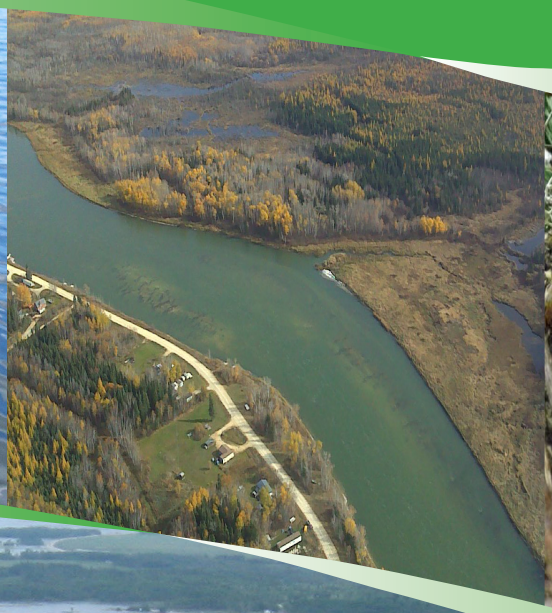
LAKE MANITOBA AND LAKE ST. MARTIN OUTLET CHANNELS PROJECT EIS

Manitoba






VOLUME 5:
Conclusions and Other Assessments

11.0 - Cumulative Effects
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March 2020

Manitoba

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

CHAPTER 11

CUMULATIVE EFFECTS

March 2020

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11.0 CUMULATIVE EFFECTS

11.1 OVERVIEW OF CHAPTER

11.1.1 Basis of Assessment

This cumulative effects assessment 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 7.6.3 of the Canadian Environmental Assessment Agency (the Agency) EIS Guidelines for the Project (CEAA 2018), indicate that the EIS will identify and assess the Project's cumulative effects using the approach described in the Agency's Operational Policy Statement entitled *Addressing Cumulative Environmental Effects under the Canadian Environmental Assessment Act, 2012* and the guide entitled *Technical Guidance for Assessing Cumulative Environmental Effects under the Canadian Environmental Assessment Act, 2012*. It notes that cumulative effects are defined as changes to the environment due to the project combined with the existence of other past, present and reasonably foreseeable physical activities, and that VCs that would not be affected by the Project or would be affected positively by the project can, therefore, be omitted from the cumulative effects assessment. It describes an approach that is reflected in the methodology section (11.1.2).

The Environmental Assessment Scoping Document for the Project (Manitoba Infrastructure 2018) submitted to Manitoba Sustainable Development indicates that the EIS will include an assessment of potential cumulative effects (i.e., the potential for Project effects to act in combination with the effects of other past, present and/or reasonably foreseeable future projects in the area), including the approach and methods used and in a manner that complies with the approach described in the aforementioned Agency's Operational Policy Statement.

11.1.2 Assessment Approach and Methods

This chapter assesses the Project-related residual effects that have the potential to act cumulatively with effects of other projects and activities in the regional assessment areas (RAAs) of the valued components (VCs).

The assessment of cumulative effects is presented following the same procedure used for the Project effects assessment sections. The cumulative effects assessment evaluates construction and operations that include consideration of overlapping infrastructure (roads) and considers the effects from reasonably foreseeable projects as applied for regulatory approval, announced in the media or expected to be developed.

This assessment of potential cumulative effects is organized into the following steps:

1. Selection of VCs identifies the VCs assessed or not assessed.
2. Project Inclusion List identifies other past, present or future projects or physical activities that may interact cumulatively with residual effects of the Lake Manitoba and Lake St. Martin Outlet Channels Project (the Project).
3. Regional Context is an overview of the Project within the regional landscape of southern Manitoba.
4. Approach to Assessing Cumulative Effects provides additional details on the methods used.

Following these steps, the cumulative effects assessment for each VC is presented, including examining effects for construction and operations, mitigation measures and residual effects.

The effects of the Project are assessed within the local assessment area (LAA) specific to each VC in Chapters 6 through 10. Those assessments consider any past and present projects and physical activities in the LAA and are assessed in a study area adequate to allow the identification and characterization of effects directly attributable to the Project. The baseline state of the VCs in those assessments reflects the VC's response to conditions in the LAA, and often also to conditions beyond the LAA. Therefore, these effects typically are representative of similar interacting effects more broadly in the region. The assessment of potential cumulative effects of the Project with past and present other projects and activities is accomplished by recognizing in the interactions table where such interactions may occur, and in consideration of the regional context described in section 11.1.5.

Rationale for conclusions, and identification of any assumptions, are provided for each assessed VC, most notably in each *Residual Cumulative Effects on...* and *Summary of Cumulative Effects on...* subsections within VC sections 11.8 to 11.19; and, in Section 11.22 Conclusions. This includes cumulative effects on the health and socio-economic conditions for Indigenous peoples as discussed in Section 11.19 Indigenous Health and Socio-Economic Conditions.

The scenario of the effects of the Project on the existing environment establishes the cumulative effects of the Project on the past and present environment. These effects are considered to continue in the same manner into the future (e.g., roads will continue to be maintained, agriculture practices and fishing will continue, communities will continue to exist etc.), and the Project will be constructed and operated. This assessment of past and current effects is presented in the VC chapters. The cumulative effects assessment of future projects and activities is presented in the following sections of this chapter. The cumulative effects of accidents and malfunctions are addressed separately in Section 11.15.

Overall description of methodological details to the assessment of cumulative effects is first provided in Section 4.5.2, Step 7: Assessment of Cumulative Environmental Effects and Section 11.1.2 Assessment Approach and Methods. Regarding specific details within:

- "valued components likely to be affected" in Section 4.4.1 Step 1: Selection of Valued Components and Section 11.1.2.1 Selection of VCs

- "spatial boundaries" in Section 4.4.3.1 for generalized definition, and in the *Boundaries* sub-section of each VC assessed (Sections 6, 7, 8; 9, and 10) in which the VC study areas are defined, including the Regional Assessment Area (RAA)
- "temporal boundaries" in Section 4.4.3.2 Temporal Boundaries
- "sources of potential effects" in Section 4.5.2.1 Identification of Other Projects or Activities and Section and Section 11.1.2.2 Project Inclusion List and Section 11.1.2.3 Regional Context
- "future scenario with and without the Project" is explicitly provided for future scenario with Project (i.e., overall) and implicitly provided for future scenario without Project (by subtraction of project contribution). This is further discussed in Section 11.1.2.4.
- "mitigation measures" in Section 4.5.1.3 Mitigation of Environmental Effects and Section 4.5.2.3 Mitigation of Cumulative Environmental Effects and the *Mitigation for Cumulative Effects on Change* sub-section for each assessed VC in Section 11
- "significance" in Section 4.4.4.1 Characterization of Residual Environmental Effects, Section 4.4.4.2 Thresholds for Determining Significance of Residual Environmental Effects, Section 4.5.2.4 Characterization of Residual Cumulative Environmental Effects and Section 4.5.3 Step 8: Significance Determination and Prediction Confidence and the *Summary of Cumulative Effects* sub-section for each assessed VC in Section 11
- "follow-up and monitoring" in Section 4.5.4 Step 9: Follow Up and Section 11.1.2.5

11.1.2.1 Selection of VCs

The cumulative effects assessment builds on the Project-specific residual effects assessments presented in Chapters 6 through 10. In accordance with the the Canadian Environmental Assessment Agency Guidelines for the Project (Chapter 7, Section 7.6.3), a cumulative effects assessment is required for a VC only where the Project may result in adverse residual effects on that VC; if a VC would not be affected by the Project or would be affected positively, then it may be omitted from the cumulative effects assessment.

Project-specific VCs that have adverse residual effects and, therefore, also assessed for potential cumulative effects, are:

- atmospheric environment
- geology and soils
- groundwater and surface water
- fish and fish habitat
- vegetation
- wildlife
- land and resource use
- infrastructure and services

- economy
- human health
- traditional land and resource use
- Indigenous health and socio-economic conditions
- Aboriginal and treaty rights

Cumulative effects for accidents and malfunctions (Project-related are discussed in Chapter 14) during construction and operations are also addressed in this chapter.

Cumulative effects were not assessed for heritage resources (from Chapter 9, Section 9.6). A preconstruction heritage resources impact assessment of the PDA will be conducted and submitted to the Manitoba Historic Resources Branch (HRB). Project-specific environmental effects will be mitigated to the standards established by the HRB. Although an interaction of the Project with this site is not expected, to mitigate any residual effects of changes to the cemetery reported on Sturgeon Bay by Dauphin River First Nation, a preconstruction visit to the site will be carried out with Knowledge Holders from the First Nation to facilitate avoidance by an appropriate distance. With mitigation following the recommendation of HRB and mitigation to avoid effects on the Bayton St. Thomas Lutheran Cemetery, no adverse residual environmental effects on historical resources are anticipated. In the absence of residual effects, there is no pathway for cumulative effects and, therefore, no cumulative effects assessment is warranted.

11.1.2.2 Project Inclusion List

Other projects or physical activities that have been, or will be, carried out are identified for inclusion in the cumulative environmental effects assessment, based on their potential for residual environmental effects that could interact spatially and temporally with the residual environmental effects of the Project. The assessment considers the nature and degree of change from these existing conditions due to both the Project and the other projects or activities.

In Sections 11.2 through 11.12, each VC includes a table entitled “Interactions with the Potential to Contribute to Cumulative Effects”. This table identifies which past, present and future projects effects may interact with the same effects (for the same VC) for the Project. These interaction tables, like the PIL, are organized by past and present, and then future. The “project-related physical activities” row recognizes for completeness the Project’s effects.

The environmental effects of other past and present projects or physical activities that have been carried out are reflected in the existing environment within the RAA. Such effects were also considered in the existing conditions for the Project-related environmental effects assessment for each VC within the local assessment area (LAA).

The other projects or physical activities identified for consideration in the cumulative environmental effects assessment for this EIA are listed in Table 11.1-1, referred to as a Project Inclusion List (PIL). Future projects and physical activities were identified from publicly available information and are "certain, planned, or reasonably foreseeable" as per CEAA guidelines. All reasonably foreseeable flood mitigation and water management projects and hydroelectric projects have also been identified in Table 11.1-1 and identified in Figure 11.1-1.

Figure 11.1-1 illustrates the location of the future projects and physical activities.

Manitoba Infrastructure is proposing to undertake improvements to the Provincial Highway System. The PTH 6 Rehabilitation – Phase 2 Project (construction planned for the 2019-2021 timeframe) will involve rehabilitation of PTH 6 along a stretch of the road between Ashern and Grahamdale. Work will involve the over-paving of the existing road surface, replacement of some culverts, and slope extensions from the north junction of PR 325 to PR 239.

Manitoba Infrastructure has also proposed the Upgrade to the Lake St. Martin Access Road. An application was submitted to Manitoba Sustainable Development in June 2019 for regulatory and public review. The Lake St. Martin Access Road (construction planned for 2019-2021) involves upgrading 19.5 km of winter road to an all-season road. This proposed road is located across provincial crown land.

Plans (i.e., locations and timing) for development of quarries and borrow sites for Project construction are not defined at this time but there are potential sites within the RAA, as shown in Figure 11.1-1. Some sites may be developed for the Project by third-party Contractors but other sites may be developed for non-Project uses. Because of the lack of details on quarries and borrow sites to be used for the Project, all potential sites are considered as future projects and activities and have been assessed as cumulative effects. Any site developer would be responsible for their licensing and operation.

The likely only source of vibration emanating from the Project would be associated with blasting during construction. However, these events are likely infrequent and, more importantly, each of a very brief duration. For a cumulative effect to occur, an effect directly associated with the Project must overlap (in time and space) with the same effect on the same VC by other physical activities. Given this temporal nature of Project related blasting, the likelihood of a cumulative effects occurring through vibration (i.e., identical moments of blasting) are likely immeasurably low.

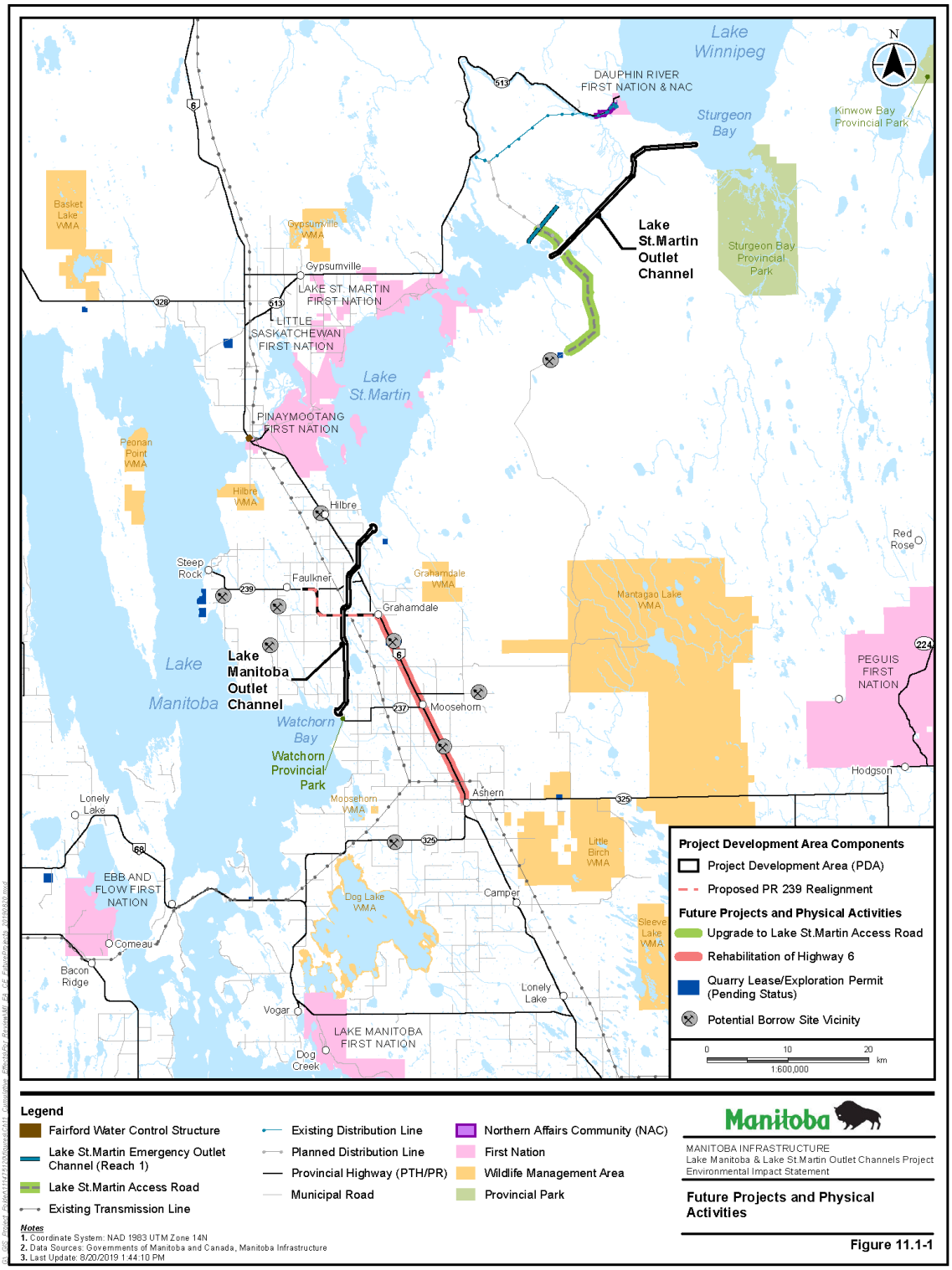

Figure 11.1-1 Future Projects and Physical Activities

Table 11.1-1 Other Projects and Physical Activities for Consideration of Cumulative Environmental Effects

General Category of Projects or Physical Activity	Specific Project or Activity	Description
Past and Present (have been carried out)		
Agriculture	Use of land or resources for ranching or farming activities	Due to the quality of the soil, the majority of agricultural activities are related to cattle production, with some areas used for pastures and forage crops where the land is suitable for these practices
Fishing	Commercial or Subsistence fishing	Commercial and subsistence fishing take place in the RAA in Lake Manitoba, Lake St. Martin, Dauphin River, Mantagao River, Sturgeon Bay and some tributaries to Lake Manitoba, Lake St. Martin and Sturgeon Bay.
Infrastructure	Roads	The provincial highway network includes primary routes (Provincial Truck Highways [PTHs]) and secondary routes (Provincial Roads [PRs]). PTH 6 is the primary road in the RAA. PRs in the vicinity of the immediate Project area include PR 325, PR 239 and PR 513.
	Power transmission	Transmission lines located within the RAA include a section of the Bipole I and II High Voltage Direct Current (HVdc) lines that pass through the RAA in a ROW adjacent to PTH 6, and sections of two 230 kV transmission lines that connect to communities in the region. There is a transformer station located at Ashern.
	Railway Lines	There is one rail line in the RAA that parallels PTH 6. The 104 km long line segment for the Warren to Steep Rock Junction and its associated spur lines were abandoned in 1997.
	Telecommunications	There are communications cables and towers throughout the RAA.
	Airports	There is one airport in the RAA located in Ashern.
	Waste Disposal	There are six solid waste disposal grounds and seven wastewater lagoons located in the RAA.
	Flood Control	The Lake St. Martin emergency outlet channel (EOC) was constructed following the 2011 flood.
Resource Use	Industrial Land Use	Graymont Western Canada Inc. limestone and gypsum quarries and processing plant is located in the RAA
	Trapping and Hunting	There are Registered Trap Lines, Open Trapping Area and Game Hunting Areas in the RAA.
	Mineral and Aggregate Resources	Quarry withdrawal activity, quarry lease, private quarry permits, mining claims and casual quarry permits present in the RAA.
	Forestry	Forest Management Units (FMUs) 10, 41, 42, 43 and 45 are present in the RAA

Table 11.1-1 Other Projects and Physical Activities for Consideration of Cumulative Environmental Effects

General Category of Projects or Physical Activity	Specific Project or Activity	Description
Residential and communities	Residential dwellings and communities	RM of Grahamdale and RM of West Interlake, and communities of: Moosehorn, Gypsumville, Ashern, Camper, Grahamdale, Hilbre, Faulkner, and Steep Rock.
	Reserves	Dauphin River FN, Dauphin River NAC, Lake St. Martin FN, Pinaymootang FN, Little Saskatchewan FN, Peguis FN, Fisher River CN, Kinonjeoshtegon FN the Lake St. Martin Northern Affairs area, Lake Manitoba FN, Fisher Creek FN, and Kinonjeoshtegon FN are in the RAA
	Cottage Developments	Cottage developments are present on the eastern shores of Lake Manitoba
Recreation and tourism	Campgrounds	There are five campgrounds in the RAA.
	Provincial Parks	Watchorn Provincial Park, Sturgeon Bay Provincial Park are in the RAA,
	Snowmobile trails	Snoman Trails occur in the vicinity of Gypsumville, Grahamdale, Moosehorn,and Ashern, and in proximity to PTH 6.
	Lodges and outfitters	There are five lodges and outfitters in the RAA.
	Recreational fishing	Recreational fishing take place in the RAA in Lake Manitoba, Lake St. Martin, Dauphin River, Mantagao River, Sturgeon Bay and some tributaries to Lake Manitoba, Lake St. Martin and Sturgeon Bay.
Reasonably Foreseeable Future (may or will be carried out), see Figure 11.1-1		
Roads and Trails	Rehabilitation of PTH 6	Manitoba Government announced in February 2019, PTH 6 Rehabilitation-Phase 2 from the north junction of PR 325 to the PR 239 realignment. This is the stretch between Ashern and Grahamdale. This work will involve over paving of the existing surface, replacement of some culverts and some slope extensions. Work is scheduled within the 2019-2021 time frame. The proponent is Manitoba Infrastructure.
	Upgrade of Lake St. Martin access road	Application submitted to Manitoba Sustainable Development in June 2019. Construction planned for 2019-2021. The proponent is Manitoba Infrastructure.
Quarries and Borrow Pits	Borrow and Rock for construction	Locations and timing are not defined but there are potential sites in the RAA. Some are expected to be used during construction of the Project. Proponents are currently unknown.

11.1.2.3 Regional Context

The archaeological record indicates the region surrounding the Project was inhabited 4,000 to 5,000 years before the present. European contact occurred in the late seventeenth century. Fur trading was predominant in the nineteenth century and the first European settlers appeared in 1905. The local fur trading post closed in 1912 and the area now supports the agriculture, fishing, recreation and tourism, mining and forestry industries. The rural municipalities (RMs) of Eriksdale and Siglunes were established on the east side of Lake Manitoba in 1918 and they amalgamated to form the RM of West Interlake in 2015. The Local District of Grahamdale, north of West Interlake, was established in 1945 and it became the RM of Grahamdale in 1997. The lands in the RMs are a mixture of private and provincial crown lands. The lands on the east and north sides of Lake St. Martin, outside of the RMs, are provincial crown lands, known as unorganized territory. Several First Nation communities (federal lands) are present in the RAA. The RM of Grahamdale has four communities and seven smaller settlement areas. The RM of West Interlake has four communities. There are no communities or settlement centres in the unorganized territory.

Water diversion for agriculture, power generation and flood control in Manitoba has been carried out since the early 1900s. Hydro power generation in northern Manitoba commenced in 1961 with the Kelsey generating station on the Nelson River. Since that time, Manitoba Hydro has constructed 11 generation and water regulation projects on the Nelson River and Churchill River watersheds with the Keeyask Generation Project currently under construction. A regional cumulative effects assessment of the Nelson River and Churchill River watersheds was completed by Manitoba Hydro in 2015 (Manitoba Hydro 2015). Their study area extended from the north shore of Lake Winnipeg to Hudson Bay and touches the northern extent of the Project RAA.

In the Interlake Region, where the Project regional assessment areas (RAAs) are located, the Portage Diversion (since 1970), Fairford Water Control Structure (since 1961), and Red River Floodway (since 1969) work in tandem to reduce the effects of flooding in the region. The Lake Manitoba and Lake St. Martin Outlet Channels Project will add to the flood control structures in this region.

Effects of the 2011 flood are included in the baseline environment and, as relevant, reflected in the *Existing Conditions* sub-section of each VC assessed for project-specific effects. As such, that flood event is considered a past activity within the cumulative effects assessment.

11.1.2.4 Future with and without Project

The assessment of cumulative effects provides an assessment of overall cumulative effects (i.e., from all interacting physical activities on a VC) and of Project contribution to that overall effect. The future scenario without the Project is therefore that overall effect less that of the Project contribution. The following provides further information reflective of that scenario as a qualitative summary.

The Project is a flood mitigation project with the goal of reducing effects from flooding in the Project area. As such, a future with no Project will not benefit from the positive effects associated with its flood mitigation.

An accurate characterization of such a future in one scenario cannot be specifically made given the highly complex and stochastic nature of any flood event; however, generalizations can be made as follows.

If the Project does not proceed, the existing baseline conditions (which include the cumulative effects of previous floods, including the 2011 flood) will be further affected by anticipated floods (based on projections from historical frequencies and other future changes) as will the future projects or physical activities. The future projects and physical activities listed in Table 11.1-1 have relatively short term (less than two year) construction periods (rehabilitation of PTH 6, upgrade of Lake St. Martin access road) and/or small areal extent (quarries and borrow pits).

The future scenario without the Project is therefore as described in the Existing Conditions sub-sections for each VC with the addition of the effects from additional flooding. The effects may be generally similar to those described for the effects pathways for a breach of the proposed channels (see Section 11.2.1 Cumulative Effects of Accidents and Malfunctions). These include short-term changes to sediment transport dynamics and surface water quality (e.g., turbidity, suspended sediment concentrations, herbicides), direct loss or alteration of vegetation, flooding or infilling of wildlife habitat, mortality of wildlife (including migratory birds and species at risk that may be nesting).

Effects on public health in relation to drinking water quality would likely also occur. Effects to fish, wildlife and vegetation could affect country foods. Effects on infrastructure and services could occur due to direct damage of infrastructure such as downstream bridges and roads. Repairs would have economic effects and would temporarily interrupt travel. A temporary restriction of use and access of land and water resources for recreation and traditional uses could occur from flooding of lands or from emergency response measures after a flood. Federal lands (i.e., Indigenous reserves) could be affected by flooding. The duration of the effects would remain until damage from flooding is repaired (where possible).

11.1.2.5 Mitigation and Follow-up

The assessment of each VC (Sections 11.2 to 11.13) provides information to support the assessment of potential cumulative effects, including mitigation measures. Specifically, other physical activities are identified by which Project effects may interact cumulatively, effects pathways identified and assessed, mitigation identified, and residual effects concluded. Mitigation effectiveness relies on the same rationale as provided in the assessment of project-specific effects, including the mandated and precedence proven nature of many. This reflects the relevance and importance of mitigation, in a cumulative effects context, as most importantly reflecting the mitigation relevant to the Project, and, as applicable, equivalently applied to other physical activities.

As is common for cumulative effects assessments, the majority of mitigation, and often the most effective, originates with the measures implemented by individual projects (as it is these effects that cause cumulative effects). Additional measures unique to cumulative effects (e.g., regionally coordinated joint initiatives) may also possibly be applied if individual project measures may not be adequate; however, such measures would typically be reasonable and useful only under conditions of substantial effects compromising the state of VCs in landscapes certain to yet undergo continued landscape-scale transformation. However, given the limited nature of reasonably foreseeable physical activities that may interact with the Project, such additional measures are viewed as unnecessary towards achieving adequate management of effects.

Manitoba Infrastructure does not view as necessary the implementation of additional cumulative effects management measures, including those directly outside its care and control based on jurisdictional responsibility.

Adverse effects from the Project that will act cumulatively with the effects of other future projects and activities, for example, can be mitigated through the adherence to standard operating procedures for road construction and borrow development. The rehabilitation of PTH 6 and upgrade of the Lake St. Martin access road are projects that will be undertaken by Manitoba Infrastructure and will follow their standard construction specifications (Government of Manitoba 2015) which address environmental protection. Quarry and borrow pit development is regulated under the Quarry Minerals Regulation of the *Manitoba Mines and Minerals Act* (Province of Manitoba 1992) which includes regulations for the operation and rehabilitation of quarries.

Follow-up measures to confirm effectiveness of mitigation measures to manage cumulative effects are, as discussed above, already discussed, as appropriate and relevant, in follow-up discussions for each assessed VC in the project-specific assessments for each VC (Sections 11.1 to 11.13).

11.2 ATMOSPHERIC ENVIRONMENT

11.2.1 Project Residual Effects Likely to Act Cumulatively

Table 11.1-1 presents the PIL which identifies other projects and physical activities that might act cumulatively with the Project. Where residual atmospheric environment effects from the Project act cumulatively with those from other projects and physical activities (Table 11.2-1), a cumulative effects assessment is undertaken.

The construction phase will result in exhaust emissions (that include GHG) and daytime noise emissions from construction equipment and fugitive dust emissions from surface disturbance activities. In addition, nighttime construction activities will require artificial lighting.

During the operations and maintenance phase, emissions will be limited to periodic inspections and routine maintenance activities; these effects have been assessed as negligible. Therefore, there are negligible atmospheric interactions of the Project during the operations and maintenance phase with those of future projects and activities.

With respect to cumulative effects during construction, the expected Project construction period will be spread over a five-year period, with the largest amount of work occurring during the first 2.5 to 3 years. Channel excavation is currently planned to occur during the winter of 2020. Cumulative effects of the Project in combination with past and present physical activities are addressed in the discussion of residual Project effects in Chapter 6, Section 6.2.4. The future physical activities identified in Table 11.1-1 have construction activities that are also of limited duration. Emissions associated with the construction of the upgrade of the Lake St. Martin access road, the rehabilitation of PTH 6, and the development of various quarries and borrow sites for the Project could take place during the Project construction period and are overlapping with Project emissions in the atmospheric environment RAA.

Table 11.2-1 Interactions with the Potential to Contribute to Cumulative Effects on Atmospheric Environment

Other Projects and Physical Activities with Potential for Cumulative Environmental Effects	Potential Cumulative Environmental Effects			
	Change in Air Quality	Greenhouse Gases	Change in Acoustic Environment	Change in Ambient Light
Past and Present Physical Activities and Resource Use				
Agricultural Conversion	-	✓	-	-
Fishing	-	-	-	-
Infrastructure	✓	✓	✓	✓
Resource Use	✓	✓	✓	✓
Residential Development	✓	✓	✓	✓
Recreation	-	-	-	-
Project-Related Physical Activities	✓	✓	✓	✓
Future Projects or Physical Activities				
Upgrade of Lake St. Martin access road	✓	✓	✓	✓
Quarries and borrow sites	✓	✓	✓	✓
Rehabilitation of PTH 6	✓	✓	✓	✓

NOTES:
✓ = those "other projects and physical activities" whose residual effects are likely to interact cumulatively with project residual environmental effects.

11.2.2 Cumulative Effects Assessment for Change in Air Quality

11.2.2.1 Cumulative Effect Pathways for Change in Air Quality

During construction, products of combustion result from construction equipment and vehicular exhausts, and fugitive dust emissions result from surface disturbance activities. Oxides of nitrogen (NO_X) and fine particulate ($PM_{2.5}$) emissions result from equipment and vehicle exhausts. Particles of various size ranges (i.e., $PM_{2.5}$, PM_{10} and TSP) result from surface disturbance activities that include the construction haul roads. Ambient air quality in the LAA will be influenced by emissions from the Project and from other future sources. Cumulative effects of the Project on air quality in combination with past and present physical activities are addressed in the discussion of residual Project effects in Chapter 6, Section 6.2.4.2.

Ambient concentrations downwind from each emission source are the greatest near the emission source and decrease with increasing distance from the source due to atmospheric dispersion processes. For short-term air quality changes, emission plumes from different sources will only align under limited wind direction conditions.

The upgrade of Lake St. Martin access road (south of the LSMOC PDA) will occur over a two-year period from 2019 to 2021. The emission profile associated with these activities is expected to be similar to that associated with the Project (i.e., diesel fueled construction equipment and fugitive dust emissions).

The rehabilitation of PTH 6 is south-east of the LMOC PDA. Emissions will result from overpaving and culvert replacement activities that will be spread over a two-year period from 2019 to 2021. The emission profile associated with the overpaving and replacement activities is expected to be similar to that associated with the Project (i.e., diesel fueled construction equipment and fugitive dust emissions).

Multiple quarries and borrow sites in the air quality RAA will support Project construction and other activities. Emissions associated with these sites will overlap with the whole Project construction period from 2019 to 2023. The emission profile associated with the quarries and borrow site activities is also expected to be similar to that associated with the Project (i.e., diesel fueled construction equipment and fugitive dust emissions).

11.2.2.2 Mitigation for Cumulative Effects on Change in Air Quality

Mitigation measures identified in Chapter 6, Section 6.2.4.2 will be implemented to manage and reduce Project emissions during the construction phase. No additional mitigation measures specific to cumulative effects are required or proposed.

It is expected that Manitoba Infrastructure will follow emission management practices similar to those adopted by the Project to manage construction emissions from the proposed future activities included in Table 11.1-1 to reduce air quality changes due to the proposed projects.

11.2.2.3 Residual Cumulative Effects on Change in Air Quality

Residual effects on ambient air quality due to the Project are discussed in Chapter 6, Section 6.2.4.2. Residual effects are based on baseline air quality analysis and project emissions quantification.

Relative to the future activities of upgrade of Lake St. Martin access road, and the rehabilitation of PTH 6, construction emissions are expected to occur during the two-year Project construction period. The emissions associated with the future activities are expected to be similar to, but on a smaller scale and for a shorter duration compared to the Project. Emissions from the future activities will not materially change the predicted Project residual effects conclusions.

Emissions associated with the activities for quarries and borrow sites are scattered in the air quality RAA. The emissions from the scattered sites would not materially change the predicted project residual effects conclusions nor the need for the adaptive management plan approach.

11.2.3 Cumulative Effects Assessment for Greenhouse Gases

11.2.3.1 Cumulative Effect Pathways for Greenhouse Gases

The Project construction equipment and vehicle exhausts are sources of greenhouse gas (GHG) emissions that are primarily carbon dioxide (CO_2) with smaller amounts of methane (CH_4) and nitrous oxide (N_2O). Other future projects (both inside and outside the LAA) associated with the combustion of fossil fuels also result in GHG emissions. The environmental effects associated with GHG emissions are on a global scale.

11.2.3.2 Mitigation for Cumulative Effects on Greenhouse Gases

The mitigation measures that reduce emissions from Project construction equipment and vehicle exhausts are also applicable for reducing project GHG emissions. No additional mitigation specific to cumulative effects is required or proposed.

It is expected that Manitoba Infrastructure will follow GHG emission management practices similar to those adopted by the Project to manage GHG emissions from the proposed future activities included in Table 11.1-1 to reduce changes to GHG emissions due to the proposed projects.

11.2.3.3 Residual Cumulative Effects on Greenhouse Gases

GHG emissions associated with other projects in the RAA have not been estimated since environmental effects associated with GHG emissions are on a global scale. The total estimated GHG emissions due to Project construction is 417,397 t CO_2e, occurring over a period of five years. The maximum annual Project construction emissions is 0.6% of Manitoba's 2017 GHG emission rate and 0.02% of the Canadian 2017 GHG emission rate. GHG emissions due to Project construction are expected to be low in magnitude. The contribution of the Project and the indicated future projects are small on a provincial, national and global context and would not contribute measurably to climate change.

11.2.4 Cumulative Effects Assessment for Change in Acoustic Environment

11.2.4.1 Cumulative Effect Pathways for Change in Acoustic Environment

During construction, noise emissions will primarily emanate from machinery engines, mufflers, pile driving, back-up alarms of the vehicles and machinery, drilling and rotary equipment, soil and pavement compactors and other material movement equipment. Cumulative effects of the Project on the acoustic environment in combination with past and present physical activities are addressed in the discussion of residual Project effects in Chapter 6, Section 6.2.4.4.

Existing and future physical activities have to be sufficiently close to the Project construction activities to act cumulatively. Noise emissions associated with the upgrade of Lake St. Martin access road and rehabilitation of PTH 6, and the various quarries and borrow pits could take place during the Project construction period and overlap temporally with Project noise emissions in the RAA. Therefore, overlap is

expected between residual Project noise and future physical activities and thus the Project is expected to contribute to cumulative effects.

11.2.4.2 Mitigation for Cumulative Effects on Change in Acoustic Environment

Mitigation measures will be implemented to manage and reduce Project noise emissions during the construction phase as identified in Chapter 6, Section 6.2.4.4. Mitigation measures to reduce Project noise emissions during the construction phase will reduce the Project effects that may interact cumulatively with other existing and future physical activities that overlap temporally. Therefore, no additional mitigation measures specific to cumulative effects are proposed.

11.2.4.3 Residual Cumulative Effects on Change in Acoustic Environment

The Project is expected to interact cumulatively with other existing and future physical activities during the Project construction phase only; effects during the operation and maintenance phase are expected to be negligible. Mitigation measures to reduce Project noise emissions during the construction phase will reduce the Project effects that may interact cumulatively with other existing and future physical activities. The Project construction activities are expected to be greater than those of the future activities and to form the largest proportion of the cumulative effects. The residual cumulative effects on the acoustic environment are therefore assessed to be similar to the residual Project effects.

11.2.5 Cumulative Effects Assessment for Changes in Ambient Light

11.2.5.1 Cumulative Effect Pathways for Changes in Ambient Light

The construction of the Project will likely be limited to daylight hours; however, there is potential for such activities to occur during the night depending on the construction schedule and time of year (i.e., during fall and winter days which are shorter). During this time, it is likely that portable lighting units would be used to meet visibility and worker safety needs. There would also be light associated with the use of vehicles to support the Project related transportation.

If portable lighting is required during Project construction, the levels of light trespass and glare from the operation of the mobile lighting units are expected to be less than the CIE guideline thresholds for a rural environment and will not extend beyond the LAA. The construction phase of the Project is also not expected to have a substantial contribution to existing sky glow. Therefore, for Project activities to interact cumulatively with future activities they would have to overlap spatially (i.e. within the LAA) and temporally (i.e. the Project principal construction period is 2020 to 2023). Potential cumulative lighting effects of the Project in combination with past and present physical activities are addressed in the discussion of residual Project effects in Chapter 6, Section 6.2.4.5.

Portable lighting and vehicle lighting during the construction of the Lake St. Martin access road upgrade, quarries and borrow material sites and the rehabilitation of PTH 6 operating within the LAA at the same time as such lighting was operational for the Project would have a cumulative effect.

Lighting during Project operation will be limited to the WCSs and use full cut-off luminaires wherever possible to reduce light trespass, glare, and sky glow. Cumulative contributions of Project operation would have minimal effect.

11.2.5.2 Mitigation for Cumulative Effects on Changes in Ambient Light

Mitigation measures to limit potential effects on light trespass, glare, and sky glow are identified in Chapter 6, Section 6.2.4.5. No additional mitigation measures specific to cumulative effects are proposed.

11.2.5.3 Residual Cumulative Effects on Change in Ambient Light

If mobile lighting is required during Project construction, the levels of light trespass and glare from the operation of the mobile lighting units are expected to be less than the Commission Internationale de L'Éclairage guideline thresholds for a rural environment within a kilometre from the source of the light. If activities associated with the future projects in the PIL require sources of light and will overlap with the construction of the Project spatially and temporally, there would be potential for a cumulative interaction.

The existing ambient light environment within the RAA is representative of a rural environment and the potential sources of light associated with future activities will be similar in quantity, type and intensity (if required at all) to that of the Project. The Project effects are predicted to result in a limited change to the existing levels of light trespass, glare or sky glow. The future activities offer a potential for a slight increase in levels of light trespass, sky glow and glare, however the residual cumulative effect would likely not substantially differ from the residual Project effects.

11.2.5.4 Summary of Cumulative Effects on the Atmospheric Environment

Table 11.2-2 summarizes cumulative environmental effects on the atmospheric environment.

Table 11.2-2 Summary of Cumulative Environmental Effects on the Atmospheric Environment

Residual Cumulative Effect	Residual Cumulative Effects Characterization							
	Direction	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Ecological Context
Changes in Air Quality								
Residual cumulative effect	A	ST	M	NS	RAA	RC	R	D
Contribution from the Project to the residual cumulative effect	The Project is the dominant contributor to future cumulative effects in the RAA on air quality. Its effects are described in Section 6.2.4.2.							

Table 11.2-2 Summary of Cumulative Environmental Effects on the Atmospheric Environment

Residual Cumulative Effect	Residual Cumulative Effects Characterization							
	Direction	**Duration**	**Magnitude**	**Timing**	**Geographic Extent**	**Frequency**	**Reversibility**	**Ecological Context**
Greenhouse Gases								
Residual cumulative effect	A	ST	L	NS	N/A	RC	I	D
Contribution from the Project to the residual cumulative effect	Greenhouse Gas Emissions from the Project and the future activities within the LAA or RAA are mainly from construction equipment. Therefore, their residual cumulative effect from these activities would be minimal for this short duration i.e. only during construction and later the Project will have minimal residual cumulative effects. The environmental effects associated with GHG emissions are on a global scale.							
Change in Acoustic Environment								
Residual cumulative effect	*A*	*ST*	*L*	*HS*	*RAA*	*SI*	*R*	*D*
Contribution from the Project to the residual cumulative effect	During the Project construction phase, the daytime sound levels within the LAA are expected to be higher than baseline levels and may interact cumulatively with the future activities only for the duration of construction phase. Effects during the operation and maintenance phase are expected to be negligible and limited mainly to the PDA and Project area roadways.							
Change in Ambient Light								
Residual cumulative effect	*A*	*ST*	*L*	*NS*	*RAA*	*SI*	*R*	*D*
Contribution from the Project to the residual cumulative effect	Levels of light associated with the construction of the Project are expected to be less than the CIE guideline thresholds for a rural environment within a kilometre from the source of the light, and its contribution to a residual cumulative effect would be negligible.							

KEY

Direction:
P: Positive
A: Adverse
N: Neutral

Duration:
ST: Short-term;
MT: Medium-term
LT: Long-term

Magnitude:
N: Negligible
L: Low
M: Moderate
H: High

Timing
NS: No sensitivity
MS: Moderate 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:
R: Reversible
I: Irreversible

Ecological Context:
U: Undisturbed
D: Disturbed

11.3 GEOLOGY AND SOILS

11.3.1 Project Residual Effects Likely to Act Cumulatively

The Project is expected to cause residual effects to terrain conditions and soil quantity and quality.

Table 11.1-1 presents the PIL, which identifies other projects and physical activities that might act cumulatively with the Project. Where residual terrain and soil effects from the Project act cumulatively with those from other projects and physical activities (Table 11.3-1), a cumulative effects assessment is undertaken. The rehabilitation of PTH 6 is not anticipated to act cumulatively with residual terrain and soils effects from the Project as the rehabilitation work is not expected to result in new disturbance areas that would potentially affect terrain conditions or soil quantity or quality.

Table 11.3-1 Interactions with the Potential to Contribute to Cumulative Effects on Geology and Soils

Other Projects and Physical Activities with Potential for Cumulative Environmental Effects	Potential Cumulative Environmental Effects	
	Change in Terrain Conditions	Change in Soil Quantity and Quality
Past and Present Physical Activities and Resource Use		
Agricultural Conversion	✓	✓
Fishing		
Infrastructure	✓	✓
Resource Use		
Residential Development		✓
Recreation		
Project-Related Physical Activities	✓	✓
Future Projects or Physical Activities		
Upgrade of Lake St. Martin access road	✓	✓
Quarries and borrow sites		✓
Rehabilitation of PTH 6		

NOTES:
✓ = those "other projects and physical activities" whose residual effects are likely to interact cumulatively with project residual environmental effects.

11.3.2 Cumulative Effects Assessment for Changes in Terrain Conditions

11.3.2.1 Cumulative Effect Pathways for Changes in Terrain Conditions

Residual effects from identified past and present physical activities and future physical activities are anticipated to act cumulatively with Project effects to terrain conditions. Changes to terrain conditions from the Project will be limited to alterations to drainage, which is anticipated to result in increased soil wetness potentially leading to inundation and flooding on the upgradient side of the channels and soil drying resulting in reduced soil wetness on the downgradient side of the channels. These changes are anticipated to affect soil capability and productivity for natural vegetation within the terrain LAA for the LSMOC and for agricultural capability and natural vegetation within the terrain LAA for the LMOC.

Past and present physical activities have influenced drainage conditions throughout the RAA, including:

- Agricultural conversion refers to removal of natural vegetation for agricultural crop production that has altered evapotranspiration and the water balance in areas of agricultural land use. Artificial drainage is a common improvement practice for agricultural production in wet soil-landscapes, which are common throughout the RAA.
- Infrastructure refers to existing highways, roads, municipal development (i.e., towns) and artificial drainage networks that have affected natural surface and shallow subsurface drainage pathways.

Future physical activities which may alter drainage conditions include:

- Upgrade of Lake St. Martin access road requires clearing that may alter the water balance, and presence of the road may affect surface drainage and shallow groundwater flow in proximity to the road.

The identified past and present physical activities and future physical activities that are expected to affect drainage conditions and may act cumulatively with effects from the Project effects could result in changes to soil capability and productivity for natural vegetation and agricultural capability. The cumulative effect pathways to effects to soil capability and productivity to natural vegetation are discussed in Section 11.6 and to agricultural land use in Section 11.8.

11.3.2.2 Mitigation for Cumulative Effects on Changes in Terrain Conditions

Specific project mitigation measures to reduce potential project effects on changes to terrain conditions, specifically drainage alterations, are presented in Chapter 6, Section 6.3.4.2. These will limit residual effects from the Project.

The upgrade of the Lake St. Martin access road will be carried out following Manitoba Infrastructure's General Environmental Requirements and other pertinent environmental protection and management plans. Mitigation of effects to drainage alterations for future physical activities are anticipated to include:

- revegetation of cleared areas to limit effects to the water balance
- surface and groundwater management planning, including maintenance and re-establishment of natural drainage patterns, where possible, and implementation of artificial drainage measures where restoring natural drainage is not possible

11.3.2.3 Residual Cumulative Effects on Changes in Terrain Conditions

With the consideration of mitigation (see Chapter 6, Section 6.3.4.2), alterations to drainage due to the Project are anticipated to be limited to the terrain LAA. For the LSMOC, the effects will occur in 2,400 ha within the terrain LAA for the LSMOC, representing approximately 4% of the total LAA area. When only the portion of the LAA in association with the LSMOC is considered (i.e., the area of the LSM portion of the LAA, including Lake St. Martin, and the areas of the LMOC portion of the LAA is removed), this area of affected drainage represents a large proportion of the LAA areas: up to between 40% and 50% of the LSMOC portion of the LAA.

Drainage alteration effects from past physical activities are mostly limited to developed areas within the RAA. These alterations were generally the result of desired effects from development activities including agricultural land use and infrastructure development. However, in some cases, such as alterations resulting from artificial drainage for agricultural land development and the presence of highways and roads, drainage alterations have adversely affected soil capability and productivity for natural vegetation (see Chapter 6, Section 11.6).

Effects on terrain conditions, specifically drainage alterations, are expected to be localized for future physical activities. The implementation of mitigation, namely revegetation and maintenance and re-establishment of natural drainage or artificial drainage implementation, are anticipated to limit effects to drainage to the project rights-of-way associated with the physical activities, or to within close proximity to these features. The residual effects from future physical activities are anticipated to be of lower magnitude and geographic extent than those from the Project, as these activities are anticipated to result in less additional disturbance to surface drainage and subsurface flows.

The cumulative effects of future projects and activities on terrain conditions are expected to result in a small addition to those from the Project.

11.3.3 Cumulative Effects Assessment for Changes in Soil Quantity and Quality

11.3.3.1 Cumulative Effect Pathways for Changes in Soil Quantity and Quality

Changes to soil quantity and quality are generally the result of soil disturbance from physical activities. These activities can result in soil loss and/or degradation of soil quality by such mechanisms as improper handling (e.g., loss of topsoil, loss of organic matter, soil mixing), soil erosion by wind or water and compaction.

Construction and presence of Project components and infrastructure will affect soils, and, in turn, the agricultural capability and reclamation suitability of these soils. During the construction phase, site preparation and construction of Project components will require clearing, topsoil stripping, soil excavation, and soil handling and stockpiling. These components include LMOC, PR 239 and municipal road realignments, and LSMOC, as well as rock quarry and borrow sites and temporary construction camps and staging areas. Project activities could result in soil loss and degradation of soil quality. Areas disturbed during Project construction will be reclaimed for pre-Project land uses if being returned to natural or agricultural land use or re-vegetated in the cases of Project features such as soil stockpiles, berms and dikes. Proper soil replacement will maintain topsoil and upper subsoil quantity (thickness/depth) and quality (e.g., organic matter content), to the extent feasible. Under permanent, physical Project footprints, soil areas will be lost for agricultural or natural vegetation land uses through the Project operation phase. Loss of pre-Project land uses will occur at rock quarry and borrow sites, as well as at temporary construction camps and staging areas. These losses will be temporary, and areas will undergo reclamation following the construction phase, or during the operation phase, when they are no longer required to support the Project. The Project will also result in reductions in flood levels and lake levels in Lake St. Martin, a desired Project outcome which will allow for the positive effect return of soil capability and productivity to agricultural land use (haying and pastureland) along the Lake St. Martin shoreline.

Past and present physical activities that have affected soil quantity and quality within the RAA include agricultural conversion, infrastructure and residential development. Future physical activities have the potential to affect soil quality and quantity, including the upgrade of the Lake St. Martin access road and quarries and borrow sites. Potential adverse effects to soil quantity and quality from these activities may result through the same pathways and mechanisms discussed for the Project, above, namely soil disturbance from construction activities and soil loss.

The identified past and present physical activities and future physical activities which have and are anticipated to affect soil quantity and quality are anticipated to act cumulatively with the Project effects. The cumulative effect pathways to soil quantity and soil quality will in turn be pathways to effects to soil capability and productivity to natural vegetation and agricultural land use. These are discussed for natural vegetation in Section 11.6 and for agricultural capability in Section 11.8.

11.3.3.2 Mitigation for Cumulative Effects on Changes in Soil Quantity and Quality

The upgrade of the Lake St. Martin access road and the rehabilitation of PTH 6 will be carried out following using standard mitigation measures such as Manitoba Infrastructure's Project Environmental Requirements (PER). The development of quarries and borrow sites will require work permits or leases from Manitoba Growth, Enterprise and Trade. Environmental conditions will be stipulated on the permits and leases. Specific project mitigation measures to reduce potential project effects on changes to soil quantity and quality are presented in Chapter 6, Section 6.3.4.3. These will limit residual effects from the Project.

Mitigation of effects to soil quantity and quality for future physical activities are will include:

- soil salvage planning and management, including stripping and stockpiling mineral topsoil, organic materials and good quality upper subsoil, as required to support identified revegetation, reclamation and other decommissioning needs
- soil erosion and sediment control planning
- limiting soil disturbance to the extent possible

11.3.3.3 Residual Cumulative Effects on Changes in Soil Quantity and Quality

Residual effects on soil quantity and quality from the Project will include the following:

- adverse effects due to the loss of 1,023 ha of soils with agricultural capability
- adverse effects due to soil disturbance of 1,911 ha of soils with reclamation
- positive effects due to return of soil capability and productivity for agricultural and natural vegetation over the long-term in the soils LAA for the LSMOC due to reduced flooding levels on Lake St. Martin

Residual effects from past physical activities are mostly limited to developed areas within the RAA. Soil losses are generally limited to the footprints of infrastructure and residential development. Agricultural conversion has resulted in a large proportion of the soils within the RAA being managed for agricultural land use. Effects to soil quantity and quality are expected to be localized for future physical activities. The implementation of mitigation, namely soil salvage, erosion control and limiting disturbance footprints, are anticipated to limit effects to soil quantity and quality to the project rights-of-way associated with the physical activities. The residual effects from future physical activities are anticipated to be of lower magnitude and geographic extent than those from the Project, as these activities are anticipated to result in less soil disturbance and loss.

The cumulative effects of future projects and activities on soil quantity and quality are expected to result in a minor addition to those of the Project.

11.3.4 Summary of Cumulative Effects on Geology and Soils

Table 11.3-2 summarizes cumulative environmental effects on Geology and Soils.

Table 11.3-2 Summary of Cumulative Environmental Effects on Geology and Soils

Residual Cumulative Effect	Residual Cumulative Effects Characterization							
	Direction	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Ecological Context
Changes in Terrain Conditions								
Residual cumulative effect	A	LT	L	NS	RAA	RC	I	U & D
Contribution from the Project to the residual cumulative effect	The Project will result in changes to terrain conditions, specifically alterations to drainage due to the presence of the LMOC and LSMOC. Effects from future projects or physical activities to alterations in drainage are expected to be limited to the upgrade of the Lake St. Martin access road and are anticipated to be minor in relation to the Project contribution to these cumulative effects. Therefore, the cumulative effects are anticipated to be similar to those assessed from the Project.							
Change in Soil Quantity and Quality								
Residual cumulative effect	A & P	LT	L	NS	RAA	SI	I	U & D
Contribution from the Project to the residual cumulative effect	The Project will result in adverse effects to soils with agricultural capability due to loss of soils within the LMOC PDA. Positive effects from the Project will consist of return of soil capability and productivity for agricultural land use along the Lake St. Martin shoreline, which have been negatively affected by pre-Project flooding conditions. This is a desired outcome of the Project. Effects from future projects or physical activities to soil quantity and quality are anticipated to be localized and of low magnitude relative to the Project's contribution. Therefore, the cumulative effects to soil quality and quantity are not anticipated to be substantively greater than the effects from the Project.							

KEY

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
MS: Moderate 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

11.4 GROUNDWATER AND SURFACE WATER

11.4.1 Groundwater

11.4.1.1 Identification of Projects Likely to Interact Cumulatively on Groundwater

Table 11.1-1 presents the PIL, which identifies other projects and physical activities that might act cumulatively with the Project. Where residual groundwater effects from the Project act cumulatively with those from other projects and physical activities (Table 11.4-1) a cumulative effects assessment is undertaken.

The Project is not expected to affect regional groundwater flows, levels and quality and surface water. Existing activities are part of the current groundwater baseline; no cumulative change is expected in relation with existing activities at the regional level. Future projects do not involve excavation similar to the Project; consequently, no additional effect is expected to combine with those from the Project. Although the Project will necessitate depressurization for safety during construction, artesian pressure will be maintained. Consequently, artesian pressure will keep potential surface contaminants to the surface; as such it is unlikely that the regional bedrock aquifer will be influenced by surface water.

Table 11.4-1 Interactions with the Potential to Contribute to Cumulative Effects on Groundwater

Other Projects and Physical Activities with Potential for Cumulative Environmental Effects	Potential Cumulative Environmental Effects		
	Changes in Regional Groundwater Flows, Levels and Quality & Surface Water Interactions	Changes in Local Groundwater Flow Levels and Quality	Changes in Local Groundwater – Surface Water Interactions
Past and Present Physical Activities and Resource Use			
Agricultural Conversion	✓	✓	✓
Fishing			
Infrastructure		✓	✓
Resource Use	✓	✓	
Residential Development	✓	✓	✓
Recreation			
Project-Related Physical Activities	✓	✓	✓
Future Projects or Physical Activities			
Upgrade of Lake St. Martin access road		✓	✓
Quarries and borrow sites		✓	✓
Rehabilitation of PTH 6		✓	✓

NOTES:
✓ = those "other projects and physical activities" whose residual effects are likely to interact cumulatively with project residual environmental effects.

11.4.1.2 Cumulative Effects Assessment for Changes in Local Groundwater Flows Levels and Quality

Cumulative Effect Pathways for Changes in Local Groundwater Flow Levels and Quality

Drainage from the upgrading of the Lake St. Martin access road will combine with surficial drainage caused by construction of the LSMOC. This drainage will remove near-surface groundwater within the groundwater LAA, consequently affecting sub-surface groundwater flow. Because part of the surficial groundwater flow will be diverted from within the groundwater LAA toward the LSMOC, the cut-off groundwater will not reach the groundwater RAA through the normal groundwater flow path.

Drawdown caused by dewatering operations for quarries and borrow pits, if necessary, for mining, has the potential to superimpose dewatering effects associated with the Project. This superimposition can contribute to further bedrock aquifer depressurization associated with the Project. Consequently, additional groundwater users could be affected, and hydrostatic pressure decrease could reach the RAA.

Mitigation for Cumulative Effects on Changes in Local Groundwater Flow Levels and Quality

Cumulative effects due to drawdown at quarries and borrow pits can be mitigated by the use of existing quarries and borrow pits which will help to keep dewatering at existing levels.

Residual Cumulative Effects on Changes in Local Groundwater Flow Levels and Quality

Effects on wetlands and surficial drainage for both the Lake St. Martin access road and the rehabilitated section of PTH 6 are local and not expected to overlap with the Project effects, except where the access road intersects the channel. The cumulative effects would however not be measurable within the RAA.

11.4.1.3 Cumulative Effects Assessment for Changes in Local Groundwater–Surface Water Interactions

Cumulative Effect Pathways for Changes in Local Groundwater–Surface Water Interactions

Drainage from the upgrading the Lake St. Martin access road combining with surficial drainage caused by construction of the Lake St. Martin outlet channel will decrease near-surface groundwater levels and potentially reduce flow to wetlands within the groundwater LAA. Surficial groundwater flow ultimately reaches the groundwater RAA in normal conditions.

Dewatering of quarries and borrow pits will result in depressurization of the surficial aquifer, decreasing hydrostatic pressure contributing to subsurface recharge of wetlands.

Mitigation for Cumulative Effects on Changes in Local Groundwater–Surface Water Interactions

Mitigation for cumulative effects on changes in local groundwater–surface water interactions from the upgrading of the Lake St. Martin access road involves returning the drainage water to the adjacent wetlands, provided water quality is compatible with the wetland physico-chemical profile. This mitigation would be the responsibility of the access road upgrading proponent.

Mitigation for cumulative effects on changes in local groundwater–surface water interactions from quarries and borrow pits would include maintaining dewatering level and hydrostatic pressure to reduce the potential for blow-out in the quarries and borrow pits. This mitigation would be part of quarry and pit operations and the responsibility of the quarry or borrow pit licensee.

Residual Cumulative Effects on Changes in Local Groundwater–Surface Water Interactions

No measurable cumulative effects on changes in local groundwater-surface water interactions are expected from the upgrading of the Lake St. Martin access road or the development of quarries or borrow sites in the RAA. The cumulative effects will be the same as the Project effects.

11.4.1.4 Summary of Cumulative Effects on Groundwater

Table 11.4-2 summarizes cumulative environmental effects on Groundwater.

Table 11.4-2 Summary of Cumulative Environmental Effects on Groundwater

Residual Cumulative Effect	Residual Cumulative Effects Characterization							
	Direction	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Ecological Context
Changes in Local Groundwater Flows Levels and Quality								
Residual cumulative effect	A	ST	N	NS	RAA	IF	RS	U
Contribution from the Project to the residual cumulative effect	Residual cumulative effect will not be measurable within the RAA. Springs flowing near the LSMOC outlet could decrease but will be within seasonal fluctuation range, so will be non-measurable.							
Changes in Local Groundwater - Surface Water Interactions								
Residual cumulative effect	A	LT	N	HS	RAA	RC	I	U
Contribution from the Project to the residual cumulative effect	Residual cumulative effect is possible only if there is connection between the bedrock aquifer and wetlands. Even if so, the change is unlikely to be measurable within the RAA.							

