed or not adversely affected by human activity
		Disturbed	Area has been substantially previously disturbed by human development or human development is still present

- Based on benchmarks developed using professional judgement and accepted by regulators on other recent EAs (Manitoba Hydro 2015; KHLP 2012; Nalcor 2012; JRP 2014)

8.3.1.6 Significance Definition

A significant adverse effect on wildlife is defined as one that threatens the long-term persistence or viability of a wildlife species in the RAA, including effects that are contrary to or inconsistent with the goals, objectives or activities of recovery strategies, action plans and management plans.

8.3.2 Existing Conditions for Wildlife

8.3.2.1 Methods

Existing conditions for wildlife were identified through a combination of desktop review and field surveys to better understand the occurrence, distribution, and habitat association of wildlife within the RAA, including SAR and SOCC. This section provides a brief overview of the methods used to collect baseline data.

Existing Data

Background information was obtained through several sources, literature reviews, federal, provincial, not-for-profit publications and data sources, and personal communications with provincial authorities. Below is an overview of some of the key resources used during background reviews to assist in establishing the baseline conditions for wildlife.

- Manitoba Breeding Bird Atlas (MB BBA) is a five-year citizen-science project documenting the abundance and distribution of breeding birds throughout Manitoba (MB BBA 2019).
- North American Breeding Bird Survey is a joint effort survey between the U.S. Geological Survey (USGS) and Environment and Climate Change Canada to monitor bird population trends. In addition

to providing long-term trends in regional bird populations, data are typically available for each survey route and year (Pardieck et al. 2018; Smith et al. 2019).

- Manitoba Conservation Data Centre (MB CDC) is a database for biodiversity in Manitoba, including SOCC observation data (MB CDC 2019).
- SARA Public Registry is a database containing the status of species assessed and listed under the SARA and by COSEWIC, and associated documentation including assessment and status reports, recovery strategies, and management strategies (COSEWIC 2019, Government of Canada 2019a).
- Manitoba Endangered Species and Ecosystem Act Species List is a current listing of MESEA species designations (Government of Manitoba 2019a).
- eBird is a database of locational data for bird species within the RAA (eBird 2019).
- The Manitoba Herps Atlas is a database containing locational information regarding amphibian species (MHA 2019a and b).
- Manitoba Sustainable Development refers to consultation with provincial wildlife authorities (MSD 2019, pers. comm.).
- Provincial wildlife reports discuss the status of big game in Manitoba (Stardom et al. 1999; MSD 2018).
- Land Cover Classification is remotely sensed data used to classify and quantify wildlife habitat and baseline land use metric in the RAA (Section 8.2.2).
- Existing Manitoba Infrastructure wildlife reports were also referenced (EEI 2017a, b, c).

Field Studies

Baseline field studies were conducted in 2016 and 2017 to gather data on the various outlet channel route options being considered for the Project (EEI 2017a, b, and c). These data were useful in evaluating and identifying final routes for LMOC and LSMOC. In 2018, additional baseline data were gathered in the vicinity of the LMOC in support of channel design. Of these studies, the following were used to characterize the existing conditions and aid in the assessment of potential Project effects on wildlife:

- aerial mammal survey
- aerial stick nest survey
- aerial hibernacula survey
- breeding bird point-count survey
- yellow rail survey

- piping plover survey
- remote camera survey (ongoing)

More detailed descriptions of the methods used to gather wildlife field data are available in Appendix 8D.

8.3.2.2 Overview

This section discusses the existing condition for wildlife and focuses on mammals, reptiles, amphibians, and invertebrates. Section 8.3.3 similarly discusses migratory birds and Section 8.3.4 focuses specifically on SAR and SOCC.

The Project is in the Boreal Plains Ecozone and overlaps the Interlake Plain and the Mid-Boreal Lowland Ecoregions (Section 8.1.2; Appendix 8B, Figure 8.3B-2; Smith et al. 1998). The southern part of the wildlife RAA (including the location of the LMOC) is located predominantly in the Interlake Plain Ecoregion, characterized by trembling aspen stands interspersed with agriculture, grasslands, and wetlands. The northern part of the RAA (including the location of the LSMOC) is located predominantly in the Mid-Boreal Lowland Ecoregion, which is notably low-lying and characterized by mixedwood and coniferous forests on sandy moraine ridges, graminoid dominant rich fens, and peat bogs (Smith et al. 1998).

The poorly drained and/or stony soils in the RAA has limited agricultural conversion and overall development, leaving natural wildlife habitats (e.g., forest, wetland, grassland) relatively abundant and widespread throughout much of the RAA. The quality of these natural habitats has been reduced to varying degrees by the regulation of Lake Manitoba water levels, development (e.g., roads, transmission lines, residential communities), and land conversion for agriculture. For example, before the 1960s, the wetlands along Lake Manitoba shoreline and Lakes Pineimuta and St. Martin provided important habitat for breeding and staging waterfowl (Government of Canada 2013). Since then, water level fluctuations resulting from the regulation of Lake Manitoba and the Fairford dam have reduced the quality of these habitats for waterfowl (Traverse 1999).

Land conversion for agriculture (e.g., cropland, hayland, and pastureland), draining of wetlands, and development of roads, transmission lines, quarries, communities, campgrounds, and cottages, have reduced the quality and quantity of natural wildlife habitat in the RAA, predominantly in the south surrounding the LMOC. Habitat loss or alteration has contributed to the population declines of many migratory bird species, including SAR such as red-headed woodpecker (*Melanerpes erythrocephalus;* COSEWIC 2007a) and bobolink (*Dolichonyx oryzivorus;* COSEWIC 2010). In contrast, areas surrounding the LSMOC in the north part of the RAA have experienced minimal land conversion and development due to presence of large bog and fen complexes. Notable developments in this area are the Lake St. Martin Emergency Outlet Channel (EOC), Reach 1 that spans approximately 5.5 km from Lake St. Martin towards Big Buffalo Lake and the Lake St. Martin access road that connects areas southeast of Lake St. Martin to the EOC. Each of these linear developments have contributed to the loss and fragmentation of wildlife habitat in the northern and eastern parts of the RAA.

Another factor influencing wildlife is resource use (i.e., hunting and trapping). MSD is responsible for managing and monitoring wildlife populations, including establishing harvest limits and issuing hunting and trapping permits and licenses. The RAA overlaps Game Hunting Areas (GHAs) 16, 20, 21, and 25, the Gypsumville Registered Trapline (RTL) area, open trapping area 3, and the Metis Natural Resource Harvesting Zone (Appendix 8B, Figure 8.3B-3; MMF 2018; Government of Manitoba 2019b). Regulated big game hunting seasons in the RAA exist, in one or more GHAs, for species such as white-tailed deer (*Odocoileus virginianus*), elk, moose, and black bear (*Ursus americanus*; Government of Manitoba 2018). The harvest of furs is not monitored in the open trapping area but records for the Gypsumville RTL indicate 13 furbearer species have been harvested from the region over the past 20 years (Berezanski 2018, unpublished data). Other activities in the RAA that contribute to habitat loss or alteration through disturbance and/or fragmentation include recreational activities (e.g., snowmobiling) and forestry.

Currently, the LAA is composed of 27.3% wetland habitats (i.e., bog, fen, marsh, swamp), 14.0% natural upland habitats (i.e., grassland, shrubland, forest), 55.4% water (e.g., Lake St. Martin), and 6.0% modified wildlife habitats (i.e., developed [except for roads], barren, and agricultural lands; Table 8.2-6; Appendix 8B, Figure 8.3B-4). For example, hay and pasture lands can provide breeding habitat for small mammals (e.g., meadow vole [*Microtus pennsylvanicus*]) and grassland birds (e.g., bobolink), and forage habitat for raptors, white-tailed deer, and elk. Agricultural crops can provide forage habitat for species such as black bear and elk while developed habitats can provide habitats for species such common nighthawk (*Chordeiles minor*) and barn swallow (*Hirundo rustica*).

Habitat in the PDA is composed primarily of wetland (48.2%) and modified (26.9%) habitats, with the remainder including native upland (14.6%) and water (9.1%) habitats.

Notable waterbodies in the LAA include Lake Winnipeg, Reed Lake, Clear Lake, Goodison Lake, Birch Creek, Fairford River, Lake St. Martin, Lake Winnipeg, Buffalo Lake, and Buffalo Creek (Appendix 8B, Figure 8.3B-5). The Lake St. Martin and its islands are an Important Bird Area (IBA) for colonial nesting waterbirds and are known to support breeding American white pelican, double-crested cormorant, great blue heron (*Ardea herodias*), black-crowned heron (*Nycticorax nycticorax*), Caspian tern (*Hydroprogne caspia*), and common tern (*Sterna hirundo*; IBA Canada 2019) (Appendix 8B, Figure 8.3B-5).

Provincially designated and protected lands that provide wildlife habitat in the LAA are Watchorn Provincial Park, Sturgeon Bay Area of Special Interest (ASI), and Idylwild ASI (Appendix 8B, Figure 8.3B-6). In the RAA, provincially designated and protected lands also include Sturgeon Bay Provincial Park, Grahamdale Wildlife Management Area (WMA), Hilbre WMA, Gypsumville WMA, Moosehorn WMA, and Gypsum Lake ASI. Overall, large expanses of undeveloped provincial Crown lands connect wildlife habitats between Lake Manitoba to Lake Winnipeg. Wildlife habitat in northern and eastern portions of the RAA remain relatively intact due to limited development. Other notable areas of wildlife habitat occur along the LMOC PDA and near Lake Pineimuta. Habitat fragmentation is greatest west and south of Lake St. Martin towards Lake Manitoba where development (e.g., roads, communities) is more prevalent.

The wildlife LAA is situated in a transitional area between more open habitats in the south, including grasslands, and more low-lying forested habitats in the north. As a result, the LAA supports a diverse community of SAR, SOCC, mammals, birds, amphibians, and reptiles. The RAA has the potential to support 23 SAR, including 4 mammal species, 15 bird species, 1 amphibian specie, 1 reptile specie, and 2 invertebrate species (GOC 2019a). The wildlife RAA also has potential to support 224 bird species (MB IBAP 2018; Appendix A, Table 8.3A-1), 6 amphibian and 4 reptile species (Preston 1982; MB CDC 2018), and 48 mammal species (Banfield 1974; MB CDC 2018). Detailed discussion of the existing conditions for mammals is presented below, for birds in Section 8.3.3, and for SAR in Section 8.3.4.

Mammals

The RAA supports a diverse mammal community that is characteristic of the various wetland and upland habitats represented in the Boreal Plains Ecozone. Species typical of more open, agriculturally dominated areas found in the south part of the wildlife RAA around the LMOC vary from large ungulates to small mammals and include:

- elk
- white-tailed deer
- black bear to a lesser extent
- coyote (*Canis latrans*)
- red fox (*Vulpes vulpes*)
- muskrat
- deer mouse (*Peromyscus maniculatus*)
- meadow vole
- red-backed vole (*Myodes gapperi*)
- masked shrew (*Sorex cinerus*)

Species typical of the spruce-dominated peatlands found in the central and northern parts of the RAA around the LSMOC include moose, black bear, gray wolf (*Canis lupus*), Canada lynx (*Lynx canadensis*), marten, snowshoe hare (*Lepus americanus*), red squirrel (*Tamiasciurus hudsonicus*), and red-backed vole. Bats have the potential to occur throughout the RAA due to the widespread availability of forest and wetland habitat.

As described in Section 8.3.1, moose, elk, furbearers, and bats are selected as focal species/groups because of their importance to people, to ecological function, and/or because they are representative of certain habitat types found within the LAA.

Moose

Moose is a valued species for local resource users, as identified by Indigenous and public engagement (Section 8.3.1.2), and they have experienced substantial population declines within the region. They are a representative species of the boreal habitat in the northern part of the RAA surrounding the LSMOC. Moose are North America's largest ungulate species and require a variety of forested habitats throughout the year. Moose browse on early successional vegetation typically found in regenerating boreal forest (e.g., post-burn) or riparian habitats and seek dense mature forested habitats for thermal cover in late winter (Peek 2007).

Suitable moose habitat exists predominantly in the northern and eastern parts of the RAA and in the LAA along the LSMOC where wetland shrub and coniferous forest is widespread. Habitat availability does not appear to be limiting moose in this region; however, populations in GHA 21 have been steadily declining. In 2017, MSD implemented a moose hunting closure to all licensed hunting in GHA 21 (Government of Manitoba 2018). Populations were estimated at 346 individuals in 2008, down from 1,230 in 1995. Licensed hunting is still permitted in GHA 20, and there is no licensed moose hunting in GHAs 16 or 25.

A total of five moose were observed in the north and eastern parts of the RAA during the 2016 winter baseline surveys (EEI 2017a and b). The occurrence of moose in the northern part of the RAA is consistent with MSD moose survey data. Although moose have the potential to occur along LMOC, none were detected during the remote camera survey.

Elk

Elk is a valued species for local resource users as identified by Indigenous and public engagement (Section 8.3.1.2) and are a representative species of the forest, grassland, and agriculture habitats of the southern part of the wildlife RAA surrounding the LMOC. Elk is a generalist herbivore that requires landscapes supporting dense forest and shrub patches for cover and open grasslands or haylands for foraging (Banfield 1974). They occupy large home ranges (approximately 41 km^2) that encompass a wide range of habitats (Storlie 2006). Elk are gregarious species and typically live in small groups throughout most of the year until winter temperatures and reduced food availability cause animals to join and form larger herds (Banfield 1974).

Historically, elk were more common in the south Manitoba Interlake Region until land conversion and overhunting reduced the herd to approximately 50 animals in the 1960s (Stardom et al. 1999). Management efforts, including reintroduction of 123 elk to the southern region, have restored elk populations to sustainable levels (i.e., 800 to 1,000 individuals) that currently permit regulated and non-regulated harvest throughout the region (regulated harvest of 70 to 80 elk per year). The LAA around the LMOC overlaps the northern western extent of the South Interlake elk herd range, which spans portions of GHAs 21 and 25, south of Lake St. Martin near Grahamdale to Woodlands, MB (Appendix 8B, Figure 8.3B-7; Stardom et al. 1999). According to recent MSD aerial survey data, the South Interlake elk herd population has remained relatively stable over the last two decades with estimates of 1,120 elk in 2000 and 1,557 elk in 2018 (MSD 2018). This population of elk is considered separate from the North Interlake elk herd (68 animals in 2012; Bruce 2012) that ranges north of the RAA from Lake Manitoba to Cedar Lake (Stardom et al. 1999). An interchange of DNA between the North and South Interlake herds was previously considered possible, but unlikely to occur on a regular basis (Stardom et al. 1999).The two herds are separated by a narrow, 40-km long stretch of land and water flanked by Lake Manitoba to the west and Lake St. Martin to the east. Wildlife movement may be impeded by the semi-permeable barriers that exist within this narrow stretch of land including Fairford River, Pineimuta Lake, and the wetland complex along the LMOC. Recent evidence from MSD 2018 elk collar data indicates that interchanges between herds does occur: one collared individual was recorded travelling south of the North Interlake elk range and crossing Lake Manitoba to reach the South Interlake herd (MSD 2019, pers. comm.). MSD considers it unlikely that elk would cross the Fairford River (approx. 130 m wide) due to the combination of swift current and anthropogenic disturbance along the terrestrial corridor between Lake Manitoba and Lake Pineimuta (MSD 2019).

Within the wildlife LAA, elk foraging habitat exists along the LMOC where pasture and hayfields are prevalent. Wintering habitat (i.e., forest cover adjacent to forage fields) exists primarily in the southeastern edge of the RAA east of Moosehorn (Stardom et al. 1999) outside the LAA. Based on field and desktop data (EEI 2017a and b), elk occur in the southeastern portion of the RAA, outside the LAA during the winter months and there are no known calving grounds within the LAA. A group of 13 elk were observed approximately 4.3 km east the LMOC near Clear Lake during the 2016 winter surveys. Elk were identified in this same area during MSD's 2013 winter elk survey and in an area approximately 5 km to 6 km south of Moosehorn (Bruce 2013).

The remote camera survey along LMOC yielded five elk encounters at three of 24 remote cameras between mid-February and late-May 2019. Two of the three locations occurred in the LAA while the third was approximately 800 m outside the LAA and approximately 2.5 km southwest of Grahamdale. This supports desktop results and 2018 aerial survey data that detected elk north and west of Moosehorn (MSD 2019, pers. comm.). This area is predominantly private land and characterized by a mix of wetland and terrestrial habitats, tame pasture, hayland, as well as deciduous and mixedwood forest.

Furbearers

Furbearers, as defined under Division 2, Schedule A of *The Wildlife Act,* are a diverse group of mammals that have been traditionally trapped or hunted for their furs and are a valued species for local resource users as identified by Indigenous and public engagement (Section 8.3.1.2). Sixteen furbearer species have potential to occur in the RAA, with 15 of these having been harvested in the Gypsumville Trapping Area (Table 8.3-3; Appendix 8B, Figure 8.3B-3; Berezanski 2018, unpublished data).

Typical furbearers inhabiting the LAA are American beaver (*Castor canadensis*; hereafter beaver) muskrat, red fox, coyote, and marten. Between 1996 and 2012, muskrat was the most trapped species (54% of n=6,542 animals trapped between 1996 and 2012) followed by beaver (14%), fisher (*Martes pennanti*; (9%), red squirrel (6%) and marten (6%). The remaining 17% of furbearers trapped in the Gypsumville RTL consisted of long-tailed weasel (*Mustela frenata*) and short-tailed weasel (*Mustela* *erminea*), coyote, river otter (*Lontra canadensis*), mink (*Neovision vision*), red fox, Canada lynx, and raccoon (*Procyon lotor*; Berezanski 2018, unpublished data).

Mink and muskrat were once the most common furbearing species in the marshes bordering Lake Manitoba and Lake St. Martin (LMRRAC 2003). Over the past several decades, both species have experienced population declines in the marshes bordering Lake Manitoba. These declines are consistent with the reductions in the abundance of emergent and submergent vegetation in Lake Manitoba marshes resulting from lake regulation (LMRRAC 2003).

Marten, one of Manitoba's most harvested and highest valued furbearing species (Government of Manitoba 2018), is representative of mature coniferous forest found in the northern part of the LAA and RAA surrounding the LSMOC. During the 2016 winter surveys, marten tracks were observed throughout the northern and eastern parts of the LAA surrounding the LSMOC. This area supports marginal habitat for marten due to recent burns within the last 30 years; however, it is considered an important dispersal corridor for marten and other furbearers moving along the west side of Lake Winnipeg (Berezanski 2018, pers. comm.). In the fall, young marten will disperse 40 km or more in search of new territories (Natureserve 2017).

Table 8.3-3 Furbearers with Potential to Occur in RAA[1]

Common Name	Scientific Name	Harvested from the Gypsumville Trapping Area[1]
Beaver	*Castor canadensis*	Yes
Mink	*Neovision vision*	Yes
Muskrat	*Ondatra zibethicus*	Yes
River otter	*Lontra canadensis*	Yes
American badger	*Taxidea taxus*	Yes
Fisher	*Martes pennanti*	Yes
Red fox	*Vulpes vulpes*	Yes
Coyote	*Canis latrans*	Yes
Canada lynx	*Lynx canadensis*	Yes
Bobcat	*Felis rufus*	Yes
Red squirrel	*Tamiasciurus hudsonicus*	Yes
Raccoon	*Procyon lotor*	Yes
Marten	*Martes americana*	Yes
Short-tailed weasel	*Mustela erminea*	Yes

Table 8.3-3 Furbearers with Potential to Occur in RAA[1]

Common Name	Scientific Name	Harvested from the Gypsumville Trapping Area[1]
Aquatic and Semi-aquatic Species		
Beaver	*Castor canadensis*	Yes
Long-tailed weasel	*Mustela frenata*	Yes
Wolverine	*Gulo gulo*	No
[1] – Berezanski 2018, unpublished data		

Within the LAA, beaver is found along creeks (e.g., Buffalo Creek) and rivers, and Canada lynx are found in remote, coniferous-dominated areas north and east of Lake St. Martin near the LSMOC. Fisher, a carnivorous predator of small mammals, were not detected during baseline surveys but have the potential to inhabit coniferous and mixedwood forest found in the northern part of the RAA near the LSMOC (EEI 2017a and b). River otter, a semi-aquatic predator of fish, clams, frogs, and turtles prefer riparian habitats with little human disturbance. River otter was detected along Buffalo Creek near the LSMOC and in the south basin of Lake St. Martin near Birch Bay and the LMOC outlet.

Wolverine (*Gulo gulo*), a species listed as Special Concern by Committee on the Status of Endangered Species in Canada (COSEWIC) is the only at-risk furbearer having potential to occur in the RAA. Wolverine is discussed as a SAR in Section 8.3.4.1.

Bats

Bats were selected as a focal group because they are important for ecological function and have the potential to occur throughout the RAA in both maternal roosts (e.g., mature forests) and overwintering hibernacula (e.g., karst caves). The RAA contains SARA-designated critical habitat for little brown myotis and northern myotis, two SAR (both SARA-listed as Endangered) that are discussed in greater detail in Section 8.3.4.1.

Six bat species have the potential to occur within the RAA: hoary bat (*Lasiurus cinereus*), big brown bat (*Eptesicus fuscus*), northern myotis, little brown myotis, eastern red bat (*Lasiurus borealis*), and silver-haired bat (*Lasionycteris noctivagans*). All but eastern red bat have been detected within the RAA during baseline field studies. All six species require forested areas for roosting (including maternal roosts) and open habitats for foraging on aerial insects (e.g., forest openings, wetlands). Hoary, silver-haired, and eastern red bat are migratory bats that breed in Manitoba and overwinter in areas further south, whereas northern myotis, little brown myotis, and big brown bat are resident species that overwinter in caves or caverns with suitable temperatures and humidity levels (Bilecki 2003).

Overall, the Manitoba Interlake Region provides high suitability overwintering habitat for bats due to its karst topography composition, a soluble bedrock structure that is eroded by water to produce caves suitable for overwintering bats (Bilecki 2003). Known bat hibernacula exist in caves near St. George (western edge of Lake Winnipeg), Lake St. Martin, and near Grand Rapids, MB (Bilecki 2003). The caves near Lake St. Martin fall within the boundaries of the RAA and are known to support little brown myotis (Bilecki 2003; Norquay et al. 2013). Although baseline bat hibernacula surveys did not identify the presence of additional bat hibernacula within the RAA, additional sites may exist due to the presence of karst topography (EEI 2017c).

Threats to bats include loss and degradation of foraging habitat, maternity roosts, and hibernacula, and most importantly, white-nose syndrome (WNS; Environment Canada 2015a). WNS is a fungus (*Pseudogymnoascus destructans*) that affects the skin on the nose, ears, and wings of hibernating bats. The fungus causes bats to wake up frequently during the winter, which depletes energy reserves and weakens bats immunity. Mortality rates for bats infected by WNS are quite high; over 70% of bats die within two years of detection (Environment Canada 2015a). In 2018, WNS was detected in bats inhabiting the St. George caves located approximately 55 km east of the LSMOC ROW, near Lake Winnipeg. The disease is likely spread through bat interactions and by humans visiting multiple caves and not following proper decontamination procedures (Environment Canada 2015a).

Amphibians and Reptiles

Amphibians and reptiles are a valued species, as identified during Indigenous and public engagement, (Section 8.3.1.2) and their life cycles are often tied to aquatic habitats. Six amphibian species have the potential to occur in the LAA, four of which have been detected during 2016 baseline field surveys: boreal chorus frog (*Pseudacris maculate*), wood frog (*Lithobates sylvaticus*), gray tree frog (*Hyla versicolor*), and northern leopard frog (*Lithobates pipiens*). The RAA is also in the known range of American toad (*Anaxyrus americanus*) and Canadian toad (*Anaxyrus hemiophrys*; Preston 1982; MHA 2019a).

Amphibians rely on a variety of upland and aquatic habitats throughout the year for breeding, foraging, and overwintering. Boreal chorus frogs and wood frog are two of Manitoba's most common and widespread amphibians (MHA 2019a) and are expected to occur throughout the RAA. Gray tree frog inhabits forested areas supporting wetlands, rivers, or creeks. Gray tree frog has been recorded along the Dauphin River in the northern part of the RAA, and near Hilbre in the southern part of the RAA (MHA 2019a). American and Canadian toad inhabit upland forests and grasslands and lake and wetland margins (Preston 1982; MHA 2019). Northern leopard frog is SARA-listed as special concern and relies on semi-permanent and permanent wetlands adjacent to upland areas used foraging and dispersal and is discussed in greater detail in Section 8.3.4.3.

Four reptile species have the potential to occur in the RAA: red-sided garter snake (*Thamnophis sirtalis*), plains garter snake (*Thamnophis radix*), western painted turtle (*Chrysemys picta*), and snapping turtle (*Chelydra serpentine*; MHA 2019a). Only red-sided garter snake was observed during 2016 baseline field surveys. Snapping turtle is COSEWIC-listed as special concern and relies on permanent wetlands, lakes, and watercourse year-round and is discussed in greater detail in Section 8.3.4.3.

Red-sided and plain garter snakes occur near wetlands in the grasslands and open woodlands near Lake Manitoba, and common snapping turtle and western painted turtle may occur in semi-permanent and permanent wetlands, lakes, and rivers that occur throughout the RAA (Preston 1982; MHA 2019a).

All amphibians and reptiles having the potential to occur in the RAA may inhabit the grassland, wetlands, and woodlands located within and surrounding the LMOC ROW. Permanent waterbodies and wetlands adjacent to the LMOC have the potential to provide overwintering habitat for turtles and amphibians and provide foraging habitat for frogs, turtles, and snakes. Adjacent uplands may provide foraging habitat for amphibians, as well as overwintering habitat for snakes. There are no known snake hibernacula for overwintering snakes in the RAA.

Invertebrates

The riparian, wetland, and terrestrial habitats in the wildlife LAA provide habitat for thousands of invertebrate species. Most invertebrate species play important ecological and economic roles (e.g., pollination) but the number and diversity of species precludes formal assessment and a focus is placed on SAR and SOCC. The RAA has the potential to provide habitat for two SAR and one SOCC species (Appendix A, Table 8.3A-2): transverse lady beetle (*Coccinella transversalis*), yellow-banded bumble bee (*Bombus terricol*), and gypsy cuckoo bumble bee (*Bombus bohemicus*). Invertebrate SAR and SOCC are discussed in greater detail in Section 8.3.4.

8.3.3 Migratory Birds

Migratory birds are a valued group of wildlife species as identified by Indigenous and public engagement (Section 8.3.1.2). The LAA has the potential to support 224 bird species (MB IBAP 2018), including 195 with the potential to breed within the LAA and 29 that breed in more northern habitats (Appendix A, Table 8.3A-1). Of these, 192 are migratory birds as defined by the *MBCA* while the remaining 32 species are protected under *The Wildlife Act*. Of the 195 species with potential to breed in the RAA, there are 59 waterbirds (e.g., waterfowl, shorebirds), 18 raptors (e.g., hawks, owls), 4 upland game birds (e.g., grouse), and 114 other birds (e.g., songbirds, woodpeckers, nightjars). Seventeen of these species are SAR/SOCC and discussed in greater detail in Section 8.3.4.2.

Long-term (1997-2017) North American Breeding Bird Survey results for the survey route nearest to the RAA (near south of Ashern, MB) indicate that the most commonly observed species are ring-billed gull (*Larus delawarensis*), Canada goose (*Branta canadensis*), red-winged blackbird (*Agelaius phoeniceus*), American crow (*Corvus brachyrhynchos*), savannah sparrow (*Passerculus sandwichensis*), and clay-colored sparrow (*Spizella pallida*; Pardieck et al. 2018). The remainder of this section characterizes the bird community by major habitat types (wetlands, grasslands and forests).

8.3.3.1 Wetlands

The LAA includes open-water (35,395.2 ha; 55.4%) and wetland (15,153.3 ha; 23.7%) habitat suitable for migratory birds (Table 8.2-6). Wetland habitat in the LAA is generally characterized by marsh habitats along the LMOC and bog, fen, and swamp habitats along the LSMOC (Appendix 8B, Figure 8.3B-4). Notable open water habitats in the RAA include Fairford and Dauphin Rivers, Lake Winnipeg, Pineimuta, and Manitoba, Lake St. Martin, and the smaller Gypsum, Goodison, Clear, and Reed Lakes.

Breeding species typical of wetland habitats include Wilson's snipe (*Gallinago delicata*), tree swallow (*Tachycineta bicolor*), marsh wren (*Cistothorus palustris*), common yellowthroat (*Geothlypis trichas*), swamp sparrow (*Melospiza georgiana*), and red-winged blackbird. One of the most common breeding birds observed in vegetated wetland habitats during 2016 baseline surveys was red-winged blackbird (EEI 2017a, b).

Breeding species typical of open water habitats include Canada goose, mallard (*Anas platyrhynchos*), common merganser (*Mergus merganser*), common loon (*Gavia immer*), American white pelican, double-crested cormorant, and common tern. The lakes within the RAA (e.g., Pineimuta Lake and Lake St. Martin) provide important staging and moulting habitat for waterfowl (Cowan 1975; Boychuk and Cowan 1976; Government of Canada 2013). Baseline surveys in 2016 revealed the presence of breeding waterfowl in lakes along the LMOC ROW including blue-winged teal (*Anas discors*), northern shoveler (*Anas clypeata*), northern pintail (*Anas acuta*), and mallard. Eight bald eagle nests exist within the LAA: six were identified in the north end of Lake St. Martin, one was identified on Lake Winnipeg near Willow Point, and one was identified along the LMOC ROW near Lake Manitoba (Appendix 8B, Figure 8.3B-8; EEI 2017a and b). Bald eagles breed and stage within the Lake St. Martin area due to the abundance of forage in Lake St. Martin and Dauphin River (IBA Canada 2019).

Waterfowl productivity, particularly in Lake Pineimuta and Lake St. Martin, has declined since the Fairford River Water Control Structure (FRWCS) commenced operation in 1961 (Cowan 1975; Boychuk and Cowan 1976; Traverse 1999). The control structure regulates Lake Manitoba water levels by diverting water into Pineimuta, Lake St. Martin and on to Dauphin River and Lake Winnipeg. The operation of the FRWCS has artificially increased the variation of water levels on Lake Pineimuta and Lake St. Martin compared to normal conditions (Farlinger et al. 2003). The increased variability and higher overall water levels have resulted in reduced habitat availability for breeding waterfowl (Cowan 1975; Mazerolle and Cowan 1975; Boychuk and Cowan 1976).

Data from the North American Waterfowl Breeding Population and Habitat Survey (2007-2015, survey strata 37) indicate that mallard, blue-winged teal, and Canada goose, gadwall, and scaup are the most abundant waterfowl species in the region (USFWS 2018).

Nine species of colonial waterbird are known to breed within the RAA: American white pelican, double-crested cormorant, great blue heron, black-crowned night-heron, ring-billed gull, herring gull (*Larus argentatus*), Caspian tern, common tern, and Forester's tern (*Sterna forsteri*; IBA Canada 2019). All but Caspian tern and Forester's tern have been observed during recent surveys (Wilson et al. 2014) and/or during 2016 baseline surveys.

Lake St. Martin is designated as an Important Bird Area (IBA; Appendix 8B, Figure 8.3B-8) due to its global significance for waterbird concentrations (IBA Canada 2019). Historically, this IBA supported 3,400 common tern nests, 1,500 Caspian tern nests, 2,414 double-crested cormorant nests, hundreds of

American white pelican nests, and small numbers (i.e., less than 50) of great blue heron and night crowned heron nests (Birdlife International 2018). Small numbers of Forester's tern have nested in the marshes bordering Lake St. Martin (Birdlife International 2018).

More recent surveys of Lake St. Martin islands reported 3,169 double-crested cormorant nests from three colonies, 3,765 ring-billed gull nests from two colonies, 63 herring gull nests from three colonies, and 60 common tern nests from one colony (Wilson et al. 2014). Field studies conducted in 2016 revealed the presence of great blue heron and American white pelican breeding within the Lake St. Martin IBA (Appendix 8B, Figure 8.3B-8; EEI 2017a and b). Outside of the IBA, the only other area known to support colonial breeding waterbirds is Lake Manitoba near the LMOC ROW inlet. Two islands approximately 1.5 km and 3.6 km from the LMOC inlet support double-crested cormorants (MB CDC 2018). The island farthest from the inlet has also been known to support a breeding colony of herring gulls (MB CDC 2018).

8.3.3.2 Grasslands

The LAA includes grassland habitat (5814.7.0 ha; 9.1%) that is primarily used as cattle pasture or hayland and exists predominantly along the LMOC (Table 8.2-6). Of this, 2,531.1 ha is native grassland cover. Breeding species typical of grassland habitats in the RAA include sharp-tailed grouse (*Tympanuchus phasianellus*), red-tailed hawk (*Buteo jamaicensis*), barn swallow, savannah sparrow, bobolink, western meadowlark (*Sturnella neglecta*), and clay-colored sparrow. The most common breeding birds observed in grassland habitats during 2016 baseline surveys were eastern kingbird (*Tyrannus tyrannus*), barn swallow, clay-colored sparrow, and bobolink (EEI 2017a and b).

8.3.3.3 Forests

The LAA contains forested habitat (6,377.6; 10.0%) that include 7.8% deciduous, 1.5% coniferous, and 0.6% mixedwood forest located throughout most of the LAA, predominantly as smaller patches scattered amongst other habitat types (e.g., wetlands).

Deciduous forest habitats consist primarily of trembling aspen, balsam poplar, oak, and Manitoba maple with common breeding bird species that include ruffed grouse (*Bonasa umbellus*), red-eyed vireo, ovenbird, and white-throated sparrow (*Zonotrichia albicollis*). In the south and western parts of the RAA, grassland and haylands are interspersed by patches of deciduous forest that support forest edge species such as red-headed woodpecker (Melanerpes erythrocephalus), golden-winged warbler (*Vermivora chrysoptera*), yellow warbler (*Setophaga petechia*), and brown-headed cowbird (*Molothrus ater*). The most common deciduous forest breeding birds observed during 2016 baseline surveys were red-eyed vireo, white-throated sparrow, and chipping sparrow (*Spizella passerine*; EEI 2017a and b).

Coniferous forest habitats consist primarily of jack pine, black spruce, and tamarack and are distributed primarily on the uplands/ridges in the northwestern part of the RAA, including along the LSMOC. Species typical of coniferous forest include spruce grouse (*Falcipennis canadensis*), black-capped chickadee (*Poecile atricapillus*), ruby-crowned kinglet ( ), and Swainson's thrush (*Catharus ustulatus*).

8.3.4 Species at Risk and Species of Conservation Concern

SAR is a valued group of species as identified by Indigenous and public engagement (Section 8.3.1.2) and regulators (CEAA 2018). Twenty-three SAR have the potential to occur in the RAA (4 mammal species, 15 bird species, 1 amphibian species, 1 reptile species, and 2 invertebrate species); all but American badger (*Taxidae taxus*), wolverine, piping plover, rusty blackbird (*Euphagus carolinus*), snapping turtle, yellow-banded bumble bee, and gypsy cuckoo bumble bee have been recorded within the RAA (Appendix A, Table 8.3A-2). All but trumpeter swan (*Cygnus buccinators;* MESEA-listed as Threatened) are SARA-listed species.

Three SOCC have potential to occur in the RAA based on known range and habitat suitability including three bird species and one invertebrate species (Appendix A, Table 8.3A-2). None of these species have been recorded in the RAA. SAR and SOCC are discussed in greater detail below.

8.3.4.1 Mammals

Four mammal SAR have potential to occur in the RAA: little brown myotis, northern myotis, American badger and wolverine. They are discussed in detail below.

Little Brown Myotis and Northern Myotis

Little brown myotis and northern myotis (both SARA-listed as Endangered) are two aerial insectivorous bat species that occupy the RAA year-round (COSEWIC 2013a). Little brown myotis and northern myotis require several different habitats throughout the year. Summer habitats include open foraging areas (e.g., forest openings, wetlands) located near suitable roosting or maternity colonies (i.e., areas of mature trees, buildings, and rock crevices; COSEWIC 2013a). The RAA contains suitable bat hibernacula/ overwintering habitat in karst caves formed through the erosion of water-soluble bedrock (Bilecki 2003). Karst features are relatively common throughout the Manitoba Interlake Region and are known to support federally defined critical bat hibernacula near the communities of Gypsumville and St. Martin (Bilecki 2003; Appendix 8B, Figure 8.3B-9). Although aerial and ground-based field investigations for potential bat hibernacula were conducted in 2016, no other bat hibernacula were identified within the LAA or RAA.

Both little brown myotis and northern myotis have suffered sudden and dramatic population declines throughout much of their ranges, largely attributed to the spread of WNS, a fungal infection that inhibits energy regulation during hibernation resulting in elevated mortality rates (COSEWIC 2013a). The disease, which was originally discovered in the northeastern U.S. in 2006 has spread throughout southeastern Canada and discovered in the Manitoba Interlake Region in 2018 (CWHC 2018). In 2015, a federal recovery strategy was developed that provides guidance aimed at halting and reversing population decline of little brown myotis and northern myotis and identifying critical habitat (Environmental Canada 2015a). There is no critical habitat for bats in the LAA. However, there is one 10 km x 10 km critical habitat square that contains critical habitat (i.e., known hibernacula) for little brown myotis in the RAA west of Lake St. Martin near Gypsum Lake (see Appendix 8B, Figure 8.3B-9).

