6.0 ENVIRONMENTAL ASSESSMENT AND RESIDUAL EFFECTS

The following section assesses the potential interactions between the proposed Clydesdale Ridge Wind Farm Project and the biophysical and socio-economic environment, and includes: an assessment of potential cumulative environmental effects; an assessment of the effects of the environment on the Project; and the potential effects of accidents and malfunctions.

The potential effects are described for the construction, operation and decommissioning phases of the Project and suggested mitigation is presented to reduce or eliminate these potential effects. The potential interactions between the Project and the environment are summarized, as are the proposed mitigation measures to reduce or eliminate residual (or net) effects.

Table 6.1 summarizes the potential interactions between the Project and VECs.

Table 6.1 Potential Interactions Between the Project and Valued Environmental Components

Project Activities	Valued Environmental Components													Section
	Soil	Surface Water Quality	Aquatic Environment	Terrestrial Vegetation	Wetlands	Birds & Other Wildlife	Archaeological/ Cultural Resources	Land Use	Local Community	Visual Aesthetics	Noise	Recreation and Tourism	Public Health and Safety	
Construction														
Surveying and Siting	X					X								6.1.1
Land Clearing	X	X	X	X	X	X	X				X			6.1.2
Road Construction/Modification	X	X	X	X	X	X	X	X	X		X			6.1.3
Delivery of Equipment						X			X		X			6.1.4
Temporary Storage Facilities	X	X	X	X		X	X				X			6.1.5
Foundation Construction	X	X	X			X	X	X			X			6.1.6
Tower and Turbine Assembly	X					X					X			6.1.7
Electrical Cabling Installation (Interconnection from Turbines to Substation)	X	X	X			X	X	X			X			6.1.8
Fencing/Gates														6.1.9
Parking Lots														6.1.10
Operation														
Operation & Maintenance						X		X	X	X	X	X	X	5.2

Table 6.1 Potential Interactions Between the Project and Valued Environmental Components

Project Activities	Valued Environmental Components													Section
	Soil	Surface Water Quality	Aquatic Environment	Terrestrial Vegetation	Wetlands	Birds & Other Wildlife	Archaeological/ Cultural Resources	Land Use	Local Community	Visual Aesthetics	Noise	Recreation and Tourism	Public Health and Safety	
Decommissioning														
Turbine and Ancillary Equipment Removal	X	X	X			X		X		X	X			5.3.1
Removal of Power Line	X	X	X			X		X		X	X			5.3.2
Site Remediation/ Reclamation	X	X	X			X		X		X	X			5.3.3
Accidents and Malfunctions														
Accidents and Malfunctions	X	X	X			X		X	X				X	5.4

6.1 PROJECT CONSTRUCTION ACTIVITIES – ENVIRONMENTAL EFFECTS

The following sections describe the main construction activities and the potential effects associated with each activity. All activities associated with the Project construction, including equipment maintenance and refueling, will be controlled through standard mitigation to ensure that there is a low impact associated with construction of the Project. The construction zone of impact will be localized within the Project Study Area.

Overall, potential environmental impacts will be mitigated using the following standard practices:

- limit access to the turbine site via an established access road, where possible;
- keep the size of access roads to the minimum required for the safe transportation of construction equipment;
- flag/fence areas with valued environmental features (*e.g.,* wetlands), and exclude construction activities from within these identified areas to the extent practical;
- whenever practical, time clearing activities to periods when the ground surface is best able to support construction equipment (winter or dry season) to prevent rutting and to avoid clearing during sensitive ecological periods events, such as breeding seasons for resident birds (*i.e.,* May to August); and
- upon clean-up, replace topsoil stored on-site and re-vegetate areas that were temporarily cleared, where possible, with native seed mixtures or with a mix of species similar to those on adjacent lands to restore affected lands to their previous condition.

The remainder of this section focuses on the individual phases of construction and operation, and details the potential environmental effects associated with each activity.

6.1.1 Surveying and Siting Operations

The siting of the wind turbines was initially carried out field surveys by the Proponent with a GPS, then vetted against data using computer software analyzing meteorological data. This software, however, does not account for areas that are environmentally sensitive, and site visits by biologists were conducted and combined with existing mapping data to identify environmental constraints. Subsequent to the 2011 bird, terrestrial and aquatic field surveys, some turbine locations were changed as a result of stakeholder input and addition of Project lands. While this has resulted in some discrepancy between field data availability and Project footprint, Clydesdale Ridge Wind LP believes these changes will improve the Project design and recognizes that additional site specific surveys may be required prior to construction activities to identify potential environmental constraints (*e.g.,* rare plants) at turbine locations not previously surveyed in order to assist with micrositing of infrastructure. Prior to construction, land surveyors will conduct a site visit to identify the exact location of each turbine on foot. Survey stakes will be used to mark each turbine site, temporary workspace and access road construction. These areas will be surveyed, as appropriate, by a qualified biologist to survey the area for rare and sensitive environmental features *(i.e.,* rare plants, wetlands) and recommendations will be made to avoid these constraints to the extent possible. Table 6.2 summarizes the potential environmental effects of surveying and siting activities.

Geotechnical testing will be undertaken at the turbine sites. This will require access by testing equipment and may require limited, localized brush removal to permit equipment operation. Geotechnical testing will be undertaken by qualified operators and supervised by an attending engineer. Existing right-of-ways (RoWs) will be used where possible and the equipment will not traverse watercourses or wetlands, and is expected to have minimal environmental effects.

Table 6.2 Potential Effects of Surveying and Siting Activities

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	• Visitors will remain within relevant areas, both in-vehicle and on-foot and will aim to preserve the site's natural areas.	3	1	1/1	R	2	Sensory disturbance may cause habitat avoidance but it likely will be temporary in nature, small in magnitude and restricted to the Project footprint. The area to be subject to this disturbance has been previously disturbed by human

Table 6.2 Potential Effects of Surveying and Siting Activities

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]: Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	Residual Effect
								presence (*e.g.,* forestry) and disturbance will be reversible.
Terrestrial Vegetation	Limited vegetation removal	• Minimize vegetation removal • Avoid wetlands and watercourses • Best environmental practices for geotechnical testing	1	1	1/1	R	2	Highly localized vegetation removal for equipment access will avoid sensitive ecological features and sites will be restored as part of post construction site restoration

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.

The net effects of siting and surveying activities will be spatially limited to certain areas within the Project footprint, as well as temporally limited to within the siting and surveying visits. Overall the level of impact will be **minimal** and **not significant**, especially considering that in the area, birds and wildlife already experience a certain level of sensory disturbance due to ongoing forestry and quarrying activities and associated human presence. Vegetation removal will be minimal and sensitive ecological features will be avoided. It should be noted that this phase is very important in ensuring that the overall Project is carried out with the least possible disturbance to birds and wildlife by precisely identifying sensitive habitats within or near areas proposed for disturbance. Where possible, micrositing of infrastructure will also take into consideration connectivity of landscape to maintain potential corridors for wildlife migration through the area. Appropriate construction work zones will be chosen, to the extent practical, in order to limit the degree of disturbance.

6.1.2 Land Clearing

The lands within the Project Study Area are primarily wooded with evidence of past and current forest operations. Land clearing and vegetation removal will be required for the construction of access roads, installation of poles for collection cables, and turbine foundation construction. However, this will require only minimal alteration for the majority of the Study Area land as existing

RoWs are being used to the extent practical. Table 6.3 summarizes the potential environmental effects of land clearing activities.

For the construction of the Dalhousie Mountain Wind Farm (Phase I), the Proponent used three pairs of logging horses to remove trees in some locations, which further reduced environmental impacts (quiet, less impact on land) and these initiatives are also planned for the Clydesdale Ridge Wind Farm (refer to RMS Energy handout "From Land Farming to Wind Farming" in **Appendix C**.

Table 6.3 Potential Effects of Land Clearing Activities

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	• Ensure that overall disturbance is limited to designated workspaces, and performed in compliance with the *Migratory Birds Convention Act* (MBCA). • Conduct clearing outside the breeding period of most migratory birds.	2	1	2/1	R	2	Sensory disturbance may cause habitat avoidance but it likely will be temporary in nature, small in magnitude and restricted to within several hundred metres of the Project footprint. The area to be subject to this disturbance is forested land and effects associated with sensory disturbance will be reversible.
	Habitat alteration and loss	• Clear only the land necessary for construction activities and limit the overall land disturbance to within designated workspaces. • For the majority of the Project, existing access roads will be used and this will minimize habitat loss. • Upon completion of construction and/or decommissioning, habitat will be restored to the extent possible. • Areas of significance (*e.g.,* nesting sites) will be avoided, to the extent possible.	2	1	2/1	I	2	Although some habitat loss will be considered irreversible (*i.e.*, 20 years), this "irreversible" habitat loss will be limited in geographic extent and magnitude and will ultimately be restored after Project decommissioning. Project design has attempted where feasible to make use of existing roads and cleared areas. The area of habitat that will be altered due to land clearing activities for access roads and turbines will be a very small proportion of what is available due to the

Table 6.3 Potential Effects of Land Clearing Activities

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
								fact that the majority of the Project has been sited to use existing access roads, and therefore the impact will be minimal.
	Mortality	• In order to reduce the potential of bird mortality, land clearing and construction activities will be performed in compliance with the *Migratory Birds Convention Act*. • Train onsite personnel regarding how to identify and properly deal with any wood turtles that may enter a work site.	2	1	2/1	I	2	Land clearing activities mirror current forestry operations in the Project Study Area. Due to timing of land clearing activities outside the breeding period for most migratory birds, it is predicted that there will be no residual effect on bird mortality. If clearing must be conducted during the breeding season for most birds, a contingency plan will be implemented to ensure compliance with *MBCA.*
Soils and Vegetation	Soil erosion and compaction	• Limit access to the turbine sites via established access roads, where possible. • Size of access roads will be kept to the minimum required for the safe construction, operation and decommissioning of the equipment. • Whenever practical, clearing activities will be conducted during periods when the ground surface is best able to support construction equipment (winter or dry season). • Replace/re-introduce topsoil stored on-site to enable the reclamation of land to its original condition.	2	1	2/1	R	2	Implementation of mitigation measures will ensure that soil quality within the Project Study Area will be preserved, and no residual effects will exist.

Table 6.3 Potential Effects of Land Clearing Activities

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
	Loss of plant species of conservation concern	• Follow-up vegetation surveys will be conducted to assist with micrositing of turbines and access roads. • 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. • Where Plant Species of Conservation Concern are encountered, avoidance to the extent possible will be considered, especially where there may be a threat to the regional population. Where avoidance is not possible, additional mitigative measures will be developed in consultation with NSE and NSDNR. Specifically, no turbines will be erected west of turbine S-31 to avoid an area containing dense populations of heart-leaved foamflower. Care must be taken in upgrading or constructing access roads to turbines S-12, S-13 and S-16 to avoid possible disturbance of the hydrology of the wetland in which alpine rush is located. The population of blood	2	1	2/1	R	2	Follow-up vegetation surveys will be conducted to assist with micrositing of turbines and access road layouts. Mitigation for species of conservation concern encountered within the Project footprint will ensure there is no significant residual environmental effect on Plant Species of Conservation Concern.

Table 6.3 Potential Effects of Land Clearing Activities

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
		milkwort near Bezansons Lake will be marked with symbolic fencing and the access road will be modified to minimize the potential for accidental disturbance of this population.						
Wetlands	Loss of wetland area and/or function	• Avoid all wetlands, where practical. • If wetland impact is unavoidable, a functional analysis of the wetland will be conducted and regulatory approval of the proposed alteration will be obtained prior to construction. • Erosion and sediment control measures will be implemented to protect wetlands during construction.	1	1	2/1	R	2	Follow-up surveys will be conducted, if necessary, to confirm the presence/ absence of wetland within the Project footprint and to conduct a functional analysis of the wetland habitat were avoidance is not feasible. Any loss of wetland habitat will be compensated to ensure no net loss of wetland function.
Surface Water Quality/ Aquatic Environment	Surface water contamination	• General mitigation measures from the NSE Erosion and Sediment Control Handbook will be utilized Including: • Avoidance of watercourses to the extent possibleIf alteration of watercourses is required, regulatory approval of the proposed alteration will be obtained prior to construction. • All activities, including equipment maintenance and refuelling, will be controlled or done off-site to prevent entry of petroleum products or other deleterious	2	1	2/1	R	1	By following mitigation measures, adverse interactions with surface water quality and fish habitat will be minimized and no significant residual effects will result.

