Affinity Renewables Inc.

RMS energy

Figure 6.13

Limerock Wind Farm

Visual Simulation 2

As viewed from Highway 104

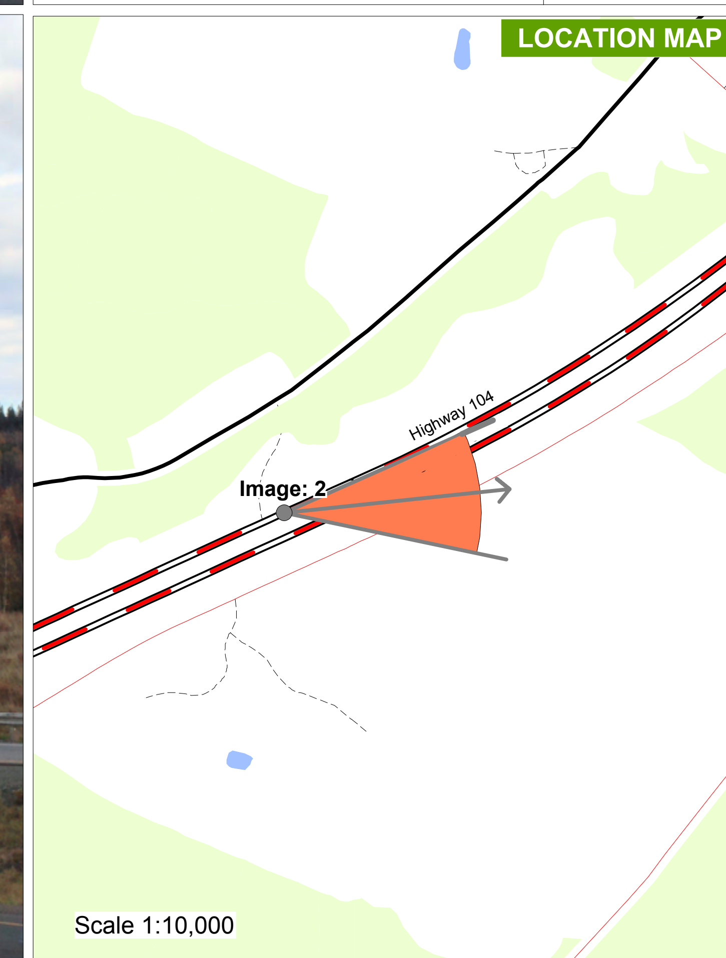
Image

Easting: 517,477
Northing: 5,045,804
Photograph Date: October 28, 2013
View Angle: 230 Degrees

Turbine

Manufacturer: General Electric
Model: GE 1.6 82.5
Hub Height: 80 m
Rotor Diameter: 82 m
Rated Power: 1680 kW

Coordinate System	UTM, NAD83, Zone 20	November 13, 2013
Analysis By: AL-PRO Wind Energy Consulting Canada Inc.		AL-PRO



Affinity Renewables Inc.

RMS energy

Figure 6.14

Limerock Wind Farm

Visual Simulation 3

As viewed from South Main St, Westville

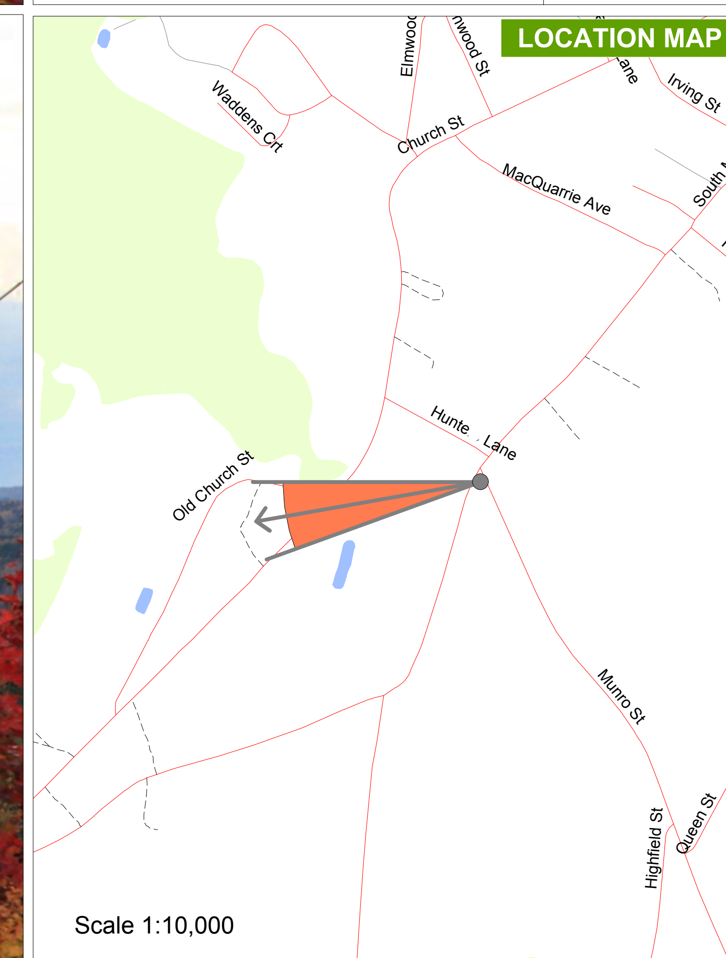
Image

Easting: 521,789
Northing: 5,044,298
Photograph Date: October 28, 2013
View Angle: 260 Degrees

Turbine

Manufacturer: General Electric
Model: GE 1.6 82.5
Hub Height: 80 m
Rotor Diameter: 82 m
Rated Power: 1680 kW

Coordinate System	UTM, NAD83, Zone 20	November 13, 2013
Analysis By: AL-PRO Wind Energy Consulting Canada Inc.		AL-PRO



The modeling software that Nortek used in this analysis is produced by EMD International (Denmark) and is part of the WindPro 2.8.579 suite of modeling software. The following inputs were used by the software to predict shadow flicker:

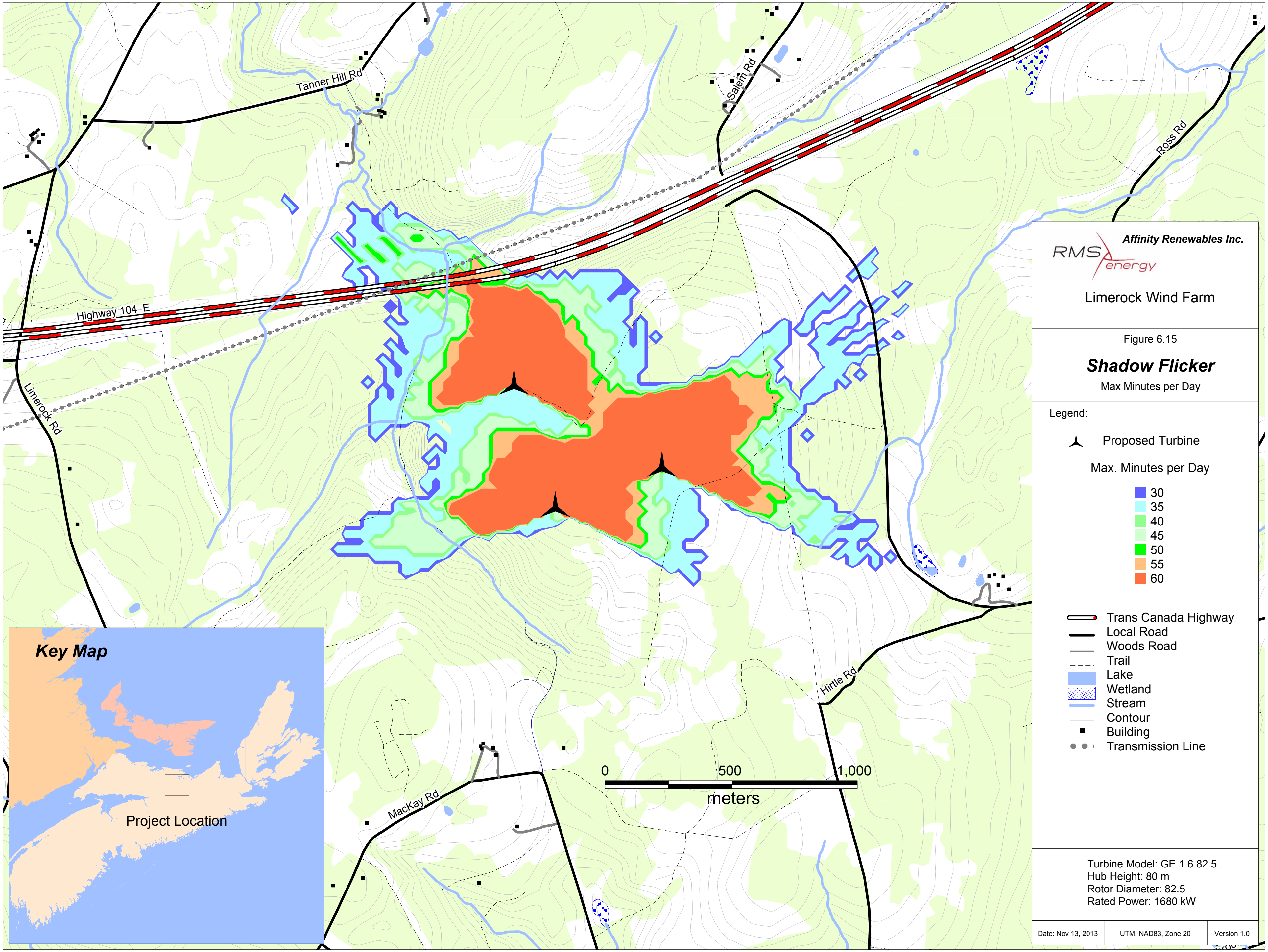
- Turbine locations;
- Receptor locations (residences and buildings within the model's analysis extent);
- Topographic elevation within analysis extent (5 m linear contours);
- Turbine details (Rotor diameter and hub height); and
- A 1 x 1 m receptor window is used, with the bottom edge 1 m above ground.

The sun's path calculated from the turbine was predicted based on geographic position of the Project. It should be noted that the model intentionally over predicts shadow flicker effects. The results represent "worse case" scenarios regardless of natural minimizing effects that may occur. These minimizing effects include:

- The reduction of the effects of shadow flicker due to overcast weather (the model assumes that the sun is shining during all daylight hours 365 days per year);
- Wind direction may cause the rotor to rotate parallel to receptor, casting no shadow on that receptor (the model assumes that the wind always comes for the same direction as the sun);
- Natural obstacles (trees, buildings, terrain, etc) occurring between the rotor and the receptor which would block the effects of shadow flicker on that receptor (the model assumes that no such objects exist within the analysis extent area); and
- The model presumes that all turbines are operating continually during daylight hours (the wind never stops blowing/ no maintenance time).

The province of Nova Scotia has no set regulatory limits for exposure to shadow flicker. However the industry commonly uses a combination of 30 hours per year and 30 minutes per day as a limit to reduce nuisance complaints. Calculations of shadow flicker for all nearby residences, given a worst-case scenario as described above, determined that no receptors could experience shadow flicker for up to 30 hours per year or up to 30 minutes per day (Figure 6.15 and 6.16). Shadow flicker modeling was conducted for three turbines. Based on site visits to the receptors following modeling results, it is believed that the model has overestimated visual exposure of the turbines to the receptors. Nevertheless, if shadow flicker becomes an issue (>30 hours/year) the Proponent has agreed to implement mitigation which may include shutdown of applicable turbines during times and conditions where shadow flicker may peak.

