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# Siting Principles and Guidelines for Wind Development on the Great Lakes

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**Great Lakes Wind Collaborative**  
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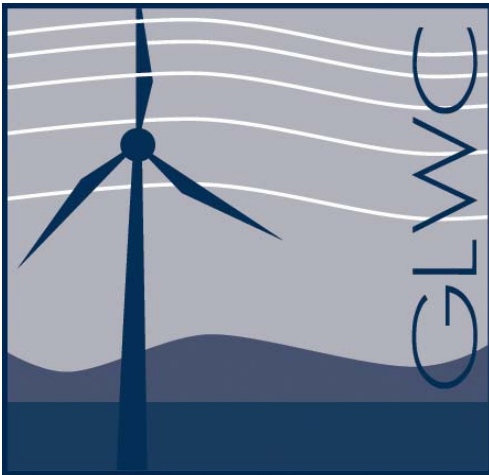
## Acknowledgments

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- U.S. and Canadian Federal Agencies
- State/Provincial Agencies
- Tribes/First Nations
- Municipal Interests
- Trade Associations and Nonprofit Organizations
- Environmental and Conservation Organizations
- Electric Utilities
- Wind Industry
- Academic Interests
- At-Large Members

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## About the Great Lakes Wind Collaborative



Great Lakes Wind Collaborative

The Great Lakes Wind Collaborative (GLWC) is a multi-sector coalition of wind energy stakeholders working to facilitate the sustainable development of wind power in the binational Great Lakes region.

The GLWC reaches across sectors and disciplines to identify and address the technical, environmental, regulatory, educational and financial issues related to the deployment of wind energy resources. Members include representatives from a wide spectrum of interests throughout the Great Lakes region. The GLWC strives for a broad, balanced membership. Members provide diverse perspectives and represent a wide array of societal sectors and work to achieve the purpose of the group.

The GLWC is committed to working by consensus of its members. The organization and its members recognize that the credibility and authority of the GLWC's work products derive from the fact

that they were developed through the cooperative efforts of a wide range of concerns and perspectives. All committees and their members make decisions and take positions by consensus. The GLWC defines consensus as overwhelming agreement among GLWC members attained through a good-faith effort to meet the interests of all stakeholders.

The GLWC is operated through a four-tiered membership structure that includes:

- **Wind Stakeholders** to allow broad participation by all interested parties;
- An **Advisory Committee** with representation from state, provincial, federal, municipal, tribal, trade association, conservation, academic and private sector (utilities and industry) interests that leads workgroup activities and provides guidance and feedback to the Steering Committee;
- A **Steering Committee**, with representation from state, provincial, federal, municipal, tribal, trade association, conservation and private sector interests that governs the GLWC's overall operations ; and
- **Issue-specific workgroups** that are assembled to focus on particular GLWC priorities.

The GLWC is staffed by the Great Lakes Commission. More information on the GLWC can be found online at: <http://www.glc.org/energy/wind>. To join the GLWC stakeholder list please contact John Hummer ([jhummer@glc.org](mailto:jhummer@glc.org)) or Victoria Pebbles ([vpebbles@glc.org](mailto:vpebbles@glc.org)).

## **Preamble and Statement of Purpose**

This document was created through a collaborative effort by members of the Great Lakes Wind Collaborative Offshore Wind Workgroup and members of the Collaborative's Steering and Advisory Committees. All products of the Great Lakes Wind Collaborative are based on the consensus of its members. Consequently, the siting principles and guidelines discussed herein do not reflect the views of any one organization, agency or individual, nor are they endorsed by members of the Collaborative. Rather, they are intended to serve as a basis of discussion and thought for stakeholders interested in the sustainable development of offshore wind in the Great Lakes region. The siting principles and guidelines in this document address a comprehensive list of issues regarding offshore wind projects along with possible methods to identify if a resource concern is present, and considerations to remedy the concern. The document also provides regulatory agencies the opportunity to utilize the siting principles to develop state- and province-wide best practices or policies that are the best fit for their jurisdiction and associated environmental resources. This is meant to be a guidance document, hence all parties utilizing it should be aware that site-specific issues may arise, and revisions and modifications will be necessary as scientific and technological knowledge advances.