Table 11.4-2 Summary of Cumulative Environmental Effects on Groundwater

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

11.4.2 Surface Water

11.4.2.1 Identification of Projects Likely to Interact Cumulatively on Surface Water

Table 11.1-1 presents the Project and physical activities inclusion list, which identifies other projects and physical activities that might act cumulatively with the Project. Where residual surface water effects from the Project act cumulatively with those from other projects and physical activities (Table 11.4-3), a cumulative effects assessment is undertaken to determine their significance.

Based on examination of the location, timeline and activities associated with the projects and activities in Table 11.1-1, the residual effects of the Project on surface water could potentially interact with two of the identified future physical activities: the rehabilitation of PTH 6 and the upgrade of the Lake St. Martin access road. There were no interactions identified between the residual effects of the Project on surface water and future quarries and borrow sites as it is expected that activities associated with the quarries and borrow sites will be regulated under the *Quarry Minerals Regulation* of the Manitoba *Mines and Minerals Act (Province of Manitoba 1992)*, which requires a setback distance of 100 m from any watercourse. Potential effects to surface water from quarries and borrow site activities will be mitigated through the use of federal and provincial guidance for mitigation of potential effects to drainage such as the *Manitoba Stream Crossing Guidelines for the Protection of Fish and Fish Habitat* (Fisheries and Oceans Canada and Manitoba Natural Resources 1996) and Manitoba Infrastructure's Project Environmental Requirements (PERs).

The activities associated with the future rehabilitation of PTH 6 and upgrade of the Lake St. Martin access road were examined to determine if these activities could interact with the residual effects of the Project due to changes in local drainage areas and local drainage patterns (Table 11.4-3). There were no other potential interactions identified that might act cumulatively with the residual effects of the Project on surface water.

Table 11.4-3 Interactions with the Potential to Contribute to Cumulative Effects on Surface Water

	Changes in Regional Flows and Water Levels	Changes in Regional Fluvial Geomorphology and Shoreline Geomorphology	Changes in Local Drainage Areas and Local Drainage Patterns	Changes in Regional and/or Local Sediment and Debris Transport	Changes in Regional and/or Local Ice Processes	Changes in Regional and/or Local Surface Water Quality
Past and Present Physical Activities and Resource Use						
Agricultural Conversion	-	-	✓	✓	-	✓
Fishing	-	-	-	-	-	-
Infrastructure	-	-	✓	✓	-	✓
Resource Use	-	-	✓	✓	-	✓
Residential Development	-	-	✓	✓	-	✓
Recreation	-	-	-	-	-	✓
Project-Related Physical Activities	✓	✓	✓	✓	✓	✓
Future Projects or Physical Activities						
Upgrade of Lake St. Martin access road	-	-	✓	-	-	-
Quarries and borrow sites	-	-	-	-	-	-
Rehabilitation of PTH 6	-	-	✓	-	-	-

NOTES:

✓ = those "other projects and physical activities" whose residual effects are likely to interact cumulatively with project residual environmental effects.

11.4.2.2 Cumulative Effects Assessment for Changes in Local Drainage Areas and Local Drainage Patterns

Cumulative Effect Pathways for Changes in Local Drainage Areas and Local Drainage Patterns

The rehabilitation of PTH 6 may require upgrading of existing culvert crossings or installation of new drainage equalization culverts. These activities could interact with the changes in local drainage areas and local drainage patterns that will occur due to the construction, operation and maintenance of the LMOC.

The upgrade of the Lake St. Martin access road will require the installation of drainage equalization culverts to maintain existing drainage at 21 sites along the selected road alignment (Manitoba Infrastructure 2019). The access road will cross the LSMOC to extend to Reach 1 of the EOC but does not cross any sections of the Buffalo Creek system.

Mitigation for Cumulative Effects on Changes in Local Drainage Areas and Local Drainage Patterns

It is expected that the required culvert crossing upgrades or drainage equalization culverts will be installed and maintained in accordance with applicable federal and provincial guidance for mitigation of potential effects to drainage such as the *Manitoba Stream Crossing Guidelines for the Protection of Fish and Fish Habitat* (DFO and MNR 1996), Manitoba Infrastructure's Project Environmental Requirements (PERs) and Manitoba Hydro's environmental protection and management plans.

Residual Cumulative Effects on Changes in Local Drainage Areas and Local Drainage Patterns

The upgrading of existing culvert crossings or installation of drainage equalization culverts can be completed and maintained using mitigation measures to reduce potential effects to drainage and retain existing drainage patterns. As such, it is expected that residual effects to local drainage areas or drainage patterns due to the rehabilitation of PTH 6 and upgrade of the Lake St. Martin access road would be negligible. Therefore, the cumulative effects of future projects or physical activities on changes in local drainage areas and local drainage patterns would be similar to the Project effects.

11.4.2.3 Summary of Cumulative Effects on Surface Water

Table 11.4-4 summarizes cumulative environmental effects on surface water.

Table 11.4-4 Summary of Cumulative Environmental Effects on Surface Water

Residual Cumulative Effect	Residual Cumulative Effects Characterization							
	Direction	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Ecological Context
Changes in Local Drainage Areas and Local Drainage Patterns								
Residual cumulative effect	A	LT	L-M	N/A	RAA	RC	I	D
Contribution from the Project to the residual cumulative effect	Future projects and physical activities are expected to have negligible effects on surface water. The cumulative effects on surface water are assessed as similar to Project effects.							

KEY

Direction:
P: Positive
A: Adverse
N: Neutral

Duration:
ST: Short-term;
MT: Medium-term
LT: Long-term

Magnitude:
N: Negligible or Low
M: Moderate
H: High

Timing
NS: No sensitivity
MS: Moderate 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

11.5 FISH AND FISH HABITAT

11.5.1 Project Residual Effects Likely to Act Cumulatively

Table 11.1-1 presents the Project and physical activities inclusion list, which identifies other projects and physical activities that might act cumulatively with the Project. Where potential residual effects on fish and fish habitat from the Project have the potential to interact cumulatively with those from other projects and physical activities (Table 11.5-1), a cumulative effects assessment is undertaken to determine their significance. Residual effects of past and present projects have already been included in the existing conditions for fish and fish habitat and have been assessed for their potential to interact with the Project in the fish and fish habitat effects assessment (Chapter 7). Therefore, potential residual effects of the Project are only assessed for their potential to interact cumulatively with future projects.

Except for quarries and borrow sites, the other two future projects are linear developments: rehabilitation of PTH 6 and upgrade of Lake St. Martin access road. The only potential impacts to fish and fish habitat from these linear development projects are from construction of stream crossings (permanent or temporary). This can cause physical alteration of habitat if it involves instream or riparian work, can result

in mobilization of sediment from the banks or channels, can introduce aquatic invasive species (AIS), and can affect upstream and downstream fish passage. Linear developments can also increase fish mortality due to new or improved access for recreational or Aboriginal fishers.

Quarries and borrow pits have the potential to physically alter fish habitat if there are streams, lakes, or ponds within their footprints. They can also be sources of sediment if they are located near streams, lakes, or ponds.

Based on these potential future effects, potential residual effects of the Project on fish and fish habitat that have the potential to interact cumulatively are:

- permanent alteration or destruction of fish habitat due to excavation of the channel inlets and outlets; realignment, isolation or dewatering of headwater streams and drains; introduction and deposition of sediment; and potential introduction of AIS
- change in fish passage due to passive or active movement of fish out of Lake Manitoba or Lake St. Martin and changes in attraction flow in Fairford and Dauphin rivers
- change in fish health and mortality due to introduction and deposition of sediment, stranding of fish in the channels, and increasing fishing pressure

The potential for each of these potential Project-related residual effects to interact cumulatively with residual effects from other past, present, or reasonably foreseeable future projects are discussed in the sections below.

Table 11.5-1 Interactions with the Potential to Contribute to Cumulative Effects on Fish and Fish Habitat

Other Projects and Physical Activities with Potential for Cumulative Environmental Effects	Potential Cumulative Environmental Effects		
	Permanent Alteration or Destruction of Fish Habitat	Change in Fish Passage	Change in Fish Health and Mortality
Past and Present Physical Activities and Resource Use			
Agricultural Conversion	✓	✓	✓
Fishing			✓
Infrastructure	✓	✓	✓
Resource Use	✓		✓
Residential Development	✓		✓
Recreation			✓
Project Related Physical Activities	✓	✓	✓

Table 11.5-1 Interactions with the Potential to Contribute to Cumulative Effects on Fish and Fish Habitat

Other Projects and Physical Activities with Potential for Cumulative Environmental Effects	Potential Cumulative Environmental Effects		
	Permanent Alteration or Destruction of Fish Habitat	Change in Fish Passage	Change in Fish Health and Mortality
Future Projects or Physical Activities			
Upgrade of Lake St. Martin access road	✓	✓	✓
Quarries and borrow sites	✓	✓	✓
Rehabilitation of PTH 6	✓	✓	✓

NOTES:
✓ = those "other projects and physical activities" whose residual effects are likely to interact cumulatively with project residual environmental effects.

11.5.2 Cumulative Effects Assessment for Permanent Alteration or Destruction of Fish Habitat

11.5.2.1 Cumulative Effect Pathways for Permanent Alteration or Destruction of Fish Habitat

Potential effects to fish habitat due to the PTH 6 restoration, the Lake St. Martin access road upgrade and quarry or borrow pit access road construction include physical alteration of instream or riparian habitat at any new or existing stream crossings. They also include the potential release and deposition of sediment mobilized by heavy machinery working in or near the streams and small ponds during installation or restoration of these stream crossings, and the potential introduction of AIS from heavy machinery working between watersheds.

11.5.2.2 Mitigation for Cumulative Effects on Permanent Alteration or Destruction of Fish Habitat

Specific project mitigation measures to reduce potential effects on fish habitat are presented in Chapter 7, Section 7.2.4.2. No other mitigation measures specifically to reduce the potential cumulative effects to fish habitat from other future projects are proposed.

Other future projects are expected to implement industry standard mitigation measures as appropriate to prevent potential effects to fish habitat. These are expected to include measures included in DFO's Measures to Avoid Causing Harm to Fish and Fish Habitat, Manitoba Infrastructure's Project Environmental Requirements (PER) document, and Manitoba's "Stream Crossing Guidelines for the Protection of Fish and Fish Habitat" (Fisheries and Oceans Canada and Manitoba Natural Resources 1996). These measures are likely to include isolation of work areas from watercourses, flow management around work areas, installation of effective erosion and sediment control measures before starting work, reduced risk timing windows, and shoreline bank re-vegetation. In the case of quarries and borrow pits,

they are expected to include maintenance of riparian buffers around fish-bearing streams, ponds and lakes.

11.5.2.3 Residual Cumulative Effects on Permanent Alteration or Destruction of Fish Habitat

Potential effects of the Project on fish habitat are low in magnitude and highly localized in the short-term. However, in the long-term, the Project is expected to result in a positive net gain in fish habitat due to the creation of 172 ha of permanently wetted habitat within the LMOC and LSMOC structures. Consequently, Project contribution to cumulative effects on fish habitat is positive.

Overall residual cumulative effects to fish habitat from the Project and reasonably foreseeable future projects are negligible to positive. This is because the mitigation measures available to eliminate or reduce potential effects of linear developments and works and activities near water on fish habitat are well understood, technically feasible and highly effective. Any residual effect from these future projects are, therefore, expected to be low in magnitude, short-term in duration, and highly localized.

11.5.3 Cumulative Effects Assessment for Change in Fish Passage

11.5.3.1 Cumulative Effect Pathways for Change in Fish Passage

Improperly designed, sized, or installed stream crossings along the PTH 6 restoration, the Lake St. Martin access road and any new roads needed to access quarries or borrow pits have the potential to impede or block upstream or downstream passage of fish. These can prevent the passive or active dispersal of fish from nursery or rearing areas, prevent to movement of fish to overwintering areas, or prevent upstream migration of spawning fish. In the short-term, these barriers can result in reduced growth or increased mortality of individual fish if they can't access feeding or overwintering areas while, in the long-term, they can affect fish populations if they prevent access from critical spawning or overwintering areas.

11.5.3.2 Mitigation for Cumulative Effects on Change in Fish Passage

Specific project mitigation measures to reduce potential effects on fish passage are presented in Chapter 7, Section 7.2.4.3. No other mitigation measures specifically to reduce the potential cumulative effects to fish passage from other future projects are proposed.

Other future projects are expected to implement industry standard mitigation measures as appropriate to prevent potential effects to fish passage. For the future linear developments, these mitigation measures are expected to include measures in Manitoba Infrastructure's Project Environmental Requirements (PER) document and Manitoba's "Stream Crossing Guidelines for the Protection of Fish and Fish Habitat" (Fisheries and Oceans Canada and Manitoba Natural Resources 1996). These include use of clear-span structures instead of close-bottom structures when possible and practical, maintaining appropriate riparian buffer widths, following reduced risk timing windows, and maintaining flows downstream if site isolation is necessary. Additional standard practices include: proper sizing of culverts to convey appropriate flood flow discharges (e.g., 1:100 year floods) and proper installation and embedding of

culverts to ensure vertical drops don't form at the downstream ends and to provide the hydraulic conditions that are passable by the fish species and life stages known or presumed to exist in the streams at critical periods (e.g., spawning).

11.5.3.3 Residual Cumulative Effects on Change in Fish Passage

The Project 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. This is despite the effectiveness of the Denil fishway in the Fairford River Water Control Structure (FRWCS) to effectively pass fish in an upstream direction under some conditions and the continued ability of fish to move freely back up into Lake St. Martin by the Dauphin River, with the Project.

The potential project effects on fish passage are not expected to interact cumulatively with potential effects on fish passage from any of the reasonably foreseeable future projects in the RAA. This is because the mitigation measures that are likely to be applied to these linear development projects are well understood, technically feasible, and highly effective for eliminating or reducing potential effects on fish passage associated with stream crossings along linear developments. In addition, the future projects will not affect any stream or river that provides any critical migration route for any commercial, recreational and Aboriginal (CRA) fish population in Lake Manitoba, Lake St. Martin, or Lake Winnipeg; all future projects would affect, at most, unnamed headwater tributaries or man-made drains.

11.5.4 Cumulative Effects Assessment for Change in Fish Health and Mortality

11.5.4.1 Cumulative Effect Pathways for Change in Fish Health and Mortality

Potential effects to fish health and mortality due to the PTH 6 restoration, the Lake St. Martin access road upgrade and quarry or borrow pit access road construction include release and deposition of sediment mobilized by heavy machinery working in or near the streams and small ponds during installation or restoration of stream crossings, and new or improved access to fish-bearing stream, ponds, and lakes that could result in higher fishing mortalities.

11.5.4.2 Mitigation for Cumulative Effects on Change in Fish Health and Mortality

Specific project mitigation measures to reduce potential effects on fish health and mortality are presented in Chapter 7, Section 7.2.4.4. No other mitigation measures specifically to reduce the potential cumulative effects to fish health and mortality from other future projects is proposed.

It is expected that all future projects in the RAA will need to follow industry standard mitigation measures to reduce erosion and sediment mobilization and deposition. These include development of an erosion and sediment control plan that includes measures in DFO's "Measures to avoid causing harm to fish and fish habitat", Manitoba Infrastructure's PER document, and Manitoba's "Stream Crossing Guidelines for the Protection of Fish and Fish Habitat" (Fisheries and Oceans Canada and Manitoba Natural Resources

1996). Specific erosion and sediment control measures that are likely to be implemented are described in Section 11.5.2.2.

Mitigation measures to reduce increased fish harvesting along new or improved linear developments are typically limited to road closure mechanisms such as gates, concrete blocks, and/or security. While these measures are effective for restricting cars and trucks, they are generally ineffective for ATVs and snowmobiles.

11.5.4.3 Residual Cumulative Effects on Change in Fish Health and Mortality

Potential effects on fish health and mortality due to mobilization and deposition of sediment caused by residual effects of the Project and potential future residual effects from future projects are expected to be negligible. This is because the mitigation measures to control erosion and sediment for the Project and for future projects are well known, technically feasible and highly effective. Although sediment mobilization and deposition cannot be completely eliminated, any residual sediment entering watercourses or waterbodies, either from the Project or from future projects, is expected to be low in magnitude, short-term in duration, and highly localized and, therefore, have no measurable effect on individual fish in the fish and fish habitat LAA or fish populations in the fish and fish habitat RAA.

The Project and future projects have the potential to cumulatively increase access to fish bearing streams and ponds, increases that are unlikely to be effectively mitigated by any measure to prevent recreational or Aboriginal fishers from accessing these sites. However, no measurable cumulative effects to CRA fish populations in the LAA or RAA are expected to occur because any new access provided by the Project or by future projects are to streams, ponds, and lakes that are either already accessible or too small to be attractive for recreational or Aboriginal fishers, particularly given the proximity of Lake Manitoba, Lake St. Martin, and Lake Winnipeg. These large lakes are already accessible by recreational, commercial, and Aboriginal fishers, which wouldn't change with the Project or any of the future projects.

The Project could result in concentrations of fish below the control structures or drop structures in the channels which could pose a risk of increased harvesting.

11.5.5 Summary of Cumulative Effects on Fish and Fish Habitat

Table 11.5-2 summarizes cumulative environmental effects on fish and fish habitat.

Table 11.5-2 Summary of Cumulative Environmental Effects on Fish and Fish Habitat

Residual Cumulative Effect	Residual Cumulative Effects Characterization							
	Direction	**Duration**	**Magnitude**	**Timing**	**Geographic Extent**	**Frequency**	**Reversibility**	**Ecological Context**
Permanent Alteration or Destruction of Fish Habitat								
Residual cumulative effect	A/P	LT	NL	NS	RAA	RC	I	D
Contribution from the Project to the residual cumulative effect	The Project will have local effects on fish habitat but, overall, is expected to result in a net gain of approximately 172 hectares of fish habitat in the RAA once the channels are built.							
Ch**ange in Fish Passage**								
Residual cumulative effect	N	LT	NL	NS	RAA	RC	R	D
Contribution from the Project to the residual cumulative effect	The Project will result in an increase of downstream fish passage between Lake Manitoba and Lake St. Martin and between Lake St. Martin and Lake Winnipeg by providing two new channels for fish to passively or actively migrate.							
Change in Fish Health and Mortality								
Residual cumulative effect	A	LT	NL	HS	RAA	SI	R	D
Contribution from the Project to the residual cumulative effect	The Project may result in mortality of individual fish but not to the extent that would result in any measurable effect on any CRA fish species population the LAA or RAA.							

KEY

Direction:
P: Positive
A: Adverse
N: Neutral

Duration:
ST: Short-term;
MT: Medium-term
LT: Long-term

Magnitude:
N: Negligible or Low
M: Moderate
H: High

Timing
NS: No sensitivity
MS: Moderate 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

11.5.6 Significance of Residual Cumulative Environmental Effects

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

- 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 or
- a permanent alteration or disruption of fish passage that is likely to result in an irreversible, measurable reduction of critical upstream or downstream movements 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 or
- 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

Potential cumulative effects on fish habitat, fish passage, and fish health and mortality due to residual effects from the Project interacting with potential residual effects from future projects are assessed as not significant. This is because all potential residual effects of the Project are expected to be negligible to low in magnitude and most are expected to be restricted to the fish and fish habitat LAA, because the mitigation measures available for eliminating or reducing potential effects of all future projects are well known, technically feasible, and highly effective, and because any residual effects of future projects on fish habitat, fish passage, or fish health and mortality are expected to be highly localized due to their small footprints and low in magnitude because of the nature of their effects on fish populations.

11.6 VEGETATION

11.6.1 Project Residual Effects Likely to Act Cumulatively

The Project is expected to cause adverse effects to vegetation, including landscape diversity, community diversity, species diversity and wetland functions. Table 11.6-1 presents the Project and physical activities inclusion list, which identifies other projects and physical activities that might act cumulatively with the Project on vegetation. Where residual vegetation effects from the Project act cumulatively with those from other projects and physical activities (Table 11.6-1), a cumulative effects assessment is undertaken to determine their significance.

Table 11.6-1 Interactions with the Potential to Contribute to Cumulative Effects on Vegetation

Other Projects and Physical Activities with Potential for Cumulative Environmental Effects	Potential Cumulative Environmental Effects			
	Change in Landscape Diversity	Change in Community Diversity	Change in Species Diversity	Change in Wetland Functions
Past and Present Physical Activities and Resource Use				
Agricultural Conversion	✓	✓	✓	✓
Fishing	-	-	-	-
Infrastructure	✓	✓	✓	✓
Resource Use	✓	✓	✓	✓
Residential Development	✓	✓	✓	✓
Recreation	-	✓	✓	✓
Project-Related Physical Activities	✓	✓	✓	✓
Future Projects or Physical Activities				
Upgrade of Lake St. Martin access road	✓	✓	✓	✓
Quarries and borrow sites	✓	✓	✓	✓
Rehabilitation of PTH 6	✓	✓	✓	✓

NOTES:
✓ = those "other projects and physical activities" whose residual effects are likely to interact cumulatively with project residual environmental effects.

Changes in vegetation from past and present fishing activities (e.g., boat launches, docks, non-native invasive plant introduction) are included with recreation and residential development. Effects to landscape diversity are not expected from recreation as recreational users are likely using existing provincial roads, or roads and trails created for resource use and exploration.

11.6.2 Cumulative Effects Assessment for Change in Landscape Diversity

11.6.2.1 Cumulative Effect Pathways for Change in Landscape Diversity

Future projects could interact cumulatively with the Project through direct vegetation removal with a resulting reduction in the number and size of remaining native vegetation patches, including large patches, and potentially a change in perimeter length. Effects are most likely to occur from the upgrade of the Lake St. Martin access road as linear disturbances will be required and the projects predominately intersect native vegetation. Most of the land cover adjacent to PTH 6 has been converted to agriculture (Figure 8.2-4); however, patches of native vegetation may be intersected.

11.6.2.2 Mitigation for Cumulative Effects on Change in Landscape Diversity

Specific Project mitigation measures to reduce potential Project effects on vegetation landscape diversity are presented in Chapter 8, Section 8.2.4.2. These are viewed as sufficient to also address potential cumulative effects. The future projects are expected to implement industry standard mitigation measures as appropriate.

11.6.2.3 Residual Cumulative Effects on Change in Landscape Diversity

Past and present physical activities have contributed to a change in landscape diversity in the RAA. Most of the RAA south and west of Lake St. Martin has been converted to agriculture and remaining native vegetation is highly fragmented.

The PDA is expected to contribute to existing cumulative effects on landscape diversity by further fragmenting native vegetation. Only one large forested patch (>200 ha minus an internal 100 m strip) is intersected by the PDA and no size class, including larger classes of grassland or wetlands, are lost from the RAA as a result of the Project. Mean patch perimeter length is expected to decrease for forested patches and shrubland patches, remain unchanged for grasslands and increase for wetlands. Changes in mean perimeter length range from 3.2% to -27%. The Project will mostly reduce the size of existing patches and remove patches less than 10 ha in size.

The Lake St. Martin access road ROW already exists and will be upgraded and expanded to an all-season road with a 24-30 m ROW. The access road will be upgraded from the northern terminus of Idylwild Road (at approximately NE-28-30-6 W1) and extend near the LSMOC inlet structure in an area predominantly composed of wetlands, mainly fen and swamp, and interspersed patches of upland forest to the EOC. The number of large patches intersected by the access road upgrade and expansion has not been quantified, but mapping of existing conditions indicates no large forested patches are intersected. Large wetlands will be intersected and a reduction in the total area of large patches is expected. The number of large wetland patches is not expected to be affected as mapped wetlands are much larger than the planned ROW expansion and individual wetlands will likely not be lost, only reduced in size.

Rehabilitation of PTH 6 will consist of culvert replacement and extension of the existing road embankment at select locations. No large forest or wetland patches will be intersected.

The locations of quarries and borrow 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 (Figure 11.1-1). 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 Lake St. Martin access road upgrade has not been developed. Development of the quarry would likely reduce the area of intact wetlands. A reduction in the number of large wetlands is not expected due to the size and abundance of wetlands at the potential quarry site and surrounding area.

Overall, cumulative effects on change in landscape diversity remain moderate in magnitude as large patches of native vegetation in the RAA will likely not be lost, including remaining large forest patches south of Gypsumville, but the area of large patches will be reduced. Large forest and wetland patches will be intersected and reduced in size; however, none will be removed from the RAA. Residual cumulative effects will occur continuously following the construction of the future projects and will be irreversible as the Project and the future projects will result in the permanent removal of native vegetation. Timing is not applicable as changes in landscape diversity will be the same regardless of the timing of vegetation removal.

11.6.3 Cumulative Effects Assessment for Change in Community Diversity

11.6.3.1 Cumulative Effect Pathways for Change in Community Diversity

Future projects could interact cumulatively with the Project through direct vegetation removal with a resulting reduction in the area of native upland and wetland vegetation communities. Effects are most likely to occur from the upgrade of the Lake St. Martin access road as it predominately intersects native vegetation. Most of the land cover adjacent to PTH 6 has been converted to agriculture; however, native vegetation communities, including wetland-shrub wetland-herb and forested may be intersected.

11.6.3.2 Mitigation for Cumulative Effects on Change in Community Diversity

Specific project mitigation measures to reduce potential project effects on community diversity are presented in Chapter 8, Section 8.2.4.3. These are viewed as sufficient to also address potential cumulative effects. Other future projects would be expected to implement industry standard mitigation measures as appropriate.

11.6.3.3 Residual Cumulative Effects on Change in Community Diversity

Past and present physical activities have contributed to a change in community diversity in the vegetation RAA. Most of the RAA south and west of Lake St. Martin has been converted to agriculture. Agriculture occupies 21.4% (72,687.2 ha) of the RAA, all located west and south of Lake St. Martin. Recreational activities (e.g., fishing, ATV/snowmobile use, hunting) have also likely contributed to community loss and introduction and spread of weeds and non-native invasive species. Some of the loss is included in developed areas, which occupy 0.9% (3015.1 ha) of the RAA.

The PDA is expected to contribute to existing cumulative effects on community diversity by further decreasing the area of native upland and wetland vegetation. No native vegetation communities are lost from the RAA as a result of the Project and no COCC were identified. There is potential for unique or uncommon communities to occur in the PDA in areas of saline soils, shallow bedrock, or sandy soils. Most native upland vegetation communities will be reduced by less than 1% due to construction, with the exception of shrubland (-20.6%) (Table 11.6-2). Wetland abundance will be reduced by 0.8% in the RAA.

Table 11.6-2 Change in Land Cover Types in the RAA

Land Cover Category	Land Cover	Existing Conditions		Construction			Access Road			Total Change	
		Area (ha)	% RAA	Area (ha)	Area Change (ha)	% Change in RAA	Area (ha)	Area Change (ha)	% Change in RAA	Area Change from Existing Conditions (ha)	% Change from Existing Conditions in RAA
Agriculture	Agriculture	12670.3	3.7	12145.8	-524.5	-4.1	12670.3	0.0	0.0	-524.5	-4.1
Bare Ground	Bare Ground	1041.1	0.3	1040.1	-1.0	-0.1	1041.1	0.0	0.0	-1.0	-0.1
Developed	Developed	3015.1	0.9	4957.5	1942.4	67.0	3070.4	55.3	1.8	2306.6	76.5
Native Upland	Coniferous Forest	22267.1	6.6	22195.1	-72.0	-0.3	22265.5	-1.7	<-0.1	-72.8	-0.3
	Deciduous Forest	25233.7	7.4	25055.5	-178.2	-0.7	25231.5	-2.2	<-0.1	-179.4	-0.7
	Mixedwood Forest	13971.0	4.1	13940.1	-30.9	-0.2	13967.8	-3.3	<-0.1	-34.1	-0.2
	Shrubland	146.7	0.0	116.5	-30.2	-20.6	146.7	0.0	0.0	-30.2	-20.6
	Grassland	54303.3	16.0	54295.2	-8.1	0.0	54302.2	-1.1	<-0.1	-9.2	<-0.1
	Total	**115921.8**	**34.2**	**115602.24**	**-319.4**	**-0.3**	**115913.7**	**-8.1**	**0.0**	**-325.7**	**-0.3**
Wetland	Dugout	7.5	0.0	6.7	-0.8	-10.7	7.5	0.0	0.0	-0.8	-10.7
	Bog	28.4	0.0	23.2	-5.2	-18.3	28.4	0.0	0.0	-5.2	-18.3
	Fen	2807.9	0.8	2331.4	-476.5	-17.0	2807.9	0.0	0.0	-476.5	-17.0
	Marsh	1659.8	0.5	1385.7	-274.1	-16.5	1658.2	-1.6	-0.1	-275.7	-16.6
	Shallow Open Water	510.7	0.2	473.9	-36.8	-7.2	510.2	-0.5	-0.1	-37.3	-7.3
	Swamp	1717.4	0.5	1511.2	-203.9	-11.9	1717.0	-0.4	<-0.1	-204.3	-11.9
	Wetland - herb	36109.2	10.6	36108.4	-0.8	<-0.1	36100.0	-9.2	<-0.1	-10.0	<-0.1
	Wetland - shrub	82619.6	24.4	82591.5	-28.1	<-0.1	82584.3	-35.3	<-0.1	-63.4	-0.1
	Wetland - treed	6019.1	1.8	6019.0	-0.1	<-0.1	6018.8	-0.3	<-0.1	-0.4	<-0.1
	Total	**131479.6**	**38.8**	**130451.0**	**-1028.6**	**-0.8**	**131432.4**	**-47.2**	**<-0.1**	**-1073.5**	**-0.8**
Water	Water	75136.0	22.1	74945.1	-190.9	-0.5	75136.0	0.0	0.0	-381.8	-0.5
Grand Total[4]		**339264.0**	**100.0**	**339264.0**	**0.0**	**0.0**	**339264.0**	**0.0**	**0.0**	**-2306.6**	**-0.7**

NOTES:
[1] Wetland areas equal area intersected by ROW. Structure will be affected along the ROW, but wetland loss will likely be restricted to structure footprints. Location and size of structure footprints unknown.
[2] Grassland likely hayland and tame pasture based on air photo review.
[3] Cover types identified from Project mapping of the LAA and not included in LCC data set.
[4] Individual values may not equal total due to rounding.

The Lake St. Martin access road will intersect native upland and wetland areas, reducing native upland land cover abundance by 7.0 to 8.1 ha (less than 0.1%), depending on whether or not grassland is native, and wetlands by 47.2 ha (less than 0.1%) (Table 11.6-2). Forested and grassland cover types will be affected, with most of the effect occurring to mixedwood forest (3.3 ha). Loss of wetland area will mainly be to wetland-shrub (35.3 ha) and wetland-herb classes (9.2 ha).

The specific locations of quarries and borrow sites selected for aggregate and limestone material are unknown. Native upland and wetland vegetation communities may be cleared for expansion of existing quarries or development of new quarries, particularly the possible quarry site near the start of the LSMOC access road upgrade. This location is currently composed of native wetlands and scattered upland forest.

Adjacent land use along the planned PTH 6 rehabilitation route, from approximately Ashern to north of Moosehorn, has largely been converted to agricultural use. Native vegetation loss is unlikely based on the limited culvert replacement and extension of the existing road embankment along the proposed highway; however, native vegetation may be lost where the existing road ROW is widened as wetlands and remnant patches of forest are present adjacent to the existing road at some locations.

Cumulative effects on plant community diversity will remain moderate in magnitude for the western portion of the RAA south of Gypsumville as forest cover is likely below the Environment Canada (2013) recommended 30% value and the Project and known future projects will contribute to further reductions in community abundance. Cumulative effects will remain low in magnitude for the portion of the RAA east of Lake St. Martin and north of Gypsumville as this portion of the RAA will remain largely intact. With mitigation, the Project will act cumulatively with past and known future activities to reduce community diversity, but the residual contribution will be small as no vegetation communities will be lost. Residual cumulative indirect effects will occur from non-native invasive species introduction and spread. Residual cumulative effects will occur continuously as the future projects go forward and will be irreversible as the future projects will result in the permanent removal of native vegetation. Residual cumulative effects from the timing of construction will be increased during the growing season and reduced if construction is scheduled during dry or frozen conditions.

11.6.4 Cumulative Effects Assessment for Change in Species Diversity

11.6.4.1 Cumulative Effect Pathways for Change in Species Diversity

All identified future projects could act cumulatively with the Project to alter species diversity. The Project is expected to result in the direct loss of four occurrences of species of conservation concern (SOCC) and reduce the abundance and spatial distribution of plant species of interest to Indigenous groups. Indirect losses from the introduction or spread of non-native invasive plant species may also occur. Effects are most likely to occur from the upgrade of the Lake St. Martin access road which predominately intersects native upland and wetland vegetation communities. Most of the land cover adjacent to PTH 6 has been converted to agriculture and conditions suitable for SOCC growth and reproduction likely removed. Weeds are likely present adjacent to PTH 6, but species of interest to Indigenous groups may also be present.

11.6.4.2 Mitigation for Cumulative Effects on Change in Species Diversity

Specific Project mitigation measures to reduce potential project effects on species diversity are presented in Chapter 8, Section 8.2.4.4. These are viewed as sufficient to also address potential cumulative effects. The future projects would be expected to implement industry standard mitigation measures as appropriate.

11.6.4.3 Residual Cumulative Effects on Change in Species Diversity

Past and present physical activities have contributed to a change in plant species diversity in the vegetation RAA. Much of the RAA south and west of Lake St. Martin has been converted to agriculture use with a likely loss of SOCC occurrences and a reduction in the abundance and spatial distribution of plant species of interest to Indigenous groups. Remaining native vegetation south and west of Lake St. Martin consists of cultivation, hayland and tame pasture. SOCC and plant species of interest to Indigenous groups are likely largely restricted to remnant forest and shrubland patches and retained wetlands that are not regularly cultivated.

The Project is expected to contribute to existing cumulative effects on species diversity by further decreasing the SOCC occurrences and reducing the area of habitat for SOCC and plant species of interest to Indigenous groups.

The Lake St. Martin access road ROW already exists but will be upgraded and expanded to an all-season road with a 30 m ROW. No documented SOCC occurrences occur along the proposed expansion route, but undocumented occurrences could be present due to the range of community types crossed and potential for transition areas (e.g., wetland to upland) that may support less common growing conditions. The abundance and spatial distribution of plant species of interest to Indigenous groups will also be reduced due to clearing of native vegetation communities; however, the local abundance of species of interest to Indigenous groups along the proposed expansion route is not known.

Development of the quarries and borrow sites may also result in the loss of undocumented SOCC and plant species of interest to Indigenous groups. No SOCC have been documented at the potential quarry sites, but occurrences may be present in areas of native vegetation at those locations, particularly the site near the start of the Lake St. Martin access road upgrade in Township 30, Range 6, West of 1. Changes in the abundance and spatial distribution of plant species of interest to Indigenous groups could also occur if areas of native vegetation are removed.

Cumulative effects on species diversity will remain moderate in magnitude for the western portion of the RAA south of Gypsumville as the land has been partially converted for agricultural uses and likely changes in the abundance of SOCC and plant species of interest to Indigenous group. Cumulative effects are expected to remain low in magnitude for the portion of the RAA east of Lake St. Martin and north of Gypsumville as this portion of the RAA will remain largely intact; however, information on SOCC occurrences and abundance of plant species of interest to Indigenous groups is not known. Residual cumulative indirect effects will occur from non-native invasive species introduction and spread. Residual cumulative effects will occur continuously as the future projects go forward and will be irreversible as the

future projects will result in the permanent removal of native vegetation including native upland and wetlands. Residual cumulative effects from the timing of construction will be increased during the growing season and reduced if construction is scheduled during dry or frozen conditions. With mitigation, the Project will act cumulatively with the known future activities to reduce species diversity, but the residual contribution is uncertain as the abundance and distribution of SOCC and plant species of interest to Indigenous groups along the proposed future project routes is not known.

11.6.5 Cumulative Effects Assessment for Change in Wetland Functions

11.6.5.1 Cumulative Effect Pathways for Change in Wetland Functions

All identified future projects could act cumulatively with the Project to alter wetland function. The Project is expected to result in the direct loss of 1,013.6 ha of wetland area (296.0 ha from construction of the LMOC and PR239 realignment, and 717.6 ha from construction of the LSMOC). Indirect alterations in flooding regimes of remaining wetland areas may also occur, as well as changes in water quality from road run-off. Direct loss and indirect alteration of wetland functions are also likely from future projects due to vegetation clearing, wetland infilling and alteration of surface drainage patterns. Wetlands are abundant adjacent to each future project route and complete wetland avoidance is unlikely.

11.6.5.2 Mitigation for Cumulative Effects on Change in Wetland Functions

Specific Project mitigation measures to reduce potential project effects on wetland functions are presented in Chapter 8, Section 8.2.4.5. These are viewed as sufficient to also address potential cumulative effects. The future projects would be expected to implement industry standard mitigation measures as appropriate.

11.6.5.3 Residual Cumulative Effects on Change in Wetland Functions

Past and present physical activities have likely resulted in the loss of wetlands in the vegetation RAA south and east of Lake St. Martin and in reduced wetland function. The Project-intersected sub-watersheds south of Lake St. Martin have largely been converted to agricultural use and wetlands either infilled, drained or native vegetation cover altered. Wetlands in these sub-watersheds likely also receive increased nutrients. Wetlands in the LSMOC-intersected sub-watersheds are largely unaltered and disturbances are limited to the Lake St. Martin Emergency Channel, logging and trails.

The Project will further reduce wetland abundance in the RAA by 1028.6 ha (0.8% loss relative to existing conditions). No wetland class will be lost from the RAA and effects from the LMOC and PR 239 realignment will be offset by wetland compensation. Wetlands may be created in the LSMOC and LMOC channels during Project reclamation; however, reclamation plans have not been finalized and therefore the area of wetlands created in the channels is not subtracted from the area of predicted wetland loss from Project construction. Water quality of wetlands adjacent to PR 239 will be affected by salts and oils in road run-off and will likely persist.

Most potential effects on wetland functions from the future projects will be due to the Lake St. Martin access road upgrade. The Lake St. Martin access road will cross several wetlands and expansion of the existing trail will reduce wetland area by approximately 47.2 ha (less than 0.1% of existing wetland area). With mitigation, particularly proper culvert design, adjacent wetlands are expected to persist and effects to water levels and vegetation composition will be limited to a few metres from the road. Individual wetlands will likely not be lost due to the size of wetlands in the RAA west and north of Lake St. Martin.

Wetlands may be affected by future quarry development, particularly if a new quarry is developed near the proposed Lake St. Martin access road and wetland area will likely be reduced by the rehabilitation of PTH 6, primarily in areas of road bed expansion.

With mitigation, the cumulative effects are considered adverse, but low in magnitude. Wetland abundance will be reduced, but effects south of Lake St. Martin will be offset by wetland compensation. Effects north and east of Lake St. Martin are small and will not affect the sustainability of wetlands in the RAA. Effects will be long-term and irreversible as the Project and the future projects will be permanent. Effects from construction will be infrequent and likely occur during the fall or winter, a moderately sensitive time. Effects from operations will be continuous and extend to the RAA.

11.6.6 Summary of Cumulative Effects on Vegetation

Table 11.6-3 summarizes cumulative environmental effects on Vegetation.

Table 11.6-3 Summary of Cumulative Environmental Effects on Vegetation

Residual Cumulative Effect	Residual Cumulative Effects Characterization							
	Direction	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Ecological Context
Change in Landscape Diversity								
Residual cumulative effect	A	LT	M/L	NA	RAA	RC	I	U and D
Contribution from the Project to the residual cumulative effect	The Project will result in the loss of patches of native vegetation and reduce the area of large forested and wetland patches. However, no large patches will be lost as a result of the Project.							
Change in Community Diversity								
Residual cumulative effect[1]	A	LT	M/L	NA	RAA	RC	I	U and D
Contribution from the Project to the residual cumulative effect	The Project will result in the loss of an additional 1348.0 ha of native vegetation communities which is 96.0% of the total native community loss from all projects in the RAA.							

Table 11.6-3 Summary of Cumulative Environmental Effects on Vegetation

Residual Cumulative Effect	Residual Cumulative Effects Characterization							
	Direction	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Ecological Context
Change in Species Diversity								
Residual cumulative effect [1]	A	LT	M/L	NA	RAA	RC	I	U and D
Contribution from the Project to the residual cumulative effect	The Project will result in the loss of four known SOCC occurrences and may reduce the area of suitable SOCC habitat. A total of 62.7% of the reduction in potential SOCC habitat is from the Project in the RAA.							
Change in Wetland Functions								
Residual cumulative effect	A	LT	L	M	RAA	RC	I	U and D
Contribution from the Project to the residual cumulative effect	The Project will result in the loss of an additional 1028.6 ha of wetland which is 95.6% of the total wetland loss from all projects in the RAA. This number will be reduced by wetland compensation.							

KEY

Direction:
P: Positive
A: Adverse
N: Neutral

Duration:
ST: Short-term;
MT: Medium-term
LT: Long-term

Magnitude:
N: Negligible or Low
M: Moderate
H: High

Timing
NS: No sensitivity
MS: Moderate 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

NOTE:

[1] Magnitude is considered high and low due to differences in the abundance of native communities west of Lake St. Martin and south of Gypsumville compared to east and north of Lake St. Martin.

[2] Wetlands lost due to the Project south of Lake St. Martin will be compensated.

11.6.7 Significance of Residual Cumulative Environmental Effects

A significant cumulative effect on vegetation is one that:

- 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 traditionally use plants within the RAA

With mitigation, cumulative effects from the Project and known future projects are considered not significant for landscape diversity, community diversity, species diversity and wetland functions. Cumulative effects will further contribute to a reduction in the area of large native vegetation patches, including forest and wetlands, however, no large patches are expected to be lost. Wetlands south of Lake St. Martin will be offset by wetland compensation. The abundance of native upland communities will also be reduced, thereby affecting SOCC habitat, potentially removing undocumented SOCC occurrences and reducing the abundance and spatial distribution of plant species of interest to Indigenous groups, but no native upland community type will be removed from the RAA and overall reductions are less than 1% with the exception of shrublands. The Project will contribute 97.5% of the total native upland community loss from all projects in the RAA.

11.7 WILDLIFE

11.7.1 Project Residual Effects Likely to Act Cumulatively

Table 11.1-1 presents the Project and physical activities inclusion list, which identifies other projects and physical activities that might act cumulatively with the Project. Where residual wildlife effects from the Project act cumulatively with those from other projects and physical activities (Table 11.7-1), a cumulative effects assessment is undertaken to determine their significance.

Project residual effects are expected to include:

- the direct loss of wildlife habitat through vegetation clearing activities and an indirect change in habitat due to sensory disturbance (i.e., noise and artificial light), edge effects from fragmentation, and altered wetland function
- increased mortality risk due to vegetation clearing activities, increased Project-related traffic, conveyance of floodwaters in the outlet channels, and increased access by predators and people
- alteration of wildlife movement due to the development of a linear landscape features (i.e., LMOC and LSMOC) that may present a barrier to wildlife, particularly during the conveyance of floodwaters

Table 11.7-1 Interactions with the Potential to Contribute to Cumulative Effects on Wildlife

Other Projects and Physical Activities with Potential for Cumulative Environmental Effects	Potential Cumulative Environmental Effects		
	Change in Habitat	Change in Mortality Risk	Change in Movement
Past and Present Physical Activities and Resource Use			
Agricultural Conversion	✓	✓	✓
Fishing	✓	✓	✓
Infrastructure	✓	✓	✓
Resource Use	✓	✓	✓
Residential Development	✓	✓	✓
Recreation	✓	✓	✓
Project-Related Physical Activities	✓	✓	✓
Future Projects or Physical Activities			
Upgrade of Lake St. Martin access road	✓	✓	✓
Quarries and borrow sites	✓	✓	✓
Rehabilitation of PTH 6	✓	✓	✓

NOTES:
✓ = those "other projects and physical activities" whose residual effects are likely to interact cumulatively with project residual environmental effects.

11.7.2 Cumulative Effects Assessment for Change in Habitat

11.7.2.1 Cumulative Effect Pathways for Change in Habitat

Potential cumulative effects on change in habitat due to future projects and activities have similar effects as those identified for the Project. Specifically, vegetation clearing associated with future projects has potential to result in direct habitat loss or alteration and sensory disturbance has the potential to deter wildlife from using otherwise suitable habitat (i.e., indirect habitat loss). Direct effects will be limited to the respective project footprints while indirect potential effects may temporarily extend into the wildlife LAA.

Residual effects from future physical activities listed in Table 11.7-1 are anticipated to have minimal spatial overlap with the Project's residual effects on wildlife due to the localized nature of Project effects.

11.7.2.2 Mitigation for Cumulative Effects on Change in Habitat

Specific project mitigation measures to reduce potential Project effects on wildlife habitat are presented in Chapter 8, Section 8.3.6.2. These measures are viewed as sufficient to also address potential cumulative effects on wildlife habitat in the wildlife RAA. Other future projects are expected to implement industry standard mitigation measures as appropriate. The upgrade of the Lake St. Martin access road will provide access to the LSMOC and associated infrastructure, reducing direct effects to habitat in the RAA that would have otherwise occurred with a completely new, dedicated Project access route.

11.7.2.3 Residual Cumulative Effects on Change in Habitat

Past and present activities and developments have resulted in the loss of native grassland, wetland, and forest habitats which has reduced habitat availability for some species at risk (SAR) and SOCC in the RAA, such as eastern whip-poor-will, red-headed woodpecker, and bobolink. Overall, agriculture, residential development, resource use, and transportation corridors have altered and fragmented the current regional landscape and contributed to an existing cumulative effect on wildlife in the RAA. Under existing conditions, only 4.9% of the RAA contains anthropogenic lands (i.e., agricultural and disturbed lands; Table 11.6-2) with the remaining lands being predominantly wetland (38.8%), water (22.1%), and forested (34.2%) habitats for wildlife.

Vegetation clearing along the PDA (1913.9 ha) is expected to contribute to existing cumulative effects, however, the direct change in habitat loss or alteration is 0.6% of all cover types available to wildlife in the RAA (332,886 ha). Similarly, indirect effects (i.e., sensory disturbance, altered wetland function) will increase the proportion of habitat loss or alteration but are not expected to result in a marked increase within the RAA. Construction and vegetation removal associated with identified future projects will result in additional direct and indirect habitat loss or alteration where project components overlap in time and space, which will contribute to cumulative effects on wildlife, including for migratory birds and SAR and SOCC in the LAA.

The Lake St. Martin access road ROW is currently a winter road that will be upgraded and expanded to an all-season road with a 30 m ROW. The access road traverses the Project LAA near the LSMOC inlet structure, in an area predominantly containing wetland habitats (i.e., fen, swamp) interspersed with deciduous and mixedwood forest. SAR most likely to be affected are eastern whip-poor-will in upland habitat and yellow rail in wetland habitat. The access road and outlet channel contribute to cumulative effects on habitat change within the eastern whip-poor-will 10 x 10 km critical habitat square. Vegetation clearing will result in the direct loss or alteration of 24 ha of forest habitat within the eastern whip-poor-will critical habitat square (none of which is considered suitable for the species, i.e., edges of dense forest or open forest patches larger than 3 ha on well drained soils). Most (i.e., 94%) of the 24 ha of forest cleared will be within the LSMOC PDA (i.e., 22.5 ha); only 1.45 ha of the critical habitat square's forest will be removed as a result of the access road ROW. The cumulative effects of the two projects is expected to reduce habitat availability for eastern whip-poor-will within the 10 x 10 km critical habitat square by 2.0%. Quarries are not expected to be located within the critical habitat square.

The upgrade of the Lake St. Martin Lake St. Martin access road will cumulatively contribute to an increase in habitat fragmentation in the northern extent of the RAA; however, it is an upgrade project along an existing ROW. The road upgrade will remove wetland habitat (e.g., graminoid fen) having potential to support migratory birds and SAR such as yellow rail. Road upgrades may also alter wetland function, however with mitigation, particularly proper culvert design, adjacent wetlands are expected to persist and effects to water levels and vegetation composition will be limited to a few metres from the road. However, given the natural edges and patchy landscape created by the mosaic of wetland and upland habitats, edge effects (e.g., wildlife avoidance of forest edges) are anticipated to be negligible.

Development of new quarries and borrow sites will result in the loss or alteration of wildlife habitat outside of the LAA. Construction and operation of quarries and borrow pits will have direct (i.e., vegetation clearing) and indirect (i.e., sensory disturbance) effects on wildlife such as migratory birds, furbearers, and ungulates (in southern parts of the RAA, on elk).

Adjacent land along the planned PTH 6 rehabilitation route, approximately Ashern to north of Moosehorn, has largely been converted to agricultural use. Loss of wildlife habitat is unlikely based on the limited culvert replacement and extension of the existing road embankment along the proposed highway; however, habitat for migratory birds and amphibians may be lost where widening of the existing road ROW affects wetlands and remnant patches of forest.

The cumulative effect for change in wildlife habitat availability is adverse as some habitat in the RAA will be lost or altered as a result of the Project and reasonably foreseeable future projects. However, the magnitude of this effect is low due to the location of most projects in previously disturbed habitat (e.g., access road upgrades along existing winter road, quarries or borrow pits in agricultural areas). The access road upgrades will result in the additional loss of critical eastern whip-poor-will habitat; however, the loss will be offset by the eastern whip-poor-will mitigation and offset plan if required. Residual cumulative effects of change in habitat will occur intermittently as future projects are developed and will be irreversible because future projects will be permanent.

11.7.3 Cumulative Effects Assessment for Change in Mortality Risk

11.7.3.1 Cumulative Effect Pathways for Change in Mortality Risk

Potential cumulative effects on change in mortality due to future projects and activities have similar effects as those identified for the Project. Vegetation clearing associated with future projects has potential to result in a direct change in mortality risk to small mammals, breeding birds, amphibians, and denning furbearers and increased Project-related traffic could increase mortality risk to furbearers, birds, bats, and big game such as deer and moose. Enhanced access by predators and resource users (i.e., hunters and trappers), particularly in the northern part of the RAA, may indirectly increase mortality risk to upland game birds, furbearers, and moose.

11.7.3.2 Mitigation for Cumulative Effects on Change in Mortality Risk

Specific Project mitigation measures to reduce potential project effects on wildlife mortality are presented in Section 8.3.6.3. These are viewed as sufficient to also address potential cumulative effects. The future projects would be expected to implement industry standard mitigation measures as appropriate.

11.7.3.3 Residual Cumulative Effects on Change in Mortality Risk

Of the reasonably foreseeable projects, the Lake St. Martin access road upgrade, and quarries and borrow sites have the potential to contribute to cumulative effects on wildlife mortality risk through vegetation clearing and site preparation. Species most susceptible to effects are small mammals, breeding birds, amphibians, and denning furbearers unable to escape heavy equipment. Mortality risk to wildlife is anticipated to be negligible for the PTH 6 upgrade as this project involves upgrades to existing infrastructure that will require limited vegetation removal.

Increased traffic volumes along the Lake St. Martin access road may be temporarily elevated during construction phases with negligible volumes persisting throughout the operational phases. Traffic poses a collision risk to wildlife, particularly upland game birds, raptors, bats, furbearers, deer and moose.

The Lake St. Martin access road has the potential to contribute to an indirect increase in mortality risk for wildlife due to enhanced access for predators and people, particularly at the LSMOC outlet structure where the three projects converge.

With mitigation, the incremental contribution of future activities combined with the Project's residual effect on mortality risk will be low in magnitude, occur intermittently as future projects go forward, and will be irreversible as future projects will be permanent.

11.7.4 Cumulative Effects Assessment for Change in Movement

11.7.4.1 Cumulative Effect Pathways for Change in Movement

Potential cumulative effects on change in movement due to future projects and activities have similar effects as those identified for the Project. Specifically, alteration of wildlife movement due to the development of linear features (i.e., Lake St. Martin access road upgrade) or localized disturbances (i.e., quarries) in both developed and undeveloped landscapes. Potential effects typically extend beyond the project footprints.

11.7.4.2 Mitigation for Cumulative Effects on Change in Movement

Specific mitigation measures to reduce potential Project effects on wildlife mortality are presented in Section 8.3.6.4. These are viewed as sufficient to also address potential cumulative effects. Other future projects would be expected to implement industry standard mitigation measures as appropriate.

11.7.4.3 Residual Cumulative Effects on Change in Movement

Past and present activities (e.g., land conversion for agriculture) and developments (e.g., existing road network, transmission lines) have reduced landscape connectivity and created physical and sensory barriers that have likely contributed to cumulative changes in terrestrial wildlife movement in the RAA. The Project's contribution to cumulative effects on wildlife movement are considered low as most species will be capable of crossing the outlet channels following construction and during periods of low flow (70-87% of the time). The Lake St. Martin access road and PTH 6 upgrade projects involve upgrades to existing infrastructure that have already contributed to a cumulative change in wildlife movement in the RAA. The quarries or borrow pits will result in further residual cumulative effects on wildlife movement.

With mitigation, the incremental contribution of future activities combined with the Project's residual effect on wildlife movement will be low in magnitude, occur intermittently as future projects go forward, and will be irreversible as future projects will be permanent.

11.7.5 Summary of Cumulative Effects on Wildlife

Table 11.7-2 summarizes cumulative environmental effects on wildlife.

Table 11.7-2 Summary of Cumulative Environmental Effects on Wildlife

Residual Cumulative Effect	Residual Cumulative Effects Characterization							
	Direction	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Ecological Context
Change in Habitat								
Residual cumulative effect	A	LT	L/M	HS	RAA	RC	I	U/D
Contribution from the Project to the residual cumulative effect	The Project will result in the direct loss or alteration of 1913.9 ha of terrestrial and aquatic wildlife habitat. . When current and reasonably foreseeable future project effects on wildlife habitat are considered, the Project's contributions to direct change in habitat availability is low in magnitude. Similarly, the Project's contributions to direct change in habitat availability for eastern whip-poor-will are also low (2% of forest affected in the 10 x 10 km critical habitat square and 2.2% of potential eastern whip-poor-will habitat in LAA and 0.2% in RAA). For red-headed woodpecker, the Project's contribution to habitat change is moderate magnitude as 7.8% of the LAA's potential red-headed woodpecker habitat (1% of potential habitat in RAA) will be affected.							
Change in Mortality Risk								
Residual cumulative effect	A	MT	N	HS	RAA	RC	R/I	U/D
Contribution from the Project to the residual cumulative effect	The Project will increase mortality risk to wildlife primarily through vegetation clearing and Project-related traffic. The development of linear features may improve access for predators and resource users, particularly in northern parts of the RAA.							

Table 11.7-2 Summary of Cumulative Environmental Effects on Wildlife

Residual Cumulative Effect	Residual Cumulative Effects Characterization							
	Direction	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Ecological Context
Change in Movement								
Residual cumulative effect	A	MT	L/M	HS	RAA	RC	R/I	U/D
Contribution from the Project to the residual cumulative effect	The Project 's contribution to change in wildlife movement is considered low as most wildlife will be capable of crossing the channels following construction and during periods of low flow (when channels are not conveying flood waters; 70-87% of the time).							

KEY

Direction:
P: Positive
A: Adverse
N: Neutral

Duration:
ST: Short-term;
MT: Medium-term
LT: Long-term

Magnitude:
N: Negligible
L: Low
M: Moderate
H: High

Timing
NS: No sensitivity
MS: Moderate 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

11.7.6 Significance of Residual Cumulative Environmental Effects

Past and current projects and activities have altered habitat for wildlife in the southern and western portions of the RAA. In this region, agriculture is the dominant land use. Most lands are used for pasture or are hayed, support small wetlands and fragments of deciduous forest, and a diversity of wildlife such as red-headed woodpecker, bobolink, white-tailed deer, and elk. Lands in the north and eastern parts of the RAA are relatively intact and dominated by various wetland types that support migratory birds, including yellow rail, eastern whip-poor- will, furbearers, and moose.

With the application of mitigation, including the implementation of the red-headed woodpecker and eastern whip-poor-will mitigation and offset plans, residual cumulative effects on current conditions of wildlife are predicted to be not significant. The Project's contribution to the cumulative effects on wildlife are not expected to further threaten the long-term persistence or viability of wildlife in the RAA, and hence are also not significant.

11.8 LAND AND RESOURCE USE

11.8.1 Project Residual Effects Likely to Act Cumulatively

Table 11.1-1 presents the Project and physical activities inclusion list, which identifies other projects and physical activities that might act cumulatively with the Project. Where residual land and resource use effects from the Project act cumulatively with those from other projects and physical activities (Table 11.8-1), a cumulative effects assessment is undertaken to determine their significance.

The upgrade of the Lake St. Martin access road will occur on Crown land and will not interact with change in land use or agricultural land use. The rehabilitation of PTH 6 between Ashern and Grahamdale is expected to be confined within the existing road ROW. As such, residences, residential development areas (settlements) and land use development potential within the RAA are not anticipated to be affected as there would be no changes to current land use.