In summary, even considering the "worst-case scenario" model conditions are extremely unlikely to exceed recommended shadow flicker limits. The shadow flicker from blades will only extend as far as the sun and angles will allow. The model demonstrates that it will not be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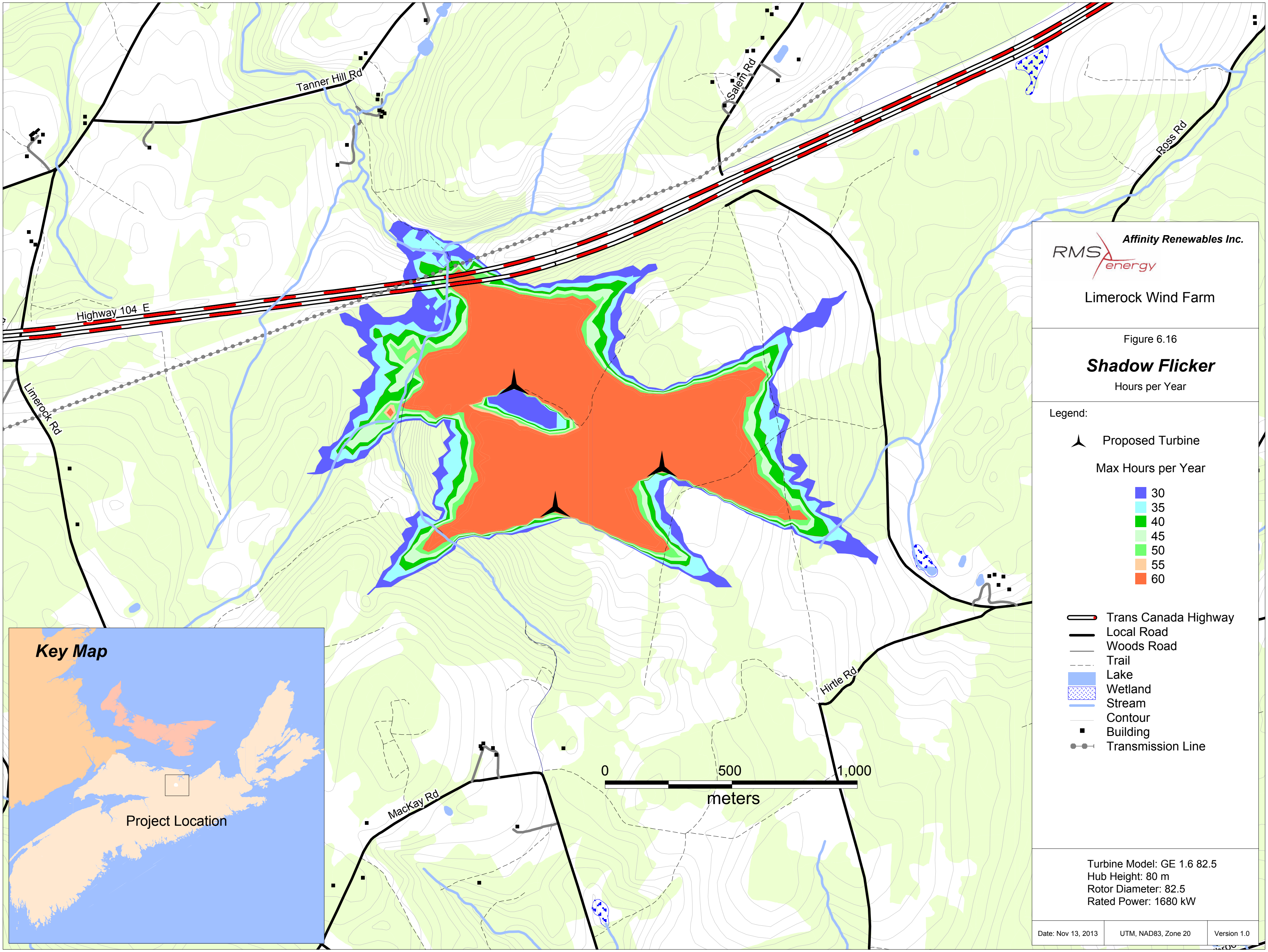
RMS energy
Limerock Wind Farm
Figure 6.15
Shadow Flicker
Max Minutes per Day
Legend:
Proposed Turbine
Max. Minutes per Day
30
35
40
45
50
55
60
Trans Canada Highway
Local Road
Woods Road
Trail
Lake
Wetland
Stream
Contour
Building
Transmission Line
Turbine Model: GE 1.6 82.5
Hub Height: 80 m
Rotor Diameter: 82.5
Rated Power: 1680 kW
Date: Nov 13, 2013
UTM, NAD83, Zone 20
Version 1.0
Key Map
Project Location
0
500
1,000
meters
Tanner Hill Rd
Salem Rd
Ross Rd
Highway 104 E
Limerock Rd
Hirtle Rd
MacKay Rd



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RMS energy
Limerock Wind Farm
Figure 6.16
Shadow Flicker
Hours per Year
Legend:
Proposed Turbine
Max Hours per Year
30
35
40
45
50
55
60
Trans Canada Highway
Local Road
Woods Road
Trail
Lake
Wetland
Stream
Contour
Building
Transmission Line
Turbine Model: GE 1.6 82.5
Hub Height: 80 m
Rotor Diameter: 82.5
Rated Power: 1680 kW
Date: Nov 13, 2013
UTM, NAD83, Zone 20
Version 1.0
Key Map
Project Location
0
500
1,000
meters
Highway 104 E
Tanner Hill Rd
Salem Rd
Ross Rd
Limerock Rd
Hirtle Rd
MacKay Rd

possible to experience shadow flicker at homes in the project surroundings.

A registry will be created to document complaints of shadow flicker. If a complaint or complaints of shadow flicker are received from a receptor, shadow flicker will be reassessed from that receptor. Information collected from the shadow flicker monitoring (if applicable) will be used will be used to develop further mitigation, if warranted. Times of operation for certain turbines causing higher levels of shadow flicker on certain residences can be varied to help reduce the level of shadow flicker on that residence.

No mitigation measures are required for the residential receptors evaluated for the visual impact assessment. The residual effect of the Project on the area's visual aesthetics is considered to be **low** but **not significant**.

6.2.1.7 Sound Impacts

Noise can be simply defined as "unwanted sound". Sound level limits are identified on an A-weighted decibel scale (abbreviated as dBA), which is generally accepted to reflect how humans perceive sound. Conversation in close quarters is usually at a sound level of 50 to 60 dBA and an alarm clock may emit sound to levels of approximately 80 dBA. Currently, the province of Nova Scotia does not have set sound level limits specific to wind turbine operations however Nova Scotia Environment considers anything above 40 dBA to be unacceptable. This guidance was considered during the development of a sound impact assessment for the Limerock Project, completed by Nortek Resources (see Appendix D). For assessment purposes in this study, a limit of 40 dBA was used, which was adopted from the recommendations from NSE.

Wind turbine generators produce sound through a number of different mechanisms which can be categorized into mechanical and aerodynamic sound sources. The major mechanical components, including the gearbox, generator and yaw motors, each produce their own characteristic sounds, including sound with tonal components. Other mechanical systems such as fans and hydraulic motors can also contribute to the overall sound emissions. Mechanical sound is radiated at the surfaces of the turbine, and by openings in the nacelle casing. Mechanical issues involving yaw motor supports or power train design can result in anomalous sounds such as periodic booming or tonal sounds.

The interaction of air and the turbine blades produces aerodynamic sound through a variety of processes as air passes over and past the blades. The sound produced by air interacting with the turbine blades tends to be broadband sound, but its amplitude is modulated as the blades pass the tower, resulting in a characteristic 'swoosh'. Generally, wind turbines radiate more sound as the wind speed increases.

The predicted sound levels resulting from the proposed Project are an accurate representation of the potential sound levels at the selected receptor locations. Sound modelling was conducted using Wind Pro 2.8.579 which includes the calculation methodology of the International Organization for Standardization (ISO) *Standard 9613-2 – Attenuation of Sound during*

Propagation Outdoors Part 2. This international standard provides a conservative estimate of sound propagation and subsequent environmental attenuation as a result of ground porosity, atmospheric attenuation and geometric spreading. Local terrain was considered in modelling. Sound power level data provided by the manufacturer were used to model operational sound at the selected receptors.

The study results presented in Appendix D show that the predicted sound levels at the receptor locations are below the guidance adopted for this Project (36 dBA) (Figure 6.17). It is not expected that the Project will have a significant impact, with respect to sound, on nearby receptors.

Ground attenuation is considered and uses the alternative case described in the ISO-9613-2 standard. This method uses the surface shape of the terrain to determine the sound dampening characteristic between the turbine hub and the receiver. The terrain is considered to be a bare earth model with no forest, vegetation or buildings. The terrain model was developed from 5 m contour data obtained from the Nova Scotia Geomatics Center and originated from stereo interpretation of 1:10,000 aerial photography.

The A-weighted sound pressure levels are modeled and represent the range of frequencies that are audible to the human ear. Noise emission data were obtained from the turbine manufacturer specifications and are based on calculated sound pressure levels for a variety of wind speeds. The following turbine models and hub heights were modeled:

Table 6.10-a: Turbine Specifications Used for Sound Modeling.

Description	Specification
Manufacturer	General Electric
Model	GE 1.6, 82.5
Hub Height	80 m
Rotor Diameter	82.5 m
Rated Power Output	1,600 kW
Maximum Sound Level (nacelle)	106.0 dBA

A conservative and standardized approach has been incorporated into the analysis which is based on modeling the representative sound levels at the mean wind speed of 7.0 m/s at hub height. The sound pressure levels where calculated and mapped to determine the impacts of the turbines on surrounding receptors. The threshold levels are currently used by the Ontario Ministry of the Environment and specified in *"Noise Guidelines for Wind Farms – Interpretation* *for Applying MOE NPC Publications to Wind Power Generation Facilities, October 2008"* and are summarized in Table 6.10-b.

Table 6.10-b: Sound Level Thresholds for Wind Turbines for Class 3 Areas (Rural).

Wind Speed (m/s) at 10 m height	Sound Level Limits (dBA)
4	40
5	40
6	40
7	43
8	45
9	49
10	51

The results presented in Figure 6.17 show that the sound pressure threshold levels for the range of wind speeds analyzed meet the current MOE standards. Existing dwellings on adjacent properties are located below the threshold limits shown in Table 6.10-b

The nearest receptor is no closer than 1100m from any turbine. In addition, routine maintenance of the wind turbines and associated equipment will be conducted as recommended by the manufacturer to ensure the turbines operate efficiently and do not produce additional sounds.

For the sound modeling exercise, three receptors were chosen to populate results at that exact position during worst case scenario sound level emissions. These are the closest buildings located to the nearest turbine at Limerock: to the south-west between Millbrook and Lovat; north-east (Tanner Hill); and north-east (Salem Road). Results were all below the provincial threshold of 40 dBA at 38.9 dBA, 36.7 dBA and 36.0 dBA, respectively (Appendix D).

