NextEra Energy Canada, ULC

Final Construction Plan Report – Bluewater Wind Energy Centre

Prepared by:

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60155032

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Glossary of Terms

ABCA .....Ausable Bayfield Conservation Authority
ANSI.....Area of Natural and Scientific Interest
DFO .....Department of Fisheries and Oceans Canada
EIS .....Environmental Impact Study
GE.....General Electric
GIS.....Geographic Information System
kV.....Kilovolt
LLC .....Limited Liability Company
m .....Metre
MNR.....Ontario Ministry of Natural Resources
MOE.....Ontario Ministry of the Environment
MTCS.....Ontario Ministry of Tourism, Culture and Sport
MTO .....Ontario Ministry of Transportation
MW.....Megawatt
NextEra .....NextEra Energy Canada
O.Reg. 359/09.....Ontario Regulation 359/09
PDR .....Project Description Report
PSW.....Provincially Significant Wetland
REA.....Renewable Energy Approval
SGRA.....Significant Groundwater Recharge Area
The Project.....Bluewater Wind Energy Centre
ULC.....Unlimited Liability Corporation

1. Introduction

Varna Wind, Inc., a wholly owned subsidiary of NextEra Energy Canada, ULC (NextEra) is proposing to construct a wind energy Project in the Municipalities of Bluewater and Huron East in Huron County, Ontario (Figure 1-1). The project will be referred to as the Bluewater Wind Energy Centre (the "Project") and will be located on private lands east of Highway 21 in the vicinity of the shoreline of Lake Huron. The wind turbine technology proposed for the Project is the 1.6 MW GE model wind turbine. With a total nameplate capacity of 60 MW, the Project is categorized as a Class 4 facility. Although NextEra is seeking a Renewable Energy Approval (REA) for 41 wind turbines, up to a total of 37 are proposed to be constructed for the Project.

This *Construction Plan Report* was prepared in accordance with the requirements of the REA process outlined in Ontario Regulation 359/09 (O. Reg. 359/09) and the Technical Guide to Renewable Energy Approvals (Ontario Ministry of the Environment (MOE), 2011).

The following sections provide information on the construction and installation activities, potential negative environmental effects of construction and installation activities and mitigation measures for the identified negative effects.

1.1 Summary of Construction Plan Report Requirements

The requirements for the *Construction Plan Report* defined under *O.Reg. 359/09* are provided in the following table (**Table 1-1**) in addition to the corresponding report section.

Table 1-1 Adherence to Construction Plan Report Requirements

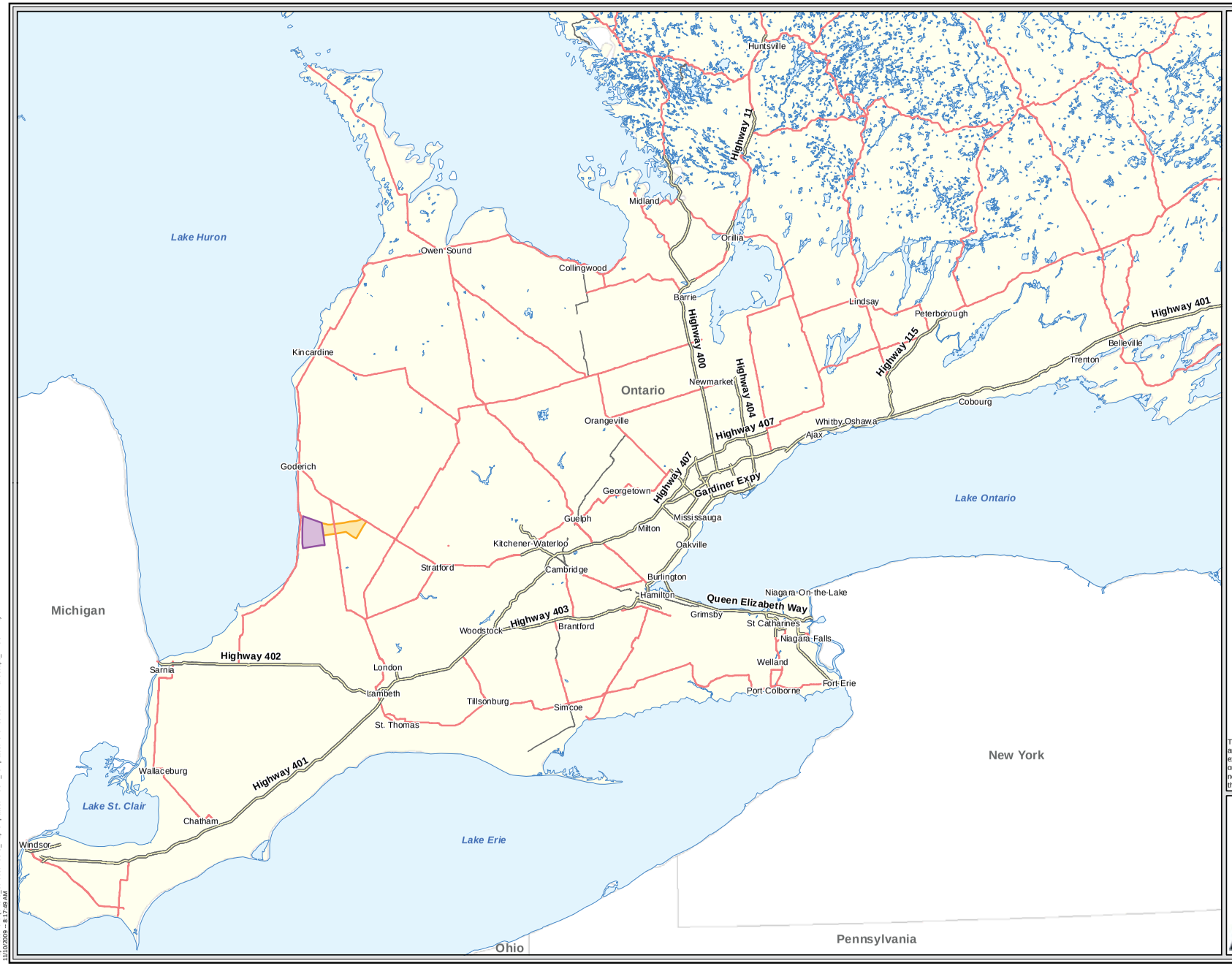
Requirement	Completed	Corresponding Section
Details of construction or installation activities	Yes	Section 2
The location and timing of any construction or installation activities for the duration of the construction or installation	Yes	Section 1.3 and Figure 2-1 Section 2.1
Any negative environmental effects that may result from construction or installation activities	Yes	Section 3
Mitigation measures in respect of any negative environmental effects	Yes	Section 3 and the Environmental Effects Monitoring Plan in the Design and Operation Report

1.2 The Proponent

The Project will be owned and operated by Varna Wind, Inc., a subsidiary of NextEra. NextEra's parent company is NextEra Energy Resources, LLC, a global leader in wind energy generation with a current operating portfolio of over 85 wind energy projects is North America. In Canada, wind energy centres currently owned and operated by NextEra Energy Canada include: Mount Copper and Mount Miller, (both 54 megawatts (MW)) located in Murdochville, Quebec; Pubnico Point, (31 MW) located near Yarmouth, Nova Scotia; and Ghost Pine (82 MW), located in Kneehill County, Alberta.

The primary contacts for the Project are as follows:

Project Proponent	Project Consultant
Nicole Geneau Project Director NextEra Energy Canada, ULC 5500 North Service Road, Suite 205 Burlington, Ontario, L7L 6W6 Phone: 1-877-257-7330 Email: Bluewater.Wind@NextEraEnergy.com Website: www.NextEraEnergyCanada.com	Marc Rose Senior Environmental Planner AECOM 300-300 Town Centre Blvd. Markham, Ontario, L3R 5Z6 Phone: 905-477-8400 x388 Email: marc.rose@aecom.com



Legend

- Wind Energy Centre Study Area
- Transmission Line Study Area
- Expressway
- Highway
- Secondary Highway

Basemapping from Ontario Ministry of Natural Resources

N
W E
S

Kilometers

0 10 20 40 60 80

1:1,500,000

UTM Zone 17N, NAD 83

Bluewater Wind Energy Centre

Study Area in Ontario

February 2012
Project 60155032

AECOM

Map Document: (O:\GIS_Utilities\ArcGIS_Map Templates\AECOM_Templates\November09\11x17-Landscape_AECOM.mxd)
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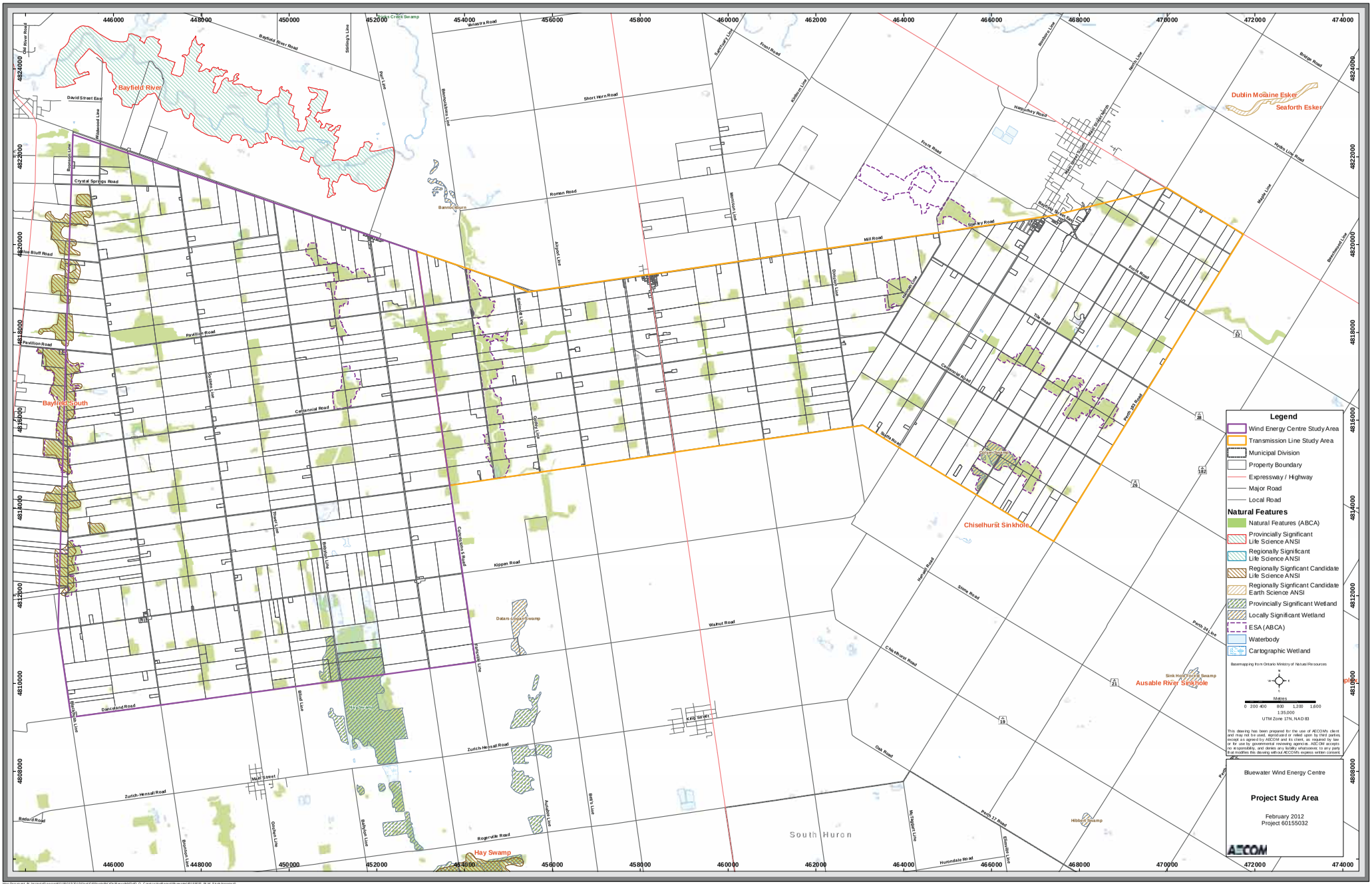
1.3 Project Study Area

The proposed Project is located in Huron County, within the Municipalities of Bluewater and Huron East. The Project Study Area consists of the areas being studied for the wind farm components (Wind Energy Centre Study Area), as well as for the interconnection route (i.e., the area being studied for transmission lines to connect the Project to the electrical grid) (Transmission Line Study Area) (Figure 1-2). The Wind Energy Centre Study Area is generally bounded by Blackbush Line/Bronson Line to the west, Mill Road to the north, Concession 5 Road to the east, and Danceland Road/Staffa Road to the south, in the Municipality of Bluewater. The Transmission Line Study Area is located to the east of the Wind Energy Centre Study Area, and is generally bounded by Concession 5 Road to the west, Mill Road to the north, Huron Road and Perth 183 Road to the east, and Staffa Road to the south, extending into the Municipality of Huron East.

The location of the Project Study Area was defined early in the planning process for the proposed wind energy facility, based on the availability of wind resources, approximate area required for the proposed project, and availability of existing infrastructure for connection to the electrical grid. The Project Study Area was used to facilitate information collection.

The following co-ordinates define the external boundaries of the Project Study Area:

Longitude	Latitude
-81.680043	43.553413
-81.350138	43.534437
-81.402727	43.471275
-81.679229	43.433866


Bayfield River
Dublin Moraine Esker
Seaforth Esker
Bayfield South
Chiselhurst Sinkhole
Ausable River Sinkhole
Hay Swamp
South Huron
Legend
Wind Energy Centre Study Area
Transmission Line Study Area
Municipal Division
Property Boundary
Expressway / Highway
Major Road
Local Road
Natural Features
Natural Features (ABCA)
Provincially Significant Life Science ANSI
Regionally Significant Life Science ANSI
Regionally Signficant Candidate Life Science ANSI
Regionally Signficant Candidate Earth Science ANSI
Provincially Significant Wetland
Locally Significant Wetland
ESA (ABCA)
Waterbody
Cartographic Wetland
Basemapping from Ontario Ministry of Natural Resources
Metres
0 200 400 800 1,200 1,600
1:35,000
UTM Zone 17N, NAD 83
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Bluewater Wind Energy Centre
Project Study Area
February 2012
Project 60155032
AECOM

2. Description of Construction and Installation Activities

The Project Location is defined as per O. Reg. 359/09 as "*..a part of land and all or part of any building or structure in, on or over which a person is engaging in or proposes to engage in the project and any air space in which a person is engaging in or proposes to engage in the project*". As described therein, the Project Location boundary is the outer limit of where site preparation and construction activities will occur (i.e., Disturbance Areas described below) and where permanent infrastructure will be located, including the air space occupied by turbine blades.

