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Great Lakes Wind Feasibility Study Public Webinar #4

November 17, 2021

Sherryll Huber

NYSERDA Project Manager

Meeting Procedures

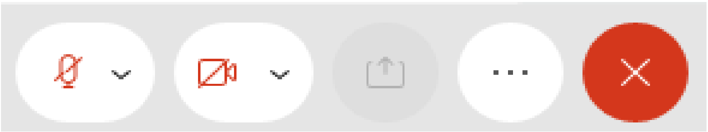
Participation for Members of the Public:

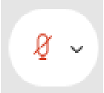
> Members of the public are muted upon entry

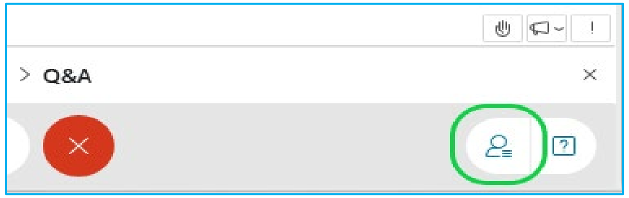
> Questions and comments may be submitted in writing through the Q&A feature at any time during the event

- Chat is disabled
- Today's materials along with a recording of the webinar will be posted to NYSERDA's Great Lakes Wind website

> If technical problems arise, please contact Sal.Graven@nyserda.ny.gov

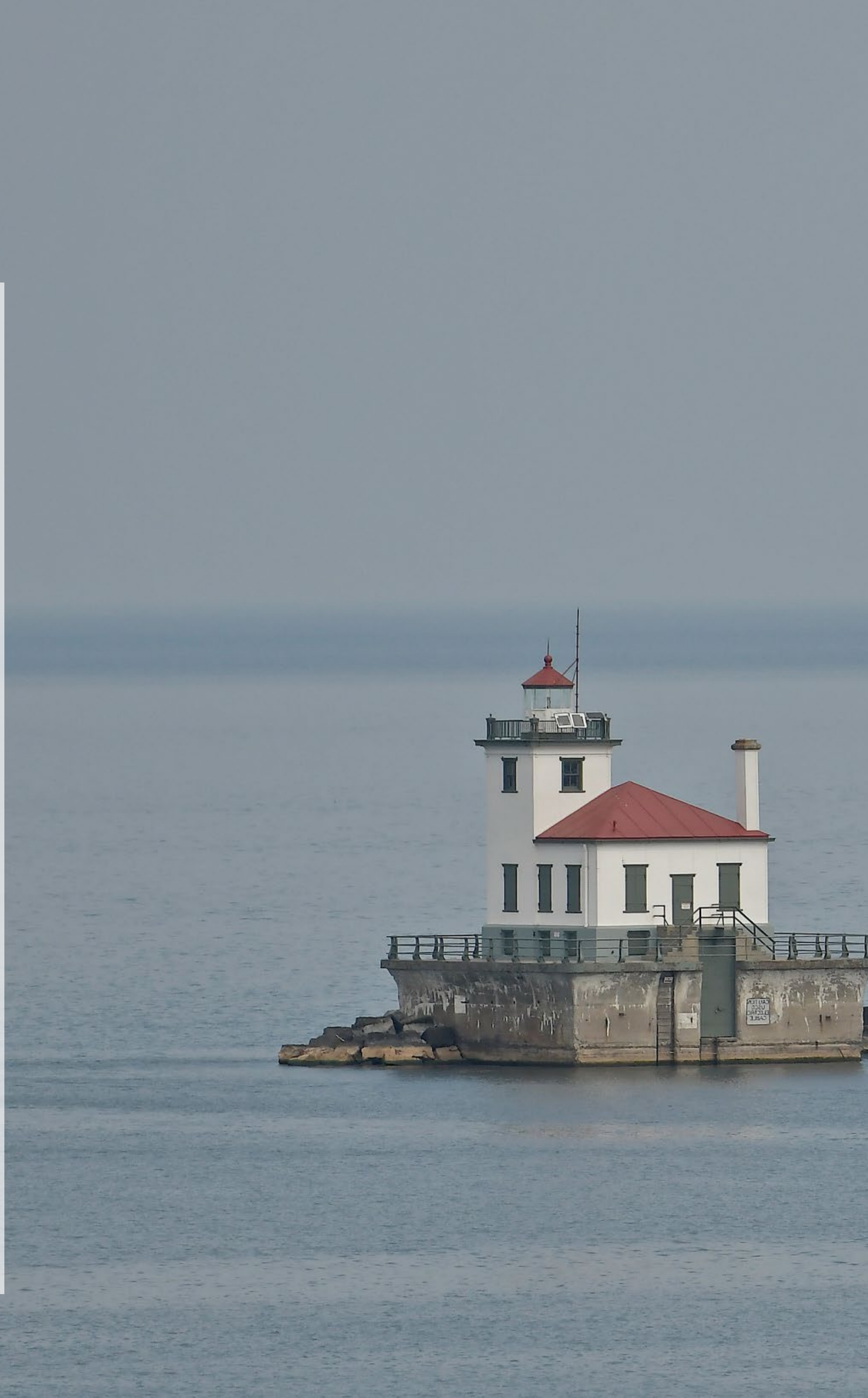


You'll see  **when your microphone is muted**



Agenda

- > **Overview of Feasibility Study**
- > **Lake Resource Characterization, Port Infrastructure**
  National Renewable Energy Laboratory (NREL)
- > **Technology, Cost Analysis, Economic Development**
  National Renewable Energy Laboratory (NREL)
- > **Permitting, Risk/Benefit Analysis, Visualization Study**
  Advisian
- > **Interconnection to Electric Grid**
  Pterra/Brattle Group
- > **Overview of Study Outreach**
- > **Next Steps and Study Timeline**
- > **Q&A**



Today's Objectives

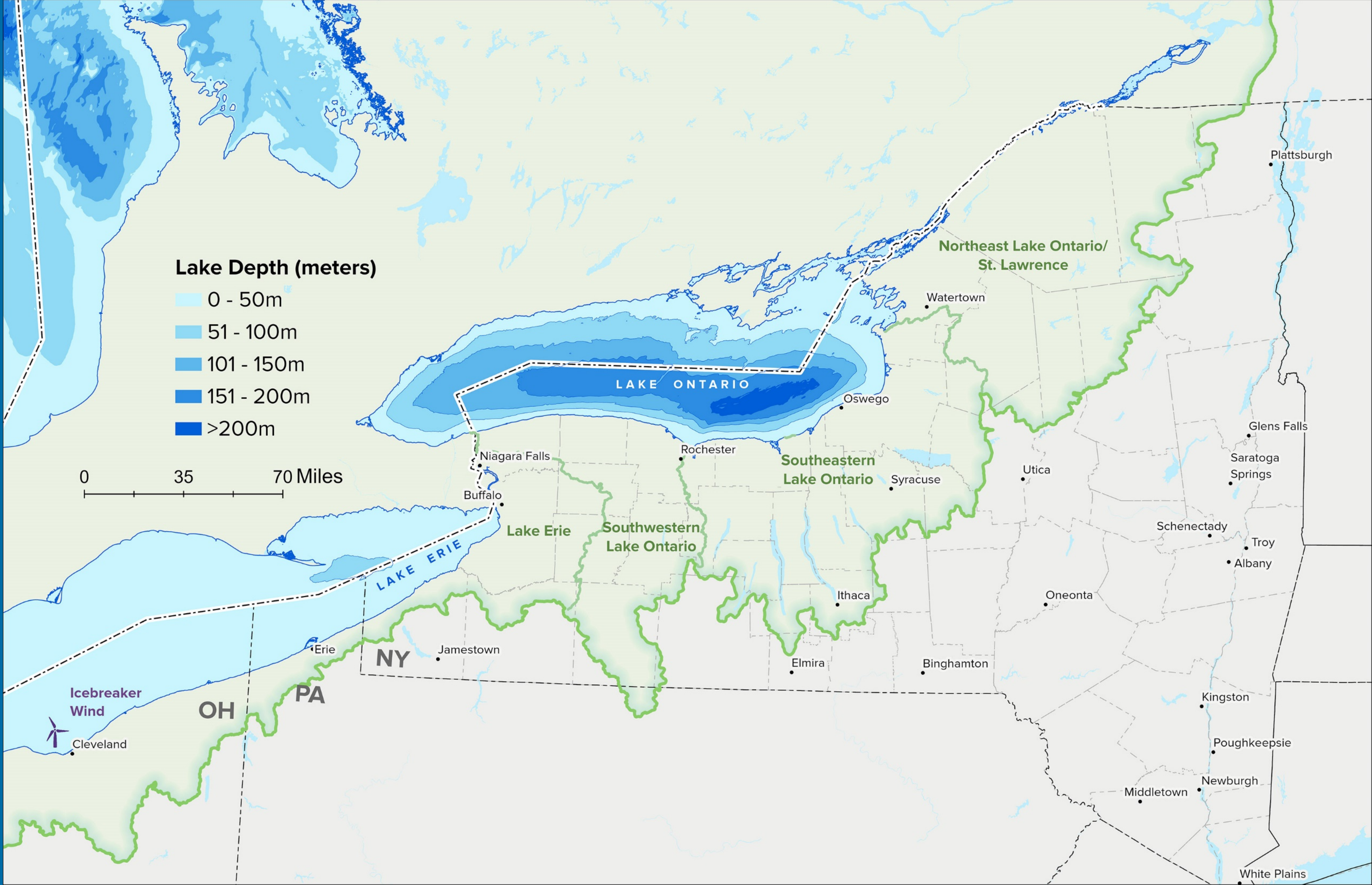
> Provide a brief overview of the Study

> Share recent findings from Study research team

> Provide an overview of:

- Study Outreach this year
- The remaining timeline for Study completion
- Next steps after Study publication

