Samsung Renewable Energy Inc. and

Pattern Renewable Holdings Canada ULC

3 Construction Plan Report

For

Armow Wind Project

Summary of Report Revisions

Section of Report	Report Date: August, 2012	Report Date: September, 2012	Report Date: November, 2012	Report Date: REA Submission November, 2012
Section 4.0	The following construction-specific potential effects and mitigation measures have been identified and analyzed for any negative environmental effects that may result from construction/installation activities within 120 m from the boundary of the Project Location.	Revised: The following construction-specific potential effects and mitigation measures have been identified and analyzed for any negative environmental effects that may result from construction/installation activities within 300 m from the boundary of the Project Location.		
Section 4.2.1	Significant wildlife habitat are discussed in more detail in the Draft Natural Heritage Assessment Environmental Impact Study, which considers the following wildlife habitat types: waterfowl stopover and staging areas (terrestrial and aquatic), shorebird migratory stopover areas, bat maternity colonies, colonial-nesting bird breeding habitats (tree/shrub and ground), waterfowl nesting areas, winter deer yards, amphibian breeding habitats (woodland), marsh bird breeding habitats, and, open country bird breeding habitat.	Revised: Significant wildlife habitat are discussed in more detail in the Draft Natural Heritage Assessment Environmental Impact Study, which considers the following wildlife habitat types: waterfowl stopover and staging areas (terrestrial and aquatic), shorebird migratory stopover areas, bat maternity colonies, colonial-nesting bird breeding habitats (tree/shrub and ground), waterfowl nesting areas, winter deer yards, amphibian breeding habitats (woodland), marsh bird breeding habitats, and, open country bird breeding habitat.		

Section 4.2.2	Construction activities occurring in close proximity to woodlots will use tree protection fencing or implement a tree preservation plan and wildlife habitats within 30m of construction activities will be delineated to avoid disturbance or damage.	Revised: Construction activities occurring in close proximity to woodlots will use erosion control fencing and wildlife habitats within 30m of construction activities will be delineated to avoid disturbance or damage.		
Section 4.2.2		Deleted (repetitive sentence): In addition, vegetation removal will be done outside of identified breeding seasons for locally breeding bird species.		
Section 4.2.4		Added: Reference to Table 8		
Table 8		Added: Table 8: Summary of Removal of Vegetation and Habitat Environmental Effects Monitoring Plan		
Throughout Report		Updated: Table references as a result of Table 8 being added		
Table 2		Project Lifespan (approval to decommissioning)	Revised: Project Lifespan (commercial operation)	
Section 2.0			Added: A microwave tower	

Table 4		Up to three meteorological towers are proposed to be constructed within the Project Study Area (see Figure 1).	Revised/Added: Up to three meteorological towers are proposed to be constructed up to 100m tall within the Project Study Area (see Figure 1). The meteorological towers will be constructed on a concrete foundation or guyed.	
Table 4			Added: Microwave Tower A microwave tower used for communication purposes will be constructed within the substation construction disturbance area. The microwave tower will be up to 100m tall and constructed on a concrete foundation or guyed	
Section 3.2.8			Added: Junction boxes may contain equipment related to splices, junctions, cable splices, and disconnect switches.	

Section 3.2.8		Where the underground collector lines must be spliced, a splice pit measuring up to 1.2 m deep, 1 m wide, and 2 m long will be excavated. The splice boxes will be either below or aboveground.	Revised: Where the underground collector lines must be joined, a junction pit measuring up to 1.2 m deep, 1 m wide, and 2 m long will be excavated. The junction boxes will be either below or aboveground.	
Table 6			Added: Microwave Tower	
Section 4.3.3.3			Added: If pile type foundations are determined to be suitable at some locations, no adverse impacts to the water table are anticipated.	
General Update			A total of 99 turbines will be permitted to provide contingency positions.	Revised: A total of 98 turbines will be permitted to provide contingency positions.
3.9				Added: Emergency Response Plan
3.10				Added: Health and Safety Plan

November 2012

SP ARMOW ONTARIO LP
ARMOW WIND PROJECT

Construction Plan Report

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REPORT

Golder Associates

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1.0 GENERAL INFORMATION

The Armow Wind Project (the "Project") is an up to 180 megawatt (MW) commercial wind energy generation facility located substantially on leased privately owned lands in the Municipality of Kincardine, Bruce County, Ontario (see Figure 1). The Project is being developed by SP Armow Wind Ontario GP Inc., in its capacity as general partner of SP Armow Wind Ontario LP (the "Proponent"). The Proponent is a joint venture limited partnership owned by affiliates of Pattern Renewable Holdings Canada ULC ("Pattern") and Samsung Renewable Energy Inc. ("Samsung"). The Proponent is proposing to develop, construct, and operate the Project in response to the Government of Ontario's plan to integrate more renewable energy into the province's power grid.

In 2009, the Government of Ontario introduced the *Green Energy and Green Economy Act* and Ontario Regulation (O. Reg.) 359/09. The regulatory amendments to O. Reg. 359/09 came into force on July 1, 2012 as O. Reg. 195/12[1]. The Renewable Energy Approval ("REA") integrates previous requirements under the *Environmental Assessment Act* with clear provincial rules and standards in a new regulation under the *Environmental Protection Act*. This Construction Plan Report has been prepared to provide details of the Project as part of the REA.

Table 1, below, highlights the requirements and how they are addressed in this Construction Plan Report.

Table 1: Construction Plan Report Requirements under O. Reg. 359/09, as amended

O. Reg. 359/09 Requirement, as amended	Report Section
Details of any construction and installation activities.	Section 3
The location and timing of any construction or installation activities for the duration of the construction or installation.	Location: Section 3; Figure 1 Timing: Section 3.2
Any negative environmental effects that may result from construction or installation activities within a 300 m radius of the activities.	Section 4
Mitigation measures in respect of any negative environmental effects mentioned in paragraph 3.	Section 4

This Construction Plan Report will be provided to Aboriginal communities, the Municipality of Kincardine, County of Bruce and the public following the distribution requirements and timing constraints outlined in O. Reg. 359/09, as amended, and the Draft Technical Guide to Renewable Energy Approvals (MOE, 2012; MOE, 2012).

1.1 The Project Location

The proposed Project is situated in Bruce County, 3 km from Lake Huron; approximately 2 km northeast of Kincardine, Ontario (see Figure 1).

The Project location, is defined in O. Reg. 359/09, as amended, (in relation to a renewable energy project) to mean "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 proposed to engage in

[1] All references to Ontario Regulation 359/09 refer to the Regulation as amended Regulation 195/12 which came into force July 1, 2012

the project". The Project location is bounded by Highway 21 to the west, Concession 4 to the north, County Road 1 to the east and the North Line to the south. The area encompassed by these boundaries is referred to in this document as the "Project Study Area".

The proposed Project Study Area, covering approximately 18,800 hectares of land in the Municipality of Kincardine, Ontario, is primarily comprised of agricultural lands with fragmented blocks of forest and riparian areas associated with small creeks and farm drains (see Figure 1). The Project will be located primarily within portions of privately owned land parcels with collection cables being placed in public road allowances. Portions of privately owned land parcels that contain Project infrastructure will be under lease or easement to the Proponent for the duration of the Project.

The location of the Project was established based on interest expressed by local landowners, its proximity to high-voltage transmission lines, and its excellent wind resource.

1.2 Project Vital Statistics

Table 2: Summary of Project Vital Statistics

General	
Project Name	Armow Wind Project
Project Ownership and Operation	SP Armow Wind Ontario LP
Project Lifespan (commercial operation)	20 Years
Project Nameplate Capacity	Up to 180 MW
Project Area (as shown in Figure 1)	
Location of Project	Privately-owned land and Public Road Allowances Municipality of Kincardine, County of Bruce
Total Project Study Area	18,800 ha
Total Area of Project Location (total disturbance area)	472.9 ha
Wind Turbine Generators	
Model	Siemens SWT-2.3-101
Total Number Permitted	98
Approximate Number Constructed	90
Nominal Power	1.8 to 2.3 MW
Number of Blades	3
Blade Length	49 m
Hub Height	99.5 m
Rotor Diameter	101 m
Cut-in Wind Speed	3 m/s
Cut-out Wind Speed	25 m/s
Rated Wind Speed	12 – 13 m/s
Swept Area	8,000 m^2
Foundation Dimensions	20 m diameter
Access Roads	
Operation Roads (includes shoulder, travel width and ditch)	58 km x 4-8 m
Construction Roads (with shoulder)	58 km x 7-15 m
Temporary Roads / Crane Walks	3.22 km x 7-15 m
Collector Lines	
34.5 kV Collector Lines in public ROW (total combined length of proposed underground and/or overhead)	132 km x 2-6 m
34.5 kV Collector Lines on private lands (underground)	60 km x 2-6 m

Other Project Structures and Facilities	
Collector Substation	200 m x 150 m
Operations and Maintenance Building	50 m x 30 m
Point of Interconnect	1 acre
Temporary Land Use (Construction Phase)	
Construction Staging Areas	10 acres
Wind Turbine Laydown Area (each turbine)	5000 m^2
Crane Pads	40 m x 20 m

1.3 Contact Information

Applicant

The proponent for the Project is SP Armow Wind Ontario LP, by its general partner SP Armow Wind Ontario GP Inc. The Proponent is a joint venture limited partnership owned by affiliates of Pattern Renewable Holdings Canada ULC and Samsung Renewable Energy Inc. The contacts for the Project are as follows:

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Consultant

The Proponent has retained Golder Associates Ltd. (Golder) to prepare an REA Application under O. Reg. 359/09, as amended. Contact information for the Golder Project Manager is as follows:

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2.0 PROJECT COMPONENTS

To facilitate the construction of the proposed Project, a number of temporary construction components are required. These temporary components, described further in Table 3, include crane pads, turbine laydown areas, crane walks, roads and construction staging areas.

Table 3: Description of Temporary Project Components

Component	Description
Crane Pads	Crane pads will be constructed in tandem with wind turbine access roads (Table 4) Crane pads will be: ■ Located directly adjacent to wind turbine locations and within the associated construction disturbance area. The crane pad areas will be approximately 40 m by 20 m, and will be constructed with geo-grid/geotextile overlaid with a mixture of heavier granular material, native materials, and engineered fill as appropriate; ■ Removed following the construction of each wind turbine; ■ Restored to allow agricultural activities to continue; and ■ Reconstructed and removed as required for maintenance and decommissioning activities throughout the life of the Project.
Wind Turbine Laydown Areas	Laydown areas adjacent to wind turbine locations have been incorporated into the construction disturbance area (part of the Project location) for each turbine. Each wind turbine laydown area is approximately 5,000 m^2 and will allow for temporary turbine component storage and assembly. Temporary wind turbine laydown areas will be restored following construction activities to allow for agricultural activities to continue.
Potential Construction Staging Areas	Four potential temporary construction staging areas may be located: 1) On the east side of Bervie Side Road just north of Concession Road 9 (see Figure 1); 2) On the west side of County Road 1, north of Concession Road 2 (see Figure 1); 3) On the south side of County Road 15, west of County Road 1 (see Figure 1); and 4) On the north side of Concession 7, east of Sideroad 20 (see Figure 1) The temporary construction staging areas will be gravelled with compacted surface material suitable for vehicular traffic. The depth of the gravelled areas will vary and will be dependent upon conditions encountered during the time of construction. The four construction staging areas will each be up to ten acres in size and may serve the following aspects of the Project construction: ■ Laydown areas for Project components; ■ Temporary construction offices; ■ Parking areas for Project staff; ■ Waste disposal containers; ■ Water and rinsing facilities; ■ Construction equipment storage and maintenance;

	■ Fuelling area; ■ First aid station ■ Portable generators; and ■ Self-contained temporary toilet facilities. It is possible that the last three listed aspects could be located at the turbine laydown area during construction. Following construction and installation activities, the temporary construction laydown areas will be restored to pre-existing conditions to allow agricultural activities to continue.

The major components of the Project include wind turbine generators, access roads, collector lines, collector substation, meteorological towers, a microwave tower, interconnection structures and an operations building. Table 4 provides descriptions of these major components along with ancillary components required for the operation of the Project. Additional detail regarding the wind turbine generators is provided in the Wind Turbine Specifications Report, which will form part of the Project's REA Application.

Table 4: Description of Project Components

Component	Description
Wind Turbine Generators	The Project will use wind turbines (Siemens WT-2.3-101) with a generating capacity ranging from 1.8 to 2.3 MW. The wind turbine nacelle includes the electric generator, gearbox, wind direction and speed sensors, and auxiliary equipment. These components are located at the top of a supporting tower and are connected to three blades and a hub via a main shaft.
Wind Turbine Foundation	Each turbine tower is anticipated to have a concrete foundation approximately 20 m in diameter and 2.5 m deep. The land base of each spread-footing turbine foundation will be dependent on subsurface conditions determined during geotechnical investigations. Following geotechnical investigations it may be determined that pile type foundations may be suitable for certain locations.
Pad-mounted Transformers	A pad-mounted transformer will be located immediately adjacent to each wind turbine. This transformer 'steps-up' the electricity generated by the wind turbine (600 V) to a common collector line voltage (34.5 kV).
Wind Turbine Access Roads	During construction and operation of the proposed Project, access roads are required in order to access wind turbine locations. Access roads will be constructed of native materials or engineered fill and will be up to 15 m wide during construction in order to accommodate cranes and transportation equipment used to deliver wind turbine components. Subject to landowner consultation, following construction and installation activities, roads may be reduced to 4-8 m wide, which would allow access to turbines and associated infrastructure for maintenance and repairs.

Component	Description
Meteorological Towers	Assessment of meteorological conditions and wind resources requires permanent meteorological stations to be constructed. Up to three meteorological towers are proposed to be constructed up to 100m tall within the Project Study Area (see Figure 1). The meteorological towers may be constructed on a concrete foundation or guyed.
Microwave Tower	A microwave tower used for communication purposes may be constructed within the substation construction disturbance area. The microwave tower may be up to 100 m tall and constructed on a concrete foundation or guyed.
Collector Lines	Collector lines carry the electricity from the pad-mounted transformers to the Project substation (described below). The collector lines will be standard utility 34.5 kV. From the turbine to the municipal and county roads, collector lines will be buried on private land. Collector lines along municipal and county roads will be located within the existing road rights-of-way and, where possible, buried. Underground collector lines will be buried at a depth of approximately 1.0-1.5m. If determined that overhead collector lines are required, they will be constructed on single pole structures that are similar to existing medium voltage distribution lines within the Project Study Area.
Collector Substation	A collector substation is required to bring together all of the collector lines. The collected power will be transformed from the collector line voltage (34.5 kV) to a transmission voltage (230 kV). The collector substation is proposed to be located approximately 400 m from the existing Hydro One transmission line. The collector substation will be connected to the Hydro One line by a single circuit overhead line, supported by 3 to 4 interconnection structures. The collector substation will be constructed within a construction disturbance area of approximately 200 m by 150 m on a raised pad or a prepared base of either engineered fill or native soil to a depth of approximately 2 m. The substation will comply with the requirements of O. Reg. 359/09, as amended, by including a 20 kg/m^2 acoustic barrier that breaks the line of sight with any noise receptors and is located at a distance of at least 500 metres from the nearest noise receptor. Collector substation equipment will include isolation switch(es), circuit breaker(s), step-up power transformer(s), distribution switch-gear(s), capacitor banks, instrument transformers, grounding transformers, revenue metering, substation grounding and a control building. Substation grounding will follow the Canadian Electrical Code (CEC). An oil containment system designed for the main transformer(s) will be installed at the site to prevent soil contamination in the event of a leak.

