TABLE OF CONTENTS

Page

LIST OF TABLES

11.0 EFFECTS OF THE ENVIRONMENT ON THE PROJECT

The determination of potential effects of the environment on the proposed Project is based on the ability of the constructed Project to withstand normal and potential extreme environmental events. Normal and potential extreme environmental events that have the highest risk of occurring within the Project area include, but are not limited to: extreme weather conditions; flooding; and forest fires. **Sections 11.1** through **11.6** assess potential effects of the environment on the Project in consideration of:

- The risk of extreme environmental events occurring;
- Mitigation inherent in the road design and related components (e.g., bridges) to withstand normal environmental conditions and atypical natural hazard events; and
- Environmental protection plans and emergency response procedures for the Project (**Chapter 5**).

11.1 Weather Conditions

The proposed Project will be subject to occasional severe or extreme weather events such as heavy snow falls, blizzards, extreme winds, intense rain storms, and possibly tornadoes. Tornadoes are relatively uncommon in the Regional Assessment Area; there is less than one tornado occurrence per 10,000 km^2 with a return period of 105 years (Cheng *et al.* 2013). During construction, severe weather events could adversely affect the Project resulting in cost overruns, Project completion delays and adverse effects to the environment in the Local Assessment Area (e.g., erosion of road bed and downstream sedimentation). During operation and maintenance, severe weather events could force closure of the road for extended periods of time due to heavy snow accumulations during winter and stream washouts during the high-risk spring and summer seasons. Although severe weather events may result in localized erosion and sedimentation, landslides are not anticipated due to the relatively flat topography (**Chapter 7**, **Section 7.1.3.1**). Severe weather events can also lead to vehicle accidents which may result in fuel and other hazardous liquid releases and temporary road closures.

Information regarding climate normals and the probability of extreme weather events (1 in 5 year events and 1 in 100 year events) for rainfall and snowfall in the Local Assessment Area is provided in **Chapter 7**, **Section 7.1.1**. Excessive rainfall and/or snowfall events may increase the probability of flooding and the increased potential of localized effects to the road. The Project design, as detailed in **Chapter 3**, has incorporated standard design measures (e.g., design standard of 1:100 year flood event for stream crossings) that are expected to mitigate potential effects of typical and predictable weather events and severe/extreme weather events expected to occur in the Local Assessment Area. Sufficient depth of rock base layer in the roadbed design coupled with the placement of large-diameter (≥ 900 mm) stream crossing culverts, and equalization culverts in fen and bog complexes, are key elements in the road design that are expected to mitigate the probability of washout/erosion and sedimentation events. **Sections 11.2** and **11.3** discuss mitigation measures that will be implemented in

the event of less predictable and more extreme events due to flooding and forest fires. Drought conditions are not anticipated to significantly affect the integrity of Project components although drought conditions can increase the potential for forest fires.

With proper road design, good construction practices and implementation of emergency response plans, environmental protection plans and associated mitigation measures (**Chapter 5**), the potential impacts of extreme weather events on the Project are expected to be limited in extent and short-term in duration. Periodic inspection and maintenance of the Project will be conducted and repairs/ maintenance (**Chapter 3**, **Sections 3.4.8** and **3.4.9**) completed on an as-needed basis to reduce the potential for impacts on the Project associated with extreme weather events

11.2 Flooding

There is some potential for the proposed Project to be affected by flooding due to seasonal flood events resulting from the rapid melting of high snow volumes and/or heavy rain events. The Project design standard of 1:100 year flood event for stream crossings is intended to limit the potential for flood damage and washouts at crossings and along the proposed Project all-season road. In addition, the road design includes stream crossing culverts and equalization culverts placed at regular intervals in bog and fen areas (culvert diameter ≥ 900 mm) to accommodate seasonal drainage flows. Should ice jams result in a threat to the integrity of Project components due to flooding and scouring of banks, feasible methods to breakup ice jams will be considered. The large diameter (≥ 900 mm) of proposed culverts used in the Project intends to minimize the probability of ice jams at culverts. Bridge abutments will be designed to deflect floating debris and ice flows/ice jams (**Chapter 3**, **Section 3.4.9**).

