Great Lakes Wind Energy Development in New York State

Visibility and Visual Impact of Off-Shore Wind Turbines

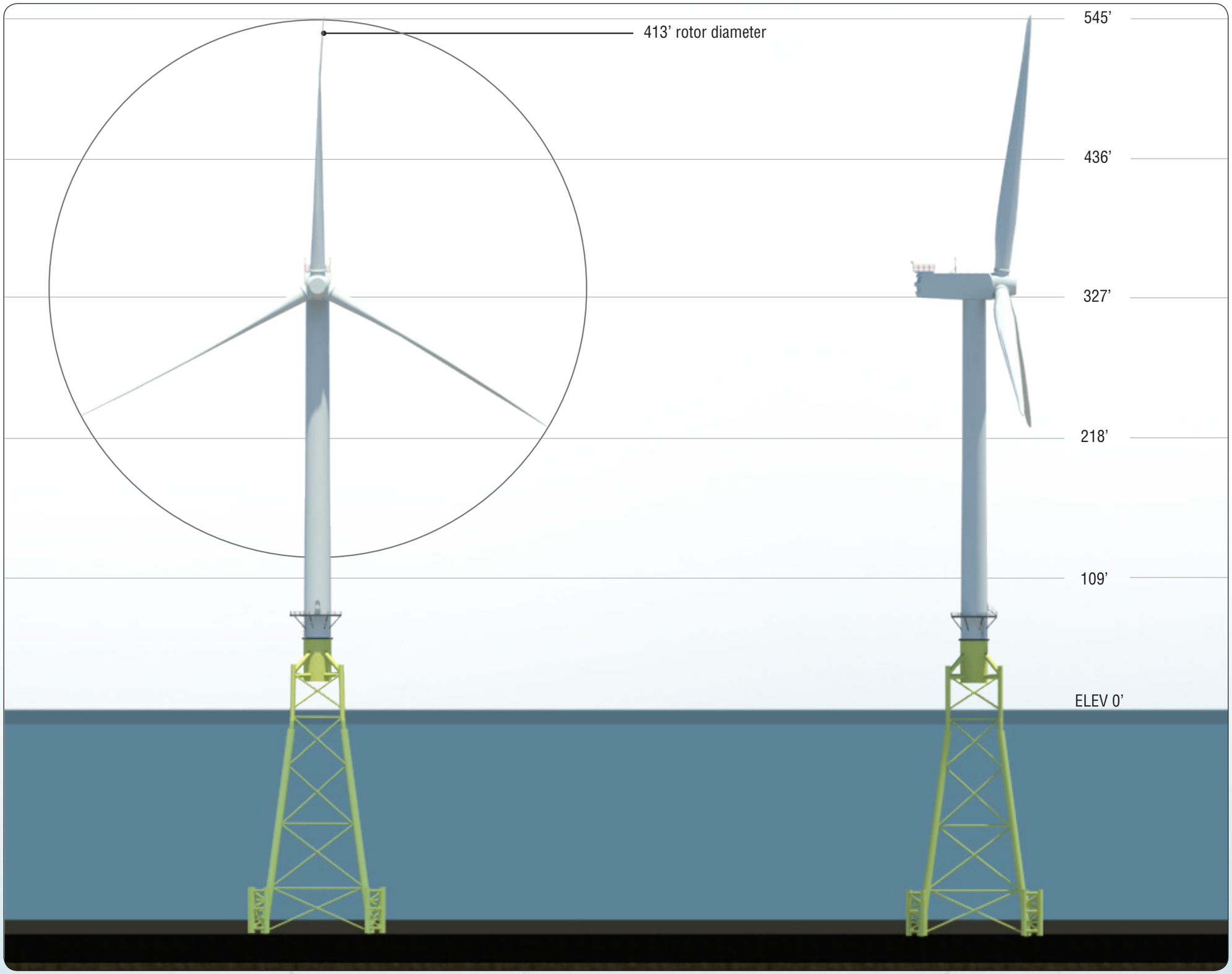
Turbine Components

Tower - Tubular steel structure. Typically 70-100 meters tall

Rotor - 3 Blades spinning at approximately 10-20 RPM. Typically 80-100+ meters in diameter