In response to sound complaints, if any occur, the Proponent would measure ambient sound levels and wind speed at selected residential receptors. The sound and wind data will then be combined to produce a plot of background ambient sound pressure levels versus wind speed. If the ambient sound levels at any residential receptors are higher than permitted levels, a report shall be filed with NSE with the particulars of the concern, the suspected source, and any remedial actions taken or to be taken to resolve the concern.

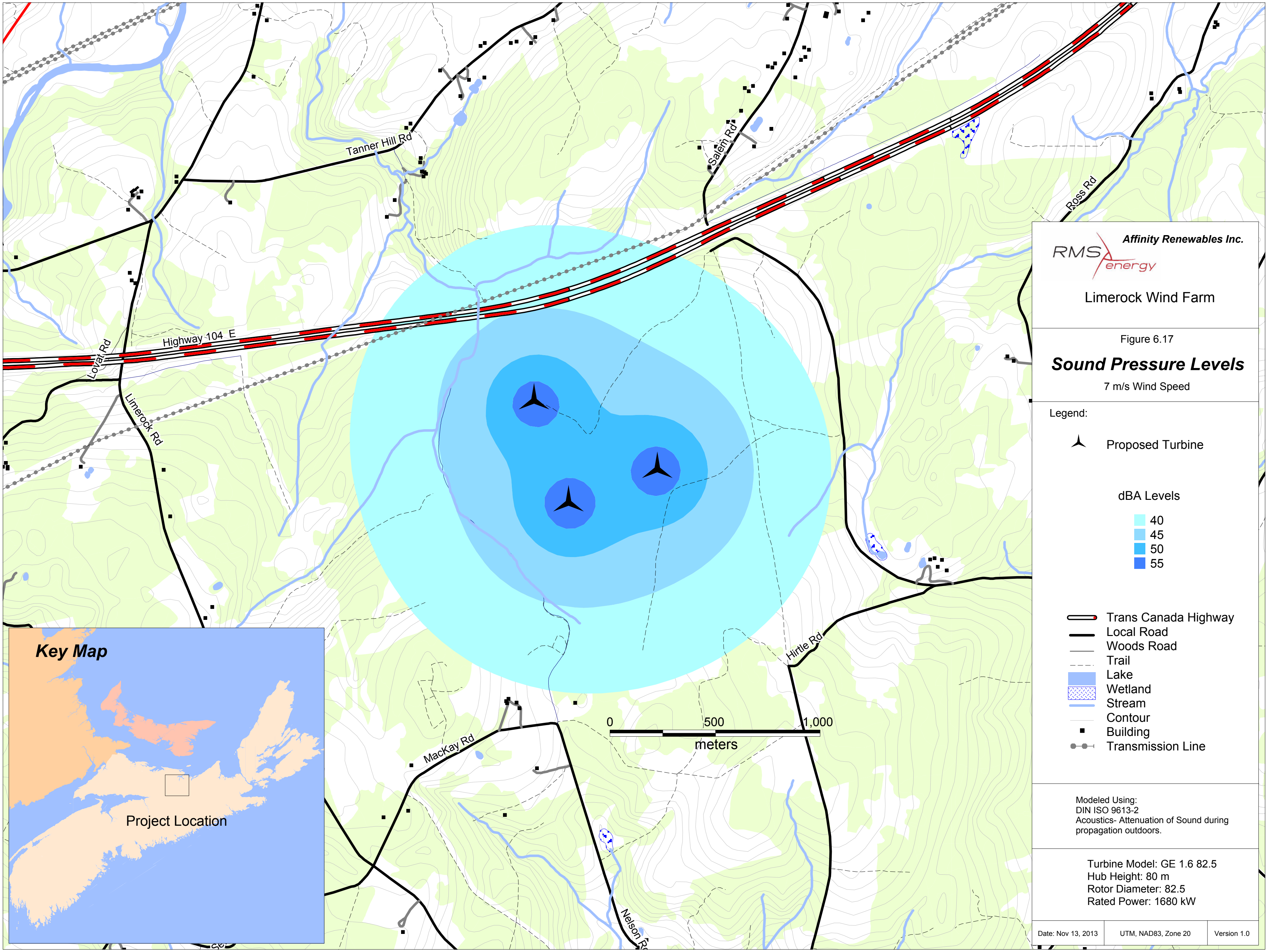

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Figure 6.17
Sound Pressure Levels
7 m/s Wind Speed
Legend:
Proposed Turbine
dBA Levels
40
45
50
55
Trans Canada Highway
Local Road
Woods Road
Trail
Lake
Wetland
Stream
Contour
Building
Transmission Line
Modeled Using:
DIN ISO 9613-2
Acoustics- Attenuation of Sound during propagation outdoors.
Turbine Model: GE 1.6 82.5
Hub Height: 80 m
Rotor Diameter: 82.5
Rated Power: 1680 kW
Date: Nov 13, 2013
UTM, NAD83, Zone 20
Version 1.0
Key Map
Project Location
0
500
1,000
meters
Highway 104 E
Tanner Hill Rd
Salem Rd
Ross Rd
Lovat Rd
Limerock Rd
Hirtle Rd
MacKay Rd

Up to date data for the GE 1.6 MW series 1.85m machine is used for the sound modelling, as well as assumptions that there is no tree cover/ obstructions. The loudest output on the turbine occurs at 7.0 m/sec: this wind speed sound rating is used for the modelling. The Limerock Project will not be feasible if there is potential to exceed sound emissions above 40 dBA.

Provided these mitigation measures are followed, the potential residual effect of the Project on sound is considered to be **not significant**.

6.2.1.8 Recreation and Tourism

As indicated in Section 5, the Project area is located in a forested/ rural residential area. The Limerock Project is not anticipated to have an adverse effect on the tourism industry in the area. There is not any perceived tourism industry in the area.

The existing road entrance to the site is currently the Ross Road. The road is open to vehicles as it is a public road. Some trails and paths are used by ATVs or snow-mobiles; however, they will not be affected by the construction and operation of the three turbines at Limerock. In accordance with any landowner agreements, access will be controlled so as to discourage trespassing on private lands. Therefore the Project is not expected to increase recreational vehicle use in the area and trespassing on private lands.

Visual and sound effects that could be experienced by tourists and recreational users in the area are discussed Sections 6.2.1.5 and 6.2.1.7, respectively.

The potential residual effect of the Project on recreation and tourism is considered to be **minimal** and **not significant**.

6.2.1.9 Health and Safety Issues

In recent years there has been considerable interest in potential health issues associated with the operation of wind farms. Public interest groups, government stakeholders, and industry have commissioned various studies to explore alleged health effects associated with a variety of issues, of which the most commonly discussed include turbine sound, shadow flicker, and electromagnetic fields (EMFs). Additional safety concerns include potential turbine blade and structural failure, and icing issues.

The debate over potential health issues has been waged in scientific, peer-reviewed studies published in scientific journals and popular literature and internet. Popular literature and internet sources are often based on anecdotal evidence, yet they are usually the most accessible sources to the general public. In many cases, this type of literature has been generated to support or oppose wind development. Knopper and Ollson (2011) reviewed both types of literature (peer-reviewed and popular) and found that both agree that wind turbines can be a source of annoyance for some people, although the difference between both types of literature is the reason for annoyance. In general, peer-reviewed literature finds that reported health effects are attributable to a number of environmental stressors that result in an annoyed/stressed state, but popular literature attributes reported health effects directly to turbine-specific variables like audible sound, infrasound or EMF (Knopper and Ollson 2011).

To address real and perceived health and safety issues, minimum setback distances and exposure levels have been established to reduce or avoid potential effects for people living in proximity to wind turbines. As referenced in Section 3.3, the Municipality of the County of Pictou established a wind development bylaw in 2007 with setback distances from residences of 600m. At a provincial level, there are no legislated setback distances although based on recent experience from the latest reviewed wind farms in the province and discussions with NSE staff, it would appear that the minimum setback distance should be in the range of 550 m and/or a received sound level 40 dBA. The Limerock Sound Level Study suggests these setback distances should effectively address any potential concerns associated with health and safety issues associated with wind farm operations. It may be necessary to retain both minima to account for the fact that the setback distance itself does not prevent the situation where multiple turbines are at or near the setback, all contributing to the received sound level. The added criterion of sound level allows for this.

6.2.1.9.1 Sound (Audible, Low Frequency, and Infrasound)

Section 6.2.1.7 discusses the predicted sound levels from the operation of the wind farm.

Several studies have been undertaken to explore the possible relationship between proximity to wind turbines and health effects. A review of peer-reviewed literature indicates that some people living near wind turbines experience annoyance and that some people are also disturbed in their sleep by wind turbines. Scientific literature does not dispute that health effects may occur due to stress associated with annoyance and sleep deprivation and suggests that most anecdotal reports of health effects attributed to wind turbines are likely associated with these stressors.

In April 2012, Health Canada announced that it would be conducting an assessment of all available data to address complaints of health issues and their relation to exposure to wind turbine noise. The results of this research will support decision makers by contributing to the evidence base of peer-reviewed scientific research that ultimately supports decisions, advice and policies regarding wind power development proposals, installations and operations. *The data obtained will contribute to the global knowledge of the relationship between wind turbine noise and health. It is important to note that this research is being conducted to provide additional insight into an emerging issue; however, the results will not provide a definitive answer on their own* (Health Canada 2012). Health Canada goes on to state that *there is currently insufficient scientific evidence to conclude whether there is a relationship between exposure to wind turbine noise and harm to human health. However, the most rigorous studies available to date do not show a link between exposure to wind turbine noise and harm to human health. Health Canada continues to review emerging scientific evidence. Should new evidence become available that supports a direct link between wind turbine noise and adverse health* *effects, the Department will review the research and, if necessary, work with the responsible authorities to address these emerging concerns* (Health Canada, 2012).

The World Health Organization (WHO) Europe recommends a night-time noise guideline (not specifically for wind) of 40 dBA for the protection of public health from community noise (WHO 2009). According to WHO, this guideline is below the level at which effects on sleep and health occur. This value of 40 dBA is considered to be the lowest observed adverse effect level for night noise based on expert evaluation of scientific evidence in Europe. This guideline is intended to protect the public including the most vulnerable groups such as children, the chronically ill and the elderly (WHO 2009). The United States Environmental Protection Agency (EPA) document titled Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety (1974) recommends that indoor-day-night-level (DNL) not exceed 45 dBA. DNL is a 24-hour average that gives 10 dB extra weight to sounds occurring between 10 pm and 7 am, assuming that during these sleep hours, levels above 35 dBA indoors may be disruptive. Based on the proposed setbacks and predicted sound modeling, there are no receptors who will be exposed to sound levels greater than 35 dBA (outdoor noise level). Indoor sound levels are about 10 to 20 dBA lower than those outdoor, depending on the structure of the home.

Various studies have explored the relationship amongst annoyance and wind turbine sound (Pederson and Persson Waye 2004, 2007, 2008; Pederson 2010). Knopper and Ollsen (2011) synopsize these studies into three key conclusions:

1. people tend to notice sound from wind turbines almost linearly with increasing sound pressure level;
2. a proportion of people that notice sound from wind turbine find it annoying; and
3. annoyance is not only related to wind turbine sound but also to subjective factors like attitude to visual impact, attitude to persons or companies involved, attitude to wind turbines and sensitivity to noise (refer to citations above for details on individual studies).