American Badger

American badger (SARA-listed as special concern) is a burrowing furbearer that inhabits grassland habitats, including pastures and haylands, and typically avoids forested habitats (COSEWIC 2012a). The RAA is on the northern limit of the species' range and while suitable habitat does exist in the southern half of the RAA in grassland habitats along the LMOC, American badger distribution is also limited by prey availability (i.e., small mammals) and soil structure for burrowing (COSEWIC 2012a). There are no records of American badger in the RAA but the Gypsumville RTL data contains one record of an American badger being harvested.

Wolverine

Wolverine (SARA-listed as special concern) is a wide-ranging carnivore that inhabits a variety of forested habitats and its distribution is driven by both anthropogenic disturbance and prey availability (COSEWIC 2014a). Although suitable habitat types may exist for wolverine in the region and they may travel through the northern part of the RAA (MSD 2019, pers. comm.), the RAA is outside of this species current range (COSEWIC 2014a).

8.3.4.2 Birds

Fourteen bird SAR and three SOCC have potential to occur in the LAA. SAR and SOCC are discussed below relative to their dominant habitat preference: wetlands, grasslands, or forests.

Wetlands

Five bird SAR and one SOCC have the potential to inhabit riparian and/or wetland habitats in the LAA (Appendix A, Table 8.3A-2): trumpeter swan, horned grebe (*Podiceps auritis*), least bittern (*Ixobrychus exilis*), yellow rail (*Conturnicops noveboracensis*), piping plover, and bank swallow (*Riparia riparia*).

Trumpeter Swan

Trumpeter swan (MESEA-listed as endangered) is a large waterfowl species that breed in shallow lakes or wetlands supporting an abundance of forage (e.g., aquatic plants) and muskrat or beaver lodges for nesting (Mitchell and Eichholz 2010). Suitable breeding habitat for trumpeter swan may exist within lakes (e.g., Lake Pineimuta), but trumpeter swan is rare throughout the region with no breeding records within the RAA (eBird 2019; MB BBA 2019). Three trumpeter swans were observed using a wetland located outside of the LAA, east of Lake St. Martin adjacent to the all-season road during 2016 baseline surveys (EEI 2017b).

Horned Grebe

Horned grebe (COSEWIC-listed as special concern) is a secretive waterbird that typically breeds and constructs a floating nest on small, relatively open wetlands (COSEWIC 2009a). Suitable breeding habitat for horned grebe exists throughout the RAA where semi-permanent and permanent wetlands and lakes exist (e.g., lakes in the wildlife LAA adjacent to the LMOC). There were no observations in the LAA during 2016 baseline surveys, however breeding records exist in the western part of the RAA near Faulkner, Gypsumville and the Fairford River (eBird 2019; MB BBA 2019).

Least Bittern

Least bittern (SARA-listed as threatened) is a secretive waterbird that breeds in wetland habitats containing dense expanses of emergent vegetation (e.g., cattails) for nesting, adjacent to areas of open water for foraging (COSEWIC 2009b). Suitable breeding habitat for least bittern exists throughout the RAA where semi-permanent and permanent wetlands and lakes exist (e.g., Lake Pineimuta, Goodison Lake, Reed Lake). There were no observations during 2016 baseline surveys (EEI 2017a and b); however, breeding records exist in the LAA along the LMOC near Goodison Lake and near the LMOC inlet (eBird 2019; MB BBA 2019). In 2014, a federal recovery strategy was developed that provides guidance aimed at halting and reversing population decline of least bittern, expanding the species' distribution, and identifying critical habitat (Environment Canada 2014). There is no critical habitat for least bittern designated within the RAA.

Yellow Rail

Yellow rail (SARA-listed as special concern) is a nocturnal waterbird that breeds in wet meadows and fields, grassy marshes containing less than 12 cm of water, bogs, and floodplains (COSEWIC 2009c). Suitable breeding habitat for yellow rail can vary annually depending on fluctuating water levels, but may occur throughout the RAA, particularly along the LMOC and west of Lake St. Martin. Yellow rail was not detected during 2016 baseline surveys (EEI 2017a and b), but breeding records exist 4 km east of the LMOC, near Birch Bay, west of Lake St. Martin, and outside the LAA in the northeastern part of the RAA near Gypsum Lake (eBird 2019; MB BBA 2019). In 2013, a federal management plan was developed for yellow rail that focuses on maintaining the species' distribution while promoting conservation and management of habitat (Environment Canada 2013a).

Piping Plover

Piping plover (SARA-listed as endangered) is a small shorebird that typically breeds along sand and pebble beaches of semi-permanent and permanent lakes (COSEWIC 2013b). Potential breeding habitat for piping plover may exist in the RAA on Lake Winnipeg and Lake Manitoba where appropriate beaches and water conditions exist (Environment Canada 2007). Piping plover was not observed during 2016 baseline surveys (EEI 2017 b) and there are no breeding records within the RAA (eBird 2019; MB BBA 2019). In 2006, a federal recovery strategy was developed that provides guidance aimed at halting and reversing population decline of piping plover, expanding the species' current distribution, and identifying critical habitat (Environment Canada 2006). The recovery strategy identifies Lake Winnipeg and Lake Manitoba as basins that have the potential to provide critical habitat for piping plover (Environment Canada 2007).

Bank Swallow

Bank swallow (SARA-listed as threatened) is an aerial insectivore that nests in cavities dug into vertical banks, including in the banks of streams, rivers, and aggregate piles located near open foraging habitat such as grasslands, meadows, and pasture (COSEWIC 2013c). Suitable breeding habitat for bank swallow may exist in the LAA for the LMOC where suitable banks exist as individuals were recorded during 2016 baseline field studies (EEI 2017a). Two additional incidental observations of bank swallow were detected during 2016 baseline surveys west of Lake St. Martin near Dauphin River (EEI 2017b).

Grasslands

Three bird SAR have the potential to breed in grassland habitats (including pasture and haylands) in the RAA (Appendix A, Table 8.3A-2): short-eared owl (*Asio flammeus*), barn swallow, and bobolink.

Short-eared owl

Short-eared owl (SARA-listed as special concern) is a wide-ranging, ground-nesting owl species that breeds in open habitats including grasslands, pasture and haylands, marshes, and tundra (COSEWIC 2008a). Suitable breeding habitat for short-eared owl exists throughout the RAA and includes grassland habitats and open peatlands within the PDA. The only record of short-eared owl in the RAA comes from an incidental observation recorded during 2016 baseline surveys (EEI 2017a). A single bird was observed foraging over pasture located outside of the LAA, south of Lake St. Martin. In 2016, a federal management plan was developed for short-eared owl focusing on stabilizing and increasing the species' declining population tend while increasing the area of occupancy, particularly in southern Canada (Environment Canada 2016a).

Barn Swallow

Barn swallow (SARA-listed as special concern) is an aerial insectivore that nests primarily on buildings (e.g., barns), under bridges, and in road culverts adjacent to foraging habitats including grasslands, pastures, wetlands, and residential areas (COSEWIC 2011). Habitat for barn swallow exists predominantly in the southern parts of the LAA where development is more prevalent and supports suitable nesting sites. Barn swallow were frequently encountered along the LMOC ROW during 2016 baseline surveys (EEI 2017a and b) and existing breeding records exist near Goodison Lake, Fairford River, Little Saskatchewan First Nation, Gypsumville, and the Dauphin River (eBird 2019; MB BBA 2019).

Bobolink

Bobolink (SARA-listed as threatened) is a ground-nesting songbird that breeds in grasslands, pasture and haylands, wet meadows, abandoned fields, and graminoid peatlands (COSEWIC 2010). The LAA is on the northern limit of the species' breeding range but suitable breeding habitat within the LAA exists to the south and west of Lake St. Martin. Bobolink were observed using haylands and pasture along the LMOC

ROW during 2016 baseline surveys (EEI 2017a). Several existing breeding records exist between Lake Manitoba and Lake St. Martin and one near Little Saskatchewan First Nation (eBird 2019; MB BBA 2019).

Forests

Six bird SAR and two SOCC have the potential to breed in forested habitats in the LAA (Appendix A, Table 8.3A-2): eastern whip-poor-will (*Antrostomus vocife*rous), common nighthawk, red-headed woodpecker, eastern wood-pewee (*Contopus virens*), olive-sided flycatcher (*Contopus cooperi*), golden-winged warbler, rusty blackbird, and evening grosbeak (*Coccothraustes vespertinus*).

Eastern Whip-poor-will

Eastern whip-poor-will (SARA-listed as threatened) is a ground-nesting aerial insectivore that typically breeds in a variety of mature forest habitats, preferring sites that are structurally suitable with forest openings for nesting and foraging (COSEWIC 2009d, ECCC 2018b). Suitable breeding habitat for eastern whip-poor-will exists throughout the LAA and RAA but predominantly east and north of Lake St. Martin. Eastern whip-poor-will have been observed along the east and western shores of Lake St. Martin, north of Gypsumville, and north of Lake St. Martin along Dauphin River (eBird 2019; MB BBA 2019). In 2018, a federal recovery strategy was developed providing guidance aimed at halting and reversing population decline of eastern whip-poor-will and identifying critical habitat (Environment Canada 2015b). The recovery strategy designates two 10 km x 10 km critical habitat squares mostly within the wildlife RAA that contain critical habitat for eastern whip-poor-will: one along the northeast shore of Lake St. Martin and one near Gypsumville (Appendix 8B, Figure 8.3B-10).

Common Nighthawk

Common nighthawk (SARA-listed as threatened) is a ground-nesting insectivore that breeds in a variety of natural and disturbed habitats, nesting on gravelly shorelines, rocky outcrops, peatlands, grasslands, and sparsely vegetated forest openings (COSEWIC 2007b). Suitable breeding habitat for common nighthawk exists throughout the RAA. Common nighthawk was detected in open peatland east of Lake St. Martin during 2016 baseline surveys and is known to occur throughout the LAA (eBird 2019; MB BBA 2019). In 2016, a federal recovery strategy was developed that provides guidance aimed at halting and reversing population decline of common nighthawk, but existing data has been inadequate for determining critical habitat for common nighthawk (Environment Canada 2016b).

Red-headed Woodpecker

Red-headed woodpecker (SARA-listed as threatened) is a cavity-nesting woodpecker that breeds in open deciduous forest or forest edges, and open habitats (e.g., grasslands or pastures containing windrows) where mature or dead trees are available for nesting (COSEWIC 2007a). The LAA is near the northern limit of the species' breeding range (MB BBA 2019) but suitable habitat, including federally protected critical habitat, does exist in the southern half of the RAA along the LMOC (Appendix 8B, Figure 8.3B-11). The species was detected in hayland and pasture habitats located along the LMOC ROW near Reed and

Goodison lakes during 2016 field surveys (EEI 2017a). Red-headed woodpecker has also been recorded along the Fairford River and west of Gypsumville (eBird 2019; MB BBA 2019). In 2019, a federal recovery strategy (proposed) was developed to provide guidance aimed at halting and reversing population decline of red-headed woodpecker and identifying critical habitat (ECCC 2019). The recovery strategy proposes two 10 km x 10 km critical habitat squares completely within the RAA that contain potential critical habitat for red-headed woodpecker that are both within the LAA adjacent to the LMOC (Appendix 8B, Figure 8.3B-11).

Eastern Wood-pewee

Eastern wood pewee (COSEWIC-listed as special concern) is a songbird species that breed in open, intermediate to mature mixedwood and deciduous forests, including forest edges (COSEWIC 2012b). Suitable breeding habitat for the eastern wood-pewee may exist throughout the LAA, however the LAA is on the northern limit of the species' breeding range (MB BBA 2019). The species was observed in the PDA at one survey location in mixedwood habitat along the LSMOC during 2016 baseline surveys (EEI 2017b), but no other records exist in the RAA (eBird 2019; MB BBA 2019).

Olive-sided Flycatcher

Olive-sided flycatcher (SARA-listed as threatened) is a songbird species that breed along the edges of coniferous forest where tall trees and snags are abundant, often in riparian areas along streams or wetlands (COSEWIC 2007c). The LAA is on the southern limit of the species' breeding range (MB BBA 2019) but suitable habitat does exist in the northern half of the LAA where coniferous forest habitat is present. Olive-sided flycatcher were not detected during 2016 baseline surveys (EEI 2017a and b); however, the species has been recorded breeding east of Lake St. Martin, approximately 10 km south of the LSMOC inlet (eBird 2019; MB BBA 2019). In 2016, a federal recovery strategy was developed that provides guidance aimed at halting and reversing population decline of olive-sided flycatcher, but existing data has been inadequate for determining critical habitat for olive-sided flycatcher (Environment Canada 2016c).

Golden-winged Warbler

Golden-winged warbler (SARA-listed as threatened) is a songbird species that breeds in early-successional shrub habitat adjacent to mature forest (COSEWIC 2006). The LAA is on the northern limit of the species' breeding range and suitable breeding habitat is likely limited within the RAA. Golden-winged warbler was not detected during 2016 baseline surveys (EEI 2017a and b); however, there is one previous record of the species along Dauphin River, approximately 16 km west of the LSMOC ROW (eBird 2019; MB BBA 2019). In 2016, a federal recovery strategy was developed to provide guidance aimed at halting and reversing population decline of golden-winged warbler and identifying critical habitat (ECCC 2016a). The RAA does not contain areas designated as containing critical habitat.

Rusty Blackbird

Rusty blackbird (SARA-listed as special concern) is a songbird species that inhabits coniferous forest edges, particularly in riparian habitats along wetlands and streams (COSEWIC 2017). The LAA is on the extreme southern limit of the species' breeding range (eBird 2019; MB BBA 2019). There were no rusty blackbird observations during 2016 baseline survey (EEI 2017a and b) and there are no existing breeding records in the RAA (eBird 2019; MB BBA 2019). In 2015, a federal management plan was developed for rusty blackbird focusing on addressing knowledge gaps while halting population declines and a long-term objective of maintaining and increasing population levels (Environment Canada 2015c).

Evening Grosbeak

Evening grosbeak (SARA-listed as special concern) is a songbird that breeds in open, mature, coniferous-dominated mixedwood forests (COSEWIC 2016a). Suitable breeding habitat exists in the LAA in areas that contain suitable forest habitat, predominantly on the east, west, and north sides of Lake St. Martin. There were no evening grosbeak observations recorded during 2016 baseline survey (EEI 2017a and b) but there are breeding records near the southeast end of Lake St. Martin, near Gypsumville, and along Dauphin River northwest of the LSMOC (eBird 2019; MB BBA 2019).

8.3.4.3 Amphibians and Reptiles

One amphibian and one reptile SAR have potential to occur in the RAA and are discussed in detail below.

Northern leopard frog

Northern leopard frog (SARA-listed as special concern) requires highly oxygenated, semi-permanent and permanent waterbodies for overwintering, shallow waterbodies for breeding, and moist upland habitats (e.g., grasslands) for summer foraging and dispersal (COSEWIC 1998). Habitat for northern leopard frog exists throughout the LAA and RAA and the species has been recorded in wetland habitats along both outlet channel ROWs during the 2016 field survey (EEI 2017a and b) and in wetlands adjacent to the Dauphin River (in the RAA; MHA 2019b). In 2013, a federal management plan was developed for northern leopard frog that focused on maintaining sustainable populations by maintaining and/or increasing the distribution of the species while reducing threats (e.g., habitat loss or degradation, environmental contamination; Environment Canada 2013b).

Snapping Turtle

Snapping turtle (SARA-listed as special concern) inhabit permanent waterbodies such as slow-moving creeks, lakes, and wetlands with dense vegetation and soft mud bottoms (COSWEIC 2008b). Despite the RAA being within the species' expected range (northern extent of range not well known) and containing suitable habitat for snapping turtle, none have been detected within the RAA (MHA 2019a, 2019b). In 2016, a federal management plan was developed for snapping turtle that focuses on maintaining sustainable populations by maintaining and/or increasing the distribution of the species while reducing threats (e.g., habitat loss or degradation, legal and illegal harvesting), particularly to adults (ECCC 2016b).

8.3.4.4 Invertebrates

Two invertebrate SAR and one SOCC have the potential to occur in the LAA (Appendix A, Table 8.3A-2): transverse lady beetle (COSEWIC-listed as special concern), yellow-banded bumble bee (SARA-listed as special concern), and gypsy cuckoo bumble bee (SARA-listed as endangered). All three invertebrate species have broad distributions in Canada and are habitat generalists, occupy a variety of habitats such as farmland, grasslands, riparian areas, and deciduous and coniferous forests (COSEWIC 2014b, 2015, 2016b). Although the LAA supports suitable habitat for all three invertebrate species, none have been detected within the region. While habitat conversion may have contributed to bumble bee population declines, primary threats include pesticide use and pathogen-infected farmed bees (COSEWIC 2014b, 2015). The decline in other bee species has also contributed in the decline of the gypsy cuckoo bumble bee, a parasitic species that lays eggs in interspecific bumble bee colonies (COSWIC 2014b). Transverse lady beetle population declines are thought to be a result of the spread of non-native lady beetles, predation, and the introduction of pathogens (COSEWIC 2016b).

8.3.5 Project Interactions with Wildlife

Table 8.3-4 identifies for each potential effect, the Project components and physical activities that might interact with wildlife during construction and operation and maintenance phases and result in the identified environmental effects. These interactions are identified by check marks (✓) and are discussed in detail in Section 8.3.6 in the context of effects pathways, standard and Project-specific mitigation, and residual effects.

Table 8.3-4 Project-Environment Interactions with Wildlife During Construction and Operation

Project Components and Physical Activities	Environmental Effects		
	Change in Habitat	Change in Mortality Risk	Change in Movement
Construction			
Site preparation of Project components[1] (development of the PDA prior to construction activities [e.g., removal of existing infrastructure, vegetation clearing and initial earthworks, development of temporary construction camp and staging areas])	✓	✓	✓
Project-related transportation within the LAA (movement of trucks, equipment, bulk materials, supplies, and personnel within the LAA)	✓	✓	✓
Construction of Project components[1]	✓	✓	✓

Table 8.3-4 Project-Environment Interactions with Wildlife During Construction and Operation

Project Components and Physical Activities	Environmental Effects		
	Change in Habitat	Change in Mortality Risk	Change in Movement
(physical construction of infrastructure and other facilities)			
Quarry development (blasting and aggregate extraction used for the construction of Project components[1])	✓	✓	✓
Water development and control (dewatering and realignment of existing water works)	✓	✓	✓
Operations and Maintenance			
Operation and maintenance of the outlet channels (normal operational conditions when the outlet channels and associated infrastructure [e.g., water control structures] are either actively conveying water or are non-operational)	✓	✓	✓
Operation and maintenance of other Project components[1] (normal operational conditions associated with PR 239 and municipal road realignments, the distribution line, and bridges and culverts)	✓	✓	✓
Project-related transportation within the LAA (movement of trucks, equipment, bulk materials, supplies, and personnel within the LAA)	✓	✓	✓
Operation, maintenance, and reclamation of quarries	✓	✓	✓

NOTES:
✓ indicates a potential interaction.
– indicates no potential interactions are expected.
[1] Components include: outlet channels, water control structures, distribution line, bridges and culverts, PR 239 realignment, temporary construction camps and staging areas, and quarries.

8.3.6 Assessment of Residual Environmental Effects on Wildlife

8.3.6.1 Analytical Assessment Techniques

Land cover data (i.e., LCC data (2005), 2017 orthophotos and LiDAR data) were used to estimate wildlife habitat abundance in the LAA and RAA. For a detailed description of vegetation mapping methods, see Section 8.1.2.1. Direct change in habitat availability for wildlife was estimated by calculating the total area (ha) of each land cover class overlapping the PDA. Indirect changes in habitat availability were assessed qualitatively through a review of pertinent literature describing the extent to which wildlife respond to construction noise and activity (Hockin et al. 1992; Lackey 2010), and to the presence of infrastructure (Jalkotzy et al. 1997; Benitez-lopez et al. 2010; Bartzke et al. 2014).

Mapping potential breeding habitat for eastern whip-poor-will in the LAA followed descriptions in the species' recovery strategy (ECCC 2018b) and included habitat classes for all open forest habitats (deciduous, mixedwood, and coniferous) and the outer 30 m of dense forest stands where stands were greater than 3 ha and on well drained soils. For red-headed woodpecker, habitats followed descriptions in the species' recovery strategy (ECCC 2019) and included open deciduous forests and a 50 m buffer of the surrounding grassland, shrub, and/or wetland habitat. Analyses included portions of the LAA where suitable habitats exist (i.e., along the wildlife LAA for the LMOC and west side of Lake St. Martin).

The eastern whip-poor-will recovery strategy identifies a management goal of retaining a minimum of 25% forest cover in 10 km x 10 km critical habitat squares (ECCC 2018b). When forest cover falls below 25%, the potential for eastern whip-poor-will to abandon remaining suitable habitat increases. Land cover data was used to determine the amount of existing forest cover within the critical habitat square with and without the Project. This calculation excluded water (i.e., Lake St. Martin) and focused on the amount of forest cover available relative to the area of terrestrial habitat.

8.3.6.2 Change in Habitat

Wildlife habitat can be defined as an area containing a combination of resources (e.g., feeding, nesting, and overwintering) and environmental conditions (e.g., presence or absence of predators and competitors) that allows individuals to survive and reproduce (Morrison et al. 2012). A change in habitat for a specific species can alter a species' ability to carry out basic life requisites such as breeding and overwintering. The construction and operation of the Project components has the potential to interact directly (i.e., vegetation clearing and ground disturbance) and indirectly (i.e., sensory disturbance) with habitat (Table 8.3-4).

Project Pathways

Project pathways for change in habitat are presented by Project phase as the pathways relating to each Project component is expected to vary during construction and operation and maintenance.

Construction

Vegetation clearing and ground disturbance associated with PDA preparation during the construction phase are the primary pathways for a direct change in habitat. Habitat loss and alteration has the potential to affect several wildlife species, including migratory birds and SAR (e.g., eastern whip-poor-will, red-headed woodpecker, little brown myotis).

Vegetation clearing during site preparation, sensory disturbance, and altered wetland function resulting from construction of the Project are the primary pathways for an indirect change in habitat. Vegetation clearing, described above, will fragment contiguous habitats along the distribution line and LSMOC, creating an unnatural transition between the cleared PDA and the adjacent wildlife habitat (i.e., edge effects). Edge effects can include changes in microclimate (e.g., Murcia 1995), vegetation structure (e.g., Harper et al. 2005), community structure (e.g., Schmiegelow et al. 1997), or behavioral responses of wildlife (e.g., Machtans 2006). These effects are expected to be minimal along LMOC as the existing mosaic of upland and wetland habitat is highly fragmented by anthropogenic disturbance (e.g., agriculture, roads, transmission lines).

Sensory disturbances (i.e., noise) is expected to be the primary pathway for an indirect change in habitat attributed to construction activities that results in adjacent habitats experiencing reduced ecological function (i.e., animals avoiding otherwise suitable habitats). Project-related noise from construction activities (e.g., heavy equipment operation, infrastructure construction, increased traffic volumes) has the potential to disturb wildlife such as migratory birds, elk, moose, and furbearers and change the way wildlife use habitat around the PDA (e.g., habitat avoidance). Depending on the type of human disturbance, potential edge effects and sensory disturbance can create a zone of influence where habitat adjacent to the PDA reduces habitat effectiveness (Benitez-Lopez et al. 2010; Webb et al. 2011).

Water development and control activities associated with the excavation of the LMOC and LSMOC may also result in the loss or alteration of habitat by altering wetland function adjacent to the PDA by changing surface and sub-subsurface water flow patterns, particularly for marsh and fen habitats along the LMOC and LSMOC. Reduced marsh and shallow open water wetland abundance, partial wetland loss near Watchorn Bay, at Reed Lake and Clear Lake, and altered wetland water levels in the intersection of the LMOC with PR 239 sub-watersheds could affect the distribution of wetland dependent wildlife such as waterfowl, marsh birds (e.g., least bittern, yellow rail), and northern leopard in the LAA. Most of the smaller wetlands, and potentially some of the larger wetlands, have likely been altered by surrounding agriculture. The outside drain on the west side of the LMOC should help reduce alterations to wetland levels from changes in sub-watershed water flow paths and limit ponding in existing upland areas adjacent to the channel.

Operation and Maintenance

Fluctuating water levels during outlet channel operations (open condition of the water control structure gates) is the primary pathway for a direct change in habitat. As the outlet channels transition between gates closed and open, the water balance of the outlet channels is expected to be most affected whereas levels in the interconnecting lakes are expected to be affected to a lesser degree, which may directly affect the habitat available for certain wildlife species, particularly those that inhabit lake margins (e.g., muskrat) and/or islands (e.g., colonial waterbirds).

Following construction activities, the use of temporary activity sites such as work camps will cease and some areas (e.g., near LSMOC) may be reclaimed to a naturalized state that provides beneficial habitat opportunities for terrestrial wildlife.

Following construction, the PDA along the outlet channels may provide suitable wildlife habitat for species that use grass and shrub-dominated habitats (e.g., bobolink, short-eared owl, small mammals, furbearers, and elk), and marginal aquatic habitat for waterfowl and frogs. New infrastructure such as the water control structures and bridges may support species adapted to nesting on structures such as barn swallow. Vegetation maintenance along the distribution line and PR 239 realignment is expected to be required on occasion (and may temporarily affect wildlife in the LAA due to sensory disturbance. Infrastructure may contain lighting that can indirectly affect wildlife near the PDA.

Mitigation for Change in Habitat

As discussed in Chapter 2, Project routing and design considered both socioeconomic and environmental constraints such as agricultural land and wetlands along the LMOC; and wetlands, creeks and lakes along the LSMOC. Standard industry practices and avoidance measures, along with Project-specific mitigation outlined in the Project environmental requirements (PER; Manitoba Infrastructure 2019) will be implemented during construction and operation.

Key mitigation measures outlined in the PER that will be implemented during construction and operation to reduce potential Project effects on habitat, include:

- Clearing will not occur between April 1 and August 31 to avoid disturbance to nesting birds and other wildlife (ECCC 2018a).
- Clearing within 30 m of a waterbody will be done by hand.
- Effective erosion and sediment control measures will be properly installed before starting any work to prevent undesirable soil movement or the entry of sediment into any waterbody or wetland.
- Spoil piles, overburden and topsoil will not be placed within 100 m of any waterbody's ordinary high-water mark. Spoil piles will be positioned and maintained in a manner that prevents direct or indirect sediment releases into a waterbody.
- Wildlife habitat will not be destroyed or damaged, except pursuant to a licence, permit or other authorization issued for the Project.
- No blasting will be permitted within close (approximately 1 km) to known sensitive wildlife habitat during critical lifecycle periods.
- Trees containing large nests of sticks and areas where active dens or burrows occur will be identified as part of the Wildlife Management Plan, left undisturbed, and reported to the Natural Resources Officer.
- Terrestrial buffers, as identified by the Manitoba Conservation Data Centre's Recommended Development Setback Distances from Birds (MB CDC 2014) and/or MSDs Forest Management Guidelines for Terrestrial Buffers (MSD 2017) will be adhered to for all applicable sites.
- All equipment supplied for use on the Project will be effectively "sound-reduced" by means of proper silencers, mufflers, acoustic linings, acoustic shields or acoustic sheds.
- Immediately following construction and decommissioning, all salvaged and stockpiled organics and soils which were set aside during site development will be spread back over the area from which they

originated and shall be seeded. If local soils are not available, other organic-based covers may be used to allow seed germination.

Key mitigation measures not outlined in the PER but are standard industry best management practices that will be implemented during construction and operation to reduce potential Project effects on habitat, include:

- Design for limiting the size of the PDA to the extent practical.
- Design for use of down-lighting, a technique of directing night lighting downward, to reduce light disturbance to wildlife.
- Develop and implement Project-specific environmental management plans and monitoring programs, to mitigate potential Project-related effects to wildlife (see Section 8.3.10).
- Clearly identify and install exclusionary flagging or fencing, as appropriate if and when required, around ESSs (e.g., dens, roosts, stick nests, hibernacula) or sensitive habitats prior to clearing and construction, and evaluate features for additional mitigation measures (e.g., setbacks).
- Retain treed habitats where safe and technically feasible to do so. If removal is required, removal activities will be scheduled, to the extent practical, outside the core maternity roosting season for bats. If tree clearing is required during the maternity roosting period, a qualified biologist will review the trees to determine the likelihood of occupancy before removal. This will also reduce the risk to other species that use trees for denning or shelter (e.g., marten).
- Retain large diameter snags where feasibly/practical having potential to support red-headed woodpecker nests.
- Develop rehabilitation plans that include objectives for restoration of natural conditions, erosion protection, sediment control, non-native and invasive plant species management, and wildlife habitat (particularly SAR habitat) restoration.
- Siting of future temporary Project infrastructure (e.g., staging areas, construction camps, quarries) will be subject to a biophysical review to avoid ESSs or sensitive habitats.
- Use existing trails, roads, or cut-lines for access wherever possible.
- Limit vegetation maintenance along the proposed outlet channel ROW during the operational phase of the Project, to the extent possible. Where consistent with adjacent land use, allow low growing shrubs and trees to re-establish outside of spoil banks to a height that does not impede the safe and practical operation of the infrastructure.

Key measures to reduce effects to species at risk habitat:

- Red-headed woodpecker and eastern whip-poor-will mitigation and offset plans will be developed (Section 8.3.10). in consultation with provincial and federal regulators, stakeholders and indigenous communities. Offset plans will describe measures to secure, enhance, or restore habitat for red-headed woodpecker and eastern whip-poor-will.

- Remove and save snags containing nesting cavities or having potential to support nesting cavities along portions of the ROW that will be cleared. Snags saved prior to land clearing will be erected post-construction along new ROW edges in areas supporting potential red-headed woodpecker habitat.
- Erect new nesting structures for red-headed woodpecker if suitable cavity trees can not be salvaged.

Project Residual Effects

Construction

Construction of the Project will result in the loss or alteration of 1,913.9 ha of aquatic (i.e., lakes, streams, channels) and terrestrial habitat (i.e., wetland, forest, shrubland, grassland, hayland, pasture, bare ground),within the LAA, a -3% change from baseline conditions (Section 8.2.2.2, Table 8.2-4). Clearing and excavation of the PDA will result in a direct loss of 1,013.6 ha of wetland habitat, 268.4 ha of forested habitat, 30.2 ha of shrubland, and 410.0 ha of grassland (i.e., hayland, pasture, grassland) (Section 8.2.2.2, Table 8.2-4). These estimates are conservative and assume all habitat within the PDA is lost. Final design will reduce the PDA to the extent required and some of the habitat lost during vegetation clearing, particularly grassland and shrubland, will be re-established along the upland berms and/or spoil banks of the ROWs following reclamation (as discussed in Chapter 3.7). Development of side channels/drains and revegetation of parts of the invert channels may lead to the establishment of wetland habitat, offsetting some of the open water wetland habitat lost during construction. These wetland habitats may provide marginal habitat for waterfowl and amphibians.

The power distribution line for the LSMOC water control structure will be located north of Lake St. Martin, extending from an existing distribution line near PR 513 to the PDA (Appendix 8B, Figure 8.2-2). The planned distribution line crosses an area composed mainly of wetlands and forest. Vegetation clearing required for the construction of the distribution line is expected to increase fragmentation north of Lake St. Martin as existing intact wetland and forested patches will be intersected. Removal of tall trees and shrubs along the length of the ROW will reduce habitat for some birds (e.g., owls) and furbearers (e.g., marten) however low shrubs, herbs, grasses and non-vascular cover will be retained and used by migratory birds and moose.

Direct loss or alteration of wildlife habitat is also expected for the temporary workspaces, and construction camps. Loss of habitat in most of these areas is expected to be small because temporary workspaces and construction camps will be sited in previously disturbed areas or areas having low potential to support sensitive wildlife habitat.

An indirect loss or alteration of wildlife habitat is expected through sensory disturbance, edge effects, and altered wetland function that can result in habitat avoidance and reduced habitat effectiveness for wildlife, including migratory birds, SAR, moose, elk, and furbearers in areas adjacent to the PDA. Sensory disturbance (i.e., noise and artificial light) emitted during construction is expected to cease immediately following the conclusion of construction and reclamation activities. Edge effects potentially resulting in reduced habitat effectiveness are expected to persist beyond construction but be minimal along the outlet channels due to the existing level of anthropogenic disturbance (e.g., residences, agricultural activity, roads) in the LMOC PDA and the presence of relatively contiguous, yet open wetland-dominated habitats along the LSMOC (i.e., 56% of LSMOC PDA). With mitigation, hard or abrupt edges formed during clearing of trees and shrubs in the PDA will eventually be 'softened' as transitional vegetation (e.g., forbs, shrubs, young trees) re-establish along the ROW edges. Softened or feathered edge habitat can provide nesting habitat for birds, foraging habitat for small mammals, and concealment cover for a variety of prey species including marten and elk. The Project will result in increased habitat fragmentation and associated edge effects in the RAA, but core areas of large patches will not be lost and mean patch area and perimeter will not change dramatically (Section 8.2.4.2; Table 8.2-13).

Information presented in the groundwater and surface water assessment indicates that activities related to construction will not result in changes in surface water quality (Chapter 6, Section 6.4.6.7). Water quality in aquatic habitats used by waterfowl, waterbirds, amphibians, and aquatic furbearers are not expected to change as a result of this Project.

Species at Risk

Wetlands

Given the availability of suitable habitat and known occurrences of SAR within the LAA, the species most likely to be affected by the direct loss or alteration of wetland habitat are northern leopard frog, least bittern, and yellow rail. Construction will result in the direct and indirect loss or alteration of several wetland habitat types having potential to support northern leopard frog breeding and overwintering habitat (primarily small lakes along the LMOC, LMOC outlet, and the creeks traversing the LSMOC). A direct loss of 281.7 ha (-17.0%) of marsh habitat in the LAA (primarily around the LMOC) has the potential to affect least bittern and northern leopard frog, which is known to occur in the permanent wetlands to the east of the LMOC ROW (Section 8.3.4). The loss of marsh habitat and 196.7 ha (-16.6%) of graminoid fen along both outlet channels has the potential to reduce the availability of potential breeding habitat for yellow rail. Although yellow rail has not been reported within the LAA, they are known to breed in the RAA (Section 8.3.4). Reductions in marsh habitat could also affect trumpeter swan, horned grebe, and rusty blackbird, however these species are not known to breed in the LAA. Development of side channels/drains and revegetation of parts of the invert channels may lead to the establishment of wetland habitat, offsetting some of the wetland habitat lost during construction. The drains and the channel may provide marginal habitat for northern leopard frog.

Reduced marsh and shallow open water wetland abundance, partial wetland loss near Watchorn Bay, at Reed Lake and Clear Lake, and altered wetland water levels in the intersection of the LMOC with PR 239 sub-watersheds could affect the distribution of least bittern, yellow rail, and northern leopard in the LAA. Most of the smaller wetlands, and potentially some of the larger wetlands, have likely been altered by surrounding agriculture. The outside drain on the west side of the LMOC should help reduce alterations to wetland levels from changes in sub-watershed water flow paths and limit ponding in existing upland areas adjacent to the channel.

Grasslands

Construction will result in the direct loss of 410.0 ha of grassland (-7.1%), most of which exists along LMOC and is only 7.8 ha native cover [-0.4%]. Of the grassland SAR species known to occur in the region and the availability of habitat within the LAA, bobolink and short-eared owl are the species most likely to be affected by changes in grassland (e.g., pasture, hayland) habitat. Records of bobolink exist along LMOC and surrounding area, and for short-eared owl outside the LAA (Section 8.3.4.2). With reclamation, some of this habitat (i.e., mix of grass and forbs) will be restored along parts of the LMOC ROW (see Revegetation Plan, Section 3.7.2) and as serve as potential nesting habitat for bobolink and foraging habitat for short-eared owl. Loss of existing infrastructure such as farm buildings and bridges, may reduce barn swallow nesting habitat but mitigation will protect existing nesting structures and new infrastructure may provide birds with alternate nesting options. Effects on bank swallow are not expected as potential bank swallow habitat (e.g., creeks or rivers with steep banks) will not be affected during construction. Construction could remove potential American badger habitat however American badger have not been identified within the LAA.

Forests

The species most likely to be affected by the direct loss or alteration of forested habitat are little brown myotis, northern myotis, eastern whip-poor-will, common nighthawk, red-headed woodpecker, and olive-sided flycatcher. Change in forest cover is not expected to affect wolverine because the RAA is outside of the current range of wolverine (Section 8.3.4.1). Construction will result in the direct and indirect loss or alteration of several forest habitat types that have the potential to support common nighthawk (e.g., open forest), eastern wood-pewee and evening grosbeak (e.g., open mixedwood forest), golden-winged warbler (e.g., edge of mature deciduous forest) olive-sided flycatcher (e.g., edges of mature coniferous forest), and bats (e.g., mature forest with large diameter trees). Construction may result in a loss of maternal roosting trees for little brown myotis and northern myotis, however overwintering hibernacula will not be affected because no hibernacula exist in the LAA and none were found during baseline studies (Section 8.3.4.1; Appendix 8D).