Nacelle - Generally rectangular. Approximately 10 meters long, 3 meters wide, and 3 meters tall

Total Height - 120-150 Meters (390-490 ft)

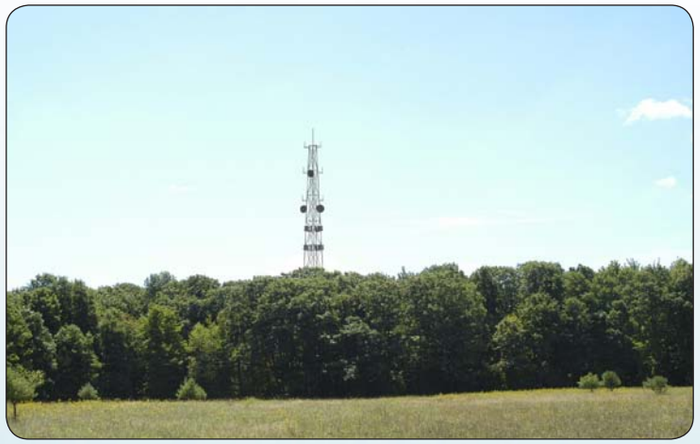

413’ rotor diameter
545’
436’
327’
218’
109’
ELEV 0’

Turbines in the Landscape

- Very tall structures
- Moving rotor
- Multiple turbines within a project
- These factors result in a high level of visibility in most locations

Turbines in the Landscape

- High visibility does not always equate to adverse visual impact.
- Based on public reaction to existing projects, wind turbines are not viewed in the same way as other highly visible infrastructure projects.



Communications Tower

Power Plant

Wind Power Facility

Turbines in the Landscape

Turbines can be perceived as compatible with certain landscapes

Especially working agricultural landscapes

Turbines in the Landscape

In other settings, turbines may appear more out of character.

Wooded Ridge Tops

Off Shore Facilities

Factors Affecting Turbine Visibility

Turbine Color

Not many options. Typically white or off-white: Works well under most conditions.