Recognizing that annoyance can result in a heightened sense of anxiety and potentially affect the physical, mental and social well-being of individuals, the mitigation to reduce potential effects is implemented to establish appropriate setback distances and sound level limits. Based on peer-reviewed literature, the limits proposed for this Project are considered appropriate mitigation.

The Proponent lives within 200m of a GE 1.5 MW turbine, with 33 others at various distances from the home. This has been the primary place of residence since March 2013. At no time has one of the family of 4 been unable to sleep due to noise, EMF, infrasound, vibrations or anything that could possibly be attributed to the wind turbines (*pers. Obs.). (*Figure 6.18)

Figure 6.18 View from second floor of Proponent's home, Turbine #15 is at a distance of 175m. Dalhousie Mountain, 2013

Low frequency sound is generally defined as sound at a frequency of less than 200 Hz. Infrasound is considered to be sound frequencies below human's audible range (less than 20 Hz) and is usually measured in terms of dB or dBG instead of A-weighted decibels (dBA). The A-weighting network is commonly used to adjust sound levels to approximate the sensitivity of human hearing whereas the G-weighting network was defined specifically by the International Standards Organization to deal with infrasound (HGC Engineering 2006). In the 1980s, low frequency sound was considered an associated problem with wind turbines. However, this has been attributed to earlier designs of turbines where turbine blades were placed downwind of the tower resulting in a sound output that generated high levels of energy in the infrasound range. Since then, turbine design has progressed, resulting in modern turbines with blades placed upwind of the tower, generally negating the problem (National Research Council 2007; Leventhall 2004). Research on low frequency sound and modern turbines confirms that levels of low frequency sound have been below accepted thresholds and therefore should not be considered a problem (BWEA 2005; Leventhall 2004).

Infrasound is produced by physiological processes like respiration, heartbeat and coughing, as well as man-made sources like air conditioning systems, vehicles, some industrial process and wind turbines (Knopper and Ollsen 2011). Although infrasound cannot be "heard", there is some degree of auditory perception below frequencies of 20 Hz (*e.g.*, stimulation of outer hair cells of the cochlea) and there are non-auditory mechanisms such as the vestibular balance system and resonant excitation of body cavities by which humans can sense infrasound (HGC Engineering 2006; Salt and Hullar 2010).

Infrasonic levels created by wind turbines are often similar to the ambient levels prevalent in the natural environment due to wind. Under many conditions, low frequency sound below 40 Hz from wind turbines cannot be distinguished from environmental background noise from the wind itself (Leventhall 2006; Colby *et al* 2009, cited in CMOH 2010). There is no evidence of adverse health effects caused by infrasound below the sound pressure level of 90 dB (Leventhall *et al.* 2003).

In 2013, the Environment Protection Authority of Australia presented the findings of a study into the level of infrasound within typical environments in South Australia, with a particular focus on comparing wind farm environments to urban and rural environments away from wind turbines. Through various controlled measurements at homes located both near and far from wind turbines. The study concluded that the level of infrasound at houses near the wind turbines assessed is no greater than that experienced in other urban and rural environments, and that the contribution of wind turbines to the measured infrasound levels is insignificant in comparison with the background level of infrasound in the environment (Evans *et al, 2013).* Infrasound that was detected at houses near wind turbines had the turbines shut down completely and measurements were taken again. The results were the same indicating that the infrasound that was detected was not produced by the wind turbines. Furthermore, the levels are significantly below the human perception threshold (Evans *et al, 2013).*

International standards have been established to define acceptable thresholds for infrasound exposure based on human sensitivity at 85 dBG. Therefore it is reasonable to assume that someone may be annoyed if they can perceive infrasound in the range of 85 dBG. O'Neal *et al*. (2011; cited in Knopper and Ollson 2011) conducted a study to measure wind turbine noise outside and within nearby residences of turbines (nearest turbines 305 m and 467 m from residences) at a wind farm in Texas and measured low frequency sound and infrasound at both distances. The turbine models included in the study were the GE 1.5sle (1.5 MW) and Siemens SWT-2.3-93 (2.3 MW) wind turbines. The authors concluded that the results of their study suggest there should be no adverse public health effects from infrasound or low frequency noise at distances greater than 305 m from the two wind turbine types measured (O'Neal *et al*. 2011). The Limerock Project is over 1000m from receptors. There is no evidence for direct physiological effects from either infrasound or low frequency sound at the levels generated from wind turbines (indoors or outside) (Colby *et al*. 2009).

6.2.1.9.2 Shadow Flicker

A shadow flicker study of Limerock demonstrates that shadow flicker cannot and will not extend to homes therefore; no residences will receive shadow flicker effects from the turbines in Limerock.

Concerns have been raised about the potential for wind turbines to cause epileptic seizures as a result of shadow flicker. As discussed in Section 6.2.1, shadow flicker is caused by the rotating blades of the turbines interrupting sunlight causing flicker. Individuals diagnosed with photosensitive epilepsy (approximately 0.03% of the population) are at risk for seizures caused by flickering light at certain frequencies. Photosensitive epileptic patients are most sensitive to flickering light at 5-30 Hz, although some report sensitivity as low as 3 Hz or as high as 60 Hz (Epilepsy Action 2007). At 3 Hz or below, the cumulative risk of inducing a seizure is about 1.7 per 100,000 of the photosensitive population (Harding *et al.* 2008). At maximum rotational speeds, most turbines flicker at a frequency below 3 Hz. It is therefore concluded that shadow flicker effects would represent, at worst, a visual annoyance, rather than a health impact (refer to Section 6.2.1.6 for a discussion of shadow flicker visual effects).

6.2.1.9.3 Electromagnetic Fields

An electromagnetic field (EMF) is a physical field containing electric and magnetic aspects which is caused due to the movement of an electrical charge. All electronic devices, power-lines and generating stations produce EMFs (Sierra Club Canada 2011).

Wind turbines are not considered a significant course of EMF exposure since emission levels around wind farms are low (CMOH 2010). Previous studies have shown that magnetic field levels as a result of the cable distribution system are a fraction of those found in the vicinity of household appliances such as hairdryers, blenders or televisions (National Institute of Environmental Health Sciences 2002). At present, there are no Canadian government guidelines for exposure to EMFs at ELF. Health Canada does not consider guidelines for the Canadian public necessary because the scientific evidence is not strong enough to conclude that exposures cause health problems for the public (Health Canada 2010).

EMFs created by the three operating wind turbines will be localized and become weaker with distance. The EMF produced by the equipment within the turbines will be very weak, reduced not just by distance, but also by objects such as trees and other objects that conduct electricity. As a result, there is no evidence that the proposed Project will present any human health effects related to EMFs.

6.2.1.9.4 Additional Safety Issues

Additional safety issues that have been raised include potential turbine blade and structural failure, and icing issues.

Turbine Blade and Structural Failure

Wind turbine safety standards have improved considerably since they were first introduced on a commercial scale, with wind turbine safety standards meeting wind strengths equivalent to hurricane forces (Chatham-Kent 2008). Tower collapse and/or blade detachment from the turbine structure is highly improbable. However, should either of these events occur there is potential that the collapse zone and/or landing area would be damaged by the impact. The structural integrity of the turbines is designed to withstand wind speeds of about 200 km/hour (equivalent to a Level 2 tornado). However, during high wind events (>25 m/s or 90 km/h) the turbines will cease operations. The blade of a turbine weighs several tonnes, therefore in the unlikely event where a blade detaches from the rotor, it would drop to the ground rather than be flung a large distance. Maintenance technicians who work on the Proponent's existing Dalhousie Mountain Wind Farm will also maintain the three GE turbines at Limerock. The redundancy mechanisms in place for this type of failure include a factory installed alignment indicator (checked and calibrated minimum two times per year), as well as after-market installation of vibration sensors. Visual blade inspections are done officially during semi-annual maintenance, and also with each visit to the individual turbines. Given the built-in safety features as well as ongoing maintenance of equipment, the likelihood of tower collapse and/or blade detachment is extremely remote and is not predicted to result in a significant adverse residual effect on public health and safety.

Icing Issues

Under certain weather conditions (*e.g.*, based on the right combination of air temperature, wind speed and moisture in the air), ice can form on the turbine tower and blades. Falling ice and the throwing of ice therefore present a hazard to on-site personnel during maintenance and operation of the wind turbines.

Falling ice from an immobile turbine does not differ from other tall structures.

Ice throw distance depends on a variety of factors including turbine specifications, wind speed and geometry and mass of the ice fragment itself. Several studies conducted under the Wind Energy in Cold Climates (WECO) project in Europe have analyzed the risk to public health associated with turbine icing. Morgan *et al.* (1998) report results of a survey of turbine operators on the occurrence of icing including mass and location of any observed ice debris flung off the rotor. Results showed most fragments on the ground were estimated to be in the range of 0.1 to 1 kg in mass and were found approximately 15 to 100 m from the turbines. Simulations and risk assessments have been developed to project ice throw trajectories and predict probability of events and risk to public safety. Initial work on risk assessment methodology demonstrates that the risk of being struck by ice thrown from a turbine is diminishingly small at distances greater than approximately 250 m from the turbine in a climate where moderate icing occurs (Morgan *et al.* 1998).

Monitoring at an existing Tacke TW600 wind turbine near Kincardine, Ontario between its installation in December 1995 until March 2011 revealed ice build-up on the wind turbine on 13 occasions out of 1000 inspections conducted during this time. In most cases, only a few pieces of ice were found on the ground. During one monitoring event in February 1996, about 1 tonne of ice in approximately 1000 pieces was estimated on the ground, with the largest pieces 5 inches long, 2 inches thick and 2 inches wide (12.5x5x5 cm). The pieces were scattered up to 100 m from the base of the turbine in the same direction as the blade arms were pointing. Most pieces were found within 50 m of the tower base. There was no event recorded by the operator in which the ice that was thrown from the turbine struck any property or person (LeBlanc 2007).

A computer modeling study used to estimate the number of potential residential, vehicle and person ice strikes within a typical wind farm in Southern Ontario calculated that, assuming a building setback of 300 m, the potential number of ice strikes to buildings would be one in every 500,000 years. Predicted number of ice strikes to vehicles, with a setback of 200 m would be one in every 260,000 years and number of ice strikes to individuals on the ground (assuming a setback of 300 m) would be one in every 137,500,000 years (LeBlanc 2007). Given the large setbacks used for this Project, the risk to the public from ice drop or ice throw is very small in comparison with average risk levels. The impact of turbine icing would be greatest for construction or maintenance workers when the blade is at rest and not rotating.

As already indicated, there are some trail systems and paths used by ATVs and snowmobiles on or around the lands used for the Limerock project. This occurs mostly with the owners of the lands. During construction and operation activities, access to the wind turbine facilities will be restricted to authorized personnel wearing proper personal protective equipment and who have had appropriate safety training. Signage will be displayed with warnings about ice throw and distances to maintain from the machines.