Local beaver populations in the vicinity of the Project may cause damage due to the construction of beaver dams and the blocking of culverts. This may result in erosion at culvert locations and localized flooding. Regular inspections and maintenance activities, such as culvert clean-outs and beaver activity control as necessary, will minimize the potential for damage to the road and culvert crossings. The use of large diameter (≥ 900 mm) culverts and beaver deceivers in the road design will also minimize culvert blockage due to beaver activity.

11.3 Forest Fires

As indicated in **Chapter 9, Section 9.1,** approximately three quarters of the Local Assessment Area was burned by forest fires between 1920 and 1929. Since then, there has been little to no fire activity documented over the proposed Project Footprint or Local Assessment Area. Long-term trends in boreal forest fire statistics suggest that boreal forest fire occurrence may be increasing in Canada and possibly linked to climate change (Weber and Stocks 1998). However, local area fire predictions are more dependent on short-term local weather (dry spells and wind events) rather than longer-term seasonal weather patterns (Flannigan, Girardin, Tardif, and Bergeron 2003). Approximately 40% of the Project right-of-way occurs within low-lying fen and bog complexes or sparsely-forested areas and is therefore less susceptible to forest fires in those areas, there is a potential for more densely forested portions of

the proposed road right-of way to be subject to forest fire events over the operational phase of the Project.

In the event of a forest fire in the vicinity of the Project, mitigation procedures outlined in the Emergency Response Plan will be implemented (**Chapter 5**). This may include temporary closure of the all-season road, as required, to minimize the potential for vehicle collisions due to reduced visibility caused by smoke. Substantial damage to Project components as a result of forest fires is not anticipated considering most Project components are made from materials that are not easily affected by fire (e.g., rock/gravel road fill; steel and concrete bridge structures). Should a forest fire burn with extreme intensity in the vicinity of Project water crossings, there may be the potential for some structural damage to culverts and/or bridges; however, the likelihood is considered to be very low. Project components such as bridges, culverts, and signage will be inspected following a forest fire event along the all-season road to determine the extent of damage, if any, and repairs will be initiated as required. In the event of a forest fire in the vicinity of the Project, the proposed road will benefit from increased access to regional firefighting resources given the proximity of the Project to the Poplar River and Berens River First Nations communities.

11.4 Permafrost and Subsidence Risk

11.4.1 Permafrost

Permafrost terrain is ground that remains below 0°C all year based on the thermal state of the soil or rock and occurs in northern regions of Canada where the mean annual air temperature is below 0°C. The mean annual temperature of the Project Local Assessment Area is approximately 0.6°C (**Chapter 7**, **Section 7.1.1**) and the Project is not located within a permafrost zone (Natural Resources Canada 2000).

11.4.2 Subsidence Risk

The risk of ground subsidence in the Local Assessment Area may result from: washout (erosion) events; changes to soil moisture content due to removal of vegetation; and variations in seasonal and annual precipitation. Installation of stream crossing and equalization culverts, as discussed in **Chapter 3**, **Section 3.4.6**, will minimize the potential for erosion and scouring that can compromise the integrity of the road base and embankment and result in potential ground subsidence and road damage. An additional measure that will be implemented to mitigate the potential for subsidence includes use of appropriate geosynthetic material (geotextile), as needed. Geotextile will be used to separate the road structure from areas with unsuitable soils to protect road structure integrity and provide for road and culvert reinforcement by containing road fill material at fen and bog crossing locations in consideration of the latest effective techniques for road construction in boreal wetland areas (see **Figure 3-5, Chapter 3**).

As part of operational activities, the condition of the proposed all-season road will be regularly inspected for maintenance planning purposes and to identify potential safety hazards. In the event of

minor subsidence, additional aggregate will be added to the road surface. In more extreme instances, a culvert installation may be deemed necessary.

11.5 Climate Change

It is generally acknowledged that warming trends due to climate change can put northern road systems at risk by impacting road structures that overlie permafrost and by shortening the duration of winter roads built on ice or seasonally frozen ground (McGregor *et al.* 2008). Although the Project is not located in the permafrost zone of Manitoba, the existing seasonal winter road connecting the Berens River and Poplar River communities to the southern all-season road network has experienced less predictable safe seasonal use days due to intermittent years of considerably shorter winter road use seasons as compared to the average trend experienced in the past.