Clear

Partly Cloudy

Overcast

Factors Affecting Turbine Visibility

Proximity to viewer

Factors Affecting Turbine Visibility

Proximity to viewer

Offshore projects are relatively far away from most viewers

Factors Affecting Turbine Visibility

Lighting Conditions

Front - Lighting

Back - Lighting

Factors Affecting Turbine Visibility

Weather Conditions

Clear Skies

Hazy Skies

Factors Affecting Turbine Visibility

FAA Lighting

Generally an unavoidable adverse visual impact, but can be minimized

Late Afternoon

Early Evening

Twilight

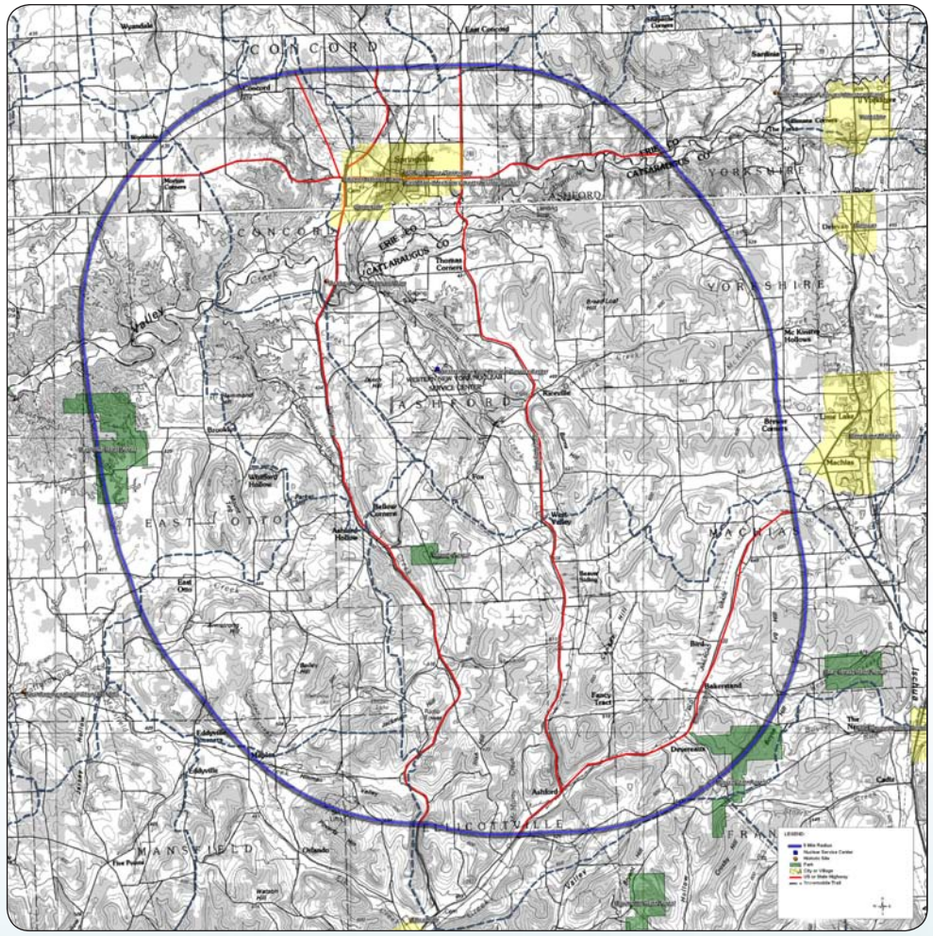
Night

Visual Impact Assessment Process

- Inventory of Visual/Sensitive Resources
- Analysis of Potential Project Visibility
- Accurate Illustration of Project
- Visual Impact Assessment

Inventory of Visually Sensitive Resources

- Defined by NYSDEC Visual Policy
- Historic sites
- Park and recreational facilities
- State/Federally designated resources
- Areas of high intensity land use



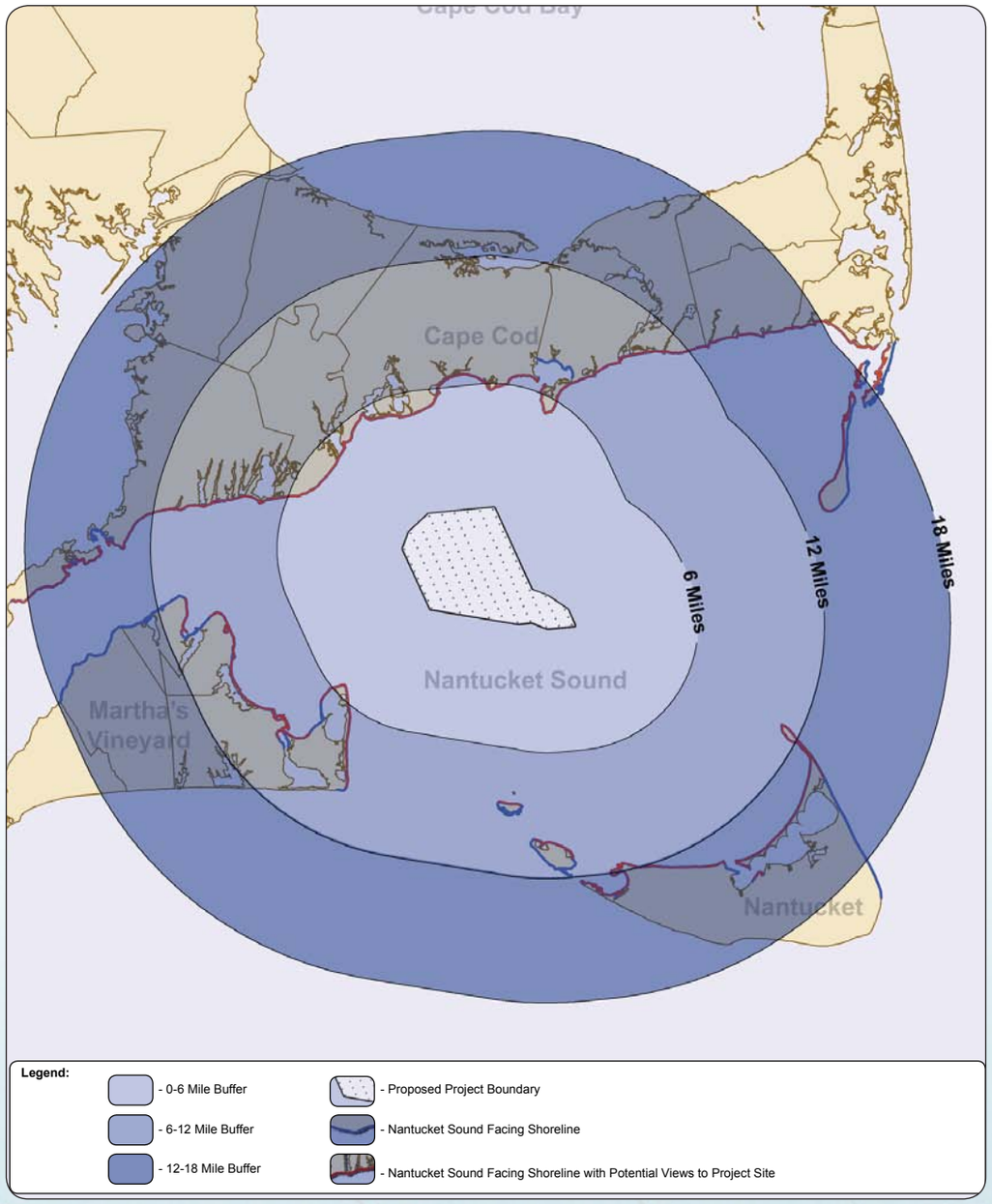
Analysis of Potential Project Visibility