Component	Description
Operations and Maintenance Facilities	Operations and maintenance facilities with an approximate footprint of 3 acres will be constructed to accommodate offices, mess facilities, control facilities, storage space, maintenance work area, and a parking area. The operations and maintenance facilities will be within the Project Location. The operations and maintenance building will be a structure constructed on a concrete foundation. An access road to the will be constructed to accommodate construction equipment and on-site traffic during the operation of the proposed Project. The operations and maintenance building will be powered by local distribution power company, with an onsite backup power supply. Power will be delivered via underground lines adjacent to the access road.

The following sections provide a summary of construction and installation activities for the Project. Additional details regarding Project activities are provided in the following Reports. These reports will form part of the Project's REA Application:

- Project Description Report;
- Design and Operations Report; and
- Decommissioning Plan Report.

3.0 CONSTRUCTION AND INSTALLATION ACTIVITIES

The following sections provide the following information for each of the Project components that are to be constructed:

- Materials brought on site;
- Construction equipment used; and
- Explanation of how the component will be constructed.

In general, all work crews will drive automobiles (typically light trucks) to reach the Project Study Area. Flatbed trucks will be used to transport specialized equipment (e.g., tracked bulldozers, excavators, loaders, dump trucks, compactors and graders) to the Project Study Area. Construction equipment, fuel and lubricants will be delivered to temporary storage/laydown areas by large truck and trailer combinations.

3.1 Pre-construction Activities

3.1.1 Land Survey

Prior to construction, a registered Ontario Land Surveyor (or equivalent) will survey all access roads, collector lines, turbine locations, and all other foundations, as appropriate. Temporary work locations may also be surveyed. Equipment used for surveying will include a small number of light duty trucks and all-terrain vehicles.

3.1.2 Geotechnical

Prior to construction, geotechnical studies will be completed to allow for detailed foundation designs. Geotechnical studies will consist of borehole drilling and sampling, laboratory testing, and geotechnical analysis. Information collected will include details of soil compaction, grain size, resistivity, soil pH, and depth to groundwater. A borehole will be drilled for each wind turbine foundation, with additional boreholes performed for the collector substation and along collector lines.

Geotechnical sampling of turbine sites will require a truck-mounted or tracked drill rig, which is a self-contained unit that will be driven to each sampling location.

3.2 Construction Activities

3.2.1 Access Roads

Access roads will be constructed to allow access to wind turbine sites during the construction, installation, operation, and maintenance of the Project. Where possible, access roads will follow property boundaries and will be located to minimize the loss of arable land, disturbance to agricultural operations and limit the number of watercourse crossings. Access road locations have been determined through constraint mapping exercises and consultation with landowners. As necessary, ditches and culverts will be constructed to maintain existing site drainage.

Prior to access road construction, soil from the access road footprint will be stripped, stockpiled and reused during construction to reclaim the site. A woven geotextile or cement-stabilized soil will be utilized where

necessary. Dump trucks will transport gravel from a local aggregate source and each truck will transport approximately 9 tons each trip. The maximum roadbed depth will be a maximum of 1 m. Table 5 provides details on the dimensions and materials required for access road construction.

Table 5: Description of Access Road Dimensions and Materials Required for Construction

Access Road Description		Measurement	Estimated Quantity Required (up to)
Roadbed Depth	Granular Base Material[1]	0.50-0.75 m	350,000 m^3
	Crushed Gravel	0.10-0.20 m	92,000 m^3
	Total	0.60-0.95 m	442,000 m^3
Permanent Road Width[2]		4-8 m	--
Road Length		58 km	--

[1] A woven geotextile or cement stabilized soil may be utilized which would reduce the amount of granular base material required. Approximately 50,000 m^2 of geotextile material may be required for access road construction.
[2] This width includes shoulder, travel width and ditch

Water course crossing locations are provided in the Water Assessment and Water Body Report under a separate cover, as well as a description of their potential environmental effects.

Equipment required for access road construction will include light-duty trucks, tracked bulldozers, excavators, loaders, dump trucks, compactors, graders, and water trucks. The timeline for constructing an access road to a particular turbine site is expected to vary between two to four days, depending on the length of the access road.

3.2.2 Crane Pads

Temporary crane pads will be located adjacent to each wind turbine location and within the construction disturbance area. Bulldozers will remove topsoil and subsoil and crane pad locations filled with a varying mixture of granular base material and crushed gravel depending on site specific conditions. Geotextile will be used as required to meet crane bearing capacity requirements. Crane mats (large pieces of wood) will be used to stabilize cranes during their operation. The crane pad dimensions will be approximately 40 m x 20 m. Following the erection of the wind turbine generators, crane pads will be removed. Granular base material and crushed gravel will be removed, native topsoil replaced, and crane pads returned to their pre-construction condition.

Equipment required for the construction and installation of crane pads will include light-duty trucks, tracked bulldozers, loaders, dump trucks, compactors, graders, and water trucks. The timeline for constructing a crane pad is approximately two to four days.

3.2.3 Wind Turbine Laydown Areas

A temporary storage and laydown area will be constructed around each wind turbine location. The construction disturbance of each temporary laydown area will be approximately 5,000 m^2. Soil stockpiles, separated into subsoil, topsoil and other major horizons, where present, will be temporarily maintained at each wind turbine site within the storage and laydown area. Laydown areas will be covered by a thin layer of gravel. Significant compaction of these areas will not be required. Distribution of subsoil and topsoil following the completion of construction and installation activities is discussed in Section 4.2.

Equipment required for the construction and installation of wind turbine laydown areas will include light-duty trucks, tracked bulldozers, loaders, dump trucks, compactors, graders, and water trucks. The timeline for constructing a wind turbine laydown area is approximately one to three days.

3.2.4 Construction Staging Areas

Up to four potential temporary construction staging areas may be located within the Project Study Area (see table 3 for locations). The temporary construction staging areas will each be approximately 10 acres in size and will serve the aspects of Project construction listed in Table 3.

Topsoil and subsoil will be stripped and stockpiled on site in a wind row where required, and the construction staging areas will be gravelled with compacted surface material suitable for vehicular traffic and equipment/component storage. The depth of the gravelled areas will vary and will be dependent upon conditions encountered during the time of construction. Following Project construction, the temporary construction laydown area will be restored to pre-existing conditions to allow agricultural or prior activities to continue.

Equipment required to prepare the construction staging areas will include flatbed trucks, excavators, tracked bulldozers, dump trucks, grader, and compaction equipment. The construction staging areas will take approximately 2-4 weeks to prepare.

3.2.5 Wind Turbine Foundations

A determination of a final turbine foundation design will be based on results of site-specific geotechnical assessments that will be carried out in Q2 of 2013. Following the removal of topsoil and subsoil, the wind turbine foundations are expected to be spread footing and measure approximately 20 m in diameter with an excavated depth of approximately 3 m. Formwork and rebar will be installed to reinforce the wind turbine foundation. Based on site specific conditions that will be determined from geotechnical assessments, blasting may be required during wind turbine foundation excavation. Following the assessments, it may be determined that pile type foundations are more suitable for specific locations.

After excavations for the foundation are complete, a thin concrete slab will be installed to provide a clean work surface. Wooden or reusable steel formwork and steel reinforcing bars will be installed according to engineering design specifications. Ready-mix concrete will then be delivered from a local supplier, poured, and allowed to cure to its specified compressive strength.

Equipment required for the construction and installation of wind turbine foundations will include light-duty trucks, tracked bulldozers, excavators, loaders, dump trucks, compactors, graders, concrete trucks, concrete pump trucks, and water trucks. An estimated 50 concrete truck loads will be required for each wind turbine foundation.

3.2.6 Wind Turbine Generators

Wind turbine generator towers will be delivered in sections and assembled on-site by qualified installers. The first tower section will be bolted to the wind turbine foundation (as described in Section 3.1.5), and the remaining sections will be delivered and then lifted by a heavy-lift crane (600 – 800 ton) one at a time for attachment. Following the erection of the wind turbine tower, the nacelle (which will be assembled prior to delivery) will be lifted into place by the heavy-lift crane. The wind turbine rotor, which consists of three blades and the hub, will be lifted into place by a combination of two cranes. One smaller crane will stabilize the rotor as the larger crane does the heavy lifting. In some circumstances, a single blade and hub lifting technique may be utilized where space or high wind constraints prevent the rotor from being lifted in one piece.

It is expected that approximately 11 oversized heavy haul trucks will be required to deliver the respective sections for each wind turbine generator. Crane transport between wind turbine locations will occur on access roads, municipal and county roads. Wind turbine components will be placed, as required, in the temporary wind turbine laydown area prior to being installed. Equipment required for installation of the wind turbine generators will include cranes, light-duty trucks, flatbed trucks, and trailers. Assembly and erection of a wind turbine generator is expected to take between three to five days depending on environmental conditions (i.e., high wind conditions would delay installation).

3.2.7 Pad Mounted Transformers

Pad mounted transformers are located at the base of each wind turbine generator and foundation. A typical size of a pad mounted transformer is 2.5 m x 2.5 m. A small crane will be used to lift the transformer from a flatbed delivery truck onto the wind turbine foundation. Appropriate measures will be taken to ensure that the pad mounted transformer is connected to the overall wind turbine ground grid. The installation of a pad mounted transformer will take approximately 1 to 2 days.

3.2.8 Collector Lines

Collector lines will carry the electricity from the pad-mounted transformers at each turbine location to the Project substation. The collector lines may be a combination of underground lines on private lands and overhead and/or underground lines on public road allowances.

All underground collector lines will be installed in a trench approximately 1.0 – 1.5 m deep and/or in conduits installed by directional drilling. Junction boxes may contain equipment related to splices, junctions, cable splices, and disconnect switches. Where the underground collector lines must be joined, a junction pit measuring up to 1.2 m deep, 1 m wide, and 2 m long will be excavated. The junction boxes will be either below or aboveground.

Overhead collector lines along public road allowances will require installation of wood, steel or concrete monopoles to a depth of approximately 5 - 6 m. Aluminum conductors will be strung from pole to pole in a manner similar to local electrical distribution circuits, and will be spaced approximately 45-60 m apart. The overhead collector lines will converge at the collector substation.

Equipment required for underground collector line installation will include excavators, dozers, dump trucks, direction drilling equipment and compaction equipment. The timeline for installing the underground collector lines, including trenching, backfilling, direction drilling, and ploughing methods will be approximately eight to ten months.

Equipment required for overhead collector line installation will include utility bucket trucks, auguring trucks (or excavators), pole trailers, reel stand vehicles, an excavator, conductor puller vehicles, and tensioner vehicles. Installing the overhead collector lines (including pole installations, tension stringing of the conductor, and commissioning).

3.2.9 Collector Substation

The collector substation will be constructed on an area of approximately 200 m x 150 m that will be within a larger construction disturbance area that may also include the operations and maintenance facilities (see Section 3.1.10). Topsoil and subsoil will be removed to create an even work surface and the collector substation will be constructed on a raised pad or a prepared base of engineered fill or native soil to a depth of approximately 2 m.

Existing vegetation (agricultural crops) will be stripped with the topsoil, which will be stockpiled separately from stripped subsoil in a temporary (i.e., during construction) workspace adjacent to the collector substation. Stockpiled soil will be utilized during site restoration after construction activities are completed.

Following soil removal, a ground grid will be installed, a foundation will be poured, a grounding system and electrical equipment will be installed, and a crushed stone cover applied. Switchgear and protection and control equipment will be housed in an enclosed building.

The substation will comply with the requirements of O. Reg. 359/09, as amended, by including a 20 kg/m^2 acoustic barrier that breaks the line of sight with any noise receptors and is located at a distance of at least 500 metres from the nearest noise receptor. A berm will also be constructed between the existing road and the collector substation. The collector substation will follow the Canadian Electrical Code (CEC) for grounding, which will consist of a below grade grid of copper cable that will be interconnected to collector substation equipment and a fence for controlling access. The transformer foundation will be approximately 8 m x 6 m and have a depth of approximately 2 m. A secondary concrete containment system will be installed around the collector substation transformer(s) that will be connected to the stormwater drainage system through an oil water separator that will be buried below grade.

Equipment required for the construction and installation of the collector substation will include flatbed trucks, tracked bulldozers, dump trucks, excavators, compaction equipment, concrete trucks, concrete pump trucks, water trucks, and a crane. Construction of the collector substation facilities will take up to 10 months.

3.2.10 Operations and Maintenance Building

The operations and maintenance building will be a structure constructed on a concrete foundation with a footprint of approximately 50 m x 30 m. A gravelled vehicle and parts storage area will be located around the perimeter of the operations and maintenance building that will be contained by a chain link fence. An access road to the operations and maintenance building will be constructed to accommodate construction equipment and on-site traffic during the operation of the proposed Project.

The operations and maintenance facilities will be located within the Project Location and will be powered by a local utility distribution company. The power for the operations and maintenance building will be delivered via underground lines adjacent to the access road and will terminate on a transformer adjacent to the operations and maintenance building.

Equipment required for the construction of the operations and maintenance building will include flatbed trucks, tracked bulldozers, dump trucks, excavators, compaction equipment, concrete trucks, concrete pump trucks, water trucks, and a small crane. Construction of the operations and maintenance building will take approximately 6 months.

3.3 Project Testing Commissioning

Testing and commissioning will be performed prior to Project connection to the existing Hydro One transmission line. Wind turbines, collection lines, and the collector substation will be checked for system continuity, reliability, and performance, and identified issues addressed. Portable generators may be used for turbine commissioning.

