OCS Study
BOEM 2015-044

Renewable Energy Viewshed Analysis and Visualization Simulation for the New York Outer Continental Shelf Call Area: Compendium Report

U.S. Department of Interior
Bureau of Ocean Energy Management
Office of Renewable Energy Programs

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Prepared under BOEM Contract
Call Order No. M14PD00012
by
URS Group, Inc.

U.S. Department of Interior
Bureau of Ocean Energy Management
Office of Renewable Energy Programs

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DISCLAIMER

Study concept, oversight, and funding were provided by the U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs, Sterling, VA, under Call Order No. M14PD00012. This report has been technically reviewed by BOEM and it has been approved for publication. The views and conclusions contained in this document are those of the authors and should not be interpreted as representing the opinions or policies of the U.S. Government, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

REPORT AVAILABILITY

This report will be made available on the U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs' website at: www.boem.gov/Renewable-Energy/.

SUGGESTED CITATION

URS Group, Inc. and Truescape. 2015. Renewable Energy Viewshed Analysis and Visualization Simulation for the New York Outer Continental Shelf Call Area: Compendium Report. Prepared by URS Group, Inc. and Truescape, for the U.S. Department of the Interior, Bureau of Ocean Energy Management. BOEM Call Order No. M14PD00012 85 pp. + appendices

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ACRONYMS, ABBREVIATIONS, AND SYMBOLS

ASOS	automated surface observation system
BOEM	Bureau of Ocean Energy Management
FAA	Federal Aviation Administration
HDR	High Dynamic Range
KOPs	Key Observation Points
Lidar	Light Detection and Ranging
MOR	meteorological optical range
NAD83	North American Datum of 1983
NCDC	National Climatic Data Center
NED	National Elevation Dataset
NJ	New Jersey
NM	nautical miles
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NRA	National Recreation Area
NY	New York
OCS	Outer Continental Shelf
$PM_{2.5}$	particulate matter with a diameter of 2.5 microns or less
RH	relative humidity
SHPO	State Historic Preservation Office
URS	URS Group, Inc.
USACE	U.S. Army Corps of Engineers
USGS	United States Geological Survey
UTM	Universal Transverse Mercator
WTG	Wind Turbine Generator

1 INTRODUCTION

The Bureau of Ocean Energy Management (BOEM) mission is to protect the environment while ensuring the safe development of the Nation's offshore energy and marine mineral resources. With the passage of the Energy Policy Act of 2005, BOEM acquired regulatory authority for renewable energy activities on the Outer Continental Shelf (OCS). In 2009, President Barack Obama announced final regulations for the OCS Renewable Energy Program, which provide a framework for issuing leases, easements, and rights-of-way for OCS activities that support production and transmission of renewable energy. This includes offshore wind, ocean wave energy, and ocean current energy.

To help inform BOEM's planning and leasing process, BOEM has established Intergovernmental Renewable Energy Task Forces in states that have expressed interest in development of offshore renewable energy. The role of each Task Force is to collect and share relevant information that would be useful to BOEM during its decision-making process. Task Force and other stakeholder input has helped to identify areas of significant promise for offshore renewable energy development and provide early identification of, and steps toward resolving, potential conflicts.

In coordination with other Federal agencies and BOEM's New York (NY) Intergovernmental Renewable Energy Task Force, BOEM has identified an area for consideration for potential future wind energy leasing offshore NY (Call Area). See http://www.boem.gov/State-Activities-New-York/ for additional information. BOEM has determined that competitive interest exists in this area and has initiated planning and analysis to determine if the Call Area should be designated as a Wind Energy Area and further considered for commercial leasing and development. The public has expressed support for offshore development of renewable energy resources to achieve the State's clean energy goals, improve air quality and human health, reduce the need for additional fossil fuel power plants, and mitigate climate change. However, concerns were raised by stakeholders about siting wind energy development in this region and the potential for viewshed impacts and effects to historic properties.

In response to this concern, a visibility study was conducted for a hypothetical wind energy project (Hypothetical Project) located on the OCS offshore New York. The study aims to demonstrate potential visibility of the Hypothetical Project by:

- Completing a meteorological conditions assessment to document average and maximum visibility and common weather conditions in the vicinity of the Hypothetical Project;
- Developing viewshed models detailing potential visibility of the Hypothetical Project from the surrounding landscape; and

- Preparing accurate and realistic visual simulations of a Hypothetical Project offshore Long Island, NY, from photographs and video taken at various locations identified as important by stakeholders.

This Compendium Report documents each stage of the study, including: a meteorological conditions assessment; viewshed analysis; base photographic documentation of Key Observation Points (KOPs); development of single frame simulations, panoramic photomontages, and video simulations: and a visibility assessment. The study area was defined as the region surrounding the NY Call Area, and included the locations of KOPs and meteorological stations.

1.1 DESCRIPTION OF THE HYPOTHETICAL OFFSHORE WIND PROJECT

The Hypothetical Project used as the basis for creating the photographic and video simulations is located within the New York Call Area (Figure 1-1). The New York Call Area is located on the OCS off the coast of Long Island, New York, beginning approximately 11 nautical miles (NM) south of Long Beach, New York. From its western edge, the area extends approximately 26 NM southeast at its longest portion. The call area consists of 5 full OCS blocks and 148 sub-blocks. The entire area is approximately 127 square miles, 81,130 acres, or 32,832 hectares.

BOEM is not currently considering the approval of a specific project within the Call Area; therefore, the simulated development is conceptual in nature and limited only to offshore components including wind turbines and two electrical service platforms. The Hypothetical Project was designed to represent a technically feasible scenario consistent with industry trends regarding turbine size and configuration (Navigant Consulting, Inc., 2014). The simulated turbine array was designed with 134 Senvion 6.2M 152 wind turbine generators measuring 577.4 feet (176 meters) from water level to blade tip and configured at a 10 by 10 spacing (i.e., in a grid pattern spaced 4,986.8 feet [1520 meters] between turbines). For the purpose of this study, wind turbines were assumed to be painted pale gray per Federal Aviation Administration (FAA) guidelines (FAA 2007).

1.2 KEY OBSERVATION POINTS

The visibility study created simulations from 16 locations in the States of New York and New Jersey. These locations, referred to as KOPs, were selected by BOEM in coordination with the National Park Service (NPS) and the New Jersey State Historic Preservation Office (NJ SHPO). The majority of KOPs were located on or near the shoreline; however, one KOP was placed inland at the Green-Wood Cemetery in Brooklyn, NY. The KOPs were selected to provide a representative geographic distribution of onshore areas likely within the viewshed of renewable energy development within the New York Call Area and to also include locations of specific concern to NPS, including National Historic Landmarks and natural areas. Scientific Research and Collecting Permits were obtained per the NPS requirement to support work conducted at Fire

Island National Seashore (Permit # FIIS-2014-SCI-007) and Gateway National Recreation Area (Permit # GATE-00370). A Special Use Permit was obtained from the Twin Lights National Historic Site. Permits are provided in Appendix A.

The following KOPs were placed at Fire Island National Seashore:

- Otis Pike Wilderness
- Sunken Forest
- Fire Island Lighthouse

The following KOPs were placed in the Gateway National Recreation Area:

- Jacob Riis Park
- Breezy Point Tip
- Fort Wadsworth
- Great Kills Park
- Sandy Hook Lighthouse
- Sandy Hook North Beach
- Sandy Hook Area D

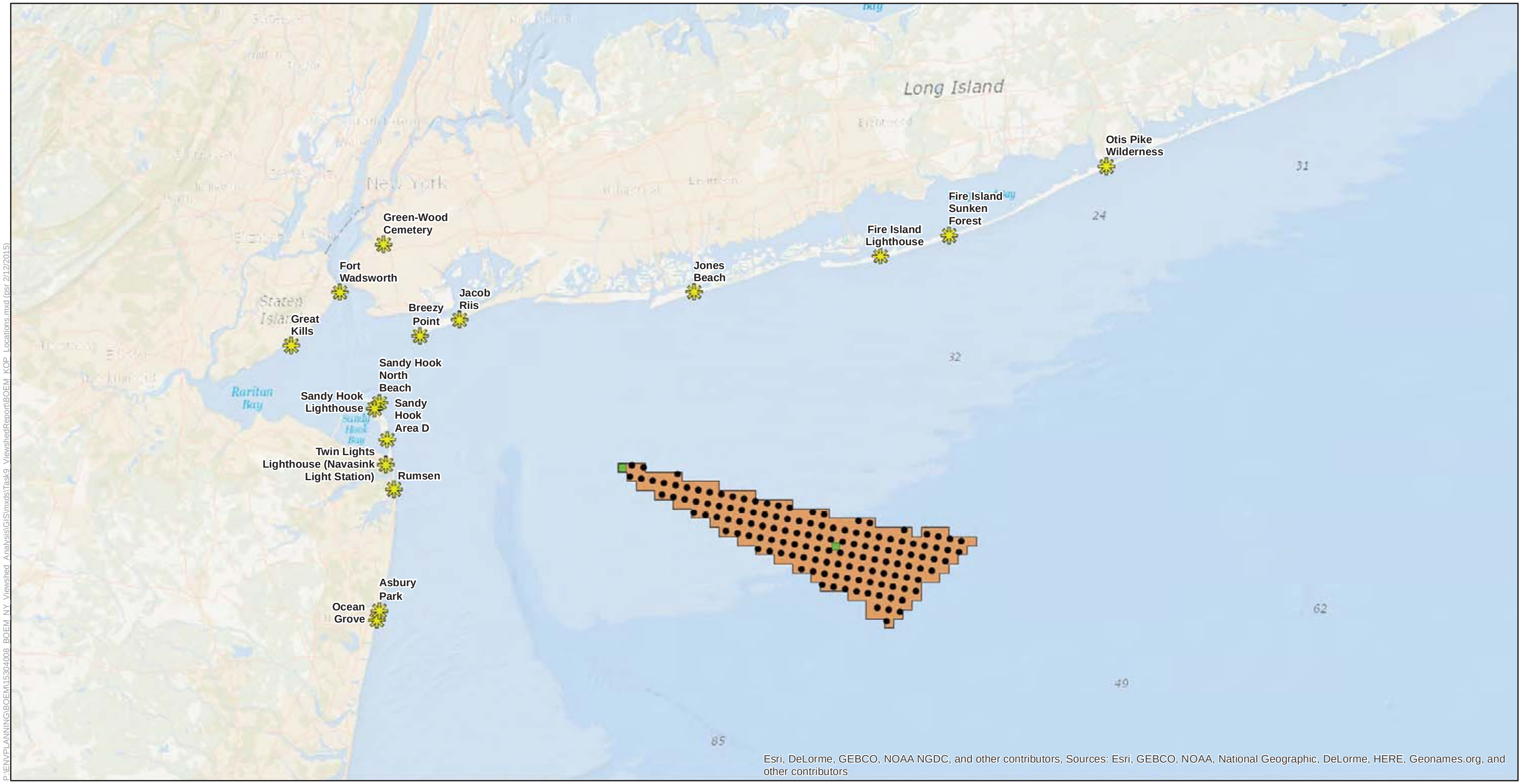
The locations of KOPs are provided in Table 1-1, below, and shown in Figure 1-1.

Table 1–1. Locations of Key Observation Points Used in the Visibility Study

Key Observation Point	State	Latitude	Longitude	KOP Location
Otis Pike Wilderness	NY	40.732304	-72.866598	At end of boardwalk leading to beach, adjacent to visitors center
Fire Island Sunken Forest	NY	40.654935	-73.112372	On lighthouse deck
Fire Island Lighthouse	NY	40.632419	-73.218569	On boardwalk
Jones Beach	NY	40.59421	-73.507291	On boardwalk
Jacob Riis Park	NY	40.565889	-73.869745	At Rockaway Gateway Greenway, in front of Riis Bathhouse
Breezy Point Tip	NY	40.547231	-73.93107	At end of path leading from sand access road to beach.
Fort Wadsworth	NY	40.599661	-74.05371	View from beach-side park, overlooking Lower Bay and the Atlantic Ocean
Great Kills Park	NY	40.537553	-74.129602	On bathhouse deck, overlooking beach and ocean
Sandy Hook Lighthouse	NJ	40.461707	-74.002015	View from lighthouse deck
Sandy Hook North Beach	NJ	40.468987	-73.994414	On beach, approximately half way between shoreline and bathhouse/interpretative area
Sandy Hook Area D	NJ	40.425513	-73.98319	At end of path leading from parking lot to beach

Key Observation Point	State	Latitude	Longitude	KOP Location
Green-Wood Cemetery	NY	40.655679	-73.985403	On hill overlooking cemetery, view directed toward Atlantic Ocean
Twin Lights Lighthouse[1]	NJ	40.396035	-73.98546	On lighthouse deck
Rumson	NJ	40.366991	-73.973794	On path leading to publically accessible adjacent to bridge
Asbury Park	NJ	40.224404	-73.998334	On Asbury Park Boardwalk adjacent to Convention Hall
Ocean Grove	NJ	40.213252	-74.002402	In front of beach pavilion

[1]Also referred to as Navesink Light Station



Legend

- Key Observation Point Location
- Substation
- Wind Turbine Generator (WTG)
- NY Planning Area

URS

0 5 10 20 Kilometers

0 5 10 20 Nautical Miles

0 5 10 20 Miles

Coordinate System: NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983

Figure 1-1
Location of NY Call Area and Key Observation Points

NY Renewable Energy Viewshed Project

BOEM

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2 METEOROLOGICAL CONDITIONS ASSESSMENT

2.1 INTRODUCTION

A meteorological assessment was completed to identify common weather patterns, predict visibility within the study area, and support the development of accurate and realistic visual simulations. For the meteorological conditions assessment, visibility was defined as "the greatest distance at which an observer can just see a black object viewed against the horizon sky" (Malm 1999). An object is usually referred to as at "threshold contrast when the difference between the brightness of the sky and the brightness of the object is reduced to such a degree that an observer can just barely see the object" (Malm 1999). This concept of visibility is largely dependent on the size of the object (Malm 1999). The *operational definition* of visibility (or meteorological optical range, MOR), as defined by the World Meteorological Organization, defines visibility without the same dependence on the size of the object. This definition focusses on optics, defining visibility as the length of a path in the atmosphere required to reduce the intensity of light to 5 percent of its original value (WMO 2011). This 5 percent value is considered the threshold contrast, and the outer limits at which an observer can still identify an object.

This assessment included:

1. A descriptive analysis of meteorological conditions, such as winds, common weather conditions, reported visibilities, and average temperature and humidity on an annual, seasonal, and daily basis;
2. A synthesis of existing meteorological data to determine the correlation between atmospheric conditions and visibility from onshore locations; and
3. The development of models to predict visibility beyond 10 miles, which is the extent of visibility predictions typically provided by airports.

2.2 METHODS

For this analysis, seasons were defined as follows:

1. Spring, March 22 – June 21;
2. Summer, June 22 – September 21;
3. Fall, September 22 – December 21; and
4. Winter, December 22 – March 21.

Daytime hours were assumed to be 7:00 a.m. through 6:59 p.m., while nighttime hours were assumed to be 7:00 p.m. through 6:59 a.m. This methodology captured average annual day and night conditions.

2.2.1 Meteorological Station Selection

Nineteen meteorological stations were identified within the study area. Data from the DS3505 data set, available from the National Climatic Data Center (NCDC), were selected as potentially suitable data sources for this analysis. DS3505 comprises global hourly meteorological data with approximately 10,000 stations currently active. Data from a variety of networks (e.g., National Weather Service and the U.S. Air Force Combat Climatology Center) are put into this standardized format to create a spatially and temporally wide-ranging data set.

To identify robust data sets suitable to achieve the goals of the analysis, data were evaluated based on the following criteria:

- Geographic Location: Located in the study area and near the coast
- Duration of Data Collection: Period of data collection equal to 8 years or more
- Availability of Contemporary Data: Data available up to present day, or within last several years
- Availability of Required Meteorological Parameters: Parameters of temperature, dew point, and atmospheric pressure must be available

Results of the meteorological station selection are provided in Table 2-1. Selected stations included: John F. Kennedy Airport in Queens, NY (JFK), Long Island MacArthur Airport (LI MacArthur/LIMA), Monmouth Executive Airport in New Jersey (Monmouth), Newark Airport in New Jersey (Newark), and Westhampton Beach Airport on Long Island (Westhampton). The location of each selected station is provided in Figure 2-1. For all stations, only the most recent 10 years of data were used.

Table 2–1. Meteorological Station Selection Criteria

Station[1]	Criteria for Selection: Near KOPs & coastal	Data record ≥ 8 years	Currently collecting data[2]	Data includes required parameters	Period of data downloaded	Notes
Ambrose Light	x	x	---	---	---	---
Bay Shore/Fire Island	x	x	---	---	---	---
Belmar ASC	x	x	---	---	---	---
Brookhaven	x	x	x	---	---	Not selected because KOPs were adequately covered by other

Station[1]	Criteria for Selection: Near KOPs & coastal	Data record ≥ 8 years	Currently collecting data[2]	Data includes required parameters	Period of data downloaded	Notes
						stations.
JFK Airport[3]	x	x	x	x	2004-2013	---
LaGuardia Airport	x	x	x	---	---	Not selected because there were other stations closer to the KOPs with required data; inclusion of this data set would have been redundant.
Linden	x	---	x	---	---	---
Long Island MacArthur Airport[3]	x	x		x	2000-2009	Data collection ended in 2010; selected because data are still recent, there is a long period of record, and it is a reliable site.
Monmouth[3]	x	x	x	x	2006-2013	---
Newark Airport[3]	x	x	x	x	2004-2013	---
NYPD Air Ops Heliport	x	x	---	---	---	---
Ocean Grove	x	---	---	---	---	---
Red Bank/ Watson Lab	x	---	---	---	---	---
Republic	x	x	x	---	---	Not selected because KOPs were adequately covered by other stations.
Robins Reef	x	---	x	---	---	Downloaded data did not include dew point and only 7 years available.
Sandy Hook	x	x	x	---	---	Downloaded data only included wind speed/direction. No other stations in that area.
Short Beach	x	x	---	---	---	---
The Battery	x	x	x	---	---	Downloaded data and discovered majority was missing.
Westhampton Beach[3]	x	x	x	x	2004-2013	Selected over Brookhaven (as most eastern station on LI) because it has a longer data record.

Notes:

1. Station name as provided by NCDC on this interactive map: http://gis.ncdc.noaa.gov/map/viewer/#app=cdo&cfg=cdo&theme=hourly&layers=1

2. BOEM chose to limit site selection to those currently collecting data so that the time period analyzed for each KOP or cluster of KOPs would be comparable. Whether common meteorological conditions from the 1970s (for example) are still representative of conditions today was not an issue, and common weather at one site in the 1970s and other sites in the 2000s was not compared. Even with these criteria, there is sufficient data and geographic coverage.

3. Meteorological station was selected for analysis.

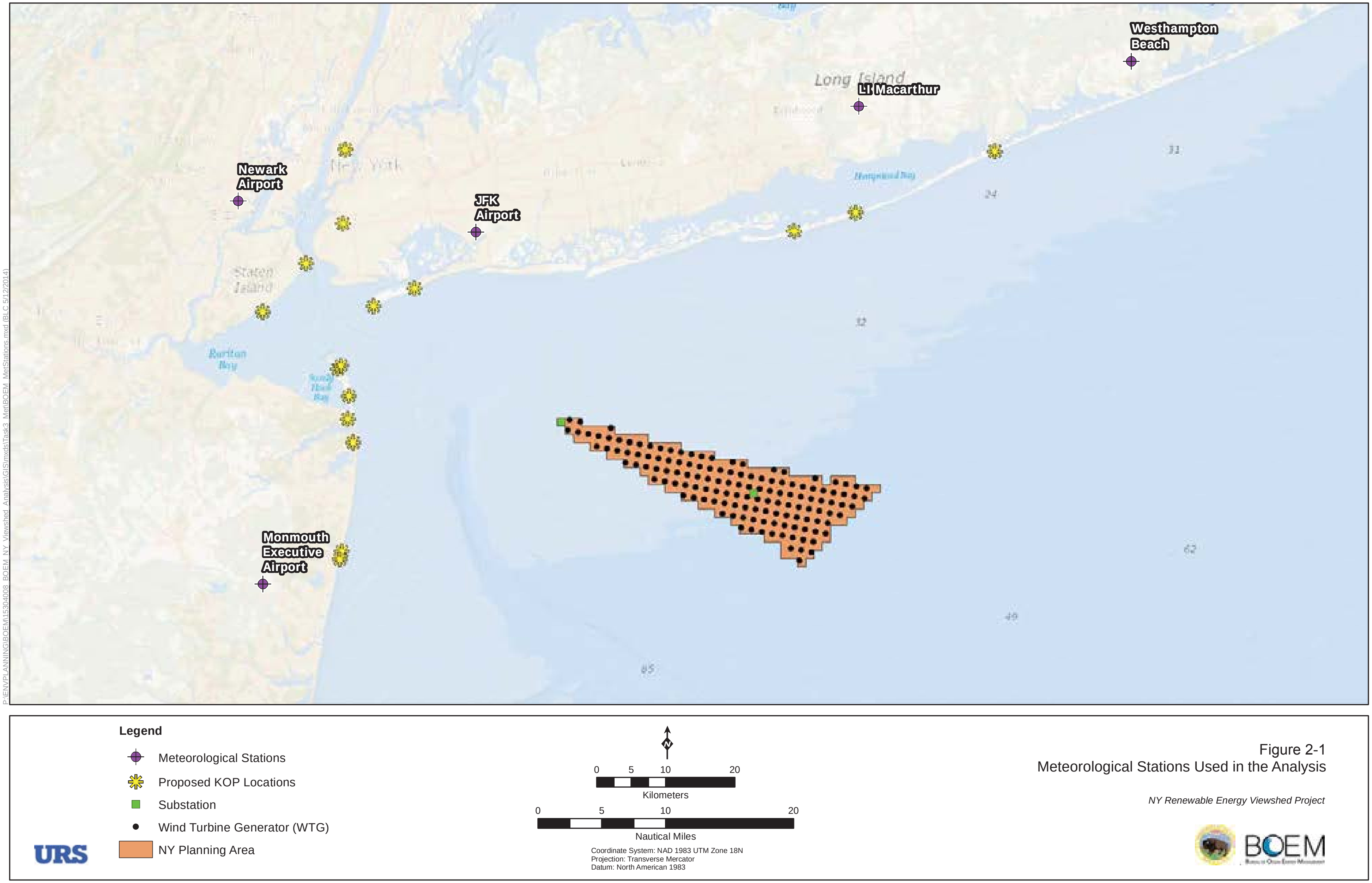


Figure 2-1
Meteorological Stations Used in the Analysis

NY Renewable Energy Viewshed Project

2.2.2 DS3505 Data Validation and Processing

Data sets that met all four criteria were downloaded for validation and processing. Hourly data were imported into Microsoft Access for management, processing, and validation. It was discovered that the data contained many more records (with each record representing one observation) than the number of hours in a given time period, indicating duplicate records. A total of 9.3 percent of the hours (51,631 hours) contained more than one record. Inspection of duplicates indicated that both a manual observation and a standard automated observation were often recorded in a given hour. Where this occurred, the automated observation was retained and the manual observation removed. This approach maximized consistency across records, as the vast majority of records were automated. Some "Summary of Day" and "Summary of Month" records were removed because they were inconsistent with the hourly data. In total, 11.6 percent of the initial raw data (64,060 records) were removed as duplicates or non-hourly data.

Retained data records were further screened to determine presence of temperature and dew point data, as these were integral to the visibility prediction portion of the study. Only records with temperature and dew point data were maintained, resulting in the removal of an additional 74,316 records. A total of 412,460 records remained in the valid data set, representing five stations as detailed in Table 2-2.

Table 2–2. Total Records by Station

Station	Total Records
JFK	87,575
LI MacArthur	87,286
Monmouth	63,558
Newark	87,574
Westhampton	86,467
TOTAL	**412,460**

Validation for data completeness consisted of comparing the number of remaining records to the number of possible records in a given year or season. Seasonal completeness is important to ensure that a given year's data (and thus study results) were not biased toward a particular time of year. As shown in Table 2-3 and Table 2-4, all selected sites exceeded the minimum 80 percent completeness goal of this study for each year and season.

Table 2–3. Data Completeness by Year and Station (percent)

Stations	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
JFK	--	--	--	--	99.0	100	100	100	100	100	100	100	100	100
LI MacArthur	99.5	99.1	99.0	99.4	98.9	100	100	100	100	100	--	--	--	--
Monmouth	--	--	--	--	--	--	82.6	93.7	91.5	97.1	89.6	90.0	82.9	97.7
Newark	--	--	--	--	99.0	100	100	100	100	100	100	100	99.9	100
Westhampton	--	--	--	--	97.2	99.7	98.4	98.9	98.6	99.6	98.7	96.3	99.5	99.4

Table 2–4. Data Completeness by Season at Each Station (percent)

Station	Winter	Spring	Summer	Fall
JFK	98.8	99.9	99.9	99.9
LI MacArthur	98.4	99.7	99.5	99.6
Monmouth	92.8	88.2	92.4	87.9
Newark	98.7	99.9	99.9	99.9
Westhampton	96.7	99.0	98.3	99.4

In addition to the hourly DS3505 data, 1-minute data from datasets DSI-6405 (“page 1” data) and DSI-6406 (“page 2” data) were downloaded from the JFK station for the period of 2004 through 2013. Page 1 data contained measurements of visibility extinction coefficient, wind speed, and wind direction. Page 2 data included corresponding measurements of precipitation, station pressure, temperature, and dew point. The two “pages” were combined into one record per timestamp. These data were included because they contained more detailed measurements of visibility, temperature, and dew point, which could be used to determine the relationship between visibility and relative humidity. This relationship could then be applied to the DS3505 data for the other four meteorological stations for which this detailed 1-minute data were not available. The combined “page 1” and “page 2” data and its application to visibility predictions are further described in Section 2.4.

2.3 DESCRIPTIVE DATA ANALYSIS

2.3.1 Wind Patterns

Prevailing weather at any given site can be understood by typical wind patterns. This relationship is illustrated by wind roses, which display the frequency with which the wind blows from a given direction on a polar plot representing all compass directions. Longer barbs indicate more frequent winds from that direction. Within each barb, different levels of wind speed are broken down, showing typical wind speeds originating from a particular direction. Collectively, wind direction and speed indicate approaching weather, such as warm and humid tropical air masses, or cooler and drier continental air masses. Calm winds were defined as reported winds less than 1 meter per second and are not included in the wind roses.

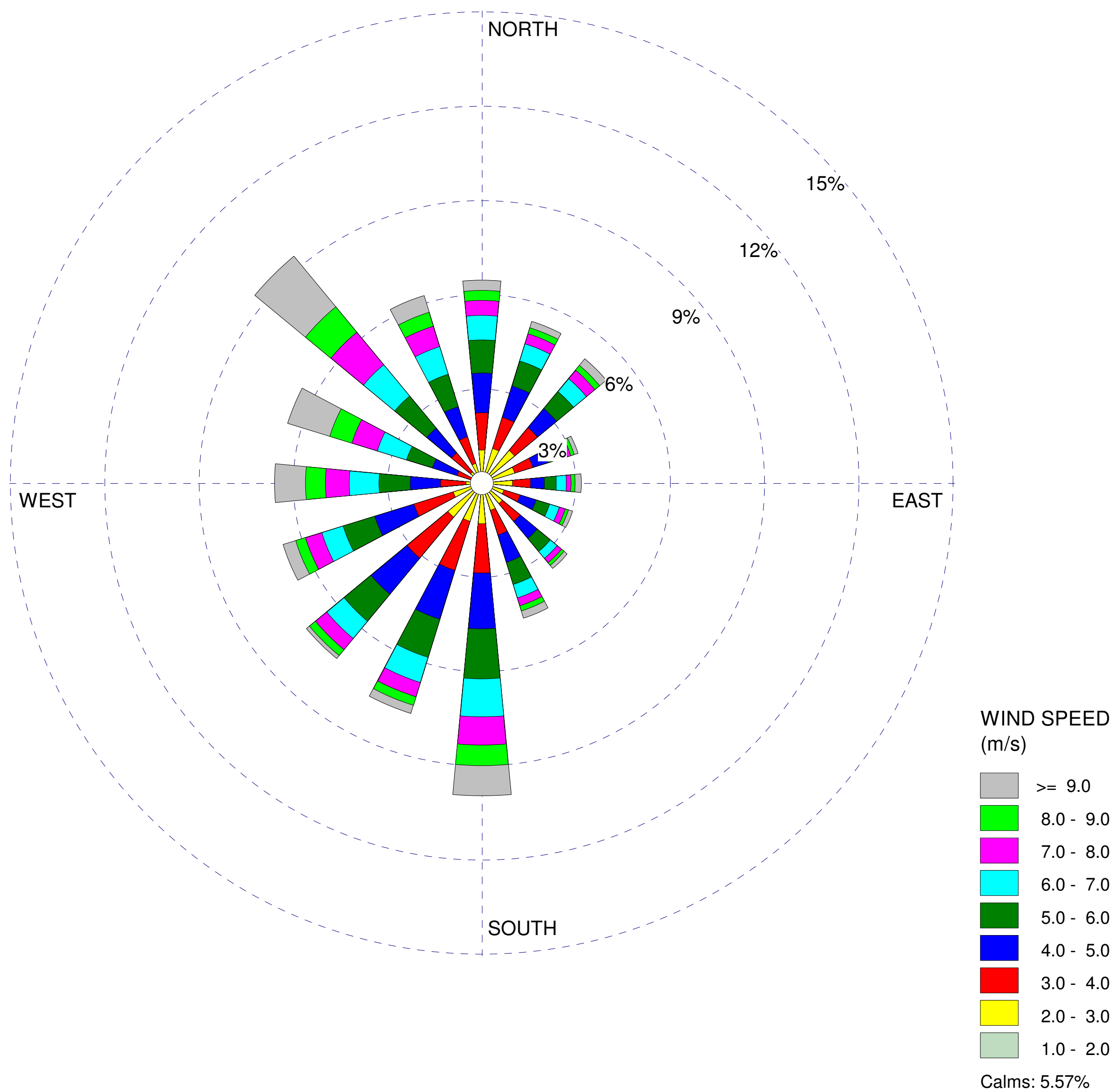
Annual wind roses for each site are shown in Figures 2-2 through 2-6. Prevailing winds at each site are generally from the southwest, with variance from southwest clockwise through northeast. The percent of hours with calm winds ranges from about 5 percent (JFK) to nearly 20 percent (Westhampton, LI MacArthur). Variation in wind directions and speed at each site is likely due to the location of the site relative to water, both in terms of cardinal direction and distance, and local geographic variations.

Wind roses are provided for each site by month (e.g., average January winds, for all January months in the data set) in Appendix B. In this region, winds generally originate from the south or southwest in the spring and summer, shifting to west and northwest in the fall and winter. Spring and fall are transitional periods with more variation in wind direction. The highest wind speeds (and fewest calm winds) occur in winter, with the passage of winter storms, while the lowest average speeds and most calm winds occur in the more often stagnant conditions of summer.

WIND ROSE PLOT:

John F. Kennedy International Airport
Annual Windrose

DISPLAY:
Wind Speed
Direction (blowing from)



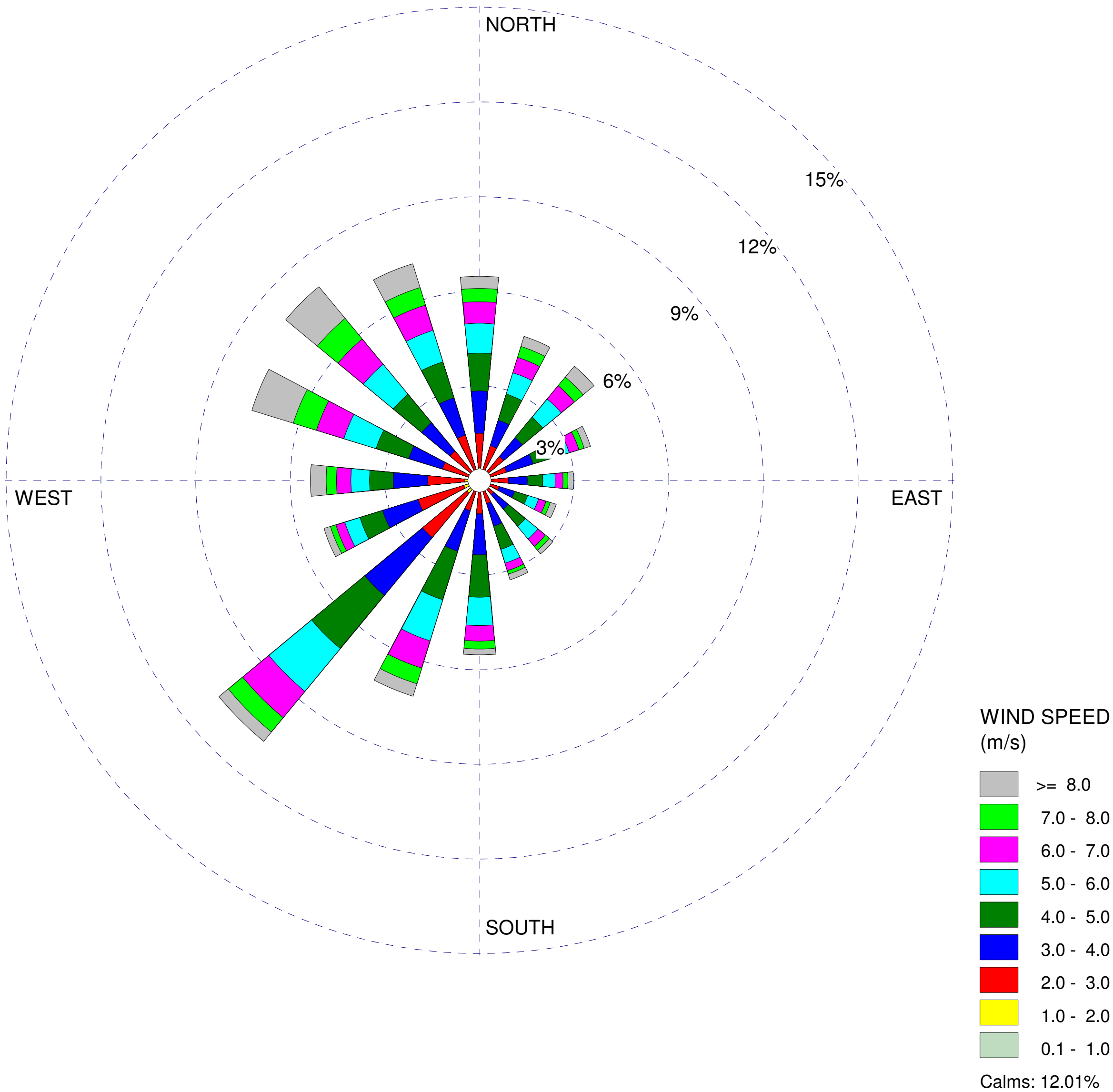
COMMENTS:	DATA PERIOD: **Start Date: 1/1/2004 - 00:00** **End Date: 12/31/2013 - 23:00**	COMPANY NAME: **URS**	
		MODELER: **LMB**	Figure 2–2 Annual wind rose for JFK
	CALM WINDS: **5.57%**	TOTAL COUNT: **87665 hrs.**	
	AVG. WIND SPEED: **5.03 m/s**	DATE: **4/15/2014**	

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

Long Island MacArthur Airport
Annual Windrose

DISPLAY:
Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD: **Start Date: 1/1/2000 - 00:00** **End Date: 12/31/2009 - 23:00**	COMPANY NAME: **URS**	
		MODELER: **LMB**	Figure 2–3 Annual wind rose for LI MacArthur
	CALM WINDS: **12.01%**	TOTAL COUNT: **87613 hrs.**	
	AVG. WIND SPEED: **4.10 m/s**	DATE: **4/15/2014**	

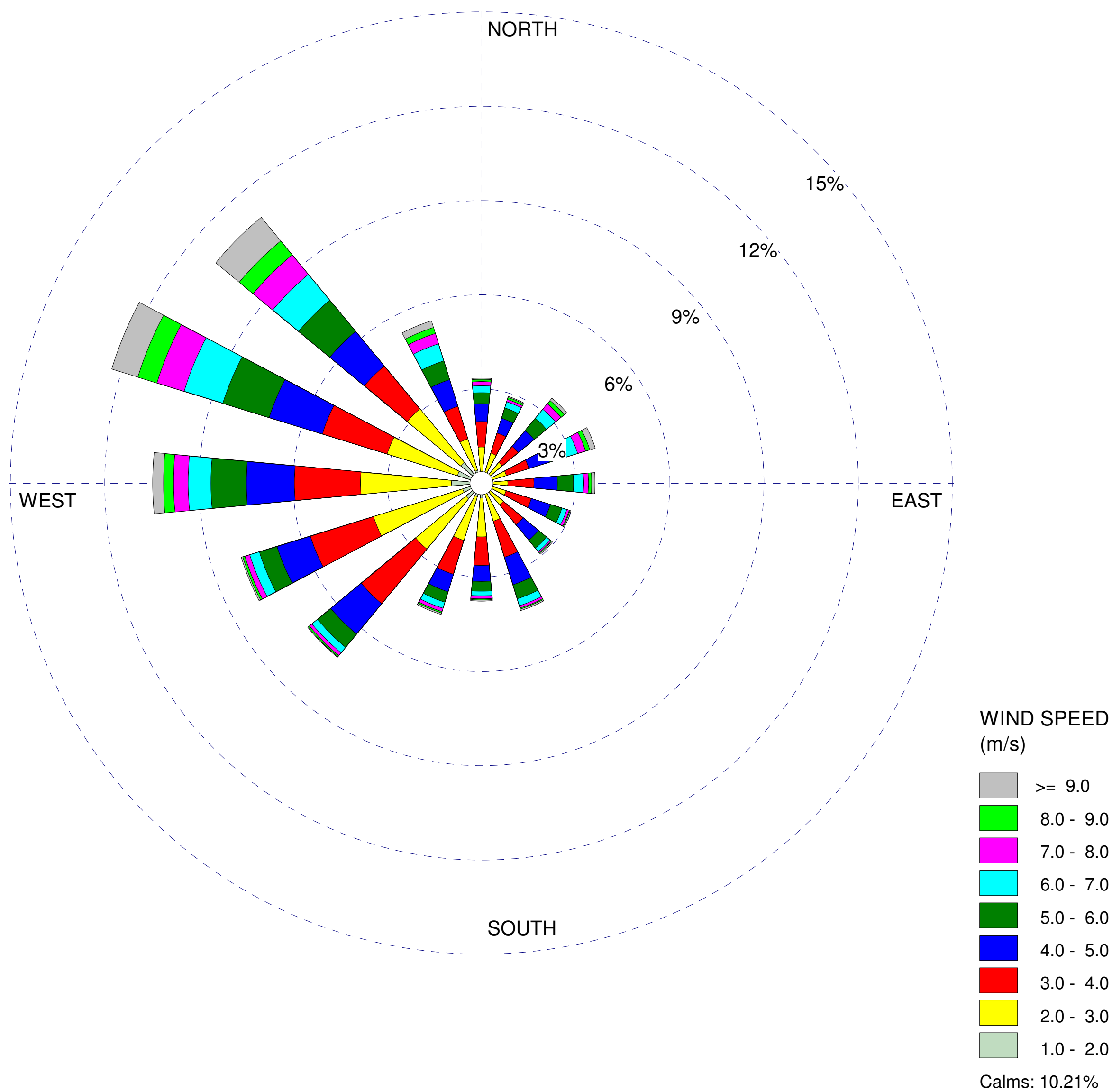
WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

Monmouth Executive Airport
Annual Windrose

DISPLAY:

Wind Speed
Direction (blowing from)

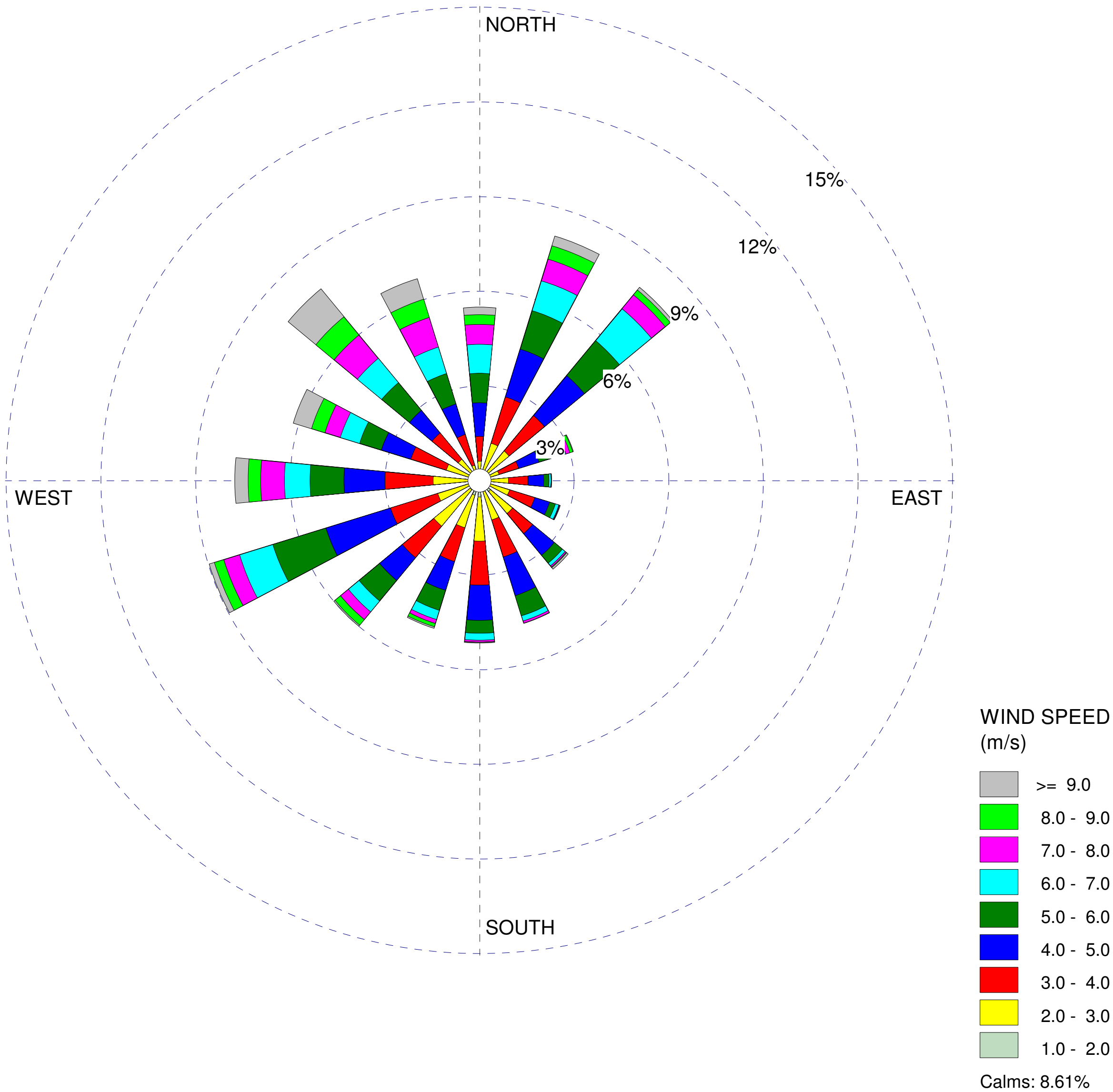


COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 1/1/2006 - 00:00 **End Date: 12/31/2013 - 23:00**	**URS**	
		MODELER: **LMB**	Figure 2–4 Annual wind rose for Monmouth
	CALM WINDS: **10.21%**	TOTAL COUNT: **65934 hrs.**	
	AVG. WIND SPEED: **3.71 m/s**	DATE: **4/15/2014**	

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:
Newark Liberty International Airport
Annual Windrose

DISPLAY:
Wind Speed
Direction (blowing from)

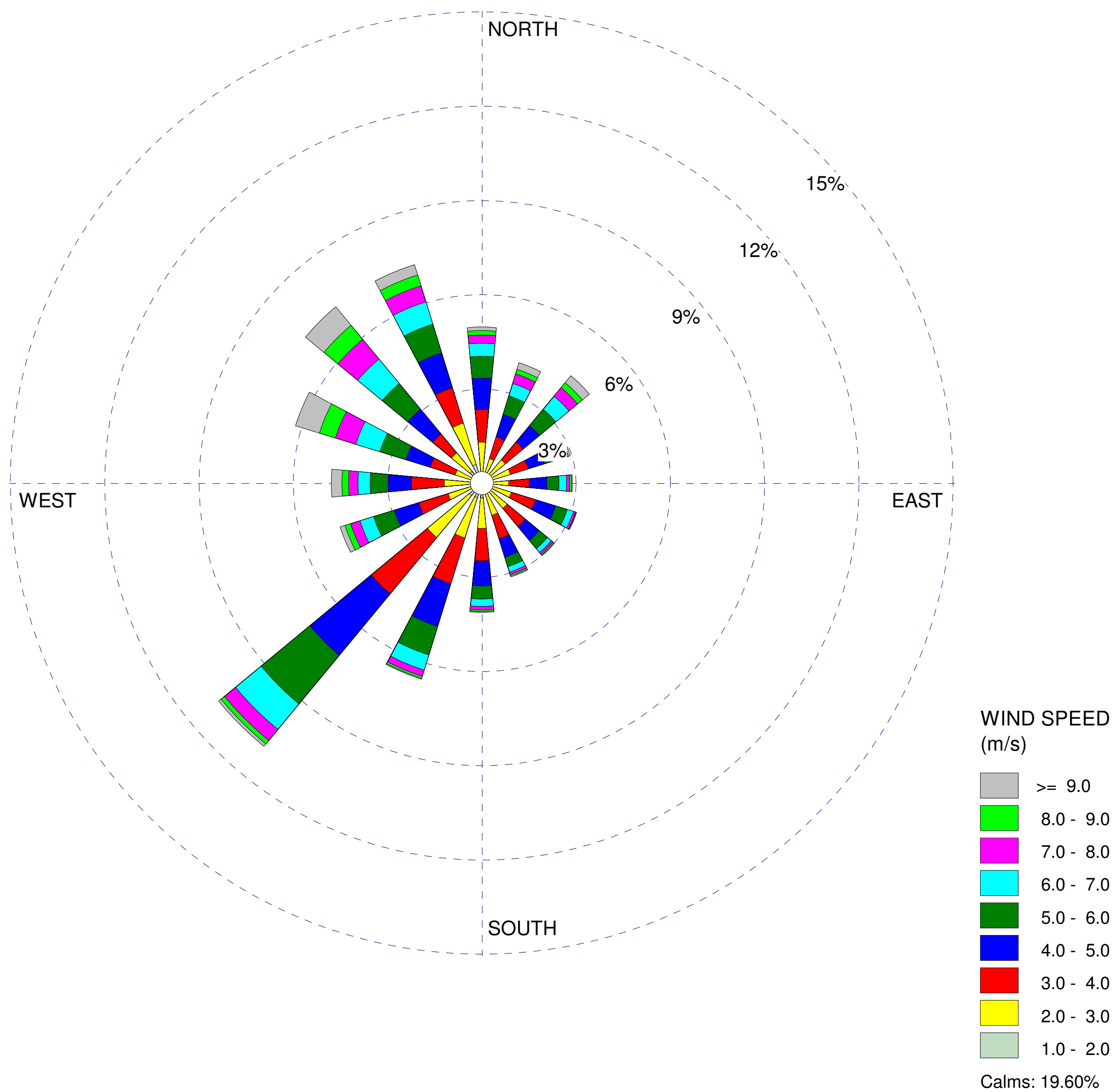


COMMENTS:	DATA PERIOD: **Start Date: 1/1/2004 - 00:00** **End Date: 12/31/2004 - 23:00**	COMPANY NAME: **URS**	
		MODELER: **LMB**	Figure 2–5 Annual wind rose for Newark
	CALM WINDS: **8.61%**	TOTAL COUNT: **8785 hrs.**	
	AVG. WIND SPEED: **4.31 m/s**	DATE: **4/15/2014**	

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:
Francis S. Gabreski Airport, Westhampton
Annual Windrose

DISPLAY:
Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 1/1/2004 - 02:00 **End Date: 12/31/2013 - 23:00**	**URS**	
		MODELER: **LMB**	Figure 2–6 Annual wind rose for Westhampton
	CALM WINDS: **19.60%**	TOTAL COUNT: **86619 hrs.**	
	AVG. WIND SPEED: **3.62 m/s**	DATE: **4/15/2014**	

WRPLOT View - Lakes Environmental Software

2.3.2 Average Temperature and Humidity

Average temperature and humidity are other metrics useful in understanding visibility at a given location.

All meteorological stations evaluated displayed the expected patterns of temperature change throughout the year, as shown in Figure 2-7. Small differences between the stations were observed, as illustrated in Figures 2-8 through 2-10. Figures 2-8 and 2-9 show seasonal average daily high and low temperatures; the stations farther inland or surrounded by more land (JFK, Monmouth, and Newark) are characterized by higher daily maximum and minimum temperatures, while the stations with more marine influence (LI MacArthur, and Westhampton) have lower average temperatures. This pattern is also seen in Figure 2-10, where the marine-influenced stations display higher average relative humidity than the stations with more land influence. Histograms of the temperature distribution for each season and station are provided in Appendix C, Temperature Distribution.

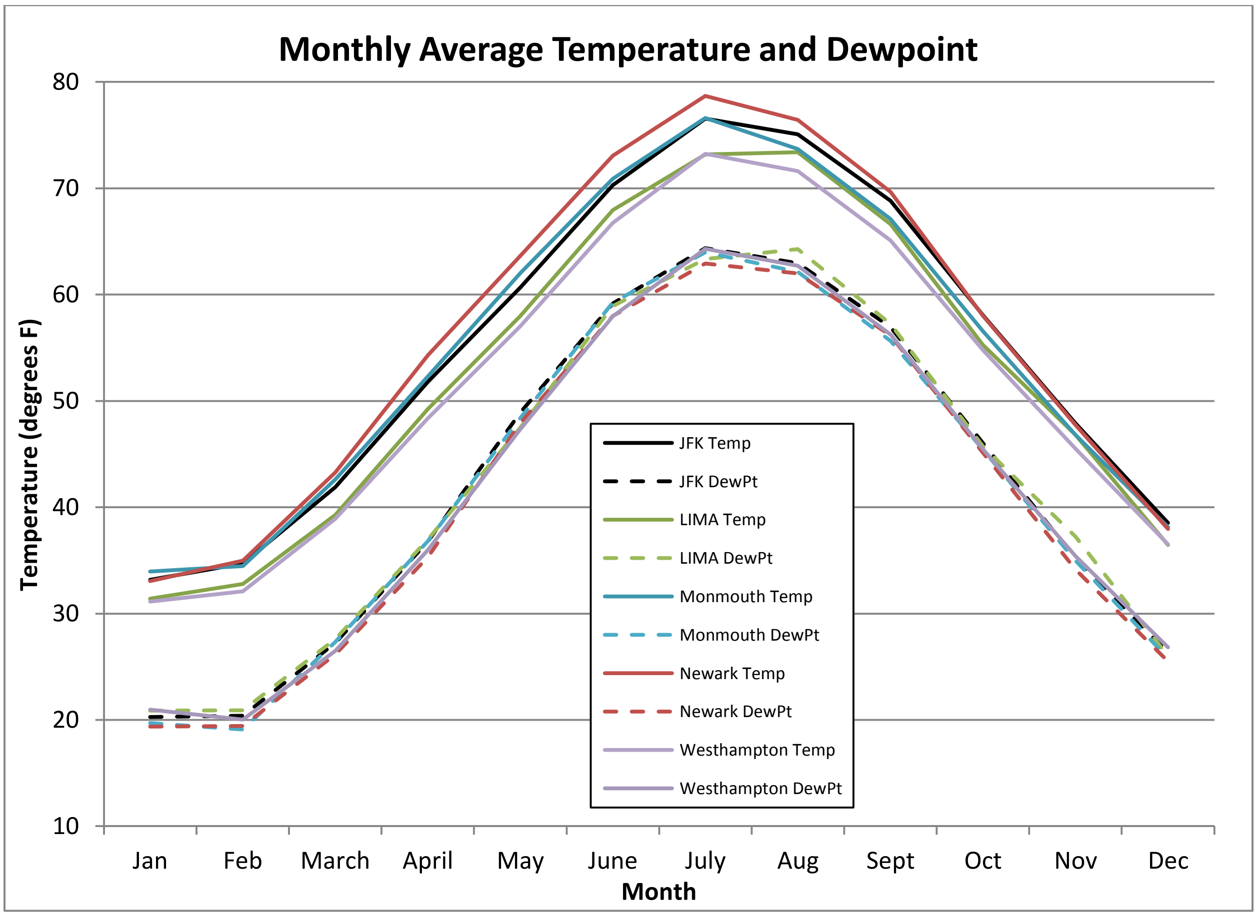


Figure 2–7. Monthly average temperature and dew point at all stations

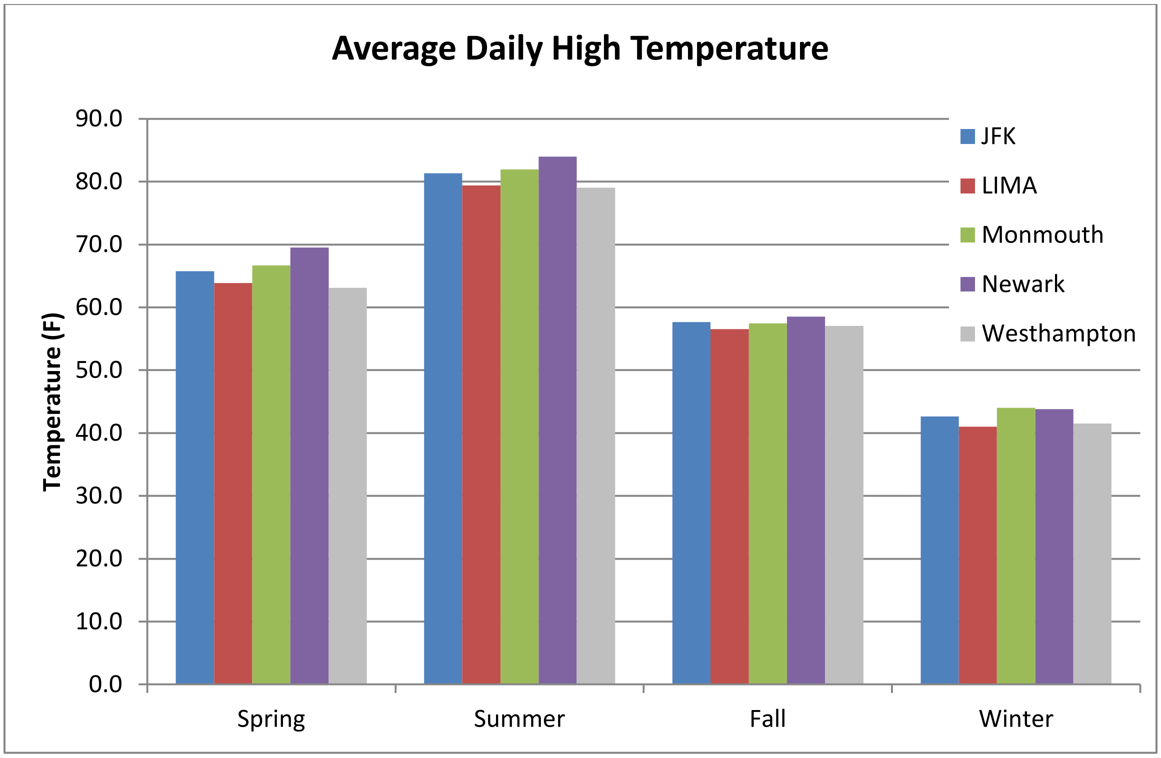


Figure 2–8. Average daily high temperature

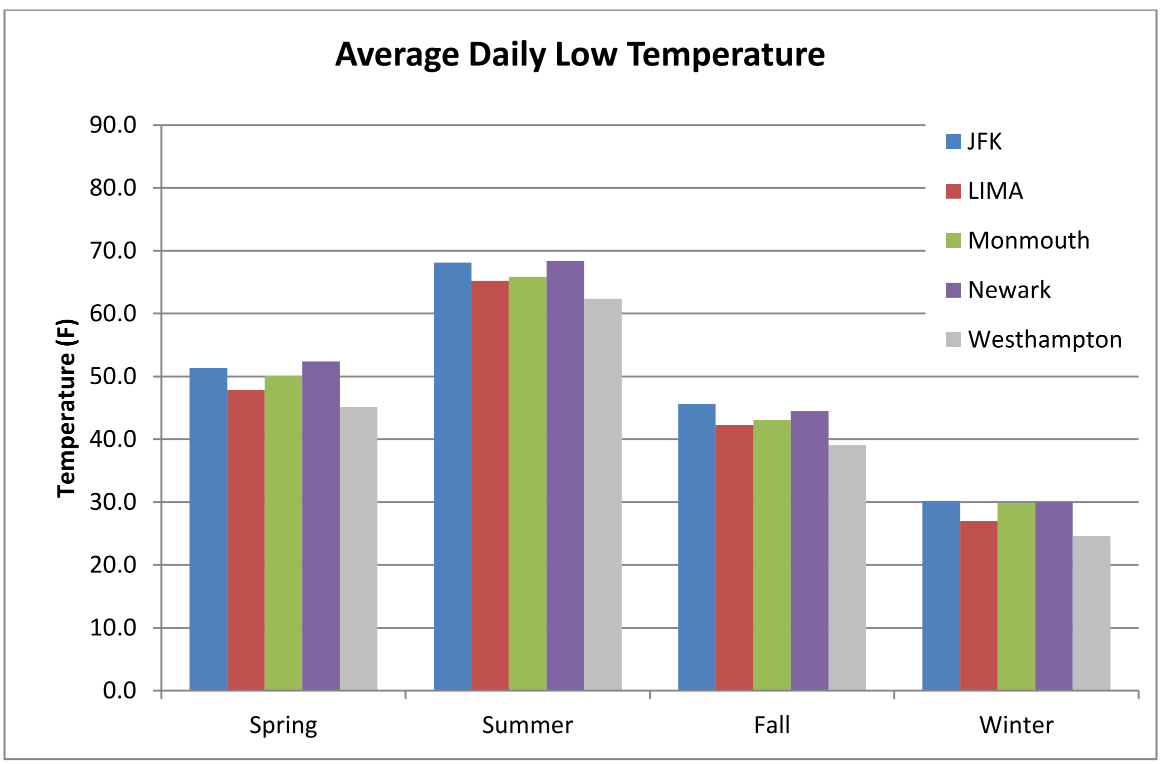


Figure 2–9. Average daily low temperature

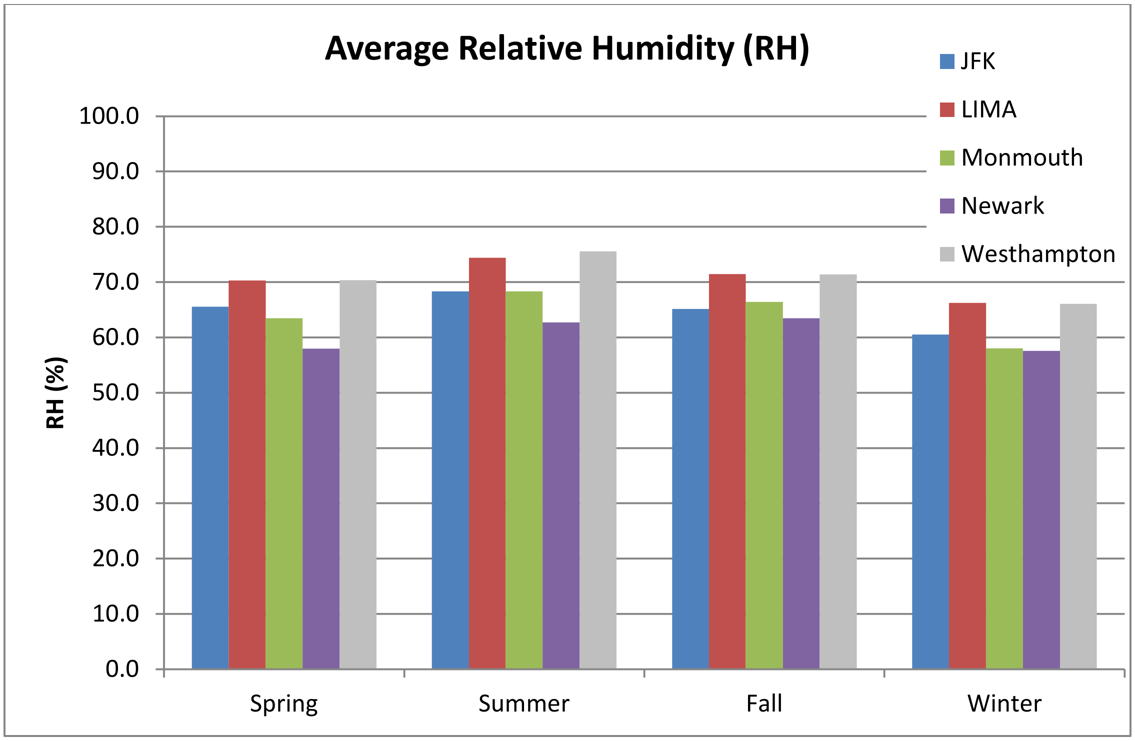


Figure 2–10. Average relative humidity

Relative humidity has been shown to have a strong effect on visibility (Richards et al. 1996; Trijonis and Yuan 1978; Xingang et al. 2007). Higher levels of moisture in the air result in greater light obstruction through increased light absorption and scattering. Water vapor also condenses on particles in the air, thereby increasing their size and the corresponding amount of light scattered or absorbed. The relationship between humidity and visibility is discussed further in Section 2.4.