Great Lakes Wind Feasibility Study



Public Service Commission Order

Published 10/15/2020

Directs NYSERDA to:

> Conduct a feasibility study for wind energy generation in the Great Lakes

> Commence work with 180 days of Order within a $1 million budget

Feasibility Study Process

NYSERDA

NREL
Technology and Ice Modeling Costs/Cost Reduction, Economic Development

Advisian
Permitting, Risk/Benefit and Environmental Sensitivity, Sediments and Geohazards, Visual Impacts

Pterra/Brattle Group
Grid Interconnection

New York State Public Service Commission

Great Lakes Wind Feasibility Study

NYSERDA White Paper
Recommendations to the PSC

No Action

Further Study

Pilot Projects

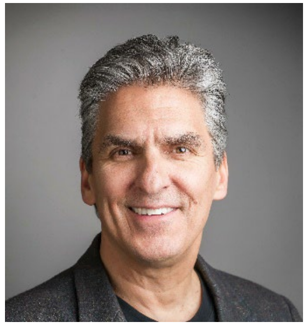
Solicit Great Lakes Wind Projects

Public Comment Opportunities

NREL

Transforming ENERGY

Great Lakes Wind Feasibility Study



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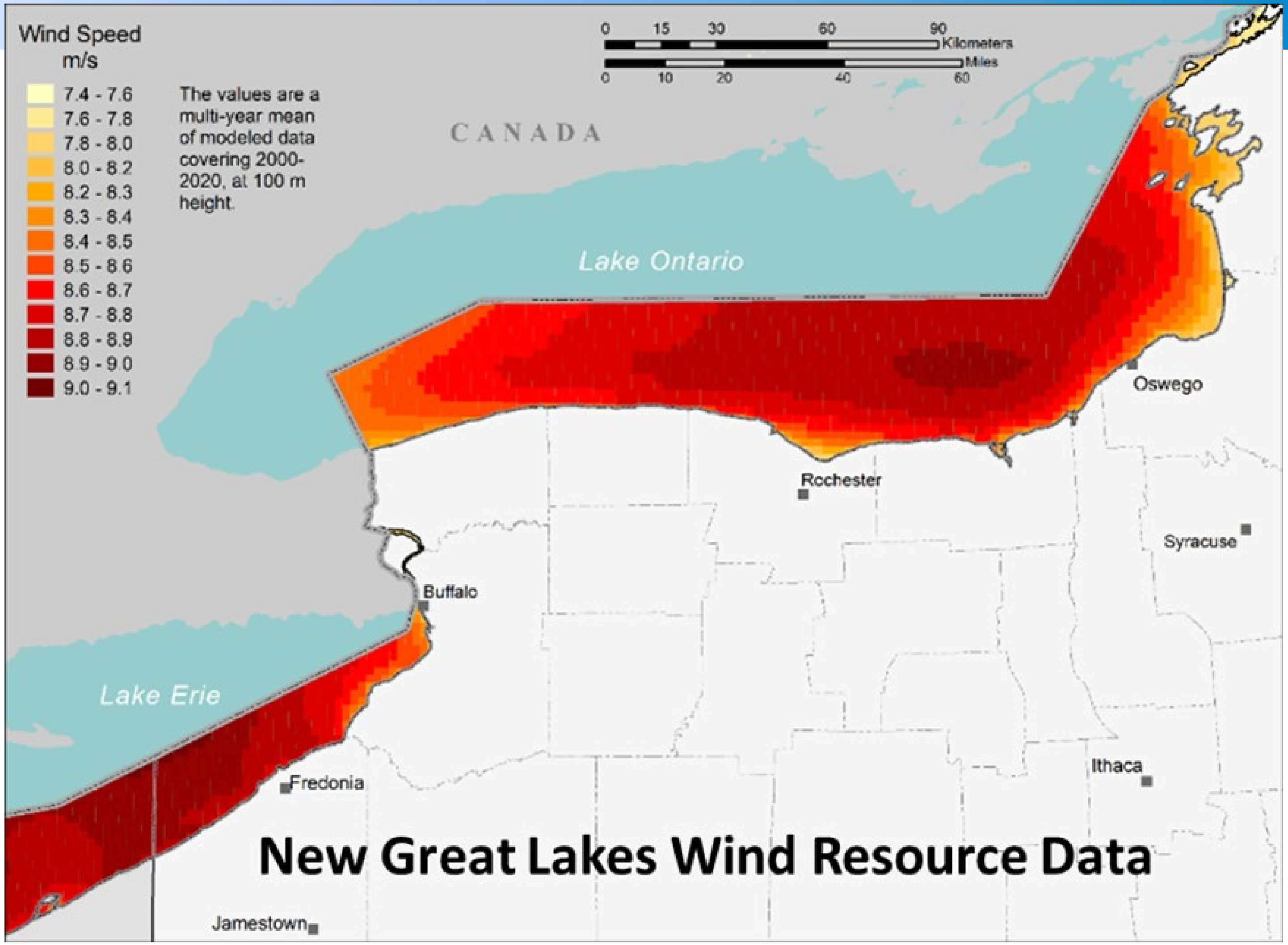
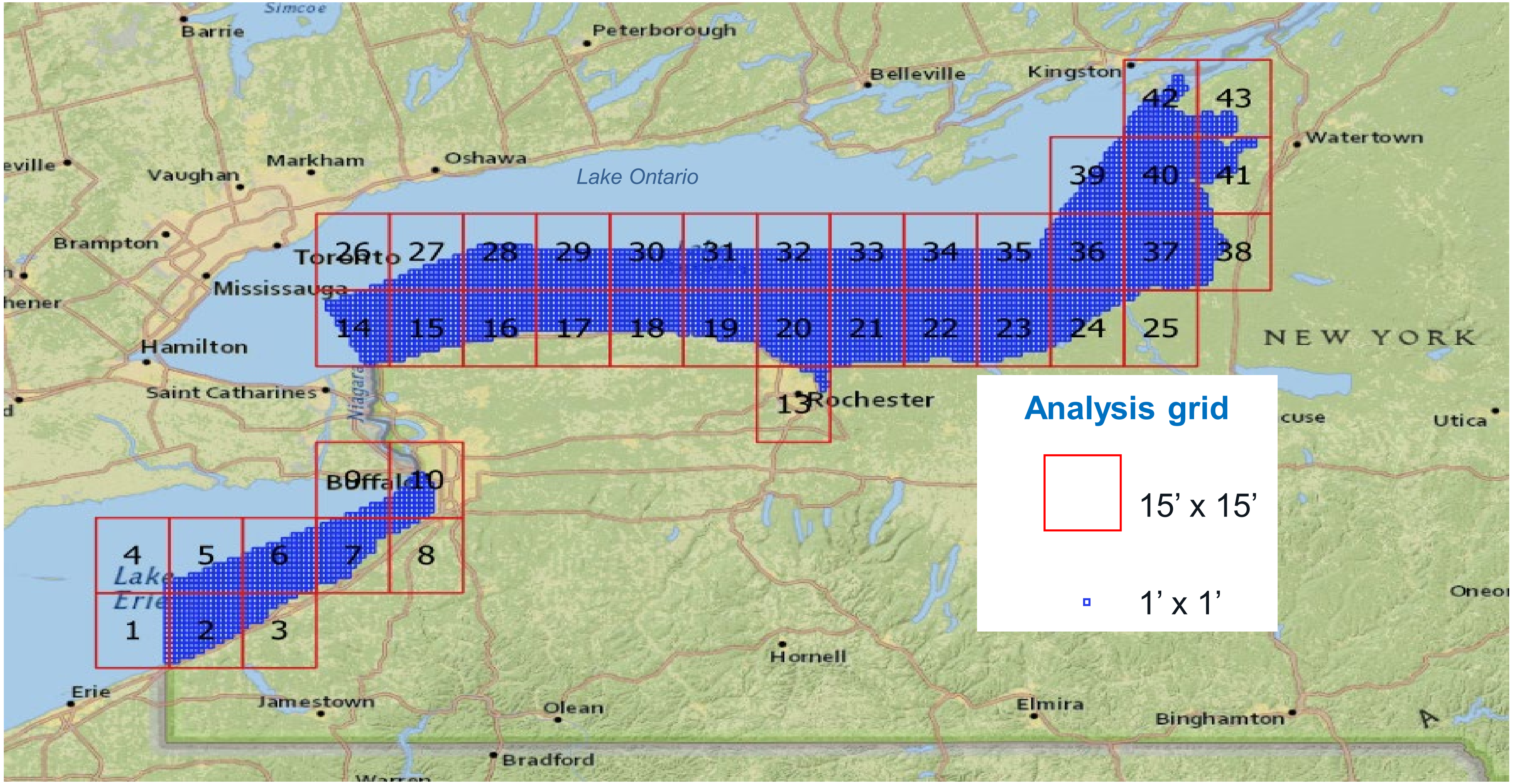
New Wind Resource Data for The Great Lakes

- 2021 ensemble data replace WIND Toolkit data from 2015
- Updated 2021 data to cover longer 21-year period (previous 7-yrs) and use recent advances in the Weather Research and Forecasting (WRF) numerical weather prediction model
- Higher wind speeds were found in the new data
- Average wind speeds range from 8.5 m/s to 9.0 m/s
- Wind Resource data for the Great Lakes are publicly available (See: NREL 2021)



