8.0 Effects of the Environment on the Undertaking

Effects of the environment on the Project are those effects related to risks of natural hazards and influences of the natural environment that might affect the normal execution of the Project or cause damage to infrastructure related to it. Potential effects of the environment on any project are a function of project or infrastructure design in the context of its receiving environment, and ultimately how the project is affected by the natural environment. These effects may arise from physical conditions, land forms, and site characteristics or other attributes of the environment which may act on the project such that the project components, schedule, and/or costs could be substantively and adversely changed.

Based on the nature of the undertaking, the following environmental attributes have been selected for consideration in this assessment:

- Climate and climate change;
- Severe weather events;
- Turbine Icing; and
- Forest fires resulting from causes other than the Project.

8.1 Climate Change

Climate is defined as the statistical averages of precipitation, temperature, humidity, sunshine, wind velocity, and other phenomena such as fog, frost and hail storms for a particular region and time period, generally taken over a 30 year period (NASA 2021). Climate change is an acknowledged change in climate that has been documented over two or more 30-year periods. According to the Intergovernmental Panel on Climate Change (IPCC), climate change may be due to natural internal processes or external forces, or to persistent anthropogenic changes in the composition of the atmosphere or in land use (IPCC 2014). The United Nations Framework Convention on Climate Change (UNFCCC) makes a distinction between climate change attributed to human activities and climate variability attributable to natural causes, by defining climate change as a change of climate directly or indirectly attributed to human activity that alters the composition of the global atmosphere, and which is in addition to natural climate variability observed over comparable time periods (IPCC 2014).

Climate change is important to consider as the project is expected to be operational for 25+ years. Some of the long-term effects of global climate change include rising temperatures, changes in precipitation patterns, increases in droughts and heatwaves, stronger and more intense hurricanes and in increase in sea level (NASA 2021). Climate change could impact the Project by impacting the ability of the WTG to function due to high temperatures. The Project site was selected in a location with an elevation greater than 100 m above sea level (ASL), therefore, the effects of sea level rise are not anticipated to directly impact the operation of the Project.

The Climate Atlas of Canada (CAC) uses the Pacific Climate Impacts Consortium (PCIC) data (BCCAQv2) to provide climate projections for two future 30-year periods (2021-2050 and 2051-2080) and a baseline period (1976-2005) (CAC 2019). According to the CAC, the region of Oxford is projected to experience an increase in the mean annual temperature and the number of very hot (i.e., +30°C temperature) days from the baseline period to 2021-2050. The mean annual temperature between 1976 and 2005 was 5.8 °C is projected to increase to 7.8°C between 2021 and 2050 and the number of days with temperatures of +30°C is projected to increase from 1.9 to 8.6 (CAC 2019).

A summary of the ways climate change could impact the Project is presented in Table 55.

TABLE 55: POTENTIAL INTERACTIONS & PROPOSED MITIGATION OF EXTREME WEATHER EVENTS ON THE PROJECT

Potential Interactions due to Climate Change	Proposed Mitigation
Increase in temperatures could impact the function of the WTG	• The WTGs are designed with incorporated technology to prevent damage from rising temperatures. Weather conditions will be monitored throughout the operational life of the project with SCADA systems in place to remotely monitor the WTGs and with the ability to halt operations if needed.

8.2 Severe Weather Events

Extreme precipitation and storms can occur in Nova Scotia throughout the year, but tend to be more common and severe during the winter season. Winter storms can generally bring high winds and a combination of snow, rain and ice.

In Nova Scotia, an extreme rainfall event is when 25 mm or more rain falls over a 24-hour period, ECCC issues a rainfall warning when this is forecasted to occur (ECCC 2020b). According to the Climate Atlas of Canada, the projected change in mean heavy precipitation days (i.e., 20 mm or more precipitation within a 24 hour period) between 2021 and 2050 is an increase by 1.9 days (CAC 2019).

Significant ice storms have also affected Nova Scotia with an increased frequency. Ice buildup on power infrastructure during these storms has led to significant damage to equipment and transmission/ distribution infrastructure, as well as impassable roads, wide-spread power outages, and health emergencies.

Severe weather events could potentially damage the wind turbines due to conditions exceeding the operational design of the wind turbines. High winds, extreme temperatures and icing on blades all have the potential to shut down the wind turbines. Extreme weather events that could occur at the Project site are listed in Table 56.