2.3.3 Reported Visibilities

Visibility measurements from meteorological stations are typically recorded in intervals ranging from ¼ to 10 statute miles. For the DS3505 data set, visibility was measured and recorded on a 1-minute basis, averaged across hours, and then binned to the following categories: less than ¼ mile, ¼ mile, ½ mile, ¾ mile, 1 mile, 1¼ miles, 1½ miles, 1¾ miles, 2 miles, 2½ miles, 3 miles, 3½ miles, 4 miles, 5 miles, 7 miles, and 10 miles or greater for the hourly reports. As shown in Table 2-5, analysis of the hourly data indicates that a relatively small percentage of hours have a reported visibility of less than 10 miles, with a much larger percentage of hours reported as "10 miles or greater."

Table 2–5. Frequency of Reported and Truncated Visibility Ranges

Station	Less than 10 miles (percent)	10 miles or greater (percent)
JFK	21	79
LI MacArthur	27	73
Monmouth	15	85
Newark	22	78
Westhampton	27	73

2.3.4 Common Weather Conditions

The types of meteorological conditions observed are referred to as "present weather." At the time of an observation, any conditions not captured by the measured parameters (e.g., temperature or station pressure) are coded and listed in a "Present Weather" field. Present weather conditions include events such as haze, fog, various forms and intensities of precipitation, and even more obscure events such as dust storms. More than one condition may be reported at any time. Conditions that may be considered notable, such as extreme heat or high winds, are adequately captured by the measured parameters and are not included as present weather codes. The Monmouth site rarely reports present weather, and consequently was not included in this portion of the analysis. These data were retained in the study data set, however, because of their utility in characterizing other meteorological attributes (i.e., local winds, average temperature) and for the visibility prediction.

For the purposes of this study, the conditions most likely to affect visibility, and thus most relevant, are those that would be included in the "Present Weather" field of an observation. For that reason, both the automated ("Wx-A") and manual ("Wx-M") Present Weather fields were analyzed. Up to four automated conditions and seven manual conditions may be included in one observation. Human observers may manually add observations of weather conditions that the automated instrument cannot detect.

For the vast majority of records no present "weather" is reported. In other words, conditions were clear, and no "events" (such as haze, fog, various forms and intensities of precipitation, and even more obscure events such as dust storms) occurred on that day. These results are understandable considering day-to-day weather, in that "events" such as rain or fog occur infrequently relative to hours in which no "events" are occurring. However, these data do not indicate periods of high visibility, such as those that may occur under low humidity and temperature. Likewise, these data do not indicate periods of lower visibility, such as that which may occur under periods of high humidity and temperature. The percentage of hours for which present weather is reported or not reported is shown in Table 2-6. The remaining discussion of present weather will focus on hours for which one or more present weather condition is reported.

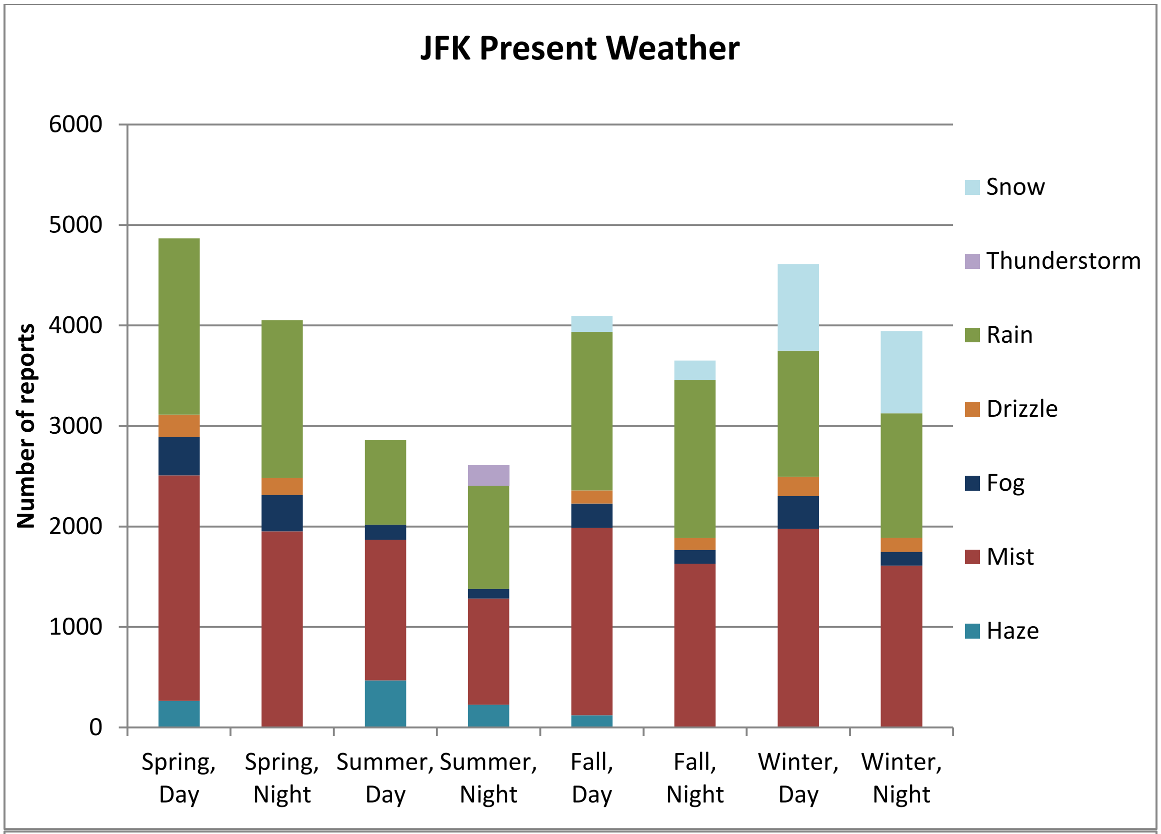
Table 2–6. Frequency of Present Weather Reports (percent)

Station	Present Weather Reported				Present Weather Not Reported			
	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall
JFK	16.20	18.60	13.50	15.70	83.80	81.40	86.50	84.30
LI MacArthur	20.10	23.00	21.60	19.20	79.90	77.00	78.40	80.80
Monmouth*	0.00	0.20	0.60	0.00	100.00	99.80	99.40	100.00
Newark	17.10	17.00	13.40	15.90	82.90	83.00	86.60	84.10
Westhampton	18.20	23.30	22.90	18.00	81.80	76.70	77.10	82.00

* Monmouth station not analyzed further for present weather conditions.

When present weather was reported, the most common conditions were mist and rain. This was evident at JFK, Newark, and Westhampton across all seasons, and under both day and night conditions. At LI MacArthur, mist and rain were the most common weather conditions recorded, with the exception of summer days and winter days, when fog occurs slightly more often than rain. During these periods, mist was still the dominant condition. The average distribution of these conditions on a daily basis is provided in Appendix D, Common Weather Conditions.

Figures 2-11 and 2-12 show the frequency of common weather conditions at each site, by season and day/night hours. Any condition that constituted 2 percent or more of the present weather reports in any season/time of day grouping was included in the charts.



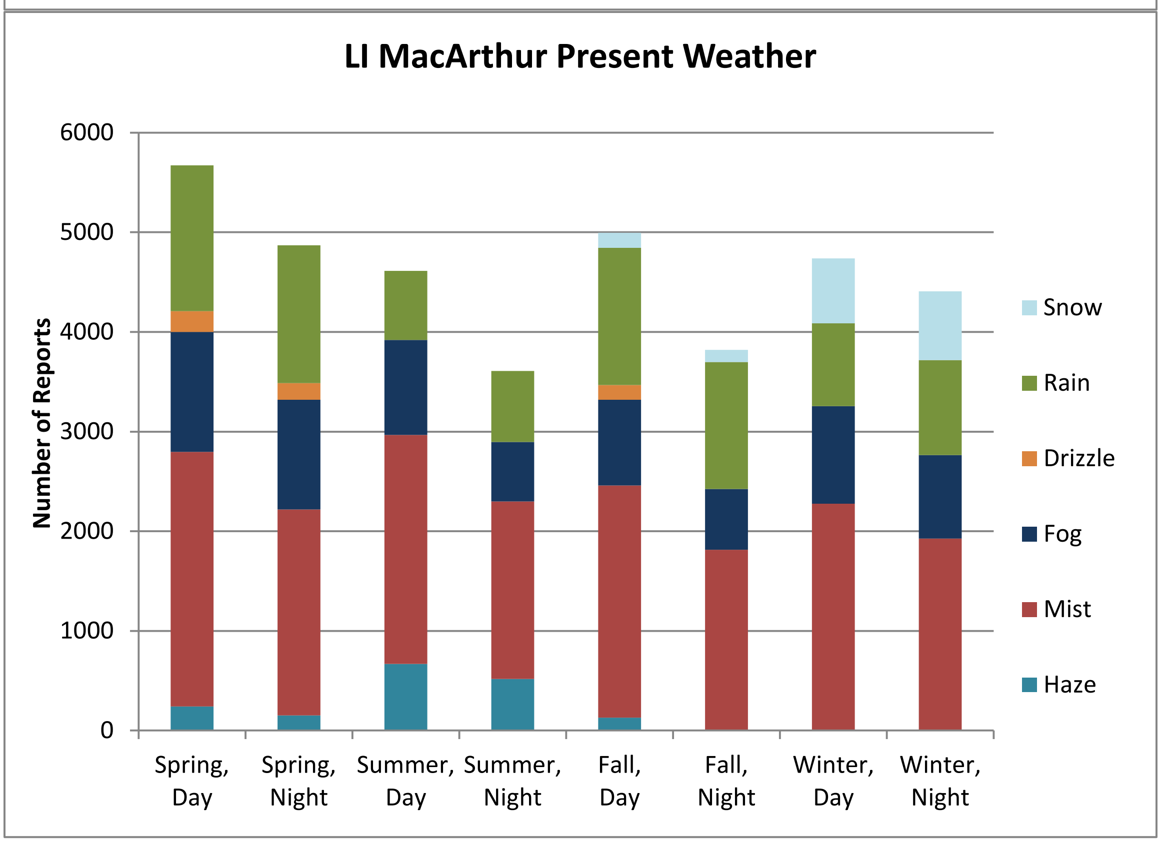


Figure 2–11. Distribution of weather conditions at JFK and Long Island MacArthur

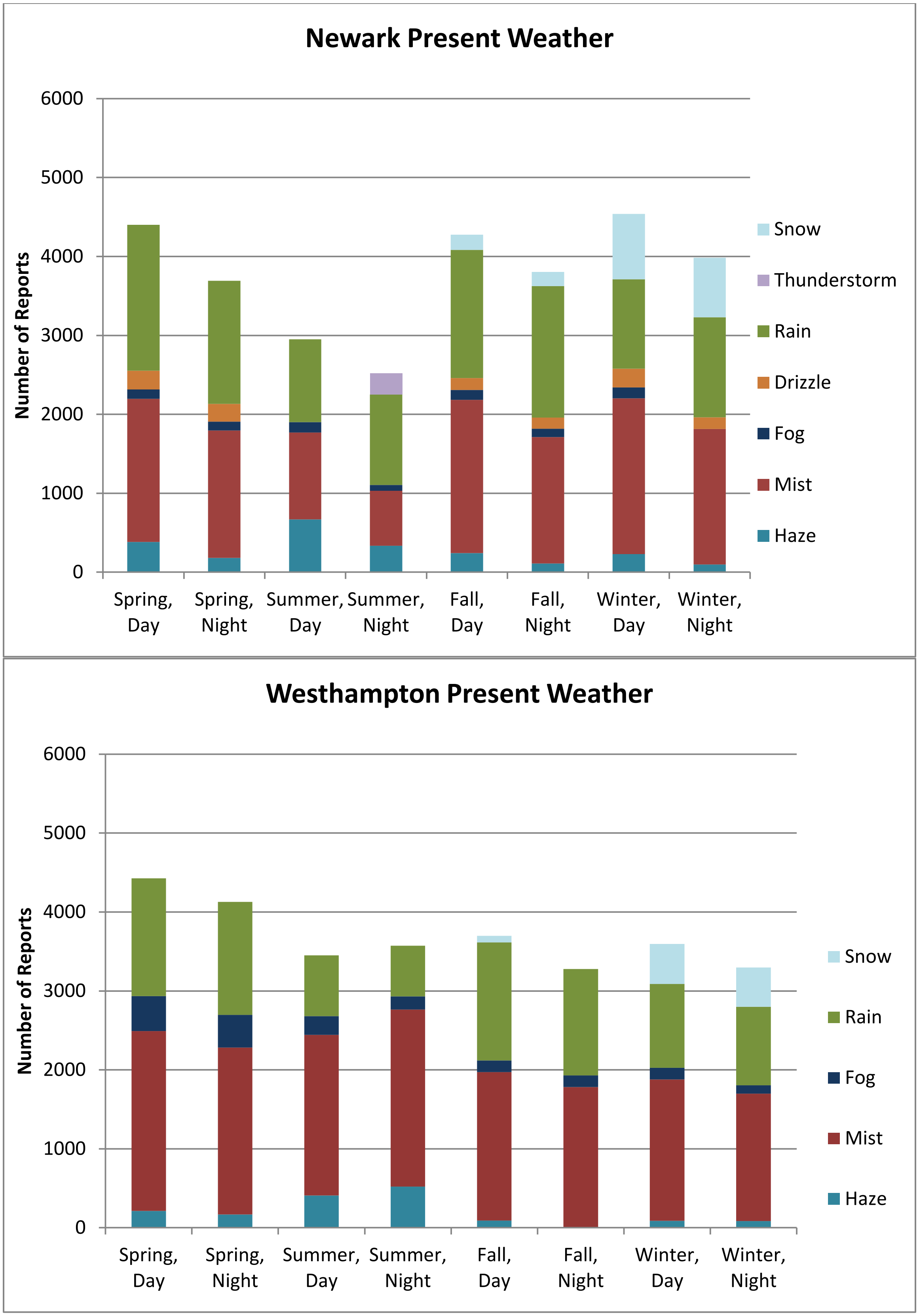


Figure 2–12. Distribution of weather conditions at Newark and Westhampton

2.4 VISIBILITY PREDICTION

2.4.1 Introduction

Because the analysis of the hourly data indicated a large percentage of hours reported visibility as "10 miles or greater," actual visibility extent must be predicted to determine average visibility, distribution of visibility, and maximum visibility using currently available data. To fill this data gap, daily typical visibility ranges and potential maximum and average visibility across seasons were calculated using the Beer-Lambert law. Both 1-hour and 1-minute resolution data from meteorological stations in the study area, geographically spaced to represent the range of KOPs, were used in this analysis.

Although physical site and observer characteristics can greatly affect visibility, the scope of this prediction focused on optics, and included meteorological variables that affect visibility most. Consequently, the meteorological visibility metric provided in this section does not equate to actual visibility of wind turbine structures. The ability of an observer to see offshore renewable energy structures will depend on the combined influence over several other factors (e.g., turbine color, scale, movement, distance, and observer geometry) and is not solely determined through the meteorological definition of visibility.

2.4.2 Visibility

As discussed above, visibility was defined as "the greatest distance at which an observer can just see a black object viewed against the horizon sky" (Malm 1999). The *operational definition* of visibility (or meteorological optical range, MOR), as defined by the World Meteorological Organization, is the length of a path in the atmosphere required to reduce the intensity of light to 5 percent of its original value (WMO 2011). This 5 percent value is considered the threshold contrast, and the outer limits at which an observer can still identify an object.

Over the length of a path, light will be diminished or attenuated by scattering and absorption of light from gases and particles in the atmosphere. The extinction coefficient, or b_{ext}, determines how much light is attenuated, and is equal to the sum of all scattering and absorption:

$$b_{ext} = b_{sp} + b_{sg} + b_{ap} + b_{ag} \qquad \text{(Eqn 1)}$$

Where:

s = scattering
a = absorption
p = particles/aerosol
g = gases

Scattering due to gases (b_{sg}) is also known as Rayleigh scattering, where the scattering objects are much smaller than the wavelength of light. This is the baseline scattering caused by air that is always present, even in the most pristine environment. Scattering due to aerosol particles has a larger impact on the total b_{ext}, and its calculation requires knowledge of the ambient aerosol: the size distribution, optical properties, composition, and number of particles. According to Seinfeld and Pandis (1998), in urban areas, scattering due to ambient aerosols accounts for 50 to 85 percent of total light extinction. The contribution from absorption depends primarily on concentrations of gaseous nitrogen dioxides and particulate elemental carbon.

The extinction coefficient, b_{ext}, relates to visibility and contrast according to the Beer-Lambert law of extinction:

$$\frac{I}{I_0} = e^{(-b_{ext} * x)} \quad \text{(Eqn 2)}$$

Where:

I	= intensity at distance x
I_0	= intensity at the observer
I/I_0	= contrast
x	= visibility distance

For a defined contrast of 5 percent, the equation simplifies to:

$$x = \frac{-\ln(0.05)}{b_{ext}} \quad \text{(Eqn 3)}$$

Therefore, determining visibility distance at any given time requires knowledge of the extinction coefficient as detailed in Equation 1. Although absorption and scattering due to ambient air (gases) play a role in determining visibility—and these processes are influenced by meteorological variables such as temperature, dew point, and pressure—the greatest contributor to reduced visibility (by means of a large extinction coefficient) is scattering by fine particulate matter (Seinfeld and Pandis 1998). As with ambient air (gases), scattering by fine particulates is increased by high relative humidity; hygroscopic particles grow as water condenses on them, increasing their ability to scatter light. Hygroscopic particles such as ammonium nitrate, and especially ammonium sulfate, have been shown to have the largest impact on visibility (Trijonis and Yuan 1978; Gray and Kleinhesselink 1996).

2.4.3 Visibility Measurement

Because visibility is so strongly affected by scattering of particles, time-resolved (daily or hourly) speciated particulate matter data (e.g., mass of constituents like sulfates, nitrates, and carbon) and relative humidity data are necessary to predict visibility “from the ground up” by calculating a site- and time-specific extinction coefficient. For the study area, these data were only available on a 24-hour average basis, provided at 3-day intervals. However, the basis for reported hourly (DS3505) visibility data is a *direct measurement* of the extinction coefficient on a 1-minute time resolution. These data were used to calculate visibility, which was then binned to discrete intervals representing distances up to 10 miles before being reported. Although the measured extinction coefficient, and thus the calculated visibility data, account for actual ambient particulate matter, this post-processing makes it very difficult to correlate hourly visibility data with any other monitored parameter such as relative humidity and hourly fine particulate matter (defined as particulate matter with a diameter of 2.5 microns or less, or $PM_{2.5}$).

One-minute data, however, were available in their raw form (i.e., not summarized or binned), thereby providing a more precise measurement of visibility. These data are collected by an automated surface observation system (ASOS). The visibility sensor on the ASOS unit operates by measuring the amount of forward scattering across a path of known length. A transmitter projects a beam of light through a 0.75-cubic-foot volume of air (an approximately 3.5-foot horizontal path length), and the amount of forward scattering at the receiver is measured (NOAA et al. 1998).

The advantage of using these data for predicting visibility is that the wide range of variables affecting visibility are included, thereby negating the need to measure or approximate each one. However, one variable likely not captured by these data is the presence of sea spray and sea salts; since the monitor is on land, it would not measure any sea spray over the ocean's surface that would reduce visibility (similarly, the aerosol component over the ocean's surface is not fully captured by $PM_{2.5}$ data measured on land, either). No long-term data collection sites (at airports or buoys) collect these data. Thus, visibility measurements using this measured extinction coefficient represent an upper bound of the actual visibility for an observer on land looking out over the ocean.

One-minute raw ASOS data from NCDC datasets 6405 and 6406 were obtained for JFK airport for the years 2004 through 2013. These data are also available at Newark airport, but because JFK is nearer to the coast and is likely more representative of the study KOPs, JFK was selected for analysis. As noted by Gray and Kleinhesselink (1996), visibility estimates are generally spatially representative because they are strongly driven by sulfate particles, which are formed secondarily and are quite uniform in a given region.

As reported by Husar (2002) and observed in the downloaded data, the ASOS visibility sensor has a lower detection limit of 0.05 km^{-1}. This corresponds to a maximum visibility of approximately 37 miles (32 NM). According to the Weather Observer Supervisor at JFK airport, maximum visibility on the clearest of days is around 35 miles or 30 NM (B. Hepler, personal communication, May 7, 2014). Thus, the instrument is sufficiently capturing the range of visibilities at this location.

There are three visibility sensors at JFK airport: two on the main pad southeast of the control tower (sensors 1 and 3), and one on the secondary pad northwest of the control tower (sensor 2). Based on initial analysis of data from these three sensors, it was determined that sensor 1 is most reliable (i.e., has a reasonable range of data values, fewest values at the lower detection limit); this was confirmed by the Weather Observer Supervisor.

2.4.4 Visibility Data (6405 and 6406 Dataset)

The 1-minute ASOS data from JFK airport for the years 2004 through 2013 were imported into Microsoft Access. The data set is neither delimited nor fixed width, which presented challenges to systematically importing the data into the correct fields. URS applied basic data validation measures, such as checking that the visibility coefficient is less than 10, station pressure is less than 32 pound force per square inch, dry bulb temperature is less than 103°F, and dew point is less than dry bulb temperature, to ensure the correct data were being used. After this validation, the 1-minute data were summarized into hourly averages. A total of 79,949 hourly records were used in the analysis.

For each hour, visibility was calculated from the hourly average extinction coefficient, and assuming a contrast threshold of 5 percent, according to the Beer-Lambert law (equation 3). The threshold contrast was set at 5 percent for this work following the World Meteorological Organization definition of visibility, and also because this is the contrast used by ASOS in converting the measured extinction coefficient to visibility (for the hourly data set). Also for each hour, the dry bulb and dew point temperatures were used to calculate an hourly average relative humidity (RH), to be used later in the analysis.

The annual distribution of visibility distances at JFK in Figure 2-13 shows a relatively flat trend, with only minor maximums at around 5 to 7 miles and 19 to 22 miles. There is also a peak at the upper end of visibility because of the instrument's detection limit, which should be viewed as "32 miles or greater"; this final bin is not included in the histograms. Values of 32 miles or greater constitute only 6 percent of the data on an annual basis. The cumulative frequency distribution of annual visibility at JFK in this data set (Figure 2-14) is very similar to those found by Trijonis and Yuan (1978) at a number of sites in the Northeast, showing a nearly straight line and indicating a uniform distribution. The small fluctuations in the annual distribution are influenced by seasonal trends, shown in Figure 2-15.

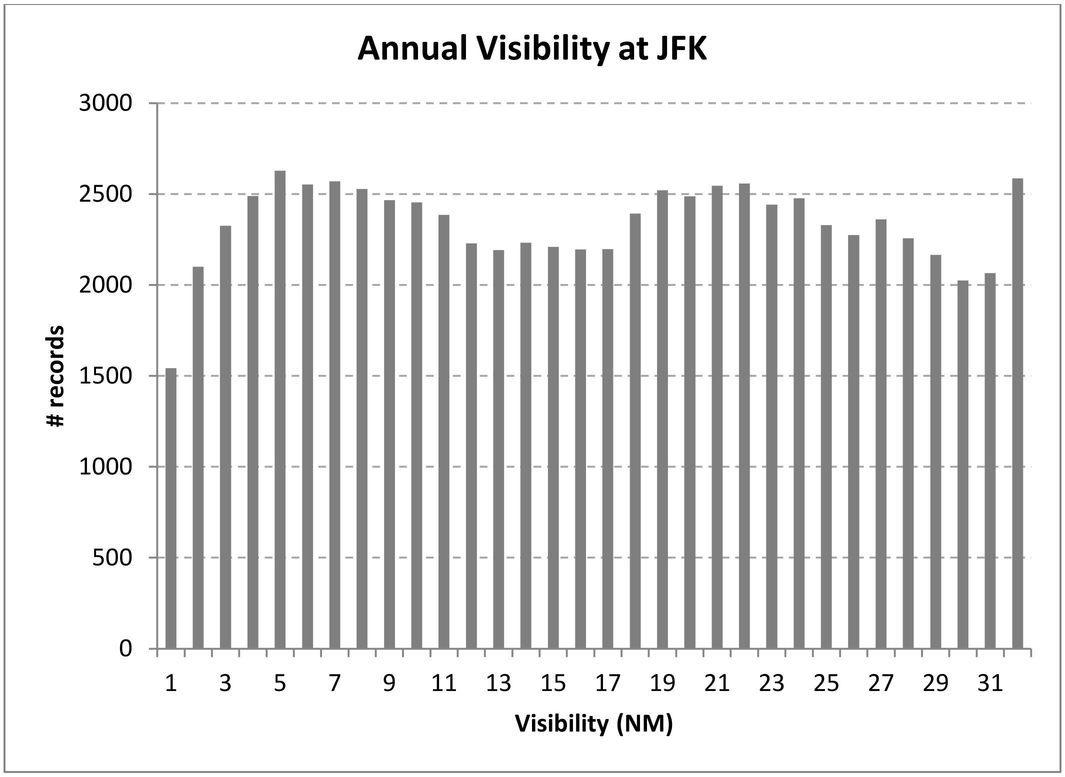


Figure 2–13. Histogram of annual visibility distribution at JFK (measured data)

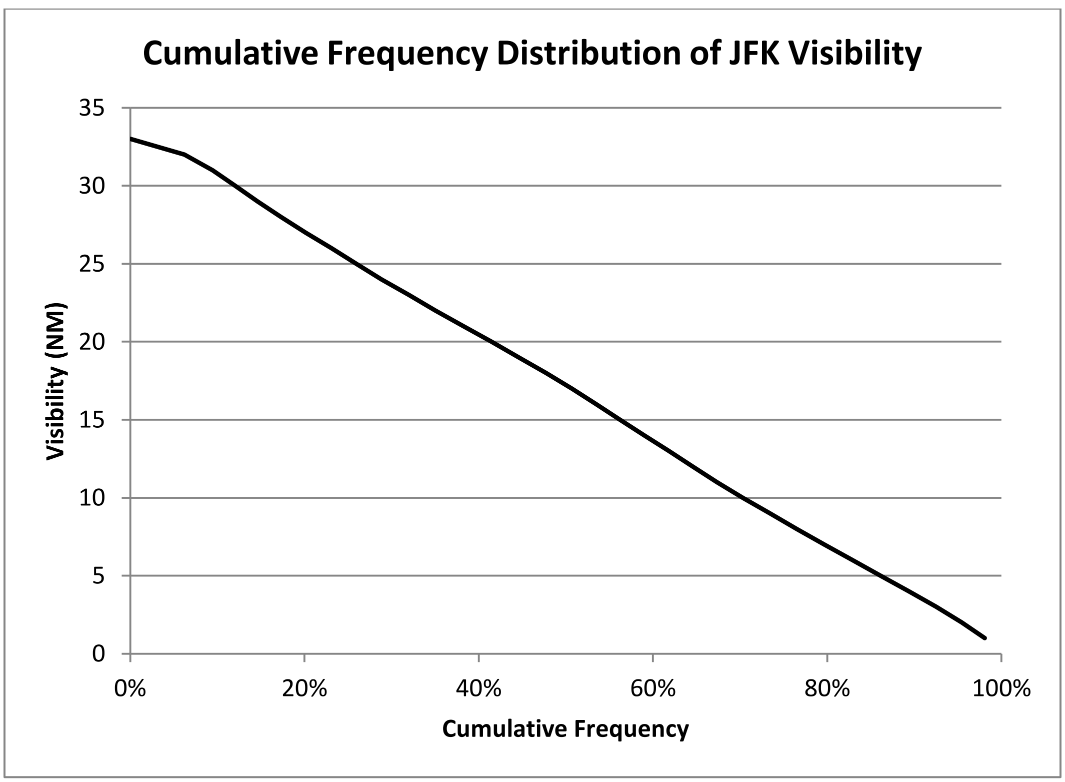


Figure 2–14. Cumulative frequency distribution of visibility at JFK

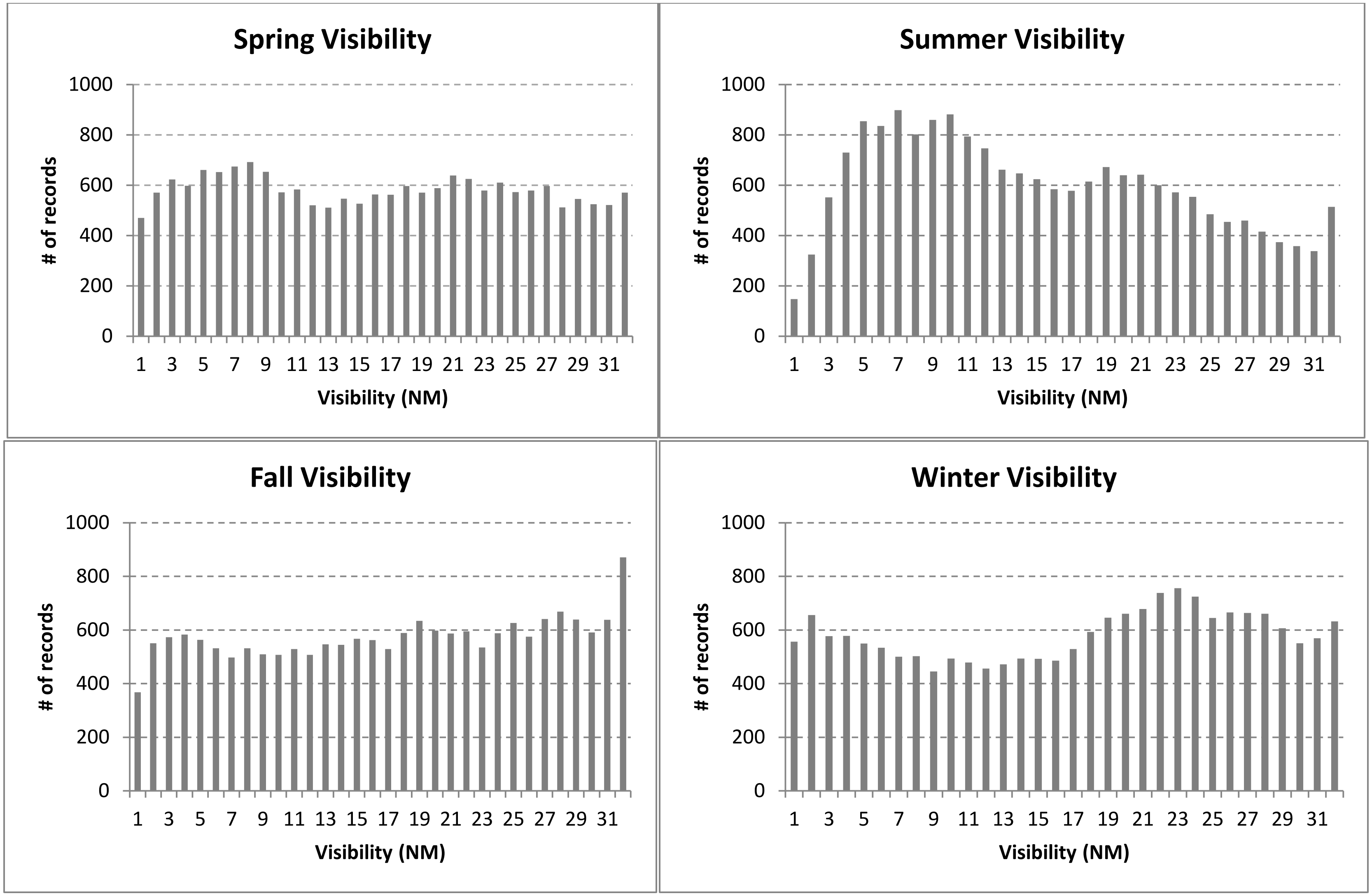


Figure 2–15. Seasonal distributions of visibility at JFK

On average, visibility at JFK is highest in the fall and lowest in the summer, as shown in Table 2-7. Maximum visibility in all seasons is similar as it reaches the instrument detection limit. This maximum visibility was corroborated by staff at JFK, and therefore is assumed to be capturing the majority of the data, and not failing to record significantly longer visibilities. Average visibility is a better indication of trends by season, as on any day in a given season the conditions may be right for the maximum possible visibility. The percent of days annually, and across seasons, with at least 1 hour exceeding a threshold visibility (10, 15, 20, 25, or 30 NM) are shown in Figure 2-16.

Table 2–7. Seasonal Average and Maximum Visibility

Season	Visibility (NM)		
	Min	Max	Avg
Annual	0.2	32.9	17.0
Spring	0.2	32.4	16.6
Summer	0.2	32.4	15.7
Fall	0.2	32.9	18.3
Winter	0.2	32.4	17.6

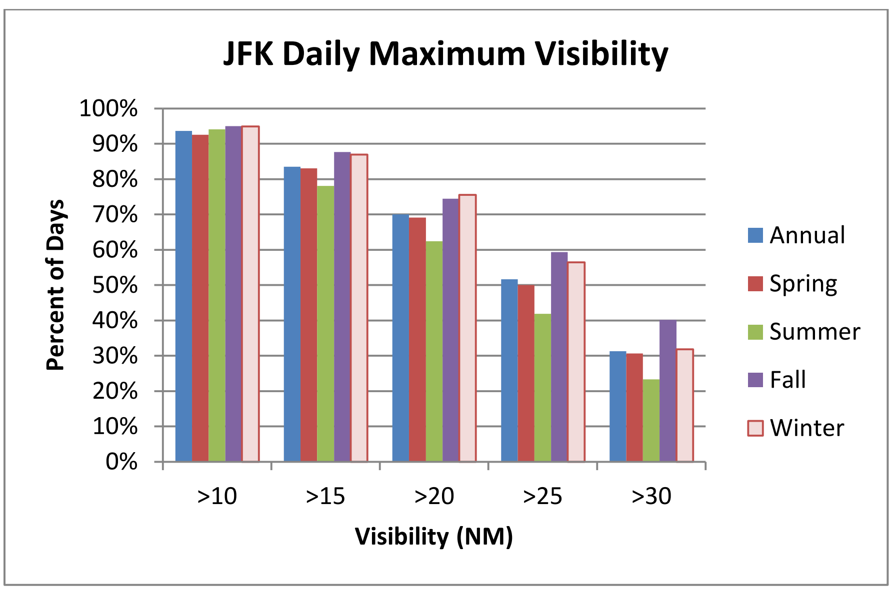


Figure 2–16. Percent of days annually and in each season with at least one hour exceeding threshold visibility distances

A more detailed picture of the distribution of visibility can be achieved by looking at the percent of hours in which a given threshold visibility distance is exceeded. This breakdown by daytime and nighttime hours within each season is shown in Figures 2-17 and 2-18. In both cases, the highest visibilities occur in the fall (and sometimes winter is comparable) and the lowest visibilities occur in the summer. Higher humidity and higher concentrations of photochemical smog likely cause the reduced visibility in summertime.

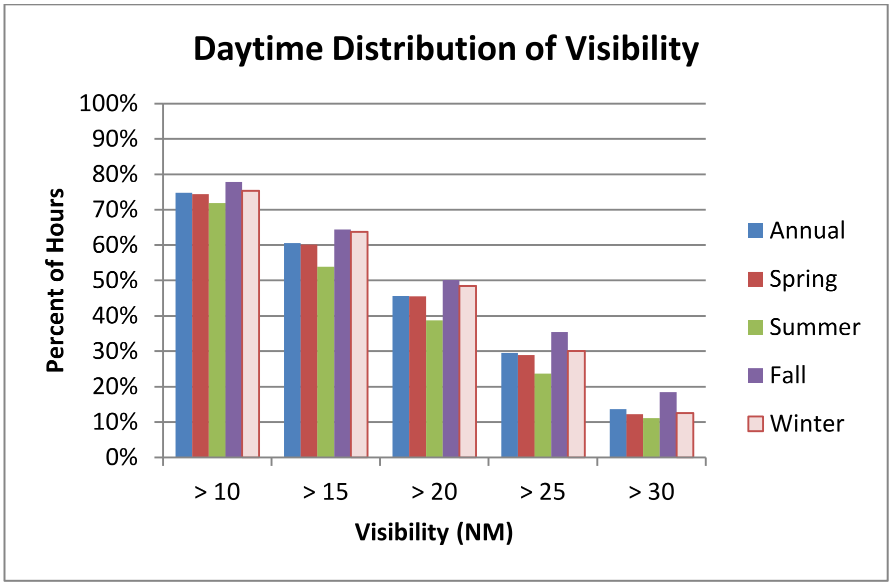


Figure 2–17. Daytime distribution of visibility distance at JFK

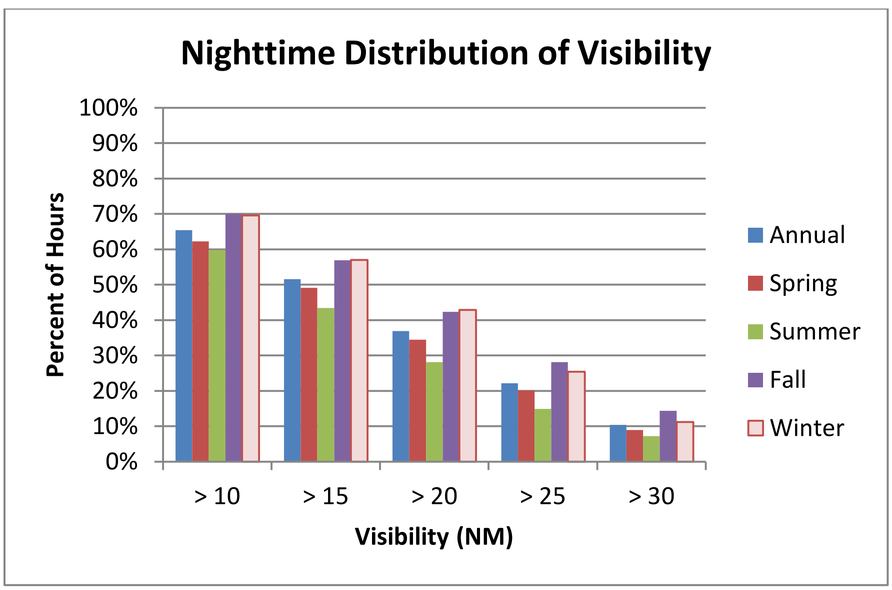


Figure 2–18. Nighttime distribution of visibility distance at JFK

Using the Beer-Lambert law as shown in Equation 2, for a known extinction coefficient and distance, one can calculate the contrast at that distance. This contrast estimates what percentage of light, compared to that present at an observer's location, reaches an object at that distance. Based on seasonal average and maximum visibility extinction coefficients (for all hours of the day), contrast at distances of 15, 20, 25, and 30 NM was calculated as shown in Table 2-8.

These site- and season-specific contrasts were subsequently used to inform the development of photosimulations.

Table 2–8. Average and Maximum Contrast at Varying Distances for JFK (percent)

	Average Contrast at Distance (NM):				Maximum Contrast at Distance (NM):			
Season	**15**	**20**	**25**	**30**	**15**	**20**	**25**	**30**
Annual	7.1	3.0	1.2	0.5	25.6	16.2	10.3	6.5
Spring	6.7	2.7	1.1	0.4	24.9	15.7	9.9	6.2
Summer	5.7	2.2	0.8	0.3	24.9	15.7	9.9	6.2
Fall	8.5	3.8	1.7	0.7	25.6	16.2	10.3	6.5
Winter	7.8	3.3	1.4	0.6	24.9	15.7	9.9	6.2

2.4.5 Application of JFK Data (6405 and 6406 Data) to Other Stations (3505 data)

Since RH is the meteorological variable most closely related to visibility, the hourly average RH was compared to the hourly average visibility to discern any trends. While there is a significant amount of scatter, there is a clear inverse relationship between visibility and RH (Figure 2-19). Although the scatter plot in Figure 2-19 shows 6405/6406 data at JFK for the winter season, the same relationship is seen across all other seasons. This is expected because with increased RH, there is more water vapor in the air that condenses on particles, making them larger and more effective at attenuating light and reducing visibility.

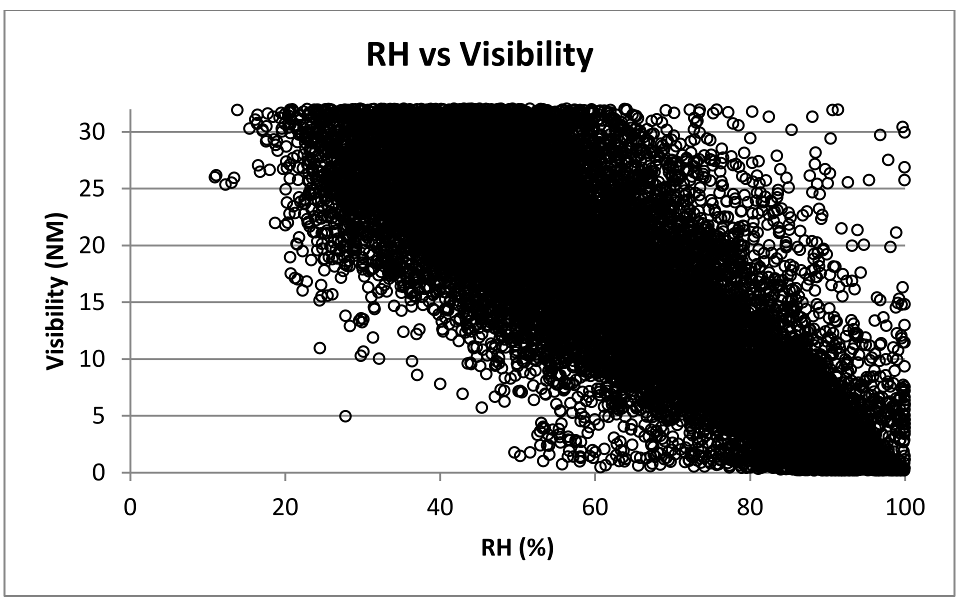


Figure 2–19. Relationship between hourly average visibility and RH, based on measurements at JFK in winter

The scatter in this relationship is due to the many other factors influencing visibility besides RH, which were captured in the visibility measurement, but were not explicitly and individually measured as part of this data set. As discussed in Section 2.1, gases and particles in the atmosphere cause absorption and scattering of light. Without measurements of ambient concentrations of gases (e.g., nitrogen dioxides), and particles (e.g., sulfate, nitrate, carbon, sea salt), the contribution of these sources to variance in the data could not be quantified. These parameters are currently only measured at a few locations, and at a sampling frequency of only once every 3 days. However, sufficient data were available in the 6405 and 6406 data sets from JFK to establish a seasonal relationship between visibility and RH, which could then be applied to the other four meteorological stations using the 3505 data set. This was done by calculating the average and standard deviation of visibility occurring in a small range of RH (5 percent) to answer the questions, “For measured relative humidity from 50 percent to 55 percent (or any other 5-percent bin), what is the average visibility?” and “What is the standard deviation of these visibilities?” The result is the relationship shown in Figure 2-20, where visibility decreases with increasing RH; the error bars indicate one standard deviation above and below the mean visibility, a range that captures approximately 68 percent of the variability in visibility measurements. This is a simplified representation of the detailed visibility and RH data, such as that shown in Figure 2-19.

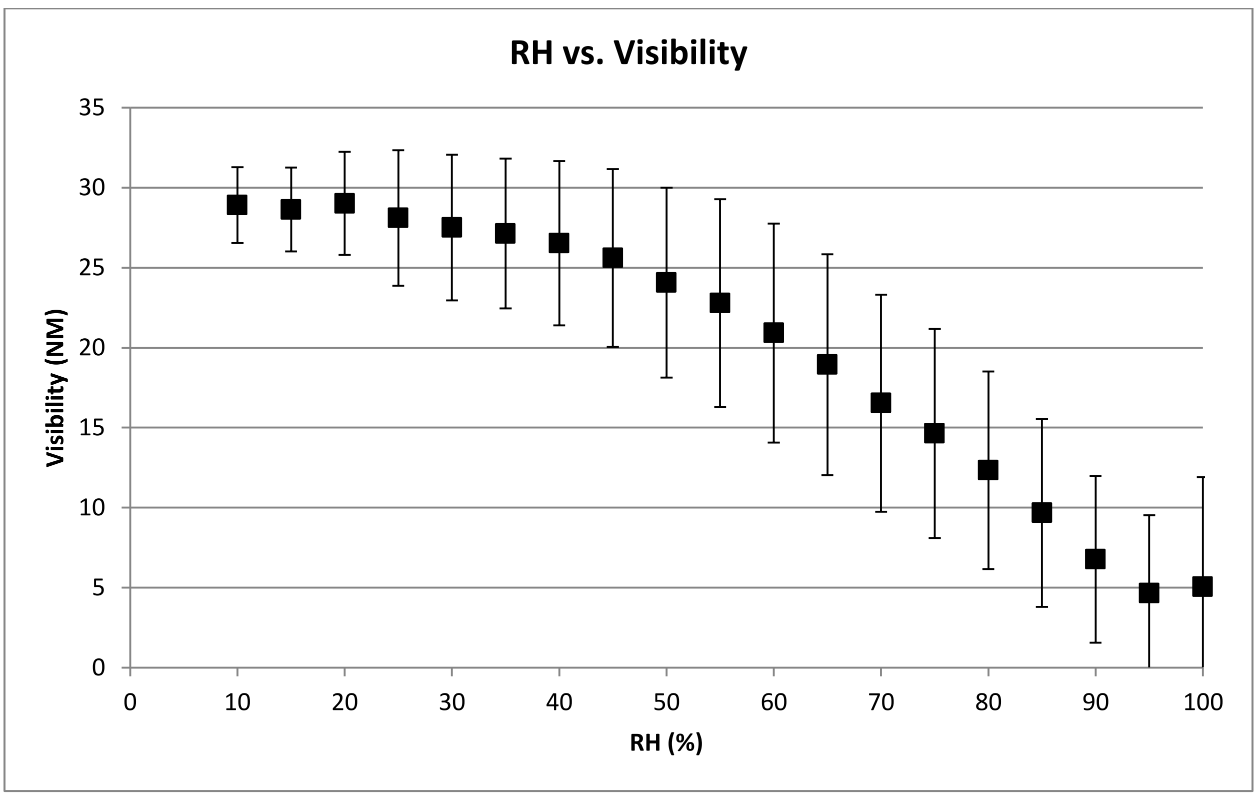


Figure 2–20. Relationship between RH and visibility at JFK (all seasons combined)

Average visibility was estimated at each site based on RH by fitting this data curve across each season. The analysis was based on seasons because of the seasonal variability of relative humidity (i.e., higher in summer, lower in winter). Additionally, air quality factors that are captured by the visibility measurement also vary by season, and a seasonal analysis will capture these changes. These plots, and the equation describing the relationship, are shown in Figure 2-21.

These equations were applied to the hourly data (DS3505) at Long Island MacArthur, Monmouth, Newark, and Westhampton on a seasonal basis to predict visibility. Predicted and measured seasonal average visibilities at each station are shown in Table 2-9. Because the equations were derived based on average visibility for a given relative humidity, the equations can only predict average visibility. As noted above and shown in Figure 2-19, there is scatter of the visibility measurements at all values of RH. This scatter is due to other factors affecting visibility that are not captured in the available data; therefore, these factors cannot be included in any prediction method.

Table 2–9. Seasonal Average Visibility by Station

Station	Average Visibility (NM)			
	Spring	Summer	Fall	Winter
JFK (measured)	16.6	15.7	18.3	17.6
JFK (predicted)	17.7	16.3	19.0	18.6
Long Island MacArthur (predicted)	15.9	14.7	16.5	16.4
Monmouth (predicted)	18.2	16.3	18.6	19.5
Newark (predicted)	20.2	17.7	19.7	19.7
Westhampton (predicted)	16.0	14.4	16.6	16.7

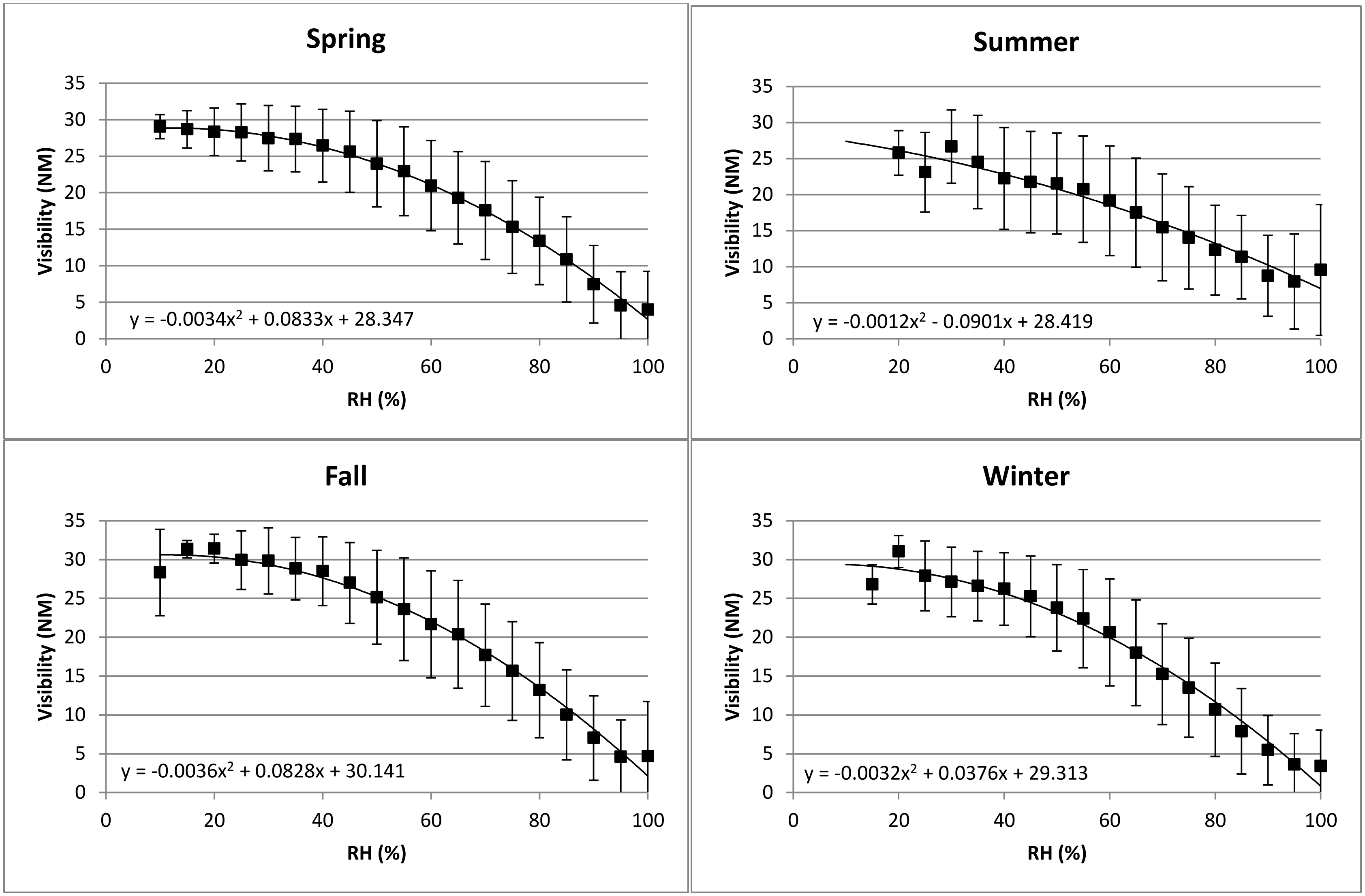


Figure 2–21. Relative humidity versus visibility plots for JFK data, in each season

2.5 CONCLUSION

The Beer-Lambert law describes the attenuation of light based on an extinction coefficient (incorporating environmental factors) over a path of travel. The Beer-Lambert law was used to measure extinction coefficients at JFK airport to determine the hourly visibility distances, and the distribution of visibility distances on an annual, seasonal, and day/night basis. Average visibility at JFK is highest in the fall and lowest in the summer. This relationship of the measured data at JFK (DSI-6405 and DSI-6406) was analyzed and applied to hourly data (DS3505) at the four other meteorological stations, and average visibility at each of these stations in each season was determined.

The average visibilities predicted at the Long Island MacArthur, Monmouth, Newark, and Westhampton stations are expected to be representative of local conditions. The prediction method is based on measured data at JFK, a location central to the study area. The JFK 6405 and 6406 measurements capture the effect of ambient air quality on visibility, so while this key variable is not directly used, it is included in the data. Furthermore, because sulfate has such a strong effect on visibility and is generally uniform over a given region, variations in air quality between stations would not likely have a significant effect on visibility. The range of visibility distances predicted in this report was corroborated by the Weather Observer Supervisor at JFK airport.

Different factors affect visibility, including air quality, sea spray and salts over the ocean's surface, the angle of the sun, and relative humidity. Relative humidity is the only variable for which adequate data were available to correlate with visibility. The presence of sea spray and salts affects visibility but is not likely captured by the measurements. Therefore, calculated and predicted visibility may be slightly overestimated since they do not account for this light-reducing factor.

3 VIEWSHED ANALYSIS

3.1 INTRODUCTION

To improve our understanding of the potential visibility of the Hypothetical Project from onshore locations, a viewshed analysis was completed to identify locations where the project could potentially be seen and where it would be hidden by existing topography, vegetation, and/or structures. This analysis determines visibility based on the relationship between these viewshed-limiting factors, the height of wind turbine components, and average eye height of the observer. The resulting “seen area,” or viewshed, represents the area where one or more turbines or components of the turbines could potentially be seen; however, it does not represent an exact measure of the visibility of the project to an observer onshore. The ability of an observer to see offshore renewable energy structures depends on a variety of factors, including the potential visual contrast of the turbines against the backdrop of the horizon, existing lighting and how it is falling on the turbines, the degree of atmospheric haze or other meteorological conditions, and observer characteristics, such as position, relative height, and distance from the turbines.

This chapter describes the methods used to conduct the viewshed analysis, including data inputs, software, and assumptions.

3.2 DATA COLLECTION AND PROCESSING

3.2.1 Baseline Data

For the purposes of this study, the term “baseline” is defined as the surface of the earth without consideration of other features, such as buildings or vegetation. The United States Geological Survey (USGS) National Elevation Dataset (NED) was used as the baseline dataset standard (USGS 2013). Data for the Hypothetical Project area were available at two spatial resolutions: approximately 10 feet (3 meters), and approximately 30 feet (10 meters). Because only the 30-foot (10-meter) resolution data were available for the entire study area, these data were selected for use in the baseline analysis. These data were downloaded for a geographic area measuring roughly 200 miles to the north and south and 150 miles to the east and west of the hypothetical turbine array.

Seven raster datasets were obtained from USGS for the baseline dataset utilizing the approximately 30-foot (10-meter) NED data. These datasets were individually projected to the standard project Universal Transverse Mercator (UTM) projection system. The seven raster files were then combined into a new raster dataset to create one baseline raster surface, which became the basis for the baseline viewshed analysis. The final data set was clipped to a radius of 50 miles surrounding the hypothetical turbine array.

3.2.2 Top of Canopy Data

For the purpose of this study, the term "top of canopy" is defined as the overall surface of the earth, including features with vertical relief, such as buildings or vegetation. The following data sets were used to build the top of canopy viewshed.

3.2.2.1 Lidar Data

Light Detection and Ranging (Lidar) data from the National Oceanic and Atmospheric Administration (NOAA) Coastal Services Center was used to develop part of the raster surface for the top of canopy viewsheds model (NOAA 2012). Two Lidar data projects for coastal areas near the New York Call Area were identified, both of which were conducted in November 2012 after Hurricane Sandy:

- U.S. Army Corps of Engineers (USACE), Joint Airborne Lidar Bathymetry Technical Center of Expertise Topobathy Lidar: Post Super Storm Sandy – Coastal New Jersey and New York (excluding Long Island)
- USGS, 2012 U.S. Geological Survey Topographic Lidar: Northeast Atlantic Coast Post-Hurricane Sandy

The native format of the NOAA Lidar data is LAS (.LAS), which is a standard Lidar file format. For these data to be used in ArcGIS, URS converted each LAS file to a LAS dataset. These datasets were projected using the standard project coordinate system (UTM) to review the statistics and classification of the points. Points classified as "ground" or "unassigned" were selected for use in the viewshed analysis. Other Lidar classifications, including "overlap," "water," "noise," or "reserved," were not considered to accurately represent the true ground or top of canopy surface, and were therefore not carried forward to the viewshed analysis.

The 174 LAS datasets were each processed at a 1-meter resolution using ESRI Model Builder to create unique raster surfaces for points classified as "unassigned" and "ground." The resulting raster datasets were then mosaicked into two raster datasets representing the USACE and USGS Lidar using a mosaic method of "*maximum*" to get the highest possible value of each location based on the Lidar. The resulting mosaicked rasters were then clipped to a 10-meter buffer to remove any erroneous data created during processing.

3.2.2.2 New York City Buildings Data

Because of the Hypothetical Project's urban setting in and around New York City, the building footprint data published by the New York City Department of Transportation were used to develop the top of canopy viewshed model (NYOD 2014). These data included over 1 million building polygons in New York City indicating each building's base elevation and rooftop height. These data were not available for portions of the study area located outside of the New York City limits.