Preliminary Data

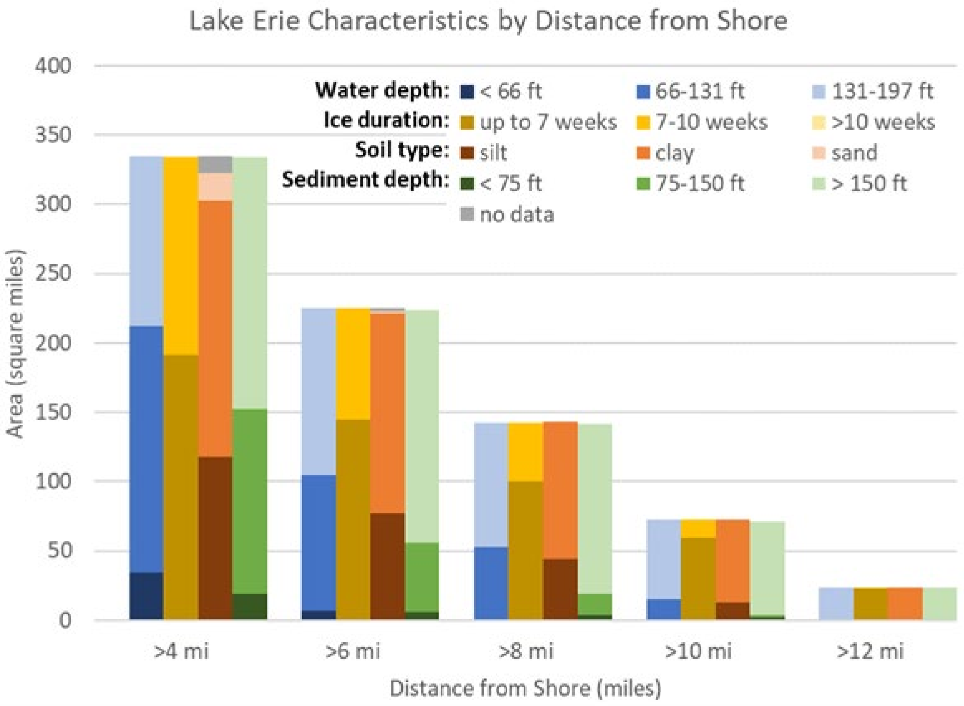
Analysis Grid to Assess Physical Characteristics

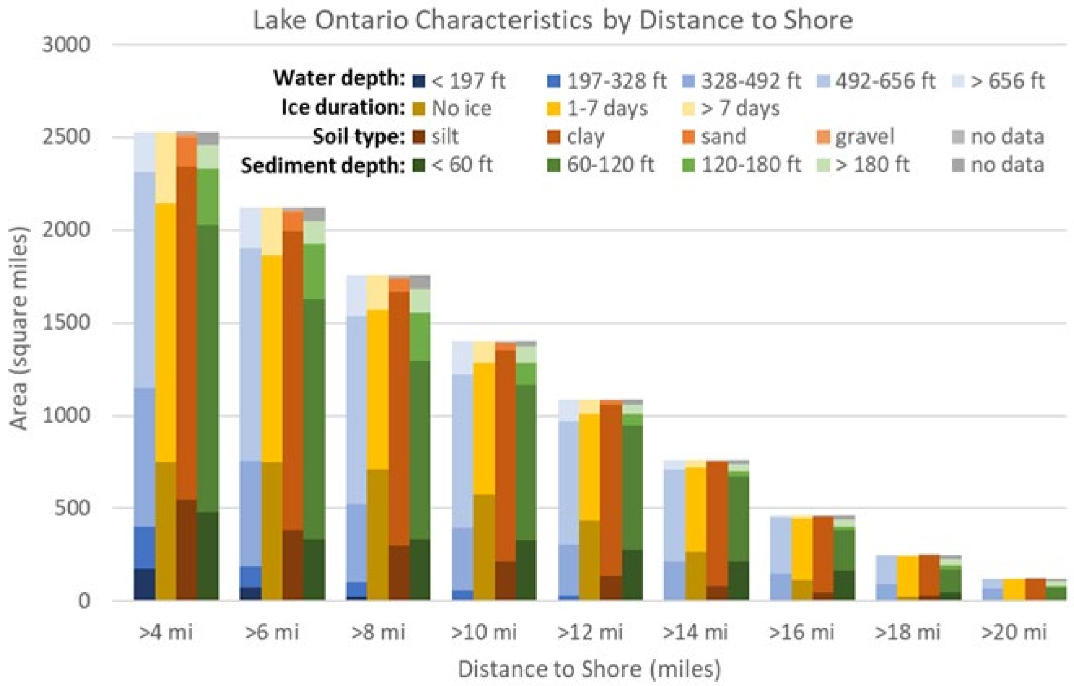


Preliminary Data

Technology Feasibility Depends on Physical Characteristics

> **Water Depth** – Determines technology type; floating or fixed bottom and support structure cost
> **Ice Duration** – Helps define loads and substructure geometry – Ice floes are assumed but severity varies
> **Soil Type** – Sets limits for foundation and anchor types and cable burial – soft soils may exclude some types
> **Sediment Depth** – Further defines pile driving limits and foundation type (e.g., monopiles need >100 feet)





Geophysical, Geotechnical, and Surface Ice Data Help Determine Support Structure Feasibility

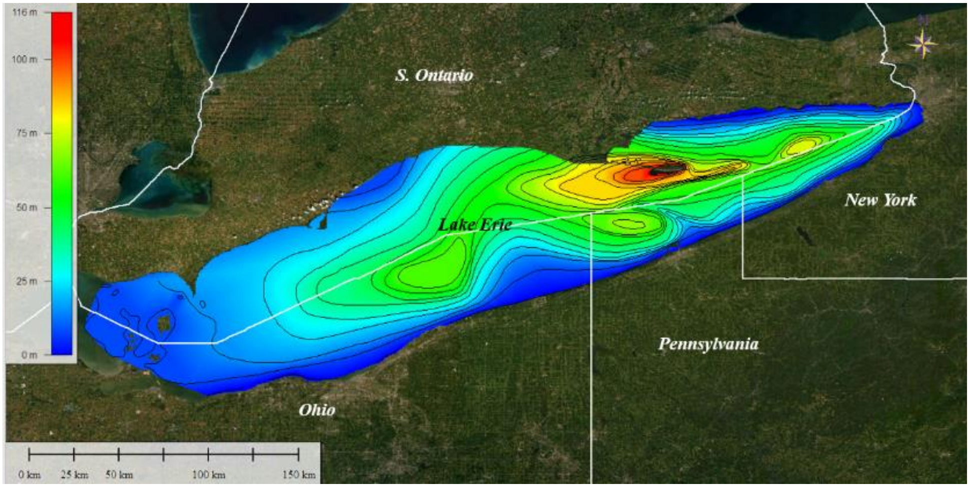
Lake Erie

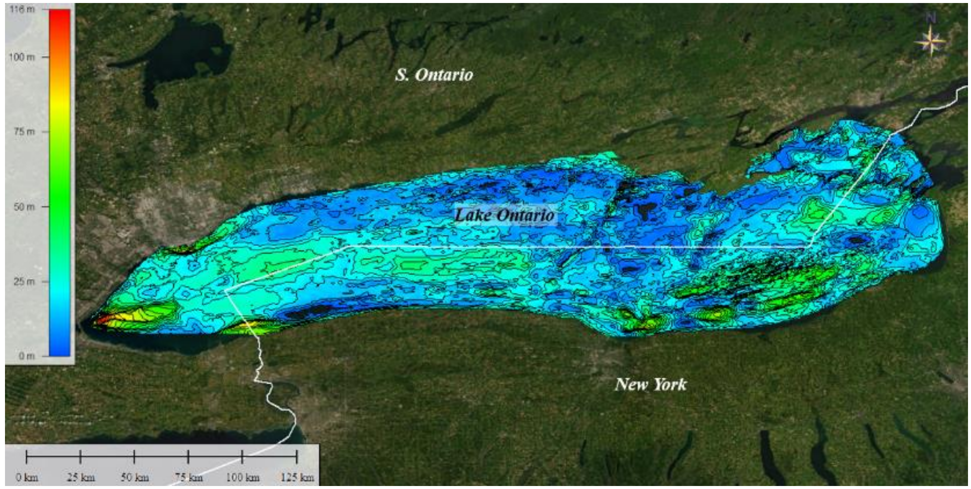
- Average depth of bedrock below lakebed surface was found to be about 100 ft (30.5 m), enabling certain types of conventional piled foundations
- Softer clay soils may limit use of monopiles
- Ice floes will require slender profiles at waterline and ice cones

Lake Ontario

- Average depth of bedrock below the lakebed surface was found to be about 74.8 ft (22.8 m), which would be too shallow for many fixed foundations; However, these soil thicknesses will be suitable for most conventional anchors used in floating foundations
- A small percentage of area contains rocky glacial deposits (drumlins) that may preclude anchor placement in some locations
- Lower ice thickness and cover (especially near the lake center) may reduce structural loads relative to Lake Erie, but ice cones and slender profiles are recommended