3.4 Site Reclamation

Following Project construction, construction areas will be reclaimed by removing all construction waste and temporary disturbance areas (crane pads, laydown and construction staging areas) will be restored by replacing stockpiled soil and reseeded with native plants or hydro-seeded as appropriate. Access road widths will also be reduced to 4 – 8 m. Site reclamation equipment will include bulldozers, excavators, loaders, graders, dump trucks, seed spreaders, tractors, and pick-up trucks.

3.5 Timing of Construction and Installation Activities

The timing and duration of proposed construction and installation activities are provided in Table 6. Construction and installation activities will be restricted to hours outlined in Schedule B of by-law no. 2008-076. These hours are generally consistent with times of day when agricultural machinery would normally be in operation. Construction, installation, and reclamation activities are expected to take up to 30 months, with commercial operation anticipated to begin in late 2014.

Table 6: Timing and Duration of Construction and Installation Activities

Construction and Installation Activity	Estimated Start Time[1]	Estimated Duration
Preliminary surveying	Spring 2013	2-3 months
Pre-construction surveys and geotechnical investigations	Spring 2013	3-4 months
Land clearing	Spring 2013	2 months
Access road construction	Spring 2013	5 months
Access road maintenance	Spring 2013	18 months
Temporary storage/laydown area construction	Spring 2013	6 months
Wind turbine foundation construction	Summer 2013	12 months
Installation of collector lines	Summer 2013	12 months
Installation of collector substation	Summer 2013	10 months
Installation of operations and maintenance facilities	Summer 2013	18 months
Installation of meteorological towers and microwave tower	Spring 2014	1 month
Wind turbine assembly and installation	Spring 2014	8 months
Wind turbine testing and commissioning	Fall 2014	3 months
Clean-up and reclamation	Fall 2014	12 months

Note:
[1] The projected schedule is based on information known at the time of the completion of this Report. Modifications to the construction and installation schedule for the Project will be publicly available on the Project website: www.armowwind.com

3.6 Temporary Uses of Land

As discussed in Section 3.3 to 3.5, construction and installation activities will utilize temporary storage and laydown areas adjacent to access roads, wind turbines, collector substation, and operations and maintenance building. Lands used for temporary storage and laydown areas will be converted from their current state to one appropriate for their use prior to construction. Since the lands proposed for the temporary storage and laydown areas are already actively worked by heavy agricultural equipment, the impacts from construction will be less than if undisturbed areas were used. Soil management will be incorporated into the creation and use of these areas to facilitate site reclamation, and all temporary workspaces will be converted back to their previous land use after the completion of the construction and installation phase. Temporarily-used areas will be reclaimed approximately 2 years from initial construction disturbance or sooner. An assessment of potential environmental effects as a result of temporary uses of land is provided in Section 4.7.

3.7 Temporary Water Takings

It is possible that during excavation for turbine foundations, groundwater or precipitation from the excavation will require pumping. A technical desktop assessment and review of groundwater elevation was conducted to determine if foundation construction associated with the wind turbines will intercept groundwater, and if so, what potential dewatering rates will be required in support of the foundation construction. The assessment concluded that there is a relatively low potential that the depth of the proposed excavations will intercept the water table (or saturated ground) under conditions that will require foundation dewatering for construction purposes other than the management of precipitation catchment.

Two water wells will be constructed in two of four possible locations to provide non-potable water supply to the operations and maintenance building and to provide water for dust suppression. Water takings from these two wells will be monitored to ensure that water pumped is less than 50,000 L/day at each well. These temporary water taking activities are discussed in Section 4.3.3.

3.8 Materials/Waste Generation and Transportation

Materials and waste that will be brought to the Project Study Area during construction and installation will include equipment/component packaging, scraps, fuels and lubricants. Packing frames for the wind turbine components and cabling spools will be returned to their respective vendors or will be recycled. Plastics from other containers and packaging will be disposed of through the local landfill and recycling facilities where appropriate. Construction materials and scrap metals (e.g., copper wiring and conductor) will be removed and sold to a local scrap metal dealer. Oils, fuel and lubricants used in maintenance and operation of construction equipment will be stored temporarily in accepted containment systems and will subsequently be removed by a licensed contractor. The licensed contractor will be required to dispose of these wastes through conventional waste-oil and hazardous waste disposal streams.

Materials and waste will also be generated as a result of construction and installation activities. Concrete wash out of empty cement trucks will adhere to applicable regulations. Sanitary sewage collected in portable toilets and wash stations will be transported to an off-site facility by a licensed hauler. Small amounts of spoil material from borehole drilling during geotechnical surveys may be re-distributed on disturbed areas at respective drill sites. Topsoil and/or subsoil stripped from access roads and temporary storage/laydown areas may be re-used on-site, where feasible. If any grubbing of the site is required prior to construction activities, the grubbing materials (e.g., vegetation, branches, tree stumps) will remain on site and will be buried within disturbance areas. As required, stockpiles will be covered with plastic sheeting, tarps or following Best Management Practice (BMP) to prevent erosion and propagation of noxious weeds. During wind turbine foundation, collector substation and other infrastructure construction, excavated subsoil and topsoil will be stored in piles on-site at each temporary storage/laydown area until they are replaced during clean-up and reclamation activities. Any excess subsoil will be distributed with landowner input, and excess clean topsoil will be re-distributed to adjacent lands as appropriate. If contaminated soil is encountered during the course of excavations, this soil will be disposed of in accordance with the current appropriate provincial legislation.

Disposal and recycling of materials and waste generated will require the use of flatbed trucks and large dump trucks that are capable of transporting heavy loads. Determining the type and number of truck trips necessary will be determined by the licensed construction contractor prior to the construction and installation of the Project. Disposal and recycling of waste will occur throughout the construction and installation of the Project since there are no plans for long-term storage of waste in the Project Study Area.

3.9 Emergency Response Plan

The Emergency Response Plan (ERP) is described in Section 6.0 of the Design and Operations Report. The ERP is to be used in the event of an emergency and includes contact information for regulators, landowners, and

other stakeholders. All appropriate regulators will be notified should the emergency include any potential impact to the health and safety of local residents or the environment.

3.10 Health and Safety Plan

- The Proponent and its construction contractor shall institute a Health and Safety Plan during the construction period. A detailed plan will be developed and the construction workforce will be made aware of the plan. Measures to be implemented will include for example: Sanitary facilities shall be well equipped (e.g., protective creams and soaps);
- Personal protective equipment (PPE), including non-slip footwear, eye protection, clothing, and hardhats, will be worn by operations and maintenance personnel when on duty;
- Elevated platforms, walkways, and ladders will be equipped with handrails, toe boards, and nonslip surfaces; and
- Electrical equipment will be insulated and grounded in compliance with the appropriate electrical code.

The Proponent and its construction contractor shall maintain a master Incident Report that documents illnesses and accidents. The Incident Report shall document all activities resulting in incapacity to work for at least one full workday beyond the day on which the illness or accident occurred. Records will also be maintained noting the total number of days of absence from work as a direct result of the illness or accident.

4.0 DESCRIPTION OF POTENTIAL ENVIRONMENTAL EFFECTS AND MITIGATION MEASURES

In accordance with Chapter 5 (*Guidance for preparing the Construction Plan Report*) of the Draft Technical Guide to Renewable Energy Approvals (MOE, 2012), this section provides a summary of the potential negative environmental effects that could arise from construction and installation activities associated with the Project, including details on the following:

- Potential negative effects of construction activities within 300 m of the Project Study Area;
- The nature and magnitude of each effect;
- Any proposed mitigation measures; and
- Where considered appropriate, environmental monitoring plans.

Baseline information on the existing natural environment can be found in the Natural Heritage Assessment Report, Water Assessment and Water Body Report, Stage 1 Archaeological Assessment Report, and Heritage Assessment Report. All of these Reports will accompany the REA Application for the Project.

The following construction-specific potential effects and mitigation measures have been identified and analyzed for any negative environmental effects that may result from construction/installation activities within 300 m from the boundary of the Project Location. A description of the existing natural environment can be found within the NHA/EIS, Heritage and Archaeological Report, and Water Assessment and Water Body Report.

4.1 Air and Noise Emissions

4.1.1 Potential Effects

Excavation activities, construction vehicle traffic, temporary generator operation, and temporary exposure of soil stockpiles have the potential to generate short-term localized dust emissions that could result in nuisance effects. Operation of heavy construction vehicles, potential blasting and temporary generators could also result in nuisance noise at nearby residents or businesses and disturbance to local wildlife.

Operation of construction equipment as described in Section 3, in particular vehicles using diesel fuel, will result emissions including particulate, sulphur dioxide, nitrous oxides, volatile organic compounds, polyaromatic hydrocarbons, and carbon dioxide. Furthermore, traffic delays caused by construction could result in increased vehicle emissions in the Study Area as vehicles travel slowly through construction zones. Air and noise emissions will be highest during land clearing and other activities that involve significant levels of material handling (e.g., aggregate laydown for access road construction and preparation for the installation of underground collector lines).

4.1.2 Mitigation Measures

Air and noise emissions generated during the construction and installation of the Project will be minimized by the implementation of Best Management Practices (BMPs), which will help reduce the potential for fugitive dust generation and off-site movement, including:

- Implementing a speed limit that will lead to reduced disturbance of dust on paved and unpaved surfaces;

- Ensure proper operation and maintenance of vehicles and machinery to limit noise;
- Minimize vehicular traffic on exposed soils and stabilize high traffic areas with clean gravel surface layer or other suitable cover material;
- Minimize mud tracking be construction vehicles along access routes and areas outside of the immediate work site, and ensuring timely cleanup of any tracked mud, dirt, or debris;
- Applying dust suppressants to unpaved areas (i.e., unpaved roads, storage piles), which may include the use of water or a natural dust suppressant. The frequency of application will be determined based on climatic factors during the construction and installation of the Project;
- Re-vegetation of cleared areas, as soon as possible, and maintenance of vegetation to ensure growth;
- Covering loads of friable materials during transport;
- Scheduling excavations or activities involving the movement of soil and/or gravel on days with low wind; and
- Implementing a complaint response program, whereby complaints received from the public are recorded and investigated. The investigations should be focused on determining the cause of the complaint and, if necessary, mitigation measures should be implemented. Details on the complaint response program are provided in the Design and Operations Report.

To minimize the inconvenience of noise emissions generated during construction and installation activities, all vehicles and equipment will be operated in accordance with Municipality of Kincardine noise By-law No. 2008-076. Construction or installation activities that could create excessive noise will be restricted to hours outlined in Schedule B of By-Law No. 2008-076 unless otherwise approved by the Municipality.

All construction equipment will be kept in good repair and will operate in accordance with local by-laws, MOE publication NPC-115 and manufacturer recommendations. An Environmental Compliance Monitor will be on-site for the duration of construction activities to ensure that environmental regulations are being adhered to by construction contractors.

4.1.3 Net Effect

By implementing appropriate mitigation measures (Section 4.1.2), air and noise emissions are predicted to be limited to the general vicinity of the construction and installation activities. Effects from air and noise emissions are expected to be minor, with short-term effects that are similar to the operation of agricultural machinery and consistent with effects generated by any construction project. In terms of emissions from combustion engines, all construction equipment will meet the emissions requirements of the MOE and/or Ministry of Transportation (MTO). This will assist in minimizing the Project's short-term contributions of greenhouse gases, odour, and other airborne pollutants.

4.1.4 Environmental Monitoring

Table 7 presents measures that will be used to monitor the effectiveness of the proposed fugitive dust and noise mitigation measures for the duration of construction and installation activities. Contingency measures are also defined in the unlikely case that performance objectives are not met.

Table 7: Summary of Fugitive Dust and Noise Environmental Monitoring Plans

Potential Negative Effect	Performance Objectives	Mitigation Measures	Monitoring Plan and Contingency Measures	Methods and Sampling Protocols
Fugitive dust is an environmental nuisance to local residents and nearby woodlots/ vegetation.	No persistent dust films (observable build-up) on nearby properties or vegetation.	■ Implementing a speed limit for construction equipment and trucks; ■ Application of dust suppressants to unpaved areas; ■ Re-vegetating cleared areas as soon as possible; and ■ Installing wind fences, as required.	■ Qualitative monitoring of wind conditions and dust accumulation; and ■ Monitoring complaints through the Project operations staff contact number (see Design and Operations Report).	■ Regular visual inspections by a construction Environmental Compliance Monitor.
Dust emissions reduce surface water quality.	No persistent dust films on adjacent water bodies, no measurable change in Total Suspended Solids (TSS).	■ Same as above.	■ Same as above.	■ Same as above.
Construction noise can be disruptive to local residents.	Adherence to Municipality of Kincardine noise by-law no. 2008-076.	■ Activities that may be considered disruptive will be scheduled to be consistent with noise by-laws; and ■ Noise emissions from construction equipment will be in accordance with MOE publication NPC-115 and manufacturer recommendations.	■ Observing wind conditions and noise levels; and ■ Monitoring complaints through the Project operations staff contact number (see Design and Operations Report).	■ If complaints about construction noise are received, on-site staff will conduct nearby noise level observations and will communicate with landowners and the construction team to seek an acceptable resolution.

4.2 Removal of Vegetation and Habitat

4.2.1 Potential Effects

The majority of land within the Project Study Area consists of fields under active cultivation. Based on this primary land use in the Project Study Area, there is limited anticipated destruction of native vegetation and habitat from construction and installation activities. There is potential for disturbance to wildlife during the construction phase of the project as a result of vegetation removal, increased activity and noise. Significant wildlife habitat are discussed in more detail in the Natural Heritage Assessment Environmental Impact Study, which considers the following wildlife habitat types: waterfowl stopover and staging areas (terrestrial and aquatic), shorebird migratory stopover areas, bat maternity colonies, colonial-nesting bird breeding habitats (tree/shrub and ground), waterfowl nesting areas, winter deer yards, amphibian breeding habitats (woodland), marsh bird breeding habitats, and, open country bird breeding habitats.

Minor removal of upland and riparian vegetation may occur where watercourse or hedgerow crossings are required, and this effect is discussed further in the Natural Heritage Assessment Report. Construction staging areas, turbine laydown areas, and crane pads will result in soil compaction, which will need to undergo remediation to prior land use following the completion of construction and installation activities. For installation of underground collector lines, excavation and trenching activities may result in changes to soil properties and some loss of productivity due to mixing of subsoil in the surface soil horizons. However, by limiting the width of the trenches to approximately 1 m, the amount of land area affected by the Project will be minimized.