Table 11.8-1 Interactions with the Potential to Contribute to Cumulative Effects on Land and Resource Use

Other Projects and Physical Activities with Potential for Cumulative Environmental Effects	Potential Cumulative Environmental Effects			
	Change in Land Use	Change in Agricultural Land Use	Change in Parks, Recreation & Tourism	Change in Resource Use
Past and Present Physical Activities and Resource Use				
Agricultural Conversion	✓	✓		
Fishing			✓	✓
Infrastructure	✓	✓		✓
Resource Use	✓	✓	✓	✓

Table 11.8-1 Interactions with the Potential to Contribute to Cumulative Effects on Land and Resource Use

Other Projects and Physical Activities with Potential for Cumulative Environmental Effects	Potential Cumulative Environmental Effects			
	Change in Land Use	Change in Agricultural Land Use	Change in Parks, Recreation & Tourism	Change in Resource Use
Residential Development	✓	✓		
Recreation			✓	
Project-Related Physical Activities	✓	✓	✓	✓
Future Projects or Physical Activities				
Upgrade of Lake St. Martin access road			✓	✓
Quarries and borrow sites	✓	✓	✓	✓
Rehabilitation of PTH 6				✓

NOTES:
✓ = those "other projects and physical activities" whose residual effects are likely to interact cumulatively with project residual environmental effects.

11.8.2 Cumulative Effects Assessment for Change in Land Use

11.8.2.1 Cumulative Effect Pathways for Change in Land Use

Future projects in the land and resource use RAA (e.g., quarry and borrow pit development) have the potential to interact cumulatively with the Project if the development of facilities occurs in areas of existing residences and properties. Cumulative effects arising from these future activities have similar effects pathways as effects arising from the Project, including degradation, disturbance and nuisance effects (i.e., noise, dust) on residences (i.e., proximity), and change in property (i.e., loss, presence). Quarry and borrow site development could infringe upon current use of lands. However, reclamation of quarry and borrow pits could facilitate future land use of these areas.

11.8.2.2 Mitigation for Cumulative Effects on Change in Land Use

Implementation of mitigation measures described in Chapter 9, Section 9.2.4.2 will reduce the effects on land use from the Project and are applicable to cumulative effects. The development of quarries and borrow sites will require work permits or leases from Manitoba Growth, Enterprise and Trade. Environmental conditions will be stipulated on the permits and leases.

11.8.2.3 Residual Cumulative Effects on Change in Land Use

A portion of the RAA (57,851ha [approximately 1.9%) has already been disturbed due to agricultural land use. Urban and developed areas account for approximately 5,807 ha (0.2%) of the RAA (or 1.1% if the major waterbodies are excluded from the RAA).

Future projects proposed within the RAA that spatially and temporally overlap with the Project can contribute to cumulative nuisance effects. In areas of overlap, cumulative nuisance effects may extend for a longer duration or be of higher magnitude than in the Project case alone.

With the addition of Project effects and those of future quarries and borrow sites, cumulative effects would be over the long term and low to moderate in magnitude. The Project's contribution to cumulative environmental effects would be as described in the assessment of Project effects.

11.8.3 Cumulative Effects Assessment for Change in Agricultural Land Use

11.8.3.1 Cumulative Effect Pathways for Change in Agricultural Land Use

Adverse residual effects to agricultural land use from the Project are limited to the LMOC area of the PDA and consist of agricultural land loss and conflict with activities. Positive effects from the Project will occur within agricultural hayland and pasture lands along the Lake St. Martin shoreline due to flood and lake level reduction. Agricultural conversion is responsible for a portion of the RAA being under agricultural land use. Residential development, infrastructure and resource use is necessary for agricultural development in the area, but these developments have also contributed to agricultural land loss and conflict with agricultural activities within the RAA. Besides the Project, future developments that could act cumulatively with agriculture land use are quarries and borrow site development. Although the location and timing of these developments are unknown at this time, the development of quarries and borrow sites would represent an agricultural land loss if located in agricultural areas. If such sites are able to be reclaimed then agriculture losses would be considered temporary in nature, otherwise, there would be anticipated to be a small permanent agricultural land loss.

Given its location, the upgrade of the Lake St. Martin access road will not interact with agricultural activities or land use. The rehabilitation of PTH 6 is not expected to act cumulatively with Project effects on agricultural land use as the rehabilitation work is not anticipated to result in agricultural land losses or otherwise have a measurable effect on agricultural activities.

Section 11.3 provides further discussion on cumulative effects related to soils affecting agricultural capability.

11.8.3.2 Mitigation for Cumulative Effects on Change in Agricultural Land Use

Implementation of mitigation measures described in Chapter 9, Section 9.2.4.3 will reduce the effects on agriculture from the Project and the Project's contribution to cumulative effects on agriculture. Proponents for the development of quarries and borrow sites will be required to follow permitting regulations from

Manitoba Growth, Enterprise and Trade. This is assumed to include reclamation and rehabilitation to equivalent land use on decommissioning of quarries and borrow sites, if possible.

Additionally, it is assumed that proponents would engage with agricultural landowners prior to site disturbance to discuss specific mitigation measures to lessen the effects on agricultural land use.

11.8.3.3 Residual Cumulative Effects on Change in Agricultural Land Use

A portion of land capable of supporting agriculture in the RAA has already been disturbed due to residential development and industrial development (including previous linear projects). Approximately 57,851 ha (1.9 %) of the land and resource use RAA is occupied by land under agricultural land use, while 0.2 % is considered developed. However, 82% of the land and resource use RAA is occupied by water, comprised largely of Lake Manitoba, Lake Winnipeg and Lake St. Martin. When the areas of these large water bodies are removed from the evaluation, agricultural land use represents 10.4% of the remainder of the RAA and developed land represents 1.1%. Based on residual characterizations defined in Table 11.8-2, existing non-agricultural land uses have collectively had a low magnitude effect on loss or degradation of agricultural land in the RAA. Although there has been a measurable loss or degradation, production has continued at or near pre-disturbance levels.

Future quarry/borrow pit development within the RAA could result in additional permanent losses of agricultural land. Proposed quarry/borrow pit development has the potential to interact cumulatively with the Project if the plans include facilities located in areas under agricultural land use. The amount of land loss is unknown at this time; however, it will be minor in relation to agricultural land losses resulting from the Project.

Therefore, future projects and physical activities aren't expected to appreciably increase the magnitude of cumulative effects to agricultural land loss relative to the Project contribution, which is approximately 1,054 ha or approximately 1.8 % of the approximately 57,851 ha of agricultural land within the land and resource use RAA. This represents a small but measurable effect on the capacity for agriculture in the RAA.

Existing land use activities have resulted in interference and nuisance with agricultural activities in the RAA. Proposed quarry/borrow pit development in areas under agricultural land use has the potential to interfere with agricultural activities; however, this effect will be small and is likely not measurable due to the small footprint of these developments and the ability of agricultural landowners to accommodate the effect these temporary changes in land use will have on their operations.

The Project contribution to effects on interference with agricultural activities represents the dominant such effect, and overall cumulative effects are of low magnitude and long-term duration. These effects will not result in impairment of the capacity of agriculture in the RAA because production is anticipated to continue at near pre-disturbance levels. The Project's contribution to cumulative effects on interference with agricultural activities is therefore not expected to measurably affect the capacity of agriculture within the RAA.

11.8.4 Cumulative Effects Assessment for Change in Parks, Recreation and Tourism

11.8.4.1 Cumulative Effect Pathways for Change in Parks, Recreation and Tourism

Future quarry/borrow pit development and the upgrading of the Lake St. Martin access road have the potential to interact cumulatively with the Project as their plans include the development of facilities in recreational areas. Cumulative effects arising from future activities potentially have similar effects mechanisms as effects arising from the Project, including degradation of recreational opportunities, activities and access.

Quarry and borrow pit development could infringe upon lands used for recreational activities. However, reclamation of quarry and borrow pits could facilitate future recreational use of these areas.

11.8.4.2 Mitigation for Cumulative Effects on Change in Parks, Recreation and Tourism

Implementation of the mitigation measures described in Chapter 9, Section 9.2.4.4 will reduce adverse effects on parks, recreation and tourism from the Project and the Project's contribution to cumulative effects. Proponents for quarry and borrow pit development may adopt mitigation measures to mitigate their own adverse project effects related to the degradation of recreation and subsequent reclamation of developed sites for recreational use (a positive benefit).

11.8.4.3 Residual Cumulative Effects on Change in Parks, Recreation and Tourism

Portions of the land in the RAA have already been disturbed due to predominant agricultural land use and industrial and residential development.

Within the RAA, the disturbance of the Sturgeon Bay Area of Special Interest from the PDA will result in degradation of 418 ha; however, no pathway for cumulative effects related interactions with future projects is anticipated with this site.

It is anticipated that there will be some cumulative overlap from the Project with PTH 6 rehabilitation. This future project has the potential to cause disturbance and nuisance effects during Project construction. The resultant disturbance effect from PTH 6 rehabilitation is limited to an area encompassing a segment of PTH 6 being improved and the realignment of Highway 239 at Grahamdale. In addition, there is some spatial overlap with the recreational snowmobile route along PTH 6 between Ashern and Grahamdale. Otherwise, there is limited potential in the RAA overall for cumulative effects on recreation.

With the addition of Project effects and those of other projects, cumulative effects would be considered of low magnitude and long term. The Project's contribution to cumulative environmental effects is not anticipated to result in a change that widely degrades continued recreational land use activities within the RAA.

11.8.5 Cumulative Effects Assessment for Change in Resource Use

11.8.5.1 Cumulative Effect Pathways for Change in Resource Use

Hunting and Trapping

Future projects in the RAA (PTH 6 rehabilitation, Lake St. Martin Access Road, and quarry/borrow pit development) have the potential to interact cumulatively with the Project if their plans include the development of facilities in hunting and trapping areas. Cumulative effects arising from future activities potentially have similar pathways as effects arising from the Project, including degradation and disturbance effects on hunting and trapping due to noise disturbance, damage to areas and sites, visual aesthetics, as well as change in access and loss of wildlife habitat. Projects that can affect hunting and trapping include linear developments that involve land clearing, developments that may increase or reroute traffic and developments that may result in direct mortality to wildlife (e.g., from wildlife collisions). The PTH 6 rehabilitation and some of the potential quarry and borrow sites are in previously disturbed areas which provide little or no wildlife habitat or, therefore, hunting or trapping potential.

Mining and Aggregates

Some of the potential future quarries and borrow sites are in areas where existing sites occur (Figure 11.1-1). Cumulative effects arising from future activities have similar pathways as effects arising from the Project, including degradation and disturbance effects on existing quarries and borrow sites as well as access restrictions.

Forestry

Land clearing and channel excavation will result in some productive forestlands being removed from the available land base of FMUs 41, 43, 45 for the duration of the Project. However, this effect is limited to the PDA. The Project will reduce the productive forest within the FMUs by 3.1%.

The Lake St. Martin access road, and quarry and borrow site development have the potential to interact cumulatively with the Project effects to the extent that they will result in productive forest loss or are located in high value forest sites. The future activities could have similar pathways as those associated with the Project, which could affect productive forest and high value forest sites through disruption effects (e.g., loss of areas). The access road will follow an existing cleared ROW that will be widened for these linear infrastructure projects. Quarry and borrow site development will involve some clearing of forest cover for excavation.

Groundwater and Surface Water Use

Channel excavation and groundwater depressurization from temporary subsurface dewatering will result in some change to groundwater quantity. The effect is limited to the PDA and sites near the PDA. Manitoba Infrastructure will undertake to replace water wells where potable water supply is affected by the Project to mitigate effects on groundwater use.

The quarry and borrow site development have the potential to interact cumulatively with the Project effects if their plans include the development of facilities in groundwater and surface water use areas (e.g., flowing, high water level well areas, groundwater wells). Cumulative effects arising from future activities have similar pathways as effects arising from the Project, including potential degradation effects on groundwater quantity and disruption to the use of potable water.

Surface water use (i.e., license areas) will not be affected by future projects, as there are no such allocations in the RAA. As such, no pathway for cumulative effects on surface water use is anticipated.

11.8.5.2 Mitigation for Cumulative Effects on Change in Resource Use

Implementation of the mitigation measures described in Chapter 9, Section 9.2.4.5 will reduce the effects on hunting and trapping, mining and aggregates, forestry, and groundwater and surface water use. As well, mitigation designed to reduce the effects on wildlife will also benefit hunting and trapping (Chapter 8, Section 8.3.6), and mitigation designed to reduce effects on groundwater (Chapter 6, Section 6.4.4) will also benefit resource use. These mitigation measures are also applicable to the effects of identified future projects or physical activities.

11.8.5.3 Residual Cumulative Effects on Change in Resource Use

Hunting and Trapping

The Open Trapping Area (OTA) Zone 3 and Gypsumville registered trap line (RTL) encompass a total area of approximately 646,817 ha in the RAA. Of this total, the Project intersects approximately 1,672 ha, or 0.3% of OTA Zone 3 and 372 ha or 0.6% of the Gypsumville RTL. Five game hunting areas encompass the entire RAA, totaling an area of approximately 1,828,182 ha. The PDA intersects approximately 2,045 ha, or 0.01% of the game hunting areas used for hunting and guide outfitting in the RAA.

The future projects proposed within the RAA have the potential to degrade and cause disturbance effects on hunting and trapping during the construction phase.

There may be cumulative overlap of the Project effects and those of the Lake St. Martin access road and quarries and borrow sites. There is minimal spatial overlap between the projects and Game Hunting Areas (GHAs) 21 and 25 which encompass the RM of Grahamdale and unorganized provincial Crown land (see Chapter 9, Appendix 9B.2, Figure 9.2B-15). Similarly, there is limited spatial overlap between the Projects and OTA 3 (RM of Grahamdale, unorganized provincial Crown land).

With the addition of Project effects and those of other projects, cumulative effects from the development of the required footprints for these infrastructure projects would be long term and low in magnitude. The Project's contribution to cumulative environmental effects is not anticipated to measurably result in a change that widely degrades continued hunting and trapping activities within the RAA.

Mining and Aggregates

Portions of the land in the RAA have already been disturbed due to predominant agricultural land use and some industrial and residential development. The Project does not substantially overlap with mining activities. Mining activities in the RAA correspond to an area totaling approximately 18,914 ha. The Project overlap (105 ha) represents 0.5% of the total area of mining activities in the RAA.

The future projects proposed within the RAA have the potential to cause degradation and disturbance effects during the construction phase. A new borrow site developed adjacent to an existing site would continue to cause disturbance effects for the life of the project.

There may be some cumulative overlap with the addition of Project effects and those of other projects (i.e., quarries/borrow sites). Spatial overlap between future quarry/borrow pit projects and existing mineral dispositions (i.e., private quarry permit, quarry withdrawals, aggregate deposits) is evident in the RM of Grahamdale (with PTH 6 rehabilitation) and in unorganized provincial Crown land (with the Lake St. Martin Access Road).

With the addition of Project effects and those of other projects, cumulative effects from the development of the required footprints for these infrastructure projects would be long term and low in magnitude. The Project's contribution to cumulative environmental effects is not anticipated to result in a change that widely degrades continued resource use activities or reduces the quality of sites within the RAA that is not mitigated.

Forestry

Portions of the land in the RAA have already been disturbed due to predominant agricultural land use and industrial and residential development. As was discussed in Chapter 9, Section 9.2.4.5, the Project overlaps with productive forest and high value forest sites consisting of past personal permit areas. The future projects proposed within the RAA have the potential to remove productive forest land from the land base and reduce areas of high value forest sites (e.g., personal permit areas) during the construction phase.

There is no spatial overlap between the future projects and timber supply areas, and there is minimal overlap of the Lake St. Martin access road and quarry and borrow areas with high value forest sites (i.e., past personal permit areas) limited to a few sites in the RM of Grahamdale and Lake St. Martin Area unorganized territory. The potential for cumulative interactions is limited as the future projects would largely avoid high value forest sites. Given the renewable nature of the resource, activities would have limited additive interaction.

With the addition of Project effects and those of other projects, cumulative effects from the development of the required footprints for these infrastructure projects on productive forestland and high value forest sites would be low in magnitude. The Project's contribution to cumulative environmental effects will not measurably result in a change that widely disrupts continued resource use activities or degrades the quality of sites within the RAA that is not mitigated.

Groundwater and Surface Water Use

Portions of the land in the RAA have already been disturbed due to predominant agricultural land use and industrial and residential development. As was discussed in Chapter 9, Section 9.2.4.5, the Project overlaps with numerous flowing and high-water level well areas and groundwater wells. Flowing and high water level well areas in the RAA corresponds to an area of approximately 48,206 ha. The Project overlap (691 ha) represents 1.4% of the total area of flowing and high-water level well areas in the RAA.

There is a greater degree of spatial overlap between the future projects and groundwater resources (i.e., groundwater wells, flowing and high-water level well areas) in the RM of Grahamdale with PTH 6 rehabilitation, and quarry and borrow sites and less so in unorganized provincial Crown land.

With the addition of Project effects and those of other projects, cumulative effects from the development of the required footprints for these infrastructure projects would be long term and low to moderate in magnitude. The Project's contribution to cumulative environmental effects is not anticipated to result in a change that widely degrades continued resource use activities or reduces the quality of sites within the RAA that is not mitigated.

11.8.6 Summary of Cumulative Effects on Land and Resource Use

Table 11.8-2 summarizes cumulative environmental effects on land and resource use.

While the Project will have a cumulative effect, with the implementation of mitigation measures, cumulative effects are anticipated to be of low to moderate magnitude. Cumulative effects will occur in a resilient socio-economic context and are anticipated to occur throughout the RAA. Cumulative effects will be long term, occurring on regular continuous or infrequent basis.

Table 11.8-2 Summary of Cumulative Environmental Effects on Land and Resource Use

Residual Cumulative Effect	Residual Cumulative Effects Characterization							
	Direction	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Socio-Economic Context
Change in Land Use								
Residual cumulative effect	A	LT	L/M	N/A	RAA	RC	I	R
Contribution from the Project to the residual cumulative effect	The Project is the main contributor to future cumulative effects on land use in the RAA.							
Change in Agricultural Land Use								
Residual cumulative effect	A/P	LT	L/M	NS	RAA	RC	RL/I	R

Table 11.8-2 Summary of Cumulative Environmental Effects on Land and Resource Use

Residual Cumulative Effect	Residual Cumulative Effects Characterization							
	Direction	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Socio-Economic Context
Contribution from the Project to the residual cumulative effect	The Project is the main contributor to future cumulative effects on agricultural land use in the RAA.							
Change in Parks, Recreation and Tourism								
Residual cumulative effect	A	LT	L	N/A	RAA	RC	I	R
Contribution from the Project to the residual cumulative effect	The Project is the main contributor to future cumulative effects on parks, recreation and tourism in the RAA.							
Change in Resource Use								
Residual cumulative effect	A	LT	L/M	NS	RAA	RC/IF	I/RS	R
Contribution from the Project to the residual cumulative effect	The Project is the main contributor to future cumulative effects on resource use in the RAA.							

KEY

Direction:
P: Positive
A: Adverse
N: Neutral

Duration:
ST: Short-term;
MT: Medium-term
LT: Long-term

Magnitude:
N: Negligible
L: Low
M: Moderate
H: High

Timing
NS: No sensitivity
MS: Moderate 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

Socio-Economic Context:
R: Resilient
NR: Not resilient

11.8.7 Significance of Residual Cumulative Environmental Effects

The existing land base in the RAA has been partially modified through agricultural conversion and industrial and residential development that has occurred over the past two hundred years.

The cumulative effects from degradation, disturbance of land and resource base and the reduction or loss of land and resources do not occur at levels that restrict land and resource activities such that existing activities cannot continue within the RAA at current levels. The PDA is predicted to account for minimal contribution to the cumulative effects case (approximately 2,045 ha, or 0.01% of the RAA). All of the land and resources uses are assessed as not significant.

While future projects and the Project will contribute to a change in land use within the RAA, Manitoba Infrastructure will acquire land through expropriation according to the *Expropriation Act*. Through the expropriation process, landowners will be compensated for the permanent land loss and current land uses, such as industrial activity, consumptive and non-consumptive recreational use and resource use, including agricultural land use, would be able to continue at or near baseline levels after construction is completed. As such, the cumulative effects on land and resource use are not significant.

11.9 INFRASTRUCTURE AND SERVICES

11.9.1 Project Residual Effects Likely to Act Cumulatively

Table 11.1-1 presents the Project and physical activities inclusion list, which identifies other projects and physical activities that might act cumulatively with the Project. Where residual infrastructure and services effects from the Project act cumulatively with those from other projects and physical activities (Table 11.9-1), a cumulative effects assessment is undertaken to determine their significance.

Project construction may result in adverse residual effects on accommodations, community infrastructure and services, road traffic and the road network, and utilities. These effects may result from the Project construction workforce requiring temporary accommodations and increasing the demand on community infrastructure and services. During construction, movement of workers, materials, and equipment to construction sites, staging areas and workforce accommodations in the infrastructure and services RAA will increase traffic volumes resulting in some increase in road congestion. Project construction may also result in changes to utility infrastructure (e.g., utility relocations due to realignment of PR 239 or the upgrade of PTH 6).

Past and present physical activities in the RAA required infrastructure and services to facilitate these activities. As the RAA for the assessment of infrastructure and services shares the same spatial boundary as the LAA, the contributions of these activities and uses to the infrastructure and services has been described in the baseline conditions for the assessment (Chapter 9, Section 9.3.2) and are embodied in the assessment of Project residual effects. These activities are not considered again in the cumulative effects assessment which focusses on the effects of the Project together with future physical projects and activities. Future physical projects and activities have potential to contribute to cumulative effects on the

infrastructure and services by increasing demands on accommodations, community infrastructure and services, and the road network and causing changes in utilities in the RAA.

Table 11.9-1 Interactions with the Potential to Contribute to Cumulative Effects on Infrastructure and Services

Other Projects and Physical Activities with Potential for Cumulative Environmental Effects	Potential Cumulative Environmental Effects			
	Change in Accommodations	Change in Community Infrastructure and Services	Change in Road Traffic and Road Network	Change in Utilities
Past and Present Physical Activities and Resource Use				
Agricultural Conversion		✓	✓	✓
Fishing		✓	✓	
Infrastructure	✓	✓	✓	✓
Resource Use		✓	✓	
Residential Development	✓	✓	✓	✓
Recreation	✓	✓	✓	
Project-Related Physical Activities	✓	✓	✓	✓
Future Projects and Physical Activities				
Upgrade of Lake St. Martin access road	✓	✓	✓	
Quarries and borrow sites			✓	
Rehabilitation of PTH 6	✓	✓	✓	✓

NOTES:
✓ = those "other projects and physical activities" whose residual effects are likely to interact cumulatively with project residual environmental effects.

11.9.2 Cumulative Effects Assessment for Change in Infrastructure and Services

11.9.2.1 Cumulative Effect Pathways for Change in Infrastructure and Services

Potential cumulative effects on change in infrastructure and services due to future projects and activities have similar pathways of effects as those identified for the Project. These pathways are:

- increased demand on accommodations in the RAA due to construction workforces for the future projects and activities
- a reduction in available capacity and/or quality of services required for the future projects, resulting in an increased demand for health, emergency and protection services for local residents and visitors to the area and which may increase response times

- increased road traffic during construction phases potentially contributing to roadway congestion
- severance, alteration or relocation of utilities (e.g., water and sewage mains; electricity and telecommunications lines) in the LAA

11.9.2.2 Mitigation for Cumulative Effects on Change in Infrastructure and Services

Mitigation measures to address Project effects on the changes in infrastructure and services are identified in Section 9.3.4.2. Because the LAA is the same as the RAA, these measures would also mitigate the cumulative effects on infrastructure and services.

11.9.2.3 Residual Cumulative Effects on Change in Infrastructure and Services

The residual cumulative effects due to changes in the RAA are anticipated to be similar to Project effects because the availability of infrastructure and services in the RAA is limited. For example, the availability for accommodations to service additional future projects and activities is limited to approximately 70 rooms. The potential for cumulative effects also depends on the extent of temporal overlap between the Project and other projects and activities identified in Table 11.7-1. Construction of the Project is anticipated to overlap with the upgrade of the Lake St. Martin access road. Upgrades to PTH 6 between Ashern and Grahamdale, which involve culvert and slope replacements, may be completed prior to the construction of the Project.

11.9.3 Summary of Cumulative Effects on Infrastructure and Services

Table 11.9-2 summarizes cumulative environmental effects on infrastructure and services. It is anticipated that there will be some cumulative overlap from the Project with other projects (e.g., PTH 6 rehabilitation project). These future projects have the potential to effect infrastructure and services during Project construction.

While the Project will have an adverse cumulative effect on infrastructure and services, with the implementation of mitigation measures, cumulative effects will be of low in magnitude for road traffic and utilities, and moderate in magnitude for accommodations and community infrastructure and services. Timing is anticipated to be moderately sensitive. Cumulative effects will occur in a resilient socio-economic context and are anticipated to occur throughout the RAA. Cumulative effects will be short term for accommodations and community infrastructure and services, and medium term for road traffic and utilities. Effects are reversible in the short term for accommodation and community infrastructure and services, and reversible in the long term for road traffic and utilities.

Table 11.9-2 Summary of Cumulative Environmental Effects on Infrastructure and Services

Residual Cumulative Effect	Residual Cumulative Effects Characterization							
	Direction	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Socio-economic Context
Change in Accommodations								
Residual cumulative effect	A	ST	M	MS	RAA	RC	RS	R
Contribution from the Project to the residual cumulative effect	The Project is the main contributor to future cumulative effects on change in accommodations in the RAA.							
Change in Community Infrastructure and Services								
Residual cumulative effect	A	ST	M	MS	RAA	RC	RS	R
Contribution from the Project to the residual cumulative effect	The Project is the main contributor to future cumulative effects on change in community infrastructure and services in the RAA.							
Change in Road Traffic and Road Network								
Residual cumulative effect	A	LT	L	MS	RAA	RC	RL	R
Contribution from the Project to the residual cumulative effect	The Project is the main contributor to future cumulative effects on change on road traffic and road network in the RAA.							
Change on Utilities								
Residual cumulative effect	A	LT	L	MS	RAA	RC	RL	R
Contribution from the Project to the residual cumulative effect	The Project is the main contributor to cumulative effects on change on utilities in the RAA.							

Table 11.9-2 Summary of Cumulative Environmental Effects on Infrastructure and Services

KEY	***Magnitude:***	***Frequency:***
Direction:	*N: Negligible*	*IF: Infrequent*
P: Positive	*L: Low*	*SI: Sporadic/Intermittent*
A: Adverse	*M: Moderate*	*RC: Regular/Continuous*
N: Neutral	*H: High*	***Reversibility:***
Duration:	***Timing***	*RS: Reversible (short-term)*
ST: Short-term;	*NS: No sensitivity*	*RL: Reversible (long-term)*
MT: Medium-term	*MS: Moderate sensitivity*	*I: Irreversible*
LT: Long-term	*HS: High sensitivity*	***Socio-economic Context:***
	Geographic Extent:	*R: Resilient*
	PDA: Project development area	*NR: Not resilient*
	LAA: local assessment area	
	RAA: regional assessment area	
	N/A: Not applicable	

11.9.4 Significance of Residual Cumulative Environmental Effects

The existing RAA has been partially modified through agricultural conversion and industrial and residential development that has occurred over the past two hundred years. Future projects and activities are expected to have an incremental effect on infrastructure and services given that these projects are relatively small in comparison.

The cumulative effects from previous projects, and future projects and activities in combination with the current Project are not anticipated to occur at levels such that existing activities and use of infrastructure and services cannot continue within the RAA at current levels. None of the infrastructure and services are believed to be at a threshold where cumulative effects will be significant (i.e., to a point where they cannot continue at or near baseline levels).

While both the Project and future projects will contribute to a change in infrastructure and services in the RAA, Indigenous groups, residents and others affected by the Project are anticipated to be able to continue to use infrastructure and services at or near baseline levels after construction is completed. As such, the cumulative effects on infrastructure and services are expected to be not significant.

11.10 ECONOMY

11.10.1 Project Residual Effects Likely to Act Cumulatively

Table 11.1-1 presents the Project and physical activities inclusion list, which identifies other projects and physical activities that might act cumulatively with the Project. Where residual economic effects from the Project act cumulatively with those from other projects and physical activities (Table 11.10-1), a cumulative effects assessment is undertaken.

Project construction may result in adverse residual effects to the regional economy, labour availability and goods and services. These effects may result from the procurement of goods and services, and hiring of labourers from communities within the economy LAA, which, while also generating economic benefits could result in competition for labour and higher labour costs for employers within the LAA, and reduced availability and higher costs of some services for households within the LAA.

Past and present physical activities and resource use within the economy RAA require human labour. The contributions of these activities and uses to the economy has been described in the baseline conditions for the assessment of economy, presented in Chapter 9, Section 9.4.2, and are embodied in the assessment of residual effects. Future physical activities have potential to contribute to cumulative effects on the economy by hiring labour and purchasing goods and services within the RAA.

Table 11.10-1 Interactions with the Potential to Contribute to Cumulative Effects on Economy

Other Projects and Physical Activities with Potential for Cumulative Environmental Effects	Potential Cumulative Environmental Effects		
	Change in Regional Economy	Change in Labour	Change in Goods and Services
Past and Present Physical Activities and Resource Use			
Agricultural Conversion	✓	✓	✓
Fishing	✓	✓	✓
Infrastructure	✓	✓	✓
Resource Use	✓	✓	✓
Residential Development	✓	✓	✓
Recreation	✓	✓	✓
Project-Related Physical Activities	✓	✓	✓
Future Projects or Physical Activities			
Upgrade of Lake St. Martin access road	✓	✓	✓
Quarries and borrow sites	✓	✓	✓
Rehabilitation of PTH 6	✓	✓	✓

NOTES:
✓ = those "other projects and physical activities" whose residual effects are likely to interact cumulatively with project residual environmental effects.

11.10.2 Cumulative Effects Assessment for Changes in Regional Economy

11.10.2.1 Cumulative Effect Pathways for Changes in Regional Economy

Procurement by other projects within the RAA can result in both positive and adverse effects to the regional economy. Beneficial effects from revenue inflow into the region include potential for capital expansion, increased hiring, and other activities that result in a strengthened business base. Potential adverse cumulative effects include competition for skilled and unskilled labour, higher labour costs, and potential shortages in some services, such as those provided by skilled trades. These phenomena can result in higher operating costs and/or make it difficult for some businesses to operate at desired capacity. Land and resource use-based businesses can also be adversely affected by cumulative effects upon the land and resources upon which they depend.

11.10.2.2 Mitigation for Cumulative Effects on Changes in Regional Economy

Mitigation measures to address Project effects on the regional economy are identified in Chapter 9, Section 9.4.4.3. Because the LAA is the same as the RAA, these measures would also mitigate the cumulative effects on the regional economy.

11.10.2.3 Residual Cumulative Effects on Changes in Regional Economy

The residual cumulative effects due to expenditures in the RAA are anticipated to be similar to Project effects, with potential for both economic benefits and adverse effects. Cumulative economic benefits will result from spending and hiring within the RAA, while adverse effects could include higher costs of some services and competition for labour (addressed in Section 11.10.3). Construction of the Project is anticipated to overlap with the upgrade of the Lake St. Martin access road. Upgrades to PTH 6 between Ashern and Grahamdale, which involve culvert and slope replacements, may be completed prior to the construction of the Project.

11.10.3 Cumulative Effects Assessment for Changes in Labour

11.10.3.1 Cumulative Effect Pathways for Changes in Labour

Other civil construction projects being built in the economy RAA will require construction workforces. Given the limited construction workforce within the RAA, it is anticipated that a proportion of the labour required for other projects will be hired from outside of the RAA. The competition for the local labour can have adverse effects on businesses operating in the RAA and contribute to higher operating costs. The extent of cumulative effect on labour will depend on the degree of temporal overlap between the Project and future projects and activities. Construction of the Project is anticipated to overlap with the upgrade of the Lake St. Martin access road. Upgrades to PTH 6 between Ashern and Grahamdale, which involve culvert and slope replacements, may be completed prior to the construction of the Project.

11.10.3.2 Mitigation for Cumulative Effects on Changes in Labour

Mitigation measures to address Project effects on the labour are identified in Chapter 9, Section 9.4.4.4. Because the LAA is the same as the RAA, these measures would also mitigate the cumulative effects on labour.

11.10.3.3 Residual Cumulative Effects on Changes in Labour

The residual cumulative effects on labour in the RAA are anticipated to be similar to Project effects because the labour pool in the RAA is constrained in size. The Project could employ the entire available construction labour pool within the RAA, thus limiting the potential for other projects to access labour (because they would have to hire their construction workforces from outside of the RAA). Construction of the Project is anticipated to overlap with the upgrade of the Lake St. Martin access road. Upgrades to PTH 6 between Ashern and Grahamdale, which involve culvert and slope replacements, may be completed prior to the construction of the Project.

11.10.4 Cumulative Effects Assessment for Changes in Goods and Services

11.10.4.1 Cumulative Effect Pathways for Changes in Goods and Services

The procurement of goods and services within the RAA by large development projects could lead to reductions in availability and increased costs to LAA residents and businesses. Construction of the Project is anticipated to overlap with the upgrade of the Lake St. Martin access road. Upgrades to PTH 6 between Ashern and Grahamdale, which involve culvert and slope replacements, may be completed prior to the construction of the Project.

11.10.4.2 Mitigation for Cumulative Effects on Changes in Goods and Services

Mitigation measures to address Project effects on goods and services are identified in Chapter 9, Section 9.4.4.5. Because the LAA is the same as the RAA, these measures would also mitigate the cumulative effects on goods and services.

11.10.4.3 Residual Cumulative Effects on Changes in Goods and Services

Residual cumulative effects on changes in goods and services could be of higher magnitude than Project effects because of the greater amount of construction-related expenditure occurring. These effects may be both beneficial and adverse. Beneficial effects include additional commercial opportunities for regional businesses, and more opportunities to earn relatively high wages by RAA households. There would be moderate to high magnitude adverse effects related to potential scarcity of skilled trades and service employees who have taken up employment with one or more projects.

11.10.5 Summary of Cumulative Effects on Economy

Table 11.10-2 summarizes cumulative environmental effects on economy.

Table 11.10-2 Summary of Cumulative Environmental Effects on Economy

Residual Cumulative Effect	Residual Cumulative Effects Characterization							
	Direction	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Socio-Economic Context
Change in Regional Economy								
Residual cumulative effect	P/A	LT	M	MS	RAA	RC	R	BAC
Contribution from the Project to the residual cumulative effect	The Project will be the single largest contributor to the change in regional economy during construction phase. However, other economic sectors will be the main contributors to the regional economy over the operation and maintenance phase of the Project.							
Change in Labour								
Residual cumulative effect	P/A	LT	M	MS	RAA	RC	R	BAC
Contribution from the Project to the residual cumulative effect	The Project will be a substantial contributor to change in labour during construction phase, though it will still only account for a small proportion of the RAA labour supply. However, other economic sectors will be the main contributors to the regional economy over the operation and maintenance phase of the Project							
Change in Goods and Services								
Residual cumulative effect	A	LT	M	MS	RAA	RC	R	BAC
Contribution from the Project to the residual cumulative effect	The Project will have a minor contribution to change in goods and services within the RAA. Most effects on goods and services will result from changes in macroeconomic conditions, and overall supply of goods and services occurring outside of the RAA.							

KEY

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
MS: Moderate 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:
R: Reversible
I: Irreversible

Socio-Economic Context:
AC: Average Condition
BAC: Below Average Condition

11.10.6 Significance of Residual Cumulative Environmental Effects

The Project has the potential to act cumulatively with other projects with respect to changes in economy related to regional economic impacts, labour availability, and the cost and availability of goods and services to RAA residents and businesses. With the exception of changes to goods and services, the Project is anticipated to be the primary contributor to changes in economy because of its size and likely longer construction duration, relative to other identified future projects. The residual effects associated with Project activities on economy were determined to be not significant. The contributions of other projects to changes in economy are expected to be on a smaller scale and for a shorter duration than the Project. Thus, the cumulative effects on the economy, associated with the other projects will not materially change the predicted Project residual effects on the economy and therefore, the residual cumulative effects are not significant.

11.11 HUMAN HEALTH

11.11.1 Project Residual Effects Likely to Act Cumulatively

Table 11.1-1 presents the Project and physical activities inclusion list, which identifies other projects and physical activities that might act cumulatively with the Project. Where residual human health effects from the Project act cumulatively with those from other projects and physical activities (Table 11.11-1), a cumulative effects assessment is undertaken to determine their significance.

The Project has the potential to have adverse residual effects on human health. The potential health concerns include the inhalation of exhaust from vehicles and equipment using gasoline or diesel fuel and changes in ambient noise levels due to construction. The changes in air quality and noise would occur during the construction phase with no lasting changes afterwards. The change in human health from these emissions is a function of a person's proximity to the Project where physical activities are occurring. Specifically, people located closest to the Project would have the highest potential change in human health.

Table 11.11-1 Interactions with the Potential to Contribute to Cumulative Effects on Human Health

Other Projects and Physical Activities with Potential for Cumulative Environmental Effects	Potential Cumulative Environmental Effects	
	Change in Human Health – Air Quality	Change in Human Health – Noise Levels
Past and Present Physical Activities and Resource Use		
Agricultural Conversion		
Fishing		
Infrastructure	✓	✓
Resource Use	✓	✓
Residential Development	✓	✓

Table 11.11-1 Interactions with the Potential to Contribute to Cumulative Effects on Human Health

Other Projects and Physical Activities with Potential for Cumulative Environmental Effects	Potential Cumulative Environmental Effects	
	Change in Human Health – Air Quality	Change in Human Health – Noise Levels
Recreation		
Project-Related Physical Activities	✓	✓
Future Projects or Physical Activities		
Upgrade of Lake St. Martin access road	✓	✓
Quarries and borrow sites	✓	✓
Rehabilitation of PTH 6	✓	✓

NOTES:
✓ = those "other projects and physical activities" whose residual effects are likely to interact cumulatively with project residual environmental effects.

11.11.2 Cumulative Effects Assessment for Changes in Human Health - Air Quality

11.11.2.1 Cumulative Effect Pathways for Changes in Human Health – Air Quality

Potential cumulative effects on changes in human health related to changes in air quality due to future projects and activities have similar effects as those identified for the Project. Specifically, construction activities associated with future projects has the potential to alter air quality in the same manner as Project-related constructions activities.

The assessment of air quality effects of the Project (Chapter 6, Section 6.2.4.2) determined that emissions would not exceed guidelines. For example, baseline measured NO_2 concentrations showed that the 1-hour and annual average 90th percentile values were 4% and 8% of the Manitoba Ambient Air Quality Criteria (MAAQC), respectively, and predicted that Project emission of NO_2 would not cause a substantial change to ambient air quality (Chapter 6, Section 6.2.2.2). The air quality assessment further concluded that it is unlikely that Project emissions of SO_2, TSP, PM_{10}, $PM_{2.5}$ and CO in the RAA will cause the ambient air quality to exceed the respective MAAQCs. Based on these results, the health concerns were determined to be not significant during the construction phase of the Project.

Relative to the future activities of upgrade of Lake St. Martin access road and the rehabilitation of PTH 6, construction emissions are expected to occur during the nominal two-year Project construction period. The emissions associated with the future activities are expected to be similar to, but on a smaller scale and for a shorter duration compared to, the Project. Emissions associated with the activities for quarries and borrow pits are scattered in the air quality RAA. Emissions from the future activities will not materially change the predicted Project residual effects conclusions related to human health risks.

11.11.2.2 Mitigation for Cumulative Effects on Changes in Human Health – Air Quality

The Project will have no significant residual effects on human health and will not act cumulatively with other Projects or activities to have a measurable effect on human health. Therefore, mitigation measures to address cumulative effects on human health, beyond what are already described in Chapter 6, Section 6.2.4.2 to manage or reduce Project emissions during construction, are not necessary.

11.11.2.3 Residual Cumulative Effects on Changes in Human Health – Air Quality

Residual effects on human health related to changes in ambient air quality due to the Project are discussed in Chapter 9, Section 9.5.4.2. Anticipated residual effects are based on baseline air quality analysis and project emissions quantification provided in Chapter 6, Section 6.2.4.2.

Relative to the future activities of the upgrade of Lake St. Martin access road and the rehabilitation of PTH 6, changes in human health risk related to changes in air quality due to construction emissions are expected to occur during the nominal two-year Project construction period. The emissions associated with the future activities are expected to be similar to, but on a smaller scale and for a shorter duration compared to, the Project. Thus, the human health risks associated with the changes in air quality from these projects will not change the predicted Project residual effects on human health.

11.11.3 Cumulative Effects Assessment for Change to Human Health - Noise Levels

11.11.3.1 Cumulative Effect Pathways for Change to Human Health - Noise Levels

During construction, noise emissions will emanate from machinery engines, mufflers, pile strings during impact pile driving, back-up alarms of the vehicles and machinery, drilling and rotary equipment, soil and pavement compactors and other material movement equipment.

Future projects and physical activities must be sufficiently close to the Project construction activities to act cumulatively. Noise emissions associated with the upgrade of Lake St. Martin access road and rehabilitation of PTH 6, and the various quarries and borrow pits for the Project construction could take place during the Project construction period and overlap temporally with Project noise emissions in the RAA. Therefore, overlap is expected between residual Project noise and future physical activities and thus the Project is expected to contribute to cumulative effects.

11.11.3.2 Mitigation for Cumulative Effects on Change to Noise Levels

Mitigation measures implemented to manage and reduce Project noise emissions during the construction phase (Chapter 6, Section 6.2.4.4) will be applicable for cumulative effects of noise.

11.11.3.3 Residual Cumulative Effects on Change to Noise Levels

The Project is expected to interact cumulatively with other existing and future physical activities during the Project construction phase only. Mitigation measures to reduce Project noise emissions during the construction phase will reduce the Project effects that may interact cumulatively with other existing and future physical activities. The Project construction activities are expected to be greater than those of the future activities and to form the largest proportion of the cumulative effects. The residual cumulative effects on the acoustic environment are assessed to be the same as the residual Project effects.

11.11.4 Summary of Cumulative Effects on Human Health

Table 11.11-2 summarizes cumulative environmental effects on Human Health.

Table 11.11-2 Summary of Cumulative Environmental Effects on Human Health

Residual Cumulative Effect	Residual Cumulative Effects Characterization							
	Direction	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Socio-Economic Context
Change in Human Health – Air Quality								
Residual cumulative effect	A	ST	NL	NS	RAA	SI	R	R
Contribution from the Project to the residual cumulative effect	The Project has the potential to act cumulatively with other projects in the RAA with respect to changes in human health risk associated with changes in air quality. However, the changes in air quality for the other projects are expected to be on a smaller scale and for a shorter duration than the Project. Thus, the cumulative effects on human health associated with the other projects in the RAA will be similar to the predicted Project residual effects on human health.							
Change in Human Health - Noise Levels								
Residual cumulative effect	A	ST	M	NS	RAA	SI	R	R
Contribution from the Project to the residual cumulative effect	The Project has the potential to act cumulatively with other projects in the RAA with respect to changes in human health risk associated with changes in noise levels. However, the changes in noise levels for the other projects are expected to be on a smaller scale and for a shorter duration than the Project. Thus, the cumulative effects on human health associated with the other projects in the RAA will be similar to the predicted Project residual effects on human health.							

Table 11.11-2 Summary of Cumulative Environmental Effects on Human Health

KEY	***Magnitude:***	***Frequency:***
Direction:	*NL: Negligible or Low*	*IF: Infrequent*
P: Positive	*M: Moderate*	*SI: Sporadic/Intermittent*
A: Adverse	*H: High*	*RC: Regular/Continuous*
N: Neutral	***Timing***	***Reversibility:***
Duration:	*NS: No sensitivity*	*RS: Reversible (short-term)*
ST: Short-term;	*MS: Moderate sensitivity*	*RL: Reversible (long-term)*
MT: Medium-term	*HS: High sensitivity*	*I: Irreversible*
LT: Long-term	***Geographic Extent:***	***Socio-Economic Context:***
	PDA: Project development area	*R: Resilient*
	LAA: local assessment area	*NR: Not resilient*
	RAA: regional assessment area	
	N/A: Not applicable	

11.11.5 Significance of Residual Cumulative Environmental Effects

The Project has the potential to act cumulatively with other projects in the RAA with respect to changes in human health risk associated with changes in air quality and/or noise levels. The Project is anticipated to be the primary contributor to changes in human health for both air quality and noise during Project construction. The residual human health effects associated with Project activities were determined to be not significant. The contributions of other projects to changes in air quality and noise levels are on a smaller scale and for a shorter duration than the Project. However, the cumulative effects on human health, associated with the other projects will not change the predicted Project residual effects on human health. Overall residual cumulative effects are therefore not significant.

11.12 TRADITIONAL LAND AND RESOURCE USE

11.12.1 Project Residual Effects Likely to Act Cumulatively

The Project is anticipated to cause residual effects to traditional land and resource use (TLRU), including to availability of traditional lands and resources for current use, by changes in access to lands and traditional resources for current use, by changes to cultural and spiritual sites or areas, and by changes to the cultural value or importance associated with current use. Table 11.1-1 identifies other projects and physical activities that might act cumulatively with the Project. Where residual effects from the Project on TLRU may act cumulatively with those from other projects and physical activities (Table 11.12-1), a cumulative effects assessment is undertaken to determine their significance.

Adverse residual effects on current use sites and areas from the Project currently used for traditional purposes are limited to the TLRU LAA and are not anticipated to act cumulatively with the residual effects of future developments in the RAA. Available resources, other cultural use sites, and trails and travelways currently used for traditional purposes, which are intersected by the PDA but also extend into the LAA and RAA, are assessed for cumulative effects.

Table 11.12-1 Interactions with the Potential to Contribute to Cumulative Effects on Traditional Land and Resource Use

Other Projects and Physical Activities with Potential for Cumulative Environmental Effects	Potential Cumulative Environmental Effects			
	Change in Availability of Lands and Resources Currently Used for Traditional Purposes	Change in Access to Lands and Resources Currently Used for Traditional Purposes	Changes to Cultural and Spiritual Sites or Areas	Changes to the Cultural Value or Importance Associated with Current Use
Past and Present Physical Activities and Resource Use				
Agricultural Conversion	✓	✓	✓	✓
Fishing	✓	✓	✓	✓
Infrastructure	✓	✓	✓	✓
Resource Use	✓	✓	✓	✓
Residential Development	✓	✓	✓	✓
Recreation	✓	✓	✓	✓
Project-Related Physical Activities	✓	✓	✓	✓
Future Projects or Physical Activities				
Upgrade of Lake St. Martin access road	✓	✓	✓	✓
Quarries and borrow sites	✓	✓	✓	✓
Rehabilitation of PTH 6	✓	✓	✓	✓

NOTES:
✓ = those "other projects and physical activities" whose residual effects are likely to interact cumulatively with project residual environmental effects.

11.12.2 Cumulative Effects Assessment for Change in Availability of Lands and Resources Currently Used for Traditional Purposes

11.12.2.1 Cumulative Effect Pathways for Change in Availability of Lands and Resources Currently Used for Traditional Purposes

Potential cumulative effects to change in availability of lands and resources currently used for traditional purposes due to future projects and activities have similar effects to those identified for the Project. The residual effects of the Project could act cumulatively with the residual effects of future projects to create changes in habitat for traditionally used plant and animal species, changes in movement patterns of wildlife, changes to wildlife health or mortality, changes to plant community and diversity, and changes to the function of wetlands. Such changes could also affect hunting, trapping, fishing, and plant gathering activities for Indigenous groups.

11.12.2.2 Mitigation for Cumulative Effects on Availability of Lands and Resources Currently Used for Traditional Purposes

Mitigation measures to reduce potential Project effects on availability of traditional resources for current use are presented in Chapter 10, Section 10.2.6.4 and are anticipated to be sufficient to address cumulative effects on the availability of lands and resources for TLRU. With regard to future projects, similar mitigation measures could be taken to reduce potential cumulative effects and any specific mitigations or recommendations made by Indigenous groups could be implemented, where feasible.

11.12.2.3 Residual Cumulative Effects on Availability of Lands and Resources Currently Used for Traditional Purposes

Changes to habitat for wildlife (see Section 11.7) are anticipated to occur through indirect effects such as sensory disturbance or altered wetland function and through direct effects such as vegetation removal associated with future projects. Construction activities associated with future projects are likely to reduce habitat for bird species. Habitat fragmentation is anticipated to result from upgrades to the Lake St. Martin access road. The development of quarries and borrow sites will likely result in loss of habitat and vegetation, while sensory disturbance effects could extend beyond any quarries or borrow sites. Sensory disturbance is also likely to result from the rehabilitation of PTH 6.

Potential cumulative effects may alter wildlife movement due to the development of linear features (i.e., access road) or localized disturbances (i.e., quarries. An increase in traffic volume during construction phases could affect wildlife mortality, and the upgraded access road may contribute to an increase in wildlife mortality risk due to expanded access of predators and people.

Potential residual cumulative effects to fish habitat and fish passage from the Project and reasonably foreseeable future projects are expected to be negligible. This is because the mitigation measures available to eliminate or reduce potential effects of linear developments and works and activities near water on fish habitat are well understood, technically feasible and highly effective.

The Project and other future projects have the potential to cumulatively increase access to fish bearing streams and ponds. However, no measurable cumulative effect to commercial, recreational and Aboriginal (CRA) fish populations in the LAA or RAA are expected to occur because any new access are to streams, ponds, and lakes that are either already accessible or a too small to be attractive for recreational or Aboriginal fishers, particularly given the proximity of Lake Manitoba, Lake St. Martin, and Lake Winnipeg.

The residual effects of the Project could act cumulatively with the residual effects of future projects to create changes in plant communities and diversity (see Section 11.6). Such changes could affect plant gathering activities for indigenous groups and may further decrease the available area of upland and wetland vegetation. Upgrading of the Lake St. Martin access road will have effects on native upland and wetland areas, affecting grass cover and resulting in loss of wetland area. Quarries and borrow sites are likely to require clearing of native upland and wetland vegetation communities. The rehabilitation of PTH 6 may result in the loss of native vegetation as a result of its widening.

The residual effects of the Project could act also cumulatively with the residual effects of future projects to create changes in wetland functions. These changes could affect hunting, trapping, and plant gathering activities for Indigenous groups. The upgrading of the Lake St. Martin access road will both cross wetlands and reduce wetlands area. The development of quarries and borrow sites may also result in wetland area losses. The planned rehabilitation of PTH 6 could result in wetland area reduction through roadbed expansion.

Residual cumulative effects are expected to be adverse and long-term in duration. With the incorporation of mitigation, the incremental contribution of future activities combined with the Project's residual effects on changes in availability of lands and resources currently used for traditional purposes will be low in magnitude. It is anticipated that current land and resource use practices will be able to continue with minor alteration. Timing is highly sensitive due to the seasonality of wildlife and fish movement and habitat availability, as well as the seasonality of current land and resource use practices. Residual cumulative effects are anticipated to occur within the LAA at regular and continuous intervals and to be irreversible.

11.12.3 Cumulative Effects Assessment for Change in Access to Lands and Resources Currently Used for Traditional Purposes

11.12.3.1 Cumulative Effect Pathways for Change in Access to Lands and Resources Currently Used for Traditional Purposes

Potential cumulative effects to change in access to lands and resources currently used for traditional purposes due to future projects and activities have similar effects to those identified for the Project. Changes to access of lands and resources can occur through construction and operation activities of the outlet channels, where access is restricted due to the gated Lake St. Martin access road. Further anticipated changes include uncontrolled access due to Project construction and operations, such as the failure of restricted access gates or signage to prevent access. As well, an increase in access to

traditional hunting areas for non-Indigenous hunters due to the upgrading of the Lake St. Martin access road is likely.

Change is also likely through the direct loss or alteration of trails and travelways. For example, the snowmobile trail identified by Dauphin River First Nation appears to be intersected by the LSMOC, as well as the upgrade to the Lake St. Martin access road. For the purposes of this assessment, and in keeping with the conservative approach applied in Chapter 10, Section 10.2, spatial overlap of trails with the Project and future projects is assumed. The Dauphin River First Nation snowmobile trail (mapped in Golder Associates 2018), which borders wetlands southwest of Lake Winnipeg, would be altered at multiple points along its route by installation of the LSMOC and the upgraded Lake St. Martin access road. Peguis First Nation and Pinaymootang First Nation also identified trails which are traveled in order to access hunting, trapping, and plant harvesting areas immediately southwest of Lake Winnipeg, as well as fishing areas in Sturgeon Bay. When accessed by land, these trails may also be affected cumulatively by the LSMOC and the access road upgrade.

11.12.3.2 Mitigation for Cumulative Effects on Change in Access to Lands and Resources Currently Used for Traditional Purposes

Mitigation measures to reduce potential Project effects on change in access to lands and resources currently used for traditional purposes are presented in Chapter 10, Section 10.2.4.4. These include Manitoba Infrastructure's development of suitable means for crossing the LSMOC following construction in order to maintain access to land and resources currently used for traditional purposes, pending ongoing discussions with Indigenous groups. The upgrade of the Lake St. Martin access road and the development of Project-specific quarries are proposed in order to service the Project and will be developed by Manitoba Infrastructure or in conjunction with a collaborative third party.

11.12.3.3 Residual Cumulative Effects on Change in Access to Lands and Resources Currently Used for Traditional Purposes

The residual effects of the Project are anticipated to act cumulatively with the residual effects of future projects to create changes in access to lands and resources for traditional purposes. Such changes could affect hunting, trapping, fishing, and plant gathering activities for Indigenous groups. Changes to access for traditional purposes are anticipated to occur through the upgrading of the Lake St. Martin access road, inhibiting travel along snowmobile trails identified by Dauphin River First Nation, Peguis First Nation, and Pinaymootang First Nation. With the addition of approved mitigations for crossing the channel, travel could continue during operations, albeit with alterations. The rehabilitation of PTH 6 may result in changes to access of lands and resources for traditional purposes. The development of quarry and borrow sites may affect access to hunting and gathering areas within the LAA. Residual cumulative effects as a result of the Project and future projects are anticipated to be adverse and long-term in duration, owing to the permanent nature of the components for future projects. Implementing mitigations and continuing to engage with Indigenous groups would render the residual cumulative effects on access to traditional resources for current use as moderate in magnitude. Timing is not sensitive as changes in

access to lands and resources would occur irrespective of day or season. Residual cumulative effects are anticipated to occur within the LAA at regular continuous intervals and to be irreversible.

11.12.4 Cumulative Effects Assessment for Changes to Cultural and Spiritual Sites or Areas

11.12.4.1 Cumulative Effect Pathways for Changes to Cultural and Spiritual Sites or Areas

Potential cumulative effects on changes to cultural and spiritual current sites arising from future projects have the same effect pathways as those identified for construction and operation of the Project. Current use cultural and spiritual sites or areas could be adversely affected directly through construction-related losses, ground disturbance, vegetation clearing, barrier erection, or indirectly through sensory disturbance.

11.12.4.2 Mitigation for Cumulative Effects on Changes to Cultural and Spiritual Sites or Areas

Mitigation measures proposed to reduce potential Project effects on changes to cultural and spiritual sites or areas are presented in Chapter 10, Section 10.2.4.6. These include consideration of Indigenous groups' concerns such that Project design and routing of the outlet channels were influenced, development and implementation of Project-specific wildlife monitoring and management plans, development of detailed mapping and recording of cultural and spiritual sites in partnership with engaged Indigenous groups, opportunities for traditional plant harvest in advance of construction of the outlet channels, and the holding of culturally appropriate ceremonies prior to construction commencing.

11.12.4.3 Residual Cumulative Effects on Changes to Cultural and Spiritual Sites or Areas

Indigenous groups have indicated that cultural and spiritual sites or areas could be affected by Project activities. The Heritage Resources section of the EIS has identified 15 registered archaeological sites in the LAA and RAA (see Chapter 9, Section 9.6). Archaeological sites often represent important Indigenous heritage and culture, and as a result, residual effects of the Project could act cumulatively with the residual effects of future projects to create changes to cultural and spiritual sites or areas. Changes to cultural and spiritual sites could occur through the upgrading of the Lake St. Martin access road. Blasting and material removal-related activities associated with development of quarries and borrow sites have the potential to damage or otherwise affect cultural and spiritual sites or areas within the LAA (See also Chapter 9, Section 9.6.3). Manitoba Infrastructure has initiated engagement with potentially affected Indigenous groups, and through ongoing engagement, Indigenous groups will have the opportunity to identify cultural and spiritual sites that may be affected by future projects. In order to mitigate potential cumulative effects, Manitoba Infrastructure will continue to engage with Indigenous groups when cultural and spiritual sites are identified, and consider recommendations made by Indigenous groups regarding mitigation, as appropriate.

Residual cumulative effects as a result of the Project and future projects are anticipated to be adverse and long-term in duration. With the incorporation of mitigation and continued engagement with Indigenous groups, residual cumulative effects on changes to cultural and spiritual sites or areas are anticipated to be moderate in magnitude for future projects in the LAA. The intersecting PDAs of the Project and the upgrading of the Lake St. Martin access road are anticipated to have residual cumulative effects to cultural and spiritual sites or areas of a moderate-to-high magnitude. Timing is not sensitive as changes to cultural and spiritual sites or areas would occur irrespective of day or season. Effects resulting from future projects in the LAA are likely to be reversible, while effects from future projects occurring in the PDA and in direct disturbance areas are irreversible. These residual cumulative effects will occur at regular and continuous intervals.