## General Development Considerations for Great Lakes Offshore Wind Projects

1. Wind energy development on the Great Lakes should be located in areas that are compatible with specific resource values. Considerations should include identifying areas of critical environmental concern and commercial and recreational uses of the waterways in or near the proposed site. These areas should be avoided to the degree possible if a significant conflict would exist with the proposed development. Wind energy projects should be developed in a manner that is compatible with other uses of the Lakes to the extent possible.
2. Companies seeking to develop projects on the Lakes should consult with all appropriate state/provincial and federal regulatory and resource management agencies as early in the planning process as possible and stay engaged throughout project planning and development.
3. The regulatory and resource management agencies, along with the developer, should identify whether there are appropriate organizations to include in the siting and development process (such as local university experts, research institutes, etc.).
4. The lead federal agencies in the U.S. and Canada should initiate, as early in the planning process as possible for any proposed wind project on one of the Lakes, intergovernmental consultation with all government agencies who might be directly and substantially affected by an offshore wind project – or involved in any capacity – to ensure that issues and concerns at all phases of the project, including decommissioning, are identified and adequately addressed.
5. Regulatory agencies should, to the extent possible under laws and regulations they must implement, consider the positive effects of wind energy projects on quality of life and the environment in comparison to equivalent power generation from fossil fuel sources, when (a) evaluating the trade-offs between those benefits and potential impacts on environmental, visual, and socio-economic resources, (b) making approval decisions, and (c) establishing any non-statutory fees, payments, and mitigation requirements.
6. Regulatory agencies and the wind industry should develop and encourage passive adaptive management strategies to ensure that potential adverse impacts of wind energy development are addressed by avoiding (if possible), minimizing, or mitigating them to levels accountable to relevant policies.
7. When considering potential site locations, very early in the siting process, developers should consider visual/viewshed impacts, waterway/benthic impacts, avian/bat impacts as well as other environmental and aesthetic issues that are identified by local stakeholders. Recommendations for specific types of review are contained in this document.
8. The latest, most advanced technologies should be applied when development of an offshore wind site occurs to minimize impacts. Innovative technologies may be used in limited situations, especially if such innovations can be changed and adaptive management applied if necessary.
9. Decommissioning and removal of turbine components including blades, nacelle, tower, and containerized transformer, is anticipated to be largely a reversal of the installation process and should be subject to the same constraints. Operational wastes associated with routine maintenance, repair, upgrades, and/or decommissioning must be properly handled, stored, transported, and disposed of at a licensed facility that complies with applicable regulations.

## SITING PRINCIPLES

*The following is a comprehensive list of potential environmental concerns associated with Great Lakes offshore wind project siting, permitting, construction and operation and suggests topics for siting meetings. Developers and regulatory agencies should meet early in the siting process to determine the jurisdictional requirements, appropriate areas of environmental concern and necessary studies/mapping requirements. This list will assist all parties in determining appropriate actions for regulatory agencies and developers to ensure a comprehensive review of environmental concerns associated with a proposed offshore wind site.*

### Preliminary Siting and Pre-Construction Planning

In order to begin serious review of a particular proposed site, certain testing activities and equipment may need to be installed in the waterway (example: a meteorological tower). At this time, the developer and regulatory agencies have the opportunity to review existing research and maps of the proposed area.

1. Siting Meeting with Agencies: Based on the areas of potential concern outlined in the document below, an environmental monitoring program should be developed to ensure certain environmental resource conditions are tracked throughout all phases of a project.
  - A. Regulatory agencies should strive to develop and enforce consistent standards for monitoring impacts of wind projects on the Great Lakes during all phases of a project.
  - B. Resource conditions to be tracked during monitoring and methodologies used for tracking should be identified on a consensus basis between regulatory agencies and project developers. Where there is regulatory authority, if consensus cannot be reached, the regulating agency must issue conditions and/or deny permits.
  - C. The monitoring program should identify the monitoring methodology required for each environmental resource that may be adversely affected, set threshold impact levels for corrective action, identify potential mitigation measures, and establish protocols for incorporating responses to monitoring results and additional mitigation measures into standard operating procedures. These requirements, including adaptive management strategies, should be established in the project approval process to ensure that any actual adverse impacts are avoided, minimized, or mitigated.
  
2. Recommendations: During testing and installation of equipment for pre-construction planning, physical disruption of the environment should be minimized by:
  - A. Limiting the area disturbed by installation and operation of testing activities and equipment installed for pre-construction monitoring.
  - B. Avoiding the duplication of infrastructure by considering joint planning and facility sharing (such as substations and collector system cables) early in the project planning process to serve all projects and the likely build-out capacity in an area.
  - C. Avoiding the use of materials that could be detrimental, like guy wires.