Table 6.3 Potential Effects of Land Clearing Activities

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
		substances, including any debris, waste, rubble 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.						
	Sediment loading	• General mitigation measures from the NSE Erosion and Sediment Control Handbook will be utilized including avoidance of interaction with watercourses to the extent possible. • Land clearing and construction near watercourses (including crossing structure construction) should occur between June 1 and September 30 where practical. • 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	2	1	2-3/1	R	1	By following mitigation measures, negative interactions with surface water quality and fish habitat in the Project Study Area will be minimized and no significant residual effects are predicted.

Table 6.3 Potential Effects of Land Clearing Activities

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
		but not until permanent erosion control measures, if required, have been established.						
Noise	Increases to sound levels due to the transportation and operation of clearing equipment	• Nearby residents will be advised of significant sound generating activities and these will be scheduled to create the least disruption to receptors. • Heavy equipment will only 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.	3	2	2/1	R	2	Increased sound levels caused by land clearing will be temporary in nature and will be caused by activities conducted during working, daylight hours. Due to the short nature of this disturbance and its limited geographic range, the level of impact will be minimal and residual effect is considered not significant.
Archaeological and Cultural Resources	Disturbance	• Areas of significance will be avoided, to the extent possible. • If ground disturbance is necessary in areas of medium or high archaeological potential, these activities will be monitored by a licensed archaeologist. • An archaeological field survey will be conducted prior to construction and an Archaeological Contingency Plan will be developed. • In the event that an archeological heritage resource is discovered,	2	1	2/1	R	2	Local areas of high archaeological potential identified near the Study Area are not anticipated to be impacted by the Project. An archaeological field survey will be conducted prior to construction and a contingency plan will be implemented. No significant residual effects to archaeological and cultural resources are anticipated.

Table 6.3 Potential Effects of Land Clearing Activities

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
		work in the immediate area will stop and the appropriate authorities will be contacted.						
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.						

The amount of clearing for the Project has been reduced by using existing access roads to the extent possible and preferential placement of turbines in existing harvested areas. Considering the footprint of the turbine locations and substation, along with access roads, it is estimated that approximately 2% of the total Project Study Area will be affected by Project infrastructure, although as stated above, much of this 9.6% has already been disturbed so this is a conservative estimate of vegetation to be cleared. All but four of the 13 vegetation and land feature types identified in the Project Study Area (refer to Table 5.7) will be affected by the development. Vegetation types most affected by clearing include immature softwood, mature hardwood, clear-cut and other non-forested areas (mainly woods road right-of-ways) (refer to Table 5.7). This reflects the relative abundance of these habitats on the local landscape except that clear-cuts and immature softwood forest are represented more frequently and mature hardwood forest is represented less frequently due to the fact that turbines and access roads will be preferentially placed in areas that have been recently harvested.

The effective mapping and avoidance of natural habitat hosting vascular plant species of conservation concern during facility layout design, including site-specific vegetation and wetland surveys (if required), micrositing of turbines and ancillary structures and infrastructure, use of existing access roads and cleared areas to a large extent, and successful restoration measures during the Project’s construction, operation and decommissioning stages, will not likely result in significant environmental effects to native habitat from the Project. If wetland or watercourse alterations cannot be avoided, all necessary regulatory approvals will be obtained prior to the disturbance.

The preliminary background research indicates that the Study Area may have a high potential for containing both First Nations and historic period archaeological resources (**Appendix K**). Prior to construction, an archaeological field survey will be conducted based on final design and layout of Project infrastructure and proximity to areas deemed to have high potential for First Nation and Historical archaeological resources. The MEKS results may also provide guidance on follow-up work. Such work could include more in-depth background research, a pedestrian survey of the high potential areas, possibly, sub-surface testing and/or monitoring of high potential areas subject to excavation. Mitigation strategies for all identified heritage resources will be designed by the archaeologist in consultation with appropriate regulatory agencies.

The net effects of clearing activities will be spatially limited to certain small areas within the Project footprint. Overall the level of impact will be **minimal** and **not significant**, especially considering that the area's birds and wildlife already experience a certain level of sensory disturbance due to ongoing forestry activities and associated human activities. Standard mitigation measures to protect terrestrial resources, aquatic resources, archaeological resources and humans from increased sound levels and direct disturbance (including habitat compensation, if required) will be adequate to effectively reduce or eliminate residual effects.

6.1.3 Road Construction/Modification

To the extent possible, existing access roads will be used, and upgraded where required. Access roads will be surveyed and staked/flagged. The roads are based on a proposed layout at this time and may require alterations as the Project proceeds. Roads on the wind farm site will be up to 10 m wide to accommodate maintenance vehicles and equipment for repairs/replacements. Construction roads will be designed to accommodate the crane types that will be required to erect the wind turbine generators and towers. Roads will be constructed by placing a layer of geogrid on the native soil, followed by layers of compacted shale or sandstone with a screened stone topping.

Watercourses and wetlands will be avoided to the extent possible. In the event that a watercourse crossing is required, culverts will be designed and installed in consultation with NSE and DFO and in accordance with applicable regulations, specifications (*i.e*. Erosion and Sedimentation Control Handbook for Construction Sites (NSE 1988) and Watercourse Alteration Specifications (latest edition)) and conditions of approval. Wetland alteration, if required, will be in accordance with applicable regulations and conditions of approval including compensation planning.

The potential environmental effects associated with road construction (including culvert installation, if required) include impacts to birds and other wildlife, water quality/aquatic environment, noise levels, archaeological/cultural resources, land use and traffic. Table 6.4 summarizes the potential environmental effects of road construction/modification activities.

Table 6.4 Potential Effects of Road Construction/Modification

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	• Ensure that overall disturbance is limited to designated workspaces, and performed in compliance with the *Migratory Birds Convention Act*.	2	1	2/1	R	2	Sensory disturbance may cause habitat avoidance but it likely will be temporary in nature, small in magnitude and restricted to within several hundred metres of the Project footprint.
	Habitat loss/alteration	• Habitat loss may be mitigated by only clearing the land necessary 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.	2	1	2/1	I	2	Habitat loss will be considered to be irreversible (*i.e.*, 20 years) but the area of habitat that will be altered due to access road construction will be a very small proportion of what is available, and therefore the impact will be minimal.
	Mortality	• In order to reduce the potential of bird mortality, land clearing and construction activities will be performed in compliance with the *Migratory Birds Convention Act (e.g.,* outside of critical time periods for breeding birds). • Train onsite personnel regarding how to identify and properly deal with any wood turtles that may enter a work site.	2	1	2/1	I	2	It is predicted that there will be no residual effect on bird mortality.
Soils and Vegetation	Soil erosion and compaction	• Access to the turbine sites will be limited to established access roads, where possible. • The size of access roads will be kept to the minimum required for the safe construction, operation and decommissioning of the	2	1	2/1	R	2	Implementation of mitigation measures will preserve soil quality within the Project Study Area; no residual effects are predicted.

Table 6.4 Potential Effects of Road Construction/Modification

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
		equipment. • Whenever possible, clearing activities will be timed for periods when the ground surface is best able to support construction equipment (winter or dry season). • Compacted soil will be reclaimed as required.						
	Loss of plant species of conservation concern	• Follow-up vegetation surveys will be conducted, if necessary. • 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. Where Plant Species of Conservation Concern are encountered, avoidance to the extent possible will be considered, especially where there may be a threat to the regional population. Specifically, no turbines will be erected west of turbine S-31 to avoid an area containing dense populations of heart-leaved foamflower. Care will be taken in upgrading or constructing access roads to turbines S-12, S-13 and S-16 to avoid possible disturbance of the hydrology of the wetland in which alpine	2	1	2/1	R	2	Follow-up vegetation surveys will be conducted to confirm vegetation and habitats in the Project footprint, if necessary. Based on implementation of mitigation for species of conservation concern encountered within the Project footprint a significant residual environmental effect on Plant Species of Conservation Concern is not predicted.

Table 6.4 Potential Effects of Road Construction/Modification

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
		rush is located. The population of blood milkwort near Bezansons Lake will be marked with symbolic fencing and the access road will be modified to minimize the potential for accidental disturbance of this population. • Where this is not possible, additional mitigation will be developed in consultation with NSE and NSDNR.						
Wetlands	Loss of wetland area and/or function	• Avoid all wetlands, where possible. • All activities, including equipment maintenance and refuelling, will be controlled, or will be done off-site, to prevent entry of petroleum products or other deleterious substances, including any debris, waste, rubble or concrete material, into a wetland. • Construction material, excess material, construction debris, stockpiled soils, and empty containers will be stored away from wetlands • If alteration of wetlands is required, functional analyses of the potentially affected wetlands will be conducted and regulatory approval of the proposed alteration will be obtained prior to construction.	1	1	2/1	R	2	Follow-up wetlands surveys will be conducted if necessary to confirm the absence of wetland within the Project footprint. Any loss of wetland habitat will be compensated to achieve no net loss of wetland function.
Water Quality/ Aquatic	Surface water contamination	• Watercourses will be avoided to the extent	2	1	2/1	R	1	No residual effects are expected.

Table 6.4 Potential Effects of Road Construction/Modification

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
Environment		possible. • All activities, including equipment maintenance and refuelling, will be controlled, 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.						
	Sediment loading	• General mitigation measures from the NSE Erosion and Sediment Control Handbook will be utilized including avoidance of interaction with watercourses to the extent possible. If watercourse alterations are required, they will be done in consultation with NSE/DFO and in accordance with regulatory requirements. • Instream work will occur between June 1 and September 30 where possible, unless otherwise approved by	2	1	2/1	R	1	No residual effects are predicted.

Table 6.4 Potential Effects of Road Construction/Modification

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
		NSE. • 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. • Visual assessments will be completed in a quarterly basis and after a severe storm event to ensure effectiveness of erosion and sedimentation control.						
	Surface water flow	• General mitigation measures from the NSE Erosion and Sediment Control Handbook will be utilized including avoidance of interactions with watercourses to the extent possible. • Access roads constructed across existing watercourse that require a culvert will follow standard industry practice, installing culverts of sufficient size to accommodate expected maximum flows within the watercourse. • A Watercourse Alteration Approval will be obtained for all required	2	1	2/1	R	1	No residual effects are expected.

Table 6.4 Potential Effects of Road Construction/Modification

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
		watercourse crossings and the conditions of approvals will be followed.						
	Fish mortality	• Watercourses will be avoided to the extent possible. • Watercourse crossings, where required, will be constructed between the period of 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. In this case, a biologist would be on site to facilitate fish rescue within the dammed area. • Where fish bearing streams must be crossed (*e.g.,* culvert installation) DFO will be consulted regarding possible requirements for authorization under the *Fisheries Act.*	1	1	2/1	I	1	No residual effects are expected given these mitigation measures.
	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 weekly as well as immediately following	1	1	2/1	R	1	By following mitigation measures, adverse interactions with fish habitat will be minimized and no significant residual effects will result

Table 6.4 Potential Effects of Road Construction/Modification

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
		rainfall events.						
Noise	Increases to sound levels due to the transportation and operation of clearing equipment	• Heavy equipment will only 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.	3	2	2/1	R	2	Residual effects are expected to be minimal, as discussed in Table 6.2.
Archaeological and Cultural Resources	Disturbance	• Areas of significance will be avoided to the extent possible. • Follow-up surveys will be conducted prior to construction and an Archaeological Contingency Plan will be developed. • Additional follow-up work may be required depending on final design and layout.	3	1-2	2/1	R	2	No residual effects are expected.
Land Use	Reduction of forested land	• Existing forest roads will be used as access roads to the extent possible. • New access roads will be constructed in such a manner to minimize the Project footprint.	3	2	2/1	R	2	The area of forested land that will be lost due to access road construction will be a very small proportion of what is available and therefore the impact should be minimal.
Local Community	Hazards and/or inconveniences to forestry operations, and informal recreational activity (e.g,. ATV operations,	• Road construction schedule will consider planned forestry operations in the area to maintain required access.	3	1	2/1	R	2	There may be minor delays to unscheduled land use activities; however these will be of short duration. The impact is therefore predicted to be minimal. Safety issues are addressed in Section

Table 6.4 Potential Effects of Road Construction/Modification

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
	hunting)							5.2.1.7.