Vegetation removal has the potential to result in habitat loss or fragmentation, which may affect wildlife corridors or movement. Woodlot areas could potentially represent locally important or valued ecosystems or vegetation, and there is a potential for rare, threatened or endangered species or their habitats to occur within the Project Study Area. No tree removal is required in significant natural features and minimal tree removal will be required for access road and cable and transmission line construction. All components of the Project are located outside of wetland boundaries. Therefore, the Project will not result in direct effects on wetlands. Portions of the Project Location are located within 120 m of wetlands and could result in impacts to hydrology and the ecological function of wetlands. These potential effects are assessed in the Natural Heritage Assessment Report Environmental Impact Study, per the requirements of O. Reg. 359/09, as amended.

Installation of underground collector lines and/or culverts through watercourses has the potential to disrupt fish habitat, cause erosion and sedimentation through disturbance to the shoreline and bed of water bodies, and destroy habitat through the removal of riparian (bank) vegetation and other habitat types that provide cover, shade and food. Further discussion of potential effects on aquatic habitats is provided in Section 4.3, and additional information on potential effects of the destruction of vegetation and habitat is contained within the Natural Heritage Assessment Report.

4.2.2 Mitigation Measures

Wherever possible, access roads and construction staging and turbine laydown areas will take advantage of existing road infrastructure to avoid loss of agricultural lands or destruction of vegetation. During construction, vehicle traffic will be limited to primarily daytime hours and speed limits will be enforced to minimize disturbance to wildlife. Construction activities occurring in close proximity to woodlots will use erosion control fencing and wildlife habitats within 30m of construction activities will be delineated to avoid disturbance or damage. In addition, as practical, vegetation removal will be done outside of identified breeding seasons for locally breeding

bird species and construction activities within 30m of amphibian breeding habitat will avoid peak amphibian breeding season. In areas where significant compaction has occurred, subsoil will be ripped to alleviate compaction, and stripped subsoil and topsoil will be replaced. During installation of underground collector lines, where temporary storage of soil is required, topsoil and subsoil will be stored separately to minimize changes to soil properties following replacement of soil. In addition, soils will not be imported to the Project Study Area and pre-existing soil conditions will be taken into account during redistribution of soils so that pre-disturbance soil characteristics are maintained to the extent possible. Geotechnical investigations will include representative soil quality sampling and analysis to establish soil profile baselines for the Project location.

Wildlife and habitat records reviews and field surveys were undertaken to identify significant natural features to ensure that wherever possible, a 120 m setback between any significant features and the Project location was maintained. Significance of natural features was determined based on the composition, function and attributes of the features using recognized techniques and current provincial guidelines. Results of significant natural feature and wildlife surveys are contained in the Natural Heritage Assessment Report. The Natural Heritage Assessment Report also includes detailed environmental impact studies (EIS), which document predicted net effects to significant natural features and habitats for Project infrastructure located within 120 m as outlined by O. Reg. 359/09, as amended.

4.2.3 Net Effect

Due to the limited amount of vegetation removal within the Project Study Area and the short duration of construction activities, the above mitigation measures, and those discussed within the Natural Heritage Assessment Report, are considered sufficient to minimize and address potential negative effects. More detailed mitigation measures for specific natural feature types and species guilds are provided in the Natural Heritage Assessment Report.

4.2.4 Environmental Monitoring

Table 8 presents measures that will be used to monitor the effectiveness of the proposed mitigation measures. Where vegetation must be removed to facilitate construction and installation activities, areas that are remediated will be monitored to ensure the survival of the reseeded or re-vegetated areas until such time that it is verified that the replanted vegetation is functionally established or has reached a free growing stage. At watercourse crossings that may affect fish habitat provided by riparian vegetation, environmental monitoring requirements will be determined in consultation with the Saugeen Valley Conservation Authority (SVCA) and Fisheries and Oceans Canada (DFO), and adhered to by the Proponent.

Table 8: Summary of Removal of Vegetation and Habitat Environmental Monitoring Plans

Potential Negative Effect	Performance Objectives	Mitigation Measures	Monitoring Plan and Contingency Measures	Methods and Sampling Protocols
Short term disturbance to birds from the following habitat types: ■ Waterfowl stopover and staging area (aquatic); ■ Waterfowl stopover and staging area (terrestrial); ■ Shorebird migratory stopover area; ■ Colonial-nesting bird breeding habitat (ground); ■ Waterfowl nesting area; ■ Marsh breeding bird habitat; and ■ Open country bird breeding habitat.	Minimize disturbance to wildlife and wildlife habitat	■ Prior to construction, work area will be clearly delineated using flagging or erosion fencing. Construction contractor will ensure that there is no construction disturbance beyond the delineated area; ■ To the extent practical, construction activities within 120m of the following habitats will occur outside of the peak breeding or stopover season: ▪ Waterfowl stopover and staging area (aquatic and terrestrial) (March 15-May 31); ▪ Shorebird migratory stopover area (Spring: April 21-June 9; Fall: July 22-October 31); ▪ Colonial-nesting bird breeding habitat (ground) (May 1-June 30); ▪ Waterfowl nesting area (April-June); ▪ Marsh breeding bird habitat (May 1-June 30); ▪ Open country bird breeding habitat (May 1-July 31); and ■ See NHA EIS for complete habitat mitigation.	■ When it is not possible to avoid construction activity with 120 m of significant wildlife habitat during peak seasonal activity, a biologist will be present to confirm birds will not be impacted by construction activities; and ■ A mitigation plan will be developed in order to establish buffers and mitigation measures should nesting breeding or staging birds be observed. Buffer widths will vary based on species and will be determined in consultation with MNR.	■ Presence/absence survey protocols will be followed in accordance with guidance from MNR.
Short term disturbance to amphibians	Minimize disturbance and direct impacts to amphibians	■ Prior to construction, work area will be clearly delineated using flagging or erosion fencing. Construction contractor will ensure that there is no construction disturbance beyond the delineated area; ■ Avoid direct impacts to breeding habitat (i.e. vernal pools or other aquatic habitat surrounding wetlands; ■ Implement a sediment and erosion control plan; ■ Avoid construction activities within 30m of breeding habitat during the peak amphibian breeding season (April 15th to June 15th); ■ Construction activity within 30m of breeding habitat will occur during daylight hours; and ■ Enforce construction site speed limits and post wildlife crossing signage.	■ Fencing and flagging will be inspected to ensure that habitat is not being impacted; and ■ Erosion control measures will be inspected by a construction Environmental Compliance Monitor.	■ Regular visual inspections by a construction Environmental Compliance Monitor.

4.3 Impacts to Water Resources

4.3.1 Surface Water Runoff

4.3.1.1 Potential Effects

Construction and installation activities for the Project may result in negative environmental effects in the Project area from surface water runoff. Potential changes to surface drainage patterns (water quantity and flow paths) can negatively affect surface water quantity and quality, especially after storm events. These changes can result from soil stockpiling, vegetation removal, excavation, soil compaction from machinery, and re-grading and contouring land.

Runoff from stockpiles of gravel and soil for temporary and permanent Project components (e.g., wind turbine laydown areas and access roads) may result in sedimentation of nearby lands and watercourses. As noted in Section 4.2, vegetation removal can facilitate the movement of sediment.

Soil compaction from construction and installation equipment, especially at temporary staging and laydown areas, crane pads and access roads, can reduce water infiltration and result in greater movement of water by overland flow. Soil compaction can thereby lead to increasing runoff to surface water bodies and potentially increasing sedimentation. Increased surface runoff can lead to higher stream flow which may result in downstream erosion and sedimentation. Reduced water infiltration due to soil compaction can also affect shallow groundwater recharge, potentially resulting in a measurable decline in local groundwater levels.

4.3.1.2 Mitigation Measures

Plastic sheeting or other Best Management Practices will be used for temporary stockpiles of gravel and topsoil, to prevent erosion and runoff. Vegetation removal will be minimal, and will be avoided wherever possible adjacent to water bodies. If necessary, silt fencing will be used when construction and installation activities occur adjacent to watercourses and wetlands.

Permanent gravelled surfaces (e.g., access roads) will be contoured for effective surface drainage. Where significant compaction has occurred at temporary locations (e.g., wind turbine laydown areas) during construction and installation, subsoil will be ripped to reduce compaction. Areas with disturbed soil (e.g., trenching for underground collector lines) or areas that are re-graded with topsoil will be re-seeded to help stabilize the soil and prevent erosion.

4.3.1.3 Net Effect

Considering that the Project location, which includes temporary uses of land for construction and installation activities, represents approximately 2% of the Project Study Area, it is unlikely that there will be significant negative effects resulting from surface water runoff. As a result, the above mitigation measures are considered sufficient to control any significant negative effects due to surface water runoff, and environmental monitoring plans will involve minimal follow-up.

4.3.1.4 Environmental Monitoring

Table 9 presents measures that will be used to monitor the effectiveness of proposed surface water runoff mitigation strategies for the duration of construction and installation activities. Contingency measures are also defined in the unlikely case that performance objectives are not met.

Table 9: Summary of Surface Water Runoff Environmental Monitoring Plan

Potential Negative Effect	Performance Objectives	Mitigation Measures	Monitoring Plan and Contingency Measures	Methods and Sampling Protocols
Sedimentation in water bodies from soil excavation and/or soil stockpile runoff.	Change in turbidity or Total Suspended Solids (TSS) within Canadian Council of Ministers of the Environment (CCME) criteria for aquatic life.	■ Stockpiles of soil and gravel covered with plastic sheeting or use other BMPs; ■ Installation of silt fencing around excavation sites/soil stockpiles or affected water bodies; ■ Disturbed areas contoured for effective surface drainage; ■ Installation of drainage ditches/culverts to divert overland flow; ■ Minimal vegetation removal adjacent to water bodies; ■ Reduce compaction of compressed soils through deep tillage following construction and installation activities; and ■ Implementation of a Sediment and Erosion Control Plan consistent with agency standards and industry BMPs.	■ Field monitoring of turbidity, with supplemental TSS grab samples for laboratory analysis; and ■ Routine drainage inspections following storm events. <u>Contingency Measures</u>: ■ Provisional work stoppages at discretion of the Environmental Compliance Monitor; and ■ Installation of additional silt fencing around affected water bodies.	■ Field and laboratory water quality analysis following manufacturer instructions and approved analytical and QA/QC procedures.

4.3.2 Water Bodies

4.3.2.1 Potential Effects

Desktop studies and field surveys of water bodies within the Project Study Area were undertaken to identify significant water features so this information could be used in developing the Project layout. Classification of water features was determined based on the composition, function and attributes of the features using recognized techniques and current provincial guidelines. Results of these investigations are contained in the Water Assessment and Water Body Report.

Construction and installation activities near water bodies, including land clearing, site grading, crossings and vegetation removal have the potential to result in negative environmental effects. These potential effects include a decrease in bank stability, an increase in sediment runoff, and changes in the chemical properties and temperature of a water body. In turn, these potential effects can lead to changes in fish habitat, spawning and patterns of fish movement. The determination of the magnitude of effects is largely dependent on the characteristics of the water body, sensitivity of aquatic communities, and any crossing (if required) or mitigation techniques employed.

Effects on water bodies related to surface water runoff and sedimentation are discussed in Section 4.3.1, and effects from water discharge during dewatering of turbine foundations are discussed in Section 4.3.3. There is also the potential for fuel and oil/lubricant leakages or spills which could contaminate a water body. Potential effects related to spills are discussed in Section 4.4.

A more detailed discussion of potential effects on water bodies is contained within the Natural Heritage Assessment Report and the Water Assessment and Water Body Report.

4.3.2.2 Mitigation Measures

Following O. Reg. 359/09, as amended, a minimum setback of 30 m from the Project location to water bodies and watercourses was considered when establishing turbine and transformer(s) locations. In developing the Project layout, attempts were made to avoid watercourse crossings to the extent possible, however at some locations a crossing was determined to be required.

Where the Project location crosses a watercourse that is determined to contain fish habitat (i.e., there is a potential for harmful alteration, disruption or destruction of habitat), the crossing technique first considered will be from a DFO Operational Statement so that a review of fish and fish habitat will not be required. A list of the DFO Operational Statements that may be applicable is provided below, noting that individual crossings are likely to refer to only two or three individual statements:

- Notification Form;
- Timing Windows;
- High Pressure Directional Drilling;
- Punch and Bore Crossings;
- Temporary Stream Crossings;
- Isolated or Dry Open-cut Stream Crossings;

- Overhead Line Construction; and
- Maintenance of Riparian Vegetation in Existing Rights of Way.

Crossings of watercourses will also comply with requirements of the *Navigable Waters Protection Act* and the Minor Works and Waters (*Navigable Waters Protection Act*) Order, where applicable. Additional guidance provided by Transport Canada in the brochures, Submarine cables_TP14592B, and Temporary works_TP14893B (available on the Transport Canada website) will also be followed where criteria apply to specific crossings.

The SVCA will be consulted for activities occurring inside of their Regulation Limit boundaries. Additional information on watercourse crossings as they relate to fish habitat will be provided to the SVCA/DFO to assist in their review of permit applications for works in the Regulation Limit and in fish habitat. The Water Assessment and Water Body Report also includes a detailed environmental impact study (EIS) which documents predicted net impacts to water bodies where the Project location is located within the 30 m and 120 m distances outlined in O. Reg. 359/09, as amended.

To mitigate potential effects from any watercourse crossings, efforts will be made to design the entry and exit points and work areas for horizontal drilling operations (if required) so that they are outside of the natural feature. Other mitigation measures during watercourse crossings include maintaining a minimum 10 m no-work zone between the entry/exit point and the watercourse.

In general, removal of riparian vegetation will be avoided, if possible, and silt fencing will be used adjacent to watercourses and wetlands to prevent run-off and sedimentation effects. All equipment refuelling and maintenance activities will occur in temporary storage/laydown areas and temporary workspaces along access routes in order to localize any potential fuel, oil/lubricant leakages or spills to areas away from water bodies and watercourses. In addition, geotechnical investigations will include representative water quality sampling of groundwater and nearby surface waters to establish baselines.

4.3.2.3 Net Effect

By implementing appropriate mitigation measures, no significant adverse effects on water bodies are anticipated during the construction and installation of the Project.

4.3.2.4 Environmental Monitoring

For details on environmental monitoring plans for water bodies, refer to the Water Assessment and Water Body Report. The Construction Emergency Response and Communications Plan will contain procedures for spill contingency and response plans, spill response training, notification procedures, and necessary cleanup materials and equipment. As per s.13 of the *Environmental Protection Act*, all spills that could potentially have an adverse environmental effect, are outside the normal course of events, or are in excess of prescribed regulatory levels should be reported to the MOE's Spills Action Centre.