TABLE 56: POTENTIAL INTERACTIONS & PROPOSED MITIGATION OF EXTREME WEATHER EVENTS ON THE PROJECT

Weather Event	Potential Interaction with Project	Proposed Mitigation
Extreme wind	• Damage to blades	• Automated control system would initiate shut down.
Hail	• Damage to blades	• Appropriate wind turbine maintenance.
Heavy rain and flooding	• Flooding of road and project site	• The project has been sited on an elevated plateau in the landscape and the roads will be designed to maintain water flow where needed to prevent flooding and wash-outs from current precipitation levels and to mitigate risks associated with predicted increases in precipitation from climate change. Appropriate storm water management will also be implemented; and • New site infrastructure will be installed in ways to maintain the flow of surface water across the site.
Heavy snow	• Damage to wind turbine components	• Automated control system would initiate shut down.
Ice storms	• Icing on blades resulting in potential ice throw	• Automated control system would initiate shut down procedures until ice has melted.
Lightning	• Potential for fires within nacelle of wind turbines	• Lightning protection system would conduct electrical surge away from nacelle.

8.3 Turbine Icing

Ice accumulation on wind turbine blades can occur during the winter months when the appropriate conditions of temperature and humidity exist, or during certain extreme weather conditions, such as freezing rain (Seifert et al. 2003). In the event that ice builds up on the wind turbine blades, there are two types of risks possible: the first is ice throw from an operating wind turbine, and the second is ice fall from a wind turbine that is not in operation.

When a wind turbine is in operation, it is assumed that ice may collect on the leading edge of the rotor blade and detaches regularly due to aerodynamic and centrifugal forces (Seifert et al. 2003). The distance that the ice will be thrown from the moving wind turbine blade will vary depending on the wind speed, the rotor azimuth and speed, the position of the ice in relation to the tip of the blade, as well as characteristics of the ice fragment.

In a Canadian study titled *Recommendations for Risk Assessments of Ice Throw and Rotor Blade Failure* in Ontario (LeBlanc et al. 2007) ice throw was investigated to determine the risk probability for an individual to be struck by ice thrown from an operating wind turbine. The following parameters and assumptions were used:

- Rotor diameter of 80 m;
- Hub height of 80 m;
- Fixed rotor speed of 15 RPM (Rotations Per Minute);
- Ice fragment is equally likely to detach at any blade azimuth angle and 3 times more likely from the blade tip than the rotor;
- Ice fragments have a mass of 1 kg and frontal area 0.01 m^2;
- All wind directions are equally likely; and
- Ever-present individual between 50 m and 300 m (doughnut shaped buffer around WTG), individual equally likely in any given 1 square m within that area.

The statistical analysis found that individual risk probability for an individual is 0.000000007 strikes per year or, 1 strike in 137,500,000 years. For an individual to be ever-present in the defined area, this assumes that the individual would be outside during the unpleasant weather necessary for icing conditions. This analysis does not take into account the presence of trees that could provide shelter from potential ice throw (Seifert et al. 2003). The wind turbines that will be used for the Project may have different specifications than used in this example; however, this should be used as a general example to understand the incredibly low probability of an individual being struck by ice throw.

As with trees, power lines, masts, and buildings, ice can accumulate on a stationary wind turbine, and will eventually be released and fall to the ground. Depending on the rotor position of the stationary rotor, different fall distances along the current prevailing wind will occur (Seifert et al. 2003).

8.4 Forest Fires

The Fire Weather Index is a component of the Canadian Forest Fire Weather Index System. The index provides a numeric rating of fire intensity, and is the general index of fire danger throughout the forested areas of Canada (Natural Resources Canada [NRCan] 2021).

The mean Fire Weather Index in the Cumberland County (i.e., normally the driest month of the year), when risk of forest fire is typically greatest, is rated from 0-5, as shown in Figure 27, which is the lowest rating on the scale of possible fire risk. This risk is based on Fire Weather Normals data, representing the average value of a fire weather code or index over the 30-year period from 1981 to 2010 (NRCan 2021).