### Lake Floor Habitats

*The lake floor provides habitat to a range of wildlife species that contribute to the critical maintenance of the Great Lakes ecosystem. Long-term disruption to sensitive lake floor habitat may have negative implications on the viability of these natural populations.*

1. Siting Meeting with Agencies: Developers will gather any applicable lakebed maps and surveys, including the locations of pipes and utility infrastructure already in place, for a consultation meeting

with regulatory agencies early in the siting process. Regulatory agencies will be responsible for gathering any relevant maps and surveys that have been produced by the agency. The consultation will determine what additional lakebed mapping and pre-siting surveys are required to ensure the wind development is sited appropriately to avoid or minimize potential impacts associated with sensitive lakebed habitat, instability, and other topographic features.

2. Recommendations: To minimize impacts to the lake floor and associated habitat, the following design and construction operations should be included in the project plan:
  - A. Avoid locating facilities or anchoring vessels near known sensitive lakebed habitats, such as spawning areas or near areas of known pollution “hot spots” or contaminated sediments, such as Areas of Concern identified by the International Joint Commission, unless effective mitigation activities are planned and agreed upon in advance with appropriate regulatory or advisory bodies.
  - B. Minimize lakebed disturbance during construction and installation of the facility and associated infrastructure.
  - C. Use best practical technology and a single-operation process for underwater cable installation to minimize lakebed disturbance and sediment dispersion.
  - D. Employ appropriate measures for underwater cables to minimize the intensity of electromagnetic fields to avoid effects on fish populations.
  - E. Scouring action by currents can occur around foundations. Avoid or minimize effects on lakebed contours by using scour protection devices and conducting periodic routine inspections to ensure structural integrity.
  - F. Minimize the duration of construction to minimize disturbance. The length of the construction period can vary by project and should thus be agreed upon by the regulatory agencies and the developer prior to construction commencing.

## **Fishery Resources & Habitat**

*Fishery resources and habitat vary throughout the Great Lakes. Generally, resource concerns center around fish migration, spawning and unique or sensitive habitat.*

1. Siting Meeting with Agencies: Developers and regulatory agencies will determine the extent and methodologies of pre-siting surveys to identify any important, sensitive, and unique fish habitats in the vicinity of a proposed project site. These surveys can be used to design the project to avoid, minimize, or mitigate significant impacts to these habitats.
2. Recommendations: In order to avoid and minimize impacts to fish resources and habitat, the following should be included in the project design and construction:
  - A. Minimize construction activities in areas containing anadromous and important freshwater fish species during migration or spawning periods identified by appropriate regulatory or advisory bodies.
  - B. Avoid locating facilities near known sensitive fish habitats, such as those designated as protected areas, unless enhancement of fish habitat is planned and agreed upon in advance with appropriate regulatory or advisory bodies.
  - C. Minimize lakebed disturbance during construction of towers and installation of underwater cables.
  - D. Avoid or minimize activity near known spawning beds and nursery habitats when eggs and fry are expected to be present – as communicated by appropriate regulatory or advisory bodies.

## **Fisheries**

*Sport and commercial fishing in the Great Lakes provide recreation, jobs (to fishermen, marinas, food processors, etc) and help maintain appropriate population levels of many fish species. Offshore wind project activities that hinder this industry could result in negative consequences to all interest groups involved as well as the local and regional economies.*

1. Siting Meeting with Public, Interest Groups: Developers should review planned activities with potentially affected fishing organizations and commercial fishing operations to avoid or minimize impacts and prevent unreasonable fishing conflicts:
  - A. Work cooperatively with commercial/recreational fishing interests to ensure that construction and operation of a project will minimize potential impacts to those fisheries.
  - B. Minimize conflict with commercial fishing activity and gear by notifying registered fishermen of the location, dimensions and timeframe of project construction activities well in advance of mobilization, with updates throughout the construction period.
  - C. Avoid installing facilities and cables near known sensitive fish habitats and within known high-use fishing areas if there is a significant conflict identified. Avoid boating channels.
2. Recommendations:
  - A. Cables should be buried at a safe elevation in the lakebed to avoid conflict with fishing vessels and gear operations (adhering to applicable electrical codes).
    - i. This depth should be determined through a detailed review on this issue and an understanding of specific project circumstances.
    - ii. Developers should inspect cable burial depth periodically during project operation to ensure adequate coverage is maintained to avoid interference with fishing gear/activity.
    - iii. Apply government-approved lighting recommendations to ensure safe vessel operation.