4.3.3 Water Takings

Applicants submitting an REA Application do not require a Permit to Take Water (PTTW) from the MOE under the *Ontario Water Resources Act* and the Water Taking and Transfer Regulation (O. Reg. 387/04), as specified

in Chapter 5 (*Guidance for preparing the Construction Plan Report*) of the Draft Technical Guide to Renewable Energy Approvals (MOE, 2012). However, wind turbine foundation dewatering activities will be guided by PTTW requirements, and may require an Environmental Compliance Approval from the Ministry of Environment (MOE).

4.3.3.1 Potential Effects

There is potential for groundwater to be encountered during the installation of the turbine foundations, access roads, and underground collector lines. Dewatering during construction has the potential to temporarily alter shallow groundwater flow to waterbodies, watercourses and wetlands. Subsequent release of pumped water from foundation dewatering to discharge areas can cause overland sediment transport to waterbodies, while discharge to waterbodies could introduce suspended sediments, re-suspend existing water body materials, and affect watercourse hydrology and water temperature near the point of discharge.

In order to determine the likelihood that dewatering would be required during foundation excavation and construction, a desktop study was initiated that consisted of a review of the following information:

- Available topographic and surficial geology mapping from the MNR NRVIS database;
- Available MOE Water Well Records in the vicinity and within the Site; and
- Planned wind turbine foundation excavation depths (approximately 3 m).

Near surface soils in the vicinity of the Project Study Area, mapped by the Ontario Geological Survey (OGS), are shown on Figure 2. This mapping indicates that near surface soils are predominantly reflect fine grained, glacial till. The location of available MOE Water Well Records located in the vicinity of the Project Study Area are provided on Figure 3 and summarized in Appendix A. It is noted that the water table depth (relative to ground surface) is generally observed below 3 m (approximate excavation depth of turbine foundation). Water table depths reported within 3 m of ground surface were limited to four well record locations. Three of these wells are located in the southwest portion of the Project Study Area and one is located in the northern portion of the Project Study Area.

Operation of the two wells to obtain water for dust suppression has the potential to result in groundwater drawdown which could affect adjacent natural heritage features or private wells.

4.3.3.2 Mitigation Measures

At locations where groundwater is encountered or runoff accumulates during excavating for foundations and dewatering of excavations is required, the construction contractors will monitor and record the amount of water withdrawn on a daily basis. Should this amount be less than 50,000 L/day, then no further action is required. If it is expected that greater than 50,000 L/day will be withdrawn, then the following actions will be implemented:

- To control suspended sediment in the water, the inlet pump head will be surrounded with clear stone and filter fabric; and
- The water taker will regulate the discharge at such a rate that there is no flooding in the receiving water body or dissipate the discharge so that no soil erosion is caused that impacts the receiving waterbody.

To determine appropriate locations and depths of the two wells, testing will be undertaken that also ensures that no significant effects on adjacent natural features or private wells will occur.

4.3.3.3 Net Effect

Based on the desktop study, there is low potential that the depth of wind turbine foundation excavations will intercept the water table (or saturated ground). It is unlikely that construction dewatering will be required to support foundation construction, other than for the purpose of managing direct precipitation within the excavation area. If pile type foundations are determined to be suitable at some locations, no adverse impacts to the water table are anticipated.

In the event that the proposed construction intercepts the water table, construction dewatering will be required to remove groundwater inflow and direct precipitation into the excavation. Considering the shallow depth of dewatering and the low permeability soils, dewatering rates are not expected to exceed 50 m^3/day. As such, an MOE Permit to Take Water (PTTW) is not likely to be required to support construction.

Temporary disturbance during excavation activities for wind turbine foundations, access roads, and collector lines is possible. However, by implementing the mitigation measures discussed above, it is anticipated that any effects would not be significant and would be of short duration. Adverse effects on adjacent wells are not anticipated.

No effects on private wells or natural heritage features are anticipated in the operation of the two wells to obtain water for dust suppression.

4.3.3.4 Environmental Monitoring

Table 10 presents measures will be used to monitor the effectiveness of mitigation strategies for water takings during construction and installation activities. Contingency measures are also defined in cases where performance objectives are not met.

Table 10: Summary of Water Bodies Environmental Monitoring Plan

Potential Negative Effect	Performance Objectives	Mitigation Measures	Monitoring Plan and Contingency Measures	Methods and Sampling Protocols
Development, Interference with wetlands, alterations to watercourses, natural hazards.	Obtain Ontario Regulation 169/06 Permit approval from SVCA and conform with permit conditions.	■ Minimize extent, duration and magnitude of works within Regulation Limit; ■ Limit grade changes to those approved by SVCA; and ■ Placement of silt fences, creation of work and machine exclusion zones, sediment and erosion control measures.	■ On site monitoring of compliance to permit conditions and implementation of mitigation and BMPs by third party environmental monitor. <u>Contingency Measures</u>: ■ Environmental inspector empowered with ability to stop work of prime contractor until corrective mitigation measures taken.	■ Observational and photographic monitoring, mitigation and compliance monitoring summary reports provided by qualified third party environmental monitor.
Sedimentation of water bodies from wind turbine foundation dewatering discharge.	Change in turbidity or TSS within CCME criteria for aquatic life.	■ Using pumping systems and pipelines to minimize erosion, sedimentation or surface flooding; and ■ Making the initial point of discharge a constructed sump area or a vegetated buffer or woodlot with a low slope to reduce flow rates and minimize erosion.	■ Monitoring water bodies directly or indirectly receiving dewatering discharge. <u>Contingency Measures</u>: ■ Moving dewatering pipes away from water bodies so that more infiltration to the surface soil system can occur; ■ Installing flow dissipaters to reduce erosion potential of water exiting at the point of discharge and to encourage sheet flow; and ■ Installation of silt fencing or hay/straw bales around discharge point.	■ Visual assessment of changes in stream flow rates and turbidity by a construction Environmental Compliance Monitor; and ■ If turbidity increase observed, obtain three samples for TSS analysis at upstream background, discharge and downstream sample points and compare to CCME criteria for aquatic life.

Table 10: Summary of Water Bodies Environmental Monitoring Plan (continued)

Potential Negative Effect	Performance Objectives	Mitigation Measures	Monitoring Plan and Contingency Measures	Methods and Sampling Protocols
In the event that dewatering is required (>50m^3/day), changes in water quantity in private wells near dewatered turbine foundations.	No measurable change in water quantity.	■ Using results of Appendix A to guide dewatering activities (e.g., informing residents ahead of time where local effects are anticipated).	■ If private wells are located within 100 m of a turbine foundation requiring dewatering, at the landowner's request, the well(s) may be monitored for changes in water quantity and/or quality; ■ To control suspended sediment in the water, the inlet pump head will be surrounded with clear stone and filter fabric; and ■ The water taker will regulate the discharge at such a rate that there is no flooding in the receiving water body or dissipate the discharge so that no soil erosion is caused that impacts the receiving waterbody <u>Contingency Measures</u>: ■ If there is a measurable change in water quantity, the Proponent will provide a temporary potable water supply until dewatering is completed or other corrective measures are taken.	■ At landowner's request, measurements of private well water for levels.

Table 10: Summary of Water Bodies Environmental Monitoring Plan (continued)

Potential Negative Effect	Performance Objectives	Mitigation Measures	Monitoring Plan and Contingency Measures	Methods and Sampling Protocols
Groundwater drawdown from operation of two wells with possible effects on natural heritage features or private wells.	No adverse effects on natural heritage features or performance of adjacent private wells	■ Testing will be undertaken that also ensures that no significant effects on adjacent natural features or private wells will occur	■ Complaints regarding well performance will be investigated by the MOE. Contingency Measures: ■ If there is a measurable change in well performance, measures will be taken to ensure these effects are mitigated.	

4.4 Spills

4.4.1 Potential Effects

Accidental spills or releases of contaminants (i.e., fuel, lubricating oils and other fluids) may occur during the refuelling, operation, or maintenance of construction and installation equipment. Accidental spills have the potential to contaminate ground and surface water and soils in the Project Study Area.

4.4.2 Mitigation Measures

Implementation of BMPs associated with the use of construction and installation equipment in the Project Study Area will reduce the chances of accidental spills of contaminants. The following BMPs will be used to prevent contaminant discharge to the environment:

- Proper maintenance of vehicles and construction and installation equipment;
- Regular inspection of vehicles, equipment and the construction site to ensure BMPs and other mitigation measures are being used consistently and in the correct manner to reduce the likelihood of any spills;
- Conducting refuelling and maintenance in designated areas;
- Machinery and parking in designated areas;
- Spill kits onsite where equipment will be used;
- Maintenance of a supply of spill control materials (absorbent material, absorbent booms, etc.) in locations where construction equipment is maintained and used;
- Spill pads used under parked machinery and equipment if required;
- Proper training of workers for spill prevention and containment;
- Proper reporting of any spills;
- Regular review of the spill response plan by all construction workers;
- Removal of accumulated sediment from control measures (e.g., ponds, fencing, etc.) after construction and installation activities or after significant accumulation; and
- Minimizing construction and installation activities during wet weather.

In addition, an oil containment system will be installed at the collector substation to prevent soil contamination in the event of a leak. Any spills will be handled in accordance with the MOE's Spills and Discharges Reporting Protocol as required under Sections 15 and 92 of the Ontario *Environmental Protection Act*.

4.4.3 Net Effect

By implementing appropriate mitigation measures, no significant adverse effects as of a result of spills are anticipated during the construction and installation of the Project.

4.4.4 Environmental Monitoring

Table 11 presents measures that will be used to monitor the effectiveness of contaminant spill mitigation strategies for the duration of construction and installation activities. Contingency measures are also defined in cases where performance objectives are not met.

Table 11: Summary of Spills Environmental Monitoring Plan

Potential Negative Effect	Performance Objectives	Mitigation Measures	Monitoring Plan and Contingency Measures	Methods and Sampling Protocols
Contamination of water bodies from contaminant spills.	Prevent spills of Volatile Organic Compounds (VOCs) or Polycyclic Aromatic Hydrocarbons (PAHs) to the environment .	■ Proper maintenance and regular inspections of equipment and vehicles; ■ Regular inspections of construction sites to ensure that BMPs are being used consistently and correctly; ■ Readily available spill control materials at all construction sites; ■ Proper training of workers and regular review of spill response plans; and ■ Minimizing construction activities during wet weather.	■ Inspections of vehicles, equipment and ground surfaces for spills or leakages; and ■ Inspection of nearby water bodies for oily films. <u>Contingency Measures</u>: ■ Immediate containment and remediation of contaminated area using appropriate spill containment and clean-up measures; ■ Removing and/or replacing leaking/malfunctioning equipment; and ■ Relocation of construction activities and/or equipment away from affected water body.	■ Daily inspections by on-site personnel and a construction Environmental Compliance Monitor; ■ Where evidence of spills exists (oily films/residue), containment and remediation using absorbent materials, booms and other materials will occur immediately; ■ In cases of larger spills with a risk of contamination of sediment and downstream areas (in the case of watercourses), three samples for VOC and PAH measurements of surface water and sediment will be taken in that bisect the water body (cross-sectional to flow gradient for watercourses) at the origin of the spill, and also 50 m downstream for watercourses; and ■ If sediment samples indicate contamination associated with the spill, the area of contamination will be discerned, and affected sediment will be removed, following spill clean-up measures agreed to with MOE, MNR and DFO.

Table 11: Summary of Spills Environmental Monitoring Plan (continued)

Potential Negative Effect	Performance Objectives	Mitigation Measures	Monitoring Plan and Contingency Measures	Methods and Sampling Protocols
Contamination of soil from fuel/oil spills.	Prevent spills which may lead to petrochemical residues being transported to soil or water supply.	■ Same as above.	■ Inspections of vehicles, equipment and ground surfaces for spills and/or leakages. Contingency Measures: ■ Immediate containment and remediation of contaminated area using appropriate spill containment and clean-up measures; and ■ Removing and/or replacing leaking/malfunctioning vehicles or equipment.	■ Daily inspections by on-site personnel and a construction Environmental Compliance Monitor for visible spills; and ■ Where evidence of spills exists, soil will be removed and disposed of at the appropriate waste disposal facility.

4.5 Cultural Heritage (Protected Properties, Archaeological and Heritage Resources)

4.5.1 Potential Effects

Archaeological resources have been identified in the Project Study Area, and there is potential for construction and installation activities to have negative effects on heritage buildings, structure or sites, archaeological resources, or cultural heritage landscapes if these areas are not avoided or preserved. Damage to archaeological resources could occur during construction excavation activities, should they be located in the area being excavated.

4.5.2 Mitigation Measures

Following Sections 19 – 23 of O. Reg. 359/09, as amended, for archaeological and built heritage resources within 250 m of the Project location, potential effects must be identified and assessed and permission/approval from the appropriate authority (i.e., County, Ontario Heritage Trust and/or the Ministry of Tourism, Culture and Sport (MTCS)) must be obtained.

A Stage 1 Archaeological Assessment has been conducted, including a desktop review of available archaeological information and a site visit. In areas with identified archaeological potential, a more detailed Stage 2 Archaeological Assessment has been undertaken by qualified archaeologists to investigate the possibility of archaeological resources being present. Where archaeological resources were discovered, appropriate mitigation measures were assessed, which depending on the resource, included any of the following:

- Preservation *in situ*, requiring changes to Project layout;
- Removal and preservation; and
- Further assessment (i.e., Stage 3 Archaeological Assessment and possibly Stage 4 Archaeological Assessment).

All further details of the investigation have been summarized in two Stage 2 Archaeological Assessment Reports which were submitted to the MTCS for review and acceptance. Stage 3 and Stage 4 Archaeological Assessment Reports, where required, will also be submitted to the MTCS.

A Heritage Assessment has also been conducted, including a desktop review of available heritage information and several site visits. If protected properties and/or cultural heritage resources were to be determined to have cultural heritage value or interest, a comprehensive Heritage Impact Assessment would be done for each individual instance. However, no such properties were identified. All details of any investigations are presented in the Heritage Assessment Report which was submitted to the MTCS for review and approval.

4.5.3 Net Effect

By implementing appropriate mitigation measures, no significant adverse effects on protected properties or archaeological and heritage resources are anticipated during the construction and installation of the Project.

4.5.4 Environmental Monitoring

Once archaeological sites to be impacted by construction have been assessed archaeologically, archaeological monitoring by a licensed archaeologist is proposed during construction and installation activities. This

monitoring is intended to avoid potential effects during construction and installation activities on any archaeological sites recommended for further Stage 3 or 4 Archaeological Assessment. No residual adverse effects on protected properties and heritage resources are anticipated, therefore no follow-up environmental monitoring is proposed.

4.6 Local Roads and Traffic

4.6.1 Potential Effects

Transportation of equipment and heavy turbine components on local roads may result in damage to roads. During construction and installation activities there will be an increase in traffic as a result of these activities that may result in traffic congestion.