The New York City Buildings data were downloaded in shapefile format and projected into the standard project UTM projection system. After reviewing the metadata, it was noted a small percentage of the building polygons did not have rooftop elevations. Based on a review of the metadata provided by the New York City Department of Transportation, it was determined that the buildings without rooftop elevations were less than 12 feet tall (3.6 meters), and therefore those buildings were not included in the analysis.

Base and rooftop elevations were converted from feet to meters to be consistent with the NED and Lidar data. Building heights were calculated by adding these elevations to determine total height above mean sea level of each building. The polygon data were then converted from vector to raster, with the resulting 1-meter-resolution raster dataset representing building footprints at their highest elevations.

3.2.2.3 Top of Canopy Elevation Data

The top of canopy elevation dataset was derived from a combination of the NED, Lidar, and New York City buildings data using the following process:

- The NED data were resampled to a 1-meter resolution raster to be consistent with the Lidar and building data.
- The NED, USGS, USACE, and building raster data were processed using the “mosaic to new raster tool” with a mosaic method of “*maximum”* to incorporate the highest possible elevation when input values overlapped.

The resulting raster data provided the best available top of canopy elevation data at a 1-meter resolution for the project area. This data set was resampled to a 5-meter resolution surface to process the viewshed model.

3.3 VIEWSHED ANALYSIS

This section explains the development of baseline and top of canopy viewshed models for the Hypothetical Project. The following data and software standards were used throughout this study:

- Data were processed in UTM North American Datum of 1983 Zone 18
- Data geoprocessing was completed using ESRI ArcGIS Desktop 10.2.1, ESRI Model Builder, and Python 2.7
- Data were cross-checked in 3D using 3D analyst extension and ESRI ArcScene

- Observer elevation was assumed at 5.5 feet
- Viewshed models accounted for curvature of the earth
- Viewshed models included a refractivity coefficient of 0.13

The refractivity coefficient is incorporated into the equation by reducing the effects of the earth's curvature to only 6/7ths of the original curve. In other words, refractivity of light will lower the appearance of distant objects in relation to the horizon (from the observer's point of view) by 1/7th (0.13) of the distance that the earth's curvature gives the appearance of raising the object above the horizon. The refractivity coefficient of 0.13 is considered appropriate under standard atmospheric pressure for daytime conditions with a clear sky for locations whose elevation varies between 40 and 100 meters (Yoeli 1985).

Though not performed as part of this analysis, this value can be adjusted to model theoretical observer extent under varying atmospheric conditions and elevations. The refractivity coefficient was only used in the viewshed model, and was not a value that was incorporated into the development of the visual simulations.

3.3.1 Wind Turbine Generator Component Data

Viewshed models were developed to represent potential visibility of components of the Senvion 6.2M 152 wind turbine (Figure 3-1) using the turbine configuration provided by BOEM. Four new data sets specifying height of the blade tip, hub, above-water support structure, and substation platforms were developed using data presented in Table 3-1.

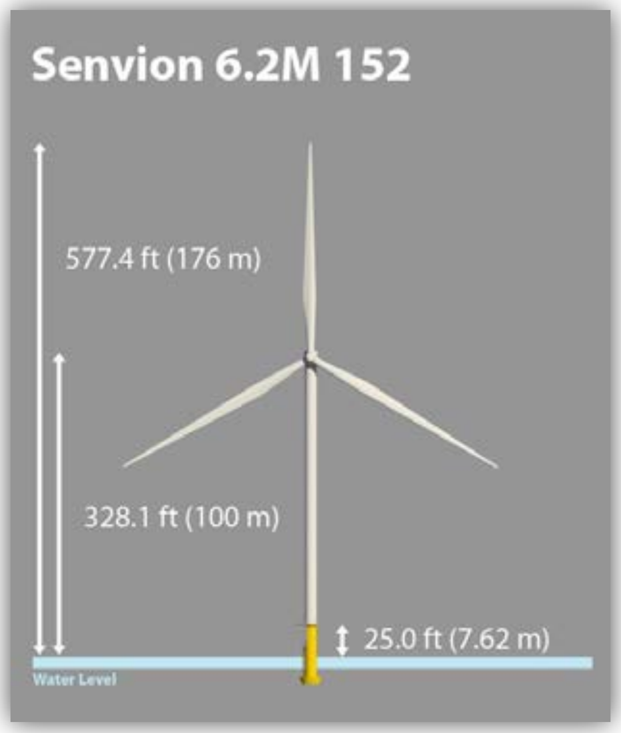


Figure 3–1. Wind turbine generator elevation schematic

Table 3–1. Component Heights

Wind Turbine Generator Component	Height above Mean Sea Level
Tip of Blade (Highest Point)	577.4 Feet (176 Meters)
Hub Height	328.1 Feet (100 Meters)
Above-Water Support Structure	25.0 Feet (7.62 Meters)
Substation Platforms	50.0 Feet (15.24 Meters)

3.3.2 Baseline Viewshed Model

The baseline viewshed model was completed using the raster surface created from the USGS NED data using Python scripting. The resulting output was a range of values between 1 and 134, corresponding to the number of WTGs, individual WTG components, or substations defined as "seen." Values calculated as zero corresponded to areas where these features would theoretically not be seen. This output was reclassified for the three WTG components to indicate seen and not seen areas. These data were then added using map algebra to generate one raster of the composite WTG viewshed. Four output values were used to complete this task, with each of the following representing potential visibility:

- 0 = no portion of the WTG is visible

- 1 = the tip of the WTG blade is visible
- 2 = the hub and tip of the blade are visible
- 3 = the water support structure or the entire turbine are visible

This resulting viewshed output, including models created for the substation, is displayed in Figure 3-2, and at a higher resolution in Appendix E. The baseline viewshed model does not account for the observer height at the top of the lighthouses; however, this observer position was modeled in the top of canopy scenario described in Section 3.3.3, below.

3.3.3 Top of Canopy Viewshed Model

Top of canopy viewshed models were created using the same process as that used for the baseline viewshed model; however, input parameters were modified to top of canopy surface elevations. The resulting viewshed output is displayed in Figure 3-3, and at a higher resolution in Appendix F. The top of canopy viewshed model was also used to determine the approximate number of turbines that could be seen from each KOP (Appendix G). This analysis accounts for observer height at the observation decks of the lighthouses.

3.3.4 Viewshed Model Results

The results of the top of canopy viewshed model show how physical viewshed limiting factors restrict potential visibility of offshore areas, and provide a more accurate representation of potential visibility of the Hypothetical Project from inland areas in New York and New Jersey. Potential views of the Hypothetical Project are largely obstructed by buildings and other structures, localized topography, and vegetation. Because Lidar data and building information were not available for Long Island, the top-of-canopy viewshed model did not differ substantially from the baseline model for the Long Island. As a result, potential blocking of views by buildings and other structures, localized topography, and vegetation was underestimated in this area.

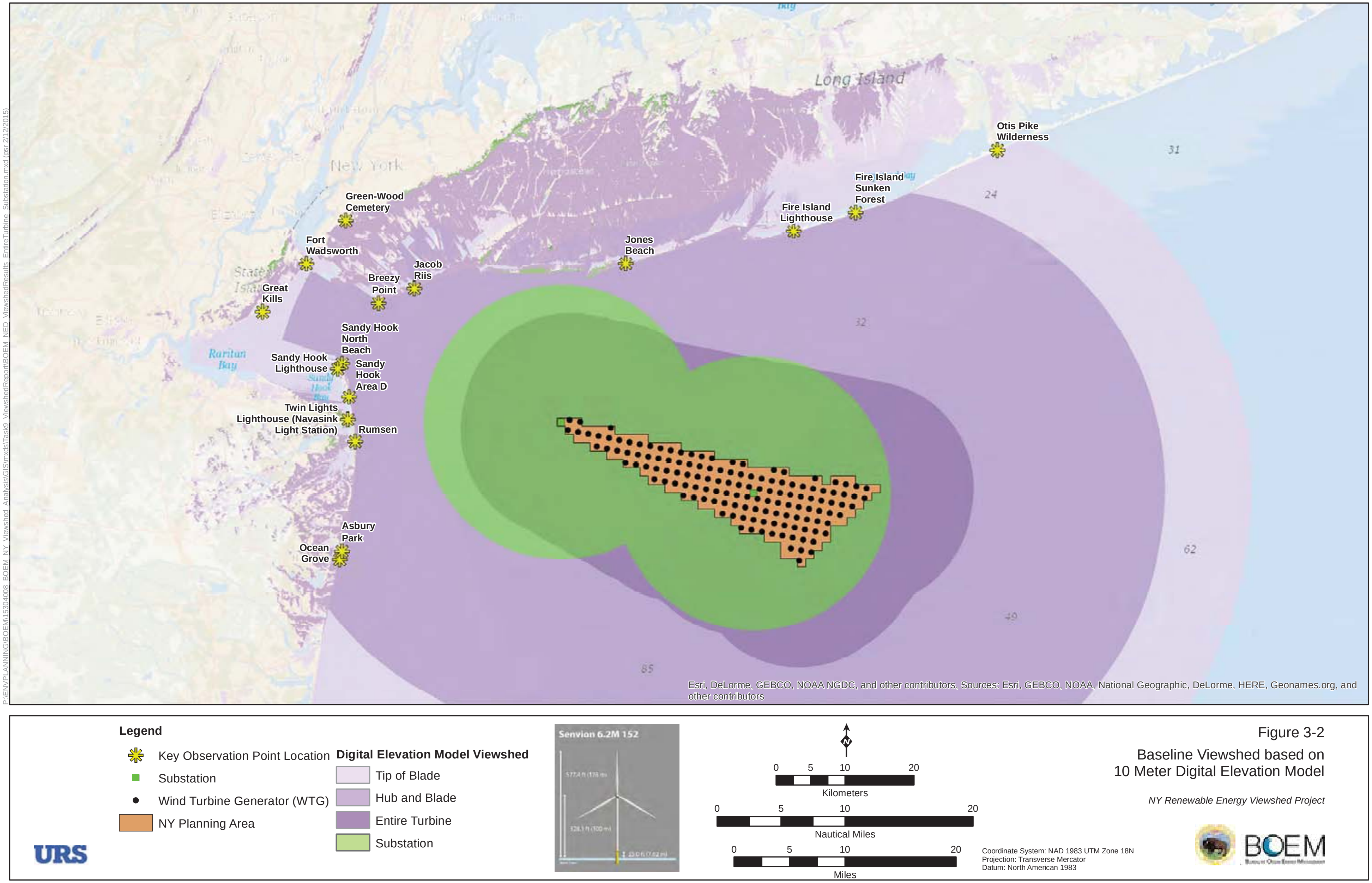


Figure 3-2

Baseline Viewshed based on 10 Meter Digital Elevation Model

NY Renewable Energy Viewshed Project

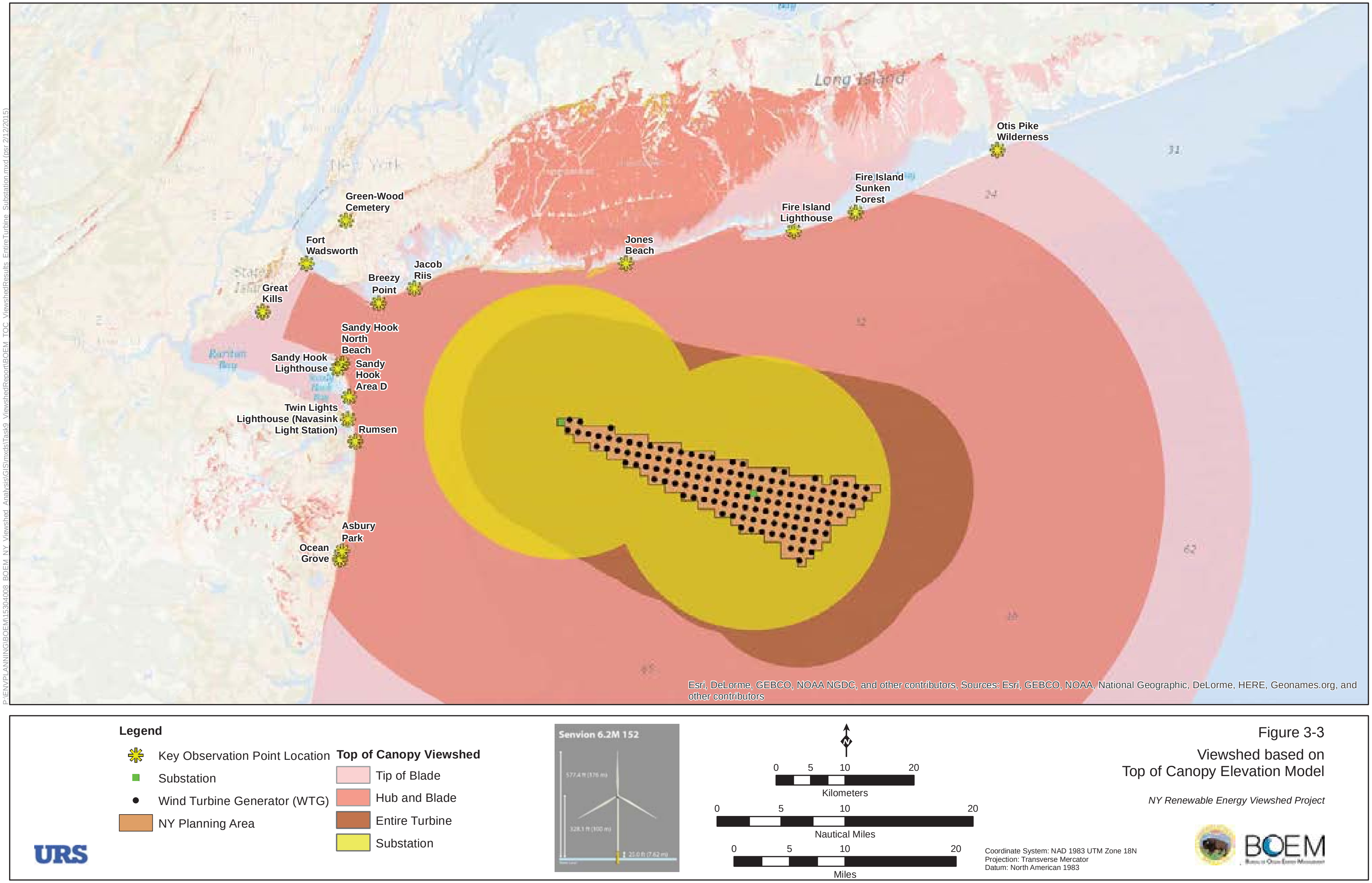


Figure 3-3
Viewshed based on
Top of Canopy Elevation Model

NY Renewable Energy Viewshed Project

4 BASELINE PHOTOGRAPHIC DOCUMENTATION OF KOPs

Photographic documentation was captured at each KOP to simulate what an observer would visually experience when standing onshore and facing the Hypothetical Project. Baseline photographs were taken at each KOP in each of the four seasons during common weather conditions and periods of maximum meteorological visibility. Photographs were taken systematically to ensure that four different lighting conditions were recorded (including morning, mid-day, afternoon, and nighttime). At each KOP, photographic points were established to ensure the observation point's contextual setting (e.g., railings, sand, piers) was expressed, while also representing open and unobstructed views of the Hypothetical Project. Contextual features were included to document the character of the area, including any potential co-dominant or focal attributes of the seascape. These features also allowed accurate geo-referencing of the photo points to ensure representative photosimulations were developed. Photographs and videos were taken at each KOP, with focus on incorporating these contextual elements. Each photo point position was surveyed using professional survey equipment (North American Datum of 1983 [NAD83] vertical datum).

Nighttime photography was captured using High Dynamic Range (HDR) imagery, and processed using HDRsoft Photomatix Pro. This approach allowed a more accurate capture and display of existing light sources, including starlit skies, overflying aircraft, and nearby street lamps.

4.1.1 Spring Baseline Photographs

Information recorded during spring season baseline photography collection is provided in Table 4-1.

Table 4–1. Baseline Daytime Photographic Data: Spring Season

LOCATION	PERIOD IN SPRING	DATE (mm/dd/yyyy)	TIME	TEMP (°F)	HUMIDITY (RH)	VISIBILITY (mi)	VISIBILITY (NM)	WEATHER
Otis Pike Wilderness	MORNING	6/16/2014	10:18 AM	69.8	51	27	24	Partly Cloudy
Otis Pike Wilderness	NOON	5/29/2014	11:19 AM	55.4	57	25	22	Partly Cloudy
Otis Pike Wilderness	AFTERNOON	6/16/2014	2:24 PM	68	38	31	26	Clear
Sunken Forest	MORNING	6/19/2014	10:30 AM	71.6	73	19	16	Overcast
Sunken Forest	NOON	6/20/2014	1:09 PM	73.4	27	32	28	Partly Cloudy
Sunken Forest	AFTERNOON	6/20/2014	3:40 PM	73.4	25	33	28	Partly Cloudy
Fire Island Light House	MORNING	6/21/2014	10:32 AM	66.2	34	31	27	Partly Cloudy
Fire Island Light House	NOON	6/16/2014	12:56 PM	69.8	34	31	27	Clear
Fire Island Light House	AFTERNOON	5/29/2014	1:58 PM	55.4	60	24	21	Partly Cloudy
Breezy Point Tip	MORNING	6/18/2014	8:39 AM	82.4	47	28	24	Clear
Breezy Point Tip	NOON	5/30/2014	1:02 PM	66.2	53	27	23	Partly Cloudy
Breezy Point Tip	AFTERNOON	6/16/2014	4:41 PM	73.4	38	31	26	Clear
Sandy Hook North Beach	MORNING	6/20/2014	9:43 AM	69.8	43	30	25	Partly Cloudy
Sandy Hook North Beach	NOON	6/6/2014	10:52 AM	69.8	56	26	22	Partly Cloudy
Sandy Hook North Beach	AFTERNOON	5/31/2014	3:36 PM	64.4	60	24	21	Cloudy
Sandy Hook Area D	MORNING	6/20/2014	10:06 AM	69.8	43	30	25	Partly Cloudy
Sandy Hook Area D	NOON	6/6/2014	11:27 AM	69.8	53	27	23	Partly Cloudy
Sandy Hook Area D	AFTERNOON	5/31/2014	3:00 PM	64.4	52	27	23	Cloudy
Fort Wadsworth	MORNING	6/18/2014	9:49 AM	82.4	48	28	24	Clear
Fort Wadsworth	NOON	6/18/2014	1:08 PM	86	40	30	26	Partly Cloudy
Fort Wadsworth	AFTERNOON	6/20/2014	3:22 PM	75.2	25	33	28	Partly Cloudy
Great Kills	MORNING	6/18/2014	10:32 AM	84.2	44	29	25	Partly Cloudy
Great Kills	NOON	6/20/2014	2:46 PM	75.2	24	33	28	Partly Cloudy
Great Kills	AFTERNOON	5/30/2014	5:05 PM	66.2	61	24	21	Clear
Sandy Hook Light House	MORNING	6/6/2014	10:17 AM	64.4	56	26	22	Clear
Sandy Hook Light House	NOON	6/20/2014	12:21 PM	73.4	38	31	26	Partly Cloudy
Sandy Hook Light House	AFTERNOON	5/31/2014	1:41 PM	64.4	46	29	25	Overcast
Jacob Riis Park	MORNING	6/18/2014	9:10 AM	82.4	47	28	24	Clear
Jacob Riis Park	NOON	6/21/2014	12:47 PM	68	35	31	27	Partly Cloudy
Jacob Riis Park	AFTERNOON	5/30/2014	2:24 PM	66.2	65	22	19	Partly Cloudy

LOCATION	PERIOD IN SPRING	DATE (mm/dd/yyyy)	TIME	TEMP (°F)	HUMIDITY (RH)	VISIBILITY (mi)	VISIBILITY (NM)	WEATHER
Ocean Grove	MORNING	5/31/2014	10:47 AM	64.4	46	29	25	Clear
Ocean Grove	NOON	6/6/2014	1:15 PM	69.8	50	28	24	Partly Cloudy
Ocean Grove	AFTERNOON	6/18/2014	3:25 PM	87.8	40	30	26	Partly Cloudy
Asbury Park	MORNING	6/19/2014	9:29 AM	71.6	73	19	16	Overcast
Asbury Park	NOON	6/6/2014	12:42 PM	69.8	50	28	24	Partly Cloudy
Asbury Park	AFTERNOON	6/18/2014	3:50 PM	87.8	43	30	25	Partly Cloudy
Rumson	MORNING	6/19/2014	10:02 AM	71.6	73	19	16	Overcast
Rumson	NOON	6/19/2014	11:19 AM	71.6	69	21	18	Overcast
Rumson	AFTERNOON	6/18/2014	4:45 PM	86	41	30	26	Partly Cloudy
Green-Wood Cemetery	MORNING	5/30/2014	10:34 AM	66.2	50	28	24	Partly Cloudy
Green-Wood Cemetery	NOON	6/18/2014	12:28 PM	86	40	30	26	Partly Cloudy
Green-Wood Cemetery	AFTERNOON	6/18/2014	3:15 PM	87.8	35	31	27	Partly Cloudy

4.1.2 Summer Baseline Photographs

Information recorded during summer season baseline photography collection is provided in Table 4-2.

Table 4–2. Baseline Daytime Photographic Data: Summer Season

LOCATION	PERIOD SUMMER	DATE (mm/dd/yyyy)	TIME	TEMP (°F)	HUMIDITY (RH)	ESTIMATED VISIBILITY (mi)	ESTIMATED VISIBILITY (NM)	WEATHER
Sunken Forest	MORNING	9/20/2014	9:18 AM	66.2	65	22	19	Clear
Sunken Forest	NOON	7/3/2014	1:24 PM	80.6	69	21	18	Partly Cloudy
Sunken Forest	AFTERNOON	7/3/2014	3:58 PM	77	67	21	19	Clear
Sandy Hook North Beach	MORNING	9/18/2014	10:19 AM	66.2	56	26	22	Clear
Sandy Hook North Beach	NOON	8/28/2014	11:44 AM	77	50	28	24	Clear
Sandy Hook North Beach	AFTERNOON	9/5/2014	2:27 PM	82.4	66	22	19	Clear
Great Kills	MORNING	9/19/2014	10:21 AM	60.8	52	27	24	Cloudy
Great Kills	NOON	9/19/2014	12:19 PM	60.8	45	29	25	Partly Cloudy
Great Kills	AFTERNOON	9/19/2014	2:00 PM	62.6	45	29	25	Partly Cloudy
Jacob Riis Park	MORNING	8/7/2014	10:33 AM	73.4	35	31	27	Clear
Jacob Riis Park	NOON	9/19/2014	10:56 AM	60.8	50	28	24	Partly Cloudy
Jacob Riis Park	AFTERNOON	9/19/2014	2:34 PM	62.6	48	28	25	Clear
Twin Light NHL	MORNING	8/28/2014	9:24 AM	71.6	53	27	23	Clear

LOCATION	PERIOD SUMMER	DATE (mm/dd/yyyy)	TIME	TEMP (°F)	HUMIDITY (RH)	ESTIMATED VISIBILITY (mi)	ESTIMATED VISIBILITY (NM)	WEATHER
Twin Light NHL	NOON	9/18/2014	11:46 AM	71.6	43	30	26	Clear
Twin Light NHL	AFTERNOON	9/18/2014	1:50 PM	73.4	38	31	27	Clear
Asbury Park	MORNING	9/5/2014	9:45 AM	77	83	14	12	Clear
Asbury Park	NOON	9/5/2014	11:18 AM	78.8	74	18	16	Partly Cloudy
Asbury Park	AFTERNOON	8/28/2014	3:29 PM	77	39	30	26	Clear
Rumson	MORNING	9/5/2014	10:29 AM	77	74	18	16	Partly Cloudy
Rumson	NOON	9/5/2014	11:52 AM	78.8	70	20	18	Partly Cloudy
Rumson	AFTERNOON	8/28/2014	2:40 PM	77	39	30	26	Clear
Jones Beach	MORNING	9/19/2014	9:25 AM	57.2	52	27	24	Partly Cloudy
Jones Beach	NOON	9/19/2014	12:15 PM	60.8	45	29	25	Partly Cloudy
Jones Beach	AFTERNOON	8/7/2014	2:12 PM	78.8	34	31	27	Clear

4.1.3 Fall Baseline Photographs

Information recorded during fall season baseline photography collection is provided in Table 4-3.

Table 4–3. Baseline Day and Nighttime Photographic Data: Fall Season

LOCATION	PERIOD FALL	DATE (mm/dd/yyyy)	TIME	TEMP (°F)	HUMIDITY (RH)	VISIBILITY (mi)	VISIBILITY (NM)	WEATHER
Fire Island Otis Pike	MORNING	11/21/2014	8:12 AM	30.2	47	28	25	Clear
Fire Island Otis Pike	NOON	11/20/2014	1:26 PM	46.4	39	30	26	Partly Cloudy
Fire Island Otis Pike	AFTERNOON	10/20/2014	3:09 PM	59	44	29	25	Partly Cloudy
Fire Island Otis Pike	NIGHT	11/20/2014	11:00 PM	33.8	42	30	26	Cloudy
Sunken Forest	MORNING	12/12/2014	9:19 AM	33.8	64	23	20	Overcast
Sunken Forest	NOON	12/12/2014	12:28 PM	35.6	55	26	23	Partly Cloudy
Sunken Forest	AFTERNOON	12/12/2014	3:20 PM	35.6	55	26	23	Partly Cloudy
Sunken Forest	NIGHT	10/24/2014	8:45 PM	59	77	17	15	Partly Cloudy
Fire Island Light House	MORNING	11/21/2014	9:31 AM	30.2	42	30	26	Partly Cloudy
Fire Island Light House	NOON	11/20/2014	12:31 PM	42.8	37	31	27	Partly Cloudy
Fire Island Light House	AFTERNOON	10/20/2014	1:35 PM	59	41	30	26	Partly Cloudy
Fire Island Light House	NIGHT	11/20/2014	9:48 PM	35.6	34	31	27	Overcast
Breezy Point Tip	MORNING	11/11/2014	9:38 AM	60.8	81	15	13	Cloudy
Breezy Point Tip	NOON	10/20/2014	11:02 AM	55.4	47	28	25	Cloudy

LOCATION	PERIOD FALL	DATE (mm/dd/yyyy)	TIME	TEMP (°F)	HUMIDITY (RH)	VISIBILITY (mi)	VISIBILITY (NM)	WEATHER
Breezy Point Tip	AFTERNOON	11/11/2014	1:41 PM	62.6	73	19	16	Partly Cloudy
Breezy Point Tip	NIGHT	10/21/2014	12:34 AM	59	64	23	20	Cloudy
Sandy Hook North Beach	NIGHT	10/20/2014	6:58 PM	59	51	27	24	Partly Cloudy
Sandy Hook Area D	MORNING	10/20/2014	10:13 AM	50	43	30	26	Partly Cloudy
Sandy Hook Area D	NOON	10/20/2014	11:56 AM	55.4	44	29	25	Partly Cloudy
Sandy Hook Area D	AFTERNOON	10/20/2014	2:41 PM	60.8	39	30	26	Partly Cloudy
Sandy Hook Area D	NIGHT	10/20/2014	7:25 PM	59	54	26	23	Cloudy
Fort Wadsworth	MORNING	11/30/2014	7:39 AM	48.2	61	24	21	Partly Cloudy
Fort Wadsworth	NOON	10/31/2014	11:18 AM	51.8	54	26	23	Overcast
Fort Wadsworth	AFTERNOON	12/13/2014	3:41 PM	41	55	26	23	Partly Cloudy
Fort Wadsworth	NIGHT	10/23/2014	10:02 PM	51.8	83	14	12	Overcast
Great Kills	NIGHT	10/23/2014	10:55 PM	51.8	80	15	13	Overcast
Sandy Hook Light House	MORNING	11/29/2014	8:35 AM	32	64	23	20	Cloudy
Sandy Hook Light House	NOON	11/29/2014	10:34 AM	33.8	44	29	25	Overcast
Sandy Hook Light House	AFTERNOON	11/29/2014	3:09 PM	33.8	44	29	25	Overcast
Jacob Riis Park	NIGHT	11/20/2014	6:37 PM	35.6	31	32	28	Cloudy
Twin Light NHL	MORNING	11/29/2014	9:24 AM	32	55	26	23	Overcast
Twin Light NHL	NOON	11/29/2014	11:14 AM	33.8	41	30	26	Overcast
Twin Light NHL	AFTERNOON	11/29/2014	2:04 PM	33.8	44	29	25	Overcast
Twin Light NHL	NIGHT	10/20/2014	8:24 PM	62.6	54	26	23	Cloudy
Ocean Grove	MORNING	10/20/2014	11:05 AM	51.8	44	29	25	Cloudy
Ocean Grove	NOON	10/20/2014	12:45 PM	57.2	43	30	26	Partly Cloudy
Ocean Grove	AFTERNOON	10/20/2014	3:36 PM	59	39	30	26	Partly Cloudy
Ocean Grove	NIGHT	10/20/2014	11:10 PM	62.6	63	23	20	Cloudy
Asbury Park	NIGHT	10/20/2014	10:42 PM	62.6	59	25	21	Cloudy
Rumson	NIGHT	10/20/2014	9:30 PM	62.6	63	23	20	Overcast
Green-Wood Cemetery	MORNING	11/11/2014	10:40 AM	60.8	75	18	15	Cloudy
Green-Wood Cemetery	NOON	11/11/2014	12:36 PM	64.4	65	22	19	Cloudy
Green-Wood Cemetery	AFTERNOON	11/11/2014	2:45 PM	30.2	63	23	20	Partly Cloudy
Green-Wood Cemetery	NIGHT	10/23/2014	8:42 PM	46.4	77	17	15	Overcast
Jones Beach	MORNING	11/21/2014	10:18 AM	59	40	30	26	Partly Cloudy

LOCATION	PERIOD FALL	DATE (mm/dd/yyyy)	TIME	TEMP (°F)	HUMIDITY (RH)	VISIBILITY (mi)	VISIBILITY (NM)	WEATHER
Jones Beach	NOON	10/20/2014	12:24 PM	33.8	42	30	26	Partly Cloudy
Jones Beach	AFTERNOON	11/20/2014	3:10 PM	33.8	40	30	26	Clear
Jones Beach	NIGHT	10/20/2014	9:47 PM	35.6	62	24	20	Partly Cloudy

4.1.4 Winter Baseline Photographs

Information on baseline photographs taken during the winter season is provided in Table 4-4.

Table 4–4. Baseline Daytime Photographic Data: Winter Season

LOCATION	PERIOD WINTER	DATE (mm/dd/yyyy)	TIME	TEMP (°F)	HUMIDITY (RH)	VISIBILITY (mi)	VISIBILITY (NM)	WEATHER
Fire Island Otis Pike	MORNING	1/7/2015	10:33 AM	-5	40	30	26	Partly Cloudy
Fire Island Otis Pike	NOON	1/7/2015	1:02 PM	-5	39	30	26	Partly Cloudy
Fire Island Otis Pike	AFTERNOON	1/7/2015	1:54 PM	-6	44	29	25	Partly Cloudy
Breezy Point Tip	MORNING	1/14/2015	7:59 AM	-4	71	20	17	Cloudy
Breezy Point Tip	NOON	1/13/2015	11:09 AM	-5	47	28	25	Clear
Breezy Point Tip	AFTERNOON	1/13/2015	1:37 PM	-5	37	31	27	Clear
Sandy Hook North Beach	MORNING	1/23/2015	9:50 AM	23	51	27	24	Clear
Sandy Hook North Beach	NOON	1/23/2015	11:42 AM	23	48	28	25	Clear
Sandy Hook North Beach	AFTERNOON	1/23/2015	1:41 PM	21.2	48	28	25	Clear
Great Kills	MORNING	1/23/2015	10:38 AM	24.8	48	28	25	Clear
Great Kills	NOON	1/23/2015	12:48 PM	23	48	28	25	Clear
Great Kills	AFTERNOON	1/23/2015	2:20 PM	23	45	29	25	Partly Cloudy
Jacob Riis Park	MORNING	1/14/2015	8:23 AM	30.2	69	21	18	Overcast
Jacob Riis Park	NOON	1/13/2015	11:46 AM	35.6	44	29	25	Clear
Jacob Riis Park	AFTERNOON	1/13/2015	2:10 PM	37.4	37	31	27	Clear
Twin Light NHL	MORNING	1/8/2015	9:14 AM	35.6	45	29	25	Clear
Twin Light NHL	NOON	1/8/2015	12:24 PM	35.6	36	31	27	Clear
Twin Light NHL	AFTERNOON	1/8/2015	2:27 PM	37.4	39	30	26	Clear
Asbury Park	MORNING	1/8/2015	8:11 AM	24.8	44	29	25	Partly Cloudy
Asbury Park	NOON	1/7/2015	11:32 AM	23	39	30	26	Partly Cloudy
Asbury Park	AFTERNOON	1/7/2015	1:41 PM	23	36	31	27	Partly Cloudy
Rumson	MORNING	1/8/2015	8:44 AM	12.2	48	28	25	Partly Cloudy
Rumson	NOON	1/8/2015	11:55 AM	15.8	39	30	26	Clear
Rumson	AFTERNOON	1/8/2015	2:13 PM	17.6	39	30	26	Clear

LOCATION	PERIOD WINTER	DATE (mm/dd/yyyy)	TIME	TEMP (°F)	HUMIDITY (RH)	VISIBILITY (mi)	VISIBILITY (NM)	WEATHER
Green-Wood Cemetery	MORNING	1/14/2015	9:22 AM	12.2	60	24	21	Overcast
Green-Wood Cemetery	NOON	1/14/2015	10:52 AM	21.2	60	24	21	Overcast
Green-Wood Cemetery	AFTERNOON	1/13/2015	3:34 PM	21.2	46	29	25	Partly Cloudy
Jones Beach	MORNING	1/13/2015	9:45 AM	12.2	53	27	23	Partly Cloudy
Jones Beach	NOON	1/7/2015	11:47 AM	15.8	40	30	26	Partly Cloudy
Jones Beach	AFTERNOON	1/7/2015	3:03 PM	17.6	48	28	25	Partly Cloudy

4.1.5 Baseline Video

Two 30-second or longer videos (one during the day and one at night) were taken at five of the KOPs (Table 4-5). BOEM selected the final KOP locations where video would be captured, with consideration of recommendations from the URS-Truescape Team and participating stakeholders.

Table 4–5. Baseline Video Collection at Key Observation Points (KOPs)

Key Observation Point	Date	
	Daytime Video	Nighttime Video
Asbury Park	Dec. 13th 2014 - 12:52 p.m.	Dec. 13th, 2014 - 12:52 p.m.
Fire Island Light House	Aug. 7th, 2014 - 3:21 p.m.	Nov. 20th, 2014 - 9:42 p.m.
Jacob Riis Park	Aug. 7th, 2014 - 10:47 a.m.	Nov. 20th, 2014 - 6:40 p.m.
Jones Beach	Nov. 20th, 2014 - 3:12 p.m.	Jan. 6th, 2015 - 10:00 p.m.
Sandy Hook Area D	Dec. 13th, 2014 - 1:42 p.m.	Oct. 20th, 2014 - 7:51 p.m.

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5 SINGLE FRAME AND VIDEO SIMULATIONS

Single frame and video simulations were developed using photographs taken at each KOP using a digital 3D model of the Hypothetical Project and spatial data indicating locations of WTGs and auxiliary facilities (Figure 1-1). All specifications used in the model were provided by BOEM, and included the Senvion 6.2M 152 Wind Turbine, with a maximum height of 577.4 feet, and a blade diameter of 498.7 feet (Figure 5-1). Specifications associated with the substation are provided in Figure 5-2. Simulations were produced using Autodesk 3d Studio Max Design, and were Lidar-based, using a post-Hurricane Sandy 3D terrain model provided by the USACE (USACE 2012) and the USGS (USGS 2012).

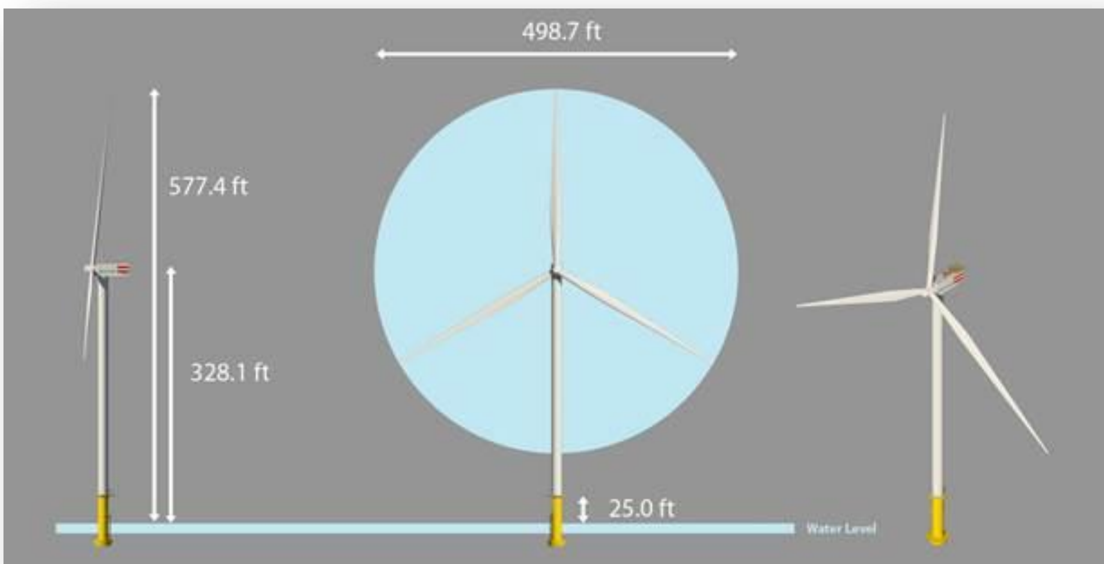

Figure 5–1. Schematic of the Senvion 6.2M 152 Wind Turbine and associated specifications used in photosimulations

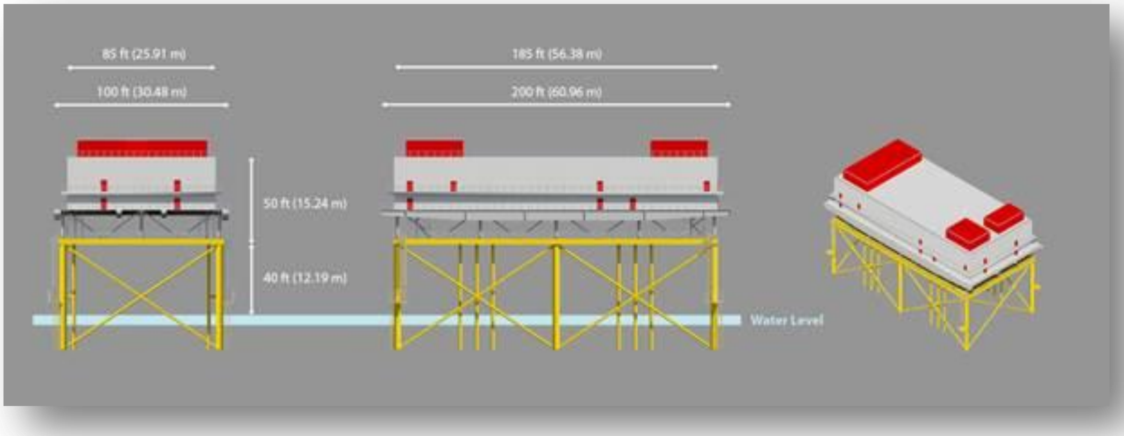

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Figure 5–2. Schematic of the substation and associated specification used in photosimulations

5.1 DAYTIME SIMULATIONS

The first stage in constructing photosimulations entailed developing wireframe simulations to depict Hypothetical Project features from the perspective of each KOP using a subset of baseline photographs (Figure 5-3). The locations of Hypothetical Project components were based on survey-grade locational data, ensuring accurate depiction of the scale and location of the turbines relative to the KOP (Figure 5-4). However, because the simulations were not rendered in a way that includes lighting and atmospheric conditions, the wireframe simulations exaggerate the visibility of the structures.

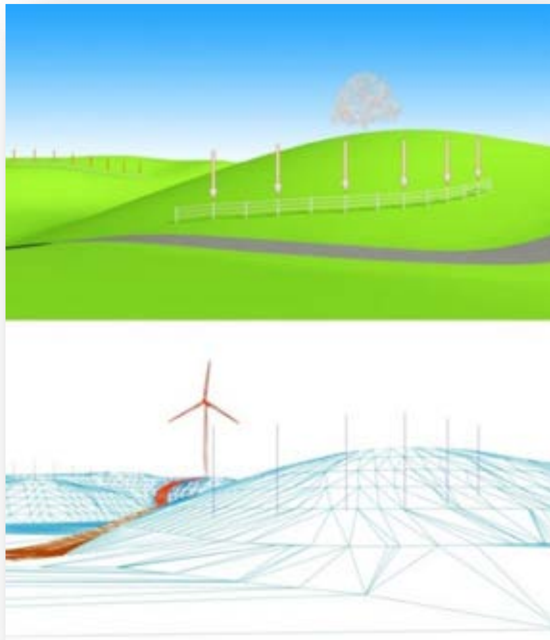

Figure 5–3. Aligning the surveyed reference points

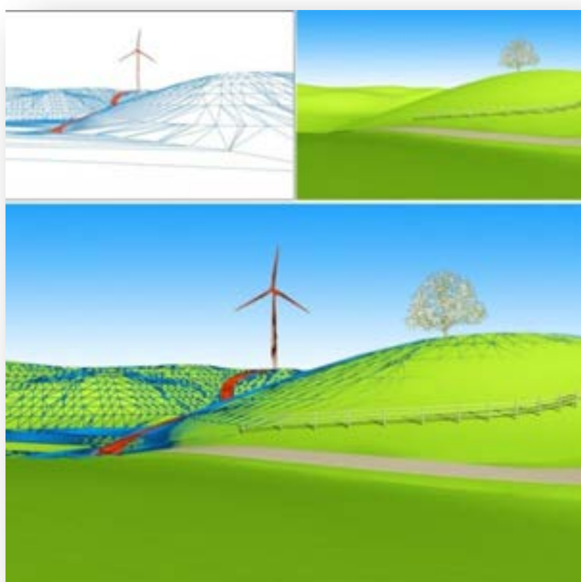

Figure 5–4. Schematic demonstrating the development of wireframe simulations

Following completion of the wireframes, two sets of simulations were developed under four lighting scenarios: early morning, mid-day, late afternoon, and starlit night (new moon). The first set of simulations was developed using imagery taken under clear daytime conditions, illustrating maximum potential visibility. The second set of simulations was based on the most prevalent meteorological conditions applicable during daytime for each of the four seasons (if different from clear conditions). Single frame simulations are provided in Appendix H-1 (spring), Appendix H-2 (summer), Appendix H-3 (fall), and Appendix H-4 (winter). Each appendix includes baseline photography, wireframe simulations, and simulations prepared for conditions of average and maximum visibility. A high degree of realism in visibility, lighting, and turbine orientation was also achieved by incorporating meteorological conditions documented during base photograph collection and as informed by the meteorological assessment. All simulations were corrected for earth curvature and refraction based on the specific location and viewing geometry. A discussion of these parameters is provided below.

5.1.1 Curvature and Refraction

Curvature of the earth was incorporated into the simulations using a customized maxscript file utilized within the Autodesk 3D Studio simulation software (Cox 2004). This script includes temperature parameters which will affect curvature and refraction values. A constant height of 0 feet and NAD83 vertical datum was assumed because the differentiation in camera height makes a negligible difference to refraction and curvature values (Table 5-1).

Table 5–1. Refraction and Curvature Coefficients as a Function of Elevation

Elevation (Feet)	Refraction Coefficient	Refraction + Curvature of the Earth
0	-0.088	0.574
1000	-0.076	0.587
10000	-0.65	0.597
15000	-0.56	0.606

The values for simulation of the project were calculated using a curvature of the earth coefficient of 0.662 and an atmospheric refraction coefficient of -0.088. The atmospheric refraction term provides a coefficient of -0.088 at an elevation of 0 feet and a temperature of 65° F.

5.1.2 Haze Simulation

The estimated visibility at the time the photographs were obtained was calculated using the Beer-Lambert law by incorporating the reported humidity for the geographic area of the KOP (see Section 2.0). The Beer-Lambert Law calculated visibility using humidity, as follows:

$$y = -0.0034x^2 + 0.0833x + 28.347, \text{ where } x = \text{humidity and } y = \text{visibility}$$

The maximum visibility per viewpoint and time of day was used to generate a grayscale alpha channel in 3D space based on the maximum visibility values obtained from the Beer-Lambert law. Following rendering of the alpha mask, this overlay was placed on the rendered turbines to create the final simulation with correct atmospheric conditions incorporated.

5.2 NIGHT SIMULATIONS

Night simulations were developed for all KOPs using still photography taken during the fall season. Video simulations were also produced from nighttime images taken at Asbury Park, Fire Island Lighthouse, Jacob Riis Park, Jones Beach, and Sandy Hook Area D. Parameters used in nighttime simulations were developed based on guidance from Federal Aviation Administration Circulars AC 150/5345-43F (FAA 2006) and AC 70/7460-1K (FAA 2007). FAA is currently in the process of updating the guidance regarding the marking and lighting of wind turbines and anticipates publishing a revision to Advisory Circular 70/7460 to reflect these updates. FAA shared these draft revisions with BOEM which were used to develop the lighting and marking scenario for the Hypothetical Project (BOEM personal communication, February 2015).

5.2.1 Wind Turbine Nighttime Lighting Configuration

The lighting layout plan for the Hypothetical Project is based on lighting specifications defined in Circular AC 70/7460-1K for this type of configuration, and additional draft guidance provided by FAA to BOEM (FAA 2007; BOEM personal communication, February 2015). Circular AC 70/7460-1K recommends a single L-864 flashing red light. Guidance provided to BOEM by the FAA during the implementation of this project suggested the following additional lighting parameters be applied:

- Equip the top of the turbine's nacelle with a second L-864 flashing red light; and
- Apply lighting to all turbines in the hypothetical array as they exceed a rotor tip height of 499 feet.

5.2.2 Lighting Choice

Circular AC 70/7460-1K indicates that wind turbine obstruction lighting should consist of flashing red (L-864) or white (L-865) lights (FAA 2007). Studies have shown that red lights are most effective and should be considered first (FAA 2007). For the purposes of this study, red (L-864) lights were used in the photosimulations.

5.2.3 Flash Rate

Circular AC 70/7460-1K states that obstruction lighting should be synchronized, or flash simultaneously (FAA 2007). Circular AC 150/5345-43F specifies that L-864 lighting should operate with a flash rate of 20 to 40 flashes per minute (FAA 2006). For the purposes of this study, a flash rate of 30 flashes per minute was used in the photosimulations.

5.2.4 Post-Processing Night Lighting Verification

The appearance of night lighting in video and still-frame simulations was verified using Computer Generated Imagery lighting methods. Photographs of existing turbine lighting were taken from an existing land-based wind project in Palm Springs, California at distances of 4.4, 9.8, 14, 20.4, and 25 miles, which correspond to the distances between the Hypothetical Project to the KOPs. These photographs were compared to simulations of night lighting of the Hypothetical Project prior to applying atmospheric conditions to the image.

6 PANORAMIC PHOTOMONTAGES

In accordance with the simulation requirements presented in the New Zealand Institute of Landscape Architects Members Documentation, *Best Practice Guide – Visual Simulations* (2010), a series of nine photographs was taken at each site. The series of photographs from each site were combined to form the baseline imagery for a photomontage, or TrueView™ simulation that accurately represents the 124 degree horizontal and 55 degree vertical primary human field of view (Figure 6-1). The photomontage accurately represents the scale of the landscape when displayed at a height where the observer's line of sight is directed at the center of the photomontage at a distance of 19.7 inches from the image (Figure 6-2).

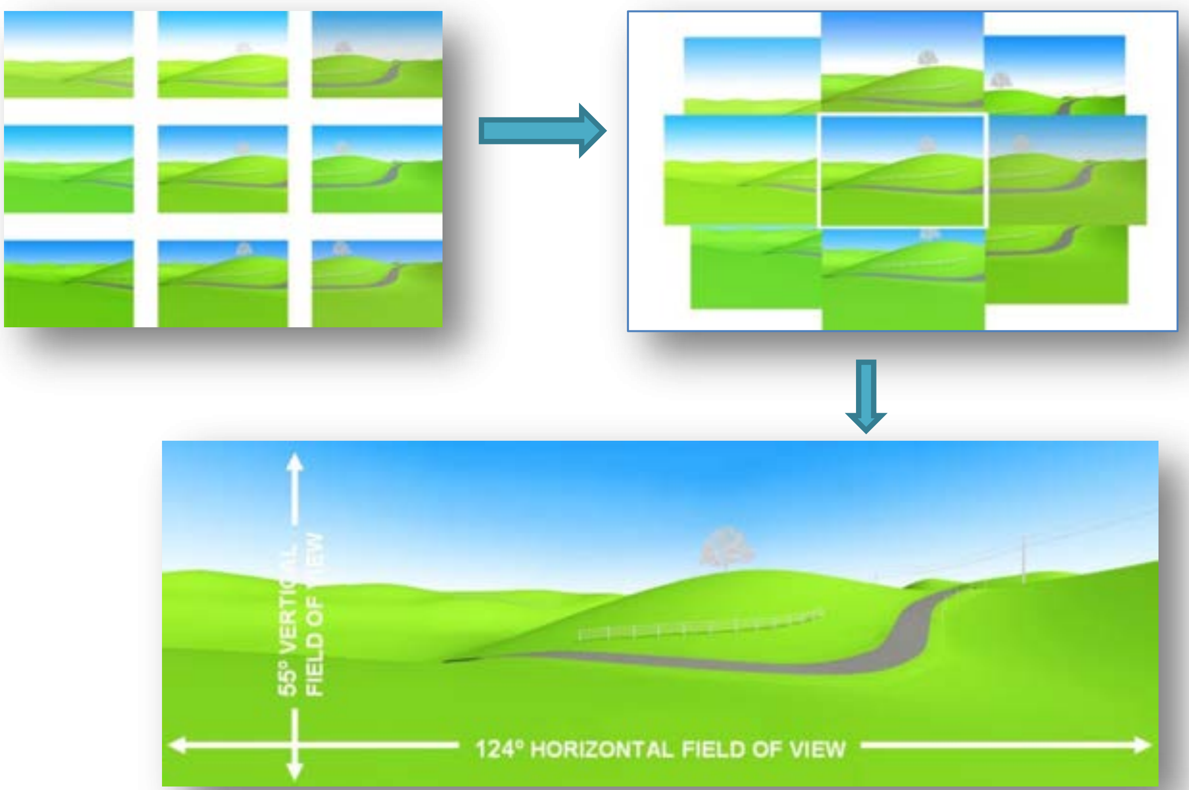

Figure 6–1. Creation of baseline photomontage for development of the TrueView™ simulation

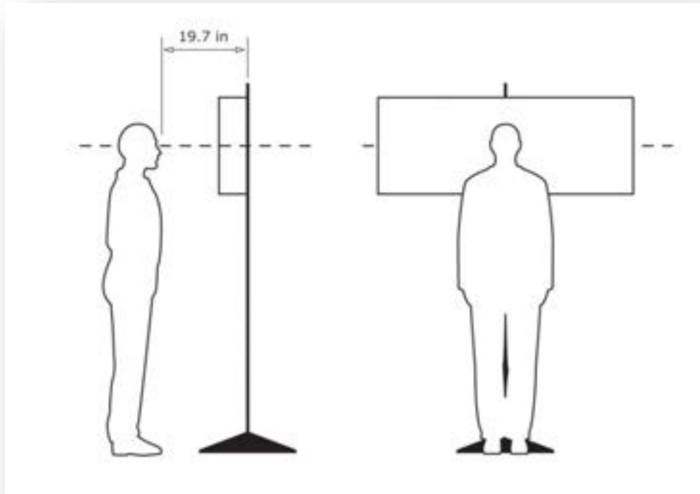

Figure 6–2. Accurate viewing conditions for a TrueView™ simulation

A total of 20 TrueView™ photomontages were developed for the Hypothetical Project (Table 6-1). TrueView™ images are provided in Appendix J.

Table 6–1. Key Observation Points Selected for TrueView™ Photomontages

Key Observation Point	Season	Time of Day
Otis Pike Wilderness	Spring	Afternoon
Sunken Forest	Summer	Morning
Sunken Forest	Fall	Night
Fire Island Lighthouse	Spring	Morning
Fire Island Lighthouse	Fall	Night
Jones Beach State Park	Summer	Afternoon
Jones Beach State Park	Fall	Night
Jacob Riis Park	Spring	Midday
Breezy Point Tip	Spring	Afternoon
Great Kills Park	Spring	Afternoon
Great Kills Park	Fall	Night
Sandy Hook Lighthouse	Spring	Morning
Sandy Hook North Beach	Summer	Midday
Sandy Hook North Beach	Fall	Night
Twin Lights Lighthouse	Winter	Afternoon

Key Observation Point	Season	Time of Day
Twin Lights Lighthouse	Fall	Night
Rumson	Summer	Afternoon
Rumson	Fall	Night
Asbury Park	Summer	Afternoon
Ocean Grove	Fall	Night

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7 SUMMARY OF HYPOTHETICAL PROJECT VISIBILITY

7.1 INTRODUCTION

The overall goal of this study was to improve the understanding of the potential onshore visibility of the Hypothetical Project offshore Long Island, NY. This goal was accomplished by modeling *potential visibility* using viewshed analysis (Section 3), and *expected visibility* using photosimulations to depict the appearance of the Hypothetical Project from various locations (Sections 5 and 6). These products were used collectively to outline the potential visibility of the Hypothetical Project from each of the 16 geographic locations in New York and New Jersey.

The ability of an observer to see offshore renewable energy structures is dependent on a host of factors. The discussion below summarizes the results of the visibility study and synthesizes some of these factors that together serve to determine the actual ability of an observer to see the Hypothetical Project from a particular KOP. Although the Hypothetical Project may be visible from a specific KOP, the consideration and determination of potential impacts to locations represented by KOPs or the surrounding landscape are outside the scope of this study and would require further investigation. This study represents an investigation of *potential* visibility of a hypothetical wind energy development within the New York Call Area. The results of the study provide information to BOEM on what portions of the Call Area wind turbines of this size would be most visible from onshore areas and under what conditions. If an actual project is proposed in this Call Area, the height, spacing, and arrangement of turbines may be different from those portrayed in these simulations.

7.2 POTENTIAL VISIBILITY

7.2.1 Viewshed Limiting Factors

As discussed in Section 3, a viewshed analysis was completed to identify locations from which the Hypothetical Project could potentially be seen. This analysis determined potential visibility based on the relationship between viewshed-limiting factors (e.g., topography, vegetation, structures, buildings, earth curvature, and atmospheric refraction), the height of proposed wind turbine components, and average eye height of the observer. The resulting "seen area," or viewshed, represents the area where one or more turbines or components of the turbines could potentially be seen.

The results of the viewshed model illustrate the influence of structures and curvature of the earth on potential visibility. As expected, seascape views from high-density urban areas and coastal towns are restricted to locations close to shorelines and higher-elevation vantage points where buildings do not block views. For locations along the shoreline where seascape views are uninterrupted, potential visibility of offshore wind turbines is most influenced by curvature of the earth. As demonstrated in Figure 7-1, the portion of the turbine potentially visible decreases with increasing distance from the observer.

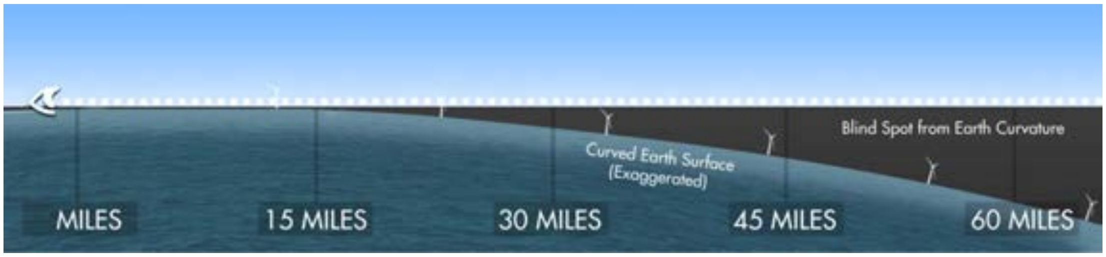

Figure 7–1. Influence of curvature of the earth on potential visibility of offshore wind turbines as demonstrated by viewshed models

Table 7-1 summarizes the portion of offshore wind turbines and extent of the Hypothetical Project potentially visible from each KOP. These estimates of potential visibility are based on the results of the top-of-canopy viewshed model presented in Section 3 and indicate the maximum number of hypothetical project components potentially visible. Note that for all KOPs, the base of the turbine (platform) was classified as not potentially visible in these models. The approximate number of turbines potentially visible was interpreted from Figure 3-6 (Section 3); numbers of turbines potentially visible are ranked as Low (approximately 0 to 45), Moderate (approximately 46 to 90), and High (approximately 91 to 134).

Table 7–1. Potential Visibility of Wind Turbine Components Based on Top-of-Canopy Viewshed Model

Key Observation Point	Approximate Distance to Closest Turbine			Wind Turbine Component(s)	Approximate Number of Turbines Potentially Visible
	Kilometers	Miles	Nautical Miles		
Otis Pike Wilderness	53	33	28	Tip of Blade	Low
Fire Island Sunken Forest	39	24	21	Hub and Blade	High
Fire Island Lighthouse	35	21	19	Hub and Blade	High
Jones Beach State Park	21	13	11	Hub and Blade	High
Jacob Riis Park	30	18	16	Hub and Blade	Moderate
Breezy Point Tip	33	20	18	Hub and Blade	Moderate
Fort Wadsworth	44	27	24	Tip of Blade	Low
Great Kills Park	47	29	25	Tip of Blade	Low
Sandy Hook Lighthouse	34	21	18	Hub and Blade	Moderate
Sandy Hook North Beach	34	21	18	Hub and Blade	Moderate
Sandy Hook Area D	32	20	17	Hub and Blade	Moderate
Green-Wood Cemetery	44	27	24	Tip of Blade	Low
Twin Lights Lighthouse	31	19	17	Hub and Blade	High

Key Observation Point	Approximate Distance to Closest Turbine			Wind Turbine Component(s)	Approximate Number of
Rumson	31	19	17	Hub and Blade	Moderate
Asbury Park	37	23	20	Hub and Blade	Moderate
Ocean Grove	38	24	21	Hub and Blade	Moderate

7.2.2 Visibility Limiting Factors

Though viewshed models provide one measure of potential visibility of the Hypothetical Project, the actual visibility of the offshore wind turbines will depend on a variety of factors, such as contrast of the turbines against the backdrop of the horizon, existing lighting and how it falls on the turbines, the degree of atmospheric haze, and observer characteristics. These factors are collectively referred to as *visibility limiting factors* (USDOI 2013). For the purposes of this study, the influence of atmospheric haze on visibility was incorporated into visual simulations and reflected conditions of average and maximum visibility. The visibility limiting factors with the greatest influence on potential visibility of the Hypothetical Project are discussed below.

Visual Contrast – Visual contrast is described as the extent to which an object appears different from the surrounding visual environment. It is measured using the four basic design elements of form, line, color, and texture (BLM 1986). Primary sources of visual contrast for offshore wind facilities typically include form and line, based on the straight vertical lines of the turbines relative to the flat horizontal lines of the horizon. Movement of the turbine blades and flashing red aircraft avoidance lighting are also major sources of visual contrast. Because the turbines are painted light gray, color is not expected to be a major source of visual contrast for the Hypothetical Project, as the backdrop is generally characterized by the pale, muted tones produced by sea spray and haze low on the horizon at offshore distances beyond 15 miles. Likewise, the smooth texture of the turbines does not contrast strongly against the existing seascape at the distances analyzed in this study.