## **Avian Impacts**

*Numerous avian species use both the waters and airspace in the Great Lakes for migration, feeding, resting and wintering. Large-scale offshore wind development may alter these behavioral patterns and could result in displacement or mortality. More study is needed in this area to document impacts of Great Lakes offshore wind on avian species.*

1. Siting Meeting with Agencies: Early consultation between the developer and regulatory agencies will determine the need and extent for the types of avian studies necessary. Studies using standardized methodologies should be conducted before siting, review and construction, as well as after construction to evaluate the potential and actual impacts on avian species. Avian-use surveys should be scientifically rigorous; and the amount and extent of ecological baseline data required shall be determined by location and on a project footprint basis. Types of studies may include:
  - A. Studies during the Siting Process
    - i. Conduct surveys of offshore areas to identify important migration areas, flight path and height, and use of waters for feeding, resting, staging, and wintering areas. Avoid siting facilities in or near those areas.
    - ii. Evaluate current avian use of the project area and design the project to minimize or mitigate the potential for bird strikes, exclusion and habitat loss.
  - B. Post-construction Studies
    - i. The scope of post-construction monitoring should be based on the anticipated level of avian activity. For instance, a nearshore project in an area with significant bird activity should be treated differently than a project in the middle of a lake when avian studies have indicated very minimal potential conflict. Avian studies should be made available to regulators.
    - ii. Studies and monitoring should focus on comparing actual impacts to predicted risks, establishing causal mechanisms of impact, and applying effective mitigation measures to reduce risk which may include seasonal feathering. Studies and monitoring should also document compliance with avian species protection laws, such as the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act.
2. Recommendations: Follow the recommendations of the new U.S. Fish and Wildlife Service (USFWS) Wind Turbine Guidelines for Wildlife (upon completion) developed by the Federal Advisory Committee. Minimize the use of bright lights to reduce the attraction of birds. Follow the recommendations of the USFWS Communication Tower Working Group, including the use of low-intensity strobe lights, consistent with U.S. Coast Guard and Federal Aviation Administration lighting guidelines. Canadian projects should follow guidelines of Canadian federal and/or provincial agencies.

## **Bat (Chiroptera) Impacts**

*Little is known about bat foraging or migration over open water or the use of islands and points by bats to cross the Great Lakes. Nor is it known if some bats follow the Great Lakes shoreline during their spring and fall migration or drift over open water as do nocturnal migrating landbirds. It is known that bats are highly susceptible to mortality from wind turbines, particularly migrating bats. These concerns illuminate the need for study on this topic regarding Great Lakes offshore wind development.*

1. Siting Meeting with Agencies: Pre-construction monitoring should be planned and conducted for bats.

2. Recommendations: Met towers should routinely have sonic bat detectors installed when they are first erected to determine bat use of the area. Any radar monitoring should record the presence of bats along with birds. As knowledge on this topic increases, open water areas may be able to be identified where bats do not occur or only during migration periods.

### **Acoustic Environment**

*Significant changes in the aerial and water acoustic environment has the potential of impacting avian and fisheries habitat by disrupting birds' courting, migration and nesting behavior and periods as well as disturbing fish and other aquatic life, including spawning activities, from high pressure sound waves.*

1. Siting Meeting with Agencies: Acoustic modeling of underwater operational sound at the proposed site of a wind farm project can determine the baseline and predicted underwater sound levels from operation of the project. Consultation with regulator agencies will determine if a study is needed and the methodology to be used. Study recommendations include:
  - A. Acoustic tests can follow the same guidelines that are used by state/provincial departments of transportation.
  - B. Minimize the use of seismic surveys for site characterization; instead employ geophysical means to obtain measurements for characterization of the lake bottom.
2. Recommendations: To avoid and minimize impacts to the acoustic environment, the following should be utilized in design, construction and operations:
  - A. Time major noise-generating activities, such as pile driving and cable trenching, to avoid periods when birds are courting and nesting and fish are spawning.
  - B. Employ attenuation devices similar to what has been used in pile driving for bridge construction to minimize disruption and disturbance to aquatic life from sound and high pressure waves.
  - C. Reduce the effects of sound pressure in the water by using proven means to deter fish (such as horn blasts, strobes, electric seines) and reduce pressure waves (such as bubble curtains and cofferdams), while avoiding migration and spawning periods, and increasing noise levels gradually.
  - D. Use a "soft start" of the pile driving equipment during installation of foundations and pilings to minimize impacts to fish from underwater sound levels.
  - E. Meet or exceed the standards that have been established by state/provincial transportation departments related to the construction of infrastructure over bodies of water that require pile installation.