11.12.5 Cumulative Effects Assessment for Changes to the Cultural Value or Importance Associated with Current Use

11.12.5.1 Cumulative Effect Pathways for Changes to the Cultural Value or Importance Associated with Current Use

Cumulative effects to changes to the cultural value or importance associated with current use are:

- effects to the spiritual and cultural experience of an activity or practice
- effects to an Indigenous group or individual's sense of place or well-being
- effects on the applicability and transmission of indigenous laws, understandings, customs, and traditions.

Engaged Indigenous groups indicated that changes to land are a fundamental concern, beyond the activities specific to the Project and to future projects. As a result, it can be conservatively assumed that changes to the cultural value or importance associated with current use introduced by future projects in the LAA would also be a residual effect.

11.12.5.2 Mitigation for Cumulative Effects on Changes to the Cultural Value or Importance Associated with Current Use

Mitigation measures to reduce potential Project effects on changes to the cultural value or importance associated with current use are presented in Chapter 10, Section 10.2.4.7 and are anticipated to be sufficient to address cumulative effects on the changes to the cultural value or importance associated with current use.

11.12.5.3 Residual Cumulative Effects on Changes to the Cultural Value or Importance Associated with Current Use

The residual effects of the Project could act cumulatively with the residual effects of future projects to create changes to cultural value or importance associated with current use. The upgrading of the Lake St. Martin access road will potentially cause effects to hunting and gathering practices near the northern

channel outlet. The rehabilitation of PTH 6 could cause sensorial disturbances, including increased noise, increased dust, odours, emissions, and light pollution and affect huntable game in the southern portion of the RAA, resulting in a loss of value or importance to Indigenous groups. Development of quarry and borrow sites has the potential to cause sensory disturbance in the form of diminished enjoyment of the landscape and its features, or through effects to culturally valued areas or places.

11.12.6 Summary of Cumulative Effects on Traditional Land and Resource Use

Table 11.12-2 summarizes cumulative environmental effects on traditional land and resource use.

Table 11.12-2 Summary of Cumulative Environmental Effects on Traditional Land and Resource Use

Residual Cumulative Effect	Residual Cumulative Effects Characterization							
	Direction	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Socio-Economic Context
Change in Availability of Lands and Resources Currently Used for Traditional Purposes								
Residual cumulative effect	A	LT	L	HS	RAA	RC	I	R
Contribution from the Project to the residual cumulative effect	The Project will result in residual cumulative effects to the availability of lands in the RAA and resources currently used for traditional purposes that are low in magnitude. It is anticipated that at or near pre-Project levels of traditional use could continue with minor alterations.							
Change in Access to Lands and Resources Currently Used for Traditional Purposes								
Residual cumulative effect	A	LT	M	NS	RAA	RC	I	R
Contribution from the Project to the residual cumulative effect	The Project will result in residual cumulative effects in the RAA through change in access to lands and resources currently used for traditional purposes that are moderate in magnitude. With the addition of an approved crossing mechanism, travel along and across the LSMOC, although altered, can continue such that Indigenous access to lands and resources is maintained.							
Changes to Cultural and Spiritual Sites or Areas								
Residual cumulative effect	A	LT	M-H	NS	RAA	RC	RL/I	NR
Contribution from the Project to the residual cumulative effect	The Project will result in residual cumulative effects in the RAA through changes to cultural and spiritual sites or areas that are moderate-to-high in magnitude, with effects concentrated within the PDA and direct disturbance areas. Application of mitigations, in tandem with continued Indigenous engagement, will reduce effects.							

Table 11.12-2 Summary of Cumulative Environmental Effects on Traditional Land and Resource Use

Residual Cumulative Effect	Residual Cumulative Effects Characterization							
	Direction	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Socio-Economic Context
Changes to the Cultural Value or Importance Associated with Current Use								
Residual cumulative effect and contribution from the Project to the residual cumulative effect	As noted in Section 10.3.1.3, residual effects are characterized narratively, and as such, are not included in this table.							

KEY

Direction:
P: Positive
A: Adverse
N: Neutral

Duration:
ST: Short-term;
MT: Medium-term
LT: Long-term

Magnitude:
N: Negligible
L: Low
M: Moderate
H: High

Timing
NS: No sensitivity
MS: Moderate 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

Socio-Economic Context:
R: Resilient
NR: Not resilient

11.12.7 Significance of Residual Cumulative Environmental Effects

Areas available for TLRU pursuits have been impacted by past and current development, most especially in the southern portion of the LAA. The northern outlet channel will be installed in land that has previously remained relatively undisturbed. As a result, cumulative effects from past and future projects are anticipated to availability, access, and cultural sites or areas. However, with the implementation of appropriate mitigations, residual cumulative effects are predicted to be not significant, and TLRU activities are likely to continue within the LAA at or near current levels.

11.13 INDIGENOUS HEALTH AND SOCIO-ECONOMIC CONDITIONS

11.13.1 Cumulative Effects on Indigenous Health and Socio-economic Conditions

Project effects on Indigenous health and socio-economic conditions are related to the effects on other biophysical and socio-economic VCs: human health, traditional land and resources use, land and resources use, infrastructure and services, and economy. As discussed above for the cumulative effects on these VCs, the effects of the future projects and activities as listed in Table 11.1-1 result in a small increase to the residual Project effects and the residual cumulative effects characteristics are the same as for the Project effects. The residual cumulative effects of VCs influencing the health conditions of Indigenous peoples will be the same as the residual Project effects. The effects are long term and low to medium in magnitude. The residual cumulative effects on change in Indigenous socio-economic conditions will be the same as residual Project effects which are adverse in the short term but positive in the long term and are of medium magnitude. The timing of effects is characterized as highly sensitive based on the seasonality of harvested species both for country foods and commercial purposes. The socio-economic context in which residual effects on Indigenous health and socio-economic conditions will take place is characterized as below standard condition. The Indigenous groups who were evacuated in 2011 and 2014 and specifically Indigenous groups whose housing and infrastructure were severely damaged have social and economic context, such as unemployment rates, household incomes, and socio-economic determinants of health, which are lower than the provincial average.

Section 6.4.12.3 Changes in Regional Flows and Water Levels concludes “No discernable effect is expected on Lake Winnipeg or further downstream.” As such, given no project-effects (that are measurable or otherwise can be identified) there are no cumulative effects due to Lake Winnipeg water levels on potential effects to health and socioeconomic conditions of Indigenous peoples or any other VCs.

11.13.2 Summary of Cumulative Effects on Indigenous health and socio-economic conditions

Table 11.13-1 summarizes cumulative environmental effects on Indigenous health and socio-economic conditions.

Table 11.13-1 Summary of Project Residual Effects and Cumulative Effects on Indigenous Health and Socio-economic Conditions

Residual Effect	Residual Effects Characterization							
	Direction	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Socio-economic Context
Change in Indigenous Health Conditions	A	LT	L-M	HS	RAA	RC	IR	BS
Change in Indigenous Socio-economic Conditions	A-P	ST-LT	M	HS	RAA	R	R	BS

KEY

Direction:
P: Positive
A: Adverse
N: Neutral or Negligible

Duration:
ST: Short-term
MT: Medium-term
LT: Long-term

Magnitude:
N: Negligible or Low
L: Low
M: Moderate
H: High

Timing
NS: No sensitivity
MS: Moderate 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
SR: Sporadic/Intermittent
RC: Regular/Continuous

Reversibility:
RS: Reversible (short-term)
RL: Reversible (long-term)
I: Irreversible

Ecological/Socio-Economic Context:
BS: Below standard condition
S: Standard condition
R: Resilient
NR: Not resilient

11.13.3 Significance of Residual Cumulative Environmental Effects

The residual cumulative effects on Indigenous health and socio-economic conditions are assessed as the same for the Project effects and their significance is the same.

A significant effect on Indigenous health conditions is one that results in:

- a long-term loss of availability of traditional use resources or access to lands relied on for current use practices or current use sites and areas, such that current use is critically reduced or eliminated from the LAA or

- chemical exposures that exceed objectives established by relevant regulatory organization(s) and are likely to result in a long-term change in the health of an identified receptor(s) or
- audible noise levels that exceed provincial guidelines, and where there is a reasonable expectation that the predicted changes in noise levels could result in an increase in public annoyance and could affect public health and welfare

Although some alteration of behavior will be required to continue harvesting country foods changes to current use practices will not be critically reduced. No changes are expected to surface water quality, groundwater quality, soil quality or chemical quality of country food; chemical exposure levels are below objectives. Noise levels are not anticipated to affect public health and welfare. As a result, residual effects on Indigenous health conditions are not significant.

A significant effect on Indigenous socio-economic conditions is one that results in:

- wide degradation, restriction or disruption of present land and resource uses to a point where these activities and production cannot continue at or near baseline levels or cannot be adequately compensated or
- an exceedance of available capacity or a substantial decrease in the quality of a service provided, on a persistent and ongoing basis, which cannot be mitigated with current or anticipated programs, policies or mitigation measures. A significant adverse residual effect is also unlikely to recover to existing conditions or
- economic effects which are distinguishable from current conditions and trends and cannot be managed or mitigated through adjustments to programs, policies, plans, or through other mitigation measures

The reductions in lake levels and flood levels in Lake St. Martin as a result of the Project will provide positive effects to agricultural land use within Lake St. Martin First Nation, Little Saskatchewan First Nation and Pinaymootang First Nation. Residual effects on commercial fishing, trapping, forestry, and recreation and tourism are expected particularly during construction; however, activities will be able to continue at similar levels as under existing conditions. Changes to accommodation will take place during Project construction but are not anticipated to be persistent and ongoing. A Traffic Management Plan and Emergency Response Plan will be implemented to mitigate residual effects on community infrastructure and services. Positive effects on infrastructure and services are expected during operations (gates open) when the Project will alleviate flooding in low-lying areas and roadways and other infrastructure that may otherwise be flooded may remain operational. Changes in labour force and regional economy are unlikely to pose a substantial risk or benefit to the economy. It is expected that residual effects can be managed through the Project's mitigation which increase Indigenous participation. As a result, residual effects on Indigenous socio-economic conditions are not significant.

11.14 ABORIGINAL AND TREATY RIGHTS

Effects on Aboriginal and treaty rights may occur where the Project has a residual effect on traditional harvesting or on physical activities associated with traditional use. Therefore, the cumulative effects on TLRU would be the same as cumulative effects on Aboriginal and treaty rights. These are discussed in Section 11.12.

11.15 CUMULATIVE EFFECTS OF ACCIDENTS AND MALFUNCTIONS

Accidents and malfunctions are rare events and typically are relatively localized in spatial extent, with effects often subject to emergency response already planned following prescribed protocols. The exact details of such events cannot however be further determined given various possibilities of precise location, timing and characteristics of such effects (e.g., magnitude, duration). As such, given also the uncertainties in such details for most other projects and physical activities identified with effects that may interact with the Project (as listed in Table 11.1-1), conducting a cumulative effects assessment of accidents and malfunctions is a highly uncertain exercise with limited opportunity to provide other than a general and qualitative characterization of cumulative effect. Such a discussion follows based on consideration of a few dominantly influencing factors: relative spatial containment of effect, occurrence (or at least higher probability) during specific project phases, and nature of effects management response. Generally, most events are relatively spatially limited with an expectation of rapid containment of any released substances. The more spatially and temporally limited the event, the less the likelihood of a cumulative effect.

Potential cumulative effects can be organized into localized effects - relatively brief and spatially limited to within or no further than adjacent to the PDA, or non-localized effects - of longer duration and spatially extending further out to the relevant RAAs.

The following three events result in relatively localized effects to the source of the event: fire, hazardous materials spill, and collisions. All effects would occur within or likely at most adjacent to the PDA, and would more likely occur, were they to occur at all, only during construction. Based on the Project Inclusion List, effects from the upgrade of the Lake St. Martin access road may have potential to interact cumulatively with Project fire, hazardous materials spill, and collisions during construction. The PTH 6 rehabilitation project and quarries and borrow sites are likely too distant from the PDA to result in a cumulative effect. While the most likely, if not only potential pathway, for cumulative effects with the Project is for airborne emissions, the intermittency and spatial separation of these effects, however, makes cumulative effects unlikely. In further consideration of implementation of the emergency response measures as described, the cumulative effects would be not significant.

The breach or overtopping of the outlet channels could result in effects that extend beyond the PDA. It would only occur, were it to occur at all, during flood operations. The upgrade of the Lake St. Martin access road, PTH 6 rehabilitation and nearby quarries and borrow sites could act cumulatively with a breach or overtopping of the outlet channels. The water from a breach would follow the local drainage pattern to the adjacent lake. A breach of the dikes would result in lesser effects to VCs relative to an

unmitigated flood (i.e., in the absence of the Project), since the excavated channel would contain a portion of the water. while the magnitude of dike breach or control structure failure could be high, the likelihood and resultant risks are low. With the implementation of design and construction requirements, regular inspections, and emergency response plans to address public safety concerns and mitigate damage to infrastructure and services, cumulative effects are predicted to be not significant.

11.16 CONCLUSIONS

Cumulative effects were determined for all VCs that had residual effects. The list of future projects and activities that the Project could act interact with in the RAA is short (three items) and all have small development areas. In all cases, the Project effects are the dominant contributor to the future cumulative effects and the Project effect characterizations describe the cumulative effects. The cumulative effects are mitigated with the mitigation proposed for the Project effects. As such, the Project contribution to cumulative effects is not significant for all VCs.

The Project's intent by design is a positive effect by reducing the outcomes of a major natural flood on some of the human and natural values in that region.

11.17 REFERENCES

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Manitoba

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

CHAPTER 12

FOLLOW-UP AND MONITORING PROGRAM

March 2020

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12.0 FOLLOW-UP AND MONITORING PROGRAM

12.1 OVERVIEW

This chapter describes the preliminary follow-up and monitoring program (henceforth referred to as the "program") for the Project, scoped to address the needs of the assessment of the valued components (VCs). It follows the Environmental Management Program framework described in Section 3.7. It is also developed 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 front of this EIS. Follow-up and monitoring information provided in this chapter will be described in greater detail in monitoring plans associated with the Environmental Management Program (Section 3.7).

Section 9 of the Canadian Environmental Assessment Agency (CEAA) Environmental Impact Statement (EIS) Guidelines for the Project (CEAA 2018) states that the purpose of the program is to verify the accuracy of predictions and the effectiveness of mitigation measures, and to ensure that proper measures and controls are in place in order to decrease the potential for environmental degradation during all phases of Project development.

Section 6 of the Environmental Assessment Scoping Document for the Project (Manitoba Infrastructure 2018) submitted to Manitoba Sustainable Development indicates that the purpose is to facilitate compliance with mitigation measures, confirm effect predictions related to anticipated effects to determine whether unexpected effects are occurring, and allow for adaptive management and appropriate mitigation measures if unexpected effects do occur. The Project Scoping Document states that monitoring and follow-up will focus on areas of key potential effects to VCs, and that the EIS will describe preliminary plans that will be finalized after the specific regulatory requirements are known. Finalizing the program will integrate the various relevant approval conditions (both provincial and federal) and assist in further refinement of the Project design.

The EIS Guidelines state that the program needs to incorporate mechanisms to disseminate follow-up results among the concerned populations, include Indigenous knowledge and the suggestions and concerns raised through engagement. As discussed in Chapter 5 and detailed further in Appendix 5C, MI intends on continuing to engage with Indigenous groups and individuals, the public and various stakeholders through the construction and operations phases of the Project. As results become available from the monitoring and follow up program, they will be provided to regulators, posted to the Project website and shared during any meetings or open houses. Manitoba Infrastructure will follow government procurement policies and procedure with respect to labour, and goods and services, and will explore possible monitoring and economic opportunities with Indigenous groups.

The EIS Guidelines state that the program should address the nature of potential cumulative effects. Cumulative effects are discussed in Chapter 11 and are predicted to be not significant Project contributions to cumulative effects are predicted to be low; the many Project-specific mitigation measures

and follow-up programs to address residual environmental effects identified in the EIS reduce the Project's contribution to cumulative environmental effects. As noted in Chapter 11, while Manitoba Infrastructure is responsible for mitigating and monitoring the effects of the Project, it is not responsible for monitoring impacts of future projects and activities of other proponents or the impacts of future government regulatory initiatives on regional development.

This chapter describes the preliminary program for each identified VC requiring monitoring and follow-up. It provides information on the purpose and objectives, and proposed approach for the monitoring programs. In general, the level of detail for each VC monitoring program is proportional to the nature of the VC, its anticipated effects and mitigation. The following is the list of VCs used in this EIS:

- atmospheric environment
- geology and soils
- groundwater and surface water
- fish and fish habitat
- vegetation
- wildlife
- land and resource use
- infrastructure and services
- economy
- human health
- heritage resources
- traditional land and resource use
- Indigenous health and socio-economic conditions

Based on the assessment results, some of these VCs do not require monitoring, and where appropriate, this is explained in the sections that follow.

12.2 ATMOSPHERIC ENVIRONMENT

Follow-up and monitoring are not proposed for atmospheric environment; however, in terms of acoustic environment, while not expected, monitoring may be required in the event of residential complaints related to construction noise. As such, any acoustic monitoring program will be designed on an as needed basis if and when a response to complaints is required.

12.3 GEOLOGY AND SOILS

12.3.1 Purpose and Objectives

There are no follow-up or monitoring requirements for geology because there are no residual effects identified for this subcomponent of geology and soils. However, follow-up and monitoring recommendations related to geology are identified for groundwater (Section 12.4). Project disturbance will affect terrain conditions, specifically alterations to drainage, and soil quantity and quality, resulting from soil stripping, excavation and stockpiling along the channels and at temporary Project components, including rock quarries, borrow material sites, temporary construction camps and staging areas.

12.3.2 Approach

Follow-up is required to confirm effects of drainage alterations on soils in the vicinity of the Project and to soil quality and quantity at temporary Project components whose locations are yet to be identified. Where appropriate, construction monitoring will be conducted to confirm effectiveness of mitigation in minimizing soil loss and degradation from soil handling during construction and along engineered Project structures (i.e., soil stockpiles, channel slopes) through operations. Monitoring for soils to confirm the effectiveness of mitigations applied include:

- Monitoring soil salvage during construction including soil excavation, handling and stockpiling will confirm appropriate soil salvage and maintenance of soil quantity.
- Periodic monitoring through construction of soil stockpiles will confirm adequate stabilization and erosion control.

12.4 GROUNDWATER AND SURFACE WATER

12.4.1 Purpose and Objectives

12.4.1.1 Groundwater

The effects of the Project on groundwater and domestic water wells have been noted as a concern by landowners in the area and by local Indigenous groups. A groundwater follow-up and monitoring plan will improve and validate hydrogeological interpretations and monitor the effects of dewatering operations on groundwater in the groundwater LAA. The objective of the groundwater follow-up and monitoring program is to determine whether there are changes to the volume and accessibility or quality of the groundwater in the groundwater LAA as a result of construction or operations and update and implement mitigation measures and responses accordingly.

The residual effects during construction and operation of the Project include a change in local groundwater flow due to dewatering operations, and a change in groundwater–surface water interaction due to surficial drainage diversion and bedrock aquifer depressurization. The change in local groundwater elevations will potentially affect domestic water wells and cattle watering wells along the LMOC by

reducing the hydrostatic head at their locations. The scale of effect at any given well is currently unknown, but the analytical approach was used to estimate general effect. The scale of effect will vary with local geology, which is normally assumed between existing boreholes. The monitoring and analysis program will provide information to better predict and quantify potential effects and confirm which locations of the groundwater LAA should be further monitored during aquifer depressurization. Domestic water wells, because of their purpose, will be monitored for their quality.

The change in groundwater–surface water interactions is at two levels: surficial hydrogeology and bedrock hydrogeology:

- For the first level, the Project will divert surficial drainage (surficial hydrogeology) that would normally flow towards surrounding wetlands by altering current flow conditions along the entire length of both outlet channels.
- The second level consists of altering the artesian pressure (bedrock hydrogeology) by dewatering operations along both main Project components. Once excavated, the overburden may be too thin to counteract artesian pressure, which could lead to potential blow-out. Dewatering will consist of depressurization that could affect the upward flow toward wetlands as well as flow to springs (at a discrete section along LSMOC).

Field investigations and monitoring will provide further information on geological stratigraphy and hydrogeological parameters to further quantify potential effects due to depressurization. As discussed in Section 3.7, a groundwater monitoring plan will be developed incorporating:

- further investigation into groundwater in the LSMOC area
- further aquifer investigation and modelling to determine effect of construction dewatering on specific domestic water wells in the potentially affected LMOC area
- analyses of effects of dewatering, and then communications with the local well users that may be affected (developing mitigation plans will involve working with affected well users)
- additional observation wells installed prior to construction dewatering to monitor effects in the area during dewatering of each section during construction
- mitigation plans modified if/as required during dewatering as specific information is received from observation wells and local well users

12.4.1.2 Surface Water Hydrology

The changes in flows and water levels caused by the Project may have minor effects on fluvial geomorphology, sediment and debris transport, and ice processes in the surface water LAA, but primarily during and immediately after construction. Suspended sediment levels may temporarily increase at work sites during construction activities, and at outlet areas during initial operation (gates open) of the outlet channels after a period of non-operation (gates closed). Local drainage areas and drainage patterns will be unavoidably altered in the areas where the Project will be located, which may affect surface water and groundwater interactions, and wetland hydrology. As such, the purpose and objectives of follow-up

activities will be to monitor and further understand the residual effects on surface water hydrology due to the Project.

A Surface Water Monitoring Plan will be developed on monitoring local drainage and hydrology and methods to establish aspects such as temporary diversions and snow accumulations (see Section 3.7). The Project EMP (Section 3.7) also includes sediment, debris, and ice management plans. For the LMOC, monitoring will be developed in consultation with RM of Grahamdale and local residents. Hydrologic monitoring (water levels and flows) will be required as a key input to operation of the Project.

Once the Project is constructed and in operation infrastructure will be operated in accordance with the Operating Guidelines (Chapter 3, Appendix 3D), which includes considerations for maintaining flow levels, and ice management. The residual effects of the operation of the Project on regional flows and lake levels include a reduction in peak flood levels, reduced flood inundation areas, and an increase in the amount of time that Lake Manitoba and Lake St. Martin are within the regulated range. These effects are a desired positive outcome and objective of the Project and, therefore, there are no mitigation or follow-up activities required.

12.4.1.3 Surface Water Quality

Adverse changes to overall surface water quality are not predicted in the regional or local area waterways, as the composition and volume of water being transported from Lake Manitoba to Sturgeon Bay is not altered by Project construction or operation as all flows from the Lake Manitoba basin will enter Sturgeon Bay with or without the Project. As noted above, temporary increases in suspended sediments may occur in local waterways due to construction activities, or at the channel outlet areas during periods of initial outlet channel operation (gates open).

Manitoba Infrastructure is developing an Aquatic Effects Monitoring Plan (AEMP) for the Project, which will include continued collection of surface water samples from regional and local waterways, and analyses of a suite of parameters to provide information on surface water quality in the Project area during Project construction, operation and maintenance activities. The purpose and objective of surface water quality monitoring will be to document existing surface water quality conditions prior to the commencement of clearing or construction of the proposed outlet channels and provide ongoing monitoring of watercourses and waterbodies in the Project area during Project construction, operation or maintenance activities.

12.4.2 Approach

12.4.2.1 Groundwater

To monitor for potential effects to groundwater, monitoring of water levels will occur during construction and operation at observation wells that will be located between the Project and well users. Water quality data will include water levels and a broad suite of analytical parameters for water quality and human health.

Further investigation into groundwater in the LSMOC area will be carried out prior to construction. Boreholes will be drilled at strategic locations, in relation with wetlands and springs, so the final coverage will be relatively uniform along the PDA and within the groundwater LAA. Observation water wells will be established, so groundwater samples can be taken, water levels and artesian flow can be measured, and instrumentation can be installed if required. A series of observation wells has been established in order to obtain baseline water quality readings and to allow monitoring both during and after construction. Post-construction monitoring will occur to determine if there are any long-term effects on groundwater within the regional of the LSMOC.

12.4.2.2 Surface Water Hydrology

Operation of the LMOC and LSMOC is dependent upon the existing level monitoring network on Lake Manitoba and Lake St. Martin. As described in Section 3.7, the Environmental Management Program will include the development of a Surface Water Management Plan (SWMP), Sediment Management Plan (SMP), and Debris Management Plan (DMP). The SWMP will describe measures and methods to monitor changes in local drainage and flows, during construction dewatering. The SMP will describe measures to monitoring total suspended solids (TSS) inputs into the waterway that may occur as a result of in-channel and construction shoreline erosion, and commissioning of the Lake Manitoba and Lake St. Martin Outlet Channels. If necessary, a stand-alone DMP would be developed that would include methods to monitor any material entering, within or exiting the LMBOC and LSMOC, including floating or submerged (e.g., driftwood, plants), suspended sediment or bed load moved by flowing water.

12.4.2.3 Surface Water Quality

An Aquatic Effects Monitoring Plan (AEMP) will be developed that will include a surface water quality monitoring component. Surface water quality monitoring will be conducted to document existing surface water quality conditions prior to the commencement of clearing or construction of the proposed outlet channels. The monitoring will also provide ongoing data on watercourses and waterbodies in the Project area during the Project construction, operation or maintenance activities. The data and analyses generated by monitoring will be used to provide information on the effectiveness of mitigation measures, aid in the validation of predicted residual effects, and provide data and results required for environmental licensing requirements.

Sampling locations and sampling frequency will be determined prior to commencement of Project construction activities. The key parameters expected to be examined include *in situ* “routine” field parameters, nutrients, and metals and major ions for which there are Manitoba Water Quality Standards, Objectives and Guidelines (MWQSOGs) for the protection of aquatic life (PAL), Canadian Council of Ministers of the Environment (CCME) guidelines for the protection of freshwater aquatic life, or MWQSOGs or Health Canada guidelines for drinking water. Decision thresholds will be developed as part of the monitoring plan and may utilize regulated criteria, input from stakeholders, and consideration of findings from applicable Management Plans.

12.5 FISH AND FISH HABITAT

12.5.1 Purpose and Objectives

A monitoring program for fish and fish habitat will be implemented as part of the Environmental Management Program (EMP), as described in Chapter 3.7. As indicated, the EMP will include an AEMP. In addition to water quality (as described in Section 12.4.2.3), the AEMP will monitor for the potential effects to fish and fish habitat as described in the EIS, with the following objectives:

- *monitor the effectiveness of key mitigation measures, and accuracy of the assessment*
- *identify any unexpected effects of the Project to the aquatic environment and the need for additional mitigation or remedial actions*
- *confirm compliance with the regulatory requirements and authorizations for the Project*

The intent of the AEMP will be to monitor the measurable parameters identified in Section 7.2.4.1 for each potential pathway of effect with the greatest likelihood of occurrence and/or greatest potential consequence to fish and fish habitat.

12.5.2 Approach

Monitoring will focus on the primary effects on key components of fish and fish habitat, rather than addressing all potential changes. In addition to the components discussed in Section 12.4.2.2 and 12.4.2.3, components monitored as part of the AEMP will likely include the quality and quantity of fish habitat compared to baseline conditions, and abundance and distribution of focal fish populations relative to the Project, as discussed in Section 7.2.4.1.

Monitoring of the aquatic environment during construction will be part of the Construction Environmental Management Plan (CEMP) developed for the Project as part of the Environmental Management Program (EMP; see Section 3.7). Prior to construction, additional fish and fish habitat information will be collected to provide a better understanding of baseline conditions for comparison of monitoring results during the construction and operational phases. In addition to winter dissolved oxygen levels, monitoring will likely include fish movement, fish-bearing status and fish community composition in targeted locations, including in the channels. Project construction will require a *Fisheries Act* Authorization, which will include several details specific to final design for the Project. Monitoring during construction will primarily focus on criteria or details included in the future *Fisheries Act* Authorization.

Monitoring of the aquatic environment during operations will be part of the EMP (see Section 3.7). The duration of operations monitoring will be determined during consultations with MSD, DFO, and local stakeholders. During the gates closed condition, the no-flow condition monitoring of the aquatic environment will include summer and winter conditions (e.g., dissolved oxygen) in the LMOC upstream and downstream of the water control structure and in the pools located upstream of the drop-structures in the LSMOC, and fish use of the outlet channels. During the gates open condition, water flowing conditions will be determined during consultations with MSD, DFO, and local stakeholders monitoring of

the aquatic environment will include enumeration of spawning runs in targeted locations, including fish moving upstream in the channels, egg deposition and larval drift in the channels; and flow monitoring in the channels during implementation of ramping rates.

12.6 VEGETATION

12.6.1 Purpose and Objectives

A monitoring plan for vegetation will be implemented as one of the plans associated with the Environmental Management Program (EMP), as described in Section 3.7. The EMP will prescribe measures and practices to avoid and reduce adverse environmental effects on vegetation. The EMP will include a Vegetation Monitoring Plan (VMP) that will provide detailed methods on how predicted changes to vegetation species diversity, wetlands will be verified and how the effectiveness of mitigation strategies (e.g., revegetation) will be evaluated. The VMP will also identify reporting commitments and schedule(s).

12.6.2 Approach

The VMP will provide details on the design, methods, and schedule for the programs. Additional pre-construction surveys will be completed for species of conservation concern (SOCC) and wetlands. Revegetation will be assessed shortly after construction and for several years following construction. Proposed survey methods will be discussed with Manitoba Sustainable Development in advance of field survey.

Species of conservation concern SOCC surveys will involve collecting additional pre-construction data to inform mitigation and determine whether unexpected effects may occur. SOCC surveys will focus on areas of low sampling density including patches of remnant native vegetation along the LMOC, and areas of higher rare plant potential along the LSMOC PDA (e.g., transition areas from wetland to upland and areas of shallow bedrock).

Wetland mapping of the LMOC PDA will be evaluated to identify all potentially affected wetlands. Wetland compensation may include wetland creation, and wetland enhancement or restoration. Effectiveness of wetland compensation will be conducted as part of post-construction revegetation monitoring.

Shortly after construction, monitoring will be focused on assessing the rate of establishment of a healthy vegetation cover, and the quick recognition and mitigation of soil erosion. To avoid growth and establishment of regulated weeds, topsoil and subsoil piles will be monitored for weed growth during construction and corrective measures (e.g., spraying, mowing, hand-pulling) will be implemented where necessary. Areas of poor vegetation growth will also be identified for additional seeding.

12.7 WILDLIFE

12.7.1 Purpose and Objectives

The wildlife assessment identifies changes to habitat availability and potential changes in mortality risk and movement during the construction and operation of the Project. A monitoring program for wildlife will be implemented as part of the Environmental Management Program (EMP), as described in Chapter 3.7. 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 detailed methods on how predicted changes to wildlife habitat availability and wildlife mortality risk and movement will be verified and how the effectiveness of mitigation strategies will be evaluated. The WMP will also identify reporting commitments and schedule(s).

12.7.2 Approach

The WMP will provide details on methods, and schedule for all mammal, bird, and amphibian survey and monitoring programs. SAR monitoring will focus primarily on ground-based point count surveys for species most likely to be affected by the Project: red-headed woodpecker, and eastern whip-poorwill. Pre-construction surveys will focus on identifying occupied habitats within the PDA and wildlife LAA to aid in species-specific mitigation efforts during construction. Surveys during the construction and post-construction phases will focus on previously occupied habitats (i.e., from pre-construction surveys) to assess the effectiveness of mitigation measures and reclamation and/or restoration efforts.

For mammals, monitoring may involve a continuation of the remote camera study to capture presence/absence and movement data for wide-ranging large bodied species and/or predators. Additional monitoring for birds may also include surveys to assess potential Project effects to other sensitive habitats within the wildlife LAA.

The WMP will include the development of a Red-headed Woodpecker and/or Eastern Whip-poor-will Mitigation and Offset Plan to mitigate a change in habitat for SAR whose critical habitat may be affected by the Project. Components of the plan regarding follow-up and monitoring may include, but are not limited to:

- 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, including monitoring of the effectiveness of offsets, restoration efforts, and/or land parcels set aside for SAR

General compliance monitoring during Project construction for sensitive wildlife features and habitats will be undertaken as part of the EMP. Decision thresholds will be developed as part of the monitoring plan and may utilize regulated criteria, input from stakeholders, and consideration of findings from applicable management plans.

12.8 LAND AND RESOURCE USE

12.8.1 Purpose and Objectives

Land and resource use activities within the land and resource use RAA are the subject of ongoing planning, management, regulatory enforcement and monitoring by the federal, provincial and municipal governments. This includes monitoring and the collection of information on, for example, municipal land use, hunting and angling activity and development for the purpose of licensing, enforcement and resource management. Manitoba Infrastructure has provided and will continue to provide Project information to relevant agencies and organizations as required and requested.

12.8.2 Approach

Monitoring required for land and resource use includes compliance monitoring to confirm that manure stockpiles have been effectively located off the right-of-way prior to construction. In addition, monitoring agricultural biosecurity during construction activities will be carried out to confirm that mitigation measures are effectively implemented.

12.9 INFRASTRUCTURE AND SERVICES

No follow-up monitoring plans for effects on infrastructure and services have been identified.

12.10 ECONOMY

No follow-up monitoring plans for economic effects have been identified.

12.11 HUMAN HEALTH

Monitoring for human health is typically based on the outputs of physical environment monitoring, such as air and water quality. No air quality monitoring is currently envisioned, so examination of results from a health perspective will be based on groundwater monitoring (Section 12.4.2.1) and surface water monitoring (Section 12.4.2.3). If results indicate that applicable quality standards are exceeded, a human health risk assessment may be necessary to determine whether the noted changes represent a potential human health risk. A key aspect of the process is the efficient communication with those potentially exposed to human health risks.

12.11.1 Purpose and Objectives

Development of monitoring plans is ongoing and incorporates outputs from engagement/consultation and regulatory review process. The plans will include rationale and justification, and efficient protocols for communicating results of physical environment monitoring, particularly if they appear to result in a concern to human health and the need for a risk assessment. Manitoba Infrastructure anticipates that follow-up and monitoring developed for aquatic and terrestrial programs will also serve to confirm predictions regarding effects to the resources necessary for Indigenous and Treaty rights. Similarly, follow-up and monitoring programs for atmospheric environment (air, noise), human health, and socioeconomics will also serve to confirm predictions regarding effects to the conditions that support the exercise of Indigenous and Treaty rights.

12.11.2 Approach

Ongoing engagement through Project construction/operation will be used to share results of VC monitoring/follow-up and pathways to Indigenous peoples and potential impacts to Aboriginal or Treaty rights. Manitoba Infrastructure is committed to ongoing engagement with Indigenous groups as outlined in the Indigenous Consultation Approach and Current Status document in Appendix 5C. Further information regarding efforts to engage with Indigenous groups to verify the applicability of proposed follow-up and monitoring programs with respect to potential effects to Indigenous peoples and impacts to Aboriginal or Treaty rights are described there.

12.12 HERITAGE RESOURCES

12.12.1 Purpose and Objectives

Monitoring heritage resources is important prior to and during construction to identify and recover any artifacts unearthed, record the site context, and make decisions as to how to manage them if they are at risk. Manitoba Infrastructure and its construction contractors will abide by requirements issued by the provincial regulator for site avoidance, excavation or heritage resource monitoring.

12.12.2 Approach

A Heritage Resources evaluation will include a pre-construction Heritage Resources Impact assessment (HRIA). The pre-construction HRIA will be carried out under a valid permit from the Historical Resource Branch (HRB) and will use predictive modelling to identify locations of high heritage potential and then examination and testing of those locations for heritage resources. If heritages resources are discovered at any of those locations, assessment by systematic testing will determine whether the resources are intact or disturbed. Intact resources, if required by HRB, will be mitigated through scientific salvage excavation. A confidential HRIA report will be filed with the Province, as required by the archaeological investigation permit. The report will detail cultural and ecological background, methods, results, and recommendations for further study, if any.

Construction monitoring of areas of high heritage resource potential (if any) will be carried out based on the results of the HRIA will be conducted at the request of HRB. Construction monitoring involves the on-site presence of an archaeologist to map, collect and assess heritage resources exposed by construction activities, as required. During construction, any inadvertent discoveries of heritage resources will be reported to provincial authorities, as required under provincial heritage legislation. A baseline photographic survey will be is used as a comparative model to periodically check the cemetery as part of a follow up and monitoring program.

12.13 TRADITIONAL LAND AND RESOURCE USE

Monitoring requirements specific to traditional land and resource use (TLRU) have not yet been identified. The current planned approach will be to share the results of other relevant monitoring (fisheries, wildlife, etc.) with communities as part of the ongoing engagement process (see Section 5.3.5 and Appendix 5C). This will also be used to share and discuss the effects of the Project, efficacy of proposed mitigation, and acceptability of proposed monitoring. If any need for follow-up and monitoring related to TLRU is identified, Manitoba Infrastructure will discuss this with Indigenous groups.

12.14 INDIGENOUS HEALTH AND SOCIO-ECONOMIC CONDITIONS

As with TLRU, the current approach to monitoring for Indigenous Health and Socio-economic Conditions will be based on sharing the results of other relevant monitoring with communities as part of the ongoing engagement process (see Section 5.3.5). This will also be used to share and discuss the effects of the Project and efficacy of proposed mitigation. If any need for monitoring related to indigenous health and socio-economic conditions is identified through the future engagement process outlined in Appendix 5C, Manitoba Infrastructure will discuss this with Indigenous groups.

12.15 ABORIGINAL AND TREATY RIGHTS

As with other issues important to Indigenous peoples and communities, the current approach to monitoring regarding Aboriginal and Treaty Rights will be based on sharing information with communities, developing TLRU studies, and sharing the results of other relevant monitoring with communities as part of the ongoing engagement process (see Section 5.3.5 and Appendix 5C). This will also be used to share and discuss the anticipated effects of the Project and efficacy of proposed mitigation. If any issues regarding Aboriginal and Treaty Rights arise, Manitoba Infrastructure will discuss this with Indigenous groups.

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

CHAPTER 13

PROJECT SUSTAINABILITY

March 2020

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13.0 PROJECT SUSTAINABILITY

13.1 OVERVIEW OF CHAPTER

As described in Chapter 1 (Section 1.2.2) sustainability is embedded in the Mission Statement guiding the operation of Manitoba Infrastructure, which is to “ensure safe, reliable and sustainable infrastructure and service for Manitoba and its communities.” Manitoba Infrastructure has applied the principles and guidelines of sustainable development through the planning, design and environmental assessment of the Project. This chapter demonstrates the broad application of the principles of sustainable development.

The Canadian Environmental Assessment Agency (The Agency) Environmental Impact Statement (EIS) Guidelines for the Project (CEA Agency 2018) require the EIS to discuss the extent to which the proposed Project contributes to sustainability (Part 1 - Section 3.2). Section 7 of The Environmental Assessment Scoping Document for the Project (Manitoba Infrastructure 2018) submitted to Manitoba Sustainable Development indicates that the EIS will contain information on the principles and guidelines of sustainable development and a Project sustainability assessment.

This chapter provides information showing the alignment of the Project with the federal and provincial principles and guidelines of sustainable development. The term was popularized in the 1987 World Commission on Environment and Development report entitled “Our Common Future,” more commonly known as the Bruntland Commission report, and is generally defined as follows: "sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”

Sustainable development concepts are of relevance to most major developmental and planning decisions in that they integrate social, environmental and economic considerations into decision-making, and there is a strong relationship with the environmental assessment process. The information gathered and developed in an environmental assessment can be used to inform a determination about the Project in terms of its consistency with the broader sustainable development concepts relating to environmental, economic and social considerations. This chapter provides information showing the commitment of Manitoba Infrastructure to, and alignment of the Project with, the federal and provincial environmental sustainability priorities, goals and policies.

13.2 REGULATORY CONTEXT

The concept of sustainable development has been instituted as policy for both the federal and provincial governments for future development in Canada and Manitoba, respectively. The Government of Canada has embedded the goal of achieving sustainable development into the “Purposes” section 4 (1)(h) of the *Canadian Environmental Assessment Act 2012* “to encourage federal authorities to take actions that promote sustainable development in order to achieve or maintain a healthy environment and a healthy economy.” The Government of Manitoba has similarly embedded sustainable development concepts into legislation. *The Environment Act* (Intent and Purposes section 1(1)) lists its intent as being “to develop

and maintain an environmental protection and management system in Manitoba which will ensure that the environment is protected and maintained in such a manner as to sustain a high quality of life, including social and economic development, recreation and leisure for this and future generations."

In addition to being embedded in environmental assessment legislation, both orders of government have developed legislation specifically to address sustainable development. The 2008 *Federal Sustainable Development Act* provides the legal framework for the Federal Sustainable Development Strategy and like the Bruntland report, section 2, defines sustainable development as **"**development that meets the needs of the present without compromising the ability of future generations to meet their own needs." It requires the Minister of Environment and Climate Change to table a new Strategy every three years to both improve the Strategy and to reflect new priorities. It sets out various environmental sustainability priorities, establishes goals and targets, and identifies actions to achieve them. It includes the following environmental indicators:

- Air refers to air quality, air pollutant emissions, harmful substances, impacts to human health caused by pollution.
- Climate refers to climate change, greenhouse gas emissions.
- Water refers to water quality and quantity, pressures on water quality, regional ecosystems.
- Nature refers to biodiversity, habitat, ecosystem health, biological resources.
- Human influence refers to pollution and waste, natural resource protection and use, human health and the environment.

The Manitoba government has made commitments to follow sustainable development principles incorporated in the *Climate and Green Plan Act* (2018), which was used to generate a framework for sustainable development in Manitoba. Similar to the federal act, it requires the Minister of Sustainable Development to develop a plan with a comprehensive framework of programs, policies and measures to reduce greenhouse gas emissions and address the effects of climate change, promote sustainable development, improve the management and protection of Manitoba's water resources, and preserve and protect Manitoba's natural habitat and biodiversity. The plan has four pillars represented by 16 keystones as follows:

- Climate includes clean energy, sector emissions reductions, carbon pricing, adaptation.
- Jobs incudes innovation and cleantech, skills and training, financing and investment, green infrastructure.
- Water includes agriculture and land use, flood and drought, wetlands and watersheds, water quality.
- Nature includes parks and protected areas, forest and natural areas, wild species and habitat, conservation.

Manitoba Infrastructure also applied the principles and guidelines of sustainable development through the planning, design and environmental assessment of the Project. This included consideration of the Impact Assessment Agency of Canada's 2019 Interim Framework: Implementation of the Sustainability Guidance lists the following sustainability principles:

- Consider the interconnectedness and interdependence of human-ecological systems
- Consider the well-being of present and future generations
- Maximize overall positive benefits and minimize adverse effects of the designated project
- Apply the precautionary principle and consider uncertainty and risk of irreversible harm

Although this guidance was developed for the *Impact Assessment Act* of 2019 and postdates CEAA 2012, under which the Project is being assessed, MI's EIS applied these principles and the *Manitoba Climate and Green Plan Act* pillars when planning the Project and assessing alternatives. As stated in Chapter 2 of this EIS, Project Justification and Alternatives Considered, minimizing adverse effects and maximizing positive effects on the biophysical and social environment were considered when comparing alternatives. The interconnectedness and interdependence between surface water quality, flooding, erosion and fish resources were considered; interactions between vegetation, wildlife and fish habitat and fish resources were considered; and effects on land use and ownership, and access were considered. Table 13.2-1, from KGS Group (2016, p708) compares environmental concerns for the alternative options. The environmental concerns were considered with geotechnical and cost comparisons in the selection of the preferred channels.

Table 13.2-1 Summary of Environmental Concerns

Criteria	Lake Manitoba Outlet Channels						Lake St. Martin Outlet Channels			
	A	B	C	D	E	F	R1	R2	R3JB	R3WP
Biophysical Environment										
Surface Water Quality										
• Flow Rate	6[1]	6	6	6	8	7	9	9	9	9
• Flooding	7	9	9	8	6	7	8	9	9	9
• Erosion/Sedimentation	4	7	7	5	8	1	6	8	5	4
Groundwater	6	6	5	7	8	8	8	8	8	8
Terrestrial Environment										
• Vegetation	7	7	8	6	9	7	9	8	8	7
• Wildlife/Habitat	7	7	8	6	9	7	8	7	7	6
Fish Habitat	6	8	8	7	6	2	6	8	7	7
Fish Resources										
• Habitat Change	5	8	8	7	4	6	8	9	7	7
• Species Composition	5	8	8	7	4	6	5	8	6	6
Subtotal	53	66	67	59	62	51	67	74	66	63

Table 13.2-1 Summary of Environmental Concerns

Criteria	Lake Manitoba Outlet Channels						Lake St. Martin Outlet Channels			
	A	B	C	D	E	F	R1	R2	R3JB	R3WP
Social Environment										
Land Use/Ownership	2	9	9	8	3	2	8	9	5	7
Access	5	8	7	5	9	8	7	6	6	6
First Nation Litigation[2]	1	8	8	8	1	1	8	8	7	8
Subtotal	8	25	24	21	13	11	23	23	18	21
TOTAL	61	91	91	80	75	62	90	97	84	84

NOTES:
[1] Ranking numbers range from 1 (largest effects) to 10 (smallest effects)
[2] Refers to unresolved litigation affecting the channel option route

13.3 PROJECT CONTRIBUTION TO SUSTAINABILITY

13.3.1 Overview

The purpose of the Project is to develop a permanent flood control management system for Lake Manitoba and Lake St. Martin for alleviating flooding in the Lake St. Martin region. It addresses the widespread flooding that has occurred historically that has affected Indigenous communities as well as landowners, cottagers and many other communities in the region. Effects from this flooding have included damaged property, and in some cases displacement and evacuation from the community for several years.

As described in Chapter 2, the proposed Project was selected for development from a variety of other flood protection options, and the selection of the Project was based on balancing economic, environmental and social factors, and incorporating input from locally affected landowners and Indigenous groups. The Project is being proposed to avoid catastrophic social and economic losses, human health effects and social stress resulting from effects of extreme flood events, while minimizing environmental effects.

13.3.2 Application of the Principles of Sustainable Development

This section demonstrates the broad application of the principles of sustainable development to the Project, including reference to the federal indicators and provincial pillars, and the locations in the EIS where these issues are addressed.

13.3.2.1 Air Quality and Climate

The Project environmental assessment includes an examination of air quality, including harmful substances and potential air pollutant and greenhouse gas emissions (Section 6.2), climate change (Section 6.2 and 15.5), and an assessment of effects to human health (Section 9.5). Mitigation measures

are presented in these sections to reduce emissions and effects to human health and contributions to climate change, as well as addressing some of the effects of climate change. Specific examples of how the Project design addresses air quality and climate change issues includes the following:

- While the construction phase will result in increases in air emissions, these will be local and short-term, and measures will be taken to reduce vehicle emissions (e.g., reducing idling, compliance with emission standards).
- As described in Section 3.7, a set of Project Environmental requirements has been developed that includes measures to reduce vehicle and equipment emissions.
- Where possible, source excavated material including composite materials to build banks and berms will be reused. This will reduce the need for new material as well as reduce the haul distance to the construction site, thus reducing greenhouse gas emissions.
- The Environmental Management Program (Section 3.7) includes the development of a Dust Control Plan to address the products used and methods of application, and trucks hauling dusty materials will be required to use a tarpaulin to minimize dust issues.
- The operation of the channel will involve opening and closing of the Water Control Structures primarily powered by hydroelectric power, requiring low or negligible GHG impacts.
- In terms of global impacts, the Project will have very low or negligible impacts to the environment. While it cannot reduce the occurrences of extreme events due to climate change, it will improve the resilience of the region to flooding, as well as reducing in the impacts on the environment, economy, and human health and social well-being of the region by moderating flood levels.

13.3.2.2 Water

The Project includes an examination of existing land use and resource use, including agriculture (Section 9.1), wetlands (Section 8.1) and regional ecosystems (Chapter 7 for fish, and Sections 8.2 and 8.3 for vegetation and wildlife). Watersheds and water quantity and quality are assessed (Section 6.4), and all these sections include an assessment of potential effects of the Project, and measures to address and mitigate adverse effects. The primary purpose of the Project is to adverse effects of flooding on people and sustain current land use and resources. As described in Section 3.7, the Environmental Management Plan will include the development of a Groundwater Management Plan, Surface Water Management Plan, and Sediment Management Plan to address a broad variety of water-related issues, and the Project will include the development of an Aquatic Effects Monitoring Plan that includes water quality and quantity monitoring. Specific examples of how the Project design addresses water-related issues include the following:

- The inlets are designed such that change to the morphology of the natural and constructed shoreline is minimized and/or prevented, and excavation is done in a manner where suspension and transport of lake bed sediments is minimized and/or prevented (e.g., limiting excavations to the minimum areas required to efficiently convey water into and out of the channels).
- A portion of the existing Reach 3 of the EOC will be repurposed to reduce additional disturbance.

- Mitigation measures will be incorporated, such as water control structures and drop structures that facilitate safe downstream fish passage.
- Fish stranding will be prevented and, where feasible, measures will be implemented to provide fish habitat.
- Appropriate setbacks from work areas and waterbodies will be provided, or a buffer zone of undisturbed vegetation will be established between a work area and a waterbody to minimize erosion and sedimentation issues.
- Erosion protection will be incorporated through channel design and use of specific materials, including use of rock for armoring sites vulnerable to erosion.
- Follow-up measures will be taken if adverse effects impacting sustainability are observed, and adaptive measures will be explored, where and when possible, to minimize or eliminate this occurrence.

13.3.2.3 Nature

This environmental assessment evaluates Project-related effects on fish and fish habitat (Chapter 7), vegetation (Section 8.2) and wildlife (Section 8.3). It also describes the efforts that have been made to retain ecosystem health and reduce or avoid effects to biological resources through routing, prescriptive mitigation measures to minimize construction effects (see Section 3.7), and a commitment to developing habitat compensation to offset or otherwise mitigate effects to critical habitat. In addition, routing has avoided parks and protected areas. Specific examples of how the Project design addresses nature-related issues includes the following:

- All construction activities will be restricted to the PDA by locating temporary staging areas in the right-of-way wherever feasible and leaving some vegetation in place to promote recovery of native vegetation.
- Exclusionary flagging or fencing will be installed, as appropriate, around sensitive sites (e.g., roosts, stick nests, hibernacula) or sensitive habitats prior to clearing and construction, and features will be evaluated for additional mitigation measures (e.g., setbacks).
- Activities, such as clearing and in-water works, will be conducted outside of restricted activity periods and other sensitive periods, wherever feasible, to reduce or avoid impacts on vegetation, wildlife, fish and other environmental receptors.
- The channels will be designed for minimizing the use of rip-rap and minimizing side slopes, to the extent feasible, to facilitate wildlife movement and lessen affects on fish and fish habitat.
- Planting of native vegetation along the side slopes of the channels will provide erosion protection and wildlife habitat.
- Where possible, excavated material, including composite materials, will be reused to build banks and berms.
- Construction sites will be rehabilitated when they are no longer required.

- Employees, workers and other staff will not hunt, trap or harass wildlife.
- 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.
- Wherever feasible, disturbed areas will be revegetated with native plant species, and regeneration of vegetation will be monitored, to limit erosion, potential weed establishment and nutrient inputs.
- Monitoring efforts will be initiated by multiple environmental disciplines to confirm the effectiveness of the function of the Project, and its components, as they relate to environmental designs and mitigation measures. If adverse effects impacting sustainability are observed, adaptive measures will be explored where and when possible to minimize or eliminate this occurrence

13.3.2.4 Jobs and Human Influence

The Project has received financing and investment from both the provincial and federal government and will provide skills and training opportunities for the construction workforce, as well as economic opportunities for local businesses. Economic impacts are assessed in the EIS (Section 9.4). The assessment includes examining potential effects to various aspects of the human environment, including land and resource use (Section 9.2), infrastructure and services (Section 9.3), the economy (Section 9.4), human health (Section 9.5) and heritage resources (Section 9.6). Chapter 5 describes the important role and influence that engagement has had in the Project to reduce or avoid effects to people and natural resources. Measures have been developed in the above-referenced sections to manage and mitigate effects from pollution and waste, including the development of monitoring and follow-up plans (Chapter 12) and a structured environmental protection program (summarized in Section 3.7). Particular attention has been given to Indigenous peoples, including incorporating their local and traditional knowledge (Section 5.3), and assessing effects to traditional land and resource use (Section 10.2), health and socio-economic effects (Section 10.3), and Aboriginal and Treaty rights (Section 10.4). Specific examples of how the Project design addresses human-related issues includes the following:

- The Project itself will result in fewer effects to humans due to flood moderation and the need to have greater levels of human intervention in the future in response to flood events.
- Mitigation measures have been developed to minimize or avoid negative effects caused by the development and operation of the Project. These mitigation measures will include incorporating best management practices, design innovations, and compliance with regulatory requirements.
- Where appropriate, source excavated material including composite materials to build banks and berms will be reused, to reduce the need for new material as well as reduce the haul distance to the construction site.
- The use and inclusion of a portion of Reach 3 of the EOC takes advantage of existing infrastructure and reduces additional excavation requirements.
- During construction, contractors will make environmentally responsible decisions to implement proper waste management processes. Waste will be deposited in accordance with provincial legislation and guidelines. Waste materials will be transported to local waste and recycling facilities.

- Where possible and appropriate, construction material and equipment will be reused, repurposed, or recycled.
- Through avoidance of the social and economic consequences of flooding, the Project will provide direct economic and social benefits for current generations and many generations in the future. These benefits are expected to provide indirect human health benefits.
- An engagement program (see Chapter 5) has been implemented to communicate and review comments with the public, regulators, First Nations, Metis and stakeholders in the region. Concerns and comments from the engagement process have been assessed and considered for response, action, and inclusion into the planning process of the Project. Continuous access will be provided to updated information throughout the Project planning and design phase, and through a publicly accessible website.

13.4 SUMMARY

One of the most relevant keystones of the Project is water management to address flooding and land use. The Project also addresses air quality and climate and improving the resiliency of the region to deal with extreme events. Through the environmental assessment process, the Project addresses sustainability themes around nature, including wild species and habitat, biological resources and conservation. Finally, it addresses jobs and human influence, through addressing human health and providing opportunities for the development of skills and training and benefits to the local economy.

Through all phases of the Project, the Manitoba Government will continue engagement with the public, stakeholders, and indigenous communities, to assess and, where necessary, address concerns. Manitoba Infrastructure has demonstrated through the environmental assessment process that, with the implementation of the mitigation measures, no significant residual effects to the environment will be observed. Monitoring and follow up programs will be developed and implemented during the construction and operational phases to verify the accuracy of the predicted effects and address any unacceptable effects with appropriate mitigation. The Project itself is essentially action today to provide benefit for many generations into the future.

13.5 REFERENCES

Canadian Environmental Assessment Agency. 2018. Guidelines for the preparation of an environmental impact statement, Lake Manitoba and Lake St. Martin Outlet Channels Project proposed by Manitoba Infrastructure. Version 1: May 15, 2018.

Manitoba Infrastructure. 2018. Lake Manitoba and Lake St. Martin Outlet Channels Project Environmental Assessment Scoping Document. Prepared for Environmental Approvals Branch Manitoba Sustainable Development. March 2018.

KGS Group. 2016. Assiniboine River & Lake Manitoba Basins Flood Mitigation Study Final Report. Prepared for Manitoba Infrastructure.

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CHAPTER 14

ACCIDENTS AND MALFUNCTIONS

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14.0 ACCIDENTS AND MALFUNCTIONS

14.1 OVERVIEW OF CHAPTER

This chapter documents the analysis of the risks of accidents and malfunctions for the Project, including their potential effects and preliminary emergency response measures. The Agency EIS Guidelines (CEAA 2018) state in Section 7.6.1 the requirement to identify the probability of potential accidents and malfunctions related to the Project, including an explanation of how those events were identified, potential consequences, the plausible worst-case scenarios and the effects of these scenarios. In the Scoping Document (Manitoba Infrastructure 2018) submitted to Manitoba Sustainable Development's Environmental Approvals Branch, Section 5.6 states that Project-related accidents and malfunctions relative to VCs will be considered and described in the EIS, including accidental spills or releases of hazardous products during construction, and structural failure of channels and associated structures during and after operation. Based on professional judgment, experience with similar projects, and, in consideration of comments provided by agencies, Indigenous groups and the public, the following accidents and malfunctions scenarios have the potential to occur because of the Project or during Project activities:

- breach or overtopping of channel dikes, and/or failure of control structures
- spill of hazardous materials
- fire
- collisions of vehicles with other vehicles, people or wildlife

These scenarios are each based on a single fundamental causal action that initiates a sequence of events. As such, each scenario is intrinsically a "worst-case" event reflective of that fundamental action.

Regarding probabilities, while each scenario is "plausible" (in the sense that at least one occurrence is considered theoretically possible over the life of the Project), the statistical likelihood of any such event is considered low (a basic premise of any scenario) and, given the unpredictable nature of such events due to a series of complex circumstances, is not amenable to quantification with any useful or meaningful degree of accuracy.