Viewshed Analysis

- Can evaluate a large area: 5 - 10 Miles Typically
- Used to help define areas that require additional study
- Worst case analysis: based on topography only
- Limited value for shoreline areas

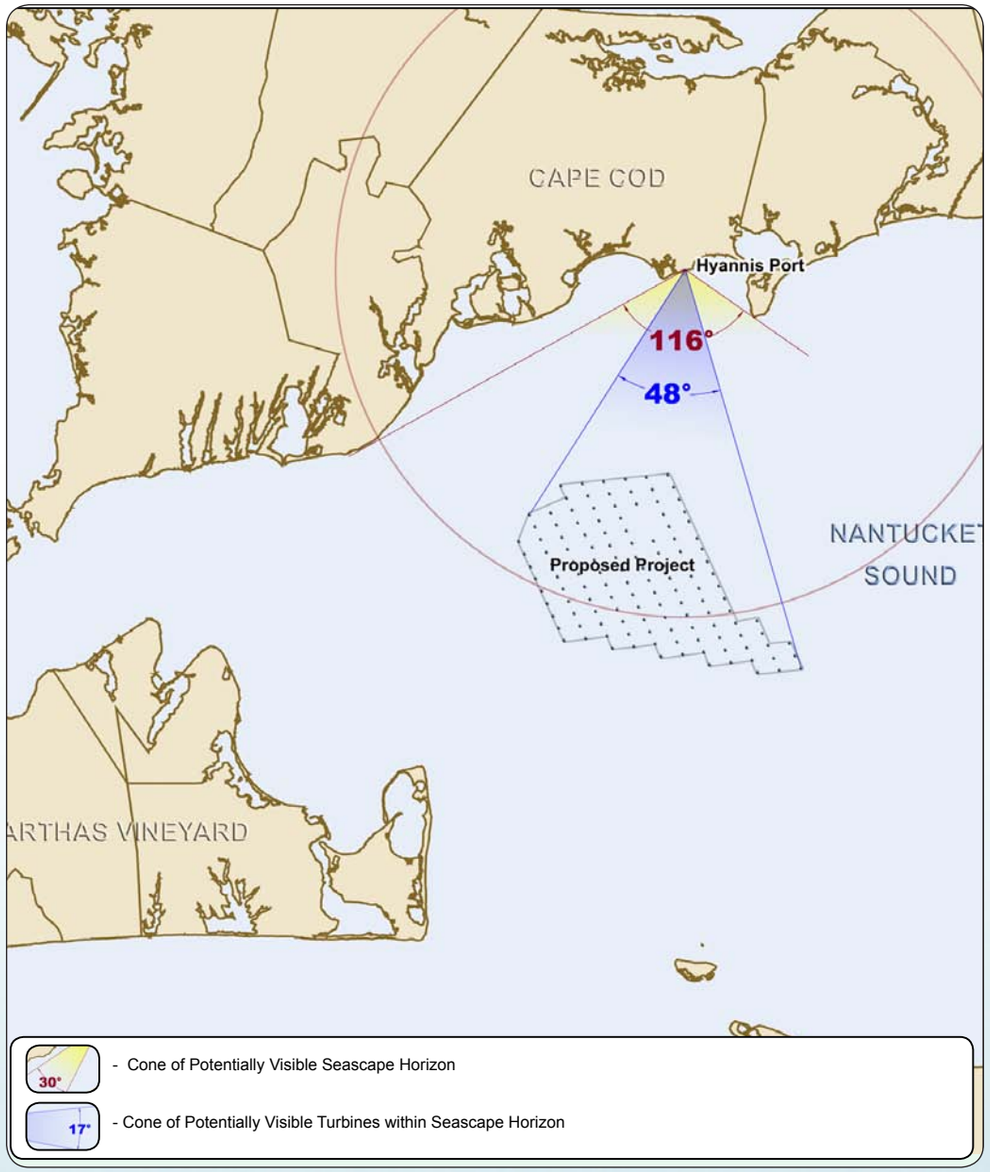
Analysis of Potential Project Visibility