### **Lake Shore Habitats (shoreline, or near shore projects)**

*While the vast majority of work will occur in the lake habitat, there will be activities involving the lake shoreline, such as connection of cables to substations, on and off-loading of material, and increased ship activity. This has the potential of impacting the shoreline by disrupting drainage patterns, infringing upon wetlands and associated habitat, and causing potential erosion issues.*

1. Siting Meeting with Agencies: Identify likely areas of shoreline that could be impacted by development activities and based on existing resource mapping, determine if there are existing resources that may require avoidance or protection measures.
2. Recommendations: To avoid and minimize impacts to the shoreline and nearshore habitats including wetlands, developers should utilize the following measures in the design and construction of the proposed project:

- A. Implement turbidity reduction measures to minimize effects to shorelines and vegetation from construction activities.
- B. Implement best management practices for erosion and sediment control.
- C. Maintain natural surface drainage patterns.
- D. Maintain buffers around wetlands. Note: Compliance with federal and applicable state/provincial wetland laws must be met, as with all types of development.

### **Transportation and Vessel Traffic Safety**

*Recreational, commercial, and military traffic occurs throughout the Great Lakes. There are existing shipping and ferry lanes used by government agencies as well as the private sector that could be impacted by offshore wind development in some manner.*

1. Siting Meeting with Agencies and/or Public: The proposed location of a wind project may potentially impact use of the waters in and adjacent to the development by commercial and recreational users. To assess the potential impacts and whether mitigation measures are necessary, developers, in consultation with regulatory agencies, should:
  - A. Complete an assessment of potential year-round risks/impacts to the safe use of the proposed wind project waters – including shipping channels and dredged material disposal areas – as well as the adjacent waters, by commercial, governmental and recreational users.
  - B. Contact the Coast Guard to discuss and assess potential impacts to the ability of the agency to execute its search and rescue, marine environmental response, homeland security (especially concerning projects proposed near the U.S.-Canada international border) and waterways management missions.
  - C. Identify proposed mitigation measures for any potential risk/impacts identified in items A and B.
  - D. Work with appropriate federal agencies to ensure that wind projects are added to the applicable nautical charts well before construction begins.
  
2. Recommendations:
  - A. Developers should implement measures that reduce the likelihood of vessel accidents and fuel spills.
  - B. Use proper lighting and signage on wind project structures to aid navigation and air traffic safety in and around the development site.

## Visual (Scenic), Historic and Cultural Resources

*The concept of what should be considered “visually pleasing” varies among people. Generally, it is preferable to minimize the visual impact of wind turbines when viewed from the shoreline. On-shore structures or other elements may also impact the overall visual appearance of a particular site. Historical resources like shipwrecks and historically significant lighthouses should be avoided and are protected under Section 106 of the Historic Preservation Act.*

1. Siting Meeting with Agencies and/or Public: Simulated photos can provide an excellent visual reference of the expected wind project scenic impact. By using state-of-the-art viewshed mapping, photographic and virtual simulations, computer simulation and field inventory techniques the visible aspects of the proposed project can be documented with reasonable accuracy.
  - A. Simulations should evaluate effects at sensitive and scenic viewpoints<sup>1</sup>.
  - B. Visualizations of the wind project should be designed for public review that demonstrate a person’s view from the shore of the wind facility.
  
2. Recommendations:
  - A. Minimizing lighting should be a high priority, to the extent allowed by applicable federal agencies. Daytime lighting should be avoided if possible by use of clearly visible wind turbine generator colors.
  - B. Siting and turbine design should address key visual elements including consistency with environmental color schemes, effects of tower designs, and avoidance of visually-disruptive commercial markings.
  - C. The public should be informed and consulted when evaluating the visual site design elements of proposed wind energy facilities.
  - D. To evaluate the visual impacts of wind energy projects, the focus should be on:
    - i. The characteristics of the “lakescape” in which the project will be located that contribute to scenic quality;
    - ii. The relative sensitivity of viewing areas; and
    - iii. The potential for degradation of documented scenic and historical resource values, rather than on personal aesthetic opinions of the project.

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<sup>1</sup> These would include parks and other locations where the appearance of wind turbines could substantially diminish the aesthetic appearance of the view of the lake, and the enjoyment of the view.