The proposed Project can be viewed as a mitigation response to the effects of climate change impacts on the transportation needs of the local Berens River and Poplar River communities. The Project will provide all-season road access to these communities rather than the communities having to rely on temporary and less predictable winter road access and costly air transportation. It is possible that without the Project, and if future climate change trends continue to adversely impact the reliability of the winter road, there will be a greater reliance on air transportation resulting in increased greenhouse gas emissions and high goods and services costs.

11.6 Seismic Events

The Province of Manitoba, including the Project Local Assessment Area, is a low seismic hazard area in Canada (**Chapter 7**, **Section 7.1.3.4**). Therefore, all-season road design standards in Manitoba do not incorporate mitigation for potential effects of seismic activity associated with earthquakes.

11.7 Assessment Summary

The all-season road design standards incorporate mitigation into the Project design to avoid or minimize adverse effects of normal environmental conditions of the area. Due to the unpredictable (unplanned) and therefore unknown nature, timing, scope, and extent of the potential occurrence of extreme environmental events, an assessment of the 'risk' to the Project from such events occurring is provided.

Taking into consideration the likelihood and risk of weather events and the implementation of mitigation measures and follow-up actions, no residual adverse effects of the environment on the Project are anticipated. The risk analysis for the effects of the environment on the Project and analysis of the potential for significant residual effects on the environment in consideration of mitigation measures is summarized in **Table 11.1**.

Table 11.1: Evaluation of Effects of the Environment on the Project

Potential Effects of the Environment on the Project	Mitigation Measures	Evaluation of Potential Risk to the Project	Evaluation of Residual Effects to the Environment
Construction Phase			
Risk of Project component damage, cost overruns and Project schedule delays due to extreme weather events during construction.	▪ Suspend construction activities during extreme weather events (summer/winter storms). ▪ Provide additional erosion protection and sediment control as required. ▪ Emergency response plans for road construction will include response to extreme weather events. ▪ Inspect and repair Project components as required after extreme weather events.	Low	Not Significant
Risk of Project component damage, cost overruns and Project schedule delays due to flooding during construction.	▪ Suspend construction activities during flooding events. ▪ Provide additional erosion protection and sediment control as required. ▪ Emergency response plans for road construction will include response to flood events. ▪ Inspect and repair Project components as required after flood events.	Low	Not Significant
Risk of Project component damage, cost overruns and Project schedule delays due to forest fires during construction.	▪ Enforce no smoking by workers during high and extreme fire conditions; provide designated smoking areas for workers under all other conditions. ▪ Burn windrows during winter. ▪ Emergency response plans for road construction will include response to forest fire events. ▪ Inspect and repair Project components as required after forest fire event.	Low	Not Significant
Operation and Maintenance Phase			
Risk of damage to road and crossing structures and potential road closures due to extreme weather events during operation and maintenance.	▪ Coordinate contingency procedures with First Nations and Northern Affairs Communities in communication with the Royal Canadian Mounted Police (RCMP) regarding RCMP's decisions to close roads due to unsafe conditions. ▪ Inspect and repair Project components as required after extreme weather events.	Low	Not Significant

Potential Effects of the Environment on the Project	Mitigation Measures	Evaluation of Potential Risk to the Project	Evaluation of Residual Effects to the Environment
Risk of damage to road infrastructure and road closures due to flooding during operation and maintenance.	▪ Project designed to withstand 1:100 year flood events. ▪ Prepare Emergency Response Plan for road operation that includes flooding. ▪ Coordinate contingency procedures with First Nations and Aboriginal Affairs communities in communication with the RCMP regarding RCMP's decisions to close roads due to unsafe conditions. ▪ Inspect and repair Project components as required after flood events.	Low	Not Significant
Risk of damage to road infrastructure and road closures due to forest fires during operation and maintenance.	▪ Manage vegetation along road shoulders. ▪ Prepare Emergency Response Plan for road operation that includes extreme weather events. ▪ Coordinate contingency procedures with First Nations and Aboriginal Affairs communities in communication with the RCMP regarding RCMP's decisions to close roads due to unsafe conditions. ▪ Inspect and repair Project components as required after forest fire event.	Low	Not Significant