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.

The construction of access roads on individual landowner's private property will comprise a relatively small portion of the Study Area, and thereby should not jeopardize species habitat. The Proponent will take advantage of existing access roads and upgrade those as necessary. Sensory disturbance for birds and other wildlife will be temporary in nature and low in magnitude. Culverts will be installed according to all regulatory requirements and wetland alteration will require regulatory approvals. Mitigation to control surface water and thereby erosion will follow the methods outlined in the NSE Erosion and Sediment Control Handbook and further outlined in the EPP. Should it be deemed necessary, compensation to ensure DFO's policy of no net loss of function will be undertaken post-construction. Upon completion of decommissioning, and after consulting with the appropriate landowners, Clydesdale Ridge Wind LP intends to reclaim property access roads, if the landowner is in agreement, thereby limiting any long-term impacts. Overall it is anticipated that with implementation of the above-stated mitigation measures, the environmental impact associated with access road construction and modification activities will be **minimal** and **not significant**.

6.1.4 Delivery of Equipment

Currently, traffic patterns in and around the Project Study Area, are largely related to forestry and quarry operations. With the exception of its boundary roads, the Project Study Area receives very little traffic other than movements of local residents and occasional visits by tourists and other outdoor enthusiasts.

The trucks used for the heavy loads have multiple axles, with the potential to add more, and have steering capability at the back end, allowing them to turn corners much tighter than trucks without such rear steering capability. A large mobile crane will also be required, approximately the size of a standard semi-trailer.

It is anticipated that the current road network (outside of onsite turbine access roads) will not require upgrades to accommodate construction traffic and therefore a transport study is not proposed.

Approvals for transporting these materials will be sought from the provincial transportation departments. As the turbine components are oversized, a Special Move Permit and any associated approvals will be obtained through NSTIR for heavy load transport.

The tower sections, the nacelles, and rotor parts will be moved to each turbine site within the Project Study Area by flatbed truck and placed into an exact position for picking up using cranes. One flatbed truck will be used for each of the three tower sections. In addition, a flatbed truck will be used for the nacelle, and one flatbed truck will be required to transport two rotor blades. By stacking the blades side by side on the flatbed, similar to high heeled shoes in a shoe box, the transportation cost and fuel consumption is reduced by 50% for the blade transportation. One additional truckload will be required for the rotor hub for each machine. Parts shipped loose will require two truckloads in total for all 28 turbines. Each crane requires multiple trucks to bring in the components for erection and ballast. As well, padmount transformers will be delivered three per truck, totalling 10 loads for delivery of the whole park's transformers. This site preparation will require approximately ten people for five days for each turbine. All the equipment at the site will be cleaned using a pressure washer and biodegradable truck wash.

The effect on land use will be primarily temporary access loss/disruption during the construction of the turbines which will involve the delivery of up to 210 loads. These deliveries may slow or interrupt traffic on the Trans Canada Highway at Exits #18a and #19 and onto the Highway Route 4 before turning onto Glen Road and/ or the driveway of Weeks Construction Ltd quarry. However, at no time will the private landowners be unreasonably prevented from gaining access to their land.

There is the possibility for impacts to local sound levels and traffic due to the transportation of materials. In addition, the potential increase in sound levels may cause sensory disturbance to birds and other wildlife, although the Weeks quarry processes approximately 50 – 75 trucks per day in and out of the quarry during operation (7 days per week from May to December), so the sound levels associated with large trucks are very typical sound levels experienced in the area. Table 6.5 summarizes the potential environmental effects of activities associated with the delivery of equipment to the site.

Table 6.5 Potential Effects of Delivery of Equipment

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	• Delivery vehicles will remain on designated roads.	3	1	1/1	R	2	Sensory disturbance may cause habitat avoidance but it likely will be temporary in nature, small in magnitude and restricted to within several hundred metres of the Project footprint. The area to be subject to this disturbance is forested land however disturbance will be reversible.
Noise	Increase in sound levels	• Equipment will be delivered between 7:00 a.m. and 10:00 p.m., avoiding Sundays and holidays unless absolutely necessary.	3	2	1/1	R	2	Increased sound levels caused by delivery of equipment will be temporary in nature and will be conducted during working, daylight hours. Due to the short nature of this disturbance and its limited geographic range, the level of impact will be minimal and residual effect is considered not significant.
Local Community	Hazards and/or inconveniences to traffic	• It is anticipated that the same travel routes used for the Dalhousie Mountain Wind Farm will be used for the Clydesdale Ridge Wind Farm. No modifications to existing roads are expected at this time. • A Special Move Permit and any associated approvals will be obtained through the Department of Transportation and Infrastructure Renewal for heavy load transport.	2	1	1/1	R	2	No significant impact on road use is expected.

Table 6.5 Potential Effects of Delivery of Equipment

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	

Note 1 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.

It is anticipated that with implementation of the above-mentioned mitigation measures, the residual effects of the delivery of equipment will be **minimal** and **not significant**. Traffic is relatively low along the potential access routes and therefore it is unlikely that there will be a significant inconvenience to local motorists or emergency services.

6.1.5 Temporary Storage Facilities

Temporary storage facilities/equipment lay-down will comprise a small portion of the Project Study Area, and should not jeopardize species habitat. Sensory disturbance and habitat loss/alteration for birds and other wildlife will be temporary in nature and not significant. The area's birds and wildlife already experience a certain level of sensory disturbance due to ongoing forestry activities and associated human activities. Upon completion of construction, the temporary storage facilities will be removed and the ground will be remediated to its previous use. The environmental effects of temporary storage facilities are principally due to land clearing and delivery of equipment, and are discussed in Sections 6.1.2 and 6.1.4. Overall it is anticipated that with the implementation of the above-stated mitigation measures, the environmental impact associated with the temporary storage facilities will be **minimal** and **not significant**.

6.1.6 Foundation Construction

Foundations of turbines and padmount transformers will leave a small footprint on the landscape that will last the extent of the Project's life. Excavation of soils and installation of the engineered foundations have the potential to interact with several environmental components. Environmental components that potentially could be impacted as a result of foundation construction include birds and other wildlife, soils, water quality/aquatic environment, land use, noise and archaeological/cultural resources. Table 6.6 summarizes the potential environmental effects of activities associated with foundation construction.

Table 6.6 Potential Effects of Foundation Construction

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.* • Train onsite personnel regarding how to identify and properly deal with any wood turtles that may enter a work site.	3	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 within several hundred metres of the turbine locations. The area to be disturbed is primarily forested land however disturbance will be reversible.
	Mortality	• Construction activities will be performed in compliance with the *Migratory Birds Convention Act*.	2	1	1/2	I	2	It is predicted that there will be no residual effect on bird mortality.
Soils	Soil disturbance and erosion	• 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.	2	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.
Water Quality/ Aquatic Environment	Surface water contamination	• Watercourses will be avoided to the extent possible. • All activities, including equipment maintenance and refuelling, will be controlled, or will be done off-site, to prevent entry of petroleum products or other deleterious substances, including any debris, waste, rubble or concrete material, into a watercourse. • Construction material,	2	1	1/1	R	2	No residual effects are predicted.

Table 6.6 Potential Effects of Foundation Construction

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
		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.						
	Sediment loading	• General mitigation measures from the NSE Erosion and Sediment Control Handbook will be utilized to control water, reduce erosion and limit sedimentation. • Land clearing and construction (excluding crossing structure construction) 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.	2	1	1/1	R	2	No residual effects are predicted.
Land Use	Reduction of land available for forestry	• Turbines, with their relatively small footprint on the land, have been sited with consideration for the potential impact to existing land uses.	2	2	1/2	R	2	The area of forested land that will be lost due to foundation construction will be a very small proportion of what is available and will be

Table 6.6 Potential Effects of Foundation Construction

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
		• The substation required to transfer the power from the wind farm to the grid is already constructed and in use for Dalhousie.						situated to minimize disturbance to existing forestry operations. Due to the limited footprint, its reversibility after decommissioning and small proportion of land to be directly impacted by foundation construction, the residual effect is expected to be minimal.
Noise	Increases to sound levels due to operation of equipment	• 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.	3	2	1/2	R	2	Increased sound levels caused by foundation construction will be temporary in nature and will be conducted during working, daylight hours. Due to the short nature of this disturbance and its limited geographic range, the level of impact will be minimal and residual effect is considered not significant.
Archaeological and Cultural Resources	Disturbance	• Areas of significance will be avoided to the extent possible.	3	1	1/2	R	2	No residual effects are predicted.

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.

The foundations will comprise a relatively small portion of the Project Study Area land. Sensory disturbance for birds and other wildlife during foundation construction will be temporary in nature. Upon completion of construction, the ground surrounding the foundations will be restored. Overall, it is anticipated that with the implementation of the above-stated mitigation measures, the residual effects associated with foundation construction will be **minimal** and **not significant**.

6.1.7 Tower and Turbine Assembly and Installation

The tower comes in three sections that will be assembled on site. The rotor blade system, consisting of three blades and a hub, will also be assembled on site, attached to the generator and lifted into place at the top of the tower by a large hydraulic crane. This will require approximately ten people for three days per turbine. An additional 1-2 days will be required to install the remainder of the turbine assembly. Control and switching equipment will be placed on each turbine pad by a crane. A large crawler crane with a hydraulic crane will be used to install each tower section. Each tower section will be lifted and secured with bolts to the section below, followed by the nacelle secured to the top tower section. Finally, the assembled rotor will be lifted and attached to the nacelle.

This phase of construction could potentially have impacts on birds and other wildlife, soils and vegetation, and sound levels. Table 6.7 summarizes the potential environmental effects of activities associated with tower and turbine assembly and installation.

Table 6.7 Potential Effects of Tower and Turbine Assembly and Installation

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*. • Train onsite personnel regarding how to identify and properly deal with any wood turtles that may enter a work site.	3	1	2/1	R	2	Sensory disturbance likely will be temporary in nature, small in magnitude and restricted to within several hundred metres of the turbine locations. The residual effect is considered minimal.
Soils	Soil compaction and contamination	• Trucks and equipment will remain in designated workspaces. • Whenever possible, delivery will be timed for periods when the ground surface is best able to support construction equipment (winter or dry season). • Compacted soil will be reclaimed as required.	3	1	2/1	R	2	No residual effects are expected.
Noise	Increases to sound levels due to the transportation	• Heavy equipment will only be operated between 7:00 a.m. and 10:00 p.m., avoiding Sundays and	3	2	2/1	R	2	Increased sound levels caused by equipment assembly and installation will be temporary in

Table 6.7 Potential Effects of Tower and Turbine Assembly and Installation

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1] Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	Residual Effect
	and operation of equipment	holidays unless absolutely necessary. • 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.						nature and will be conducted during working, daylight hours. Due to the short nature of this disturbance and its limited geographic range, the level of impact will be minimal and residual effect is considered not significant.

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.

Sensory disturbance for birds and other wildlife will be temporary in nature, limited in extent, and low in magnitude. The area's birds and wildlife already experience a certain level of sensory disturbance due to ongoing forestry activities and associated human activities, and therefore are expected to be able to tolerate the similar disturbance associated with construction activities, or use available habitat outside the range of disturbance. There is very little sensitive habitat such as interior forest within the vicinity of the Project activities. Compacted soil will be remediated and reclaimed as appropriate, and measures will be in place to decrease the likelihood of this occurring. Overall it is anticipated that with the implementation of the above-stated mitigation measures, the residual effects associated with the tower and turbine assembly and installation will be **minimal** and **not significant**.

6.1.8 Interconnection from Turbine to Substation

Above-ground 34.5 kV electrical cables will be installed running from each turbine to the on-site substation, largely following existing linear disturbances (*i.e.,* access road system).