Maps Showing Depth to Bedrock



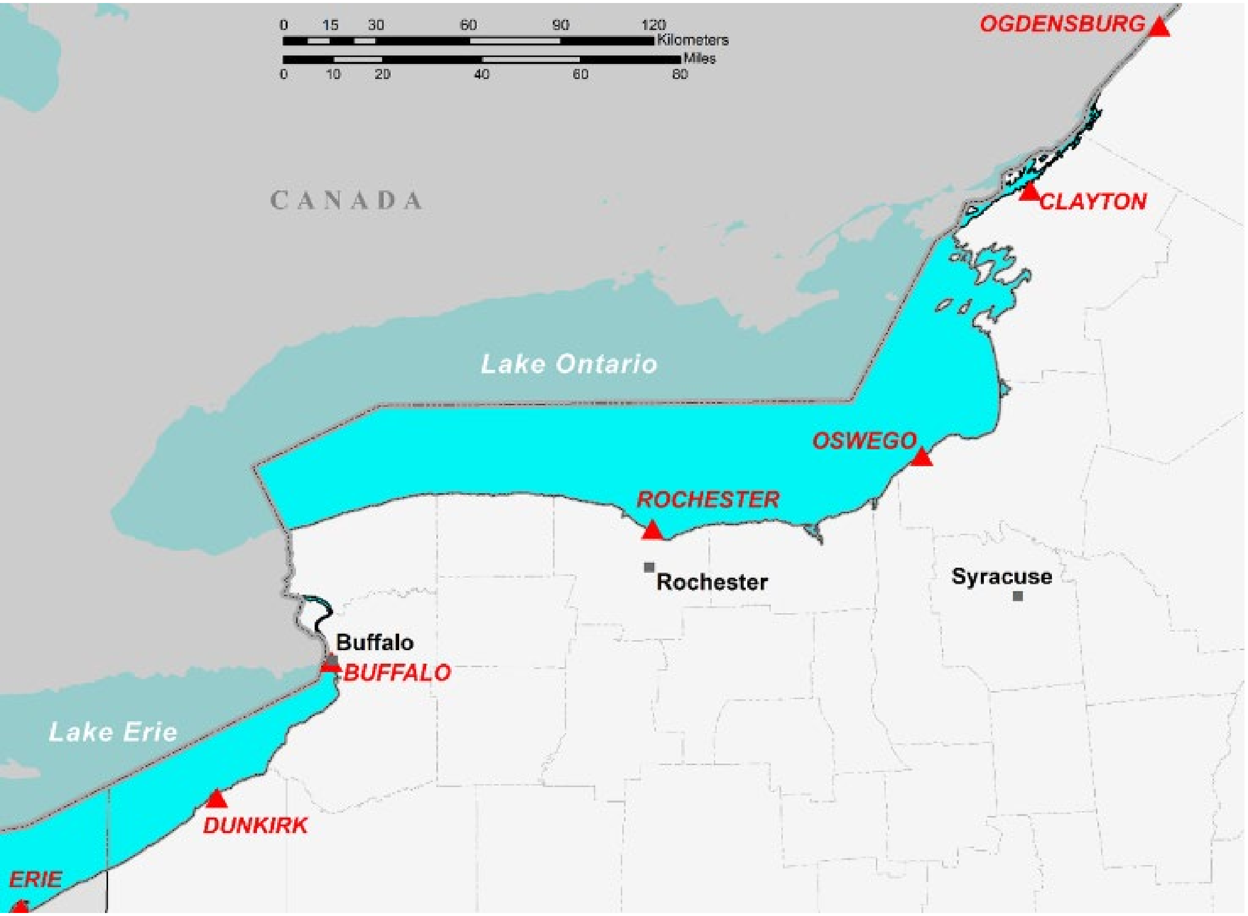


Morgan, N. A., B. J. Todd, and C.F. M. Lewis. 2020. Interpreted seismic reflection profiles, sediment thickness and bedrock topography in Lake Erie, Ontario, Canada and Michigan, Ohio, Pennsylvania and New York, U.S.A. Open File 8733, Geological Survey of Canada, 26. https://doi.org/10.4095/326715.

Hutchinson, D. R., C.F. M. Lewis, and G. E. Hund. 1993. "Regional Stratigraphic Framework of Surficial Sediments and Bedrock Beneath Lake Ontario." Geographie physique et Quaternaire 47 (3): 337-352. http://doi.org/10.7202/032962ar.

National Geophysical Data Center. 1999. "Bathymetry of Lake Ontario." Data set. Edited by NOAA. National Geophysical Data Center. https://doi.org/10.7289/V56H4FBH.

Ports and Infrastructure – Requirements Vary by Lake



Lake Erie

- Offshore wind turbines will be fixed to the lakebed
- Heavy lift vessel capacity limits define possible turbine size
- St. Lawrence Seaway lock dimensions prohibit conventional wind turbine installation vessels due to width limitations
- Smaller turbines may be required to adapt to smaller vessels that can be found on the lake
- New technology may allow float-out turbine options

Lake Ontario

- Offshore wind turbines will be floating and anchored to the lakebed
- Floating wind turbines will be assembled in a suitable port and towed out to the lake site
- Heavy lift cranes are required in the port but not on the lake

Turbine Selection

> Representative turbine: GE Cypress 6.0-164
  - Specific Power 284 W/m2
  - Rotor Diameter 164 m
  - Turbine rating 6.0 MW
  - Hub heights available up to 112 m

> Selection of a smaller land-based model due to installation heavy lift constraints

> Supply chain for 6.0 MW scale land-based turbines may be more sustainable

> IEC Class I or II machines are considered viable– many options

> One GE Cypress 6.0-164 wind turbine can produce more than 20 GWh per year – enough to power about 2,800 NY homes

> Floating turbines in Lake Ontario are only size-limited by crane capacity at the port

GE Cypress Platform Prototype

Lake Erie Port Requirements: Fixed-Bottom

> Assumption: 6.0 Megawatt turbines, 164-meter rotor diameter

> Three deployment scenarios considered

- US vessel for installation (soccer pitch barge)
- Non-US vessel for installation
- Float out substructures

> Key parameters for offshore wind port: Dock length, water depth at port, crane capacity and large staging area

Sarens Soccer Pitch Barge
(altered barge)

Preliminary Data

Port Capabilities

	Lake Ontario				Lake Erie		
	Ogdensburg	Clayton	Oswego	Rochester	Buffalo	Dunkirk	Erie
Channel Depth	[Yellow]	[Yellow]	[Yellow]	[Yellow]	[Yellow]	[Yellow]	[Yellow]
Crane Capacity	[Yellow]	[Yellow]	[Yellow]	[Yellow]	[Yellow]	[Yellow]	[Yellow]
Quayside Space	[Yellow]	[Red]	[Green]	[Red]	[Green]	[Red]	[Green]
Air Draft (overhead clearance)	[Red]	[Green]	[Green]	[Yellow]	[Yellow]	[Yellow]	[Green]

- Red box signifies the port does not meet the specifications and it may not be feasible for upgrades.
- Yellow box signifies that it may be feasible if upgraded to the specified criteria.
- Green box indicates that the port may be equipped with the given criteria.

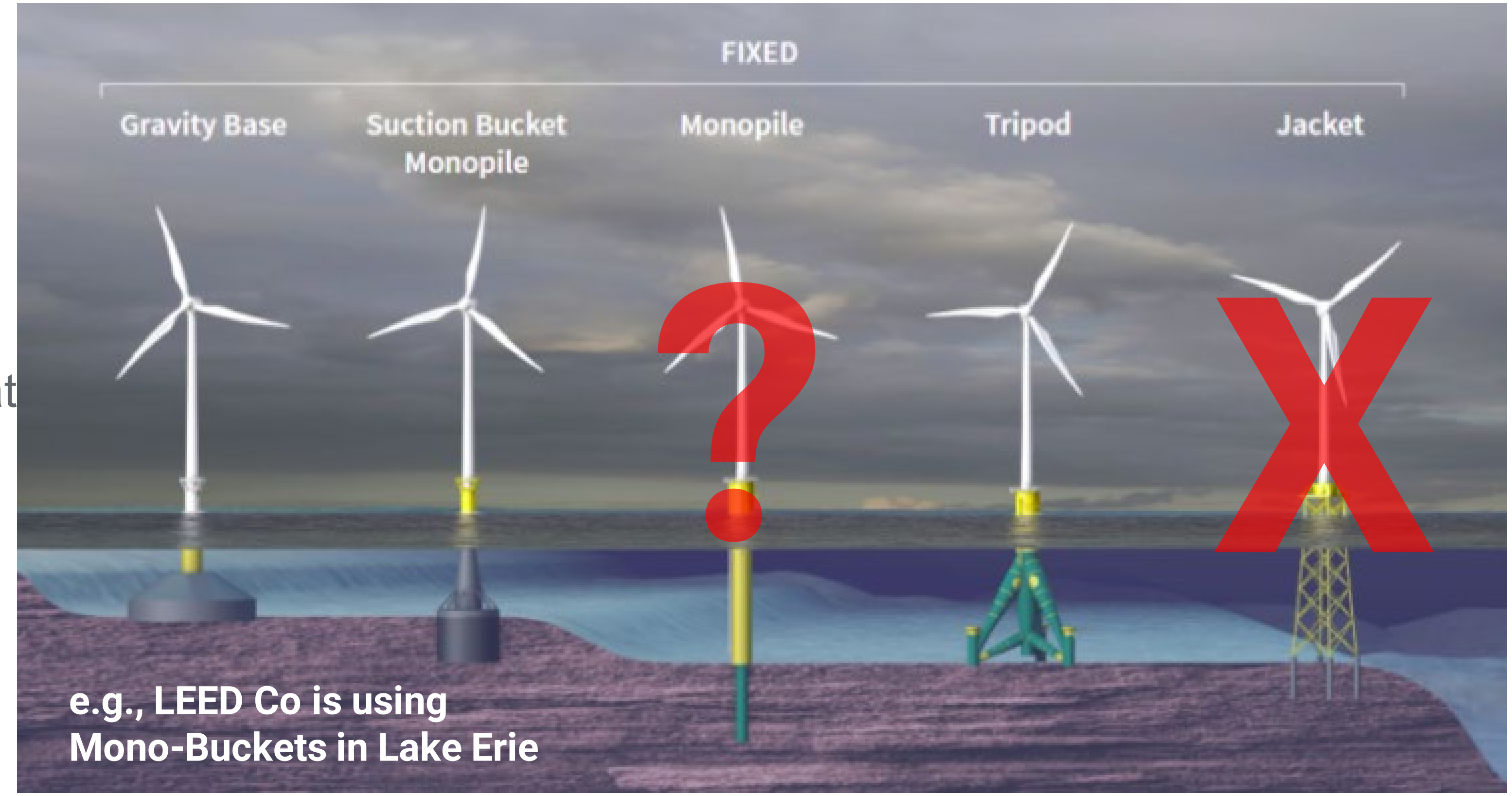
Each Lake has at least one port that could be upgraded to accommodate offshore wind.