Viewing Geometry – Viewing geometry refers to the spatial relationship of the observer to the viewed object (i.e., the Hypothetical Project), including both the vertical and horizontal angles of view (USDOI 2013). The vertical angle of view refers to the observer's elevation relative to the viewed object. For example, a person standing on a lighthouse deck overlooking the ocean would be described as having a superior viewing angle relative to an offshore facility. A person viewing that same offshore facility from the beach would have a vertical viewing angle that was "at grade" or "level." An observer having a superior viewing position has the potential to see a greater percentage of the array, as the height of the observer's platform offsets the influence of the curvature of the earth.

The horizontal angle of view refers to the compass direction of the view from the observer to the object. The horizontal angle of view is particularly important for the Hypothetical Project considered in this study because visibility is expected to be greater for observers with a lateral view of the arrays than it would be for those observers whose viewing angle is directed at the tip of the array.

Distance – The degree of perceived visual contrast and scale dominance of an object is influenced by its distance from the observer. As viewing distance increases, the project would appear smaller and less dominant. Likewise, as distance increases, the apparent contrast of color would decrease (BLM 1986).

7.3 EXPECTED VISIBILITY

Expected visibility of the Hypothetical Project was assessed using a combination of visualizations prepared for the study, including single frame simulations, TrueView™ panoramic photomontages, video simulation (night), and a time-lapse video simulation (night) (Sections 4, 5, and 6). Based on the review of these sources, a visibility rating was assigned to each KOP using criteria established by Sullivan et al. (2013) (Table 7-2). Using this metric allowed a standard approach to summarizing expected visibility; however, it is not an indication of impact on visual or scenic resources or historic setting. The visibility assessment for each KOP in the Hypothetical Project is described below. Visibility ratings are summarized in Table 7-3. The following assumptions were made as part of this assessment:

- With the exception of the Fire Island, Twin Lights, and Sandy Hook Lighthouses, observers would experience the landscape from a stationary or mobile viewing position (i.e., sitting or walking along the shoreline). Observers located at the Lighthouses are assumed to be stationary.
- Visibility ratings for each KOP are based on views oriented generally toward the Hypothetical Project, as described in the information banner on the side of the photosimulations. No peripheral views are considered in the ranking of visibility.
- Visibility ratings for each KOP assume views toward the Hypothetical Project are prolonged or fixed. The potential for intermittent views to minimize potential visibility is not considered in this assessment.
- Foreground is defined as less than 3 miles from the observer; middle ground is defined as 3 to 5 miles from the observer; background is defined as more than 5 miles from the observer.

Table 7–2. Criteria Used to Rank Expected Visibility of the Hypothetical Project

Visibility Rating	Criteria
1	Visible only after extended, close viewing; otherwise invisible.
2	Visible when scanning in the general direction of the study subject; otherwise likely to be missed by casual observers.
3	Visible after a brief glance in the general direction of the study subject and unlikely to be missed by casual observers.
4	Plainly visible, so could not be missed by casual observers, but does not strongly attract visual attention or dominate view because of its apparent size for views in the general direction of the study area.
5	Strongly attracts the visual attention of views in the general direction of the study subject. Attention may be drawn by the strong contrast in form, line, color, [or] texture.
6	Dominates the view because the study subject fills most of the field for views in its general direction. Strong contrasts in form, line, color, texture, luminance, or motion may contribute to view dominance.

(SOURCE: Sullivan et al. 2013)

Table 7–3. Summary of Ranking of Expected Visibility of the Hypothetical Project

Key Observation Point (KOPs)	Visibility Ranking	
	Daytime Conditions	Nighttime Conditions
Otis Pike Wilderness	ND	ND
Fire Island Sunken Forest	2	5
Fire Island Lighthouse	3	5
Jones Beach State Park	6	6
Jacob Riis Park	3	5
Breezy Point Tip	3	5
Fort Wadsworth	ND	----
Great Kills Park	ND	2
Sandy Hook Lighthouse	2	----
Sandy Hook North Beach	2	4
Sandy Hook Area D	3	5
Green-Wood Cemetery	ND	----
Twin Lights Lighthouse[1]	4	5
Town of Rumson	2	5
City of Asbury Park	2	5
Town of Ocean Grove	3	5

[1]Also referred to as Navesink Light Station
[2] ND = Not Detectable

7.3.1 Otis Pike Wilderness

Otis Pike Wilderness is located on the Fire Island National Seashore, on public lands administered by the NPS. Potential visibility of the Hypothetical Project from this area was assessed from the Fire Island Wilderness Visitor Center. The KOP was placed at the end of a boardwalk leading to the beach (Figure 1-1). Observer groups represented by this KOP include recreators, tourists, and educational groups. A boardwalk is located adjacent to the Visitor Center where the upland dunes and seascape can be viewed. The Visitor Center provides access to designated fishing areas, trails, and wilderness campsites. Observers experience the seascape from both a stationary and mobile position. The seascape, as viewed from the Otis Pike Wilderness, is large in scale, panoramic, and dominated by the broad horizontal plane of the Atlantic Ocean. Dominant colors in the landscape include the varied blue tones of the ocean and sky, the pale tan of the sandy beach, and the greens of upland vegetation. The horizon appears pale tan/white due to atmospheric haze and sea spray.

The Hypothetical Project is located approximately 33 miles (28 NM) from this KOP. Observer geometry relative to the Hypothetical Project is at grade, with a lateral view of the northern edge of the grid. Seascape views from upland ground-level locations are intermittently blocked by dunes and coastal vegetation. Views to the ocean from the beach are unobstructed, limited only by the curvature of the earth and light refraction.

Based on a review of the TrueView™ Panorama for daytime conditions and single frame simulations for day and night conditions, visibility of the Hypothetical Project from this location was classified as **"Not Detectable."** Because of the distance of the project and curvature of the earth, only the tips of the turbine blades of the northern-most turbines are potentially visible from this location. Potential visibility is greatly reduced by additional visibility limiting factors such as the minimal contrast of the gray-colored turbines against the horizon and the influence of atmospheric haze. Because the turbine hubs fall below the horizon at this distance, night lighting was also classified as **"Not Detectable."**

7.3.2 Fire Island Sunken Forest

Fire Island Sunken Forest is located on the Fire Island National Seashore, on public lands administered by the NPS. Potential visibility of the Hypothetical Project from this area was assessed from the boardwalk trail. The KOP was established on the boardwalk, at a location where natural openings in vegetation allow views extending across the dunes to the Atlantic Ocean (Figure 1-1). Observer groups represented by this KOP include recreators, tourists, and educational groups. Observers experience the seascape in a stationary position at observation decks or interpretive signs and while walking along the boardwalk. The foreground is dominated by the extensive dunes. Topography of the dunes is gentle, characterized by shallow, undulating hills that create enclosure in the foreground. Seascape views from upland ground-level locations are intermitted blocked by low dunes and coastal vegetation. From high-elevation vantage points, views extend outward over the dunes to include the large-scale panorama and dominant horizontal line of the Atlantic Ocean. The existing night sky appears pristine and is not affected by artificial lighting.

The Hypothetical Project is located approximately 24 miles (21 NM) from this KOP. Observer geometry is at grade (level), oriented south-southwest toward the northern edge of the grid. The Hypothetical Project could occupy approximately half of the total field of view to the south. Taking into account the curvature of the earth and atmospheric refraction, the viewshed model indicates that the hubs and blades of the majority of turbines in the array would potentially be visible from this location (Table 7-1). Expected visibility was assessed based on a review of TrueView™ Panoramas and single frame simulations produced for day and night conditions.

Visibility of the Hypothetical Project from this location was assigned a **Visibility Rating of 2** under daytime conditions. The Hypothetical Project is expected to appear "very small and/or faint," but may be discernable when scanning the horizon in the direction of the Hypothetical Project. Visibility of the Hypothetical Project may decrease under certain lighting conditions or during periods of greater atmospheric haze. At this distance it is expected that visibility would be most strongly influenced by atmospheric haze, lighting, and movement of the blades.

Because the turbine hubs would be located above the horizon, FAA avoidance lighting would be visible from this location. TrueView™ Panorama and single frame simulations of night conditions demonstrate the lateral view of the turbine array and the distinct and linear appearance of the turbine rows, particularly in the southeast portion of the grid. The visibility of turbine rows is apparent because aircraft avoidance lighting would be placed on all turbines within the array, including those in the center of the grid (see Section 5 for information on turbine lighting). Lighting from the Hypothetical Project would occupy the majority of an observer's field of view, resulting in a **Visibility Rating of 5**. Turbine lighting would contrast strongly with the surrounding landscape elements, attracting the attention of the observer and becoming focal to the seascape.

7.3.3 Fire Island Lighthouse

The Fire Island Lighthouse is located on the Fire Island National Seashore, on public lands administered by the NPS. Potential visibility of the Hypothetical Project from this location was assessed from the Fire Island Lighthouse deck, with the KOP established outside the door leading from the lens house (Figure 1-1). Observer groups represented by this KOP include recreators, tourists, and educational groups. An NPS staff member accompanies visitors on the deck to facilitate discussion of views from the lighthouse.

Views from the lighthouse deck encompass 360 degrees surrounding the structure. On days of high visibility, observers may view the Manhattan skyline, approximately 50 miles to the northwest. The seascape appears large in scale, panoramic, and dominated by the broad horizontal plane of the beach in the foreground and the Atlantic Ocean beyond. Under nighttime conditions, artificial lighting from residential and commercial centers on the mainland is apparent to the north, east, and west. The night sky above the Atlantic Ocean appears natural, despite the influence of light scatter from the mainland.

The Hypothetical Project is located approximately 21 miles (19 NM) from this KOP. Observer geometry relative to the Hypothetical Project is superior, oriented with a lateral view of the northern edge of the grid. Views to the ocean from the lighthouse deck are unobstructed, limited only by the curvature of the earth and light refraction. Taking into account curvature of the earth and atmospheric refraction, the viewshed model indicates that the hub and blade of the turbines would potentially be visible from this location. A high percentage of the turbines in the array are potentially visible, mostly due to the superior observer position from the lighthouse deck (Table 7-1). Expected visibility of the Hypothetical Project from this location was assessed based on review of TrueView™ Panorama, single frame simulations, and video simulations produced for day and night conditions.

Visibility of the Hypothetical Project from this location was assigned a **Visibility Rating of 3** under daytime conditions. The Hypothetical Project would be visible after a brief glance in the general direction of the study subject, and unlikely to be missed by casual observers. Visibility of the Hypothetical Project may decrease depending on lighting conditions or during periods of greater atmospheric haze. At this distance it is expected that visibility would be most strongly influenced by atmospheric haze, lighting, and movement of the blades.

Because the turbine hubs would be located above the horizon, FAA avoidance lighting would be visible from this location. As discussed for Fire Island Sunken Forest, TrueView™ Panorama and single frame simulations demonstrate the lateral view of the turbine array and the distinct and linear appearance of the turbine rows, particularly in the center of the grid. The visibility of turbine rows is apparent because aircraft avoidance lighting would be placed on all turbines in the array (see Section 5 for information on turbine lighting). Lighting would occupy the majority of an observer's field of view, resulting in a **Visibility Rating of 5**. Turbine lighting would contrast with the surrounding landscape elements and attract the attention of the observer. Night simulations of the Hypothetical Project from this location illustrate red flashing turbine lighting occupying the majority of the field of view, becoming a dominant element of the seascape at night.

7.3.4 Jones Beach State Park

Jones Beach State Park is located on the south shore of Long Island and includes 6.5 miles of beachfront and 2,400 acres of maritime environment. Approximately 6 to 8 million people visit this park each year (NYPRHP 2015). Potential visibility of the Hypothetical Project from this area was assessed from the shoreline, with the KOP established on a boardwalk overlooking the beach (Figure 1-1). Observer groups represented by this KOP primarily include recreators. The seascape from Jones Beach appears large in scale, panoramic, and dominated by the broad horizontal plane of the beach in the foreground and the Atlantic Ocean beyond. During the summer months, high visitor use results in a foreground characterized by a high density of recreators and recreation equipment (e.g., beach umbrellas, chairs) that, collectively, dominate foreground views and interrupt views toward the horizon.

The Hypothetical Project is located approximately 13 miles (11 NM) from this KOP. Observer geometry relative to the Hypothetical Project is at grade, oriented southeast across the northern edge of the grid. Views to the ocean from the beach are unobstructed. Taking into account curvature of the earth and atmospheric refraction, the viewshed model indicates that the hub and blade of the majority of turbines in the hypothetical array would potentially be visible from this location (Table 7-1). Expected visibility of the Hypothetical Project from this location was assessed based on a TrueView™ Panorama, single frame, and video simulations produced for day and night conditions.

Visibility of the Hypothetical Project from this location was assigned a **Visibility Rating of 6** under daytime conditions. The form and line of the wind turbines would contrast strongly against the existing flat, horizontal lines of the horizon. The motion of the turbine blades would attract the attention of the observer. The turbine array could fill the majority of the field of view from this location and appear dominant.

As discussed for other locations on Long Island, night simulations demonstrate the lateral view of the turbine array and the distinct and linear appearance of the turbine rows. The visibility of turbine rows is apparent because aircraft avoidance lighting would be placed on all turbines (see Section 5 for information on turbine lighting). Turbines appear more cluttered near the “base” of the triangular grid, largely due to the angle of the view at this location and the configuration of the grid. Night simulations of the Hypothetical Project from this location illustrate FAA lighting as occupying the majority of the field of view. The Hypothetical Project would be a dominant feature in the night sky and would attract the attention of the observer. Visibility of the Hypothetical Project from this location was assigned a **Visibility Rating of 6** under nighttime conditions.

7.3.5 Jacob Riis Park

Jacob Riis Park is located on the Rockaway Peninsula, a narrow spit separating Jamaica Bay from the Atlantic Ocean. The park is administered by the NPS as part of the Gateway National Recreation Area (NRA). Potential visibility of the Hypothetical Project from this area was assessed from the Rockaway Gateway Greenway. The KOP was established in front of the Riis Bathhouse (Figure 1-1).

The seascape from the Riis Bathhouse appears large in scale and panoramic. When standing on the greenway, foreground views are interrupted by the railing and recreational activity on the beach. To the northeast, large-stature buildings can be seen along the shoreline of Rockaway Beach. Artificial lighting illuminates the boardwalk and beach. The night sky is influenced by light from adjacent urban areas and the shoreline of Long Beach. Observer groups represented by this KOP primarily include recreators and tourists. Views toward the ocean from the beach are unobstructed, limited only by the curvature of the earth and light refraction.

The Hypothetical Project is located approximately 18 miles (16 NM) from this KOP. Observer geometry relative to the Hypothetical Project is at grade, oriented southeast toward the tip of the triangular grid. Taking into account the curvature of the earth and atmospheric refraction, the viewshed model indicates that the hub and blade of the turbines would potentially be visible from this location. The approximate number of turbines potentially visible was classified as moderate, as the more distant rows of turbines would drop below the horizon (Table 7-1). Expected visibility of the Hypothetical Project from this location was assessed based on a TrueView™ Panorama produced for daytime conditions, and single frame and video simulations produced for both day and night conditions.

Visibility of the Hypothetical Project from this location was assigned a **Visibility Rating of 3** under daytime conditions. The offshore wind turbines would be easily detected after a brief look and would be visible to most casual observers; however, the size and scale of the Hypothetical Project when viewed from this location would not compete with the major landscape elements, as views would be limited to the closest rows of turbines, thereby minimizing the apparent scale of the project.

Visibility of the Hypothetical Project from this location was assigned a **Visibility Rating of 5** under nighttime conditions. The configuration of turbines within the grid is apparent from this vantage point, as the view is directed southeast toward the tip of the array. Distinct rows of turbines are apparent in the center of the array, and individual turbines can be seen along the northern edge of the array. The visibility of turbine rows is apparent because aircraft avoidance lighting would be placed on all turbines in the array (see Section 5 for information on turbine lighting). The number of turbines visible in each row is limited to less than 5, as beyond that the lighted hubs drop below the horizon due to the curvature of the earth. Lighting from the

Hypothetical Project would occupy the majority of an observer's field of view and become a major focus of visual attention.

7.3.6 Breezy Point Tip

Breezy Point Tip is located at the tip of the Rockaway Peninsula. Breezy Point Tip is administered by the NPS as part of the Gateway NRA. The KOP was established at a remote access point at the end of a dirt road leading to the beach from Rockaway Point Boulevard (Figure 1-1). Observers at this location are primarily recreators. The seascape from Breezy Point Tip appears large in scale and panoramic, with uninterrupted views extending to the horizon. Buildings are visible to the east at Jacob Riis Park and neighboring areas. The night sky is influenced by artificial lighting emanating from nearby urban areas. At the time of the study, offshore cranes and support vessels were stationed near the shore, to the north of the Hypothetical Project. The vessels were equipped with bright night lighting and appeared dominant on the horizon.

The Hypothetical Project is located approximately 20 miles (18 NM) from this KOP. Observer geometry relative to the Hypothetical Project is at grade, oriented southeast toward the tip of the triangular grid. Taking into account the curvature of the earth and atmospheric refraction, the viewshed model indicates that the hub and blade of the turbines would potentially be visible from this location. The approximate number of turbines potentially visible was classified as moderate because the more distant rows of turbines would drop below the horizon (Table 7-1). Expected visibility of the Hypothetical Project from this location was assessed based on a TrueView™ Panorama produced for daytime conditions and single frame simulations produced for day and nighttime conditions.

Visibility of the Hypothetical Project from this location was assigned a **Visibility Rating of 3** under daytime conditions and periods of maximum visibility. Under such conditions, the Hypothetical Project is expected to be “visible after a brief glance in the general direction of the study subject and unlikely to be missed by casual observers.” As demonstrated by simulations of the Hypothetical Project under average visibility, the degree to which project components may be detectible will depend largely on atmospheric and lighting conditions. It is expected that the motion of the turbine blades would also influence visibility.

For the nighttime condition, visibility of the Hypothetical Project from this location was assigned a **Visibility Rating of 5**. Because the observer's orientation is directed toward the tip of the triangular array, the Hypothetical Project appears smaller in scale compared to other locations on Long Island. Though the grid configuration is apparent toward the center of the array, turbines appear more clustered than linear from this vantage point. The Hypothetical Project is not expected to occupy the majority of a viewer’s field of view. Turbine lighting would be limited to the closest rows of turbines, after which the lighted hubs would drop below the horizon. However, the flashing lights of the turbines would be a major focus of visual attention.

7.3.7 Fort Wadsworth

Fort Wadsworth is located on Staten Island, NY, on lands administered by the NPS Gateway NRA. The KOP was established at the shoreline, in front of a day-use picnic area (Figure 1-1). Observers at this location are primarily recreators. Taking into account the curvature of the earth and atmospheric refraction, the top-of-canopy viewshed model indicates the tips of turbine blades would potentially be visible from this location. Expected visibility of the Hypothetical Project from this location was classified as **"Not Detectable"** based on review of the single frame photosimulations.

7.3.8 Great Kills Park

Great Kills Park is located on Staten Island, NY, on lands administered by the NPS Gateway NRA. The KOP was established in front of the bathhouse, overlooking Lower Bay and the Atlantic Ocean (Figure 1-1). Observers at this location are primarily recreators. The seascape appears large in scale and panoramic; however, some of the New Jersey coastline to the south and the City of Brooklyn and Brighten Beach to the east encroach the view. Under night conditions, artificial lighting emanates from the City of Brooklyn, Brighten Beach, and New Jersey, dominating the night sky from this location and adding to enclosure of the seascape. Isolated white and red lights occupy the horizon of Lower Bay.

The Hypothetical Project is located approximately 29 miles (25 NM) from this KOP. Observer geometry relative to the Hypothetical Project is at grade, oriented southeast toward the tip of the triangular grid. Taking into account the curvature of the earth and atmospheric refraction, the viewshed model indicates that the tips of turbine blades would potentially be visible from this location. The number of turbines potentially visible was classified as low, as only turbines located at the tip of the triangular grid rise above the horizon (Table 7-1). Expected visibility of the Hypothetical Project from this location was assessed based on TrueView™ Panoramas and single frame simulations produced for day and nighttime conditions.

Visibility of the Hypothetical Project from this location was classified as **"Not Detectable."** Because of the distance of the Hypothetical Project and the influence of the curvature of the earth, the viewshed model predicted that only the tips of the turbines would be potentially visible from this location (see Section 3). This potential is greatly reduced by additional visibility-limiting factors such as the minimal contrast of the gray-colored turbines against the horizon and the presence of atmospheric haze.

Simulations of the Hypothetical Project under night sky conditions indicate that FAA lighting from two turbines could be visible from this location, with remaining turbine hubs and associated lighting dropping below the horizon. Turbine lighting would appear similar in size and scale to other sources of light on the horizon. Because aircraft avoidance lighting would be blinking, turbines could be detected when scanning in the general direction of the Hypothetical Project. Consequently, visibility of the Hypothetical Project from this location was assigned a **Visibility Rating of 2** under nighttime conditions.

7.3.9 Sandy Hook Lighthouse

Sandy Hook Lighthouse is located on the northern portion of the Sandy Hook Spit, on public lands administered by the NPS Gateway NRA. The KOP for this location was established on the lighthouse deck, with views directed east-southeast (Figure 1-1). Foreground views from the lighthouse are dominated by mature deciduous coastal forest. Historic buildings, local surface streets, and visitor parking are visible. An observer's attention is drawn outward toward the Atlantic Ocean, where a narrow beach separates the upland forest from the water.

The Hypothetical Project is located approximately 21 miles (18 NM) from this KOP. Observer geometry relative to the Hypothetical Project is superior, oriented east-southeast toward the tip of the triangular grid. Taking into account the curvature of the earth and atmospheric refraction, the viewshed model indicates that the hubs and blades of the turbines would potentially be visible from this location. The percentage of the project potentially visible was ranked as moderate, largely due to the superior observer's position of the lighthouse deck (Table 7-1). Expected visibility of the Hypothetical Project from this location was assessed based on a TrueView™ Panorama produced for daytime conditions and single frame simulations produced for day and nighttime conditions.

Visibility of the Hypothetical Project from this location was assigned a **Visibility Rating of 2** under daytime conditions and periods of maximum visibility. Wind turbines would appear small in scale and low on the horizon. The structures would likely not be detected by the casual observer. When scanning the horizon, turbines would appear low on the horizon, and the movement of the blades could be apparent.

No nighttime visual simulations were prepared for this location due to the interference of the lighthouse strobe. The light house is an active aid to navigation with an electronically lit Fresnel lens maintained by the U.S. Coast Guard. Based on observer geometry and proximity to the Hypothetical Project, it is expected that the aircraft avoidance lighting on top of the turbine arrays would appear distinct, as views would extend along the axis of the grid. Visibility of lighted turbines would be limited to the upper portion of the tip of the triangular grid, as turbines located in the eastern half of the grid (i.e., base of the triangular grid) would drop below the horizon due to distance and curvature of the earth.

7.3.10 Sandy Hook North Beach

Sandy Hook North Beach is located on the eastern shoreline of the Sandy Hook Spit, on public lands administered by the NPS Gateway NRA. The KOP was established on the beach overlooking the Atlantic Ocean, with views generally directed to the southeast (Figure 1-1). Observers at this location are primarily recreators.

The seascape of Sandy Hook North Beach is dominated by the broad, horizontal lines of the beach and ocean. The landscape is both large in scale and panoramic, with views extending to the horizon. Color is composed primarily of the tan colors of the sand, and—on a clear day—the deep blue of the water and sky. A band of light tan to off-white haze was present on the horizon for many of the days this location was visited. Under night conditions, lighting from the Long Island shoreline is visible, providing enclosure to the seascape to the north.

The Hypothetical Project is located approximately 21 miles (18 NM) from this KOP. Observer geometry relative to the Hypothetical Project is at grade, oriented east-southeast across the tip and the southwestern edge of the turbine array. Taking into account the curvature of the earth and atmospheric refraction, the viewshed model indicates that the hubs and blades of the turbines would potentially be visible from this location. The number of the turbines visible from this location was classified as moderate (Table 7-1). Expected visibility of the Hypothetical Project from this location was assessed based on TrueView™ Panoramas and single frame simulations produced for day and nighttime conditions.

Visibility of the Hypothetical Project from this location was assigned a **Visibility Rating of 2** under daytime conditions. Wind turbines would appear small in scale and low on the horizon. When scanning the horizon, turbines would appear low on the horizon, and the movement of the blades could be apparent.

Visibility of the Hypothetical Project from this location was assigned a **Visibility Rating of 4** under nighttime conditions. The aircraft avoidance lighting would be plainly visible, so could not be missed by casual observers, but would not strongly attract attention or dominate the view because of its apparent size. As for views from the Sandy Hook Lighthouse, visibility of lighted turbines would be limited to the upper portion of the tip of the triangular grid, as turbines in the eastern half of the grid (i.e., base of the triangular grid) would drop below the horizon due to distance and curvature of the earth.

7.3.11 Sandy Hook Area D

Sandy Hook Area D is located on the eastern shoreline of the Sandy Hook Spit, on public lands administered by the NPS Gateway NRA. The KOP was established on the beach overlooking the Atlantic Ocean, with views generally directed to the east (Figure 1-1). Observers at this location are primarily recreators.

The seascape of Sandy Hook Area D is similar to that observed at Sandy Hook North Beach: large in scale and panoramic, with views extending to the horizon and dominated by the broad, horizontal lines of the beach and ocean. Color is composed primarily of the tan colors of the sand, and—on a clear day—the deep blue of the water and sky. Under night conditions, lighting from the Long Island shoreline is visible, providing enclosure to the seascape to the north. Lighting from overflying commercial aircraft is common.

The Hypothetical Project is located approximately 20 miles (17 NM) from this KOP. Observer geometry relative to the Hypothetical Project is at grade, oriented east-southeast across the tip and the southwestern edge of the turbine array. Taking into account curvature of the earth and atmospheric refraction, the viewshed model indicates that the hubs and blades of the turbines would potentially be visible from this location. The number of turbines visible from this location was classified as moderate (Table 7-1). Expected visibility of the Hypothetical Project from this location was assessed based on single frame and video simulations (including one time-lapse night video simulation).

Visibility of the Hypothetical Project from this location was assigned a **Visibility Rating of 3** under daytime conditions and periods of maximum visibility. Wind turbines would be visible when scanning in the general direction of the study subject; otherwise, turbines are likely to be missed by casual observers. When scanning the horizon, turbines would appear low on the horizon, and the movement of the blades could be apparent.

Visibility of the Hypothetical Project from this location was assigned a **Visibility Rating of 5** under nighttime conditions because the aircraft avoidance lighting would be plainly visible. Blinking of aircraft avoidance lights would attract the attention of observers and could dominate the horizon. However, because the observer angle is oriented toward the tip of the triangular array, turbine rows appear linear, thereby minimizing the apparent scale of the Hypothetical Project.

7.3.12 Green-Wood Cemetery

Green-Wood Cemetery is a private cemetery located in Brooklyn, NY. This site is a registered National Historic Landmark. The KOP was established on a prominent hill in the cemetery, overlooking the skyline and Jamaica Bay toward the Atlantic Ocean (Figure 1-1). Observers at this location include individuals attending burial services, tourists, and cemetery managers and maintenance workers. Taking into account the curvature of the earth and atmospheric refraction, the top-of-canopy viewshed model indicates the tips of turbine blades would potentially be visible from this location; however, the number of turbines with potential visibility was classified as low (Table 7-1). Expected visibility of the Hypothetical Project from this location was classified as **"Not Detectable"** based on review of the single frame photosimulations under day and night conditions.

7.3.13 Twin Lights Lighthouse

Twin Lights Lighthouse is located in Highlands, NJ, in Monmouth County. The lighthouse is situated on top of a high bluff overlooking the communities of Highlands, Atlantic Highlands, Navesink, Rumson, Fairhaven, and Seabright, and the open beaches and natural areas of Sandy Hook, the Navesink River, and Sandy Hook Bay. Highway 36 extends across the foreground, crossing the Navesink River and heading south along the New Jersey shoreline. The KOP was placed on the lighthouse deck (Figure 1-1). Views from this location are seen through safety railings on the lighthouse deck. Though visual elements of the foreground are complex, the eye is drawn to the broad, flat panorama of the Atlantic Ocean during daytime conditions.

Under night conditions, foreground views are dominated by artificial lighting illuminating the highway, residential areas, and docks. Light is reflected off the flat water of the Navesink River. To the north, Long Island appears distinct due to contiguous lighting along the shoreline, adding to the enclosure of the seascape. Light sources appear as white to golden tones. Commercial aircraft on approach or ascent from local airports are apparent due to lighting against the night sky.

The Hypothetical Project is located approximately 19 miles (17 NM) from this KOP. Observer geometry relative to the Hypothetical Project is superior, oriented eastward across the tip and the southwestern edge of the turbine array. Taking into account the curvature of the earth and atmospheric refraction, the viewshed model indicates that the hubs and blades of the turbines would theoretically be visible from this location. The number of turbines within the grid considered potentially visible was classified as high, largely due to the superior observer position from the lighthouse deck and the resulting offset to the curvature of the earth (Table 7-1). Expected visibility of the Hypothetical Project from this location was assessed based on TrueView™ Panoramas and single frame simulations for day and nighttime conditions.

Visibility of the Hypothetical Project from this location was assigned a **Visibility Rating of 4** under daytime conditions. Wind turbines would be "plainly visible, so could not be missed by casual observers"; however, the turbines would not attract attention or dominate the view. Configuration of turbines in a linear grid pattern would not be apparent under daytime conditions.

Visibility of the Hypothetical Project from this location was assigned a **Visibility Rating of 5** under nighttime conditions because the aircraft avoidance lighting would attract the attention of observers and appear as a dominant element in the seascape. Parallel turbine arrays would be distinct, as the observer geometry from the lighthouse provides for views along the axis of the grid. Arrays would appear as a series of approximately seven lines leading southeast away from the shoreline. Turbine lighting could increase the enclosure of the seascape already provided by night lighting visible from Long Island.

7.3.14 Town of Rumson, NJ

The Town of Rumson, NJ, is located on the north shoreline, in Monmouth County. The KOP was established on a pathway leading to a public beach (Figure 1-1). Views from this location are oriented eastward. From this location, the seascape of the Atlantic Ocean appears large in scale and panoramic, with views extending to the horizon.

The Hypothetical Project is located approximately 19 miles (17 NM) from this KOP. Observer geometry relative to the Hypothetical Project is at grade, oriented eastward across the tip and southwestern edge of the turbine array. Taking into account the curvature of the earth and atmospheric refraction, the viewshed model indicates that the hubs and blades of the turbines could potentially be visible from this location. The number of turbines in the array considered potentially visible was ranked as moderate (Table 7-1). Expected visibility of the Hypothetical Project from this location was assessed based on TrueView™ Panoramas and single frame simulations produced for day and nighttime conditions.

Visibility of the Hypothetical Project from this location was assigned a **Visibility Rating of 2** under daytime conditions. Wind turbines would appear small in scale and low on the horizon. The structures would likely not be detected by the casual observer. Though turbines would be low on the horizon, the movement of the blades could attract attention. This movement would be most pronounced for turbines at the northwestern-most tip of the triangular grid, as the hub of turbines in rows situated in the eastern portion of the grid would drop below the horizon.

Visibility of the Hypothetical Project from this location was assigned a **Visibility Rating of 5** under nighttime conditions because the aircraft avoidance lighting would attract the attention of observers and appear as a dominant element in the seascape. Rows of turbines on the southern edge of the array would be apparent due to the angle of that edge relative to the observer. Visibility would be limited to approximately five rows of turbines situated at the top portion of the triangular grid (at the tip), as the lighted hubs of turbines located farther east would drop below the horizon.

7.3.15 City of Asbury Park, NJ

The City of Asbury Park, NJ, is located in Monmouth County, along the northern shoreline of New Jersey. The KOP was established on Asbury Park Boardwalk, adjacent to the Convention Hall (Figure 1-1). The view from the KOP is directed northeast and encompasses the boardwalk, beach, and Atlantic Ocean. The seascape appears large in scale and panoramic, with views extending to the horizon.

The closest turbine of the Hypothetical Project is located approximately 23 miles (20 NM) from this KOP. Observer geometry relative to the Hypothetical Project is at grade, oriented eastward along the southwestern edge of the turbine array. Taking into account the curvature of the earth and atmospheric refraction, the viewshed model indicates that the hubs and blades of the turbines would potentially be visible from this location. The number of turbines in the array considered potentially visible was ranked as moderate (Table 7-1). Expected visibility of the Hypothetical Project from this location was assessed based on a TrueView™ Panorama produced for daytime conditions, and single frame and video simulations produced for day and nighttime conditions.

Visibility of the Hypothetical Project from this location was assigned a **Visibility Rating of 2** under daytime conditions. Wind turbines would appear small in scale. Due to the curvature of the earth, turbine hubs would be visible just above the horizon, with the downward rotation of the blades dipping below the horizon. Consequently, the structures would likely not be detected by the casual observer. Though turbines would be low on the horizon, the movement of the blades could attract attention.

Visibility of the Hypothetical Project from this location was assigned a **Visibility Rating of 5** under nighttime conditions because the aircraft avoidance lighting would attract the attention of observers and appear as a dominant element in the seascape. Offshore wind turbines of the Hypothetical Project would appear as a broad line across the horizon, as only turbines in the most proximate rows along the southern edge of the array would be visible. Turbines to the northeast would drop below the horizon, and therefore would not be visible.

7.3.16 Ocean Grove, NJ

The Town of Ocean Grove is located in Neptune Township, Monmouth County, NJ. The town is situated on the New Jersey shoreline and characterized by iconic Victorian architecture, a boardwalk paralleling the beach, and a central beach pavilion. The KOP was established in front of the beach pavilion (Figure 1-1). A narrow corridor of tall shrubs exists between the boardwalk and the beach, blocking views of the shoreline and Atlantic Ocean from much of this walkway. From the beach, views extend to the horizon and appear large in scale and panoramic. The beach is accessible for a fee. Views from the beach pavilion are partially blocked by tall shrubs and dunes. Observers at this location are primarily residents, recreators, and tourists. The pavilion is used for public meetings and religious services.

The Hypothetical Project is located approximately 24 miles (21 NM) from this KOP. Observer geometry relative to the Hypothetical Project is at grade, oriented eastward along the southwestern edge of the turbine array. Taking into account the curvature of the earth and atmospheric refraction, the viewshed model indicates that the hubs and blades of the closest turbines would potentially be visible from this location. The number of turbines in the array considered potentially visible was ranked as moderate (Table 7-1). Expected visibility of the Hypothetical Project from this location was assessed based on a TrueView™ Panorama produced for nighttime conditions and single frame simulations produced for day and nighttime conditions.

Visibility of the Hypothetical Project from this location was assigned a **Visibility Rating of 3** under daytime conditions, indicating that the Hypothetical Project is expected to be “visible after a brief glance in the general direction of the study subject and unlikely to be missed by casual observers.” Though turbines would be low on the horizon, the movement of the blades is expected to attract attention. The turbines would be apparent, but would not dominate or compete with existing landscape elements.

Under nighttime conditions, visibility of the Hypothetical Project from this location was assigned a **Visibility Rating of 5** because as the aircraft avoidance lighting would attract the attention of observers and appear as a dominant element in the seascape. As described for Asbury Park, offshore wind turbines of the Hypothetical Project would appear as a broad line across the horizon. Visibility would be limited to the most proximate rows along the southern edge of the array. Turbines located to the northeast would drop below the horizon, and therefore would not be visible.

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Appendix A: Permits

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SCIENTIFIC RESEARCH AND COLLECTING PERMIT

Grants permission in accordance with the attached general and special conditions

United States Department of the Interior
National Park Service
Fire Island

Study#: FIIS-00092
Permit#: FIIS-2014-SCI-0007
Start Date: May 07, 2014
Expiration Date: Dec 27, 2014
Coop Agreement#:
Optional Park Code:

Name of principal investigator:

Name: Louise Kling	Phone:503.948.7291	Email:louise.kling@urs.com

Name of institution represented:
URS Corporation

Co-Investigators:

Name: Edward Twiss	**Phone:** 518.573.9001	**Email:** edward.twiss@truescape.com
Name: William Hoffman	**Phone:** 703.787.1549	**Email:** william.hoffman@boem.gov
Name: Austin Beausoleil	**Phone:** 917.587.5422	**Email:** austin.beausoleil@truescape.com
Name: Louise Kling	**Phone:** 503.948.7291	**Email:** louise.kling@urs.com

Study Title:
Bureau of Ocean Energy Management (BOEM) Renewable Energy Viewshed Analysis

Purpose of study:
To support Bureau of Ocean Energy Management (BOEM) in identifying an area offshore Long Island, New York suitable for renewable energy development, URS is supporting BOEM's objective to inform planning and decision-making regarding renewable energy development by:
•Providing stakeholders with accurate and realistic visual simulations of a wind energy facility offshore Long Island, NY from various stakeholder key observation points (KOPs) determined in coordination with the National Park Service (NPS)
•Developing viewshed models detailing theoretic visibility of the proposed project from the KOPs and the surrounding landscape

Subject/Discipline:
Coastal / Marine Systems

Locations authorized:
Photographs will be obtained at NPS-selected key observation points (KOPs) identified as follows:

Fire Island Light House (LAT: 40.632506, LONG: -73.218414)
Sunken Forest (LAT: 40.655022, LONG: -73.112003)
Fire Island Otis Pike Wilderness (LAT 40.730627, LONG -72.871315)

Specific camera locations established at each KOP may be subject to change based on ongoing coordination with NPS staff.

Transportation method to research site(s):
KOPs will be access via automobile, foot travel, and ferry.

Collection of the following specimens or materials, quantities, and any limitations on collecting:

Name of repository for specimens or sample materials if applicable:

Specific conditions or restrictions (also see attached conditions):

1. Collection of specimens - Only authorized collections allowed, based on specific permit request and approval.

2. Reports - The permittee is required to submit an Investigator s Annual Report by December 31, of each year that the permit is valid. A final IAR is required by Dec. 31 of the final year of the project. Copies of final reports/ materials resulting from the study (copies of field notes, databases, maps, photos, and/or other materials may also be requested and need to be discussed with the park research coordinator) are required within 6 months of the end date of the permit. (Contact Chief of resources Management for information on how to submit information. See numbers below)

3. Methods of travel - Vessel travel within the park is subject to marina regulations. Vehicle travel within the park is subject to park driving regulations, conditions specified by the townships of Islip and Brookhaven and FIIS. Driving permits from the townships must be obtained before applying for an FIIS driving permit. (Contact the Chief Rangers Office for more information. See number below)

4. Mechanized equipment - No use of mechanized equipment in designated wilderness allowed .

5. NPS participation - The permittee should not anticipate assistance from Fire Island staff, unless previously agreed to under other stipulations. A PreSurvey meeting needs to take place with Survey crew leader and park Visitor and Protection Staff. Contractor should call Chief rangers Office to set time and date.

6. Permanent markers and field equipment - The permittee is required to remove all markers or equipment from the field after the completion of the study.

7. Access to park and restricted areas - Approval for any activity is contingent on the park being open and staffed for required operations. No entry into restricted areas is allowed unless authorized in additional park specific stipulations attached to this permit.

8. Notification - The permittee is required to contact the Chief Ranger s office prior to initiating any fieldwork authorized by this permit. The Chief Ranger should be notified of the investigator s schedule of fieldwork, including dates, times and sampling locations and of any changes to said schedule.

9. Expiration date - Permits expire on the date listed. Nothing in this permit shall be construed as granting any exclusive research privileges or automatic right to continue, extend, or renew this permit(s).

10. Other stipulations - This permit includes by reference all stipulations listed in the application materials or in additional attachments as provided.

Chief of Resources Management - 631-687-4760
Chief Ranger - 631-687-4757

Recommended by park staff(name and title):

Approved by park official:

Title:

Superintendent

Reviewed by Collections Manager:

Yes X No ____

Date Approved:

4/28/2014

I Agree To All Conditions And Restrictions Of this Permit As Specified
(Not valid unless signed and dated by the principal investigator)

(Principal investigator's signature)

5/23/2014
(Date)

THIS PERMIT AND ATTACHED CONDITIONS AND RESTRICTIONS MUST BE CARRIED AT ALL TIMES WHILE CONDUCTING RESEARCH ACTIVITIES IN THE DESIGNATED PARK(S)

United States Department of the Interior

NATIONAL PARK SERVICE
Gateway National Recreation Area
210 New York Ave., Staten Island, N.Y. 10305

IN REPLY REFER TO:

N22 (GATE-NRM)

May 5, 2014

Ms. Louise Kling
URS Corporation
111 SW Columbia St., Suite 1500
Portland, OR 97232

Dear Ms. Kling:

We are pleased to enclose the Scientific Research and Collecting Permit that you requested for *Bureau of Ocean Energy Management (BOEM) renewable energy viewshed analysis.* The permit number is GATE-2014-SCI-0028. The permit remains valid through December 31, 2015. Please note that your National Park Service (NPS) study number is GATE-370. The study number is the umbrella identification of all NPS permits issued in Gateway NRA for your viewshed surveys. Please refer to this study number when referencing your permit.

Please read your permit carefully to ensure that you are familiar with all the NPS general conditions listed in the enclosed blue pages, as well as specific conditions listed in the permit. In addition, we request that you sign the last page of the permit prior to initiating any fieldwork. Please be aware that your signature indicates agreement with all the mentioned conditions and restrictions of the permit. You are requested to send a photocopy, e-mail attachment, or fax of the one signature page to:

Research and Collecting Permit Coordinator
Natural Resource Management Division
Gateway National Recreation Area
210 New York Avenue
Staten Island, New York 10305-5019
[fax 718-354-4548; e-mail george_frame@nps.gov]

Keep the entire original signed permit with you, to show to conservation law enforcement officers and other park staff whenever requested.

An Investigator's Annual Report should be completed at the end of the calendar year by going to the National Park Service web site [https://irma.nps.gov/RPRS/]. You will receive a username and password in December of each year. At this website, you will find a short form to complete a brief summary of the year's results from your project. If you have any questions regarding the website, please contact us.

Before you begin your fieldwork, please contact the Unit Coordinators and the natural resources specialist at each site, as explained in the Specific Conditions section of your permit.

We look forward to reviewing your findings and appreciate your cooperation. If you have any questions, please contact me at 718-354-4510. A park brochure and map of the Jamaica Bay Unit boundary are enclosed.

Sincerely,

Douglas A. Adamo

Douglas A. Adamo
Chief, Natural Resource Management Division

Enclosures
cc: Permit Coordinator, NRMD

SCIENTIFIC RESEARCH AND COLLECTING PERMIT Grants permission in accordance with the attached general and special conditions United States Department of the Interior National Park Service Gateway	Study#: GATE-00370 Permit#: GATE-2014-SCI-0028 Start Date: May 05, 2014 Expiration Date: Dec 31, 2015 Coop Agreement#: Optional Park Code: SHU, SIU, JBU, DNR

Name of principal investigator:

Name: Louise Kling | **Phone:**503.948.7291 | **Email:**louise.kling@urs.com

Name of institution represented:
URS Corporation

Co-Investigators:

Name: William Hoffman	**Phone:** 703.787.1549	**Email:** william.hoffman@boem.gov
Name: Edward Twiss	**Phone:** 518.573.9001	**Email:** edward.twiss@truescape.com
Name: Austin	**Phone:** 917.587.5422	**Email:** austin.beausoleil@truescape.com

Study Title:
Bureau of Ocean Energy Management (BOEM) Renewable Energy Viewshed Analysis

Purpose of study:
To support Bureau of Ocean Energy Management (BOEM) in identifying an area offshore Long Island, New York suitable for renewable energy development. URS is supporting BOEM's objective to inform planning and decision-making regarding renewable energy development by:
•Providing stakeholders with accurate and realistic visual simulations of a wind energy facility offshore Long Island, NY from various stakeholder key observation points (KOPs) determined in coordination with the National Park Service (NPS)
•Developing viewshed models detailing theoretic visibility of the proposed project from the KOPs and the surrounding landscape

Subject/Discipline:
Land Use - Mining, oil, gas

Locations authorized:
Fieldwork is authorized within all 3 administrative units of Gateway National Recreation Area, NJ & NY.

Photographs will be obtained at NPS-selected key observation points (KOPs) identified as follows:

Breezy Point Tip (LAT: 40.543508, LONG: -73.939703)
Sandy Hook North Beach (LAT: 40.466288, LONG -73.996325)
Sandy Hook Area D (LAT: 40.426825, -73.983523)
Fort Wadsowrth (40.600127, -74.05445)
Great Kills (LAT: 40.537628, LONG: -74.129291)
Sandy Hook Light House (LAT: 40.461721, LONG: -74.002019)
Jacob Riis Park (LAT: 40.565932, -73.869772)

Specific camera locations established at each KOP may be subject to change based on ongoing coordination with NPS staff.

Transportation method to research site(s):
Vehicles will be parked in designated visitor parking lots.
Travel from the parking lots will be on foot.

Collection of the following specimens or materials, quantities, and any limitations on collecting:
Fieldwork consists of visual observations, photography, and computer simulation of landscapes during changing seasons throughout the year.

This permit does not authorize handling or collecting plants or animals.

Name of repository for specimens or sample materials if applicable:

Specific conditions or restrictions (also see attached conditions):
This is a replacement of permit number GATE-2014-SCI-0013, which now is cancelled because of a change in contractor and

principal investigator. When communicating with NPS about this research, please refer to study number GATE-370. The website for NPS Scientific Research and Collecting Permits is:
https://irma.nps.gov/RPRS/

Always carry a copy of this permit when doing fieldwork within Gateway NRA. Also, carry copies of other permits or licenses that you currently hold for this research, e.g. from USFWS and NYSDEC or NJDEP. Law enforcement officers and NPS staff may ask to see your permits

The Principal Investigator is responsible for complying with all federal, state, and local laws and regulations. The P.I. must obtain all necessary permits from the State of New Jersey Department of Environmental Protection (e.g., Division of Fish and Wildlife, Wildlife Permits Unit, P.O. Box 400, Trenton, NJ 08625-0400, telephone 609-292-9410), State of New York Department of Environmental Conservation (e.g., Division of Fish and Wildlife, Special Licenses Unit, 625 Broadway, Albany, NY 12233-4752, telephone 518-402-8985). If part of the research is to be done outside the national park boundary, the P.I. should also check with the City of New York Department of Parks and Recreation to see if their permit is needed (contact their Natural Resources Group at e-mail: research.permits@parks.nyc.gov).

IN CASE OF EMERGENCY, or to report environmental crimes, contact the United States Park Police dispatch at 718-338-3988 [in New York only], or the Sandy Hook NPS 24-hour off-site Communications Center Dispatch at 732-872-5900 [in New Jersey only].

Before commencing fieldwork at the start of the season, please inform the local Gateway NRA Coordinator:

Jamaica Bay Unit Coordinator Dave Taft (telephone 718-338-3338, ext. 238) or Rita Mullally (telephone 718-338-3338, ext. 234).

Staten Island Unit Coordinator Brian Feeney (telephone 718-354-4641 or 718-354-4663) or William Tate (telephone 718-351-6985, cell 347-865-7770).

Sandy Hook Unit Coordinator Pete McCarthy (cell phone 917-295-1518, office telephone 732-872-5913), Facility Manager Brian Forseth (cell phone 732-682-3266, office telephone 732-872-5921), or Operations Chief Robert Louden (mobile telephone 732-489-0734).

Other helpful local site contacts are the following:
JBU - Jamaica Bay Wildlife Refuge: acting refuge manager (telephone 718-318-3486) or Edgardo Castillo (718-318-4340);
JBU - Breezy Point beaches: Hanem Abouelezz (office phone 718-338-3338 x 222), or Tony Luscombe (private cell phone 917-861-4775);
SIU - Great Kills Park, Hoffman Island, Swinburne Island, Miller Field, Fort Wadsworth: William Tate (telephone 718-351-6985, cell 347-865-7770), or the Great Kills Ranger Station (telephone 718-987-6729);
SHU - Jeanne McArthur-Heuser (cell phone 908-309-6282).

Prior to initiating fieldwork, please contact Jessica Browning (telephone 718-338-3338, extension 246; e-mail jessica_browning@nps.gov), to get seasonal Researcher Identification Badges and Parking Permits from the Resource Learning Center (formerly Jamaica Bay Institute) at Bldg. 69 on Floyd Bennett Field, Brooklyn, NY 11234. The Identification Badge, when displayed on each fieldworker, will identify the individual as being authorized to walk off visitor trails when doing research. The brightly colored 3x4-inch Identification Badges and the 8.5x11-inch Parking Permits may be requested in advance and received by mail.

Researchers are restricted from entering the Pennsylvania Avenue Landfill, the Fountain Avenue Landfill, heronry islands, and demarcated Threatened or Endangered bird nesting areas. All authorized boat access to national park islands will be done in coordination with other researchers to minimize disturbance to nesting birds.

Researchers who expect to approach near the 100-yard security perimeter of JFK International Airport should telephone the Port Authority Police a day in advance; their telephone numbers are 718-244-4321 (Tour Commander), 718-244-4335 (Police Desk), or 718-244-8125 (for a live person to talk to).

Researchers and all visitors to Great Kills Park in the Staten Island Unit are prohibited from entering the closed area, where there are possible hazards from radiation. The closed area extends from Buffalo Avenue to the road that parallels the east shore of Great Kills harbor, and from Hylan Boulevard to the boat launch ramp and field stations. The entire shoreline of Great Kills Harbor (within the NPS boundary) is open to fishermen and pedestrians. Only Buffalo Avenue and the parking lots around the ferry dock and on the ocean side of Buffalo Avenue are open to vehicles.

The Principal Investigator must complete an Investigator Annual Report (IAR) on the NPS website. At the end of each calendar year a reminder will be sent, along with the username and password. Please summarize the research results in a few paragraphs, report the number of person-days spent at each site, and quantify the items collected at each site.

The Principal Investigator is responsible for providing at least two copies of all unpublished and published reports that result from this research. Please mail the reports to:
Scientific Research & Collecting Permits Coordinator
Natural Resource Management Division
Gateway National Recreation Area
210 New York Avenue
Staten Island, NY 10305-5019
Digital copies may be e-mailed to the following [george_frame@nps.gov].
The Permits Coordinator will distribute the copies within Gateway NRA.

Questions about Scientific Research and Collecting Permits may be directed to:
Doug Adamo
Chief, Natural Resource Management Division
210 New York Avenue
Staten Island, NY 10305-5019
[tel. 718-354-4510, fax 718-354-4548, email doug_adamo@nps.gov].

Recommended by park staff(name and title):
Douglas A. Adamo, Chief NRMD 5/5/14

Reviewed by Collections Manager:
Yes DBu No ___

Approved by park official:

Date Approved:
5/5/14

Title:
Chief, Resource Mgmt. Division

I Agree To All Conditions And Restrictions Of this Permit As Specified
(Not valid unless signed and dated by the principal investigator)

(Principal investigator's signature)

May 9, 2014
(Date)

THIS PERMIT AND ATTACHED CONDITIONS AND RESTRICTIONS MUST BE CARRIED AT ALL TIMES WHILE CONDUCTING RESEARCH ACTIVITIES IN THE DESIGNATED PARK(S)

GENERAL CONDITIONS
For
SCIENTIFIC RESEARCH AND COLLECTING PERMIT

United States Department of the Interior
National Park Service

1. **Authority** - The permittee is granted privileges covered under this permit subject to the supervision of the superintendent or a designee, and shall comply with all applicable laws and regulations of the National Park System area and other federal and state laws. A National Park Service (NPS) representative may accompany the permittee in the field to ensure compliance with regulations.

2. **Responsibility** - The permittee is responsible for ensuring that all persons working on the project adhere to permit conditions and applicable NPS regulations.

3. **False information** - The permittee is prohibited from giving false information that is used to issue this permit. To do so will be considered a breach of conditions and be grounds for revocation of this permit and other applicable penalties.

4. **Assignment** - This permit may not be transferred or assigned. Additional investigators and field assistants are to be coordinated by the person(s) named in the permit and should carry a copy of the permit while they are working in the park. The principal investigator shall notify the park's Research and Collecting Permit Office when there are desired changes in the approved study protocols or methods, changes in the affiliation or status of the principal investigator, or modification of the name of any project member.

5. **Revocation** - This permit may be terminated for breach of any condition. The permittee may consult with the appropriate NPS Regional Science Advisor to clarify issues resulting in a revoked permit and the potential for reinstatement by the park superintendent or a designee.

6. **Collection of specimens (including materials)** - No specimens (including materials) may be collected unless authorized on the Scientific Research and Collecting permit.

The general conditions for specimen collections are:

- Collection of archeological materials without a valid Federal Archeology Permit is prohibited.
- Collection of federally listed threatened or endangered species without a valid U.S. Fish and Wildlife Service endangered species permit is prohibited.
- Collection methods shall not attract undue attention or cause unapproved damage, depletion, or disturbance to the environment and other park resources, such as historic sites.
- New specimens must be reported to the NPS annually or more frequently if required by the park issuing the permit. Minimum information for annual reporting includes specimen classification, number of specimens collected, location collected, specimen status (e.g., herbarium sheet, preserved in alcohol/formalin, tanned and mounted, dried and boxed, etc.), and current location.

12. **Mechanized equipment -** No use of mechanized equipment in designated, proposed, or potential wilderness areas is allowed unless authorized by the superintendent or a designee in additional specific conditions associated with this permit.

13. **NPS participation** - The permittee should not anticipate assistance from the NPS unless specific arrangements are made and documented in either an additional stipulation attached to this permit or in other separate written agreements.

14. **Permanent markers and field equipment -** The permittee is required to remove all markers or equipment from the field after the completion of the study or prior to the expiration date of this permit. The superintendent or a designee may modify this requirement through additional park specific conditions that may be attached to this permit. Additional conditions regarding the positioning and identification of markers and field equipment may be issued by staff at individual parks.

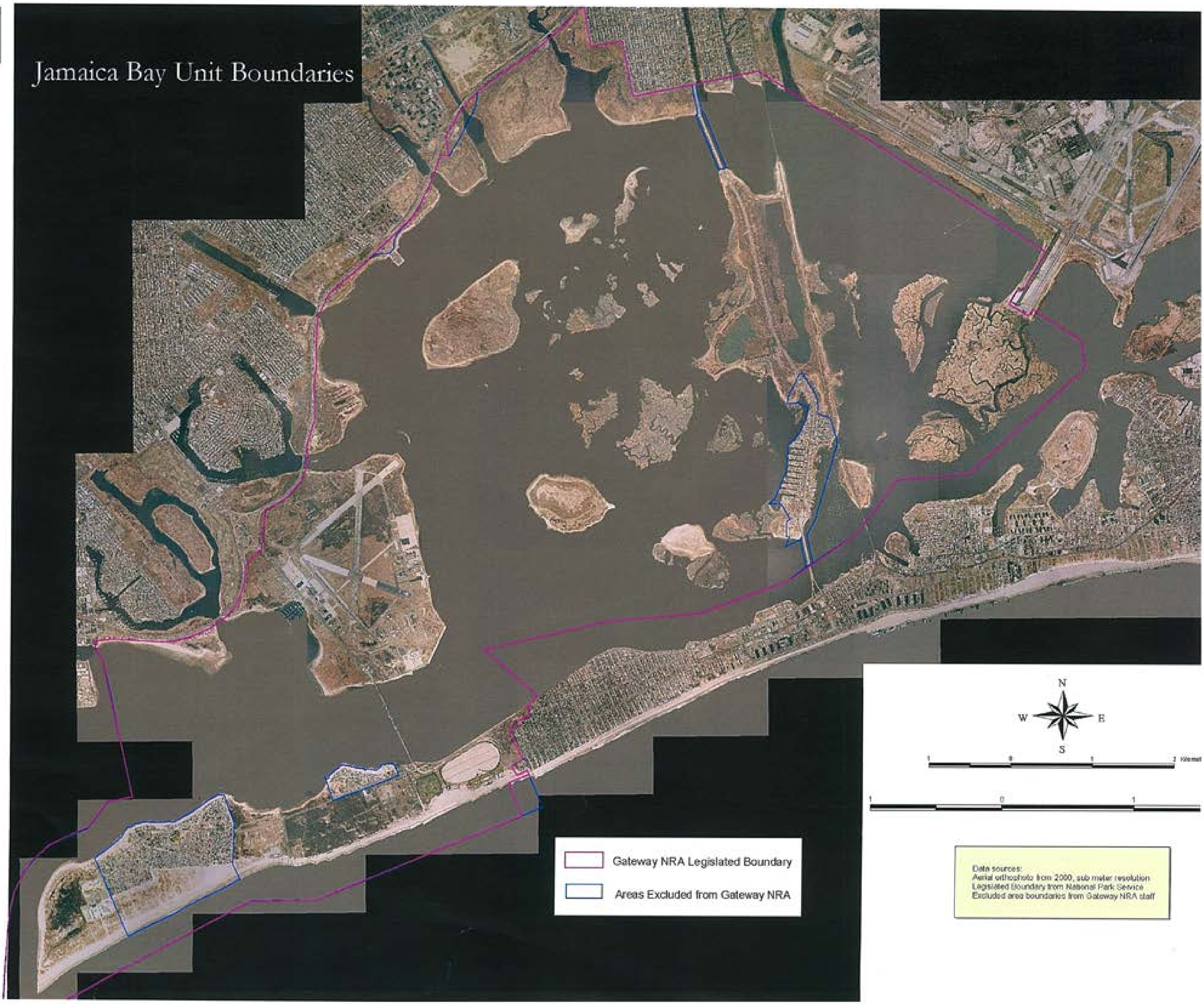
15. **Access to park and restricted areas** - Approval for any activity is contingent on the park being open and staffed for required operations. No entry into restricted areas is allowed unless authorized in additional park specific stipulations attached to this permit.

16. **Notification** - The permittee is required to contact the park's Research and Collecting Permit Office (or other offices if indicated in the stipulations associated with this permit) prior to initiating any fieldwork authorized by this permit. Ideally this contact should occur at least one week prior to the initial visit to the park.

17. **Expiration date** - Permits expire on the date listed. Nothing in this permit shall be construed as granting any exclusive research privileges or automatic right to continue, extend, or renew this or any other line of research under new permit(s).

18. **Other stipulations -** This permit includes by reference all stipulations listed in the application materials or in additional attachments to this permit provided by the superintendent or a designee. Breach of any of the terms of this permit will be grounds for revocation of this permit and denial of future permits.

Jamaica Bay Unit Boundaries



number of person-days spent at each site, and quantify the items collected at each site.

The Principal Investigator is responsible for providing at least two copies of all unpublished and published reports that result from this research. Please mail the reports to:
Scientific Research & Collecting Permits Coordinator
Natural Resource Management Division
Gateway National Recreation Area
210 New York Avenue
Staten Island, NY 10305-5019
Digital copies may be e-mailed to the following [george_frame@nps.gov].
The Permits Coordinator will distribute the copies within Gateway NRA.

Questions about Scientific Research and Collecting Permits may be directed to:
Doug Adamo
Chief, Natural Resource Management Division
210 New York Avenue
Staten Island, NY 10305-5019
[tel. 718-354-4510, fax 718-354-4548, email doug_adamo@nps.gov].