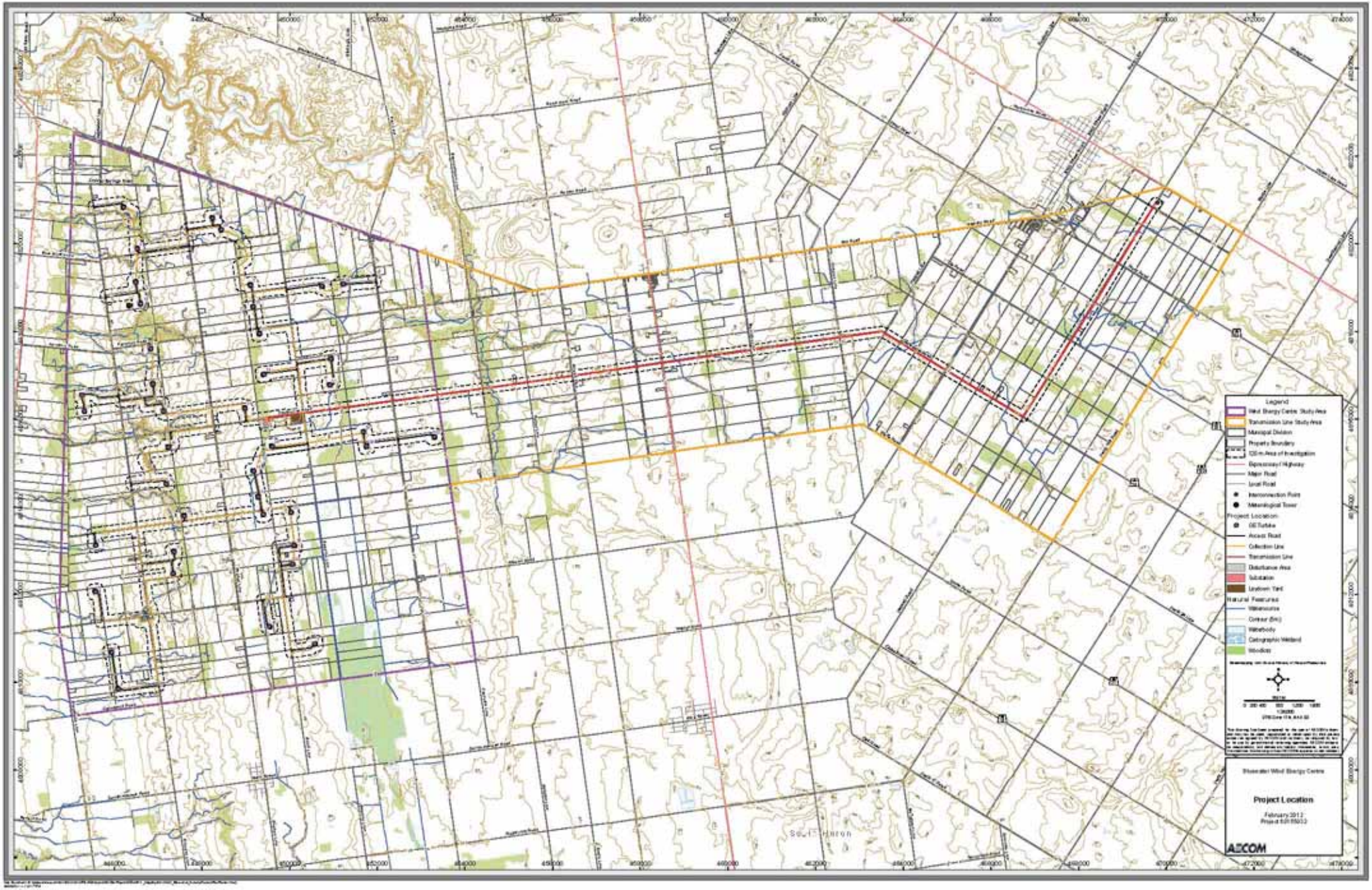
The proposed Project Location is shown on **Figure 2-1, 2-2** and **2-3**, and includes the components of the Project listed below:

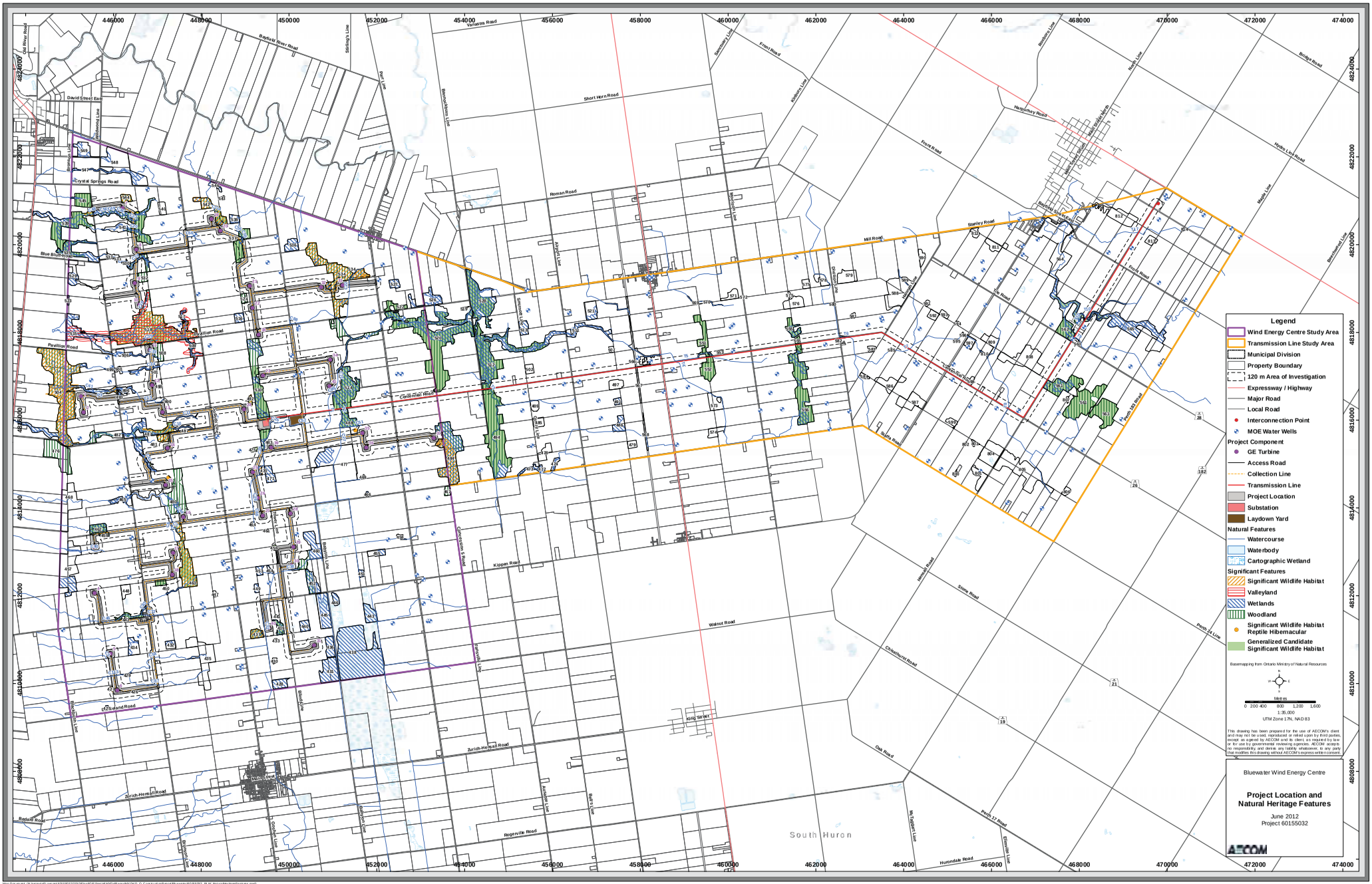
- Up to 41 1.6 MW GE model wind turbine generator locations and pad mounted step-up transformers are proposed for permitting (a maximum of 37 turbines will ultimately be constructed);
- Laydown and storage areas (including temporary staging areas, crane pads and turnaround areas surrounding each wind turbine);
- Approximately 52 km of 34.5 kV underground electrical collection lines to connect the turbines to the proposed transformer substation;
- Approximately 24 km of 115 kV transmission line proposed along Centennial Road and Hensall Road from the proposed transformer substation to the existing Hydro One Seaforth Transformer Station;
- Approximately 40 km of turbine access roads; and
- An operations and maintenance building.

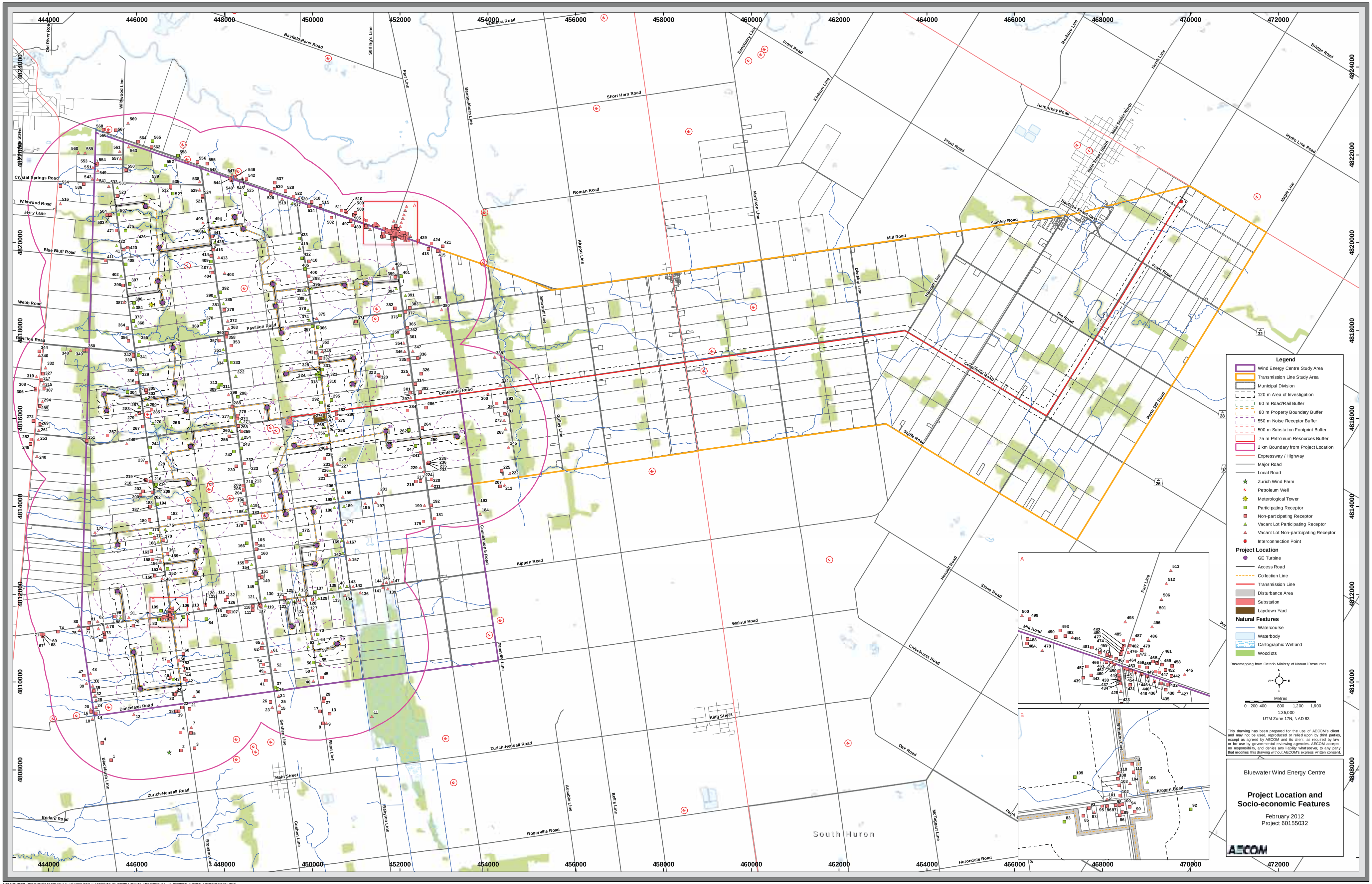
Disturbance Areas have been identified surrounding various Project components, which are depicted on the Project Location figure by the item "Project Location" in the legend. These denote areas where temporary disturbance during the construction phase may occur as a result of: temporary project component laydown and storage areas, crane pad construction and turbine turnaround areas. With the exception of the project components described above, no permanent infrastructure is proposed within these areas. Following construction activities, the land will be returned to pre-construction conditions.

The above mentioned Project components are depicted in the Project Location figures described below:

- Figure 2-1: shows the locations of Project components including: wind turbines, access roads, the electrical collection system, 115 kV transmission line, the operations and maintenance building, the proposed transformer substation, Hydro One Seaforth Transformer Station and temporary laydown/storage areas. This figure also shows topographical land contours and surface water drainage for all land within 120 m of the Project Location.
- Figure 2-2: shows the location of Project components in relation to surrounding natural heritage and water body features such as: wetlands, woodlots, streams, and Areas of Natural and Scientific Interest, in addition to water wells identified in MOE's database. This figure also demonstrates compliance with the 120 m setback distance for natural heritage features, measured from the boundary of the Project Location, the 30 m setback distance for water bodies, measured from the Project Location boundary for turbines, and highlights significant natural heritage features that are within those setback distances.
- Figure 2-3: shows the location of Project components in relation to surrounding socio-economic features such as: property boundaries, roads and railway right-of-ways, petroleum resources, and noise receptors. This figure also demonstrates the setback distances between these features and the Project components. Note that noise compliance is demonstrated in Appendix A - Noise Study Report, of the Design and Operations Report.


Legend
Wind Energy Centre Study Area
Transmission Line Study Area
Municipal Division
Property Boundary
120 m Area of Investigation
Expressway / Highway
Major Road
Local Road
Interconnection Point
Meteorological Tower
Project Location
GE Turbine
Access Road
Collection Line
Transmission Line
Disturbance Area
Substation
Laydown Yard
Natural Features
Watercourse
Contour (5m)
Waterbody
Cartographic Wetland
Woodlot
Bluewater Wind Energy Centre
Project Location
February 2012
Project #: 60155013
AECOM
Lake Huron




Legend
Wind Energy Centre Study Area
Transmission Line Study Area
Municipal Division
120 m Area of Investigation
60 m Road/Rail Buffer
80 m Property Boundary Buffer
550 m Noise Receptor Buffer
500 m Substation Footprint Buffer
75 m Petroleum Resources Buffer
2 km Boundary from Project Location
Expressway / Highway
Major Road
Local Road
Zurich Wind Farm
Petroleum Well
Meterological Tower
Participating Receptor
Non-participating Receptor
Vacant Lot Participating Receptor
Vacant Lot Non-participating Receptor
Interconnection Point
Project Location
GE Turbine
Access Road
Collection Line
Transmission Line
Disturbance Area
Substation
Laydown Yard
Natural Features
Watercourse
Waterbody
Cartographic Wetland
Woodlots
Basemapping from Ontario Ministry of Natural Resources
Metres
0 200 400 800 1,200 1,600
1:35,000
UTM Zone 17N, NAD 83
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Bluewater Wind Energy Centre
Project Location and Socio-economic Features
February 2012
Project 60155032
AECOM
South Huron
Centennial Road
Babylon Line
Mill Road
Front Road
Perth 183 Road
Zurich-Hensall Road
Blackbush Line
Danceland Road
Goshen Line
Blind Line
Kippen Road
Concession 5 Road
Airport Line
Morrison Line
Division Line
Hensall Road
Stone Road
Walnut Road
King Street
Main Street

The exercise of siting infrastructure is an iterative process that involves balancing the wind resource with environmental, socio-economic and engineering constraints, while at the same time adhering to the setback distances prescribed by the Province and outlined in O. Reg. 359/09. Optimum turbine siting on individual properties was also determined in consultation with the landowner.

The following sections outline the activities anticipated for the Construction Phase of the Project and provide details on the timing of the activities, materials brought on site, construction equipment used, and temporary uses of land. Note that no water takings greater than 50,000 L/day are anticipated for the construction phase.

These project activities are also described in Section 2.2.1 of the Project Description Report (PDR).

2.1 Project Timing

Subject to the receipt of the necessary permits and approvals, site work for the Bluewater Wind Energy Centre is expected to begin in approximately May 2013 and last for approximately 6 months. **Table 2-1** presents the anticipated construction schedule and approximate order of construction activities for the proposed Project; although some construction activities will overlap.

Table 2-1 Construction Schedule

Activity		Timing of Activity	Duration
Surveying		Prior to construction – preference is winter months	< 1 day per turbine location
Geotechnical Sampling		Prior to construction – preference is winter months	one to two hours per turbine location
Land Clearing and Construction of Access Roads		Late spring or summer – preference is to conduct during drier months	one to three days per access road to each turbine
Temporary Crane Paths		Late spring or summer – preference is to conduct during drier months	One to two days
Installation of Culverts		Late spring or summer – preference is to conduct during drier months	One to two days per culvert
Construction Laydown Area		Late spring or summer – preference is to conduct during drier months	One week
Turbine Site and Crane Pad Construction		Late spring or summer – preference is to conduct during drier months	Two to four days per turbine location
Delivery of Equipment		Throughout construction phase as needed, and in compliance with Traffic Management Plan	As needed throughout construction phase
Turbine Foundations		Late spring or summer – preference is to conduct during drier months	Three to four days (excluding curing)
Wind Turbine Assembly and Installation		Late spring or summer – preference is to conduct during drier months	Four to five days per turbine location
Electrical Collector System	**Pad Mount Transformers**	Late spring or summer – preference is to conduct during drier months	Four to six days
	Collection Lines	Late spring or summer – preference is to conduct during drier months	Dependent upon the required length of the lines; however, between 4 and 8 km of collector lines can be installed in a week.
Transformer Substation		Late spring or summer – preference is to conduct during drier months	15 – 20 weeks
Operations Building		Late spring or summer – preference is to conduct during drier months	Eight weeks
Clean-up and Reclamation		Following turbine construction	Will be conducted as site is constructed
Turbine Commissioning		Late spring or summer – preference is to conduct during drier months	One to three days

2.2 Construction Activities

The proposed Project will consist of 37 1.6 MW GE model wind turbine generators with a nameplate capacity of 60 MW and pad mounted step-up transformers (41 turbines are shown for permitting purposes). The electricity generated from the wind turbines will be collected through a network of collection lines to an on-site transformer substation located on leased private land on Centennial Road (west of Babylon Line). A 115 kV transmission line will connect the transformer substation to the Hydro One transmission system and is proposed to be installed along Centennial Road easterly to Hensall Road and northerly to the Village of Seaforth. Turbine access roads along with laydown and storage areas (including temporary staging areas) are planned for the site. A permanent meteorological (weather monitoring) tower and maintenance and operations building will be constructed on site.