Preliminary Data

Fixed-Bottom Substructure Types: Lake Erie

Key drivers for support structure feasibility

- Installation method/port adaptability
- Seabed compatibility – soil stiffness and thickness above bedrock
- Ice structure interaction – low profiles at waterline
- Local manufacturability
- Cost
- Technology readiness



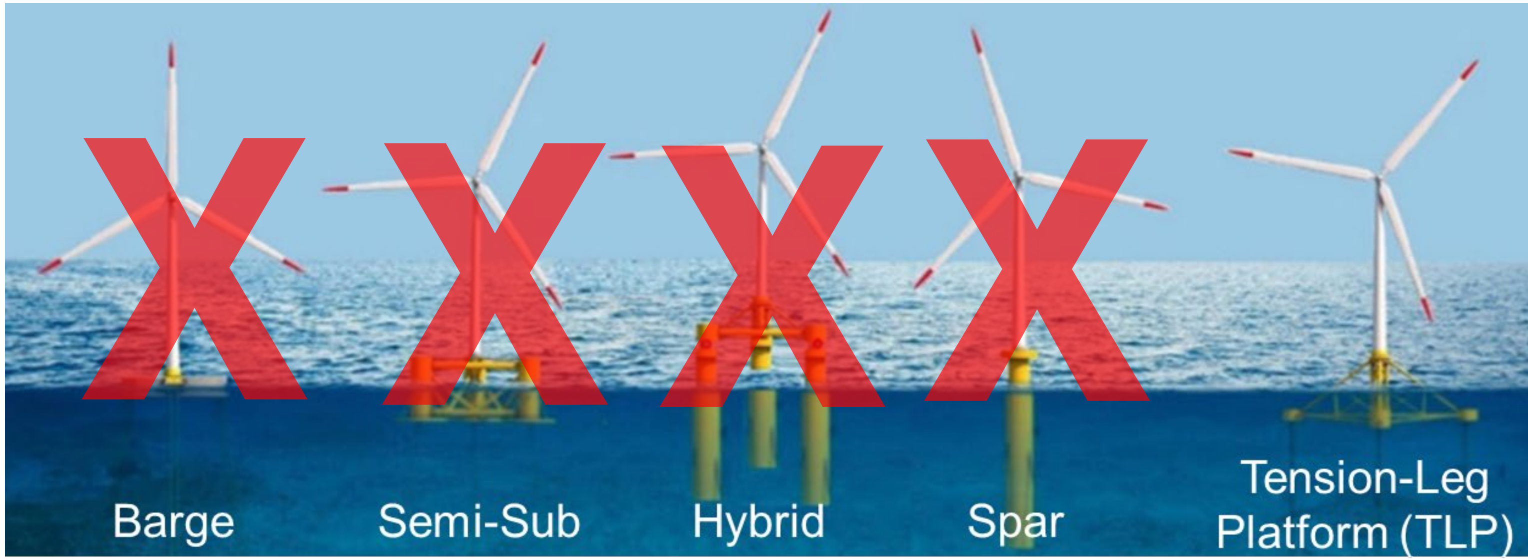
Many fixed substructure types may be feasible but customization to minimize heavy lift barriers may help optimization.

Preliminary Data

Floating Substructure Types: Lake Ontario

> Floating substructures have not yet been deployed in ice-covered waters

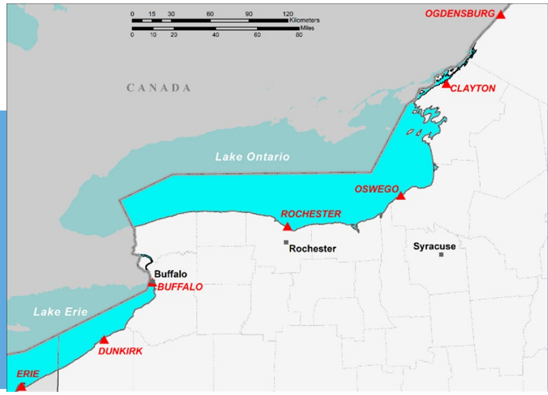
> Key drivers for support structure feasibility
  - Installation method/port adaptability
  - Seabed compatibility
  - Ice structure interaction/low profiles at waterline
  - Local manufacturability
  - Cost
  - Technology readiness
  - Mooring system



Many floating substructure types may be feasible but customization for ice will be needed.

Preliminary Data

Preliminary Economic Assumptions



- 6-MW wind turbines
- 600-MW wind farms
- Port upgrades and access will not be part of project cost
- Land-based grid interconnection cost is excluded
- Distance to installation port and service port will use the most likely port
- Workforce and supply chain is available and established
- Financing based on industry averages
- No judgements made on regulatory exclusions (beyond the project scope)

Scenario development

- Fixed and floating scenarios
- Capacities and technologies based on commercial operation date (COD)

Model customization

- Updating generic assumptions in ORCA and ORBIT for the Great Lakes
- Ports, vessels, grid, turbine rating, capacity factors, ice protection

Cost and sensitivity study

- ORBIT: Installation timelines and costs
- ORCA: LCOE heat maps, cost projections, detailed cost breakdowns

Jobs and Economic Development

> Estimating the job and economic impacts using NREL's Jobs and Economic Development Impact (JEDI) model
  - Results will include the impacts of development, manufacturing, installation, and operations for New York State

> Assessing the workforce and economic development potential from port utilization to support wind development in Lake Erie and Ontario

> Identifying existing workforce programs at vocational schools, community colleges, and universities which could train and educate a Great Lakes wind workforce

Thank you

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NREL
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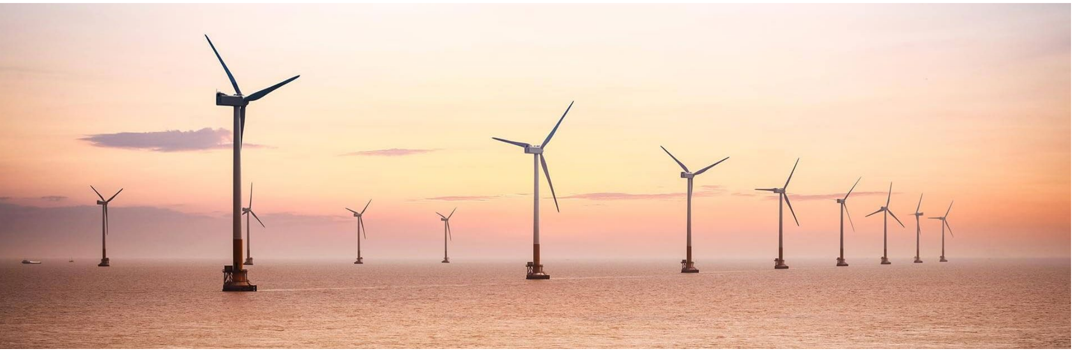
Worley Group

Great Lakes Wind Feasibility Study



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Great Lakes Wind Feasibility Study

The Advisian Team is working on three aspects of the NYSERDA Great Lakes Wind Feasibility Study

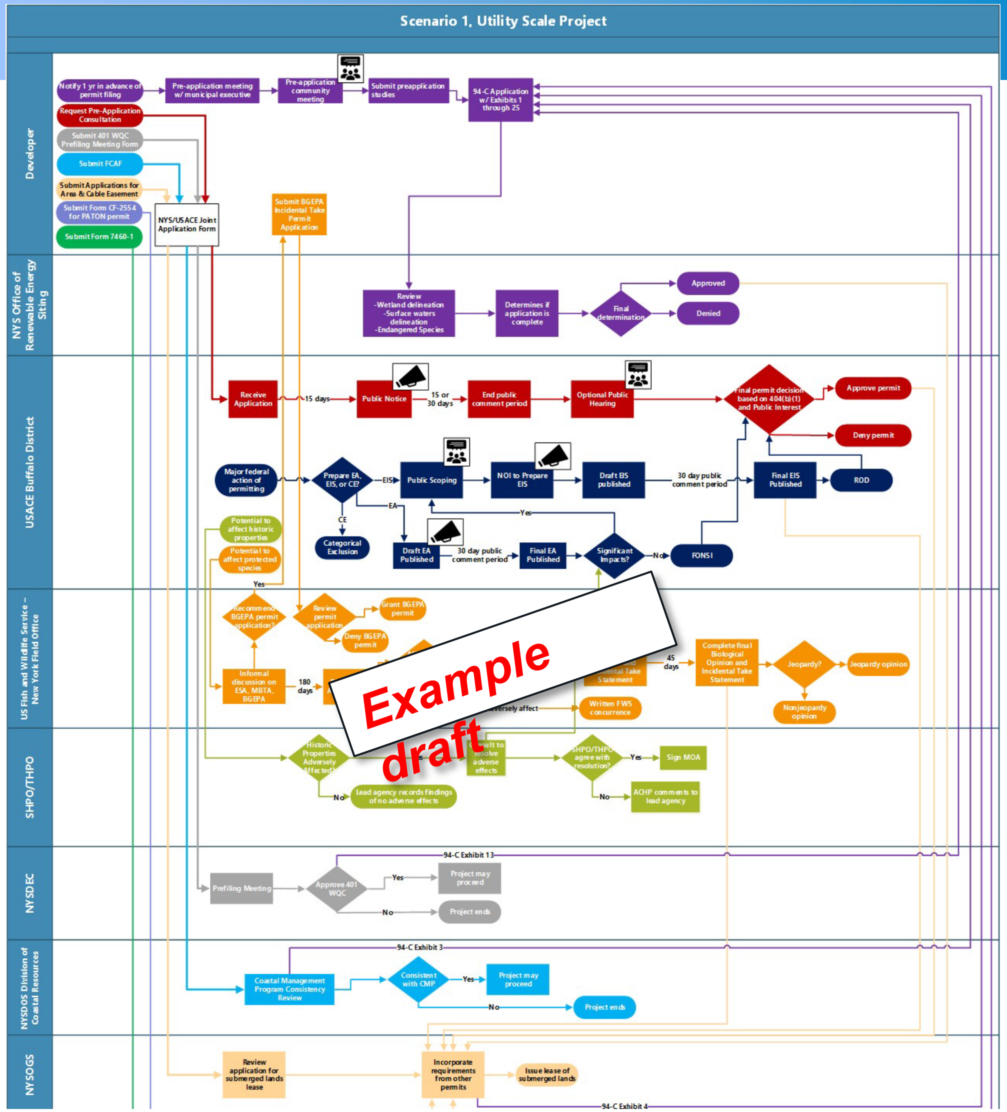
- State and Federal Permitting Study
- Geophysical and Geohazards Study
- Relative Risk, Minimization/Mitigation, and Benefits Study