The Project will affect potential critical habitat identified in the recovery strategies for two species, eastern whip-poor-will and red-headed woodpecker.The PDA overlaps with the 10 km x 10 km critical habitat square for eastern whip-poor-will at the LSMOC inlet (145.4 ha of the square). The only known occurrences of eastern whip-poor-will in this square are outside the PDA, along the southern shore of Lake St. Martin. Habitat mapping was used to identify where vegetation clearing would affect the amount of forest cover remaining in the square (relative to the management objective of a minimum of 25% forest cover retention in square; ECCC 2018b). To calculate the amount of forest habitat within the 10 km x 10 km critical habitat square, water (i.e., Lake St. Martin) was excluded, and the percent forest cover was assessed based on the 6,774.5 ha of remaining terrestrial habitat. Even with this modification, the percentage of existing forest cover is already below the management objective of 25% forest cover for eastern whip-poor-will (i.e., 17.2% or 1,164.3 ha). Land clearing in the potential critical habitat square will have a negligible change on the amount of forest cover in the square as only a direct loss of 2% (22.5 ha) of forest is expected in the square and none of the forest cover removed is considered suitable for eastern whip-poor-will (i.e., none is dense or open forest on well drained soils).

The LAA contains 676.1 ha of potential eastern whip-poor-will breeding habitat (i.e., edges of dense forest, and open forest greater than 3 ha and on well drained soils; Section 8.3.6.1). Approximately 14.7 ha (2.2% of the LAA and 0.2% of the RAA; Appendix 8B, Figure 8.3B-10) will be lost during development of the PDA. All potential habitat affected is located along the LMOC and PR 239. Revegetation efforts will facilitate the restoration of some eastern whip-poor-will habitat, particularly along edges of the ROW where dense forest is bisected. While some indirect effects (e.g., sensory disturbance causing habitat avoidance) may extend into the LAA, these are expected to be temporary and cease upon completion of the construction phase. Overall, estimated loss of habitat is expected to decrease with mitigation, which includes minimizing the PDA in final design, particularly where the PDA overlaps potential eastern whip-poor-will habitat.

The LAA overlaps two 10 km x 10 km potential critical habitat squares for red-headed woodpecker along PR 239 realignment and a portion of LMOC (Appendix 8B, Figure 8.3B-11). Only 35.4 ha (i.e., 0.2%) of this 20,000-ha area of potential red-headed woodpecker critical habitat falls within in the PDA. To assess effects on red-headed woodpecker, potential red-headed woodpecker breeding habitat (i.e., open deciduous forest, forest edge; Section 8.3.6.1) was mapped and the amount potentially affected within the PDA was quantified. Approximately 165.75 ha (7.8% of the potential red-headed woodpecker habitat in the LAA [2,135.3 ha] and 1% of the RAA [16,568.5 ha]; Appendix 8B, Figure 8.3B-11) will be lost during development of the LMOC PDA (no red-headed woodpecker habitat is affected along the LSMOC). Estimated habitat losses will decrease with mitigation, which includes minimizing the PDA in final design, particularly where the PDA overlaps with critical and/or potential red-headed woodpecker habitat. Some of the affected habitat will be reclaimed as the ROW is revegetated and snags (i.e., existing and/or potential nesting cavities) saved prior to land clearing are erected along channel ROW edges.

Wetland

Construction will not affect open-water habitats beyond the footprint of the water control structures located at each end of the outlet channels. Construction noise and activity at the inlets and outlets will deter trumpeter swan and piping plover from nesting or staging in these areas. Based on available data and habitat preferences, the potential for these areas to support these species during the breeding period is considered low. However, swans may use Lake St. Martin for staging during the spring and fall migration seasons. The area of disturbance at the inlet and outlet locations on Lake St. Martin are considered small, and birds will have access to alternate staging areas in other parts of the lake. Construction of water control structures has the potential to affect snapping turtle inhabiting Lake St. Martin and the shorelines of Lake Manitoba and Lake Winnipeg; however, this potential is considered low because snapping turtle have not been detected within the RAA. Construction effects on bank swallow are predicted to be low due to limited overlap of the Project with potential bank swallow habitat (e.g., river, lake, or creek banks).

Migratory Birds

Migratory birds have the potential to breed in all habitat types within the LAA and will be affected by the habitat loss and alteration resulting from Project construction. In addition to the sensitive habitat types described above for SAR, the Project has the potential to affect ESSs such as raptor nests and colonial nesting waterbird colonies (Appendix 8B, Figure 8.3B-8). Known raptors nests (e.g., bald eagle) within the LAA are located along the shores of Lake St. Martin and likely to be unaffected by the Project given their distance (over 1 km) from the PDA. Similarly, due to the distance between the PDA and location of nesting colonies (i.e., several kilometres) on Lake Manitoba and Lake St. Martin, construction noise and activity is not expected to affect colonial waterbirds. Construction noise and activity may reduce the number of migratory birds such as ducks and geese, breeding or staging in the aquatic habitats located near the inlet and outlet structures and along parts of the LMOC, particularly Reed Lake, Clear Lake, and Goodison Lake.

The Project is not expected to affect the distribution of birds through altered predatory/prey relationships or the composition of wildlife inhabiting the LAA. However, in some areas of the PDA, removal of forest cover may temporarily attract predators such as owls to exposed small mammals such as voles and mice.

Summary of Construction Residual Effects on Wildlife Habitat

Following the implementation of mitigation measures described above, residual effects for change in habitat during construction are characterized as the following:

- direction is adverse because there will be a net loss of habitat for wildlife
- duration is long-term because effects may persist for greater than 10 years
- magnitude for wildlife, including migratory birds, is low because less than 10% of habitat in the LAA will be affected and there are currently no known ESSs within the PDA
- magnitude for SAR is low to medium because habitat loss or alteration will result in the loss of less than 5% habitat in the LAA for eastern whip-poor-will and less than 10% for red-headed woodpecker
- land clearing will occur outside of the sensitive breeding period for migratory birds, but construction is expected to be ongoing during highly sensitive life periods for wildlife
- residual effects will extend to the LAA
- frequency of effects will be continuous over the construction phase
- direct effects will be irreversible (Project is permanent) and indirect effects will be reversible in less than 5 years because vegetation regrows along ROW edges

- ecological context varies from undisturbed (relatively undisturbed or adversely affected by human activity) in the wildlife LAA for the LSMOC to disturbed (substantial existing disturbance by human activity) in the wildlife LAA for the LMOC.

Operation and Maintenance

Under average (non-flood) water conditions, it is predicted that opening the WCS gates will result in a 2.4 cm and 6.4 cm decrease in water levels in Lake Manitoba and Lake St. Martin, respectively, while water levels are expected to remain unchanged in Lake Winnipeg (Chapter 6.3.2.4). Opening the gates will result in marked decreases in maximum water levels during major flooding events (38.7 cm in Lake Manitoba and 74.1 cm in Lake St. Martin), while resulting in a 3.1 cm increase in Lake Winnipeg water levels. Similarly, opening the gates is expected to reduce the amount of peak flows entering Lake Pineimuta, which would result in lower lake levels and decrease the area of inundation during peak flow periods. Within the outlet channels, water fluctuation is expected to be greatest during operation when gates are open. Water levels in LMOC are expected to drop when gates are open, negatively affecting the marginal habitat that will form along the channel shoreline. An increase in water levels and flooding of marginal channel habitat is expected in LSMOC.

The water control structures are expected to remain closed 70% to 87% of the time, depending on the month (see Chapter 3.5.3.1 for operating guidelines) but the overall effect will result in reduced water levels in the LAA. Operation of the outlet channels and lowering of lake levels may benefit some of the species that rely on the shallow marsh areas along the shores of Lake St. Martin (e.g., muskrat and waterfowl).

Information presented in the groundwater and surface water assessment indicates that activities related to operations will not result in changes to surface water quality (Chapter 6, Section 6.4.6.7). As a result, water quality in aquatic habitats used by waterfowl, waterbirds, amphibians, and aquatic furbearers will not change as a result of this Project.

The PR 239 realignment will result in a change in habitat but is along an existing ROW, traverses similar habitat types as the existing ROW, and there are no known ESS, sensitive habitats, or movement corridors along the proposed realignment route. The existing PR 239 ROW that will become a municipal road will benefit from reduced traffic levels that will offset adverse effects of the new realignment ROW; there is no net effect. Mechanical and chemical vegetation maintenance associated with the PR 239 realignment is expected to be temporary (i.e., once per year) and will not have a measurable effect on wildlife habitat.

Other operation and maintenance activities including the presence of infrastructure lighting, are not expected to result in a residual effect on habitat. Maintenance of ROW vegetation will be described in the Vegetation Management Plan and is not expected to result in the additional loss of habitat for wildlife.

Species at Risk

There are no pathways for adverse effects resulting from the operation of the Project on SAR as it relates to a change in habitat because overall water levels and maximum flood levels are expected to be reduced. Although the channels will retain water throughout operation (even in non-flood conditions), the design limits the channels' potential to support SAR. For example, the rocky channel substrates and presence of fish are not favorable for northern leopard frog.

Reclamation of the upland berms along LMOC may provide habitat for species at risk such as bobolink, red-headed woodpecker, and short-eared owl. Project infrastructure (e.g., bridges, outlet structures) may provide suitable nesting structures for barn swallow.

Migratory Birds

Potential adverse effects on migratory birds during operation are associated with vegetation management along the distribution line because this activity has the potential to affect nesting habitat for migratory birds. Vegetation management will occur outside of the sensitive breeding period for migratory birds and will adhere to measures described in the the Operations Manual (See Chapter 3.5).

The LAA includes the Lake St. Martin IBA, which contains several nesting islands for colonial nesting waterbirds that have the potential to be affected by altered water regimes (Section 8.3.3.1; Appendix 8B, Figure 8.3B-8). Overall water levels and maximum flood levels are expected to be reduced on Lake St. Martin, which will reduce flooding of nesting islands, shorelines, and overwater nests. Reduced water levels may improve the conditions of the shallow marsh habitats located along the shore of Lake St. Martin, which would benefit breeding and staging waterfowl. Presence of Project infrastructure (e.g., bridges, outlet structures) may provide suitable structures for some species (e.g., cliff swallow).

Summary of Operation and Maintenance Residual Effects on Wildlife Habitat

Following the implementation of mitigation measures described above, residual effects in terms of change in habitat during Project operation and maintenance are characterized as follows:

- direction is neutral to positive because a further net loss of habitat for wildlife is not expected and some habitats and species may benefit from a return to lower water levels
- duration is long-term because effects may persist for greater than 10 years
- magnitude for wildlife, including migratory birds and SAR, is low because effects are primarily associated with reduced flooding and erosion of nesting islands and shorelines of Lake St. Martin
- channel operations may overlap with highly sensitive life periods for wildlife in some years
- residual effects will be primarily limited to the outlet channels PDA and Lake St. Martin
- frequency of effects will be infrequent over the operations and maintenance phase

- residual effects will be irreversible
- ecological context varies from undisturbed (relatively undisturbed or adversely affected by human activity) in the wildlife LAA for the LSMOC to disturbed (substantial existing disturbance by human activity) in the wildlife LAA for the LMOC

8.3.6.3 Change in Mortality Risk

Project construction and operation has the potential to result in direct and indirect increased mortality risk to wildlife, including SAR and SOCC. Vegetation clearing and ground disturbance activities during construction can result in the destruction of wildlife features such as bird nests, bat roosts, and/or mammal dens. In addition, there might be an increased risk of direct mortality to mammals, birds, and amphibians from accidental collisions with Project-related equipment and vehicles during construction (Fahrig and Rytwinski 2009; Bishop and Brogan 2013), bird-wire strikes due to the distribution line, and from removal of wildlife due to human-wildlife conflict. Operation of the outlet channels has the potential to increase direct mortality risk for some species, primarily through drowning, and indirect mortality through enhanced access that facilitates increased hunting/trapping and predation.

Project Pathways

Project pathways for change in mortality risk are presented by Project phase because the pathways relating to each Project component are generally expected to vary by phase (i.e., construction and operation and maintenance).

Construction

Vegetation clearing and ground disturbance during site preparation, and collisions associated with Project-related traffic, are the primary pathways for a direct change in mortality risk during the construction phase. Ground-nesting birds (e.g., bobolink [*Dolichonyx oryzivorus*]) and species with decreased mobility (i.e., amphibians, small mammals) are most susceptible to direct mortality during site preparation as individuals may be unable to escape construction activities. Land clearing could also put bat maternity roosts at risk, particularly in areas where large diameter trees are removed. Construction of Project components by excavation and earth moving (in addition to general quarry development and construction of the distribution lines by others) have the potential to increase wildlife mortality risk because individuals, particularly small mammals such as mice and voles and amphibians (e.g., frogs), may be crushed by equipment, or become entrapped in open excavations. Increased traffic volumes during construction activities has the potential to result in increased mortality risk to wildlife, including migratory birds, due to potential vehicle collisions in the LAA.

Operation and Maintenance

Fluctuating water levels during open and closed conditions of the WCS gates is the primary pathway for a direct change in wildlife mortality risk. As the outlet channels transition between gates open and gates closed, the water balance of the outlet channels has the potential to result in increased mortality risk for wildlife inhabiting the channels (e.g., bird nests, denning mammals, or species with decreased mobility such as mice and voles). Increased access for predators and hunters/trappers, particularly along the LSMOC ROW (i.e., channel sides), is the primary pathway for an indirect change in mortality risk. The Project will create continuous linear features that will increase predator efficiency and provide access to portions of the LAA that were previously more isolated. Additionally, mortality risk for furbearers such as marten crossing the outlet channels, particularly the LSMOC, may be elevated due to the reduced availability of predator escape cover. The risk of wildlife drowning could increase during periods of high flow. The outlet channels are designed to minimize fish stranding by containing water, and potentially fish, throughout the year. The presence of predatory fish (e.g., northern pike) in the channels could increase mortality risk for migratory birds such as geese and ducks, small mammals such as mice and voles, and amphibians attracted to the channels. Mortality risk is elevated for migratory birds that have the potential to strike overhead infrastructure associated with the Project, primarily the distribution line.

Mitigation for Change in Mortality Risk

As discussed in Chapter 2, Project routing and design considered both socioeconomic and environmental constraints such as agricultural land and wetlands along the LMOC, and wetlands, creeks and lakes along the LSMOC. Standard industry practices and avoidance measures, along with Project-specific mitigation outlined in the Project environmental requirements (PER; MI 2019) will be implemented during construction and operation.

Key mitigation measures outlined in the PER that will be implemented during construction and operation to reduce potential Project effects on mortality risk, include:

- Clearing will not occur between April 1st and August 30th of any to avoid disturbance to nesting birds and other wildlife (ECCC 2018a).
- Construction camps and worksites will be kept clean and tidy. All food, garbage or waste that may attract wildlife shall be stored in an appropriate manner and be disposed of at an area which has been designated as an appropriate waste disposal site.
- Nuisance wildlife will be immediately reported to the Natural Resources Officer and the Engineer.
- Employees, workers and other staff will not hunt, trap or harass wildlife.
- The contractor will not remove, destroy or disturb species pursuant to Manitoba Regulation 25/98, or any future amendment thereof, respecting *threatened*, *endangered* and *extirpated* Species, or species listed in the federal *Species at Risk Act*.
- No person will take or be in possession of or willfully destroy the nest or eggs of birds.
- No person will remove, disturb, spring or in any way interfere with any trap set out lawfully by any other person for the purpose of taking furbearing animals.
- No blasting will be permitted close (approximately 1 km) to known sensitive wildlife habitat during critical lifecycle periods.

- Terrestrial buffers, as identified by the Manitoba Conservation Data Centre's Recommended Development Setback Distances from Birds (MB CDC 2014) and/or MSDs Forest Management Guidelines for Terrestrial Buffers (MSD 2017) will be adhered to for all applicable sites.
- To reduce the possibility of vehicle collisions with wildlife, vehicle speed will not exceed posted speed limits and wildlife warning signs will be installed where appropriate.
- Prior to reinstating a quarry or borrow site, the area will be surveyed to determine presence or absence of bank swallows and or common nighthawk nests. If nests are discovered, work will be suspended and the engineer will be contacted for further advice.
- Prior to removing temporary structures, an inspection will be conducted to determine the presence or absence of barn swallow nests. If nests are discovered, work will be suspended and the Engineer will be contacted for further advice.

Key mitigation measures not outlined in the PER but are standard industry best management practices that will be implemented during construction and operation to reduce potential Project effects on habitat, include:

- Install signage indicating restriction of unauthorized access to the outlet channels during operation.
- Develop and implement Project-specific environmental management plans and monitoring programs, to mitigate potential Project-related effects to wildlife (see Section 8.3.10).
- Retain treed habitats where safe and technically feasible to do so. If removal is required, removal activities will be scheduled, to the extent practical, outside the core maternity roosting season for bats (May 15 to August 31; MNRF 2014). If tree clearing is required during the maternity roosting period, a qualified biologist will review the trees to determine the likelihood of occupancy before removal. This will also reduce the risk to other species that use trees for denning or shelter (e.g., marten).
- Clearly identify and install exclusionary flagging or fencing, as appropriate, around ESSs (e.g., dens, roosts, stick nests, hibernacula) or sensitive habitats prior to clearing and construction, and evaluate features for additional mitigation measures (e.g., setbacks).
- Limit vegetation maintenance along the outlet channel ROWs outside of spoil banks during the operational phase of the Project, to the extent possible. Where consistent with adjacent land use, allow low growing shrubs and trees to re-establish to a height that does not impede the safe and practical operation of the infrastructure.
- Install exclusionary fencing around open excavations near wetlands when and where there is potential for entrapment of amphibians or other wildlife species.
- Reduce the amount of Project-related vehicle traffic by using multi-passenger vehicles where feasible.
- Add cover plantings (e.g., trees an shrubs) along select upland areas of the channels to provide escape cover and break up sight lines for species crossing the outlet channel ROWs.

Project Residual Effects

Construction

PDA preparation, including vegetation clearing, is expected to begin in the fall of 2020 and take approximately one year to complete (Section 8.3.1.4). PDA preparation and construction will follow mitigation measures that consider timing restrictions for wildlife species, including sensitive breeding periods for migratory birds, bats, and amphibians. Construction is currently scheduled to begin outside the primary nesting period for migratory birds (Zone B5; April 22 to August 24; ECCC 2018a); however, if vegetation removal is required within the primary nesting period, pre-construction avian use surveys (territorial, breeding behavior) and nest searches will be completed to limit mortality risk during construction by identifying, avoiding or otherwise mitigating effects on active nests. Similarly, construction timing is expected to reduce potential effects on bats as they will have dispersed from maternity roosts prior to the start of clearing activities.

During construction, there is potential for increased mortality risk to small mammals, reptiles, and amphibians due to their limited mobility (e.g., crushed by construction equipment). There is also potential for wildlife mortality for species that become entrapped in open excavations or become stranded or injured during dewatering activities. However, proposed mitigation around open excavations (e.g., exclusion fences) is expected to reduce mortality risk for these species. Overwintering amphibians and mammals are also at greater risk as they may encounter heavy machinery during ground disturbance activities. Vehicle-related wildlife mortality has the potential to affect a wider range of species, including migratory birds, SAR and SOCC, and large mammals. Vehicles will abide by posted speed limits and multi-passenger vehicles will be used, where practical, to reduce the potential for wildlife-vehicle collisions. Proper management of wastes, including at temporary camps, will reduce the potential for wildlife to be attracted to the construction site (e.g., black bear), thus reducing the potential for mortality risk related to human-wildlife conflict.

Species at Risk

SAR are not uniquely susceptible to a change in mortality risk during the construction phase in comparison to other species. Following mitigation measures and adherence to timing restrictions and/or MB CDC (2014) activity restriction setback buffers will reduce the potential Project effects on SAR and SOCC. Species most likely to be affected include bobolink, northern leopard frog, and invertebrates.

Migratory Birds

Mitigation measures and adherence to timing restrictions and/or activity restriction buffers for clearing and construction will reduce the potential Project effects on migratory birds breeding in the LAA. Species most likely to be affected are ground-nesting species (e.g., clay-colored sparrow) and species that inhabit upland and wetland habitats adjacent to roadways (e.g., mallard).

Summary of Construction Residual Effects on Wildlife Mortality Risk

Following the implementation of mitigation measures described above, residual effects for change in mortality risk during construction are characterized by the following:

- direction is adverse because there will be a net increase in wildlife fatalities
- duration is medium-term because effects will persist until completion of construction phase
- magnitude for wildlife, including migratory birds and SAR, is low because effects will not result in a measurable change in the abundance of wildlife in the LAA
- construction may occur during highly sensitive life periods for wildlife
- residual effects will extend to the LAA
- frequency of effects will be continuous over the construction phase
- effects will be reversible following completion of the construction phase
- ecological context varies from undisturbed (relatively undisturbed or adversely affected by human activity) in the wildlife LAA for the LSMOC to disturbed (substantial existing disturbance by human activity) in the wildlife LAA for the LMOC

Operation and Maintenance

The outlet channels are expected to contain water throughout the year, with potential marked flow increases typically limited to spring flooding events in some years. While this has the potential to result in increased mortality risk for ground-nesting birds or species with decreased mobility (e.g., mice, voles), it is unlikely that this would be a regular occurrence or that water levels would rise suddenly enough to drown or fatally sweep away wildlife using the channels. Species that attempt to cross during periods of high flow are also at greater mortality risk.

Mitigation measures will be implemented to limit public access to the outlet channel ROWs; however, increased mortality risk to furbearers and ungulates will persist as a result of hunting and trapping. The linear features provide an efficient mechanism to move across the landscape that also provides relatively clear, elevated sightlines that are desirable to resource users. Furthermore, while access may be controlled at regular crossings (i.e., road), it will not be controlled adjacent to private property. Similarly, the continuous linear features have the potential to increase predator efficiency where the ROW remains devoid of cover. However, open habitats are not limiting along the LMOC and while the LSMOC traverses relatively intact habitats, it is predominantly a mix of open fen and deciduous and mixedwood swamp habitats. Waterbirds, particularly juveniles, and reptiles, amphibians and small mammals that use or traverse the wetted channel have the potential to be preyed upon by fish (e.g., northern pike [*Esox lucius*]) inhabiting the channels.

Overall, the Project will result in reduced water levels and maximum flood levels that is expected to return water levels to more beneficial conditions for terrestrial wildlife (e.g., moose) prior to flooding in 2011, given the reduction in overland flooding as a result of Project operations.

Species at Risk

SAR are not uniquely susceptible to a change in mortality risk during the operation and maintenance phase in comparison to other species. Northern leopard frog is a SAR most likely to be affected through increased predation risk in the outlet channels and mortality during dispersal periods. Permanent Project infrastructure such as outlet structures and bridges have the potential to provide nesting habitat for bird SAR (e.g., barn swallow).

Migratory Birds

Migratory bird species are uniquely susceptible to a change in mortality risk during the operation phase of the Project from electrocution or collision with the 15-km long distribution line. Additionally, some species may be at greater mortality risk due to altered hunting (i.e., game birds) and/or predation dynamics (e.g., juvenile waterbird species [described above]). Permanent Project infrastructure such as outlet structures and bridges have the potential to provide nesting habitat for migratory bird species (e.g., barn swallow, American robin) while pole structures along the distribution line may provide nesting platforms for raptors. The Project will not adversely affect colonial nesting waterbirds because water levels are expected to be reduced.

Summary of Operation Residual Effects on Wildlife Mortality Risk

Following the implementation of mitigation measures described above, residual effects for change in mortality risk during operations and maintenance are characterized by the following:

- direction is adverse because there will be a net increase in wildlife fatalities
- duration is long-term because effects will persist for the lifetime of the Project
- magnitude for wildlife, including migratory birds and SAR, is low because effects will not likely result in a measurable change in the abundance of wildlife in the LAA
- channel operation may occur during highly sensitive life periods for wildlife
- residual effects will extend to the LAA
- frequency of effects will be infrequent over the phase
- residual effects will be reversible for the main Project components

- ecological context varies from undisturbed (relatively undisturbed or adversely affected by human activity) in the wildlife LAA for the LSMOC to disturbed (substantial existing disturbance by human activity) in the wildlife LAA for the LMOC

8.3.6.4 Change in Movement

Physical features, such as rivers and channels, have the potential to restrict or impede wildlife movement and the ability for wildlife to move between resource patches (e.g., patches of high suitability habitat) is important for a species' persistence. Barriers to movement can reduce access to key resources, lead to range shifts and/or alter seasonal movement patterns and dispersal events (Johnson et al. 1992; Nathan et al. 2008; Ament et al. 2014).

Project Pathways

Project pathways for change in movement are presented by Project phase because the pathways relating to each Project component are expected to vary during construction and operation.

Construction

Site preparation activities (i.e., vegetation clearing) and construction of the outlet channel ROWs as well as projects carried out by others (e.g., the distribution line) are the primary pathways to effect a change in movement. The creation of linear features on the landscape, particularly in forested habitats, is expected to result in habitat fragmentation and thereby altered movement patterns for wildlife. In more open habitats or previously altered landscapes, the addition of a linear feature may exacerbate existing fragmentation and affect movement patterns for wildlife (e.g., moose; Stewart and Komers 2017). Wildlife may be reluctant to cross linear features because of higher levels of human activity, sensory disturbance, or because the features are too difficult to physically move across (i.e., height, width, substrate composition; Bennett 1997). These effects will also persist for the construction of the PR 239 realignment. The Project will result in a loss of habitat availability and connectivity, which may result in altered daily and seasonal wildlife movements and persist throughout the post-construction and maintenance phase. However, these potential effects are not likely to affect migratory bird species or bird SAR and SOCC.

MSD has noted that elk along the wildlife LAA for the LMOC and marten along the wildlife LAA for the LSMOC may be particularly susceptible to an adverse interaction with the Project due to the construction of the outlet channels. Elk and other wildlife may be reluctant to cross the PDA due to construction noise and activity. For furbearers, including marten, the concern is the development of a barrier that would impede dispersal across a relatively undisturbed corridor between Lake St. Martin and Lake Winnipeg (MSD 2019, pers. comm). During construction, noise and activity will deter furbearer movement across both channels. For most species, a change in movement will be temporary because animals will resume regular movements once construction has completed. However, for species such as marten, movement patterns may not resume until adequate vegetation cover has reestablished.

Operation and Maintenance

Floodwater conveyance during WCS gate opening is the primary pathway for a change in movement. When the outlet channels contain water, particularly when conveying floodwaters, they have the potential to exacerbate changes to wildlife movement by adding another element to the existing ROW barrier. Terrestrial wildlife such as amphibians, small mammals, furbearers and ungulates may reduce movement across channels when WCS gates are open. However, most wildlife will be capable of crossing the outlet channels following construction and during periods of low flow (70-87% of the time).

The PR 239 realignment may result in a change in movement as traffic levels and associated sensory disturbances are altered within the LAA. Vegetation maintenance along the outlet channels and PR 239 realignment is expected to be required and may temporarily affect wildlife movement due to sensory disturbance.

Mitigation for Change in Movement

As discussed in Chapter 2, Project routing and design considered both socioeconomic and environmental constraints such as agricultural land and wetlands along the LMOC, and wetlands, creeks and lakes along the LSMOC. Standard industry practices and avoidance measures, along with Project-specific mitigation outlined in the Project environmental requirements (PER; MI 2019) will be implemented during construction and operation.

Key mitigation measures not outlined in the PER but are standard industry best management practices that will be implemented during construction and operation to reduce potential Project effects on movement, include:

- Design for minimizing the use of rip rap and minimizing the side slopes, to the extent feasible, to facilitate wildlife movement.
- Develop and implement Project-specific environmental management plans and monitoring programs, to mitigate potential Project-related effects to wildlife (see Section 8.3.10).
- Add cover plantings (e.g., trees and/or shrubs) along select upland areas of the channels to facilitate movement of wildlife.
- Monitor wildlife movement using the ongoing remote camera survey into post-construction.

Project Residual Effects

Construction

During construction, noise and activity associated with heavy equipment and personnel will deter wildlife from using or crossing the active construction portions of the PDA for the short-term. Moose, elk, and furbearers will likely avoid movements through the active construction areas. The Project will result in increased habitat fragmentation and associated edge effects in the RAA, but core areas of large patches will not be lost and mean patch area and perimeter will not change dramatically (Section 8.2.4.2; Table 8.2-13).

The LSMOC will bisect a potentially sensitive terrestrial corridor between large patches of contiguous habitat and may present a semi-permeable barrier for marten dispersal (MSD 2019, pers. comm.). Marten occupy a wide variety of forested habitats throughout the year but generally prefer to inhabit mature coniferous forests (e.g., Environment Canada 2013c). These mature forests make up a small portion of the LAA surrounding the LSMOC (Appendix 8B, Figure 8.3B-4), while the potential corridor is composed primarily of a mix of open fen and deciduous and mixedwood swamp habitats that form a mosaic of predominantly open habitat. When not dispersing, marten typically remain within 100 m for forest cover and edges for security (Hargis and McCollough 1984; Slough 1988; Lofroth and Steventon 1990). Despite this, marten have been shown to disperse through large expanses (10 km to 20 km) of non-forested habitats (Buskirk 2002) and forestry management guidelines for marten suggest avoiding the creation of gaps between core habitat areas of 1 km to 2 km (Watt et al. 1996). The LSMOC ROW likely does not present a physical barrier that would limit dispersal or access to resources; rather, wildlife may avoid open habitats along the outlet channel in response to reduced security cover (i.e., change in mortality risk). Regardless, the addition of cover plantings along the upland portion of the ROW adjacent to existing forested habitats would help facilitate wildlife movement across the ROW by minimizing the crossing distance and providing security cover.

The PR 239 realignment will result in a change in movement, but it is an existing ROW, traverses similar habitat types as the existing ROW and there are no known ESS, sensitive habitats, or movement corridors along the proposed realignment route. The existing PR 239 ROW that will become a municipal road will benefit from reduced traffic levels that will offset adverse effects of the new realignment ROW; there is no net effect.

The approximately 15-km long distribution line traverses a relatively intact expanse of habitat west of the LSMOC through a mix of open fen and deciduous and mixedwood swamp habitats that form a mosaic of predominantly open habitat. The distribution line does not bisect the terrestrial corridor between Lake St. Martin and Lake Manitoba, and it will not limit wildlife movement or access to resources. However, all aspects of the power line connections (including specific routing, design, assessment, mitigation, permitting, construction, operation, and maintenance of the distribution line and ROW) will be conducted by Manitoba Hydro, as necessary to satisfy provincial acts and regulations.

Based on existing data (Section 8.3.3.2), the South Interlake elk herd rarely moves beyond their northern range limit, which extends to Grahamdale, approximately 3 km east of the LAA (Appendix 8B, Figure 8.3B-7). Small groups of elk have been observed outside of their range near Spearhill, but rarely in areas west of Reed, Clear, and/or Goodison Lake. Seasonal movements of elk occur within their delineated range, with elk overwintering primarily in the Mantagao Lake WMA over 20 km east of LMOC but also along the southeast side of Lake St. Martin and in areas of agricultural land where suitable forage and cover is available. Spring and summer movements including location of calving areas is less known (MSD 2019, pers. comm.).

Overall, the LMOC is not expected to affect elk movement because existing data and local knowledge of elk movement in the area suggests the South Interlake elk herd primarily uses areas west of the outlet channel. Movement of individual elk between the north and south herds has been documented. However, pathways are through Lake Manitoba and not across Fairford River and the terrestrial corridor that lies between Lake Manitoba and Lake St. Martin. MSD considers it unlikely that elk would cross Fairford River (approximately 130 m wide) because the combination of swift current and anthropogenic disturbance along the narrow terrestrial corridor between Lake Manitoba and Lake Pineimuta creates a barrier for movement (MSD 2019, pers. comm.).

The South Interlake elk herd has maintained a stable, harvestable population in a landscape with areas of a high degree of anthropogenic disturbance (e.g., hydroelectric transmission lines, roads, agriculture). While elk may avoid moving through the PDA during construction, it is unlikely that elk would show a strong aversion to crossing the 400 m LMOC ROW. Regardless, the addition of cover plantings along the ROW adjacent to existing forested habitats would help facilitate the movement of elk and other wildlife across the ROW by providing security cover.

Species at Risk

SAR are not uniquely susceptible to a change in movement during the construction phase in comparison to other species. There is no pathway for bird, bat, and reptile SAR movement to be affected. Northern leopard frog is the species most likely to be affected but they are known to disperse across expanses of open habitat (Environment Canada 2013b) and the outlet channel, where rip rap is absent, will not create a barrier for movement or dispersal. There is no pathway for a change in movement for wolverine or American badger as they are not expected to regularly occupy the LAA.

Migratory Birds

There is no pathway for a change in movement for migratory birds and no related adverse effects will occur.

Summary of Construction Residual Effects on Wildlife Movement

Following the implementation of the proposed mitigation measures described above, residual effects for change in movement during construction are characterized (Table 8.3-2) as follows:

- direction is adverse because construction activities will alter wildlife movements
- duration is medium-term because effects will persist until completion of construction phase
- magnitude for wildlife, including migratory birds and SAR, is low because a measurable change in the abundance of wildlife in the LAA is unlikely but may result in temporary local shifts in distributions
- construction may occur during highly sensitive life periods for wildlife
- residual effects will extend to the LAA

- frequency of effects will be continuous over the construction phase
- some effects will be irreversible following completion of the construction phase.
- Ecological context varies from undisturbed (relatively undisturbed or adversely affected by human activity) in the wildlife LAA for the LSMOC to disturbed (substantial existing disturbance by human activity) in the wildlife LAA for the LMOC

Operation and Maintenance

The conveyance of water, and increased volumes of floodwater at times, in the outlet channels during the operation and maintenance phase of the Project will alter the dynamics of the linear features as a potential barrier for wildlife movement. Both outlet channels will contain water throughout the year that is expected to varying from 30-60 m wide, depending on the volume of water being conveyed and slope of the side-channel sides. When the WCS gates are close (i.e., 70% to 87% of the time depending on the month; see Section 3) the LMOC will maintain water depths of 4 m to 8 m while the LSMOC will maintain 1 m to 2.5 m of water. During floods, the LMOC will convey 212 m^3/s of water at a velocity of up to 1.3 m/s (with higher velocities near bridges and control structures) and depths of 6-12 m (see Section 3.4.2). The LMOC will convey 326 m^3/s of water at a velocity of up to 1.0 m/s and a depth of up to 4 m (see Section 3.4.3). The water velocities in the LSMOC are kept relatively low at less than 1.0 m/s (Section 3.0, Table 3-1) even under high flow conditions.

For most of the year, the water control structures will not be conveying large volumes of water, which will not dramatically increase the potential for the ROWs to present a barrier for wildlife because most wildlife species are capable of crossing static or slow-moving water. During flood conditions, however, the increased depth, wetted width, and flow of water within the channels has the potential to increase the potential for the ROWs to affect wildlife movements despite only occurring temporarily and not every year. For both channels and most species, including marten and elk, it is difficult to predict how the outlet channels will affect a change in movement during flooding events. For comparison, the mean peak annual flow for Dauphin River (1977 to 2016) is 143 m^3/s (Government of Canada 2019b) with a width of approximately 120 m to 200 m. On Dauphin River, flow velocities can range between 0.5 to 1.5 m/s over the first 40 km and increase to about 2 m/s over the lower 10 km (See Appendix 6D Surface Water Existing Environment). These velocities are as fast or faster than in the LSMOC. Similarly, the mean peak annual flow for Fairford River (1912 to 2018) is 144 m^3/s (Government of Canada 2019c) with a width of approximately 110 m to 175 m. While MSD does not expect elk to cross Fairford River (MSD 2019, pers. comm), it is unknown whether that aversion is related to the watercourse or the combination of multiple factors including an existing high degree of anthropogenic disturbance in surrounding areas.

During normal operations and maintenance, the LMOC and LSMOC will not markedly increase the potential for the Project to disrupt wildlife movement beyond that experienced during the construction phase. However, for most species the operational characteristics during floods may serve to temporarily reduce the “permeability” (i.e., increase the barrier effect) of the ROWs to regular or seasonal movements by terrestrial species.

The PR 239 realignment will result in a change in movement, but it is along an existing ROW and traverses similar habitat types as the existing ROW. There are no known ESS, sensitive habitats, or movement corridors along the proposed realignment route. The existing PR 239 ROW that will become a municipal road will benefit from reduced traffic levels that will offset adverse effects of the new realignment ROW; there is no net effect. Mechanical and chemical vegetation maintenance associated with the PR 239 realignment is expected to be temporary (i.e., once per year) and will not have a measurable effect on wildlife movement.

Species at Risk

SAR are not uniquely susceptible to a change in movement during the operational phase in comparison to other species. There is no pathway for bird, bat, and reptile SAR movement to be affected. Potential effects on SAR described above for the construction phase are likely to persist during the operational phase and may be exacerbated during temporary periods of floodwater conveyance (i.e., for northern leopard frog).

Migratory Birds

There is no pathway for a change in movement for migratory birds.