4.6.2 Mitigation Measures

The implementation of transportation planning during construction and installation activities will minimize potential effects related to road damage and traffic congestion. If a traffic management plan is required by local governments (Municipality or County), such a plan will be prepared by the Proponent in consultation with local governments. The construction contractor and/or turbine manufacturer would oversee the implementation of the traffic management plan during the detailed Project design phase, which may include measures such as signage, road closures, speed restrictions, truck lighting, dust control, load restrictions and equipment inspections.

A survey to determine the roads and travel routes within the Project Study Area that are capable of accommodating the oversized vehicles and heavy loads associated with construction and installation activities will be conducted in conjunction with the County and Municipality prior to the delivery of Project components and equipment. Given the availability of alternate routes, any required upgrading or other construction works are not likely to substantially affect traffic congestion or travel times.

4.6.3 Net Effects

By implementing a Traffic Management Plan prior to the start of construction and installation activities, no significant adverse effects to local roads and traffic are anticipated during construction and installation activities.

4.6.4 Environmental Monitoring

The proposed mitigation measures are deemed sufficient to prevent potential negative effects on local roads and traffic. Therefore, no follow-up environmental monitoring is proposed.

4.7 Land Use and Resources and Infrastructure

4.7.1 Potential Effects

There will be a temporary loss of agricultural land during construction and installation activities as a result of temporary Project components, including crane pads, turbine laydown areas, and the construction staging areas (see Figure 1). However, these areas will be small relative to the total land area within the Project Study Area, and these lands will be returned to agricultural use after construction and installation activities are completed.

The loss of agricultural land during the lifespan of the project due to turbine footprints and access roads will represent less than 0.5% of all lands within the Project Study Area and associated crops. Excavation activities during construction have the potential to damage tile drains.

There is a low likelihood that waste generated by the Project will cause any disruption to local residents or waste management facilities. Prior to commencing construction and installation activities, the Proponent will estimate waste volumes and the capacities of local disposal facilities to determine the timing, quantities, and types of materials that can be disposed of locally (see Design and Operations Report). A likely local disposal facility that will be utilized during construction and installation activities is the Kincardine Waste Management Centre which is located at 437 Side Road 15N in the Municipality of Kincardine. The Kincardine Waste Management Centre is scheduled to open in two stages, with the first stage opening in November 2011. Once completed, the Kincardine Waste Management Centre is expected to have a design capacity of 640,000 m^3 (Patterson 2009).

If this waste management centre is unable to handle the quantities of waste generated by construction and installation activities for the Project, the Proponent will consult with local Municipalities to determine another suitable facility or facilities.

There are no areas known to be protected by the Provincial Policy Statement within 120 m of the Project Location.

Hunting and other recreational uses will not be permitted on lands required during the construction phase of the Project (unless permitted by the Proponent and/or the construction contractor) as it would be unsafe for recreational users due to the large construction equipment on-site. No fisheries resources will be impacted during the construction of the wind component of the Project. The construction of the Project will not result the creation of access to previously inaccessible areas as the Project is located in areas already cleared for agricultural uses.

While lands designated for mineral and aggregate resource extraction may be present within proximity to the Project Location, construction of the Project is not anticipated to have any potential effects on these resources as the lands required for the Project have been granted for renewable energy development instead of mineral and aggregate extraction by each participating landowner. The Project will not require the creation of a new pit or quarry to provide the required aggregate materials and as such a licence of permit under the *Aggregate Resources Act* will not be sought for the Project. A final location of the source of the required aggregate will be determined prior to construction, however it is planned that local sources will be used to the greatest extent possible.

There are no anticipated significant effects to telecommunication/radar systems during the construction of the Project. Potential effects to these systems following erection of the turbines is detailed in the Design and Operations Report.

Provincial and local infrastructure which may be impacted during construction includes provincial and local roads and municipal drains. There is potential for an increase of traffic during construction on Provincial Highways the transport of Project components, equipment and supplies, and to remove excess materials and waste from the area (transportation routes to the Project Location are to be determined prior to construction). Transport of Project equipment and supplies would include carrying excess loads and large tower components (e.g. turbine components). Permits from the Ministry of Transportation (MTO) may be required to facilitate the component transportation on provincial highways. It is not anticipated that the additional traffic on the provincial highways would cause any significant traffic congestion. Truck trips on local roads will be noticeably reduced after the

access roads and foundations have been installed and the turbine components are on-site. The increase in traffic, including excess load traffic, may result in short-term, localized disturbance to traffic, create potential traffic safety hazards, and/or produce abnormal wear on the roads.

Municipal road allowances would be used for the siting of the collector lines and thus there may be short term impacts to local roads during the installation of the collector lines

To the extent possible, the Proponent and/or the Construction Contractor will source required goods and services from local qualified suppliers where these items are available in sufficient quantity and at competitive prices. Disruptions in the vicinity of local businesses would be largely due to an increase in traffic, and would be short term and are not expected to affect use of these businesses.

4.7.2 Mitigation Measures

To the extent possible, restoration activities in the Project Study Area will occur immediately following the decommissioning of Project components (see Decommissioning Plan Report). Where the Project location is situated in agricultural areas, lands will be restored so that agricultural activities can continue. Restoration of agricultural land may involve de-compaction, establishing original soil horizons, soil types and nutrient content. It is assumed that each landowner will continue their desired agricultural management practices and plant their desired crop during the next planting season post-decommissioning.

In addition, consultation with landowners has been taken into consideration when siting the location of the turbines to reduce impact to existing agricultural operations. The construction contractor will respond to complaints of damaged tile drains and will ensure the alleged damage is investigated by a licensed technician.

Prior to commencing construction and installation activities, the Proponent will estimate the waste quantity and waste type expected to be generated. Non-hazardous waste, such as plastics, building materials, demolition debris and road gravel may be crushed (as required) and sold to private companies or recycling facilities for reuse where possible, or may be disposed of at the nearest local landfill licensed to receive these materials. Metals and other structural materials from dismantled Project components (e.g., collector substation, operations and maintenance buildings, wind turbine generators, collector lines) may be sold to a licensed scrap metal facility. Sanitary waste generated during the construction phase will be collected via portable toilets and wash stations supplied by a licensed third party who will be retained prior to the start of major construction activities.

During construction, the Construction Contractor would implement a site-specific waste collection and disposal management plan, which may include site practices such as:

- Systematic collection and separation of waste materials within on-site storage areas (not waste disposal areas) in weather-protected areas located at either central construction areas or the O&M building;
- All waste materials and recycling would be transported off-site by private waste material collection contractors licensed with a Certificate of Approval – Waste Management System;
- Contractors would be required to remove their excess materials from the site (e.g. extra cable, formwork, scrap metals, pallets, etc.);

- Excess materials generated during the course of construction excavations of soil would be handled in accordance with the MOE's Protocol for the Management of Excess Materials in Road Construction and Maintenance; excess excavated soils may be reused elsewhere on the property with landowner permission;
- Labelling and proper storage of hazardous and liquid wastes (e.g. used oil, drained hydraulic fluid, and used solvents) in a secure area that would ensure containment of the material in the event of a spill. As per s.13 of the *Environmental Protect Act*, all spills that could potentially have an adverse environmental effect, are outside the normal course of events, or are in excess of the prescribed regulatory levels would be reported to the MOE's Spills Action Centre;
- Dumping or burying wastes within the Project sites would be prohibited;
- Should contaminated soil be encountered during the course of excavations the contaminated material would be disposed of in accordance with the current appropriate provincial legislation, such as Ontario Regulation 347, the General – Waste Management Regulation;
- Disposal of non-hazardous waste at a registered waste disposal site(s);
- If waste is classified as waste other than solid non-hazardous, a Generator Registration Number is required from the MOE and the generator would have obligations regarding manifesting of waste. Compliance with Schedule 4 of Regulation 347 is mandatory when determining waste category;
- Implementation of an on-going waste management program consisting of reduction, reuse, and recycling of materials; and
- Disposal of sanitary wastes would be the responsibility of the contracted third party and they would ensure disposal in accordance with appropriate legislation, standards and policies.

It is recommended that Construction Waste Management Plans be developed by the Construction Contractor and should include protocols for the reuse, recycling and/or disposal of solid, hazardous and sanitary waste.

4.7.3 Net Effect

The temporary loss of agricultural lands associated with the construction and installation activities will represent approximately 2% of the total Project Study Area. Lands will be returned to agricultural use after construction and installation activities are completed.

Overall waste volumes from the construction and installation activities are not likely to pose a strain on the existing waste management centre.

There are no anticipated significant effects related to land use, resources and infrastructure as a result of construction of the Project. The Project's effect on the rural community during construction, including the suspension of recreational uses, traffic, and some disturbance to adjacent land uses, these effects will be temporary and will be minimized through the implementation of good site practices, transport planning, and good communication with the community. Road safety is not expected to be an issue during the construction phase; however, the potential for accidents along the haul routes and on-site cannot be totally avoided.

A positive net effect is anticipated on the local economy during construction of the Project. The Project provides income, employment, and fiscal benefits to the local area, including the municipality and participating

landowners. The municipality would receive ongoing property tax income and participating landowners would receive land lease payments. Existing businesses within local communities could benefit from the demands of the Project workforce during construction.

4.7.4 Environmental Monitoring

Table 12 presents measures that will be used to monitor the effectiveness of mitigation strategies for effects on land use and resources for the duration of Construction and Installation activities. Contingency measures are also defined in cases where performance objectives are not met.

Table 12: Summary of Land Use and Resources Environmental Monitoring Plan

Potential Negative Effect	Performance Objective	Mitigation Measures	Monitoring Plan and Contingency Measures	Methods and Sampling Protocols
Disposal of construction materials meets or exceeds capacities of local waste management facilities (e.g., Kincardine Waste Management Centre).	■ No disruption of waste management facilities or their use by local residents.	■ Estimate construction waste volumes and capacities of local waste disposal facilities.	■ Communicate with potentially used waste management facilities; ■ Systematic collection and separation of waste materials within on-site storage areas; ■ Use of licensed contractors for waste collection; ■ Contractors required to remove construction waste from site; ■ Comply with MOE's Protocol for the Management of Excess Materials in Road Construction and Maintenance; ■ Labelling and proper storage of hazardous and liquid wastes in a secure area; ■ Disposal of non-hazardous waste at a registered waste disposal site(s); and ■ If waste is classified as waste other than solid non-hazardous, a Generator Registration Number is required from the MOE and the generator would have obligations regarding manifesting of waste. Compliance with Schedule 4 of Regulation 347 is mandatory when determining waste category; and ■ Implementation of an on-going waste management program consisting of reduction, reuse,	■ Monthly communication with waste disposal facilities about capacities and anticipated intake.

Table 12: Summary of Land Use and Resources Environmental Monitoring Plan (continued)

Potential Negative Effect	Performance Objective	Mitigation Measures	Monitoring Plan and Contingency Measures	Methods and Sampling Protocols
			and recycling of materials. 7Contingency Measures: ■ Change the timing or quantities of disposal; ■ Dispose of select materials at other locations outside of the region that have capacity; and ■ Entirely shift disposal to facilities outside of the immediate region that have capacity.	
Reduction in agricultural land.	■ No significant economic reduction in agricultural yields on lots containing Project infrastructure.	■ Using existing right-of-ways where possible for access roads; and ■ Where possible, utilizing County roads to minimize access road construction.	■ Discussion with Bruce County and local residents; and ■ Repair any damaged tile drains. Contingency Measures: ■ Width reduction of access roads at selected locations as agreed to by the Proponent prior to the completion of construction and installation activities.	■ Receiving feedback through the Proponent Ontario construction manager.

5.0 CONSTRUCTION ENVIRONMENTAL EFFECTS MONITORING PLAN

The Construction Contractor would be the primary party responsible for the implementation of Construction Environmental Effects Monitoring Plan measures. Implementation of these measures would be undertaken in compliance with applicable municipal, provincial, and federal standards and guidelines. Monitoring will consist of weekly inspections of the Project Location by an environmental inspector. The inspector will ensure that all mitigation measures described in the report are adhered to and are functioning as predicted. If required, remedial actions will be recommended and work ceased in the area of interest until these remedial actions are implemented.

6.0 REFERENCES

Bruce County. 2006. County of Bruce Official Plan. Office Consolidation. January 2006.

Government of Ontario. 2009. Ontario Bill 150, Green Energy and Green Economy Act. May 14, 2009.

Ministry of the Environment (MOE). 2009. Ontario Regulation 359/09. Renewable Energy Approvals under Part V.0.1 of the Environmental Protection Act.

Ministry of the Environment (MOE). 2011. Technical Guide to Renewable Energy Approvals. July 2011.

Patterson, Troy. 2009. Armow landfill project to extend usage 38 years. The Kincardine News. Article ID# 1703507. Accessed from http://www.kincardinenews.com/ArticleDisplay.aspx?e=1703507&archive=true on December 1, 2011.

The Corporation of the Municipality of Kincardine. 2008. By-Law No. 2008-076. Accessed from http://www.google.ca/#sclient=psy-ab&hl=en&source=hp&q=municipality+of+kincardine+noise+by-law&pbx=1&oq=municipality+of+kincardine+noise+by-law&aq=f&aqi=&aql=&gs_sm=e&gs_upl=124l7136l0l7382l41l17l0l0l0l0l426l712l2-1.0.1l2l0&bav=on.2,or.r_gc.r_pw.,cf.osb&fp=238f0fdaf0ce6052&biw=1366&bih=566 on January 19, 2012.