Permitting

In final stage – State and Federal Permitting Study

> Developed cross-functional process flow charts for the overall permitting process

- Two scenarios developed
- Shows activities of the developer and all federal and state regulators
- Handoffs between agencies and actors (i.e., integration points)
- Opportunities for public comment and public announcements
- Visualizes triggers, decisions points, and information flows between processes



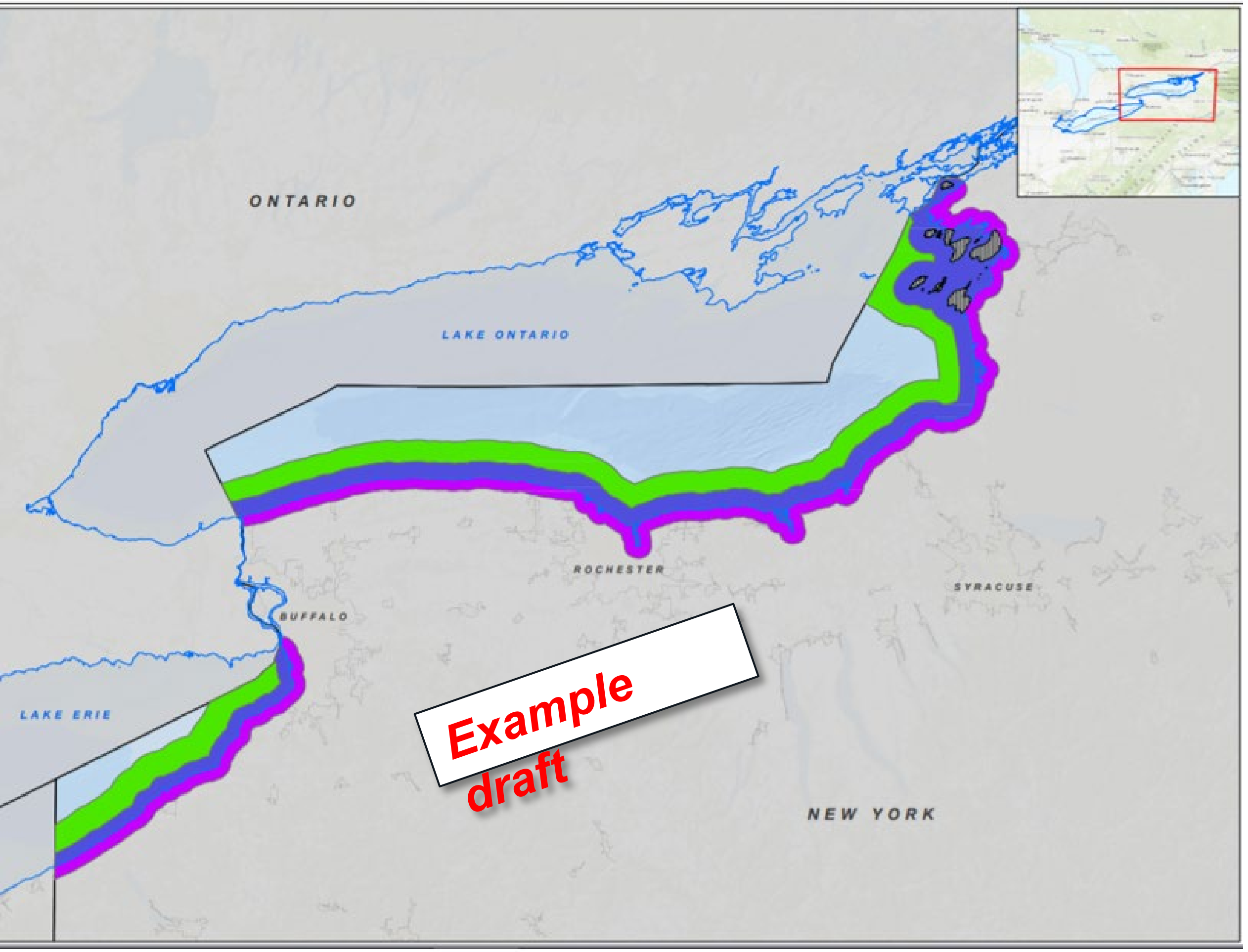
Risks/Benefits

In progress - Relative Risks, Minimization/Mitigation, Benefits Study

Pre-Construction Stressors (Short-Term)	Construction Stressors (Short-Term)	Post-Construction Stressors (Long-Term)
Sound/particle motion	Sound/Particle Motion	Sound/Particle Motion
Bottom Disturbance	Sound/Particle Motion with Pile-Driving	Scour
Increased Vessel Traffic	Increased Vessel Traffic	Electromagnetic Fields, Vibration, Heat
Short-Term Structures	Bottom Disturbance	Long-Term Structures
	Habitat Alteration	Increased Vessel Traffic

Receptor Groups
Shorebirds
Waterfowl
Land birds
Gulls and Terns
Bats
Dunes
Walleye Fishing Areas
Wetlands
Commercial Shipping Lanes
Wrecks
Cattaraugus Reservation

Risks/Benefits



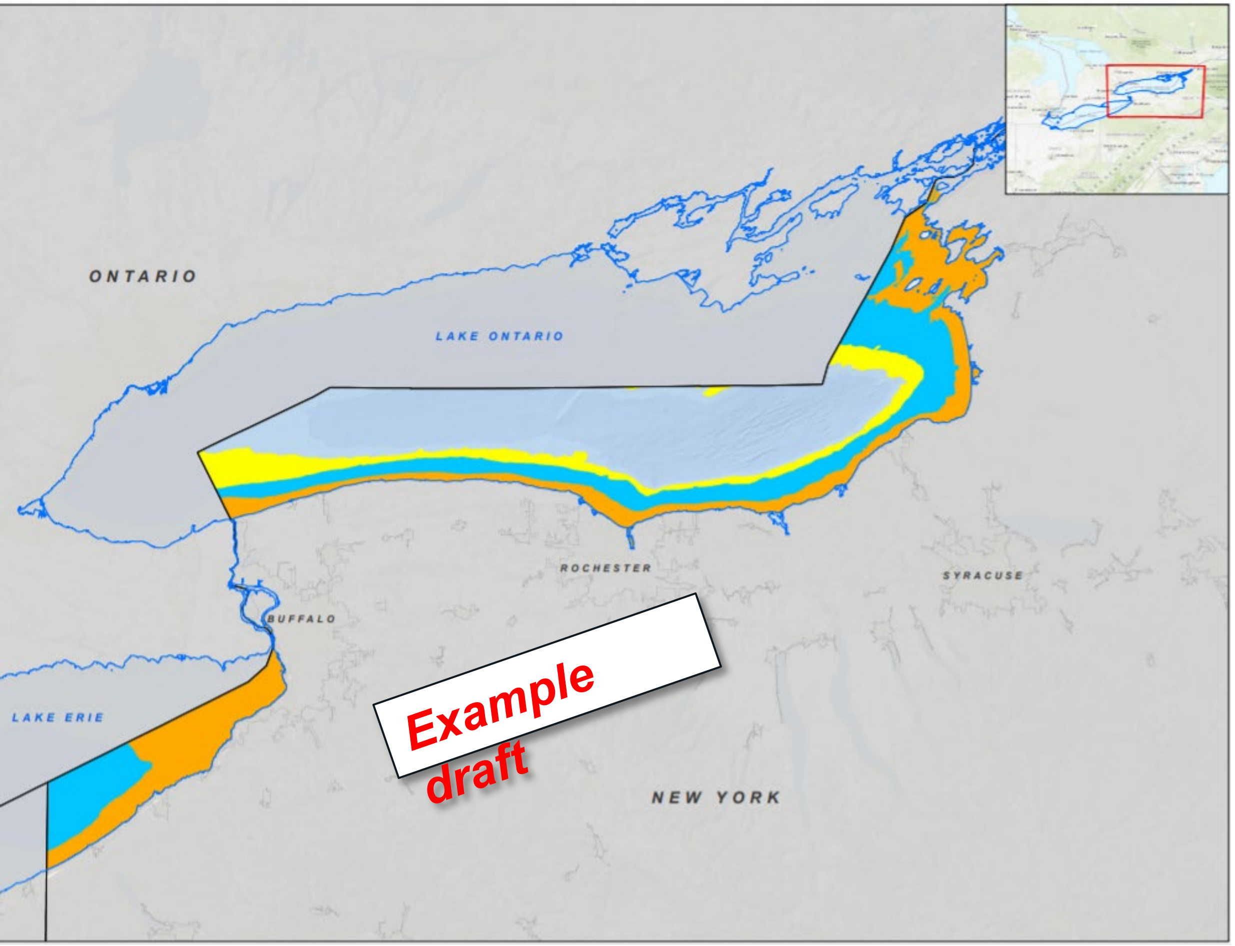
In progress - Relative Risks, Minimization/Mitigation, Benefits Study

> Distribution
- Represent where bird guilds are most likely to occur
- Does not represent across-lake migration areas

> Potential Impacts
- Displacement
- Collision

> Current Data Gaps
- Flight altitude and paths
- changes in flight patterns over the lakes relative to weather and light conditions