Summary of Operation and Maintenance Residual Effects on Wildlife Movement

Following the implementation of the proposed mitigation measures described above, residual effects of a change in wildlife movement during construction are characterized as follows:

- direction is adverse because operational activities may alter wildlife movements
- duration is long-term because effects will persist for the lifetime of the Project
- magnitude for wildlife, including migratory birds and SAR, is low because a measurable change in the abundance of wildlife in the LAA is unlikely but may result in temporary local shifts in distributions
- construction is year-round and will therefore occur during highly sensitive life periods for wildlife
- residual effects will extend to the LAA
- frequency of effects will be infrequent over the operational phase
- residual effects will be reversible following flooding events
- ecological context varies from undisturbed (relatively undisturbed or adversely affected by human activity) in the wildlife LAA for the LSMOC to disturbed (substantial existing disturbance by human activity) in the wildlife LAA for the LMOC

8.3.6.5 Summary of Project Residual Effects

Table 8.3-5 summarizes the residual environmental effects on wildlife during construction and operations.

Table 8.3-5 Summary of Project Residual Effects on Wildlife

Residual Effect	Residual Effects Characterization								
	Project Phase	Direction	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Ecological Context
Change in Habitat	C	A	LT	L/M	HS	LAA	RC	R/I	U/D
	O	A/P	LT	N/L	HS	LAA	IF	R	D
Change in Mortality Risk	C	A	MT	L	HS	LAA	RC	R/I	U/D
	O	A	MT	L	HS	LAA	IF	R	D
Change in Movement	C	A	MT	L	HS	LAA	RC	R/I	U/D
	O	A	MT	L	HS	LAA	IF	R	D

KEY
See Table 8.3-2 for detailed definitions

C: Construction
O: Operations

P: Positive
A: Adverse
N: Neutral/

ST: Short-term
MT: Medium-term
LT: Long-term

L: Low
M: Medium
H: High

NS: No sensitivity
MS: Moderate sensitivity
HS: High sensitivity

PDA: Project development area
LAA: local assessment area
RAA: regional assessment area

N/A: Not applicable

IF: Infrequent
SI: Sporadic/Intermittent
RC: Regular/Continuous

R: Reversible
I: Irreversible

U: Undisturbed
D: Disturbed

8.3.7 Determination of Significance

8.3.7.1 Significance of Residual Environmental Effects from the Project

A significant residual effect on wildlife is defined as one that, following the application of mitigation measures, threatens the long-term persistence or viability of a wildlife species in the RAA.

The Project is in an area that supports a diversity of SAR and SOCC, including potential critical habitat for red-headed woodpecker and eastern whip-poor-will. Relative to the wildlife LAA, change in SAR habitat is expected to be low in magnitude for eastern whip-poor-will and medium in magnitude for red-headed woodpecker. For both species, this is a change in less than 1% of potential breeding habitat in the RAA as potential habitat is abundant and widespread throughout the region. With mitigation, and the commitment to implement the Red-Headed Woodpecker and Eastern Whip-Poor-Will Mitigation and Offset Plans to secure, enhance, or restore habitat for red-headed woodpecker and eastern whip-poor-will. Project effects on SAR and SOCC will be not significant.

Based on the assessment of the proposed effects of the Project on wildlife (including migratory birds) and the proposed mitigation measures, the residual effects are considered not significant as the Project is not expected to threaten the viability of a wildlife species.

8.3.8 Potential Effects on Federal Lands

The Project is not expected to affect wildlife on, or passing through, First Nations reserves within the RAA (i.e., Pinaymootang, Little Saskatchewan, Lake St. Martin, or Dauphin River First Nation Reserves) or others outside the RAA. Follow-up and monitoring for wildlife is provided in Section 8.3.9; no additional follow-up and monitoring programs beyond those identified are required specifically for federal lands.

8.3.9 Prediction Confidence

Prediction confidence for the residual effects on wildlife is considered moderate based on the amount and quality of data available, experience with similar projects, and confidence in the effectiveness of mitigation measures in the Environmental Management Program, which reflect accepted best industry practice. Limitations in the quality and quantity of baseline information used to predict Project residual effects has resulted in uncertainty associated with the distribution and abundance of wildlife, particularly SAR and SOCC, within the LAA. Predictions are based largely on existing data sources that provide insight into the distribution and habitat associations of wildlife within the RAA and inferences are then made to corresponding habitats in the LAA.

8.3.10 Follow-Up and Monitoring

A monitoring program for wildlife will be implemented as part of the Environmental Management Program (EMP), as described in Chapter 3.7. The EMP is a framework for implementation, management, monitoring and evaluation of the protection activities committed to in this assessment. The EMP will prescribe measures and practices to avoid and reduce adverse environmental effects on wildlife (*e.g.*, clearing outside of the primary nesting period for migratory birds, buffers for wildlife and sensitive wildlife habitat). The EMP will include a Wildlife Monitoring Plan (WMP) that will provide the detailed methods on how predicted changes to wildlife habitat availability and wildlife movement will be verified and how the effectiveness of mitigation strategies will be evaluated. The WMP will also identify reporting commitments and schedule(s).

The WMP will also include Red-headed Woodpecker and/or Eastern Whip-Poor-Will Mitigation and Offset Plan which may include:

- commitments to gather additional field information on SAR and SOCC occurrence prior to construction
- measures to manage effects on SAR and SOCC
- measures to restore SAR and SOCC habitat, including within the ROWs
- the implementation of offset program for SAR

Reports describing the results of follow-up and monitoring activities for wildlife and wildlife habitat may reveal the need for adaptive management to address unanticipated environmental effects. Unanticipated effects may require the application of additional mitigation or require modifications to existing mitigation measures. Knowledge gained through ongoing monitoring and associated analysis will be used to make recommendations for ongoing improvements to mitigation measures, the monitoring plan, methods, and analysis.

8.3.11 Conclusions

8.3.11.1 Change in Habitat

During Project planning and preliminary design, efforts were taken to reduce the potential for adverse interactions between the Project and wildlife. Mitigation used to reduce potential Project effects on wildlife included avoidance (i.e., shifting of the LMOC ROW west of Reed Lake, Clear Lake, Goodison Lake) and design (e.g., vegetated channel sides) and were influenced by information received during the IPEP.

Project construction will remove or alter 1913.9 ha or 3% of terrestrial and aquatic habitat used by migratory birds, SAR, and other wildlife. Approximately 2.2% of potential eastern whip-poor-will breeding habitat and 7.8.% ha of potential red-headed woodpecker habitat in the LAA (less than 1% of potential habitat in the RAA for both species) has the potential to be directly affected during construction. However, with mitigation and reclamation/channel revegetation, estimates of habitat loss will be reduced. Final design will limit overlap with SAR habitats to the extent feasible and reclamation plans will consider re-establishing vegetation communities along parts of the ROW upland berms or spoil banks in a manner that benefits SAR. A Red-headed Woodpecker Mitigation and Offset Measures Plan and Eastern Whip-poor-will Mitigation and Offset Measures Plan will be developed in consultation with provincial and federal regulators, stakeholders and indigenous communities.

Construction noise and activity may deter wildlife, including SAR and SOCC and migratory birds, from using areas within and adjacent to the active construction areas of the PDA for the short-term, with animals returning to the area when disturbance ceases. Positive effects will occur during operation and mainly benefit the Lake St. Martin IBA and its waterbird colonies through reduced flooding and erosion of habitat and nests. Other wildlife such as muskrats, ducks, grebes, loons, and geese that nest or occupy marshy lake shores, will also benefit from reduced flooding on Lake St. Martin.

The PR 239 realignment may affect wildlife habitat; however, it is not expected to exceed existing risks associated with the existing PR 239 alignment.

8.3.11.2 Change in Mortality Risk

During construction, there is potential for increased mortality risk (because of encounters with construction equipment) to small mammals, nesting birds, reptiles, and amphibian due to their limited mobility. Clearing outside of the sensitive breeding period for migratory birds and adherence to mitigation measures is expected to reduce mortality risk for these species.

During operation and maintenance, the outlet channel ROWs have the potential to increase predator and hunter/trapper efficiency by providing access along a continuous, linear corridor. Prey species encountering the outlet channels may be at a greater risk to predation until cover plantings (i.e., escape or concealment cover) are well established.

Although most wildlife species will be able to cross the channels during operation, wildlife mortality risk will be elevated for all species attempting to cross the channels during high flow periods. The outlet channel ROWs, and the distribution line to a lesser extent, have the potential to increase mortality risk by providing a travel corridor that increases hunting/trapping and predator efficiency. Limiting public access to the ROWs and adding cover plantings to reduce sight lines and provide escape cover will reduce mortality risk to wildlife. The PR 239 realignment may also increase mortality risk for wildlife; however, it is not expected to exceed existing risks associated with the existing PR 239 alignment.

8.3.11.3 Change in Movement

The outlet channel ROWs have the potential to alter wildlife movement in the LAA, particularly during construction and during flood events when the channels are conveying floodwater. Terrestrial wildlife movements may be impacted during flood events, which could limit dispersion of wildlife for the short-term. As per the Vegetation Management Plan, the ROWs will be revegetated and include additional cover plantings in strategic locations to facilitate wildlife movement across the outlet channels. Movement of most wildlife through the LAA, including elk, moose, furbearers, migratory birds and SAR and SOCC are not expected to change during gates closed. The PR 239 realignment may affect wildlife movement; however, it is not expected to be different than existing effects associated with the existing PR 239 alignment.

8.3.12 References

8.3.12.1 Vegetation

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8.3.12.2 Wildlife

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Appendix 8A TABLES

Appendix 8A TABLES

LIST OF TABLES

Table 8.2A-1 LAA Land Cover Classes for the LMOC and LSMOC A.2
Table 8.2A-3 Land Cover Classes in the LAA A.7
Table 8.2A-4 SOCC with the Potential to Occur in the RAA A.9
Table 8.2A-5 Plant Species Inventory from the 2016 Field Surveys A.13
Table 8.2A-6 Plant Species of Interest to Indigenous Groups from Literature Review A.19
Table 8.2A-7 Change in Native Vegetation Patch Metrics for the RAA A.22
Table 8.3A-1 Bird Species with Potential to Occur in the RAA1.. A.23
Table 8.3A-2 Species at Risk and Species of Conservation Concern with the Potential to Occur in the RAA A.30

Table 8.2A-1 LAA Land Cover Classes for the LMOC and LSMOC

Land Cover Category	Land Cover Class	Definition[2]
Native Upland Vegetation[1]	Grassland	>5% native grass cover, <20% shrub cover, <10% tree cover
	Shrubland	≥20% shrub cover, shrubs ≥1m -5m tall, <10 tree cover
	Deciduous Forest - Dense	>60% crown closure, trees >5m tall, 75-100% of tree canopy cover is deciduous/broadleaf or hardwood
	Deciduous Forest - Open	26-60% crown closure, trees >5m tall, 75-100% of tree canopy cover is deciduous/broadleaf or hardwood
	Deciduous Forest - Sparse	10-25% crown closure, trees >5m tall, 75-100% of tree canopy cover is deciduous/broadleaf or hardwood
	Coniferous Forest - Dense	>60% crown closure, trees >5m tall, 75-100% of tree canopy cover is coniferous or softwood
	Coniferous Forest - Open	26-60% crown closure, trees >5m tall, 75-100% of tree canopy cover is coniferous or softwood
	Coniferous Forest - Sparse	10-25% crown closure, trees >5m tall, 75-100% of tree canopy cover is coniferous or softwood
	Mixedwood Forest - Dense	>60% crown closure, trees >5m tall, Forested land where 26-74% of canopy cover is mix of conifer or broadleaf/deciduous species
	Mixedwood Forest - Open	26-60% crown closure, trees >5m tall, Forested land where 26-74% of canopy cover is mix of conifer or broadleaf/deciduous species
	Mixedwood Forest - Sparse	10-25% crown closure, trees >5m tall, Forested land where 26-74% of canopy cover is mix of conifer or broadleaf/deciduous species
Wetland[3]	Bog - Forested	Peatland receiving water only from precipitation and not influenced by groundwater; >25% tree cover of trees taller than 2m
	Bog – Shrub	Peatland receiving water only from precipitation and not influenced by groundwater; >25% shrub cover, ≤25% tree cover, shrubs >2m tall
	Bog - Open	Peatland receiving water only from precipitation and not influenced by groundwater; ≤25% tree or shrub cover
	Fen - Forested	Peatland receiving water rich in dissolved minerals and influenced by groundwater; >25% tree cover of trees taller than 2 m
	Fen - Shrub	Peatland receiving water rich in dissolved minerals and influenced by groundwater; >25% shrub cover, ≤25% tree cover, shrubs >2m tall
	Fen - Graminoid	Peatland receiving water rich in dissolved minerals and influenced by groundwater; ≤25% tree or shrub cover

Table 8.2A-1 LAA Land Cover Classes for the LMOC and LSMOC

Land Cover Category	Land Cover Class	Definition[2]
	Swamp – Forested Coniferous	Periodically standing surface water and gently moving, nutrient-rich groundwater; >60% of canopy cover is coniferous or softwood and trees are > 10m tall
	Swamp – Forested Deciduous	Periodically standing surface water and gently moving, nutrient-rich groundwater; >60% of canopy cover is broadleaf/deciduous or hardwood and trees are > 10m tall
	Swamp – Forested Mixedwood	Periodically standing surface water and gently moving, nutrient-rich groundwater; >60% of canopy cover is broad/leaf/deciduous or hardwood and trees are > 10m tall
	Swamp - Shrub	Periodically standing surface water and gently moving, nutrient-rich groundwater; >30% shrub cover, shrubs 2-10m tall
	Marsh	Periodic or persistent standing water or slow moving surface water which is circumneutral to alkaline and generally nutrient-rich; >25% emergent cover, ≤25% tree or shrub cover
	Shallow Open Water	Wetlands with free surface water up to 2 m deep, present for all or most of the year and ≤25% emergent vegetation cover
	Dugout	Human constructed holding area for water
Agriculture	Cultivated	Annually tilled or seeded annual or perennial cropland
	Tame Pasture	Non-native grasses, area potentially used form grazing livestock
	Hayland	Perennial non-native grassland cut for hay
Developed	Roads	Primary and secondary roads, rural roads
	Industrial	Predominately built up area, including commercial and industrial plant and mine sites. Vegetation not present or sparse (incl. gravel pits)
	Railway	Railroad and associated right of way
	Residential	Populated urban areas, rural buildings and actively managed surrounding areas (e.g., lawns)
Water	Lakes	Open water deeper than 2 m
	River/Streams/Creeks	Flowing water forms
	Channel	Human constructed ditch or trench diversion with flowing water
Bare Ground	Rock/Sand	Naturally bare rock or sand (e.g., beaches, exposed rock), <5% veg cover

Note[1] Native upland vegetation classes are based on the Canadian Land Cover Classification System (Government of Canada 2003). [2] Tree and shrub height categories are obtained from Zoladeski et al. 1995.

[3] Wetland classes follow the Canadian Wetland Classification System (National Wetland Working Group 1997) and Boreal Wetland Classes in the Boreal Plains Ecozone of Canada (Ducks Unlimited Canada 2018).

Table 8.2A-2 Land Cover Classes for Lake St. Martin and the RAA

Land Cover Category	Land Cover Class	Definition
Upland	Herb	Vascular plants without woody stem (native grasses, crops, forbs, graminoids). Minimum of 20% ground cover.
	Shrubland	≥20% shrub cover, shrubs ≥1m -5m tall, <10 tree cover
	Deciduous Forest - Dense	>60% crown closure, trees >5m tall, 75-100% of tree canopy cover is deciduous/broadleaf or hardwood
	Deciduous Forest - Open	26-60% crown closure, trees >5m tall, 75-100% of tree canopy cover is deciduous/broadleaf or hardwood
	Deciduous Forest - Sparse	10-25% crown closure, trees >5m tall, 75-100% of tree canopy cover is deciduous/broadleaf or hardwood
	Coniferous Forest - Dense	>60% crown closure, trees >5m tall, 75-100% of tree canopy cover is coniferous or softwood
	Coniferous Forest - Open	26-60% crown closure, trees >5m tall, 75-100% of tree canopy cover is coniferous or softwood
	Coniferous Forest - Sparse	10-25% crown closure, trees >5m tall, 75-100% of tree canopy cover is coniferous or softwood
	Mixedwood Forest - Dense	>60% crown closure, trees >5m tall, Forested land where 26-74% of canopy cover is mix of conifer or broadleaf/deciduous species
	Mixedwood Forest - Open	26-60% crown closure, trees >5m tall, Forested land where 26-74% of canopy cover is mix of conifer or broadleaf/deciduous species
	Mixedwood Forest - Sparse	10-25% crown closure, trees >5m tall, Forested land where 26-74% of canopy cover is mix of conifer or broadleaf/deciduous species
Wetland	Treed	Land with a water table near, at, or above the soil surface for enough time to promote wetland or aquatic processes. The majority of vegetation is trees.
	Shrub	Land with a water table near, at, or above the soil surface for enough time to promote wetland or aquatic processes. The majority of vegetation is shrub.
	Herb	Land with a water table near, at, or above the soil surface for enough time to promote wetland or aquatic processes. The majority of vegetation is graminoid or herb.
Agriculture	Cultivated	Annually tilled or seeded annual or perennial cropland
	Perennial Cropland and Pasture	Non-native grasses, area potentially used form grazing livestock, and perennial non-native grassland cut for hay
Exposed Land	<5% vegetation. River sediments, exposed soils, pond or lake sediments, reservoir margins, beaches, landings, burned areas, road surfaces, mudflat sediments, cutbanks, moraines, gravel pits, tailings, railway surfaces, buildings and parking, or other non-vegetated surfaces.	
Rock/Rubble	Bedrock, rubble, talus, blockfield, rubbley mine spoils, or lava beds.	

Table 8.2A-2 Land Cover Classes for Lake St. Martin and the RAA

Land Cover Category	Land Cover Class	Definition
Water	Lakes, reservoirs, rivers, streams, or salt water.	
Shadow	-	
Cloud	-	
No Data	-	

Note:
Cover classes are based on the Canadian Land Cover Classification System (Government of Canada 2003).

Table 8.2A-3 Land Cover Classes in the LAA

Land Cover Category	Land Cover Class[1]	LMOC	PR239	Lake St. Martin	LSMOC
Agriculture	Cultivated	503.3	334.7	23.1	0.0
	Hayland	2,038.3	1,113.6	110.9	0.0
	Hayland and Pasture[2]	0.8	0.0	50.9	0.0
	Tame Pasture	198.7	42.2	0.0	0.0
Bare ground	Bare ground[2]	0.0	<0.1	66.8	12.3
	Rock/Sand	4.2	0.0	0.6	5.7
Developed	Developed[2]	0.0	<0.1	74.7	0.0
	Industrial	0.0	0.0	0.0	50.1
	Residential	63.0	17.9	2.8	0.0
	Roads	42.3	44.0	1.0	0.0
Native Upland Vegetation	Coniferous Forest - Dense	0.0	0.0	243.8	342.7
	Coniferous Forest - Open	0.0	0.0	353.7	36.7
	Deciduous Forest - Dense	708.6	403.7	2,800.0	20.2
	Deciduous Forest - Open	274.7	194.2	622.7	6.9
	Grassland	14.0	1.0	2,503.9	24.5
	Mixedwood Forest - Dense	10.8	57.5	151.4	184.4
	Mixedwood Forest - Open	0.0	23.1	0.0	0.0
	Shrubland	34.2	0.0	2.5	37.6
Water	Channel	9.2	1.5	0.0	5.3
	Lakes	248.3	0.0	44.7	99.3
	River/Streams/Creeks	32.0	0.1	16.8	5.7
	Water	501.6	0.0	34,448.1	668.7
Wetland	Bog - Forested	0.0	0.0	0.0	8.2
	Bog - Shrub	0.0	0.0	0.0	20.2
	Dugout	3.7	4.6	0.3	0.0
	Fen - Forested	0.0	0.0	0.0	922.3
	Fen - Graminoid	0.0	0.0	7.5	1,186.8
	Fen - Shrub	0.0	0.0	3.2	698.8
	Marsh	1,429.9	323.4	77.1	57.0
	Shallow Open Water	384.2	48.8	83.7	110.0
	Swamp - Forested Coniferous	0.0	0.0	13.1	1,126.0
	Swamp – Forested Deciduous	0.7	0.0	0.0	24.1
	Swamp – Forested Mixedwood	0.0	0.0	52.8	240.5
	Swamp - Shrub	2.8	0.0	6.1	318.1

Table 8.2A-3 Land Cover Classes in the LAA

Land Cover Category	Land Cover Class[1]	LMOC	PR239	Lake St. Martin	LSMOC
Wetland	Wetland-herb[2]	44.6	0.0	3,968.6	58.3
	Wetland-shrub[2]	32.4	0.2	4,426.3	53.9
	Wetland-treed[2]	0.0	0.0	26.6	0.8
Grand Total		**6,582.1**	**2,610.6**	**50,183.8**	**6,325.0**

[1] Based on desktop mapping data.
[2] Based on LCC data.

Table 8.2A-4 SOCC with the Potential to Occur in the RAA

Ecoregion[1]	Scientific Name[2]	Common Name	S Rank	G Rank	MBESEA	COSEWIC	SARA Status	On Schedule 1?
Interlake Plain	*Achnatherum richardsonii*	Richardson needle grass	S1S2	G5	-	-	-	-
Interlake Plain	*Agalinis aspera*[3]	rough agalinis	S2	G5	endangered	endangered	endangered	yes
Lake Manitoba Plain	*Agalinis gattingeri*	Gattinger's agalinis	S1	G4	endangered	endangered	endangered	yes
Interlake Plain	*Agalinis tenuifolia*[3]	narrow-leaved agalinis	S2S3	G5	-	-	-	-
Interlake Plain	*Agrimonia gryposepala*	common agrimony	S1S2	G5	-	-	-	-
Interlake Plain	*Alisma gramineum*	narrow-leaved water-plantain	S1	G5	-	-	-	-
Interlake Plain	*Amorpha fruticosa*	false indigo	S1S2	G5	-	-	-	-
Interlake Plain	*Arabidopsis lyrata* subsp. *lyrata*	lyre-leaved rock cress	S1S2	G5	-	-	-	-
Interlake Plain/Mid-Boreal Lowland	*Aralia racemosa*	spikenard	S2	G5	-	-	-	-
Interlake Plain/Mid-Boreal Lowland	*Arethusa bulbosa*	dragon's-mouth orchid	S2	G5	-	-	-	-
Interlake Plain	*Asclepias verticillata*	whorled milkweed	S3	G5	-	-	-	-
Interlake Plain	*Astragalus australis*	indian milkvetch	S1S2	G5	-	-	-	-
Interlake Plain	*Astragalus neglectus*	neglected milkvetch	S1	G4	-	-	-	-
Interlake Plain	*Astragalus pectinatus*	narrow-leaved milkvetch	S2	G5	-	-	-	-
-	*Bolboschoenus fluviatilis*	river bulrush	S3	G5	-	-	-	-
Interlake Plain	*Boltonia asteroides* var. *recognita*	white boltonia	S2S3	G5T3T5	-	-	-	-
Interlake Plain	*Botrychium campestre*	prairie moonwort	S1	G3G4	-	-	-	-
Interlake Plain	*Botrychium hesperium*	daisy-leaf moonwort	S1	G5	-	-	-	-
Interlake Plain	*Bouteloua curtipendula*	side-oats grama	S2	G5	-	-	-	-
Interlake Plain	*Bromus latiglumis*	wild chess	S2S3	G5	-	-	-	-
Interlake Plain	*Bromus porteri*	Porter's chess	S2S3	G5	-	-	-	-
Interlake Plain	*Calamagrostis montanensis*	plains reed grass	S3	G5	-	-	-	-
Interlake Plain/Mid-Boreal Lowland	*Calopogon tuberosus*	swamp-pink	S2	G5	-	-	-	-
Interlake Plain	*Canadanthus modestus*	large northern aster	S2	G5	-	-	-	-
Interlake Plain	*Cardamine bulbosa*	spring cress	SH	G5	-	-	-	-
Interlake Plain	*Carex conoidea*	field sedge	S1	G5	-	-	-	-
Interlake Plain	*Carex cryptolepis*	northeastern sedge	S1	G4G5	-	-	-	-
Interlake Plain	*Carex douglasii*	Douglas sedge	S2	G5	-	-	-	-
Mid-Boreal Lowland	*Carex flava*	yellow sedge	S2	G5	-	-	-	-
Mid-Boreal Lowland	*Carex garberi*	elk sedge	S1?	G5	-	-	-	-
Interlake Plain/Mid-Boreal Lowland	*Carex hystericina*	porcupine sedge	S3	G5	-	-	-	-
Interlake Plain	*Carex livida*	livid sedge	S3	G5	-	-	-	-
Interlake Plain	*Carex parryana*	Parry's sedge	S3	G4G5	-	-	-	-
Interlake Plain/Mid-Boreal Lowland	*Carex pedunculata*	stalked sedge	S3	G5	-	-	-	-
Mid-Boreal Lowland	*Carex projecta*	necklace sedge	S3?	G5	-	-	-	-

Table 8.2A-4 SOCC with the Potential to Occur in the RAA

Ecoregion[1]	Scientific Name[2]	Common Name	S Rank	G Rank	MBESEA	COSEWIC	SARA Status	On Schedule 1?
Interlake Plain	*Carex sterilis*	dioecious sedge	S2	G4G5	-	-	-	-
Interlake Plain	*Carex stricta*	tussock sedge	S1	G5	-	-	-	-
Interlake Plain	*Carex supina* ssp. *spaniocarpa*	weak sedge	S2S3	G5T5	-	-	-	-
Interlake Plain	*Carex tetanica*	rigid sedge	S3	G4G5	-	-	-	-
Interlake Plain/Mid-Boreal Lowland	*Carex vulpinoidea*	fox sedge	S3	G5	-	-	-	-
Interlake Plain	*Caulophyllum thalictroides*	papoose-root	S2	G5	-	-	-	-
Interlake Plain	*Ceanothus herbaceus*	New Jersey tea	S2S3	G5	-	-	-	-
Interlake Plain	*Chrysosplenium iowense*	Iowa golden-saxifrage	S1	G4	-	-	-	-
Interlake Plain	*Cladium mariscoides*	twig rush	S2S3	G5	-	-	-	-
Interlake Plain	*Clematis ligusticifolia*	western virgin's-bower	S1	G5	-	-	-	-
Interlake Plain	*Clematis virginiana*	virgin's-bower	S2?	G5	-	-	-	-
Interlake Plain	*Corispermum villosum*[3]	hairy bugseed	S1S2	G5	-	-	-	-
Interlake Plain	*Cyperus erythrorhizos*[3]	red-root flatsedge	S1	G5	-	-	-	-
Interlake Plain/Mid-Boreal Lowland	*Cyperus houghtonii*	Houghton's umbrella-sedge	S2S3	G4?	-	-	-	-
Interlake Plain/Mid-Boreal Lowland	*Cypripedium arietinum*	Ram's head lady's-slipper	S2S3	G3	-	-	-	-
Interlake Plain	*Cypripedium candidum*	small white lady's-slipper	S1	G4	endangered	threatened	threatened	yes
Interlake Plain	*Desmodium canadense*	beggar's-lice	S2	G5	-	-	-	-
Mid-Boreal Lowland	*Drosera linearis*	slender-leaved sundew	S2?	G4G5	-	-	-	-
Mid-Boreal Lowland	*Dulichium arundinaceum*	three-way sedge	S2	G5	-	-	-	-
Mid-Boreal Lowland	*Eleocharis engelmannii*[3]	Engelmann's spike-rush	S1S2	G4G5	-	-	-	-
Interlake Plain	*Elymus lanceolatus*	northern wheat grass	S3	G5	-	-	-	-
Interlake Plain	*Elymus lanceolatus* ssp. *lanceolatus*	thickspike wheatgrass	S3	G5T5	-	-	-	-
Mid-Boreal Lowland	*Eriophorum callitrix*	beautiful cotton-grass	S2	G5	-	-	-	-
Interlake Plain	*Festuca hallii*	plains rough fescue	S3	G5	-	-	-	-
Interlake Plain	*Fraxinus nigra*	black ash	S2S3	G5	not listed	threatened	no status	no
Mid-Boreal Lowland	*Galium aparine*[3]	cleavers	S3	G5	-	-	-	-
Interlake Plain	*Gentiana rubricaulis*	closed gentian	S3	G4?	-	-	-	-
Interlake Plain	*Geranium maculatum*	wild crane's-bill	S1	G5	-	-	-	-
Interlake Plain/Mid-Boreal Lowland	*Goodyera tesselata*	tesselated rattlesnake plantain	S2	G5	-	-	-	-
Mid-Boreal Lowland	*Gymnocarpium robertianum*	limestone oak fern	S1	G5	-	-	-	-
Interlake Plain	*Hesperostipa curtiseta*	western porcupine grass	S3	G5	-	-	-	-
Mid-Boreal Lowland	*Heteranthera dubia*[3]	water star-grass	S2S3	G5	-	-	-	-
Interlake Plain	*Hudsonia tomentosa*	false heather	S3	G5T5Q	-	-	-	-
Interlake Plain	*Krigia biflora*	two-flowered dwarf-dandelion	S2S3	G5	-	-	-	-
Interlake Plain	*Lactuca canadensis*[3]	tall yellow lettuce	S3	G5	-	-	-	-

Table 8.2A-4 SOCC with the Potential to Occur in the RAA

Ecoregion[1]	Scientific Name[2]	Common Name	S Rank	G Rank	MBESEA	COSEWIC	SARA Status	On Schedule 1?
Interlake Plain	*Lactuca floridana*[3]	woodland lettuce	SH	G5	-	-	-	-
Interlake Plain	*Lechea intermedia*	pinweed	S1?	G5	-	-	-	-
Interlake Plain	*Linum sulcatum*[3]	grooved yellow flax	S3	G5	-	-	-	-
Mid-Boreal Lowland	*Listera auriculata*	auricled twayblade	S1	G3G4	-	-	-	-
Interlake Plain	*Lomatium foeniculaceum*	hairy-fruited parsley	S3	G5	-	-	-	-
Interlake Plain	*Lomatium macrocarpum*	long-fruited parsley	S2S3	G5	-	-	-	-
Interlake Plain	*Lysimachia quadriflora*	whorled loosestrife	S2	G5?	-	-	-	-
Interlake Plain	*Maianthemum racemosum* ssp. *amplexicaule*	false spikenard	S1	G5	-	-	-	-
Mid-Boreal Lowland	*Malaxis monophyllos*	white adder's-mouth	S2?	G5	-	-	-	-
Interlake Plain	*Malaxis monophyllos* var. *brachypoda*	white adder's-mouth	S2?	G5	-	-	-	-
Interlake Plain	*Malaxis paludosa*	bog adder's-mouth	S1?	G3G4	-	-	-	-
Mid-Boreal Lowland	*Malaxis unifolia*	green adder's-mouth	S2?	G5	-	-	-	-
Interlake Plain	*Muhlenbergia andina*	foxtail muhly	S1	G4	-	-	-	-
-	*Myriophyllum verticillatum*	whorled water-milfoil	S2	G5	-	-	-	-
-	*Nymphaea loriana*	water lily	S1	G1G2	-	-	-	-
Lac Seul Upland/Lake of the Woods/ Mid-Boreal Lowland	*Nymphaea odorata*	fragrant water-lily	S2?	G5	-	-	-	-
Interlake Plain	*Oenothera perennis*	sundrops	S1	G5	-	-	-	-
Interlake Plain/Mid-Boreal Lowland	*Onoclea sensibilis*	sensitive fern	S3?	G5	-	-	-	-
Interlake Plain	*Ophioglossum pusillum*	northern adder's-tongue	S1	G5	-	-	-	-
Interlake Plain	*Orobanche fasciculata*[3]	clustered broom-rape	S3	G4G5	-	-	-	-
Interlake Plain	*Orobanche ludoviciana*[3]	Louisiana broom-rape	S2	G5	-	-	-	-
Interlake Plain/Mid-Boreal Lowland	*Osmunda claytoniana*	interrupted fern	S2S3	G5	-	-	-	-
Interlake Plain	*Oxytropis lambertii*	purple locoweed	S3	G5	-	-	-	-
Interlake Plain	*Parnassia parviflora*	small grass-of-parnassus	S1	G5?	-	-	-	-
Interlake Plain/Mid-Boreal Lowland	*Pellaea gastonyi*	Gastony's cliffbrake	S1	G3	endangered	-	-	-
Mid-Boreal Lowland	*Pellaea glabella*	smooth cliffbrake	S2	G5	-	-	-	-
Interlake Plain/Mid-Boreal Lowland	*Pellaea glabella* ssp. *occidentalis*	western dwarf cliffbrake	S2	G5T4	-	-	-	-
Interlake Plain	*Penthorum sedoides*	ditch-stonecrop	S1S2	G5	-	-	-	-
Interlake Plain	*Phryma leptostachya*	lopseed	S3	G5	-	-	-	-
Mid-Boreal Lowland	*Pinus resinosa*	red pine	S2S3	G5	-	-	-	-
Mid-Boreal Lowland	*Plantago maritima*	seaside plantain	S2	G5	-	-	-	-
Mid-Boreal Lowland	*Platanthera lacera*	fringed orchid	S1S2	G5	-	-	-	-
Interlake Plain	*Platanthera praeclara*	western prairie fringed orchid	S1	G3	endangered	endangered	endangered	yes

Table 8.2A-4 SOCC with the Potential to Occur in the RAA

Ecoregion[1]	Scientific Name[2]	Common Name	S Rank	G Rank	MBESEA	COSEWIC	SARA Status	On Schedule 1?
Mid-Boreal Lowland	*Pogonia ophioglossoides*	rose pogonia	S1	G5	-	-	-	-
Interlake Plain	*Polygala verticillata*[3]	whorled milkwort	S2	G5	-	-	-	-
Mid-Boreal Lowland	*Polypodium sibiricum*	Siberian polypody	S3	G5?	-	-	-	-
-	*Potamogeton foliosus*	leafy pondweed	S3	G5	-	-	-	-
-	*Potamogeton foliosus* ssp. *foliosus*	leafy pondweed	S3	G5T5	-	-	-	-
-	*Potamogeton obtusifolius*	blunt-leaved pondweed	S2S3	G5	-	-	-	-
-	*Potamogeton pusillus* ssp. *tenuissimus*	small pondweed	S2	G5T5	-	-	-	-
Hayes River upland/Mid-Boreal Lowland/Mid-Boreal Uplands	*Potamogeton strictifolius*	straight forward pondweed	S2S3	G5	-	-	-	-
Interlake Plain/Mid-Boreal Lowland	*Pyrola americana*	round-leaved pyrola	S2?	G5	-	-	-	-
Interlake Plain	*Ranunculus hispidus* var. *caricetorum*	bristly buttercup	S2	G5T5	-	-	-	-
Interlake Plain/Mid-Boreal Lowland	*Rhynchospora alba*	white beakrush	S3	G5	-	-	-	-
Interlake Plain/Mid-Boreal Lowland	*Rhynchospora capillacea*	horned beakrush	S2S3	G4G5	-	-	-	-
Interlake Plain/Mid-Boreal Lowland	*Sceptridium multifidum*	leathery grape-fern	S3	G5	-	-	-	-
Interlake Plain	*Selaginella densa*	prairie spike-moss	S3	G5	-	-	-	-
Interlake Plain	*Sisyrinchium campestre*	white-eyed grass	S3	G5	-	-	-	-
Interlake Plain	*Solidago mollis*	velvety goldenrod	S3	G5	-	-	-	-
Interlake Plain	*Solidago riddellii*	Riddell's goldenrod	S2S3	G5	threatened	special concern	special concern	yes
Interlake Plain	*Spiranthes magnicamporum*	Great Plains ladies'-tresses	S1S2	G3G4	endangered	-	-	-
Interlake Plain	*Symphyotrichum sericeum*	western silvery aster	S2S3	G5	threatened	threatened	threatened	yes
Mid-Boreal Lowland	*Taxus canadensis*	Canada yew	S3	G5	-	-	-	-
Interlake Plain	*Teucrium canadense*	American germander	S3	G5	-	-	-	-
Interlake Plain	*Thalictrum revolutum*	waxleaf meadow-rue	S1	G5	-	-	-	-
Mid-Boreal Lowland	*Thalictrum sparsiflorum*	few-flowered meadow-rue	S1S3	G5	-	-	-	-
Interlake Plain/Mid-Boreal Uplands	*Utricularia minor*	lesser bladderwort	S3	G5	-	-	-	-
Interlake Plain/Mid-Boreal Lowland	*Vaccinium caespitosum*	dwarf bilberry	S3	G5	-	-	-	-
Lake Manitoba Plain	*Vernonia fasciculata*	western ironweed	S1	G5	endangered	endangered	endangered	yes
Interlake Plain	*Veronicastrum virginicum*	Culver's-root	S1S2	G5	threatened	-	-	-
Interlake Plain/Mid-Boreal Lowland	*Viola labradorica*	early blue violet	S3	G5	-	-	-	-
Mid-Boreal Lowland	*Viola selkirkii*	long-spurred violet	S2	G5	-	-	-	-
Mid-Boreal Lowland	*Woodsia glabella*	smooth woodsia	S2	G5	-	-	-	-

[1] Ecoregion data from MBCDC date unknown.
[2] Naming convention follows MBCDC 2018.
[3] Annual species (USDA 2019).