Recommended by park staff(name and title):
Douglas A. Adamo, Chief NRMD 5/5/14

Reviewed by Collections Manager:
Yes ______ No ____

Approved by park official:

Date Approved:
5/5/14

Title:
Chief, Resource Mgmt. Division

I Agree To All Conditions And Restrictions Of this Permit As Specified
(Not valid unless signed and dated by the principal investigator)

(Principal investigator's signature)

May 9, 2014
(Date)

THIS PERMIT AND ATTACHED CONDITIONS AND RESTRICTIONS MUST BE CARRIED AT ALL TIMES WHILE CONDUCTING RESEARCH ACTIVITIES IN THE DESIGNATED PARK(S)

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Twin Lights National Historic Landmark
Special Use Permit Application
May 16, 2014

1. Summary

Background

URS is currently supporting Bureau of Ocean Energy Management (BOEM) in identifying an area offshore Long Island, New York suitable for renewable energy development. BOEM's mission is to protect the environment while ensuring the safe development of the Nation's offshore energy and marine mineral resources. BOEM's Office of Renewable Energy Programs (OREP) takes a proactive approach in engaging with Federal, state, local and tribal government partners, allowing the identification and mitigation of potential concerns early in the planning process.

On September 8, 2011, BOEM received an unsolicited request for a commercial lease from the New York Power Authority (NYPA) to install wind turbines within the area on the Outer Continental Shelf (OCS) offshore Long Island. Public comments voiced support for the proposed project's contribution to achieving the State's clean energy goals, improving air quality and human health, and reducing the need for additional fossil fuel power plants and risk to climate change. However, concerns were raised about the siting of the project and potential viewshed impacts to historic properties. In response to this concern, BOEM seeks to understand the potential visibility of offshore wind energy development within the area on the OCS offshore Long Island. This effort is conducted in coordination with the National Park Service (NPS) and is based on specific observation points provided by NPS to BOEM.

URS is supporting BOEM's objective to inform planning and decision-making regarding renewable energy development by:

- Providing stakeholders with accurate and realistic visual simulations of a wind energy facility offshore Long Island, NY from various stakeholder key observation points (KOPs) determined in coordination with the National Park Service (NPS)
- Developing viewshed models detailing theoretic visibility of the proposed project from the KOPs and the surrounding landscape

Description of Field Activities

Photographs and video will be collected at Twin Lights National Historic Landmark (Navesink Light Station), specifically the view from the lantern. This imagery will serve as the baseline for production of visual simulations of the proposed project as seen from that location.

All photographs will be geo-referenced during collection to ensure that photography collected across multiple visits will be captured from the same photo point. Base photographic documentation will be recorded, including camera specifications, date, and time of photographs. Ground disturbance will be negligible, and no equipment will be left on site. A temporary marker measuring <1 cm would be established to identify a photo point. During professional survey, temporary stakes may be placed on site while work is being completed. This marker will be removed when the project is completed. A maximum of 4 people will be working onsite a given time.

2. Contact Information

Louise Kling	William Hoffman
Project Coordinator	Bureau of Ocean Energy Management (BOEM)
503.948.7291	703.787.1549
louise.kling@urs.com	william.hoffman@boem.gov

3. Project Schedule

Beginning in May 2014, the URS team would capture multiple sets of photography from each KOP during periods of both maximum visibility, and during the most prevalent daytime meteorological conditions experienced across each of the four seasons, if different from the clear conditions and as confirmed by the meteorological assessment. Photographs will be collected systematically to ensure that the four different lighting conditions are recorded, includinging nighttime darkness.

The site will be accessed a maximum of 20 times between May 28th and December 31, 2014. The site will be accessed at one time during night conditions. URS may need support of Park Police / Security at that time.

Our field crews will need to mobilize under short notice to capture specific lighting, weather, meterological conditions, and/or sea conditions as needed. URS will notify appropriate personal within 24 hours of performing work. A record of dates when the site was accessed will be maintained in an ogoing manner, and provided to permitees at project-close-out (Table 1).

Table 1. Site Access Record: Twin Lights National Historic Landmark (Navesink Light Station)			
Meteorological Conditions	**Lighting Conditions**	**Field Work Date**	**Field Work Time**
Clear Conditions	Early Morning	TBD	TBD
	Mid-Day	TBD	TBD
	Late Afternoon	TBD	TBD
	Night	TBD	TBD
Average Conditions: Spring (March 22-June 21)	Early Morning	TBD	TBD
	Mid-Day	TBD	TBD
	Late Afternoon	TBD	TBD
Average Conditions: Summer (June 22-Sept 21)	Early Morning	TBD	TBD
	Mid-Day	TBD	TBD
	Late Afternoon	TBD	TBD
Average Conditions: Fall (September 22-December 1)	Early Morning	TBD	TBD
	Mid-Day	TBD	TBD
	Late Afternoon	TBD	TBD
Average Conditions: Winter	Early Morning	TBD	TBD
	Mid-Day	TBD	TBD
	Late Afternoon	TBD	TBD

4. Location of Event and Site map

The location of the proposed work is at the Twin Lights National Historic Landmark (Navesink Light Station), specifically at the lantern. A site map is provided in Attachment 1.

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SPECIAL USE PERMIT APPLICATION PACKAGE

Any Special Use Permit (SUP) Application (Application) must be submitted to the State Park Service (SPS) area administering the Application with sufficient time given for planning and permitting purposes. SUP applications are considered on a first come, first served basis. Please keep in mind that the larger and more complex the event is, the more time will be needed for this review process. Failure to have Application completed 90 days in advance of the proposed SUP could result in your Application being denied.

A.) PERMIT PROCESS

1.) The first step in the SUP process is to fill out this Application package. In order to ensure adequate time for SUP evaluation the application should be submitted at least 90 days prior to the event. If the special use or event is extremely large or complex, at least one-year notice is recommended for approval. Applications are first accepted 16 months prior to event.

2.) Upon review of this Application area Superintendent may require an Operations Plan to be completed. The Operations Plan needs to be completed 60 days prior to date of special event (larger events will require more time). Please see Paragraph J, below, for further explanation.

3.) Once the final SUP is fully executed the Applicant is authorized to use or have an event at the designated SPS area. Advertising for any event must not occur prior to SUP being fully executed. If early advertising is needed you will need to begin the SUP process further in advance.

4.) No changes to the SUP will be allowed unless submitted in writing and approved by the SPS. Submittals for change must be received at a minimum of 14 days prior to event.

5.) Failure to comply with any of the above requirements may result in the application being denied.

B.) FEES

(THIS SECTION SHOULD BE AREA SPECIFIC BASED ON ADMIN. CODE FEES)

C.) INSURANCE

Insurance to be provided by the Applicant shall be as follows:

(i) Public liability insurance as broad as the standard coverage forms currently in use in the State of New Jersey which shall not be circumscribed by any endorsements limiting the breadth of coverage. The policy shall be endorsed to include:

1) Broad Form Comprehensive General Liability
2) Premises/Operations
3) Products/Completed Operations
4) Protection and Indemnity; and

5) Applicant owned, operated, or non-owned motor vehicles.

Limits of liability shall be maintained at the minimum level of One Million ($1,000,000.00) Dollars per occurrence as a combined single limit for bodily injury and for property damage.

(ii) Property insurance to cover loss or damage on an "All Risk" of physical loss form of coverage against fire, loss, theft, and damage on the contents owned by Applicant. Said insurance shall be in an amount not less than the appraised value of those contents. Applicant shall obtain and provide, at its own expense, an appraisal of the contents owned by Applicant for the purpose of obtaining and maintaining the aforementioned insurance.

(iii) Worker's Compensation applicable to the Laws of the State of New Jersey and Employer's Liability Insurance with limits of not less than One Hundred Thousand ($100,000.00) Dollars per occurrence for bodily injury liability and One Hundred Thousand ($100,000.00) Dollars occupational disease per employee with an aggregate limit of Five Hundred Thousand ($500,000.00) Dollars occupational disease.

(iv) Such other insurance and in such amounts as may from time to time be reasonably required by the SPS.

(v) The limits of said policies described in (i) through (v) above shall be increased from time to time to meet changed circumstances including but not limited to changes in the purchasing power of the dollar, as measured by changes in the Consumer Price Index and changes indicated by the course of plaintiffs' verdicts in personal injury actions.

B. All insurance policies providing the coverage required shall be obtained from an insurance company authorized to do business in the State of New Jersey and shall, except for Worker's Compensation Insurance, name the **State of New Jersey, Department of Environmental Protection as an "Additional Insured"** with respect to this SUP. Prior to the approval of this SUP, Applicant shall provide SPS with a current certificate of insurance in form and substance satisfactory to SPS showing that Applicant has obtained the insurance coverage required. The certificate shall provide that the insurance coverage shall not be canceled for any reason except after thirty (30) days written notice.

D.) ADDITIONAL PERMITS

1.) Applicant may be required to contact municipal, county, state or federal authorities. However, SPS will offer assistance in providing points of contact and information regarding the possible requirements by these offices.

2.) Examples of applicable permits include but are not limited to: Alcohol, Tax ID, Vendor Licensing and DCA – Tent, Fire or Electric.

3.) Copies of all permits must be provided to the administering SPS area.

E.) GENERAL

1.) The Applicant will comply with all Federal, State, Municipal, SPS, laws, rules and/or regulations. Failure to comply may result in denial and/or cancellation of the SUP and denial of future SUP Applications.
2.) Applicant is responsible to maintain the site in a clean and sanitary fashion during the event.
3.) Site rental is "as is". The Applicant must provide all amenities, for example: chairs, tables, equipment, etc.
4.) The SUP, in-whole or in-part, is not assignable or transferable.
5.) Applicant must have a representative on-site to direct deliveries and pick-ups, SPS will not accept nor be responsible for deliveries. Deliveries without Applicant representation will be turned away.
6.) The Applicant will not charge any fee for the use of the area to any individual or organization without the written approval of the area Superintendent.
7.) Only one SUP per site, per day, will be accepted. Second applications will be asked to find another date or another site.
8.) The permitted area will be left in the same condition at the activities completion as it was before the activity. Applicant is responsible for all damage by its agents, contractors, and attendees.
9.) Requests for the exclusive use of specified areas must be made at time of application. Public thoroughfares must remain open at all times.

F.) COMMERCIAL PHOTOGRAPHY

1.) Definitions:
   a.) **Movie** is defined as a major motion picture production.
   b.) **Video** is all motion filming that is not a major motion picture production.
   c.) **Still** is any single frame photography.
2.) For commercial photography only, and on a case-by-case basis as determined by SPS staff, the 30-day SUP-signing deadline may be waived. This decision will be made based on complexity of event and available resources at the area.

3.) SUP conditions may require SPS or State Park Police (SPP) personnel to be assigned to your shoot to provide for public safety and resource protection. We may not be able to accommodate changes. To ensure a successful shoot please submit a complete and accurate Application in a timely manner.

G.) BREAKING NEWS

1.) Breaking News is defined as an unplanned currently occurring event.
2.) Prior to setup for a Breaking News Event the Applicant must fill out a Breaking News Form at the Administrative Office.

H.) FIRST AMENDMENT GUIDELINES

The New Jersey State Park Service will allow public assemblies, meetings, demonstrations, religious activities and other public expressions of views conducted under the First Amendment of the U.S. Constitution in parks, in accordance with State Park Service regulations provided that a SUP has been obtained from the area Superintendent. To ensure public safety, protect park resources and avoid assigning the same time and location to two or more activities, the State Park Service may manage these activities by regulating the time, location, number of participants, use of facilities and number and types of equipment used, but not the content or message. Locations within the area that are available for public assemblies and other First Amendment activities, including the distribution of printed matter, will be designated on a map by the area Superintendent. When the State Park Service allows one group use an area or facility for expressing views, it must allow all other groups a similar opportunity, if requested. No group wishing to assemble lawfully may be discriminated against or denied the right of assembly, provided that all applicable SUP criteria and requirements are met. Whenever religious activities are conducted in SPS areas, any State Park Service actions pertaining to them must reflect a clearly secular purpose, must have a primary effect that neither advances nor inhibits religion and must avoid excessive governmental entanglement with religion. New Jersey SPS or SPP Staff on duty at an area in which a First Amendment activity is being conducted will be neutral toward the activity but will remain responsible for the protection of participants, spectators, private property, public property and SPS resources. On-duty SPS or SPP staff may not participate in the First Amendment activity. State Park employees exercising their First Amendment rights when off duty will not imply any Official SPS or SPP endorsement of the activity.

I.) APPLICATION

SEE ATTACHED SUP APPLICATION

J.) OPERATIONS PLAN

Directions for submitting the SUP Operations Plan:

The Operations Plan is a planning document that organizes all the necessary elements for managing a special use or event at the location. To help you write this operations plan, we have created a series of questions and separated them into 17 sections. Each question must be answered and placed in the appropriate section. If a section or question does not apply to your special use or event, please put "N/A or Not Applicable". In addition to these questions, please provide us with as much information about your event as possible. The more information you provide us with initially, the faster we will be able to process your application and ultimately approve your Application.

1. SUMMARY

1.1. Provide a brief summary of your proposed event.

1.2. Important details to include are: type of event, location of event, dates, number of attendees, etc.

2. CONTACT INFORMATION

2.1. Primary Contact Name

2.2. Email Address

2.3. Cell Phone Number

2.4. Office Number

2.5. Fax Number

3. PROJECT SCHEDULE

3.1. The Applicant shall submit a detailed schedule (date and times) of the setup, event, and breakdown. Include drop-offs and deliveries in schedule.

3.2. Set up will begin on what date and time.

3.3. Time your event staff will be on and off site each day.

3.4. If your event will involve multiple days, please give a detailed project schedule stating what time you will be on location and what time you will be off site each day.

3.5. Does your set-up or clean-up require park access before 6 am or after 10pm?

3.6. Will you need vehicle access to the site for set-up/ break-down?

3.7. Will there be any deliveries to the area for this event?

4. LOCATION OF EVENT AND SITE MAP

4.1. Please refer to the pre-existing maps .

4.2. Submit a detailed site plan (map) showing the layout of your event. Important details include: location of tents, staging, dumpsters, restroom facilities, generators, food areas, parking, transportation routes, and signage. Make sure you read through this entire document before finalizing your submission for this section.

4.3. Vehicular access for site set-up and deliveries is limited. Remote locations in the area may necessitate the need for non-motorized alternative ways of getting equipment and staff out to the site (ie. carts, hand trucks etc.).

5. PERMIT DOCUMENTATION

5.1. This section was developed to help you think about additional permits your event may require. These may include: Health and Safety, Department of Community Affairs (DCA) for fire, building or electric, Taxation, Gaming, Insurance, etc.

5.2. Will you be digging in the ground for any reasons? If yes please explain why.

5.3. If yes, you will need to submit a Health and Safety Plan- (please ask to see the SPS Health and Safety Plan for more information).

5.4. Will your event be putting up tents and need to put stakes in the ground?

5.5. If you answered yes to either digging or putting stakes in the ground you must contact "U Dig" for a utility mark-out. (1-800-272-1000). It is your responsibility to ensure the mark-out has taken place prior to any digging or placing of stakes.

5.6. Will you have any tents larger than 30'x 30' (900 sq ft total)?

5.7. If yes, you will need DCA fire inspection. Please call Division of Community Affairs (DCA) 609-633-6132.

5.8. Do your tents meet or exceed NFPA 102 requirements?

5.9. Will you be building any temporary equipment or structures on the site you are renting (for example, bleachers)?

5.10. If yes, please describe in detail what you propose to build. If possible please include any diagrams or building plans.

5.11. If no, please skip to section 5.13.

5.12. Please be advised that before approval is given, the park requires DCA review and approval of all plans for any temporary structures. Please contact 609-777-4521 for building permits.

5.13. Possession of alcoholic beverages is prohibited in the park, however, the Director of Parks and Forestry may waive the policy to allow alcohol for approved special events in a controlled area.

5.14. Do you wish to serve and / or sell alcoholic beverages at your event?

5.15. If your answer is no, please skip to section 6.0

5.16. If yes, you will need to submit a letter to the attention of the Director of Parks and Forestry, sent to administering area. This letter needs to request the waiver of the State Park Service Policy prohibiting the possession and consumption of alcoholic beverages SPS locations, and it needs to explain why your event would like to serve alcohol here in the area. This letter needs to be submitted to the Director as soon as possible.

5.17. If granted, you will need to contact the Alcoholic Beverage Commission (ABC) for any and all required permits. Please call 609-984-2830 for ABC permits.

5.18. If permission is granted, you must provide us with a copy of your Liquor License.

5.19. If permission is granted, you must provide us with proof of Alcohol Liability insurance for your event.

5.20. The insurance must state that "Liability and Property damage shall not be less than One Million ($1,000,000) Dollars per occurrence as a combined single unit" and "The State of New Jersey, Department of Environmental Protection" will be named "additionally insured" on any and all insurance policies.

6. FOOD AND CONCESSIONS

6.1. Use this section to provide a description of the food services your event plans to offer.

6.2. Will your event be serving food?

6.3. If yes, will you be charging money for food?

6.4. Will you be cooking on the premises?

6.5. What will you be using to cook / heat your food?

6.6. Where do you plan to set up your food area?

6.7. You will need to provide copies of Board of Health Certification with your vendor list.

6.8. Will your event be selling non- food concessions?

6.9. If yes, what kind of concessions will you be selling?

Note. This SPS area may have a contracted Concessionaire. Your event does not have to contract with this company to provide food to your event as long as your sales are confined to the premises of the special event. However, if you wish to contact them for assistance please ask the area Superintendent for their contact information.

7. SANITARY SEWERAGE

7.1. Restroom facilities exist in certain areas and may be used. Once the number of attendees or use exceeds acceptable limits other facilities must be brought in at expense of Applicant. Please note that water is not available in all locations.

7.2. How many people will be at your event?

7.3. How many port-a-johns will you be using?

7.4. How many ADA units will you be using (one ADA unit must be provided per every five units)?

7.5. What are the locations of the units? (Please place on the appropriate site map(s))

7.6. Who is providing the units?

7.7. When will they be dropped off?

7.8. When will they be picked up?

7.9. Are you planning on using park restrooms?

7.10. If yes, you may be assigned a park employee at the rate of $55/hr for the duration of your event.

7.11. Will your event need water access?

7.12. If yes, you will be charged to have staff hook up to hydrants in the area.

8. SOLIDWASTE COLLECTION & DISPOSAL

8.1. We are not responsible for trash generated by your event. How will you be disposing the garbage your event creates?
8.2. Are you renting dumpsters?
8.3. If you answered no, please skip to question 8.8.
8.4. Who is the company?
8.5. What date will it be delivered?
8.6. What date will it be removed?
8.7. Please note the dumpster location on your site map.
8.8. If carrying out your own trash, please make sure you remove all garbage at end of visit. Any refuse that is left behind will result in forfeiture of security deposit in whole or part.

Note. Applicants are responsible for maintaining the site in a clean and sanitary fashion throughout setup, event and breakdown.

9. ELECTRICAL & LIGHTING

9.1. Will you need electricity for your event?
9.2. If no, please go to section 10.0.
9.3. Will you need more than a couple of standard house outlets? If yes, you will need to provide your own generators and the following information:
9.4. How many generators will you have? What is the size of the generators?
9.5. Where will they be located? Place your generators on the site map you submit.
9.6. Do you want to see about tapping into existing electrical service? If yes please contact the area Superintendent for more information.

Note. Electricity is not available in all locations, please ask for availability. Applicant will make no changes to the existing electrical service without prior approval from the area Superintendent. All electrical connections to temporary service boxes will be done by licensed electricians, approved by the SPS at the Applicant's expense.

10. SIGNAGE

10.1. Will you be posting any signs for this event?
10.2. If yes, you will need to fill out a sign map and submit it
10.3. It is your responsibility to remove all signage at the end of the event. Failure to do so will result in a clean-up fee of $25.00 per sign.

Note. Directional, informational and advertisement signage is the responsibility of the Applicant. All signage must be freestanding. No tape, staples, nails, tacks etc are to be used to affix signs to SPS structures.

11. SECURITY

11.1. All security plans must be coordinated and reviewed by the area Sergeant. A security plan will be a required part of large event planning, however it may be finalized at a later date. Please check with the area Superintendent to see if your event requires a security plan.
11.2. Do you believe your event will have a need for security personnel?
11.3. If no, please skip to question 12.0.
11.4. If yes, please detail your security needs.

11.5. Will you have any overnight storage or security needs?

11.6. Any overnight security detail must include a SPP officer at the $55/hr rate.

11.7. Event conditions may require SPS or SPP personnel to be assigned to your event to provide for public safety and resource protection at the expense of the Applicant for $55/hr.

Note. State Park Police have jurisdiction in all SPS areas. All security must be unarmed and licensed /bonded. Due to safety reasons, neither on-duty nor off-duty police officers from outside jurisdictions are permitted to work as security within SPS locations.

12. COMMUNICATIONS

12.1. Will your event be communicating with the use of portable radios?

12.2. If yes, your park contact must be provided with a radio for the duration of the event.

Note. The Applicant is responsible for providing proper communication between itself and SPS officials. You must provide one (1) on-site contact (including cell phone number) for each day you are on SPS premises. This agent will be the only authorized liaison between your event and SPS & SPP staff. If your event has SPS or SPP staff assigned, this person will be your primary contact on the day of your event. All communications will go through this person.

13. TRANSPORTATION & PARKING

13.1. The Transportation Plan must include diagrams of all traffic routes that will be used by the event. This includes but is not limited to shuttle routes, routes for walk-a-thons or runs, and drop-off and loading areas. Have you included the Transportation and Parking Plan on your site map?

13.2. Any vehicular access for site set-up and deliveries is limited. Remote locations in the area may necessitate the need for non motorized alternative ways of getting equipment and staff out to the site. See attached map for designated access points for walkway and fields.

13.3. Will you have need to use any non-public roads (this includes but is not limited to paths, service roads, sidewalks, etc.) they need to be pre-approved and marked on the Transportation and Parking Map. If you do not have prior permission park staff on site will not make changes to the SUP on the day of the event.

13.4. The Transportation and Parking Plan will be heavily scrutinized during this stage of the permitting process. Please be very concise and provide additional information if necessary.

13.5. Total number of attendees to the event?

13.6. How will attendees get to the event?

13.7. What are you basing your reply to question 13.6 on?

13.8. How many parking spots are you proposing to be used in each location (place on map you submit)? Numbers next to each parking lot indicate total numbers of spots and is given for information purposes only. We will not allow all area parking spaces to be used for event parking because parking for the public must be maintained.

13.9. Will your event need off-site parking?

13.10. If yes, please include the locations of each off site area, number of parking spaces available for your event, and how you plan to get attendees to and from these lots.?

13.11. Will there be a shuttle?

13.12. If yes, what is the route of the shuttle (include in transportation plan on park map)?

13.13. Will you provide a shuttle to move public park patrons who are affected by the parking demands of your event?

13.14. How many staff will be working the event? Will you be hiring any other companies to work with?

13.15. Where will your staff park?

13.16. Are there any other transportation parking concerns we should be made aware of?

13.17. How will your attendees be advised of the transportation route and parking locations?

Note. Applicant may be required to hire a professional parking company and bus/shuttle service at their expense. Professional parking company may not direct traffic on park roads. Only State Park Police may direct traffic on park roads.

14. MEDICAL & EMERGENCY

14.1. Will your event have emergency medical staff on site?

14.2. If yes, please provide us with a copy and list of what arrangements have been made and with whom.

14.3. The event site shall provide a network of access points and paths that will be kept clear at all times for service and emergency vehicles.

15. FIRE SAFETY

15.1. Have you made/taken the proper precautions so that no flammable or volatile liquids or materials shall be stored in or adjacent to the area of the event, and that adequate fire fighting equipment is available to protect the life and health of the people attending the event.?

15.2. Will your event be cooking, heating or storing flammable /volatile liquids on site or adjacent to the event?

15.3. If yes, you are responsible for acquiring all needed DCA permits for cooking, temporary heating, etc. Please see section 5.7 for contact information for DCA.

16. SITE RESTORATION

16.1. Will your event leave a physical impact on the area that will require restoration work? If yes, what are the anticipated impacts? What is your plan to remedy these impacts? What is the anticipated timeline?

16.2. You are responsible for complete site restoration. If you fail to restore the site to its previous condition or better, you will be responsible for the labor and materials used to restore the site after you leave.

16.3. On what date and time will be the final site inspection take place?

Note. The Applicant will submit detailed plans for site restoration and final clean up of the event site. The site will be restored to the condition or better condition as the site was found. A final site inspection is required at completion of site restoration.

17. SPECIAL REQUESTS

17.1. Does your event have any special requests that fall outside the suggestions of this document?

17.2. If yes, please use this section to outline your request to the best of your ability.

O. APPEAL PROCESS

If an Applicant's SUP is rejected for any reason by the Superintendent and the Applicant wishes to appeal the decision they may do so. All written appeals will be heard by the Regional Superintendent. Appeals will be sent to: Regional Superintendent, **AREA SPECIFIC TO LIST PERTINENT ADDRESS INFO**

Department of Environmental Protection
Division of Parks and Forestry
State Park Service

Special Use Permit (SUP) Application

Please print/type the following application and return it with a ~~$58.00~~ $65.00 *non-refundable application fee made payable to "Treasurer- State of New Jersey" at the State Park Service (SPS) area that will administer the event, at least 90 days prior to the requested date. Contact the administering SPS area with any questions, pertaining to this application or process. At SPS discretion, an additional Operations Plan may be required, depending on complexity of request. This application is not fully approved until a final SPS authorized* ***Special Use Permit*** *is issued and signed by all required parties.*

State Park Service (Area): Twin Lights National Historic Landmark

Type of Special Use/Event: photography collection / professional land survey

Date & Time of use: (Date) May 28, 2014 - Dec 31, 2014 (Start/Time) 7:00 am (End/Time) 10:30 pm *

Applicant(s) Name: LOUISE KLING

Company/Organization: URS Corporation

Street Address: 111 SW Columbia, Suite 1500

City/Town: Portland **State:** OR **Zip Code:** 97201

Telephone/Contact #'s: (Home, Bus.) (503) 948-7291 (Cell) (503) 680 9810

FAX #: 503 . 222 - 4292 **Email Address:** louise.kling@urs.com

Estimated Attendance: up to 4 people (typically 1 to 2) **Estimated # of Vehicles:** 1

Please Check Yes (Y) or No (N) to answer the following questions

Have you completely read and understand the accompanied Application Package? Y ☒ N ☐

Are you familiar with the site? Y ☒ N ☐ **Will there be any fees charged?** Y ☒ N ☐ $65.00

Will you offer food for sale? Y ☐ N ☒ **Will any items/goods be for sale?** Y ☐ N ☒

Are you a SPS Officially Recognized Friends Organization (ORFO)? Y ☐ N ☒

Does request include commercial photography? Y ☐ N ☒ **If YES: (Still ☐ Video ☐ Movie ☐)**

Will you be requesting assistance with/of: Maintenance: Y ☐ N ☒ **Park Police/Security:** Y ☒ N ☐ For night access

Parking: Y ☐ N ☒ **Water/Electric Connection:** Y ☐ N ☒ **Early or Late Open/Close:** Y ☐ N ☒

Application continues on next page

* Note that photographs will be collected during a maximum of 20 visits during this period. Night photography will also be collected at one field visit.

In the space provided below give a brief description of your proposed special use or event and give further explanation to any questions above, in which you checked/answered **Yes (Y)**. *Also, please describe any special needs you may have.*

See Attached.

Also note additional contact on this application:
William Hoffman (BOEM): (703) 787-1549

The applicant by his/her signature certifies that: 1.) All information is correct. False information will result in denial or revocation of permit. **2.)** All SPS rules and regulations pertaining to use of area are understood and will be fully complied with by the applicant. **3.)** Applicant will not discriminate on the basis of race, color, religion, sex, national origin, age, or disability.

Name of Applicant (Print): LOUISE KLING

Signature of Applicant: [signature] **Date:** May 19, 2014

FOR SPS USE ONLY

SPS Approved: Yes ___ **No** ___ **Conditional** ____ **Superintendent:** ____________

SPP Approved: Yes ___ **No** ___ **Conditional** ____ **Sergeant:** ____________

Comments/Explanation of Conditional Approval:

Legend

Proposed KOP Locations

0 0.25 0.5 1
Kilometers

0 0.25 0.5 1
Nautical Miles

Coordinate System: NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983

URS

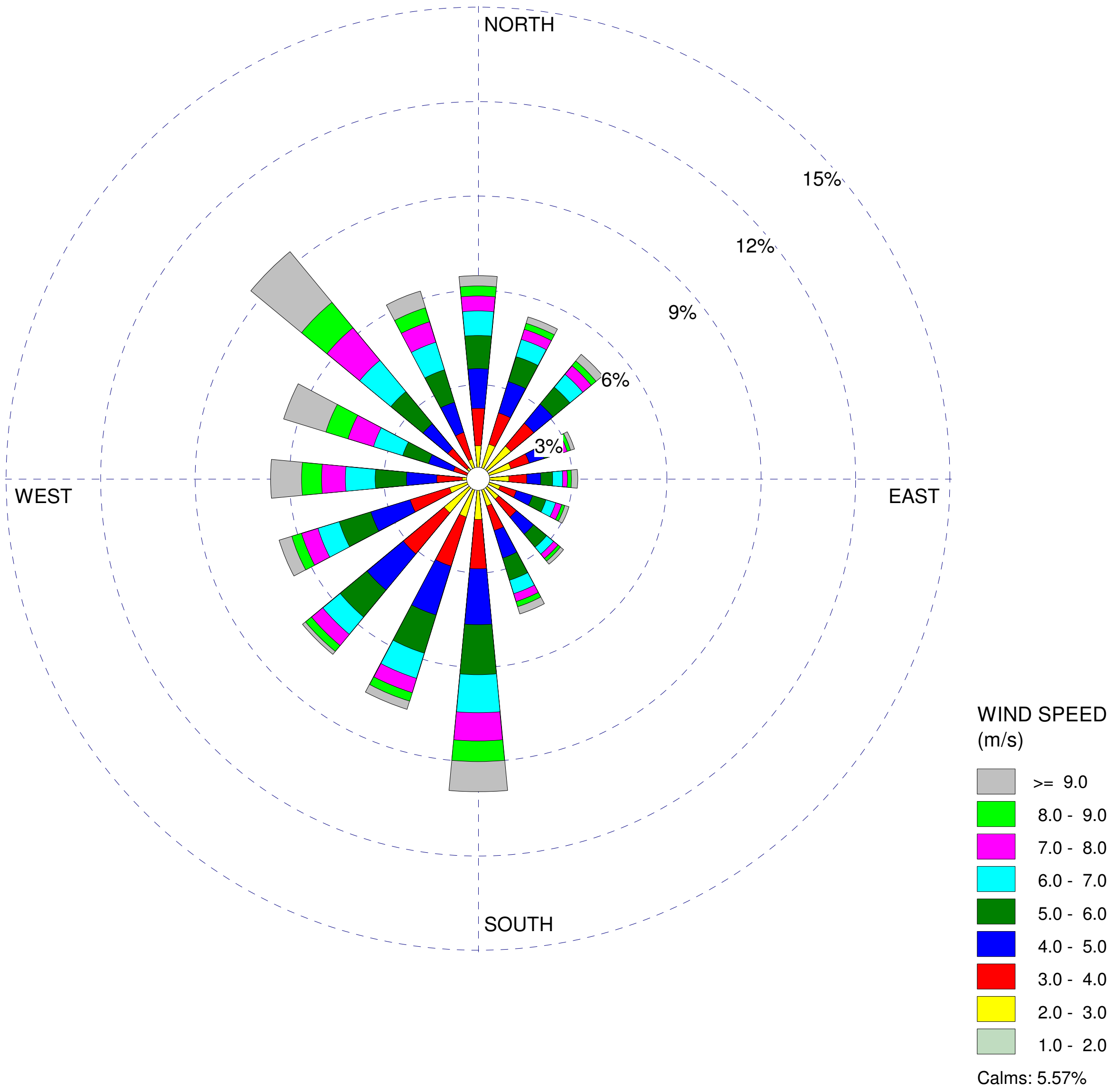
Proposed KOP Locations
Twin Light NHL

NY Renewable Energy Viewshed Project

BOEM
Bureau of Ocean Energy Management

Appendix B: Wind Roses

WIND ROSE PLOT:	DISPLAY:
John F. Kennedy International Airport **Annual Windrose**	**Wind Speed** **Direction (blowing from)**



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
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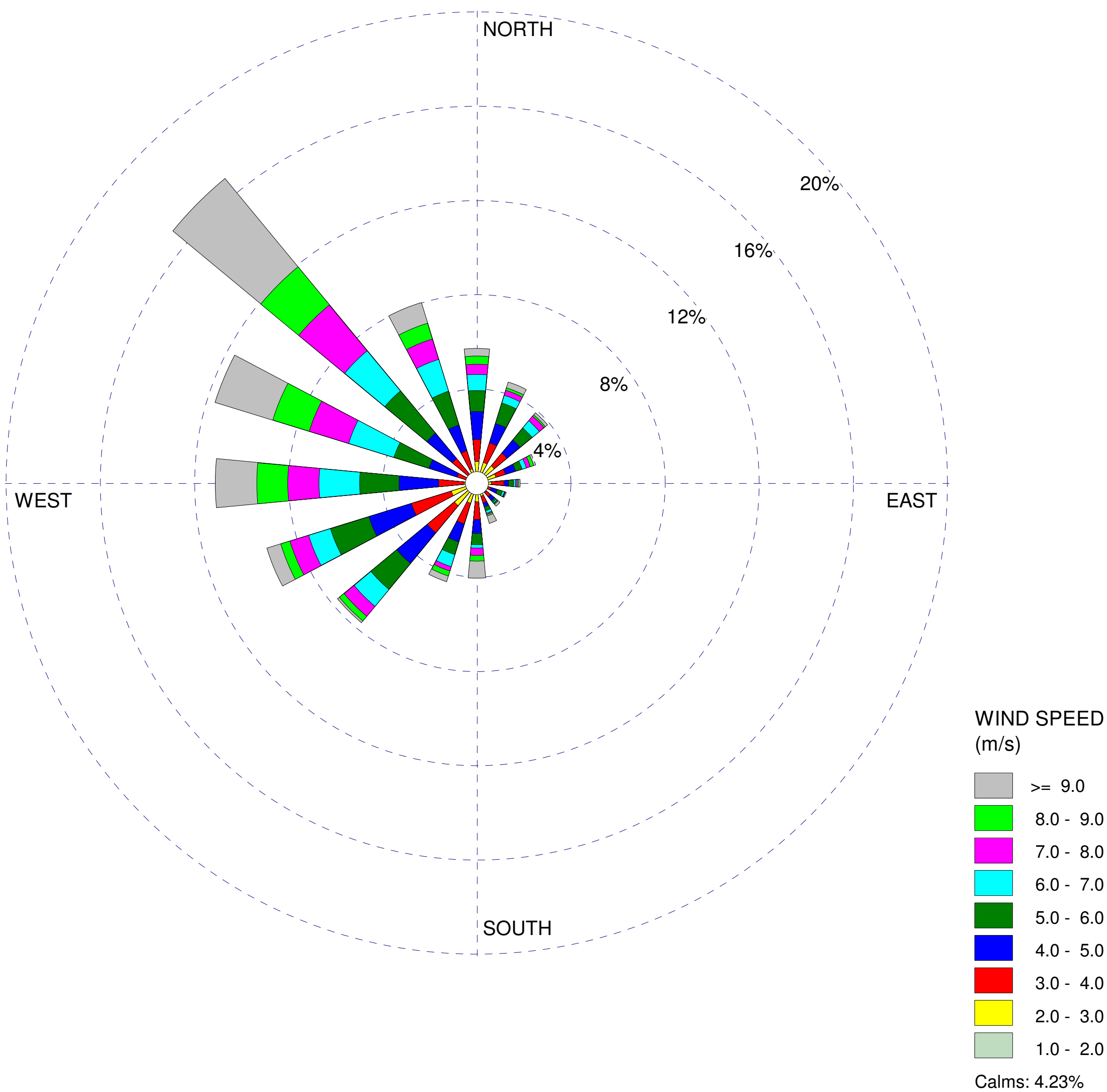
		MODELER: **LMB**	
	CALM WINDS: **5.57%**	TOTAL COUNT: **87665 hrs.**	
	AVG. WIND SPEED: **5.03 m/s**	DATE: **4/15/2014**	

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

John F. Kennedy International Airport
January Windrose

DISPLAY:
Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
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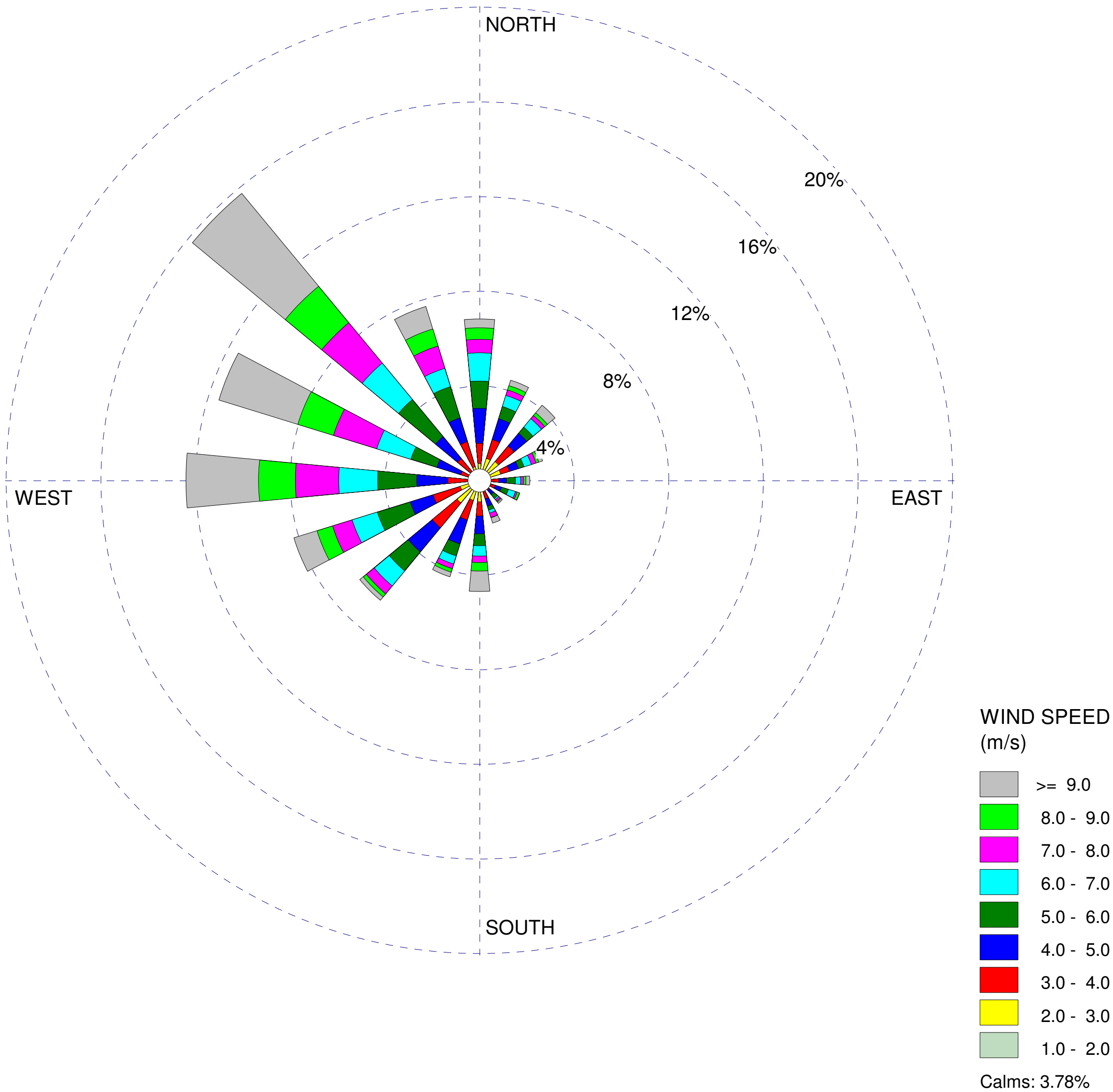
		MODELER: **LMB**	
	CALM WINDS: **4.23%**	TOTAL COUNT: **7440 hrs.**	
	AVG. WIND SPEED: **5.65 m/s**	DATE: **4/18/2014**	

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:
John F. Kennedy International Airport
February Windrose

DISPLAY:
Wind Speed
Direction (blowing from)



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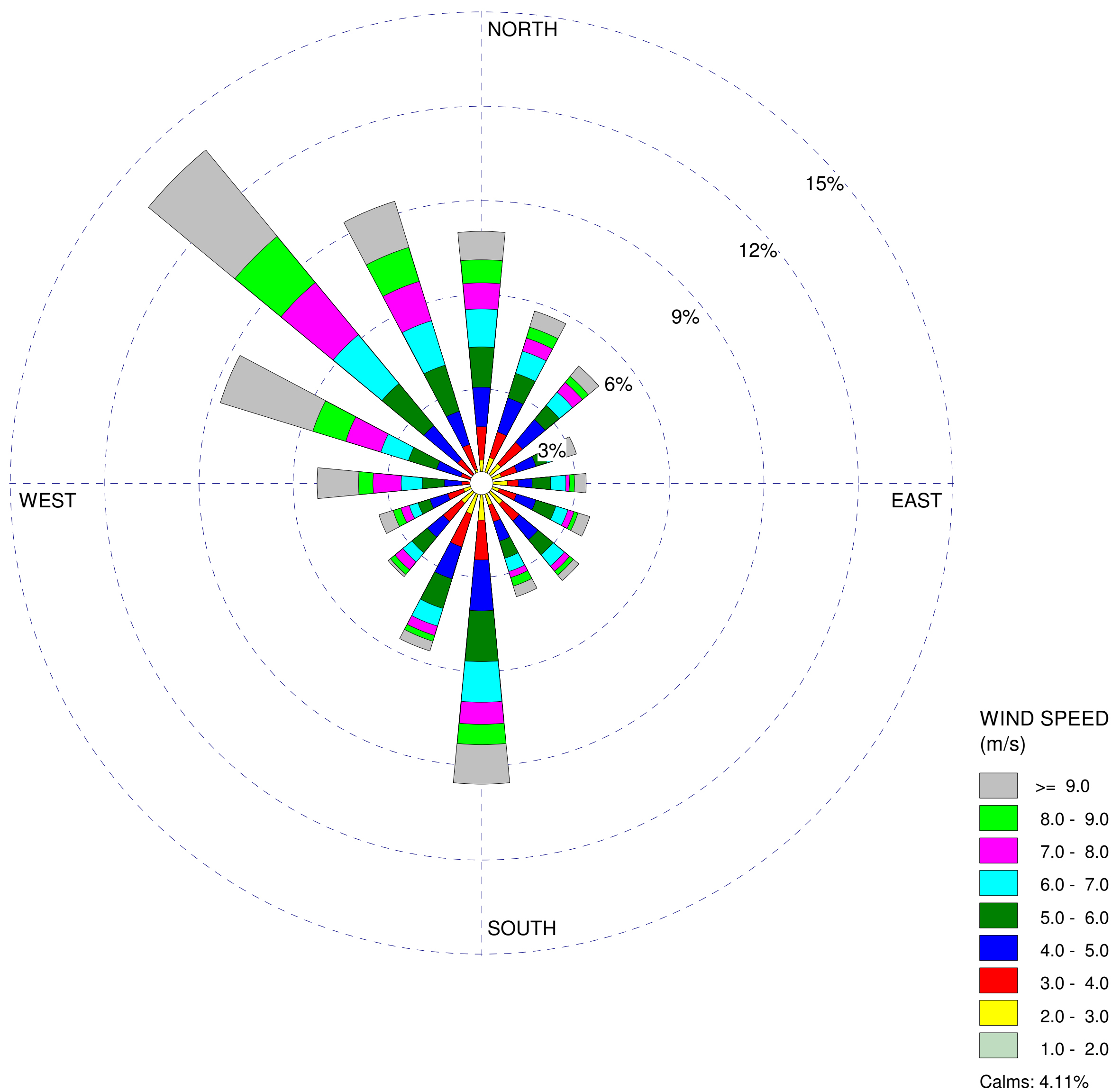
		MODELER: **LMB**	
	CALM WINDS: **3.78%**	TOTAL COUNT: **6720 hrs.**	
	AVG. WIND SPEED: **5.97 m/s**	DATE: **4/18/2014**	

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

John F. Kennedy International Airport
March Windrose

DISPLAY:
Wind Speed
Direction (blowing from)



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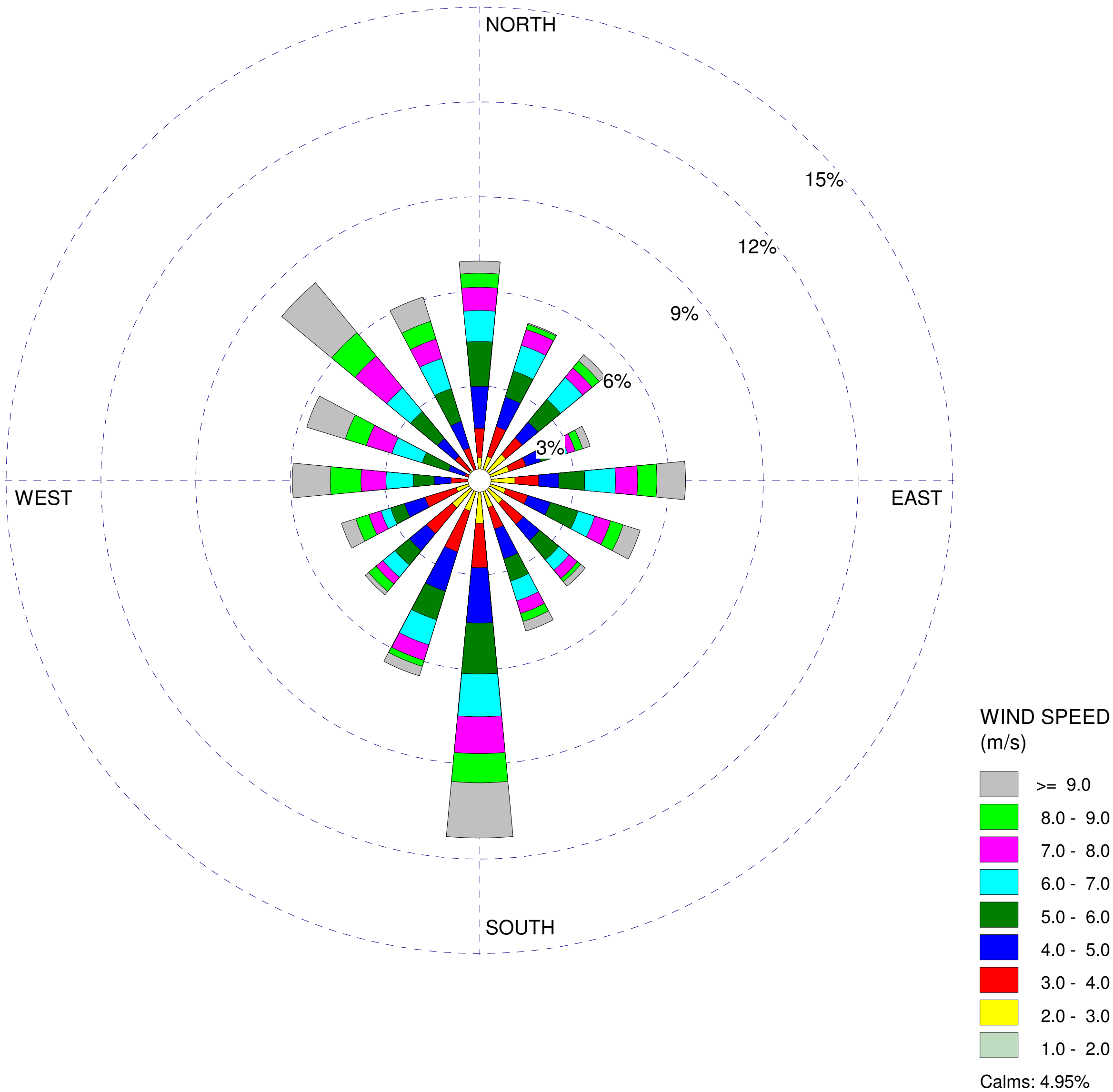
		MODELER: **LMB**
	CALM WINDS: **4.11%**	TOTAL COUNT: **7439 hrs.**
	AVG. WIND SPEED: **5.82 m/s**	DATE: **4/18/2014**

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

John F. Kennedy International Airport
April Windrose

DISPLAY:
Wind Speed
Direction (blowing from)



COMMENTS:

DATA PERIOD:

Start Date: 4/1/2004 - 00:00
End Date: 4/30/2013 - 23:00

COMPANY NAME:

URS

MODELER:

LMB

CALM WINDS:

4.95%

TOTAL COUNT:

7199 hrs.

AVG. WIND SPEED:

5.44 m/s

DATE:

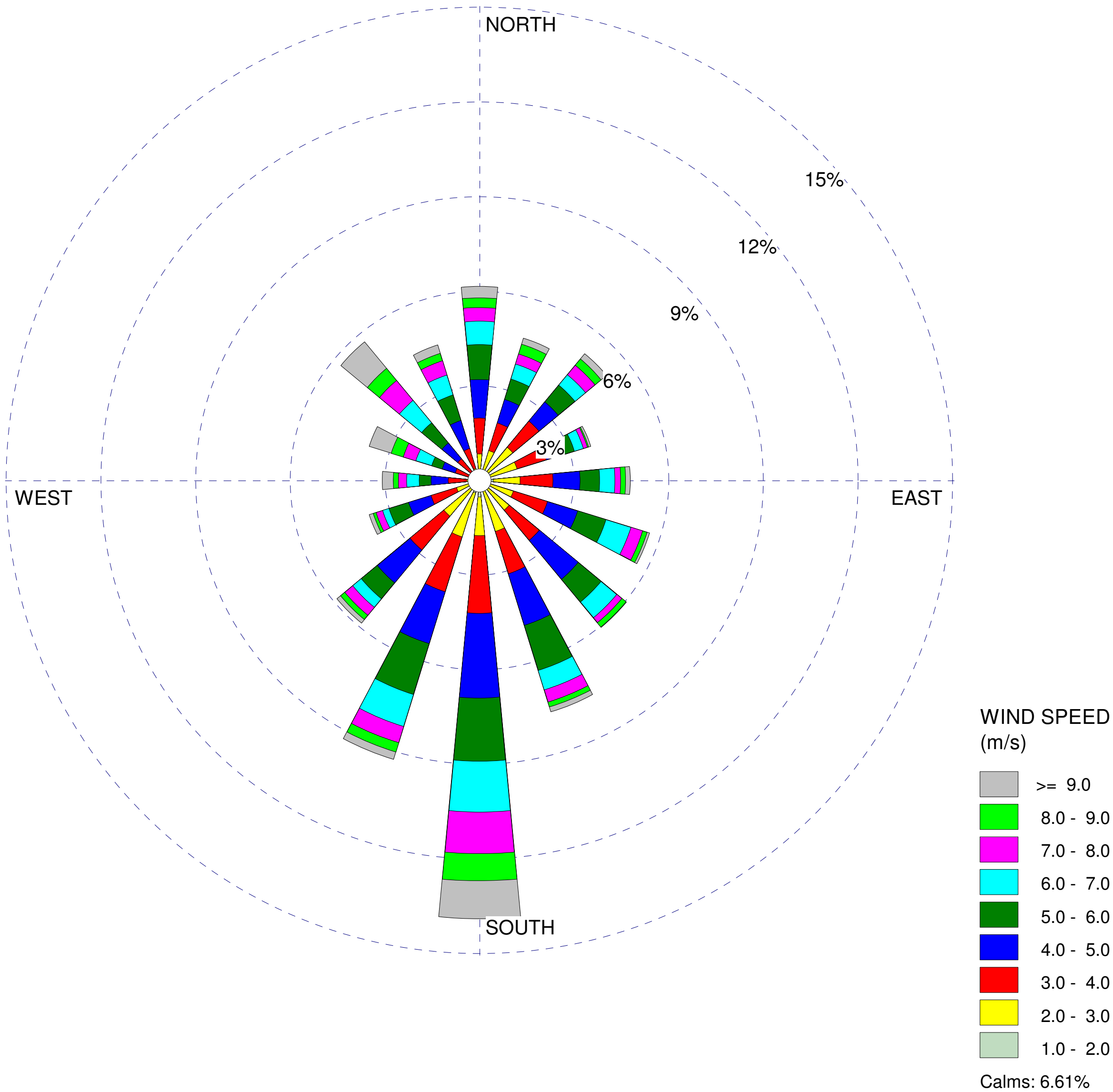
4/18/2014

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

John F. Kennedy International Airport
May Windrose

DISPLAY:
Wind Speed
Direction (blowing from)



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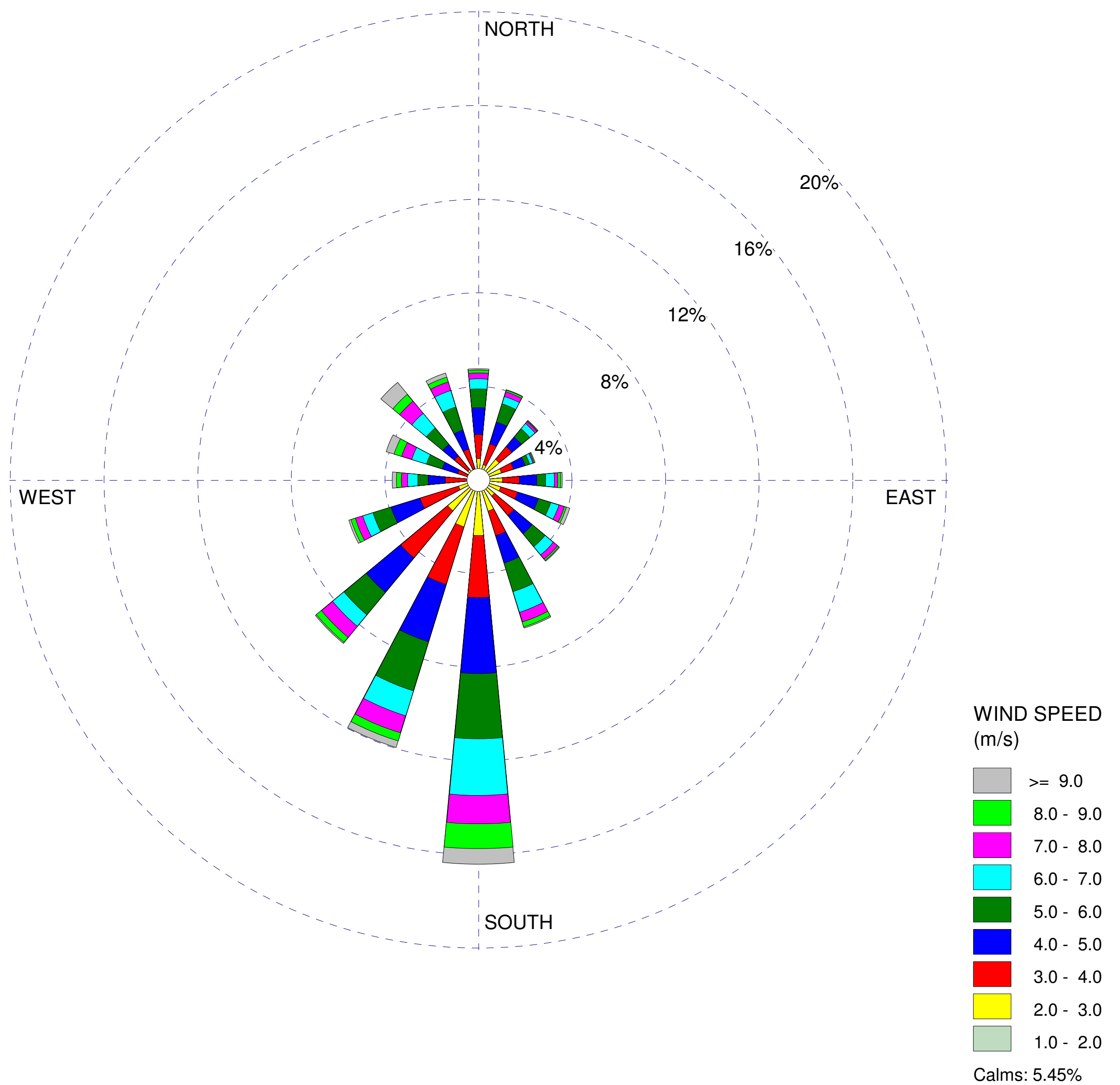
	CALM WINDS: **6.61%**	TOTAL COUNT: **7440 hrs.**	
	AVG. WIND SPEED: **4.58 m/s**	DATE: **4/18/2014**	

WIND ROSE PLOT:

John F. Kennedy International Airport
June Windrose

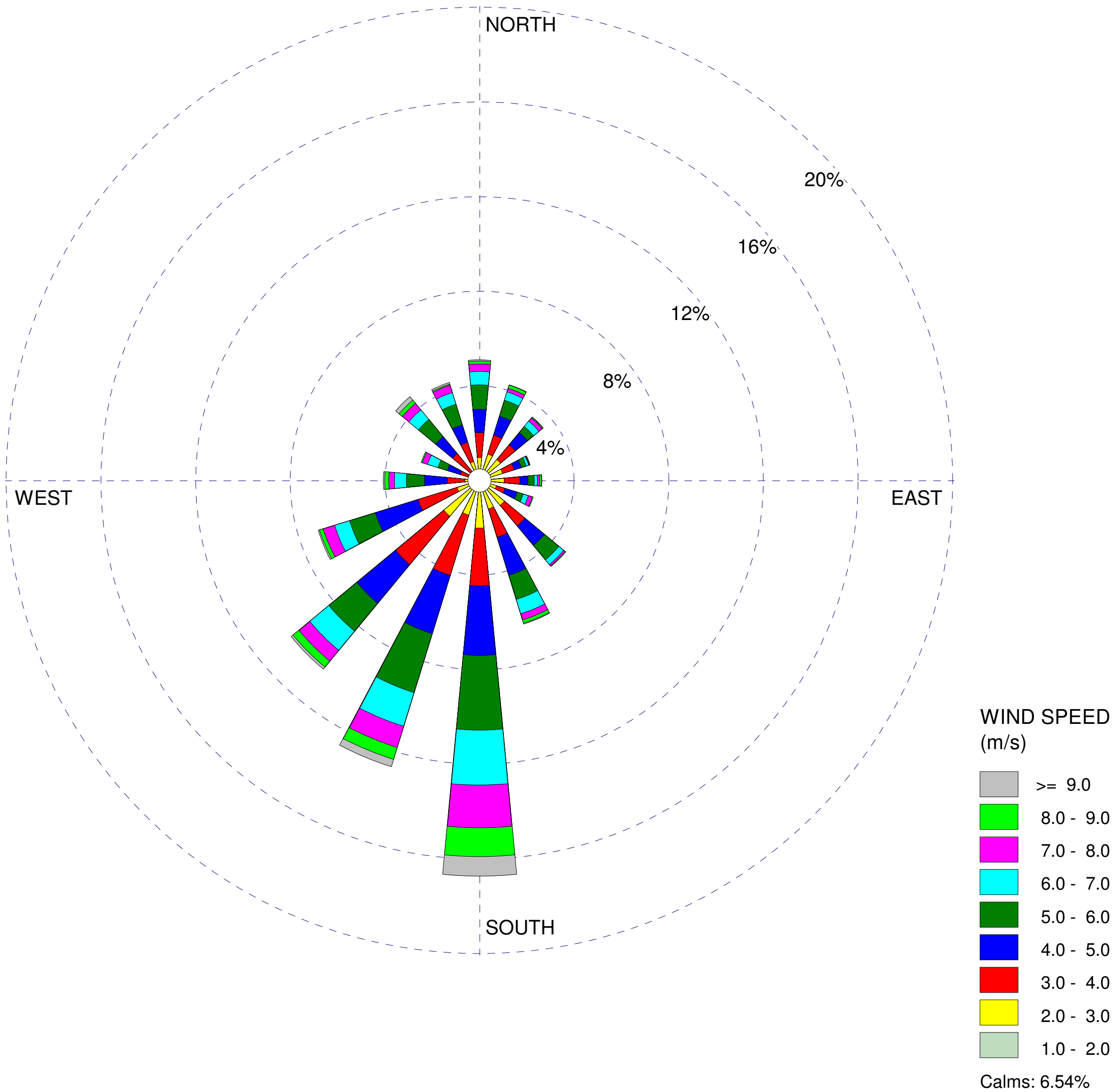
DISPLAY:
Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD: **Start Date: 6/1/2004 - 00:00** **End Date: 6/30/2013 - 23:00**	COMPANY NAME: **URS**
		MODELER: **LMB**
	CALM WINDS: **5.45%**	TOTAL COUNT: **7200 hrs.**
	AVG. WIND SPEED: **4.45 m/s**	DATE: **4/18/2014**

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:	DISPLAY:
John F. Kennedy International Airport **July Windrose**	**Wind Speed** **Direction (blowing from)**



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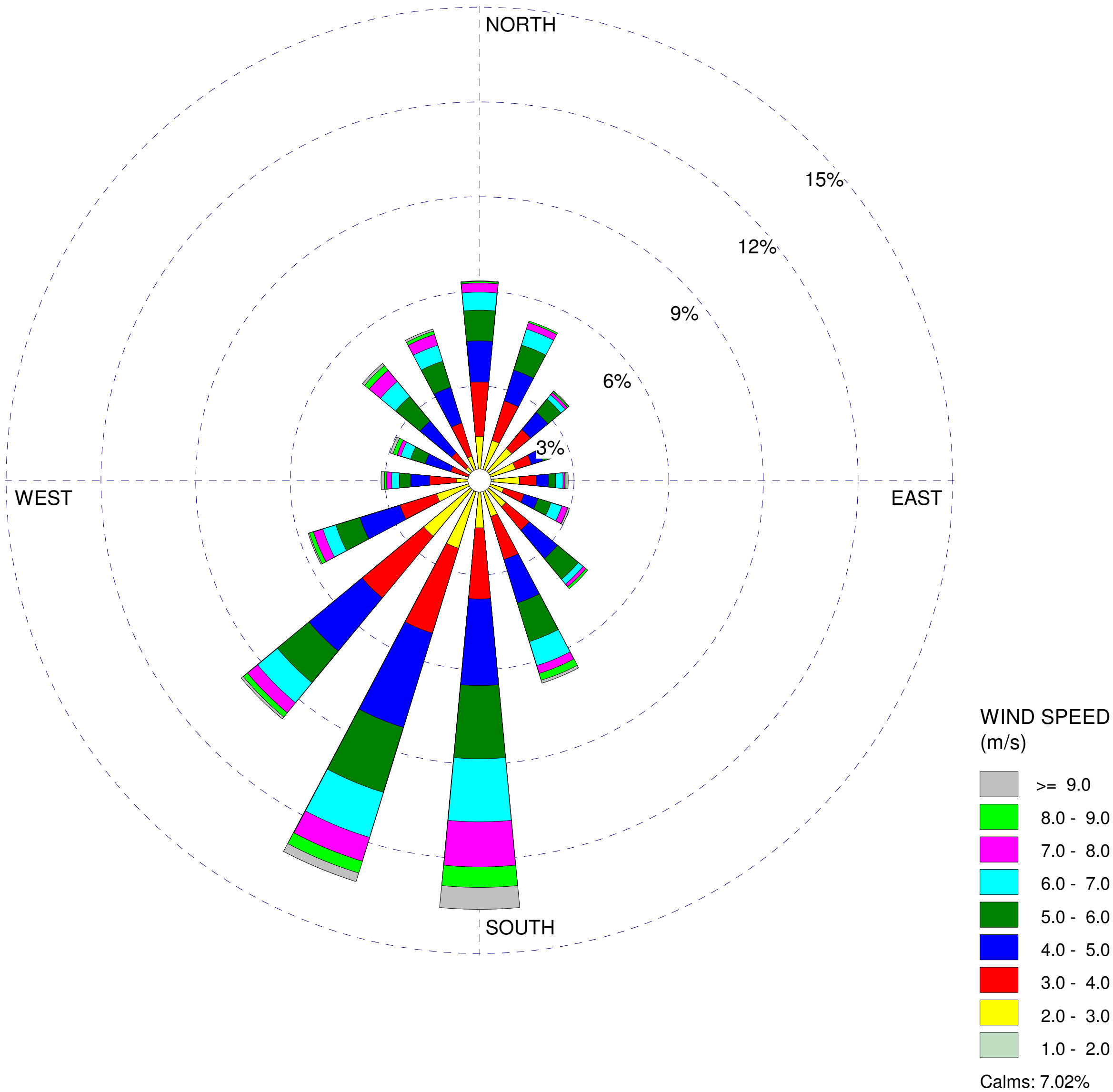
		MODELER: **LMB**	
	CALM WINDS: **6.54%**	TOTAL COUNT: **7437 hrs.**	
	AVG. WIND SPEED: **4.30 m/s**	DATE: **4/18/2014**	

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

John F. Kennedy International Airport
August Windrose

DISPLAY:
Wind Speed
Direction (blowing from)



COMMENTS:

DATA PERIOD:

Start Date: 8/1/2004 - 00:00
End Date: 8/31/2013 - 23:00

COMPANY NAME:

URS

MODELER:

LMB

CALM WINDS:

7.02%

TOTAL COUNT:

7439 hrs.

