6 RESIDUAL ENVIRONMENTAL EFFECTS AND DETERMINATION OF SIGNIFICANCE

6.1 APPROACH TO DETERMINATION OF SIGNIFICANCE

The assessment or determination of the significance of potential effects is based on the framework/criteria provided in Canadian Environmental Assessment Agency (Agency) guidance document "Responsible Authorities Guide" (Agency, 1994) which summarizes the requirements that have been applied to similar projects in the past. An updated version is now available for Projects designated under CEAA 2012 (Agency, 2015). These documents are similar in nature and are widely accepted as guidance documents used by government and regulatory agencies in Canada are used as the basis for determining the significance of identified potential effects. This consists of the following steps:

— Determining whether the residual environmental effect is adverse
— Determining whether the adverse environmental effect is significant
— Determining whether a significant environmental effect is likely

For the purposes of the EIA, an effect is defined as the change to VECs as a result of project activities. A project-induced change may affect specific groups, populations, or species, resulting in modification of VECs in terms of an increase or decrease in its nature (characteristics), abundance, or distribution. Effects are categorized as either negative (adverse) or positive. Any adverse effects are then determined to be significant or non-significant in consideration of assessment criteria discussed above. The assessment focuses on those interactions between VECs and Project activities which are likely to cause residual effects.

6.2 SUMMARY OF RESIDUAL EFFECTS AND DETERMINATION OF SIGNIFICANCE

The residual effects classification is based on the magnitude, geographic extent, duration/frequency, reversibility and ecological context and is to describe residual effects predicted for the Project. The criteria are used to describe the nature and type of an effect on VECs. The residual effects classification is then used to determine the environmental significance of Project effects to VECs. The definitions of the criteria are presented below.

Magnitude is a measure of the intensity of a residual effect or the degree of change cause by a Project on a VEC relative to the existing conditions. Geographic extent and duration of an effect is important in classifying magnitude for a VEC. For magnitude, the criteria is defined as follows:

— High: A residual environmental effect affecting a whole stock, population, habitat or ecosystem, outside the range of natural variation that may be near or exceed the resilience limits of a population or community, such that communities do not return to pre-Project levels for multiple generations. For social environment VECs, the residual effect is expected to substantially enhance or interfere with existing conditions in communities in the local area and beyond.
— Moderate: A small, measureable residual environmental effect affecting a portion of a population or habitat, or ecosystem, returns to pre- Project levels in one generation or less, rapid and unpredictable change, temporarily outside range of natural variability. For social environment VECs, the residual effect is noticeable and may be potentially beneficial or detrimental to individuals and communities in the local area but not beyond.
— Low: A negligible residual environmental effect affecting a specific local group, habitat, or ecosystem, returns to pre-Project levels in one generation or less, within natural variation. For social environment VECs, the residual effect is limited to a slight positive effect or nuisance to individuals or communities in the local area.

- Nil: No discernable change to a VEC.
- Unknown: A residual environmental effect affecting an unknown portion of a population or group or where the changes in a specific parameter are unknown.

Geographic extent refers to the spatial extent of the area affected and is related to the spatial distribution and movement of a VEC. When considering geographic extent in the determination of magnitude, it is important to understand that local scale effects are less severe than those that extend to the regional scale or beyond. Geographic extent is broken into local, regional, and beyond regional as defined as follows:

- Local scale effects are those largely associated with direct effects from the Project footprint (i.e., removal of vegetation for construction of project components) and project specific small-scale indirect changes (i.e., within the Local Assessment Area).
- Regional scale effects are those that are associated with incremental and cumulative changes from the Project and other developments but are restricted to within the Regional Assessment Area.
- Beyond regional includes cumulative residual effects from the project and other developments that extend beyond the Regional Assessment Area.

Frequency refers to how often a residual effect will occur but is not to be confused with the frequency of the activity that causes a residual effect. Frequency is explained by identifying when the source of change and residual effect occurs. Frequency is broken into the following categories:

- Infrequent – isolated or confined to a discrete period
- Frequent – occur repeatedly over the assessment period
- Continuous – occurs continuously over the assessment period.