Shoreline Visibility Study



Analysis of Potential Project Visibility

Seascape Horizon Study



Analysis of Potential Project Visibility

Field Evaluation/Documentation

Accurate Illustration of Project

Selection of Viewpoints

- Should have a defined selection process
- Needs to be representative of Landscape Similarity Zones
- Needs to show project from various distances and directions
- Should illustrate different ambient lighting conditions
- Should include sensitive sites and areas of local concern

Accurate Illustration of Project

Computer Modeled Simulations

- Only defensible way to create photo simulations
- Use proposed turbine specifications and coordinates
- Use viewpoint data obtained during field work (know the limits of its accuracy)
- Models need to be accurate and should include all proposed project components
- Materials/color should match those of proposed action
- All support data can be made available upon request

Accurate Illustration of Project

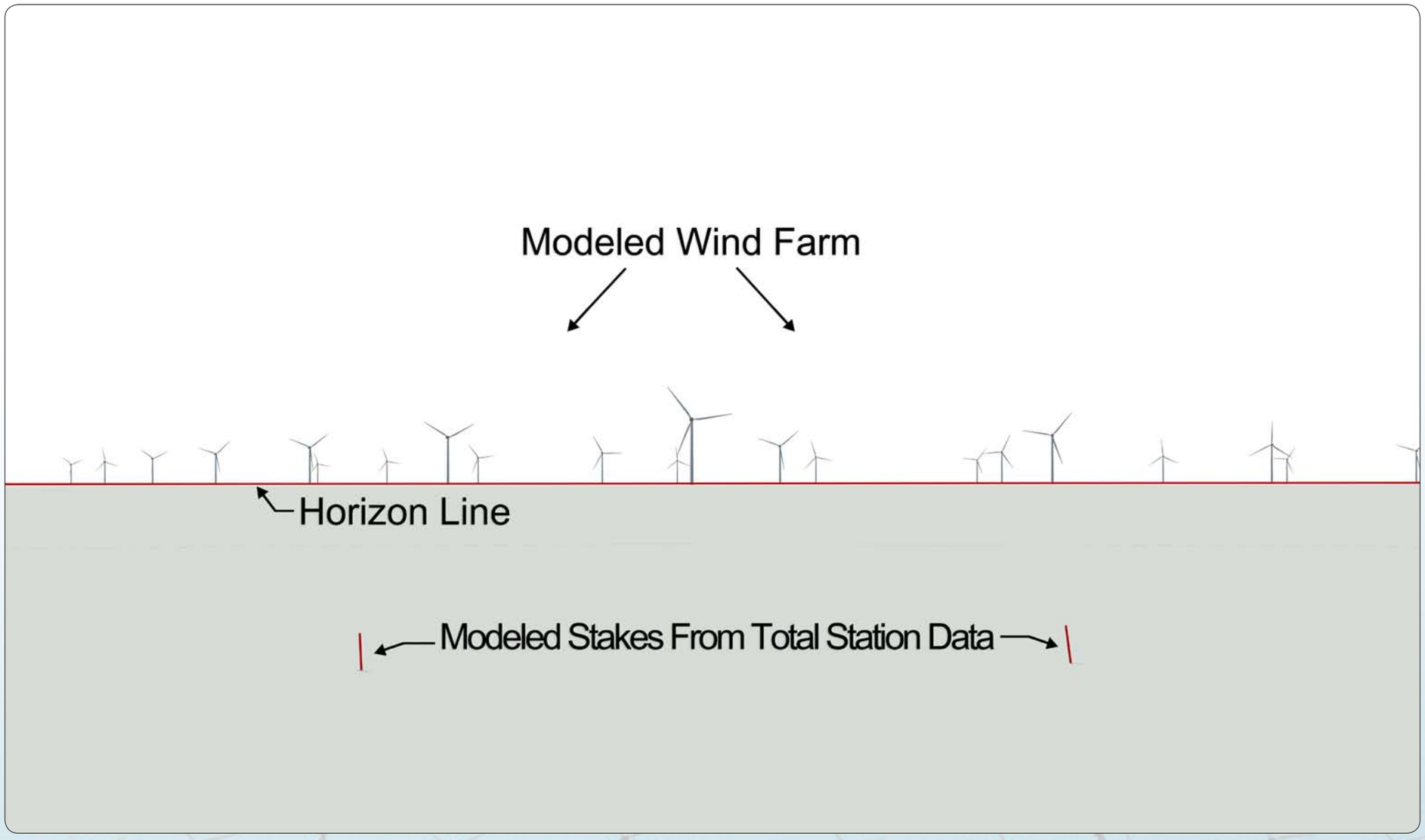
Simulation Methodology

Photos are selected to illustrate typical views of the proposed project that will be available to representative viewer/user groups from representative shoreline settings