AVG. WIND SPEED:

4.14 m/s

DATE:

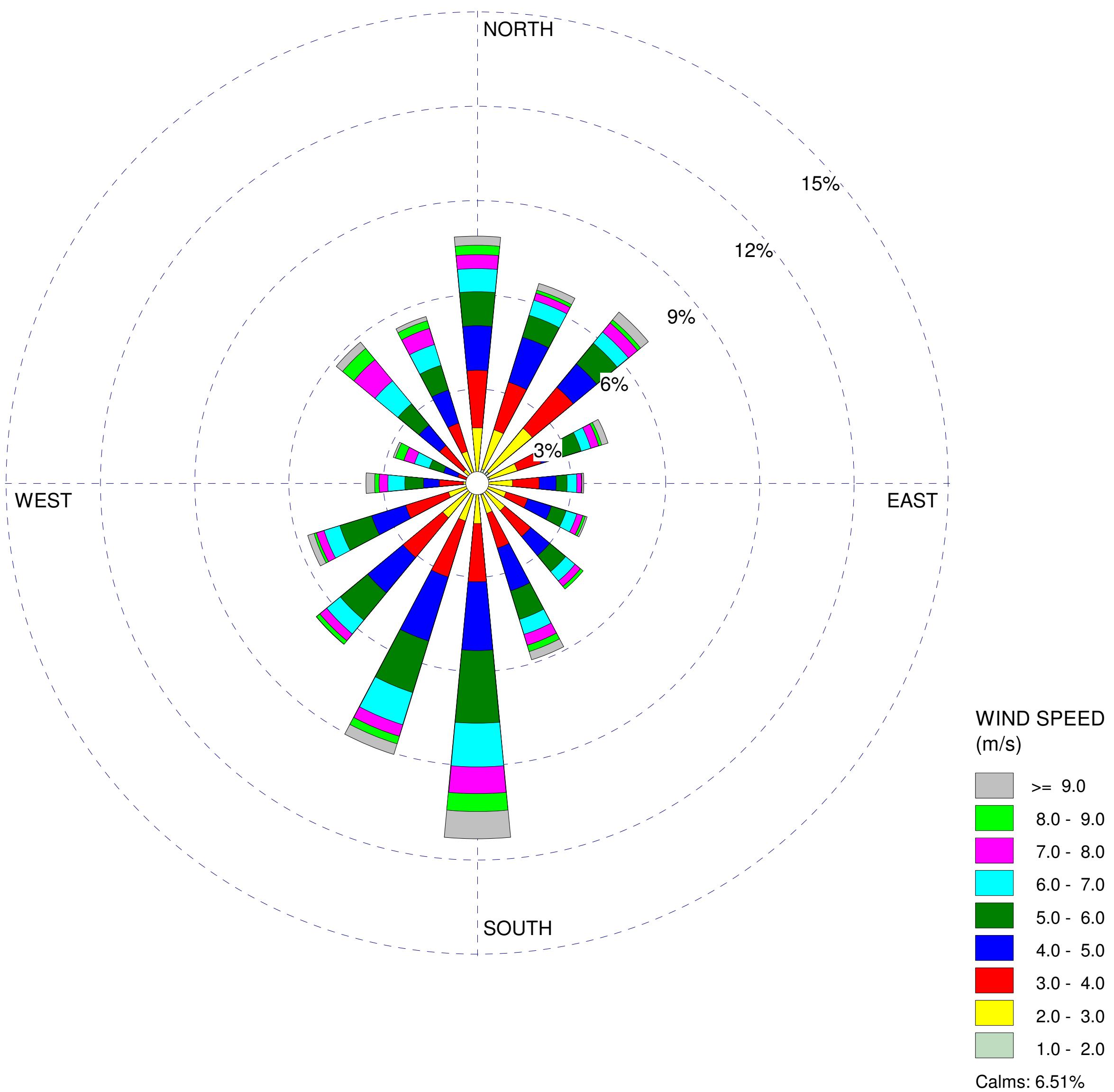
4/18/2014

WIND ROSE PLOT:

John F. Kennedy International Airport
September Windrose

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:

DATA PERIOD:

Start Date: 9/1/2004 - 00:00
End Date: 9/30/2013 - 23:00

COMPANY NAME:

URS

MODELER:

LMB

CALM WINDS:

6.51%

TOTAL COUNT:

7199 hrs.

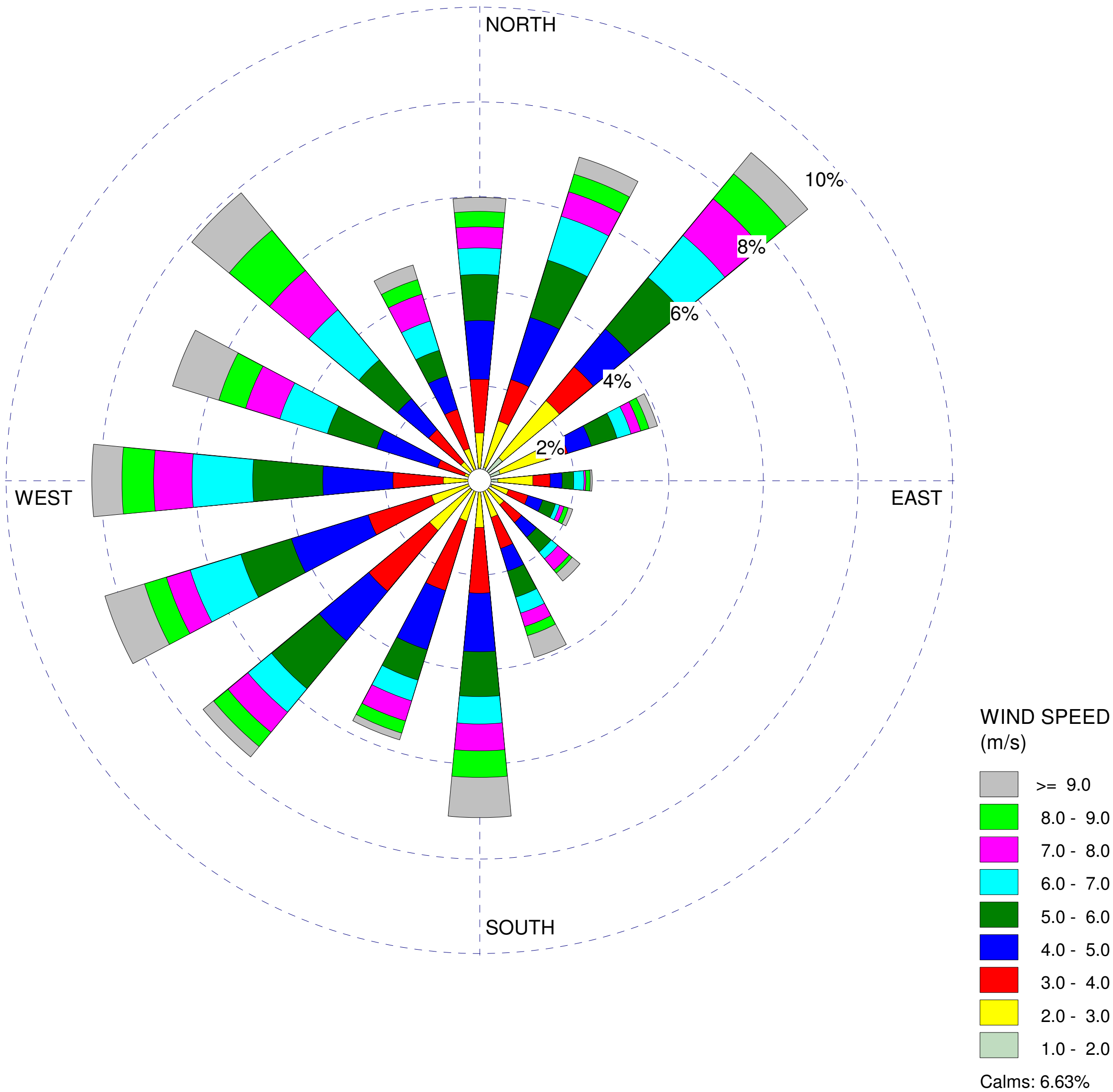
AVG. WIND SPEED:

4.35 m/s

DATE:

4/18/2014

WIND ROSE PLOT:	DISPLAY:
John F. Kennedy International Airport **October Windrose**	**Wind Speed** **Direction (blowing from)**



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		MODELER: **LMB**	
	CALM WINDS: **6.63%**	TOTAL COUNT: **7440 hrs.**	
	AVG. WIND SPEED: **4.94 m/s**	DATE: **4/18/2014**	

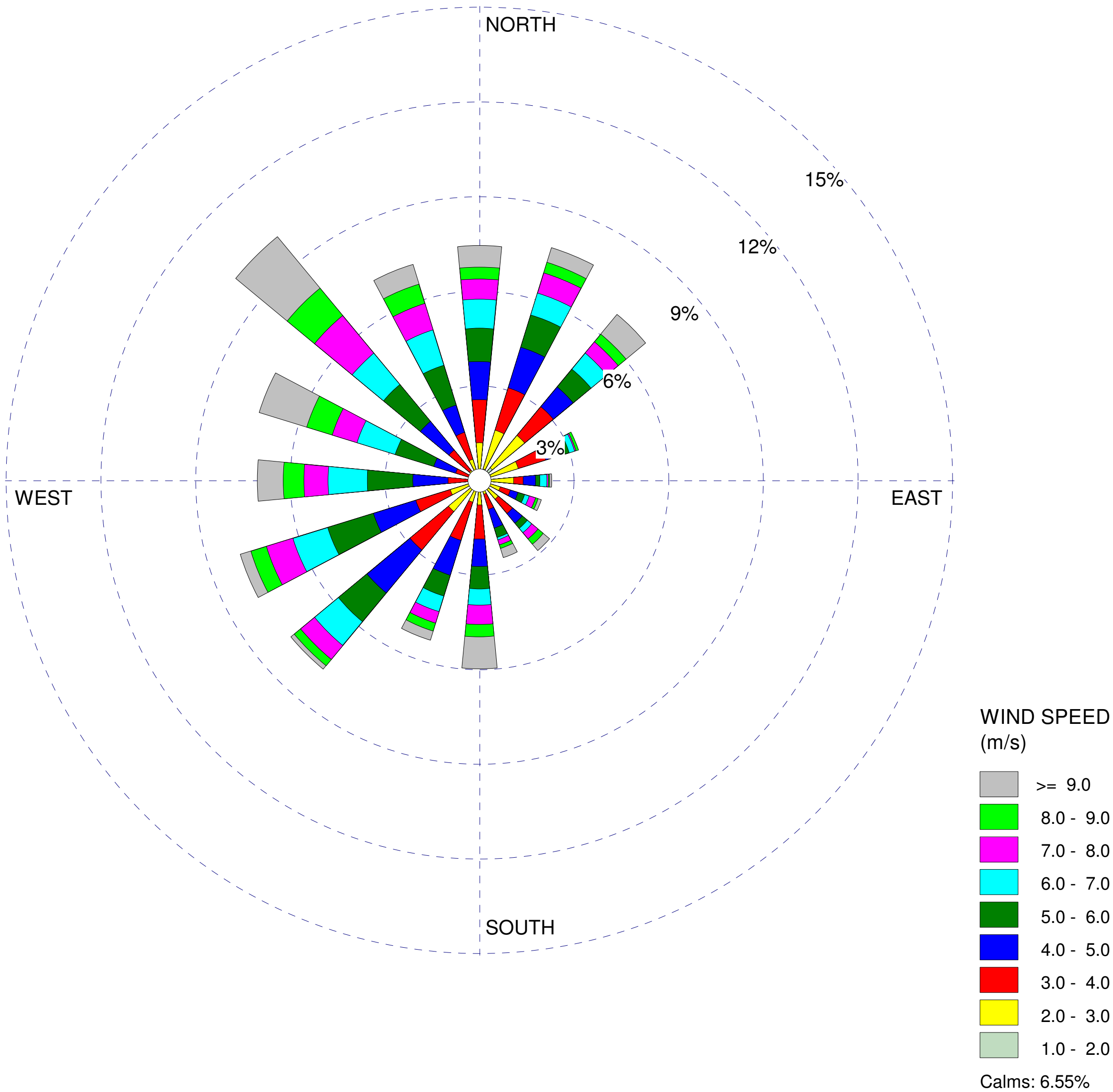
WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

John F. Kennedy International Airport
November Windrose

DISPLAY:

Wind Speed
Direction (blowing from)

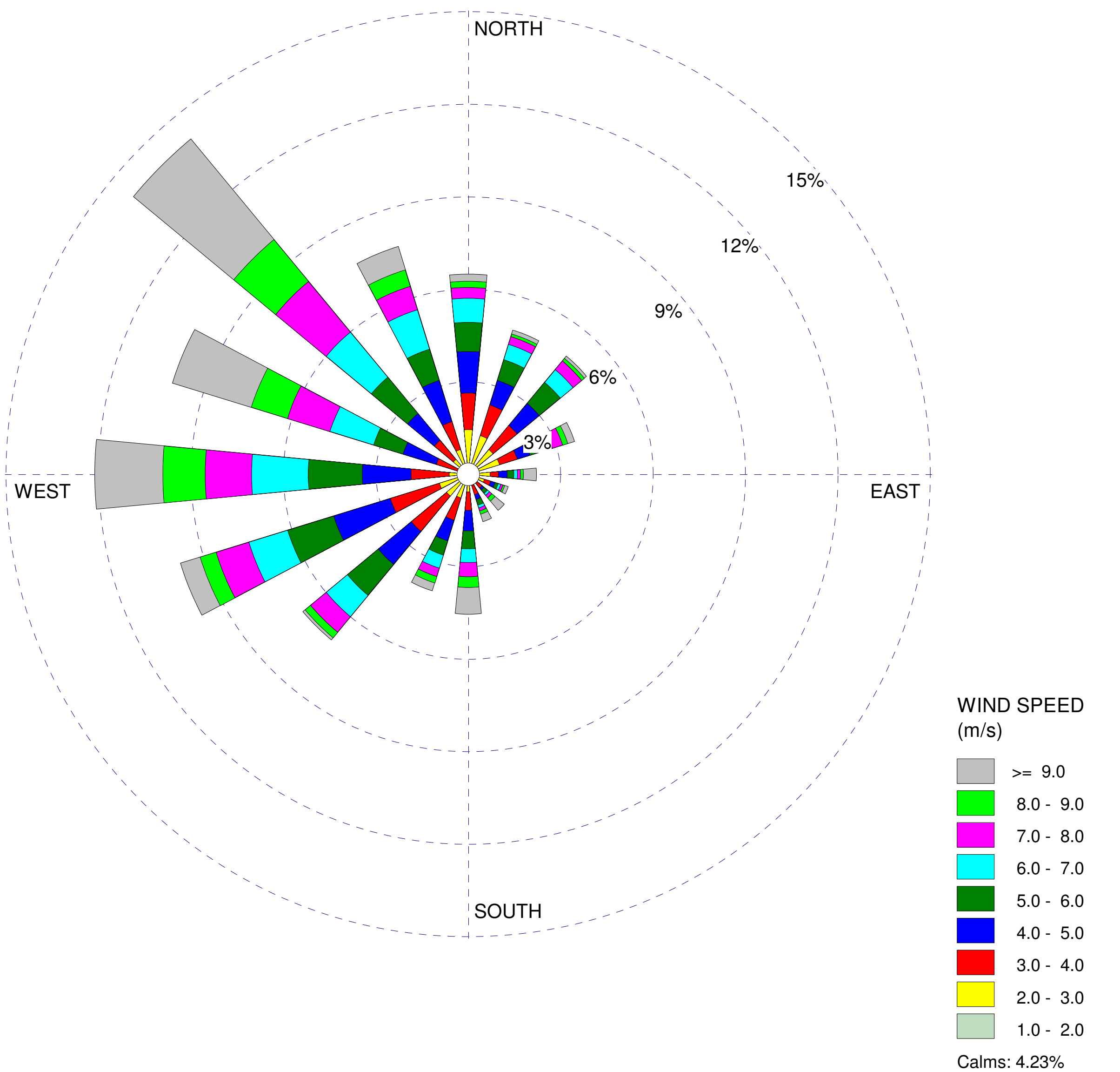


COMMENTS:	DATA PERIOD: **Start Date: 11/1/2004 - 00:00** **End Date: 11/30/2013 - 23:00**	COMPANY NAME: **URS**	
		MODELER: **LMB**	
	CALM WINDS: **6.55%**	TOTAL COUNT: **7199 hrs.**	
	AVG. WIND SPEED: **5.11 m/s**	DATE: **4/18/2014**	

WIND ROSE PLOT:

John F. Kennedy International Airport
December Windrose

DISPLAY:
Wind Speed
Direction (blowing from)



COMMENTS:

DATA PERIOD:

Start Date: 12/1/2004 - 00:00
End Date: 12/31/2013 - 23:00

COMPANY NAME:

URS

MODELER:

LMB

CALM WINDS:

4.23%

TOTAL COUNT:

7441 hrs.

AVG. WIND SPEED:

5.66 m/s

DATE:

4/18/2014

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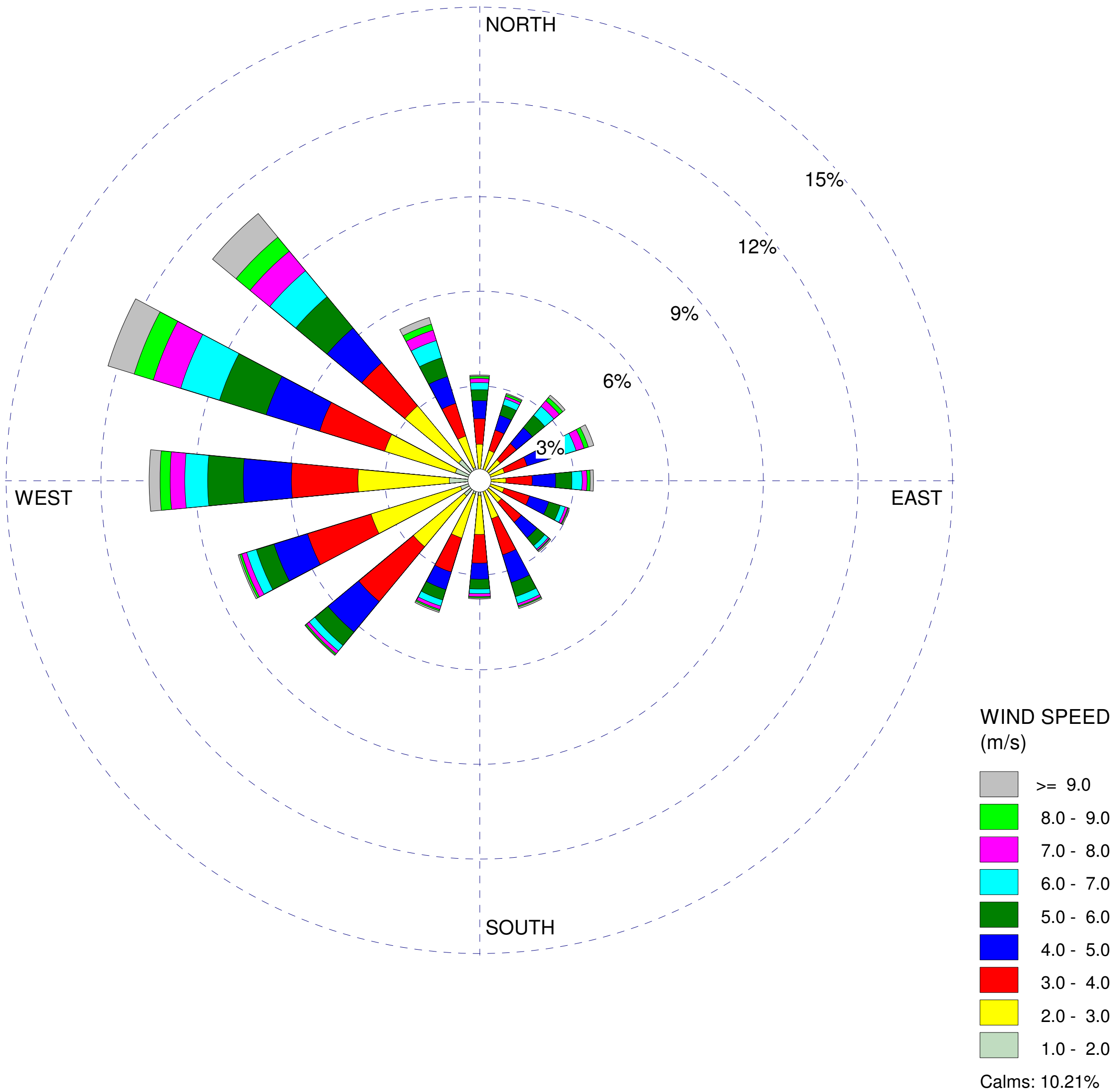
WIND ROSE PLOT:

Monmouth Executive Airport
Annual Windrose

DISPLAY:
Wind Speed
Direction (blowing from)

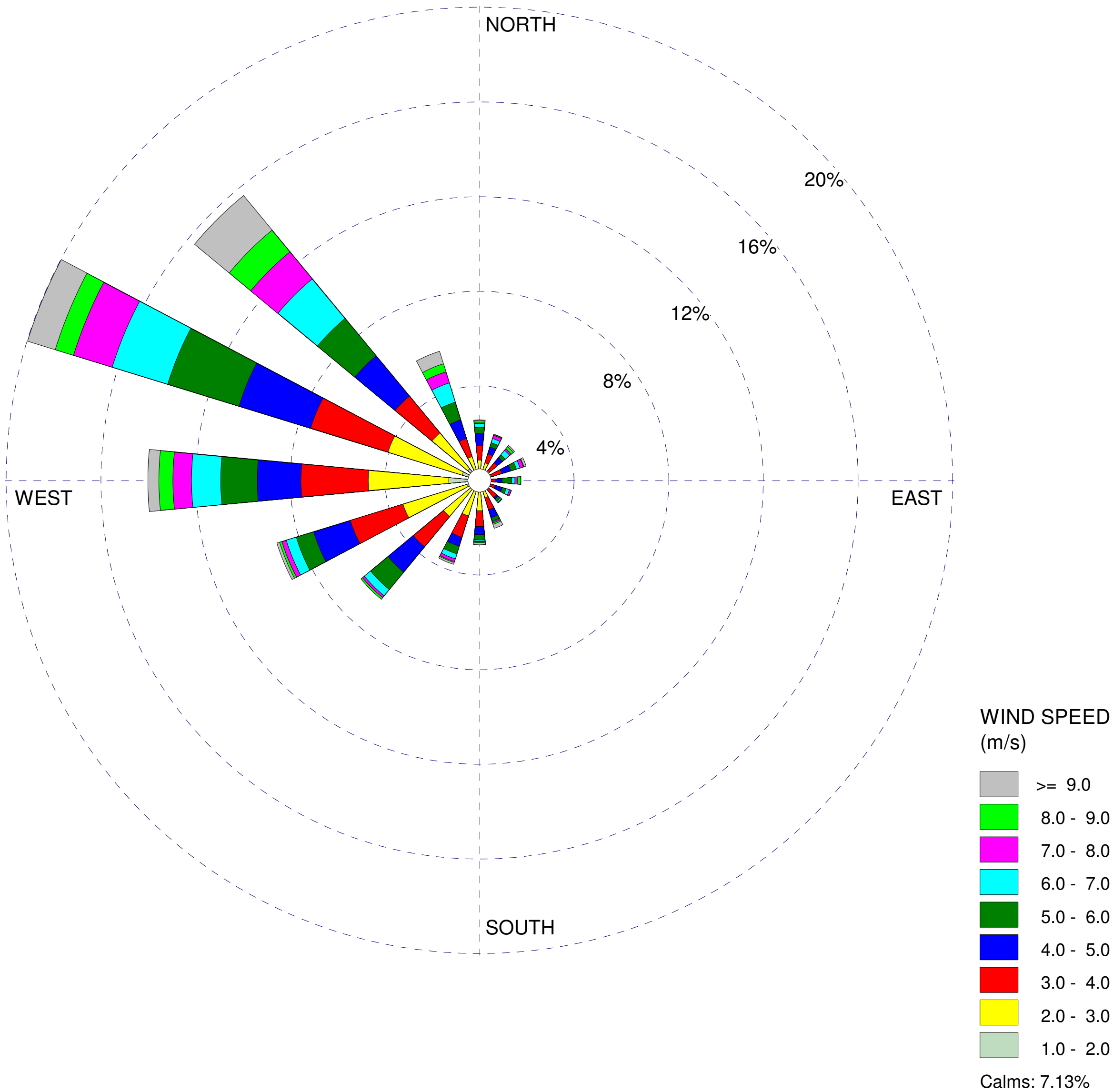


COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 1/1/2006 - 00:00 **End Date: 12/31/2013 - 23:00**	**URS**	
		MODELER: **LMB**	
	CALM WINDS: **10.21%**	TOTAL COUNT: **65934 hrs.**	
	AVG. WIND SPEED: **3.71 m/s**	DATE: **4/15/2014**	

WIND ROSE PLOT:

Monmouth Executive Airport
January Windrose

DISPLAY:
Wind Speed
Direction (blowing from)

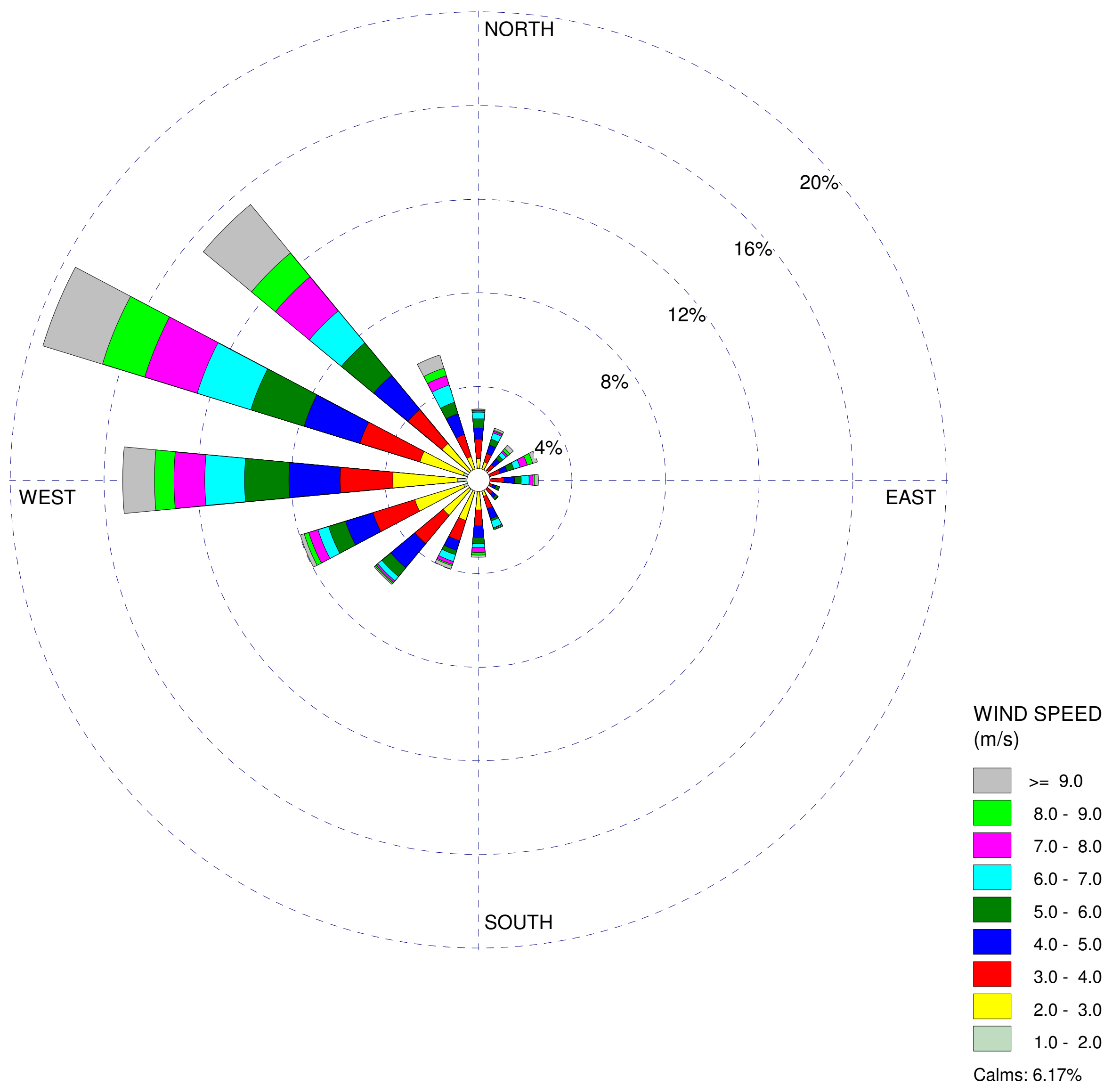


COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 1/1/2006 - 00:00 **End Date: 1/31/2013 - 23:00**	**URS**	
		MODELER: **LMB**	
	CALM WINDS: **7.13%**	TOTAL COUNT: **5857 hrs.**	
	AVG. WIND SPEED: **4.20 m/s**	DATE: **4/17/2014**	

WIND ROSE PLOT:

Monmouth Executive Airport
February Windrose

DISPLAY:
Wind Speed
Direction (blowing from)



COMMENTS:

DATA PERIOD:

Start Date: 2/1/2006 - 00:00
End Date: 2/28/2013 - 23:00

COMPANY NAME:

URS

MODELER:

LMB

CALM WINDS:

6.17%

TOTAL COUNT:

5306 hrs.

AVG. WIND SPEED:

4.68 m/s

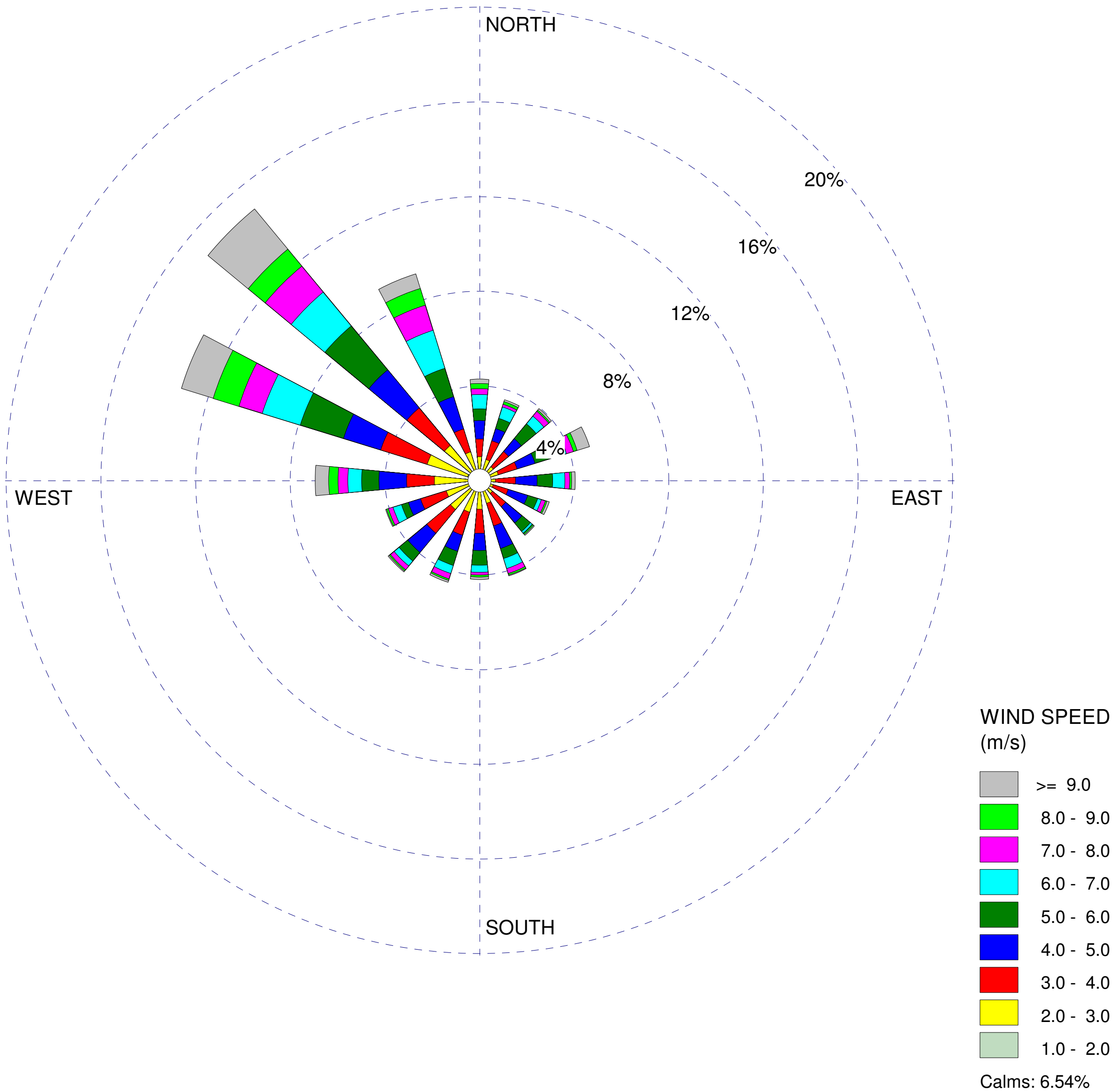
DATE:

4/17/2014

WIND ROSE PLOT:

Monmouth Executive Airport
March Windrose

DISPLAY:
Wind Speed
Direction (blowing from)



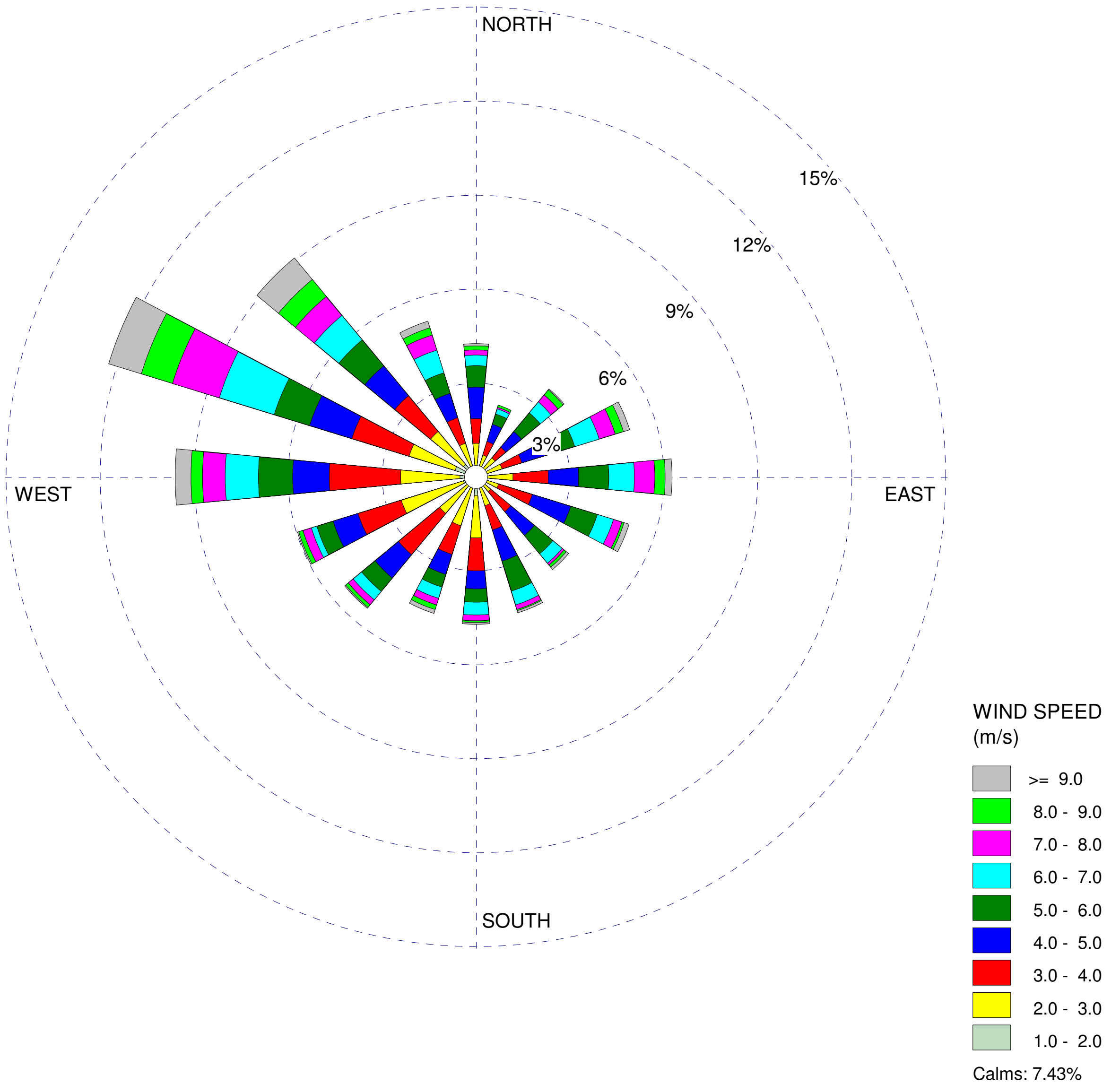
COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 3/1/2006 - 00:00 **End Date: 3/31/2013 - 23:00**	**URS**	
		MODELER: **LMB**	
	CALM WINDS: **6.54%**	TOTAL COUNT: **5912 hrs.**	
	AVG. WIND SPEED: **4.56 m/s**	DATE: **4/17/2014**	

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

Monmouth Executive Airport
April Windrose

DISPLAY:
Wind Speed
Direction (blowing from)

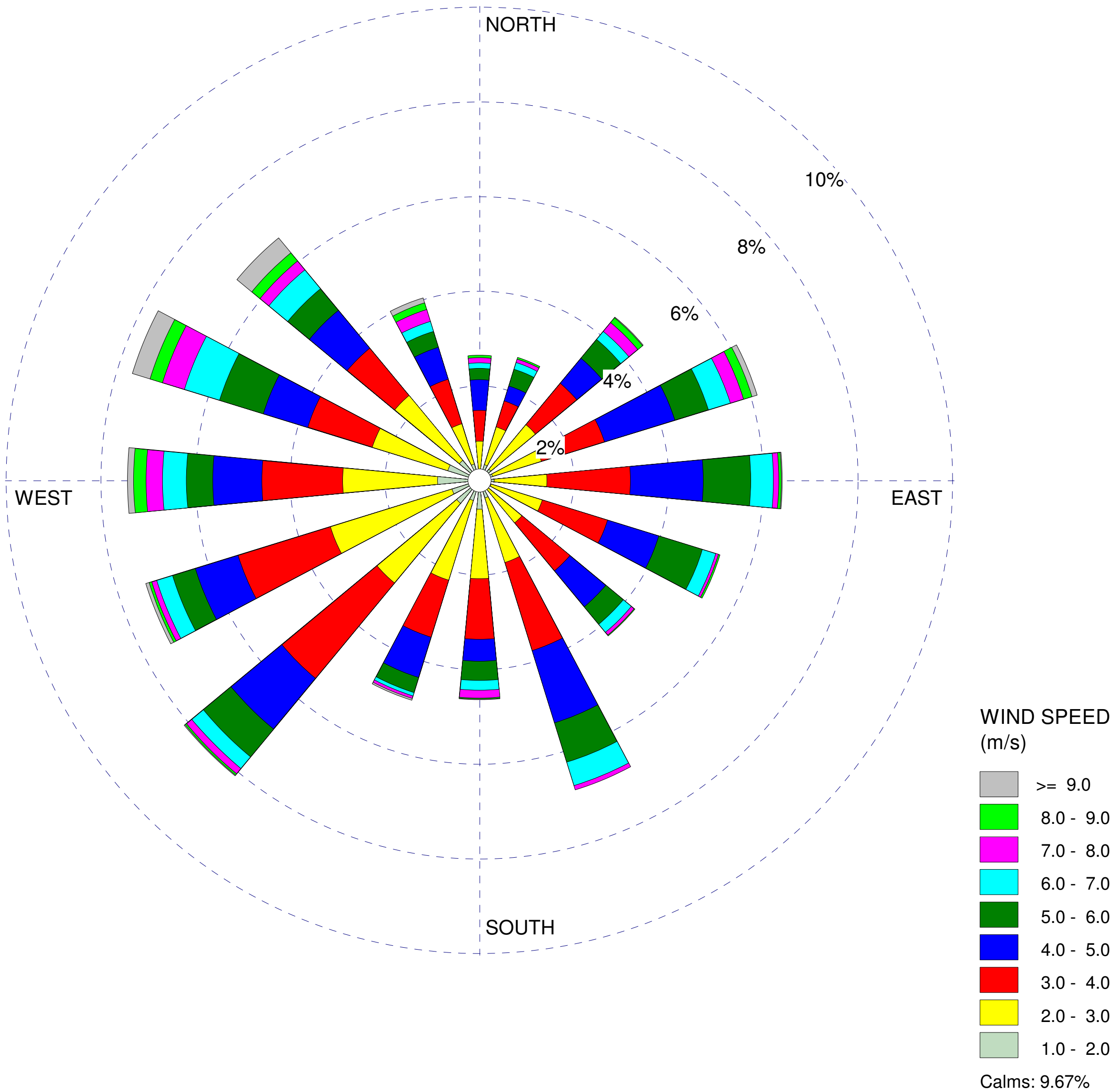


COMMENTS:	DATA PERIOD: **Start Date: 4/1/2006 - 00:00** **End Date: 4/30/2013 - 23:00**	COMPANY NAME: **URS**
		MODELER: **LMB**
	CALM WINDS: **7.43%**	TOTAL COUNT: **5407 hrs.**
	AVG. WIND SPEED: **4.26 m/s**	DATE: **4/17/2014**

WIND ROSE PLOT:

Monmouth Executive Airport
May Windrose

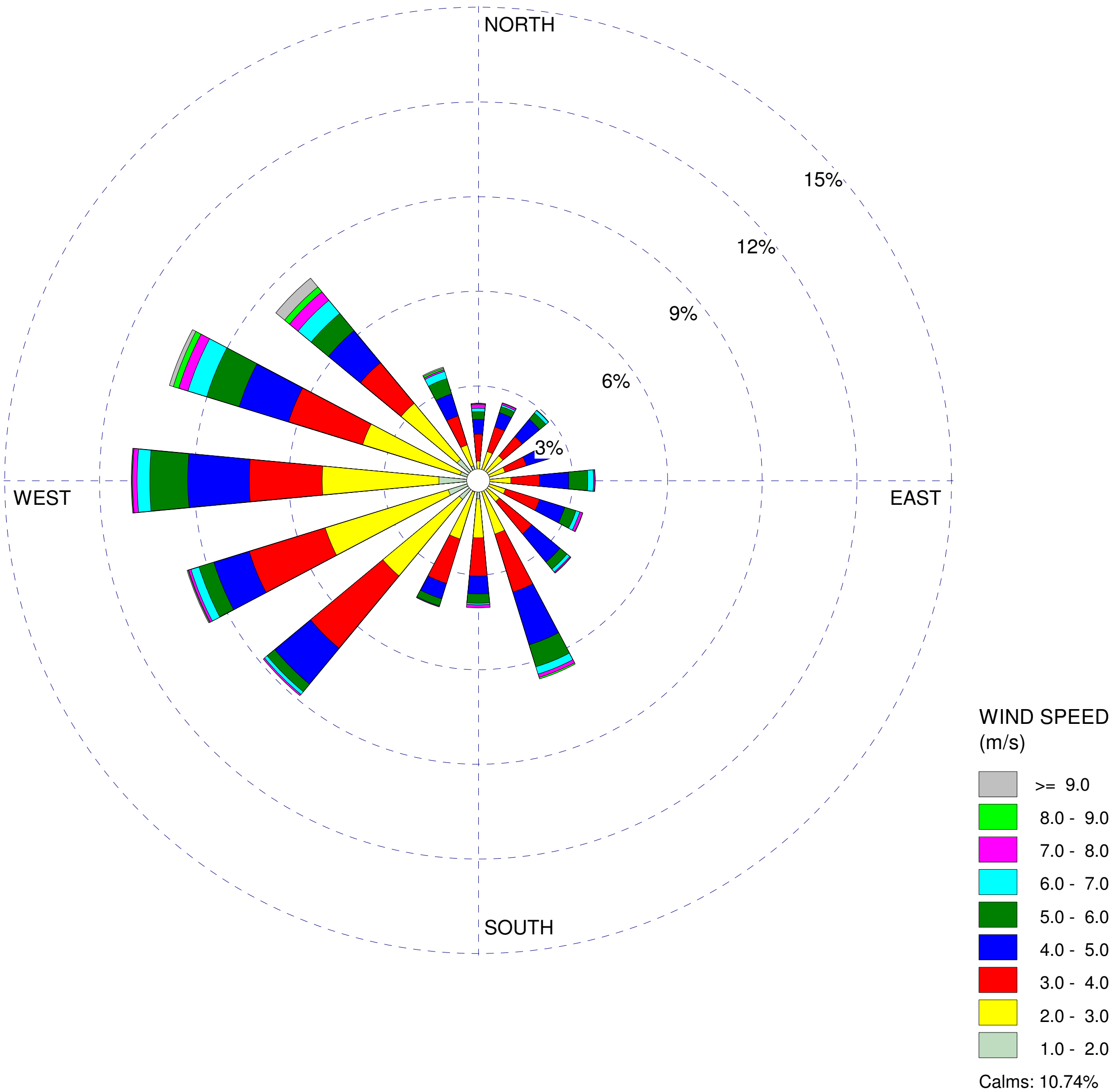
DISPLAY:
Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 5/1/2006 - 00:00 **End Date: 5/31/2013 - 23:00**	**URS**	
		MODELER: **LMB**	
	CALM WINDS: **9.67%**	TOTAL COUNT: **5405 hrs.**	
	AVG. WIND SPEED: **3.43 m/s**	DATE: **4/17/2014**	

WIND ROSE PLOT:
Monmouth Executive Airport
June Windrose

DISPLAY:
Wind Speed
Direction (blowing from)



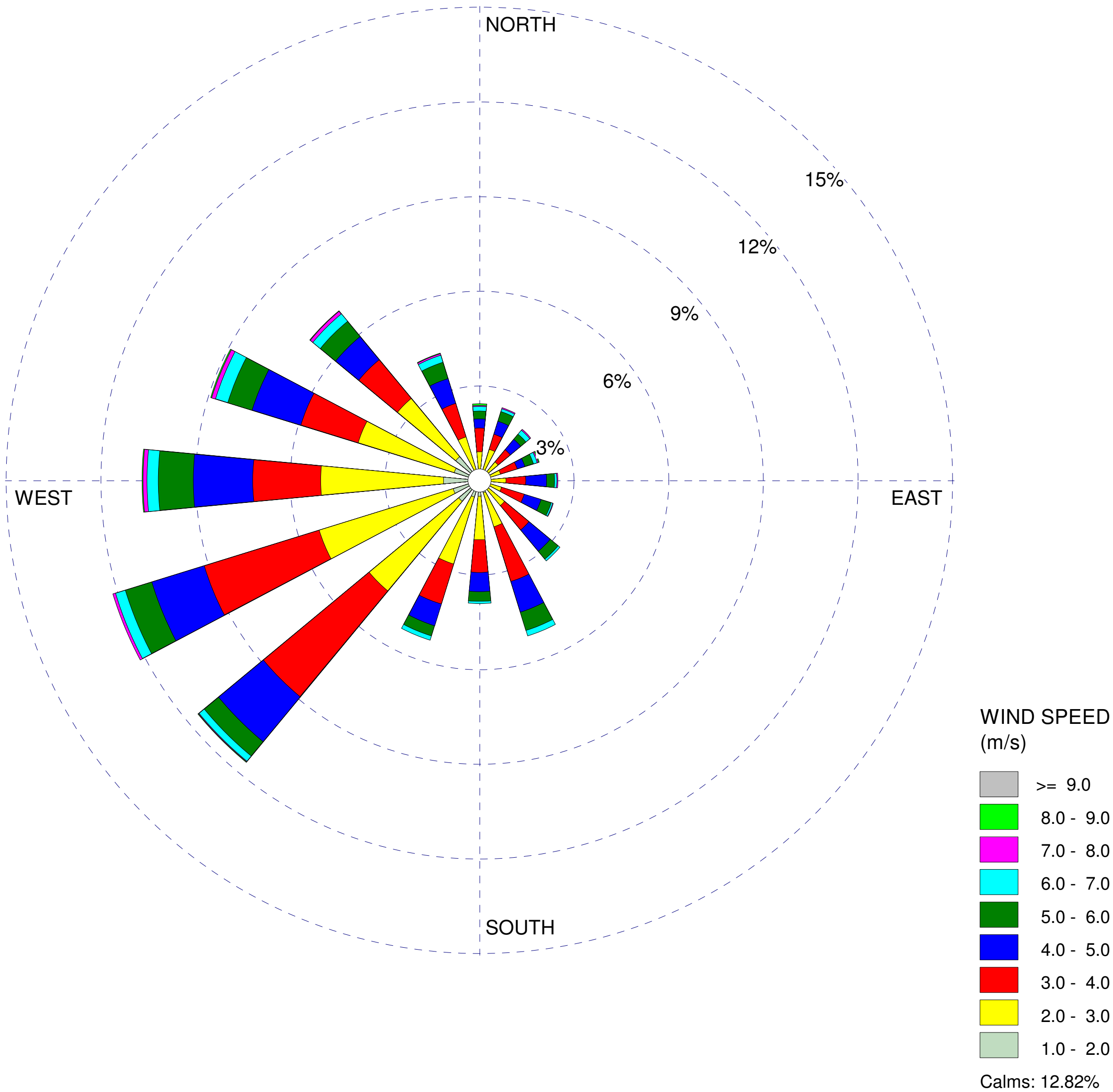
COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 6/1/2006 - 00:00 **End Date: 6/30/2013 - 23:00**	**URS**	
		MODELER: **LMB**	
	CALM WINDS: **10.74%**	TOTAL COUNT: **5509 hrs.**	
	AVG. WIND SPEED: **3.11 m/s**	DATE: **4/17/2014**	

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

Monmouth Executive Airport
July Windrose

DISPLAY:
Wind Speed
Direction (blowing from)

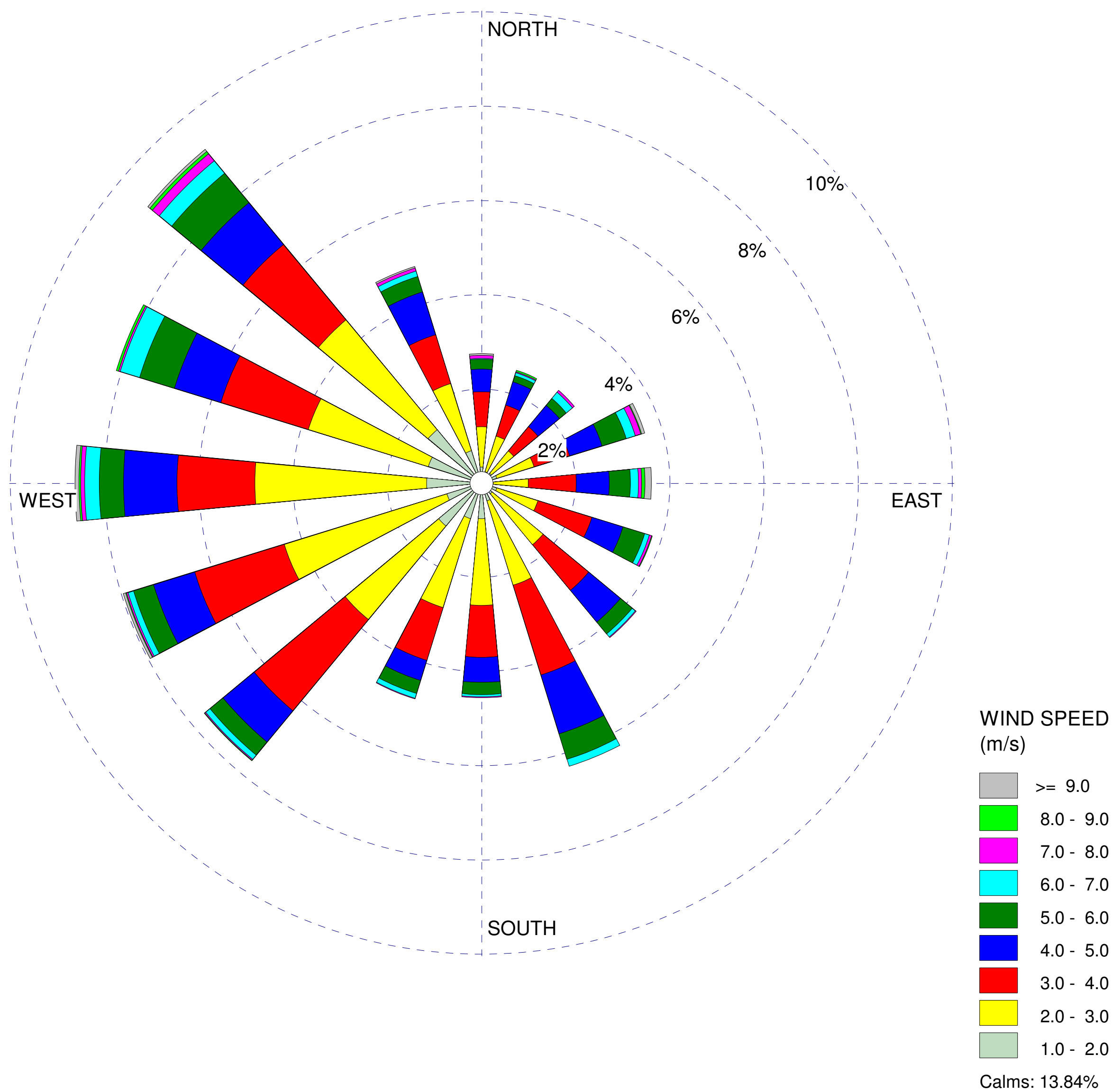


COMMENTS:	DATA PERIOD: **Start Date: 7/1/2006 - 00:00** **End Date: 7/31/2013 - 23:00**	COMPANY NAME: **URS**
		MODELER: **LMB**
	CALM WINDS: **12.82%**	TOTAL COUNT: **5593 hrs.**
	AVG. WIND SPEED: **2.88 m/s**	DATE: **4/17/2014**

WIND ROSE PLOT:

Monmouth Executive Airport
August Windrose

DISPLAY:
Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:
	Start Date: 8/1/2006 - 00:00 **End Date: 8/31/2013 - 23:00**	**URS**
		MODELER: **LMB**
	CALM WINDS: **13.84%**	TOTAL COUNT: **5830 hrs.**
	AVG. WIND SPEED: **2.78 m/s**	DATE: **4/17/2014**

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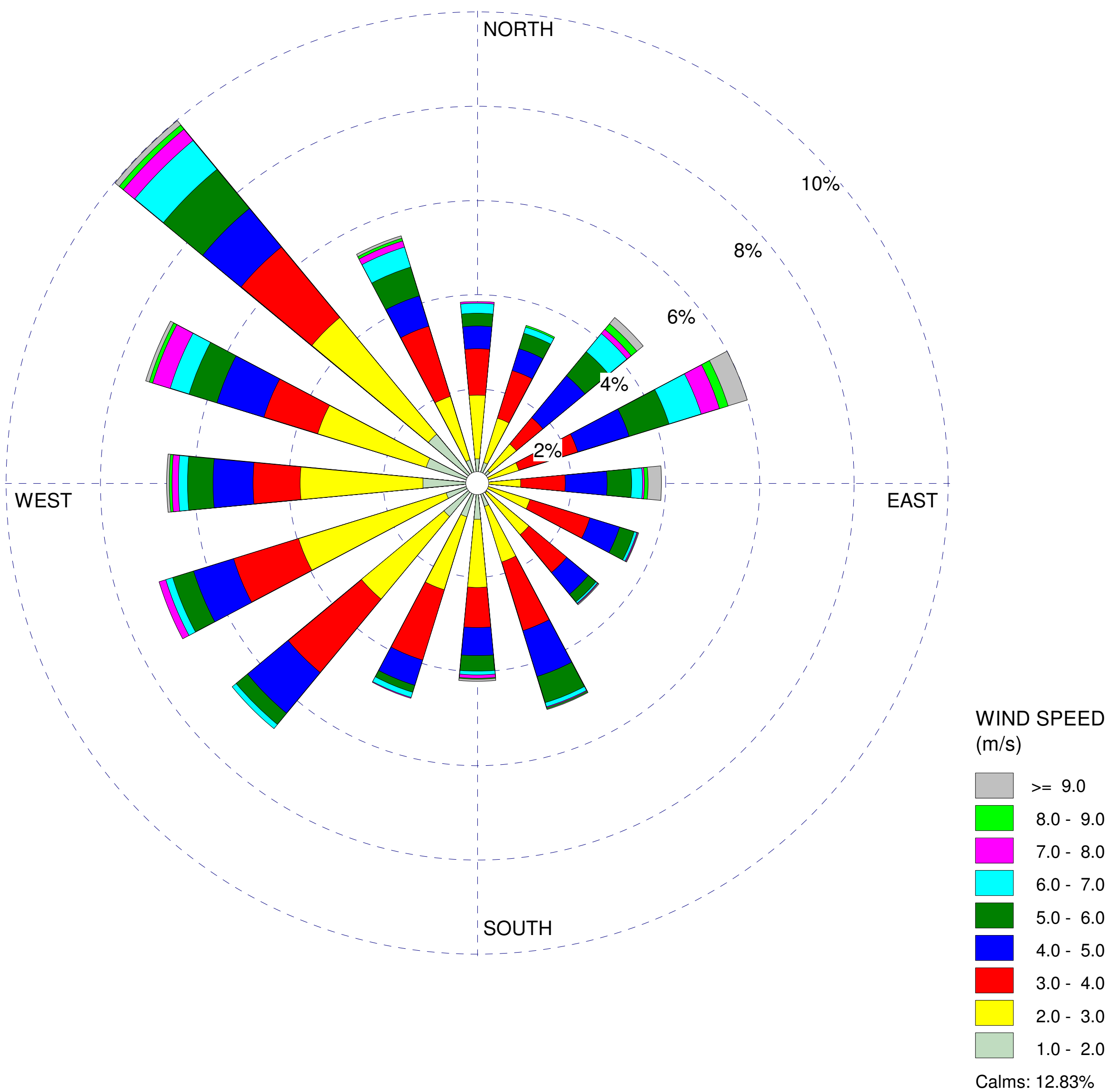
WIND ROSE PLOT:

Monmouth Executive Airport
September Windrose

DISPLAY:
Wind Speed
Direction (blowing from)



COMMENTS:

DATA PERIOD:

Start Date: 9/1/2006 - 00:00
End Date: 9/30/2013 - 23:00

COMPANY NAME:

URS

MODELER:

LMB

CALM WINDS:

12.83%

TOTAL COUNT:

5198 hrs.