6.2.2 Maintenance Activities

The wind turbines will be visited for routine servicing and inspections. Furthermore, the facility will include a sophisticated wind energy oriented Supervisory Control and Data Acquisition (SCADA) data analysis program, as well as alarm and notification protocols. With such a system, faults can be instantly detected and addressed, operations can be monitored, equipment performance can be analyzed, trend analyses can be performed and long-term records maintained. For service-oriented visits the site will be accessed via light trucks. Although sensory disturbance to wildlife is possible, it will be short in duration, infrequent, in a small geographic area and will not be noticeable above the existing disturbance created by existing and ongoing forestry activities.

6.3 DECOMMISSIONING ACTIVITIES

Well-designed and constructed wind energy facilities may be operated for decades. The Proponent expects individual wind turbines to perform for up to 25 years without significant repair or replacement. Transformer facilities and electrical cabling facilities are designed for at least a 50 year life span. Individual wind turbines may be replaced or repaired as their useful life comes to an end, or if more efficient and cost-effective technology becomes available. The

Proponent has legally binding commitments regarding decommissioning to the landowners on whose land the equipment is placed.

6.3.1 Removal of Turbine and Ancillary Equipment

Upon a decision to decommission a single wind turbine or both machines at Limerock, all equipment above ground, including towers, nacelles, transformers and controllers will be removed. Wind turbines that are operational and have market value would be carefully removed using a crane, essentially in a reverse process to assembly and installation. The resale value of such equipment would cover the cost of removal in such a case. A market for good, used wind turbines has developed in North America, and a number of wind turbines installed in Alberta in the early 1990s originated from the U.S. used wind turbine market.

Wind turbines that are no longer operational may also be removed by crane, but with less attention to preserving individual components, labelling them and storing them. Inoperative wind turbines have high salvage value. Steel and copper components are easily recycled, and there is a ready market for such materials. The remaining materials are primarily fibreglass and plastic. These may be sold to recycling facilities, or crushed and deposited in landfill sites.

Other above-ground equipment in the wind farm, including transformers and wiring, has a ready market in either used equipment sales or in salvage. Transformers will be simply removed and sold. Wiring will be removed and sold to metal salvage companies.

Figure 6.19 Wind turbine recycled into a children's playground

Environmental components that potentially could be impacted as a result of turbine and ancillary equipment removal include soils, water quality/aquatic environment, birds and other wildlife, land use, and noise. Table 6.11 summarizes the potential environmental effects of activities associated with removal of turbine and ancillary equipment.

Table 6.11 Potential Effects of Turbine and Ancillary Equipment Removal

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
Birds and Other Wildlife	Sensory disturbance	• Overall disturbance will be limited to designated workspaces, and performed in compliance with the *Migratory Birds Convention Act.* • onsite personnel will be trained regarding how to identify and properly deal with any species at risk or other special considerations at the time that may enter a work site	2	1	1/2	R	2	Sensory disturbance may cause habitat avoidance but it is likely to be temporary in nature, small in magnitude and restricted to the Project footprint.
Soils	Soil disturbance and erosion	• Soils around the excavation will be disturbed but will be managed to minimize erosion and runoff.	1	1	1/2	R	2	By implementing these standard mitigation measures, the residual effect on soils will not be significant and will have a minimal level of impact.
Wetlands/ Water Quality and Aquatic Environment	Surface water contamination	• Wetlands and watercourses will be avoided to the extent possible. • All activities, including equipment maintenance and refueling, will be controlled, or will be done off-site,	1	1	1/1	R	2	No residual effects are predicted.

Table 6.11 Potential Effects of Turbine and Ancillary Equipment Removal

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
		to prevent entry of petroleum products or other deleterious substances, including any debris, waste, rubble or concrete material, into a watercourse or wetland. • Construction material, excess material, construction debris, and empty containers will be stored away from watercourses and watercourse banks or wetlands. • A contingency plan for accidental spills will be developed for the decommissioning of the Project.						
	Sediment Loading	• General mitigation measures from the NSE Erosion and Sediment Control Handbook and other applicable guidelines will be utilized to control	1	1	1/1	R	2	No residual effects are predicted.

Table 6.11 Potential Effects of Turbine and Ancillary Equipment Removal

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
		water, reduce erosion and limit sedimentation. • Decommissioning will not take place in the immediate vicinity of a watercourse. • Temporary erosion and sediment control measures, silt fence, straw bales (etc.) will be used and maintained until 100% of all work within or near a watercourse has been completed and stabilized. • Temporary sediment control measures will be removed at the completion of the work but not until permanent erosion control measures, if required, have been established.						
Land Use	Remediation of land	• A small footprint will be disturbed but remediated in accordance with landowner agreements.	1	2	1/2	R	2	Due to the small proportion of land to be directly impacted by foundation construction/ decommissioning and its reversibility after

Table 6.11 Potential Effects of Turbine and Ancillary Equipment Removal

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1] Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	Residual Effect
								decommissioning, the residual effect is expected to be minimal. The area disturbed directly by the turbines is less than ½ acre.
Sound	Increases to sound levels due to operation of equipment required for decommissioning	• All internal combustion engines will be fitted with appropriate muffler systems. • Noise abatement equipment, in good working order, will be used on all heavy machinery used on the Project.	1	1	1/2	R	2	Increased sound levels caused by decommissioning will be temporary in nature and will be conducted during working, daylight hours. Due to the short nature of this disturbance, the residual effect is considered negligible and the level of impact will be minimal.

1 Note	Geographic Extent	1 = <500 m^2, 2 = 500 m^2 – 1 km^2, 3 = 1 –10 km^2, 4 = 11 – 100 km^2, 5 = 101 – 1000 km^2, 6 = >1000 km^2
	Magnitude	1 = Low: *e.g.,* specific group or habitat, localized one generation or less, within natural variation, 2 = Medium: *e.g.,* portion of a population or habitat, one or two generations, rapid and unpredictable change, temporarily outside range of natural variability, 3 = High: *e.g.,* affecting a whole stock, population or habitat outside the range of natural variation.
	Duration	1 = <1 month, 2 = 1-12 months, 3 = 13-36 months, 4 = 37-72 months, 5 = >72 months.
	Frequency	1 = <11 events/year, 2 = 11-50 events/year, 3 = 51-100 events/year, 4 = 101-200 events/year, 5 = >200 events/year, 6 = continuous.
	Reversibility	R = reversible, I = irreversible.
	Ecological Context	1 = Pristine area or area not adversely affected by human activity, 2 = evidence of adverse effects.

6.3.2 Removal of Power Line

Power poles and cabling will be removed and recycled/disposed of as required. Environmental components that potentially could be impacted as a result include soils, water quality/aquatic environment, birds and other wildlife, land use, and noise. Refer to Table 6.11 for a summary of the potential environmental effects of activities.

6.3.3 Site Remediation/Reclamation

Wind energy facilities do not use or produce harmful waste products. There is no need for concern about residual toxic chemicals or exhaust products. Aside from normal recovery of lubricants from the gearbox and yaw mechanism, decommissioning activities do not produce waste. Lubricants will not contain any PCBs. Site remediation/reclamation will be conducted in accordance with landowner agreements and in accordance with the applicable regulations at the time. Environmental components that potentially could be impacted as a result include soils, water quality/aquatic environment, birds and other wildlife, land use, and noise. Refer to Table 6.11 for a summary of the potential environmental effects of activities.

6.4 ACCIDENTS AND MALFUNCTIONS

The largest risks associated with all phases of any operations involving vehicles and machinery in forested areas include contamination by petroleum products and waste, if spilled, migrating into the surroundings; and in extreme situations a risk of fire, causing damage if not controlled immediately.

A spill of hydrocarbons associated with equipment involved in construction and maintenance of the Project could cause a variety of adverse effects on the environment, in particular to the watercourses within the Project Study Area. Spill prevention is the most important step in preventing these potential effects; prevention is based on effective and well-planned procedures and maintenance of equipment. These strategies will be outlined in a Project-specific EPP, which will be developed prior to the commencement of construction activities. Spills that could reasonably be expected to occur would be limited to relatively small quantities.

Contact with the local Alma and West River Fire Departments has determined that a procedure will be in place upon commissioning to deal with logistics of fires and spills and would outline the appropriate measures for responding. A site map will be provided to the chiefs and to the Proponent’s employees. Setbacks from sensitive areas will be in place as will radio communications to the control center to provide lockout confirmation and procedures for safe contact with electrical components. NSE will be notified at the time of any applicable emergencies. Notification will be given to the department upon making the decision to decommission and any necessary amendments to the existing emergency measures will be added.

The plans described below are expected to mitigate any potential accidents and malfunctions that may occur. Therefore, the level of impact is considered **low** and **not significant**.

6.4.1 Corporate Environmental, Safety & Health Management Plan

An Environmental, Safety & Health (ESH) Management Plan has been developed and implemented for the existing Dalhousie Mountain Wind Farm and will be expanded and updated where necessary to include activities and operations at the Limerock Project to ensure that environmental, safety and health requirements are consistently met throughout the Project, specifically throughout the construction and operating phases. The ESH Management Plan has been developed in conjunction with Project contractors, and shall be at all times in strict compliance with all applicable Provincial and local requirements.

The Proponent will ensure that the construction and operation contractors will be duly certified by the appropriate safety associations. As part of the ESH Management Plan, the elements of an Environmental, Safety & Health Management System (ESH-MS) for the Project will include:

- Safety Management Statement, which shall clearly articulate the health and safety objectives and commitment to continually improve the effectiveness of the ESH-MS;
- Safety System Manual, which shall define the scope of the ESH-MS and describe the structure of the ESH-MS;
- Safety Project Plans, which shall explain the strategy and approach to be used in managing activities critical to delivery of work, containing as a minimum:
  - Worksite Hazard Assessment Plan;
  - Fall Protection Plan;
  - Safety Emergency Response Plan, and
  - Safety Orientation and Education Plan;
- Safety Project Procedures, which shall contain where necessary documented procedures to ensure specific tasks will be successfully completed to a consistent level satisfying all the requirements of the agreements;
- Safety Records, which will be established and maintained to provide evidence of conformity to agreements, applicable certification requirements and ESH-MS requirements;
- Accident and Incident Investigation, which shall contain a documented process to investigate, document and report all accidents and incidents, to be carried out by suitably trained personnel, and where corrective or preventative action is required, such action will be fully documented and completed;
- Joint Environmental, Safety & Health Committee, which shall consist of one or more members from each of various work groups to ensure all personnel have representation, members of which will receive appropriate training and meet monthly;
- Personal Protective Equipment, which shall assess worksites for hazards and establish the requirements for appropriate personal protective equipment, communicate such requirements to involved personnel and worksite visitors;
- Internal Auditing, which shall contain documented processes to confirm compliance with ESH-MS processes, and identify necessary corrective/preventative actions; and
- Continual Improvement, which will initiate measures to continually monitor the ESH-MS and the delivery of the work, to be implemented by a designated Environmental, Safety & Health Manager.

6.4.2 Emergency Response Planning

The Proponent will update the current emergency response plan for the unlikely event of a site emergency during any phase of the Project. The emergency response plan will include a report form and a map of the Project site, showing the most direct route from the site to an emergency resource such as a hospital. All on-site personnel and contractors will be required to complete a site safety and emergency response orientation prior to the start of pre-construction and construction activities. In May 2013, the Proponent provided specialized training to local fire departments for aid to workers during high rescue and suspension trauma.