2.2.1 Surveying and Geotechnical Study Activities

Surveys will be required to locate the turbines, crane pads, access roads, electrical lines and the substation. Crews will drive light trucks to reach sites primarily using existing roads. They will then walk the site for the surveying and mark the locations using stakes. For the wind energy centre site, the surveys will typically take one to two days per turbine location.

Existing buried infrastructure located on public property will be identified using the Ontario One Call service and buried infrastructure located on private property will be identified by private contractors prior to construction and updated throughout construction, as required.

Geotechnical sampling will be required for turbine foundation locations. Typically a truck-mounted drill rig visits the sampling locations, drills the borehole and collects geotechnical information. This operation typically uses two operators and requires one to two hours per turbine location.

Equipment will include, at a minimum, trucks, a truck mounted drill rig, and possibly a track-mounted drill rig. The trucks will be driven to the site via existing municipal roads. No materials will be brought on site for these activities and any waste generated would be comprised of drill cuttings which will be scattered in the vicinity of the boreholes. The only chemicals required for this phase are oils, gasoline, and grease used to operate construction equipment. Fuel-handling will be conducted in compliance with the mitigation measures outlined below in Section 3.

2.2.2 Land Clearing and Construction of Access Roads

Access roads will be constructed to transport equipment to the construction sites. Typically the access roads will be 11 m wide during the construction phase to accommodate the large cranes (with an additional 2 m clearance on each side for travel), and may be reduced in width following construction at the landowner's request. The road length will be different for each turbine according to its location.

The construction of the access road will typically require clearing and grubbing of any vegetation, excavation of the topsoil layer and adding a layer of compacted material to a typical thickness of 300 to 600 mm, depending upon site specific geotechnical conditions. Clean granular material (typically "A" or "B" gravel) will be brought to the site as needed and will not be stockpiled onsite. The topsoil will be kept and re-used on site. The access road to each turbine will typically require one to three days of construction time. Depending on the length of the access roads, construction may require approximately 25 trucks of gravel.

New steel culverts may be required to maintain drainage in ditches at junctions with roadways and these will be constructed to support the construction equipment and delivery trucks. The location of proposed water crossings is summarized in the Water Assessment and Water Body Report and the potential effects are described in detail below

in Section 3. The exact details of culverts and their installation in addition to erosion control measures will be determined in conjunction with the Ausable Bayfield Conservation Authority (ABCA) as part of their permitting process; however, the culverts are proposed to be open bottom and are proposed to be left in place following the operation phase, in consultation with the landowner.

Temporary crane paths will also be constructed. These will be 11 m wide and constructed in a manner similar to the other roads described above. Once the construction activities have been completed, the granular base will be removed and distributed to the landowners, if desired, or removed from the site and disposed of in an approved and appropriate manner. The disturbed area will have the topsoil replaced from stockpiled material and will be reseeded in consultation with the landowner.

Equipment will include, at a minimum, trucks, graders, and bulldozers. Municipal and provincial roads will also be used for transporting equipment, and minor modifications may be required to some of the existing roads (e.g., widening the turning radius) to handle the oversized loads. Any road damages will be repaired prior to the completion of the construction phase. The trucks and graders will be driven to the site and the bulldozers will be transported via trailers. The only chemicals required for this phase are oils, gasoline, and grease used to operate construction equipment. Fuel-handling will be conducted in compliance with the mitigation measures outlined below in Section 3.

2.2.3 Construction of Laydown Areas

A 4 hectare (10 acre) site will be constructed for the temporary storage of construction material (i.e., no turbine components). Following clearing and grubbing of any vegetation, the topsoil at the Construction Laydown Area will be removed and approximately 600 mm of clean compacted crushed gravel will be imported as needed. The excavated topsoil will be re-used on site as feasible. Construction activities are expected to last approximately one week and will require 100 loads of gravel, and a crew of six people. Following the construction phase, the gravel will be removed from the site or re-used, to be determined in consultation with the landowner. The stockpiled topsoil will then be redistributed throughout the Temporary Laydown Area.

Equipment will include, at a minimum, trucks, graders, and bulldozers. The trucks and graders will be driven to the site and the bulldozers will be transported via trailers. The only chemicals required for this phase are oils, gasoline, and grease used to operate construction equipment. Fuel-handling will be conducted in compliance with the mitigation measures outlined below in Section 3.

2.2.4 Construction of Turbine Sites and Crane Pads

Prior to construction, the construction area will be cleared and grubbed. In order to provide sufficient area for the laydown of the wind turbine components and its assembly, a 122 m by 122 m square around the wind turbine must be cleared, levelled, and be accessible during the construction phase. The topsoil is typically removed and some material may need to be added depending upon site specific geotechnical conditions. Where the site laydown areas are close to watercourses, erosion control measures will be implemented, as described below in Section 3.

Crane pads will be constructed at the same time as the road and will be located adjacent to the turbine locations. The crane pads will typically 15 m by 35 m in area. The topsoil at the crane pad will be removed and approximately 600 mm of clean compacted crushed gravel will be imported as needed. The excavated topsoil will be re-used on site as feasible. Once the turbine erection is complete, the crane pad will be removed and will be restored to prior use. The construction crew is anticipated to require four to six people and construction activities are expected to last for approximately one to two days.

Equipment will include, at a minimum, trucks, graders, and bulldozers. The trucks and graders will be driven to the site and the bulldozers will be transported via trailers. The only chemicals required for this phase are oils, gasoline, and grease used to operate construction equipment. Fuel-handling will be conducted in compliance with the mitigation measures outlined below in Section 3.

2.2.5 Delivery of Equipment

Equipment will be delivered by truck and trailer throughout the construction phase and stored at the temporary lay-down sites surrounding each turbine. A Traffic Management Plan will be developed using Ontario Ministry of Transportation (MTO) Book 7 standards and will be provided to Huron County. Alternative traffic routes will be prepared to address traffic congestion, as needed.

2.2.6 Construction of Turbine Foundations

A backhoe will be used to excavate an area approximately 3 m deep x 20 m x 20 m with the material being stockpiled for future backfilling. Stockpiled material will have topsoil and subsoil separated out and surplus excavated material will be removed from the site for disposal in an approved manner. The foundation, with an approximate footprint of 400 m^2, will be constructed of a wooden frame, poured concrete and reinforced with steel rebar to provide strength. The construction timeframe for turbine foundations is three to four days, excluding curing time. After construction the foundation will be backfilled and the surface will be landscaped for drainage. The only surface evidence of the foundation will be a small protrusion of concrete to which the tower is attached; as such land can be cultivated to within a few metres of the turbine. Any wood-waste generated will be removed from the site and recycled. Spent welding roads will be disposed of as hazardous waste by a licensed contractor.

Typical construction equipment, on a per turbine basis, will include:

- Excavator for removing material;
- Flatbed trucks (four to six) for delivery of rebar, turbine mounting assembly and forms;
- Truck mounted crane or rough terrain forklift for unloading and placement of rebar and forms;
- Concrete trucks for delivery of concrete (30-40 loads);
- Construction trucks (three to four vehicles with multiple visits); and
- Dozer, loader and trucks to backfill and compact foundation and remove surplus excavated materials.

The trucks and graders will be driven to the site and the bulldozers will be transported via trailers. The only chemicals required for this phase are oils, gasoline, and grease used to operate construction equipment. Fuel-handling will be conducted in compliance with the mitigation measures outlined below in Section 3.

2.2.7 Wind Turbine Assembly and Installation

Turbine components will arrive on-site using flat bed and other trucks and will be temporarily stored on-site in the immediate vicinity of the base prior to assembly. Typically two cranes will be used to install the turbines. The larger crane is usually a crawler type with a capacity of 400 tonnes or larger, and is used for the higher lifts.

Clearing and grubbing will be required for the erection area. The erection cranes and crew will follow the foundation crew and erect the wind turbines once the foundations are completed and the concrete has set. This will typically be in five lifts (three for the towers, one for the nacelle and one for the rotor) over a period of two to three days. The lower tower sections may be installed several days before the upper tower sections and the turbine to optimize installation sequence. The lower tower section will also include electrical and communications equipment. Total

turbine assembly and installation will typically require four to five days for each turbine. Fifteen to twenty people may be required at the site during the turbine installation; they will be transported using light duty vehicles.

Packing frames for the turbine components are returned to the turbine vendor. Following commissioning, the surrounding area will be returned to its original use.

Equipment will include, at a minimum, trucks, two cranes, graders, and bulldozers. The trucks and graders will be driven to the site and the bulldozers will be transported via trailers. The larger track mounted crane can move from turbine site to turbine site; however, it will need to be disassembled to move it along roadways and from the Project site. The only chemicals required for this phase are oils, gasoline, and grease used to operate construction equipment. Fuel-handling will be conducted in compliance with the mitigation measures outlined below in Section 3.

2.2.8 Construction of Electrical Collector System

The electrical collector system will consist of pad mounted transformers, underground cabling for use on private property and a buried collection system running along turbine access roads and municipal road right-of-ways. These components are described below.

- Pad Mount Transformers: A concrete transformer pad, approximately 2.2 m by 2.5 m in size, will be installed adjacent to each turbine at the same time as the turbine base installation. The construction will consist of excavation, soil storage, installation of the buried electrical grounding grid, installation of the concrete pad, installation of the transformer, and electrical connections. Transformer installation and cabling between the turbine and transformer is expected to take three days per turbine. Equipment will include flatbed trucks to transport the equipment to site, and a truck-mounted crane for the installation. These activities will likely require four to six trucks, a work force of two people per vehicle per day, and will last between four to six days.
- Collection Lines: Cables and fibre optics lines (for communications) from each turbine to the transformer substation will be buried and will be located on private property adjacent to the turbine access roads, where feasible. The excavated soil will be stored temporarily and then reused as backfill. Power conductors will be approximately 0.9 m below grade and the location will be marked. Farming practices will not be affected by the underground cabling due to the depth of the cables and location of the cable beneath the access roads. Equipment will include trenchers or diggers (depending on soil type) and construction will require a crew of six people. The construction timeframe is dependent upon the required length of the lines.
- Horizontal Directional Drilling: Electrical cables may need to be installed using horizontal directional drilling to minimize effects to woodlots or watercourses. Erosion control devices will be installed at the drill location and drill cuttings will be collected and removed from the site for disposal in an approved and appropriate manner. An entrance and exit pit will be excavated on either side of the feature to be bored under. The directional drilling equipment will be set up at the entrance pit and a drill bit attached to rod segments is advanced until it reaches the exit pit. A slurry of bentonite and/or polymer mixed with water will be injected into the hole while drilling to help stabilize the bore hole and reduce friction. Once the drill bit has reached the exit pit the drill bit will be removed and a “reamer” attached and pulled back through the hole to enlarge the bore by 120-150%. The electrical cable will then be installed through the hole. Equipment will include a directional drilling rig and two to three support trucks to carry drilling rods, drilling supplies and cable.

The only chemicals required for this phase are oils, gasoline, and grease used to operate construction equipment, and the polymer used for directional drilling. Fuel-handling will be conducted in compliance with the mitigation measures outlined below in Section 3.

2.2.9 Construction of Electrical Transmission Line

The 115 kV electrical transmission line that will be built from the transformer substation to the connection point at the Seaforth Transformer Station is proposed to be located within the existing road right-of-ways along Centennial Road and Hensall Road in the Municipalities of Bluewater and Huron East. It is anticipated that the transmission line will be mounted on new hydro poles. The poles are proposed to be constructed of wood, concrete or steel and will be between 18 and 30 m tall.

Holes for new hydro poles are typically augured in the ground using a truck mounted auger device. The poles will then be inserted using special cranes to a typical depth of 1 to 2 m below grade and “dressed” (made ready to accept conductors) using a boom truck. Typically, one crew will install the poles and one crew will dress them. Approximately six construction vehicles (including trucks and a pole loader) and a crew of 12 to 15 people are anticipated for construction of the transmission lines. Twelve to sixteen poles can be installed and dressed in one day. Once the poles are in place and dressed, cables will be strung in place using boom trucks and special cable reel trucks. Finally, any pre-existing poles that are no longer in use will be removed. Some packing-material waste may be generated. All recyclable materials will be separated from non-recyclable materials and both streams will be removed from the site and disposed of at an approved and licensed facility.

The interconnection plan for any wind energy centre is subject to study, design and engineering by the Integrated Electricity System Operator which manages the Province’s electricity grid, Hydro One which owns the transmission lines, the local distribution company and the Ontario Energy Board, which regulates the industry through the Transmission System Code and the Distribution System Code.

Equipment will include, at a minimum, a truck mounted crane, flatbed trailers and a truck mounted auger. The only chemicals required for this phase are oils, gasoline, and grease used to operate construction equipment. Fuel-handling will be conducted in compliance with the mitigation measures outlined below in Section 3.

2.2.10 Construction of Transformer Substation

Approximately two to three hectares in size, the transformer substation will include an isolation switch, a circuit breaker, a step-up power transformer, transmission switch gear, instrument transformers, grounding and metering equipment. Substation grounding will meet the Ontario Electrical Safety Code. The substation area will be gravelled with clean material imported to the site on an as needed basis and sloped to facilitate drainage. A secondary containment system will be installed around the transformer in the event of an oil leak to prevent any soil contamination.

During construction of the substation, topsoil and subsoils will be stripped and stockpiled separately. Stripped topsoil and subsoil will be placed in the temporary storage facility area and topsoil stripped from the substation area will be distributed on other Project properties. The construction crew will consist of approximately 25-40 people and is expected to last for about four months. Some packing-material waste may be generated. All recyclable materials will be separated from non-recyclable materials and both streams will be removed from the site and disposed of at an approved and licensed facility.

Construction equipment will include small trenchers, a small crane, forklifts, concrete trucks and a bulldozer. The trucks and graders will be driven to the site and the bulldozers will be transported via trailers. The only chemicals required for this phase are oils, gasoline, and grease used to operate construction equipment and transformer oil. Fuel-handling will be conducted in compliance with the mitigation measures outlined below in Section 3.

2.2.11 Construction of Operation and Maintenance Building

An operations building, approximately 30 m by 15 m in size, will be constructed on privately held lands or an existing suitable structure will be purchased/leased for the purpose of monitoring the day-to-day operations of the wind energy centre and supporting maintenance efforts. A small parking lot will be constructed to accommodate staff vehicles. Prior to the construction phase, a Stormwater Pollution Prevention Study will be conducted to address any potential effects associated with stormwater runoff.

Potable water will be supplied by a well or through the municipal water system and if required, a septic bed will be constructed for the disposal of sewage. The septic bed will be constructed to the minimum size required for the size of the operation and maintenance building. Both will be constructed in accordance with applicable municipal and provincial standards. Construction of the operations building may take up to three months to complete and will require a crew of approximately 10 to 15 people.

Equipment will include, at a minimum, forklifts, concrete trucks and smaller crew trucks. The only chemicals required for this phase are oils, gasoline, and grease used to operate construction equipment. Fuel-handling will be conducted in compliance with the mitigation measures outlined below in Section 3.

2.2.12 Permanent Meteorological Towers

Two permanent meteorological towers will be installed at the Project. These are typically up to 80 m in height and use either a monopole or lattice structure installed using a drill truck. The towers will be erected using winches and secured with three guy wires tied off to anchors or a small monopole foundation. No significant soil or vegetation disturbance is anticipated. Construction of the meteorological towers will take approximately two days and require a crew of six people.

Permanent meteorological towers are an operational requirement of the Independent Electricity System Operator (IESO) as an electricity market participant (this includes all generators of electricity) and allow the IESO to operate the system reliably and safely.

2.2.13 Clean-up and Reclamation

Site clean-up will occur throughout the construction phase and site reclamation will occur after construction has been completed. Waste and debris generated during the construction activities will be collected by a licensed operator and disposed of at an approved facility. All reasonable efforts will be made to minimize waste generated and to recycle materials including returning packaging material to suppliers for reuse/recycling.

Stripped soil will be replaced and re-contoured in the construction areas and disturbed areas will be re-seeded, as appropriate. Erosion control equipment will be removed once inspections have determined that the threat of erosion has diminished to the original land use level or lower. High voltage warning signs will be installed at the transformer substation and elsewhere, as appropriate. At the conclusion of construction, vehicles and construction equipment will be removed from the site.

2.2.14 Turbine Commissioning

Turbine commissioning will occur once the wind turbines and substation are fully installed and Hydro One is ready to accept grid interconnection. The commissioning activities will consist of testing and inspection of electrical, mechanical and communications systems. Some packing-material waste may be generated. All recyclable materials

will be separated from non-recyclable materials and both streams will be removed from the site and disposed of at an approved and licensed facility.