Potentially affected environmental components include birds and other wildlife, soils, water quality/aquatic environment, noise, land use and archaeological/cultural resources. Table 6.8

summarizes the potential environmental effects of activities associated with interconnection of the turbine collector system and substation.

Table 6.8 Potential Effects of the Interconnection from Turbines to Substation

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. • 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. • Train onsite personnel regarding how to identify and properly deal with any wood turtles that may enter a work site. • Mitigation recommended by the Avian Power Line Interaction Committee (1994, 1996 and updates) will be considered to minimize effects of overhead distribution lines.	3	1	2/1	R	2	Sensory disturbance likely will be temporary in nature, small in magnitude and restricted to the Project Study Area. The residual effect is considered minimal.
Soils	Compaction and contamination – via heavy equipment	• Topsoil will be stored on-site for future use in restoring the land to its original condition. • Standard erosion and sediment control measures will be implemented as required.	3	1	2/1	R	2	No residual effects are expected.
Water Quality/ Aquatic Environment	Surface water contamination	• Watercourses will be avoided to the extent possible. • All activities, including equipment maintenance and refuelling, will be controlled, or will be done off-site, to prevent entry of petroleum products or other deleterious substances, including any debris, waste, rubble or	2	1	2/1	R	1	No residual effects are expected.

Table 6.8 Potential Effects of the Interconnection from Turbines to Substation

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
		concrete material, into a watercourse or wetland.						
	Sediment loading	• General mitigation measures from the NSE Erosion and Sediment Control Handbook will be utilized to control water, reduce erosion and limit sedimentation. • Watercourses will be avoided to the extent possible. • 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.	2	1	2/1	R	1	No residual effects are expected.
Noise	Increases to sound levels due to the transportation and operation of equipment	• Heavy equipment will only be operated between 7:00 a.m. and 10:00 p.m., avoiding Sundays and holidays unless absolutely necessary. • 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.	3	2	2/1	R	2	Increased sound levels will be temporary in nature and will be conducted during working, daylight hours. Due to the short nature of this disturbance and its limited geographic range, the level of impact will be minimal and residual effect is considered not significant.

Table 6.8 Potential Effects of the Interconnection from Turbines to Substation

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
Land Use	Reduction of forested land	• Existing forest and access roads built earlier in the construction schedule will be used to install the collection system. • The Project will connect at the existing substation for Dalhousie, eliminating the need to clear and disturb the required space	3	1	2/1	R	2	Provided these mitigation measures, and considering the temporary and reversible nature of this effect over a small spatial scale, no residual effects are expected.
Archaeological and Cultural Resources	Disturbance	• Areas of significance will be avoided to the extent possible.	3	1	2/1	R	2	No residual effects are expected.

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.

Overall it is anticipated that, with the implementation of the above-mentioned mitigation measures, the residual effects of the collection system installation will be **minimal** and **not significant**.

6.1.9 Fencing/Gates

With the exception of the substation that is already present, the need for fencing or gates is not anticipated for the Clydesdale Ridge Wind Farm Project, therefore environmental effects and mitigation are not discussed.

6.1.10 Parking Lots

The need for a parking lot is not anticipated for the Clydesdale Ridge Wind Farm Project therefore environmental effects and mitigation are not discussed.

6.2 OPERATIONAL ACTIVITIES – ENVIRONMENTAL EFFECTS

The environmental components that may be adversely affected by the operation of the Clydesdale Ridge Wind Farm Project include land use, local community, recreation, visual aesthetics, ambient sound levels, birds and other wildlife and health and safety. Table 6.9 provides a general overview of these components and associated impacts. The remainder of Section 6.2 describes these interactions and potential effects in greater detail.

Table 6.9 Summary of Potential Effects of Operational Activities

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
Birds	Sensory disturbance	• None required.	3	2	5/6	R	2	It is anticipated that sensory disturbance during Project operations may cause birds to change their flight patterns in order to avoid the towers and rotating blades. This will serve to reduce the number of bird collisions. There is potential for avoidance of habitat within the vicinity of the turbines; this will be evaluated during post-construction monitoring.
	Mortality	• Lighting will be the minimum allowed by Transport Canada for aeronautical safety, and white or red flashing or continuous lights (CL-865) may be used with the minimum intensity and flashes per minute allowable. The turbines for this Project will be built using tubular steel towers, as some data indicate that lattice towers encourage perching by raptors during hunting and, as a result, may put these birds at risk of collisions.	3	2	5/6	I	2	Given existing information from operating wind energy facilities elsewhere in North America, and the two years of operation of the Dalhousie Mountain Wind Farm, it is anticipated that fatalities due to avian collision with wind turbines will not cause significant bird fatalities, either of sensitive species or large numbers of birds. Post-construction monitoring will be implemented to confirm that the effect of the Project on bird populations is not significant.
Other Wildlife	Sensory disturbance	• In light of the discovery of what appears to be a limited moose presence in the Project Study Region, a moose monitoring program	3	2	5/1	R	2	Studies of game animals in western North America (*e.g.,* Anderson *et al.* 1999) have shown that species are either unaffected by wind energy

Table 6.9 Summary of Potential Effects of Operational Activities

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]: Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	Residual Effect
		(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. This study will help to determine if the turbines and associated infrastructure are an impediment to free movement of mammals.						facilities, given their small footprint and the preservation of existing land use, or that they can readily adapt to the presence of wind turbines. At this site, habitat avoidance will most likely occur during periods of construction, and may be more intermittent during periods of operation, when on-site human activities are less frequent and would occur on a short-term basis.
	Mortality	• Post-construction monitoring (*e.g.,* bat 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.	3	2	5/1	I	2	Based on existing information from monitoring programs elsewhere in North America, as well as the location of the Project relative to the existing facility at Dalhousie and its post construction monitoring results, it is anticipated that the impact of wind farm operations on bat mortality will not be significant. However, post-construction monitoring will be implemented to confirm this expectation. The risk of bat collisions is greater for migrating bats than for resident breeding, commuting or foraging bats. Therefore, post-construction monitoring will be conducted in the fall in order to correspond to migration activities by migratory species and the movement of resident species to hibernacula.

Table 6.9 Summary of Potential Effects of Operational Activities

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]: Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	Residual Effect
Land Use	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.	2	2	5/1	R	2	The effect of wind turbines on undeveloped woodlands is negligible with only a small portion of the available land required for wind turbines, ancillary equipment and access roads.
Local Community	Effect on local economy	• Local residents will be employed to the extent possible during the construction, operation and decommissioning of the Project.	4	1	5/6	R	2	A positive residual effect would be realized by the operation of the Project, through increases in employment opportunities, direct landowner payments, increases in private spending due to an influx of Project personnel, and an increase in the municipal tax base.
	Effect on property values	• None required	4	1	5/6	R	2	Existing information indicates that property values are not adversely affected by the construction and operation of wind farms. At the existing Dalhousie Mountain Wind Farm, property values have not been affected.
Recreation and Tourism	Effect to tourism and recreation	• None required.	4	2	5/6	R	2	The Project is expected to have a minor positive effect on tourism and recreation in the Study Area.
Visual	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.	4	2	5/6	R	2	Given the viewing distances and sparse population, the visual impact will not be significant. Some landowners within the Study Area will have views of the wind turbines from the residences, but many views will be obstructed by terrain, existing vegetation and distance.

Table 6.9 Summary of Potential Effects of Operational Activities

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]					Residual Effect
			Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	
	Lighting	• Lighting will be the minimum allowed by Transport Canada to ensure the appropriate level of aeronautical safety.	4	2	5/6	R	2	Given the viewing distance of approximately greater than 500 m, the presence of these lights will not place excessive nighttime visual pollution within several kilometers of the Study Area.
	Shadow flicker	• For any turbines that contribute to shadow flicker above the 30 hrs/yr , the Proponent has agreed to shutting down these turbines for the times when shadow flicker may peak (e.g., shut down for a few hours to a day per year)	3	2	5/1	R	2	Modeling of shadow flicker indicates there are minimal potential visual impacts at the locations throughout the Project Study Area caused by shadow flicker due to the limited duration and distance of visibility under "ideal" viewing conditions as well as the presence of existing vegetation which would effectively mitigate potential adverse effects. A registry will be created to document complaints of shadow flicker. When a complaint or complaints of shadow flicker are received from a receptor located within 1,000 m of the turbine, shadow flicker will be monitored from that receptor. Information collected from the shadow flicker monitoring will be used will be used to develop further mitigation, if warranted.
Noise	Increases to sound levels	• None required.	3	2	5/6	R	2	Modelling of predicted sound levels caused by the operation wind turbines indicated that all the receptors within the Project Study Area are expected to receive sound exposures from the proposed wind farm within acceptable sound limits.

Table 6.9 Summary of Potential Effects of Operational Activities

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]: Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	Residual Effect
								As a result, any increase in sound levels due to the operation of the Project will be not significant.
Health & Safety	Electromagnetic fields (EMFs)	• None required.	2	2	5/1	R	2	The strength of the EMF from equipment within the substation, such as transformers, decreases rapidly with increasing distance. Beyond the substation, the EMF produced by this equipment is typically indistinguishable from background levels. Similarly, 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. Overall the EMF is not anticipated to have any negative results on human health and safety.
	Infrasound energy	• None required.	2	1	5/1	R	2	There is no evidence that the wind turbine technology proposed for this Project presents any potential problems related to the generation of infrasound energy.
	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	3	1	5/1	R	2	Due to the distance to the nearest residence, a minimum of approximately 600 m, it is extremely unlikely that ice throw would present a risk to landowners. For maintenance personnel, the potential of ice throw presents a greater risk to health and safety. With the implementation of the

Table 6.9 Summary of Potential Effects of Operational Activities

Potential Interaction	Potential Effect	Mitigation	Significance Criteria for Adverse Effect[1]: Geographic Extent	Magnitude	Duration/ Frequency	Reversibility	Ecological Context	Residual Effect
		up-wind of the turbines. • During operation, access to the wind turbine sites will be restricted to authorized personnel only.						mitigation measures proposed herein, the risk of injury and property damage will be reduced.

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

6.2.1 Wind Turbine Operation

The following sections discuss the potential effects of the operation of the Project on the biophysical and socio-economic environment.

6.2.1.1 Effects on Birds

Environment Canada's "Wind Turbines and Birds – A Guidance Document for Environmental Assessment" and "Recommended Protocols for Monitoring Impacts of Wind Turbines on Birds" (Environment Canada 2007a and 2007b) were considered during the pre-construction surveys and EA of Project impacts on birds.

In particular, Tables 1 to 3 of Environment Canada (2007a) were consulted to identify the sensitivity, facility size, and level of concern. According to the criteria identified in the aforementioned tables, the facility would be considered Large due to the combined number of turbines between the existing Dalhousie Mountain Wind Farm and the proposed Clydesdale Ridge Wind Farm Project, but is considered to have an overall low sensitivity due to the general lack of landform structures in the Study Area and the results of previous pre-construction surveys and the recent post-construction monitoring program. As a result, the Project would be considered a Category 2. Table 6.10 identifies the information that Environment Canada would expect to be considered for projects with a Category 2 level of concern. Although a Species at Risk was identified near the Project Study Area (*i.e.*, Olive-sided Flycatcher), it was identified as likely nesting in close proximity of existing disturbances (local quarry), and is located 1.2 km from the nearest proposed turbine location. Therefore the site sensitivity does not warrant elevation to very high.