Duration is defined as the amount of time from the beginning of a residual effect to when that effect on a VEC is reversed. Duration is the results of two factors, the amount of time between the start and end of a project activity that causes stress on a VEC and the time required for the effect to be reversible. The duration of individual Project activities and the period in which the residual effect may occur are considered. Some effects are reversible shortly after the stress has been removed (e.g., changes in the distribution of some wildlife species following the removal of noise after decommissioning and abandonment), while others may take longer to be reversed (e.g., the change in abundance of some species until revegetation has occurred). In some cases, a prediction of duration may be well beyond the temporal boundary of the Project, it is not known when those effects may be reversed, and a VEC may never return to a state that was unaffected by the Project. In these cases, the likelihood of reversibility is so low that the effect is classified as irreversible. Therefore, duration is broken into the following categories:

- Short-term – the residual effect is reversible at the end of construction
- Medium-term – the residual effect is reversible at the end of operation of the project
- Long-term – the residual effect is reversible within a defined length of time where prediction certainty can predict the effect is reversible after decommissioning and abandonment.
- Permanent – the residual effect is predicted to influence a VEC indefinitely. This is applied when an effect is determined to be irreversible.

Reversibility is considered is the likelihood that the Project will no longer affect a VEC and as the ability of a VEC to return to an equal or improved condition once the interaction with the Project has ended. Reversibility has two alternatives, reversible or irreversible. Reversible is applied to short- medium- and long-term duration residual effects where the Project no longer cases changes to a VEC. Irreversible is applied when the residual effect is predicted to influence a VEC indefinitely or the duration of an effect is unknown.

For adverse residual effects, the evaluation for the individual criteria was combined into an overall rating of significance as follows:

- Major: Potential impact could jeopardize the long term sustainability of the resource, such that the impact is considered sufficient in magnitude, aerial extent, duration, and frequency, as well as being considered irreversible. Additional research, monitoring, and/or recovery initiatives should be considered.

— Medium: Potential impact could result in a decline of a resource in terms of quality/quantity, such that the impact is considered moderate in its combination of magnitude, aerial extent, duration, and frequency, but does not affect the long term sustainability (that is, it is considered reversible). Additional research, monitoring, and/or recovery initiatives may be considered.
— Minor: Potential impact may result in a localized or short-term decline in a resource during the life of the Project. Typically, no additional research, monitoring, and/or recovery initiatives are considered.
— Minimal: Potential impact may result in a small, localized decline in a resource during the construction phase of the Project, and should be negligible to the overall baseline status of the resource.

An adverse effect is considered "significant" where its residual effects are classified as major; while they are considered "not significant" where residual effects are classified as medium, minor, or minimal. For effects of the Project to have a significant effect on VECs, individuals would have to be affected to the extent that there would be a permanent adverse change to survival and reproduction at the population level.

6.2.1 EFFECTS ON BIRDS

The effects of a wind farm on birds are variable and depend on factors such as the development design, topography of the area, habitats affected, and the bird community in the wind farm area (Drewitt and Langston, 2006). Although some effects are related to construction (e.g., habitat alteration), most potential effects on avifauna are related to mortality resulting from direct collision and sensory disturbance.

The most apparent potential effect of the Project on birds is direct mortality resulting from collision with WTG blades during the operational phase. Most evidence suggests that mortality levels resulting from WTG collisions are low (Environment Canada et al., 2012). A recent review of Canadian wind farms concluded that less than 0.2% of the population of any species is affected by either collisions with, or displacement by, WTGs (Zimmerling et al., 2013).

Collision risk is greater on or near areas used by large numbers of foraging or roosting birds or in important migratory flyways (Drewitt and Langston, 2006). The probability of raptor collision with WTGs depends on the species, WTG height, and local topography (de Lucas et al., 2008). Collision risk can be greatly reduced by incorporating knowledge of the avifauna into the design and placement of wind power infrastructure. Available research suggests that the probability of large-scale fatality events occurring at wind farms is low (Kerlinger et al., 2010). Because no major migratory movements of passerines, shorebirds, waterfowl, or birds of prey were observed at the Project site, it is unlikely that significant mortality events will occur as a result of collisions with WTGs and other Project infrastructure.

Sensory disturbance to birds can occur during the construction, operation, and decommissioning and abandonment phases of the Project, and can be caused by the increased presence of personnel, vehicle movement, operation of heavy equipment, and the operation of the WTGs (Drewitt and Langston, 2006). It is thought that sensory disturbance to birds may have a greater population impact than collisions, although research is lacking in this area (Kingsley and Whittam, 2005). Some studies have shown that birds will exhibit avoidance behaviours, leading to a variable degree of displacement from previously used habitat (Drewitt and Langston, 2006). However, while birds may avoid specific sites, the evidence does not suggest that birds abandon the general area as a whole. Other research indicates that the presence of WTGs has no effect on the distribution of the bird community (Devereux et al., 2008) and birds may habituate to the presence of operating WTGs (Madsen and Boertmann, 2008). The majority of the Project crosses existing roads and forest that is currently disturbed by harvesting activities and has been sited to avoid environmentally sensitive areas thereby minimizing disturbance to new areas which can reduce displacement effects to birds.