In locating wind projects, the balance between proximity to load capacity and proximity to residents is a delicate one. The Greenfield Project is not accessible by vehicles not properly equipped to deal with mud, large rocks, steep slope and possibly a significant amount of precipitation. The Proponent is equipped to access the Project site during an emergency, especially in the winter months. (Figure 6.20)

Figure 6.20 Maintenance vehicle used by RMS

6.4.3 Project Environmental Protection Plan

The Proponent will prepare a Project-specific Environmental Protection Plan (EPP) that will be used on-site during all construction, operation and maintenance activities. The EPP will be written in construction specification format and will include the recommended mitigation measures in this EA report, as well as industry-accepted construction practices. The EPP will be used by the construction contractor and by all operations and maintenance workers during the life of the Project.

6.5 EFFECTS OF THE ENVIRONMENT ON THE PROJECT

The following section outlines the effects of the environment on the Project, which includes climatic fluctuations and extreme events that could potentially occur over the life of the Project.

6.5.1 Climatic Fluctuations

Several aspects of the potentially changing climate have been considered, and must continue to be monitored during the lifetime of the Project. The turbines are designed to have a safe upper working limit for wind speeds. As the frequency of storms increases, particularly the strong late summer hurricanes that are anticipated to retain strong wind speeds as tropical depressions as they move up the coast, there would be an associated increase in the frequency of conditions exceeding the safe operating envelope for the turbines. During such conditions, the turbines are halted and generation suspended until safe working conditions occur again. The lost generation due to the marginal increase in storm frequency is a relatively small quantity of generation time; that is, it is not anticipated to significantly negatively affect the economic viability of the Project. Similarly, any change in the frequency of freezing rain, or blade-icing conditions, is not anticipated to significantly affect operating times, and the monitoring instruments in place will allow the physical risk to the turbines to be managed effectively.

6.5.2 Extreme Events

Weather events that put wind turbines at risk include icing conditions, particularly freezing rain, lightning, and extreme winds. Although Nova Scotia has fewer lightning storms than, for example, central Canada, the lightning protection must, and will, be designed to cope with accepted industry standards. Freezing rain is an operations issue. Blade specifications are sufficient to cope with foreseeable icing loads, but it is possible that an event that exceeds this level could be encountered. In such an event, the turbine would have been halted, and the damage would be confined to the immediate vicinity of the turbine base, should ice falling, or structural damage occur.

The wind turbines will be the highest features in the surrounding landscape, and therefore it is necessary that a lightning protection system be incorporated into each turbine. For the Project, each turbine blade material is fibreglass-reinforced epoxy resin with integral lightning protection supply. Each blade and each turbine tower are grounded to prevent adverse effects from lightning strikes. Additional grounding rods can be installed at each turbine site. Most effects from a lightning strike would be dissipated. If lightning struck the generator at the top of the tower, serious damage could occur and the generator may be damaged.

The generator is designed to automatically shut down at wind speeds that exceed 25 m/s. The turbine tower is designed to withstand excessive wind speeds. Comprehensive geotechnical work at each site will enable for proper design of wind turbine foundation. Extreme wind conditions are used as a parameter in this design.

In the event of a lightning strike that hits a wind turbine generator, severe damage could occur and a new generator may need to be installed. However, it is highly unlikely that lightning would hit a wind turbine generator accurately enough to severely damage it. Taking into consideration the design features that will be used in the Project, a significant effect is unlikely to occur as a result of extreme weather events.

6.6 CUMULATIVE EFFECTS

The assessment of cumulative effects is based on methodology developed to satisfy cumulative effects analysis requirements under *CEAA*. Although a CEAA screening assessment is not required for this Project, CEAA guidance and methodology for cumulative effects assessment is used for good practice. The evaluation of cumulative environmental effects follows five steps:

- Step 1- Identify environmental effects resulting from Project-related activities.
- Step 2- Identify other projects or activities that could interact with Project-related environmental effects.
- Step 3- Exclude environmental effects of other projects or activities that are not likely to act in combination with the environmental effects of the Project.
- Step 4- Identify the likely cumulative environmental effects that could result from the interaction of Project-related environmental effects with other past and future projects and activities.
- Step 5- Evaluate the significance of likely cumulative environmental effects.

Under *CEAA*, an EA must determine whether the project under review adds to the combined adverse effects of past, existing and imminent projects and activities. Specifically, the assessment determines the degree to which a single project is contributing to the total cumulative effects of human activities and developments in the region. For this study, "The Proponent's Guide to Wind Power Projects: Guide to Preparing an Environmental Assessment Registration Document" (NSE 2007, updated 2012) was also used to ensure provincial requirements for registration are met for describing other undertakings in the area.

A critical step in any EA is determining what other projects or activities have reached a level of certainty (*i.e.,* will be carried out) such that they are required to be considered.

It is helpful to consider the clarification provided by the Joint Review Panel for the Express Pipeline Project in Alberta. Following an analysis of subsection 16(1)(a) of *CEAA*, the Joint Review Panel determined that certain requirements must be met for the Panel to consider cumulative environmental effects:

- there must be a measurable environmental effect of the project being proposed;
- that environmental effect must be demonstrated to interact cumulatively with the environmental effects from other projects or activities; and
- it must be known that the other projects or activities have been, or will be, carried out and are not hypothetical (NEB and CEA Agency 1996).

Furthermore, the Joint Review Panel indicated that it is an additional requirement that the cumulative environmental effect is *likely* to occur, that is, there must be some *probability*, rather than a mere possibility, that the cumulative environmental effect will occur. These criteria were used to guide the assessment of cumulative environmental effects of the proposed Project.

Environmental effects resulting from Project-related activities were identified and assessed in Sections 6.1 to 6.4. The evaluation of cumulative environmental effects is warranted for several environmental components discussed in these sections, namely birds and other wildlife, visual impact, sound and economic development. This section outlines cumulative environmental effects that may result from the Project in combination with other projects or activities that have been or will be carried out, within the regional area. For the purposes of this cumulative effects assessment, the regional area is defined as Western Pictou County.

6.6.1 Past, Present and Future Projects/Activities in the Regional Area

There is no significant industrial development within or surrounding the Study Area. The Proponent is proposing to construct and operate the Trails Wind Project; a one turbine (1.3 MW) wind energy facility added to the existing two 800kW Enercon E-48 machines. This facility is about 11km north-west of Limerock. As well, the 51 MW Dalhousie Mountain Wind Farm is located approximately 10 km west of the proposed Project. There are other COMFIT projects approved by Nova Scotia's Department of Energy, including the Affinity's other projects.

One turbine was constructed in Pictou County in September 2013 about 12km from Limerock. The Dalhousie Mountain project, with 34 turbines, is operational and is about 10km from Limerock. The Glen Dhu project in Bailey's Brook, with 29 turbines, is over 25km from Limerock.

Other activities that would be expected to potentially interact cumulatively with the Project include the land use activities in and around the Study Area, including farming, forestry and residential. These activities have occurred in the past thereby influencing the current landscape and will continue to occur in the future (thereby overlapping temporally with the Project) and would have effects on bird and other wildlife, visual impact, noise and economic development that could potentially interact cumulatively with the effects predicted for the Limerock Project.

6.6.2 Interactions between Projects/Activities and Description of Cumulative Environmental Effects

Identifying potential cumulative effects is considered through a comparison of the temporal and spatial scope of the additional projects identified in the regional area. Spatially, those projects that are within the regional area are considered to be relevant. Temporally, those projects that have existed in the past, exist presently, or are likely to exist in the near future are considered relevant.

6.6.2.1 Birds and Other Wildlife

Past and ongoing forestry and residential development activities in the regional area as well as the construction and operation of the TransCanada Highway 104 have resulted in a loss of forest and wetland habitat and reduced the area of contiguous mature forest habitat. The Project is not expected to result in additional loss of high quality habitat or expected to contribute significantly to the cumulative environmental effects of human activities on wildlife habitat, given the limited amount of forest that will be affected by the Project (>3 ha).

With respect to this Project and other projects in the area, birds and other wildlife could be affected on a regional scale. Wildlife mortality, specifically bird and bat mortality, is a residual environmental effect associated with the proposed Project. Bird and bat mortality may also occur as a result of collisions with overhead power lines, vehicles, communication towers and buildings resulting in a cumulative effect. Historical evidence (see Section 6.2.1.1 and Appendix G) as well as the post-construction monitoring reports prepared for the existing Dalhousie Mountain Wind Farm, have shown that the wind turbines do not likely kill large numbers of birds and bats compared with other structures. It is therefore unlikely that the incremental contribution of the three turbines at the Limerock Project to bird and bat mortality will affect these species on a population basis causing adverse cumulative effects. Bird surveys did not reveal extensive use of the site by species of conservation concern making it also unlikely that rare species would experience significant cumulative effects. A post-construction bird and bat monitoring program will confirm these predictions. As a result, the cumulative effects of this Project with other activities on birds and other wildlife is deemed to be **not significant.**

6.6.2.2 Visual Impact

The development of the Project, taken into consideration with forest harvesting activities, existing and future power lines, existing and planned TransCanada Highway and communication towers, could be considered a further visual obstruction. However, since the landscape has already been influenced by human activities, the visual effect of the Project is incremental. As a result, the cumulative effect of this Project with the other existing structures in the landscape is deemed to be **not significant**.

6.6.2.3 Sound

Acceptable sound levels are expected to be produced by the Limerock Project (Appendix D). The three turbines at Limerock will not cumulatively affect the sound produced in the area as a result of the 1100m setback from the nearest receptor. The Project is expected to only result in an incremental increase in sound and is considered to be **not significant**.

6.6.2.4 Economic Development

This Project will continue to contribute to the community through job creation for local contractors. It is estimated that the Project will provide 15 to 20 new or existing jobs during the construction phase, two new or existing jobs during the operation and maintenance phase. In addition, the Project will provide significant municipal tax revenues and income for landowners. Through the fund-raising partnership with the SPCA, the Proponent is also committed to local community benefits. Some examples of recipients include the Alma Volunteer Fire Department, Millbrook Community Center, LORDA, Pictou County Lite Horse Club, 4-H Club, Union Center Community Hall and other local charitable organizations such as the Special Olympics, food bank, Cancer fundraising and local benefit scenarios that occur in small communities for families in need. These increases in employment and economy will have a positive cumulative benefit for economic development in the region.

6.6.2.5 Summary

With the adherence to mitigation presented in this report, in addition to compliance with regulatory requirements (including terms and conditions of approval), the residual environmental effects of the Project, including cumulative effects, are predicted to be **not significant**.

6.7 SUMMARY OF POTENTIAL ENVIRONMENTAL IMPACTS

A summary of recommended measures for managing and mitigating effects of the Project, based on the preceding analysis, is provided in Table 6.12.

Table 6.12 Summary of Impact Management and Proposed Mitigation Measures

Environmental Component	Project Activity	Potential Effects	Mitigation Measures
Birds and Other Wildlife	Construction & Decommissioning	Sensory disturbance	• Visitors will remain within relevant areas, both in-vehicle and on- foot and will aim to preserve the site's natural areas. • Overall disturbance will be limited to designated workspaces and performed in compliance with the *Migratory Birds Convention Act*. • Delivery vehicles will remain on designated roads.