Temporary portable generator sets may be used to electrically commission the turbines prior to connection to the grid. The generators are required for approximately one day per turbine. The generators are supplied with a Certificate of Approval to the owners. Following the commissioning phase, the portable generators will be removed from the site and returned to the owners.

Equipment will include support trucks which will be driven to the construction site. The only chemicals required for this phase are oils, gasoline, and grease used to operate construction equipment and portable generators, gearbox oil, and lubricants. Fuel-handling will be conducted in compliance with the mitigation measures outlined below in Section 3.

3. Description of Environmental Effects and Mitigation Measures

The following section describes potential effects associated with the construction and installation of the Project, in addition to mitigation measures and monitoring commitments that will be made to minimize these potential effects. The potential effects described below are also presented in Section 3 of the PDR.

For each potential negative effect, performance objectives were developed to describe a desired outcome of mitigation. Next, mitigation measures were proposed to achieve the performance objectives. Residual effects, which are those effects that remain following the application of mitigation measures and monitoring commitments, were then assessed based on professional judgment as well as previous Project experience. Where possible, the significance of residual adverse effects has been described based on the following:

Magnitude.....the size or degree of the effect compared against baseline conditions; and
Likelihood.....the probability that the effect will occur.

Finally, where monitoring commitments were identified, they are intended to verify that the mitigation measures achieve performance objectives. Should the monitoring reveal that the mitigation measures are not achieving the intended result, the identified contingency measures would then be implemented.

This description of effects was completed for all 41 turbines and associated infrastructure shown on the Project Location figures. Note that ultimately, 37 turbines will be constructed, resulting in a conservative assessment of effects. Where other REA reports provide further details on potential environmental effects and proposed mitigation, these reports are noted.

3.1 Cultural Heritage

Stage 1 and 2 Archaeological Assessments were conducted and factored into the overall Project layout. The Stage 1 Archaeological Assessment, consisting of an initial desktop archaeological study, was carried out in the fall of 2010 and determined that there are known archaeological resources within the Project Study Area, in addition to properties with the potential to contain archaeological resources.

In 2011 and 2012, Stage 2 pedestrian surveys were conducted within the Bluewater Wind Energy Centre Project Study Area, according to the 2011 *Standards and Guidelines for Consultant Archaeologists* issued by the Ontario Ministry of Tourism, Culture and Sport (MTCS). A total of 25 archaeological sites were identified and include 18 pre-contact Aboriginal sites and seven historic Euro-Canadian sites. Four historic Euro-Canadian sites have been recommended for further Stage 3 archaeological assessment, which is currently underway. None of the pre-contact Aboriginal sites have been recommended for further Stage 3 archaeological assessment at this time.

Both the Stage 1 and Stage 2 Archaeological Assessment Reports were submitted to the MTCS for review and acceptance into the Ontario Public Register of Archaeological Reports by the MTCS. Sign-off from the MTCS was received on April 5, 2012 and confirmed that: (1) the ministry was satisfied with the recommendations in the report; and, (2) the fieldwork and reporting for the archaeological assessment is consistent with the ministry's standards and the terms and conditions for archaeological licences.

A Cultural Heritage Assessment was also completed to address built heritage and cultural heritage landscape resources related to the Euro-Canadian land use in the area dating prior to 1970. All work was carried out in accordance with the Ontario Heritage Act, the Provincial Policy Statement, and the Environmental Assessment Act. The report identified 76 structures (45 houses and 31 barns) as greater than 40 years old within the Project Study Area and as having general historical interest as they contribute to the character of the vernacular rural landscape.

When applying the criteria set out in Ontario Regulation 9/06, none of these structures were determined to have cultural heritage value or interest. This report was submitted to the MTCS for review and comment. Sign-off from the Ministry confirming that the report is satisfactory was received on March 22, 2012.

3.1.1 Potential Effects

Potential effects from construction and installation activities are as follows:

- Disturbance or displacement of 4 archaeological resources (i.e., historic Euro-Canadian sites) identified through the Stage 2 Archaeological Assessment due to construction of project infrastructure.

No effects to protected properties or heritage resources are anticipated, as the Project Location was selected to avoid these features.

3.1.2 Mitigation Measures, Residual Effects and Monitoring Plan

Table 3-1 provides mitigation measures, residual effects and the monitoring plan for each potential effect identified above.

Table 3-1 Mitigation Measures, Residual Effects and Monitoring Plan: Cultural Heritage

Potential Effect	Performance Objectives	Mitigation Strategy	Residual Effects	Monitoring Plan and Contingency Measures
Disturbance or displacement of 4 archaeological resources (i.e., historic Euro-Canadian sites) identified through Stage 2 Assessment due to construction of project infrastructure.	• Avoid disturbance/ loss of archaeological sites	• Install a fence a minimum of 20 m from the site boundaries to protect it from adjacent construction activities and then enact the monitoring plan; or • Conduct Stage 3 archaeological assessment, document findings in Stage 3 assessment report, and submit report to Ministry of Tourism, Culture and Sport (MTCS) for approval. Any potentially interested Aboriginal communities will be contacted, as appropriate, from at least this point onward. • If Stage 4 archaeological assessment is recommended based on the outcome of the Stage 3 assessment: ▪ Install a fence a minimum of 10 from the site boundaries to protect it from adjacent construction activities and then enact the monitoring plan; or ▪ Conduct Stage 4 archaeological assessment, document findings in Stage 4 assessment report, and submit report to MTCS for approval.	• Disturbance or displacement of archaeological resources avoided or minimized through application of mitigation measures. • Low likelihood and limited magnitude of effect as a result.	• Retain a licensed archaeologist to monitor any construction activities within a 50 m monitoring zone for an archaeological resource surrounded by a 20 m buffer where a Stage 3 archaeological assessment has been recommended. Submit a report to MTCS detailing the results of any monitoring activities. • Retain a licensed archaeologist to monitor any construction activities for Stage 4 avoidance close to the 10 m buffer area fenced off that may affect archaeological resources. • Contingency Measures: ▪ Cease work immediately should previously unidentified archaeological resources be discovered during the construction phase. The area will be secured and a licensed archaeologist contacted to conduct further archaeological work. Construction will only resume in the location when any archaeological assessment has been completed. Any potentially interested Aboriginal communities will be contacted, as appropriate. ▪ Cease work immediately should human remains be found during construction, and contact the police or coroner and the Registrar of Cemeteries at the Ministry of Consumer Services.

3.2 Natural Heritage

Effects to natural heritage features; including significant wetlands, woodlots, wildlife habitat, and valleylands are identified in the Natural Heritage Assessment Report which was prepared based on the *Natural Heritage Assessment Guide for Renewable Energy Projects*. The potential effects, mitigation measures, net effects and monitoring commitments regarding the natural heritage features, in addition to birds and bats, are evaluated in the Natural Heritage Assessment Report and the Environmental Effects Monitoring Plan and were submitted to the Ontario Ministry of Natural Resources (MNR) for review and sign-off. Sign-off from the MNR confirming that the report is satisfactory was received on March 28, 2012.

Following the completion of the Records Review and Site Investigation for all natural heritage features located within 120 m of the Project Location, an Evaluation of Significance was conducted to identify any features that required an Environmental Impact Study (EIS).

Table 3-2 and **Figure 2-2** document the significant natural heritage features located within 120 m of the Project Location for which an EIS was conducted.

Table 3-2 Summary of Natural Features Carried Forward to the EIS

Feature	Natural Features Carried Forward to EIS
Wetlands	The following ten wetland units or wetland complexes were treated as significant and carried forward to the EIS: • WET-01, WET-03, WET-04, WET-05, WET-06, WET-07, WET-08, WET-10, WET-12 and WET-13.
Woodlands	The following 32 woodlands were determined to be significant or treated as significant and therefore carried forward to the EIS: • D, E, F, G, H, K, L, M, N, O, P, Q, R, S, T, U, V, X, Y, AA, AE, AF, AH, AJ, AK, AL, AM, AO, AP, AQ, AR and AS.
Valleylands	The following valleyland feature was determined to be significant and therefore carried forward to the EIS: • VAL-01
Significant Wildlife Habitat	The following candidate significant wildlife habitats were confirmed within the 120 m Area of Investigation and within 120 m of qualifying project infrastructure, and were therefore carried forward to the EIS. Features evaluated and determined to be significant: • Bat maternity colonies (BMC-01, BMC-07, BMC-08 and BMC-13); • Amphibian woodland breeding habitat (AWO-11); and • Rare vegetation communities (RVC-01). Features treated as significant for the purpose of this submission (a determination as to whether the mitigation measures described in the EIS will be applied will be made based on the outcome of evaluation of significance studies to be completed prior to construction): • Reptile hibernacula (RH-01 and RH-02); • Bat maternity colonies (BMC-02, BMC-03, BMC-10, BMC-12 and BMC-14); • Amphibian woodland breeding habitat (AWO-03, AWO-04, AWO-05, AWO-06 and AWO-08); and • Amphibian wetland breeding habitat (AWE-01).
	The following candidate significant wildlife habitats were identified within the 120 m Area of Investigation however not within 120 m of qualifying project infrastructure, and were therefore carried forward to the EIS as *Generalized Candidate Significant Wildlife Habitat*: • Waterfowl nesting areas (Natural Area 537); • Reptile hibernacula (Natural Area 541); • Bat maternity roosts (Natural Areas 426, 439, 456, 475, 487, 488, 494, 512, 514, 520, 537, 539, 545, 551, 552, 555, 556 • and 561); • Amphibian woodland breeding habitat (Natural Areas 450, 463, 483, 510, 534, 537 and 541); • Amphibian wetland breeding habitat (Natural Areas 494, 564 and 565); • Old growth and mature forest stands (Natural Areas 456, 483, 487, 510, 514, 537, 541 and 542); • Woodland raptor nesting habitat (Woodland Unit N); • Seeps and springs (Natural Areas 437, 439, 463, 510, 518, 532, 534, 537 and 539); • Marsh bird breeding habitat (Natural Area 495); and • Habitats of species of conservation concern (numerous).

3.2.1 Potential Effects

3.2.1.1 Generalized Candidate Significant Wildlife Habitat

The features containing generalized candidate significant wildlife habitat are identified above in the table called *Summary of Natural Features Carried Forward to the EIS*. The potential effects from construction and installation activities on generalized candidate significant wildlife habitat are as follows:

- Increased erosion, sedimentation and turbidity resulting in increased inputs of nutrients and contaminants to wetlands, woodlands and other significant natural features, resulting from:
  - clearing and grubbing for construction of turbines, access roads, temporary crane paths and pads/turnaround areas, collection lines, transmission line, operations building and substation;
  - excavation and backfilling for construction of turbines, collection lines, transmission line, operations building and substation;
  - directional drilling for construction of collection lines;
- Removal/disturbance of topsoil and increased soil compaction from manoeuvring of heavy machinery, excavation and backfilling of turbine foundation for construction of turbines, access roads, temporary crane paths and pads/turnaround areas, collection lines, transmission line, operations building and substation;
- Disturbance and/or mortality to terrestrial wildlife, including barriers to wildlife movement from construction of turbines, access roads, temporary crane paths and pads/turnaround areas, collection lines, transmission line, operations building and substation;
- Disturbance to or loss of wildlife habitat from construction of turbines, access roads, temporary crane paths and pads/turnaround areas, collection lines, transmission line, operations building and substation;
- Damage to vegetation while operating equipment used in construction of turbines, access roads, temporary crane paths and pads/turnaround areas, collection lines, transmission line, operations building and substation;
- Soil / water contamination by oils, gasoline, grease and other materials from:
  - construction equipment, material stockpiling and handling for construction of turbines, access roads, temporary crane paths and pads/turnaround areas, collection lines, transmission line, operations building and substation;
  - bentonite or polymer used during directional drilling of collection lines, resulting from the escape of drilling mud into the environment as a result of a spill, tunnel collapse or the rupture of mud to the surface in the event of a “frac-out”; and
- Changes in surface water drainage patterns (e.g., obstruction of lateral flows in surface water to wetlands) from construction of turbines, access roads, temporary crane paths and pads/turnaround areas, resulting in effects to soil moisture and species composition of vegetation.

3.2.1.2 Significant Wetlands, Woodlands, Valleylands and Wildlife Habitat:

The features containing significant wetlands, woodlands, valleylands and wildlife habitat are identified above in the table called *Summary of Natural Features Carried Forward to the EIS*. The potential effects from construction and installation activities on these features include those discussed above under Generalized Candidate Significant Wildlife Habitat and additional potential effects as outlined below:

- Accidental intrusion into natural features resulting in:
  - habitat damage at Reptile Hibernacula Features RH-01 and RH-02 and Bat Maternity Colony Features BMC-01, BMC-07, BMC-08, BMC-13, BMC-02, BMC-03, BMC-10, BMC-12 and BMC-14 from turbine construction;

  - habitat damage at Reptile Hibernacula Features RH-01 and RH-02 from access road construction;
  - damage to trees at Significant Woodland Units E, F, H, K, L, M, N, O, P, Q, T, U, X, Y, AA, AE, AF, AH, AJ, AK, AM from turbine construction and Units G, K, P, U from access road construction, and Units Q,V,Y and AK from collection line construction;
  - damage to wetland form and function at Significant Wetland Unit Features WET-01, WET-04, WET-05, WET-06, WET-07, WET-08, WET-10 resulting from turbine construction and Features WET-01, WET-04, WET-05, WET-06, WET-07, WET-08, WET-10 from access road construction;
  - habitat damage at Amphibian Woodland Breeding Habitat Features AWO-03, AWO-04, AWO-05, AWO-06, AWO-08 and AWO-11 and Amphibian Wetland Breeding Habitat Feature AWE-01 from access road construction;
- Noise disturbance to bats during turbine construction at Bat Maternity Colony Features BMC-01, BMC-07, BMC-08, BMC-13, BMC-02, BMC-03, BMC-10, BMC-12 and BMC-14;
- Sedimentation or erosion from:
  - turbine and access road construction at Significant Wetland Feature WET-01;
  - from turbine foundation excavation at Significant Valleylands Feature VAL-01;
  - directional drilling at Wetland Complexes WET-01, WET-04 and WET-05; and,
  - transmission line construction at Wetland Complexes WET-05, WET-06, WET-12, and WET-13;
- Accidental spills of fuel at Significant Wetland Feature WET-01 from turbine and access road construction due to proximity to construction (< 30 m);
- Soil/water contamination from spills during directional drilling at Wetland Complexes WET-01, WET-04 and WET-05;
- Disruption of amphibians moving to breeding pools and home range and possible indirect threats by changes to surface water drainage patterns resulting from access road construction at Amphibian Woodland Breeding Habitat Features AWO-03, AWO-04, AWO-05, AWO-06, AWO-08 and AWO-11, and Amphibian Wetland Breeding Habitat Feature AWE-01;
- Mortality to reptiles from construction equipment for turbines and access roads at Reptile Hibernacula Features RH-01 and RH-02;
- Unplanned intrusion into woodlands/wetlands in event of equipment malfunction due to directional drilling under Significant Woodlands (Units Q (two locations), V, and AK), Wetland Complexes WET-01, WET-04 and WET-05 due to directional drilling; and
- Unintended damage to adjacent vegetation due to proximity of transmission line to significant woodlands and wetlands, small size of the right-of-way and constrained work area at Woodland Units: AL, AO, AP, AQ, AR, AS; and Wetland Complexes WET-05, WET-06, WET-12, and WET-13.

3.2.2 Mitigation Measures, Residual Effects and Monitoring Plan

3.2.2.1 Generalized Candidate Significant Wildlife Habitat

Table 3-3 provides mitigation measures, residual effects and the monitoring plan for Generalized Candidate Significant Wildlife Habitat potential effects identified above.

3.2.2.2 Significant Wetlands, Woodlands, Valleylands and Wildlife Habitat:

Table 3-4 provides Feature/Unit specific mitigation measures, residual effects and the monitoring plan for each potential effect identified in section 3.2.1.2. Note that at all locations described below, the best management practices and mitigation measures outlined in the Generalized Candidate Significant Wildlife Habitat table will be applied.