Table 6.10 Questions for Consideration as per Environment Canada (2007a)

Question	Answer
Identify the species that breed and winter at the site and in the surrounding area, and indicate their relative abundance.	See Section 5.4.1.
Identify any species at risk, including species listed under the *Species at Risk Act (SARA),* provincially or territorially designated species, species designated by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), or species designated as priority species by the ACCDC, Partners in Flight (PIF) or the CWS.	See Section 5.4.1. The *SARA*-listed Olive-sided Flycatcher was observed outside the Project Study Area at one location late in the breeding season, more than 1.2 km from the nearest proposed turbine, and near existing disturbance (a local quarry).
Identify bird colonies (note species, size, location).	No bird colonies have been identified during pre-construction surveys, and none have been identified during other surveys in the region, including the MBBA (2006-2010).
Identify raptors, shorebird concentrations.	See Section 5.4.1.
Identify species that give aerial flight displays.	Few species that typically give aerial flight displays during the breeding season have been identified. See **Appendix H.**
Identify the species that congregate at significant migration staging areas at or near the site.	The Project Study Area does not appear to be a major staging or stopover site for migration (see Section 4.4.1 and **Appendix H**).
Identify the species that frequently migrate through or near the area.	See Section 5.4.1.
Identify the species that commute (*i.e.,* between breeding and foraging habitats) through or near the area, as compared to other locations within the region.	There were no commuting species noted by the surveyor during the pre-construction survey.See Section 5.4.1.
What habitat types occur on the site and in the surrounding area?	See Section 5.4.1 and Figure 5.2.
Do these habitats typically support habitat-sensitive or habitat specialist species, *e.g.,* forest-interior species, grassland species, or shrubland species?	The Project Study Area does not provide valuable habitat for bird species compared to other areas in the region (*e.g.,* Gully Lake Wilderness Area). Due to the fragmentation that has already occurred in the Study Area, much of the forested habitat is considered edge habitat, and very little interior forest will be lost. The use of existing access for the majority of the layout will reduce the fragmentation caused by the Project.
What is the relative density of breeding birds in these habitats?	See Section 5.4.1. Breeding bird data collected to date will be supplemented by additional surveys planned for 2012, to be used to compare to post-construction monitoring results.
What breeding or migrating birds do these habitats typically support?	See Section 5.4.1.

Table 6.10 Questions for Consideration as per Environment Canada (2007a)

Question	Answer
How much of each habitat type or function will be lost or altered as a result of this development?	The Project footprint will be primarily on recently logged lands and only a small proportion of the area within the Study Area will be altered (2%). The area is heavily logged and Project infrastructure locations (including access roads) will maximize use of existing roads and cleared lands. Table 5.7 presents a detailed breakdown of habitat types and areas to be affected. Most affected (according to NSDNR forestry data) include immature softwood, mature hardwood, clear-cut, and other non-forested areas. This generally reflects the relative abundance of these habitats on the local landscape except that other non-forest habitats are represented more frequently due to the fact that turbines and access roads will be preferentially placed along existing roads. In addition, mature forests are less represented in the Project footprint, and immature forests (*e.g.*, softwood plantations) are more prevalent in the footprint.
What topographical features, such as islands, peninsulas, and ridges, are located on or near the site that may influence bird activity and movement?	Project site is situated in hilly terrain common to the Cobequid Hills Ecodistrict, however there are few locations that would be classified as a ridge likely to concentrate migrating birds. The Study Area is at least 15 km from the coast (Tatamagouche Bay to north and Pictou Harbour to east), and 20 km from the Northumberland Strait.
What is the expected amount and type of human presence (vehicles, pedestrians, tourism, etc.) at the site at different times of the year, during and following construction?	See Section 2 for information on Project traffic. The area is already subjected to human disturbance as a result of forestry, agriculture (*e.g.* hayfields and blueberry fields) and quarry operations.
What are the relevant meteorological data, such as wind speed, wind direction and visibility (*e.g.,* number of days during migration period with visibility <200 m or cloud bases <200 m) for the site?	Typical climatological data for the region is provided in Section 5.5.1. Information on the frequency of low visibility conditions is unavailable for this area.
If a bird colony is located within 5 km of the Project area, or if a nationally recognized site occurs within 1 km, do individual birds pass through the proposed turbine locations as part of their daily movements? What proportion of the colony does this represent?	No bird colonies are known to occur within 5 km of the Project Study Area, nor is there a nationally recognized site within 1 km. Given the distance to the coast, there is low risk to seabird colonies. No seabirds have been recorded near the Project Study Area.
Do raptors breed at the site or within 1 km of the site? If so, what species are present and how close do they nest to the proposed facility?	No raptors were confirmed breeding at the site, nor were any raptor nests observed. However, a few species were considered possible breeders based on observations made during breeding bird surveys, including Red-tailed Hawk, and Northern Harrier (refer to Section 5.4.1).
If the site is recognized by local experts as having bird habitat that is locally important, how much of this habitat would be lost or altered by the proposed Project?	The Project Study Area is not considered to have bird habitat that is locally important. The majority of Project lands have already been impacted by forestry, agriculture or quarry operations.
If the site contains land features (islands, ridges, shorelines, peninsulas, areas of open water in winter, etc) that may concentrate birds on migration, while staging, or in winter: Do birds concentrate at this site during any of the seasons mentioned above?	As indicated in Section 5.4.1, the survey data generally shows no evidence of large concentrations of birds in the Project Study Area.

Table 6.10 Questions for Consideration as per Environment Canada (2007a)

Question	Answer
If the site is recognized by CWS or local experts as regionally or locally important to birds, how does the number and diversity of birds that use the site in the season of interest compare to other locations in the region or province? How much habitat would be lost or altered by the proposed Project?	The site is not recognized by CWS or local experts as regionally or locally important to birds. The habitat included in the Project Study Area is not regionally or locally important to birds. The Project Study Area is characterized primarily by fragmented forest habitat of little value compared to other locations in the region or province. Less than 2% of the habitat in the Project Study Area is expected to be directly impacted by Project construction. Of the 36 ha of habitat affected by the Project, 14 ha (39.%) is composed of relatively undisturbed habitat types including mature forest and wetland habitat. The remaining 61% of the project footprint is composed of recently disturbed habitat, mostly immature softwood forest and recent clear-cuts.
If large numbers of birds may commute through or near the area during the day, what is the height and direction of this movement, and how does this relate to the proposed Project design and turbine locations?	Refer to Section 5.4.1. No large numbers of birds were observed commuting through or near the area during the day.

The potential environmental effects resulting from Project-related activities on birds include sensory disturbance and mortality. Section 5.4.1 provides detailed information on the breeding, wintering and migrating birds of the Project Study Area and the broader regional area.

Sensory Disturbance

Sensory disturbance of birds may occur during all phases of the Project as a result of on-site human activities such as surveying, clearing, trenching, turbine assembly, equipment operation, site inspections and site decommissioning. A certain level of sensory disturbance to birds in the area has already resulted from ongoing agricultural, forestry and quarry activities and associated human presence. The operation of the wind turbines may also result in visual and auditory disturbance of wildlife, including birds. Breeding birds may avoid habitat within a zone surrounding the immediate Project footprint, although sensitivity is species-specific (Kingsley and Whittam 2005). Many species will not avoid habitat near rotating wind turbines, as has been noted by James (2003) and James and Coady (2003), but other species show a reduction in breeding densities near turbines (Johnson *et al.* 2000). Habitat avoidance will most likely occur during periods of construction, and may be more intermittent during periods of operation, when human presence on-site is less frequent and typically of short duration. Given the use of existing roads and previously disturbed areas for the majority of the proposed wind farm infrastructure, only a small fraction of the project will add to habitat fragmentation, with even less loss of interior forest habitat.

The flight behaviour of birds may be influenced by Project development. Operation of the turbines may affect bird movements through the partial obstruction of regular flight paths. Certain species (*e.g.,* waterfowl) appear to exhibit avoidance behaviour when flying close to an operating wind farm, while others do not appear to be influenced by the presence of a wind farm (James 2003; Kingsley and Whittam 2005). Breeding birds at Pickering, Ontario, do not appear to be disrupted by the 1.8 MW operating turbine, and birds continue to nest and move within the area as before (James 2003). Most diurnal migrants fly at low altitude, within 40 m of the ground, and are unlikely to be significantly disturbed by the wind turbines or associated facilities. At night, migrants fly well above the height of the wind turbines, typically greater than 150 m above the ground, and are thus also unlikely to be disturbed by the Project. However, visual or auditory features that cause bird avoidance may have a constructive effect in that birds will be less likely to accidentally collide with turbines. Migration surveys conducted for the proposed Project and the associated Dalhousie Mountain Wind Farm would suggest the site is of relatively low risk, given the low numbers of migrating birds and typically small flock sizes. The Project Study Area does not appear to be in a major migration pathway.

Mortality

A possible effect of this Project on birds is mortality due to collisions with the operating wind turbines. There is a perception that wind turbines cause many bird deaths, and it has been highlighted by regulatory agencies and non-governmental agencies as an issue that needs to be addressed. General information about bird-turbine collisions is presented below.

Kingsley and Whittam (2005) provide a detailed review of available information regarding turbine-related bird fatalities in North America and elsewhere. Numerous studies during the last 20+ years have been conducted to estimate bird mortality at wind farms, from a single turbine or small wind farms such as the present proposal, to larger wind farms with thousands of wind turbines (Gill *et al.* 1996; Erickson *et al.* 2001; Percival 2001). This level of study effort is principally due to the circumstances at one large site in California, Altamont Pass, which alerted industry, government and the public to potential bird mortality at wind-farms. Thousands of wind turbines installed in the early 1980s at Altamont Pass were shown to cause high raptor (hawks, eagles and falcons) mortality. Collisions with the turbine structures were the primary cause of death, although electrocution and wire collisions also played a part (Orloff and Flannery 1992). These raptor fatalities triggered an increase in scrutiny of potential wind farm developments, which has led to the development of monitoring protocols and a substantial amount of data on bird use and mortality at proposed and existing wind farms.

Despite these early studies in California, very few raptors have been found killed at other North American wind farms (Erickson and West 2001; Kingsley and Whittam 2005). Songbirds are the most frequent casualties of wind farms in North America, and tend to collide with wind turbines more frequently during migration. Breeding birds appear to adapt to the presence of wind turbines near their nesting and/or foraging areas and avoid collision (Erickson *et al.* 2002; James 2003; James and Coady 2003; Kingsley and Whittam 2005). Songbirds can make up anywhere from 10% to 90% of the overall bird fatalities, depending on the location of the wind turbine site (Erickson *et al.* 2001). Excluding California, 78% of bird casualties at wind farms in the United States tend to be of migratory species (Kingsley and Whittam 2005). Many of these collisions occur at night, when individuals may be attracted to lit structures and collide with transmission wires, turbine towers or other structures in a wind farm. Findings at a West Virginia wind farm, where 27 birds were killed by colliding with a substation and the three wind turbines closest to the substation on a foggy night during May 2003, are probably attributable to the sodium vapour lights of the substation, which, combined with the very low visibility and the presence of the wind farm on a rise in elevation, may have caused this rare mortality event (Kerlinger 2003). No fatalities were found at any of the other 41 wind turbines of the wind farm, located further away from the substation and its sodium vapour lights (Kerlinger 2003). In Spring 2011, a similar event occurred in Nova Scotia during a persistent fog event. Bird mortality was observed at two wind farms (Glen Dhu and Nuttby Mountain) in the region. In both cases, these wind farms have lighted substations located within their wind farm facilities. No such mortalities were observed at Dalhousie Mountain during this fog event, which lies between the Nuttby Mountain and Glen Dhu wind farms, and it has been surmised that this may be due to the separation of the substation from the wind farm facility.

Although fatalities occur at wind energy facilities, the number of fatalities is generally small. This is especially noticeable when compared to bird fatalities caused by other sources, such as communication towers, roads and buildings. Erickson *et al.* (2001) compared estimates of bird mortality caused by different human sources in the United States, and estimated that an average of 2.19 birds per turbine, or between 10,000 and 40,000 birds, are killed each year. Compared to other sources, such as buildings (98-980 million birds killed each year), communication towers (40-50 million birds killed each year) and vehicles (60-80 million birds killed each year), the mortality caused by wind turbines is significantly less (Erickson *et al.* 2001). Each house in North America kills on average between 1 and 10 birds each year, and tall buildings kill many more (Dunn 1993, Kingsley and Whittam 2005). Additionally, Kingsley and Whittam (2005) indicate that the effects are small compared to the millions of birds that travel through existing wind power developments in the U.S. each year. This has been noted for two sites in Washington and one site in Minnesota, where conservative estimates of mortality, using surveillance radar and carcass surveys to determine passage rates and fatality rates, respectively, are less than 0.01% of birds passing through each wind farm (Erickson 2003). In Canada, existing wind farms in Alberta were included in a research study examining the movement of nocturnal migrant birds (and bats) using radar and sound recording technology. This research, conducted during the fall of 2004, compared the behaviour and abundance of birds and bats between operating wind farms and comparable sites without wind turbines. Millikin (2005) estimated that approximately 0.02% of the individuals (birds and bats combined) observed on radar may have resulted in a collision with a turbine. Furthermore, this research identified that these nocturnally migrating birds exhibited avoidance behaviour, with individuals reducing their speed and increasing their flight height to avoid the turbines (Millikin 2005). Nocturnal bird studies were not conducted as a part of the Project.