Report Signature Page

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Principal

KM/IC/AC:gf/ch

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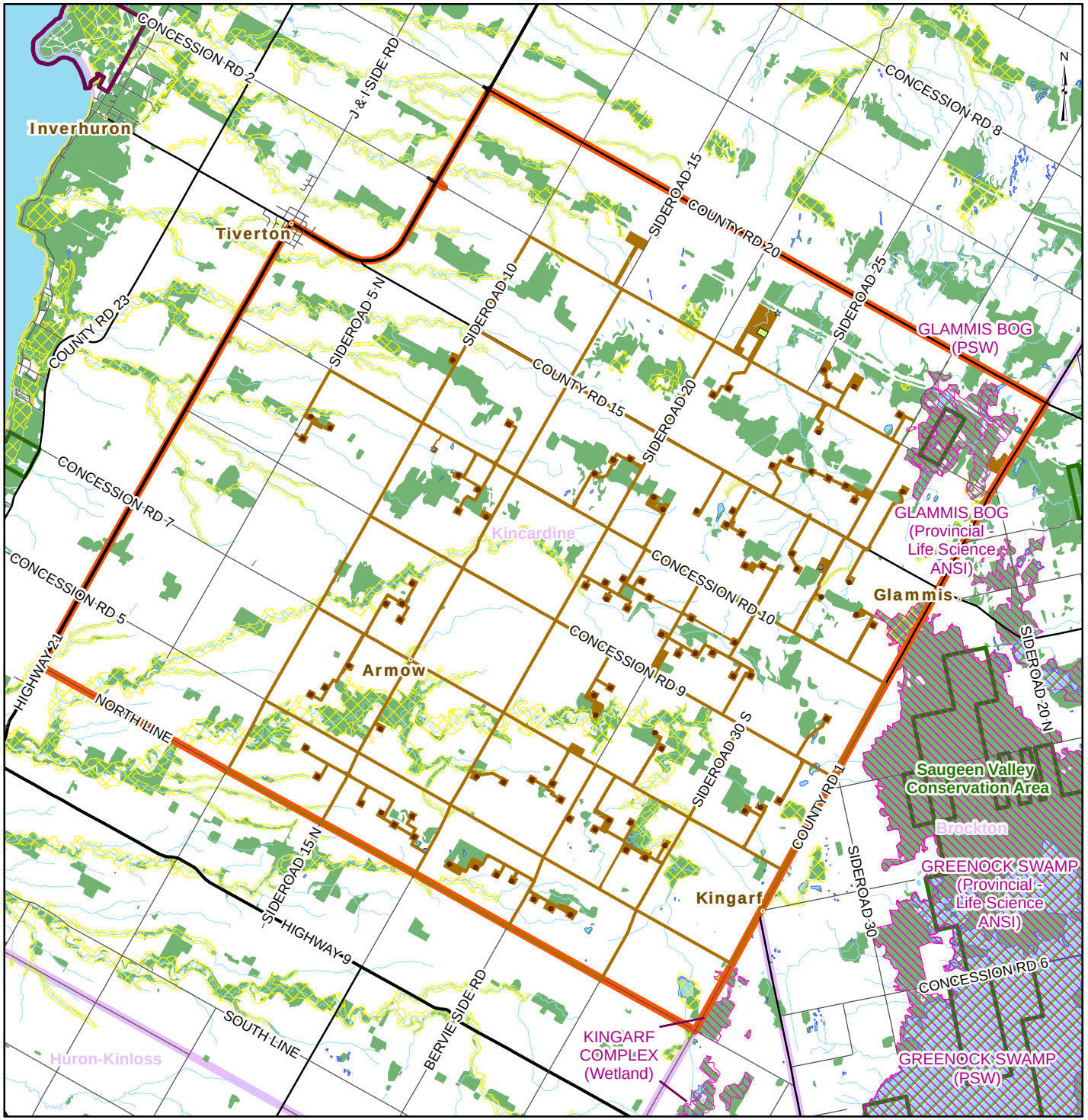
FIGURE 1

Project Location

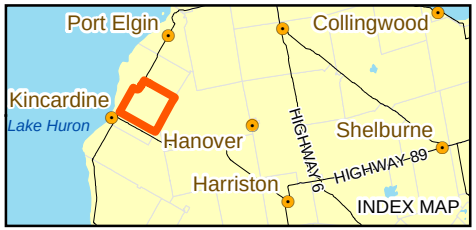


LEGEND

- Turbine
- MET Tower
- Point Of Interconnect (POI)
- Community
- Railway
- Highway
- Major Road
- Local Road
- Watercourse
- Project Study Area
- Project Location
- Substation
- Provincial Park
- Conservation Area
- Natural Feature
- Kincardine Hazard Land
- Wetland
- Waterbody
- Wooded Area
- Municipal Boundary

NOTES:

All potential project collector routes are shown on this figure, final design will likely reduce overall footprint.



REFERENCE

1. Base Data - MNR LIO, obtained 2009
2. Natural Features compiled by Golder from NRVIS base data, NHIC Natural Areas and MNR Wetland and ANSI data, obtained 2010
3. Hazard Lands - Bruce County, obtained 2010

Produced by Golder Associates Ltd under licence from Ontario Ministry of Natural Resources, © Queens Printer 2010
Projection: UTM Datum: NAD 83 Coordinate System: UTM Zone 17

0 0.75 1.5 3 4.5 6

SCALE 1:110,000 KILOMETRES

PROJECT

ARMOW WIND PROJECT

TITLE

PROJECT LOCATION

Golder Associates
Mississauga, Ontario

PROJECT NO. 11-1151-0247			SCALE AS SHOWN	REV.
DESIGN	ME	23 Jul. 2012		
GIS	ME	15 Nov. 2012		
CHECK	KM	15 Nov. 2012		
REVIEW	IC	15 Nov. 2012		

FIGURE: 1

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APPENDIX A

Desktop Review of Groundwater Elevation Near Armow, Ontario

TECHNICAL MEMORANDUM

DATE July 19, 2012 **PROJECT No.** 11-1151-0247

TO Ian Callum, Project Manager
Golder Associates Ltd.

FROM Laura Elmhirst, M.A.Sc.,
Stephen Di Biase, P.Geo. **EMAIL** Stephen_DiBiase@golder.com

CONSTRUCTION DEWATERING DESKTOP REVIEW
ARMOW WIND PROJECT

SP Armow Wind Ontario LP (SP Armow Wind Ontario) is proposing to construct approximately 90 wind turbines within a 472.9 ha total disturbance area, referred to as the Armow Wind Project (the Site). A total of 99 turbines will be permitted to provide contingency positions. Golder has been advised by SP Armow Wind Ontario that excavations required to support the construction of the wind turbine foundations will be approximately 22 m x 22 m and extend to a depth of approximately 3 m below ground surface (bgs). The proposed wind turbine locations within the Site are shown on Figure 2.

The purpose of this desktop review is to determine if localized dewatering will likely be required to support wind turbine foundation construction, and if so, indicate the potential dewatering rates that may be required.

As part of this desktop study, the following information was considered:

- Available topographic and surficial geology mapping from Ministry of Natural Resources (MNR) Land Information Ontario (LIO) database;
- Available Ontario Ministry of the Environment (MOE) Water Well Records (WWR) in the vicinity and within the Project area; and
- Planned excavations depths for the wind turbine foundation construction.

An assessment of groundwater levels and potential dewatering requirements was made based on a review of the above information.

Local Hydrogeological Conditions

Near surface soils in the vicinity of the Site, which have been mapped by the Ontario Geological Survey (OGS), are shown on Figure 2. This mapping indicates that near surface soils are predominantly reflect fine grained, glacial till.

Figure 3 shows the location of MOE Water Well Records located in the vicinity of the Site. Reported groundwater elevations at the MOE water well record locations are provided within Table 1 and summarized on Figure 3. It is noted that the water table depth (relative to ground surface) is generally observed below 3 m. Water table depths reported within 3 m of ground surface were limited to four well record locations. Three of

these wells are located in the southwest portion of the Project Study Area and one is located in the northern portion of the Project Study Area.

Based on the information provided above, there is low potential that the depth of wind turbine foundation excavations will intercept the water table (or saturated ground). It is unlikely that construction dewatering will be required to support foundation construction, other than for the purpose of managing direct precipitation within the excavation area.

In the event that the proposed construction intercepts the water table, construction dewatering will be required to remove groundwater inflow and direct precipitation into the excavation. Considering the shallow depth of dewatering and the low permeability soils, dewatering rates are not expected to exceed 50 m^3/day. As such, an MOE Permit to Take Water (PTTW) is not likely to be required to support construction.

Limitations

This technical memorandum, which has been prepared for SP Armow Wind Ontario, represents a desktop review to determine the general depth to groundwater in the vicinity of the Site. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the sole responsibility of such third parties.

This report is based on data collected from MOE and MNR databases and information provided by SP Armow Wind Ontario. Golder has completed no independent field investigation to assess hydrogeological or environmental conditions. Golder has relied in good faith on the data and information provided by SP Armow Wind Ontario and on other materials as noted in this report. Golder has assumed that the information provided was factual and accurate. Golder accepts no responsibility for any deficiency, misstatement or inaccuracy contained in this report as a result of omissions, misinterpretations or fraudulent acts of persons interviewed or contacted.

References

Ontario Geological Survey. 1991. 1:1 000 000 scale bedrock geology of Ontario; Ontario Geological Survey.

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LE/SMD/cg/gf

Attachments: Table 1 Summary of MOE Water Well Record Information
Figure 2 Surficial Geology
Figure 3 Groundwater Elevation

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TABLE 1
Summary of MOE Water Well Record Information

Summary of MOE Water Well Record Information

Well ID	Date	Ground Elevation (m)	Groundwater Elevation (m)	Depth To Water (m)
1400784	3/29/1963	250.29	179.88	70.41
1400785	6/16/1966	265.59	192.74	72.85
1400786	11/18/1948	275.17	188.00	87.17
1400787	6/29/1961	282.43	203.48	78.94
1400788	10/9/1953	275.34	205.54	69.80
1400789	11/6/1964	289.37	217.43	71.93
1400790	6/30/1961	284.94	220.93	64.01
1400796	11/20/1949	263.65	255.42	8.23
1400797	7/20/1966	269.76	194.47	75.29
1400798	11/20/1967	268.15	225.18	42.98
1400805	8/14/1961	260.04	179.27	80.77
1400806	8/13/1947	260.00	178.92	81.08
1400807	10/12/1955	261.34	190.02	71.32
1400808	9/18/1967	267.04	174.08	92.96
1400810	8/15/1966	268.11	197.39	70.71
1400811	11/29/1966	268.11	196.79	71.32
1400812	5/18/1965	263.38	220.10	43.28
1401682	5/8/1957	245.24	176.36	68.88
1401683	12/5/1957	268.43	198.93	69.49
1401684	6/22/1962	284.68	216.10	68.58
1401685	11/18/1966	283.32	219.32	64.01
1401686	6/8/1962	288.44	239.67	48.77
1401687	2/11/1956	281.51	210.49	71.02
1401688	2/1/1956	284.17	205.53	78.64
1401689	10/13/1967	251.22	194.52	56.69
1401690	12/5/1966	259.27	206.23	53.04
1401691	11/4/1967	271.09	205.25	65.84
1401692	12/8/1948	277.39	205.77	71.63
1401693	9/13/1947	259.55	194.62	64.92
1401694	11/18/1947	264.95	218.01	46.94
1401695	10/12/1961	283.41	207.21	76.20
1401696	11/5/1957	286.67	206.81	79.86
1401697	10/27/1954	287.42	203.60	83.82
1401698	7/31/1950	290.10	252.00	38.10
1401700	8/22/1967	232.08	175.09	57.00
1401701	8/26/1947	274.74	193.36	81.38
1401702	9/23/1963	237.14	183.80	53.34
1401703	8/23/1967	240.03	183.64	56.39
1401704	3/27/1957	240.50	188.69	51.82
1401705	11/15/1952	262.22	187.24	74.98
1401706	5/15/1957	282.02	215.27	66.75
1401708	11/25/1950	281.98	249.98	32.00
1401709	9/16/1966	275.54	209.40	66.14
1401720	9/13/1963	225.21	165.78	59.44
1401721	8/17/1960	264.80	218.16	46.63
Source: Ontario Ministry of Environment (MOE) Water Well Records				

Summary of MOE Water Well Record Information

Well ID	Date	Ground Elevation (m)	Groundwater Elevation (m)	Depth To Water (m)
1401722	6/15/1962	261.28	230.80	30.48
1402120	12/1/1948	240.77	172.50	68.28
1402121	4/18/1963	241.98	183.46	58.52
1402204	9/6/1968	237.28	191.86	45.42
1402206	8/21/1968	225.16	172.43	52.73
1402295	3/24/1969	244.14	150.27	93.88
1402307	5/1/1969	243.96	179.95	64.01
1402315	6/4/1969	257.88	200.57	57.30
1402325	7/21/1969	261.80	195.96	65.84
1402334	8/4/1969	289.60	224.07	65.53
1402343	8/6/1969	276.63	222.38	54.25
1402532	6/17/1970	235.77	179.68	56.08
1402557	7/21/1970	246.21	181.90	64.31
1402558	7/28/1970	270.54	186.11	84.43
1402624	9/24/1970	280.05	199.28	80.77
1402736	7/1/1971	266.11	196.92	69.19
1402776	8/27/1971	265.03	203.15	61.87
1402806	10/26/1971	283.12	206.92	76.20
1402877	11/19/1971	254.60	183.89	70.71
1402925	5/16/1972	261.89	179.29	82.60
1402940	5/24/1972	258.90	202.82	56.08
1402978	7/20/1972	265.45	195.35	70.10
1403115	11/7/1972	285.30	215.81	69.49
1403153	5/7/1973	241.74	181.39	60.35
1403158	3/30/1973	245.19	179.65	65.53
1403237	8/3/1973	285.38	211.31	74.07
1403239	7/31/1973	291.96	206.31	85.65
1403243	7/25/1973	282.41	212.61	69.80
1403311	9/21/1973	263.93	208.15	55.78
1403362	11/19/1973	280.91	226.66	54.25
1403379	12/3/1973	282.15	210.82	71.32
1403380	12/5/1973	280.74	228.01	52.73
1403420	11/1/1973	235.96	187.19	48.77
1403428	1/23/1974	264.16	231.24	32.92
1403459	4/29/1974	247.25	190.86	56.39
1403514	6/24/1974	288.96	228.31	60.66
1403548	6/27/1974	290.00	204.65	85.34
1403560	8/14/1974	245.56	224.22	21.34
1403686	12/6/1974	245.50	149.19	96.32
1403687	12/11/1974	284.91	210.53	74.37
1403691	11/7/1974	255.10	189.87	65.23
1403752	3/20/1975	269.84	228.99	40.84
1403785	4/11/1975	272.70	194.06	78.64
1403792	6/6/1975	266.81	234.80	32.00
1403796	5/27/1975	276.43	223.70	52.73
Source: Ontario Ministry of Environment (MOE) Water Well Records				