AVG. WIND SPEED:

3.06 m/s

DATE:

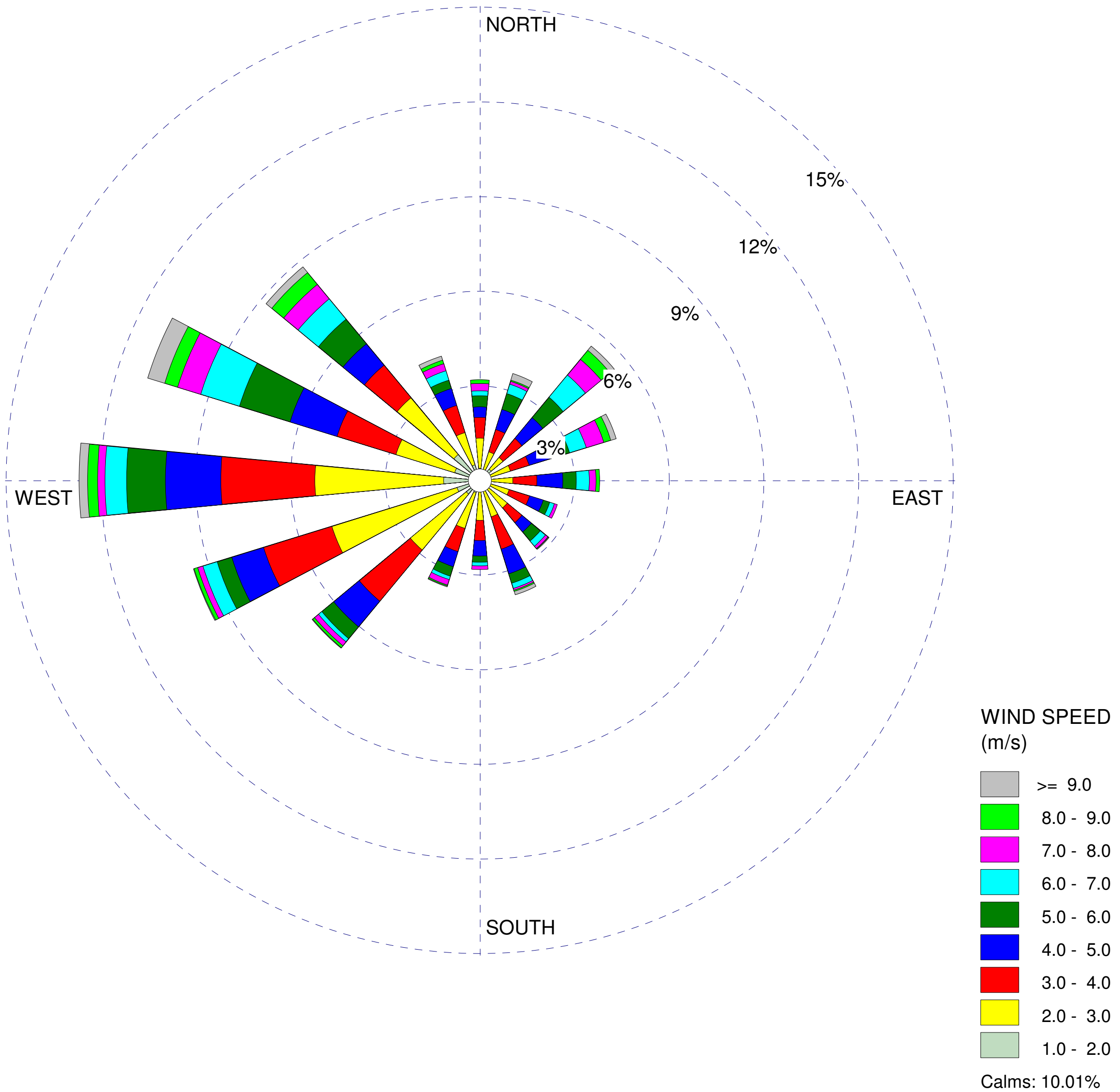
4/17/2014

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

Monmouth Executive Airport
October Windrose

DISPLAY:
Wind Speed
Direction (blowing from)



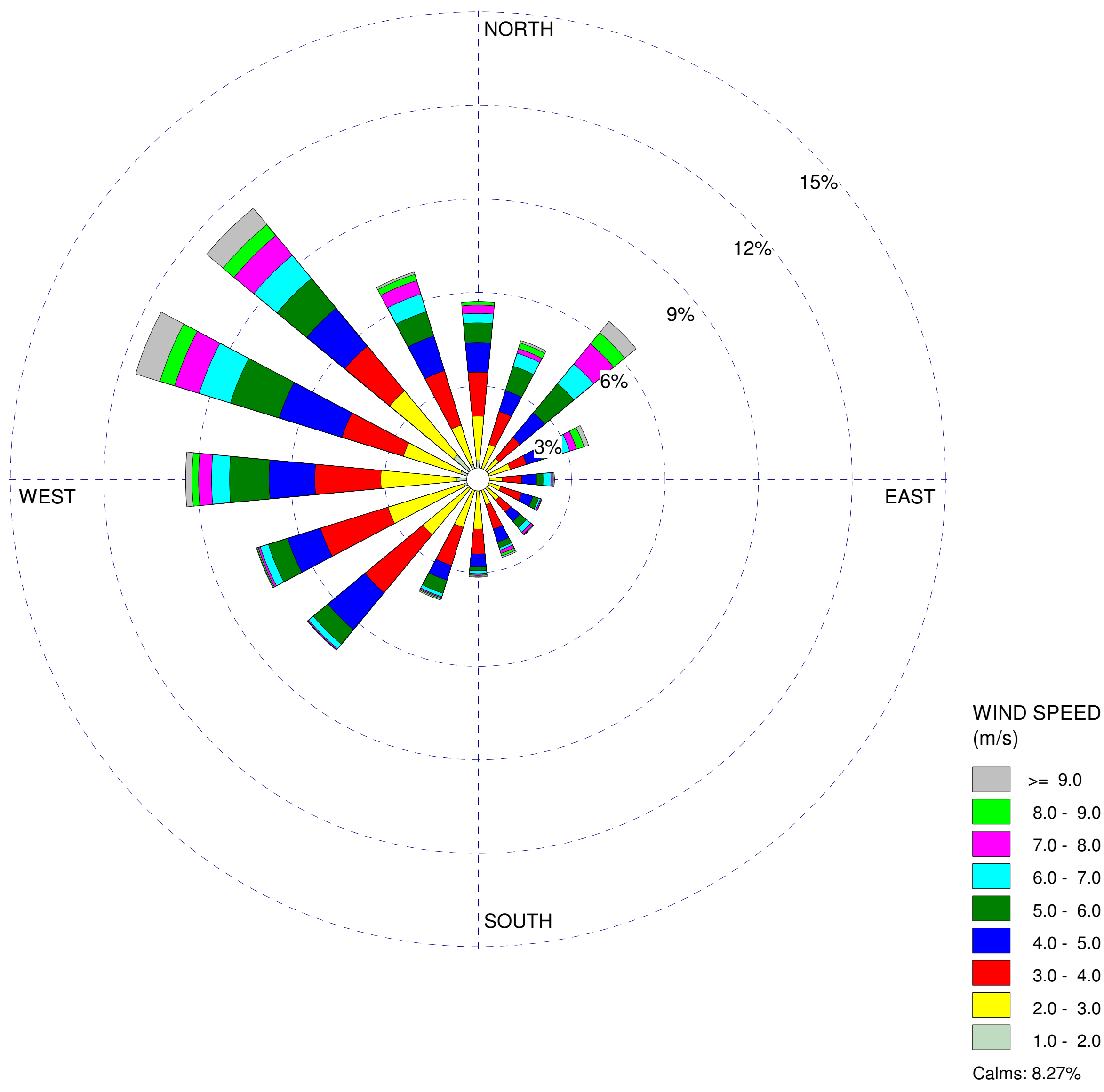
COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 10/1/2006 - 00:00 **End Date: 10/31/2013 - 23:00**	**URS**	
		MODELER: **LMB**	
	CALM WINDS: **10.01%**	TOTAL COUNT: **5142 hrs.**	
	AVG. WIND SPEED: **3.57 m/s**	DATE: **4/17/2014**	

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

Monmouth Executive Airport
November Windrose

DISPLAY:
Wind Speed
Direction (blowing from)



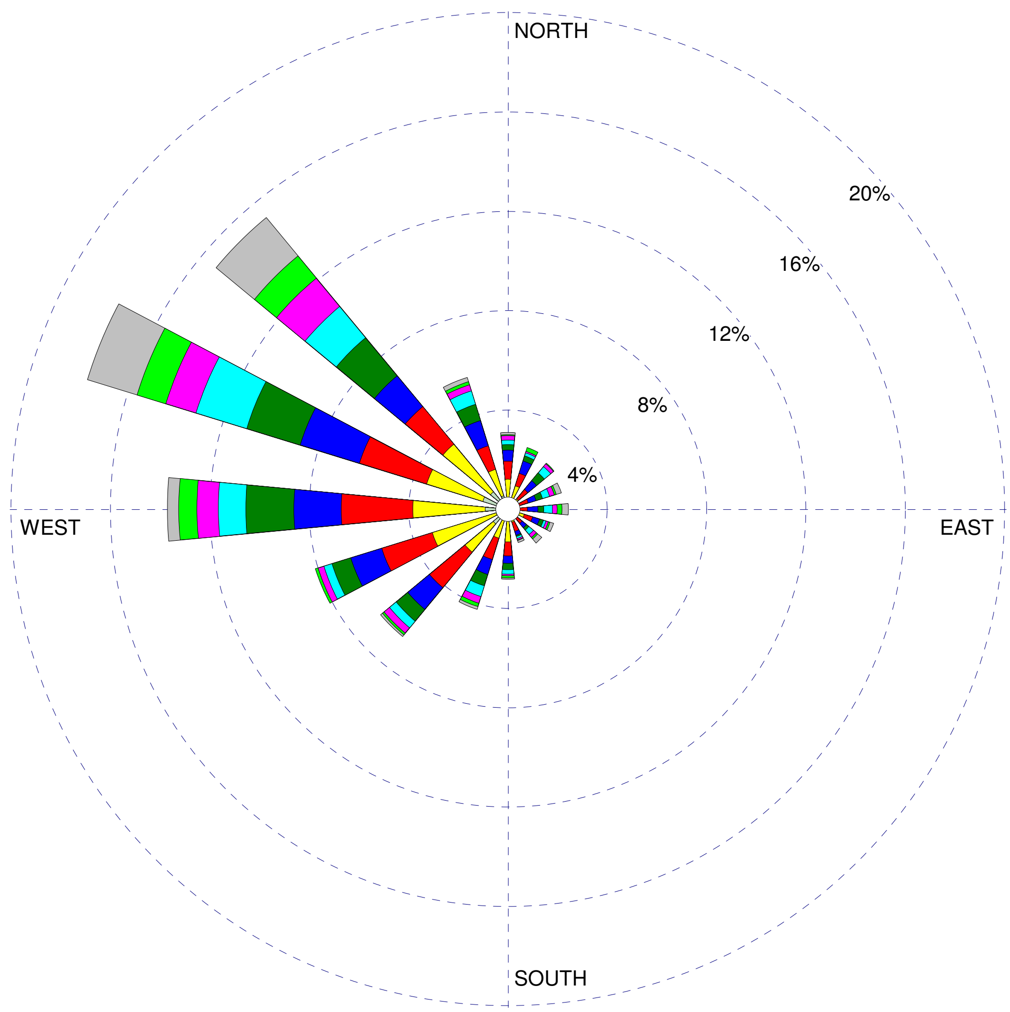
COMMENTS:	DATA PERIOD: **Start Date: 11/1/2006 - 00:00** **End Date: 11/30/2013 - 23:00**	COMPANY NAME: **URS**	
		MODELER: **LMB**	
	CALM WINDS: **8.27%**	TOTAL COUNT: **5266 hrs.**	
	AVG. WIND SPEED: **3.76 m/s**	DATE: **4/17/2014**	

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

Monmouth Executive Airport
December Windrose

DISPLAY:
Wind Speed
Direction (blowing from)



WIND SPEED
(m/s)

- >= 9.0
- 8.0 - 9.0
- 7.0 - 8.0
- 6.0 - 7.0
- 5.0 - 6.0
- 4.0 - 5.0
- 3.0 - 4.0
- 2.0 - 3.0
- 1.0 - 2.0

Calms: 7.50%

COMMENTS:	DATA PERIOD: **Start Date: 12/1/2006 - 00:00** **End Date: 12/31/2013 - 23:00**	COMPANY NAME: **URS** MODELER: **LMB**
	CALM WINDS: **7.50%**	TOTAL COUNT: **5461 hrs.**
	AVG. WIND SPEED: **4.25 m/s**	DATE: **4/17/2014**

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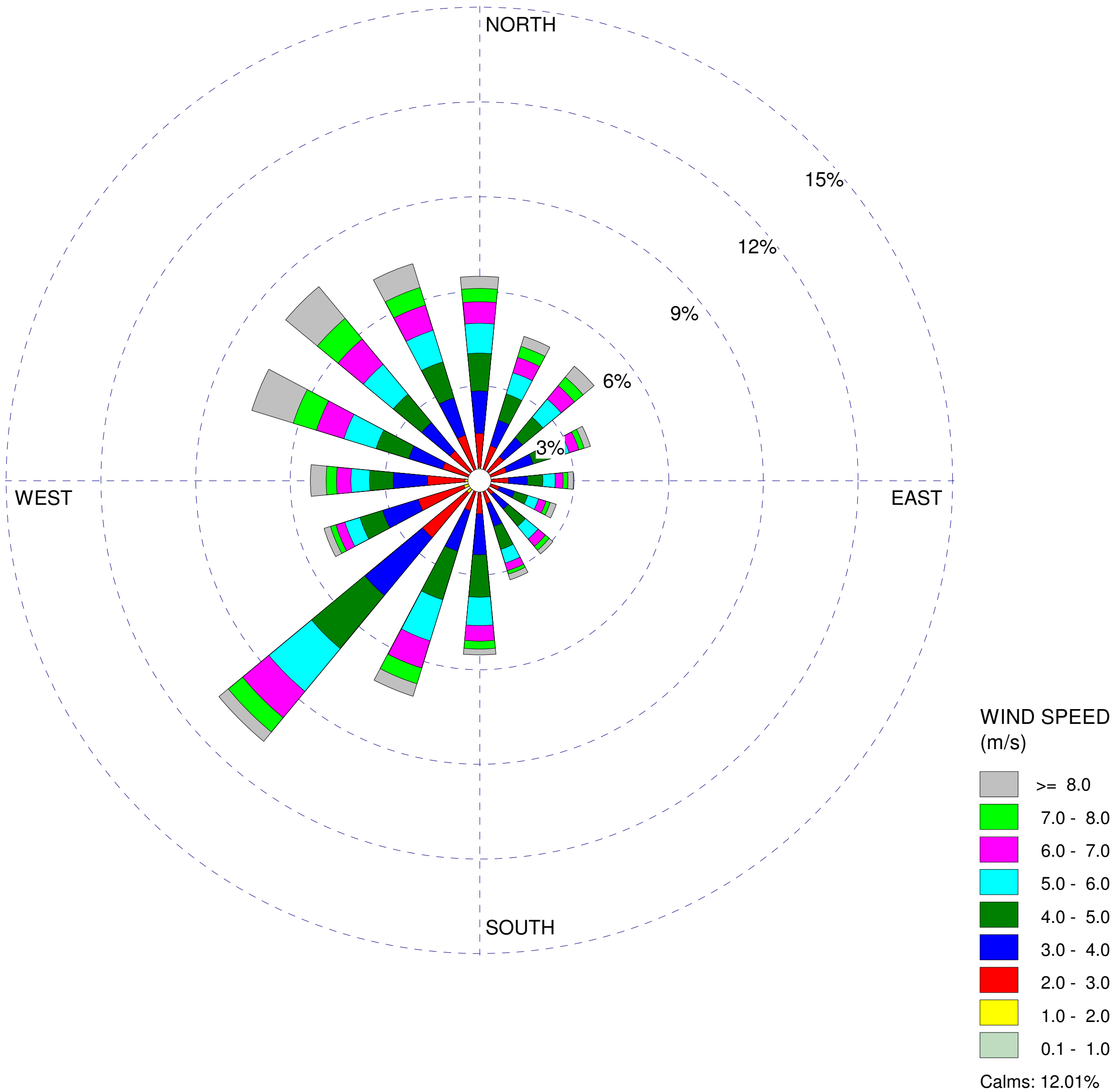
WIND ROSE PLOT:
Long Island MacArthur Airport
Annual Windrose

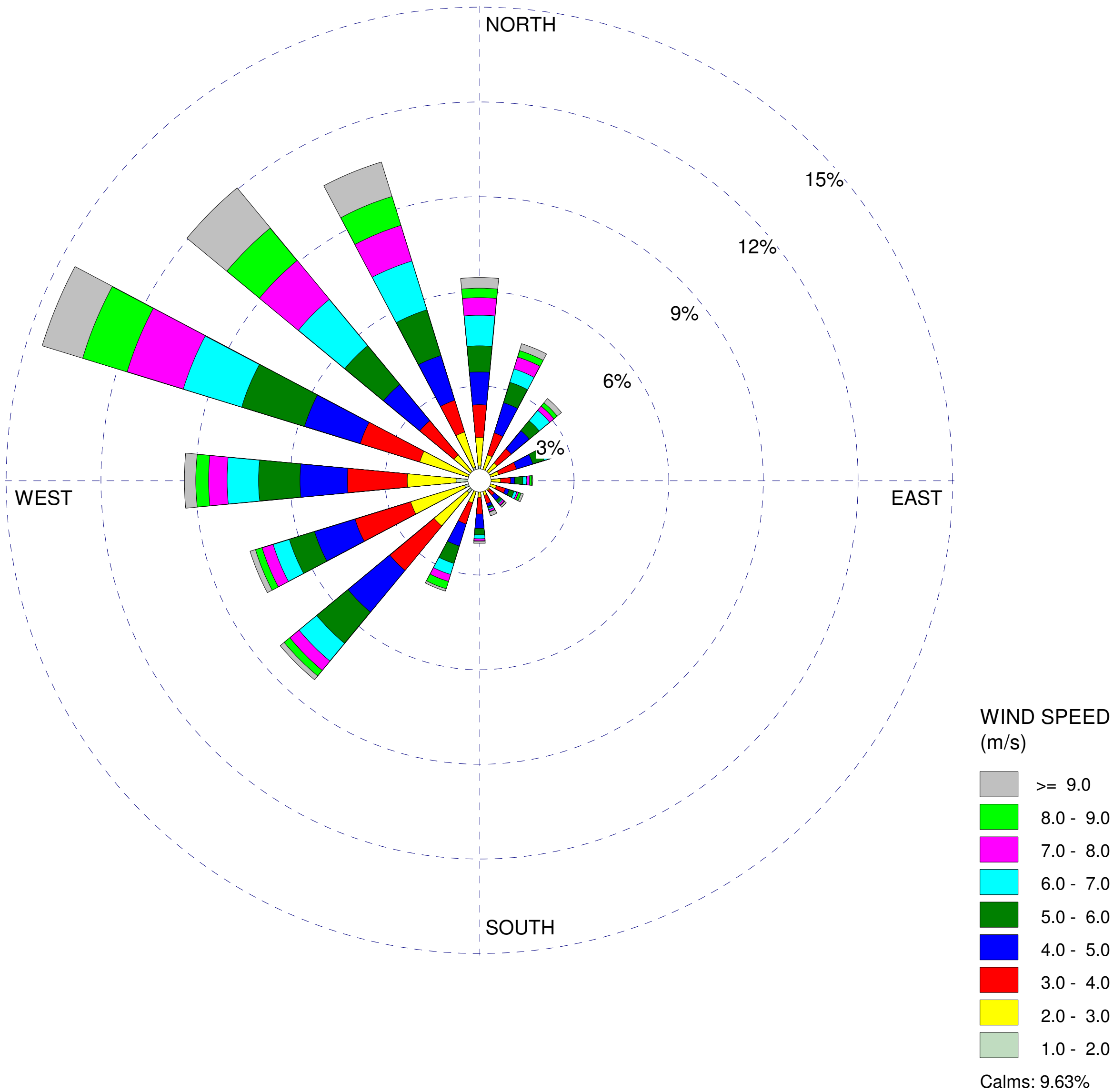
DISPLAY:
Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 1/1/2000 - 00:00 **End Date: 12/31/2009 - 23:00**	**URS**	
		MODELER: **LMB**	
	CALM WINDS: **12.01%**	TOTAL COUNT: **87613 hrs.**	
	AVG. WIND SPEED: **4.10 m/s**	DATE: **4/15/2014**	

WIND ROSE PLOT:
Long Island MacArthur
January Windrose

DISPLAY:
Wind Speed
Direction (blowing from)

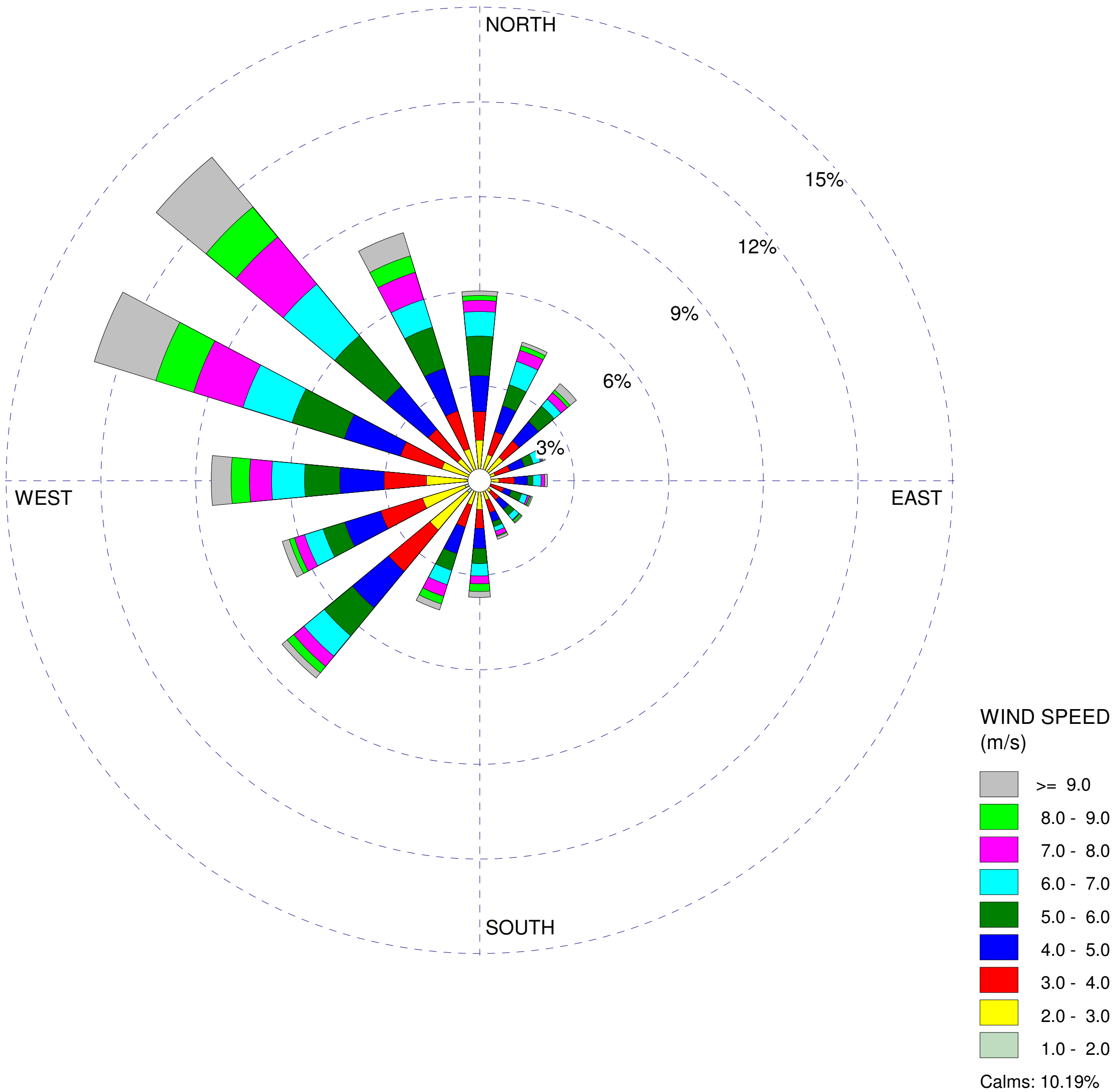


COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 1/1/2000 - 00:00 **End Date: 1/31/2009 - 23:00**	**URS**	
		MODELER: **LMB**	
	CALM WINDS: **9.63%**	TOTAL COUNT: **7415 hrs.**	
	AVG. WIND SPEED: **4.56 m/s**	DATE: **4/17/2014**	

WIND ROSE PLOT:

Long Island MacArthur Airport
February Windrose

DISPLAY:
Wind Speed
Direction (blowing from)



COMMENTS:

DATA PERIOD:

Start Date: 2/1/2000 - 00:00
End Date: 2/28/2009 - 23:00

COMPANY NAME:

URS

MODELER:

LMB

CALM WINDS:

10.19%

TOTAL COUNT:

6720 hrs.

AVG. WIND SPEED:

4.66 m/s

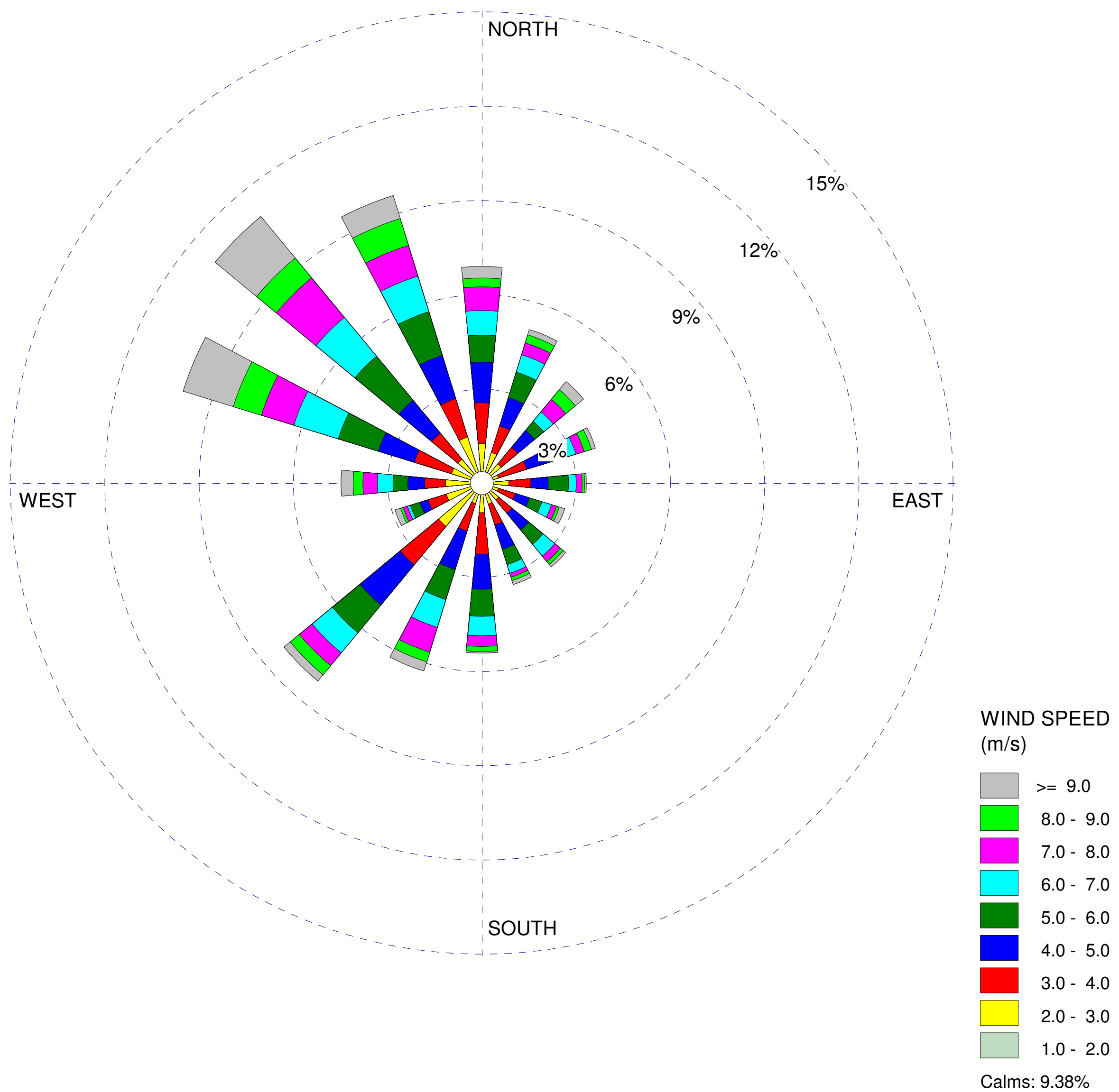
DATE:

4/17/2014

WIND ROSE PLOT:

Long Island MacArthur Airport
March Windrose

DISPLAY:
Wind Speed
Direction (blowing from)

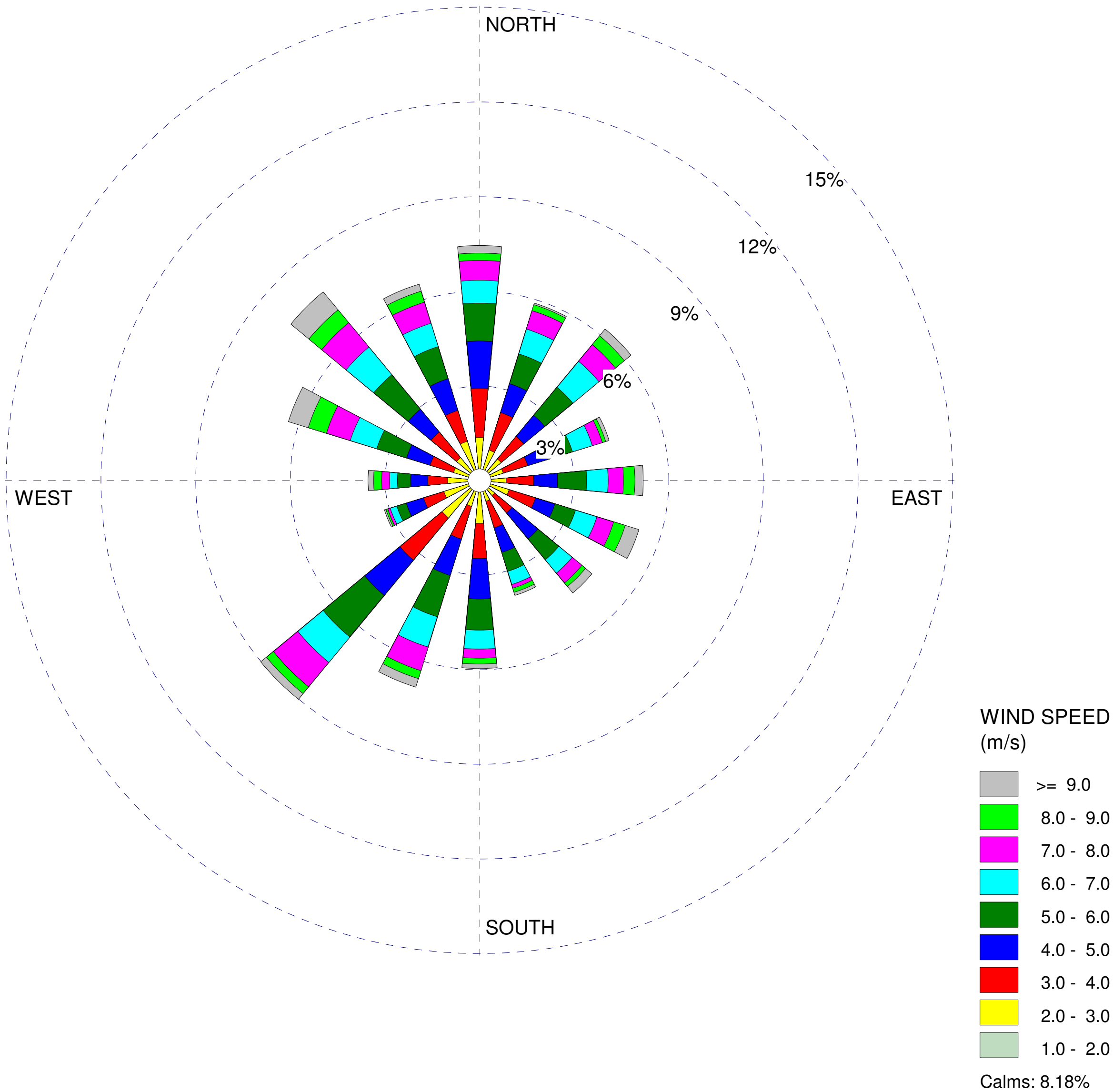


COMMENTS:	DATA PERIOD: **Start Date: 3/1/2000 - 00:00** **End Date: 3/31/2009 - 23:00**	COMPANY NAME: **URS**
		MODELER: **LMB**
	CALM WINDS: **9.38%**	TOTAL COUNT: **7437 hrs.**
	AVG. WIND SPEED: **4.70 m/s**	DATE: **4/17/2014**

WIND ROSE PLOT:

Long Island MacArthur Airport
April Windrose

DISPLAY:
Wind Speed
Direction (blowing from)

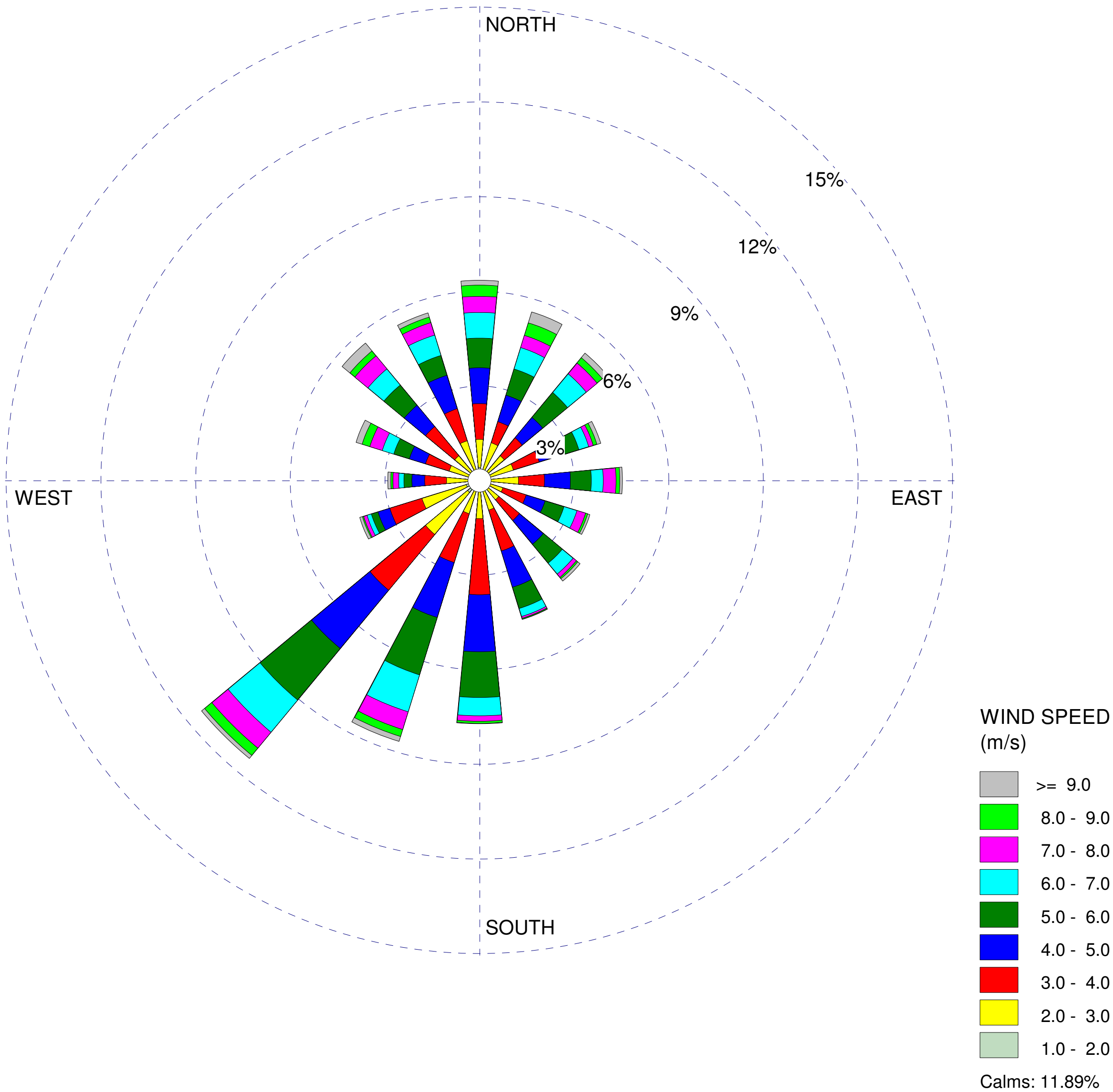


COMMENTS:	DATA PERIOD: **Start Date: 4/1/2000 - 00:00** **End Date: 4/30/2009 - 23:00**	COMPANY NAME: **URS**	
		MODELER: **LMB**	
	CALM WINDS: **8.18%**	TOTAL COUNT: **7198 hrs.**	
	AVG. WIND SPEED: **4.57 m/s**	DATE: **4/17/2014**	

WIND ROSE PLOT:

Long Island MacArthur Airport
May Windrose

DISPLAY:
Wind Speed
Direction (blowing from)



COMMENTS:

DATA PERIOD:

Start Date: 5/1/2000 - 00:00
End Date: 5/31/2009 - 23:00

COMPANY NAME:

URS

MODELER:

LMB

CALM WINDS:

11.89%

TOTAL COUNT:

7430 hrs.

AVG. WIND SPEED:

3.97 m/s

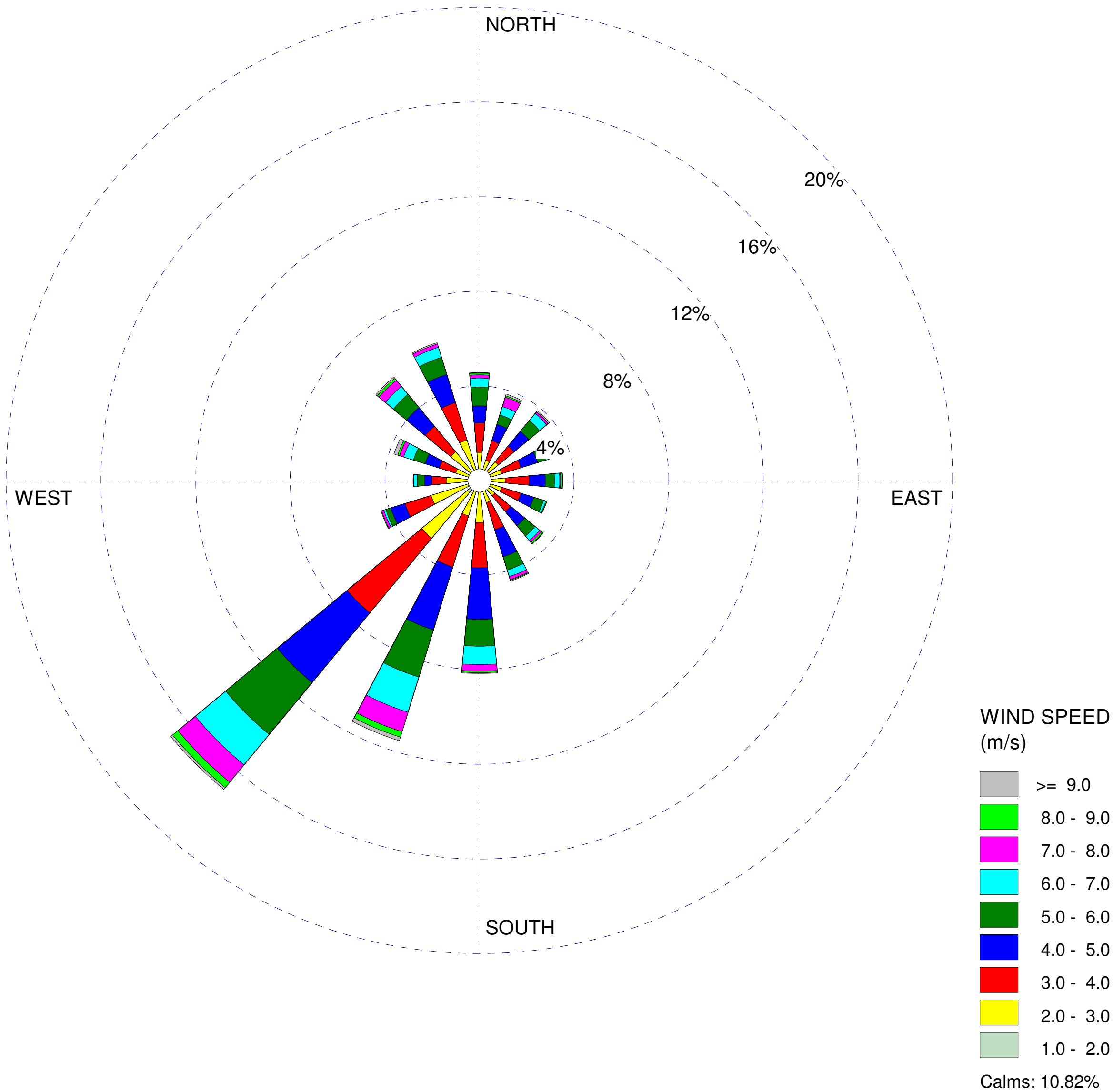
DATE:

4/17/2014

WIND ROSE PLOT:

Long Island MacArthur Airport
June Windrose

DISPLAY:
Wind Speed
Direction (blowing from)



COMMENTS:

DATA PERIOD:

Start Date: 6/1/2000 - 00:00
End Date: 6/30/2009 - 23:00

COMPANY NAME:

URS

MODELER:

LMB

CALM WINDS:

10.82%

TOTAL COUNT:

7196 hrs.

AVG. WIND SPEED:

3.67 m/s

DATE:

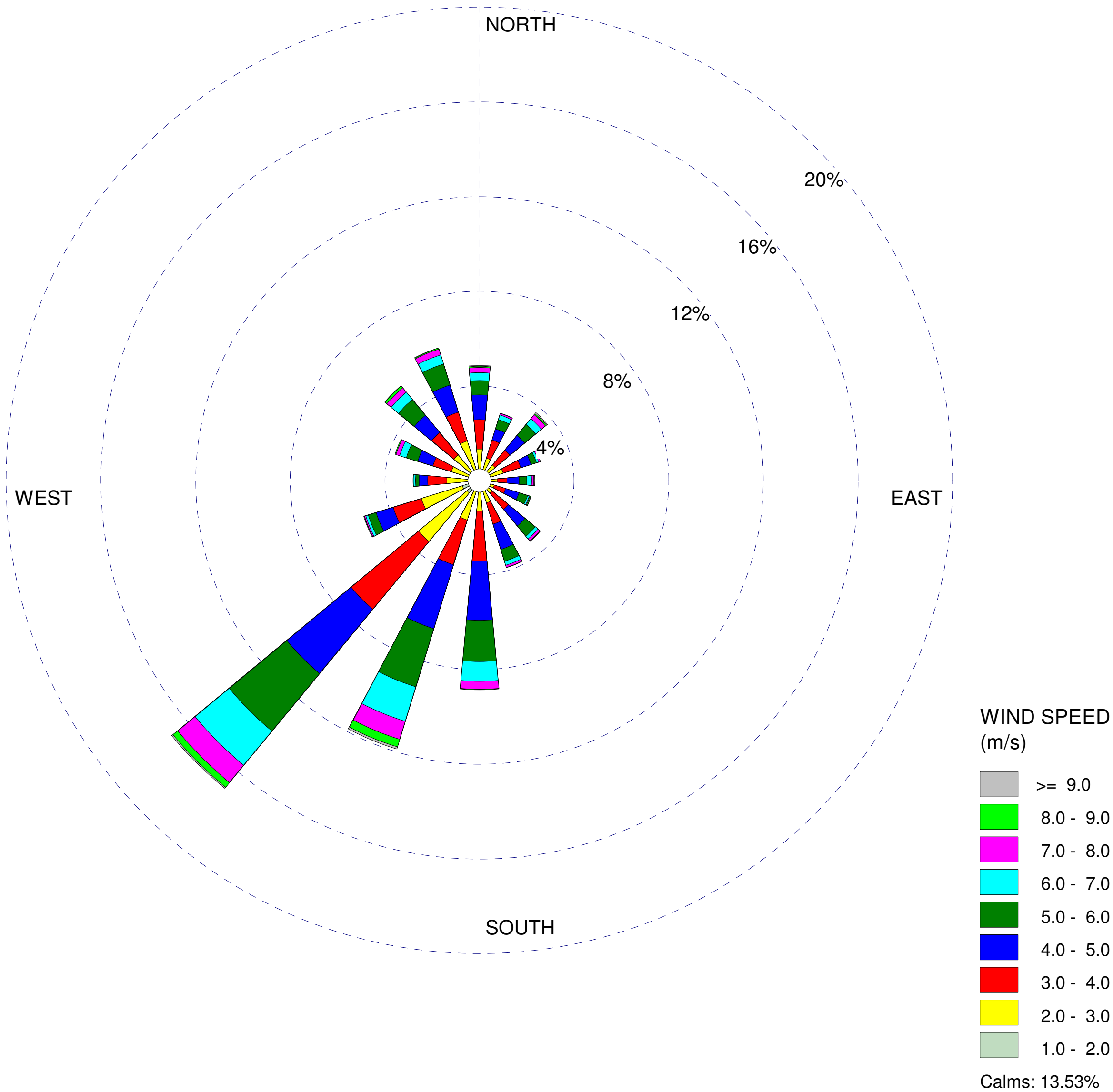
4/17/2014

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

Long Island MacArthur Airport
July Windrose

DISPLAY:
Wind Speed
Direction (blowing from)

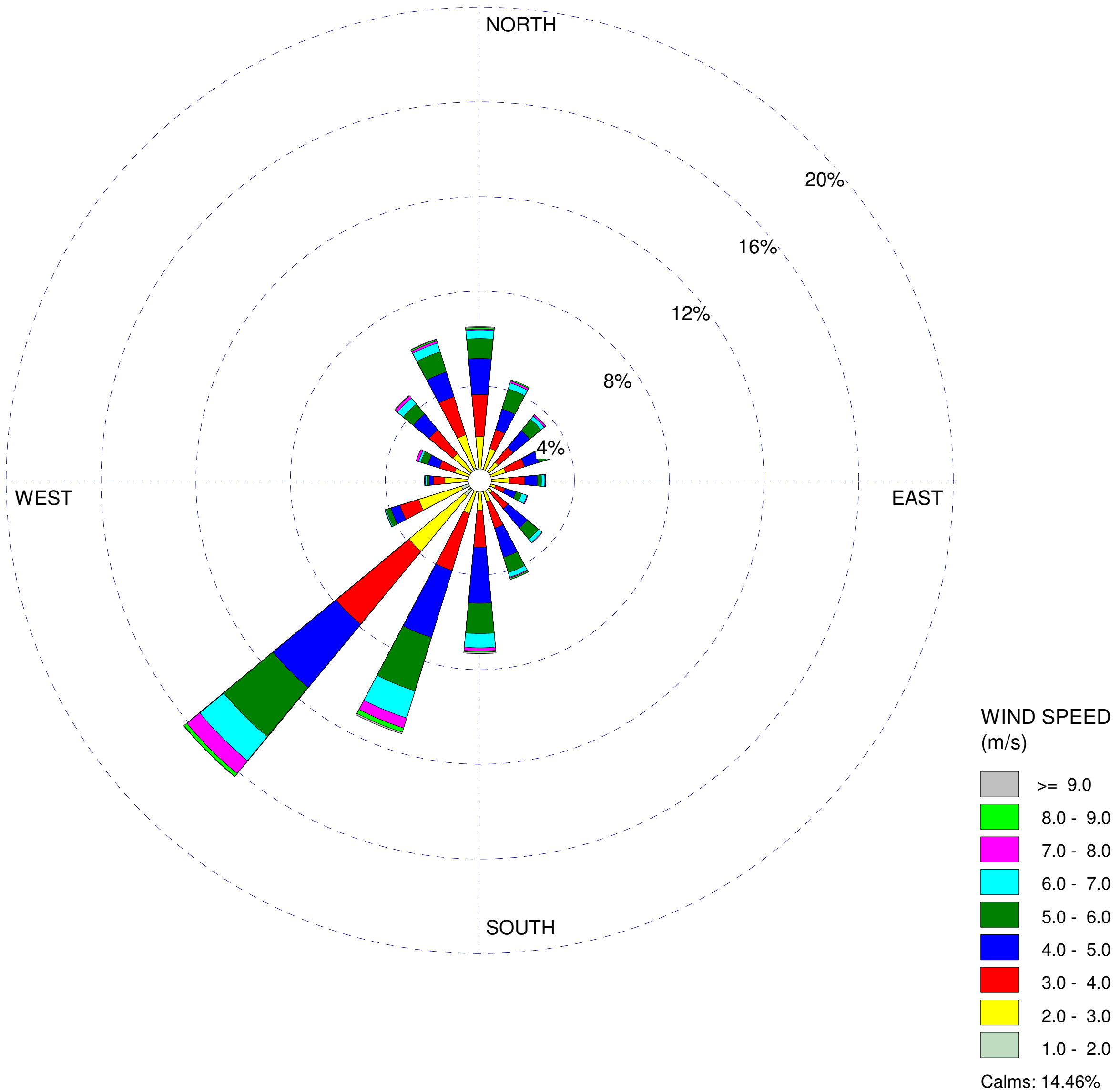


COMMENTS:	DATA PERIOD: **Start Date: 7/1/2000 - 00:00** **End Date: 7/31/2009 - 23:00**	COMPANY NAME: **URS**	
		MODELER: **LMB**	
	CALM WINDS: **13.53%**	TOTAL COUNT: **7439 hrs.**	
	AVG. WIND SPEED: **3.53 m/s**	DATE: **4/17/2014**	

WIND ROSE PLOT:

Long Island MacArthur Airport
August Windrose

DISPLAY:
Wind Speed
Direction (blowing from)



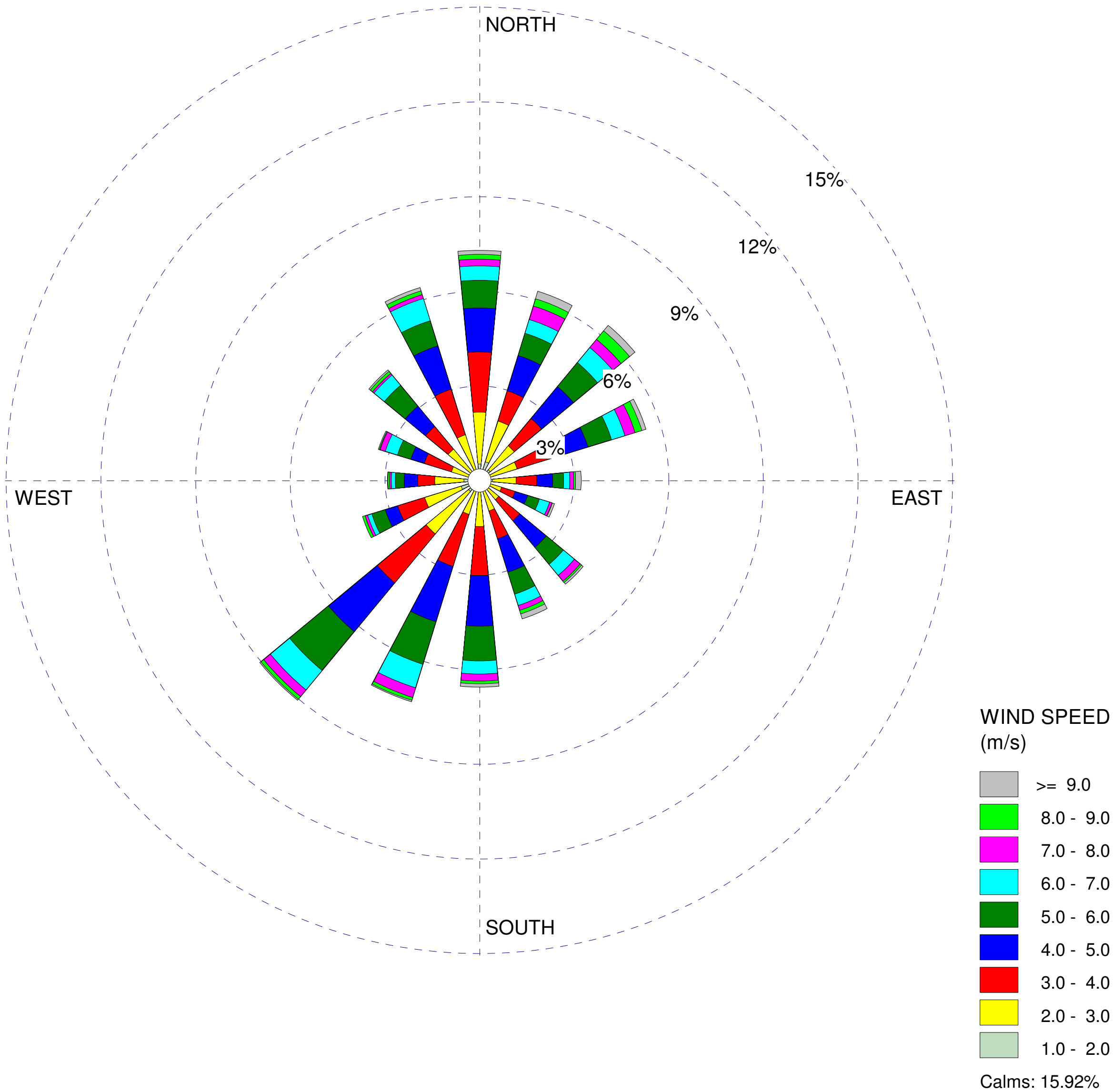
COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 8/1/2000 - 00:00 **End Date: 8/31/2009 - 23:00**	**URS**	
		MODELER: **LMB**	
	CALM WINDS: **14.46%**	TOTAL COUNT: **7428 hrs.**	
	AVG. WIND SPEED: **3.33 m/s**	DATE: **4/17/2014**	