The National Wind Coordinating Collaborative (Strickland *et al*. 2011) summarized the bird mortality rates from 63 studies of wind power facilities across North America and Canada. The NWCC reports that bird mortality rates range from 0-14.0 birds per MW per year, with two-thirds reporting less than or equal to three fatalities per MW per year. Data collected during the casualty monitoring program at the Dalhousie Mountain Wind Farm in 2010 and 2011 suggest mortality rates are at the low end of the ranges reported by NWCC.

Overall, the findings of the studies discussed above indicate that bird fatalities caused by wind turbines are very low in the majority of cases (Erickson *et al.* 2001; Percival 2001; Erickson and West2002; Kingsley and Whittam 2005). Locally, two years of post-construction monitoring of the Dalhousie Mountain Wind Farm facility, in operation since December 2009, has resulted in very low recorded mortalities (1 bird in 2010 and 2 birds in 2011; no bats in 2010 and 1 bat in 2011) (Desjardins 2012a,b). However, it is important to reduce or eliminate fatalities to the extent possible, and it is important to understand what factors may increase the collision risk of birds at a wind farm. A number of factors may influence the potential for bird-turbine interactions that lead to bird kills, including weather and lighting, landscape features, turbine design, facility design and bird abundance and behaviour. These are described further in the following discussion.

Weather and Lighting

When conditions are clear, there is low likelihood that birds will collide with wind turbines (Crockford 1992; Kingsley and Whittam 2005). However, low visibility (<200 m) may cause nocturnal migrants to fly at lower altitudes, and lights may attract individuals (Jones and Francis 2003; Kingsley and Whittam 2005).

Birds may be attracted to red visibility beacons or other lighting associated with turbine structures. Lighting that attracts birds can increase the probability of bird-turbine collisions and result in kills. CWS recommends that the minimum amount of pilot warning and obstruction avoidance lighting should be used on tall structures. Only strobe lights will be used at night, at the minimum intensity and minimum number of flashes per minute (longest duration between flashes) allowable by Transport Canada. The use of solid-burning or slow pulsing warning lights at night will be avoided. Transport Canada typically specifies red flashing lights for wind farms in Canada (Canadian Aviation Regulations Standard 621.19); CL-864 medium intensity red flashing lights were installed on selected turbines of the Dalhousie Mountain Wind Farm. Spotlights or other exterior or decorative lights will not be used to illuminate turbines. Lighting elsewhere within the Project will be the minimum necessary for safety. Lighting for the safety of the employees will be shielded to shine down and only to where it is needed, without compromising safety, and turned off when not in use. Final lighting selection will be determined in consultation with Transport Canada. A recent study of communications towers found that fewer avian fatalities are recorded at flashing versus steady-burning lights, regardless of the colour (Gehring *et al.* 2009).

Turbine Design

Turbine height is believed to be a strong influence on the likelihood of collision with taller structures having an increased risk of collision, while structures below 150 m cause minimal mortality (Kerlinger 2000; Crawford and Engstrom 2001; Kingsley and Whittam 2005). Migratory birds typically fly at altitudes greater than 150 m such that structures lower than 150 m in height do not usually obstruct migratory bird movements or result in bird mortality (Kingsley and Whittam 2005). The turbines of the Project will be 80 m hub height with a rotor diameter of 82.5 m. As a result, the greatest height of the turbines will be 121.25 m above the foundation, or well below 150 m. At this height, the turbines are not predicted to obstruct the movements of most migratory birds that frequent the region or to increase risk of material collision. Furthermore, results from a research project in Alberta indicate that migrating birds will modify their flight paths to increase in flight height when approaching an operating wind farm (Millikin 2005).

Facility Design

The scale of the wind farm has a direct influence on the potential for bird-turbine collisions. Facilities of 100 turbines or more are thought to more likely have a greater effect in terms of bird mortality due to the increased number of vertical obstacles (potential collision hazards) in the landscape (Environment Canada 2007a). The Project will consist of a maximum of 28 turbines and will would therefore be considered to be a medium-sized facility, although added to the turbines at nearby Dalhousie Mountain Wind Farm, the total number of turbines in the area will be 62, which makes the combined facility "large" (41-100 turbines). Although the site sensitivity is considered low to medium, the large size of the combined facilities makes the facility a Category 2 level of concern (Environment Canada 2007a).

Bird Abundance and Behaviour

When considering the results of the avian pre-construction monitoring program, the vast majority of birds observed during the study were flying less than 40 m of the ground, which roughly corresponds to the air space below the turbine blade sphere (*i.e.,* below where the turbine blades would be turning).

In general, the area does not seem to be a major staging or stopover area for migrating birds or for birds traveling over the Study Area to get to some other location. The spring and fall migration counts generally show no evidence of major peaks of arrival or departure like that observed in other parts of Nova Scotia (*i.e.,* Brier Island).

Although species of conservation concern were recorded in or near the Project Study Area, it is unlikely that any are at risk of collision, due to the very low use of the site by these species, the general absence of habitat suitable within the Project footprint for their breeding or staging, and the expected low number of fatalities overall, based on previous studies undertaken at the Dalhousie Mountain Wind Farm and elsewhere in North America. As a result, no specific mitigation measures or monitoring programs have been identified to address potential effects to species of conservation concern.

Potential Impact and Mitigation

Evidence from wind farms in North America and elsewhere, as noted above, suggests that bird collisions are likely to occur but are in very low numbers, and the potential for significant bird kills is low. The results of the pre-construction bird survey program and collection of existing data indicate that the bird use of the Project Study Area does not cause concern with regards to increasing risk of collision, disturbance or habitat alteration. However, there are further monitoring measures that will help verify these potential effects to bird populations.

Bird surveys will continue in the vicinity of the Study Area in 2012 to further add to the knowledge of bird use in the region, in particular associated with the post-construction monitoring of the neighbouring and overlapping Dalhousie Mountain Wind Farm facility.

Construction on-site will occur outside of the breeding season to the extent possible to avoid contravention of the *Migratory Birds Convention Act*. If clearing activities cannot be scheduled to avoid the breeding season for most birds (May to August), then a birder on-site will use non-intrusive searching methods to identify the potential for nests within or immediately adjacent to work areas, and flag them for avoidance during construction. In cases when nests are known to be easy to locate, active nest searches may be performed.

To determine the accuracy of the predicted environmental effects and ensure all mitigation measures are successful, post-construction monitoring will be conducted as has been conducted for the past two years for the Dalhousie Mountain Wind Farm. This study includes breeding bird, migration, mortality, scavenger efficiency, and searcher efficiency surveys. The length of the post-construction bird monitoring program will be determined in consultation with CWS and NSDNR although it is expected that two years of monitoring may be required (see Section 7.2). The results of the post-construction monitoring will be used to assess the success of the mitigation measures.

Taking into account the mitigation measures, there likely will be residual effects of the Project on local bird populations. In general, sensory disturbance will be infrequent, temporary in nature, reversible, small in magnitude and restricted to the Project Study Area given the mitigation measures proposed. Residual effects of sensory disturbance are not predicted to be significant. Fatalities as a result of colliding with structures within the Project will be irreversible, but they are expected to be infrequent and minor in magnitude and in geographic extent, as has been demonstrated by low mortalities at the Dalhousie Mountain Wind Farm. It is unlikely that mortality will affect birds at a population level. As a result, the residual effect of this mortality is considered to be **low** and **not significant.**

6.2.1.2 Other Wildlife

Other wildlife species of the Project Study Area include mammals, reptiles and amphibians. Most species are year-round residents of the Project Study Area and adjacent lands, although certain local or long-distance migrations of some species occur. Potential environmental effects of the Project on wildlife include habitat alteration, mortality and sensory disturbance.

Sensory Disturbance

Wildlife sensory disturbance may occur as a result of on-going human activity on-site as well as visual and auditory disturbance related to the operation of the turbines. Sensitivity of wildlife to disturbance varies by species and life-stage.

Human presence (noise, sight and smell) and vehicles may disturb wildlife. During operation of the wind-farm, Project-related vehicles and personnel will be in the vicinity of wind turbines on a regular basis for ongoing maintenance. It is likely that some disturbance of diurnal wildlife will occur during operation and maintenance of the Project. Bats are unlikely to be affected by human presence as they are nocturnal and the majority of human presence will occur in the Project Study Area during the day. Although there is the potential for limited human presence induced disturbance to wildlife, significant adverse effects are not predicted for several reasons. First, the Project Study Area has a high degree of existing human disturbance (*i.e.,* forestry activities) and thus wildlife species have either become acclimatized to some degree of human disturbance or have already left the area. Second, disturbance will be intermittent and generated noise will be of low levels (*i.e.,* human speech and vehicle noise). Third, no rare or at-risk wildlife species were reported as breeding in the Project Study Area. In order to further reduce the severity of the effects of human disturbance on wildlife, worker presence on-site should be minimized and limited to designated work areas. In addition, all Project-related vehicles will be maintained to minimize noise and no idling will be permitted. In consideration of existing conditions and suggested mitigation, no significant adverse effects are predicted on wildlife due to human presence during operation and maintenance.

The operation of the wind turbines may also result in visual and auditory disturbance of wildlife. However, studies in the western United States have shown that there has been no significant effect of the construction and operation of wind farms on big game (Strickland and Erickson 2003), indicating that species are either unaffected by these developments, given their small footprint and the preservation of existing land use, or that they can readily adapt to the presence of wind turbines. At this site, habitat avoidance will most likely occur during periods of construction, and may be more intermittent during periods of operation, when human presence on-site is less frequent and would occur on a short-term basis.

The Project Study Area is identified as having potential habitat for mainland moose population. The degree to which the proposed Project will adversely affect the mainland moose populations is related to the degree to which moose use the Project Study Area. A moose pellet group study conducted in 2007 as well as interviews with local residents did not reveal the presence of moose in the vicinity of the Project Study Area although this species had been present in the area until the 1980s. Recent investigations and observations indicated that moose do occasionally pass through the Project Study Area, although there is no evidence that they spend much time there. These observations may represent random incursions of moose into the Project Study Area but could also represent the initial stages of reoccupation of the area by moose. If moose presence in the Project Study Area is increasing, the potential for adverse interactions between the Project and moose will increase. A moose pellet group inventory was conducted in the Spring of 2010, 2011, and 2012 by the same surveyor as in 2007. The results of these surveys revealed no sign of moose again in 2010. In the 2011 and 2012 surveys, signs of browse on striped maple were noted, but no pellets were observed. In order to determine if moose presence in the Study Area is increasing, the pellet group survey transects that were conducted for the Dalhousie Mountain Wind Farm will continue to be repeated. The results of these surveys are submitted directly to NSDNR. These surveys are discussed further in Section 7.1.

One potential concern regarding the layout of the wind turbines is that a long linear array may act as a barrier to wildlife movement. In order to address this concern, a monitoring program will be initiated to determine whether the presence of the turbines discourages wildlife from using habitat adjacent to the turbine. This monitoring program is discussed further in Section 7.1.

Mortality

Mortality of wildlife has the potential to occur during all phases of Project development. During construction and decommissioning, there is a small chance that small mammals may be harmed as a result of limited site clearing and through the use of heavy equipment for moving materials on and off the Project site. However, additional potential for mortality relates to interactions between operating wind turbines and bats. Bats have been identified as animals with the potential to be affected by wind energy facilities, as measured by numbers of carcasses found during surveys at wind farms in the United States and Canada. The remainder of this section describes the issue of bat mortality at wind farms in more detail, places the issue in the Nova Scotia context and provides background to the assessment.