Risks/Benefits



In progress - Relative Risks, Minimization/Mitigation, Benefits Study

> Distribution
- Represent where invertebrates are most likely to occur
- Does not represent across-lake migration areas

> Potential Impacts
- Bottom disturbance
- Habitat alteration

> Next Steps
- Integrate the findings from the Summary Characterization of New York's Great Lakes Fisheries by NYSDEC
- Synthesize Public Feedback Session from NYSERDA
- Final analysis of interactions between stressors and receptors

Visibility and Related Impacts

> Hypothetical Scenarios based on NREL's selection of base modeled turbines for use in the overall Study

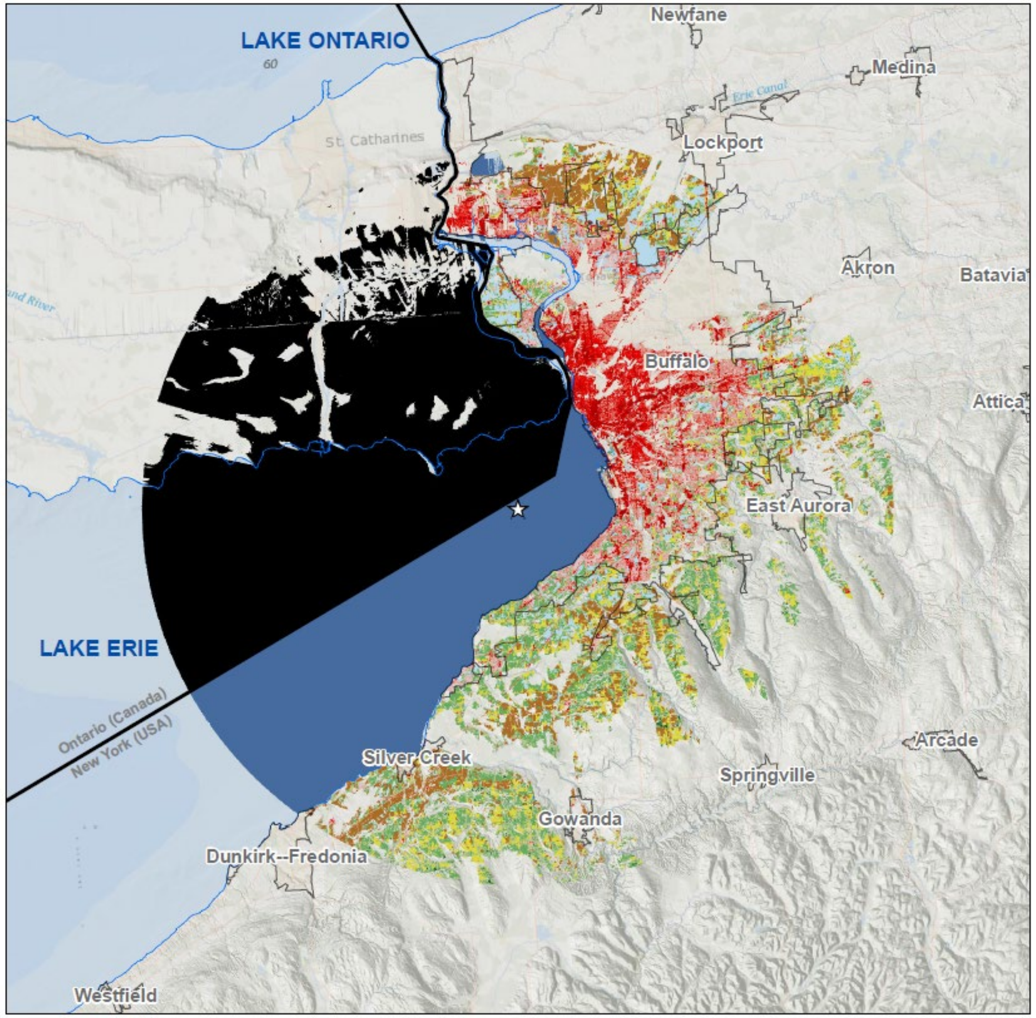
> The Feasibility Study will present the range of opportunities and impacts

> Distance from shore not only has aesthetic implications; it influences many of the risks and benefits in a substantiative way

> Building viewshed assessments at indicative distances from shore as part of the overall Feasibility Study

Hypothetical Site Viewshed

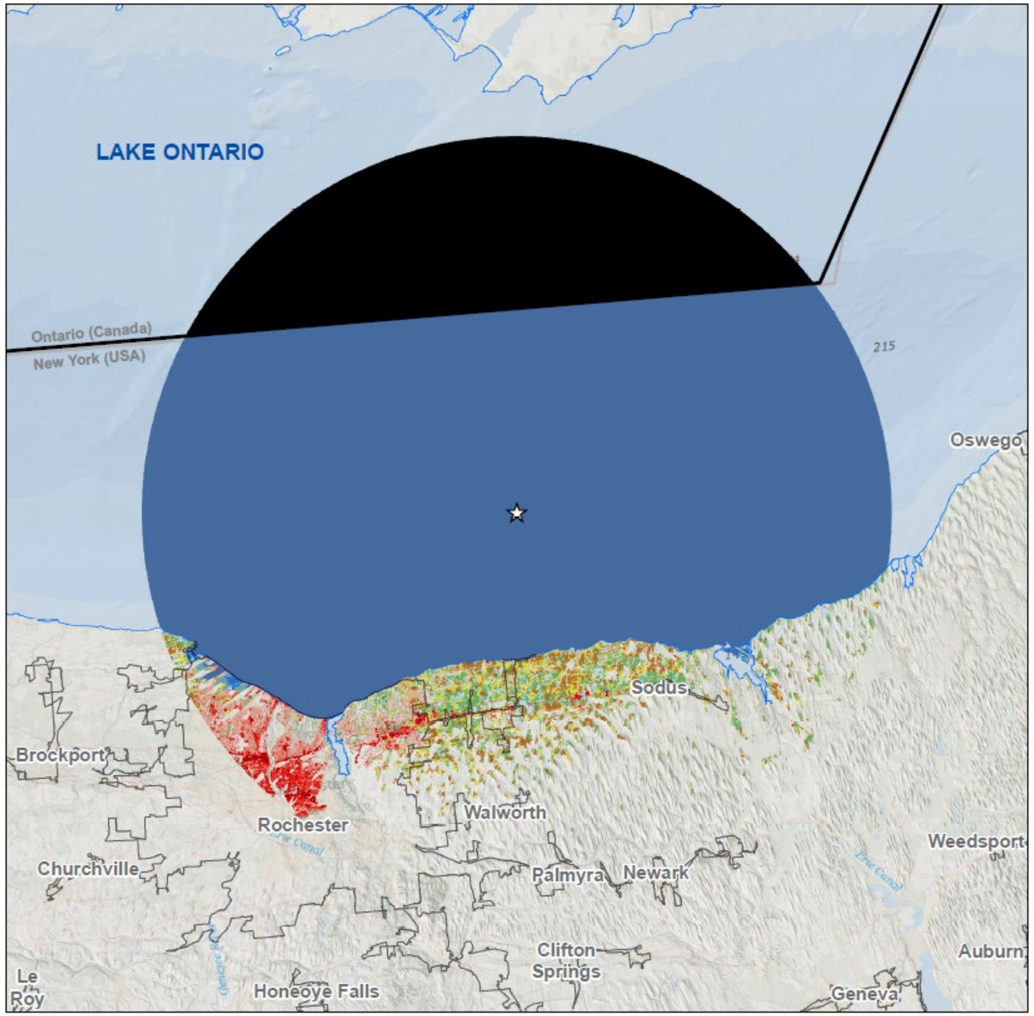
Lake Erie East



Land Cover Class (Multi-Resolution Land Characteristics Consortium (MRLC) 2021)	Approx. Calculated Area of Coverage within ZTV		Approx. % of Total ZTV
	km^2	mi^2	
Unclassified	1,424 km^2	550 mi^2	40.0%
Open Water	747 km^2	288 mi^2	21.0%
Developed, Open Space	147 km^2	57 mi^2	4.1%
Developed, Low Intensity	172 km^2	67 mi^2	4.8%
Developed, Medium Intensity	122 km^2	47 mi^2	3.4%
Developed High Intensity	66 km^2	26 mi^2	1.9%
Barren Land (Rock/Sand/Clay)	7.1 km^2	2.7 mi^2	0.2%
Deciduous Forest	245 km^2	95 mi^2	6.9%
Evergreen Forest	9.0 km^2	3.5 mi^2	0.3%
Mixed Forest	97 km^2	37 mi^2	2.7%
Shrub/Scrub	7.2 km^2	2.8 mi^2	0.2%
Grassland/Herbaceous	9.1 km^2	3.5 mi^2	0.3%
Pasture/Hay	200 km^2	77 mi^2	5.6%
Cultivated Crops	174 km^2	67 mi^2	4.9%
Woody Wetlands	127 km^2	49 mi^2	3.6%
Emergent Herbaceous Wetlands	7.3 km^2	2.8 mi^2	0.2%

Hypothetical Site Viewshed

Lake Ontario East-Central



Land Cover Class (Multi-Resolution Land Characteristics Consortium (MRLC) 2021)	Approx. Calculated Area of Coverage within ZTV		Approx. % of Total ZTV
	km²	mi²	
Unclassified	993 km²	383 mi²	21.4%
Open Water	3,216 km²	1,242 mi²	69.4%
Developed, Open Space	52 km²	20 mi²	1.1%
Developed, Low Intensity	62 km²	24 mi²	1.3%
Developed, Medium Intensity	34 km²	13 mi²	0.7%
Developed High Intensity	14 km²	5.4 mi²	0.3%
Barren Land (Rock/Sand/Clay)	0.7 km²	0.3 mi²	0.01%
Deciduous Forest	82 km²	32 mi²	1.8%
Evergreen Forest	2.3 km²	0.9 mi²	0.05%
Mixed Forest	23 km²	8.9 mi²	0.5%
Shrub/Scrub	1.9 km²	0.7 mi²	0.04%
Grassland/Herbaceous	2.0 km²	0.8 mi²	0.04%
Pasture/Hay	61 km²	24 mi²	1.3%
Cultivated Crops	63 km²	24 mi²	1.4%
Woody Wetlands	20 km²	7.7 mi²	0.4%
Emergent Herbaceous Wetlands	5.6 km²	2.2 mi²	0.1%