The assessment considers all seasons of the year and addresses site-specific sensitivities and potential pathways of effects. It also describes the safeguards that have been established to prevent such occurrences and the contingency and emergency response procedures that would be put in place if such events were to occur. A discussion of potential cumulative effects of accidents and malfunctions is presented in Chapter 11.

Table 14.1-1 presents the potential interactions among VCs and the potential accidents and malfunctions. Project and cumulative effects of the accident or malfunction on each VC are described, and the significance of the effect is determined using the same thresholds as those for the Project environmental

effects. Any event that results in human mortality is considered significant. The potential for, and consequence of, accidents and malfunctions were assessed considering information from Manitoba Infrastructure's experience and for other similar projects.

Table 14.1-1 VC Interactions with Accidents and Malfunctions

Valued Component/ Subcomponent	Potential Accident or Malfunction			
	Channel Breach/ Control Structure Failure	Hazardous Materials Spill	Fire	Collisions
Atmospheric environment	–	✓	✓	–
Geology and soils	✓	✓	–	–
Groundwater	–	✓	–	–
Surface water	✓	✓	–	–
Fish and fish habitat	✓	✓	–	–
Vegetation	✓	✓	✓	–
Wildlife	✓	✓	✓	✓
Land and resource use	✓	✓	✓	✓
Heritage	✓	–	✓	–
Traditional land and resource use	✓	✓	✓	✓
Human health	✓	✓	✓	✓
Infrastructure and services	✓	–	✓	✓
Economy	✓	–	✓	✓

The assessment for each accident or malfunction scenario identified above involved the following steps:

1. Causes are identified for potential accidents or malfunctions and general conditions that would lead to each accident and malfunction during each Project phase.
2. Incident prevention identifies Project safety, design measures, or contingency planning for preventing.
3. Effects pathways identify the interaction and description of potential effects between VCs (if applicable) for each accident and malfunction scenario.
4. Incident response and mitigation identifies the emergency response procedures for managing or mitigating risk for each accident and malfunction scenario that is presented.
5. Summary of residual effects describes the residual environmental effects and associated significance on VCs that may result from accidents and malfunctions in consideration of emergency response plans.

14.2 OUTLET CHANNEL BREACH/CONTROL STRUCTURE FAILURE

14.2.1 Causes

The primary purpose of the Project is to address effects resulting from flooding on Lake Manitoba and Lake St. Martin during flood events. The Project consists of the following two primary components:

- A 24.1 km Lake Manitoba Outlet Channel (LMOC) with an inlet at Watchorn Bay on Lake Manitoba and outlet at Lake St. Martin. There will be four bridges, including one with a control structure incorporated. The channel will accommodate a flow of 212 m^3/s at a Lake Manitoba water level of 814 feet asl and a Lake St. Martin level of 801 feet asl. There are containment dikes that run the full length of the channel; however, the primary flow will be contained within the excavated channel.
- A 23.8 km Lake St. Martin Outlet Channel (LSMOC), with an inlet positioned at the east end of Lake St. Martin and an outlet at Willow Point on Sturgeon Bay of Lake Winnipeg. The channel will include a control structure with a bridge. The channel will accommodate a flow of 326 m^3/s at a Lake St. Martin water elevation of 801 feet asl and a Lake Winnipeg water elevation of 713.9 feet asl. Although much of the primary flow will be contained within the excavated channel, the water surface may extend above prairie grade at some locations, contained within containment dikes that run the full length of the channel. The channel will also have a series of drop structures to control the gradient of the water surface profile in the channel.

The channels will be excavated below prairie grade, and there are containment dikes along the full length of the channels, so breach of the channel itself is not possible unless a dike was breached or overtopped, or a control structure failed. The following conditions and factors have been identified as the most likely causes of breach or overtopping of the channels or associated dikes, or uncontrolled flows between lakes:

1) Extreme Flood Event

The channels and associated control structures and bridges are designed with capacity to accommodate specific flood events and ice conditions. Flood events in excess of the design event may result in overtopping and subsequent breach of the channel dikes.

2) Slope Instability or Failure

Slope instability on the channel side slopes or containment dikes could result in failure of the banks and subsequent breach of the dikes.

3) Temporary Constriction of the Channels

If flow on the channels is constricted, this could lead to an artificial and uncontrolled increase in the water level within the channel that could result in overtopping and breach of the containment dikes. Potential causes of a constriction in the channel are ice jams and/or debris accumulation within the channel, or

failure of one of the bridges and collapse into the channel. The LMOC may be prone to accumulation of large pieces of floating overburden (that break-off along the shores of Lake Manitoba and travel down the channel). The LSMOC will be less prone to debris accumulation because of its location downstream of the LMOC control structure, so the likelihood of debris accumulation on this channel is considered small.

4) Malfunction or Failure of the Control Structures

If either of the control structures malfunctioned and could not open, this could result in back-up of water upstream of the structures leading to overtopping and breach of the channel dikes. If a control structure or bridge failed (e.g., pier failure) or could not close, this could result in a greater than planned for volume of water flowing down the channel leading to overtopping and breach of the channel dikes. It could also affect lake levels by lowering those on the upstream lake and raising those on the downstream lake, beyond operating guidelines.

5) Vandalism

The channels could breach if material was removed from the linear dikes that are to be constructed along the length of the channels, or if the control structures were tampered with in a manner that results in back-up of water in the channels.

14.2.2 Incident Prevention

As described in Chapter 2, the Province of Manitoba has been managing and operating flood infrastructure for several decades, including the Fairford River Water Control Structure, Shellmouth Dam, Portage Diversion, Red River Floodway and numerous flood protection diking systems. As such, they have developed experience, skills and insights dealing with accidents and malfunctions on these types of structures and appropriate operating strategies and design standards, including contingency and emergency response planning and controls. For each of the potential causes of a dike breach (one of the worst scenarios evaluated in this section), the following principles and practices will be incorporated to reduce the likelihood of the incident occurring:

1) Extreme Flood Event

Project-specific operating criteria (Chapter 3, Section 3.5.3) address worst-case conditions, including assessing numerous scenarios involving the Lake Manitoba/Lake St. Martin Water Balance Model, integrating input from the Portage Diversion and Fairford River control structure. The operating guidelines describe how the Project is designed to work as an integrated system and to address anticipated larger flood events.

Manitoba Infrastructure has experience operating flood control structures in events that exceed the original infrastructure design capacity (e.g., 1979, 1997, 2011, 2014 flood events), and how these structures can be augmented temporarily to facilitate the flow without failure of the structures. In the event that a flood in excess of the design capacity of the structures occurred, Manitoba Infrastructure would endeavor to operate and supplement the structures in a manner that would preserve the structures and

minimize damages to the surrounding and downstream areas. Manitoba Infrastructure has demonstrated an ability to operate flood protection infrastructure and implement other measures in past extreme flood events. Specific design considerations will be applied to the Lake Manitoba and Lake St. Martin Outlet Channels, as described in Section 14.2.3.

The Manitoba Emergency Plan (Province of Manitoba 2018) documents measures for prevention and mitigation, preparedness, response, and recovery. It describes the "coordinated provincial response to prevent/limit loss of life, injury to persons, damage to property or the environment and significant economic loss or reduction." The focus is on addressing vulnerability and resiliency. An annex to this plan is developed specifically for flood control.

2) Slope Instability or Failure

The slopes of the channel and containment dikes will be designed in accordance with current industry and Manitoba Infrastructure's geotechnical standards for slope stability, which consider both normal and temporary or extreme conditions. The structures will also have routine maintenance and inspection to ensure they continue to perform as designed.

3) Temporary Constriction of the Channels

Manitoba Infrastructure has experience operating water control structures with ice conditions, and as such has methods of operation that reduce the risk of ice jams occurring. The linear design of the channels will also reduce the likelihood of an ice jam occurring. There are not any proven measures that can be implemented in these types of sites to prevent debris moving through the channels. Mitigation of this risk requires monitoring during operation and deploying equipment to address any issues that arise as they occur. During operation, the channels will be monitored for ice and debris jams, and equipment will be available to remove the blockages as they occur.

The bridges in the channel will be designed based on current industry standards and will be hydraulically sized to accommodate the design flows. Manitoba Infrastructure also has a comprehensive bridge inspection program that monitors the conditions of the bridges to confirm they can continue to perform as designed. With these measures in place, the risk of failure and collapse into the channels is considered low.

4) Malfunction or Failure of the Water Control Structures

The water control structures will be designed and inspected in accordance with the Canadian Dam Association (CDA) guidelines, so the likelihood of failure is low. Manitoba Infrastructure has a comprehensive inspection program for the provincial dams, combined with data collection and asset management strategies. This strategy by Manitoba Infrastructure has led to no major failures due to conditional deficiencies. The structures will also be constructed with certain redundancies in place, in terms of back-up power and spare parts, which will reduce the risk of malfunctions. Manitoba Infrastructure has experience with the maintenance and repair of these types of structures and will endeavour to address any malfunctions during operation and maintenance.

Aquatic invasive species that may interact with Project components include zebra mussels that may attach to control structures and channel substrates and several species of plants that could become established in the channels. In terms of potential changes to Project infrastructure, there are greater risks from zebra mussels than other aquatic invasive species. Adult zebra mussels can attach to, and colonize, Project infrastructure such as the Water Control Structures, and there is a risk that this may impact their function, particularly between open-gate periods. Project mitigation to control the spread of AIS is described in Section 7.2.4.2. As indicated in the EIS, the likelihood that the Project will notably increase the risk of AIS dispersal in the LAA and RAA is low. As described in Table 7.2-6 in Section 7.2.4.2, Manitoba Infrastructure will comply with Provincial AIS Regulations throughout the life of the Project to mitigate/prevent the spread/introduction of invasive species.

Emergency Response and Preparedness Plans (ERP and EPP) will be developed for both of the water control structures. Through previous experience, Manitoba Infrastructure has developed and refined its response procedures and will continue to do so into the future.

5) Vandalism

The water control structures will also have video surveillance as part of the security system to detect any acts of vandalism or tampering.

14.2.3 Effects Pathways

In the event of a breach of the outlet channel dikes, potential adversely affected VCs include geology and soils, groundwater and surface water, fish and fish habitat, vegetation, wildlife, land and resource use, infrastructure and services, economy, and human health (including downstream community safety, drinking water quality and country foods) for Indigenous and non-Indigenous receptors. There is also the potential for adverse effects on traditional land and resource use (including heritage resources) downstream, where they exist.

If a breach were to occur, effects to VCs would be similar during a flood event in the absence of the Project. The release of water during such an event may not change the hydrological regime (beyond the range in the historical record) but would likely create short-term changes to sediment transport dynamics, and surface water quality (e.g., turbidity, suspended sediment concentrations, herbicides). There is a low likelihood that changes to fish habitat or direct death of fish would occur as a result of a breach. Direct loss or alteration of vegetation could occur from the release of water and sediment deposition. Flooding or infilling of wildlife habitat could occur, particularly at the location of the breach and directly downstream. Mortality of wildlife (including migratory birds and species at risk that may be nesting) may also occur from the release of water and sediment, but the likelihood is low due to the low volume and anticipated rate of release. Effects on public health in relation to drinking water quality are not likely because of the short-term duration of the event effects. However, potential effects to fish, wildlife and vegetation could affect country foods, although the likelihood is low. Effects on infrastructure and services could occur due to direct damage of infrastructure such as downstream bridges and roads. Repairs would have economic effects and would temporarily interrupt travel. A temporary restriction of use and access of land and water

resources for recreation and traditional uses could occur from flooding of lands downstream, or from emergency response measures after a breach. Federal lands (i.e., Indigenous reserves) could be affected by a breach, since the channels are designed to protect these lands from flooding. The duration of the effects would remain until damage from flooding is repaired (where possible).

The Lake Manitoba Outlet Channel (LMOC) has a capacity of 7,500 cfs with Lake Manitoba and Lake St. Martin at elevation 814 and 801 feet, respectively. There is also a prescribed design flow of 11,500 cfs for the Lake St. Martin Outlet Channel. The ultimate capacity would then be a function of the resulting design, and would allow for additional flow with reductions in freeboard or factor of safety requirements as approved by MI. To date the flood protection level (FPL) has been generalized as the design water surface profile during operation, or high water levels during non-operation, plus at least 1 m (3.3 feet). Manitoba Infrastructure's design group are currently evaluating the actual FPL using industry standards for design of water infrastructure, i.e., the Canadian Dam Association (CDA) Dam Safety Guidelines (DSG). As such, water retaining structures would then need to be designed with the CDA Guidelines in mind.

In accordance with the CDA Guidelines, the FPL of both channels and associated infrastructure will be assigned a consequence classification. The consequence classification is determined after a detailed analysis investigates dam breaches and the flooding extent that would occur during a range of hypothetical scenarios. The hypothetical scenarios described in this EIS include a range of lake levels that could occur during operating and non-operating periods combined with wind setup. Open water and winter scenarios will be modelled (e.g., with HEC-RAS model based on the results of calibrated RIVICE simulations conducted in prior investigations by KGS) and further evaluate a number of dam breach scenarios. This information will provide the basis for determining the ultimate capacities of both channels and associated infrastructure, upon which final designs will be based.

14.2.4 Incident Response and Mitigation

The Province has established an emergency alerting process, managed by the Manitoba Emergency Measures Organization under *The Emergency Measures Act* (https://www.gov.mb.ca/emo/alerting /index.html). In the event of forecasted flooding, media releases and coordination with local governments would occur to warn the public; Manitoba Infrastructure's first priority is to ensure public safety; it maintains an emergency contact number 24 hours per day, seven days a week, which can be used to gain information during a flood. The Manitoba Infrastructure's website also provides public information on preparing for a flood and what to do in the event of a flood. It carries out regular monitoring of its flood control system and hydrology and receives severe weather forecasts from professional meteorologists. These detailed forecasts are used to model upcoming flow conditions to provide as much advanced warning as possible.

During forecasted flooding, Manitoba Infrastructure would conduct 24-hour monitoring and take pre-emptive measures to control or eliminate a breach. Should a breach occur, emergency response procedures as per the Manitoba Flood Coordination Plan (Manitoba Infrastructure 2019) would be implemented to address public health and safety concerns and reduce potential damage to infrastructure

and services during flooding. An option currently being considered is to direct the water from such a breach to the existing Lake St. Martin Emergency Outlet Channel (EOC). This would also be used if an emergency flood situation takes place before the permanent channels are constructed. Not all spoil piles are meant for containment, so no breach should occur at these points.

The Province of Manitoba uses adaptive management measures whenever feasible to address pending inundation from flood waters. With the possible exception of periodic extreme events, forecasters from the Hydrologic Forecasting Centre of the Water Management and Structures Division of Manitoba Infrastructure anticipate potential flood waters and initiate planning measures to address these on a case by case basis. There are two general approaches that the Province of Manitoba takes when managing events that exceed design limits of existing infrastructures and natural systems:

1. Incorporate locations for controlled dam breaches, such as spillways, for directing excess flows in directions that minimize damages (i.e., loss of life, cultural or environmental impacts, and infrastructure damage). For example, Portage Diversion flows peaked at 962.8 cms (34,000 cfs) on May 14, 2011, and the Hoop and Holler Bend controlled release site was activated. The release site was closed on May 20, 2011.
2. Conduct temporary measures to contain flows (i.e., raising containment dikes). For example, the volume of water flowing down the Portage Diversion in 2011 was unprecedented. This was because the total volume of flood water upstream of Portage la Prairie was also unprecedented, being twice as large as the previous record amount in 1976. Temporary measures were taken to open the Portage Diversion in 2011 to and beyond its maximum capacity. This involved increasing the capacity of the Portage Diversion though the use of measures such as raising dikes using earth works and man-made infrastructure. During the Red River's Flood of the Century in 1997, 9.3 million acre-feet of water flowed past Ste. Agathe on the Red River between April 1 and August 31. In advance of the pending floodwaters in 1997, sand bagging and community dikes (e.g., in St. Agathe and Emerson) were installed and/or raised. For the same months in 2011, almost the same amount of water, 9.1 million acre-feet, flowed into the Portage Reservoir on the Assiniboine River.

As a result of the design considerations listed in Section 14.2.3, the incident response and mitigation measures listed above, and considering ongoing maintenance, pre-operating inspections and infrastructure monitoring requirements which will be outlined in the Operation and Maintenance Manual (O&M Manual; Chapter 3), Manitoba Infrastructure anticipates that measures will be effective in preventing incidents such as outlet channel breaches or water control structure failure.

14.2.5 Worst-Case Scenario

The worst-case scenario of an outlet channel breach or control structure failure, ignoring incident prevention and mitigation, is presented in Section 14.2.3, and would be similar to the effects of a flood without the Project. These would include short-term changes to sediment transport dynamics, and surface water quality (e.g., turbidity, suspended sediment concentrations, herbicides and other agricultural chemicals). Direct loss or alteration of vegetation and flooding or infilling of wildlife habitat could occur.

Potential effects to fish, wildlife and vegetation could affect country foods and effects on infrastructure and services could occur due to direct damage of infrastructure such as downstream bridges and roads. Federal lands (i.e., Indigenous reserves) could be affected by a breach, since the channels are designed to protect these lands from flooding. Flooding could also result in human and wildlife fatalities.

Considering Project lifespan and the rigorous design and inspection requirements in accordance with the Canadian Dam Association (CDA) guidelines, as described in Section 14.2.2, the probability of occurrence of an outlet channel breach or control structure failure is low. If it occurred, the worst-case scenario would be an extreme flood event, as described in Section 14.2.2 (flow greater than 7,500 cfs for Lake Manitoba outlet channel; greater than 11,500 cfs for Lake St. Martin outlet channel). Such an event could result in slope instability or failure which could lead to temporary constriction of the channels. The effects would be as described in Section 14.2.3, Effects Pathways and the potential consequence, following mitigation, would be as described in Section 14.2.5.

14.2.6 Summary of Residual Effects

In the event of breach of the outlet channel dikes, public health and safety, the biophysical environment, lands used for traditional and non-traditional use, infrastructure and services, and economy would potentially be affected. A breach of the dikes would result in lesser effects to VCs relative to an unmitigated flood (i.e., in the absence of the Project), including inundation of surrounding areas, as well as any residences (particularly around Lake St. Martin, since the excavated channel would contain a portion of the water).

In summary, while the magnitude of dike breach or control structure failure could be high, the likelihood and resultant risks are low. With the implementation of design and construction requirements, regular inspections, and emergency response plans to address public safety concerns and mitigate damage to infrastructure and services, residual effects on identified VCs are predicted to be not significant.

14.3 SPILLS OF HAZARDOUS MATERIALS

14.3.1 Causes

A spill is defined as the escape of a product from its vessel that occurs outside of normal work procedures or the practice of due diligence. A release to the environment is defined as:

- the deposit of a deleterious substance in water frequented by fish (*Fisheries Act*) or a fish habitat; and/or
- a hazardous material that is in contact with air, land or water beyond a containment or mitigation system.

Release includes “to spill, discharge, dispose of, spray, inject, inoculate, abandon, deposit, pour, empty, throw, dump, place and exhaust, and to cause or allow to leak, seep or emit” (Manitoba: *The Environment Act*).

The potential for emissions, discharges and releases may be a result of:

- abnormal operating conditions (weather-related circumstances)
- equipment failure
- physical location of equipment (in a sensitive area)
- new type or model of equipment with different characteristics
- work procedure changes
- the human element

Hazardous materials expected to be used by the Project are listed in Appendix 3A, Table 3A-4. Hazardous material spills may occur as the result of improper handling, use, or storage of these materials on-site. Hazardous materials will also be transported to and from the Project site. The likelihood of a hazardous material spill is higher during construction when larger amounts and more containers of fuel and hazardous materials will be stored on-site. The likelihood of a hazardous spill during operation and maintenance activities is low because a minimum quantity of materials will remain on-site and the permanent installations will be designed to properly manage these materials on a long-term basis. Because construction is expected to extend year-round, the likelihood of a hazardous spill is the same for all times of year. Due to Project activities and location, there is also the potential for hazardous materials to be spilled in a terrestrial or aquatic environment although winter conditions may mitigate the extent of effects in some cases.

14.3.1.1 Spills during Construction

The operation and maintenance of construction equipment requires the presence of various hazardous materials onsite, including fuels (gasoline, diesel and propane), lubricants (engine oil, transmission or drive train oil, hydraulic oil, gear oil and lubricating grease), coolants (ethylene glycol and propylene glycol), methanol, paints and solvents. Hazardous liquids pose the greatest threat to the environment because of their ability, if not properly contained, to flow in an uncontrolled manner and seep into porous material. Some liquids (e.g., lubricating oil, methanol and antifreeze) contain components that are toxic to plants and wildlife. In addition, many of these materials are readily flammable or explosive. Antifreeze (ethylene glycol) is toxic and has a sweet smell that may attract wildlife.

14.3.1.2 Spills of Herbicides during Vegetation Management

According to Manitoba Infrastructure (2016), “a pesticide treatment may be considered for areas that have dangerous noxious weed or invasive species issues not resolvable by other vegetation management techniques alone. It may also be considered for heavily weed infested areas where native vegetation is to be established” and application adheres to the Pesticides Regulation and the Non-Essential Pesticide Use Regulation of *The Environment Act*. Spraying equipment typically includes backpack sprayers, truck and track-mounted power sprayers equipped with a broadcast applicator system, hose and handgun, and all-terrain vehicle mounted power sprayers. Herbicide applications are completed and supervised by licensed applicators and in accordance with conditions specified in the

Pesticide Use Permit, which is obtained annually. With respect to a spill of herbicide, a worst-case scenario would be a spill of concentrated herbicide during transport and handling that finds its way into a watercourse.

14.3.2 Incident Prevention

The Spill Response and Prevention Plan (Manitoba Infrastructure 2014) covers the transportation, use, storage and transfer of hydraulic fluid, other mechanical lubricants, petroleum fuels, antifreeze and herbicides. All personnel, including contractor personnel, receive training in spill prevention. Project Environmental Requirements (PERs) have been developed (Appendix 3F) that describe measures to address accidents and spills, including reporting, cleanup, compliance training, inspection, and enforcement. Section 2.5 includes a list of measures to address machinery, fuel storage, materials handling, spill response and remediation. Specific prevention measures include the following:

- Machinery will arrive on site in a clean condition and will 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 repaired.
- All fuel handling and storage will comply with Storage and Handling of Petroleum Products and Allied Products Regulation 188/2001 under The Dangerous Goods Handling and Transportation Act C.C.S.M. c. D12.
- Storage of fuel stored in drums or containers of 230 L or less will comply with the requirements of the Manitoba Fire Code.
- 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 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.
- All designated areas used for petroleum storage will be a minimum distance of 3 m from a property line or building and 15 m horizontally from hydroelectric poles and lines.
- Tank vehicles used to deliver fuel to the work site and used to move fuel around the work site will meet the requirements for highway tanks for the shipment of dangerous goods by road set out in CSA Standard B620-14, Highway Tanks and TC Portable Tanks for the Transportation of Dangerous Goods.
- All fuel storage containers and tank vehicles will be inspected daily for leaks and spillage. Damaged or leaking fuel storage containers will be promptly removed from site. All used petroleum products and other regulated hazardous wastes will be collected and disposed of at a licensed facility in accordance with applicable legislative requirements.
- Petroleum products will be transported in accordance with the Manitoba Dangerous Goods Handling and Transportation Act.

- Construction, installation and removal of petroleum storage tank systems will occur under the supervision of a registered licenced petroleum technician.
- Prior to use or filling, all petroleum storage tanks will be registered and properly permitted, as required, with the province of Manitoba or the government of Canada (on federal lands). All permits are to be kept current.
- Dedicated petroleum storage areas will provide additional spill containment and facilitate clean up through measures such as:
  - maximum separation from environmentally sensitive features
  - clear identification of the materials present
  - restricted access to authorized vehicles and employees
  - impervious bermed storage areas
  - dedicated spill response equipment.
- Only above ground storage tanks will be used for the storage of bulk petroleum products. The tanks will be equipped with overfill protection and spill containment consisting of perimeter dikes or secondary containment in the tank design.
- All designated areas used for petroleum product storage will have the topsoil stripped and be underlain with at least 30 cm of impermeable soil or approved alternate and diked in such a manner as to contain any leakage or spillage. The dikes will be designed, constructed and maintained to retain not less than 100% of the capacity of the total number containers or 110% of the largest container, whichever is greatest. If dikes are used, the containment areas will be dewatered after a rainfall event and the containment water disposed of as approved by the Engineer and clean topsoil will be stored and used in the restoration of the site.
- Concrete barriers will be installed around all petroleum storage tanks to prevent collisions (as per Technical Bulletin PSF-004, March 2015: Impact Protection Requirements for Above Ground Storage Tanks Systems).
- All mobile equipment that is not in use will be parked within a designated area.
- All employees involved in the handling and storage of fuels will have Workplace Hazardous Materials Information System (WHMIS) and spill response training.
- All internal-combustion engines (regardless of fuel type) will be shut down during fueling.
- There will be no smoking and no open flames at the petroleum storage area at any time.
- Fueling procedures will be posted where fueling occurs.
- Storage sites for petroleum products will be secured and signs including but not limited to; hazard warnings, who to contact in case of a spill, access restrictions and under whose authority the access is restricted will be posted.

- All petroleum storage tanks with a capacity greater than 5,000 L will be registered with Manitoba Sustainable Development. New tanks will be registered before installation. Tanks will be designed, installed, and operated in accordance with the Manitoba *Dangerous Goods Handling and Transportation Act* and the Federal *Transportation of Dangerous Goods Act*. Smaller stationary tanks will adhere to requirements of the Manitoba Fire Code. A copy of the petroleum license will be posted at the fueling site.
- Bulk waste oil will be stored in aboveground oil tanks, which will have secondary containment and a weatherproof cover. Waste oil will be recycled by a reputable recycling agency.
- Used oil filters will be drained, placed into suitable storage containers and disposed of at approved facilities. The oil drained out of the used filters will be collected and handled in the same manner as used oil.
- The contractor will prevent fuel, lubricants or compounds from being released. All empty containers from equipment refueling and servicing will be removed to a licenced disposal site. The Contractor will be thoroughly familiar with provincial/federal spill response compliance procedures.
- Materials required for spill containment and clean up will be available at all work sites and designated areas. All vehicles will carry materials and equipment for emergency spill containment.
- All petroleum product storage sites and mobile transportation units will, at all times, be equipped with appropriate categories of equipment and volumes of fire suppression products

In terms of herbicide use, Manitoba Infrastructure (2016) describes the following requirements for application:

- Least toxic, least persistent and most target-specific pesticides are preferred.
- All pesticides applied are pre-approved for use by Provincial legislation.
- Applications are targeted to the season where the pest is most susceptible to treatment.
- They are applied by trained personnel who meet provincial licensing requirements.
- They are applied using equipment designed to minimize potential for drift.
- Equipment is properly calibrated to provide the most effective control dosage.
- Where possible, application will be targeted application to pest species, i.e., spot spraying.

14.3.3 Effects Pathways

Hazardous materials will be transported by road. In the event of an accidental spill, the material spilled could evaporate to produce small amounts of fugitive air emissions of various fractions of volatile organic compounds (VOCs). In addition, spills could result in:

- surface water contamination and subsequent effects on fish and fish habitat
- groundwater contamination and subsequent effects on human health if the material reaches an aquifer used for human consumption

- wildlife mortality, and loss or alteration of wildlife habitat
- loss or alteration of vegetation
- soil contamination
- destruction of, or access restrictions to lands used by First Nations and Metis or other land users

Effects from a hazardous material spill are dependent on the volume, location, and type of material spilled. Spills are more likely to occur during construction as more materials will be transported to and remain on-site during this phase. Hazardous materials may also be spilled outside of the Project site while being transported.

In the event of a spill, soil quality could be affected in the area. Subsequent removal of the contaminated soil would result in soil loss. Effects would also depend on the location and extent of the spill. Because an event is more likely to occur during construction, the potential soil effects would likely be confined to a localized, contiguous and defined area and be identified quickly via monitoring and reporting protocols in the construction contracts. This would facilitate faster cleanup and remediation. Effects on vegetation could occur through direct contact with a spilled substance, or vegetation loss through removal of affected soils and vegetation during cleanup. There is also the low potential for materials to remain in the soil for prolonged periods of time if not identified during monitoring, or if not reported, which could affect soil capability and the ability for vegetation to grow. Depending on the characteristics of the material, terrestrial wildlife species (including migratory birds, species at risk, and country foods) could be potentially affected by a spill of hazardous material. Ungulates and other terrestrial wildlife could be affected if they contact, inhale or ingest the material. However, wildlife would likely avoid the area due to noise from Project activities and activities associated with cleanup efforts.

The release of materials into an aquatic environment could occur during the construction phase. However, due to much of the Project activities being conducted on land, or in a dewatered channel, the likelihood of a spill into an aquatic environment is lower than one to a terrestrial environment. The potential effects with a release into an aquatic environment would likely be greater because of the difficulty in containing and subsequently cleaning up contaminants, compared with a release on land, which typically is more quickly contained and cleaned. The effects associated with a spill into an aquatic environment are largely related to surface water quality and aquatic ecology. Release of material into an aquatic environment could alter water chemistry and create short-term effects on water quality parameters and possible exceedance of applicable guidelines (including drinking water). Changes to fish habitat and direct fish mortality could occur through the toxicological effects of the material spilled. The effects of a spill on surface water quality and aquatic ecology would be influenced by seasonal timing of the release, which can affect the sensitivity of aquatic biota in the receiving water (dependent on season and life cycle activities of a specific species during that time) and the dispersion of the product (high flow versus low flow, frozen conditions, portion of spill that enters the aquatic environment). Potential environmental effects on species groups that use aquatic environments, including amphibians, waterbirds, shorebirds and semi-aquatic mammals could also result from a release of hazardous material. Potential effects of releases into an aquatic environment include increased mortality risk, reduced habitat

availability, and reduced food availability. Fuel spills could result in the destruction or access restrictions to lands used by Indigenous groups or other land users.

14.3.4 Incident Response and Mitigation

In the event of a release during Project construction, contractors will follow their own spill response plans, which will have been reviewed and approved by Manitoba Infrastructure as part of their contracts. During maintenance activities, Manitoba Infrastructure (the site owner) has the ultimate responsibility for dangerous goods, hazardous wastes and controlled product releases in their areas of jurisdiction. Contractors who provide maintenance services have the same responsibilities for their work.

The PERs (Appendix 3F) include the following requirements regarding spill response and prevention:

- All spills (of quantities less than those defined) and without a potential impact to the environment will be contained and cleaned up immediately by on-site personnel in accordance with the approved on-site emergency response and containment plan and reported to the Engineer.
- In the event that there is a spill, leak or release onto the ground surface from any piece of equipment (e.g. broken hydraulic hose) the entire affected area will be cleaned up and all contaminated soil will be appropriately disposed of at a licenced soil recycling facility. If contaminated soil is to be stored on site for any time a designated storage area is to be identified and prepared to prevent secondary contamination.
- A spill kit or sufficient supply of materials for clean-up or spill containment (i.e. absorbent material, high density HDPE groundsheets and absorbent oil booms when working near water) will always be available on site and replenished as needed. If necessary, additional material will be made available on short notice.
- The Contractor will designate a qualified supervisor(s) as the onsite emergency response coordinator(s) who will be on site at all times that work is undertaken. The emergency response coordinator(s) will have the authority to redirect manpower and equipment in order to respond in the event of a spill.
- The designated emergency response coordinator will periodically review and if necessary, revise the on-site emergency spill response plan as approved by the Engineer.
- As dangerous goods/hazardous waste storage areas are taken out of service remediation will be conducted, including the appropriate disposal of the contaminated material to the satisfaction of the Engineer.
- Contaminated runoff or water will be contained and prevented from entering any waterbody. The collected contaminated runoff or water will be hauled off site for disposal at an approved disposal facility.

In the event of a spill, response measures would focus on containment of the spill to limit the effects, cleanup of the spill, and remediation of the affected areas as quickly as possible. Hazardous wastes will be disposed of at approved facilities.

As indicated, activities associated with the handling of hazardous materials will be within designated areas of the Project site. Worker health, safety, and environment training will include spill prevention and response procedures. All workers will be required to have WHMIS training. Equipment will be operated and maintained to applicable standards to reduce the likelihood of a spill. To reduce the potential for a spill during transportation, transport of hazardous materials to and from the Project site, storage, use and disposal will be in accordance with regulatory requirements, and hazardous materials associated with the Project will be in compliance with the federal *Transportation of Dangerous Goods Act* as well as the provincial *Dangerous Goods Handling and Transportation Act* and related regulations such as the Storage and Handling of Petroleum Products and Allied Products Regulation 188/2001.

Activities near water will be planned and completed in the dry or otherwise isolated from watercourses to prevent hazardous materials from entering a watercourse. Hazardous materials will be stored, used and disposed of in accordance with regulatory requirements. Consistent with the selection of any designated area outlined in the PER, a minimum 100 m setback between stored hazardous materials and rivers, streams and surface water bodies will be implemented or otherwise appropriately designed, constructed, and operated in accordance with regulatory approval. With such mitigation, cleanup response times are anticipated to be adequate to contain and remediate downstream effects. Mitigation measures will also be implemented to reduce the interaction of wildlife with Project components during construction (e.g., nest searches), making the likelihood of a wildlife interaction with a hazardous material spill low.

14.3.5 Worst-Case Scenario

As described in Section 14.3.1, the probability of a hazardous material spill is higher during construction when larger amounts and more containers of fuel and hazardous materials will be stored on-site. Given measures described in Section 14.3.2, such as the Spill Response and Prevention Plan and Project Environmental Requirements, the probability of routine issues is moderate but manageable, and the probability of more substantial/worst-case spills is low. The worst-case hazardous material spill would be an overturned tanker truck supplying diesel fuel to construction equipment along Highway 6 north of Grahamdale at the Lake Manitoba Outlet Channel crossing. A full fuel truck has the capacity to hold 50,000 litres of diesel. If it overturned across the channel and ruptured, the fuel would go into the channel and flow into Lake St. Martin. If the channel was still under construction, the spilled diesel would flow into an existing stream and into Birch Bay at the southern end of Lake St. Martin. The spill would result in injury or mortality to fish and wildlife species along the stream and Birch Bay, public health issues (water quality degradation of the stream and lake, country foods, public safety), and potential destruction of traditional land and resource use. The likelihood of this event happening is low, given the application of Manitoba Infrastructure's Spill Response and Prevention Plan, as described in Sections 14.3.2 and 14.3.4.

14.3.6 Summary of Residual Effects

There are a variety of potential sources of hazardous materials spills during all phases of the Project, influenced by aspects such as weather conditions, equipment failure, and human error. Spills could range from small localized fuel spills during construction, to more substantial events such as regional flooding or a fire or explosion that damages containment structures. These spills have the potential to contaminate soils and vegetation or enter surface water and affect VCs such as fish and fish habitat, wildlife and wildlife habitat, health, traditional land and resource use and other resource use.

A hazardous materials spill could result in contamination of the biophysical environment and lands used for traditional and non-traditional resource use and pose immediate threats to public health. Given the potentially high consequences, Manitoba has developed, through several decades of experience, robust hazardous materials management and emergency response plans as well as Project-specific environmental requirements that will accompany the environmental protection plan. Training and appropriate handling, use, and storage of hazardous materials on-site are designed to prevent hazardous materials spills. If they occur, hazardous materials spills are therefore anticipated to be small in scale and to be cleaned-up and remediated using standard equipment. Although in extreme cases, spills that destroy habitat for vegetation, wildlife or fish species of conservation concern would be deemed significant, with the implementation of preventative measures and emergency response procedures and both point and non-point containment in place, the potential for such a spill to reach the receiving environment is low. Overall, the effects of spills on the VCs are assessed as being not significant.

14.4 FIRE

14.4.1 Causes

As discussed in Chapter 15 (Effects of the Environment on the Project, Section 15.7), fire may be caused by natural events such as lightning strikes and wildfire, electrically powered Project component malfunction (e.g., distribution line connections, outlet channel control structures, controls and instrumentation in control building), equipment malfunction, or anthropogenic activities. Due to the storage of combustible materials or wastes, operation of internal combustion engines (e.g., vehicles, heavy equipment) and the presence of workers during Project construction, brush and wildfires could be ignited. Hot combustion engines on vehicles driving over dry grass or fields can cause wildfires. Lightning strikes and wildfire may occur on a seasonal basis (higher probability in the summer and fall) during any phase of the Project. Project component malfunction is most likely to occur during flood operations or during maintenance while components are in use. Equipment malfunction and other anthropogenic activities causing fire are most likely to occur during construction.

14.4.2 Incident Prevention

The Manitoba Emergency Plan (Manitoba Infrastructure 2018) provides information on prevention and mitigation, preparedness, response and recovery for issues such as fires. It includes an Annex specific to wildfires, and notes that each spring Manitoba Sustainable Development provides estimates of fire hazard and provides routine updates and public fire advisories. Project Environmental Requirements (PERs) have been developed (Appendix 3F) that contain requirements for burning and brush disposal. Section 2.10 describes measures to address the risk of wildfires, as follows:

- An evacuation and emergency preparedness plan addressing wildfires will be implemented and accepted by the Engineer prior to commencing construction.
- No fires will be started without first taking sufficient precautions to ensure that the fire can be kept under control.
- Open fires are prohibited from April 1st to November 15th annually. In the event that burning is required during that period, an application for a burning permit will be submitted for approval to Manitoba Sustainable Development. All conditions imposed by the burning permit will be adhered to.
- No activity will be conducted which may cause a fire to spread. Similarly, burning or smoldering matter will not be placed where it may cause a fire to spread.
- A primary zone will be established around camp sites and other longer-term temporary structures associated with construction and maintenance activities. Flammable materials such as leaves, brush, dead limbs, and fallen trees will be cleared from the area regularly.
- The locations of construction camps, offices, and related structures will be chosen in such a fashion as to minimize the risk of exposure to wildfires.

Prior to construction, contractors will be required to develop fire protection procedures to address fire prevention and emergency response during construction. On-site personnel will be trained in fire prevention, including proper disposal of hot or burning material and designated smoking areas, and response. Equipment and Project components will be maintained to applicable standards to reduce likelihood of malfunction resulting in fire and explosion. Flammable materials will be stored in accordance with regulatory requirements.

Work permits contain requirements for onsite firefighting equipment. Under the *Wildfires Act*, there is no requirement for a burning permit between November 16 and March 31. During Project construction, brush piles may be burned during winter or under a Work Permit and Burning Permit issued by Manitoba Sustainable Development; they will also be located far enough away from the ROW edge to avoid damaging uncleared vegetation, and where feasible, will be located on mineral (sand and gravel) or previously cleared areas.

Equipment and Project components will be maintained to applicable standards in order to reduce the likelihood of malfunction resulting in fire and explosion. Temporary access roads constructed to the PDA would be decommissioned upon completion of the construction phase, and permanent access roads in

the PDA (e.g., along the berms) would be permanent for the life of the Project and allow for access to the PDA by firefighters during all phases of the Project.

14.4.3 Effects Pathways

In the unlikely event of an accidental fire, the adversely affected VCs could include atmospheric environment (air quality), vegetation, wildlife, land and resource use, infrastructure and services, economy, and human health (including country foods) for Indigenous and non-Indigenous receptors. There is also the potential for adverse effects on traditional land and resource use (including heritage resources) within the Project area, where they exist. A fire at a Project location could interact with wildlife, vegetation and agriculture as a result of habitat loss, crop destruction, loss of livestock or contamination with sediment-laden water used to extinguish the fire. Heritage resources could be damaged if the fire burns though the sod layer or destroys surface artifacts. Infrastructure and services could be affected by stress on public services, such as emergency fire response. Traditional land and resource use could be affected through the risk of loss or damage to property or resources, or loss of access to resources that are destroyed or damaged by fire. Fire could also result in a change in visual quality of the landscape. Health could be affected by risk of injury and mortality, emissions from smoke, and soil contamination from water used to extinguish the fire.

During a fire, potential substances would depend upon the material under combustion. Combustion of hydrocarbon-based operational chemicals, such as hydraulic oil or motor fuel, would primarily generate CO_2, CO, combustion gases, and water vapour. Smoke and other particulate matter would impair air quality for the duration of the fire.

Effects from a fire would be dependent on the spatial extent and location of the fire. Larger fires could pose a risk to life as well as damage to infrastructure and surrounding lands (resources used for recreation, traditional uses, and wildlife habitat). Fires of a larger size could also result in temporary exceedances of applicable ambient air quality standards (e.g., dust and smoke). However, the likelihood of a Project-related fire of that size occurring is low. Should a fire occur, effects on vegetation would be limited to the location of the fire.

The effect on wildlife (including migratory birds, species at risk, and country foods) would likely be restricted to those species with limited mobility to avoid a fire (e.g., some small mammals, amphibians and juvenile birds in nests), which could result in injury or mortality. Species that are highly mobile, such as large mammals and adult birds, would likely disperse from the area. Indirect effects on wildlife may result from the loss of habitat due to burning of vegetation, or avoidance of the area because of the fire or subsequent emergency response activities.

14.4.4 Incident Response and Mitigation

As indicated, the Manitoba Emergency Plan provides information on prevention and mitigation, preparedness, response and recovery for emergency issues (Province of Manitoba 2018). It describes a "coordinated provincial response to prevent/limit loss of life, injury to persons, damage to property or the environment and significant economic loss or reduction" and receives overall direction from the Minister responsible for the *Emergency Measures Act.* It includes an Annex specific to wildfires and includes response procedures such as evacuations of hospitals and personal care homes.

The Project Environmental Requirement document (Appendix 3F) contains requirements for burning and brush disposal. Section 2.10 describes measures to respond to a wildfire, as follows:

- In the event that a wildfire occurs, it will be immediately reported to the Engineer and to Manitoba Sustainable Development at 1-800-782-0076.
- All reasonable steps will be taken in order to prevent a fire from burning out of control or spreading from land owned or occupied for construction purposes.
- In the event that a wildfire is identified where construction activities are taking place, all reasonable attempts will be made in order to extinguish the wildfire. All available equipment, services and labor will be made available at the disposal of an officer for the purposes of wildfire protection operations.
- All construction and related activities taking place in the vicinity of a wildfire will cease until advised by the Engineer that it is safe to resume operations.

Fires will be completely extinguished after burning of slash and burn piles and will be monitored so that no hot spots remain. Any damage to Project infrastructure caused by wildfires during dry operations and post-flood operations would be repaired.

In the unlikely event of a Project-related fire, Manitoba Infrastructure will follow policies and procedures outlined in the Manitoba Emergency Plan and PERs. Local emergency response teams will also be contacted, and their assistance sought, if necessary, to reduce the severity and extent of damage.

Given the location of the Project components in relation to other properties, if a Project-related fire were to occur it would likely remain within the PDA. The likelihood of damage to residential or commercial infrastructure, or to federal lands from Project-related fires is low. Short-term disruption of use and access of land for recreation and traditional uses could occur from emergency response measures.

14.4.5 Worst-Case Scenario

Given the safety training that will be a contractual requirement for workers on the Project, the probability of Project-caused fires would be low, and it is more likely that worst-case scenarios would occur from accidents outside of the Project control. A worst-case fire would be a large uncontrolled bush fire in the pasture and cultivated lands west and south of Lake St. Martin. Such a fire could result in human and wildlife fatalities, degradation of air quality, destruction of agricultural land, loss of the traditional use of the land, impairment to the long-term viability of wildlife species in the area, and damage to infrastructure and

services. Agricultural chemicals could be ignited by fires resulting in air, soil, and water contamination. The likelihood of a Project-related fire caused by Project component or equipment malfunction is low, given the fire prevention measures that are part of Project Environmental Requirements, any Project or non-Project caused bush fire will be responded to using the Manitoba Emergency Plan to reduce the damage extent.

14.4.6 Summary of Residual Effects

The magnitude of the effects of a Project-related fire will depend on its location, timing and severity. A small-scale fire that is brought under control and extinguished in a timely manner is not expected to have a significant effect on the environmental or socio-economic VCs. A larger fire has the potential to result in significant effects if it diminishes the capacity of critical habitat to provide for the recovery or survival of species at risk or threatens the long-term viability of wildlife populations or plant species, results in the loss of agricultural land and loss of operations such that existing levels cannot continue, and/or land use and traditional land and resource use cannot continue as they have been. Since the magnitude of effect could be large, efforts focus on reducing the likelihood of occurrence. This includes monitoring fire risk conditions and providing training in terms of use of flammable materials and fire prevention methods.

The likelihood of Project-related fire caused by Project component or equipment malfunction is low. Fire is more likely to occur because of lightning strikes. A large fire could result in temporary exceedances of applicable ambient air quality standards and effects on public health through changes in air quality and immediate threats to safety and infrastructure. It could also affect crops, grazing land, native vegetation, wildlife habitat, land and resource use, and traditional land and resource use. However, the potential for fires because of Project activities is low and fire prevention measures on-site will meet applicable standards. Fires may occur because of natural events, in which case emergency response procedures are designed to extinguish fires quickly and limit damage. Fire would be most likely restricted to the PDA if it is caused by a Project component and equipment malfunction or anthropogenic activities at the PDA; a fire caused by natural causes (e.g., a wildfire caused by lightning strikes) may extend into the RAA. With the implementation of preventative measures and emergency response procedures, residual effects of fire on identified VCs as a result of Project components are predicted to be not significant.

14.5 COLLISIONS

14.5.1 Causes

Vehicle traffic will occur during all phases of the Project and all times of year due to movement of equipment, supplies, materials, and personnel to and from the Project site and along the public highway and road network that crosses the Project. A vehicle collision could occur on roads leading to/ from or within Project sites. Vehicle accidents can result in injury or death to humans and wildlife, the release of hazardous materials into a terrestrial or aquatic environment, and damage to property or infrastructure. The release of hazardous materials is discussed in Section 14.4.

There is a potential for vehicles or heavy equipment to collide with other vehicles, people or wildlife. The operation of vehicles and heavy equipment on highways, access roads and the ROW could result in human or wildlife mortality or injury. The potential for these types of collisions is influenced by traffic volumes and weather conditions. Wildlife incidents may affect both large and small animals, including mammals, birds and amphibians. Other wildlife-related incidents could occur as a result of vehicle travel over natural terrain (e.g., crushing nests or dens with young, or slow-moving animals). The potential for vehicle–wildlife interactions is influenced by the time of year, the surrounding habitat type, and the time of day.

Frequency of vehicle traffic will be higher during Project construction, when there is more vehicle activity and more transportation of workers during hours of low visibility or higher wildlife activity; however, the likelihood of motor vehicle collisions is expected to be low throughout Project operation and maintenance due, in part, to a relatively small Project-related operational traffic load.

14.5.2 Incident Prevention

The focus of incident prevention will be on prevention of collisions through compliance with traffic laws and regulations. Preventative measures to reduce the risk of collisions include signage, traffic control flag persons, road surface controls (e.g. dust suppression), maintaining vehicles and reducing traffic to the communities and the Project site during construction. This will include the use of group transportation where possible. Project vehicles will follow posted speed limits and exercise caution in areas frequented by wildlife. During Project operation and maintenance, vehicle travel and access onto the PDA will be at a reduced speed regardless of the time of year due to terrain, equipment used and the nature of work.

14.5.3 Effects Pathways

Vehicle collisions as a result of Project-related activities could affect health through collisions that cause injury or death, or through the involvement of emergency response services. Collisions could interact with wildlife by causing injury to, or mortality of, wildlife species. Vehicle collisions could also affect traditional land use, infrastructure and services, and the economy through temporary loss of access and cost of damages.

14.5.4 Incident Response and Mitigation

Response measures would vary depending on the location and type of vehicle accident. Response measures may include contacting on-site emergency response personnel or regional emergency services. A vehicle collision would likely result in a call to 911 (or other local emergency contact number) and use of emergency response services. As a vehicle collision is unlikely to result in any large-scale event, response is expected to be within the capacity of local emergency response services. A vehicle collision involving injury or fatality would typically be an isolated event.

Mitigation to reduce the risk of vehicle accidents includes development of traffic accommodation strategies. All workers would be required to work in a safe manner and complete health, safety, and environment training. Project-related vehicles would be required to follow traffic rules such as speed limits and weight restrictions and federal and provincial highway regulations.

14.5.5 Worst-Case Scenario

As noted in Section 14.5.1, the probability of motor vehicle collisions is expected to be low throughout Project operation and maintenance due, in part, to a relatively small Project-related operational traffic load. The worst-case collision scenario is a collision between a tanker truck and a multi-passenger vehicle during construction resulting in fatalities. The likelihood of such an event is low, assuming that applicable traffic laws, regulations and corporate policies on vehicle use and on the implementation of safety measures.

14.5.6 Summary of Residual Effects

Collisions can occur during the operation of any moving equipment, with potential consequences of injury and loss of life. As a result, efforts focus on reducing the likelihood of occurrence. This includes a requirement for staff and contractors to comply with applicable traffic laws and regulations and corporate policies on vehicle use, and the implementation of safety measures such as access management and posted speed limits. With the implementation of preventative measures and emergency response procedures, residual effects of vehicle collisions on identified VCs are predicted to be not significant.

14.6 SUMMARY OF RESIDUAL EFFECTS

The assessment of accidents, malfunctions and unplanned events for the Project addressed the following:

- outlet channel breach, dike overtopping, or control structure failure including failure of erosion protection and sediment control measures
- spill of hazardous materials
- fire
- collisions

The magnitude of an accident and/or malfunction will be dependent upon the location of the incident and the characteristics of the event (volume of water causing a breach of channel dikes, volume and type of material spilled, extent of fire, etc.). Table 14.6-1 presents the magnitude of worst-case accidents and malfunctions, describing the quantity, mechanism, rate, form and characteristics of the contaminants and other materials that may be released into the environment. The likelihood of the worst-case scenarios occurring is low, given the accident prevention and other mitigation measures as discussed in Sections 2 through 5. The magnitude of events less than the worst-case will be less than those characterized in the table.

Table 14.6-1 Characterization of the Magnitude of Accidents and Malfunctions

Accident or Malfunction	Characteristics of the Accident or Malfunction				
	Quantity	**Mechanism**	**Rate**	**Form**	**Contaminants**
Outlet Channel Breach/Control Structure Failure	Worst case - Extreme flood event Other cases, smaller quantity	• Extreme flood • Slope instability or failure • Temporary constriction of the channels • Malfunction of control structures • Vandalism	Beyond capacity of 7,500 cfs for Lake Manitoba channel and beyond 11,500 cfs for Lake St. Martin channel	Stored materials, solids, liquids, gases	Materials present in the areas flooded including hazardous agricultural, industrial and residential materials (fertilizers, petroleum products, building materials)
Spills	Worst Case – 50,000 litres of diesel Other cases, depend on size of container	• Collision • Container failure	Variable, depending on accident or malfunction. Worst case, volume spilled into the environment in a matter of hours.	Solids, liquids gases	Diesel, gasoline, propane, oil, hydraulic fluid, acetylene, explosives, uncured concrete, de-icing fluids, concrete sealer, asphalt damp proofing, concrete primer, concrete curing compound, hot poured rubberized asphalt waterproofing, tack coat (emulsion or liquid asphalt), fine aggregates, sewage
Fire	Worst Case – wildfire in agricultural lands south of LMOC – 348,000 ha	• Equipment failure • Wildfire	Variable, depending on rate of spread of fire and speed of response.	Stored materials, solids, liquids, gases	Materials present in the area burned, including hazardous agricultural, industrial and residential materials (fertilizers, petroleum products, building materials)
Collisions	Worst Case – any fatality	• Vehicle issues • Road conditions • Driver error	Variable, depending on accident or malfunction.	Solids, liquids, gases	Petrochemicals from vehicles; contents of vehicles

Manitoba Infrastructure has been successfully constructing and operating flood control projects for several decades; as described in Chapter 1, its Mission Statement is to ensure safe, reliable and sustainable infrastructure and services for Manitoba and its communities. A Project environmental management program (Chapter 3, Section 3.7) is being developed. along with health and safety programs that include specific protection, management and monitoring plans for each project. These plans reduce the likelihood of environmental effects from the Project and include measures to prevent accidents and malfunctions. In the event of an accident, malfunction or unplanned event, the EMP provides protocols for addressing such events.

The assessment of accidents and malfunctions concluded that the mitigation measures for such occurrences will result in effects that are not significant, with the following exceptions:

- any event that results in a human fatality
- spills that destroy habitat for vegetation, wildlife or fish species of conservation concern
- fires that destroy critical habitat or affect agricultural land so that current operations cannot continue, or land use and traditional land and resource use cannot continue as presently carried out

With the environmental protection plans, mitigation measures and emergency response plans in place, the likelihood of significant environmental or socio-economic effects occurring is low.

14.7 REFERENCES

Canadian Environmental Assessment Agency. 2018. Guidelines for the preparation of an environmental impact statement, Lake Manitoba and Lake St. Martin Outlet Channels Project proposed by Manitoba Infrastructure. Version 1: May 15, 2018.

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Manitoba

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

CHAPTER 15

EFFECT OF THE ENVIRONMENT ON THE PROJECT

March 2020

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15.0 EFFECT OF THE ENVIRONMENT ON THE PROJECT

15.1 OVERVIEW OF CHAPTER

This chapter discusses the analysis of the effect of the environment on the Project's design, construction and operation, including natural events and human management of the existing environment during Project activities. It also provides details of the planning, design and construction strategies intended to reduce or avoid the potential effects of the environment on the Project.

The Agency Guidelines for the Preparation of an Environmental Impact Statement (CEAA 2018) Part 2, Section 7.6.2, state the requirement for the EIS to take into account how local conditions and natural hazards, such as severe and/or extreme weather conditions and external events could adversely affect the Project and how this, in turn, could result in effects to the environment (e.g., extreme environmental conditions result in malfunctions and accidental events). Section 5.7 of the Scoping Document (Manitoba Infrastructure 2018) submitted to Manitoba Sustainable Development's Environmental Approvals Branch states that the potential for local conditions and natural hazards (e.g., severe weather conditions) to adversely affect the Project will be described in the EIS, as well as how this, in turn, could result in effects to the environment.

It is important to keep in mind the purpose of the Project. It is a flood mitigation project, designed to protect the environment, both biophysical and human, from the effects of flooding in the Lake Manitoba-Lake St. Martin area. Environmental effects on the Project evaluated in this chapter are those that will lessen its capability to achieve this purpose.

15.1.1 Types of Effects on Project

Projections are provided on how local conditions and natural hazards, such as severe or extreme weather conditions and external events could adversely affect the Project, and how this in turn could affect the environment. The scope of this assessment does not include regular operations and maintenance issues that are readily addressed by existing management plans; these are addressed in various other sections of the EIS. For the purposes of this assessment, this chapter considers how the following environmental conditions and natural hazards could affect the Project:

- extreme weather conditions, including winds, extreme temperatures, severe precipitation, ice storms, tornadoes and lightning that are applicable to the Project region
- extreme hydrological conditions, including droughts and flooding, that are applicable to the Project region
- climate change and its potential effects on long-term future average and extreme climate conditions
- regional geotechnical and geophysical hazards, including ground instability, erosion and earthquakes
- vegetation growth and high fire hazards (grass fires and forest fires)

Each of these conditions are described in further detail below, including existing conditions, potential effects and proposed mitigation. The potential physical effects on the Project due to the environment include:

- temporary stoppage of construction or maintenance activities during extreme weather events
- damage to infrastructure
- change in Project's ability to operate as designed
- potential threats to Project personnel or the public

15.1.2 Effects on VCs

In some cases, these effects on the Project can have subsequent effects on the receiving environment. Ultimately, the mitigation of these effects requires planning, design and operation procedures that consider both normal and extreme physical environmental conditions for the operational setting. Monitoring and forecasting of physical environmental conditions are also necessary, particularly for thresholds related to effects triggers, such that Project activities can be adaptively managed to maintain a safe working environment.

Almost all effects of the environment are natural, often short-term events that are part of existing seasonal/annual variability. Project-specific measures to deal with high winds, precipitation, erosion, and wildfires are not anticipated to have a measurable effect on VCs.

The focus of such assessments is to describe how natural environmental causes may result in effects on the Project; specifically, on the engineered physical works and operations to the extent that the Project is not performing as intended. As such, there is one situation in which an effect of the environment on the project may further lead to effects on other VCs; namely, under natural conditions of flooding. Such effects are assessed in the accident and malfunction scenario "Outlet Channel Breach/Control Structure Failure", as described in in Section 14. The context of this pathway (natural flooding causing Project failure and then causing effects to VCs) however must be considered in the context of the primary purpose of the Project as a flood control management system; i.e., the Project itself is intended by design to mitigate an effect of the environment on the project (and all other human and environmental conditions during flood events and within the flood mitigation areas).

15.1.3 Mitigation of Effects

The primary mitigation tool to address these types of effects is adequate engineering design and the implementation of sound planning and monitoring and follow up programs. Designs adhere to engineering standards and reflect Manitoba Infrastructure's experience with similar projects. The outlet channels and other structures will be designed to resist both normal and extreme physical environmental conditions, based on historical records and future climate predictions. These standards consider physical environmental criteria, such as temperature, wind, rain, snow and ice loading for historical climate conditions.