No important concentrations of bird was detected during the winter, summer or autumn field surveys (Section 4.8.1). Only few birds of prey were noted. A total of five (5) bird SOCC were observed and included pine siskin, turkey vulture, common nighthawk, eastern wood-pewee, and evening grosbeak. Pine siskin and turkey vulture are ranked by the ACCDC; however, both are not listed under the NB SARA, designated by COSEWIC or listed under SARA. Additional spring bird migrations surveys are being completed in April/May 2018 to supplement the data in this report.

The collision of birds with WTGs and other Project infrastructure and displacement of birds from the Project was determined to be moderate in magnitude because it is unknown what the effects would be at the population level (Table 6.2-1). The Project consists of 5 WTGs in an area that appears to have highly variable distribution of birds based on habitat availability (Section 4.8.1). Similar observations were recorded at the Kent Hills wind farm about 5 km north of the Project. The incremental effects from the Project are predicted to be local in geographic extent and the effects are expected to be reversible following decommissioning and reclamation (long-term). The incremental contribution of the Project to existing conditions is not likely to decrease the resilience and increase the risk to local or sub-regional bird populations in the area. Therefore, the Project was given an overall significance rating of medium and is predicted to not have significant adverse effects on birds. Confidence in this prediction is moderate because of limited knowledge about the resilience of bird populations in the area. To test the prediction of significance presented in this EIA and to reduce uncertainty, a Post-construction Monitoring program will be implemented (Section 8). If the Project is found to be causing significant mortality during post-construction monitoring, additional mitigation will be evaluated.

6.2.2 EFFECTS ON BATS

Wind projects have the potential to affect bats both directly and indirectly (Arnett et al., 2007). Although some effects are related to construction (e.g., habitat alteration), most potential effects on bats are related to mortality resulting from direct collision and sensory disturbance.

Activities that cause noise, vibration, and dust, such as deforestation, earth-moving, excavation, blasting, transportation, and construction activities, could disturb local populations of bats. Because bats use echolocation in their movements and to locate and capture prey, the presence of anthropogenic noise could conflict with these activities. The effects of sensory disturbance varies among species of bats because each uses a specific range of ultrasound frequencies (Bunkley et al., 2015). The noise generated by road traffic have frequencies varying between 0 kHz and 50 kHz; typical ranges are between 1 kHz and 20 kHz (Schaub et al., 2008). These frequencies are likely to cause a greater sensory disturbance in species using low frequencies for echolocation such as hoary bat and big brown bat than in other species. However, traffic noise is unlikely to affect peak activity times of bats in the study area because construction is scheduled to occur during daytime hours. Vibrations generated by the Project near bat maternity colonies can lead to a reduction in reproductive success or cause bats to leave the site to find an alternative location (McCracken, 2011; ECCC, 2015). Among the recorded bat species, *Myotis* species, tri-colored bat, and big brown bat are resident species that over winter in NB in habitats where conditions are suitable for hibernation. Frequent awakenings during the hibernation period can be a cause of mortality (Gauthier et al., 1995; Thomas, 1995). No potential hibernaculum or other critical habitat (maternity sites) for bats was identified during field surveys. The closest known bat hibernaculum is located about 18 km north from the Project area.

Bat activity is mostly nocturnal and bats can be affected by light pollution (Stone et al., 2015). The presence of artificial light appears to disrupt the movements of some species of bats and can cause them to use alternative routes which may require higher energy costs and increased risk of predation (Stone et al., 2009; Stone et al., 2015). Conversely, species such as big brown bat and *Myotis* species may use areas of artificial light for foraging because artificial light can concentrate many flying insects (Rydell, 1992; Stone et al., 2015). Lighting on WTG hubs and blades will be limited to minimum levels while still meeting requirements of Transport Canada.

Increased vehicles and equipment traffic may result in collisions with bats (Lesiński et al., 2011; Medinas et al., 2013). Mortality rates are highest near roosts and active foraging areas (Medinas et al., 2013) and forest-adapted species, such as northern long-eared bat and tri-colored bat, have the highest risk due to their characteristic low and slow flight (Abbott et al., 2015). However, construction is scheduled during daytime hours and speed limits will be enforced during the Project, thereby reducing the potential for bat-vehicle collisions.