Thank you

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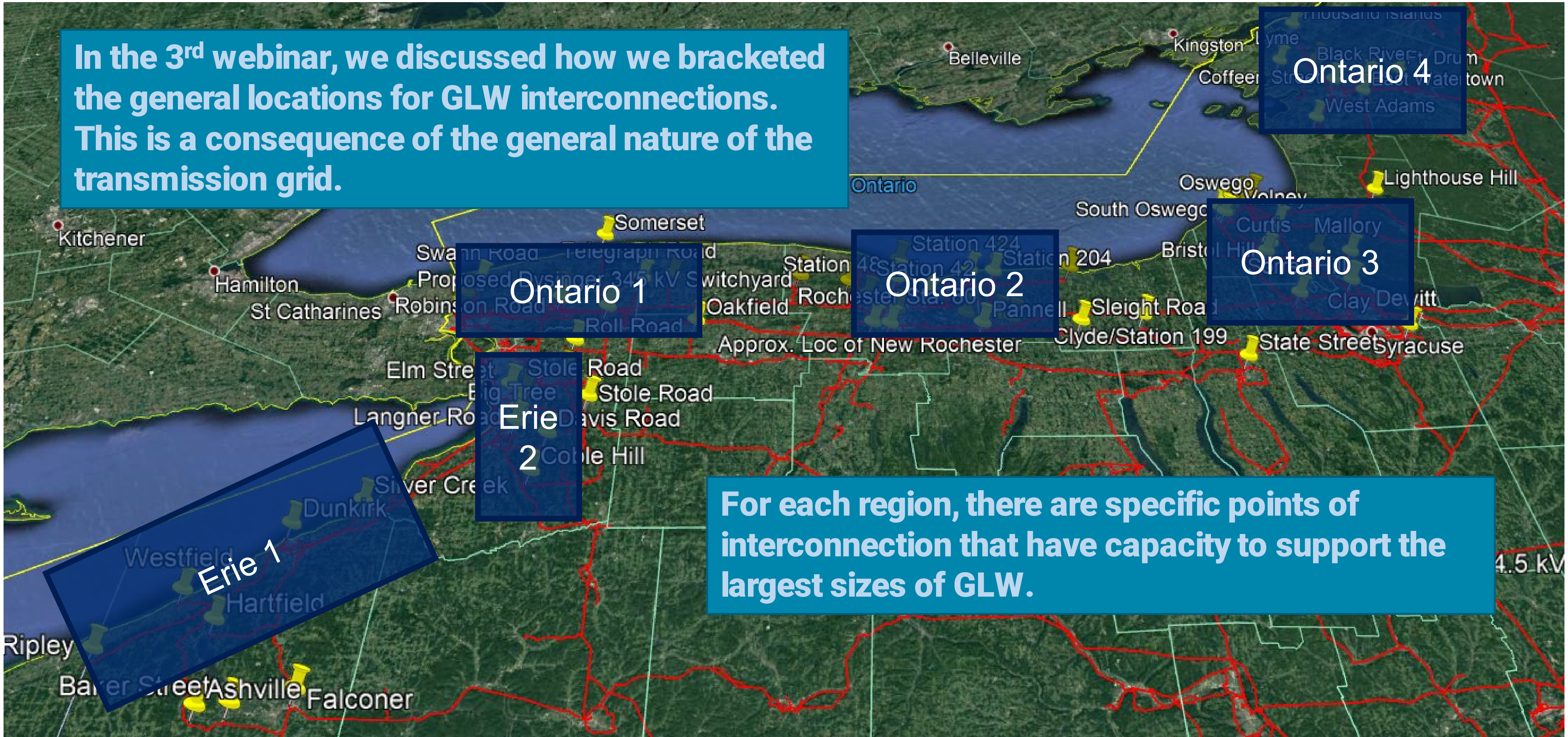
GLW Interconnection Regions

In the 3rd webinar, we discussed how we bracketed the general locations for GLW interconnections. This is a consequence of the general nature of the transmission grid.



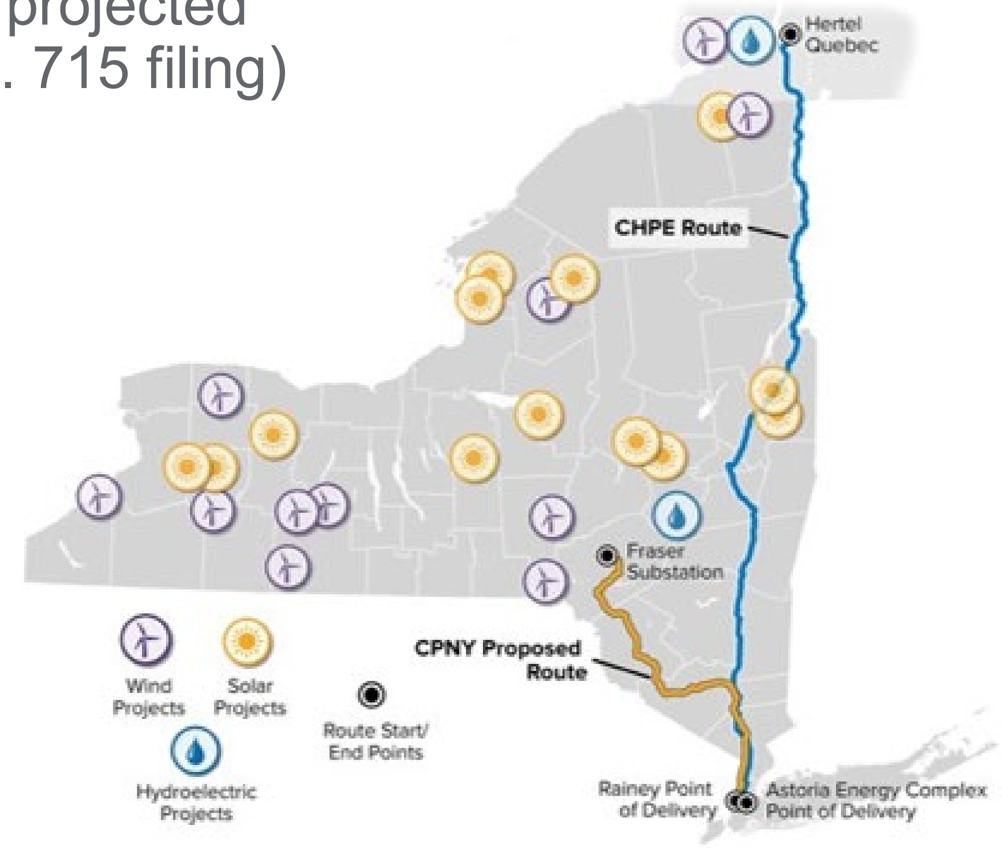
For each region, there are specific points of interconnection that have capacity to support the largest sizes of GLW.

Model for Headroom Analysis

> New York Independent System Operator (NYISO) projected system for 2030 as filed with FERC (as Report No. 715 filing)

> Accounting for the impact of the Tier 4 awards (in progress):

- Clean Path NY (CPNY)
- Champlain Hudson Power Express (CHPE) will not be included in the analysis as it will have no direct impact to the analysis



Calculation of Available Headroom for Interconnection

> Calculation will be consistent with the Headroom MW capacity methodology recommended by the DPS

> Two levels of Headroom MW will be calculated:

- **Solo Injection Headroom** – This determines the maximum MW of GLW that can be connected at any one interconnection point with no other GLW interconnections.
- **Simultaneous Headroom** – Given a set of possible GLW interconnections, determines the total maximum MW capacity that can be interconnected in all the GLW interconnection regions

Thank you

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Pterra CONSULTING

Brattle

Overview of Feasibility Study Outreach Great Lakes Wind Feasibility Study Public Input

- Four informational Public Webinars in 2021 (March, May, August, November)
- Dedicated Public Feedback Session held virtually (June)
- Correspondence with Tribal Nations (Cayuga, Oneida, Onondaga, St. Regis Mohawk, Seneca, Tonawanda, Tuscarora)
- Presentation to Haudenosaunee Environmental Task Force
- Meetings with Pennsylvania, Ontario, Quebec, Canada federal government
- Industry and academia interviews via Study Researchers
- Robust communication via Study website and dedicated email
- Print Ads (counties of Chautauqua, Cayuga, Erie, Jefferson, Monroe, Niagara, Orleans, Oswego, Wayne)

Next Steps

Great Lakes Wind Feasibility Study Remaining Timeline

Draft Study
Fall 2021

- Continued research and study production
- Internal NYSERDA review
- Public Webinar #4 (November)

Final Study
Early 2022

- Filling with PSC to satisfy order
- NYSERDA white paper
- Public release
- Additional public webinars (as needed)

Public Service Commission 2022

- Decision on feasibility of GLW
- Related public comment periods per regulation (if needed)

Great Lakes Wind Feasibility Study Engagement

Multiple opportunities to stay engaged!

Early 2022 Study Submission by NYSERDA to the Public Service Commission

Sign-up for email updates and get the latest on study progress

> nyserda.ny.gov/Great-Lakes-Wind-Feasibility-Study

Email the Great Lakes Wind Team

> greatlakeswind@nyserda.ny.gov

Thank you

For more information, please contact
the NYSERDA Great Lakes Wind Team:
greatlakeswind@nyserda.ny.gov

Visit the project website at:
nyserda.ny.gov/Great-Lakes-Wind-Feasibility-Study