Bat Turbine Collisions

Despite having the ability to navigate cluttered environments in the darkness, bats are known to collide with large man-made structures, occasionally with fatal consequences. Bat collision mortality has been identified to occur with various kinds of tall structures including lighthouses, buildings, power lines, communication towers and wind turbines. Bat collision with human structures appears to be an infrequent occurrence, but it has the potential to be of concern. A recent study by Long *et al*. (2010) found that echoes returned from moving turbine blades that could render them attractive or difficult for approaching bats to detect and locate in time for avoidance, which might explain the sometimes inordinant rates of mortality at some wind farms.

The first report of bat fatalities at a wind farm was by Hall and Richards (1972). Over four years, 22 White-striped Mastiff-Bats (*Tadarida australis*) were found at the base of turbines at an Australian wind farm. Since then, bat fatalities have been reported at several wind farms in North America (Arnett *et al*. 2006). A report by Arnett *et al*. (2006) synthesized available information from 21 post-construction fatality studies across the United States and Alberta . This summary shows a consistent trend in fatalities occurring in late summer and fall among primarily lasiurine migratory species. Hoary bats, red bats, and silver-haired bats had the constituted most of the mortality at wind farms. At one wind development where the tri-colored bat is the most common resident bat, tri-colored bat mortaility approached 25%. However, fatalities among resident bat species such as *Myotis* spp. and big brown bats were low with the exception of two sites located in Alberta and Iowa where little brown myotis comprised 25% of mortality. There were no reports of fatalities of threatened or endangered species. Overall estimated mean fatality rates per MW varied between 0.2 and 53.3 (0.1 and 69.6 deaths/turbine/year) with the highest rates occurring in the eastern US. The average rate across all sites was 11.6 fatalities/MW/year. The study also found that fatalities were not generally concentrated around particular turbines and strobe lights recommended by the FAA did not influence rates of fatality.

Based on the timing of spring migration (Koehler and Barclay 2000), spring migrations of Hoary, Eastern Red and Silver-haired bats are most likely to occur in May. Despite these movements, Arnett *et al*. (2008) found that far fewer collision fatalities occurred in the spring at wind farms in the United States and Alberta. Erickson *et al.* (2002) found that of 536 recorded bat collision fatalities at wind farms across the United States, only two were killed in May (Erickson *et al.* 2002). Collision data collected from other types of structures also support these findings. For example, of 50 dead Eastern Red Bats collected at a building in Chicago, 48 were found in the fall and two in the spring (Timm 1989). It is not clear why spring migrants collide with wind turbines far less frequently than fall migrants. Behavioral differences between migrating hoary bats in the spring and fall may influence collision risk, as suggested by Johnson *et al.* (2002). These differences have been reported in Florida, where autumn migration occurred in waves, whereas the spatial distribution of bats during spring migration appears to be far more scattered (Zinn and Baker 1979).

The principal factors adversely affecting bat populations are predation, white-nose syndrome and habitat alteration/destruction, not collision with wind turbines or any other human structure (Bat Conservation International 2001). Despite this, bats are being killed at wind farms, or at least some wind farms, though the factors putting them at risk of colliding with wind turbines are still poorly understood. Without a clear understanding of what would place bats at risk of collision, it is difficult to predict the frequency of bat-turbine collisions. For example, Erickson *et al.* (2002) report on several instances where bats were observed foraging very close to turbines without being struck by the turbine blades. This is further complicated by a lack of understanding of bat ecology, especially on migration, and the paucity of data on abundance and movement of bats at multiple spatial scales (continent-wide, provincial, regional) that could provide context for pre-construction surveys.

Barotrauma

It is understood that barotrauma could be the cause of death of some bats found at wind energy facilities (Baerwald *et al.* 2008). Barotrauma involves tissue damage to air containing structures (*i.e.,* lungs) caused by rapid or excessive air pressure change. In this case, it is believed that air pressure change at turbine blades (in movement) causes expansion of air in the lungs not accommodated by exhalation, therefore resulting in lung damage and internal hemorrhaging. However, a more recent study by Grodsky *et al.* (2011) used radiology to investigate causes of mortality and found that a majority of the bats (74%; 29 of 39) examined had bone fractures that are likely to have occurred during direct collision with turbines. Approximately one-half (52%; 12 of 23) of bats whose ears were examined had mild to severe hemorrhaging in the middle or inner ears (or both). The true nature of mortality resulting from turbine collision remains poorly understood.

Fatalities in the Northeast

While pre-construction bat surveys have demonstrated little correlation with actual fatalities post-construction, competed wind farms in the area have demonstrated that bat fatalities are low. The operational Kent Hills Wind Farm located near Prosser Brook along the Bay of Fundy could be considered a high potential site for bat interaction based on its location near a known hibernaculum, and proximity to the Bay of Fundy Coast. Despite these factors, mortality at this site has been low over the last two years of carcass monitoring (32 turbines) with only one bat carcass found in 2009 and four in 2010. The estimated casualties corrected for searcher efficiency over the entire period is 0.10 casualties per turbine (Stantec 2010, 2011a).

Likewise, a post construction monitoring study at the Mars Hill Wind Development along the New Brunswick/Maine border found no unreasonable adverse impact to these species, recording only 0.17 fatalities per turbine per year in 2008, and 0.43 in 2007 (Stantec 2009). These numbers represent only a fraction of the mortality experienced at many other wind developments in the eastern US. These low numbers could be considered noteworthy given that the Mars Hill wind development follows a highly pronounced north-south running ridge, surrounded by agricultural plateau that could present an obvious migratory marker for any bats that might be moving through the area.

While nearby wind developments have demonstrated low rates of mortality, migration pathways can be localized and our ability to predict the locations of migration corridors is limited. There are also other post construction monitoring programs underway in the Maritimes that may help to shed additional light on the general hazard of fatalities to bats in the region.

Pre-construction bat surveys at the proposed Clydesdale Wind Farm Project were not undertaken due to the inability to be able to evaluate the significance of the site for bat migration, due to a lack of knowledge of what numbers of bats exist in and migrate through or within Nova Scotia, and the inability to be able to predict impact if site-specific data existed. However the Broders (2007) study completed for the Dalhousie Mountain Wind Farm (**Appendix I**) is also applicable for the Clydesdale Wind Farm Project Study Area. For the Broders (2007) study, acoustic bat monitoring was performed for one month during core migration at two turbine locations which reflect the most likely corridor of flight. There were no unexpected species recorded, nor was there an indication that the Dalhousie Mountain Wind Farm lies along a migration route (see **Appendix I**). As indicated in Section 5.4.2.2.1, there is only one possible bat hibernaculum located within 5 km of the Study Area. This mine, located along Route 104, is listed as uninspected by NSDNR staff and little information is recorded for it. While this possible hibernaculum site (abandoned mine shaft) may have some minor potential to accommodate hibernating bats, it is nearly 5 km away from the southeastern corner of the Project Study Area, and is of low concern.

This assessment of risk based on landscape level and site specific features attributed to elevated risk levels for bat mortality found that there are no important risk factors evident within or around the proposed Project Study Area. Features considered to have potential for elevated risk to bats such as known hibernacula or potential caves or mines; coastline, major water bodies, and wetlands; or forested ridge habitat are either absent, or do not likely pose an important risk to bats. The Project Study Area is at, or beyond the northern range limits for migratory species and while it cannot be ruled out, high rates of mortality of the locally common *Myotis* species is not anticipated.

Post-construction fatality monitoring will be conducted at the site for at least one season, including the fall migration period from mid-August to late September. The duration of the monitoring could depend on levels of mortality found in the first season. In the event that mortality is high at the site, operational mitigation can be employed to reduce mortality which may include changes to cut-in wind speeds, feathering of blade under certain wind speeds, or shut-downs during high activity periods. The Ontario Ministry of Natural Resources (OMNR) (2010) recommends a threshold of 10 bat deaths/turbine/year after-which mitigation should be implemented to reduce mortality through operational mitigation. There are currently no guidelines in Nova Scotia for monitoring bat populations, in part due to the lack of good baseline data. In the absence of these guidelines, post-construction monitoring protocols and mitigation measures, should monitoring in the first year of operations deem them necessary, will be developed in consultation with NSDNR. Monitoring will include fall bat mortality surveys to be conducted at a frequency to be determined though consultation with regulators.

As discussed above, Clydesdale Ridge Wind LP is committed to monitoring the Project during its first year of operation to identify if bats are being killed, and will be prepared to adopt post-construction mitigation measures should there be a need. The Proponent is also committed to taking part in the Broders study, upon receiving a PPA. At this stage, the level of impact is considered **low** and **not significant**. These surveys are discussed further in Section 7.0.

6.2.1.3 Land Use

As indicated in Section 5.3 of this report, the majority of the land required for Project development is forested land which has historically been subjected to forestry activities. The Project Study Area does support other vegetation types including wetlands, blueberry fields and disturbed areas such as roads and quarries. The effect of wind turbines on undeveloped lands within the Project Study Area is negligible with only a minor portion of land use required to house turbines and their ancillary equipment. There is also agricultural land within the Study Area, although Project infrastructure is not proposed to be sited on these lands. Experience has shown wind farms to be a compatible land use with agriculture (CanWEA 2001). The U.S. Department of Energy has indicated that wind turbines have minimal effects on farming and ranching operations. They indicate that turbines have a small footprint so crops can grow and livestock can graze right up to the base of the turbine (U.S. Department of Energy 2004). Land use impacts associated with construction and operation of the Project will be negligible since it will not impair or impact current land uses, change land use patterns, or be incompatible with existing uses. The residual impact to existing land use is considered to be **minimal** and **not significant**.

6.2.1.4 Property Values

Prior to 2003, there was a general lack of empirical data assessing the impact of wind energy facilities on the economic value of properties whether within a wind farm or within site of a wind farm. However, Sterzinger *et al.* (2003) undertook such a study, statistically testing whether the perception that property values are negatively affected by wind farms is true or false. For their study, Sterzinger *et al.* (2003) compiled data on every U.S. wind energy development commissioned between 1998 and 2001 that was of a capacity of 10 MW or greater. Property sales records for the area within 5 miles (8 km) of the wind farm were collected for the three years prior to commissioning and the three years following commissioning, to determine if there was a difference between pre-construction and post-construction property sales. For comparison, sales records were also collected for the same time period from communities comparable to that included for each wind farm. A total of 10 wind power projects were analysed, including two projects from New York, two projects in Pennsylvania and one project in Vermont (Sterzinger *et al.* 2003).

Overall, property values increased with the same rate in wind farm communities within 8 km of a wind farm compared to similar communities without wind farms (Sterzinger *et al.* 2003). Nine of the ten projects showed a greater increase in property values after commissioning compared to the period prior to commissioning, and when looking at the rate of increase in property values after commissioning of the wind farm, communities near a wind farm actually had greater increases to property values than those without a nearby wind farm (Sterzinger *et al.* 2003). These findings indicate that there is no support for the notion that the development of wind farms decreases property values.

Further assessment of the potential impact of wind farms on property values was conducted by ECONorthwest (2002). For this assessment, interviews were conducted with tax assessors from 13 counties in the United States for which wind farms had been developed during the previous 10 years. Based on these interviews with unbiased and trained assessors of property values, ECONorthwest (2002) concluded that there is no loss of value for those residential properties with views of wind turbines (*i.e.,* views of wind turbines do not negatively impact property values).

A report conducted by the Renewable Energy Policy Project (REPP 2003) concluded that, based on a study of nine different communities from across the United States, property values of homes within a wind farm's viewshed were not harmed by the construction and operation of the wind energy facility. To the contrary, for the majority of the projects analyzed, property values actually rose more quickly in the viewsheds than in comparable communities outside of the viewsheds (REPP 2003). Furthermore, statistical evidence does not support the idea that property values within the viewshed of wind farms suffer or perform poorer than in comparable regions (REPP 2003). This statistical analysis is supported by a literature review conducted as part of the REPP (2003) study.

The Environmental Review Report for the Wolfe Island Wind Project near Kingston, Ontario (CREC 2007) also includes a comprehensive review of literature on property value studies conducted in Australia, Denmark, United Kingdom, the United States, and Canada. These studies consistently reported a neutral or positive effect on property values (CREC 2007).