Table 6.12 Summary of Impact Management and Proposed Mitigation Measures

Environmental Component	Project Activity	Potential Effects	Mitigation Measures
		Habitat loss/alteration	• Habitat loss will be mitigated by only clearing the land necessary for construction and for decommissioning; only using the land previously cleared for construction activities and by limiting the overall land disturbance to within designated workspaces. • Upon completion of construction and/or decommissioning, habitat will be restored to the extent possible. • Areas of significance (*e.g.,* wetlands) will be avoided, to the extent possible.
		Mortality	• In order to reduce the potential of bird mortality, construction and/or decommissioning activities will be performed in compliance with the *Migratory Birds Convention Act (e.g.,* clearing (if necessary) outside the critical time periods for breeding birds). • Onsite personnel were trained in June 2012 regarding how to identify and properly deal with any wood turtles that may enter a work site. Proponent and workers will continue to receive training for specific species as needed.
	Operation	Sensory disturbance	• A pre- and post-construction Mainland Moose Monitoring PGI Survey will be conducted. • A moose monitoring program (pellet group counts) will be implemented to determine the degree to which moose use the Project Study Area. • Overall, the Proponent is also committed to working with NSDNR and landowners to protect the mainland moose population, e.g., through initiatives in the Mainland Moose Recovery Program.
		Mortality	• To reduce the potential for increased bird fatalities due to collision with wind turbines, several decisions were made in the planning of the wind farm. The turbines to be used extend no higher than 150 m above the ground thus avoiding the flight height of nocturnally migrating landbirds. Lighting will be the minimum allowed by Transport Canada for aeronautical safety, and red lights (CL-865) may be used with the minimum intensity and flashes per minute allowable. Non-flashing red lights are

Table 6.12 Summary of Impact Management and Proposed Mitigation Measures

Environmental Component	Project Activity	Potential Effects	Mitigation Measures
			also still an option, depending on the recommendations of NavCanada, Transport Canada, and CWS combined. The turbines for this Project will be built using tubular steel towers, as some data indicate that lattice towers encourage perching by birds which are hunted by raptors which can cause collisions of blades and raptors, also that lattice towers encourage perching by raptors during hunting and, as a result, may put these birds at risk of collisions. Post-construction monitoring will direct the need and form of further post-construction mitigation measures. • A bird and bat monitoring program will be developed in consultation with NSDNR and CWS. Based on the results of the program, necessary modifications to mitigation plans and/or wind farm operations will be undertaken.
Soils and Vegetation	Construction & Decommissioning	Soil erosion and compaction	• Access to the turbine sites will be limited to established access road, where possible. • Size of access road will be kept to the minimum required for the safe construction, operation and decommissioning of the equipment. • Whenever possible, clearing activities will be timed to periods when the ground surface is best able to support construction equipment (winter or dry season). • Compacted soil will be reclaimed as required. • Standard erosion and sediment control measures will be implemented as required. • Topsoil and subsurface soils will be separated and stored on-site to be replaced appropriately after the pouring of the concrete foundation. When the soils are stored they will be protected from erosion and runoff.
		Loss of plant species	• Rare plant surveys have been conducted to assist with micro-siting of turbines and access roads. • Where Plant Species of Conservation Concern are encountered, avoidance to the extent possible will be considered, especially where there maybe be a threat to the regional population. Prior to construction, digital way-point files revealing the precise locations of all “Sensitive”, “May be at Risk”, “At Risk” and “Undetermined” listed species identified during field work within the area proposed for development will be provided to NSDNR.

Table 6.12 Summary of Impact Management and Proposed Mitigation Measures

Environmental Component	Project Activity	Potential Effects	Mitigation Measures
Wetlands	Construction & Decommissioning	Loss of wetland area and/or function	• Wetlands will be avoided. • All activities, including equipment maintenance and refuelling, will be controlled, and/or will be done off-site, to prevent entry of petroleum products or other deleterious substances, including any debris, waste, rubble, stockpiled soils, or concrete material, into a wetland. • Construction material, excess material, construction debris, and empty containers will be stored away from wetlands. • Erosion and sediment control measures will be implemented to minimize interactions with wetlands. • Functional analyses will be conducted for wetlands that cannot be avoided. • Regulatory approval will be obtained (including compensation for no net loss of function) from NSE for wetland alteration as required. • Turbines will not be constructed within 30 m of a wetland unless approved by NSE.
Water Quality/ Aquatic Environment	Construction & Decommissioning	Surface water contamination	• Watercourses will be avoided. • If alteration of a watercourse is required, regulatory approval from NSE of the proposed alteration will be obtained prior to construction. • All activities, including equipment maintenance and refuelling, will be controlled, and/or will be done off-site, to prevent entry of petroleum products or other deleterious substances, including any debris, waste, rubble, stockpiled soils, or concrete material, into a watercourse. • Construction material, excess material, construction debris, and empty containers will be stored away from watercourses and watercourse banks. • A contingency plan for accidental spills will be developed for the Project. • Turbines will not be constructed within 30 m of a watercourse unless approved by NSE.
		Sediment loading	• Watercourses will be avoided to the extent possible • General mitigation measures from the NSE Erosion and Sediment Control Handbook will be utilized to control surface water, reduce erosion and limit sedimentation. • If watercourse alterations are required, they will be done in consultation with NSE/DFO in accordance with regulatory requirements.

Table 6.12 Summary of Impact Management and Proposed Mitigation Measures

Environmental Component	Project Activity	Potential Effects	Mitigation Measures
			• Land clearing near watercourses (including crossing structure construction) will occur between June 1 and September 30. • Temporary erosion and sediment control measures, silt fence, straw bales (*etc.*) will be used and maintained until 100% of all work within or near a watercourse has been completed and stabilized. • Visual assessments will be completed bi-weekly and after severe storm events to ensure the effectiveness of erosion and sedimentation controls. • Temporary sediment control measures will be removed at the completion of the work but not until permanent erosion control measures, if required, have been established.
		Surface water flow	• Watercourses will be avoided to the extent possible. • If an existing watercourse that requires a culvert will follow standard industry practice, installing a culvert of sufficient size to accommodate expected maximum flows within the watercourse. • A Water Approval will be obtained for all required watercourse crossings and the conditions of approvals will be followed.
		Loss of fish habitat	• In-water work will be avoided. • New and replacement culverts will be of an open-bottom design. • Existing stream flows will be maintained downstream of the de-watered work area during all stages of work. • All sediment and erosion control measures will be inspected quarterly as well as immediately following rainfall events.
		Fish mortality	• Watercourses will be avoided to the extent possible. • Watercourse crossings, where required, will be constructed from June 1 to September 30, unless otherwise approved by NSE. • Where possible, culverts will be installed during low flow periods. If water is present, watercourses will be dammed and flow will be preserved through water pumps with a properly sized fish screen on the intake end of the hose. In this case, personnel would be on site to facilitate fish rescue within the dammed area.
Sound	Construction &	Increases in sound levels	• Nearby residents will be advised of significant sound generating activities and these will be scheduled to

Table 6.12 Summary of Impact Management and Proposed Mitigation Measures

Environmental Component	Project Activity	Potential Effects	Mitigation Measures
	Decommissioning	due to the transportation and operation of clearing equipment	create the least disruption to receptors. • Heavy equipment will be operated between 7:00 a.m. and 10:00 p.m., avoiding Sundays and holidays unless absolutely necessary. • Construction equipment will have mufflers. • Noise abatement equipment, in good working order, will be used on all heavy machinery used on the Project.
	Operation	Increase sound levels	• None required.
Tourism	Construction & Decommissioning	Effect on tourism and recreation	• Delivery of turbines and components will use the same highway exit as Pleasant Valley's Magic Valley Fun Park and LORDA. The Proponent has been in discussions with, and will continue to update the owners about construction schedules, operational procedures and extended dialogue for any concerns or issues that may arise.
	Operation	Effect on tourism and recreation	• The Limerock Project is located near Pleasant Valley's Magic Valley Fun Park. The Proponent has been in discussions with, and will continue to update the owners of the park about any major maintenance schedules, operational procedures and extended dialogue for any concerns or issues that may arise.
Visual	Operation	Change to visual landscape	• Turbines will be all of the same type and model, and will be painted light grey to reduce reflection. • Screening opportunities for adjacent residences through tree planting or other measures may be considered where post-construction evaluation indicates a legitimate concern.
		Lighting	• Lighting will be the minimum allowed by Transport Canada to ensure the appropriate level of aeronautical safety.
		Shadow flicker	• None required
Archaeological and Cultural Resources	Construction	Disturbance	• An archaeological field survey has been conducted and an Archaeological Contingency Plan developed. • Upon discovery of an artifact, work will be stopped in the area and the appropriate authorities will be contacted.
Land Use	Construction	Reduction of	• Existing right-of-ways (RoWs) will be used to the greatest

Table 6.12 Summary of Impact Management and Proposed Mitigation Measures

Environmental Component	Project Activity	Potential Effects	Mitigation Measures
		forested land	extent possible to minimize the Project footprint. • Turbines, with their relatively small footprint on the land, have been sited with consideration for the potential impact to existing land uses. • Existing logging and access roads built earlier in the construction schedule will be used to install the collection system.
	Operation	Disruption to undeveloped woodlands or infrastructure	• The Project has been designed to minimize impacts to the local land use. No mitigation, therefore, is required as no significant impacts are predicted.
Health and Safety	Operation	Electromagnetic Fields (EMFs)	• None required.
		Infrasound energy	• None required.
		Ice throw	• During construction and operation activities, access to the wind turbine facility will be restricted to authorized personnel wearing proper personal protective equipment and who have had appropriate safety training. • During site visits, vehicles will be parked up-wind of the turbines. • Warning signs will be posted at the perimeter of the Project Study Area, discouraging trespassing on private lands. • During operation, access to the wind turbine sites will be restricted to authorized personnel only.
Local Community	Construction	Hazards and/or inconveniences to day-to-day traffic flow	• No modification to existing roads expected. • A Special Move Permit and any associated approvals will be obtained through the Department of Transportation and Infrastructure Renewal for heavy load transport.
	Operation	Effect on local economy	• Local residents will be employed to the extent possible during the construction, operation and decommissioning of the Project. • Financial benefits will be extended to the Alma Fire Department and other local organizations annually. • The SPCA will receive a significant annual donation from

Table 6.12 Summary of Impact Management and Proposed Mitigation Measures

Environmental Component	Project Activity	Potential Effects	Mitigation Measures
			the production at this site. • Municipal taxes will be remunerated, thus increasing the local tax base, which could be used to increase funding of local municipal initiatives.
		Effect on property values	• None required.

7.0 FOLLOW-UP AND MONITORING

The Proponent is committed to conducting monitoring activities to address residual environmental effects with a high level of concern or uncertainty. While it is anticipated that the residual environmental effects of the Limerock COMFIT Wind Project will not be significant, an Environmental Management Plan (EMP) and corresponding Environmental Protection, Monitoring, and Contingency Plans will be developed to address potential issues and concerns. In addition, there are site-specific pre-construction follow-up measures which the Proponent is committed to, in order to assist with micro-siting of turbine and access road locations, refine mitigation as required, and support environmental regulatory approvals as required (*e.g.*, Water Approvals). The level of information contained in this EA Registration is considered sufficient to confidently predict the significance of residual Project-related environmental effects (including cumulative effects).