Accurate Illustration of Project

Simulation Methodology

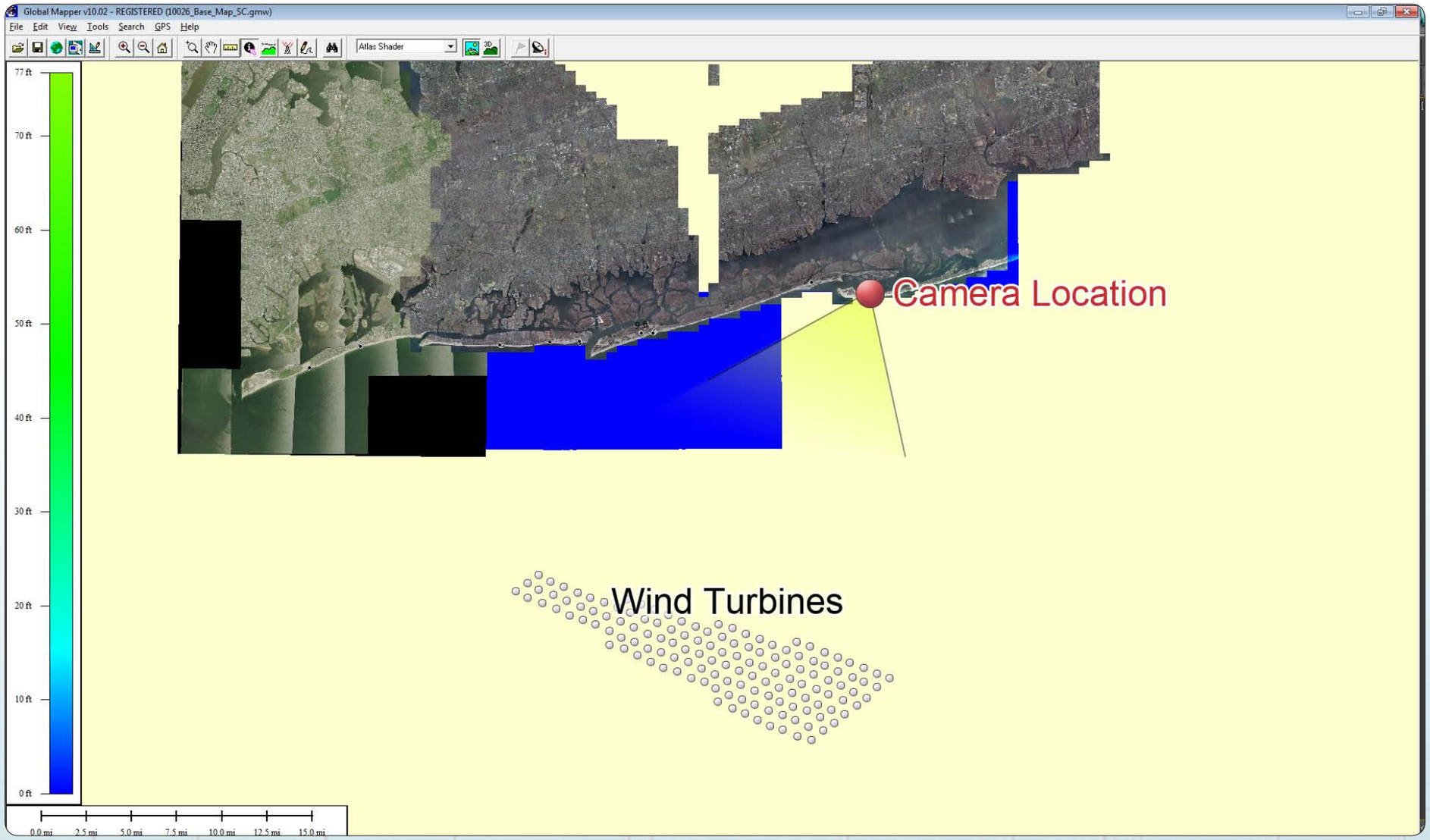
A three-dimensional computer model of the project is built based on proposed turbine specifications and tower site coordinates



Accurate Illustration of Project

Simulation Methodology

Aerial photographs, survey (Total Station) data, and sub-meter accuracy GPS data collected in the vicinity of the viewpoints are used to align the photo with the 3D model



Accurate Illustration of Project

Simulation Methodology

Blow-up of the camera location and alignment points documented with the sub-meter accuracy GPS and Total Station

Accurate Illustration of Project

Simulation Methodology

These data are superimposed over photographs from each of the viewpoints, and minor camera changes are made to align all known reference points within the view

Accurate Illustration of Project

Simulation Methodology

The foreground stakes are removed and the proposed exterior color/finish of the turbines is then added to the model. The appropriate sun angle is simulated based on the specific date, time and location at which each photo was taken

Visual Impact Assessment

MANAGEMENT CLASSIFICATION SYSTEM

Date:
Personnel:
Similarity Zone:
Photo Reference:

1) Rate the aesthetic quality/sensitivity on each resource on a score of 1 to 9

(1 liability to 9 distinct)

	SCORE
Water Resources:	
Landform:	
Vegetation:	
Land use:	
User Activity:	

2) Respond to each question below using a score of 0 to 3

(0 not present to 3 being high density)

Does this zone contain any cultural or historic landmarks ?	
Are there other aesthetic elements that add to this resource?	

3) Respond to the question below using a score of 0 to 3

(0 littered/polluted to 3 free of litter/pollution)

Is this zone free from pollution and/or litter ?	