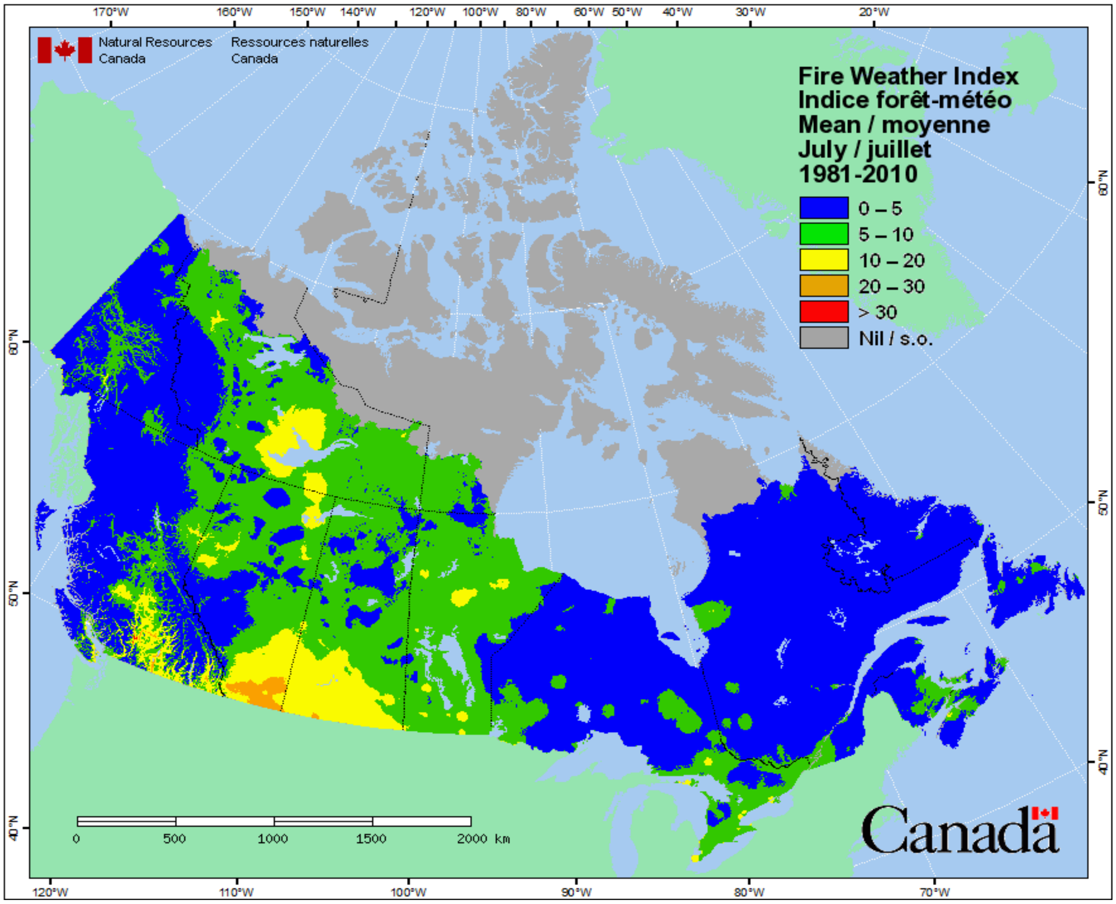

FIGURE 27: NATURAL RESOURCES CANADA FIRE WEATHER INDEX

8.5 Significance of Residual Effects

The Proponent recognizes the vulnerability of this project to impacts from the environment. However, careful design measures have been implemented based on the Project's location and the Project's technology to protect the Project from potential impacts from climate change, extreme weather and other environmental factors throughout the operational phase.

Extreme weather events have been considered while selecting the proper technology and the proper turbine model for its specific location. Using the most advanced technology will help ensure the turbine can withstand these events and that appropriate mitigation measures will be activated during the events. Examples of such mitigation measures include but are not limited to shutting down the turbine by pitching the blades, and rotating the hub to help avoid damage to the machinery.

Additionally, for extreme events occurring in the winter months, technology is now available that detects the formation of ice on the blades and shuts down the wind turbines until the ice has melted either passively or actively. Safety signage will be added to the site to notify any land users of the risks.

In the case of a forest fire or extreme weather event, the turbine can be shut down remotely if deemed necessary.