Table 3-3 Mitigation Measures, Residual Effects and Monitoring Plan: Generalized Candidate Significant Wildlife Habitat

Potential Effect	Performance Objectives	Mitigation Strategy	Residual Effects	Monitoring Plan and Contingency Measures
Increased erosion, sedimentation and turbidity resulting from clearing and grubbing, excavation, backfilling and stockpiling.	• Minimize erosion, sedimentation and turbidity from clearing, grubbing, excavation, backfilling and stockpiling.	• Develop and implement an erosion and sediment control plan before commencement of construction. • Utilize erosion blankets, erosion control fencing, straw bales, etc. For construction activities within 30 m of a wetland, woodland or water body, to mitigate potential excessive erosion and sedimentation. Extra erosion and sediment control materials should be kept on hand, (i.e. heavy duty silt fencing, straw bales). • Keep sediment and erosion control measures in place until disturbed areas have been stabilized (i.e., re-vegetated). • Schedule grading within 30 m of a watercourse or wetland to avoid times of high runoff volumes (spring and fall), wherever possible. Temporarily suspend work if high runoff volume is noted or excessive flows of sediment discharges occur until mitigation measures are in place. • Re-vegetate temporary roads to pre-construction conditions as soon as possible after construction activities are complete using species native to Ontario in naturally vegetated areas.	• Increased erosion, sedimentation and turbidity avoided or minimized through application of mitigation measures. • Low likelihood and limited magnitude of effect as a result.	• Monitor on-site conditions (i.e., erosion and sediment control, spills, flooding, etc.) where construction occurs within 30 m of a feature on the following basis: ▪ Weekly during active construction periods; ▪ Prior to, during and post forecasted large rainfall events (>20 millimetres in 24 hours) or significant snowmelt events (i.e., spring freshet); ▪ Daily during extended rain or snowmelt periods; ▪ Monthly during inactive construction periods, where the site is left alone for 30 days or longer. • Analyze water samples for general chemistry (e.g., temperature, pH, dissolved oxygen, and conductivity), suspended solids, turbidity, nutrients and total metals (e.g., copper, iron, zinc and aluminum). • In the event that a spill / flooding occurs, the details of the event will be reported back to MOE, including a description of any assessment and remediation undertaken. • Contingency Measures: ▪ Suspend work if excessive flows of sediment discharges occur until mitigation measures are in place. ▪ Water samples will be analyzed for general chemistry (e.g., temperature, pH, dissolved oxygen, and conductivity), suspended solids, turbidity, nutrients and total metals (e.g., copper, iron, zinc and aluminum).
Removal/disturbance of topsoil and increased soil compaction from manoeuvring of heavy machinery, excavation and backfilling.	• Minimize removal/disturbance of topsoil and increased soil compaction.	• Minimize vehicle traffic on exposed soils, avoid compacting or other hardening of natural ground surface, and avoid the movement of heavy machinery on areas with sensitive slopes.	• Increased erosion, sedimentation and turbidity avoided or minimized through application of mitigation measures. • Low likelihood and limited magnitude of effect as a result.	• See erosion and sedimentation above.
Increased erosion, sedimentation and turbidity resulting from directional drilling.	• Minimize erosion, sedimentation and turbidity.	• Conduct all drilling by licensed drillers in accordance with Regulation 903 under Ontario Water Resources Act, R.S.O. 1990. • Set back drill entry and exit pits at least 30 m from natural features (i.e. woodlands, wetlands) or water bodies. • Monitor natural features for signs of surface disturbance.	• Increased erosion, sedimentation and turbidity avoided or minimized through application of mitigation measures. • Low likelihood and limited magnitude of effect as a result.	• See erosion and sedimentation above.

Table 3-3 Mitigation Measures, Residual Effects and Monitoring Plan: Generalized Candidate Significant Wildlife Habitat

Potential Effect	Performance Objectives	Mitigation Strategy	Residual Effects	Monitoring Plan and Contingency Measures
Disturbance and/or mortality to terrestrial wildlife, including barriers to wildlife movement.	• Minimize disturbance and/or mortality to terrestrial wildlife.	• Time vegetation removal to avoid periods of habitat use to the extent possible, particularly to avoid sensitive life stages (e.g., breeding season for migratory birds, May 1 to July 30). Undertake active nest surveys if clearing of vegetation must take place during this period. Avoid intersecting likely wildlife migration routes wherever possible. • Construction and decommissioning activities within 30 m of woodlands or wetlands should occur during daylight hours, wherever possible. • Clearly post construction speed limits. Install and maintain wildlife crossing and speed limit signs on access roads.	• Disturbance and/or mortality to terrestrial wildlife, including barriers to wildlife movement avoided or minimized through application of mitigation measures. • Low likelihood and limited magnitude of effect as a result.	• Undertake monthly site inspections to ensure that only specified trees are removed and that there is no damage caused to the remaining trees during construction • Contingency Measures: ▪ Suspend construction during breeding periods.
Disturbance to or loss of wildlife habitat, including active bird nests. **Damage to vegetation while operating equipment.**	• Minimize disturbance to/loss of wildlife habitat and vegetation.	• Keep vegetation removal to a minimum and limited to non-significant habitats (e.g., hedgerows). • For roadside collection line routes, vegetation removal (if any) will be kept to a minimum and will be limited to the road right-of-way. • Where construction is to occur within 30 m of natural features, install and maintain protective fencing to clearly define the construction area and prevent accidental damage to vegetation. • Damaged trees should be pruned through implementation of proper arboricultural techniques.	• Disturbance to or loss of wildlife habitat and damage to vegetation while operating equipment avoided or minimized through application of mitigation measures. • Low likelihood and limited magnitude of effect as a result.	• Undertake monthly site inspections to ensure that only specified trees are removed, protective fencing is intact and that there is no damage caused to the remaining trees during construction • Contingency Measures: ▪ Suspend construction during breeding periods.
Minor vegetation removal in right of way and possible destruction of bird nests during construction of transmission line.	• Minimize vegetation removal and destruction of bird nests.	• Schedule vegetation removal outside of breeding season (May 1 to July 30) where possible. • Conduct nest surveys if any substantial vegetation to be removed in breeding season. • Construction and decommissioning activities within 30 m of woodlands or wetlands should occur during daylight hours, wherever possible. • Complete a detailed inventory of species and abundance to be removed. Re-plant following an area ratio of 1:1 of similar species association (native species) if area to be removed is greater than 1% of the woodland cover.	• Vegetation removal minimized and destruction of active bird nests avoided through application of mitigation measures. • Low likelihood and limited magnitude of effect as a result.	• Undertake monthly site inspections to ensure that only specified trees are removed, protective fencing is intact and that there is no damage caused to the remaining trees during construction • Contingency Measures: ▪ Suspend construction during breeding periods.

Table 3-3 Mitigation Measures, Residual Effects and Monitoring Plan: Generalized Candidate Significant Wildlife Habitat

Potential Effect	Performance Objectives	Mitigation Strategy	Residual Effects	Monitoring Plan and Contingency Measures
Soil / water contamination by oils, gasoline, grease and other materials from construction equipment, materials storage and handling.	• Minimize soil/water contamination.	• Ensure machinery is maintained free of fluid leaks. • Site maintenance, vehicle washing and refuelling stations where contaminants are handled at least 30 m away from natural features or water bodies. Vehicle refuelling and maintenance should be done on spill collection pads. • Store any stockpiled materials at least 30 m away from a wetland, woodland or waterbody to prevent deleterious substances from inadvertently discharging to the environment. • Develop a spill response plan and train staff on associated procedures. • Maintain emergency spill kits on site. • Control soil / water contamination through best management practices. • Dispose of any waste material from construction activities by authorized and approved off-site vendors.	• Soil and water contamination avoided or minimized through application of mitigation measures. • Low likelihood and limited magnitude of effect as a result.	• Conduct daily inspections of construction equipment for leaks / spills • Contingency Measures ▪ Install a spill collection pad for refuelling and maintenance; ▪ Notify MOE's Spills Action Centre of any leaks or spills; ▪ Assess and remediate affected soils and water; ▪ Analyze water samples for general chemistry (e.g., temperature, pH, dissolved oxygen, and conductivity), suspended solids, turbidity, nutrients and total metals (e.g., copper, iron, zinc and aluminum).
Soil / water contamination by oils, gasoline, grease and other materials from spills during directional drilling.	• Minimize soil/water contamination.	• Conduct all drilling by licensed drillers in accordance with Regulation 903 under Ontario Water Resources Act, R.S.O. 1990. • Develop and implement emergency spills plan outlining steps to contain any chemicals or to avoid contamination of adjacent features. • Collect drill cuttings as they are generated and place in a soil bin or bag for off-site disposal. • Ensure drill depth is at an appropriate depth below feature to reduce the risk of a 'frac-out'. • Install protective fencing around vegetation to prevent accidental damage.	• Risk of soil / water contamination avoided or minimized through application of mitigation measures. • Low likelihood and limited magnitude of effect as a result.	• Monitor directional drilling for the duration of such activities to ensure that "frac-out" does not occur, and if it does, to ensure that there are no effects on surface or groundwater. • Contingency Measures: ▪ In the event of a "frac-out", immediately stop all work, including the recycling of drilling mud / lubricant. ▪ Monitor "frac-out" for 4 hours to determine if the drilling mud congeals. If drilling mud congeals, take no other action that would potentially suspend sediments in the water column. If drilling mud does not congeal, erect isolation/containment environment (underwater boom and curtain). ▪ If the fracture becomes excessively large, engage a spill response team to contain and clean up excess drilling mud in the water. ▪ If the spill affects an area that is vegetated, the area will be seeded and/or replanted using species similar to those in the adjacent area, or allowed to re-grow from existing vegetation. Revegetated areas will be monitored twice per year for two years subsequent to "frac-out" to confirm revegetation is successful.

Table 3-3 Mitigation Measures, Residual Effects and Monitoring Plan: Generalized Candidate Significant Wildlife Habitat

Potential Effect	Performance Objectives	Mitigation Strategy	Residual Effects	Monitoring Plan and Contingency Measures
				▪ Document post-cleanup conditions with photographs and prepare "frac-out" incident report describing time, place, actions taken to remediate "frac-out" and measures implemented to prevent recurrence. Provide incident report to MNR and MOE forthwith.
Changes in surface water drainage patterns. **Obstruction of lateral flows in surface water to wetlands.**	• Minimize changes in surface water drainage patterns and obstruction of lateral flows in surface water to wetlands.	• Minimize changes in land contours and natural drainage; maintain timing and quantity of flows.	• Changes in surface water drainage patterns and obstruction of lateral flows avoided through mitigation measures. • Low likelihood and limited magnitude of effect as a result.	• No monitoring or contingency measures required.

Table 3-4 Mitigation Measures, Residual Effects and Monitoring Plan: Significant Wetlands, Woodlands, Valleylands and Wildlife Habitat

Potential Effect	Performance Objectives	Mitigation Strategy	Residual Effects	Monitoring Plan and Contingency Measures
Disturbance to or loss of wildlife habitat and damage to vegetation while operating equipment within significant wetlands and / or woodlands.	• Minimize disturbance to/loss of wildlife habitat and damage to vegetation.	• Clearly delineate habitat boundaries to ensure that construction activities occur outside the habitat boundaries. • Maintain 30 m setback from significant woodlands and wetlands where possible. Install and maintain protective fencing to clearly define the construction area and prevent accidental intrusion. • Construction activities within 30 m of significant woodlands should occur during daylight hours to avoid excessive noise and/or light at night.	• Accidental intrusion into natural features avoided through application of mitigation measures. • No likelihood of effects.	• Undertake monthly site inspections to ensure that protective fencing is intact and that there is no damage caused during construction. • No contingency measures required.
Noise disturbance to bats during turbine construction.	• Minimize noise disturbance to bats.	• Focus construction activities within 30 m of significant bat habitat to daylight hours during the period of May 1st to July 31st.	• Disturbance to bats from construction noise will be minimized through application of mitigation measures. • Low likelihood and limited magnitude of effect as a result.	• No monitoring or contingency measures required.
Sedimentation and erosion affecting function of significant wetland (WET-01).	• Minimize effect of sedimentation and erosion on function of significant wetland.	• Install sediment and erosion control fencing along edge of wetland within 30 m of turbine footprint (WET-01).	• Sedimentation and erosion minimized through application of mitigation measures. • Low likelihood and limited magnitude of effect as a result.	• Monitor on-site conditions (i.e., erosion and sediment control, spills, flooding, etc.) where construction occurs within 30 m of a feature on the following basis: ▪ Weekly during active construction periods; ▪ Prior to, during and post forecasted large rainfall events (>20 millimetres in 24 hours) or significant snowmelt events (i.e., spring freshet); ▪ Daily during extended rain or snowmelt periods; ▪ Monthly during inactive construction periods, where the site is left alone for 30 days or longer. • In the event that a spill / flooding occurs, the details of the event will be reported back to MOE, including a description of any assessment and remediation undertaken. • Contingency Measures: ▪ Suspend work if excessive flows of sediment discharges occur until mitigation measures are in place. ▪ Water samples will be analyzed for general chemistry (e.g., temperature, pH, dissolved oxygen, and conductivity), suspended solids, turbidity, nutrients and total metals (e.g., copper, iron, zinc and aluminum).

Table 3-4 Mitigation Measures, Residual Effects and Monitoring Plan: Significant Wetlands, Woodlands, Valleylands and Wildlife Habitat

Potential Effect	Performance Objectives	Mitigation Strategy	Residual Effects	Monitoring Plan and Contingency Measures
Sedimentation and erosion affecting function of significant valleyland (VAL-01).	• Minimize effect of sedimentation and erosion on function of significant valleyland.	• Minimize the area and duration of soil exposure. • Minimize vehicle traffic on exposed soils avoid the use of heavy machinery on slopes. • Utilize erosion control fencing where potential sedimentation, and keep in place until disturbed areas are stabilized. • Schedule grading within 30 m of feature to avoid times of high runoff during spring and fall where possible. Suspend work during periods of excessive flows. • Store stockpiled materials away from features to prevent substances from inadvertently entering feature. • Immediately re-vegetate any inadvertently disturbed soils within 30 m of the top of bank using native plant species.	• Sedimentation and erosion minimized through application of mitigation measures. • Low likelihood and limited magnitude of effect as a result.	• See erosion and sedimentation above.
Sedimentation and erosion associated with directional drilling affecting function of significant Wetland Complexes WET-01, WET-04 and WET-05.	• Minimize effect of sedimentation and erosion on function of significant Wetland Complexes.	• Locate entrance and exit pits at least 30 m from wetland edge.	• Risk of unplanned intrusion into wetland due to directional drilling will be minimized through application of mitigation measures. • Low likelihood; however, if accidental damage occurred, negative effects may be measurable but would represent a small change relative to existing conditions.	• See erosion and sedimentation above.
Sedimentation and erosion associated with transmission line construction affecting function of significant Wetland Complexes WET-05, WET-06, WET-12, and WET-13.	• Minimize effect of sedimentation and erosion on function of Wetland Complexes.	• Establish 30 m setback to significant wetlands from new pole locations where possible. • Install sediment and erosion control fencing along edge of wetland within 30 m of transmission line footprint.	• Risk of sedimentation will be minimized through the application of mitigation measures. • Low likelihood; however, if accidental damage occurred, negative effects may be measurable but would represent a small change relative to existing conditions.	• See erosion and sedimentation above.
Disruption of amphibians moving to breeding pools and home range from Amphibian Woodland Breeding Habitat Features and Amphibian Wetland Breeding Habitat Features and possible indirect threats by changes to surface water drainage patterns.	• Minimize disruption to amphibian movements and changes to surface water drainage patterns.	• Limit construction of roads within 30 m of significant amphibian habitats to daylight hours between April 1st and June 30th to avoid excessive noise and/or vehicle caused mortality, wherever possible. • Ensure no grade changes within 30 m of vernal pools during construction. • Post speed limits along construction access roads.	• Disruption to amphibians avoided and indirect impacts to habitat minimized through application of mitigation measures. • Low likelihood and limited magnitude of effect as a result.	• See sedimentation and erosion control above. • Examine condition of vernal pools within 30 m of road following completion of construction. • Inspect locations following completion of access roads to ensure no grade changes. • No contingency measures required.