TOTAL

4) Comments:

FORM 4

Visual Impact Assessment

VISUAL IMPACT ASSESSMENT

Date:
Personnel:
Similarity Zone:
Viewpoint Name/Number:

PROPOSED CONDITIONS

1) 1) Rate the aesthetic quality/sensitivity of each resource below

(1 liability to 9 Distinct)

Water Resources:		Land Use:	
Landform:		User Activity:	
Vegetation:		Special Cond.:	i.e. Any changes in Exist. Cond. question 2+3 Form 6 Existing
		TOTAL	

2) Rate compatibility of the proposed project on a score of 1 to 3

(1 compatible to 3 not compatible)

Water Resources:		Land Use:	
Landform:		User Activity:	
Vegetation:		**TOTAL**	

3) Rate scale contrast of the proposed projecton a score of 1 to 3

(1 Minimal to 3 Severe)

Water Resources:		Land Use:	
Landform:		User Activity:	
Vegetation:		**TOTAL**	

4) Rate spatial dominance of the proposed projecton a score of 1 to 3

(1 subordinate, 2 co-dominant, 3 dominant)

Water Resources:		Land use:	
Landform:		User Activity:	
Vegetation:		**TOTAL**	

5) Comments:

PROPOSED CONDITIONS FORM 6

VISUAL IMPACT ASSESSMENT

Date:
Personnel:
Similarity Zone:
Viewpoint Name/Number:

EXISTING CONDITIONS

1) Rate the aesthetic quality/sensitivity of each resource below

on a score of 1 to 9 (1 liability to 9 distinct)

Water Resources:		Land Use:	
Landform:		User Activity:	
Vegetation:			

2) Respond to each question below using a score of 0 to 3

(0 not present to 3 being high density)

Does this zone contain any Cultural or Historic Landmarks ?	
Are there other aesthetic elements that add to this resource?	

3) Respond to the question below using a score of 0 to 3

(0 littered/polluted to 3 free of litter/pollution)

Is this zone free from pollution and/or litter ?	

TOTAL

4) Comments:

EXISTING CONDITIONS FORM 6

Visual Impact Assessment

Overall Benefits of VIA Process

- Analysis is scientific: Can be repeated and checked
- Conclusions based on defensible analysis
- Can help define if mitigation is necessary and effective
- Superior to the “judge for yourself” approach

Effect on Property Values

- Common concern on most wind projects including proposed off-shore projects
- Concern generally focused on properties within 2 miles of turbines
- Relates to potential visual, noise, shadow flicker and sleep disturbance effects

Effect on Property Values

Three most commonly cited studies:

- Renewable Energy Policy Project (REPP), 2003
- Royal Institute of Chartered Surveyers, 2007
- Hoen et al., 2009

Most recent study:

- Hinman, 2010

All these studies involved statistical analysis of real estate data, and all concluded that operating wind farms do not have an adverse impact on property values

Effect on Property Values

- None of the previous studies addressed off-shore projects
- Limited information - all from Europe
- Positive reaction in coastal resort communities in Denmark with views of the Horns Rev project (Leaning, 2003)

Image courtesy of www.hornsrev.dk

Effect on Property Values

Citations

Firestone, J. and W. Kempton. 2007. *Public Opinion about Large Offshore Wind Power: Underlying Factors. Energy Policy* 35(3): 1584-98.

Hinman, Jennifer L. 2010. *Wind Farm Proximity and Property Values: A Pooled Hedonic Regression Analysis of Property Values in Central Illinois*. Available at: http://renewableenergy.illinoisstate.edu/wind/publications/2010%20Wind%20Farm%20Proximity%20and%20Property%20Values.pdf. May 2010.

Hoen, B., R. Wiser, P. Cappers, M. Thayer, and G. Sethi. 2009. *The Impact of Wind Power Projects on Residential Property Values in the United States: A Multi-Site Hedonic Analysis*. Available at: http://eetd.lbl.gov/ea/ems/reports/lbnl-2829e.pdf. December 2009.

Leaning, J. 2003. *Danes extol wind farm*. Cape Cod Times. Published: November 11, 2003.

Renewable Energy Policy Project (REPP). 2003. *The Effect of Wind Development on Local Property Values*. Available at: http://www.repp.org/articles/static/1/binaries/wind_online_final.pdf. May 2003.

Royal Institution of Chartered Surveyors (RICS). 2007. *What is the impact of wind farms on house prices?* Available at: http://www.rics.org/site/download_feed.aspx?fileID=3524&fileExtension=PDF. February 2007.