As stated above, the "primary mitigation tool to address these types of effects [effect of environment on the Project] is adequate engineering design and the implementation of sound planning and monitoring and follow up programs". Routing of the channels involved avoiding areas of concern, as described in Section 2.4. This process involved both technical studies and engagement (including with potentially-affected Indigenous groups), and trade-offs between cost savings and effectiveness of various options.

Designs adhere to engineering standards (e.g., Canadian Dam Association guidelines, Manitoba Infrastructure design standards) and reflect Manitoba Infrastructure's experience with similar projects. The outlet channels and other structures will be designed to resist both normal and extreme physical environmental conditions, based on historical records and future climate predictions. This is especially so given that the purpose of the Project is to mitigate floods. These standards consider physical environmental criteria such as temperature, wind, rain, snow and ice loading for historical climate conditions. These standards are typically based on extensive documented experience on effectiveness, with regular updating as engineering practice evolve. The anticipated effectiveness is therefore typically high.

Section 3.7 of the EIS describes the Environmental Management Program (EMP) being developed for the Project, which consists of numerous monitoring and management plans that work in concert with communication, reporting and accountability protocol. Many of the mitigation and restoration measures currently described are industry-standard methods successfully applied in other projects, resulting in approaches that are both technically and economically feasible. Monitoring and follow-up plans are also currently being developed to be specific to each VC and be measurable and verifiable.

As noted in Section 15.3.2, a key plan is the Manitoba Emergency Plan (required by The Emergency Measures Act), developed by several provincial departments drawing on decades of experience in dealing with the types of emergencies described in the EIS. Another key reference in this section is the Project Environmental Requirements document (see Section 3.7 and Appendix 3F of the EIS) that contains preventative measures for environmental protection such as:

- Contractor submittals (e.g., Section 1.3 - Evacuation and Emergency Preparedness Plan; 2.1 – Requirements for Designated Areas)
- Halting work in adverse weather (e.g., Sections 2.4.1.5; 2.12.2.11.2; 2.13.1.5)
- Planned and Unplanned Shutdowns (e.g., Section 2.15 - could include cases of extreme weather)

The O&M Manual described in Section 3.3.2 also identifies maintenance activities and maintenance schedules that will contribute to maintaining the Project in good working order and therefore less vulnerable to effects from the environment.

15.2 SIGNIFICANCE THRESHOLDS FOR EFFECTS OF THE ENVIRONMENT ON THE PROJECT

It is important to stress that this chapter focuses on extreme/severe environmental events, and not regular operations and maintenance issues that are readily addressed by existing management plans. A significant adverse residual effect of the environment on the Project is defined as one that results in one or more of the following:

- damage to Project infrastructure resulting in harm to Project workers or the public
- a substantial effect on the Project schedule, delaying ongoing Project construction activities by one month or resulting in a disruption of operation requirements for more than two weeks
- damage to Project infrastructure resulting in the need for repairs that cannot be technically or economically implemented

15.3 EFFECT OF EXTREME WEATHER AND CLIMATE CONDITIONS ON THE PROJECT

15.3.1 Existing Conditions

The Project is located in two ecozones. The Prairies Ecozone in the west is characterized by short, warm summers, long, cold winters and low levels of precipitation. Winds are frequent and often strong and precipitation in summer often occurs as localized, heavy storms (Smith *et al.* 1998). The Boreal Plain Ecozone that includes the eastern portion of the Project is characterized by moderately warm summers and cold winters. The area can be influenced by localized storms, large-scale weather systems and the occurrence of tornadoes. A description of climatic conditions is provided in Chapter 6 (Physical Environment, Section 6.2.2.2.).

As described in Section 6.2.2.2., based on 1981-2010 climatic data from the Environment and Climate Change Canada weather station in Dauphin, Manitoba, the nearest representative station (located approximately 105 km west of the Lake Manitoba Outlet Channel Inlet), the extreme cold temperature is -44.4°C (February) and the extreme high temperature is 39.2°C (May). The highest amounts of extreme daily precipitation historically occur June through September and range from 75 mm to 100 mm per day over the entire period of record. With respect to winds, average speeds range from 13.0 km/h (July) to 16.6 km/h (May).

Manitoba Hydro (2015) prepared an historic and future climate study for the Manitoba-Minnesota Transmission Project (MMTP). Their study area included the southern half of Lake Manitoba and Lake Winnipeg and their findings are summarized here, as applicable to the Project:

> *Historically, mean temperature has increased, while mean wind speed has decreased. These results are consistent with other studies, including IPCC (2013) and Wan et al. (2009). Increasing precipitation trends have also been detected. With respect to extreme weather events, a trend*

> *analysis of 25 historic extreme indices shows statistically significant upwards trends for minimum and maximum temperature, growing season length and number of tropical nights. Statistically significant downward trends were detected for diurnal temperature range, number of frost days, number of ice days and cold spells. For precipitation-based indices, statistically significant upward trends were detected for total precipitation on wet days, very heavy precipitation days and consecutive wet days. Statistically significant downward trends were detected for the simple precipitation intensity index and consecutive dry days. For wind speed-based indices, statistically significant downward trends were detected in maximum wind gusts above 90 km/h and annual maximum of mean daily wind speed. Southern Manitoba experiences on average less than 10 hours of freezing rain and 20–30 hours of freezing drizzle per year.*

According to Government of Canada Environment and Natural Resources (2016) data from 1999 to 2013, total lightning strikes in Manitoba is greater in southern areas, ranging from more than 30,000 in Winnipeg, to more than 20,000 in Dauphin, and more than 10,000 in Norway House. Average number of days with lightning also decreases from south to north, ranging from approximately 20 in the Winnipeg and Dauphin and approximately 15 in Norway House. Tornadoes are produced by thunderstorms and form suddenly, often preceded by warm, humid weather. Southern Ontario has the highest rate of tornado occurrence in Canada, followed by southern Manitoba (Newark 2008). Canada records an average of 80-100 tornadoes a year, but the actual number is probably higher, as some may occur in remote areas and are not recorded. Each year, the Prairies experience an average of 43 tornadoes (Environment Canada 2014). The peak of the tornado season is late June and early July. The area damaged by the average tornado is 0.6 km^2 (Newark 2008). The majority of Canadian tornadoes have maximum wind speeds under 180 km/h (Environment Canada 2014).

Severe hail events are also known to occur in the Prairies, with large hail stones causing damage to property and infrastructure. While most severe hail stone events occur in Alberta, they have also been recorded in southern Manitoba. According to the Canadian Disaster Database, several large-scale hail events have occurred in the past couple of decades in southern Manitoba, which have involved baseball-sized or tennis-ball sized hail stones (Government of Canada 2013).

15.3.2 Effects Analysis and Mitigation

Extreme weather conditions are typically those for which Environment Canada issues alert bulletins https://www.canada.ca/en/environment-climate-change/services/types-weather-forecasts-use/public/criteria-alerts.html). These include conditions such as:

- extreme cold (-45°C) for at least two hours
- extreme heat (greater than 32°C) for two or more consecutive days
- extreme rainfall (greater than 25 mm) within one hour
- freezing drizzle/rain for at least eight hours and/or when it is expected to pose a hazard to transportation or property

- a thunderstorm with wind gusts (greater than 90 km/h) that could cause structural wind damage or large (>2cm) hail.
- heavy snowfall (greater than 10 cm) within 12 hours or less
- blizzard conditions with high winds (greater than 40 km/h), widespread reductions in visibility (less than 400 m) for at least 4 hours
- hurricane-force winds (greater than 118 km/h)

Construction projects typically integrate measures to deal with short-term weather conditions, but long-term or particularly extreme conditions require additional attention. During construction, runoff from extreme precipitation or storm events may cause road blockages, may damage some erosion and sedimentation control measures, and may shut down Project activities until conditions return to normal. Extreme events can create difficult and unsafe working conditions and may result in work stoppages. Excessive rainfall/snowfall events can result in reduced visibility and hazardous conditions for construction operators. This can increase the potential for accidental events, including spills, which can affect the environment.

During the operation and maintenance phase, extreme temperatures or precipitation events are not expected to affect the Project beyond the ability to manage through regular operation and maintenance activities, as the Project is designed to accommodate temperature extremes and high precipitation events (within design limits). Extreme wind and icing conditions could cause concern for some of the infrastructure (e.g., power lines and access roads) and supporting maintenance/repair activities. Infrastructure could also be damaged by tornadoes, hail and lightning strikes. Damage of water control structures could result in flooding proceeding as in pre-Project conditions.

In the event of adverse weather during construction, and operation and maintenance, contractors would implement contingency and emergency response measures and stop work if conditions are unsafe. It is anticipated that an Emergency Response Plan (ERP) and other health and safety plans will form part of the Project Environmental Management Program (see Section 3.7). Damage to infrastructure caused by adverse weather conditions would be minimized and repaired as necessary; this will be facilitated by immediate event-specific site inspections at sites potentially affected by an extreme event.

The Manitoba Emergency Plan (MEP; Province of Manitoba 2018) documents measures for prevention and mitigation, preparedness, response, and recovery. It describes the “coordinated provincial response to prevent/limit loss of life, injury to persons, damage to property or the environment and significant economic loss or reduction.” An annex to this plan is developed for flood control. Project Environmental Requirements (PERs) have been developed (see Section 3.7 and Appendix 3F) that describe measures to address certain emergency conditions related to issues such as erosion and sediment control. Site-specific drainage control measures and erosion and sediment control measures (as well as potential use of the EOC) would be used during construction to mitigate effects of precipitation and flooding within the PDA. In addition, construction of the channels will likely proceed by segmenting the PDA with coffer dams and levees (inlet and outlet construction) and by establishing a sequence of smaller excavation areas

(inland excavation of LMOC) to limit potential effects to smaller areas and allow a greater ability to manage ground and surface water effects but also those from extreme weather.

The MEP represents the basic all-hazard plan for coordinating a whole of government response to significant emergencies and disasters in Manitoba. The MEP does not replace mitigation planning, emergency response measures or operating guidelines developed specifically for the Project (as described in Chapter 3, Chapter 14, and Chapter 15). The MEP does, however, allow for a greater provincial response to significant and widespread emergencies, including flood events such as those experienced in 2011 and 2014 (see Chapter 2).

The Manitoba Flood Coordination Plan (an annex to the MEP) further stipulates that Manitoba Infrastructure is the primary provincial department which is responsible for provincial flood control and mitigation. The Manitoba Emergency Measures Organization (EMO) is identified as the provincial coordinating department, which is responsible to engage other relevant departments of the provincial government, as or if required, for response to an emergency.

Information regarding additional environmental management planning objectives, development and implementation is provided throughout Chapter 3 of the EIS. Information specific to the objectives, development and implementation of environmental management plans are provided in Section 3.7. Further clarification on this topic has also been provided in Manitoba Infrastructure's response for Conformance Request C1-15 and C1-16.

Specific descriptions for environmental management plans and other measures applicable to surface water, ice, and re-vegetation are provided in the following sections of the EIS:

- Surface Water
  - Sections 3.4.3.9, 3.5.3.4, 3.5.2.11, 3.7.2, and 3.7.3
  - Appendix 3F – Project Environmental Requirements
- Ice
  - Sections 3.5.3.5, and 3.7.3
- Vegetation
  - Sections 3.5.2.12, 3.5.2.13, 3.5.3.3, 3.5.4.2,
  - Appendix 3E – Manitoba Infrastructure Revegetation Program Guidance Document
  - Appendix 3F – Project Environmental Requirements

15.3.3 Residual Effect Characterization

Despite preparation and mitigation efforts, residual effects of extreme weather may remain. During construction, one of the greatest potentials for extreme weather to affect the Project and, in turn, the environment, stems from the creation of unsafe working conditions that could lead to increased chance of a spill (e.g., snow and ice conditions leading to a vehicle collision, which leads to a spill of hazardous materials from a vehicle). Extreme weather events (e.g., torrential rainstorms) could also result in erosion of unprotected or newly revegetated slopes during construction. While extreme conditions do increase the risk of such an event occurring, Manitoba Infrastructure has policies in place to require safe working conditions, including temporary shutdowns when conditions are unsafe and safe driving policies. The design and construction of the outlet channels and realignment of PR 239 will address existing drainage patterns surrounding the site and the need to address overland flooding during spring runoff or an extreme rainfall event. If additional localized drainage is required, it will be integrated with the existing site grading and drainage design. Spill prevention and response procedures are prepared by the contractors and will be in place during the Project construction phase, and monitored and enforced by Manitoba Infrastructure. In addition, as indicated, Project Environmental Requirements (PERs) have been developed (see Section 3.7 and Appendix 3F) that describe measures to address erosion and sediment control, accidents, spill leaks, reporting, cleanup, compliance training, inspection, and enforcement.

During operation and maintenance, there is a potential that an extreme icing event or wind conditions, tornado or hail events could damage infrastructure such as bridges and the water control structures, or cause breaching of the channels (discussed further in Section 14.2). This in turn could result in safety concerns for the public, operation of the control structure, or again increased risk of spills or effects on worker health and safety if repair crews are required to work under harsh conditions.

Manitoba Infrastructure has policies in place to address worker health and safety and the Province has established an emergency alerting process, managed by the Manitoba Emergency Measures Organization under *The Emergency Measures Act* (https://www.gov.mb.ca/emo/alerting/index.html). As indicated, the Manitoba Emergency Plan (Province of Manitoba 2018) documents measures for prevention and mitigation, preparedness, response, and recovery. It describes the “coordinated provincial response to prevent/limit loss of life, injury to persons, damage to property or the environment and significant economic loss or reduction.” An annex to this plan is developed for flood control. Chapter 14 (Accidents and Malfunctions, Section 14.2.4) also addressed flood control management.

While extreme weather could result in economic costs for repair, the fact that the Project itself is designed to be resilient to some extreme weather events (e.g., Manitoba Infrastructure design standards, Canadian Dam Association guidelines) reduces the effects and these scenarios are assessed as being not significant to the Project.

15.4 EFFECT OF EXTREME HYDROLOGICAL CONDITIONS ON THE PROJECT

15.4.1 Existing Conditions

Extreme hydrological conditions include both drought and flooding. The Manitoba Drought Management Strategy (https://www.gov.mb.ca/sd/pubs/research_data_maps/drought_management_strategy.pdf) defines drought as "a natural hazard caused by a shortage of water resulting in direct effects on both human and environmental wellbeing, for a given period of time, for any location(s) where natural or managed water systems fail to meet the typical water demand for human and environmental uses." It discusses the droughts that have occurred across the prairie provinces in the 1930s, 1960s, 1980s and 2000s, and the consequences for communities, agriculture, industry, individuals, animals and ecosystems, which include issues such as reduced water supplies for irrigation, drinking water, fisheries, forestry, municipal use and firefighting. There are challenges in determining the frequency, duration and severity of historic and future droughts as documented in scientific literature (Sheffield et al. 2012; Dai 2013; IPCC SREX 2012; IPCC 2013; Trenberth et al. 2014).

As described in Chapter 2, southern Manitoba is susceptible to flooding and over the past hundred years there have been at least six major floods that have caused damage in the region around the Assiniboine River (most recently in 1976, 1995, 2011 and 2014) with at least six on the Souris River (most recently in 1976, 1999 and 2011). Major flooding on Lake Manitoba has been less frequent (most recently in 2011 and 2014, but prior to that in 1954, 1955 and 1956); primarily due to the construction of the Fairford River Water Control Structure in 1961 (Province of Manitoba 1961). The consequences of flooding can be substantial. As an example, the flood of 2011 in southwestern Manitoba resulted in thousands of hectares of farmland being flooded, bridges and highways being damaged and residences around Dauphin Lake, Lake Manitoba and Lake St. Martin being damaged or destroyed. In addition, entire communities, including Lake St. Martin FN, Little Saskatchewan FN, Dauphin River FN and Dauphin River were displaced by the 2011 flood and residences, schools, and infrastructure in these communities were severely affected.

15.4.2 Effects Analysis and Mitigation

Drought is not anticipated to substantially affect Project construction, or operation and maintenance, except where drought results in higher likelihood of wildfires (see Section 15.7) occurring near the Project. Extended drought could affect the vegetation used to rehabilitate slopes and impacted sites and this would require additional efforts to maintain, or additional erosion and sedimentation control until conditions facilitate regrowth. Potential risks to integrity of infrastructure, such as channel diking, would be addressed through regular monitoring and maintenance.

The purpose of the Project is to develop a permanent flood control management system for Lake Manitoba and Lake St. Martin for alleviating flooding in the Lake St. Martin region. As described in Chapter 14 (Accidents and Malfunctions, Section 14.2.2), the Province of Manitoba has been managing and operating flood infrastructure for several decades, and has developed experience, skills and insights

with these types of structures, in terms of appropriate operating strategies and design standards, including contingency and emergency response planning and controls.

Increased incidence of flooding, arising from the prospect of higher intensity precipitation events, has been addressed in the design of the Project. Project-specific operating criteria (Chapter 3, Section 3.5.3) address worst case conditions, including assessing numerous potential scenarios. The operating guidelines describe how the Project is designed to work as an integrated system and to address anticipated larger flood events. Addressing flood conditions will form part of the Operation Environmental Management Program (OEMP).

As indicated in Section 15.3, the design and construction of the outlet channels and realignment of PR 239 will address existing drainage patterns surrounding the site and the need to address overland flooding during spring runoff or an extreme rainfall event. If additional localized drainage is required, it will be integrated with the existing site grading and drainage design. As indicated, the Province has established an emergency alerting process under *The Emergency Measures Act*, and the Manitoba Emergency Plan (MEP 2018) includes an annex developed to address flood conditions.

15.4.3 Residual Effect Characterization

Drought is not anticipated to substantially affect the Project, particularly considering that ongoing monitoring and adaptive mitigation measures are anticipated to address most effects. The Project has been designed to address effects of flooding. Manitoba Infrastructure will implement a flood protection program and will respond to floods affecting the Project based on the OEMP. The development of site-specific drainage control measures, and the flooding response component of the OEMP will limit flooding effects on Project infrastructure and people. With mitigation in place, the residual effects of extreme hydrological conditions on the Project are predicted to be not significant.

15.5 EFFECT OF LONG-TERM CLIMATE CHANGE ON THE PROJECT

15.5.1 Climate Scenarios

Climate plays an important role in determining most of the effects of the environment on the Project, and long-term climate change could potentially alter many of these effects. There is a general understanding within the scientific community that increased greenhouse gas (GHG) concentrations will increase global temperatures (IPCC 2013); however, there is less confidence in how the climate will change at the regional or local scale, and levels of confidence in projections for future climate vary from one region to another and among climate variables.

The Climate Atlas of Canada has an on-line map (https://climateatlas.ca/) that compares climate variables from a 1976-2005 data set to those predicted for 2021-2050, and 2051-2080. The predictions are based on the Pacific Climate Impacts Consortium's modelling (https://www.pacificclimate.org/data/statistically-downscaled-climate-scenarios). The Project is located in the Dauphin River Region on the map.

For the 2021-2050 scenario, the annual mean temperature was predicted to be more than 2^0C higher, with more +30^0C days (7). There were fewer frost days (21) predicted and fewer -30^0C days (8). An increase in the change from average mean precipitation was also predicted (2.3%), with most change (more than 12%) occurring in the winter and spring

For the 2051-2080 scenario the annual mean temperature was predicted to be more than 4^0C warmer (more than 6^0C in winter), based on mean annual temperatures, and more +30^0C days (25). Fewer frost days (39) and fewer -30^0C days (11) were predicted. An increase in the change from average mean precipitation was predicted (8%), with most (more than 25%) occurring in the winter and spring.

As the Project is located immediately to the north of the climate area assessed for the MMTP, some of the information can be referenced, including a climate study done for the MMTP (Manitoba Hydro 2015), which assessed southern Manitoba up to the intake of the Lake Manitoba Outlet Channel. A summary of the outputs of the climate change study is presented to describe the potential changes in effects of the environment on the Project.

The study was based on reviewing several future climate change scenarios. Future climate scenarios were developed for Winnipeg, characterizing projections of temperature, precipitation and wind speed for the 2020s (2010-2039), 2050s (2040- 2069) and 2080s (2070-2099). These were compared to an Environment Canada 1981-2010 data set (Environment Canada 2014).

The results from the Manitoba Hydro (2015) study suggest that mean annual temperature and precipitation will generally increase with time, while mean annual wind speed will decrease:

- By 2020 temperatures are projected to increase by more than 1ºC, 3ºC by 2050, and approximately 4ºC by 2080
- Precipitation is expected to increase by more than 3% by 2020, more than 4% by 2050 and more than 6% by 2080
- Of the four seasons, winter is likely to experience the greatest increase in mean temperature and greatest increase in relative precipitation
- Summer months are projected to experience the greatest relative reduction in surface wind speed

Manitoba Hydro (2015) noted that the uncertainty in predictions increases as the models are applied to a more local scale. Therefore, while the models provide specific numerical outputs for the target time frames, it is not possible to accurately predict what this will mean to various aspects of the natural and socioeconomic environment.

Climate change is anticipated to influence weather events including temperature averages, precipitation, seasonality, seasonal flooding, and long-term drought in Western Canada (Sauchyn and Kulshreshtha 2008; NRCAN 2015). Climate change is also anticipated to increase the frequency, duration, and magnitude of extreme weather events, including extreme precipitation events (IPCC WGI 2007). The Manitoba Hydro (2015) study also included a scientific literature review of possible future scenarios for

parameters such as freezing precipitation, wind gusts, tornado occurrence, lightning strikes, droughts and forest fires, which are not readily assessed using climate models. The study found:

- changes in freezing precipitation were inconclusive (Cheng et al. 2011; Lambert and Hansen 2011)
- it is likely that the increase in frequency of wind gusts will be greater in winter than in summer (Cheng 2014)
- there could be an increase in more severe thunderstorms and tornados (Brooks 2013; Diffenbaugh et al. 2013)
- there will be an increase in more explosive storms, with increasing occurrence of convective storms leading to the formation of lightning (Price 2009)
- there are challenges in determining the frequency, duration and severity of historic and future droughts and floods (Sheffield et al. 2012; Dai 2013; IPCC SREX 2012; IPCC 2013; Trenberth et al. 2014). For central North America, there is medium confidence that future duration and intensity of droughts will increase (IPCC SREX 2012). IPCC SREX (2012) and that floods driven by heavy rainfall could increase, with earlier spring peak flows in snowmelt-fed rivers
- there is a lack of agreement about future forest fire regimes, but fire severity indices and area burned were projected to increase into the future under global climate change, as well as a lengthening of the fire season (de Groot et al. 2013), and an increase in fires caused by lightning (Flannigan et al. 2005a, 2005b)

15.5.2 Effects Analysis and Mitigation

Due to the timing of planned construction, the effects of long-term climate change on construction activities will likely be negligible and unlikely. In general, climate change signals in short-term projections (i.e., pre-2050s) are often masked by natural climate variability while longer-term projections show a more prominent climate change signal. As discussed above, and in Section 15.3, extreme weather events could result in delays in construction, but these events are not expected to be frequent enough to substantially affect the construction schedule. Monitoring, inspections and adjustments will be made over time in responses to changes in the environment and technology. Extreme weather events in the future may prevent or delay access to the Project facilities and affect maintenance during operations. Climate change may affect the frequency of flood operations and volume of floodwaters handled by the Project because of the predicted increase in precipitation rates and risk of seasonal flooding.

The environmental impact assessment, hydrologic engineering analysis, planning, design and operation of hydraulic structures accounts for possible future effects of climatic variability and change. The Project is designed to mitigate effects of climate change on flood operations, including extreme precipitation events and increased risk of seasonal flooding.

15.5.3 Residual Effect Characterization

Climate change is likely to increase the frequency, duration, and magnitude of extreme weather events, including extreme precipitation and flooding. If the magnitude of flooding events exceeds the magnitude of the design flood (anticipated to be between the 1 in 10-year and the 1 in 300-year flood event), potential residual effects on the Project infrastructure would be the same as those under extreme hydrological conditions. The Project is a flood mitigation project, therefore the effects of increased flooding events due to climate change would be less than those expected without the Project. Therefore, these potential residual effects on the Project are rated not significant. The likelihood of events such as tornadoes or drought-related wildfires damaging Project infrastructure at the same time as a flood event is low. If damage to Project infrastructure does occur at the same time as a flood event, the potential residual effects of a channel breach would extend beyond the PDA, depending on the location of the breach, and lessen the effectiveness of the Project acting as a flood mitigation measure, but the effects on the environment would likely be less than those expected without the Project. This is discussed further in Section 14.2. With the mitigation measures discussed in the above sections, the residual effects of increased tornadoes, or wildfires on the Project due to climate change are assessed as not significant.

15.6 EFFECT OF GEOPHYSICAL AND GEOTECHNICAL HAZARDS ON THE PROJECT

15.6.1 Existing Conditions

Geological hazards and seismic activity are discussed in Chapter 6 (Geology and Soil, Section 6.3.2.2). The Project is located in an area of low seismic activity, with 10 earthquakes of magnitude 2.5 or less occurring in the past 30 years and all between 200 km and 700 km northeast of the Project. While Manitoba has experienced a few minor earthquakes, it is considered by Natural Resources Canada as the province in the country least likely to experience earthquakes (Natural Resources Canada 2013). The potential for geotechnical hazards associated with steep slopes along the outlet channel route are low because most of the area has slopes ranging from level to 5% (Chapter 6, Section 6.3.2.4).

15.6.2 Effects Analysis and Mitigation

Seismic events have the potential to affect personnel, equipment, and schedule during Project construction or operation and maintenance. Seismic events during operations could also affect the functionality of the Project if the events were substantial enough to affect the structural engineering of Project components.

The area is not anticipated to experience seismic activity and any seismic activity that could occur is expected to be minor and not result in damage. A geotechnical investigation of the outlet channel route will be conducted as part of detailed planning for the Project. The channels and other structures will be designed and constructed to address foundation or stability issues. Site-specific construction techniques will be developed where necessary for difficult terrain or steep slope conditions. In the remote event of seismic activity during Project construction or operation and maintenance, contractors would implement

contingency and emergency response measures and stop work if conditions were unsafe. Damage to Project infrastructure caused by seismic events during operations would be repaired.

15.6.3 Residual Effect Characterization

Seismic activity is not predicted to result in adverse residual effects on the Project during construction or operation and maintenance. With Manitoba Infrastructure's long-term experience with similar projects, the application of general design standards for the Project and site-specific design and mitigation where needed, the residual effects of geophysical and geotechnical hazards on the Project are predicted to be negligible and not significant.

15.7 EFFECT OF FIRE HAZARDS ON THE PROJECT

15.7.1 Existing Conditions

As described in Chapter 8 (Terrestrial Environment, Section 8.1) vegetation cover along the Project region varies from cultivated, pasture and shrubland to deciduous forests, mixedwood forests, coniferous forests and varying types of wetlands. Agriculture (pasture and cultivated) is the most common land cover class west and south of Lake St. Martin. Wetlands and coniferous forests are the most common land cover classes east and north of Lake St. Martin. Most of the forest cover is located in the northeastern portion of the Project region. The average forest age in the Project region is currently approximately 36 years old and covers approximately 17,039 ha.

Table 15.7-1 provides a summary of historic forest fire data for Manitoba. Fire activity is influenced by weather/climate, fuels, ignition agents and human activity (Flannigan et al. 2005b). Weather is the most important factor influencing fires because it drives other important parameters such as fuel moisture, soil moisture, lightning ignitions and wind (Flannigan et al. 2005b). Area burned is most directly linked to temperature (de Groot et al. 2013; Flannigan et al. 2005a), which is expected to increase into the future across the Project region. Historical analysis of fire regimes in Manitoba shows a link between drought cycles and area burned (Tardif 2004). Additionally, there is correlation between soil moisture and forest fires (Girardin and Mudelsee 2008). Fires spread rapidly when the available fuel is dry and weather conditions are warm, dry and windy. Over the past 150 years, the fire cycle in parts of Manitoba has lengthened from 55 to 200 years, which raises the risk of a large fire (Tardif 2004; Flannigan et al. 2005a). The lengthening of the fire cycle may be related to modern fire suppression strategies, which increases the time between fires but can also increase the risk of large fires (Tardif 2004).

Table 15.7-1 Manitoba Historic Forest Fire Data (2003 to 2013)

Year	Number of Fires					Area Burned (ha)				
	Human-caused	%	Lightning-caused	%	Total	Human-caused	%	Lightning-caused	%	Total
2003	685	56	529	44	1214	89,859	10	828,986	90	918,845
2004	110	47	123	53	233	937	4	25,066	96	26,003
2005	110	44	138	56	248	5,545	8	64,490	92	70,035
2006	266	39	416	61	682	5,907	4	151,486	96	157,393
2007	216	57	166	43	382	5,799	2	311,985	98	317,784
2008	259	65	137	35	396	74,403	49	77,463	51	151,866
2009	117	64	67	36	184	2,132	74	740	26	2,872
2010	273	47	302	53	575	22,853	12	171,549	88	194,402
2011	156	50	159	50	315	26,229	21	100,367	79	126,596
2012	204	41	293	59	497	21,027	10	195,861	90	216,888
2013	192	39	302	61	494	896	1	1,114,519	99	1,115,415
Source: Manitoba Conservation (2013)										

15.7.2 Effects Analysis and Mitigation

Fires that could affect the Project could result from uncontrolled grass fires, forest fires, burning of brush piles during construction and uncontrolled grass or stubble fires on agricultural lands. Fires could affect all phases of the Project. Fires could affect personnel, equipment, temporary and constructed infrastructure, and schedule during Project construction and operation and maintenance. Fires during operations could damage infrastructure such as bridges, water control structures, and distribution lines, as well as vegetation and habitat for wildlife.

The Manitoba Emergency Plan (Province of Manitoba 2018) provides information on prevention and mitigation, preparedness, response and recovery for issues such as fires. The Project Environmental Requirement document (see Appendix 3F) contains requirements for burning and brush disposal. Work permits contain requirements for onsite firefighting equipment. Further detail, including specific prevention and response measures, is provided in Chapter 14 (Accidents and Malfunctions, Section 14.6).

15.7.3 Residual Effect Characterization

The effects of fire that may be accidentally started as a result of Project activities are addressed in Chapter 14 (Section 14.5.4). As described above, non-project-sourced fires could result in damage to Project infrastructure. Burning of equipment or infrastructure could also result in a short-term reduction in air quality in the immediate area. Given the measures described in Section 14.5.4, the effects on vegetation and resultant fire hazards on the Project are assessed as not significant.

15.8 SUMMARY OF THE EFFECTS OF THE ENVIRONMENT ON THE PROJECT

This chapter considered how the following environmental conditions and hazards could affect the Project:

- extreme weather or climate conditions, including winds, extreme temperatures, severe precipitation, ice storms, tornadoes and lightning, that are applicable to the Project region
- extreme hydrological conditions, including droughts and flooding, that are applicable to the Project region
- climate change and its potential effects on future average and extreme climate conditions
- regional geotechnical and geophysical hazards, including ground instability, erosion and earthquakes
- vegetation growth and high fire hazards (grass fires and forest fires)

These environmental conditions could affect personnel, equipment, and schedule during Project construction and functionality of the outlet channels and Project infrastructure during operations (through functionality of control structures, dyke breaches, etc.). The Project will be designed to meet applicable standards and design measures to mitigate risks of environmental conditions affecting the Project, but extreme weather events could still result in the requirement for repair of structures. Contingency plans and emergency response measures would be implemented in the event of adverse and extreme conditions. With Project design and the implementation of response measures, potential residual effects of the environment on the Project are limited to climate change and damage to infrastructure because of wildfires, and tornadoes. Potential residual effects could extend beyond the PDA but would be low and are rated not significant. An outlet channel breach has the potential to be significant in the unlikely event of damage to Project infrastructure during a high magnitude flooding event, but this was assessed in Section 14.2 as being not significant. While this can result in socio-economic effects and potential public safety hazards, potential effects on the biophysical environment would be limited.

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Manitoba

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

Chapter 16

Conclusions

March 2020

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16.0 CONCLUSIONS

16.1 OVERVIEW OF CHAPTER

Widespread flooding across much of southern Manitoba in 2011 resulted in unprecedented inflows into Lake Manitoba and Lake St. Martin, overwhelming the capacity of existing waterways in the region and resulting in overland flooding that affected Indigenous communities such as the Lake St. Martin First Nation (FN), Dauphin River FN, Pinaymootang FN, Little Saskatchewan FN and Dauphin River Northern Affairs Community (NAC), as well as landowners, cottagers and many other communities in the region. Effects included damaged property, and in some cases displacement and evacuation from the community for several years. The economic effects of the 2011 flood event exceeded $1.2 billion, including infrastructure repair and disaster payments as well as flood response costs. The Lake Manitoba and Lake St. Martin Outlet Channels Project has been developed by Manitoba Infrastructure to provide a permanent flood control management system for alleviating flooding in the Lake St. Martin region.

Manitoba Infrastructure began engaging with interested parties following the flood in 2011 and began environmental studies in the area at that time. Initial engagement and studies focused on the Lake St. Martin emergency outlet channel, constructed in 2011. Correspondence and meetings with Indigenous communities and groups, landowners and the public after these meetings between 2011 and 2015 focused on the Project.

An environmental assessment of the Project is required under the *Canadian Environmental Assessment Act, 2012* and *The Environment Act* of Manitoba. The environmental assessment evaluated the effects of the Project on 14 Valued Components (VCs):

Physical Environment

- atmospheric environment
- geology and soils
- groundwater and surface water

Aquatic Environment

- fish and fish habitat

Terrestrial Environment

- vegetation
- wildlife

Human Environment

- land and resource use

- infrastructure and services
- economy
- human health
- heritage resources

Indigenous Peoples

- traditional land and resource use
- Indigenous health and socioeconomic conditions
- Aboriginal and Treaty rights

The assessment followed standard environmental assessment methods describing how the Project interacts with each VC, including effects during construction, operation and maintenance, and any areas of federal jurisdiction. It presents mitigation and environmental protection measures to reduce or eliminate adverse effects, characterizes the residual environmental effects that remain after mitigation has been applied, and determines the significance of the effects. However, significance of effects was not determined for the physical environment VCs (atmospheric environment, geology and soils, groundwater and surface water). Significance was only determined for those VCs that are receptors to any change in the physical environment VCs: the aquatic environment VCs, terrestrial environment VCs, human environment VCs and Indigenous peoples.

Chapters 6 through 10 provide a detailed evaluation of the VCs selected for assessment of the Project.

As required by Section 8 of the CEAA Guidelines, three summary tables are required:

1. a summary table following the format in Appendix 1 of the Guidelines (Section 16.2 of this chapter)
2. a summary of the key mitigation measures and commitments made by Manitoba Infrastructure that will more specifically mitigate any significant adverse effects of the Project on VCs (Section 16.3 of this chapter)
3. a summary of potential impacts to Aboriginal or Treaty rights, proposed mitigation to address these impacts, and proposed accommodation to unmitigated impacts to Aboriginal and Treaty rights (Section 16.4 of this chapter)

With the implementation of the proposed commitments and mitigation measures, adverse residual environmental effects of Project-related construction activities and operation and maintenance phases are predicted to be not significant.

16.2 SUMMARY OF ENVIRONMENTAL EFFECTS

Table 16.2-1 presents a summary of the environmental effects of the Project including potential effects, key mitigation measures, residual effects, effects characterization and significance of residual effects.

Table 16.2-1 Summary of Environmental Effects

Valued Component (VC) Affected	Area of Federal Jurisdiction	Project Phase		Potential Effects	Key Mitigation Measures	Residual Effect(s)	Residual Effects Characterization								Significance of Residual Effect (s)
		Construction	Operation and Maintenance				Direction*	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Ecological and Socio-economic Context*	
Atmospheric Environment		✓		Change in ambient air quality	• Project off-road construction equipment will comply with emission standards in the Canadian Off-Road Compression-Ignition Engine Emission Regulations (GOC 2019a). • Engines and exhaust systems will be properly maintained. Equipment will not be operated, including construction equipment, that shows excessive emissions of exhaust gases until corrective repairs or adjustments are made. • The concentration of sulphur in diesel fuel shall not exceed 15 mg/kg to comply with Sulphur in Diesel Fuel Regulations (GOC 2019b). • Construction vehicle idling times will be reduced to the extent possible in order to reduce emissions, as a best management practice. • Cold starts will be limited to the extent possible to reduce emissions, as a best management practice. • Use of a work camp will reduce emissions associated with transportation of staff to and from site during construction. • All work shall be conducted in a manner that minimizes the raising of dust from construction or maintenance operations. • Only water or approved dust suppressants shall be used for dust control. The use of waste petroleum or petroleum by-products as dust suppressants is not allowed. • All vehicles used to haul soils or aggregates to or from the work site shall have the load covered with a tarpaulin cover during transport to minimize dust and prevent material from falling out.	Project construction, operation and maintenance activities will create dust and combustion emissions. Effects on air quality during the Project operation and maintenance activities are expected to be lower in magnitude, duration and extent than during the construction phase due to the completion of excavation work, reduced use of vehicles and equipment, limited areal extent, and infrequent nature of the operation and maintenance activities. Effects during the operation and maintenance phases are expected to be minor and limited mainly to the PDAs, with some use of the Project area roadways. The primary emission sources of the Project are from construction equipment vehicle exhausts, and fugitive dust emissions result from surface disturbance activities. The primary effect on air quality is related to dust concentrations (TSP, PM_{10}, $PM_{2.5}$). The CAC ambient air quality concentrations due to the Project emissions are the greatest near the PDA and decrease substantially with increasing distance from the PDA. The CAC concentrations at the nearest occupied receptors will be lower than those that occur in/adjacent to the PDA and exceedances of ambient air quality criteria, attributable to the Project, are unlikely at these receptors. The Project is less than 0.01% of provincial CAC emissions.	A	ST	N/M	NS	LAA	RC	R	D	Significance is not determined for the Physical Environment VCs

Table 16.2-1 Summary of Environmental Effects

Valued Component (VC) Affected	Area of Federal Jurisdiction	Project Phase		Potential Effects	Key Mitigation Measures	Residual Effect(s)	Residual Effects Characterization								Significance of Residual Effect (s)
		Construction	Operation and Maintenance				Direction*	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Ecological and Socio-economic Context*	
Atmospheric Environment (cont'd)				Change in ambient air quality (cont'd)	• All material stockpiles or spoil piles prone to wind erosion shall be maintained as to minimize release of particulate matter or dust. This may include, but is not limited to, covering or stabilization of material stockpiled at the work site as required. • The application of dust suppressants shall be limited to the roadway, driveway or designated area. • The amount of dust suppressant applied should not exceed the minimum amount required to effectively suppress dust. • The material must not migrate or run off the traveled portion of the roadway or designated area. • Dust suppressants must conform to the manufacturer's specifications and must not contain concentrations of contaminants that would not normally be found in the suppressant. • Application of dust suppressants will be monitored so they will not enter and contaminate waterbodies, including surface and groundwater and the product will not leave the roadway. • Dust suppression products will not be applied if precipitation is occurring or forecast to occur before the product sets or cures. • Temporary soil and overburden stockpiles will be stabilized during extended periods between usage to prevent fugitive dust emissions.									

Table 16.2-1 Summary of Environmental Effects

Valued Component (VC) Affected	Area of Federal Jurisdiction	Project Phase		Potential Effects	Key Mitigation Measures	Residual Effect(s)	Residual Effects Characterization								Significance of Residual Effect (s)
		Construction	Operation and Maintenance				Direction*	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Ecological and Socio-economic Context*	
Atmospheric Environment (cont'd)		✓		Change in greenhouse gases	The mitigation measures associated with ambient air quality to reduce combustion emissions are also applicable to the mitigation of GHG emissions because combustion sources account for virtually all the GHG emissions associated with the construction phase.	The GHG emissions associated with construction of the Project are offset by reducing or eliminating future GHG emissions that would have occurred as a result of flood associated activities such as flood emergency management, flood debris cleanup, and during reconstruction of damaged areas. The Project produces less than 0.02% and 0.6% of 2017 national and provincial annual GHG emissions respectively. Therefore, the Project GHG emissions have negligible contribution to the national and provincial GHG emissions.	A	ST	L	NS	-	RC	I	D	Significance is not determined for the Physical Environment VCs
		✓		Change in existing acoustic environment	• Residents near construction noise-generating activities where noise impacts are expected to be moderate or high will be notified as required. • Temporary noise abatement barriers may be used to reduce noise levels. If noise abatement barriers are ineffective, a temporary reduction in the intensity of construction activities may be considered. • Machinery and factory supplied noise-abatement equipment (e.g., mufflers) will be maintained in good working order. • Machinery idling will be minimized. • Loud construction activities (e.g., pile driving) will be restricted to daytime periods. • A noise complaint response procedure will be implemented to address noise complaints should they arise.	During the construction phase of the Project, the potential noise effects of the Project activities are expected to occur within the PDA and extend to the LAA. Increased noise emissions may also occur along the provincial and municipal roads used for access and transport of materials, equipment and crews in the Project area during construction activities. Duration of noise emissions from construction activities will be limited to the construction phase. Effects on acoustic environment during the Project operation and maintenance activities are expected to be lower in magnitude, duration and extent than during the construction phase due to the reduced use of vehicles and equipment and infrequent nature of activities. Effects during the operation and maintenance phase are expected to be negligible and limited mainly to the PDAs, with some use of Project area roadways.	A	ST	M	HS	LAA	SI	R	D	Significance is not determined for the Physical Environment VCs

Table 16.2-1 Summary of Environmental Effects

Valued Component (VC) Affected	Area of Federal Jurisdiction	Project Phase		Potential Effects	Key Mitigation Measures	Residual Effect(s)	Residual Effects Characterization								Significance of Residual Effect (s)
		Construction	Operation and Maintenance				Direction*	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Ecological and Socio-economic Context*	
Atmospheric Environment (cont'd)		✓		Change in ambient light	• Full cut-off luminaire will be used wherever possible to reduce glare, light trespass, and sky glow from the Project lighting. • As much as is possible, lighting will be located such that unavoidable light spill off the working area is not directed toward receptors outside of the PDAs. • Lighting will be located so that the lights are not directed toward oncoming traffic on nearby roads on or off-site because of the objectionable nuisance and safety hazard this may present. • Lights will be designed to avoid excessive use of the mobile flood lighting units and reduce potential effects by turning off lighting when they are not required. • There will be adherence to lighting design guidelines, and the lighting requirements for workspaces as enforced by Labour Canada. • The Project will comply with applicable Federal and provincial health and safety guidelines related to adequate task.	As most of the Project construction will occur during daytime hours, Project-related lighting during night-time will be limited. The use of mobile artificial lighting may occur for short periods of time during the fall and winter seasons when the working day extends into the dark or during times when nighttime construction is required to meet schedule demands. In consideration of the potential levels of light trespass and glare from the operation of mobile lighting units and the proposed mitigation, it is unlikely that sky glow levels would increase to such a level that would be representative of an urban environment. During the Project operation and maintenance, some night-time safety lighting may be required for the channel inlets and outlets, drop structures, water control structures, bridges, quarries, and road works. Full cut-off lighting is also expected to reduce sky glow contributions to light reflected off nearby surfaces, which will be minimal.	A	ST	L	NS	LAA	SI	R	D	Significance is not determined for the Physical Environment VCs
Geology and Soils			✓	Change in terrain conditions	• Channel banks, berms, dikes and ditches will be seeded and revegetated with an appropriate native seed or erosion control mix to improve stability of these features, unless these features are being stabilized by rip-rap. • Drainage channels and re-alignments on upgradient sides of LMOC and LSMOC will channel water downslope and into the channels to minimize the risk of inundation and flooding as a result of channel presence • Surface drainage patterns for other Project components will be re-established where possible.	Residual effects to terrain conditions are expected to be limited to alterations to drainage. These residual effects will persist through Project operation and are irreversible. The drainage alterations are predicted to affect soil capability and productivity for natural vegetation and agricultural crop production. The effects are anticipated to comprise an estimated area of up to 2,400 ha around the LSMOC. An undetermined but limited area around the LMOC is expected to be affected. The effects will occur in both disturbed, agricultural landscapes, and undisturbed areas of natural vegetation and wetlands.	A	LT	H	NS	LAA	RC	I	U and D	Significance is not determined for the Physical Environment VCs

Table 16.2-1 Summary of Environmental Effects

Valued Component (VC) Affected	Area of Federal Jurisdiction	Project Phase		Potential Effects	Key Mitigation Measures	Residual Effect(s)	Residual Effects Characterization								Significance of Residual Effect (s)
		Construction	Operation and Maintenance				Direction*	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Ecological and Socio-economic Context*	
Geology and Soils (cont'd)		✓	✓	Change in soil quantity and quality	• Topsoil in designated areas shall be stripped and stockpiled for later reuse in site restoration. Granular material or other surface preparation, as approved by the Engineer, shall be placed to ensure all weather accessibility • Locations within Designated Areas where equipment, hazardous material and/or wastes will be stored or maintained shall be underlain with at least 30 cm of impermeable soil or approved equal and lined with an impermeable groundsheet to contain spills and minimize cleanup costs. • All salvaged and stockpiled organics and soils which were set aside during site development shall 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 • All grubbed organic and topsoil layers with leaf litter and root mass shall be stockpiled in appropriate locations and retained for reclamation efforts • Slash shall be piled in a manner that allows for clean, efficient burning of all material. Mixing soil into the slash shall be avoided. • Erosion and sediment control measures include maintenance of vegetation cover, where possible, long-term, temporary or emergency stabilization of soil, other erosion and sediment controls (e.g., erosion control blankets), setback of soil stockpiles from waterbodies, revegetation of disturbed areas, and runoff diversion to prevent undesirable soil movement or soil releases and discharges to a waterbody • Stripped topsoil shall be stored and used in the reclamation of the site	Residual effects to soil quantity and quality will be both adverse, as a result of Project presence and soil disturbance during construction, and positive, as a result of changes to lake levels and flood levels on Lake St. Martin. For the permanent channel components, soils supporting agricultural crop production and natural vegetation will be affected through Project operations. This soil disturbance will result in adverse effects including disturbance a loss of soils with agricultural capability around the LMOC, and soils supporting natural vegetation around the LSMOC. Effects to soil quality and quantity is not expected to limit the ability to reclaim and rehabilitate areas disturbed by the Project. Positive effects will occur due reduced flooding that will allow the return of soil capability and productivity for agricultural cropping and natural vegetation along the Lake St. Martin shoreline. Soil capability and productivity are not expected to return to baseline conditions. The effects are not sensitive to timing and are expected to occur infrequently during the construction phase (i.e., soil excavation and handling) to sporadically/intermittently throughout the operation phase (i.e., changes to flooding levels). The effects will occur in both disturbed, agricultural landscapes, and undisturbed areas of natural vegetation and wetlands. Effects to soil quality and quantity, in turn, affect soil capability and productivity for natural vegetation and agricultural cropping in areas of respective land uses.	A and P	LT	M	NS	PDA and LAA	SI	I	U and D	Significance is not determined for the Physical Environment VCs

Table 16.2-1 Summary of Environmental Effects

Valued Component (VC) Affected	Area of Federal Jurisdiction	Project Phase		Potential Effects	Key Mitigation Measures	Residual Effect(s)	Residual Effects Characterization								Significance of Residual Effect (s)
		Construction	Operation and Maintenance				Direction*	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Ecological and Socio-economic Context*	
Geology and Soils (cont'd)				Change in soil quantity and quality (cont'd)	• Spills, leaks or releases shall be reported within 24 hours and contaminated soil shall be appropriately disposed of at a licensed facility or stored in a designated storage area to prevent secondary contamination • All designated areas shall 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 shall be spread to promote natural re-establishment of vegetation.										
Groundwater and Surface Water: Groundwater		✓	✓	Changes in local groundwater flows, levels and quality	• A Groundwater Management Plan will be developed to refine the analyses of effects of dewatering. • Further aquifer investigation and modelling will be carried out to determine the effect of construction dewatering on specific domestic wells. Additional observation wells will be installed prior to construction dewatering to monitor the effects during dewatering of each section during construction. Mitigation plans will be modified as required during the dewatering as specific information is received from monitoring. • Mitigation for domestic wells could include lowering existing pump, supplying new pumps, or drilling new wells. • Water from construction dewatering will be diverted to dugouts for livestock watering. Dugouts will be supplied by pressure relief artesian wells during operation. • The drainage along LSMOC will be maintained to reduce the potential effects of water backing up in the wetlands upstream, south and east of the LSMOC.	The Project may affect pressure in domestic or livestock wells within 3 to 5 km of the LMOC; however, the effect is mitigable by a groundwater management plan that will further study effects, consult with local landowners and develop specific mitigation plans for each well user. Changes in groundwater level and flow around the channel excavations is expected to be less than 1 m, and the effects will transfer over 10 to 200 m perpendicular to the channels at most. Around Lake St. Martin, the Fairford River and the Dauphin River, water levels will decrease during high dewatering conditions due to the Project. The location of the proposed LMOC was selected to reduce the risk of drinking water bacterial contamination. By optimizing and maintaining artesian pressure within the carbonate aquifer in the area, the residual effect is the decrease in the risk of the domestic use aquifer being contaminated by floods.	A	ST/ LT	M/NL	NS	LAA/ PDA	IF/ RC	RS/I	U	Significance is not determined for the Physical Environment VCs

Table 16.2-1 Summary of Environmental Effects

Valued Component (VC) Affected	Area of Federal Jurisdiction	Project Phase		Potential Effects	Key Mitigation Measures	Residual Effect(s)	Residual Effects Characterization								Significance of Residual Effect (s)
		Construction	Operation and Maintenance				Direction*	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Ecological and Socio-economic Context*	
Groundwater and Surface Water: Groundwater (cont'd)				Changes in local groundwater flows, levels and quality (cont'd)		It is expected that natural surface and shallow subsurface drainage flow may be affected along the LSMOC. Based on examination of the effects of the EOC, effects to drainage are expected to occur within a distance of 500 m or less of the channel, affecting 1,250 ha on either side of the channel.									
		✓	✓	Changes in local groundwater and surface water interactions	For LMOC: • Selection of optimal route reduces the risk of groundwater being affected by surface water: artesian pressure is used to maintain flow in upward direction thus restraining potential contaminant to infiltrate the domestic water use aquifer. • Dewatering water can be conveyed to wetlands if further water supply is needed. • Clay cut-off walls (or other measures) can be built during construction to stop leakage affecting water balance of wetlands. For LSMOC: • The drainage along LSMOC will be maintained to reduce the potential effects of water backing up in the wetlands upstream (south and east) of the LSMOC. • If the risk is deemed sufficient, grout injection of the pervious top horizon of the carbonate aquifer in areas of potential exposure prior to excavation will cut off possible artificial groundwater discharge. This would serve to maintain local artesian pressure if deemed necessary based on the detailed design process.	The potential changes in groundwater and surface water interactions due to the Project were determined to be of low magnitude in the LMOC area based on the understanding of surface water and groundwater flows in this area and the design mitigation that will be incorporated (e.g., maintenance of drainage and flows to the Birch Creek and Watchorn Creek systems) to reduce potential effects. The potential changes in groundwater and surface water interactions due to the Project were determined to be of moderate magnitude in the LSMOC area based on examination of the effects of the EOC on wetland vegetation in the area, and the need for further understanding of the wetland hydrology in the area and interactions with the LSMOC.	A	ST/ LT	NL	HS	LAA/ PDA	IF/ RC	RS/I	U	

Table 16.2-1 Summary of Environmental Effects

Valued Component (VC) Affected	Area of Federal Jurisdiction	Project Phase		Potential Effects	Key Mitigation Measures	Residual Effect(s)	Residual Effects Characterization								Significance of Residual Effect (s)
		Construction	Operation and Maintenance				Direction*	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Ecological and Socio-economic Context*	
Groundwater and Surface Water: Surface Water			✓	Changes in regional flow and water levels	The Project is designed for mitigating flooding on Lake Manitoba, Lake St. Martin and the Fairford and Dauphin Rivers. No additional mitigation to effects on regional flows and water levels is required.	The potential effects of the operation of the LMOC and LSMOC on regional flows and lake levels include a reduction in peak flood levels, reduced flood inundation areas, and an increase in the amount of time that Lake Manitoba and Lake St. Martin are within the desired regulated range. These effects are a desired positive outcome and objective of the Project.	P	LT	L-M	HS	LAA	RC	R	DR	Significance is not determined for the Physical Environment VCs
			✓	Changes in regional fluvial geomorphology and shoreline morphology	• A primary form of mitigation that could be used to offset changes to flows in the Buffalo Creek system and wetlands associated with the construction and operation of the LSMOC is the repurposing of the EOC. • Manitoba Infrastructure is developing a comprehensive Environmental Management Program (EMP) that encompasses several mitigation methods and measures to reduce or prevent potential effects to surface water during Project construction and operation, including ice processes. The Environmental Protection Plans (EPPs), Project Environmental Requirements (PERs), Waste Management Plan, Construction Decommissioning Plan, Hazardous Materials Management Plan and Emergency Response Plan will include mitigation measures that will protect surface water resources.	Minor, localized changes may occur in regards to changes in fluvial or shoreline geomorphology, and sediment and debris transport, but the changes in flows and lake levels that will occur in the regional and local waterways are within the range of high and low flows that have previously occurred in the Project area, and the magnitude of these potential effects were considered to be negligible to low.	N	LT	NL	HS	LAA	RC	I	D	
		✓	✓	Changes in local drainage areas and local drainage patterns		Local drainage areas and drainage patterns will be unavoidably altered in the areas where the LMOC and LSMOC will be located, but considerations for drainage in detailed design and application of mitigation measures will limit the magnitude and extent of these changes. The potential effects on local drainage areas and local drainage patterns were determined to be limited to the LAA.	A	LT	L-M	HS	LAA	RC	I	D	
		✓	✓	Changes in regional and/or local sediment and debris transport		Temporary increases in suspended sediments may occur in local waterways due to construction activities, or at the channel inlet and outlet areas during periods of initial outlet channel operation (gates open).	N	ST in C, LT in O	NL	HS	LAA	RC	I	D	

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Valued Component (VC) Affected	Area of Federal Jurisdiction	Project Phase		Potential Effects	Key Mitigation Measures	Residual Effect(s)	Residual Effects Characterization								Significance of Residual Effect (s)
		Construction	Operation and Maintenance				Direction*	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Ecological and Socio-economic Context*	
Groundwater and Surface Water: Surface Water (cont'd)			✓	Changes in regional and/or local ice processes	• Mitigation measures specific to the protection of surface water resources will be outlined in the Surface Water Management Plan (SWMP), the Debris Management Program (DMP) and the Sediment Management Program (SMP). Specific mitigation includes the following: – The LMOC and LSMOC will be operated in accordance with the Operating Rules developed for the Project, which includes considerations for ice management. – Signs indicating potential areas of thin ice will be used at LMOC and LSMOC inlet and outlet areas in accordance with Transport Canada requirements. – The SWMP will outline the methods and approach to document surface water quality in the Project area during construction, operation and maintenance activities, including comparison of collected samples to recommended guidelines.	The potential changes to ice processes in the regional and local waterways were considered to be neutral in direction and of negligible to low magnitude after mitigation, as the potential for adverse effects is minor and localized in nature and can be mitigated by navigational signage.	N	LT	NL	HS	LAA	SI	I	D	
		✓	✓	Changes in regional and/or local surface water quality		Although there may be low dissolved oxygen in some part of the LMOC during extended period of no operation, no adverse changes are expected to overall surface water quality in the LAA or RAA as the composition and volume of water being transported from Lake Manitoba to Sturgeon Bay is not altered by the Project construction or operation. That is, all flows from the Lake Manitoba basin will enter Sturgeon Bay, with or without the Project.	N	ST in C, LT in O	NL	HS	LAA	SI	I	D	
Fish and Fish Habitat	*Fisheries Act; Navigation Protection Act* *Species at Risk Act*	✓	✓	Permanent alteration or destruction of fish habitat	• DFO timing windows for instream work (https://www.dfo-mpo.gc.ca/pnw-ppe/timing-periodes/index-eng.htm) will be followed as practical, particularly for any instream work required "in-the-wet" Groundwater from aquifer depressurization during construction of the LMOC will be discharged to Birch Creek, Watchorn Creek, or to the lakes, wetlands, and drains to the east of the LMOC if required • Provincial AIS regulations will be complied with. • The Access Management Plan will reduce the risk of increasing dispersal of AIS including requiring all heavy machinery to be cleaned and disinfected prior to arriving on site and before moving between work areas at different lakes and drainages	None of the potential effects to fish habitat can be eliminated by the mitigation measures that will be employed during construction and operation of the channels. However, none of the potentially altered habitat is unique or limiting fish production in Lake Manitoba, Lake St. Martin, or Lake Winnipeg or their tributaries. 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 Project has been designed to only pass flows through the LMOC and LSMOC during high water events (excepting a small base flow in LSMOC) reducing effects to water levels and flows outside these periods	A	LT	NL	HS	LAA-RAA	RC-SI	I-R	U	Not significant

Table 16.2-1 Summary of Environmental Effects

Valued Component (VC) Affected	Area of Federal Jurisdiction	Project Phase		Potential Effects	Key Mitigation Measures	Residual Effect(s)	Residual Effects Characterization								Significance of Residual Effect (s)
		Construction	Operation and Maintenance				Direction*	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Ecological and Socio-economic Context*	
Fish and Fish Habitat (cont'd)				Permanent alteration or destruction of fish habitat (cont'd)	• The Sediment Management Plan will include the provision of 100 m set-backs 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; limits machine fording to one-time events; limits any instream work to low flow periods when waterbodies or watercourses are dry or frozen; installing silt curtains around excavation areas where practical; conducting excavations within dewatered cofferdams "in-the-dry"; transfer excavation spoil to upland areas away from streams and waterbodies; rip-rap sides of the channels and compact bottom sediments to the maximum extent possible; vegetate channel slopes with native vegetation.	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 fish with commercial, recreational or Aboriginal (CRA) value, such as walleye and northern pike. It is expected that the Project will result in a net gain in fish habitat as a result of the 172 ha of permanently wetted habitat created in the channels. Overall, effects to CRA fish productivity in the LAA and RAA due to potential changes in fish habitat are not expected to be measurable.								
	Fisheries Act; Navigation Protection Act Species at Risk Act		✓	Change in fish passage	• Bridges will be designed to allow fish passage and include culverts that comply with Manitoba's Stream Crossing guidelines for the Protection of Fish and Fish Habitat • The LSMOC will be designed to allow fish to exit it during the entire open-water season • Outflow discharges through the FRWSC will be designed in concordance with Lake Manitoba operational guidelines and corresponding discharges in the LMOC • The lower-most drop structure in the LSMOC will be designed to prevent upstream fish passage so that fish continue to use the Dauphin River	Changes in fish passage due to replacement or installation of new stream crossings are not expected to occur because there are specific guidelines for the design, sizing, and installation of stream crossings and these are well understood and will be followed during the Project. Mitigation measures cannot eliminate the passive or active movement of fish out of the lakes through the channels. Although it is expected there will be a small net increase in downstream movement of fish between the lakes in the long-term due to operation of the channels, the magnitude of this movement is expected to be small in comparison to the size of fish populations in the lakes and such movements are not expected to affect fish population sizes or productivity in the RAA. Small, localized changes in the abundance of schooling fish species (e.g., minnows) or life stages	N-A	LT	NL	HS	LAA	SI	RS	D-U	Not significant

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Valued Component (VC) Affected	Area of Federal Jurisdiction	Project Phase		Potential Effects	Key Mitigation Measures	Residual Effect(s)	Residual Effects Characterization								Significance of Residual Effect (s)
		Construction	Operation and Maintenance				Direction*	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Ecological and Socio-economic Context*	
Fish and Fish Habitat (cont'd)				Change in fish passage (cont'd)		(e.g., larvae) may occur intermittently when the channels are operating (gates open). However, any affect is expected to be short-term and low in magnitude as 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. Use of the channels may also affect cues that attract fish to the Fairford and Dauphin rivers, particularly by spawning fish. This is because a portion of the flow in these rivers will be carried by the channels. This is not expected to result in any change in the hydraulics or attraction flows in the Fairford or Dauphin rivers because the channels will only convey the water that would otherwise be flooding upland areas around the lakes and rivers; flows in the river themselves will remain the same as they would during flood conditions without the channels. Flow in the channels during flood events is likely to attract fish that would otherwise be attracted to the Fairford and Dauphin rivers. However, this is not expected to cause a decrease in spawning success or productivity of the fish populations in the RAA because: fish will not be able to ascend upstream beyond the lowest drop structure in the LSMOC; habitat below the water control structure in the LMOC and below the lowest drop structure in the LSMOC is likely to provide some spawning habitat for some fish species; and the channels are expected to be used only every three to four years.								