Table 8.2A-5 Plant Species Inventory from the 2016 Field Surveys

Scientific Name[1]	Common Name	Provincial Rank
Abies balsamea	balsam fir	S5
Acer negundo	Manitoba maple	S5
Acer spicatum	mountain maple	S5
Achillea millefolium	common yarrow	S5
Actaea rubra	red baneberry	S5
Agastache scrophulariifolia	giant hyssop	S5
Alnus incana	speckled alder	S5
Alnus viridis	green alder	S5
Alopecurus aequalis	short awned foxtail	S5
Amelanchier alnifolia	saskatoon serviceberry	S5
Andromeda polifolia	bog rosemary	S5
Andropogon gerardii	big bluestem	S5
Anemone canadensis	Canadian anemone	S5
Antennaria neglecta	field pussytoe	S5
Anthoxanthum monticola ssp. *alpinum*	common sweet-grass	S1S2
Apocynum androsaemifolium	wild sarsparilla	S5
Apocynum androsaemifolium	spreading dogbane	S5
Arctium lappa	great burdock	SNA
Arctostaphylos uva-ursi	bearberry	S5
Arethusa bulbosa	dragon's mouth orchid	S2
Argentina anserina	silverweed	S5
Arnica chamissonis	leafy arnica	S4
Artemisia absinthium	absinth	SNA
Artemisia frigida	pasture sage	S4S5
Asclepias syriaca	common milkweed	S3S4
Athyrium spp.	fern species	NR
Betula glandulosa	bog birch	S5
Betula occidentalis	water birch	S3S5
Betula papyrifera	white birch	S5
Brachythecium spp.	feather moss	NR
Bromus inermis	smooth brome	S5
Caltha palustris	marsh marigold	S5
Campanula aparinoides	marsh bellflower	S5
Campanula rotundifolia	harebell	S5
Carduus nutans	nodding thistle	SNA

Table 8.2A-5 Plant Species Inventory from the 2016 Field Surveys

Scientific Name[1]	Common Name	Provincial Rank
Carex atherodes	awned sedge	S5
Carex gynocrates	northern bog sedge	S5
Carex lacustris	water sedge	S5
Carex lenticularis	lakeshore sedge	S4S5
Carex rostrata	beaked sedge	S4
Carex spp.	sedge species	NR
Carex viridula	green sedge	S4?
Cerastium arvense	field chickweed	S5
Cerastium nutans	nodding chickweed	S4S5
Chamerion angustifolium	common fireweed	S5
Cicuta maculata	water hemlock	S4S5
Cirsium arvense	Canada thistle	SNA
Coeloglossum viride	bracted bog orchid	S4
Comandra umbellata	bastard toadflax	S5
Comarum palustre	marsh cinquefoil	S5
Convolvulus arvensis	field bindweed	SNA
Corallorhiza maculata	spotted coralroot	S4
Cornus canadensis	bunchberry	S5
Cornus sericea	red osier dogwood	S5
Corylus cornuta	beaked hazel	S5
Cypripedium parviflorum	yellow lady slipper	S5?
Dactylorhiza viridis	northern green bog-orchid	S4
Dasiphora fruticosa	shrubby cinquefoil	S5
Diervilla sp.	bush honeysuckle	S5
Disporum trachycarpum	rough-fruited fairybell	S4
Dodecatheon pulchellum	saline shooting star	S3
Drosera rotundifolia	sundew	S4S5
Elaeagnus commutata	wolf willow	S4S5
Eleocharis palustris	common spike rush	S5
Elymus trachycaulus	slender wild rye	S5
Equisetum arvense	common horsetail	S5
Equisetum fluviatile	swamp horsetail	S5
Equisetum hyemale	scouring rush	S5
Erigeron glabellus	smooth fleabane	S5
Erigeron philadelphicus	Philadelphia fleabane	S5

Table 8.2A-5 Plant Species Inventory from the 2016 Field Surveys

Scientific Name[1]	Common Name	Provincial Rank
Eriophorum angustifolium	tall cotton-grass	S5
Eriophorum gracile	slender cotton grass	S4S5
Eutrochium maculatum	spotted joe-pye weed	S5
Fragaria vesca	woodland strawberry	S4S5
Fragaria virginiana	common strawberry	S5
Galeopsis tetrahit	hemp nettle	SNA
Galium boreale	northern bedstraw	S5
Galium trifidum	small bedstraw	S5
Galium triflorum	sweet scented bedstraw	S5
Gentiana crinita	fringed gentian	S5
Geocaulon lividum	false toadflax	S5
Geum rivale	purple avens	S3S4
Glyceria striata	fowl mannagrass	S5
Glycyrrhiza lepidota	wild licorice	S4S5
Halenia deflexa	spurred gentian	S5
Helianthus annuus	annual sunflower	S3
Iris versicolor	blue flag iris	S3S4
Juncus balticus	wirerush	S5
Juniperus horizontalis	creeping juniper	S5
Kalmia polifolia	bog lauriel	S5
Koeleria macrantha	Junegrass	S5
Larix laricina	tamarack	S5
Lathyrus ochroleucus	creamy peavine	S5
Leucanthemum vulgare	oxeye daisy	SNA
Linnaea borealis	twinflower	S5
Lobelia kalmii	Kalm's lobelia	S5
Lonicera dioica	twinning honeysuckle	S5
Lotus corniculatus	birds foot trefoil	SNA
Lycopus uniflorus	northern water-horehound	S4S5
Lysimachia ciliata	fringed loosetrife	S5
Lysimachia thyrsiflora	tuft loosestrife	S5
Maianthemum canadense	wild lily-of-the-valley	S5
Maianthemum stellatum	star flowered false solomon's seal	S5
Maianthemum trifolium	three-leaved false solomon's seal	S5
Medicago sativa	alfalfa	SNA

Table 8.2A-5 Plant Species Inventory from the 2016 Field Surveys

Scientific Name[1]	Common Name	Provincial Rank
Melilotus albus	white sweet clover	SNA
Melilotus officinalis	yellow sweet clover	SNA
Mentha arvensis	wild mint	NR
Menyanthes trifoliata	buckbean	S5
Mitella nuda	common mitrewort	S5
Moehringia lateriflora	blunt-leaved sandwort	S5
Mulgedium oblongifolium	common blue lettuce	S5
Myrica gale	sweet bayberry	S5
Oenothera biennis	yellow evening primrose	S5
Oxytropis monticola	late yellow locoweed	S4
Oxytropis sericea	early yellow locoweed	S1
Parnassia palustris	grass of parnassus	S5
Pastinaca sativa	wild parsnip	SNA
Persicaria amphibia	water smartweed	S5
Petasite palmatus	palmate-leaved coltsfoot	S5
Petasites frigidus var. *sagittatus*	arrow-leaved coltsfoot	S5
Phleum pratense	timothy	SNA
Phragmites australis	common reed grass	S5
Physostegia virginiana	false dragonhead	S4
Picea glauca	white spruce	S5
Picea mariana	black spruce	S5
Pinus banksiana	jackpine	S5
Plantago eriopoda	saline plantain	S3S4
Plantago major	common plantain	SNA
Poa palustris	fowl blue grass	S5
Poa pratensis	Kentucky blue grass	S5
Polygala senega	seneca root	S4
Polygaloides paucifolia	fringed milkwort	S4
Populus balsamifera	balsam poplar	S5
Populus tremuloides	trembling aspen	S5
Primula incana	mealy primrose	S4
Prunus pensylvanica	pin cherry	S5
Prunus virginiana	chokecherry	S5
Quercus macrocarpa	burr oak	S5
Ranunculus abortivus	small flowered buttercup	S5

Table 8.2A-5 Plant Species Inventory from the 2016 Field Surveys

Scientific Name[1]	Common Name	Provincial Rank
Ranunculus acris	meadow buttercup	SNA
Ranunculus gmelinii	yellow water crowfoot	S5
Ranunculus macounii	Macoun's buttercup	S5
Ranunculus sceleratus	celery-leaved buttercup	S5
Rhamnus alnifolia	alder leaved buckthorn	S5
Rhododendron groenlandicum	Labrador tea	S5
Ribes americanum	wild black currant	S5
Ribes hudsonianum	northern black currant	S5
Ribes lacustre	black gooseberry	S4
Ribes triste	wild red current	S5
Rosa acicularis	prickly rose	S5
Rubus arcticus	dwarf raspberry	S5
Rubus chamaemorus	cloudberry	S5
Rubus idaeus	raspberry	S5
Rubus pubescens	dewberry	S5
Rudbeckia hirta	black-eyed susan	S5
Rumex occidentalis	western dock	S4S5
Salicornia rubra	red samphire	S4
Salix bebbiana	beaked willow	S5
Salix exigua	sandbar willow	S5
Salix lutea	yellow willow	S2S3
Salix myrtillifolia	myrtle leaved willow	S5
Salix pedicellaris	bog willow	S5
Salix spp.	Willow	NR
Sanicula marilandica	black sanicle	S5
Sarracenia purpurea	pitcher plant	S4S5
Schizachne purpurascens	false melic grass	S5
Schoenoplectus acutus	hardstem bulrush	S4
Schoenoplectus tabernaemontani	softstem bulrush	S5
Scirpus cyperinus	Woolgrass	S4S5
Scutellaria galericulata	marsh skullcap	S5
Sisyrinchium montanum	common blue-eyed grass	S5
Sium suave	water parsnip	S5
Solidago canadensis	Canada goldenrod	S5
Solidago graminifolia	flat top goldenrod	S5

Table 8.2A-5 Plant Species Inventory from the 2016 Field Surveys

Scientific Name[1]	Common Name	Provincial Rank
Solidago rigida	stiff goldenrod	S5
Sonchus arvensis	perennial sow thistle	SNA
Sphagnum spp.	sphagnum moss	NR
Stellaria calycantha	northern stitchwort	NR
Symphoricarpos albus	common snowberry	S4S5
Symphyotrichum ericoides	many-flowered aster	S4
Symphyotrichum laeve	smooth blue aster	S5
Taraxacum officinale	common dandelion	SNA
Tephroseris palustris	marsh ragwort	S4S5
Thalictrum dasycarpum	tall meadow rue	S5
Thalictrum venulosum	veiny meadow rue	S5
Trientalis borealis	northern star flower	NR
Trifolium hybridum	alsike clover	SNA
Trifolium pratense	red clover	SNA
Triglochin maritima	seaside arrow grass	S5
Tripleurospermum perforata	scentless chamomile	SNA
Typha latifolia	common cattail	S4S5
Ulmus americana	American elm	S4S5
Urtica dioica	stinging nettle	S5
Vaccinium oxycoccos	small bog cranberry	S5
Vaccinium vitis-idaea	lingonberry	S5
Valeriana dioica	northern valerian	S4
Viburnum edule	low-bush cranberry	S5
Viburnum rafinesqueanum	downy arrowwood	S4S5
Viburnum spp.	viburnum spp.	NR
Vicia americana	american vetch	S5
Viola adunca	early blue violet	S5
Viola canadensis	Canadian white violet	S5
Viola palustris	marsh violet	S4

[1] Naming convention follows MBCDC 2018.

Table Error! No text of specified style in document.**A-6 Plant Species of Interest to Indigenous Groups from Literature Review**

Traditionally Used Name[1]	Scientific Name[2]	Provincial Rank[3]	Observed During 2016 Field Surveys	Upland or Wetland
alumroot	*Heuchera richardsonii*	S5	-	upland
American hazelnut	*Corylus americana*	S4	-	upland
asparagus	*Asparagus officinalis*	SNA	-	upland
balsam fir	*Abies balsamea*	S5	x	upland
balsam poplar	*Populus balsamifera*	S5	x	upland
baneberry	*Actaea rubra*	S5	x	upland
beaked hazelnut	*Corylus cornuta*	S5	x	upland
Bicknell's geranium	*Geranium bicknellii*	S5	-	upland
blackberry	*Rubus* sp.	S5	x	upland
blueberry	*Vaccinium angustifolium*	S4	-	upland
bog blueberry	*Vaccinium uliginosum*	S5	-	wetland
bracken (fiddlehead)	*Pteridium aquilinum*	S3S4	-	upland
bunchberry	*Cornus canadensis*	S5	x	upland
bur oak	*Quercus macrocarpa*	S5	x	upland
Canada fleabane	*Erigeron canadensis*	S5	-	tame pasture, cultivated
Canada goldenrod	*Solidago canadensis*	S5	x	upland
Canada mayflower	*Maianthemum canadense*	S5	x	wetland
Canada wild plum	*Prunus nigra*	S4	-	upland
Canadian gooseberry	*Ribes oxyacanthoides*	S5	-	upland
cedar	*Thuja occidentalis*	S4?	-	upland
choke cherry	*Prunus virginiana*	S5	x	upland
cloud berry	*Rubus chamaemorus*	S5	x	wetland
columbine	*Aquilegia* sp.	S4, S5	-	upland
common bearberry	*Arctostaphylos uva-ursi*	S5	x	upland
common milkweed	*Asclepias syriaca*	S3S4	x	upland
cranberry	*Vaccinium macrocarpon*	not in MB	-	residential
dandelion	*Taraxacum officinale*	SNA	x	upland
dewberry	*Rubus pubescens*	S5	x	upland
dogbane	*Apocynum androsaemifolium*	S5	x	upland
downy arrow-wood	*Viburnum rafinesquianum*	S4S5	x	upland
dwarf birch	*Betula pumila*	S5	-	upland
dwarf blueberry	*Vaccinium caespitosum*	S3	-	upland
dwarf blueberry	*Vaccinium myrtilloides*	S5	-	upland

Table Error! No text of specified style in document.**A-6 Plant Species of Interest to Indigenous Groups from Literature Review**

Traditionally Used Name[1]	**Scientific Name[2]**	**Provincial Rank[3]**	**Observed During 2016 Field Surveys**	**Upland or Wetland**
fireweed	*Chamerion angustifolium*	S5	x	upland
giant hyssop	*Agastache foeniculum*	S5	-	upland
harebell	*Campanula* sp.	S1, S5, SNA	x	upland
hawthorn	*Crataegus* sp.	S3S4, S4S5, SNR	-	upland
hemp	*Cannabis sativa*	SNA	-	cultivated
highbush cranberry	*Viburnum opulus*	S5	-	upland
jackpine	*Pinus banksiana*	S5	x	upland
Labrador tea	*Rhododendron groenlandicum*	S5	x	upland
Labrador tea	*Rhododendron* spp.	S2?, S3S5,	-	upland
lingonberry, lowbush cranberry, “redberry”	*Vaccinium vitis-idaea*	S5	x	upland
Manitoba maple	*Acer negundo*	S5	x	upland
marsh hedge-nettle	*Stachys pilosa* var. *pilosa*	S4	-	wetland
marsh marigold	*Caltha palustris*	S5	x	wetland
marsh/bog Labrador tea	*Rhododendron tomentosum*	S3S5	-	wetland
meadowsweet	*Spiraea alba*	S5	-	upland
northern bugle-weed	*Lycopus uniflorus*	S4S5	x	wetland
paper birch	*Betula papyrifera*	S5	x	upland
pin cherry	*Prunus pensylvanica*	S5	x	upland
plum	*Prunus americana*	S3S4	-	upland
plum	*Prunus* sp.	S3 - S5	x	upland
prairie rose	*Rosa arkansana*	S4	-	upland
raspberry	*Rubus idaeus*	S5	x	upland
rattlesnake root	*Prenanthes* sp. *(Nabalus* sp.*)*	S4, S5	-	upland
red clover	*Trifolium pratense*	SNA	x	upland
red currant	*Ribes triste*	S5	x	upland
red osier dogwood	*Cornus sericea*	S5	x	upland
sage	*Artemisia* sp.	S1 - S5, SNA	x	upland
sand cherry	*Prunus pumila*	S4S5	-	upland
saskatoon berry	*Amelanchier alnifolia*	S5	x	upland
self-heal	*Prunella vulgaris*	S4	-	upland
seneca	*Polygala senega*	S4	x	upland

Table Error! No text of specified style in document.**A-6 Plant Species of Interest to Indigenous Groups from Literature Review**

Traditionally Used Name[1]	Scientific Name[2]	Provincial Rank[3]	Observed During 2016 Field Surveys	Upland or Wetland
shrubby cinquefoil	*Dasiphora fruticosa*	S5	x	upland
smooth goldenrod	*Solidago gigantea*	S5	-	upland
snowberry	*Symphoricarpos albus*	S4S5	x	upland
speckled alder	*Alnus incana*	S5	x	wetland
St. John's wort	*Hypericum perforatum*	SNA	-	upland
strawberry	*Fragaria vesca*	S4S5	x	wetland
swamp milkweed	*Asclepias incarnata*	S3S4	-	wetland
sweet grass	*Anthoxanthum monticola* ssp. *alpinum (Hierochloe odorata)*	S1S2	x	wetland
tall cinquefoil	*Drymocallis arguta*	S5	-	upland
tamarack	*Larix laricina*	S5	x	wetland
three-toothed cinquefoil	*Sibbaldiopsis tridentata*	S5	-	upland
weke	*Acorus americanus*	S4S5	-	wetland
wild black currant	*Ribes americanum*	S5	x	upland
wild ginger	*Asarum canadense*	S3S4	-	upland
wild grapes	*Vitis riparia*	S3S4	-	wetland
wild mint	*Mentha* sp.	S5, SNA	-	wetland
wild rice	*Zizania palustris*	S3S5	-	wetland
wild rose	*Rosa* sp.	S4, S5, SNA	x	upland
wild sarsaparilla	*Aralia nudicaulis*	S5	-	upland
wild strawberry	*Fragaria virginiana*	S5	x	wetland
wintergreen	*Pyrola* sp.	S2?, S3S4, S4S5, S5	-	upland
wood lily	*Lilium philadelphicum*	S4	-	upland
yarrow	*Achillea millefolium*	S5	x	upland
yellow avens	*Geum aleppicum*	S5	-	upland
yellow evening primrose	*Oenothera flava*	SU	-	upland

[1]Traditional names are those listed in the following sources (AMEC Earth & Environmental 2009, AMEC Earth & Environmental 2010, MacPherson Leslie & Tyerman LLP Lawyers 2011, Enbridge 2012, Trans Mountain Pipeline ULC 2013, National Energy Board 2015, Riversdale Resources 2015, Tsuut'ina Nation 2016 and Energy East Pipeline Ltd. 2016) that have the potential to occur within the RAA .
[2] Scientific names are inferred based on Moss 1983, Marles et al. 2000, Royer and Dickenson 2006 and professional judgement and then updated to the MBCDC naming convention.
[3] MBCDC 2018.

Table 8.2A-7 Change in Native Vegetation Patch Metrics for the RAA

Land Cover	Number of Large[1] Patches		Patch Area (ha)								Patch Perimeter (km)							
			Mean		Minimum[3]		Maximum		SD		Mean		Minimum		Maximum		SD	
	Existing Conditions	Construction	Existing Conditions	Construction	Existing Conditions	Construction	Existing Conditions	Construction	Existing Conditions	Construction	Existing Conditions	Construction	Existing Conditions	Construction	Existing Conditions	Construction	Existing Conditions	Construction
Forest	15	15	8.53	8.56	0.01	0.01	7,493.28	7,493.28	115.19	115.59	1.29	1.28	0.06	0.06	409.90	409.90	7.39	7.39
Shrubland	0	0	2.49	2.16	0.01	0.01	13.35	13.35	3.34	3.03	2.13	1.55	0.04	0.04	16.02	10.82	3.23	2.13
Grassland[2]	157	157	42.26	42.32	0.02	0.02	2,505.25	2,505.25	170.33	170.46	3.86	3.86	0.07	0.07	167.04	167.04	12.13	12.14
Wetland	91	107	24.22	25.41	0.01	0.01	87,809.36	87,109.30	1,201.12	1,225.06	1.85	1.91	0.07	0.07	4,111.29	4,081.32	56.48	57.59

Note:
[1] Large equals 200 ha, minus a 100 m strip, for forested patches and 50 ha for grassland, shrubland and wetland patches.
[2] Areas identified in LCC data are likely tame pasture or hayland.
[3] Minimum map unit equals 0.01 ha.

Table 8.3A-1 Bird Species with Potential to Occur in the RAA1

Common Name	Scientific Name	Potential to Breed in the RAA[2]	Group	MBCA[3]
Greater White-fronted Goose	*Anser albifrons*	N	Waterfowl	Y
Cackling goose	*Branta hutchinsii*	N	Waterfowl	Y
Canada goose	*Branta canadensis*	Y	Waterfowl	Y
Trumpeter swan	*Cygnus buccinator*	Y	Waterfowl	Y
Tundra swan	*Cygnus columbianus*	N	Waterfowl	Y
Wood duck	*Aix sponsa*	Y	Waterfowl	Y
American black duck	*Anas rubripes*	Y	Waterfowl	Y
Mallard	*Anas platyrhynchos*	Y	Waterfowl	Y
Northern pintail	*Anas acuta*	Y	Waterfowl	Y
Green-winged teal	*Anas crecca*	Y	Waterfowl	Y
Canvasback	*Aythya valisineria*	Y	Waterfowl	Y
Redhead	*Aythya americana*	Y	Waterfowl	Y
Ring-necked duck	*Aythya collaris*	Y	Waterfowl	Y
Greater scaup	*Aythya marila*	Y	Waterfowl	Y
Lesser scaup	*Aythya affinis*	Y	Waterfowl	Y
Bufflehead	*Bucephala albeola*	Y	Waterfowl	Y
Common goldeneye	*Bucephala clangula*	Y	Waterfowl	Y
Hooded merganser	*Lophodytes cucullatus*	Y	Waterfowl	Y
Common merganser	*Mergus merganser*	Y	Waterfowl	Y
Red-breasted merganser	*Mergus serrator*	Y	Waterfowl	Y
Ruddy duck	*Oxyura jamaicensis*	Y	Waterfowl	Y
Gray partridge	*Perdix perdix*	Y	Upland	N
Ruffed grouse	*Bonasa umbellus*	Y	Upland	N
Spruce grouse	*Falcipennis canadensis*	Y	Upland	N
Sharp-tailed grouse	*Tympanuchus phasianellus*	Y	Upland	N
Common loon	*Gavia immer*	Y	Waterbird	Y
Pied-billed grebe	*Podilymbus podiceps*	Y	Waterbird	Y
Western grebe	*Aechmophorus occidentalis*	Y	Waterbird	Y
American white pelican	*Pelecanus erythrorhynchos*	Y	Waterbird	N
Double-crested cormorant	*Phalacrocorax auritus*	Y	Waterbird	N
American bittern	*Botaurus lentiginosus*	Y	Waterbird	Y
Least bittern	*Ixobrychus exilis*	Y	Waterbird	Y
Great blue heron	*Ardea herodias*	Y	Waterbird	Y

Table 8.3A-1 Bird Species with Potential to Occur in the RAA1

Common Name	Scientific Name	Potential to Breed in the RAA[2]	Group	MBCA[3]
Great egret	*Ardea alba*	Y	Waterbird	Y
Black-crowned night-heron	*Nycticorax nycticorax*	Y	Waterbird	Y
Bald eagle	*Haliaeetus leucocephalus*	Y	Raptor	N
Northern harrier	*Circus hudsonius*	Y	Raptor	N
Sharp-shinned hawk	*Accipiter striatus*	Y	Raptor	N
Cooper's hawk	*Accipiter cooperii*	Y	Raptor	N
Northern goshawk	*Accipiter gentilis*	Y	Raptor	N
Broad-winged hawk	*Buteo platypterus*	Y	Raptor	N
Red-tailed hawk	*Buteo jamaicensis*	Y	Raptor	N
Rough-legged hawk	*Buteo lagopus*	N	Raptor	N
American kestrel	*Falco sparverius*	Y	Raptor	N
Merlin	*Falco columbarius*	Y	Raptor	N
Yellow rail	*Coturnicops noveboracensis*	Y	Waterbird	Y
Virginia rail	*Rallus limicola*	Y	Waterbird	Y
Sora	*Porzana carolina*	Y	Waterbird	Y
American coot	*Fulica americana*	Y	Waterbird	Y
Sandhill crane	*Antigone canadensis*	Y	Waterbird	Y
Black-bellied plover	*Pluvialis squatarola*	N	Shorebird	Y
American golden-plover	*Pluvialis dominica*	N	Shorebird	Y
Semipalmated plover	*Charadrius semipalmatus*	N	Shorebird	Y
Piping plover	*Charadrius melodus*	Y	Shorebird	Y
Killdeer	*Charadrius vociferus*	Y	Shorebird	Y
American avocet	*Recurvirostra americana*	Y	Shorebird	Y
Spotted sandpiper	*Actitis macularius*	Y	Shorebird	Y
Solitary sandpiper	*Tringa solitaria*	Y	Shorebird	Y
Greater yellowlegs	*Tringa melanoleuca*	N	Shorebird	Y
Lesser yellowlegs	*Tringa flavipes*	N	Shorebird	Y
Upland sandpiper	*Bartramia longicauda*	Y	Shorebird	Y
Whimbrel	*Numenius phaeopus*	Y	Shorebird	Y
Hudsonian godwit	*Limosa haemastica*	N	Shorebird	Y
Marbled godwit	*Limosa fedoa*	Y	Shorebird	Y
Ruddy turnstone	*Arenaria interpres*	N	Shorebird	Y
Red knot	*Calidris canutus*	N	Shorebird	Y

Table 8.3A-1 Bird Species with Potential to Occur in the RAA1

Common Name	Scientific Name	Potential to Breed in the RAA[2]	Group	MBCA[3]
Sanderling	*Calidris alba*	N	Shorebird	Y
Semipalmated sandpiper	*Calidris pusilla*	N	Shorebird	Y
Least sandpiper	*Calidris minutilla*	N	Shorebird	Y
White-rumped sandpiper	*Calidris fuscicollis*	N	Shorebird	Y
Pectoral sandpiper	*Calidris melanotos*	N	Shorebird	Y
Dunlin	*Calidris alpina*	N	Shorebird	Y
Stilt sandpiper	*Calidris himantopus*	N	Shorebird	Y
Short-billed dowitcher	*Limnodromus griseus*	N	Shorebird	Y
Long-billed dowitcher	*Limnodromus scolopaceus*	N	Shorebird	Y
Wilson's snipe	*Gallinago delicata*	Y	Shorebird	Y
American woodcock	*Scolopax minor*	Y	Shorebird	Y
Wilson's phalarope	*Phalaropus tricolor*	Y	Shorebird	Y
Red-necked phalarope	*Phalaropus lobatus*	N	Shorebird	Y
Ring-billed gull	*Larus delawarensis*	Y	Shorebird	Y
Herring gull	*Larus argentatus*	Y	Shorebird	Y
Franklin's gull	*Leucophaeus pipixcan*	Y	Shorebird	Y
Caspian tern	*Hydroprogne caspia*	Y	Shorebird	Y
Black tern	*Chlidonias niger*	Y	Shorebird	Y
Common tern	*Sterna hirundo*	Y	Shorebird	Y
Forster's tern	*Sterna forsteri*	Y	Shorebird	Y
Parasitic jaeger	*Stercorarius parasiticus*	N	Shorebird	Y
Rock pigeon	*Columba livia*	Y	Passerine	Y
Mourning dove	*Zenaida macroura*	Y	Passerine	Y
Black-billed cuckoo	*Coccyzus erythropthalmus*	Y	Passerine	Y
Great horned owl	*Bubo virginianus*	Y	Raptor	N
Northern hawk owl	*Surnia ulula*	Y	Raptor	N
Barred owl	*Strix varia*	Y	Raptor	N
Great gray owl	*Strix nebulosa*	Y	Raptor	N
Long-eared owl	*Asio otus*	Y	Raptor	N
Short-eared owl	*Asio flammeus*	Y	Raptor	N
Boreal owl	*Aegolius funereus*	Y	Raptor	N
Northern saw-whet owl	*Aegolius acadicus*	Y	Raptor	N
Common nighthawk	*Chordeiles minor*	Y	Nightjar	Y

Table 8.3A-1 Bird Species with Potential to Occur in the RAA1

Common Name	Scientific Name	Potential to Breed in the RAA[2]	Group	MBCA[3]
Eastern whip-poor-will	*Antrostomus vociferus*	Y	Nightjar	Y
Ruby-throated hummingbird	*Archilochus colubris*	Y	Passerine	Y
Belted kingfisher	*Megaceryle alcyon*	Y	Passerine	N
Yellow-bellied sapsucker	*Sphyrapicus varius*	Y	Passerine	Y
Downy woodpecker	*Dryobates pubescens*	Y	Passerine	Y
American three-toed woodpecker	*Picoides dorsalis*	Y	Passerine	Y
Black-backed woodpecker	*Picoides arcticus*	Y	Passerine	Y
Northern flicker	*Colaptes auratus*	Y	Passerine	Y
Pileated woodpecker	*Dryocopus pileatus*	Y	Passerine	Y
Olive-sided flycatcher	*Contopus cooperi*	Y	Passerine	Y
Eastern wood-pewee	*Contopus virens*	Y	Passerine	Y
Yellow-bellied flycatcher	*Empidonax flaviventris*	Y	Passerine	Y
Alder flycatcher	*Empidonax alnorum*	Y	Passerine	Y
Least flycatcher	*Empidonax minimus*	Y	Passerine	Y
Eastern phoebe	*Sayornis phoebe*	Y	Passerine	Y
Great crested flycatcher	*Myiarchus crinitus*	Y	Passerine	Y
Eastern kingbird	*Tyrannus tyrannus*	Y	Passerine	Y
Blue-headed vireo	*Vireo solitarius*	Y	Passerine	Y
Warbling vireo	*Vireo gilvus*	Y	Passerine	Y
Philadelphia vireo	*Vireo philadelphicus*	Y	Passerine	Y
Red-eyed vireo	*Vireo olivaceus*	Y	Passerine	Y
Blue jay	*Cyanocitta cristata*	Y	Passerine	N
Black-billed magpie	*Pica hudsonia*	Y	Passerine	N
American crow	*Corvus brachyrhynchos*	Y	Passerine	N
Common raven	*Corvus corax*	Y	Passerine	Y
Horned lark	*Eremophila alpestris*	Y	Passerine	Y
Tree swallow	*Tachycineta bicolor*	Y	Passerine	Y
Bank swallow	*Riparia riparia*	Y	Passerine	Y
Cliff swallow	*Petrochelidon pyrrhonota*	Y	Passerine	Y
Barn swallow	*Hirundo rustica*	Y	Passerine	Y
Black-capped chickadee	*Poecile atricapillus*	Y	Passerine	Y
Boreal chickadee	*Poecile hudsonicus*	Y	Passerine	Y
Red-breasted nuthatch	*Sitta canadensis*	Y	Passerine	Y

Table 8.3A-1 Bird Species with Potential to Occur in the RAA1

Common Name	Scientific Name	Potential to Breed in the RAA[2]	Group	MBCA[3]
White-breasted nuthatch	*Sitta carolinensis*	Y	Passerine	Y
Brown creeper	*Certhia americana*	Y	Passerine	Y
Sedge wren	*Cistothorus platensis*	Y	Passerine	Y
Marsh wren	*Cistothorus palustris*	Y	Passerine	Y
Golden-crowned kinglet	*Regulus satrapa*	Y	Passerine	Y
Ruby-crowned kinglet	*Regulus calendula*	Y	Passerine	Y
Eastern bluebird	*Sialia sialis*	Y	Passerine	Y
Mountain bluebird	*Sialia currucoides*	Y	Passerine	Y
Veery	*Catharus fuscescens*	Y	Passerine	Y
Gray-cheeked thrush	*Catharus minimus*	N	Passerine	Y
Swainson's thrush	*Catharus ustulatus*	Y	Passerine	Y
Hermit thrush	*Catharus guttatus*	Y	Passerine	Y
American robin	*Turdus migratorius*	Y	Passerine	Y
Gray catbird	*Dumetella carolinensis*	Y	Passerine	Y
Brown thrasher	*Toxostoma rufum*	Y	Passerine	Y
European starling	*Sturnus vulgaris*	Y	Passerine	N
American pipit	*Anthus rubescens*	Y	Passerine	Y
Cedar waxwing	*Bombycilla cedrorum*	Y	Passerine	Y
Golden-winged warbler	*Vermivora chrysoptera*	Y	Passerine	Y
Tennessee warbler	*Oreothlypis peregrina*	Y	Passerine	Y
Orange-crowned warbler	*Oreothlypis celata*	Y	Passerine	Y
Nashville warbler	*Oreothlypis ruficapilla*	Y	Passerine	Y
Yellow warbler	*Setophaga petechia*	Y	Passerine	Y
Chestnut-sided warbler	*Setophaga pensylvanica*	Y	Passerine	Y
Magnolia warbler	*Setophaga magnolia*	Y	Passerine	Y
Cape may warbler	*Setophaga tigrina*	Y	Passerine	Y
Yellow-rumped warbler	*Setophaga coronata*	Y	Passerine	Y
Black-throated green warbler	*Setophaga virens*	Y	Passerine	Y
Blackburnian warbler	*Setophaga fusca*	Y	Passerine	Y
Palm warbler	*Setophaga palmarum*	Y	Passerine	Y
Bay-breasted warbler	*Setophaga castanea*	Y	Passerine	Y
Blackpoll warbler	*Setophaga striata*	Y	Passerine	Y
Black-and-white warbler	*Mniotilta varia*	Y	Passerine	Y

Table 8.3A-1 Bird Species with Potential to Occur in the RAA1

Common Name	Scientific Name	Potential to Breed in the RAA[2]	Group	MBCA[3]
American redstart	*Setophaga ruticilla*	Y	Passerine	Y
Ovenbird	*Seiurus aurocapilla*	Y	Passerine	Y
Northern waterthrush	*Parkesia noveboracensis*	Y	Passerine	Y
Connecticut warbler	*Oporornis agilis*	Y	Passerine	Y
Mourning warbler	*Geothlypis philadelphia*	Y	Passerine	Y
Common yellowthroat	*Geothlypis trichas*	Y	Passerine	Y
Wilson's warbler	*Cardellina pusilla*	Y	Passerine	Y
Canada warbler	*Cardellina canadensis*	Y	Passerine	Y
American tree sparrow	*Spizelloides arborea*	Y	Passerine	Y
Chipping sparrow	*Spizella passerina*	Y	Passerine	Y
Vesper sparrow	*Pooecetes gramineus*	Y	Passerine	Y
Savannah sparrow	*Passerculus sandwichensis*	Y	Passerine	Y
Fox sparrow	*Passerella iliaca*	Y	Passerine	Y
Song sparrow	*Melospiza melodia*	Y	Passerine	Y
Lincoln's sparrow	*Melospiza lincolnii*	Y	Passerine	Y
Swamp sparrow	*Melospiza georgiana*	Y	Passerine	Y
White-throated sparrow	*Zonotrichia albicollis*	Y	Passerine	Y
Harris's sparrow	*Zonotrichia querula*	N	Passerine	Y
White-crowned sparrow	*Zonotrichia leucophrys*	Y	Passerine	Y
Dark-eyed junco	*Junco hyemalis*	Y	Passerine	Y
Lapland longspur	*Calcarius lapponicus*	N	Passerine	Y
Rose-breasted grosbeak	*Pheucticus ludovicianus*	Y	Passerine	Y
Indigo bunting	*Passerina cyanea*	Y	Passerine	Y
Bobolink	*Dolichonyx oryzivorus*	Y	Passerine	Y
Red-winged blackbird	*Agelaius phoeniceus*	Y	Passerine	Y
Western meadowlark	*Sturnella neglecta*	Y	Passerine	Y
Yellow-headed blackbird	*Xanthocephalus xanthocephalus*	Y	Passerine	Y
Rusty blackbird	*Euphagus carolinus*	Y	Passerine	Y
Brewer's blackbird	*Euphagus cyanocephalus*	Y	Passerine	Y
Common grackle	*Quiscalus quiscula*	Y	Passerine	Y
Brown-headed cowbird	*Molothrus ater*	Y	Passerine	Y
Baltimore oriole	*Icterus galbula*	Y	Passerine	Y
Red crossbill	*Loxia curvirostra*	Y	Passerine	Y

Table 8.3A-1 Bird Species with Potential to Occur in the RAA1

Common Name	Scientific Name	Potential to Breed in the RAA[2]	Group	MBCA[3]
White-winged crossbill	*Loxia leucoptera*	Y	Passerine	Y
Pine siskin	*Spinus pinus*	Y	Passerine	Y
American goldfinch	*Spinus tristis*	Y	Passerine	Y
Evening grosbeak	*Coccothraustes vespertinus*	Y	Passerine	Y
House sparrow	*Passer domesticus*	Y	Passerine	N
Canada jay	*Perisoreus canadensis*	Y	Passerine	N
Eared grebe	*Podiceps nigricollis*	Y	Waterbird	Y
Horned grebe	*Podiceps auritus*	Y	Waterbird	Y
Red-necked grebe	*Podiceps grisegena*	Y	Waterbird	Y
Bonaparte's gull	*Chroicocephalus philadelphia*	Y	Waterbird	Y
Osprey	*Pandion haliaetus*	Y	Raptor	N
Clay-colored sparrow	*Spizella pallida*	Y	Passerine	Y
Winter wren	*Troglodytes hiemalis*	Y	Passerine	Y
Purple finch	*Haemorhous purpureus*	Y	Passerine	Y
House finch	*Haemorhous mexicanus*	Y	Passerine	Y
Buff-breasted sandpiper	*Calidris subruficollis*	N	Shorebird	Y
Snow goose	*Anser caerulescens*	N	Waterfowl	Y
Ross's goose	*Anser rossii*	N	Waterfowl	Y
Blue-winged teal	*Spatula discors*	Y	Waterfowl	Y
Northern shoveler	*Spatula clypeata*	Y	Waterfowl	Y
Gadwall	*Mareca strepera*	Y	Waterfowl	Y
American wigeon	*Mareca americana*	Y	Waterfowl	Y
Hairy woodpecker	*Dryobates villosus*	Y	Passerine	Y
Leconte's sparrow	*Ammospiza leconteii*	Y	Passerine	Y
Nelson's sparrow	*Ammospiza nelsoni*	Y	Passerine	Y
Red-headed woodpecker	*Melanerpes erythrocephalus*	Y	Passerine	Y

[1] – Manitoba Important Birding Area Program (2018)
[2] – Y = yes; N = no (i.e., migrates through the RSA)
[3] – Species protected under the Migratory Bird Convention Act, 1994 ()

Table 8.3A-2 Species at Risk and Species of Conservation Concern with the Potential to Occur in the RAA

Common Name	Scientific Name	SARA[1]	COSEWIC[1]	MESEA[2]	MBCDC[3]	Habitat Association
Mammals						
Northern myotis	*Myotis septentrionalis*	Endangered	Endangered	Endangered	S3S4N, S4B	Open Forest
American badger	*Taxidae taxus*	Special Concern	Special Concern	No Status	S4	Grassland
Wolverine	*Gulo gulo*	Special concern	Special concern	No Status	S3S4	Forest
Birds						
Trumpeter swan	*Cygnus buccinator*	No status	No status	Endangered	S1S2B	Wetland
Horned grebe	*Podiceps auratus*	No status	Special concern	No status	S3B	Wetland
Least bittern	*Ixobrychus exilis*	Threatened	Threatened	Endangered	S2S3B	Wetland
Yellow rail	*Coturnicops noveboracensis*	Special concern	Special concern	No status	S3S4B	Wetland
Piping plover	*Charadrius melodus*	Endangered	Endangered	Endangered	S1B	Riparian
Eastern whip-poor-will	*Antrostomus vociferous*	Threatened	Threatened	Threatened	S3B	Open Forest
Common nighthawk	*Chordeiles minor*	Threatened	Threatened	Threatened	S3B	Open Forest
Red-headed woodpecker	*Melanerpes erythrocephalus*	Threatened	Threatened	Threatened	S2B	Open Forest
Short-eared owl	*Asio flammeus*	Special concern	Special concern	Threatened	S2S3B	Grassland
Eastern wood-pewee	Contopus virens	No status	Special concern	No status	S4S5	Open forest
Olive-sided flycatcher	*Contopus cooperi*	Threatened	Threatened	Threatened	S3B	Open Forest
Bank swallow	*Riparia riparia*	Threatened	Threatened	No status	S4B	Riparian
Barn swallow	*Hirundo rustica*	Threatened	Threatened	No status	S4B	Grassland, farmland, wetland
Golden-winged warbler	*Vermivora chrysoptera*	Threatened	Threatened	Threatened	S3B	Open forest, forest edge
Bobolink	*Dolichonyx oryzivorus*	Threatened	Threatened	No status	S4B	Grassland

Table 8.3A-2 Species at Risk and Species of Conservation Concern with the Potential to Occur in the RAA

Common Name	Scientific Name	SARA[1]	COSEWIC[1]	MESEA[2]	MBCDC[3]	Habitat Association
Mammals						
Rusty blackbird	*Euphagus carolinus*	Special Concern	Special Concern	No Status	S4B2	Open forest
Evening grosbeak	*Coccothraustes vespertinus*	Special Concern	Special Concern	No Status	S3	Mature forest
Amphibians and Reptiles						
Northern leopard frog	*Lithobates pipiens*	Special concern	Special concern	No status	S4	Wetland
Snapping turtle	*Chelydra serpentina serpenine*	Special Concern	Special Concern	No status	S3	Wetland
Invertebrates						
Transverse lady beetle	*Coccinella transversoguttata*	No status	Special concern	No status	N/A	Forest, grassland, riparian
Yellow-banded bumble bee	*Bombus terricola*	Special Concern	Special concern	No status	N/A	Grassland, farmland, boreal forest

Notes:

[1] - Species listed under Schedule 1 of the Species at Risk Act (Government of Canada 2019a)

[2] - Species listed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2019)

[3] - Wildlife species at risk in Manitoba listed under the *Endangered Species and Ecosystems Act* (Government of Manitoba 2019a)

[4] - Manitoba Conservation Data Centre (MB CDC 2018); ranks are:

S = Province-wide status

1 = Very rare throughout its range or in the province (5 or fewer occurrences, or very few remaining individuals). May be especially vulnerable to extirpation.