The most apparent potential effect of the Project on bats is direct mortality resulting from collision with WTG blades during the operational phase of a wind project. Mortality can either occur from direct contact with WTG blades or from barotrauma (Grodsky et al., 2011). Barotrauma is caused by rapid air-pressure reduction that causes tissue damage due to expansion of air in the lungs that is not accommodated by exhalation (Baerwald et al., 2008). A drop in atmospheric pressure along the top of a rotating WTG blade causes thoracic, abdominal, and pulmonary injury to bats when passing through the low pressure area (Baerwald et al. 2008). Recent studies indicates that barotrauma is probably the major cause of bat mortality from wind facilities (Rollins et al., 2012).

According to other post-construction monitoring programs of wind facilities, bat fatalities in Canada outnumbers bird fatalities (Environment Canada et al., 2012). Because bats have a long life span and a low reproductive rate, fatalities from wind facilities may be important. Species in the genus *Myotis* are killed by WTGs at lower rates (e.g., 0 to 13% of fatalities) relative to long-distance migratory species such as hoary bat (Arnett et al., 2008). This is likely because *Myotis* are non-migratory species that move shorter distances and generally fly at low altitudes during summer (Reynolds, 2006). Most bat fatalities are reported in the late summer months coinciding with the start of swarming and autumn migration (Johnson, 2005; Arnett et al., 2007; Environment Canada et al., 2012). Periods of high mortality may therefore be linked with the timing of large-scale insect migrations when bats feed at altitudes consistent with WTG heights (Rydell et al., 2010).

The collision of bats with WTGs and other Project infrastructure and displacement of bats was determined to be moderate in magnitude because it is unknown what the effects would be at the population level given the other pressures on bat populations (i.e., white-nose syndrome; Table 6.2-1). The Project consists of 5 WTGs in an area that appears to have relatively low bat activity (i.e., approximately 0.15 calls per night) when compared to other areas with 1.4 calls per night (Section 4.8.2). Similar observations of low bat activity were recorded at the Kent Hills wind farm about 5 km north of the Project. The incremental effects from the Project are predicted to be local in geographic extent and the effects are expected to be reversible following decommissioning and reclamation (long-term). The incremental contribution of the Project to existing conditions is not likely to decrease the resilience and increase the risk to remaining local or sub-regional bat populations in the area. Therefore, the Project was given an overall significance rating of medium and is predicted to not have significant adverse effects on bats. Confidence in this prediction is moderate because of limited knowledge about the resilience of the remaining bat populations in the area. To test the prediction of significance presented in this EIA and to reduce uncertainty, a Post-construction Monitoring program will be implemented (Section 8). If the Project is found to be causing significant mortality during post-construction monitoring, additional mitigation will be evaluated.

6.2.3 EFFECTS TO LOCAL ECONOMY

The Project will have a significant positive residual effect on the social environment in relation to employment and business opportunities (Table 6.2-1). Project construction and operations will create jobs and generate income, although much of the construction workforce may not be hired locally, which will reduce the benefits of job creation and income during Project construction. The Project will result in increased training and experience in the labour force, which will affect future opportunities. Project spending will result in increased gross domestic product and Project operations will generate tax revenue for municipal, provincial, and federal governments. WISK will attempt to source as much of the labour and materials locally when possible.

Table 6.2-1 Summary of Residual Effects Classification and Predicted Significance

Potential Interaction and Environmental Effect	Magnitude	Geographic Extent	Frequency	Duration	Reversibility	Significance
Construction and operation of the Project may result in birds and bats colliding with WTGs and other Project infrastructure	Moderate	Local	Continuous	Long-term	Reversible	Medium, Not Significant
Construction and operation of the Project may cause birds to alter their migration flyways to avoid WTGs	Low to Moderate	Local	Continuous	Long-term	Reversible	Medium, Not Significant
Employment and business opportunities	High	Regional	Continuous	Long-term	Irreversible	Significant positive effect

6.3 CUMULATIVE RESIDUAL EFFECTS

Cumulative residual environmental effects are defined as the sum of residual environmental effects from all past, current, and reasonably foreseeable projects and/or activities on the physical, biological, social and cultural components of the environment. In addition, natural disturbances such as fire, floods, insects, disease, and climate change can contribute to cumulative residual environmental effects.

The Project will implement mitigation practices to limit incremental environmental effects from the Project that will occur. Implementation of the mitigation practices is expected to result in minor changes to the biophysical and socio-economic environments from the Project relative to baseline conditions. The Project is located in an area that contains a large amount of forestry activity that will likely continue for the duration of the Project. Effects on VECs from the Kent Hills wind farm are not expected to overlap with effects on VECs in the local area. As such, no cumulative residual environmental effects are expected. As the Project progresses, SWEB will develop site-specific mitigation to further reduce the potential for cumulative environmental effects as required.