7.1 PRE-CONSTRUCTION SURVEYS AND APPROVALS

Watercourses and wetlands will be avoided to the greatest extent practical. Where these features are unavoidable, approval will be sought from NSE and DFO as appropriate for alteration. Follow-up watercourse and/or wetland functional analyses will be conducted as required to complete applications for approval. Habitat compensation planning, if required, will be done in consultation with NSE and/or DFO to ensure no net loss of function/habitat.

A post-construction Mainland Moose Monitoring Program will be conducted (see Table 7.1). The monitoring program will be confirmed with NSDNR. The area has the potential to contain habitat typical for supporting Mainland Moose. Overall, the Proponent is also committed to working with NSDNR and landowners to protect the mainland moose population, e.g., through initiatives in the Mainland Moose Recovery Program.

An archaeological field survey was conducted based on final design and layout of Project infrastructure and proximity to areas deemed to have potential for First Nations and historical archaeological resources. The results were submitted to Nova Scotia Department of Communities, Culture and Heritage for their review and comment. The ARIA process is not considered complete until the CCH has completed their review and accepted the recommendations of the archaeologists. This information will be given to NSE as an addendum upon receipt.

An MEKS was conducted for specific land use history and to provide guidance on archaeological follow-up. This report has not been received to date, but will be made available as an addendum to this document upon the Proponent receiving the results.

7.2 FOLLOW-UP AND MONITORING PROGRAMS

The following section provides a brief overview of the Project follow-up and monitoring measures to be implemented to support construction and operations activities.

The EMP is generally overseen by the Operations Manager, but all Project personnel will be trained in their specific requirements towards its implementation. Training will include the safe handling of hazardous materials and petroleum products, compliance with WHMIS, proper use of on-site firefighting equipment, and an environmental orientation prior to initiating on-site work. Currently, all employees of the Proponent are required to be trained and audited from time to time and annually to ensure safe operations and management of any unforeseen spill/ accident/ etc.

The Environmental Protection Plan (EPP) is a key component of the EMP, and has been developed for both the Construction and Operations phases of the Project. The EPP for the construction period aims to reduce the environmental impact during construction activities and consists of environmental protection measures for routine activities associated with the construction of the Project. This will be accomplished through: contingency procedures in the event of an erosion control failure, fuel and hazardous material spill, fire and/or encounter of archaeological and heritage resources; environmental monitoring, inspection and reporting requirements; a list of applicable permits, approvals and authorizations; and a key contact list. The EPP for the operating period aims to reduce the environmental impact of the operation activities and consists of guidelines for: equipment maintenance activities; the safe storage, handling, and disposal of petroleum, oils and lubricants (POL); and the safe storage, handling and disposal of hazardous materials.

Environmental Monitoring is a key component of the EMP. Table 7.1 outlines the Environmental Monitoring Programs that will be in place for the Limerock Project.

The last aspect of the EMP is the Contingency Procedure Plan, which consists of a detailed response system in the event of the accidental release of POLs or other hazardous materials. Aspects of the plan include environmental concerns, personnel training, prevention measures, response-action plan, and a spill clean-up resource list.

Table 7.1 Environmental Monitoring Programs (Operations)

Component	Method	Timing	Response-Action Plan
Sound	In response to noise complaints, if any occur, the Proponent would measure ambient sound levels and wind speed at selected residential receptors. The sound and wind data will then be combined to produce a plot of background ambient sound pressure levels versus wind speed.	In response to noise complaints, if any occur.	If the ambient sound levels at any residential receptors are higher than permitted sound levels, a report shall be filed with NSE with the particulars of the concern, the suspected source, and any remedial actions taken or to be taken to resolve the concern. If the sound exceedance is related to equipment wear,

Table 7.1 Environmental Monitoring Programs (Operations)

Component	Method	Timing	Response-Action Plan
			the maintenance schedule will be adjusted to account for this and minimize the potential for a reoccurrence.
Shadow Flicker	A registry will be created to document complaints of shadow flicker. In the event of a complaint, shadow flicker will be reviewed from that receptor using photographs, and/or video recording at the appropriate time of day and year. Anecdotal information about shadow flicker will be collected from nearby residences.	Shadow flicker will be monitored as required during operation of the Project. If required, it will be conducted once during the summer and once during the winter.	If a complaint or complaints of shadow flicker are received from a receptor located within 1,500 m of the turbine, shadow flicker will be reviewed from that receptor. Information collected from the shadow flicker monitoring will be used will be used to develop further mitigation, if warranted.
Bird and Bat Mortality	Bird and bat carcass monitoring will be performed within a 75 m radius of each selected turbine. The fatality rate will require correction for scavenger removal of carcasses and field observation abilities of surveyors. The monitoring program will be confirmed with Environment Canada (CWS) and NSDNR.	It is expected that monitoring of bird and bat mortality surveys will be conducted during the two years following wind farm commissioning, with emphasis placed on surveying during peak spring and fall migration of birds and fall migration of bats.	It is likely that two years of monitoring will be conducted for bats and birds, to be determined in consultation with NSDNR and CWS
Moose	Post-construction Mainland Moose Monitoring Programs will be conducted. The monitoring program will be confirmed with NSDNR.	A moose monitoring program (pellet group counts) will be implemented to determine the degree to which moose use the Project Study Area. Winter track surveys will be conducted to determine if moose and other mammal species avoid turbine sites.	The information can then be used as baseline or reference material for the Provincial Moose Recovery Program.

Table 7.1 Environmental Monitoring Programs (Operations)

Component	Method	Timing	Response-Action Plan
		This study will help to determine if the turbines and associated infrastructure are an impediment to free movement of mammals where turbines are not present.	
Aesthetics and Visual Impacts	A registry will be established to record both negative and positive comments on the aesthetics and visual impact of the wind turbines. Media comment on the wind turbines will also be collected and documented. If required, photographs will be taken of the turbine locations from a minimum of two vantage points.	Photographs will be taken at least once after the turbines become operational. The comment registry will be maintained and media comment will be collected throughout the operation of the Project.	Information collected from the aesthetics and visual impact monitoring will be used to develop further mitigation, if required.
Electromagnetic Interference	A complaint resolution system will be in place to record and investigate complaints regarding telecommunications interference.	In response to interference complaints, if any occur.	Mitigation will be conducted on a case by case basis pending results of the investigation.

8.0 CONCLUSION

The Limerock COMFIT Wind Project is expected to provide clean energy sufficient for 2,000 homes annually in Nova Scotia. The Project will result in displacement of burning fossil fuel with an expected avoidance of greenhouse gas emissions of approximately 17,200 tonnes of carbon dioxide, as well as tonnes of sulphur dioxide and nitrogen oxide. The Limerock Project will therefore be a component of Nova Scotia's commitment to renewable energy and reduction of air emissions from energy combustion.

Based on the results of this EA, the study team has concluded that the Limerock Project is not predicted to result in any significant adverse residual environmental effects. The following section summarizes key points from the EA in justification of this conclusion.

The Project Study Area comprises approximately 40 ha in total. However the actual footprint of the tower structures and ancillary facilities for the proposed wind farm will occupy only a small fraction of the land base within the Project Study Area (cleared turbine area and area for the right-of-way between turbines). The Project is predicted to result in physical disturbance of approximately 2-3 ha of land (including development of access roads and turbine foundations). It is believed that this prediction is an overestimate and that Project development will result in a much smaller footprint.

Existing road access will be upgraded and used for turbine access. Sensitive features including watercourses, wetlands, plant species of conservation of concern, and areas of high archaeological potential will be avoided to the greatest extent practical or possible. Where avoidance is not practical nor possible, detailed mitigation will be developed and all required permits will be obtained prior to construction. Follow-up surveys will be conducted if necessary at areas to be disturbed based on final design which will allow for precise mitigation planning to minimize localized environmental effects on sensitive habitats.

Installation of the proposed Project will be completed in approximately four months of on-site work limiting the period of potential disturbance to residents and wildlife associated with increased vehicle traffic and human activity. Construction activities will be scheduled where practical to minimize environmental effects (*i.e.,* to prevent rutting and to avoid significant life history events such as breeding season for most bird species). Remediation of disturbed surface areas will be undertaken as soon as possible after construction is complete, and the conditions of affected land will be remediated to approximate pre-construction conditions in accordance with landowner agreements. The residual environmental effects associated with Project construction are therefore predicted to be **minimal** and **not significant**.

Effects associated with operations are also predicted to be **minimal** and **not significant**. Operation of the three wind mills will result in minimal adverse effects to birds and other wildlife. While turbines present a potential collision hazard to birds and bats, this hazard is fairly low relative to other tall structures. Bird and bat collisions are expected to be infrequent considering the topography of the area, observed flying patterns, distribution of habitat, and low collision rates documented at Dalhousie Mountain (10 km away) and other wind farms in Nova Scotia, the United States and Canada. Post-construction monitoring will be conducted in consultation with Environment Canada and NSDNR. This information will be used for future planning and develop mitigation if required. Any other disturbances to birds and other wildlife (*e.g.,* sensory disturbance) will be minimal, of short duration, reversible and on a local scale.

Operation of the facility will not result in production of air emissions. Sound levels and visual effects (*e.g.,* shadow flicker) will be within acceptable standards. The visual landscape of the region will be altered by the presence of three wind turbines; while some receptors will have a clear view of the turbines, many of the homes close to the viewshed will be unable to see the wind farm due to topography and forest cover. Screening opportunities through tree planting or other measures will not likely be warranted but may be considered where post-construction assessment indicates a legitimate concern.

Existing land use (*i.e.,* residential, recreational, resource use) can continue during operation of the Project. A number of positive effects will also be realized. Landowners who are leasing their land for the Project will receive direct financial benefits from facility installation and operation, and the county will receive substantial revenue through property taxes, which will benefit county residents in turn. The power produced will provide large annual donations to the SPCA as well as annual donations on a lesser scale to the local fire department, and other community groups. The Project will offer employment and revenue to local workers.

Appropriate and effective mitigation measures have been recommended for the proposed Limerock Project to eliminate or minimize effects that may have been associated with the development. Any residual net adverse environmental effects are predicted to be **not significant** based on the results and conclusions of this EA.

9.0 SIGNATURE

This report presents details on the EA of the proposed Limerock COMFIT Wind Project , conducted in accordance with "The Proponent's Guide to Wind Power Projects: Guide to Preparing an Environmental Assessment Registration Document" (NSEL 2007, updated 2012). The *"*Environmental Impact Statement Guidelines for Screenings of Inland Wind Farms Under the *Canadian Environmental Assessment Act"* (NRCan 2003) was also used for guidance in reporting as applicable. Overall, the residual effects of the Project are not significant and are acceptable, based on a balanced assessment against all of the screening criteria and the results and conclusions of the EA.

This EA was completed internally for Affinity Renewables. Specifically, and on behalf of the Proponent, the report was prepared and reviewed by the following:

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Appendix A	Electromagnetic Interference Study Results
Appendix B	Mi'kmaq Ecological Knowledge Study
Appendix C	ACCDC and Environmental Screening (Department of Heritage) Results
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