2 = Rare throughout its range or in the province (6 to 20 occurrences). May be vulnerable to extirpation.

3 = Uncommon throughout its range or in the province (21 to 100 occurrences).

4 = Widespread, abundant, and apparently secure throughout its range or in the province, with many occurrences, but the element is of long-term concern (>100 occurrences).

5 = Demonstrably widespread, abundant, and secure throughout its range or in the province, and essentially impossible to eradicate under present conditions.

S#S# = Range of uncertainty about the exact rarity of the species.

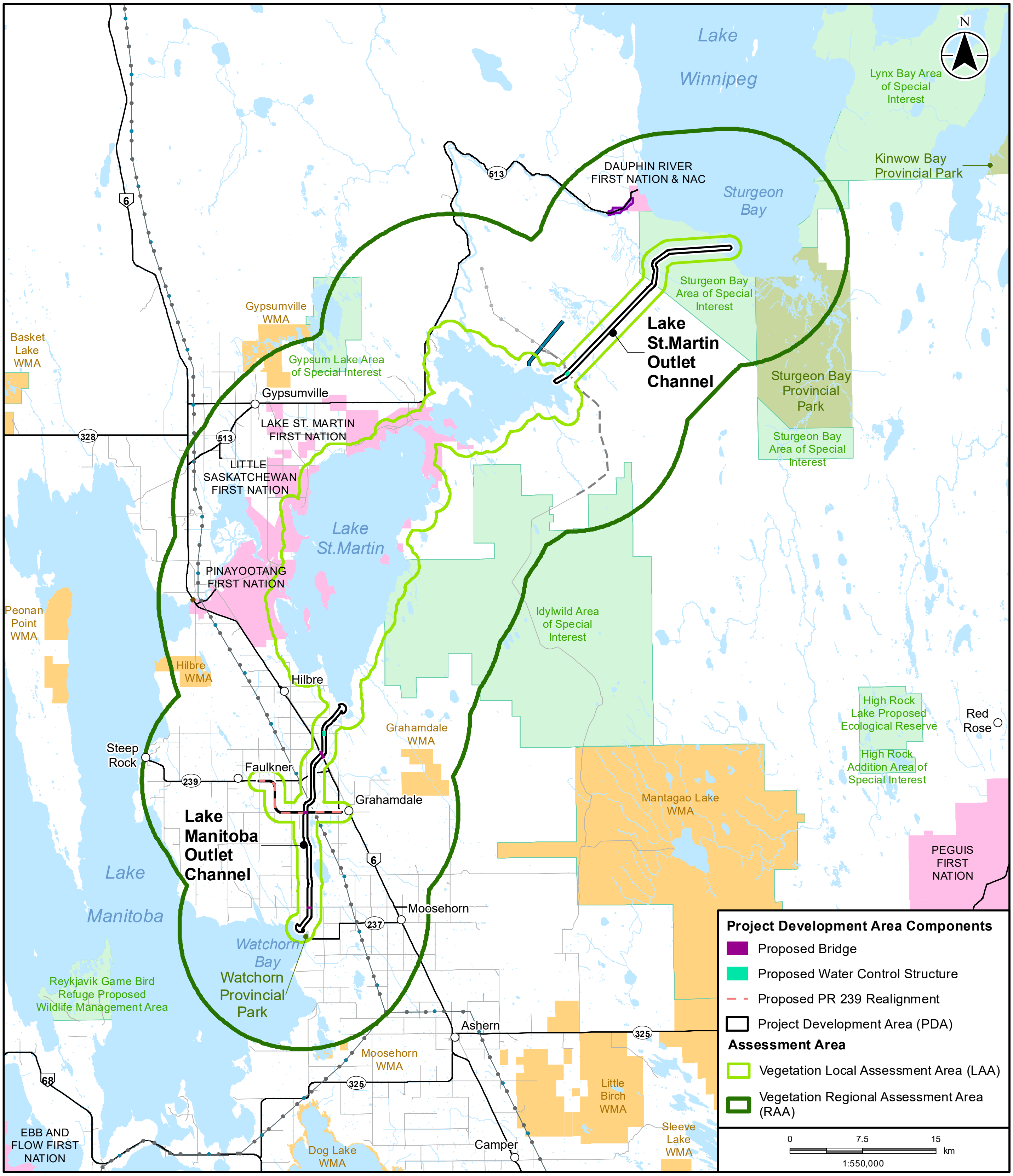
B = Breeding status of a migratory species.

N = Non-breeding status of a migratory species.

Appendix 8B FIGURES

LIST OF FIGURES

Figure 8.2B-1 Vegetation Spatial Boundaries B.2
Figure 8.2B-2 Large Native Vegetation Patches in the Vegetation RAA B.2
Figure 8.2B-3 Land Cover in the Vegetation LAA B.2
Figure 8.2B-4 Land Cover in the Vegetation RAA B.2
Figure 8.2B-5 Area Burned in the Vegetation LAA B.2
Figure 8.2B-6 SOCC Located in the PDA, LAA and RAA B.2
Figure 8.2B-7 Existing and Construction Phase Forest Patch Metrics B.3
Figure 8.2B-8 Existing and Construction Phase Shrubland Patch Metrics B.3
Figure 8.2B-9 Existing and Site Construction Phase Grassland Patch Metrics B.4
Figure 8.2B-10 Existing and Construction Phase Wetland Patch Metrics B.4
Figure 8.2B-11 Wetland Distribution and Human Disturbance in the Project Intersected Sub-Watersheds of the Lake Manitoba Outlet Channel B.5
Figure 8.2B-12 Wetland Distribution and Human Disturbance in the Project Intersected Sub-Watersheds of the Lake St. Martin Outlet Channel B.5
Figure 8.2B-13 Location of Stressed Vegetation in Relation to the Lake St. Martin EOC B.5
Figure 8.3B-1 Wildlife Spatial Boundaries B.6
Figure 8.3B-2 Ecodistricts B.6
Figure 8.3B-3 Game Hunting and Trapping Zones B.6
Figure 8.3B-4 Land Cover Classification B.6
Figure 8.3B-5 Notable Waterbodies B.6
Figure 8.3B-6 Designated Lands B.6
Figure 8.3B-7 North and South Interlake Elk Herds B.6
Figure 8.3B-8 Environmentally Sensitive Sites (IBA and Nests) B.6
Figure 8.3B-9 Critical Habitat for Bats (myotis) B.6
Figure 8.3B-10 Critical Habitat and Breeding Habitat for Eastern Whip-poor-will B.6
Figure 8.3B-11 Proposed Critical Habitat and Breeding Habitat for Red-headed Woodpecker B.6



Legend

- Fairford Water Control Structure
- Lake St.Martin Emergency Outlet Channel (Reach 1)
- Lake St. Martin Access Road
- Existing Transmission Line
- Existing Distribution Line
- Planned Distribution Line
- Provincial Highway (PTH/PR)
- Municipal Roads
- Northern Affairs Community
- First Nation
- Wildlife Management Area
- Provincial Park
- Areas of Special Interest

Notes
1. Coordinate System: NAD 1983 UTM Zone 14N
2. Data Sources: Governments of Manitoba and Canada, Manitoba Infrastructure
3. Last Update: 8/14/2019 9:45:24 AM

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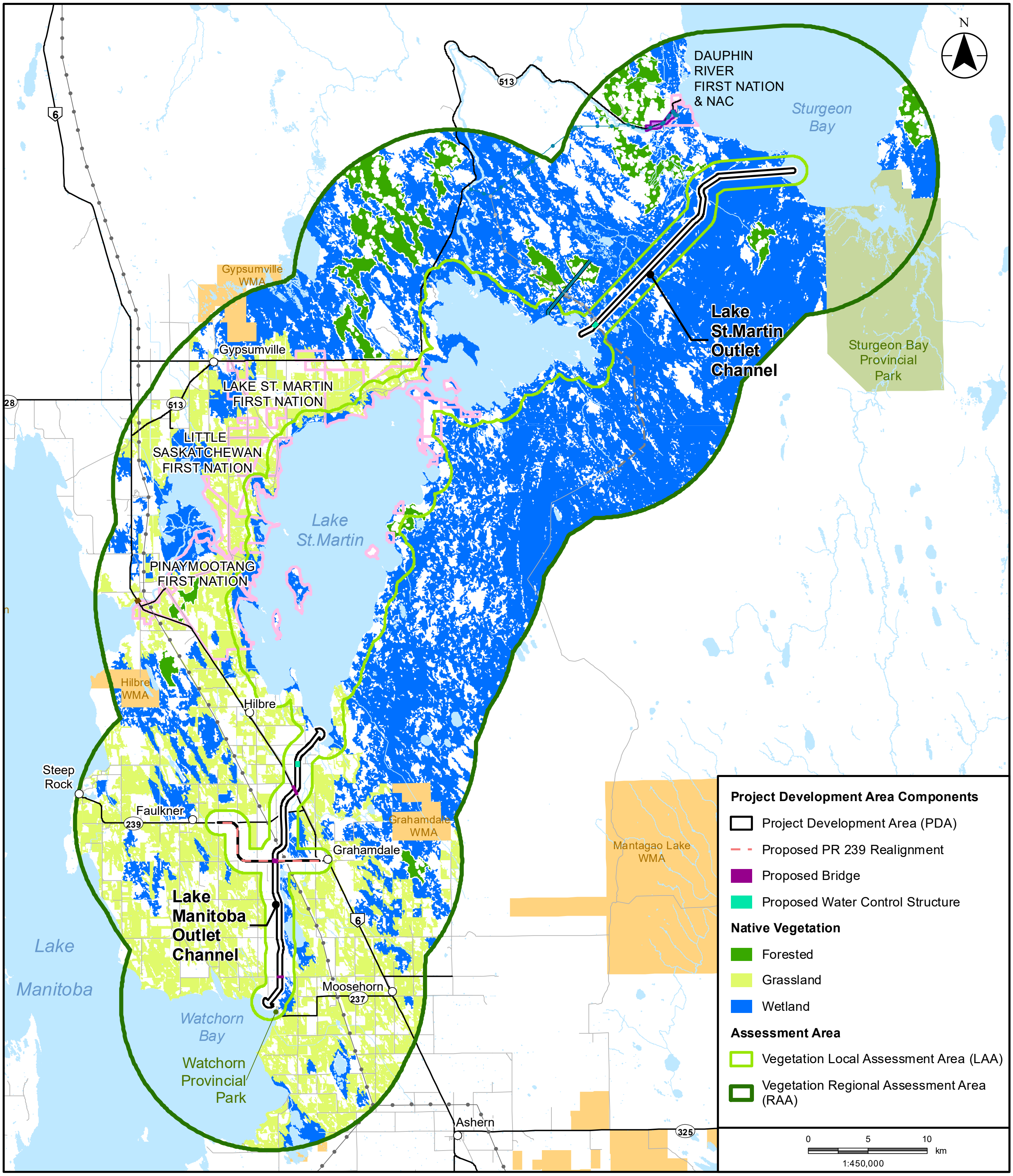
Environmental Impact Statement

Vegetation Spatial Boundaries

Figure 8.2B-1



Legend

- Fairford Water Control Structure
- Lake St.Martin Emergency Outlet Channel (Reach 1)
- Lake St. Martin Access Road
- Existing Transmission Line
- Existing Distribution Line
- Planned Distribution Line
- Provincial Highway (PTH/PR)
- Municipal Road
- Northern Affairs Community
- First Nation
- Provincial Park
- Wildlife Management Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 14N
2. Data Sources: Governments of Manitoba and Canada, Manitoba Infrastructure
3. Last Update: 8/14/2019 9:53:17 AM

G:_GIS_Project_Folder\1114751201\figures\Ch8_Terrestrial_Environment\Final\Fig 8.2B-2 TERR Vegetation Large Native Patches in the RAA.mxd

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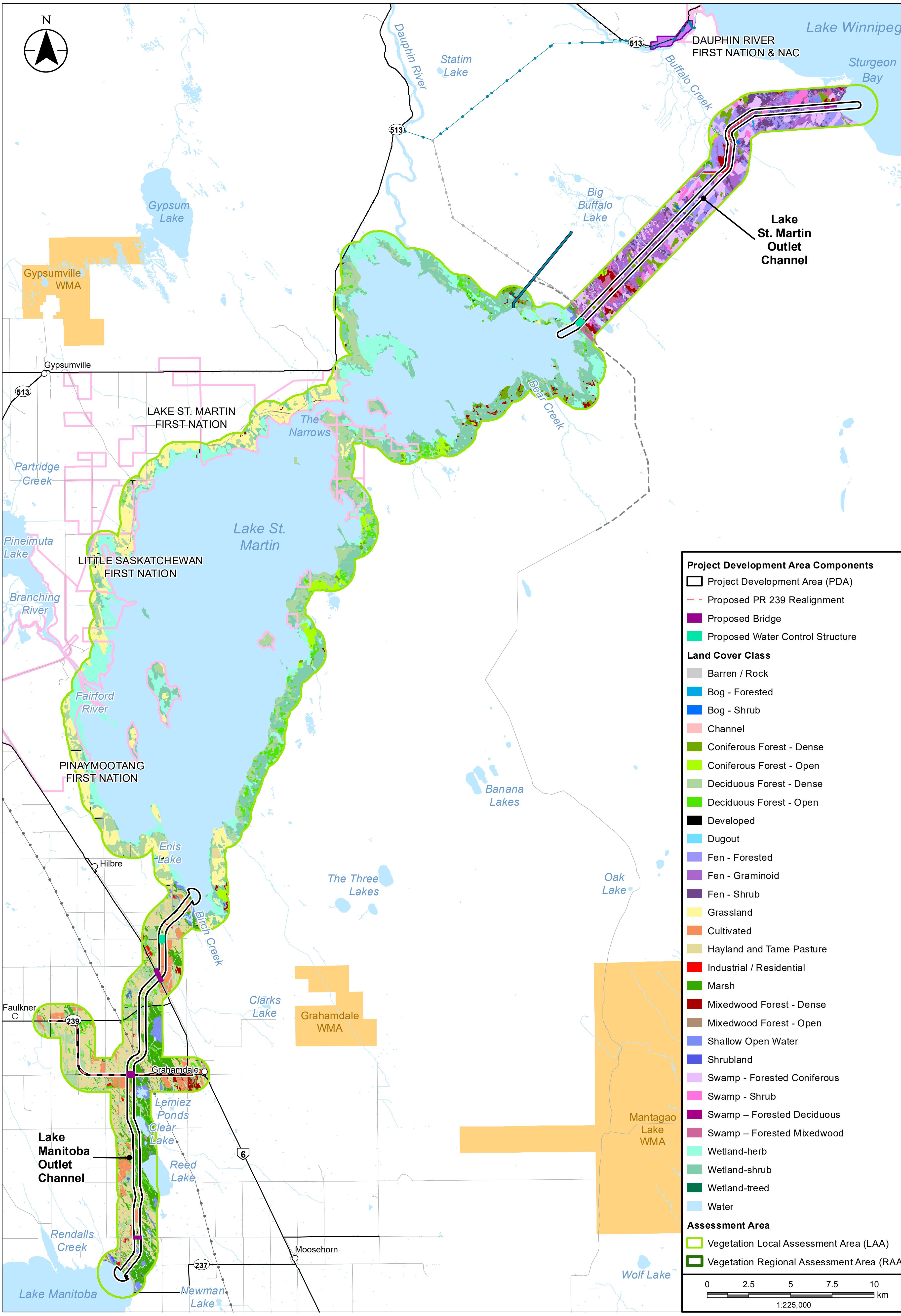
Lake Manitoba & Lake St.Martin Outlet Channels Project
Environmental Impact Statement

Large Native Vegetation Patches in the Vegetation RAA

Figure 8.2B-2



Legend

- Lake St.Martin Emergency Outlet Channel (Reach 1)
- Lake St. Martin Access Road
- Existing Transmission Line
- Existing Distribution Line
- Planned Distribution Line
- Municipal Road
- Provincial Highway (PTH/PR)
- First Nation
- Northern Affairs Community (NAC)
- Provincial Park
- Wildlife Management Area

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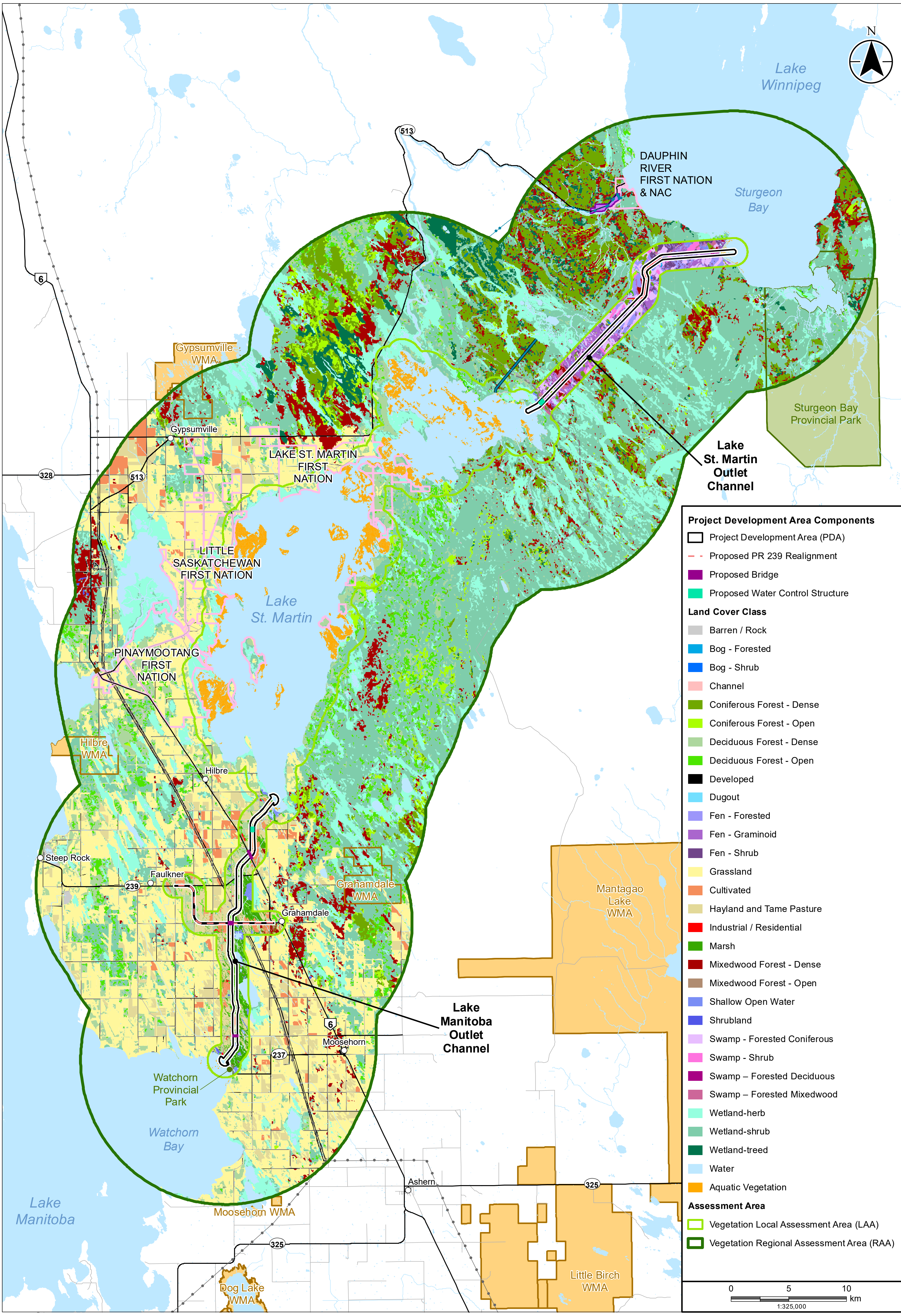
Environmental Impact Statement

Land Cover in the Vegetation LAA

Figure 8.2B-3

Notes
1. Coordinate System: NAD 1983 UTM Zone 14N
2. Data Sources: Governments of Manitoba and Canada, Manitoba Infrastructure
3. : Last Update: 8/14/2019 10:12:32 AM

G:_GIS_Project_Folder\1114751201\figures\Ch8_Terrestrial_Environment\Final\Fig 8.2B-3 TERR Vegetation Land Cover in the LAA.mxd Revised: 2019-08-14



Legend

- Fairford Water Control Structure
- Lake St.Martin Emergency Outlet Channel (Reach 1)
- Lake St. Martin Access Road
- Existing Transmission Line
- Existing Distribution Line
- Planned Distribution Line
- Municipal Road
- Provincial Highway (PTH/PR)
- First Nation
- Northern Affairs Community
- Provincial Park
- Wildlife Management

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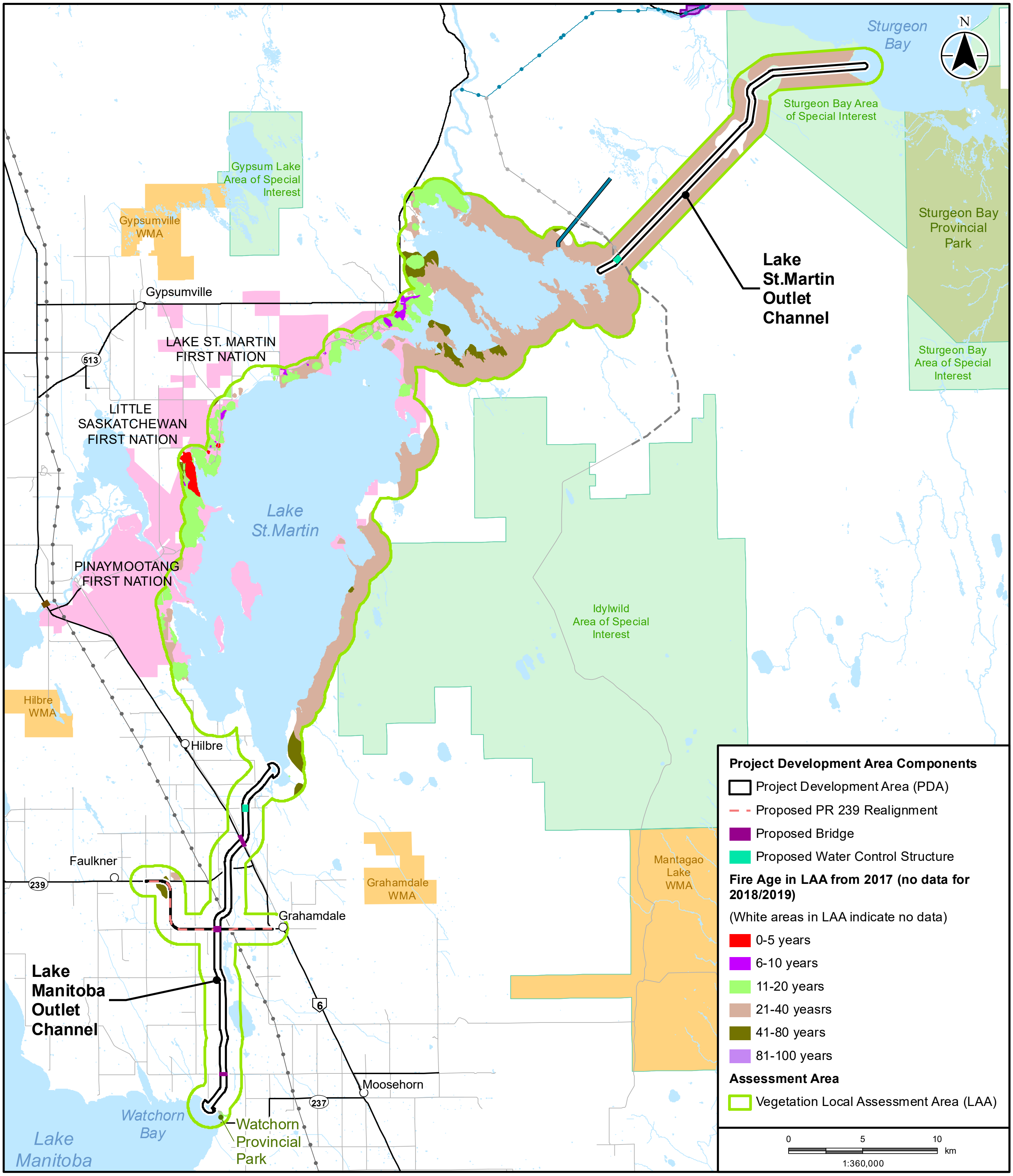
Environmental Impact Statement

Land Cover in the Vegetation RAA

Notes
1. Coordinate System: NAD 1983 UTM Zone 14N
2. Data Sources: Governments of Manitoba and Canada, Manitoba Infrastructure
3. : Last Update: 8/13/2019 4:33:40 PM

Figure 8.2B-4

G:_GIS_Project_Folder\111475120\figures\Ch8_Terrestrial_Environment\Final\Fig 8.2B-4 TERR Vegetation Land Cover in the RAA.mxd Revised: 2019-08-14 By: JHiebert



Legend

- Fairford Water Control Structure
- Lake St.Martin Emergency Outlet Channel (Reach 1)
- Lake St. Martin Access Road
- Existing Transmission Line
- Existing Distribution Line
- Planned Distribution Line
- Provincial Highway (PTH/PR)
- Municipal Road
- First Nation
- Northern Affairs Community (NAC)
- Provincial Park
- Wildlife Management Area
- Areas of Special Interest

Notes
1. Coordinate System: NAD 1983 UTM Zone 14N
2. Data Sources: Governments of Manitoba and Canada, Manitoba Infrastructure
3. Last Update: 8/14/2019 9:12:48 AM

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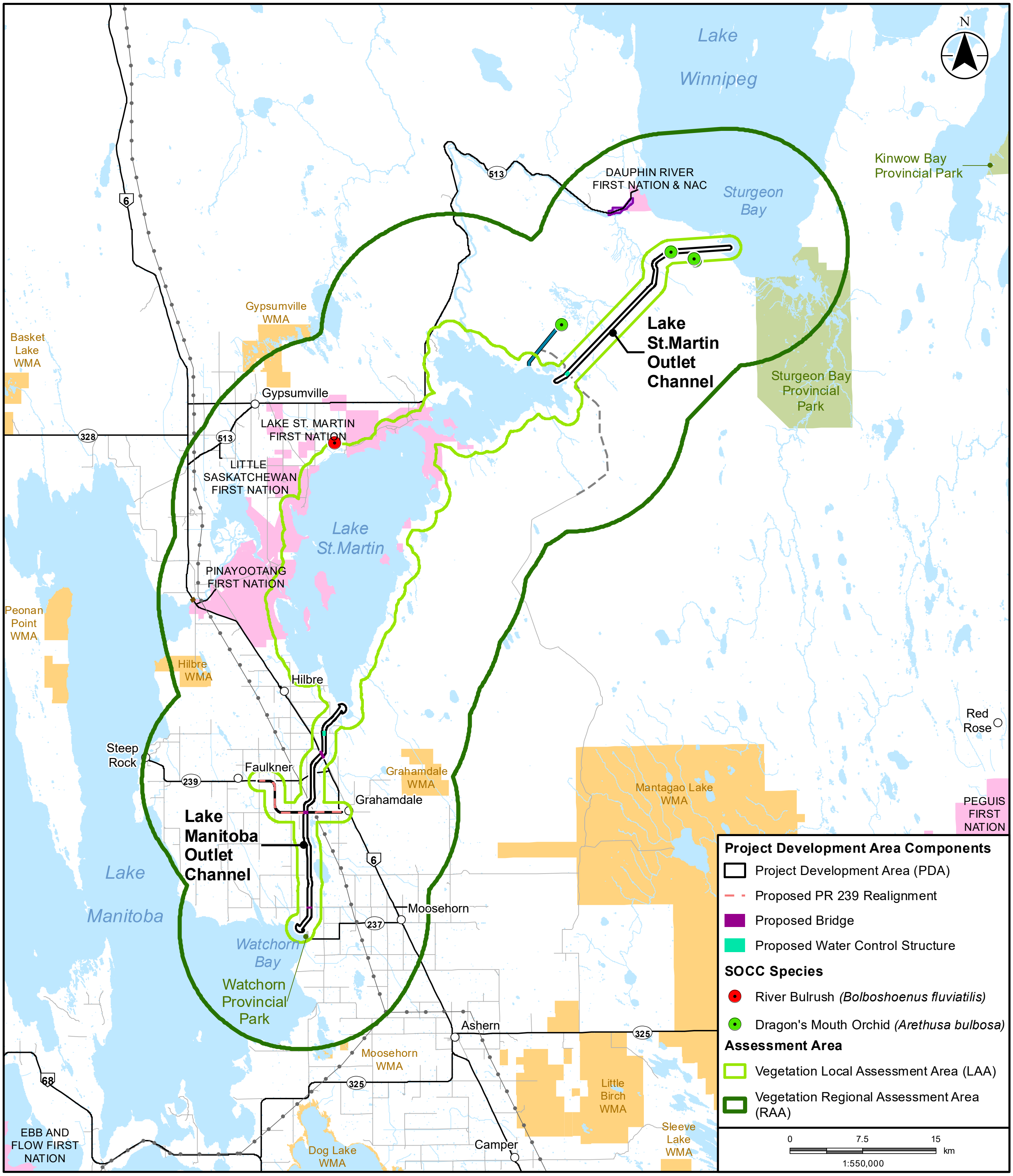
Environmental Impact Statement

Areas Burned in the Vegetation LAA

Figure 8.2B-5



Legend

- Fairford Water Control Structure
- Proposed Bridge
- Proposed Water Control Structure
- Lake St.Martin Emergency Outlet Channel (Reach 1)
- Lake St. Martin Access Road
- Existing Transmission Line
- Provincial Highway (PTH/PR)
- Municipal Road
- First Nation
- Northern Affairs Community
- Provincial Park
- Wildlife Management

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Lake Manitoba & Lake St.Martin Outlet Channels Project
Environmental Impact Statement

SOCC Located in the Vegetation PDA, LAA and RAA

Figure 8.2B-6

Notes
1. Coordinate System: NAD 1983 UTM Zone 14N
2. Data Sources: Governments of Manitoba and Canada, Manitoba Infrastructure
3. Last Update: 8/14/2019 9:14:00 AM

G:_GIS_Project_Folder\1114751201\figures\Ch8_Terrestrial_Environment\Final\Fig 8.2B-6 TERR Vegetation SOCC in the PDA LAA RAA.mxd