Table 16.2-1 Summary of Environmental Effects

Valued Component (VC) Affected	Area of Federal Jurisdiction	Project Phase		Potential Effects	Key Mitigation Measures	Residual Effect(s)	Residual Effects Characterization								Significance of Residual Effect (s)
		Construction	Operation and Maintenance				Direction*	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Ecological and Socio-economic Context*	
Fish and Fish Habitat (cont'd)	*Fisheries Act; Navigation Protection Act* *Species at Risk Act*	✓	✓	Change in fish health and mortality	• Re-fueling of machinery and storage of hydrocarbon products within 100 m from the high-water mark of waterbodies and watercourses will be prohibited. • Hydrocarbon products will be stored in secondary containment and approved storage tanks. • Accessible spill control and clean-up equipment will be maintained, and the workforce will be instructed about the Spill Response and Remediation Plan. • Equipment and vehicles will be maintained so that they are clean and free of leaks upon arrival to site and kept in good working order • Borrow-pits and quarries will be located at least 100 m away from watercourses and waterbodies. • The use of ammonium nitrate-fuel oil (ANFO) mixtures as explosives will be prohibited. • Channels will be designed and constructed with minimum residual pool depths to overwinter fish. • The downstream-most drop structure in the LSMOC will be designed to prevent fish access from Lake Winnipeg. • All drop structures in LSMOC will be designed and constructed to enable downstream movement of fish during all open-water flow conditions • The Access Management Plan will include construction of gates on access roads, a "no fishing" policy for workers and subcontractors during work shifts, and a "no fishing" policy for workers and the public in the channels at all times.	Of the potential effects on fish heath and mortality, only the potential effects of sediment, stranding of fish, and increased fishing pressure are likely to cause residual effects. Potential effects on fish health and mortality from accidental releases of deleterious substances and blasting in the borrow-pit and quarries are not carried forward 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. Effect of sediment releases on fish health and mortality are expected to be low in magnitude and restricted to the LAA and have no measurable effect on fish populations in the LAA or RAA. This is because the mitigation measures are well understood, technically feasible, and effective for the streams and lakes near the Project, sediment loads introduced during construction will be only a small proportion of the annual inputs to Lake St. Martin and Lake Winnipeg and will be highly localized and quickly dispersed by waves and currents in the lakes, and because fish species living in Lake Manitoba, Lake St. Martin, and Lake Winnipeg are adapted to living in the naturally turbid conditions. 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. Stranding of fish and eggs in the main body of the LSMOC will be prevented by providing baseflow year-round, providing deep pools for fish upstream of	A	LT	NL	HS	LAA-RAA	SI	I-R	U-D	Not significant

Table 16.2-1 Summary of Environmental Effects

Valued Component (VC) Affected	Area of Federal Jurisdiction	Project Phase		Potential Effects	Key Mitigation Measures	Residual Effect(s)	Residual Effects Characterization								Significance of Residual Effect (s)
		Construction	Operation and Maintenance				Direction*	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Ecological and Socio-economic Context*	
Fish and Fish Habitat (cont'd)				Change in fish health and mortality (cont'd)		the drop structures, and by designing the drop-structures to allow fish to leave the channel egress at any time of the year. 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 channel operations. No measurable effect on the productivity of any fish populations in the LAA or RAA is expected. Increased fish harvesting due to the presence of the workforce and improved access to fish-bearing lakes and streams is unavoidable. However, such increased harvesting is not expected to have a substantial effect on the abundance of CRA fish species in the LAA or RAA because the construction workforce will only be present for a maximum of 2.5 years, only a small proportion of this workforce is expected to be active anglers, and all anglers will need to abide by provincial fishing regulations. Importantly, none of the new roads or rights-of-way provide any new access to Lake Manitoba, Lake St. Martin, or Lake Winnipeg where most of the recreational, commercial, and Aboriginal fishing occurs. Based on the assessment of the proposed effects of the Project on fish and fish habitat, considering the avoidance and mitigation measures available, the residual effects of the Project on fish and fish habitat are predicted to be not significant.								

Table 16.2-1 Summary of Environmental Effects

Valued Component (VC) Affected	Area of Federal Jurisdiction	Project Phase		Potential Effects	Key Mitigation Measures	Residual Effect(s)	Residual Effects Characterization								Significance of Residual Effect (s)
		Construction	Operation and Maintenance				Direction*	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Ecological and Socio-economic Context*	
Vegetation	*Species at Risk Act*	✓		Change in landscape diversity	• Prior to clearing or grubbing, the work area will be clearly staked or marked. • Machinery will arrive on site in a clean condition and will 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. • Construction-related traffic will be restricted to the Project ROW and associated access routes during Project construction and maintenance. Where access routes are accessible by the public, blocking access when not in use. • Applicable setbacks will be applied to all known occurrences of federally listed species at risk and their critical habitat following Environment Canada requirements. 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. Seed collection or transplanting will be conducted, in consultation with Manitoba Sustainable Development, if occurrences cannot be avoided. • 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.	Project construction will alter mean vegetation patch size and mean patch perimeter length. 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, <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).	A	LT	M	NA	RAA	RC	I	U and D	Not significant
	Species at Risk Act	✓		Change in community diversity		Vegetation clearing will remove 306.3 ha (-3.4%) of native upland vegetation within the LAA. All native upland vegetation cover classes within the LAA will be maintained; however, clearing the ROW will change forested and shrubland areas into grassland communities and these restored communities may not have the same species composition or structure as prior to construction. Vegetation clearing includes 165.7 ha of native upland vegetation in the LMBOC of the LAA, which is predominantly dense and open deciduous forest. Along PR239, 12.7 ha of native upland vegetation will be removed in the LAA, including predominantly dense and open deciduous forest. In the LSMOC of the LAA, 127.9 ha of native upland vegetation, primarily dense coniferous and mixedwood forest, will be removed. No known areas of tall grass prairie communities of conservation concern (COCC) will be disturbed by the Project and effects on alvars are not expected. Effects on COCC will be limited	A	LT	M	MS	LAA	RC	I	U and D	Not significant

Table 16.2-1 Summary of Environmental Effects

Valued Component (VC) Affected	Area of Federal Jurisdiction	Project Phase		Potential Effects	Key Mitigation Measures	Residual Effect(s)	Residual Effects Characterization								Significance of Residual Effect (s)
		Construction	Operation and Maintenance				Direction*	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Ecological and Socio-economic Context*	
Vegetation (cont'd)				Change in community diversity (cont'd)	• 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.	to vegetation communities on seven locations of sandy soil within the PDA. 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. During operation, taller shrub and tree cover will likely be cleared from parts the ROW to maintain access roads. In addition, some native upland vegetation communities may benefit from reduced flooding including forest or grassland. Indirect effects from dust and non-native invasive species is likely to spread into the LAA.									
	Species at Risk Act	✓	✓	Change in species diversity		Plant Species of Conservation Concern - The Project will result in the direct loss of four plant SOCC within the PDA: sweet grass, saline shooting star, annual sunflower and dragon's mouth orchid. The Project will also 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 for flood control. Occurrences of annual sunflower, early yellow locoweed and yellow willow were also found in the LAA or RAA, and undocumented occurrences may occur in the PDA.	A-P	LT	L-M	MS	LAA	RC	I	U and D	Not significant

Table 16.2-1 Summary of Environmental Effects

Valued Component (VC) Affected	Area of Federal Jurisdiction	Project Phase		Potential Effects	Key Mitigation Measures	Residual Effect(s)	Residual Effects Characterization								Significance of Residual Effect (s)
		Construction	Operation and Maintenance				Direction*	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Ecological and Socio-economic Context*	
Vegetation (cont'd)				Change in species diversity (cont'd)		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 and blueberry species). The loss of marsh wetland habitat could result in the loss of seneca observed along Goodison Lake and the loss of sweet grass observed near Reed Lake as they are both wetland species. The Project will also have a positive effect on plant species of interest for Indigenous groups, including berries, 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.								

Table 16.2-1 Summary of Environmental Effects

Valued Component (VC) Affected	Area of Federal Jurisdiction	Project Phase		Potential Effects	Key Mitigation Measures	Residual Effect(s)	Residual Effects Characterization								Significance of Residual Effect (s)
		Construction	Operation and Maintenance				Direction*	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Ecological and Socio-economic Context*	
Vegetation (cont'd)				Change in species diversity (cont'd)		Non-native Invasive Species and Weeds - 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 are anticipated to persist following construction. 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, it is expected that the introduction, spread, and abundance of non-native invasive species would be managed. As the PDA and 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.								
	Species at Risk Act	✓	✓	Change in wetland function		Project clearing and channel construction is estimated to result in the loss of 290.6 ha of wetland area in the LMOC/PR239 intersected sub-watersheds and 617.7 ha in the LSMOC intersected sub-watersheds. Direct loss of wetland area in the Project intersected LMOC/PR239 sub-watersheds is restricted to shallow open water wetlands. Bogs, fens and swamps, 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. 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.	A	LT	L	MS/ NA	LAA/ RAA	RC	I	U and D	Not significant

Table 16.2-1 Summary of Environmental Effects

Valued Component (VC) Affected	Area of Federal Jurisdiction	Project Phase		Potential Effects	Key Mitigation Measures	Residual Effect(s)	Residual Effects Characterization								Significance of Residual Effect (s)
		Construction	Operation and Maintenance				Direction*	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Ecological and Socio-economic Context*	
Vegetation (cont'd)				Change in wetland function (cont'd)		Reduced catchment area may permanently reduce wetland water depth, duration of flooding and flood frequency, particularly near Birch Creek. Reduced marsh and shallow open water wetland abundance and altered wetland water levels in the Project intersected LMOC/PR239 sub-watersheds will reduce the abundance of wetland dependent plant species and alter the distribution of these plants in the RAA. The outside drain on the west side of the LMOC is expected to 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.									
Wildlife	*Migratory Birds Convention Act;* *Species at Risk Act*	✓	✓	Change in habitat	• Clearing will not occur between April 1and August 31 of any year unless otherwise authorized by the Engineer in order to avoid disturbance to nesting birds and other wildlife. • Terrestrial buffers, as identified by the Manitoba Conservation Data Centre's Recommended Development Setback Distances from Birds and/or MSDs Forest Management Guidelines for Terrestrial Buffers will be adhered to for all applicable sites. • Treed habitats will be retained 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).	Project construction will result in the loss or alteration of 1913.9 ha of terrestrial and aquatic habitat within the LAA, a 3 % decrease from baseline conditions. Clearing and excavation of the PDA will result in a direct loss of 1013.6 ha of wetland habitat, 268.3 ha of forested habitat (-4.7%), and 410 ha of grassland (8 ha native grassland cover). 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.	A/P	LT	L-M-H	HS	LAA	RC/IF	R-I	U-D	Not significant

Table 16.2-1 Summary of Environmental Effects

Valued Component (VC) Affected	Area of Federal Jurisdiction	Project Phase		Potential Effects	Key Mitigation Measures	Residual Effect(s)	Residual Effects Characterization								Significance of Residual Effect (s)
		Construction	Operation and Maintenance				Direction*	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Ecological and Socio-economic Context*	
Wildlife (cont'd)				Change in habitat (cont'd)	• A Red-headed Woodpecker and/or Eastern Whip-Poor-Will Mitigation and Offset Plan may be developed if required. in consultation with provincial and federal regulators, stakeholders and Indigenous communities. • Where feasible, snags containing nesting cavities or having potential to support nesting cavities along portions of the ROW being cleared will be removed 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 cannot be salvaged.									
	Migratory Birds Convention Act; *Species at Risk Act*	✓	✓	Change in mortality risk	• 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. • Signs will be installed on access roads to limit public from accessing outlet channel ROWs.	Project residual effects for a change in mortality risk are expected include increased mortality risk due to vegetation clearing activities, increased Project-related traffic, conveyance of floodwaters in the outlet channels, and increased access by predators and people.	A	MT	N	HS	LAA	RC/ IF	R-I	U-D	Not significant
	Migratory Birds Convention Act; *Species at Risk Act*	✓	✓	Change in movement	• The use of rip rap and side slopes will be minimized, to the extent feasible, to facilitate wildlife movement. • Where feasible, cover plantings (e.g., trees and/or shrubs) will be added along select upland areas of the channels to facilitate movement of wildlife.	Project residual effects for a change in movement are expected include alteration of wildlife movement due to the development of a linear landscape features (i.e., LMOC and LSMOC) that may present a barrier to wildlife, particularly during the conveyance of floodwaters	A	MT	L	HS	LAA	RC/ IF	R-I	U-D	Not significant

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Valued Component (VC) Affected	Area of Federal Jurisdiction	Project Phase		Potential Effects	Key Mitigation Measures	Residual Effect(s)	Residual Effects Characterization								Significance of Residual Effect (s)
		Construction	Operation and Maintenance				Direction*	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Ecological and Socio-economic Context*	
Land and Resource Use		✓	✓	Change in land use	• Manitoba Infrastructure will provide Project development information on their website. • Construction activities and equipment will be managed to avoid damage and disturbance to adjacent properties, structures and operations. • Channel excavation and disturbance will be limited to defined rights-of-way and access routes. • Existing roads, road allowances, trails, portages and other travel ways will not be blocked or altered as a result of clearing and grubbing activities so as not to interfere with other users. • There will be no entry of personnel or equipment, or work conducted on private property. • All work will be conducted in a manner that minimizes the raising of dust; only water or approved dust suppressants will be used for dust control. • All construction equipment supplied will be effectively “sound-reduced” by proper means. • Noise by-laws of the adjacent communities and municipal authorities will be complied with. • Advanced notification will be given to affected parties prior to each blasting event. • The Contractor will restore access roads not required for on-going maintenance to original condition. • Manitoba Infrastructure will implement an Access Management Plan, including control measures. • Access will be maintained into yard sites where possible for PR 239 road realignment. • Signs directing traffic to detours will be installed during construction to address public safety.	Project effects on land use have been considered and avoided or reduced through the application of mitigation measures. Land use within the PDA for the LMOC and LSMOC will change as a result of the Project. Access to areas in the PDA and LAA will be affected by construction activities temporarily and permanently with Project presence. The Project will comply with the RM of Grahamdale development plan land use policies and provincial land use policies. Residual adverse effects are anticipated to be low to moderate magnitude and will not substantially affect land use activities in the LAA. The socio-economic context for the residual effects across the LAA is dependent upon location within the PDA and is resilient as land use can accommodate some change in the baseline.	A	ST/ LT	L/M	N/A	PDA/ LAA	IF/ RC	RS/I	R	Not significant

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Valued Component (VC) Affected	Area of Federal Jurisdiction	Project Phase		Potential Effects	Key Mitigation Measures	Residual Effect(s)	Residual Effects Characterization								Significance of Residual Effect (s)
		Construction	Operation and Maintenance				Direction*	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Ecological and Socio-economic Context*	
Land and Resource Use (cont'd)				Change in land use (cont'd)	• Construction, operation and maintenance will avoid affecting neighbouring properties or operations. • All designated areas and temporary access roads will be leveled to natural or pre-existing grade and slope for decommissioning. • Access routes not required for ongoing maintenance will be leveled to natural or pre-existing grade and slope as part of decommissioning. • 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 where conditions permit, it will commence immediately upon completion of grading, capping and trimming operations. • Reclamation of temporary construction areas and aggregate/quarry sites will occur following the completion of construction once the sites are no longer needed for operation and maintenance and would be expected to follow those measures in place at the time of remediation/decommissioning and in full compliance with legislation and regulatory standards. Advanced notification will be given to affected parties prior to each blasting event. • The Contractor will restore access roads not required for on-going maintenance to original condition. • Manitoba Infrastructure will implement an Access Management Plan, including control measures. • Access will be maintained into yard sites where possible for PR 239 road realignment. • Signs directing traffic to detours will be installed during construction to address public safety.									

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Valued Component (VC) Affected	Area of Federal Jurisdiction	Project Phase		Potential Effects	Key Mitigation Measures	Residual Effect(s)	Residual Effects Characterization								Significance of Residual Effect (s)
		Construction	Operation and Maintenance				Direction*	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Ecological and Socio-economic Context*	
Land and Resource Use (cont'd)				Change in land use (cont'd)	• Construction, operation and maintenance will avoid affecting neighbouring properties or operations. • All designated areas and temporary access roads will be leveled to natural or pre-existing grade and slope for decommissioning. • Reclamation of temporary construction areas and aggregate/quarry sites will follow measures in place at the time of remediation in full compliance with legislation and regulatory standards.										
		✓	✓	Change in agricultural land use	• Drainage channels and re-alignments on upgradient sides of LMOC will channel water downslope and into channels to minimize the risk of inundation and flooding from channel presence. • Surface drainage patterns for other Project components will be re-established where possible. • Locations of manure stockpiles within the PDA will be confirmed and stockpiles will be relocated to suitable areas outside of the PDA determined in conjunction with landowners prior to construction. • Manitoba Infrastructure will develop a biosecurity management plan to address biosecurity concerns. • All equipment will arrive at the construction site clean, free of soil/vegetative debris (including weed seeds).	Project effects on agricultural land use have been considered and avoided or reduced through the application of mitigation measures. Along and adjacent to the LMOC, residual adverse effects are anticipated to be moderate to high magnitude considering the context of agricultural land use areas within the LAA, are mostly due to the permanent loss of agricultural land and conflict with agricultural activities. Following the consideration of mitigation, residual effects are predicted to be not significant. Effects to agricultural land use around the Lake St. Martin portion of the land and resource use LAA are expected to be positive, as a result of decreased lake levels and flood levels due to the Project.	A/P	LT	M-H	NS/ HS	PDA/ LAA	RC	I	R/NR	Not significant

Table 16.2-1 Summary of Environmental Effects

Valued Component (VC) Affected	Area of Federal Jurisdiction	Project Phase		Potential Effects	Key Mitigation Measures	Residual Effect(s)	Residual Effects Characterization								Significance of Residual Effect (s)
		Construction	Operation and Maintenance				Direction*	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Ecological and Socio-economic Context*	
Land and Resource Use (cont'd)	*Navigation Protection Act*	✓	✓	Change in parks, recreation and tourism	• All plant and 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. • Channel excavation will be limited to defined rights-of-way and associated access routes. • Existing roads, road allowances, trails, portages and other travel ways will not be blocked or altered as a result of clearing and grubbing activities so as not to interfere with other users. • Access routes not required for on-going maintenance will be leveled to natural or pre-existing grade and slope as part of decommissioning. • Manitoba Infrastructure will implement an access management plan, which may include control measures such as providing signage at approaches to Project access roads to restrict public access to the PDA. • Recreation will not be allowed along the outlet channels through the life of the Project. Manitoba Infrastructure will install warning signs indicating no authorized personnel where required. • Notices to boaters, involving the posting of signage (i.e., danger, do not trespass warnings) will be implemented to communicate with boaters that the channels are not to be used for navigation.	Routing of the outlet channels included the consideration of recreation and tourism. No lodges, campgrounds, resorts or cottages are traversed by the LMOC or LSMOC alignments. Project effects on parks, recreation and tourism have been considered and avoided or reduced through the application of mitigation measures. The Project will not affect the functioning of Watchorn Provincial Recreation Park and will not affect any federal or provincial existing designated or permanently protected lands. One area of special interest at Sturgeon Bay will be affected by LSMOC. Residual adverse effects are anticipated to be low magnitude and will not substantially affect recreational use activities in the LAA.	A	ST-MT/ LT	L	N/A	PDA/ LAA	IF/ RC	RS/I	R	Not significant

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Valued Component (VC) Affected	Area of Federal Jurisdiction	Project Phase		Potential Effects	Key Mitigation Measures	Residual Effect(s)	Residual Effects Characterization								Significance of Residual Effect (s)
		Construction	Operation and Maintenance				Direction*	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Ecological and Socio-economic Context*	
Land and Resource Use (cont'd)		✓	✓	Change in resource use, hunting and trapping	• Employees, workers and other staff will not hunt, trap or harass wildlife on the worksite. • 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. • Manitoba Infrastructure will restrict unauthorized access to the outlet channels during operation. • Manitoba Infrastructure will install warning signs on ROWs, where required, indicating no unauthorized personnel.	Project effects on resource use (hunting, trapping, fishing, mining/aggregates, forestry, groundwater and surface water) have been avoided or reduced through the application of mitigation measures. Residual adverse effects generally are low to moderate in magnitude and will not substantially affect any of the resource use activities within the LAA.	A	ST-MT/ LT	L	N/A	PDA/ LAA	IF/ RC	RS/I	R	Not significant
		✓		Change in resource use, fishing	• Manitoba Infrastructure will engage with commercial fish harvesters, anglers and MSD Regional Officials to address potential conflict, disturbance, or access restrictions to fishing/harvesting areas in the PDA and LAA, and availability of fish resources. • South of 53rd parallel, the Contractor will not undertake any in-water activities in fish bearing waters or potentially fish bearing waters between September 15 and June 30 of the following year, during periods of high stream flow or identified spawning periods, unless otherwise authorized by Fisheries and Oceans Canada and MSD.		A	MT	L	N/A	LAA	IF	RS	R	Not significant
		✓	✓	Change in resource use, mining/aggregates	• Quarry operations will not encroach within 15 m of any property boundary adjoining, private, municipal, or Crown leased land.		A	ST/ LT	L	NS	PDA	SI/ RC	RS/I	R	Not significant

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Valued Component (VC) Affected	Area of Federal Jurisdiction	Project Phase		Potential Effects	Key Mitigation Measures	Residual Effect(s)	Residual Effects Characterization								Significance of Residual Effect (s)
		Construction	Operation and Maintenance				Direction*	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Ecological and Socio-economic Context*	
Land and Resource Use (cont'd)		✓		Change in resource use, forestry	• Unless otherwise authorized by the Engineer, all brush and trees, except those designated to be saved will be cut level with the ground. All surface debris, excluding merchantable timber but including fallen timber, slash limbs, brush, grass and weeds will be disposed of in an appropriate manner. • There will be no bulldozing of trees or woody debris into standing timber. • Timber from which forest products can be manufactured (merchantable timber) will be cleared of limbs and neatly stockpiled within the work limits as directed or permitted by the Engineer.		A	LT	L	NS	PDA	IF	I	R	Not significant
		✓	✓	Change in resource use, groundwater/ surface water	• Manitoba Infrastructure will develop Groundwater and Surface Water Management Plans. • A qualified drilling contractor with appropriate experience will be present for work in areas underlain by artesian aquifers (i.e., flowing and high-water well areas). • Construction dewatering will be limited through appropriate construction planning and will be in accordance with terms and approval conditions of *The Groundwater and Water Well Act* and *The Water Rights Act*. • Monitoring of groundwater levels in drill holes will be conducted during drilling and channel excavation. • Drill holes will be sealed as soon as possible in the case of a groundwater level rise.		A	ST/ LT	M/L	NS	LAA/ PDA	IF/ RC	RS/I	R	Not significant

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		Construction	Operation and Maintenance				Direction*	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Ecological and Socio-economic Context*	
Land and Resource Use (cont'd)				Change in resource use, groundwater/ surface water (cont'd)	• Precautions will be taken where there is potential for mixing surface and groundwater to prevent interconnection of these waters. • Existing water wells within the PDA will be plugged and decommissioned to prevent groundwater contamination.										
Infrastructure and Services		✓		Change in accommodations	• Manitoba Infrastructure will continue to make Project information, such as construction schedules, and predicted workforce numbers available to RMs, First Nations, local communities, service providers and businesses in the RAA during construction. • Temporary construction camps will be used to house the construction workforce for the LMOC and LSMOC if required.	Due to the limited availability of such temporary accommodations in the LAA, it is expected that most workers will be housed at one or more temporary construction camps. With the implementation of mitigation measures, residual effects on accommodations are expected to be not significant. There could also be an economic benefit to the region because of spending on accommodations and related services. During the operation and maintenance phase, the Project will require the services of one or two maintenance personnel.	A/P	ST	M	MS	RAA	RC	RS	NR	Not significant
		✓		Change in community infrastructure and services	• Manitoba Infrastructure will continue to make Project information available to the RMs, First Nations, local communities, service providers and businesses in the RAA about the construction workforce and timing of construction activities. • Solid wastes generated as a result of Project-related construction and operation and maintenance phases will be regularly transferred to appropriately permitted/licensed facilities for recycling and/or disposal.	Potential effects from the Project on health, emergency and protection services will be reduced through the implementation of the Emergency Response Plan, which will include a plan for medical incidents that includes 24-hour emergency transport to hospital and a plan for fire response and evacuation.	A/P	ST	L-M	MS	RAA	RC	RS	NR	Not significant

Table 16.2-1 Summary of Environmental Effects

Valued Component (VC) Affected	Area of Federal Jurisdiction	Project Phase		Potential Effects	Key Mitigation Measures	Residual Effect(s)	Residual Effects Characterization								Significance of Residual Effect (s)
		Construction	Operation and Maintenance				Direction*	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Ecological and Socio-economic Context*	
Infrastructure and Services (cont'd)				Change in community infrastructure and services (cont'd)	• Wastewater generated as a result of the Project construction (i.e., wastewater from work camps) will be stored and transferred for disposal to existing licensed facilities by qualified carriers. Drinking water could potentially be sourced from wells or delivered by truck from the nearest licensed/permitted water treatment facility. • A Waste Management Plan will be prepared for the Project.	Safe Work Manitoba maintains data on time-off injury rates for various industries. In 2017, the time-off injury rate for the heavy construction industry was 3.6 injuries per 100 full-time equivalents. Assuming that the 2017 time-off injury work is applicable to the Project, at peak Project workforce there would be 20.7 injuries/year. In consideration of identified mitigation measures, the Project will have a negligible to low effect on services provided by first responders and medical facilities within the LAA. A detailed estimate of wastewater generation has not been completed for the Project; however, as it is estimated that there are 575 workers during peak construction, compared to the LAA permanent population, the increase in solid waste in the LAA would be approximately 5%, at maximum. With the implementation of mitigation measures, during construction, effects are expected to be not significant. With the limited number of workers during operations and maintenance, no effects on community infrastructure and services are predicted during normal operations.								
		✓		Change in road traffic and road network	• Manitoba Infrastructure will continue to make Project information available to the RMs, First Nations, local communities and stakeholders in the RAA during construction so that detours can be communicated to residents and mitigate travel delays. • Transportation of workers between construction camp/accommodations and worksites will be done in groups (e.g., vans) and often using the PDA itself for access, to reduce the potential number of vehicles on the road network.	PTH 6 will be the main access road for the transportation of equipment, materials, and personnel from Winnipeg, and other commercial centres into the infrastructure and services LAA. For LMOC construction, it is anticipated that southern sections of the PDA will be accessed via PR 237, central sections via PR 239, and northern sections via local roadways. Current traffic volumes have been assessed as being well below the traffic thresholds, so it is not anticipated that the Project will change the level of service of this road	A/P	LT	L	MS	RAA	RC	RL	R	Not significant

Table 16.2-1 Summary of Environmental Effects

Valued Component (VC) Affected	Area of Federal Jurisdiction	Project Phase		Potential Effects	Key Mitigation Measures	Residual Effect(s)	Residual Effects Characterization								Significance of Residual Effect (s)
		Construction	Operation and Maintenance				Direction*	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Ecological and Socio-economic Context*	
Infrastructure and Services (cont'd)				Change in road traffic and road network (cont'd)	• Materials transported by truck will be compliant with restrictions and constraints set out by Manitoba Infrastructure and the RMs of Grahamdale and West Interlake. • A Traffic Management Plan will be prepared for the Project. • An Access Management Plan will be developed for the Project. • Sections of municipal roads will be reconstructed, realigned or extended to provide access across the LMOC at the bridge crossings to be constructed. • Temporary detours will be used to maintain access through the LMOC PDA during construction. • Project construction-related traffic will be restricted to the Project PDA and associated temporary access routes to the extent practical and required. • Other than initial mobilization, de-mobilization, and transportation of construction materials Project construction-related traffic will be restricted to the Project PDA and associated temporary access routes to the extent practical and required. • The Contractor will repair roads if they are damaged during construction.	LSMOC construction sites will be accessed via the EOC access road. Because most of the LSMOC construction traffic will use the EOC road, it is anticipated that Project-related traffic along PTH 6, north of Grahamdale, as well as on connecting roads, such as PR 513 will be minimal, and will not affect the level of services on those roads. There will be increases in roadway volumes along local roads that connect to the EOC. Traffic flow along roadways during construction periods will be managed via a traffic control plan, which may involve re-routing traffic along alternative routes. The maximum likely re-routing during construction would add approximately 10 km to local trips, resulting in increased travel times (assuming 60 km/h) of ten minutes per trip. With the implementation of mitigation measures, during construction, effects are expected to be not significant. Because of limited workers during operations and maintenance, the Project will have negligible effects on traffic volumes post-construction. The operation of the LMOC and LSMOC will alleviate flooding in low-lying areas within the LAA which will mean that roadways that may be flooded will remain operational.								

Table 16.2-1 Summary of Environmental Effects

Valued Component (VC) Affected	Area of Federal Jurisdiction	Project Phase		Potential Effects	Key Mitigation Measures	Residual Effect(s)	Residual Effects Characterization								Significance of Residual Effect (s)
		Construction	Operation and Maintenance				Direction*	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Ecological and Socio-economic Context*	
Infrastructure and Services			✓	Change in utilities	• Manitoba Infrastructure will continue to share Project information with entities responsible for underground and above-ground utilities (e.g., the RM of Grahamdale, Manitoba Hydro), and will coordinate any utility re-routing as part of Project construction.	There is limited potential for construction related impacts to utility infrastructure in the LAA. There are no identified potable water or sewer mains that would be affected. Overhead electricity and telecommunication utilities that could be affected by roadway re-alignment would be relocated with minimal service interruption. In consideration of the above there are predicted to be no residual effects on utility infrastructure during construction. The operation of the LMOC and LSMOC will alleviate flooding in low-lying areas within the LAA. A potential concern of flooding is contamination of potable water wells from flooded septic fields or wastewater lagoons.	P-	LT-	M	MS	RAA	RC	RL	NR-	Not significant
Economy		✓	✓	Change in provincial economy	Project effects on the provincial economy are expected to be positive in direction with the addition of direct, indirect, and induced employment income and GDP. As such, no mitigation measures are proposed to address adverse effects.	The Project will have a positive effect on the provincial economy; particularly during construction. The Project would have a negligible effect on the provincial economy during the operations and maintenance phase given the relatively small annual expenditure (less than $500,000) and workforce involved (one or two persons). Manitoba Infrastructure will be responsible for the cost of operations and maintenance of Project infrastructure.	P/A	N-L	LAA	ST/ LT	C/R	R	R	N/A	Not significant
		✓	✓	Change in regional economy	• Manitoba Infrastructure will adhere to government procurement policies and procedures. • Manitoba Infrastructure will compensate the RM of Grahamdale for decreased tax revenue by paying an annual fee in lieu of taxes in accordance with the *Expropriation Act*.	The Project is predicted to have both positive and adverse effects on the regional economy. Project spending will give a financial boost to the regional economy during construction. The Project would have a negligible effect on the regional economy related to expenditures given the relatively small annual expenditure (less than $500,000) and workforce involved (one or two persons). The Project will not adversely affect the taxation base of the RM of Grahamdale, because Manitoba Infrastructure will pay a grant in lieu of property taxes.	P, A	LT	M	MS	RAA	RC	R	BAC	Not significant

Table 16.2-1 Summary of Environmental Effects

Valued Component (VC) Affected	Area of Federal Jurisdiction	Project Phase		Potential Effects	Key Mitigation Measures	Residual Effect(s)	Residual Effects Characterization								Significance of Residual Effect (s)
		Construction	Operation and Maintenance				Direction*	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Ecological and Socio-economic Context*	
Economy (cont'd)		✓		Change in regional labour force	• Manitoba Infrastructure will follow industry standard wage rates to limit potential wage inflation associated with a constrained labour market.	Project residual effects on the labour force in the economy LAA are expected to be positive during construction with the addition of direct, indirect, and induced employment, and high in magnitude relative to the labour force. Project effects are expected throughout the LAA, and because they are associated with Project construction, would be short-term in duration and occur as a regular event (albeit with fluctuations in demand for labour). Effects are reversible once construction is complete. Timing sensitivity is moderate with respect to labour supply availability. Some businesses may be adversely affected due to the competition for available labour. However, mitigation measures will help offset this and the relatively high unemployment rate within the LAA indicates that the labour market has some capacity to absorb additional demand. The Project will affect some individual agricultural operations, and other land and resource users. However, with the application of mitigation measures, such effects are not anticipated to degrade or disrupt activities such that they cannot continue near the baseline level within the LAA overall. Finally, the Project has potential to affect the cost and availability of some services within the LAA. However, community residents will have alternatives with shortages most pronounced during the relatively short peak employment period. As well, such adverse effects will be balanced by the benefits that will be enjoyed by the communities.	P	ST	H	MS	RAA	RC	R	BAC	Not significant

Table 16.2-1 Summary of Environmental Effects

Valued Component (VC) Affected	Area of Federal Jurisdiction	Project Phase		Potential Effects	Key Mitigation Measures	Residual Effect(s)	Residual Effects Characterization								Significance of Residual Effect (s)
		Construction	Operation and Maintenance				Direction*	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Ecological and Socio-economic Context*	
Economy (cont'd)				Change in regional labour force (cont'd)		The Project will have a negligible effect on the labour force within the LAA during operations because of the low number of workers that will be directly or indirectly employed during this phase.									
		✓		Change in goods and services	• Manitoba Infrastructure will construct and operate work camps for non-resident construction workforce to reduce demand on accommodations within LAA.	It is not expected that the Project will affect cost and availability of consumer and other goods to residents or visitors within the LAA because such items can easily be transported from major commercial centres. The use of construction camps will limit Project-related demands on accommodations within the LAA and effects on tourism-related businesses. Project-related hiring of skilled and unskilled workers may contribute to labour shortages in some economic sectors, including trades and service employees. This is predicted to have a moderately adverse economic effect, which will persist over the course of the construction period and be reversed upon completion of construction. Due to the relatively small amount of Project spending during the operations and maintenance phase, effects on goods and services during this phase are predicted to be negligible.	A	ST	L/M	MS	RAA	RC	R	BAC	Not significant
Human Health	CEAA 2012: 5(1)(c) Aboriginal peoples	✓	✓	Change in human health – air quality	• Project off-road construction equipment will comply with emission standards in the Canadian Off-Road Compression-Ignition Engine Emission Regulations. • Engines and exhaust systems will be properly maintained. Equipment will not be operated, including construction equipment, that shows excessive emissions of exhaust gases until corrective repairs or adjustments are made.	The Project is expected to have a residual effect on air quality; however, the concentrations of air contaminants are predicted to remain below the applicable thresholds. There are no expected changes to surface water quality, groundwater quality, soil quality or country food quality in the LAA or RAA as a result of the Project. Therefore, there are no residual effects to be characterized.	A	ST	N	NS	LAA	SI	R	R	Not significant

Table 16.2-1 Summary of Environmental Effects

Valued Component (VC) Affected	Area of Federal Jurisdiction	Project Phase		Potential Effects	Key Mitigation Measures	Residual Effect(s)	Residual Effects Characterization								Significance of Residual Effect (s)
		Construction	Operation and Maintenance				Direction*	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Ecological and Socio-economic Context*	
Human Health (cont'd)				Change in human health – air quality (cont'd)	• The concentration of sulphur in diesel fuel will not exceed 15 mg/kg to comply with Sulphur in Diesel Fuel Regulations. • Construction vehicle idling times will be reduced to the extent possible in order to reduce emissions, as a best management practice. • Cold starts will be limited to the extent possible to reduce emissions, as a best management practice. • Use of a work camp will reduce emissions associated with transportation of staff to and from site during construction.	The Project will have no substantial residual effects on air quality, surface water quality, groundwater quality, soil quality, terrestrial country food quality or aquatic country food quality. As a result, the Project will have no significant residual effects on human health.									
	CEAA 2012: 5(1)(c) Aboriginal peoples	✓		Change in human health, noise levels	• Residents near to construction noise-generating activities will be notified. Temporary noise abatement barriers may be used to reduce noise levels. If noise abatement barriers are ineffective, a temporary reduction in the intensity of construction activities may be considered. • Machinery and factory-supplied noise-abatement equipment (e.g., mufflers) will be maintained in good working order. • Machinery idling will be minimized. • A complaint response procedure will be implemented to address noise complaints should they arise.	While the Project effects on noise levels in the absence of mitigation are expected to result in an increase to levels that would exceed the 57dBA upper noise threshold at a limited number of residential receptor locations, mitigation measures will address residual effects. In addition, effects would not last beyond construction of the Project and are not expected to extend beyond the LAA. As construction moves away from a given receptor location, noise levels are expected to return to pre-Project levels. Indigenous and non-Indigenous receptors in the area are expected to be able to continue pre-Project activities in the area.	A	ST	M	NS	LAA	SI	R	R	Not significant
Heritage Resources	CEAA 2012: 5(1)(c) Aboriginal peoples	✓		Change in heritage resources	• The HRB (Historic Resources Branch of the Manitoba Sport, Culture and Heritage Department) will be informed immediately if any heritage resources, or objects thought to be heritage resources, are discovered during site preparation and construction. • Protective barriers will be placed around heritage resource sites that are inadvertently found during construction so that the area can be protected while work proceeds.	Except for the effect on the Fairford Trail, potential effects on heritage resources will be confirmed after a preconstruction HRIA of the PDA is conducted under a valid permit. An HRIA will use predictive modelling to indicate locations of high heritage potential and examine and test those locations for heritage resources. With the mitigations in place, no adverse residual effects regarding dust and noise, altered surface and ground water, or unmarked graves are anticipated.	A	LT	H	NS	PDA	IF	I	U, D, NR	Not significant

Table 16.2-1 Summary of Environmental Effects

Valued Component (VC) Affected	Area of Federal Jurisdiction	Project Phase		Potential Effects	Key Mitigation Measures	Residual Effect(s)	Residual Effects Characterization								Significance of Residual Effect (s)
		Construction	Operation and Maintenance				Direction*	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Ecological and Socio-economic Context*	
Heritage Resources (cont'd)				Change in heritage resources (cont'd)	• All heritage resources discovered during site preparation and construction will be left in their original position until HRB is contacted and provides instruction. • Orientation for Project staff working in construction areas will include heritage resource awareness and training, including the nature of heritage resources and the management of any resources encountered. • Orientation information will include typical heritage resource materials and reporting procedures. • The Contractor will report heritage resource materials immediately to the Construction Supervisor and will cease construction activities in the immediate vicinity until HRB is contacted and prescribes instruction. • The Culture and Heritage Resource Protection Plan will be adhered to during construction and operations phases of the Project.									
	CEAA 2012: 5(1)(c) Aboriginal peoples	✓	✓	Change in cemeteries	• To avoid interrupting funerals or other ceremonies in Bayton St. Thomas Lutheran Cemetery, attempts will be made to notify the St. Thomas Lutheran Church of construction and maintenance schedules to facilitate avoiding noise and dust during activities. Contact information will be posted at the cemetery during construction, so individuals planning funerals or other ceremonies can contact the appropriate construction contractors to avoid interruptions by noise and dust. • To mitigate any residual effects of changes to the Bayton St. Thomas Lutheran Cemetery because of altered surface or ground water flow, the extant burials be periodically checked for evidence of tilting headstones, cracked grave covers or new depressions with freshly faulted edges.		N	ST	NL	NS	LAA	IF	RS	R	Not significant

Table 16.2-1 Summary of Environmental Effects

Valued Component (VC) Affected	Area of Federal Jurisdiction	Project Phase		Potential Effects	Key Mitigation Measures	Residual Effect(s)	Residual Effects Characterization								Significance of Residual Effect (s)
		Construction	Operation and Maintenance				Direction*	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Ecological and Socio-economic Context*	
Heritage Resources (cont'd)				Change in cemeteries (cont'd)	• Although it is not expected that the Project will interact with this site. To mitigate any residual effects of changes to the cemetery reported on Sturgeon Bay by Dauphin River First Nation, a preconstruction site visit has been offered to the Dauphin River First Nation.										
Traditional Land and Resource Use	CEAA 2012: 5(1)(c) Aboriginal peoples	✓	✓	Change in availability of traditional resources for current use	Mitigation measures provided for fish and fish habitat, vegetation, heritage resources, wildlife, and land and resource use are applicable for mitigating effects on traditional land and resource use. Additionally, the following mitigation measures will be implemented: • A schedule of construction and Project activities will be made available to all Indigenous groups and Northern Affairs Communities engaged on the Project, so that areas and time periods of activity can be avoided. • Vegetation control will occur through mechanical methods where feasible, and hand clearing will occur along shorelines to mitigate effects to plant harvesting. • Provincial aquatic invasive species protocols will be followed to reduce risk. • The Revegetation Plan will be completed as part of the Construction Environmental Management Program (CEMP) by Manitoba Infrastructure, and will involve the collaborative participation of interested Indigenous groups.	The Project is expected to result in changes to the availability of traditional resources for current use through alteration, reduction, or loss of habitat. Although the specific degree to which the PDA is being accessed for traditional purposes is not known, it is conservatively assumed that the Project will restrict access to traditional resources, current use sites, or locations. The residual environmental effects from the Project on TLRU are predicted to not be significant. The Project will not result in the long-term loss of availability of traditional use resources or access to lands currently relied on for traditional use practices, or the permanent loss of traditional use sites and areas in the LAA and RAA. It is also expected that changes in value or importance associated with current use will be largely limited to the PDA and direct disturbance areas, and with mitigation and continued engagement with Indigenous groups, that effects can be mitigated.	A	LT	N-L	HS	LAA	RC	I	U/D	Not significant

Table 16.2-1 Summary of Environmental Effects

Valued Component (VC) Affected	Area of Federal Jurisdiction	Project Phase		Potential Effects	Key Mitigation Measures	Residual Effect(s)	Residual Effects Characterization								Significance of Residual Effect (s)
		Construction	Operation and Maintenance				Direction*	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Ecological and Socio-economic Context*	
Traditional Land and Resource Use (cont'd)	CEAA 2012: 5(1)(c) Aboriginal peoples	✓	✓	Change in access to traditional resources and areas for current use	• Mitigation measures provided for land and resource use are applicable for mitigating effects on change in access to traditional land and resource use. Additionally, the following mitigation measures will be implemented: • Manitoba Infrastructure will engage with Dauphin River First Nation, Peguis First Nation, Pinaymootang First Nation and other Indigenous groups in order to better understand the use and importance of the snowmobile trails which are intersected by the Lake St. Martin Outlet Channel and to develop suitable means of crossing the Lake St. Martin Outlet Channel following construction.		A	LT	M	NS	LAA	RC	I	D	Not significant
	CEAA 2012: 5(1)(c) Aboriginal peoples	✓	✓	Change to cultural and spiritual sites or areas	• Detailed recording and mapping of spiritual or cultural sites will be developed in partnership with Indigenous groups, leading to a decision made about the relative importance of the site and potential mitigations strategies. • An appropriate ceremony will be held prior to commencement of construction under the direction of local Indigenous groups.		A	LT	M-H	NS	PDA-LAA	RC	I	D	Not significant
	CEAA 2012: 5(1)(c) Aboriginal peoples	✓	✓	Changes to the cultural value or importance associated with current use	Manitoba Infrastructure will continue to engage with Indigenous groups regarding mitigations to changes to cultural value or importance associated with current use, and concerning the recommendations identified by Indigenous groups		Changes to the cultural value or importance associated with current use are not characterized using the standard effects characterization parameters. Residual effects characterization is discussed with each Aboriginal group.								

Table 16.2-1 Summary of Environmental Effects

Valued Component (VC) Affected	Area of Federal Jurisdiction	Project Phase		Potential Effects	Key Mitigation Measures	Residual Effect(s)	Residual Effects Characterization								Significance of Residual Effect (s)
		Construction	Operation and Maintenance				Direction*	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Ecological and Socio-economic Context*	
Indigenous Health and Socio-economic Conditions	CEAA 2012: 5(1)(c) Aboriginal peoples	✓	✓	Change in indigenous health conditions	Mitigation measures provided for health, land and resource use, and traditional land and resource use are applicable for mitigating effects on change in Indigenous health and socio-economic conditions.	No changes are expected to surface water quality, groundwater quality, soil quality or chemical quality of country food as a result of the Project. Although some alteration of behavior will be required to continue harvesting country foods, changes to current use practices will not be critically reduced. Noise levels are not anticipated to affect public health and welfare. Overall, residual effects on Indigenous health conditions are anticipated to be not significant.	A	LT	L-M	HS	LAA	RC	IR	BS	Not significant
		✓	✓	Change in indigenous socio-economic conditions		The reductions in lake levels and flood levels in Lake St. Martin as a result of the Project will provide positive effects to agricultural land use within Lake St. Martin First Nation, Little Saskatchewan First Nation and Pinaymootang First Nation. Residual effects on commercial fishing, trapping, forestry, and recreation and tourism are expected particularly during construction however it is anticipated that the activities will be able to continue at similar levels as under baseline conditions. Changes to accommodation will take place during Project construction but are not anticipated to be persistent and ongoing. Manitoba Infrastructure's Environmental Management Program (Section 2.5) will include a traffic management plan and emergency response plan to mitigate residual effects on community infrastructure and services. Positive effects on infrastructure and services are anticipated during operations when the Project will alleviate flooding in low-lying areas and roadways and other infrastructure that may otherwise be flooded may remain operational. Changes in labour force and regional economy are unlikely to pose a substantial risk or benefit to the economy. It is expected that residual	A-P	ST-LT	M	HS	LAA	R	R	BS	Not significant

Table 16.2-1 Summary of Environmental Effects

Valued Component (VC) Affected	Area of Federal Jurisdiction	Project Phase		Potential Effects	Key Mitigation Measures	Residual Effect(s)	Residual Effects Characterization								Significance of Residual Effect (s)
		Construction	Operation and Maintenance				Direction*	Duration	Magnitude	Timing	Geographic Extent	Frequency	Reversibility	Ecological and Socio-economic Context*	
Indigenous Health and Socio-economic Conditions (cont'd)				Change in indigenous socio-economic conditions (cont'd)		effects can be managed through mitigation which increase Indigenous participation. Overall, residual effects on Indigenous socio-economic conditions will be not significant.									
Treaty and Aboriginal Rights	*Constitution Act*	✓	✓	Project construction and operation restricting Aboriginal groups from exercising their treaty or Aboriginal rights.	Mitigation measures discussed in the TLRU assessment and related VC sections such as Terrestrial Environment will reduce or eliminate effects on resources which are relied upon in order to exercise Aboriginal and Treaty rights for current use, and reduce or eliminate effects on conditions that may prohibit or deter exercise Aboriginal and Treaty rights.	Residual effects on Aboriginal and Treaty rights are expected as a result of the disposition or conversion of Crown Land and changes to TLRU (changes in the sites, resources, and access relied upon to practice activities such as hunting and fishing). Minimal disruption to the ability to exercise rights is anticipated and the seriousness of effects is minor. This categorization considers that; the persistence and viability of species relied upon to exercise Aboriginal and Treaty rights within the RAA are not anticipated to change as a result of the Project, it is anticipated that activities related to the exercise of Aboriginal and Treaty rights will be able to continue with some restrictions and alteration of behaviour by members of Indigenous groups, and that the Crown land within the TLRU LAA will remain available for the exercise of Aboriginal and Treaty rights.	Changes to Treaty and Aboriginal rights are not characterized using the standard effects characterization parameters. Residual effects characterization is discussed with each Aboriginal group.							

KEY

See VC chapters for definitions of terms.

Direction:
P: Positive
A: Adverse
N: Neutral/Negligible

Duration:
ST: Short-term
MT: Medium-term
LT: Long-term

Magnitude:
N: Negligible
L: Low
M: Moderate
H: High

Timing
NS: No sensitivity
MS: Moderate sensitivity
HS: High sensitivity

Geographic Extent:
PDA: Project development area
LAA: local assessment area
RAA: regional assessment area

Frequency:
IF: Infrequent
SI: Sporadic/Intermittent
RC: Regular/Continuous

N/A: Not applicable

Reversibility:
R: Reversible
I: Irreversible

Ecological/Socio-Economic Context:
U: Undisturbed
D: Disturbed
R: Resilient
NR: Not Resilient
AC: Average Condition
BAC: Below Average Condition

16.3 KEY MITIGATION MEASURES AND COMMITMENTS

Manitoba Infrastructure has an Environmental Management Program (EMP) that will be applied to the Lake Manitoba and Lake St. Martin Outlet Channels Project. The EMP describes the environmental management processes that will be followed during construction and operation. One of the primary functions of the EMP is to demonstrate compliance with the various federal and provincial environmental regulatory requirements, including the verification that all environmental commitments are executed, monitored, evaluated for effectiveness, and that information is reported back in a timely manner to the Project management team for adjustment if required.

The EMP includes various environmental protection measures derived from Manitoba Infrastructure's corporate, environmental and safety policies, which will be incorporated into relevant contract documents and inspection processes. The plans comprising the EMP will be finalized after the regulatory review process is complete and the necessary approvals and associated conditions are received.

To effectively address the specific issues involves, the EMP is organized into a Construction Environmental Management Program (CEMP) and an Operational Environmental Management Program (OEMP), which will be finalized prior to Project construction and operation, respectively. Their finalization will benefit from the regulatory review process, as well as the ongoing Indigenous and public engagement process. They are discussed in Section 3.7 of the Project Description and are summarized in the following sections.

Construction Environmental Management Program

The purpose of the Construction Environmental Management Program (CEMP) is to guide how environmental issues will be addressed during construction and how adverse effects of activities will be mitigated. Specific or targeted plans that will guide Manitoba Infrastructure's development of the Project's contract documents and subsequently, the contractor(s) activities, in constructing the Project in an environmentally responsible manner will include:

- Environmental Protection Plan(s) (EPPs) describe the suite of environmental protection measures for key individual environmental areas. This document will guide the contractor(s) and are supplemented with standard specifications included in each construction contract's Project Environmental Requirements and other plans.
- Project Environmental Requirements (PER) are environmentally focused requirements and commitments for construction contracts that are fundamental to Manitoba Infrastructures regulatory compliance, and they are applicable to all construction and maintenance operations for the Project. In addition to Manitoba Infrastructure's existing PER, a new Project-specific PER will be developed.
- The Access Management Plan (AMP) identifies specific measures that will be undertaken to manage access to the Project site during the construction phase. The AMP will address access-related issues of concern expressed by stakeholders, the public, and Indigenous people during the Indigenous and Public engagement process; it also integrates any technical access-related effects on the environment.

- The Sediment Management Plan (SMP) describes measures to minimize the impacts of in-stream sediment from construction activities. The management and monitoring of total suspended solids (TSS) inputs into the waterway that may occur as a result of in-channel and construction, river management, shoreline erosion, and commissioning of the Lake Manitoba and Lake St. Martin Outlet Channels.
- The Water Management Plan comprises a Surface Water Management Plan (SWMP) and a separate Groundwater Management Plan (GWMP). The SWMP describes measures and methods to be used for the temporary diversions of surface water; the GWMP describes measures to take to avoid or minimize adverse effects on the groundwater quality an8d quantity in the PDA.
- The Revegetation Plan identifies the locations and methods of providing new or restoring existing vegetation cover.
- The Biosecurity Management Plan identifies biosecurity issues and risk sites and risk types as well as specific mitigation requirements such as landowner communication, notification, and equipment cleaning and disinfection requirements.
- The Wildlife Management Plan identifies wildlife management strategies to mitigate effects on wildlife based on the wildlife monitoring plan. It will provide details on methods and schedule for all mammal, bird, and amphibian survey and monitoring programs
- The Dust Control Plan describes the products to use and the methods of their application on PR 239 and other access roads used during the construction of the Project
- The Waste Management Plan describes how solid and non-hazardous liquid waste will be disposed of.
- The Hazardous Materials Management Plan describes safe practices for managing hazardous materials to protect the health and safety of employees, the public and the environment.
- The Emergency Response Plan identifies how the contractor (s) will build the Project in a manner that protects people and the environment.
- The Construction Decommissioning Plan describes the process and environmental requirements for closure and reclamation of temporary construction facilities and borrow pits

The environmental plans and other plans (e.g., Health and Safety Plan) that are pertinent to the clearing and construction of the Project will be identified in the tender document to be provided to the contractor(s).

Operation Environmental Management Program

An Operation Environmental Management Program (OEMP) will be developed for the Project prior to completion of the construction phase. The OEMP will describe the long-term operation and maintenance procedures and environmental protection measures to be implemented after construction is complete. During the operations phase, standard operating procedures and environmental best management practices will be implemented to promote the protection of environmental values potentially affected by the Project. Project operation-specific plans will likely be developed for implementation during the

operations phase. The OEMP will likely include the same plans developed to manage issues during construction, but prior to construction completion they would be revised and adapted to suit the specific needs during the operation phase.

Mitigation Measures

Table 16.3-1 lists the mitigation measures that Manitoba Infrastructure commits to for the Project and identifies who will be responsible for their implementation.