As discussed in Section 5.6.5, at the existing Dalhousie Mountain Wind Farm, property values have not been affected. If property has turbine on it, the value is greatly increased as there is an added guaranteed income associated with the property. Since the Dalhousie project is over 1,500 m from the nearest house, and all of the local homeowners are happy with the project, there has been no negative effect on the property values. In addition, the increased exposure of the Dalhousie Mountain area through media and wind farm events have made this beautiful, quiet area of Nova Scotia more widely known and therefore, potentially increased the value of the properties.

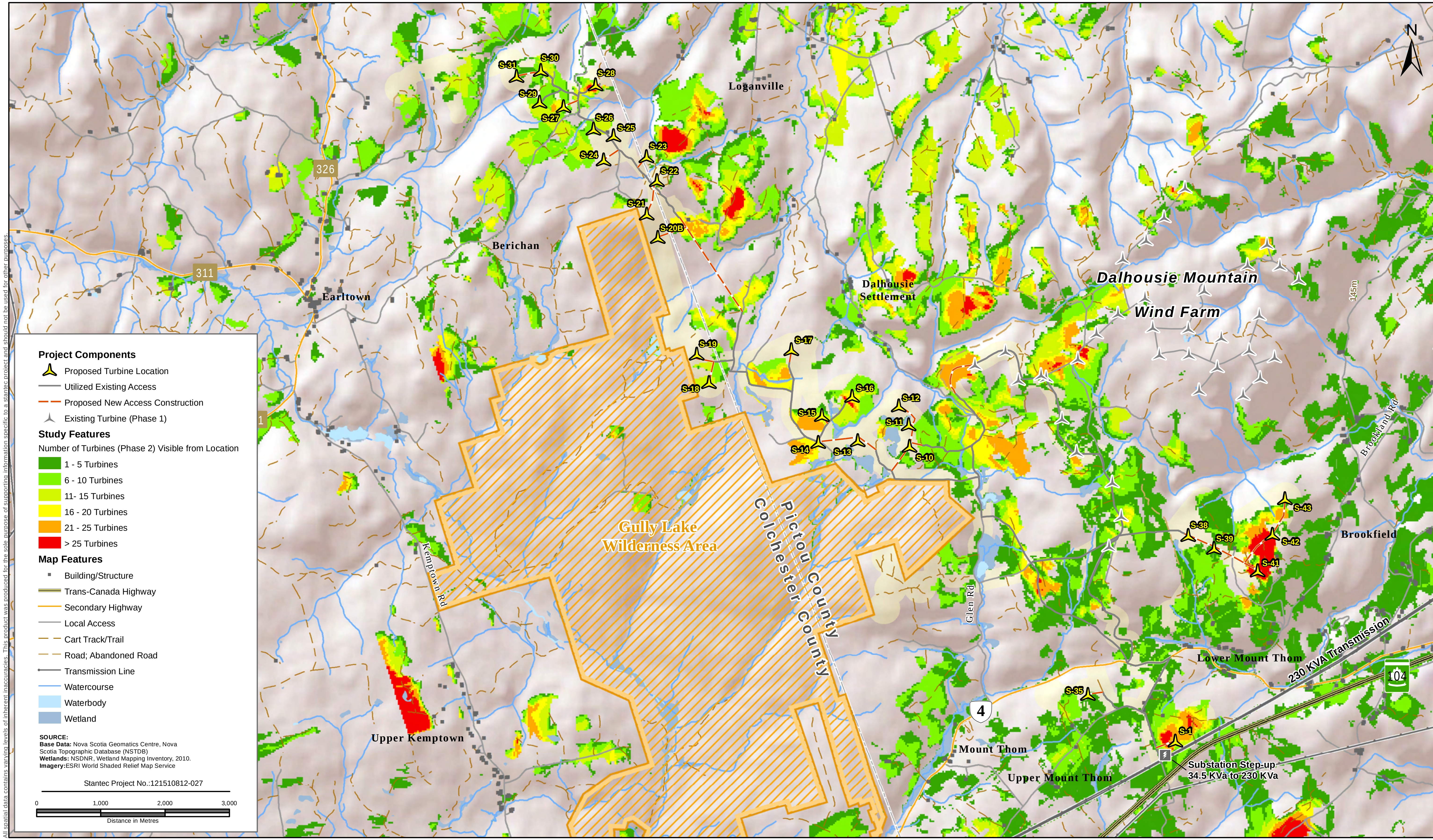
Located next to the Dalhousie Mountain Wind Farm, the proposed Clydesdale Ridge Wind Farm Project is also in a rural setting, and is surrounded by a mix of forested and agricultural lands and residential properties. The Project has the potential to represent a long-term land use, which may have the effect of promoting some stability in land values. It is conceivable that the value of specific properties could even rise as a result of an increase in the potential for tourist related commercial activities in this area. It is predicted that residual impacts on property values as a result of the wind farm are likely to be **minimal** and **not significant**.

6.2.1.5 Visual Impacts

Due to the importance of assessing the potential impact to the area's visual aesthetics, a visual impact assessment was completed. The following section summarizes the visual assessment with respect to the photo montage analysis and shadow flicker analysis that were conducted.

Viewsheds

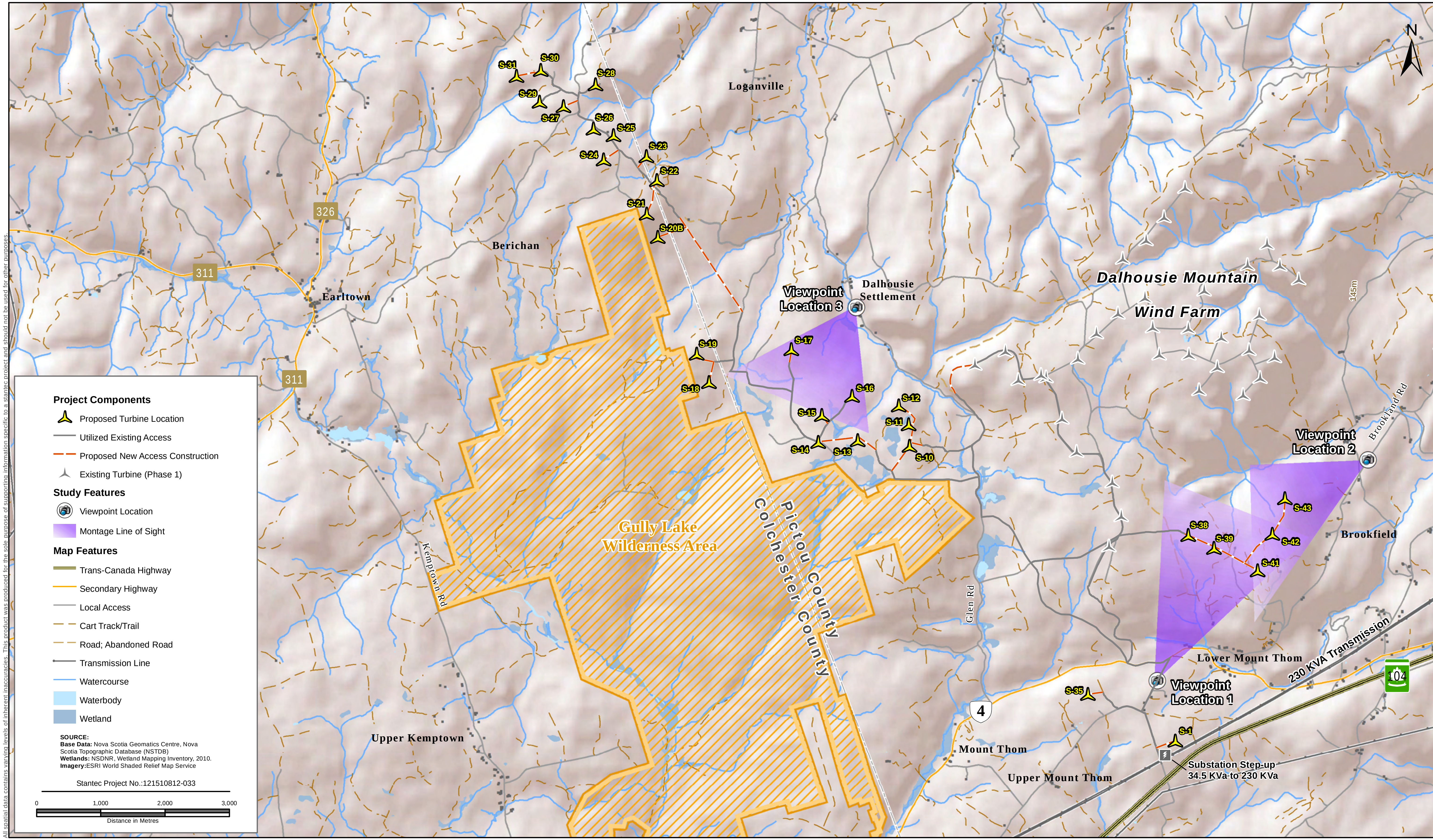
The modeling software used by Stantec to render photo montages for the assessment is produced by EMD, Denmark and is part of the WindPro 2.4 suite of modeling software. A photo montage is a photograph taken in the field from a specific location with the proposed wind farm turbines superimposed to scale. It is a graphical representation of what the constructed wind farm could potentially look like upon completion from a particular vantage point. Figure 6.1 provides a viewshed overview and Figure 6.2 shows the viewing locations selected for the assessment (*i.e.,* location from which photographs were taken). Changes to the layout since the original viewshed analysis was conducted and has resulted in a reduction of relevant photo montages. Figures 6.3-6.5 show the simulated results that remain relevant with the modified layout.



PREPARED BY: J. Petho	Clydesdale Ridge Wind Farm Project	FIGURE NO.: 6.1
REVIEWED BY: C. Shupe		DATE: May 15, 2012
CLIENT: Dalhousie Mountain Wind Farm	**Viewshed Overview - Zones of Visual Influence**	Stantec

Path: V:\1215\active\121510xxx\121510812_clydesdale_ ridge\geomatics\mapping\mxd\Report Figures\ST_NS_121510812-027_Viewshed_Overview.mxd

Coordinate System: NAD 1983 UTM Zone 20N



PREPARED BY: J. Petho	Clydesdale Ridge Wind Farm Project	FIGURE NO.: 6.2
REVIEWED BY: C. Shupe		DATE: May 15, 2012
CLIENT: Dalhousie Mountain Wind Farm	**Viewpoint Locations for Montage Simulations**	Stantec

Path: V:\1215\active\121510xxx\121510812_clydesdale_ ridge\geomatics\mapping\mxd\Report Figures\ST_NS_121510812-033_Viewshed_Locations.mxd

Coordinate System: NAD 1983 UTM Zone 20N

Technical Data:

Photograph View Point:

Photograph Number:	2
Date of Photograph:	November 29, 2011
Coordinate System:	UTM Zone 20N (NAD 1983)
Easting:	502476
Northing:	5041184
Elevation:	226m
View Direction:	NE

Wind Turbines Used:

Model:	GE - 1.6sle
Hub Height:	80m
Rotor Diameter:	82.5m

Simulation:

Total Number of Wind Turbines:	39
Total Number of Visible Turbines:	5
Closest Visible Turbine:	~ 1.1km
Furthest Visible Turbine:	~ 2.9km

Study Features

- Proposed Turbine Location
- Photo Capture Location
- View Plane of Montage One

Map Features

- Existing Turbine (Phase 1)
- Building/Structure
- Trans-Canada Highway
- Secondary Highway
- Local Access
- Cart Track/Trail
- Road; Abandoned Road
- Transmission Line
- Watercourse
- Waterbody

Stantec Project No.:121510812-029

0 1,000 2,000 3,000
Distance in Metres

PREPARED BY: J. Petho	Clydesdale Ridge Wind Farm Project	FIGURE NO.: 6.3
REVIEWED BY: C. Shupe		DATE: May 16, 2012
CLIENT: Dalhousie Mountain Wind Farm	**Photo Montage One - Simulated View of Project from Mount Thom Road - Descent to Highway 4**	Stantec

Path: V:\1215\active\121510xxx\121510812_clydesdale_ ridge\geomatics\mapping\mxd\Report Figures\ST_NS_121510812-029_Viewshed_One.mxd

Coordinate System: NAD 1983 UTM Zone 20N