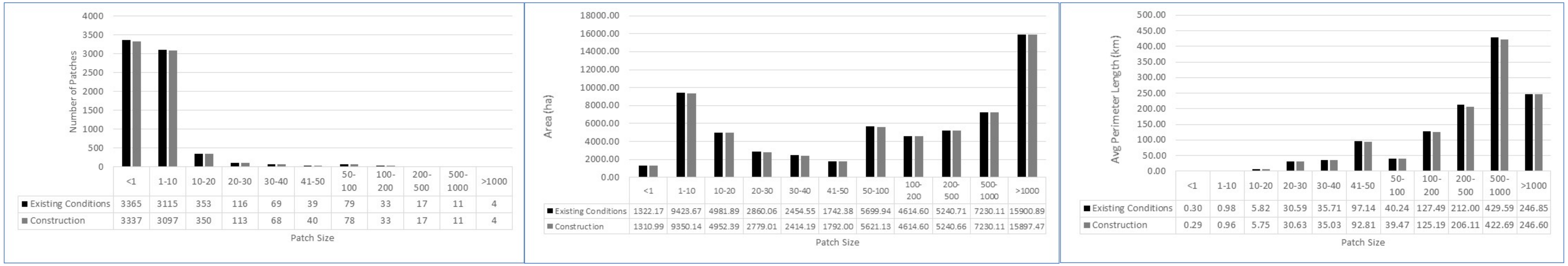


Figure 8.2B-7 Existing and Construction Phase Forest Patch Metrics

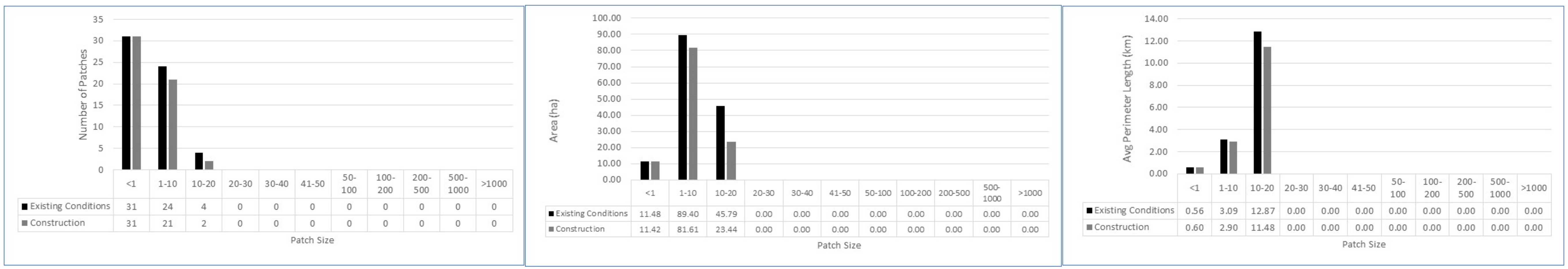


Figure 8.2B-8 Existing and Construction Phase Shrubland Patch Metrics

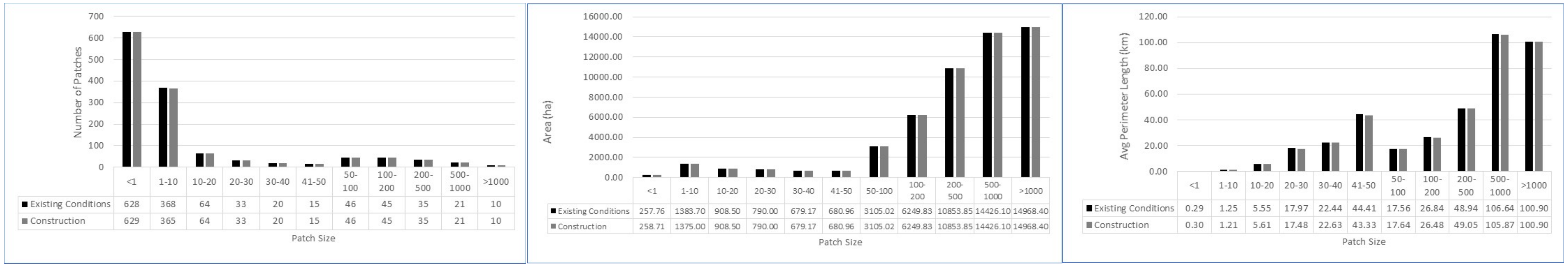


Figure 8.2B-9 Existing and Site Construction Phase Grassland Patch Metrics

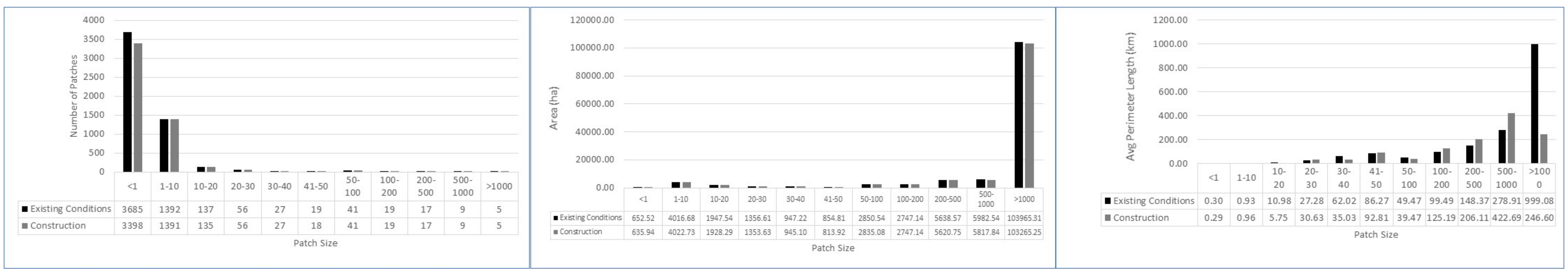
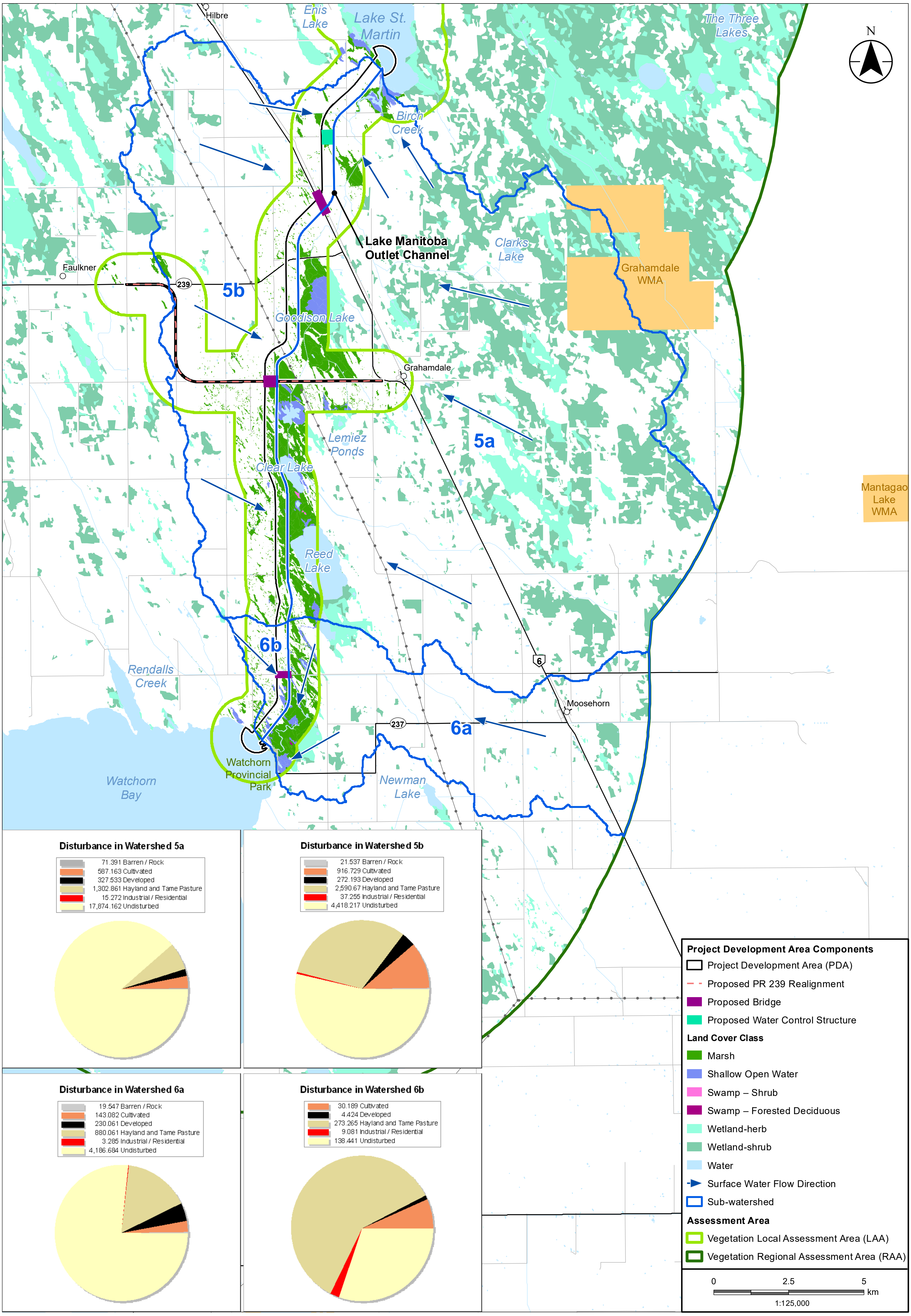


Figure 8.2B-10 Existing and Construction Phase Wetland Patch Metrics



Legend

- Existing Transmission Line
- Municipal Road
- Provincial Highway (PTH/PR)
- Provincial Park
- Wildlife Management

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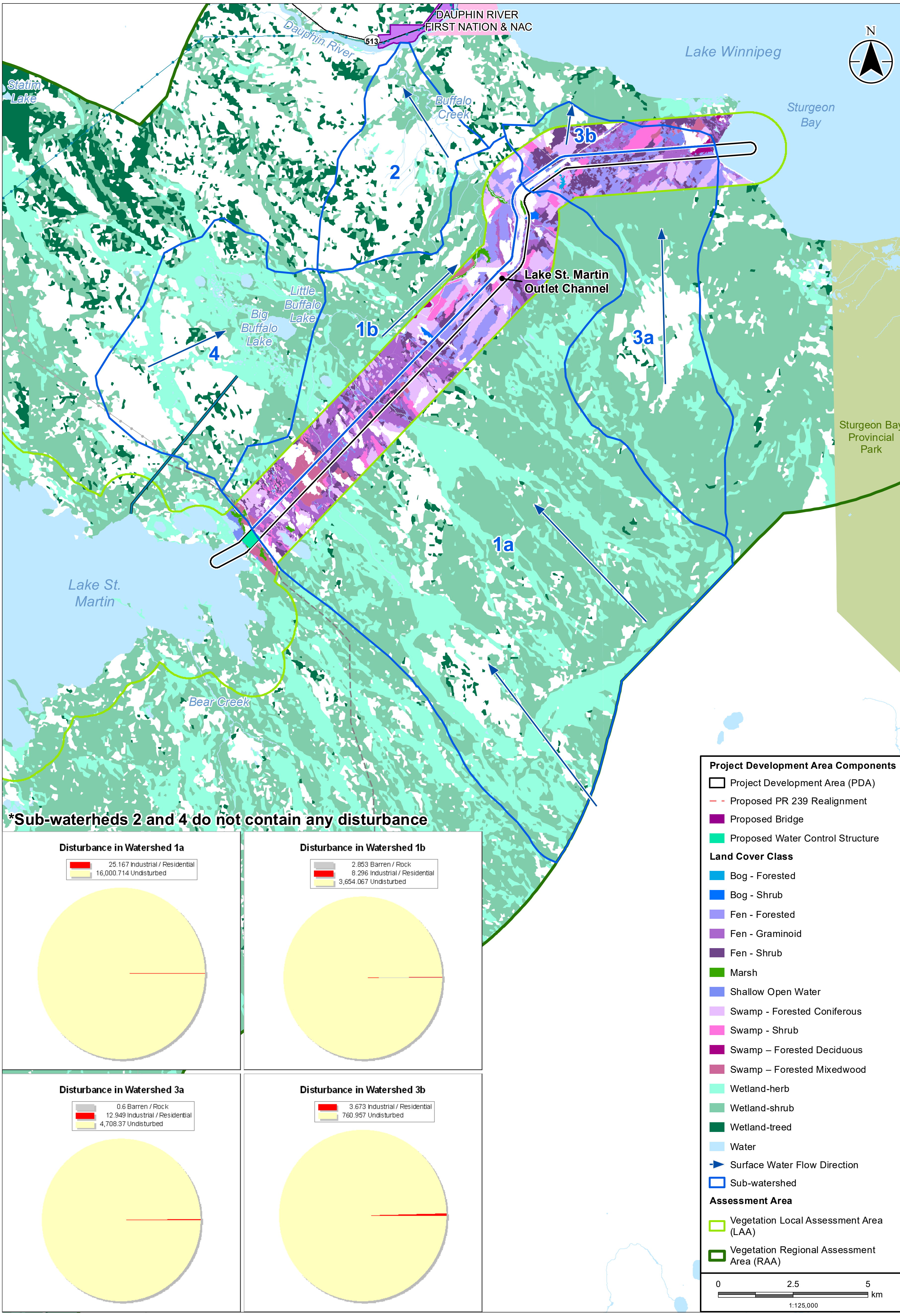
Lake Manitoba & Lake St.Martin Outlet Channels Project
Environmental Impact Statement

Wetland Distribution and Human Disturbance in the Project Intersected Sub-watersheds of the Lake Manitoba Outlet Channel Vegetation RAA

Notes
1. Coordinate System: NAD 1983 UTM Zone 14N
2. Data Sources: Governments of Manitoba and Canada, Manitoba Infrastructure
3. : Last Update: 8/14/2019 2:01:26 PM

Figure 8.2B-11

G:_GIS_Project_Folder\111475120\figures\Ch8_Terrestrial_Environment\Final\Fig 8.2B-11 TERR Vegetation Wetland Distribution and Human Disturbance in the LMOC.mxd Revised: 2019-08-14 By: JHiebert



Legend

- Lake St.Martin Emergency Outlet Channel (Reach 1)
- Lake St. Martin Access Road
- Existing Distribution Line
- Planned Distribution Line
- Municipal Road
- Provincial Highway (PTH/PR)
- First Nation
- Northern Affairs Community (NAC)
- Provincial Park

Manitoba

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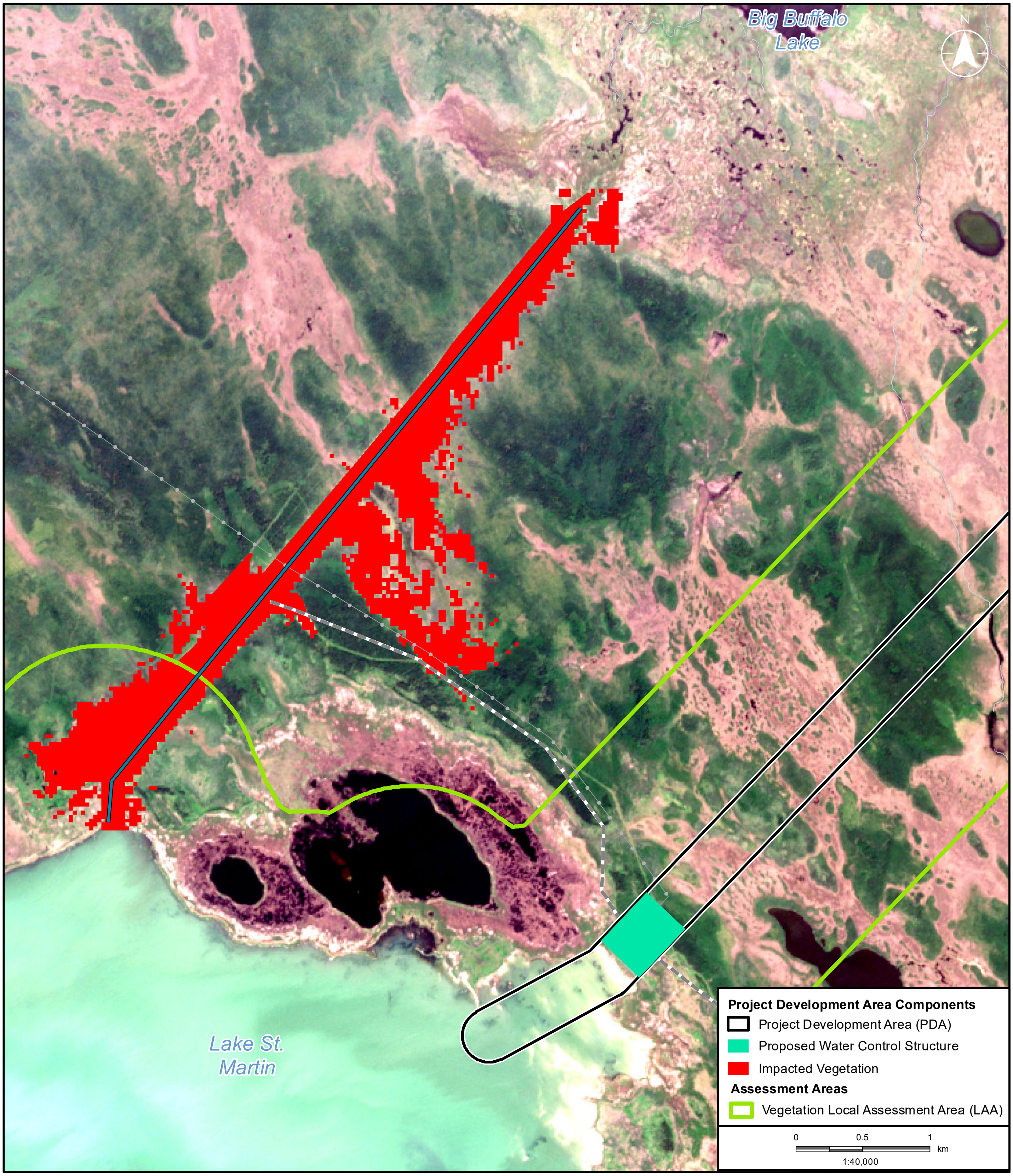
Lake Manitoba & Lake St.Martin Outlet Channels Project
Environmental Impact Statement

Wetland Distribution and Human Disturbance in the Intersected Sub-watersheds of the Lake St. Martin Outlet Channel Vegetation RAA

Notes
1. Coordinate System: NAD 1983 UTM Zone 14N
2. Data Sources: Governments of Manitoba and Canada, Manitoba Infrastructure, RM of Grahamdale
3. : Last Update: 8/14/2019 2:04:22 PM

Figure 8.2B-12

G:_GIS_Project_Folder\111475120\figures\Ch8_Terrestrial_Environment\Final\Fig 8.2B-12 TERR Vegetation Wetland Distribution and Human Disturbance in the LSMOC.mxd Revised: 2019-08-14 By: JHiebert



Legend

- Lake St.Martin Emergency Outlet Channel (Reach 1)
- Lake St.Martin Access Road
- Planned Distribution Line

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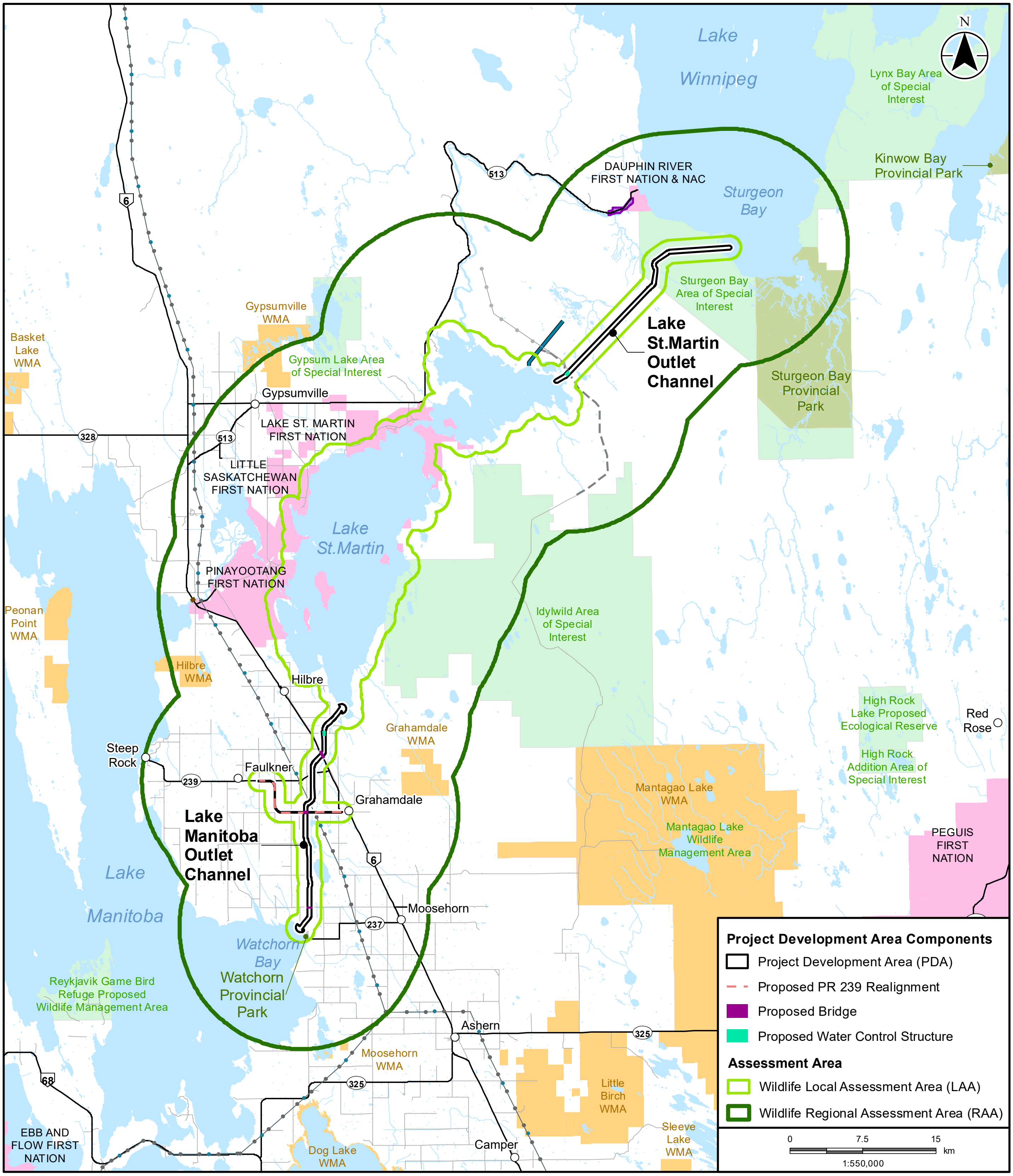
Lake Manitoba & Lake St.Martin Outlet Channels Project
Environmental Impact Statement

Location of Stressed Vegetation in Relation to the Lake St.Martin Emergency Outlet Channel (Reach 1)

Figure 8.2B-13

Notes
1. Coordinate System: WGS 1984 UTM Zone 14N
2. Data Sources: Governments of Manitoba and Canada, Manitoba Infrastructure
3. Last Update: 8/14/2019 2:05:17 PM

G:_GIS_Project_Folder\1114751201\figures\Ch8_Terrestrial_Environment\Final\Fig 8.2B-13 TERR Vegetation Stressed Vegetation is Relation to LSMOEC.mxd



Legend

- Fairford Water Control Structure
- Lake St.Martin Emergency Outlet Channel (Reach 1)
- Lake St. Martin Access Road
- Existing Transmission Line
- Existing Distribution Line
- Planned Distribution Line
- Provincial Highway (PTH/PR)
- Municipal Roads
- Areas of Special Interest
- Northern Affairs Community (NAC)
- First Nation
- Wildlife Management Area
- Provincial Park

Notes

1. Coordinate System: NAD 1983 UTM Zone 14N
2. Data Sources: Governments of Manitoba and Canada, Manitoba Infrastructure
3. Last Update: 8/11/2019 11:54:40 PM

G:_GIS_Project_Folder\1114751\20\figures\Ch8_Terrestrial_Environment\Final\Fig 8.3B-1 TERR Wildlife Spatial Boundaries.mxd

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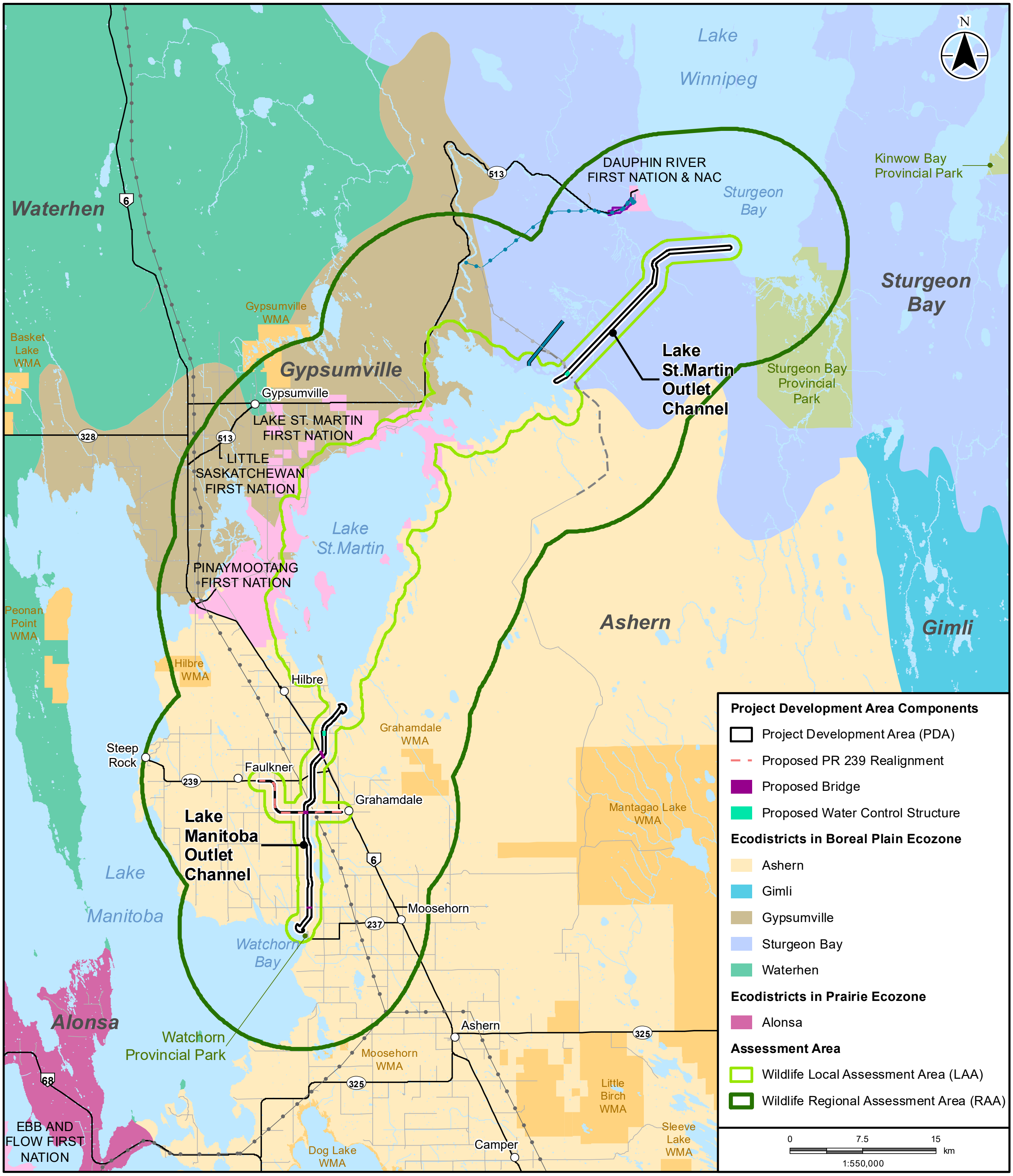
Lake Manitoba & Lake St.Martin Outlet Channels Project
Environmental Impact Statement

Wildlife Spatial Boundaries

Figure 8.3B-1



Legend

- Fairford Water Control Structure
- Lake St.Martin Emergency Outlet Channel (Reach 1)
- Lake St. Martin Access Road
- Existing Transmission Line
- Existing Distribution Line
- Planned Distribution Line
- Provincial Highway (PTH/PR)
- Municipal Road
- Northern Affairs Community (NAC)
- First Nation
- Provincial Park
- Wildlife Management Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 14N
2. Data Sources: Governments of Manitoba and Canada, Manitoba Infrastructure
3. Last Update: 8/12/2019 12:01:30 AM

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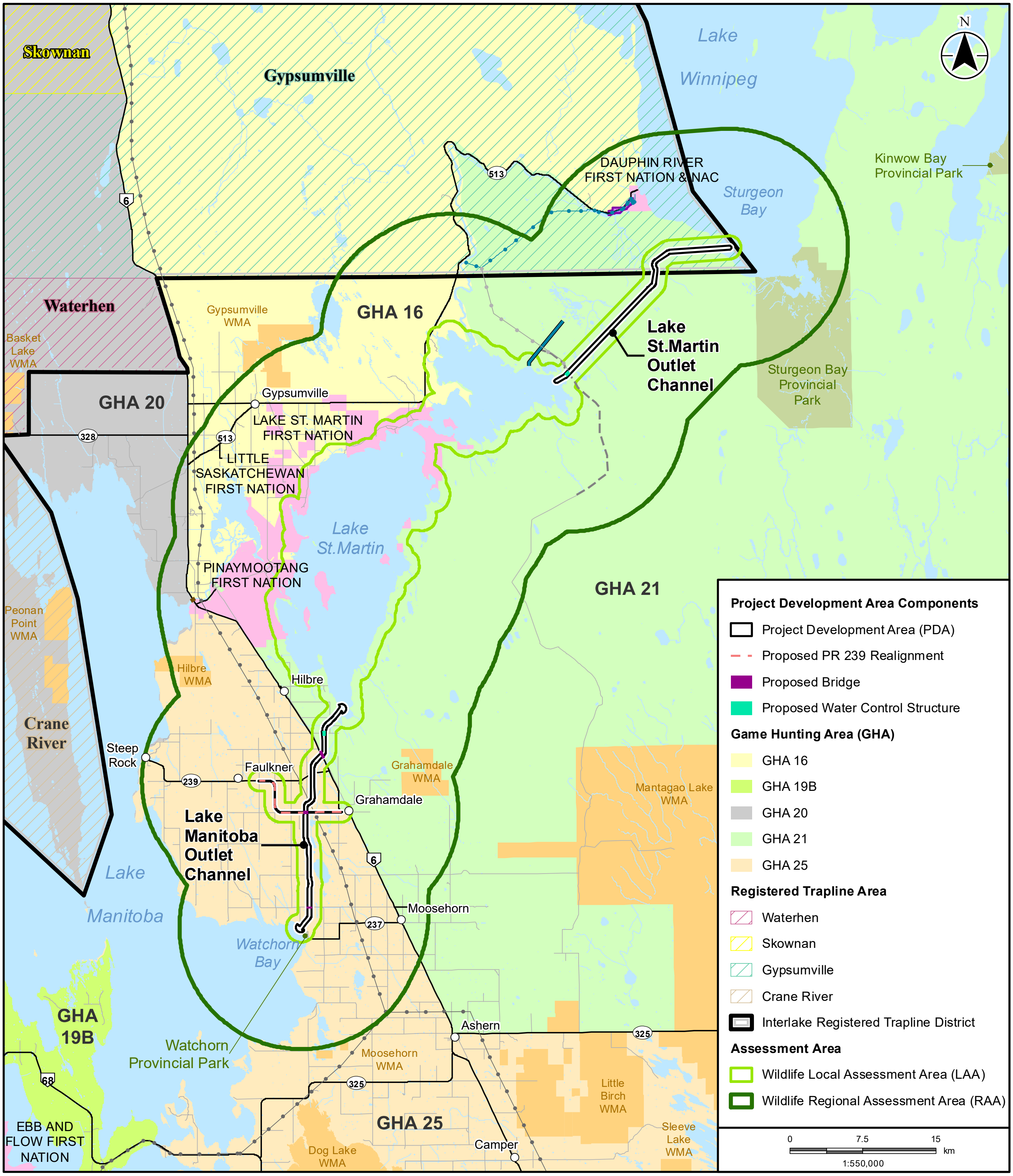
Lake Manitoba & Lake St.Martin Outlet Channels Project
Environmental Impact Statement

Ecodistricts

Figure 8.3B-2



Legend

- Fairford Water Control Structure
- Lake St.Martin Emergency Outlet Channel (Reach 1)
- Lake St. Martin Access Road
- Existing Transmission Line
- Existing Distribution Line
- Planned Distribution Line
- Provincial Highway (PTH/PR)
- Municipal Road
- Northern Affairs Community (NAC)
- First Nation
- Provincial Park
- Wildlife Management Area

Notes

1. Coordinate System: NAD 1983 UTM Zone 14N
2. Data Sources: Governments of Manitoba and Canada, Manitoba Infrastructure
3. Last Update: 8/13/2019 10:16:23 AM

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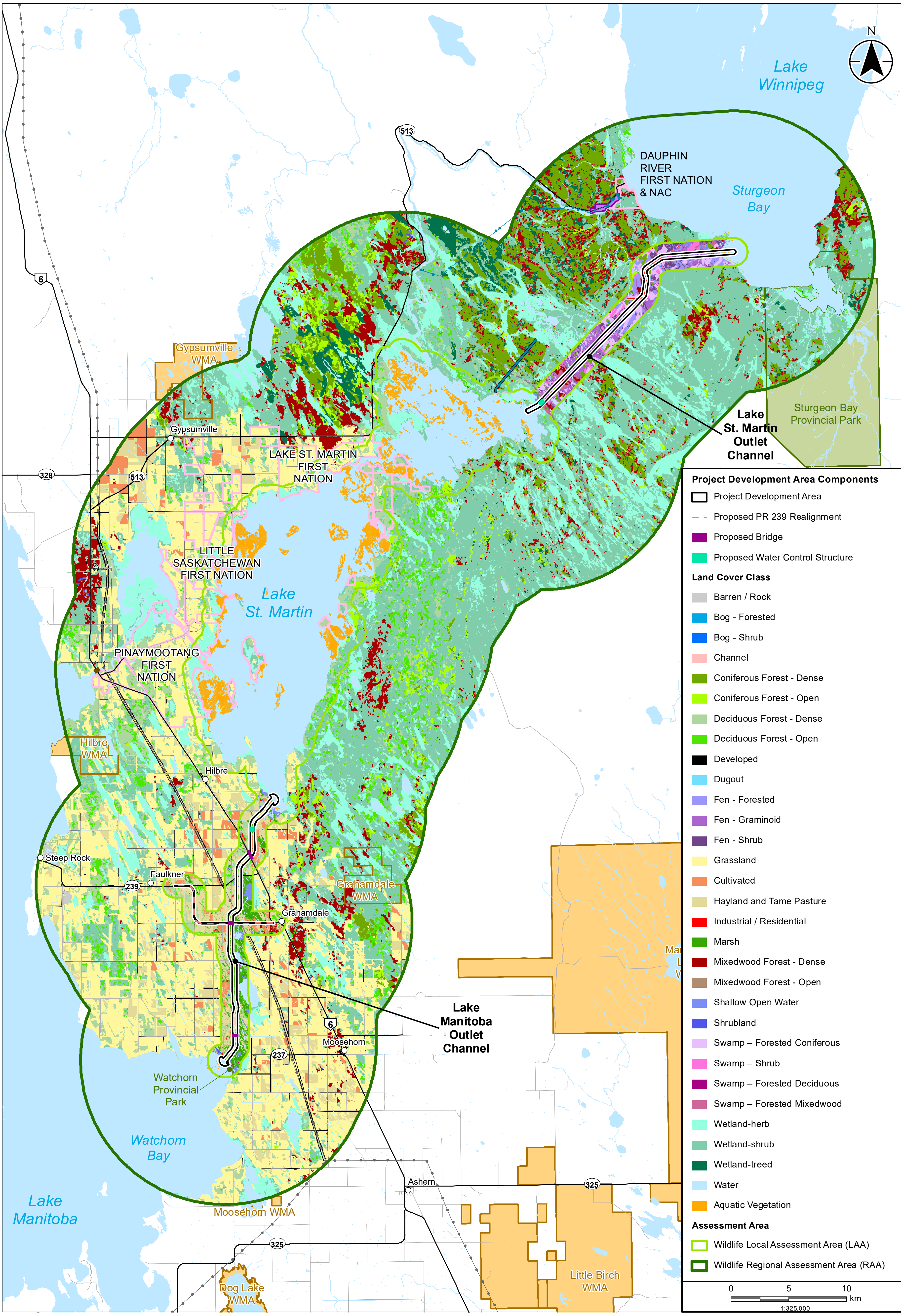
Lake Manitoba & Lake St.Martin Outlet Channels Project
Environmental Impact Statement

Game Hunting Areas and Trapping Zones

Figure 8.3B-3



Legend

- Fairford Water Control Structure
- Lake St.Martin Emergency Outlet Channel (Reach 1)
- Lake St. Martin Access Road
- Existing Transmission Line
- Existing Distribution Line
- Planned Distribution Line
- Municipal Road
- Provincial Highway (PTH/PR)
- First Nation
- Northern Affairs Community (NAC)
- Provincial Park
- Wildlife Management Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 14N
2. Data Sources: Governments of Manitoba and Canada, Manitoba Infrastructure, RM of Grahamdale
3. : Last Update: 8/12/2019 12:05:39 AM

G:_GIS_Project_Folder\111475120\figures\Ch8_Terrestrial_Environment\Final\Fig 8.3B-4 TERR Wildlife Landcover RAA.mxd Revised: 2019-08-12 By: JHiebert