Table 3-4 Mitigation Measures, Residual Effects and Monitoring Plan: Significant Wetlands, Woodlands, Valleylands and Wildlife Habitat

Potential Effect	Performance Objectives	Mitigation Strategy	Residual Effects	Monitoring Plan and Contingency Measures
Accidental intrusion into Features RH-01 and RH-02 resulting in habitat damage, or possible mortality to reptiles within feature from construction equipment.	• Minimize potential for accidental intrusion into this feature.	• Erect temporary drift fence between edge of habitat and road if hibernaculum is within 60 m of road.	• Habitat damage avoided and mortality minimized through application of mitigation measures. • Low likelihood and limited magnitude of effect as a result.	• Weekly inspection of drift fence while construction is occurring during specified timing windows. • Conduct reptile hibernacula survey during construction according to protocol described for pre-construction survey, which includes: ▪ Examination of rock piles and vicinity between mid-April and mid-May. ▪ Identifying, measuring, visually sexing and searching for identifiable markings any snakes found prior to release. ▪ Preparing a field sheet to record weather, habitat conditions, location of cover objects, UTMs and details of snakes encountered. • The findings of the reptile hibernacula survey monitoring program will be reported back to MNR after the end of the monitoring period. • Contingency Measures: ▪ Avoid construction activities within 60 m of feature within timing windows during which snakes emerge (April 15 - May 31) and return (September 1 – October 15) to hibernaculum.
Unplanned intrusion into significant woodlands in event of equipment malfunction due to directional drilling.	• Minimize potential for accidental intrusion into significant woodlands.	• Locate entrance and exit pits at least 30 m from woodland edge. • Ensure drill depth is at an appropriate depth below woodland to reduce the risk of a 'frac-out'.	• Unplanned intrusion into woodland due to directional drilling avoided through mitigation measures. • Low likelihood and limited magnitude of effect as a result.	• See directional drilling above.
Unplanned intrusion into significant wetlands in event of equipment malfunction due to directional drilling.	• Minimize potential for accidental intrusion into significant wetlands.	• Where feasible, wetlands crossings will be within existing right-of-ways adjacent to wetland areas. • Where wetlands cannot be avoided, crossings will be completed via horizontal directional drilling as per O. Reg. 359/09. • Install protective fencing around vegetation to prevent accidental damage. • Ensure drill depth is at an appropriate depth below wetland to reduce the risk of a 'frac-out'. • Restore drilling sites to pre-construction conditions once construction is complete.	• Risk of unplanned intrusion into wetland due to directional drilling minimized through application of mitigation measures. • Low likelihood; however, if accidental damage occurred, negative effects may be measurable but would represent a small change relative to existing conditions.	• See directional drilling above.
Unintended damage to adjacent vegetation within significant wetlands and woodlands due to transmission line construction.	• Minimize potential for unintended damage to significant wetlands and woodlands.	• Limit vegetation removal within significant wetlands and woodlands to the existing right-of-way.	• Damage to vegetation will be minimized through the application of mitigation measures. • Low likelihood; however, if accidental damage occurred, negative effects may be measurable but would represent a small change relative to existing conditions.	• Undertake monthly site inspections to ensure that only specified trees are removed and that there is no damage caused to the remaining trees during construction. • Contingency Measures: ▪ Suspend construction during breeding periods.

3.3 Surface Water and Groundwater

Potential effects to surface water and groundwater, resulting from locating a Project component within the prescribed setbacks to water bodies, are evaluated in the *Water Assessment and Water Body Report* and are described below.

3.3.1 Surface Water

Following the Records Review and Site Investigation, the Project was found to be within the prescribed setback distance for 48 water bodies. To aid in the assessment of water bodies and to focus mitigation measures, information was collected during site investigations that incorporated water quality, flow, aquatic habitat and riparian features in order to provide some understanding on the system's resiliency. Based on a sensitivity ranking, 2 watercourses were classified as high sensitivity (i.e., not very resilient to environmental change); 32 moderate; and 14 low. This assessment demonstrates that the majority of the watersheds are fairly resilient to environmental perturbations. In general, water quality throughout the Study Area was heavily influenced by agriculture, as evidenced by tile drain runoffs, high suspended solids and turbidity of the water, as well as algae growth in some of the channels.

In compliance with O.Reg. 359/09, a Water Body Report was prepared to assess negative environmental effects, identify mitigation measures and describe monitoring commitments to address any effects. For a detailed account of this assessment and associated methodology, please refer to the Water Assessment and Water Body Report.

3.3.1.1 Potential Effects

Potential effects from construction and installation activities are as follows:

- Reduced stream baseflows, groundwater upwelling areas and increase in water temperatures due to discharge from dewatering activities (if required) for excavation of foundation area at water body locations: C35 (High sensitivity); C41, C30, C51, C36, C18, C22, C26, C28 (Moderate sensitivity); and C32, C71,C99,C33, C40, C3 (Low sensitivity);
- Increased flows to watercourses from temporary groundwater dewatering (if required) discharges for excavation of foundation causing streambed and/or bank erosion and downstream sedimentation if not managed properly at water body locations: C35 (High sensitivity); C41, C30, C51, C36, C18, C22, C26, C28 (Moderate sensitivity); and C32, C71,C99,C33, C40, C3 (Low sensitivity);
- Increased erosion, sedimentation and turbidity from:
  - clearing and grubbing for construction of turbines, and pads/turnaround areas, at water body locations: C35 (High sensitivity); C41, C30, C51, C36, C18, C22, C26, C28 (Moderate sensitivity); and C32, C71,C99,C33, C40, C3 (Low sensitivity);
  - clearing and grubbing for construction of access roads, temporary crane paths and pads/turnaround areas at water body locations: for road crossing C46, C30, C22, C28, C113 (Moderate sensitivity) and C13, C32 (Low sensitivity); and for roads within a water body buffer: C10-A, C35 (High sensitivity); C41, C87, C51, C48, C50, C56, C18, C19, C26, C36 (Moderate sensitivity) and C3, C33, C40, C71, C99 (Low sensitivity); and
  - directional drilling activities at the following water body locations: for collection line crossings C21, C42, C20, C54, C46, C87, C52, C56, C36, C19, C28, C26, C113 (Moderate sensitivity) and C33, C27, C34, C66, C72, C83, C13, C7-A (Low sensitivity); and for collection lines within a water body buffer C10-A (High sensitivity); C88, C71, C25 (Moderate sensitivity) and C112 (Low sensitivity);

- Soil compaction, which may result in hardening of surfaces and increased runoff into watercourses from turbine construction at water body locations: C35 (High sensitivity); C41, C30, C51, C36, C18, C22, C26, C28 (Moderate sensitivity); and C32, C71,C99,C33, C40, C3 (Low sensitivity);
- Release or discharge of sediment laden surface water into the adjacent watercourse or drainage features transporting nutrients and contaminants into the watercourse from:
  - turbine construction at water body locations: C35 (High sensitivity); C41, C30, C51, C36, C18, C22, C26, C28 (Moderate sensitivity); and C32, C71,C99,C33, , C3 (Low sensitivity);
  - road crossings at the following water body locations: C46, C30, C22, C28, C113 (Moderate sensitivity) and C13, C32 (Low sensitivity); and for roads within a water body buffer at the following locations: C10-A, C35 (High sensitivity); C41, C87, C51, C48, C50, C56, C18, C19, C26, C36 (Moderate sensitivity) and C3, C33, C40, C71, C99 (Low sensitivity); and
  - collection line crossings at the following water body locations: C21, C42, C20, C54, C46, C87, C52, C56, C36, C19, C28, C26, C113 (Moderate sensitivity) and C33, C27, C34, C66, C72, C83, C13, C7-A (Low sensitivity); for collection lines within a water body buffer at the following locations C10-A (High sensitivity); C88, C71, C25 (Moderate sensitivity) and C112 (Low sensitivity);
- Obstruction of lateral flows in watercourses from water crossings at the following water body locations: C46, C30, C22, C28, C113 (Moderate sensitivity) and C13, C32 (Low sensitivity);
- Temporary disruption of substrates/habitat at locations where in-water work is required at the following water body locations: C46, C30, C22, C28, C113 (Moderate sensitivity) and C13, C32 (Low sensitivity);
- Degradation of fish habitat for water crossings at the following water body locations: C46, C30, C22, C28, C113 (Moderate sensitivity) and C13, C32 (Low sensitivity);
- Increase sediment runoff and decrease bank stability from stream diversion for the installation of watercourse crossing resulting in changes in water chemistry and temperature at C46, C30, C22, C28 and C113 (Moderate sensitivity) and C13, C32 (Low sensitivity);
- Soil/water contamination by oils, grease and other materials from construction equipment at:
  - water body locations for road crossings C46, C30, C22, C28, C113 (Moderate sensitivity) and C13, C32 (Low sensitivity); and for roads within a water body buffer at the following locations C10-A, C35 (High sensitivity); C41, C87, C51, C48, C50, C56, C18, C19, C26, C36 (Moderate sensitivity) and C3, C33, C40, C71, C99 (Low sensitivity);
  - water body locations for directional drilling of collection line crossings C21, C42, C20, C54, C46, C87, C52, C56, C36, C19, C28, C26, C113 (Moderate sensitivity) and C33, C27, C34, C66, C72, C83, C13, C7-A (Low sensitivity); and for collection lines within a water body buffer: C10-A (High sensitivity); C88, C71, C25(Moderate sensitivity) and C112 (Low sensitivity); and
- Fractures in substrate releasing pressurized drilling fluids into watercourse and causing potential change to groundwater flow patterns at the following collection line crossings for the following water body locations: C21, C42, C20, C54, C46, C87, C52, C56, C36, C19, C26, C28, C113 (Moderate sensitivity) and C33, C27, C34, C66, C72 C83, C13, C7-A (Low sensitivity).

3.3.2 Mitigation Measures, Residual Effects and Monitoring Plan

Table 3-5 provides mitigation measures, residual effects and the monitoring plan for each potential effect identified above.

Table 3-5 Mitigation Measures, Residual Effects and Monitoring Plan: Surface Water and Groundwater

Potential Effect	Performance Objectives	Mitigation Strategy	Residual Effects	Monitoring Plan and Contingency Measures
Reduced stream baseflows, groundwater upwelling areas and increase in water temperatures due to discharge from dewatering activities (if required) for excavation of turbine foundation area.	• Minimize reduction of stream baseflows and groundwater upwelling areas, and increase in water temperatures.	**Water Management** • Control rate and timing of water pumping; pump from deep wells to infiltration galleries adjacent to water bodies or wetlands. • Control quantity and quality of stormwater discharge using best management practices, and implement infiltration techniques to the extent possible. • Restrict taking groundwater and surface water during drought conditions. • The water taker will regulate the discharge at such a rate that there is no flooding in the downstream area and no soil erosion, or stream channel scouring is caused at the point of discharge. The water taker will use a discharge diffuser or other energy dissipation device, if necessary, to mitigate flows which physically alter the stream channel or banks. • Siltation control measures will be installed at both the taking location upstream of the construction site and (if necessary) the discharge site and will be sufficient for the volumes pumped. All measures will be taken to properly maintain these control devices throughout the construction period. **Timing Windows** • Time construction to avoid periods of habitat use to the extent possible, these timing windows are applied to protect fish from any works in and around water during spawning, migration and other critical life history stages. Construction timing windows are based on site specific criteria such as type of fish species present, thermal regime and fish spawning times (spring or fall). The generic restricted in-water work timing windows established by DFO are ▪ Fall Spawning Period – October 1st to May 31st ▪ Spring Spawning Period – May 1st to July 15th **Water Quality** • Develop a spill response plan and train staff on associated procedures.	• Reduced stream baseflows, groundwater upwelling areas and increase in water temperatures minimized through application of mitigation measures. • Low likelihood and limited magnitude of effects as there will only be small scale dewatering (if required).	• Monitor water level and streamflow at proposed discharge locations for duration of dewatering activities using staff gauges, water level data loggers, and manual in-stream flow measurements tools to calculate watercourse assimilation capacity. • The findings of the monitoring program will be reported back to MOE following the completion of dewatering activities for the entire Project. • Contingency Measures: ▪ Control rate and timing of water pumping; pump from deep wells to infiltration galleries adjacent to water bodies or wetlands.

Table 3-5 Mitigation Measures, Residual Effects and Monitoring Plan: Surface Water and Groundwater

Potential Effect	Performance Objectives	Mitigation Strategy	Residual Effects	Monitoring Plan and Contingency Measures
		• Maintain emergency spill kits on site. • Pass groundwater from dewatering activities (if required) through a sediment filtration system prior to being discharged to a watercourse. • Control soil / water contamination through best management practices.		
Increased flows to watercourses from temporary groundwater dewatering (if required) discharges from turbine construction causing streambed and/or bank erosion and downstream sedimentation.	• Minimize increase in flows to watercourses and erosion and/or sedimentation.	**Erosion and Sediment Control** • Develop and implement an erosion and sediment control plan before commencement of construction. • Install erosion blankets, erosion control fencing, straw bales, etc., where necessary to mitigate potential excessive erosion and sedimentation. • Ensure any materials placed in floodline are free from silt and other such particles. • Maintain extra erosion and sediment control materials on site (e.g., heavy duty silt fencing, strawbales). • Maintain sediment and erosion control measures in place until disturbed areas have been stabilized (i.e., re-vegetated). • Schedule grading within 30 m of watercourses to avoid times of high runoff volumes. • Temporarily suspending work if excessive flows of sediment discharges occur until mitigation measures are in place. • Direct discharged water to an appropriately sized energy dissipating outlet device to prevent erosion at the point of discharge. **Water Management – See above** **Timing Windows – See above**	• **I**ncreased flows to watercourses and associated streambed and/or bank erosion minimized through application of mitigation measures. • Low likelihood and limited magnitude of effects as there will only be small scale dewatering (if required).	• Monitor erosion and sedimentation of receiving watercourse before and during dewatering events, including cross-sections, bank erosion pins and bed material. • Monitor water level and stream flow at these locations to test watercourse depth and flow speed before, during, and potentially after construction. • Analyze surface water samples from discharge locations for general chemistry (e.g., temperature, pH, dissolved oxygen, and conductivity), suspended solids, turbidity, nutrients and total metals (e.g., copper, iron, zinc and aluminum). These data will be used to determine background watercourse water quality at discharge locations. In conjunction with the streamflow measurements, these data will allow for site-specific loading calculations to determine watercourse assimilation capacity. • The findings of the monitoring program will be reported back to MOE following the completion of dewatering activities for the entire Project. • Contingency Measures: ▪ Install a temporary storage basin adjacent to foundation area to allow water to infiltrate.

Table 3-5 Mitigation Measures, Residual Effects and Monitoring Plan: Surface Water and Groundwater

Potential Effect	Performance Objectives	Mitigation Strategy	Residual Effects	Monitoring Plan and Contingency Measures
Increased erosion, sedimentation and turbidity from clearing and grubbing for construction of turbines, pads/turnaround areas, access roads, and temporary crane paths, and from directional drilling activities.	• Minimize erosion, sedimentation and turbidity.	**Erosion and Sediment Control – See above** **Grading and Excavation** • Minimize changes in land contours and natural drainage; maintain timing and quantity of flows. **Equipment Use** • Ensure machinery arrives on site in a clean, washed condition and is maintained free of fluid leaks. • Minimize vehicle traffic on exposed soils, avoid compacting or other hardening of natural ground surface, and avoid the movement of heavy machinery on areas with sensitive slopes. • Locate site maintenance, vehicle washing and refuelling stations where contaminants are handled at least 30 m away from natural features including water bodies and significant woodlands, wetlands, and wildlife habitat. • Implement vehicle and equipment cleaning procedures and practices to minimize or eliminate the discharge of pollutants from vehicle/ equipment cleaning operations to watercourses or natural areas. • Limit speed of vehicles near watercourse crossings.	• Increased erosion, sedimentation and turbidity from clearing and grubbing minimized through application of mitigation measures • Low likelihood and limited magnitude of effects as a result.	• Monitor on-site conditions (i.e., erosion and sediment control, spills, flooding, etc.) where construction occurs within 30 m of a water course on the following basis: ▪ Weekly during active construction periods. ▪ Prior to, during and post forecasted large rainfall events (>20 millimetres in 24 hours) or significant snowmelt events (i.e., spring freshet). ▪ Daily during extended rain or snowmelt periods. ▪ Monthly during inactive construction periods, where the site is left alone for 30 days or longer. • In the event that a spill / flooding occurs, the details of the event will be reported back to MOE, including a description of any assessment and remediation undertaken. • Contingency Measures: ▪ Suspend work if excessive flows of sediment discharges occur until mitigation measures are in place. ▪ Water samples will be analyzed for general chemistry (e.g., temperature, pH, dissolved oxygen, and conductivity), suspended solids, turbidity, nutrients and total metals (e.g., copper, iron, zinc and aluminum).
Soil compaction, which may result in hardening of surfaces and increased runoff into watercourses	• Minimize soil compaction and increased runoff into watercourses.	**Erosion and sediment control – See above** **Grading and Excavation – See above** **Water Quality – See above**	• Soil compaction and associated increase in runoff into watercourses minimized through application of mitigation measures • Low likelihood and limited magnitude of effects as a result.	• No monitoring or contingency measures required.
Release or discharge of sediment-laden surface water into the adjacent watercourse or drainage features from construction of turbines, access roads, collection lines, and water crossings	• Minimize release or discharge of sediment-laden surface water into adjacent watercourse or drainage features.	**Water Quality – See above** **Erosion and Sediment Control – See above** **Timing Windows – See above**	• Release or discharge of sediment laden surface water into the adjacent watercourse or drainage features minimized through application of mitigation measures • Low likelihood and limited magnitude of effects as a result.	• Monitor on-site conditions (i.e., erosion and sediment control, spills, flooding, etc.) where construction occurs within 30 m of a water course on the following basis: ▪ Weekly during active construction periods. ▪ Prior to, during and post forecasted large rainfall events (>20 millimetres in 24 hours) or significant snowmelt events (i.e., spring freshet). ▪ Daily during extended rain or snowmelt periods.