Table 16.3-1 List of Mitigation Measures and Commitments for the Project

Section	Valued Component/ Monitoring/ Accidental Event	Potential Environmental Effect	Mitigation Measure/Commitment	Project Phase	Responsible Agent
3.3.2	All	General	An Operation and Maintenance Manual (O&M Manual) will be developed for the Project structures to detail maintenance needs for the Project during the operation and maintenance phase. The O&M Manual will include roles and responsibilities (e.g., legislated responsibilities, regulatory approvals/conditions, Manitoba Infrastructure and operator), records and logs (e.g., flow and water level monitoring), coordination with agencies (e.g., municipalities), emergency operations, operating guidelines, operating procedures (e.g. gate system, pre-operating inspection, notifications, monitoring, etc.), maintenance manuals, and maintenance procedures (e.g., vendor contracts, gate system, routine inspection/servicing).	Operation and Maintenance	Manitoba Infrastructure
3.5.2.17; 3.5.3.6	All	Waste disposal	Waste disposal grounds, solid wastes generated as a result of Project related construction and operation phases will be transferred to appropriately permitted/licensed facilities for recycling and/or disposal.	Construction & Operations and Maintenance	Manitoba Infrastructure and the selected Construction Contractor
3.5.2.17; 3.5.3.6	All	Waste disposal	Wastewater generated as a result of the construction and operation will be stored and transferred for disposal at existing licensed facilities by qualified carriers.	Construction & Operations and Maintenance	Manitoba Infrastructure and the selected Construction Contractor
3.4.2.8; 3.4.3.8	All	Access	Construction-related traffic will be restricted to the ROW and associated temporary access routes required during construction and maintenance. Existing trails and other travel routes will not be altered adjacent to the Project footprint area other than as required for construction and maintenance purposes. Where temporary access routes are accessible by the public, access will be blocked when not in use. After Project construction, access routes not required for on-going maintenance of the LMOC will be decommissioned by contouring, de-compacting and trimming to encourage natural revegetation and will be seeded and/or planted as required	Construction & Operations and Maintenance	Manitoba Infrastructure and the selected Construction Contractor
3.5.2.12; 3.7	Geology and Soils, Fish and Fish Habitat, Vegetation,	Erosion and sedimentation	An Erosion and Sediment Control Plan will be developed that will identify temporary and permanent measures to be incorporated during construction until vegetation has been established on disturbed areas. The Erosion and Sediment Control Plan will consider revegetation, construction management practices, water quality monitoring and follow-up, adaptive management strategies and contingency and response measures described. The measures will consider the short- and long-term drainage plan to facilitate their intended purpose to minimize and mitigate the transport and deposition of sediment beyond construction areas and into off-site receiving water bodies. The Erosion and Sediment Control Plan will consider revegetation, construction management practices, water quality monitoring and follow-up, adaptive management strategies and contingency and response measures described generally as follows	Construction & Operations and Maintenance	Manitoba Infrastructure
3.5.2.12; 3.7	Groundwater and Surface Water	Water quality effects	A water quality monitoring program may be developed to assess any changes that may result from channel construction activities and the effectiveness of proposed mitigation, and of the Erosion and Sediment Control Plan	Construction	Manitoba Infrastructure
6.2.4.2	Atmospheric Environment	Change in ambient air quality: • ambient concentration of criteria air contaminants	• Project off-road construction equipment will comply with emission standards in the Canadian Off-Road Compression-Ignition Engine Emission Regulations. • Engines and exhaust systems will be properly maintained. Equipment will not be operated, including construction equipment, that shows excessive emissions of exhaust gases until corrective repairs or adjustments are made. • The concentration of sulphur in diesel fuel will not exceed 15 mg/kg to comply with Sulphur in Diesel Fuel Regulations. • Construction vehicle idling times will be reduced to the extent possible in order to reduce emissions. • Cold starts will be limited to the extent possible to reduce emissions.	Construction	Manitoba Infrastructure and the selected Construction Contractor

Table 16.3-1 List of Mitigation Measures and Commitments for the Project

Section	Valued Component/ Monitoring/ Accidental Event	Potential Environmental Effect	Mitigation Measure/Commitment	Project Phase	Responsible Agent
6.2.4.2	Atmospheric Environment	Change in ambient air quality: • dustfall	• All work will be conducted in a manner that minimizes the raising of dust from construction or maintenance operations. • Only water or approved dust suppressants will be used for dust control. The use of waste petroleum or petroleum by-products as dust suppressants is not allowed. • All vehicles used to haul soils or aggregates to or from the work site will have the load covered with a tarpaulin cover during transport to minimize dust and prevent material from falling out. • All material stockpiles or spoil piles prone to wind erosion will be maintained as to minimize release of particulate matter or dust. This may include, but is not limited to, covering or stabilization of material stockpiled at the work site as required. • The application of dust suppressants will be limited to the roadway, driveway or designated area. • The application rate of all dust suppressants will be monitored for adequate coverage without pooling or runoff of products. • The amount of dust suppressant applied will not exceed the minimum amount required to effectively suppress dust. • Dust suppressants will conform to the manufacturer's specifications and not contain concentrations of contaminants that would not normally be found in the suppressant. • Dust suppressants will not be applied if precipitation is occurring or forecast to occur before the product sets or cures. • Temporary soil and overburden stockpiles will be stabilized during extended periods between usage to prevent fugitive dust emissions.	Construction	Manitoba Infrastructure and the selected Construction Contractor
6.2.4.3	Atmospheric Environment	Greenhouse gas emissions: • release of carbon dioxide (CO_2) • release of methane (CH_4) • release of nitrous oxide (N_2O)	• The mitigation measures associated with ambient air quality to reduce combustion emissions are also applicable to the mitigation of GHG emissions because combustion sources account for virtually all the GHG emissions associated with the construction phase.	Construction	Manitoba Infrastructure and the selected Construction Contractor
6.2.4.4	Atmospheric Environment	Change in existing acoustic environment: • Project construction may result in temporary and localized increases in sound levels	• Residents near construction noise-generating activities where noise impacts are expected to be moderate or high will be notified as required. • Temporary noise abatement barriers may be used to reduce noise levels where required. If noise abatement barriers are ineffective, a temporary reduction in the intensity of construction activities may be considered. • Machinery and factory supplied noise-abatement equipment (e.g., mufflers) will be maintained in good working order. • Machinery idling will be minimized. • Loud construction activities (e.g., pile driving) will be restricted to daytime periods. • A noise complaint response procedure will be implemented to address noise complaints should they arise.	Construction	Manitoba Infrastructure and the selected Construction Contractor
6.2.4.5	Atmospheric Environment	Change in ambient light: • Project lighting can have adverse effects through changes in nighttime lighting. • Light trespass; light output from the Project perimeter on vertical surface of receptors • Glare; horizontal contrast between Project lighting and background lighting • Sky glow; ratio of upward directed lighting to total lighting	• Full cut-off luminaire will be used wherever possible to reduce glare, light trespass, and sky glow from the Project lighting. • As much as is possible, lighting will be located such that unavoidable light spill off the working area is not directed toward receptors outside of the PDAs. • Lighting will be located so that the lights are not directed toward oncoming traffic on nearby roads on or off-site because of the objectionable nuisance and safety hazard this may present. • Lights will be designed to avoid excessive use of the mobile flood lighting units and reduce potential effects by turning off lighting when they are not required. • Lighting design guidelines, and the lighting requirements for workspaces as enforced by Labour Canada will be adhered to.	Construction	The selected Construction Contractor

Table 16.3-1 List of Mitigation Measures and Commitments for the Project

Section	Valued Component/ Monitoring/ Accidental Event	Potential Environmental Effect	Mitigation Measure/Commitment	Project Phase	Responsible Agent
6.3.4.2, 14.3.2	Geology and Soils	• Change in terrain conditions	• Channel banks, berms, dikes and ditches will be seeded and revegetated with an appropriate native seed or erosion control mix to improve stability of these features, unless these features are being stabilized by rip-rap. • Drainage channels and re-alignments on upgradient sides of LMOC and LSMOC will channel water downslope and into the channels to minimize the risk of inundation and flooding as a result of channel presence. • Surface drainage patterns for other Project components will be re-established where possible. • Efforts will be made to minimize the duration of soil exposure and run-off will be diverted away from exposed soils. • Construction and maintenance activities will be halted during heavy rains with the exception of those works pertaining to erosion and sediment control. • Sediment control measures (e.g. turbidity curtains) will be used where appropriate prior to the installation and/or removal of any isolated structures.	Construction & Operations and Maintenance	Manitoba Infrastructure and the selected Construction Contractor
6.3.4.3	Geology and Soils	• Change in soil quantity and quality	• Topsoil in designated areas (e.g., laydown and staging areas, waste storage areas, fuel storage and refueling area, work camps) will be stripped and stockpiled for later reuse in site restoration. Granular material or other surface preparation will be placed to allow all weather accessibility. • Mineral and organic topsoil horizons will be stripped and salvaged separately from subsoils. • Locations within designated areas where equipment, hazardous material and/or wastes will be stored or maintained will be underlain with at least 30 cm of impermeable soil or approved equal material and lined with an impermeable groundsheet to contain spills. • 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 will be seeded. If local soils are not available, other organic-based covers may be used to allow seed germination. • Soil stockpiles will be stabilized by contouring (Project design side slopes) and re-vegetation, if necessary. Soil tackifiers, erosion blankets or other means may be used to control erosion prior to revegetation. • All grubbed organic and topsoil layers with leaf litter and root mass will be stockpiled in appropriate locations and retained for reclamation efforts. • Slash will be piled in a manner that allows for clean, efficient burning of all material. Mixing soil into the slash will be avoided. • Spills, leaks or releases will be reported within 24 hours and contaminated soil will be appropriately disposed of at a licensed facility or stored in a designated storage area to prevent secondary contamination. • All designated areas will be leveled to natural or pre-existing grade and slope as part of decommissioning. • Soils within areas delineated as potential manure-impacted sites will be sampled and analyzed for nutrient concentrations and other pertinent parameters.	Construction	Manitoba Infrastructure and the selected Construction Contractor
6.4.4.2	Groundwater and Surface Water: Groundwater	• Changes in local groundwater flows, levels and quality	• A Groundwater Management Plan will be developed to refine the analyses of effects of dewatering. • Further aquifer investigation and modelling will be carried out to determine the effect of construction dewatering on specific domestic wells. Additional observation wells will be installed prior to construction dewatering to monitor the effects during dewatering of each section during construction. Mitigation plans will be modified as required during the dewatering as specific information is received from monitoring. • Mitigation for domestic wells could include lowering existing pump, supplying new pumps, or drilling new wells. • Water from construction dewatering will be diverted to dugouts for livestock watering. Dugouts will be supplied by pressure relief artesian wells during operation. • The drainage along LSMOC will be maintained to reduce the potential effects of water backing up in the wetlands upstream, south and east of the LSMOC.	Construction & Operations and Maintenance	Manitoba Infrastructure and the selected Construction Contractor

Table 16.3-1 List of Mitigation Measures and Commitments for the Project

Section	Valued Component/ Monitoring/ Accidental Event	Potential Environmental Effect	Mitigation Measure/Commitment	Project Phase	Responsible Agent
6.4.4.3	Groundwater and Surface Water: Groundwater	• Changes in local groundwater and surface water interactions	For LMOC: • Dewatering water can be conveyed to wetlands if further water supply is needed. • Clay cut-off walls (or other measures) can be built during construction to stop leakage affecting water balance of wetlands. For LSMOC: • The drainage along LSMOC will be maintained to reduce the potential effects of water backing up in the wetlands upstream (south and east) of the LSMOC.	Construction	Manitoba Infrastructure and the selected Construction Contractor
6.4.7.2; 6.4.7.3; 6.4.7.4; 6.4.7.5; 6.4.7.6; 6.4.7.7	Groundwater and Surface Water: Surface Water	• Changes in regional fluvial geomorphology • Changes in local drainage areas and local drainage patterns • Changes in regional and/or local sediment and debris transport • Changes in regional and/or local ice processes • Changes in regional and/or local surface water quality	• Engineering studies will be conducted to further understand fluvial geomorphology and optimize the design of the inlets and outlets on the channels to minimize environmental impacts. • Signs indicating potential areas of thin ice will be used at LMOC and LSMOC inlet and outlet areas in accordance with Transport Canada requirements. • The SWMP will outline the methods and approach to document surface water quality in the Project area during construction, operation and maintenance activities, including comparison of collected samples to recommended guidelines. • During operation the channels will be monitored for ice and debris jams, and equipment will be available to remove the blockages if they impose an imminent threat.	Construction & Operation and Maintenance	Manitoba Infrastructure and the selected Construction Contractor
7.2.4.2, 3.5.2.5; 3.5.2.6; 14.3.2	Fish and Fish Habitat	• Permanent alteration or destruction of fish habitat	• DFO timing windows for instream work (https://www.dfo-mpo.gc.ca/pnw-ppe/timing-periodes/index-eng.htm) will be followed as practical, particularly for any instream work required “in-the-wet” • Groundwater from aquifer depressurization during construction will be discharged of the LMOC to Birch Creek, Watchorn Creek, or to the lakes, wetlands, and drains to the east of the LMOC if required. • All heavy machinery will be cleaned and disinfected prior to arriving on site and before moving between work areas at different lakes and drainages. • Water control structures will be constructed in the dry and will only be exposed to water once the control gates are in place and a satisfactory level of construction has been achieved to safely allow exposure to flows. It is anticipated that construction will take place year-round once clearing is completed. • The Sediment Management Plan will include the provision of 100 m set-backs 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; limiting machine fording to one-time events, where possible; limiting any instream work to low flow periods when waterbodies or watercourses are dry or frozen; installing silt curtains around excavation areas where practical; transferring excavation spoil to upland areas away from streams and waterbodies; vegetating channel slopes with native vegetation. • Manitoba Infrastructure will monitor and take measures to control the spread of invasive species wherever possible, including into new waterbodies. • Cofferdams will be designed to accommodate any expected high flows during the construction period. • All spoil material and debris will be removed from the isolated area prior to the removal of the cofferdam. • All cofferdam materials will be removed upon the completion of work.	Construction & Operation and Maintenance	Manitoba Infrastructure and the selected Construction Contractor

Table 16.3-1 List of Mitigation Measures and Commitments for the Project

Section	Valued Component/ Monitoring/ Accidental Event	Potential Environmental Effect	Mitigation Measure/Commitment	Project Phase	Responsible Agent
7.2.4.3; 14.3.2	Fish and Fish Habitat	• Change in fish passage	• Bridges will be designed to allow fish passage and include culverts that comply with Manitoba's Stream Crossing guidelines for the Protection of Fish and Fish Habitat • Isolation structures will not constrict more than one-third of a fish-bearing waterbody. • The LSMOC will be designed to allow fish to exit it during the entire open-water season.	Construction & Operations and Maintenance	Manitoba Infrastructure and the selected Construction Contractor
7.2.4.4; ; 14.3.2	Fish and Fish Habitat	• Change in fish health and mortality	• Re-fueling of machinery and storage of hydrocarbon products within 100 m from the high-water mark of waterbodies and watercourses will be prohibited. • Hydrocarbon products will be stored in secondary containment and approved storage tanks. • Equipment and vehicles will be maintained so that they are clean and free of leaks upon arrival to site and kept in good working order. • Borrow-pits and quarries will be located at least 100 m away from watercourses and waterbodies. • In-water work areas will be isolated and fish and mussel salvages will be conducted prior to construction. • Year-round baseflow will be provided in the LSMOC channel when not in use • Channels will be designed and constructed with minimum residual pool depths to overwinter fish. • The downstream-most drop structure in the LSMOC will be designed to prevent fish access from Lake Winnipeg. • All drop structures in LSMOC will be designed and constructed to enable downstream movement of fish during all open-water flow conditions • The Access Management Plan will include construction of gates on access roads, a "no fishing" policy for workers and subcontractors during work shifts, and a "no fishing" policy for workers and the public in the channels at all times.	Construction & Operations and Maintenance	Manitoba Infrastructure and the selected Construction Contractor
8.2.4.2	Vegetation	• Change in landscape diversity	• Manitoba Infrastructure's Project-specific PER will be developed and form part of contracts with the construction Contactor. • All construction activities will be restricted to the approved construction footprint. • Prior to clearing or grubbing, the work area will be clearly staked or marked. • Clearing within 30 m of a waterbody will be done by hand. • Cleared vegetation stockpiles will be dispersed to limit available fuel sources for wildfire ignition. • Disposing of cleared trees and brush will be according the Manitoba Infrastructure's clearing guidelines. Disposal may involve burning, compacting, piling, burying, windrowing and compacting, limbing and chipping. • Machinery will arrive on site in a clean condition and will 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. • Seeding following Manitoba Infrastructure's Native Revegetation Program for boreal areas will be done as required on disturbed lands such as in areas vulnerable to erosion and sedimentation. • Construction-related traffic will be restricted to the Project ROW and associated access routes during Project construction and maintenance. Where access routes are accessible by the public, blocking access when not in use. • Wetland water levels along the LMOC and LSMOC will be monitored following construction in areas where shallow ground water is intersected and either re-directing drainage into effected wetlands or modify outside drainage ditch design to reduce changes in wetland hydrology. • A 300 m setback will be applied to all known occurrences of federally listed species at risk and their critical habitat following Environment Canada requirements. Seed collection or transplanting will be conducted, in consultation with Environment and Climate Change Canada and Manitoba Sustainable Development, if occurrences cannot be avoided. • A 30 m setback will be applied to all known occurrences of provincially listed SOCC. • 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. • 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.	Construction	Manitoba Infrastructure and the selected Construction Contractor

Table 16.3-1 List of Mitigation Measures and Commitments for the Project

Section	Valued Component/ Monitoring/ Accidental Event	Potential Environmental Effect	Mitigation Measure/Commitment	Project Phase	Responsible Agent
8.2.4.3	Vegetation	• Change in community diversity	• Manitoba Infrastructure will endeavor to conduct revegetation using a staged approach and start as soon as practical after construction commences.	Construction	Manitoba Infrastructure and the selected Construction Contractor
8.2.4.4	Vegetation	• Change in species diversity	• Construction work will be stopped if wet ground conditions cause rutting. • Where avoidance of SOCC is not possible, construction in sensitive areas will be restricted to the winter months (outside of the growing season). • An integrated pest management approach following Manitoba Infrastructure's Integrated Pest Management Plan (IPM) (2016) will be followed for controlling weeds, invasive non-native species and pests. Only pesticides approved for use by Provincial legislation will be used and application will be by licensed personnel.	Construction & Operation and Maintenance	Manitoba Infrastructure and the selected Construction Contractor
8.2.4.5	Vegetation	• Change in wetland function	• Removal of riparian vegetation will be minimized to help maintain the stability of waterbody banks. • Vegetative root masses found within the waterbody banks will remain undisturbed unless specified.	Construction & Operations and Maintenance	Manitoba Infrastructure and the selected Construction Contractor
8.3.6.2	Wildlife	• Change in habitat	• A monitoring plan for wildlife will be implemented. Clearing will not occur between April 1 and August 31 of any year unless otherwise authorized by the Engineer in order to avoid disturbance to nesting birds and other wildlife. • Exclusionary flagging or fencing will be installed, as appropriate, around environmentally sensitive sites (e.g., dens, roosts, stick nests, hibernacula) or sensitive habitats prior to clearing and construction • Blasting will not be permitted within close proximity 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, left undisturbed, and reported to the Natural Resources Officer. • Where feasible, large diameter snags having potential to support red-headed woodpecker nests will be retained. • A mitigation and offset plan may be developed for red-headed woodpecker and eastern whip-poor-will in consultation with provincial and federal regulators, stakeholders and Indigenous communities. • 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*. • 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. • Where possible, lights will be focused internally to the work site to reduce potential sensory disturbance to wildlife in the surrounding habitat. • Temporary work spaces will be reclaimed using native species that are compatible with pre-construction site conditions, as outlined in the reclamation plan.	Construction & Operations and Maintenance	Manitoba Infrastructure and the selected Construction Contractor
8.3.6.3	Wildlife	• Change in mortality risk	• 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.	Construction & Operations and Maintenance	Manitoba Infrastructure and the selected Construction Contractor
8.3.6.4	Wildlife	• Change in movement	• The use of rip rap and side slopes will be minimized to the extent feasible to facilitate wildlife movement. • Where feasible, cover plantings (e.g., trees and/or shrubs) will be added along select upland areas of the channels to facilitate movement of wildlife.	Construction & Operations and Maintenance	Manitoba Infrastructure and the selected Construction Contractor

Table 16.3-1 List of Mitigation Measures and Commitments for the Project

Section	Valued Component/ Monitoring/ Accidental Event	Potential Environmental Effect	Mitigation Measure/Commitment	Project Phase	Responsible Agent
9.2.4.2	Land and Resource Use	• Change in land use	• Manitoba Infrastructure will provide Project development information on their website. • Construction activities and equipment will be managed to avoid damage and disturbance to adjacent properties, structures and operations. • Channel excavation and disturbance will be limited to defined rights-of-way and access routes. • Existing roads, road allowances, trails, portages and other travel ways will not be blocked or altered as a result of clearing and grubbing activities so as not to interfere with other users. • There will be no entry of personnel or equipment, or work conducted on private property. • All work will be conducted in a manner that minimizes the raising of dust; only water or approved dust suppressants will be used for dust control. • All construction equipment supplied will be effectively “sound-reduced” by proper means. • Noise by-laws of the adjacent communities and municipal authorities will be complied with. • Advanced notification will be given to affected parties prior to each blasting event. • The Contractor will restore access roads not required for on-going maintenance to original condition. • Manitoba Infrastructure will implement an Access Management Plan, including control measures. • Access will be maintained into yard sites where possible for PR 239 road realignment. • Signs directing traffic to detours will be installed during construction to address public safety. • Construction, operation and maintenance will avoid affecting neighbouring properties or operations. • All designated areas and temporary access roads will be leveled to natural or pre-existing grade and slope for decommissioning. • Access routes not required for ongoing maintenance will be leveled to natural or pre-existing grade and slope as part of decommissioning. • 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 where conditions permit, it will commence immediately upon completion of grading, capping and trimming operations. • Reclamation of temporary construction areas and aggregate/quarry sites will occur following the completion of construction once the sites are no longer needed for operation and maintenance and would be expected to follow those measures in place at the time of remediation/decommissioning and in full compliance with legislation and regulatory standards.	Construction & Operations and Maintenance	Manitoba Infrastructure and the selected Construction Contractor
9.2.4.3	Land and Resource Use	• Change in agricultural land use	• Drainage channels and re-alignments on upgradient sides of LMOC will channel water downslope and into channels to minimize the risk of inundation and flooding from channel presence. • Surface drainage patterns for other Project components will be re-established where possible. • Locations of manure stockpiles within the PDA will be confirmed and stockpiles will be relocated to suitable areas outside of the PDA determined in conjunction with landowners prior to construction. • Manitoba Infrastructure will develop a biosecurity management plan to address biosecurity concerns. • All equipment will arrive at the construction site clean, free of soil/vegetative debris (including weed seeds).	Construction & Operations and Maintenance	Manitoba Infrastructure and the selected Construction Contractor

Table 16.3-1 List of Mitigation Measures and Commitments for the Project

Section	Valued Component/ Monitoring/ Accidental Event	Potential Environmental Effect	Mitigation Measure/Commitment	Project Phase	Responsible Agent
9.2.4.4	Land and Resource Use	• Change in parks, recreation and tourism	• All plant and 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. • Channel excavation will be limited to defined rights-of-way and associated access routes. • Existing roads, road allowances, trails, portages and other travel ways will not be blocked or altered as a result of clearing and grubbing activities so as not to interfere with other users. • Access routes not required for on-going maintenance will be leveled to natural or pre-existing grade and slope as part of decommissioning. • Manitoba Infrastructure will implement an access management plan, which may include control measures such as providing signage at approaches to Project access roads to restrict public access to the PDA. • Recreation will not be allowed along the outlet channels through the life of the Project. Manitoba Infrastructure will install warning signs indicating no authorized personnel where required. • Notices to boaters, involving the posting of signage (i.e., danger, do not trespass warnings) will be implemented to communicate with boaters that the channels are not to be used for navigation.	Construction & Operations and Maintenance	Manitoba Infrastructure and the selected Construction Contractor
9.2.4.5	Land and Resource Use	• Change in resource use, hunting and trapping	• Employees, workers and other staff will not hunt, trap or harass wildlife on the worksite. • 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. • Manitoba Infrastructure will restrict unauthorized access to the outlet channels during operation. • Manitoba Infrastructure will install warning signs on ROWs, where required, indicating no unauthorized personnel.	Construction & Operations and Maintenance	Manitoba Infrastructure and the selected Construction Contractor
9.2.4.5	Land and Resource Use	• Change in resource use, fishing	• Manitoba Infrastructure will engage with commercial fish harvesters, anglers and MSD Regional Officials to address potential conflict, disturbance, or access restrictions to fishing/harvesting areas in the PDA and LAA, and availability of fish resources. • South of 53rd parallel, the Contractor will not undertake any in-water activities in fish bearing waters or potentially fish bearing waters between September 15 and June 30 of the following year, during periods of high stream flow or identified spawning periods, unless otherwise authorized by Fisheries and Oceans Canada and MSD.	Construction	Manitoba Infrastructure and the selected Construction Contractor
9.2.4.5	Land and Resource Use	• Change in resource use, mining /aggregates	• Quarry operations will not encroach within 15 m of any property boundary adjoining, private, municipal, or Crown leased land.	Construction & Operations and Maintenance	Manitoba Infrastructure and the selected Construction Contractor
9.2.4.5	Land and Resource Use	• Change in resource use, forestry	• Unless otherwise authorized by the Engineer, all brush and trees, except those designated to be saved will be cut level with the ground. All surface debris, excluding merchantable timber but including fallen timber, slash limbs, brush, grass and weeds will be disposed of in an appropriate manner. • There will be no bulldozing of trees or woody debris into standing timber. • Timber from which forest products can be manufactured (merchantable timber) will be cleared of limbs and neatly stockpiled within the work limits as directed or permitted by the Engineer.	Construction & Operations and Maintenance	Manitoba Infrastructure and the selected Construction Contractor
9.2.4.5	Land and Resource Use	• Change in resource use, groundwater/surface water	• Manitoba Infrastructure will develop Groundwater and Surface Water and Management Plans. • A qualified drilling contractor with appropriate experience will be present for work in areas underlain by artesian aquifers (i.e., flowing and high-water well areas). • Construction dewatering will be limited through appropriate construction planning and will be in accordance with terms and approval conditions of *The Groundwater and Water Well Act* and *The Water Rights Act.* • Monitoring of groundwater levels in drill holes will be conducted during drilling and channel excavation. • Drill holes will be sealed as soon as possible in the case of a groundwater level rise. • Precautions will be taken where there is potential for mixing surface and groundwater to prevent interconnection of these waters. • Existing water wells within the PDA will be plugged and decommissioned to prevent groundwater contamination.	Construction & Operations and Maintenance	Manitoba Infrastructure and the selected Construction Contractor

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Section	Valued Component/ Monitoring/ Accidental Event	Potential Environmental Effect	Mitigation Measure/Commitment	Project Phase	Responsible Agent
9.3.4.2	Infrastructure and Services	• Change in accommodations	• Manitoba Infrastructure will continue to make Project information, such as construction schedules, and predicted workforce numbers available to RMs, First Nations, local communities, service providers and businesses in the RAA during construction. • Temporary construction camps will be used to house the construction workforce for the LMOC and LSMOC if required.	Construction	Manitoba Infrastructure
9.3.4.3	Infrastructure and Services	• Change in community infrastructure and services	• Manitoba Infrastructure will continue to make Project information available to the RMs, First Nations, local communities, service providers and businesses in the RAA about the construction workforce and timing of construction activities. • Solid wastes generated as a result of Project-related construction and operation and maintenance phases will be regularly transferred to appropriately permitted/licensed facilities for recycling and/or disposal. • Wastewater generated as a result of the Project construction (i.e., wastewater from work camps) will be stored and transferred for disposal to existing licensed facilities by qualified carriers. Drinking water could potentially be sourced from wells or delivered by truck from the nearest licensed/permitted water treatment facility. • A Waste Management Plan will be prepared for the Project.	Construction	Manitoba Infrastructure and the selected Construction Contractor
9.3.4.4	Infrastructure and Services	• Change in road traffic and road network	• Manitoba Infrastructure will continue to make Project information available to the RMs, First Nations, local communities and stakeholders in the RAA during construction so that detours can be communicated to residents and mitigate travel delays. • Transportation of workers between construction camp/accommodations and worksites will be done in groups (e.g., vans) and often using the PDA itself for access, to reduce the potential number of vehicles on the road network. • Materials transported by truck will be compliant with restrictions and constraints set out by Manitoba Infrastructure and the RMs of Grahamdale and West Interlake. • A Traffic Management Plan will be prepared for the Project. • An Access Management Plan will be developed for the Project. • Sections of municipal roads will be reconstructed, realigned or extended to provide access across the LMOC at the bridge crossings to be constructed. • Temporary detours will be used to maintain access through the LMOC PDA during construction. • Project construction-related traffic will be restricted to the Project PDA and associated temporary access routes to the extent practical and required. • Other than initial mobilization, de-mobilization, and transportation of construction materials Project construction-related traffic will be restricted to the Project PDA and associated temporary access routes to the extent practical and required. • The Contractor will repair roads if they are damaged during construction.	Construction	Manitoba Infrastructure and the selected Construction Contractor
9.3.4.5	Infrastructure and Services	• Change in utilities	• Manitoba Infrastructure will continue to share Project information with entities responsible for underground and above-ground utilities (e.g., the RM of Grahamdale, Manitoba Hydro), and will coordinate any utility re-routing as part of Project construction.	Construction	Manitoba Infrastructure
9.4.4.2	Economy	• Change in provincial economy	• Project effects on the provincial economy are expected to be positive in direction with the addition of direct, indirect, and induced employment income and GDP. As such, no mitigation measures are proposed to address adverse effects.		Not applicable
9.4.4.3	Economy	• Change in regional economy	• Manitoba Infrastructure will adhere to government procurement policies and procedures. • Manitoba Infrastructure will compensate the RM of Grahamdale for decreased tax revenue by paying an annual fee in lieu of taxes in accordance with *The Expropriation Act*.	Construction & Operations and Maintenance	Manitoba Infrastructure
9.4.4.4	Economy	• Change in regional labour force	• Manitoba Infrastructure will follow industry standard wage rates to limit potential wage inflation associated with a constrained labour market	Construction	Manitoba Infrastructure and the selected Construction Contractor

Table 16.3-1 List of Mitigation Measures and Commitments for the Project

Section	Valued Component/ Monitoring/ Accidental Event	Potential Environmental Effect	Mitigation Measure/Commitment	Project Phase	Responsible Agent
9.4.4.5	Economy	• Change in goods and services	• Manitoba Infrastructure will construct and operate work camps for non-resident construction workforce to reduce demand on accommodations within LAA.	Construction	Manitoba Infrastructure and the selected Construction Contractor
9.5.4.2	Human Health	• Change in human health, air quality	• Project off-road construction equipment will comply with emission standards in the Canadian Off-Road Compression-Ignition Engine Emission Regulations. • Engines and exhaust systems will be properly maintained. Equipment will not be operated, including construction equipment, that shows excessive emissions of exhaust gases until corrective repairs or adjustments are made. • The concentration of sulphur in diesel fuel will not exceed 15 mg/kg to comply with Sulphur in Diesel Fuel Regulations. • Construction vehicle idling times will be reduced to the extent possible in order to reduce emissions, as a best management practice. • Cold starts will be limited to the extent possible to reduce emissions, as a best management practice. • Use of a work camp will reduce emissions associated with transportation of staff to and from site during construction.	Construction	Manitoba Infrastructure and the selected Construction Contractor
9.5.4.2	Human Health	• Change in human health, noise levels	• Residents near to construction noise-generating activities will be notified. Temporary noise abatement barriers may be used to reduce noise levels. If noise abatement barriers are ineffective, a temporary reduction in the intensity of construction activities may be considered. • Machinery and factory-supplied noise-abatement equipment (e.g., mufflers) will be maintained in good working order. • Machinery idling will be minimized. • A complaint response procedure will be implemented to address noise complaints should they arise.	Construction	Manitoba Infrastructure and the selected Construction Contractor
9.6.4.1	Heritage Resources	• Change in heritage resources	• The HRB (Historic Resources Branch of the Manitoba Sport, Culture and Heritage Department) will be informed immediately if any heritage resources, or objects thought to be heritage resources, are discovered during site preparation and construction. • Protective barriers will be placed around heritage resource sites that are inadvertently found during construction so that the area can be protected while work proceeds. • All heritage resources discovered during site preparation and construction will be left in their original position until HRB is contacted and provides instruction. • Orientation for Project staff working in construction areas will include heritage resource awareness and training, including the nature of heritage resources and the management of any resources encountered. • Orientation information will include typical heritage resource materials and reporting procedures. • The Contractor will report heritage resource materials immediately to the Construction Supervisor and will cease construction activities in the immediate vicinity until HRB is contacted and prescribes instruction. • The Culture and Heritage Resource Protection Plan will be adhered to during construction and operations phases of the Project.	Construction	Manitoba Infrastructure and the selected Construction Contractor
9.6.4.2	Heritage Resources	• Change in cemeteries	• To avoid interrupting funerals or other ceremonies in Bayton St. Thomas Lutheran Cemetery, attempts will be made to notify the St. Thomas Lutheran Church of construction and maintenance schedules to facilitate avoiding noise and dust during activities. Contact information will be posted at the cemetery during construction, so individuals planning funerals or other ceremonies can contact the appropriate construction contractors to avoid interruptions by noise and dust. • To mitigate any residual effects of changes to the Bayton St. Thomas Lutheran Cemetery because of altered surface or ground water flow, a photographic record will be maintained and the extant burials be periodically checked for evidence of tilting headstones, cracked grave covers or new depressions with freshly faulted edges. • Although it is not predicted that the Project will interact with this site, to mitigate any residual effects of changes to the cemetery reported on Sturgeon Bay by Dauphin River First Nation, a preconstruction site visit has been offered to the Dauphin River First Nation.	Construction & Operations and Maintenance	Manitoba Infrastructure and the selected Construction Contractor

Table 16.3-1 List of Mitigation Measures and Commitments for the Project

Section	Valued Component/ Monitoring/ Accidental Event	Potential Environmental Effect	Mitigation Measure/Commitment	Project Phase	Responsible Agent
10.2.4.4	Traditional Land and Resource Use	• Change in availability of traditional resources for current use	Mitigation measures provided for fish and fish habitat, vegetation, heritage resources, wildlife, and land and resource use are applicable for mitigating effects on traditional land and resource use. Additionally, the following mitigation measures will be implemented: • A schedule of construction and Project activities will be made available to all Indigenous groups and Northern Affairs Communities engaged on the Project, so that areas and time periods of activity can be avoided. • Vegetation control will occur through mechanical methods where feasible, and hand clearing will occur along shorelines to mitigate effects to plant harvesting. • Provincial aquatic invasive species protocols will be followed to reduce risk. • The Revegetation Plan will be completed by Manitoba Infrastructure, and will involve the collaborative participation of interested Indigenous groups.	Construction & Operations and Maintenance	Manitoba Infrastructure and the selected Construction Contractor
10.2.4.5	Traditional Land and Resource Use	• Change in access to traditional resources and areas for current use	Mitigation measures provided for land and resource use are applicable for mitigating effects on change in access to traditional land and resource use. Additionally, the following mitigation measures will be implemented: • A schedule of construction and Project activities will be made available to all Indigenous groups and Northern Affairs Communities engaged on the Project, so that areas and time periods of activity can be avoided. • Manitoba Infrastructure will engage with Dauphin River First Nation, Peguis First Nation, Pinaymootang First Nation and other Indigenous groups in order to better understand the use and importance of the snowmobile trails which are intersected by the Lake St. Martin Outlet Channel and to develop suitable means of crossing the Lake St. Martin Outlet Channel following construction.	Construction & Operations and Maintenance	Manitoba Infrastructure and the selected Construction Contractor
10.2.4.6	Traditional Land and Resource Use	• Change to cultural and spiritual sites or areas	• Detailed recording and mapping of spiritual or cultural sites will be developed in partnership with Indigenous groups, leading to a decision made about the relative importance of the site and potential mitigations strategies. • An appropriate ceremony will be held prior to commencement of construction under the direction of local Indigenous groups.	Construction & Operation and Maintenance	Manitoba Infrastructure
10.2.4.7	Traditional Land and Resource Use	• Changes to the cultural value or importance associated with current use	Manitoba Infrastructure will continue to engage with Indigenous groups regarding mitigations to changes to cultural value or importance associated with current use, and concerning the recommendations identified by Indigenous groups.	Construction & Operation and Maintenance	Manitoba Infrastructure
10.3.3.1	Indigenous Health and Socio-economic Conditions	• Change in Indigenous health conditions	Mitigation measures provided for health, land and resource use, and traditional land and resource use are applicable for mitigating effects on change in Indigenous health and socio-economic conditions.	Construction & Operation and Maintenance	Manitoba Infrastructure and the selected Construction Contractor
10.3.3.2	Indigenous Health and Socio-economic Conditions	• Change in Indigenous socio-economic conditions	Mitigation measures provided for health, land and resource use, and traditional land and resource use are applicable for mitigating effects on change in Indigenous health and socio-economic conditions.	Construction & Operation and Maintenance	Manitoba Infrastructure and the selected Construction Contractor
10.4.5	Treaty and Aboriginal Rights	• Project construction and operation restricting Aboriginal groups from exercising their treaty or Aboriginal rights	Mitigation measures discussed in the TLRU assessment and related VC sections such as Terrestrial Environment will reduce or eliminate effects on resources which are relied upon in order to exercise Aboriginal and Treaty rights for current use, and reduce or eliminate effects on conditions that may prohibit or deter exercise Aboriginal and Treaty rights.	Construction & Operation and Maintenance	Manitoba Infrastructure and the selected Construction Contractor

Table 16.3-1 List of Mitigation Measures and Commitments for the Project

Section	Valued Component/ Monitoring/ Accidental Event	Potential Environmental Effect	Mitigation Measure/Commitment	Project Phase	Responsible Agent
12.3	Follow-up and Monitoring	• Geology and soils	• Once the location of rock quarries, borrow material sites, temporary construction camps and staging areas are identified, soil and terrain conditions will be confirmed and specific mitigation will be identified and prescribed, as required, to minimize potential effects to terrain, including unique landforms, terrain stability, alterations to drainage, and soil quantity and quality, specially soil loss and/or degradation relative to site reclamation requirements. • Soil salvage will be monitored during construction including soil excavation, handling and stockpiling to confirm appropriate soil salvage and maintenance of soil quantity. • Periodic soil monitoring will be carried out through construction and operation of soil stockpiles and channel slopes to confirm adequate stabilization and erosion control has been achieved through implemented measures including soil tackifiers, erosion blankets and vegetation establishment.	Construction & Operations and Maintenance	Manitoba Infrastructure
12.4; 12.4.1.1	Follow-up and Monitoring	• Groundwater	A Groundwater Management Plan (GWMP) will be developed incorporating: • further investigation into groundwater in the LSMOC area • further aquifer investigation and modelling to determine effect of construction dewatering on specific domestic water wells in the potentially affected LMOC area • analyses of effects of dewatering, and then communicated to the local well users that may be affected (developing mitigation plans will involve working with affected well users) • additional observation wells installed prior to construction dewatering to monitor effects in the area during dewatering of each section during construction • mitigation plans modified as required during dewatering as specific information is received from observation wells and local well users	Construction & Operations and Maintenance	Manitoba Infrastructure and the selected Construction Contractor
12.4; 12.4.1.2	Follow-up and Monitoring	• Surface water, hydrology	• A Surface Water Management Plan (SWMP) will be developed, focusing on monitoring local drainage and hydrology and methods to establish aspects such as temporary diversions and snow accumulations. • Engineering studies will be conducted to further understand fluvial and shoreline geomorphology and optimize the design of the channel inlets and outlets to minimize environmental effects prior to construction. • Hydrologic monitoring will be implemented as a key input to operation of the Outlet.	Construction & Operations and Maintenance	Manitoba Infrastructure
12.4; 12.4.1.3	Follow-up and Monitoring	• Surface water, water quality	• An Aquatic Effects Monitoring Plan (AEMP) will be developed for the Project, which will include continued collection of surface water samples from regional and local waterways, and analyses of a suite of parameters to provide information on surface water quality in the Project area during Project construction, operation and maintenance activities.	Construction & Operations and Maintenance	Manitoba Infrastructure
12.5	Follow-up and Monitoring	• Fish and fish habitat	Construction monitoring will include: • fish movement • fish-bearing status and fish community composition Operation monitoring, gates closed will include: • fish use of the outlet channels Operation monitoring, gates opened will include: • enumeration of spawning runs, including fish moving upstream in the channels • egg deposition and larval drift in the channels • flow monitoring in the channels during implementation of ramping rates	Construction & Operations and Maintenance	Manitoba Infrastructure

Table 16.3-1 List of Mitigation Measures and Commitments for the Project

Section	Valued Component/ Monitoring/ Accidental Event	Potential Environmental Effect	Mitigation Measure/Commitment	Project Phase	Responsible Agent
12.6	Follow-up and Monitoring	• Vegetation	A Vegetation Monitoring Plan (VMP) will be developed for the Project. It will provide methods on verifying predicted changes to vegetation species diversity and wetlands and how the effectiveness of mitigation strategies (e.g., revegetation) will be evaluated. The Plan will include: • assessment of revegetation shortly after construction and for several years following construction • Species of Conservation Concern (SOCC) surveys to collect construction data to inform mitigation and determine whether unexpected effects may occur • further wetland mapping of the LMOC PDA to identify all potentially affected wetlands • monitoring effectiveness of wetland compensation measures	Construction & Operations and Maintenance	Manitoba Infrastructure
12.7	Follow-up and Monitoring	• Wildlife	A Wildlife Management Plan will be developed for the Project. It will include: • commitments to gather additional field information on species at risk (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, including monitoring of the effectiveness of offsets, restoration efforts, and/or land parcels set aside for SAR • a continuation of the remote camera study, in order to capture presence/absence or occupancy data for wide-ranging large bodied species and/or predators • bird surveys to assess potential Project effects to sensitive habitats within the wildlife LAA	Construction & Operations and Maintenance	Manitoba Infrastructure
12.8	Follow-up and Monitoring	• Land and resource use	The follow-up program includes: • compliance monitoring to confirm that manure stockpiles have been effectively located off the right-of-way prior to construction • monitoring agricultural biosecurity during construction activities will be carried out to confirm that mitigation measures are effectively implemented	Construction	Manitoba Infrastructure
12.9	Follow-up and Monitoring	• Infrastructure and services	No follow-up monitoring plans for effects on infrastructure and services have been identified.		Not applicable
12.10	Follow-up and Monitoring	• Economy	No follow-up monitoring plans for economic effects have been identified.		Not applicable
12.11	Follow-up and Monitoring	• Health	Follow-up and monitoring for human health is based on the results of surface and groundwater monitoring, if required.		Manitoba Infrastructure and the selected Construction Contractor
12.12	Follow-up and Monitoring	• Heritage resources	• A pre-construction Heritage Resources Impact assessment (HRIA) will be conducted. • Construction monitoring will be carried out in areas of high heritage resource potential. • Periodic post-construction monitoring will be carried out of the Bayton St. Thomas Lutheran Cemetery.	Construction & Operations and Maintenance	Not applicable
12.13	Follow-up and Monitoring	• Traditional land and resource use	Follow-up and monitoring requirements specific to Traditional Land and Resource Use (TLRU) have not yet been identified. The current planned approach will be to share the results of other relevant monitoring (fisheries, wildlife, etc.) with communities as part of the ongoing engagement process.		Manitoba Infrastructure and the selected Construction Contractor
12.14	Follow-up and Monitoring	• Indigenous health and socio-economic conditions	The current approach to follow-up and monitoring for Indigenous Health and Socio-economic Conditions will be based on sharing the results of other relevant monitoring with communities as part of the ongoing engagement process.		Manitoba Infrastructure and the selected Construction Contractor
12.15	Follow-up and Monitoring	• Aboriginal and Treaty Rights	The current approach to follow-up and monitoring regarding Aboriginal and Treaty Rights will be based on sharing the results of other relevant monitoring with communities as part of the ongoing engagement process		Manitoba Infrastructure and the selected Construction Contractor

Table 16.3-1 List of Mitigation Measures and Commitments for the Project

Section	Valued Component/ Monitoring/ Accidental Event	Potential Environmental Effect	Mitigation Measure/Commitment	Project Phase	Responsible Agent
13.3.2.3	Project Sustainability	• Disturbance/mortality of wildlife and fish, vegetation disturbance	Activities such as clearing, and in-water works will be conducted outside of restricted activity periods and other sensitive periods wherever feasible to reduce or avoid effects on vegetation, wildlife, fish and other environmental receptors.	Construction	Manitoba Infrastructure and the selected Construction Contractor
13.3.2.3	Project Sustainability	• Erosion and sedimentation	Where feasible, native vegetation will be planted along the side slopes of the channels to provide erosion protection and wildlife habitat.	Construction & Operation and Maintenance	Manitoba Infrastructure and the selected Construction Contractor
13.3.2.3	Project Sustainability	• Waste material	Where possible, reusing source excavated material including composite materials to build banks and berms.	Construction	Manitoba Infrastructure and the selected Construction Contractor
13.3	Project Sustainability	• All effects	Monitoring efforts will be initiated by multiple environmental disciplines to confirm the effectiveness of the function of the Project, and its components as they relate to environmental designs and mitigation measures. If adverse effects impacting sustainability are observed, adaptive measures will be explored where and when possible to minimize or eliminate this occurrence.	Construction & Operation and Maintenance	Manitoba Infrastructure
3.5.2.14; 3.5.3.6; 14.3	Accidents and Malfunctions	• Accidental spills	Solid, liquid and hazardous wastes from the Project will be collected, stored, transported, disposed of and/or treated in accordance with relevant legislation If contaminated soil is discovered during the life of the proposed Project, the affected site will be assessed and managed in accordance with provincial regulations.	Construction & Operations and Maintenance	Manitoba Infrastructure and the selected Construction Contractor
3.5.2.14; 14.3	Accidents and Malfunctions	• Accidental spills	During construction, fuel handling and storage areas will be located a minimum of 100 m from a waterbody. Fuel storage areas will incorporate secondary containment to reduce or avoid the potential for contamination in the event of an unexpected spill or container leak. Materials and equipment for the containment and recovery of accidental hazardous material spills will be available at all construction sites.	Construction	Manitoba Infrastructure and the selected Construction Contractor
14.3	Accidents and Malfunctions	• Accidental spills	Machinery will arrive on site in a clean condition and will 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 repaired.	Construction	Manitoba Infrastructure and the selected Construction Contractor
14.3	Accidents and Malfunctions	• Accidental spills	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 100m 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.	Construction	Manitoba Infrastructure and the selected Construction Contractor
14.3	Accidents and Malfunctions	• Accidental spills	All Designated Areas used for petroleum storage will be a minimum distance of 3 m from a property line or building and 15 m horizontally from hydroelectric poles and lines.	Construction	Manitoba Infrastructure and the selected Construction Contractor
14.3	Accidents and Malfunctions	• Accidental spills	All fuel storage containers and tank vehicles will be inspected daily for leaks and spillage. Damaged or leaking fuel storage containers will be promptly removed from site. All used petroleum products and other regulated hazardous wastes will be collected and disposed of at a licensed facility in accordance with applicable legislative requirements.	Construction	Manitoba Infrastructure and the selected Construction Contractor
14.3	Accidents and Malfunctions	• Accidental spills	Construction, installation and removal of petroleum storage tank systems will occur under the supervision of a registered licensed petroleum technician.	Construction	Manitoba Infrastructure and the selected Construction Contractor
14.3	Accidents and Malfunctions	• Accidental spills	Dedicated petroleum storage areas will provide additional spill containment and facilitate clean up through measures	Construction	Manitoba Infrastructure and the selected Construction Contractor

Table 16.3-1 List of Mitigation Measures and Commitments for the Project

Section	Valued Component/ Monitoring/ Accidental Event	Potential Environmental Effect	Mitigation Measure/Commitment	Project Phase	Responsible Agent
14.3	Accidents and Malfunctions	• Accidental spills	Only above ground storage tanks will be used for the storage of bulk petroleum products. The tanks will be equipped with overfill protection and spill containment consisting of perimeter dikes or secondary containment in the tank design.	Construction	Manitoba Infrastructure and the selected Construction Contractor
14.3	Accidents and Malfunctions	• Accidental spills	All Designated Areas used for petroleum product storage will be a minimum distance of 100 m from any water body and will have the topsoil stripped and be underlain with at least 30 cm of impermeable soil or approved alternate and diked in such a manner as to contain any leakage or spillage. The dikes will be designed, constructed and maintained to retain not less than 100% of the capacity of the total number containers or 110% of the largest container, whichever is greatest. If dikes are used, the containment areas will be dewatered after a rainfall event and the containment water disposed of as approved by the Engineer and clean topsoil will be stored and used in the restoration of the site	Construction	Manitoba Infrastructure and the selected Construction Contractor
14.3	Accidents and Malfunctions	• Accidental spills	Concrete barriers will be installed around all petroleum storage tanks to prevent collisions.	Construction	Manitoba Infrastructure and the selected Construction Contractor
14.3	Accidents and Malfunctions	• Accidental spills	All employees involved in the handling and storage of fuels will have WHMIS and spill response training.	Construction	Manitoba Infrastructure and the selected Construction Contractor
14.3	Accidents and Malfunctions	• Accidental spills	All internal-combustion engines (regardless of fuel type) will be shut down during fueling.	Construction	Manitoba Infrastructure and the selected Construction Contractor
14.3	Accidents and Malfunctions	• Accidental spills	There will be no smoking and no open flames at the petroleum storage area at any time	Construction	Manitoba Infrastructure and the selected Construction Contractor
14.3	Accidents and Malfunctions	• Accidental spills	Fueling procedures will be posted where fueling occurs.	Construction	Manitoba Infrastructure and the selected Construction Contractor
14.3	Accidents and Malfunctions	• Accidental spills	Storage sites for petroleum products will be secured and signs including but not limited to; hazard warnings, who to contact in case of a spill, access restrictions and under whose authority the access is restricted will be posted.	Construction	Manitoba Infrastructure and the selected Construction Contractor
14.3	Accidents and Malfunctions	• Accidental spills	All petroleum product storage sites and mobile transportation units will, at all times, be equipped with appropriate categories of equipment and volumes of fire suppression products	Construction	Manitoba Infrastructure and the selected Construction Contractor
14.3	Accidents and Malfunctions	• Soil, water and food contamination	All pesticides applied by Manitoba Infrastructure will be pre-approved for use by Provincial legislation.	Operation and Maintenance	Manitoba Infrastructure
14.3	Accidents and Malfunctions	• Contaminated water	Contaminated runoff or water will be contained and prevented from entering any waterbody. The collected contaminated runoff or water will be hauled off site for disposal at an approved disposal facility.	Construction & Operation and Maintenance	Manitoba Infrastructure and the selected Construction Contractor
14.4	Accidents and Malfunctions	• Fire	An evacuation and emergency preparedness plan addressing wildfires will be implemented and submitted to the Engineer prior to commencing construction.	Construction & Operation and Maintenance	Manitoba Infrastructure

Table 16.3-1 List of Mitigation Measures and Commitments for the Project

Section	Valued Component/ Monitoring/ Accidental Event	Potential Environmental Effect	Mitigation Measure/Commitment	Project Phase	Responsible Agent
14.4	Accidents and Malfunctions	• Fire	Open fires are prohibited from April 1st to November 15th annually. In the event that burning is required during that period, an application for a burning permit will be submitted for approval to Manitoba Sustainable Development. All conditions imposed by the burning permit will be adhered to.	Construction & Operation and Maintenance	Manitoba Infrastructure and the selected Construction Contractor

16.4 SUMMARY OF POTENTIAL EFFECTS AND MITIGATION ON ABORIGINAL OR TREATY RIGHTS

As presented in Sections 10.2.1.4 and 10.4.3.4, concerns raised by Indigenous groups associated with the exercise of Aboriginal and treaty rights are:

- effects on fishing grounds (e.g., depleting fish stocks, Project debris, contamination of fish)
- damage to fishing equipment from debris in Lake Winnipeg affecting traditional fishing grounds
- effects on hunting and trapping (e.g., reduction in vegetation; moose populations)
- effects on gathering traditional plants for medicine
- effects of development leading to the loss of traditional lands and resources
- effects on traditional foods (e.g., berry picking)
- protection of eagle feather gathering
- reduced land use activities and harvesting opportunities
- reduction of unoccupied Crown Land availability on which to exercise Aboriginal and Treaty rights
- changes to land designations which have the potential to affect Treaty Land Entitlement selections or acquisitions

A summary of Project effects on Aboriginal or treaty rights and the mitigation proposed by Manitoba Infrastructure to address these effects is presented in Table 16.4-1. The Project will not result in the long-term loss of availability of traditional use resources or access to lands currently relied on for traditional use practices, or the permanent loss of traditional use sites and areas in the LAA and RAA. Changes in value or importance associated with current use will be largely limited to the PDA and direct disturbance areas, and with mitigation and continued engagement with Indigenous groups, that effects can be mitigated. Manitoba Infrastructure will continue to engage with Indigenous groups throughout the life of the Project to address concerns with effects on Aboriginal and treaty rights.

Table 16.4-1 Summary of Potential Project Effects and Mitigation on Aboriginal and Treaty Rights

Potential Effect	Mitigation Measures	Residual Effects	Accommodation for Unmitigated Effects
Change in availability of traditional resources for current use	Mitigation measures provided for fish and fish habitat, vegetation, heritage resources, wildlife, and land and resource use are applicable for mitigating effects on traditional land and resource use. Additionally, the following mitigation measures will be implemented: • A schedule of construction and Project activities will be made available to all Indigenous groups and Northern Affairs Communities engaged on the Project, so that areas and time periods of activity can be avoided. • Vegetation control will occur through mechanical methods where feasible, and hand clearing will occur along shorelines to mitigate effects to plant harvesting. • Provincial aquatic invasive species protocols will be followed to reduce risk. • The Revegetation Plan will be completed as part of the Construction Environmental Management Program (CEMP) by Manitoba Infrastructure, and will involve the collaborative participation of interested Indigenous groups.	The Project is anticipated to result in changes to the availability of traditional resources for current use through alteration, reduction, or loss of habitat. Residual effects are predicted to be adverse due to a loss in habitat for harvested resources, but low in magnitude as it is anticipated that current land and resource use practices will be able to continue with minor alteration of behaviour by Indigenous peoples. The direct and indirect loss of habitat for harvested species is relatively small compared to the remaining habitat available in the RAA, and the habitat reclaimed (for example due to fewer riparian plants being inundated) by reversing the effects of flooding. Residual effects on wildlife and fish will not pose a threat to the long-term persistence and viability of species in the RAA. Similarly, residual effects on vegetation will not result in the loss of vegetation communities in the LAA. The residual adverse effects of the Project on the availability of traditional resources for current use will occur infrequently and be limited to the LAA.	Manitoba Infrastructure will continue to engage with Indigenous groups regarding mitigations to Project effects on Aboriginal or Treaty Rights and concerning the recommendations identified by Indigenous groups.
Change in access to traditional resources and areas for current use	Mitigation measures provided for land and resource use are applicable for mitigating effects on change in access to traditional land and resource use. Additionally, the following mitigation measures will be implemented: • Manitoba Infrastructure will engage with Dauphin River First Nation, Peguis First Nation, Pinaymootang First Nation and other Indigenous groups in order to better understand the use and importance of the snowmobile trails which are intersected by the Lake St. Martin Outlet Channel and to develop suitable means of crossing the Lake St. Martin Outlet Channel following construction. • A schedule of construction and Project activities will be made available to all Indigenous groups and Northern Affairs Communities engaged on the Project, so that areas and time periods of activity can be avoided. • MI will restrict unauthorized access to the outlet channels during operation.	Although the specific degree to which the PDA is being accessed for traditional purposes is not known, it is conservatively assumed that the Project will restrict access to traditional resources, current use sites, or locations. Residual effects are anticipated for changes in access to lands and resources in the PDA. Travel along the snowmobile trails intersected by the Lake St. Martin Outlet Channel will be altered. However, with the implementation of mitigation measures such as a path or bridge across the Lake St. Martin Outlet Channel, travel will only be interrupted during construction and will be able to continue, with alterations, during operations. The 172.5 ha of private land being taken up by the PDA. Roads and access routes that result from the Project may affect access to resources by causing Indigenous groups to seek alternate routes to areas and sites. Increased access by non-Indigenous land users may also occur, which will have a negative effect on access to resources and areas for Indigenous groups.	
Change to cultural and spiritual sites or areas	• Detailed recording and mapping of spiritual or cultural sites will be developed in partnership with Indigenous groups, leading to a decision made about the relative importance of the site and potential mitigations strategies. • An appropriate ceremony will be held prior to commencement of construction under the direction of local Indigenous groups.	Effects on cultural and spiritual sites are site-specific and limited to the PDA. Patterns of access to cultural or spiritual sites, or areas in the LAA may be altered by access restrictions to the PDA. The land and resource use assessment identified residual effects related to changes in access conditions, which will in turn affect cultural sites and practices in the PDA.	
Changes to the cultural value or importance associated with current use	Mitigation for effects on changes to the cultural value or importance associated with current use is specific to individuals. Manitoba Infrastructure will continue to engage with Indigenous groups regarding mitigations to changes to cultural value or importance associated with current use, and concerning the recommendations identified by Indigenous groups.	Any disturbance to land or cultural site can potentially change the cultural value or importance of that area or feature. The value or importance of these components are subjective and conditional, and are contingent on beliefs, perceptions, values, and qualitative experience of Indigenous land users. Effects on cultural value or importance are not reducible to effects on biological resources or physical sites and Indigenous groups may choose not to conduct activities even where availability and access to resources are not affected. Indigenous groups cited increased noise, dust and light, and the presence of industrial activity as affecting the cultural experience of the land.	