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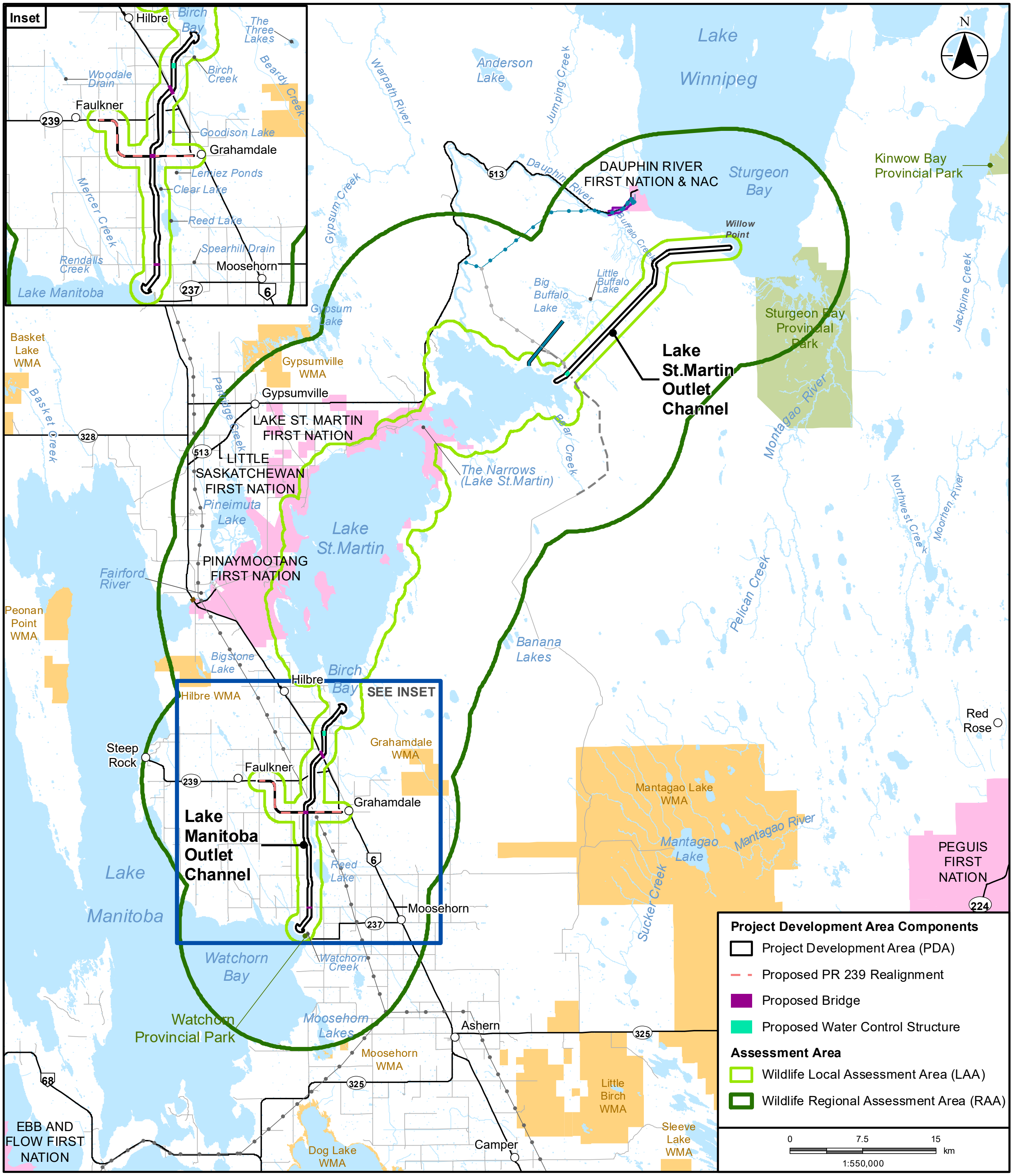
Lake Manitoba & Lake St.Martin Outlet Channels Project
Environmental Impact Statement

Land Cover in the Wildlife RAA

Figure 8.3B-4



Legend

- Fairford Water Control Structure
- Lake St.Martin Emergency Outlet Channel (Reach 1)
- Lake St. Martin Access Road
- Existing Transmission Line
- Existing Distribution Line
- Planned Distribution Line
- Provincial Highway (PTH/PR)
- Municipal Road
- Northern Affairs Community (NAC)
- First Nation
- Provincial Park
- Wildlife Management Area

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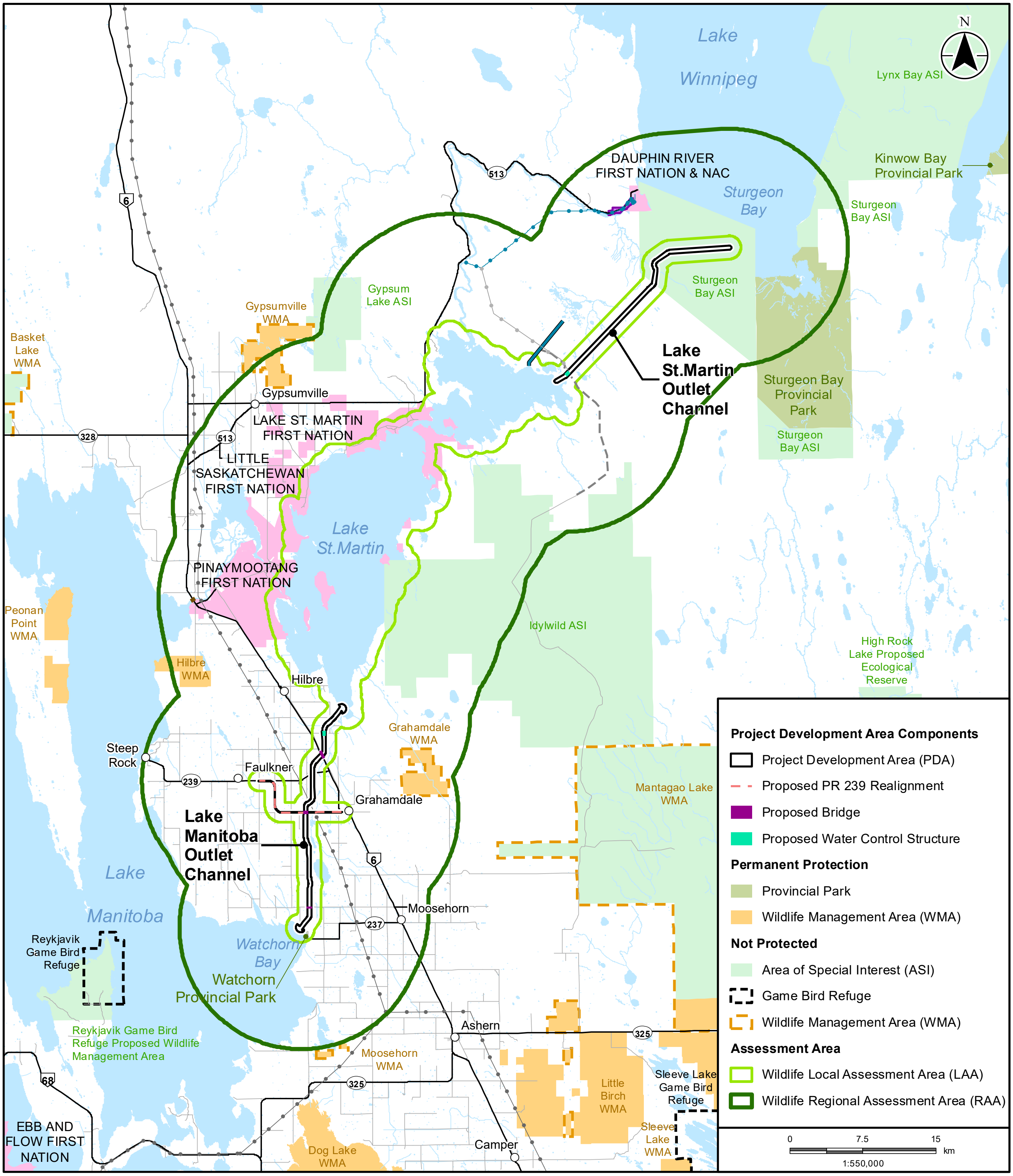
Lake Manitoba & Lake St.Martin Outlet Channels Project
Environmental Impact Statement

Notable Waterbodies

Figure 8.3B-5

Notes
1. Coordinate System: NAD 1983 UTM Zone 14N
2. Data Sources: Governments of Manitoba and Canada, Manitoba Infrastructure
3. Last Update: 8/12/2019 12:29:31 AM

G:_GIS_Project_Folder\1114751201\figures\Ch8_Terrestrial_Environment\Final\Fig 8.3B-5 TERR Wildlife Notable Waterbodies.mxd



Legend

- Fairford Water Control Structure
- Lake St.Martin Emergency Outlet Channel (Reach 1)
- Lake St. Martin Access Road
- Existing Transmission Line
- Existing Distribution Line
- Planned Distribution Line
- Provincial Highway (PTH/PR)
- Municipal Road
- First Nation
- Northern Affairs Community (NAC)

Notes
1. Coordinate System: NAD 1983 UTM Zone 14N
2. Data Sources: Governments of Manitoba and Canada, Manitoba Infrastructure
3. Last Update: 8/11/2019 11:33:47 PM

G:_GIS_Project_Folder\1114751200\figures\Ch8_Terrestrial_Environment\Final\Fig 8.3B-6 TERR Wildlife Designated Lands.mxd

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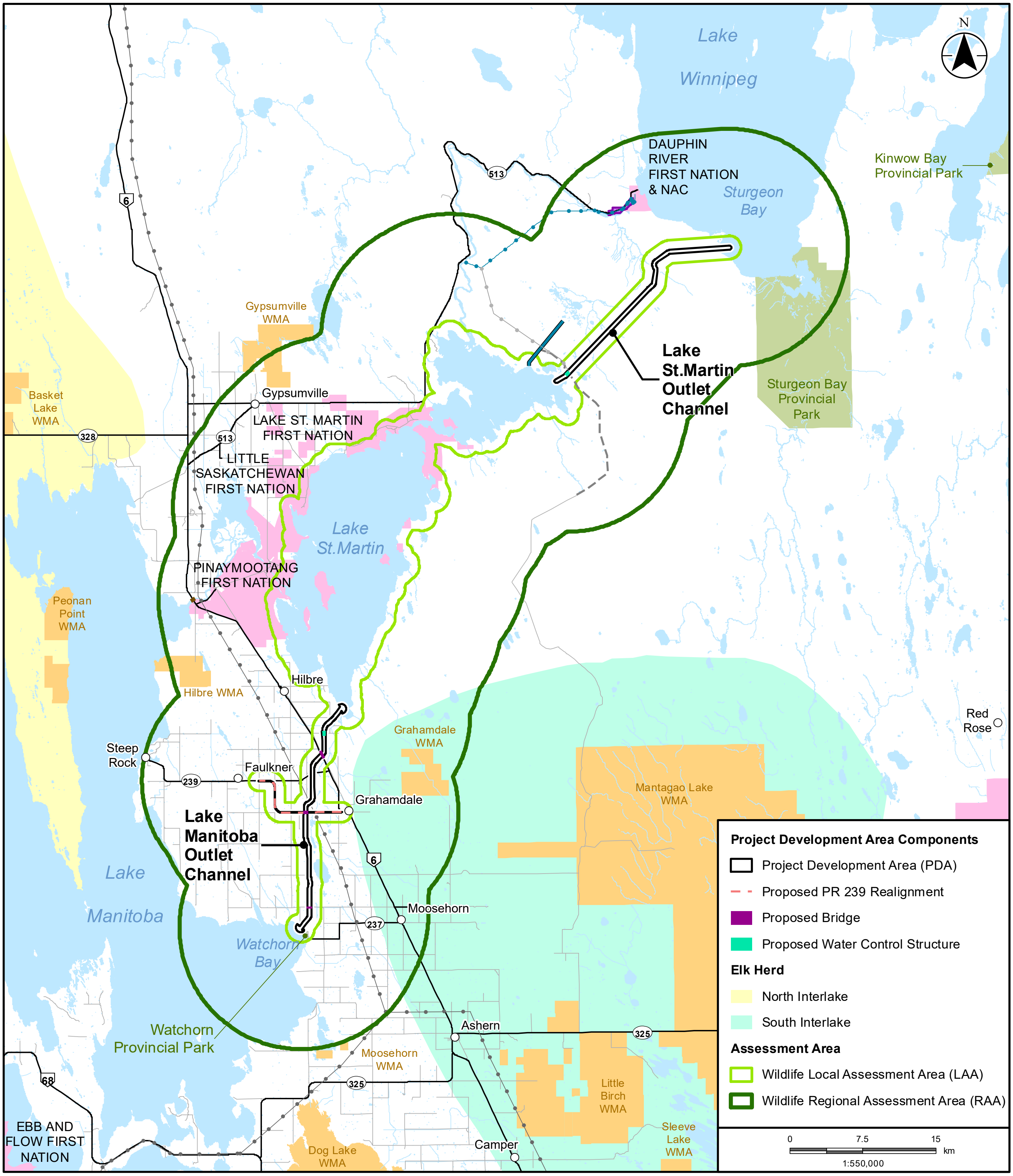
Lake Manitoba & Lake St.Martin Outlet Channels Project
Environmental Impact Statement

Protected Areas and Designated Lands

Figure 8.3B-6



Legend

- Fairford Water Control Structure
- Lake St.Martin Emergency Outlet Channel (Reach 1)
- Lake St. Martin Access Road
- Existing Transmission Line
- Existing Distribution Line
- Planned Distribution Line
- Provincial Highway (PTH/PR)
- Municipal Road
- Northern Affairs Community (NAC)
- First Nation
- Provincial Park
- Wildlife Management Area

Notes

1. Coordinate System: NAD 1983 UTM Zone 14N
2. Data Sources: Governments of Manitoba and Canada, Manitoba Infrastructure. Elk Herds from Stardom, R., Collins, G., and Teillet, D. 1999. Interlake Elk Management Strategy. Manitoba Natural Resources, Winnipeg, Manitoba.
3. Last Update: 8/12/2019 12:01:47 AM

G:_GIS_Project_Folder\111475120\figures\Ch8_Terrestrial_Environment\Final\Fig 8.3B-7 TERR Wildlife Interlake Elk Herds.mxd

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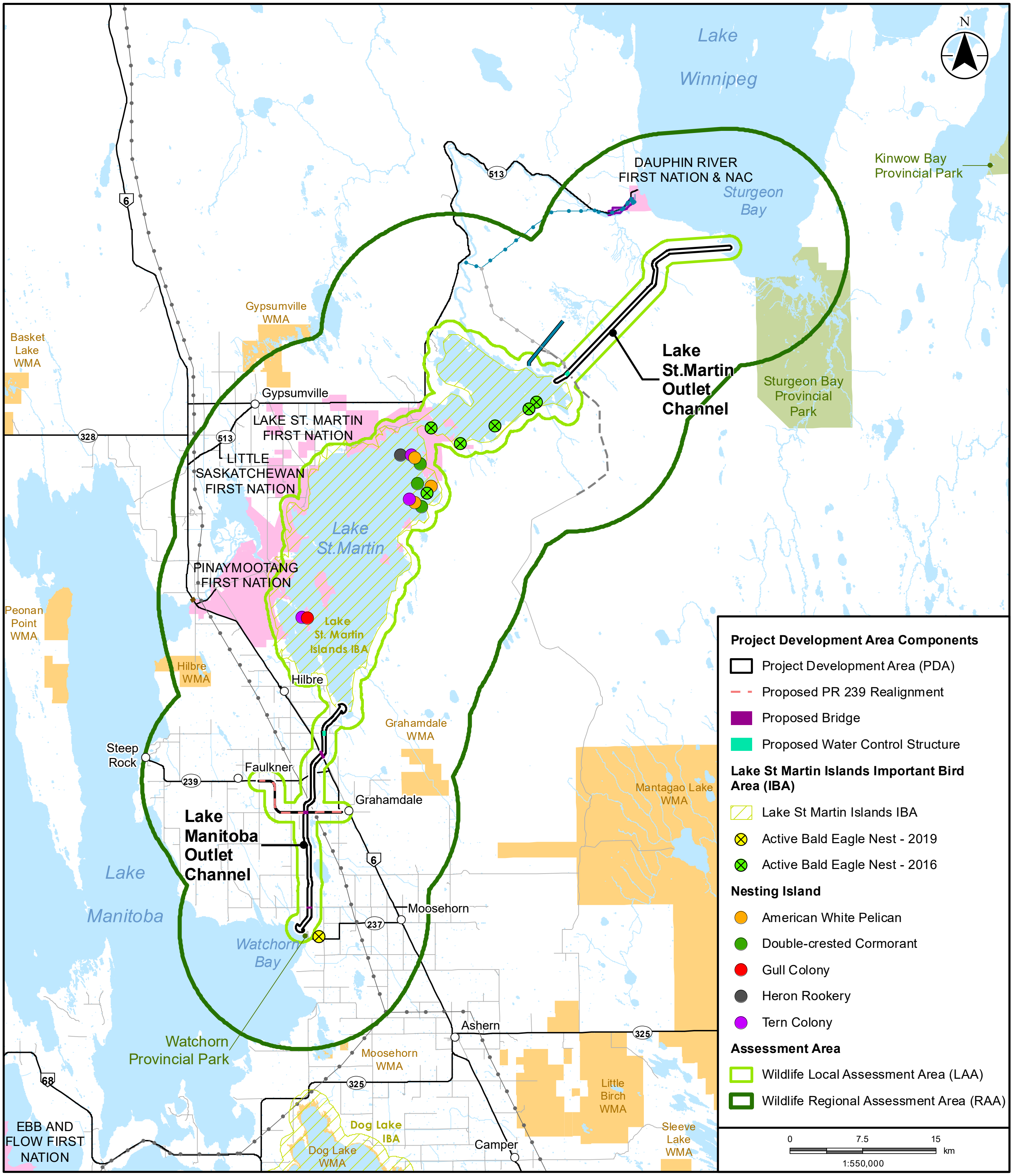
Lake Manitoba & Lake St.Martin Outlet Channels Project
Environmental Impact Statement

North and South Interlake Elk Herds

Figure 8.3B-7



Legend

- Fairford Water Control Structure
- Lake St.Martin Emergency Outlet Channel (Reach 1)
- Lake St. Martin Access Road
- Existing Transmission Line
- Existing Distribution Line
- Planned Distribution Line
- Provincial Highway (PTH/PR)
- Municipal Road
- Northern Affairs Community (NAC)
- First Nation
- Provincial Park
- Wildlife Management Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 14N
2. Data Sources: Governments of Manitoba and Canada, Manitoba Infrastructure
3. Last Update: 8/11/2019 11:36:20 PM

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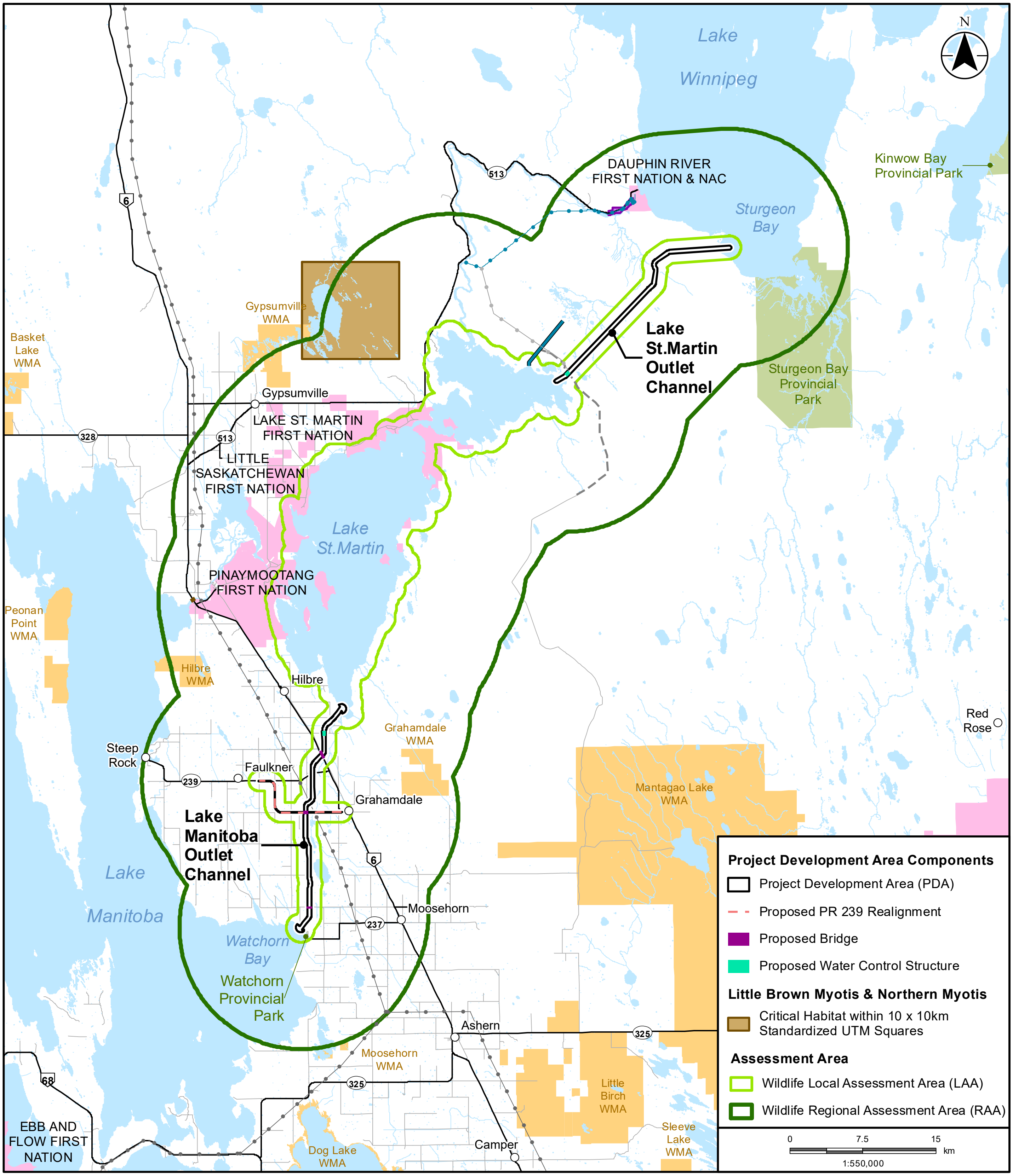
Environmental Impact Statement

Important Bird Areas, Nests and Colonies

Figure 8.3B-8



Legend

- Fairford Water Control Structure
- Lake St.Martin Emergency Outlet Channel (Reach 1)
- Lake St.Martin Access Road
- Existing Transmission Line
- Existing Distribution Line
- Planned Distribution Line
- Provincial Highway (PTH/PR)
- Municipal Road
- Northern Affairs Community (NAC)
- First Nation
- Wildlife Management Area
- Provincial Park

Notes

1. Coordinate System: NAD 1983 UTM Zone 14N
2. Data Sources: Governments of Manitoba and Canada, Manitoba Infrastructure, MB Conservation Data Centre, EcoLogic
3. Last Update: 8/11/2019 11:40:49 PM

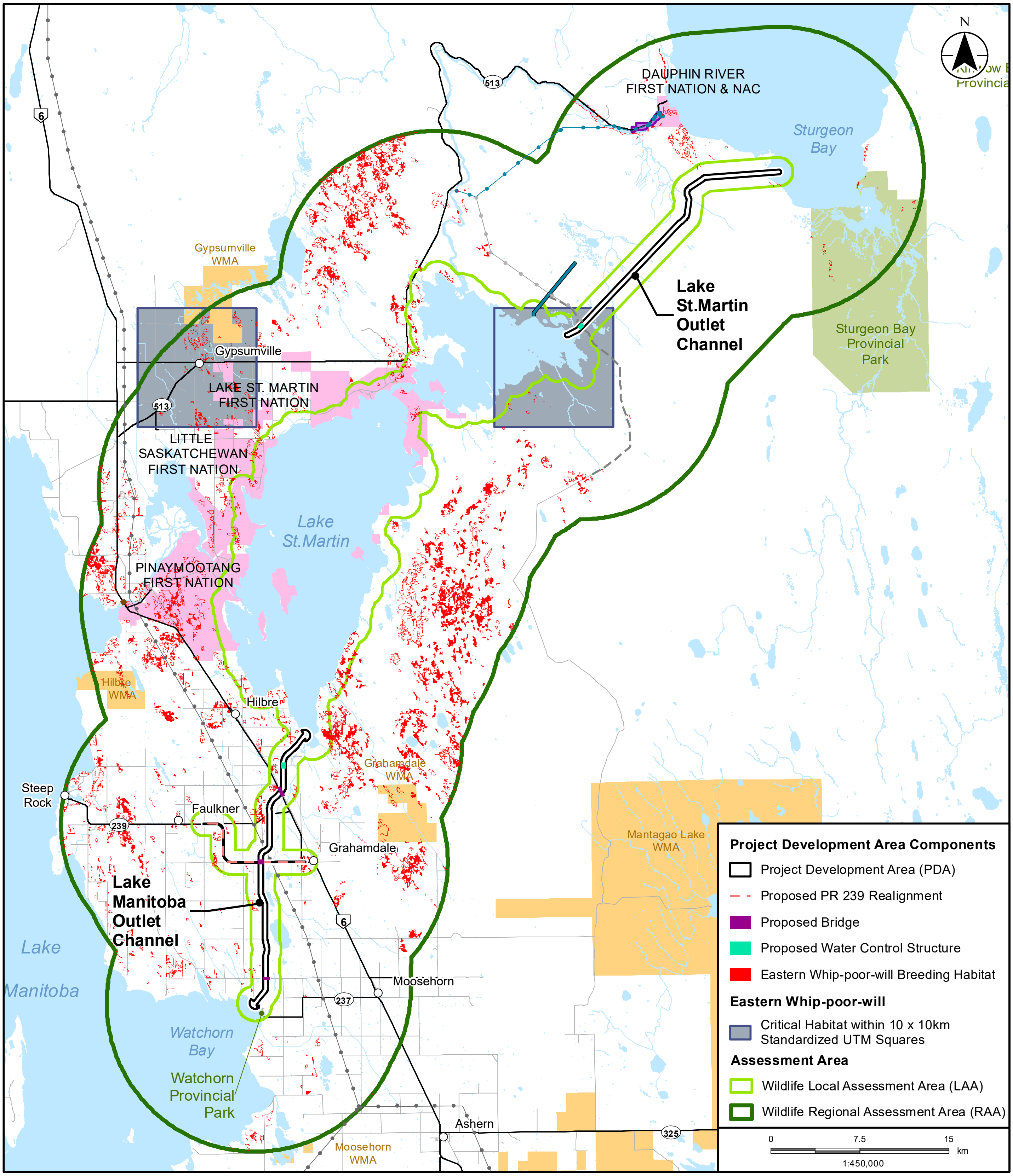
Manitoba

MANITOBA INFRASTRUCTURE
Lake Manitoba & Lake St.Martin Outlet Channels Project
Environmental Impact Statement

Critical Habitat for Little Brown Myotis and Northern Myotis

Figure 8.3B-9

G:\GIS_Project_Folder\1114751201figures\Ch8_Terrestrial_Environment\Final\Fig 8.3B-9 TERR Wildlife Critical Habitat for Bats (Myotis).mxd



Legend

- Fairford Water Control Structure
- Lake St.Martin Emergency Outlet Channel (Reach 1)
- Lake St.Martin Access Road
- Existing Transmission Line
- Existing Distribution Line
- Planned Distribution Line
- Provincial Highway (PTH/PR)
- Municipal Road
- Northern Affairs Community (NAC)
- First Nation
- Wildlife Management
- Provincial Park

Manitoba

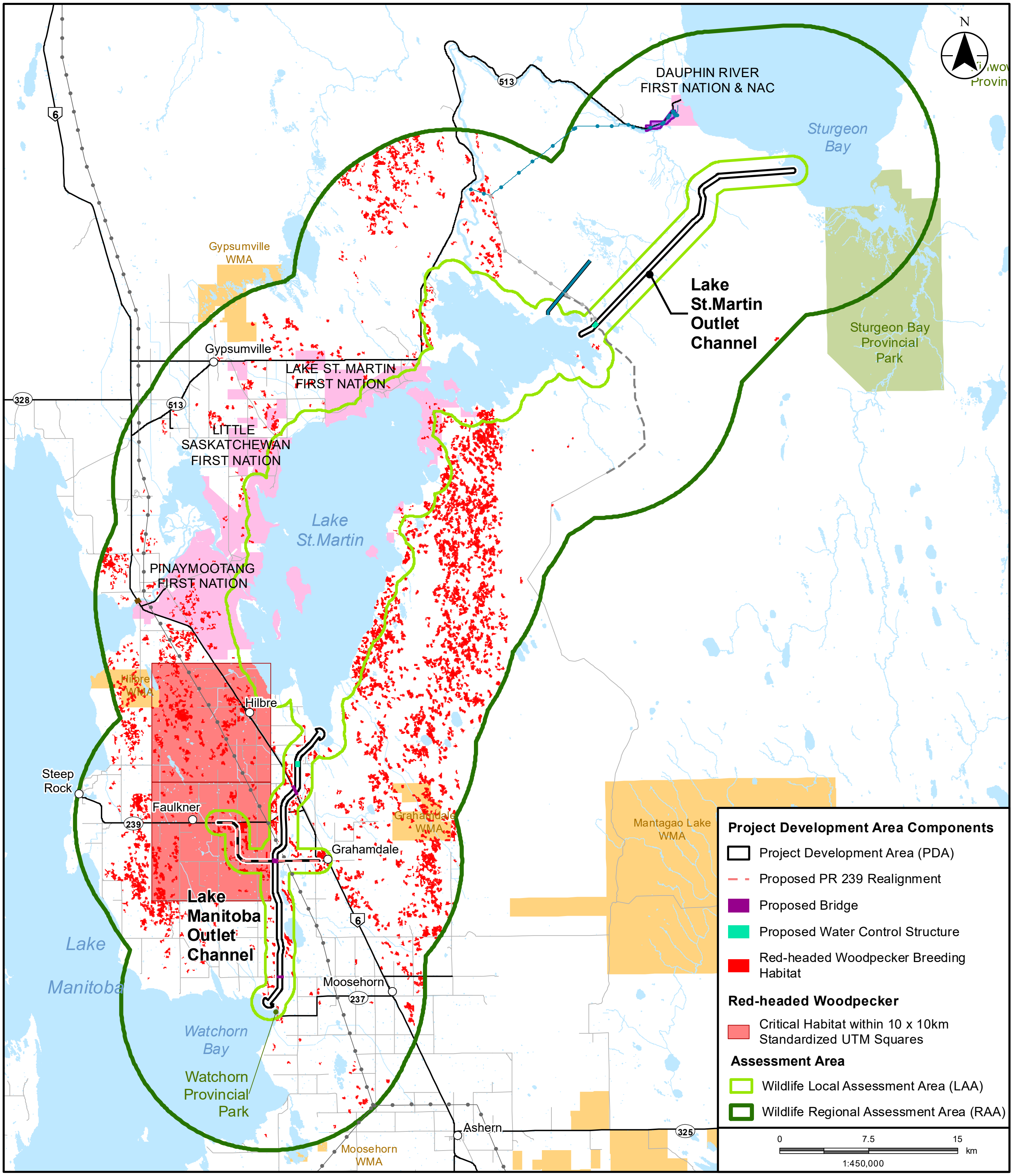
MANITOBA INFRASTRUCTURE
Lake Manitoba & Lake St.Martin Outlet Channels Project
Environmental Impact Statement

Critical Habitat for Eastern Whip-poor-will

Figure 8.3B-10

Notes
1. Coordinate System: NAD 1983 UTM Zone 14N
2. Data Sources: Governments of Manitoba and Canada, Manitoba Infrastructure, Environment and Climate Change Canada
3. Last Update: 8/13/2019 9:26:50 AM

G:_GIS_Project_Folder\1114751201figures\Ch8_Terrestrial_Environment\Final\Fig 8.3B-10 TERR Wildlife Critical Habitat for Eastern Whip-poor-will.mxd



Legend

- Fairford Water Control Structure
- Lake St.Martin Emergency Outlet Channel (Reach 1)
- Lake St.Martin Access Road
- Existing Transmission Line
- Existing Distribution Line
- Planned Distribution Line
- Provincial Highway (PTH/PR)
- Municipal Road
- Northern Affairs Community (NAC)
- First Nation
- Wildlife Management
- Provincial Park

Manitoba

MANITOBA INFRASTRUCTURE
Lake Manitoba & Lake St.Martin Outlet Channels Project
Environmental Impact Statement

Critical Habitat for Red-headed Woodpecker

Figure 8.3B-11

Notes
1. Coordinate System: NAD 1983 UTM Zone 14N
2. Data Sources: Governments of Manitoba and Canada, Manitoba Infrastructure, Environment and Climate Change Canada
3. Last Update: 8/13/2019 9:29:56 AM

Appendix 8C PHOTOS

Photo 8.2C-1 Dragon's mouth orchid (*Arethusa bulbosa*) observed at the base of a tamarack tree in a black spruce bog at Plot 6 along the LSMOC (June 8, 2016)

Appendix 8D SUMMARY OF FIELD STUDIES

Baseline field studies were conducted in 2016 and 2017 to gather data on the various outlet channel route options being considered for Lake Manitoba and Lake St. Martin (EEI 2017a, b, and c). These data were useful in evaluating and identifying final routes for LMOC and LSMOC. In 2018, additional baseline data (remote camera survey) were gathered in the vicinity of the LMOC in support of channel design and is described below. Additional methodologies are presented below for the studies used to characterize the existing conditions and aid in the assessment of potential Project effects on wildlife.

Aerial Mammal Survey

A baseline terrestrial mammal aerial distribution survey was conducted between January 31 and February 6, 2016. Surveys were conducted within 5 km of the proposed outlet channel ROWs and included extensive (1.5 km parallel transects) and intensive (i.e., 500 m parallel transects approximately 400 m above ground level) survey methods on a stratified random subset of survey units (3 km by 5 km grid cells). ArcGIS 10.3 was used to identified areas of wildlife concentrations using volume-density kernel estimates.

Aerial Stick Nest Survey

An aerial survey for large stick nests was conducted between June 2-11, 2016 and Jan 31 – February 6, 2017 to identify the location of habitual nesting sites for raptors (e.g., bald eagle) and herons. Surveys were conducted within 5 km of the proposed outlet channel ROWs and included extensive (1.5 km parallel transects) and intensive (i.e., 500 m parallel transects approximately 400 m above ground level) survey methods on a stratified random subset of survey units (3 km by 5 km grid cells).

Aerial Hibernacula Survey

An aerial survey was conducted between January 31 and February 6, 2016 and between March 2 and 4, 2017 using thermal imagery technology (FLIR) to identify surface and subterranean heat sources that could indicate the presence of hibernacula for reptile and bat species. Surveys focused on habitats within the RAA most likely to contain hibernacula and were conducted under suitable snow (equal covering), temperature (-15 and -20 °C), and cloud cover. Surveys were conducted using parallel 200 m transect at 300 to 800 feet above ground level with flight speeds ranging from 80-120 km/hr.

Potential hibernacula were geo-referenced and documented, including aerial photographs. Confirmatory ground searches of potential hibernacula were conducted on June 8, 2016 and between March 11 and April 6, 2017. Two Bat Recorders (Model SM4BAT) were deployed between early-August and mid-September 2016 to further aid in the investigation into potential hibernacula. Data were analyzed using Kaleidoscope Pro 4 Analysis Software.

Breeding Bird Point-count Survey

Breeding bird point count surveys were conducted from June 2-11, 2016 within the proposed outlet channel ROWs using a 10-minute 75-m fixed-radius point-count method. Surveys were conducted under suitable environmental conditions between 6:00 – 10:00 am. Incidental data on amphibian breeding habitat use was also recorded.

Yellow Rail Survey

Breeding bird point count surveys were conducted from June 2-11, 2016 within the proposed LMOC ROW using a 10-minute 75-m fixed-radius point-count method. Surveys were conducted in the late evening under suitable environmental condition. Incidental data on amphibian breeding habitat use was also recorded.

Piping Plover Survey

A piping plover survey was conducted on June 11, 2016 following sensitive species inventory protocol guidelines. Suitable habitat (i.e., lake shores and sandy beaches) within 400 m of the proposed ROW was investigated on foot by biologists and an aerial survey was conducted for all other sandy shore habitat areas within the Projects study area.

Remote Camera Study

The objective of the ongoing LMOC Remote Camera Study is to provide pre-construction baseline data on habitat use by large mammals in the LAA, mainly American elk (*Cervus canadensis*; hereafter elk), which can be used to evaluate wildlife movement patterns across the LMOC ROW. The data can also be used to identify high-use areas along the ROW that have the greatest potential to benefit from implementing mitigation measures (e.g., cover plantings, breaks in channel riprap) to facilitate mammal crossings and maintain wildlife movement.

Twenty-four remote cameras (Reconyx™ Hyperfire™ PC900) were deployed in early-October 2018 in suitable wildlife habitat and in strategic locations to maximize the potential for wildlife encounters along the LMOC and PR 239 road realignment. Cameras were a minimum of 500 m apart to maintain independent sampling, accessed by foot or ATV, and installed at roughly breast height (1.2 m) to optimize the range of mammals that can trigger the sensors and to allow for snow depth during the winter months. Each camera was placed so that it records activity along an active game trail or clearing. Camera data was downloaded in February and June 2016 and cameras continue to collect data.

All photographs were transferred to a central database and analyzed using Reconyx MapView Professional ™ software. Each photograph is analyzed individually, and when target species are identified as the cause of the trigger a unique event is created. Wildlife captured in each event were classified by species, number, age, and sex, if possible. The start of a new camera event occurs when there is a change in wildlife species or a gap of one hour between events when no photos are captured. For each event, a single photo is classified as the best representation of the event attributes (i.e., species, abundance, age, sex). Photos that are triggered by environmental conditions (e.g., wind, vegetation, shadows) are analyzed but not classified as an event unless an animal was present.

The species of interest and number of events were summarized for each camera location to identify which locations and/or habitat types are most likely be conduits for mammal movement.