Table 3-5 Mitigation Measures, Residual Effects and Monitoring Plan: Surface Water and Groundwater

Potential Effect	Performance Objectives	Mitigation Strategy	Residual Effects	Monitoring Plan and Contingency Measures
				▪ Monthly during inactive construction periods, where the site is left alone for 30 days or longer. • In the event that a spill / discharge of sediment occurs, the details of the event will be reported back to MOE, including a description of any assessment and remediation undertaken. • Contingency Measures: ▪ Suspend work if excessive flows of sediment discharges occur until mitigation measures are in place. ▪ Water samples will be analyzed for general chemistry (e.g., temperature, pH, dissolved oxygen, and conductivity), suspended solids, turbidity, nutrients and total metals (e.g., copper, iron, zinc and aluminum).
Obstruction of lateral flows in watercourses from water crossings	• Minimize obstruction of lateral flows in watercourses.	**Stream Flow** • Design and install culverts to prevent creation of barriers to fish movement and maintain bankfull channel functions. • Design culverts to accommodate high flows of the watercourse. • Embed the culvert below the streambed to maintain lateral flow. • Install adequate gravel base to maintain flow of shallow groundwater. • Locate crossings within straight sections of the stream, perpendicular to the bank. Avoid crossings on meander bends, braided streams and any other unstable areas. • Use only clean material (i.e., rock or coarse gravel) for approaches to culverts. **Isolated Crossing** • Install in-water works for permanent water bodies in the dry via dam and pump method or creation of a diversion channel to maintain flow around the work site. For intermittent water bodies, work is preferred to be completed in the dry and carried out during seasonally dry or when the water body is frozen to the bottom.	• Obstruction of lateral flows in watercourses avoided through application of mitigation measures. • No likelihood of effect occurring.	• No monitoring or commitments required.

Table 3-5 Mitigation Measures, Residual Effects and Monitoring Plan: Surface Water and Groundwater

Potential Effect	Performance Objectives	Mitigation Strategy	Residual Effects	Monitoring Plan and Contingency Measures
		• Develop and implement a fish rescue plan for dewatering areas. This will include appropriate sized end-of-pipe fish screen to prevent potential losses of fish due to entrainment or impingement as outlined in the DFO Freshwater Intake End-of-Pipe Fish Screen Guideline. • Retain an adequate portion of channel with sufficient width and depth to allow for fish passage if construction requires that an instream work area be isolated from the primary channel. In the event that an area must be blocked from bank to bank, construct a temporary by-pass to allow fish passage around the construction area.		
Temporary disruption of substrates/habitat associated with in-water works	• Minimise temporary disruption of substrates/habitats.	**Timing Windows – See above** **Isolated Crossing – See above** **Erosion and Sediment Control – See above** **Rehabilitation** • Re-vegetate and restore the turbine staging area following turbine installation with tiling (if desired by the owner). • Restore and maintain vegetative buffers around water bodies including within the foundation footprint where possible. • Restore and maintain vegetative buffers around water bodies including within the temporary construction areas. • Keep vegetation removal to a minimum. • Add suitable stream substrates (e.g., gravel or rip rap) to stabilize sediment and provide cover.	• Temporary disruption of substrates/habitat associated with in-water works minimized through application of mitigation measures. • Moderate likelihood and magnitude of effect occurring due to number of watercourse crossings.	• Monitor fish habitat throughout duration of in-water construction to identify any minor or major disturbances caused by construction activities by undertaking the following : ▪ Temperature monitoring with the use of temperature data loggers set to record every hour and downloaded at end of each day; ▪ Turbidity monitoring for sediment loading; ▪ Monitoring bank stability; ▪ Monitoring substrate composition; ▪ Monitoring stream flow and ensure fish passage is maintained at all times. • Document changes to aquatic habitat as a result of construction activities and obtain photographic documentation. • The findings of the monitoring program will be reported back to MOE following the completion of in-water construction activities for the entire Project. • Contingency Measures: ▪ Mitigate or compensate for any harmful alteration, disruption or destruction (HADD) of fish habitat according to Department of Fisheries and Oceans Canada (DFO) authorization and in consultation with ABCA and MNR.

Table 3-5 Mitigation Measures, Residual Effects and Monitoring Plan: Surface Water and Groundwater

Potential Effect	Performance Objectives	Mitigation Strategy	Residual Effects	Monitoring Plan and Contingency Measures
Degradation of fish habitat.	• Minimize degradation of fish habitat.	**Stream Flow – See above**	• Degradation of fish habitat minimized through application of mitigation measures. • Moderate likelihood of effect occurring due to number of watercourse crossings; however, magnitude of effect limited due to marginal habitat and common species; as such fish passage will be maintained and will continue to provide habitat.	• Monitor fish habitat throughout duration of in-water construction to identify any minor or major disturbances caused by construction activities. • Document changes to aquatic habitat as a result of construction activities and obtain photographic documentation. • Contingency Measures: ▪ Mitigate or compensate for any harmful alteration, disruption or destruction (HADD) of fish habitat according to Department of Fisheries and Oceans Canada (DFO) authorization and in consultation with ABCA and MNR.
Increase sediment runoff and decrease bank stability from stream diversion for the installation of watercourse crossing resulting in changes in water chemistry and temperature.	• Minimize sediment runoff.	**Work Area** • Stabilize banks where necessary, minimizing the area and duration of soil exposure. • Operate machinery on land and in a manner that minimizes disturbance to stream banks. • Erect sediment fencing around water bodies and areas to be avoided (i.e., near unstable banks, vegetation communities). • Locate staging areas away from watercourses to limit risk of impacts to aquatic habitat. **Timing Windows – See above** **Isolated Crossing – See above** **Stream Flow – See above** **Water Management – See above**	• Sedimentation and decrease in bank stability minimized through application of mitigation measures. • Low likelihood and limited magnitude of effect on water chemistry and temperature.	• Monitor fish habitat throughout duration of in-water construction to identify any minor or major disturbances caused by construction activities by undertaking the following : ▪ Temperature monitoring with the use of temperature data loggers set to record every hour and downloaded at end of each day; ▪ Turbidity monitoring for sediment loading; ▪ Monitoring bank stability; ▪ Monitoring substrate composition; ▪ Monitoring stream flow and ensure fish passage is maintained at all times. • Document changes to aquatic habitat as a result of construction activities and obtain photographic documentation. • The findings of the monitoring program will be reported back to MOE following the completion of in-water construction activities for the entire Project. • Monitor fish habitat throughout duration of in-water construction to identify any minor or major disturbances caused by construction activities. • Document changes to aquatic habitat as a result of construction activities and obtain photographic documentation. • Contingency Measures: ▪ Mitigate or compensate for any harmful alteration, disruption or destruction (HADD) of fish habitat according to Department of Fisheries and Oceans Canada (DFO) authorization and in consultation with ABCA and MNR.

Table 3-5 Mitigation Measures, Residual Effects and Monitoring Plan: Surface Water and Groundwater

Potential Effect	Performance Objectives	Mitigation Strategy	Residual Effects	Monitoring Plan and Contingency Measures
Soil/water contamination by oils, grease and other materials from construction equipment.	• Minimize soil/water contamination.	**Equipment Use – See above** **Material Stockpiling and Handling** • Store any stockpiled materials away from natural features to prevent deleterious substances from inadvertently discharging to the environment. • Dispose of any waste material from construction activities by authorized and approved off-site vendors. **Water Quality – See above** **Timing Windows – See above**	• Soil / water contamination minimized through application of mitigation measures. • Low likelihood and limited magnitude of effects on surface water and groundwater as a result.	• Conduct daily inspections of construction equipment for leaks / spills. • Contingency Measures: ▪ Install a spill collection pad for refuelling and maintenance. ▪ Notify MOE's Spills Action Centre of any leaks or spills. ▪ Assess and remediate affected soils and water. ▪ Water samples will be analyzed for general chemistry (e.g., temperature, pH, dissolved oxygen, and conductivity), suspended solids, turbidity, nutrients and total metals (e.g., copper, iron, zinc and aluminum).
Fractures in substrate releasing pressurized drilling fluids into watercourse and causing potential change to groundwater flow patterns due to directional drilling.	• Minimize fractures in substrates and release of pressurized drilling fluids into watercourse.	**Directional Drilling** • Conduct all drilling by licensed drillers in accordance with Regulation 903 under Ontario Water Resources Act, R.S.O. 1990. • Locate drill entry and exit pits at least 30 m from water bodies. • Collect drill cuttings as they are generated and place in a soil bin or bag for off-site disposal. • Ensure drill depth is at an appropriate depth below the water body to reduce the risk of a 'frac-out'. **Water Quality – See above**	• Fractures in substrate releasing pressurized drilling fluids into watercourse and causing potential change to groundwater flow patterns minimized through application of mitigation measures. • Low likelihood of effects as a result of mitigation measures; however magnitude of effects could be high as benthic invertebrates, aquatic plants and fish and their eggs could be smothered by the fine particles if bentonite were discharged to waterways.	• Monitor directional drilling for the duration of such activities to ensure that "frac-out" does not occur, and if it does, to ensure that there are no effects on surface or groundwater. • Contingency Measures: ▪ In the event of a "frac-out", immediately stop all work, including the recycling of drilling mud / lubricant. ▪ Monitor "frac-out" for 4 hours to determine if the drilling mud congeals. If drilling mud congeals, take no other action that would potentially suspend sediments in the water column. If drilling mud does not congeal, erect isolation/containment environment (underwater boom and curtain). ▪ If the fracture becomes excessively large, engage a spill response team to contain and clean up excess drilling mud in the water. ▪ If the spill affects and area that is vegetated, the area will be seeded and/or replanted using species similar to those in the adjacent area, or allowed to re-grow from existing vegetation. Revegetated areas will be monitored twice per year for two years subsequent to "frac-out" to confirm revegetation is successful. ▪ Document post-cleanup conditions with photographs and prepare "frac-out" incident report describing time, place, actions taken to remediate "frac-out" and measures implemented to prevent recurrence. Provide incident report to MNR and MOE within 30 days of the incident.

3.3.3 Geology and Groundwater

A desktop study was conducted to identify potential effects to the groundwater from the construction and installation of the Project. Materials used included MOE Water Well Records, geological descriptions from the Ontario Geological Survey (OGS), air photos and Geographic Information System (GIS), as well as the turbine layout for the Project Site and turbine construction details.

The predominant overburden material throughout the Project Site is the St. Joseph Till, which is characterized by glaciolacustrine-derived silty to clayey till (OGS, 2003). The St. Joseph Till has a high clay content which likely restricts infiltration and groundwater movement. Therefore shallow groundwater transport is likely through the weathered overburden flowing west toward Lake Huron or is vertical along fractures until it reaches a flow path at depth. Groundwater recharge areas within the Project Study Area are restricted to the small patches of high permeable soils of beach ridge and glacial outwash deposits found running north-south in the centre of the Project Study Area (OGS, 2003). The surface topography is influenced by the Wyoming Moraine, producing the typical hummocky/rolling topography of this area. The largest north-south glaciolacustrine deposit has been designated as a Significant Groundwater Recharge Area (SGRA) by the Government of Ontario and also houses the Hay Swamp Provincially Significant Wetland (PSW), the only PSW within the Project Study Area.

The bedrock of the Project Study Area is limestone of the Dundee formation and the Detroit River Group (Johnson *et al*., 1992). Bedrock topography slopes westerly towards Lake Huron. There are two mapped sink holes within the Study Area which indicate that Karst Topography is present within the limestone bedrock in the area.

Available MOE water well records within the Project Study Area indicate that the majority of the water supply wells within the area are screened within bedrock aquifers with static water levels greater than 30 m below ground surface (mbgs). Perched conditions are expected to exist within the overburden, especially to the west of the Site closer to Lake Huron and near the eastern border of the Project Site. Shallow water table conditions may be encountered during construction of the turbines, especially near to surface water bodies such as streams and wetlands.

Any water taking conducted during the construction phase is subject to the Renewable Energy Approval application and as such does not require a separate Permit to Take Water (MOE, 2011). The extraction of groundwater for construction dewatering purposes is expected to be low volume due to the short duration of dewatering activities (3 to 4 days per turbine base), and the shallow depth of the turbine bases (up to 4 mbgs). However, there is the potential that water taking could be greater than 50,000 L/day depending on the number of turbine foundations / collection line trenches installed at one time[1], the surficial material being excavated (sand/silt or silty/clayey till based on surficial conditions reported by the Ontario Geological Survey and the available MOE Water Well Records for the Study Area), and the amount of precipitation received during construction activities.

As such the water taking may be classified as Groundwater – Category 2 (short-term, non-recurring taking less than 30 consecutive days and less than 400,000 L/day). Appendix A contains detailed calculations on the dewatering estimates and radii of influence for the construction dewatering. Based on these calculations the conservative water taking per turbine base excavation could range from 13,000 L/day to 84,000 L/day with calculated radii of influence for the construction dewatering of 15 m and 102 m for the silty/clayey till unit and the sand/silt unit respectively. As noted previously, all turbine locations are a minimum of 120 m from any natural features or structures, and therefore the calculated maximum radius of influence is within the 120 m buffer zone. Based on the information above the proposed water taking is unlikely to result in significant impacts to the environment.

1. Requires that a maximum of one foundation for turbines within the sand / silt unit be excavated at a time

As these calculations are based on estimations from the available data, it is recommended that at least one geotechnical borehole be drilled for each turbine base location and these calculations be revisited using the new soil data found from the geotechnical investigations.

3.3.3.1 Potential Effects

Potential effects from construction and installation activities are as follows:

- Dewatering when excavating and constructing the turbine bases, resulting in a reduction in quality and quantity of groundwater.
- Increase in impervious area created by the turbine base and access roads resulting in reduced infiltration near to the noted groundwater recharge areas (beach ridge and glacial outwash deposits).
- Formation of sinkholes during foundation construction.

3.3.4 Mitigation Measures, Residual Effects and Monitoring Plan

Table 3-6 provides mitigation measures, residual effects and the monitoring plan for each potential effect identified above.

Table 3-6 Mitigation Measures, Residual Effects and Monitoring Plan: Geology and Groundwater

Potential Effect	Performance Objectives	Mitigation Strategy	Residual Effects	Monitoring Plan and Contingency Measures
Reduction in groundwater quality and quantity due to dewatering when excavating and constructing the turbine bases.	• Minimize reduction in groundwater quality and quantity.	• Restrict dewatering during extreme low flow conditions (i.e., high summer) and direct the discharge from dewatering back into the nearest watercourse (following sediment control practices) to negate the potential that drawdown will decrease baseflow into streams. • Maintain a setback of 120 m from the nearest water wells, buildings, and significant natural features. • Avoid excavating more than one foundation at a time for turbines within the sand / silt unit (Turbine Numbers 29, 30, 31, 34, 35, and 40).	• Reduction in groundwater quality and quantity minimized through application of mitigation measures. • Low likelihood and negligible magnitude of effects based on amount of dewatering required and distance between known water wells, buildings, and significant natural features (> 120 m) and dewatering activities.	• As no water wells, buildings, or significant natural features are located within the calculated radius of influence for construction dewatering, no monitoring or contingency measures are required.
Increase in impervious area created by the turbine base and access roads resulting in reduced infiltration near to the noted ground-water recharge areas (beach ridge and glacial outwash deposits).	• Minimize increase in impervious areas.	• Direct runoff from the constructed impervious surfaces to ground surface to prevent any decrease in infiltration and recharge.	• Reduced infiltration near groundwater recharge areas minimized through application of mitigation measures. • Low likelihood and limited magnitude of effects based on amount of dewatering required.	• No monitoring or contingency measures required.
Formation of sinkholes during foundation construction.	• Minimize formation of sinkholes.	• Conduct geotechnical investigations at all turbine locations prior to construction.	• Formation of sinkholes avoided through application of mitigation measures. • No likelihood of occurrence.	• No monitoring or contingency measures required.

3.4 Emissions to Air

Construction and installation activities require the operation of equipment, including trucks, cranes, and bulldozers, which represent a source of air emissions from the engines in addition to the generation of dust.

3.4.1 Potential Effects

Potential effects from construction and installation activities are as follows:

- Emissions of contaminants from portable generator sets, truck traffic and other construction vehicles, including but not limited to, nitrogen dioxide, sulphur dioxide, suspended particulates, emissions of greenhouse gases (CO2, methane).
- Dust as a result of vehicle traffic over gravel roads and/or cleared areas.

No emissions of odours are anticipated.

3.4.2 Mitigation Measures, Residual Effects and Monitoring Plan

Table 3-7 provides mitigation measures, residual effects and the monitoring plan for each potential effect identified above.