Summary of MOE Water Well Record Information

Well ID	Date	Ground Elevation (m)	Groundwater Elevation (m)	Depth To Water (m)
1404005	10/10/1975	241.67	171.87	69.80
1404187	6/23/1976	270.37	202.71	67.67
1404191	6/10/1976	275.39	203.15	72.24
1404303	10/13/1976	270.80	198.26	72.54
1404322	12/15/1976	261.25	186.87	74.37
1404446	4/5/1977	250.00	201.24	48.77
1404505	6/28/1977	245.14	187.53	57.61
1404550	7/5/1977	255.41	212.73	42.67
1404598	10/25/1977	288.56	235.22	53.34
1404650	11/9/1977	267.52	188.58	78.94
1404667	11/7/1977	231.11	186.91	44.20
1404941	8/25/1978	261.32	204.63	56.69
1404984	11/8/1978	269.74	229.81	39.93
1405123	2/20/1979	280.86	208.62	72.24
1405124	4/10/1979	287.08	223.98	63.09
1405161	8/8/1979	271.65	236.90	34.75
1405217	9/27/1979	284.17	222.30	61.87
1405219	9/19/1979	272.94	234.23	38.71
1405273	12/14/1979	284.19	232.38	51.82
1405289	10/30/1979	226.78	184.72	42.06
1405556	10/30/1980	270.02	243.80	26.21
1405741	10/28/1981	282.22	239.86	42.37
1405782	4/2/1982	262.52	188.15	74.37
1405844	9/2/1982	272.92	222.93	49.99
1405901	1/1/1982	269.39	193.19	76.20
1406144	8/14/1984	267.67	222.56	45.11
1406176	11/13/1984	292.59	217.61	74.98
1406399	2/19/1986	275.37	194.90	80.47
1406775	3/23/1988	266.65	201.73	64.92
1406786	3/25/1988	255.56	190.64	64.92
1406862	7/15/1988	265.68	205.94	59.74
1407004	12/19/1988	259.93	208.73	51.21
1407197	9/20/1989	271.84	247.46	24.38
1407250	7/14/1989	274.93	191.72	83.21
1407318	10/23/1989	286.04	225.39	60.66
1407330	10/12/1989	285.06	210.69	74.37
1407499	5/8/1990	266.62	178.54	88.09
1407723	10/29/1990	276.37	218.45	57.91
1407870	5/16/1991	233.99	150.48	83.52
1407873	4/26/1991	246.57	190.18	56.39
1408020	11/1/1991	270.31	230.07	40.23
1408080	11/13/1991	259.71	228.32	31.39
1408391	8/5/1993	252.64	195.64	57.00
1408450	8/27/1993	239.02	171.96	67.06
1408528	8/26/1993	251.61	194.61	57.00
Source: Ontario Ministry of Environment (MOE) Water Well Records				

Summary of MOE Water Well Record Information

Well ID	Date	Ground Elevation (m)	Groundwater Elevation (m)	Depth To Water (m)
1408570	5/24/1994	285.20	243.44	41.76
1408578	5/10/1994	280.58	212.61	67.97
1408596	7/19/1994	222.25	194.21	28.04
1408654	10/19/1994	278.60	251.47	27.13
1408716	1/18/1995	275.28	202.12	73.15
1408765	3/21/1995	263.43	179.61	83.82
1408796	9/21/1995	247.08	178.80	68.28
1408807	8/17/1995	275.95	205.54	70.41
1408865	11/14/1995	283.46	220.98	62.48
1408907	8/12/1996	234.85	186.69	48.16
1409015	7/7/1997	263.89	210.85	53.04
1409065	9/15/1997	255.39	207.54	47.85
1409143	5/21/1997	263.03	165.50	97.54
1409171	4/23/1998	280.92	205.94	74.98
1409207	8/28/1998	278.60	249.34	29.26
1409240	9/22/1998	275.22	200.24	74.98
1409256	11/4/1998	270.73	203.67	67.06
1409314	12/4/1998	256.32	202.07	54.25
1409398	4/27/1999	260.10	252.79	7.32
1409440	7/16/1999	286.96	210.46	76.50
1409445	7/5/1999	283.92	230.28	53.64
1409506	9/8/1999	241.53	179.05	62.48
1410016	10/10/2001	280.13	210.63	69.49
1410025	11/30/2001	281.15	212.88	68.28
1410129	4/24/2002	278.27	250.84	27.43
1410211	9/19/2002	283.09	231.27	51.82
1410319	9/20/2002	286.14	212.07	74.07
1410369	5/22/2003	258.62	204.06	54.56
1410408	2/19/2003	260.65	259.73	0.91
1410409	2/19/2003	260.59	255.72	4.88
1410410	2/20/2003	260.65	256.07	4.57
1410411	2/20/2003	260.55	255.97	4.57
1410412	2/20/2003	260.58	256.00	4.57
1410413	2/20/2003	260.41	255.83	4.57
1410420	5/27/2003	238.77	158.61	80.16
1410421	6/3/2003	238.67	151.20	87.48
1410467	7/25/2003	253.20	232.17	21.03
1410682	6/23/2004	254.04	211.34	42.70
1410691	7/19/2004	245.34	192.04	53.30
1410768	7/19/2004	271.43	205.90	65.53
1410868	6/15/2004	242.56	238.57	3.99
1410989	7/8/2005	239.20	237.70	1.50
1411033	6/23/2005	287.99	202.69	85.30
1411077	8/16/2005	270.07	224.37	45.70
1411079	8/24/2005	280.95	212.35	68.60
Source: Ontario Ministry of Environment (MOE) Water Well Records				

Summary of MOE Water Well Record Information

Well ID	Installation Date	Ground Elevation (m)	Groundwater Elevation (m)	Depth To Water (m)
1411109	9/19/2005	269.40	208.40	61.00
1411155	9/28/2005	269.03	208.03	61.00
1411166	11/3/2005	261.14	223.65	37.49
1411237	12/28/2005	290.20	224.98	65.23
1411253	4/18/2006	244.24	184.19	60.05
1411264	6/23/2006	284.29	277.59	6.70
1411317	7/7/2006	270.77	267.97	2.80
1411364	9/18/2006	275.00	200.90	74.10
1411383	10/23/2006	244.33	184.93	59.40
7034395	8/9/2006	265.50	197.50	68.00
7043118	3/14/2007	238.91	238.91	-
7045082	6/7/2007	284.64	211.54	73.10
7045083	6/1/2007	284.15	210.05	74.10
7045087	5/23/2007	245.53	190.73	54.80
7046404	5/31/2007	233.37	231.87	1.50
7046463	5/1/2007	270.13	229.59	40.54
7048826	8/16/2007	267.14	203.44	63.70
7048827	8/10/2007	256.21	189.21	67.00
7049771	6/27/2007	279.70	203.50	76.20
7050671	4/24/2007	265.61	209.83	55.78
7051287	9/20/2007	285.03	218.03	67.00
7053388	9/21/2007	245.28	181.27	64.01
7053389	9/26/2007	292.95	215.23	77.72
7053719	10/23/2007	265.07	221.79	43.28
7104594	11/13/2007	254.88	247.38	7.50
7104594	11/13/2007	253.31	245.81	7.50
7104594	11/13/2007	254.11	246.61	7.50
7104594	11/13/2007	252.81	245.31	7.50
7104594	11/13/2007	256.53	249.03	7.50
7104957	4/30/2008	286.80	219.13	67.67
7107119	5/28/2008	252.01	185.87	66.14
7108177	6/25/2008	277.88	204.88	73.00
7110137	7/16/2008	264.35	210.40	53.95
7112367	8/11/2008	247.01	211.35	35.66
7112375	7/8/2008	265.02	204.97	60.05
7112376	7/8/2008	266.70	212.75	53.95
7112378	7/9/2008	269.93	209.88	60.05
7114782	9/17/2008	257.85	175.56	82.30
7123909	4/21/2009	250.49	238.49	12.00
7124905	5/21/2009	264.77	209.90	54.86
7125513	5/26/2009	271.61	239.30	32.31
7127052	7/15/2009	235.03	180.47	54.56
7131071	7/17/2009	266.49	207.05	59.44
7137913	2/2/2009	271.36	237.23	34.14
7139665	1/1/2009	265.19	226.17	39.01

Source: Ontario Ministry of Environment (MOE) Water Well Records

FIGURE 2
Surficial Geology

452000 456000 460000 464000 468000 472000

4904000 4900000 4896000 4892000 4888000

Lake Huron

BRUCE RD 23

KING ST

BRUCE RD 20

BRUCE RD 15

HWY 21

QUEEN ST

HWY 9

BRUCE RD 7

BRUCE RD 1

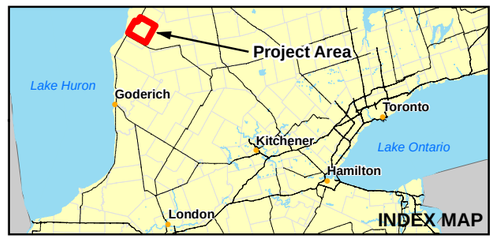
N

LEGEND

- Proposed Turbine Location
- Roads
- Watercourse
- Waterbody
- Project Area

Surficial Geology

- 3: Paleozoic bedrock
- 5b: Stone-poor, carbonate-derived silty to sandy till
- 5d: Glaciolacustrine-derived silty to clayey till
- 6: Ice-contact stratified deposits
- 7: Glaciofluvial deposits
- 8a: Massive-well laminated
- 9: Foreshore deposits
- 12: Alluvial deposits
- 17: Eolian deposits
- 18: Colluvial deposits
- 20: Organic deposits



REFERENCE

Base Data - MNR LIO, obtained 2009
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Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 17

1 0.5 0 1 2 3
SCALE 1:80,000 KILOMETRES

PROJECT
ARMOW WIND PROJECT

TITLE
SURFICIAL GEOLOGY

Golder Associates
Mississauga, Ontario

PROJECT NO. 11-1151-0247			SCALE AS SHOWN	REV. 0.0
DESIGN	ME	4 Jul. 2012	FIGURE: 2	
GIS	ME	4 Jul. 2012		
CHECK	KM	4 Jul. 2012		
REVIEW	IC	4 Jul. 2012		

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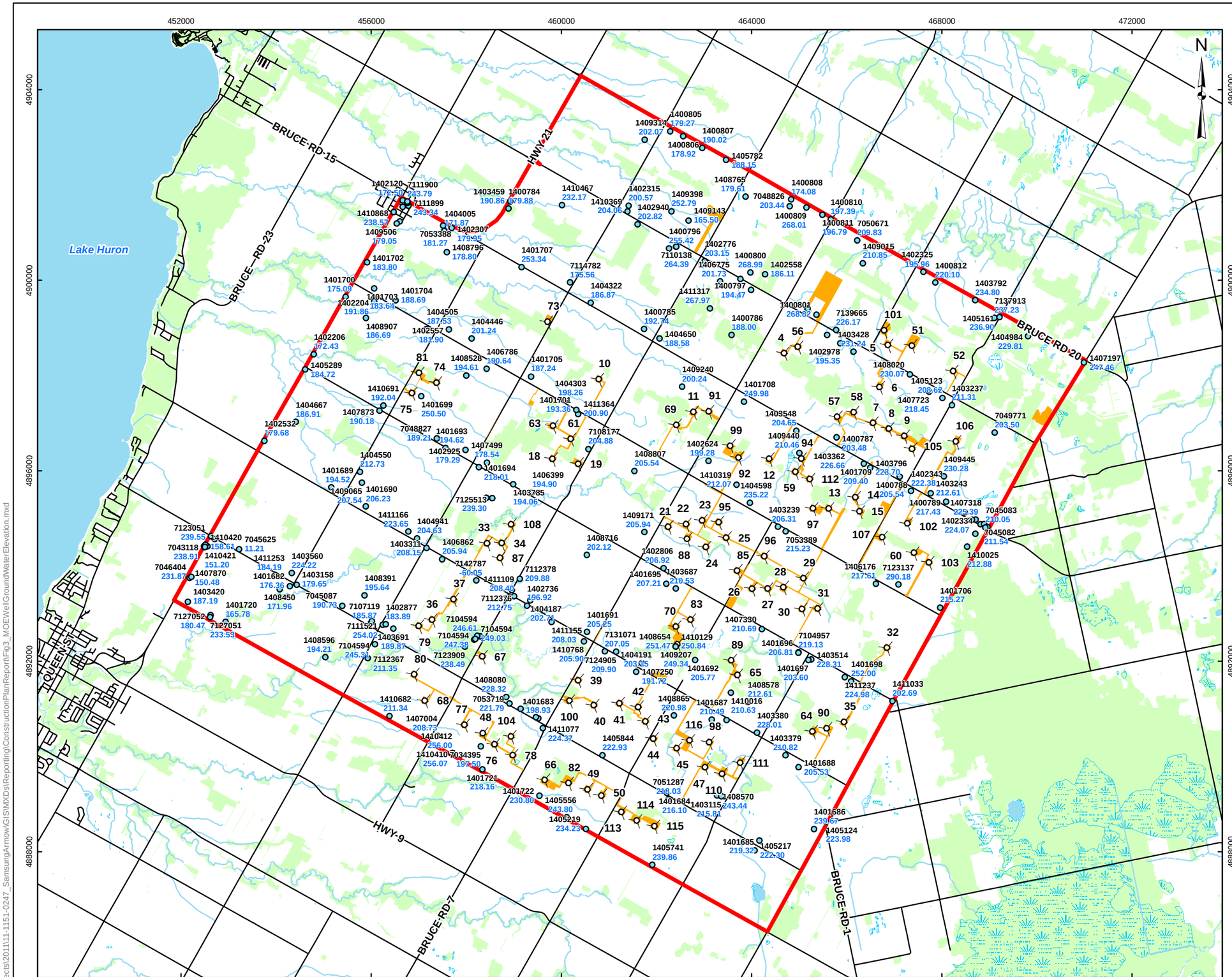
FIGURE 3
Groundwater Elevation



LEGEND

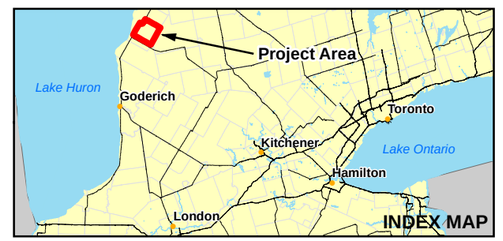
- Proposed Turbine Location
- MOE Well
- Roads
- Watercourse
- Waterbody
- Wetland
- Wooded Areas
- Project Area
- Project Location

MOE Well Label

MOE Well ID
1407197
247.46
Groundwater Elevation

NOTES:

Reported groundwater elevation sourced from Ontario Ministry of Environment Water Well Records.



DRAFT

REFERENCE

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1 0.5 0 1 2 3
SCALE 1:80,000 KILOMETRES

PROJECT
ARMOW WIND PROJECT

TITLE
GROUNDWATER ELEVATION

Golder Associates
Mississauga, Ontario

PROJECT NO. 11-1151-0247			SCALE AS SHOWN	REV. 0.0
DESIGN	ME	4 Jul. 2012	FIGURE: 3	
GIS	ME	4 Jul. 2012		
CHECK	KM	4 Jul. 2012		
REVIEW	IC	4 Jul. 2012		

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