Table 3-7 Mitigation Measures, Residual Effects and Monitoring Plan: Emissions to Air

Potential Effect	Performance Objectives	Mitigation Strategy	Residual Effects	Monitoring Plan and Contingency Measures
Increased dust and air emissions due to construction activity.	• Minimize deterioration of air quality.	• Use spray water and environmentally friendly dust suppressants applied at an environmentally acceptable rate to minimize the release of dust from gravel, paved areas and exposed soils only where necessary on problem areas; • Implement a speed limit that will lead to reduced disturbance of dust on paved and unpaved roads; and, • Ensure proper maintenance of vehicles and machinery to limit noise, Criteria Air Contaminant (CAC) emissions and leaks.	• Increased dust and air emissions minimized through application of mitigation measures. • High likelihood of effects occurring; however, any dust and air emissions are short-term and magnitude of such effects will be limited.	• Track all complaints and conduct follow-up monitoring (see Complaints Resolution Process in Emergency Response and Communications Plan). • Contingency Measures: ▪ Suspend construction in high winds.

3.5 Noise

As discussed above, construction activities require the operation of equipment, including trucks, cranes and bulldozers that generate noise.

3.5.1 Potential Effects

Potential effects from construction and installation activities are as follows:

- An increase in noise levels due to trucks, cranes and other equipment used to construct the turbines and ancillary infrastructure.

3.5.2 Mitigation Measures, Residual Effects and Monitoring Plan

The following table provides mitigation measures, residual effects and the monitoring plan for each potential effect identified above.

Table 3-8 Mitigation Measures, Residual Effects and Monitoring Plan: Noise

Potential Effect	Performance Objectives	Mitigation Strategy	Residual Effects	Monitoring Plan and Contingency Measures
Increased noise due to construction activity.	• Minimize noise increases for inhabited areas.	• Ensure that construction equipment is kept in good condition and does not exceed noise emissions as specified in MOE publication NPC-115. • Operate construction vehicles in accordance with municipal by-laws. • Implement speed limit on unpaved roads.	• Increased noise minimized through application of mitigation measures. • High likelihood of effect occurring; however, increase in noise levels associated with construction is short-term and magnitude of such effects will be limited.	• Track all complaints and conduct follow-up monitoring (see Complaints Resolution Process in Emergency Response and Communications Plan). • Contingency Measures: ▪ Repair faulty equipment resulting in increased noise levels in a timely fashion.

3.6 Local Interests, Land Use and Infrastructure

Land uses within 300 m of the Study Area were identified through the REA planning process and in consultation with the Municipalities, MTO and local landowners. The following section describes the results of the effects assessment for the construction phase of the Project.

3.6.1 Existing Land Uses and Infrastructure

Common agricultural land uses in southern Huron County are cash crops (e.g., soybeans, corn and wheat) and livestock farming. Other land uses include non-farm residential uses on separate lots created through severances for farm retirement lots, surplus farm dwelling lots and older estate lots, which are scattered throughout the Study Area in limited numbers.

3.6.1.1 Potential Effects

Potential effects from construction and installation activities on local interests, land use and infrastructure may include:

- Minor reduction in usable agricultural land.
- Increased congestion due to increase in truck traffic and short-term lane closures on local roads during delivery of project components.
- Disruption or damage to local infrastructure such as roads, water and sewage pipelines.

3.6.2 Mitigation Measures, Residual Effects and Monitoring Plan

Table 3-9 provides mitigation measures, residual effects and the monitoring plan for each potential effect identified above.

Table 3-9 Mitigation Measures, Residual Effects and Monitoring Plan: Local and Provincial Interests, Infrastructure and Land Use

Potential Effect	Performance Objectives	Mitigation Strategy	Residual Effects	Monitoring Plan and Contingency Measures
Minor reduction in usable agricultural land.	• Minimize reduction in usable agricultural land.	• Minimize length of access roads (most agricultural use only affected during construction) where possible.	• Minor reduction in usable agricultural land minimized through application of mitigation measures. • High likelihood of effect occurring; however, however limited magnitude due to size of overall footprint within the entire Project Study Area.	• No monitoring or contingency measures required.
Increased congestion due to increase in truck traffic and short-term lane closures on local roads during delivery of project components.	• Minimize disturbances to local traffic patterns.	• Develop a traffic management plan for the construction phase and submit to the Municipalities prior to construction; and, • Notify the community in advance of construction delivery schedules and install signage to notify road users of construction activity.	• Increased congestion due to increase in truck traffic and short-term lane closures minimized through application of mitigation measures. • High likelihood of effect occurring; however, limited magnitude due to spread-out nature of the project and duration of lane closures.	• Track all complaints and conduct follow-up monitoring (see Complaints Resolution Process in Emergency Response and Communications Plan). • Contingency Measures: ▪ Establish alternate delivery routes.
Damage to local infrastructure	• Minimize damage to local infrastructure.	• Adhere to best practices regarding the operation of construction equipment and delivery of construction materials; and, • Undertake roads condition survey prior to construction and post-construction.	• Damage to local infrastructure minimized through application of mitigation measures. • Moderate likelihood and magnitude of effects occurring due to presence oversize loads during delivery of turbine components.	• Track all complaints and conduct follow-up monitoring (see Complaints Resolution Process in Emergency Response and Communications Plan). • Contingency Measures: ▪ Return damaged infrastructure to original condition (or better) where appropriate.

3.7 Areas Protected Under Provincial Plans and Policies

The REA requires a determination as to whether the Project is being proposed in any of the following protected or plan areas:

- Protected Countryside or Natural Heritage Systems in the Greenbelt Plan;
- Oak Ridges Moraine Conservation Plan Areas;
- Niagara Escarpment Plan Area; or
- Lake Simcoe Watershed Plan Area.

The proposed Bluewater Wind Energy Centre is not proposed in any of these protected or plan areas. As such, there will be no effects on these areas as a result of the Project.

3.8 Public Health and Safety

Effects on public health and safety during construction have been described in sections 3.4 (Emissions to Air, including Odour and Dust), 3.4 (Noise), and 3.6 (Local and Provincial Interests, Land Use and Infrastructure).

3.9 Other Resources

There are three authorized aggregate resources located within the Project Study Area. The first aggregate resource is a 36 ha site owned by Huron County and has a Class A Licence for over 20,000 tonnes. This is located 1,510 m from the nearest Project infrastructure (access road to Turbine 33). The second aggregate resource is a 19 ha site owned by G. Heard Construction Limited and has a Class B Licence for 20,000 tonnes or less. This is located 402 m from the nearest Project infrastructure (access road to Turbine 7). The third aggregate resource is a 4 ha Class B site licensed to Donald G. Heard, but which has since been surrendered. This is located 242 m from the nearest Project infrastructure (transmission line).

There are no landfill or forest resources located within the Project Study Area.

There are two locations where project infrastructure is located within 75 m of a petroleum resource:

- The collection line between Turbines 16 and 26 is approximately 62 m from a petroleum resource.
- The turnaround box for Turbine 9 is approximately 35 m from a petroleum resource.

3.9.1 Potential Effects

No effects on aggregate resources or petroleum wells are anticipated as a result of the construction phase of the Project due to the distance between the project and these resources. In addition, there are no effects on landfills or forest resources as none are present.

4. Summary and Conclusions

Field work and data collection was undertaken to determine the potential effects to the various environmental and social features that may be affected by this Project during the construction and installation phase of the Project. Mitigation measures to manage these potential effects have been identified and monitoring and contingency plans proposed to ensure effects are minimized as outlined above.

The overall conclusion of this *Construction Plan Report* is that this project can be constructed and installed without any significant adverse residual effects.

5. References

Cooper, A.J., 1979:
Quaternary Geology of the Grand Bend-Parkhill Area, Southern Ontario. Ontario Geological Survey Report 188, 70 p.

Freeze, R.A. and J.A. Cherry, 1979:
Groundwater. Prentice-Hall, Inc., Englewood Cliffs, N.J., P. 29, Table 2.2.

Government of Ontario, 2010:
Renewable Energy Approvals Technical Bulletin One: Guidance for Preparing the Project Description Report as Part of an Application under O. Reg. 359/09. Ontario: Queen's Printer.

Johnson, M.D., D.K. Armstrong, B.V. Sanford, P.G. Telford and M.A. Rutka, 1992:
Paleozoic and Mesozoic Geology of Ontario: *in* Geology of Ontario, Ontario Geological Survey, Special Volume 4, Part 2, p.907-1010

Ontario Ministry of the Environment, 2011:
Technical Guide to Renewable Energy Approvals. Available: http://www.ene.gov.on.ca/stdprodconsume/groups/lr/@ene/@resources/documents/resource/stdprod_088422.pdf

Ontario Ministry of Natural Resources, 2010:
Biodiversity Explorer, Natural Heritage Information Centre. Accessed June 2010. Available: http://nhic.mnr.gov.on.ca/

Ontario Ministry of Natural Resources, 2008:
Noise Guidelines for Wind Farms. Ontario: Queen's Printer.

Appendix A

Hydrogeological Calculations for Dewatering Activities

Appendix A. Hydrogeological Calculations for Dewatering Activities

1. Introduction

As described in the *Technical Guide to Renewable Energy Approvals (MOE, 2011)*, an important environmental effect to consider in the Construction Plan report is the potential for the Project to interfere with existing uses of a water resource.

Section 3.3.3 (Geology and Groundwater) of the Construction Plan Report determines that the extraction of groundwater for construction dewatering purposes should be less than 50,000 litres per day (L/day). This is attributable to the following reasons:

- A short duration of dewatering activities (3-4 days per turbine base);
- The number of turbine foundations / collection line trenches installed at one time; and
- The surficial material being excavated.

2. Calculation of Water Takings

A conservative estimate of 73,000 L/day for a turbine foundation excavation in the sand/silt unit running down the centre of the Project Study Area, and 2,300 L/day for the silty/clayey till unit covering the majority of the Project Study Area were calculated. These values were calculated based on an assumed excavation of 21 x 21 m and 4 m deep with a drawdown of 3 m. The hydraulic conductivity was assumed to be 1.00E-04 m/s for the sand/silt unit and 1.00E-07 m/s for the silty/clayey till. Allowing for the additional pumping required following a precipitation event, calculations were completed for a 5 year storm event (25 mm over a 24 hour period) with the result that an additional 11,000 L/day could be added to the water taking for each turbine base excavation.

In addition, the calculated radii of influence for the construction dewatering were 102 m and 15 m for the sand/silt unit and the silty/clayey till unit respectively.

The analytical calculations used to determine the predicted groundwater inflow and radii of influence were based upon Powers *et al.* (2007)[1] and Sichart *et al.* (1930)[2].

Table 1 summarizes the predicted groundwater inflow and radii of influence.

Table 2 shows the calculations used to determine the radius of influence and groundwater inflow for the sand/silt unit.

Table 3 shows the calculations used to determine the radius of influence and groundwater inflow for the silty/clayey till unit.

Figure 1 graphically represents the radii of influence from construction dewatering for an excavation for a turbine foundation for each unit.

1. *Powers, J.P, Corwin, A.B., Schmall, P.C., Kaeck, W.E., and Herridge, C.J., 2007. Construction Dewatering and Groundwater Control: New Methods and Applications, 3rd Ed. John Wiley and Sons Inc.*
2. *Sichart, W. and Kyrieleis, W., 1930. Grundwasser Absekungen bei Fundierungsarbeiten. Berlin, Germany.*

Table 1. Summary of Predicted Groundwater Inflow and Radii of Influence

Area:	Excavation for base of single turbine
Reference DWGS:	
Initial Head:	3 m
Final Head:	0 m
Excavation Length:	21 m
Side Slope Wall Ratio:	Varies, but assume 1H:1V for calculation
Trench Width:	21 m
Number of Sides:	4
Silty/Clayey Till Hydraulic Conductivity:	1.00E-07 m/s
Sand/Silt Hydraulic Conductivity	1.00E-05 m/s

	Hydraulic Conductivity (m/s)			
	Silty/Clayey Till	***1.00E-07***	***Sand/Silt***	***1.00E-05***
Q (L/d)	2,295		22,951	
ROI (m)	15		40	

Table 2. Radius of Influence and Groundwater Inflow Rate Calculations (Sand/Silt Unit)

Radius of Influence and Groundwater Inflow Rate Calculations - Unconfined Aquifer

After: Powers et al, 2007 & Sichart and Kryieleis, 1930.
USE FOR BOX SHAPED EXCAVATIONS, WHERE x/a IS SMALL (I.E. <1.5)

Spreadsheet Instructions
Edit
Results

x/a 1

Radius of Influence

Ro = 3000(H-h)K^1/2

Sichardt's empirical relationship

Raduis of Influence	Ro =	90.00	m
Saturated Thickness before Dewatering	H =	3	m
Saturated Thickness after Dewatering	h =	0	m
Hydrualic Conductivity	K =	1.00E-04	m/s
Number of Sides	n =	4	

Equivalent Radius of Influence for Square or rectangular shaped areas

$r_e = (ax/Pi)^{1/2}$

Width of Trench	a =	21	m
Length of Trench	x =	21	m
Pi	3.1415926		
Equiv Radius of Infleunce	r_e =	11.85	m

Therefore, the Total Radius of Influence equals $R_T = Ro + r_e$

R_T = 101.85 m

Groundwater Seepage Rate

Jacob's modified non-equilibrium equation**

Q= [(xK(H^2-h^2)/2L]*n

Radius of Influence	Ro =	90.00	m
Equiv Radius of Infleunce	r_e =	11.8	m
Saturated Thickness before Dewatering	H =	3	m
Saturated Thickness after Dewatering	h =	0	
Hydrualic Conductivity	K =	1.00E-04	m/s
Length of Trench	x =	21	m
Line Source Distance*	L =	45	m
Pi	3.1415926		
Groundwater Inflow Rate	Q =	8.40E-04	m3/s
	Q =	72,576	L/day
Sheet Pile % reduction	%	0	%
Revised Total Groundwater Inflow Rate	Q' =	72,576	L/day

Notes:

*** Only good for horizontal flow, need to use darcy for vertical flow*

*** First Term is for Gravity Flow*

*** Second Term is for artesian flow (confined aquifer)*

**Line source distance is the distance where the confined aquifer is drained (i.e., under gravity flow conditions), but the confining unit is still flowing under pressure*

References:

Powers, J.P, Corwin, A.B., Schmall, P.C., Kaeck, W.E., and Herridge, C.J., 2007. Construction Dewatering and Groundwater Control: New Methods and Applications, 3rd Ed. John Wiley and Sons Inc

Sichart, W. and Kyrieleis, W., 1930. Grundwasser Absekungen bei Fundierungsarbeiten. Berlin, Germany.

Table 3. Radius of Influence and Groundwater Inflow Rate Calculations (Silty/Clayey Till)

Radius of Influence and Groundwater Inflow Rate Calculations - Unconfined Aquifer

After: Powers et al, 2007 & Sichart and Kryieleis, 1930.

USE FOR BOX SHAPED EXCAVATIONS, WHERE x/a IS SMALL (I.E. <1.5)

x/a 1

Spreadsheet Instructions

Edit

Results

Radius of Influence

Ro = 3000(H-h)K^1/2

Sichardt's empirical relationship

Raduis of Influence	Ro =	2.85	m
Saturated Thickness before Dewatering	H =	3	m
Saturated Thickness after Dewatering	h =	0	m
Hydrualic Conductivity	K =	1.00E-07	m/s
Number of Sides	n =	4	

Equivalent Radius of Influence for Square or rectangular shaped areas

r_e = (ax/Pi)^1/2

Width of Trench	a =	21	m
Length of Trench	x =	21	m
Pi		3.1415926	
Equiv Radius of Infleunce	r_e =	11.85	m

Therefore, the Total Radius of Influence equals $R_T = Ro + r_e$

R_T = 14.69 m

Groundwater Seepage Rate

Jacob's modified non-equilibrium equation**

Q= [(xK(H^2-h^2)/2L]*n

Radius of Influence	Ro =	2.85	m
Equiv Radius of Infleunce	r_e =	11.8	m
Saturated Thickness before Dewatering	H =	3	m
Saturated Thickness after Dewatering	h =	0	
Hydrualic Conductivity	K =	1.00E-07	m/s
Length of Trench	x =	21	m
Line Source Distance*	L =	1.423024947	m
Pi		3.1415926	
Groundwater Inflow Rate	Q =	2.66E-05	m3/s
	Q =	2,295	L/day
Sheet Pile % reduction	%	0	%
Revised Total Groundwater Inflow Rate	Q' =	2,295	L/day

Notes:

*** Only good for horizontal flow, need to use darcy for vertical flow*

**First Term is for Gravity Flow*

***Second Term is for artesian flow (confined aquifer)*

**Line source distance is the distance where the confined aquifer is drained (i.e., under gravity flow conditions), but the confining unit is still flowing under pressure*

References:

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Sichart, W. and Kyrieleis, W., 1930. Grundwasser Absekungen bei Fundierungsarbeiten. Berlin, Germany.

Figure 1. Radii of Influence from Construction Dewatering