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

Long Island MacArthur Airport
September Windrose

DISPLAY:
Wind Speed
Direction (blowing from)



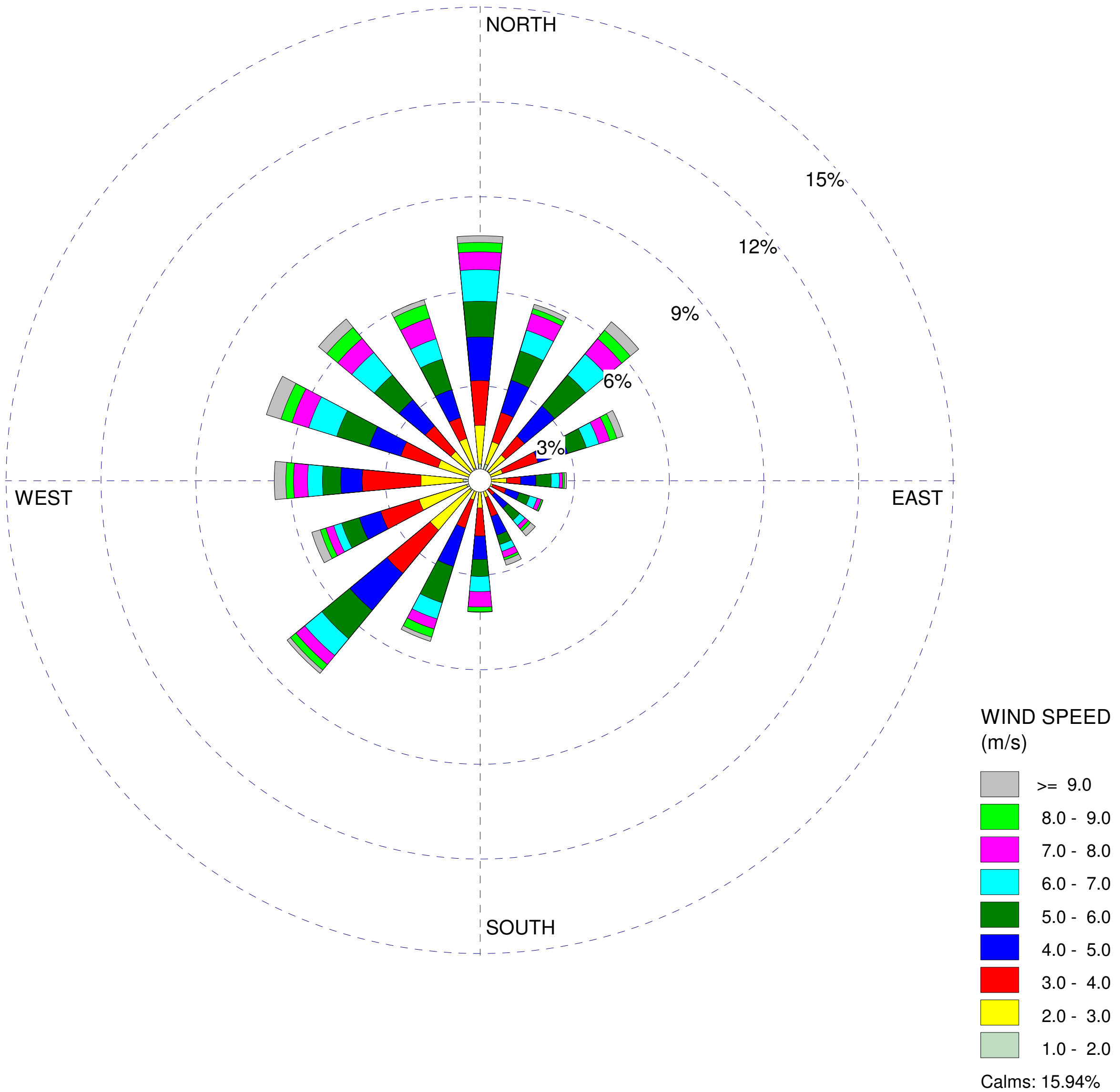
COMMENTS:	DATA PERIOD: **Start Date: 9/1/2000 - 00:00** **End Date: 9/30/2009 - 23:00**	COMPANY NAME: **URS**	
		MODELER: **LMB**	
	CALM WINDS: **15.92%**	TOTAL COUNT: **7200 hrs.**	
	AVG. WIND SPEED: **3.53 m/s**	DATE: **4/17/2014**	

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

Long Island MacArthur Airport
October Windrose

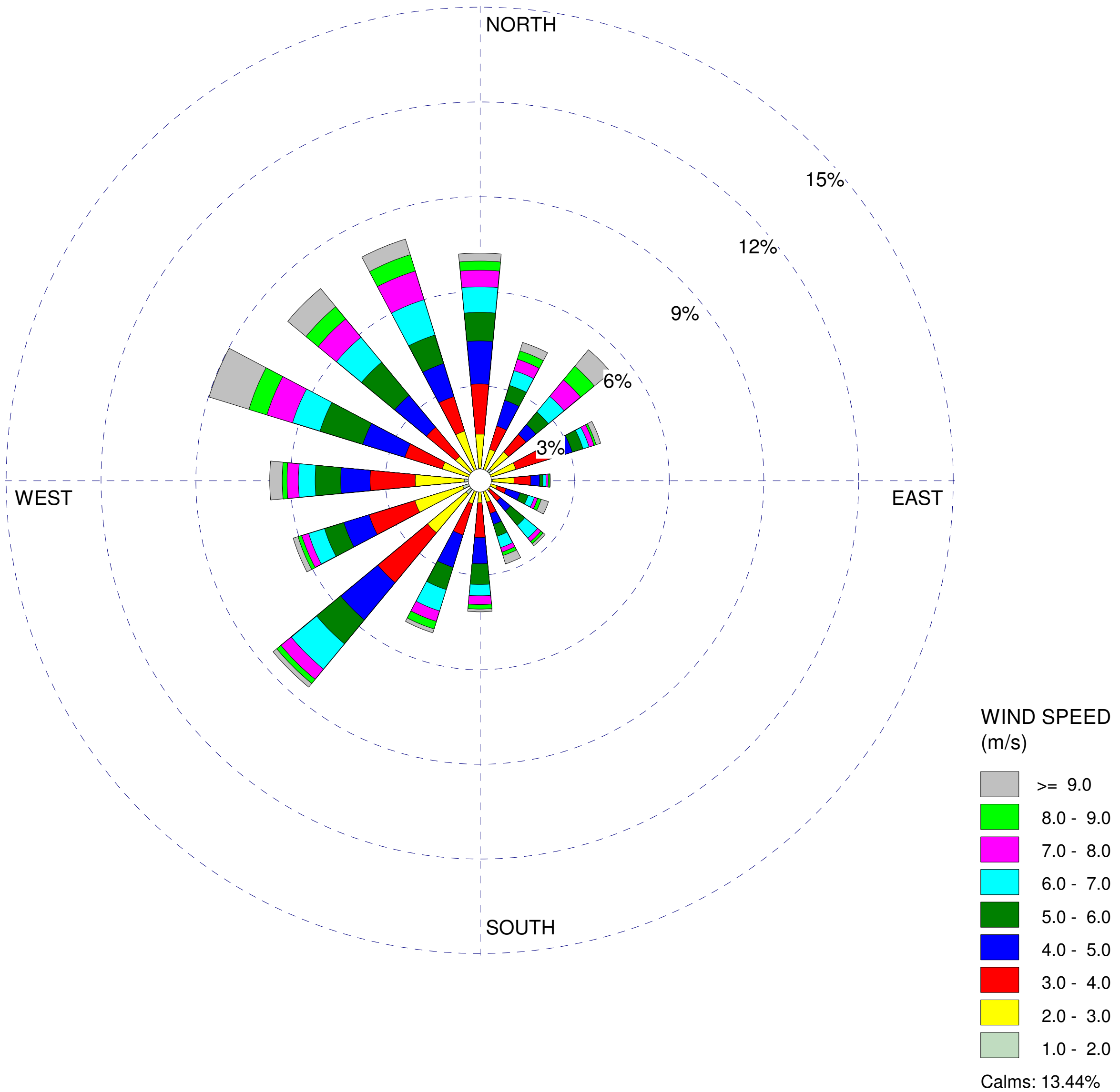
DISPLAY:
Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 10/1/2000 - 00:00 **End Date: 10/31/2009 - 23:00**	**URS**	
		MODELER: **LMB**	
	CALM WINDS: **15.94%**	TOTAL COUNT: **7437 hrs.**	
	AVG. WIND SPEED: **3.95 m/s**	DATE: **4/17/2014**	

WIND ROSE PLOT:
Long Island MacArthur Airport
November Windrose

DISPLAY:
Wind Speed
Direction (blowing from)



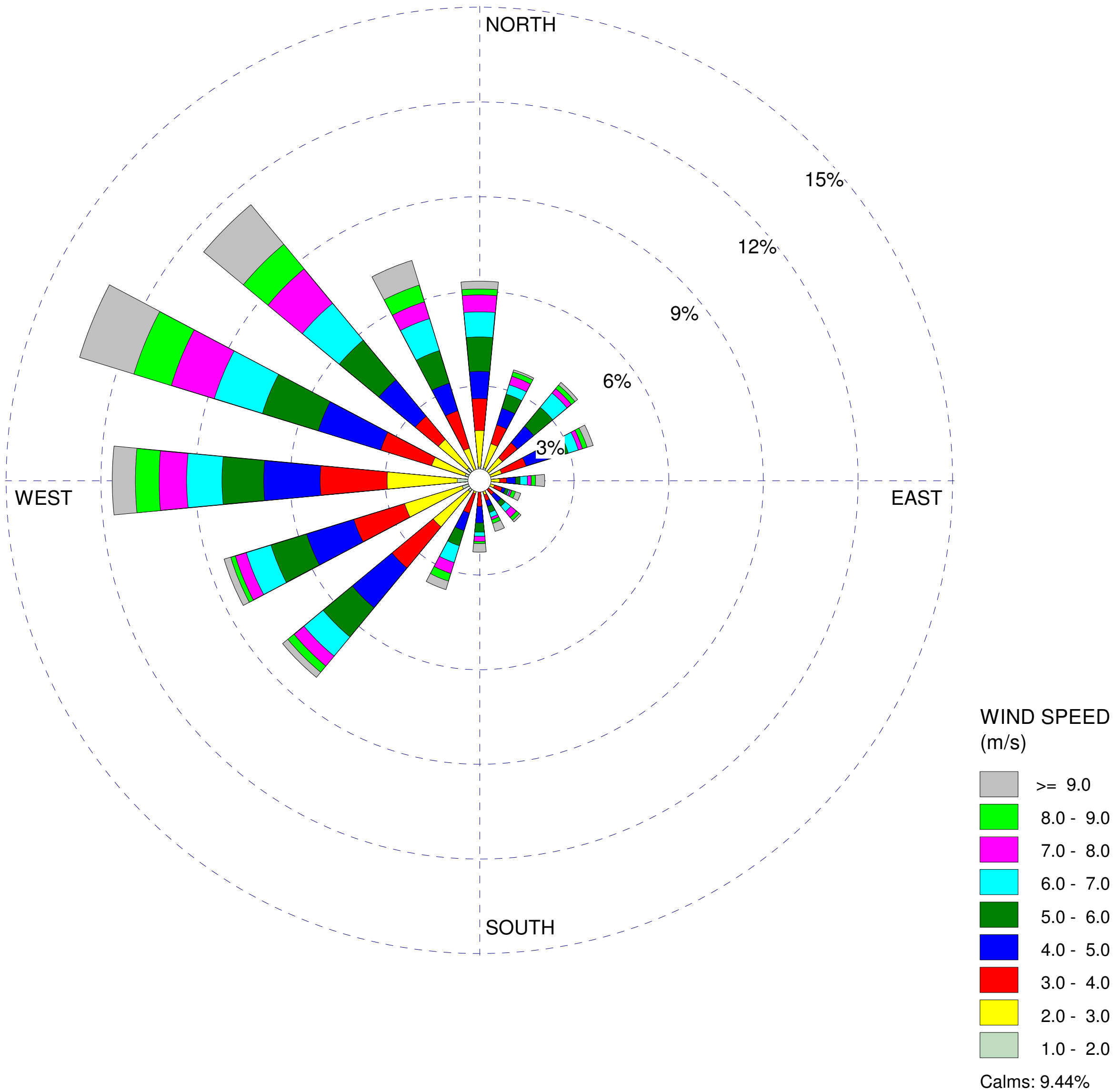
COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 11/1/2000 - 00:00 **End Date: 11/30/2009 - 23:00**	**URS**	
		MODELER: **LMB**	
	CALM WINDS: **13.44%**	TOTAL COUNT: **7199 hrs.**	
	AVG. WIND SPEED: **4.17 m/s**	DATE: **4/17/2014**	

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

Long Island MacArthur Airport
December Windrose

DISPLAY:
Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 12/1/2000 - 00:00 **End Date: 12/31/2009 - 23:00**	**URS**	
		MODELER: **LMB**	
	CALM WINDS: **9.44%**	TOTAL COUNT: **7442 hrs.**	
	AVG. WIND SPEED: **4.61 m/s**	DATE: **4/17/2014**	

WRPLOT View - Lakes Environmental Software

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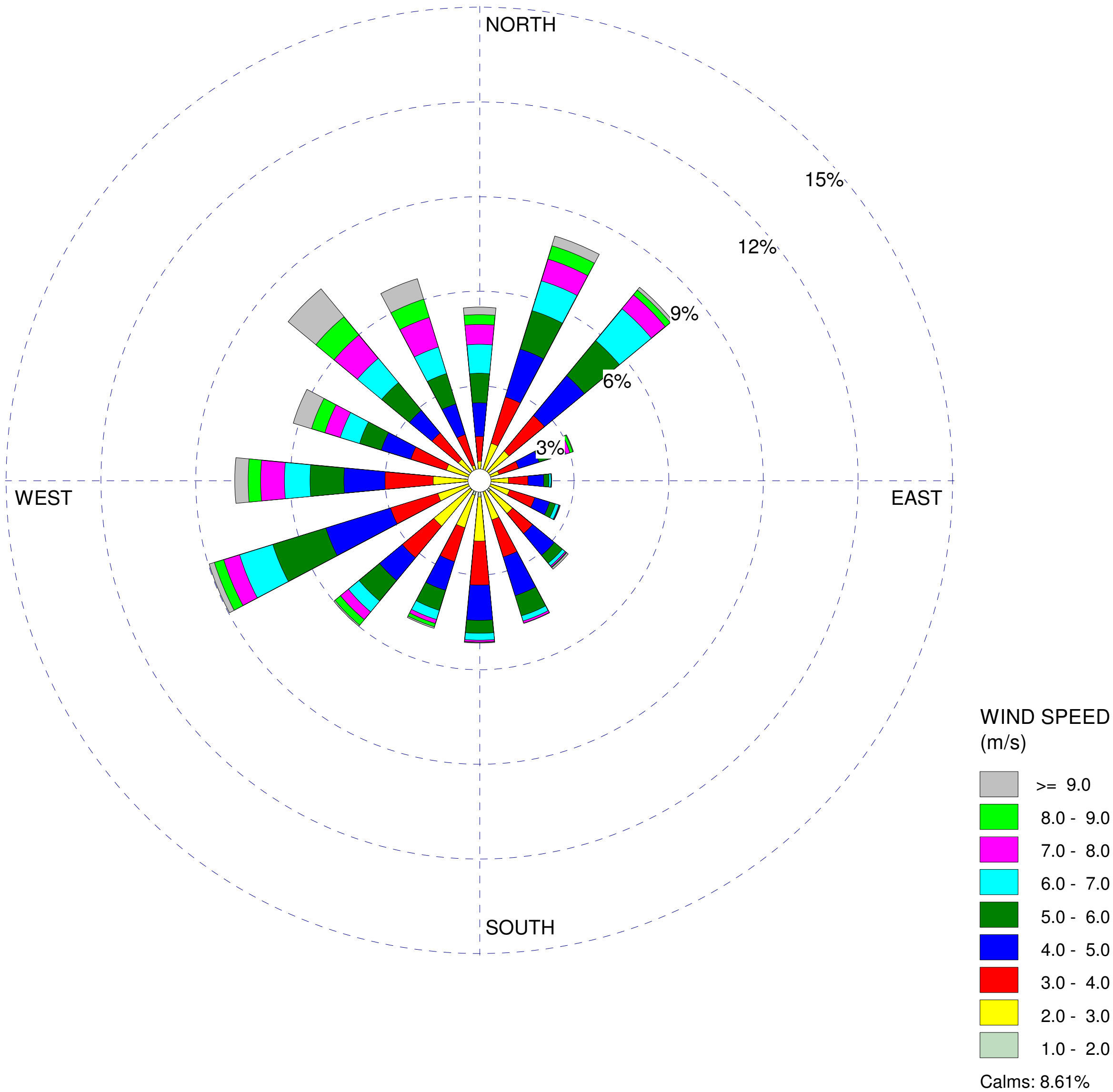
WIND ROSE PLOT:

Newark Liberty International Airport
Annual Windrose

DISPLAY:
Wind Speed
Direction (blowing from)

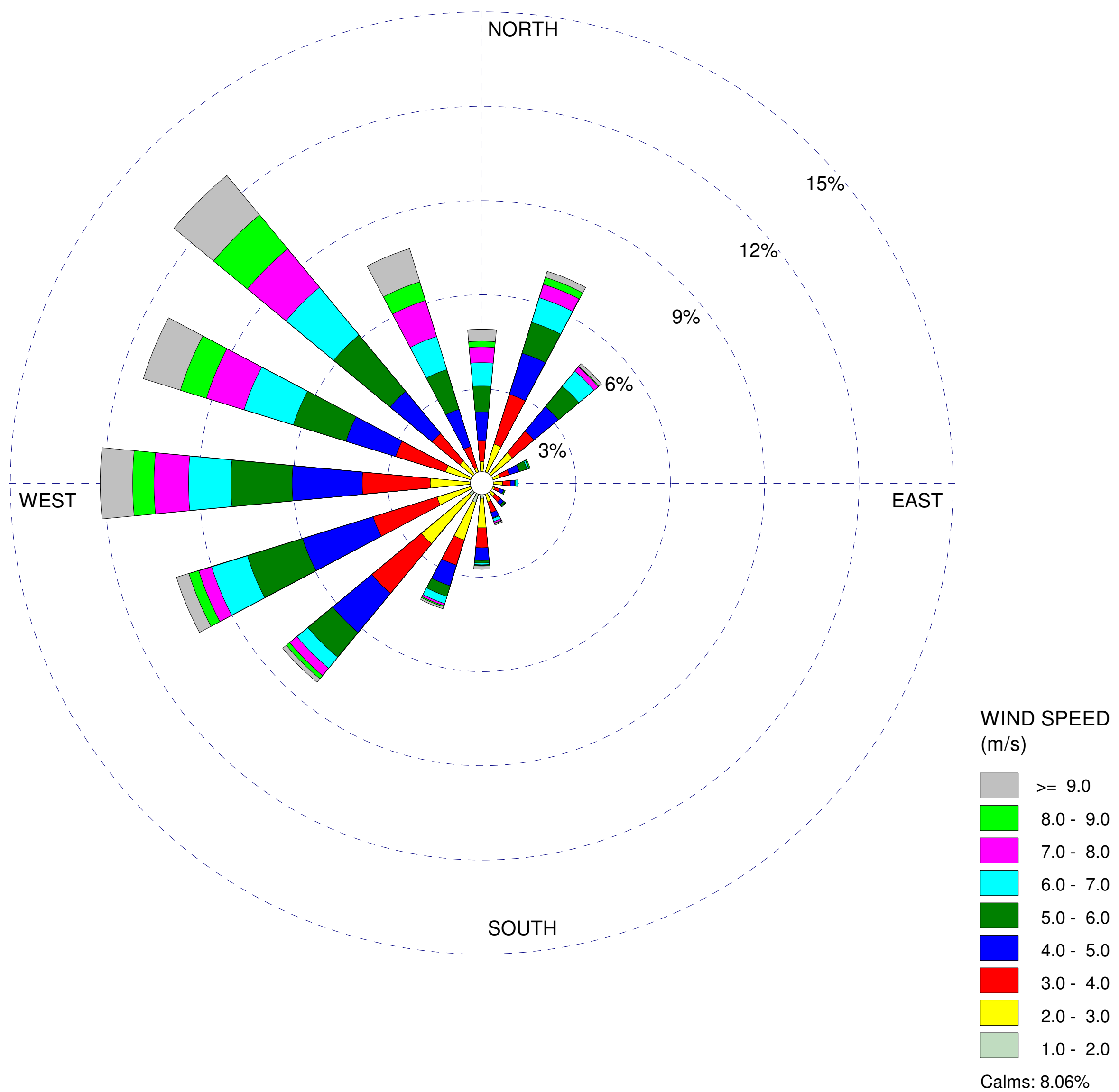


COMMENTS:	DATA PERIOD: **Start Date: 1/1/2004 - 00:00** **End Date: 12/31/2004 - 23:00**	COMPANY NAME: **URS**
		MODELER: **LMB**
	CALM WINDS: **8.61%**	TOTAL COUNT: **8785 hrs.**
	AVG. WIND SPEED: **4.31 m/s**	DATE: **4/15/2014**

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:
Newark Liberty International Airport
January Windrose

DISPLAY:
Wind Speed
Direction (blowing from)



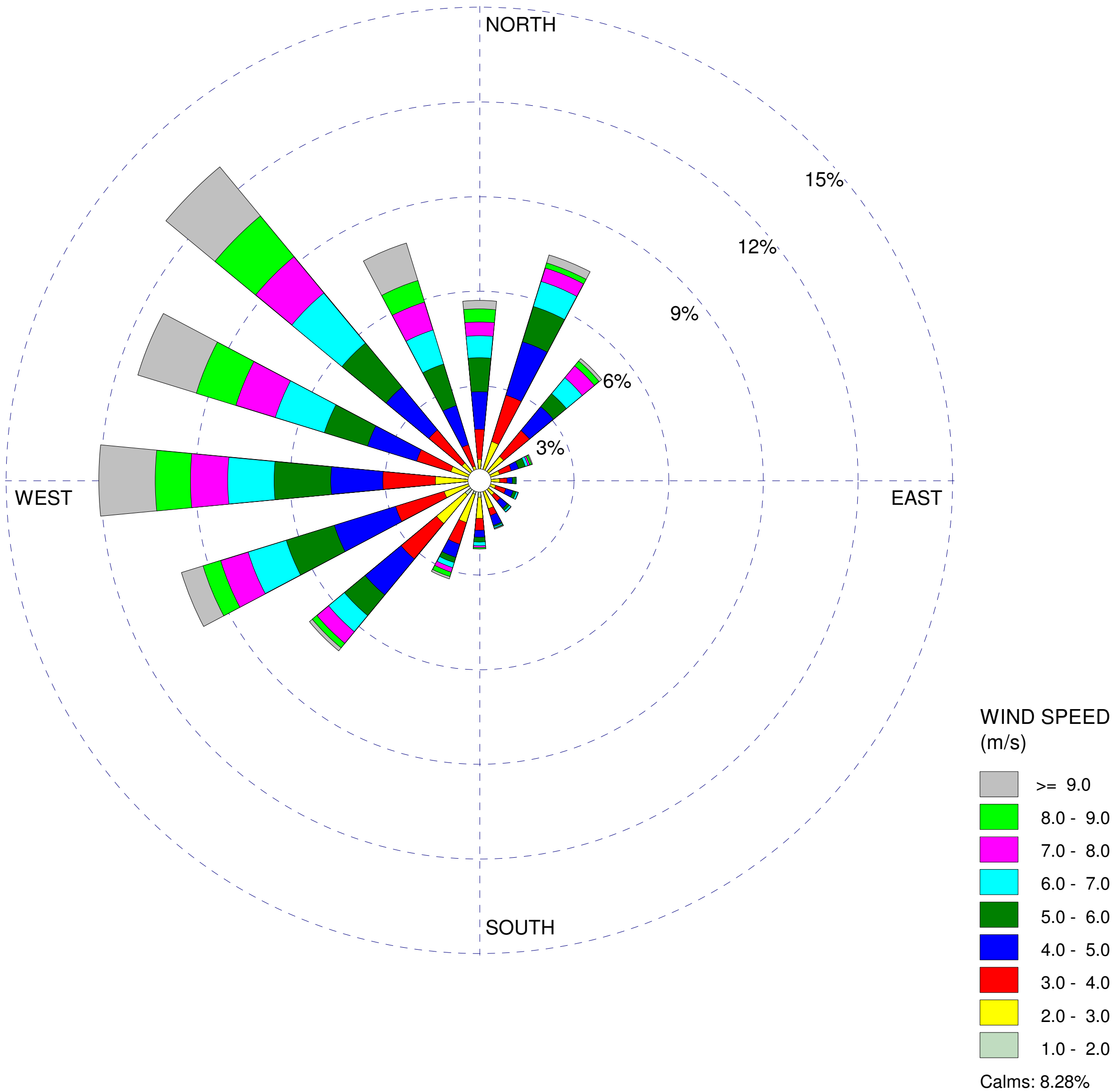
COMMENTS:	DATA PERIOD: **Start Date: 1/1/2004 - 00:00** **End Date: 1/31/2013 - 23:00**	COMPANY NAME: **URS**
		MODELER: **LMB**
	CALM WINDS: **8.06%**	TOTAL COUNT: **7439 hrs.**
	AVG. WIND SPEED: **4.62 m/s**	DATE: **4/17/2014**

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

Newark Liberty International Airport
February Windrose

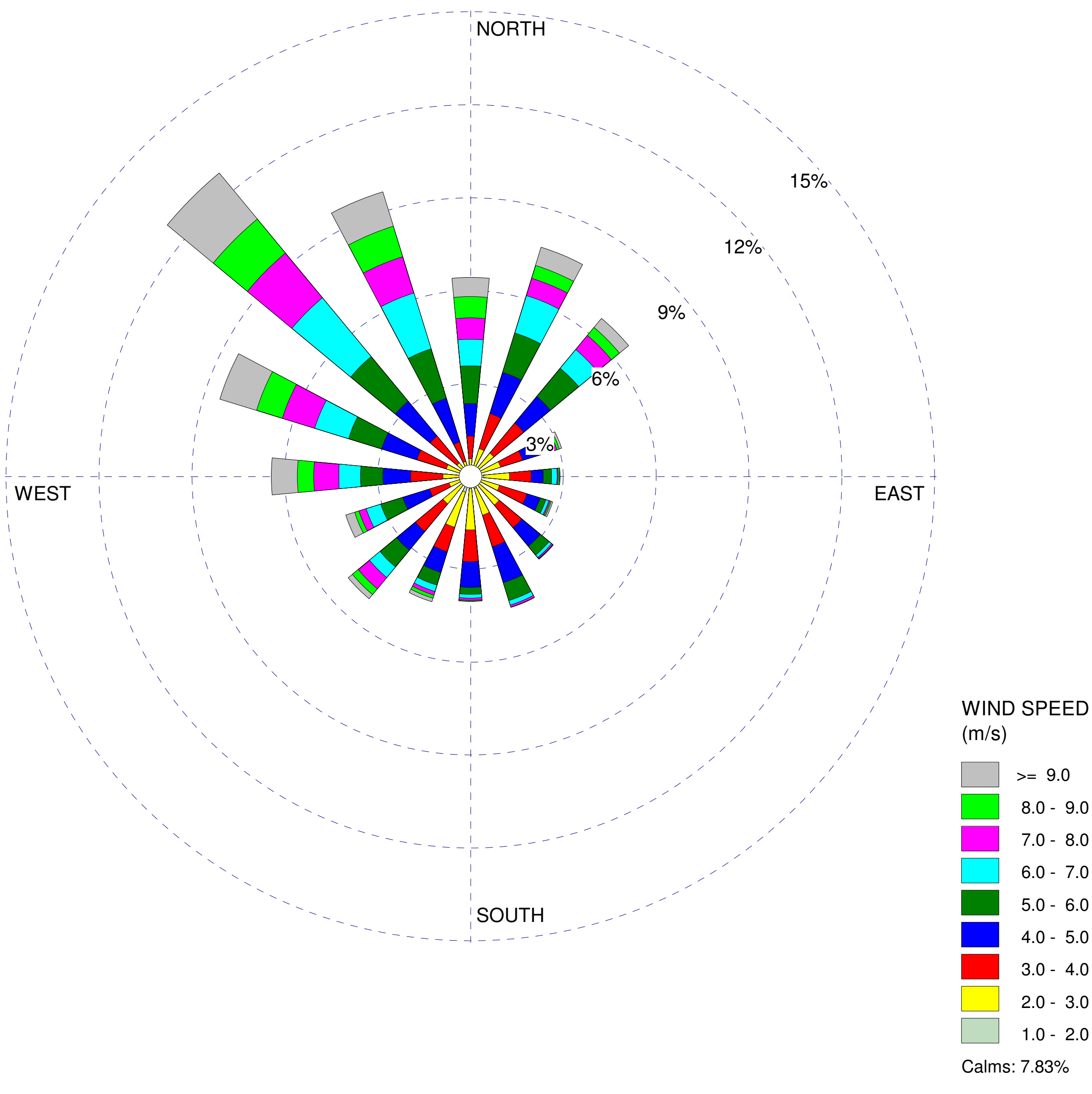
DISPLAY:
Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD: **Start Date: 2/1/2004 - 00:00** **End Date: 2/28/2013 - 23:00**	COMPANY NAME: **URS**
		MODELER: **LMB**
	CALM WINDS: **8.28%**	TOTAL COUNT: **6720 hrs.**
	AVG. WIND SPEED: **4.92 m/s**	DATE: **4/18/2014**

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:	DISPLAY:
Newark Liberty International Airport **March Windrose**	**Wind Speed** **Direction (blowing from)**



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 3/1/2004 - 00:00 **End Date: 3/31/2013 - 23:00**	**URS**	
		MODELER: **LMB**	
	CALM WINDS: **7.83%**	TOTAL COUNT: **7439 hrs.**	
	AVG. WIND SPEED: **4.82 m/s**	DATE: **4/18/2014**	

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

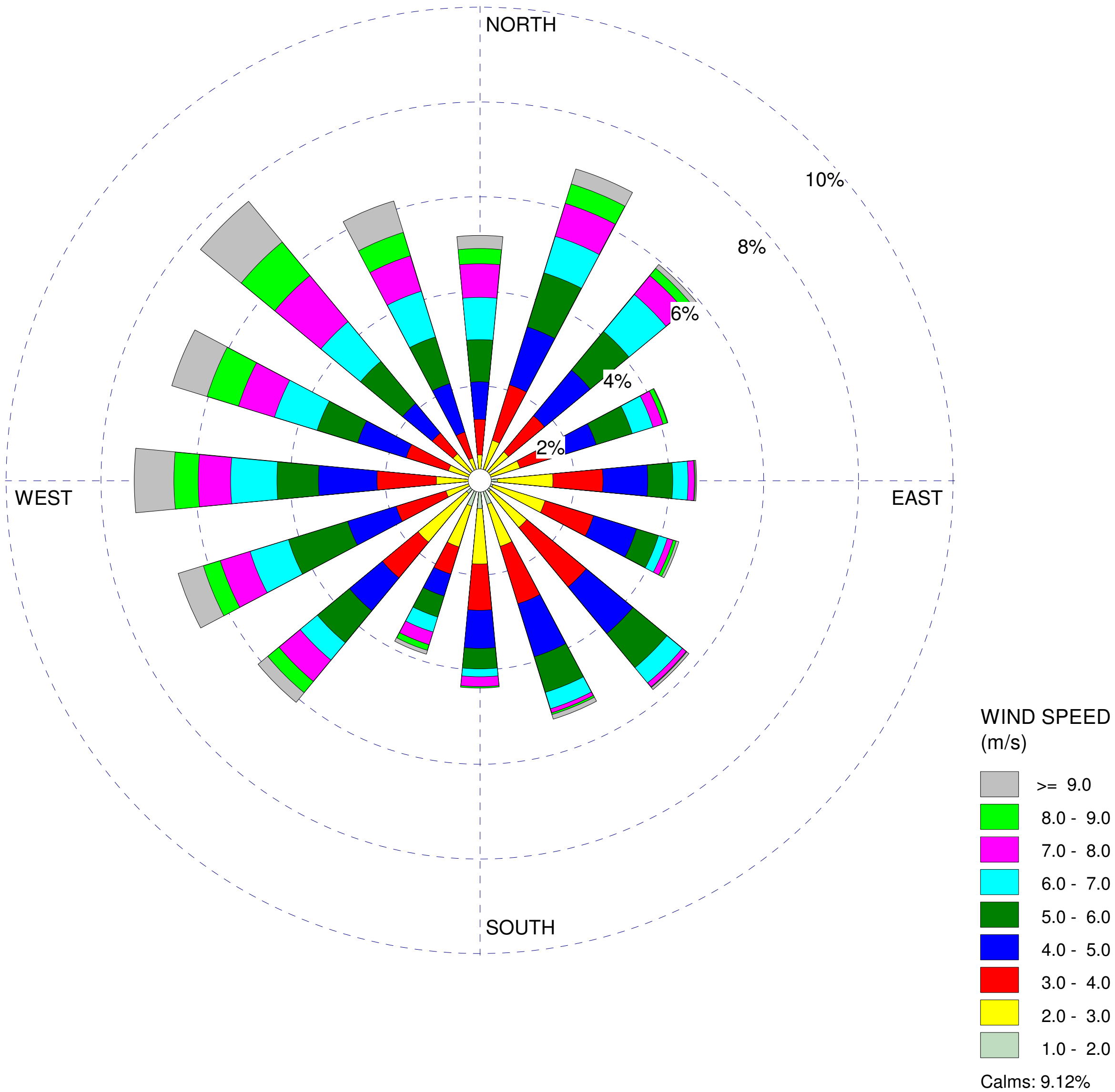
Newark Liberty International Airport

April Windrose

DISPLAY:

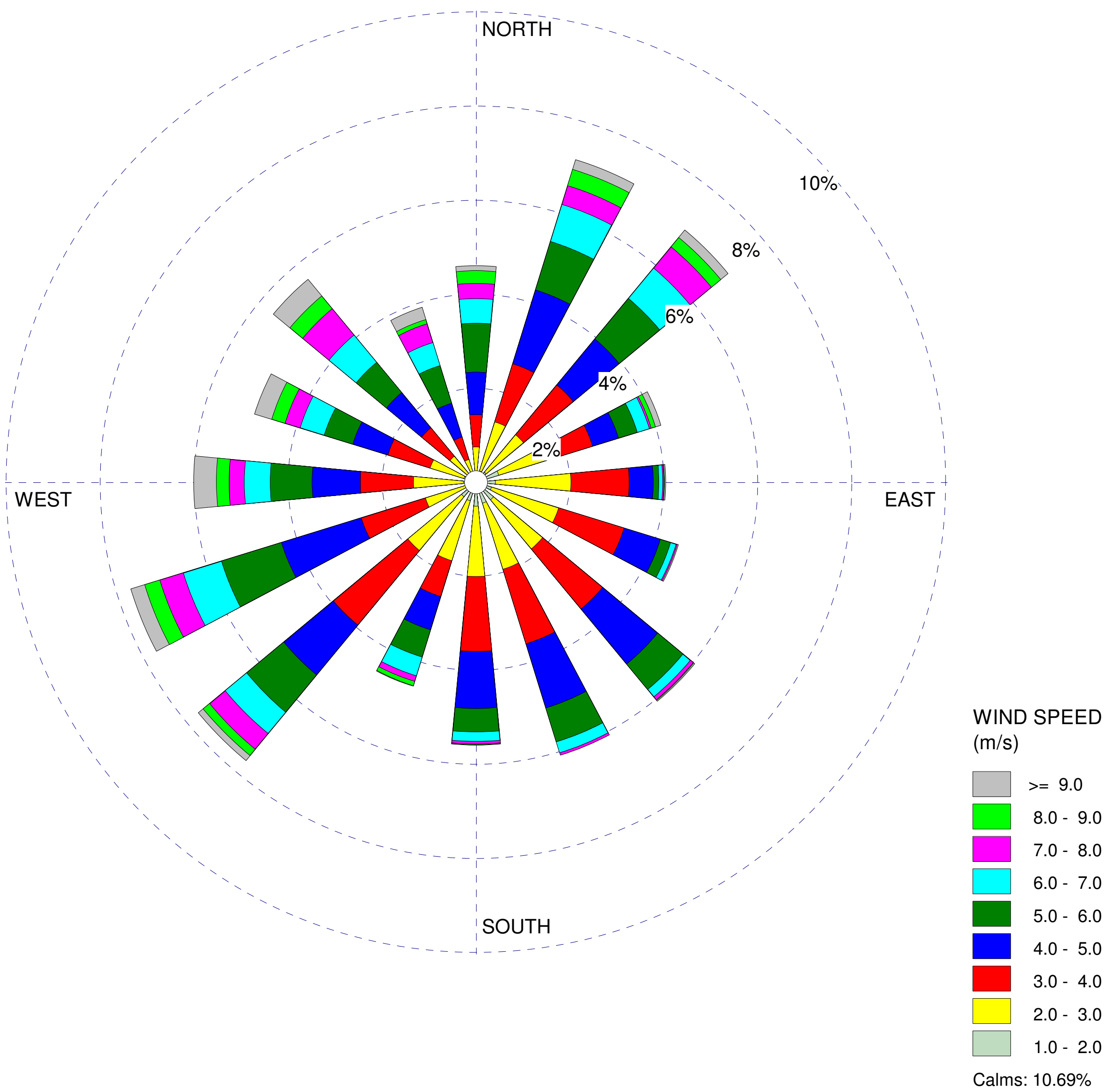
Wind Speed

Direction (blowing from)



COMMENTS:	DATA PERIOD: **Start Date: 4/1/2004 - 00:00** **End Date: 4/30/2013 - 23:00**	COMPANY NAME: **URS**
		MODELER: **LMB**
	CALM WINDS: **9.12%**	TOTAL COUNT: **7199 hrs.**
	AVG. WIND SPEED: **4.52 m/s**	DATE: **4/18/2014**

WIND ROSE PLOT: **Newark Liberty International Airport May Windrose**	DISPLAY: **Wind Speed Direction (blowing from)**



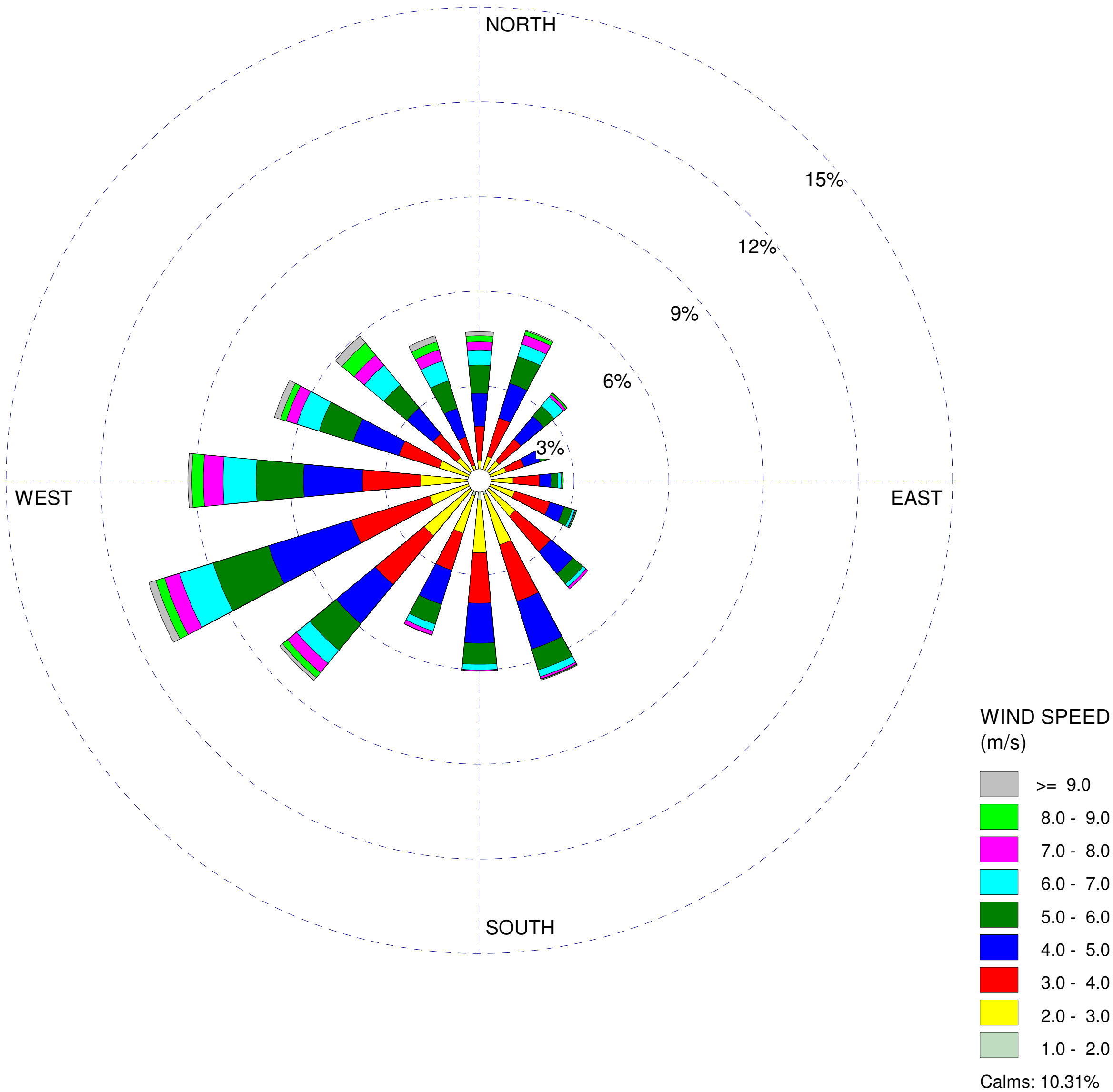
COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 5/1/2004 - 00:00 **End Date: 5/31/2013 - 23:00**	**URS**	
		MODELER: **LMB**	
	CALM WINDS: **10.69%**	TOTAL COUNT: **7439 hrs.**	
	AVG. WIND SPEED: **3.87 m/s**	DATE: **4/18/2014**	

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

Newark Liberty International Airport
June Windrose

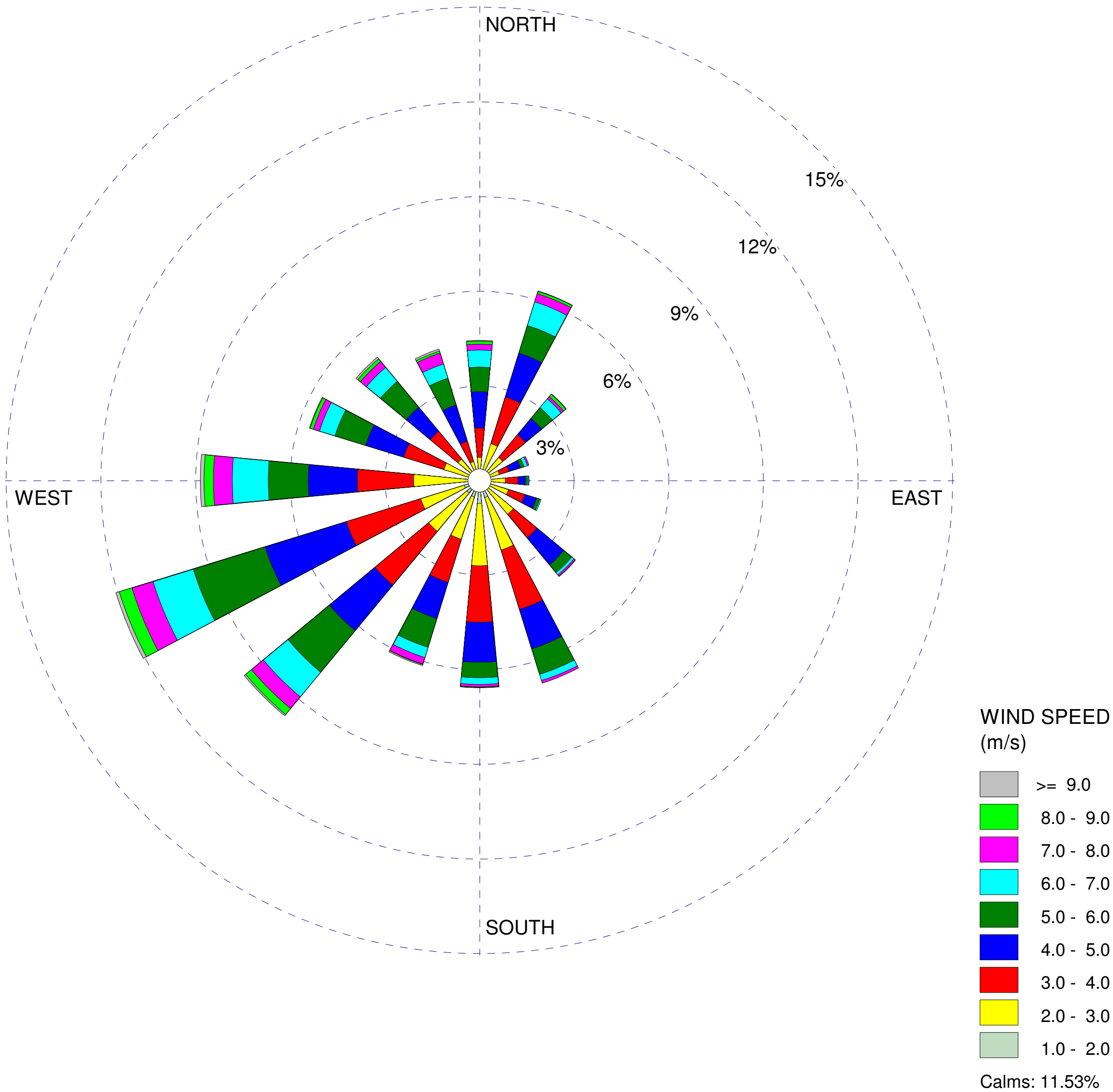
DISPLAY:
Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 6/1/2004 - 00:00 **End Date: 6/30/2013 - 23:00**	**URS**	
		MODELER: **LMB**	
	CALM WINDS: **10.31%**	TOTAL COUNT: **7200 hrs.**	
	AVG. WIND SPEED: **3.77 m/s**	DATE: **4/18/2014**	

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:	DISPLAY:
Newark Liberty International Airport	**Wind Speed**
July Windrose	**Direction (blowing from)**



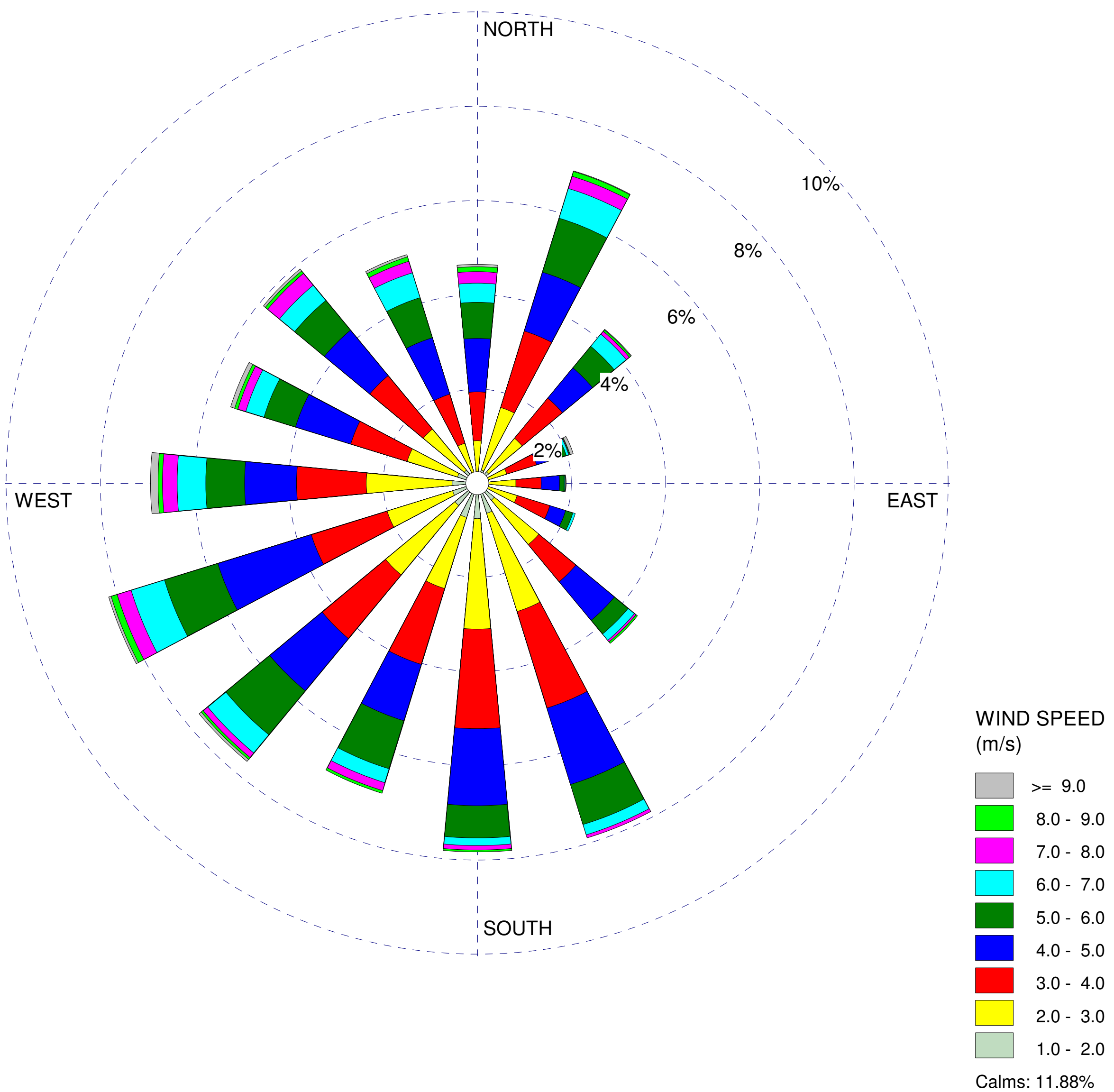
COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 7/1/2004 - 00:00 **End Date: 7/31/2013 - 23:00**	**URS**	
		MODELER: **LMB**	
	CALM WINDS: **11.53%**	TOTAL COUNT: **7440 hrs.**	
	AVG. WIND SPEED: **3.64 m/s**	DATE: **4/18/2014**	

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

Newark Liberty International Airport
August Windrose

DISPLAY:
Wind Speed
Direction (blowing from)



COMMENTS:

DATA PERIOD:

Start Date: 8/1/2004 - 00:00
End Date: 8/31/2013 - 23:00

COMPANY NAME:

URS

MODELER:

LMB

CALM WINDS:

11.88%

TOTAL COUNT:

7439 hrs.

AVG. WIND SPEED:

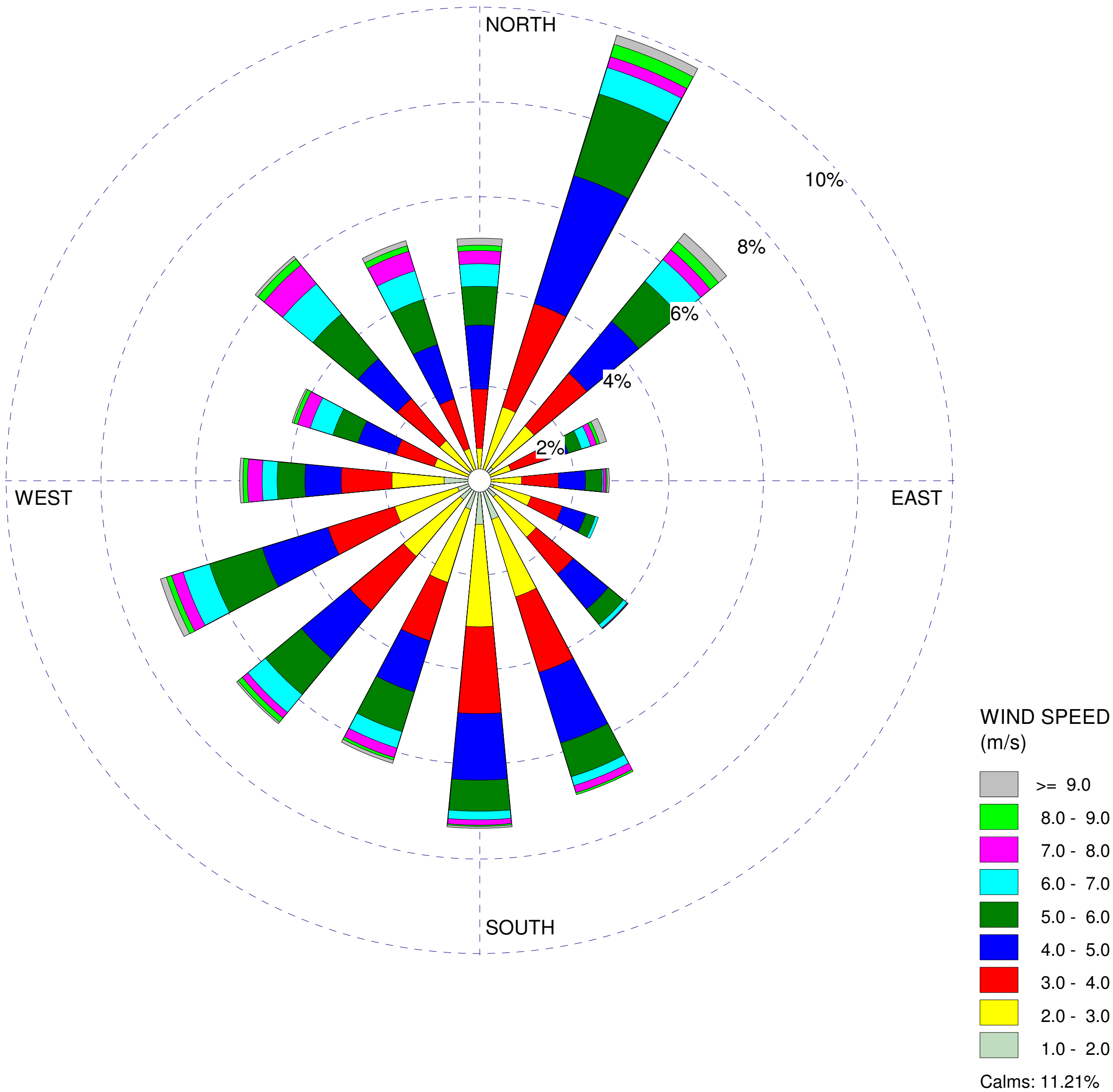
3.40 m/s

DATE:

4/18/2014

WIND ROSE PLOT:
Newark Liberty International Airport
September Windrose

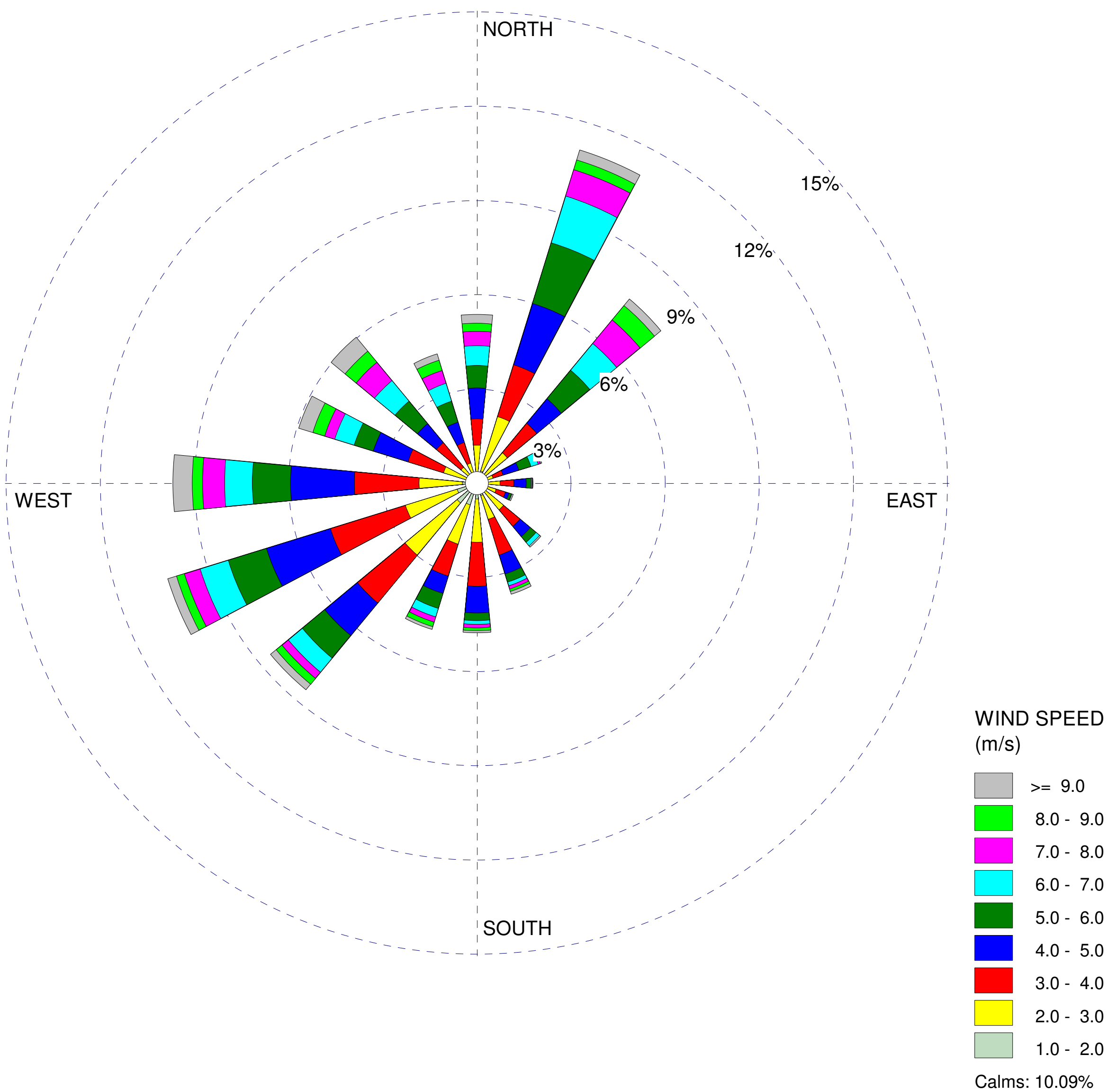
DISPLAY:
Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD: **Start Date: 9/1/2004 - 00:00** **End Date: 9/30/2013 - 23:00**	COMPANY NAME: **URS**
		MODELER: **LMB**
	CALM WINDS: **11.21%**	TOTAL COUNT: **7198 hrs.**
	AVG. WIND SPEED: **3.61 m/s**	DATE: **4/18/2014**

WIND ROSE PLOT:
Newark Liberty International Airport
October Windrose

DISPLAY:
Wind Speed
Direction (blowing from)



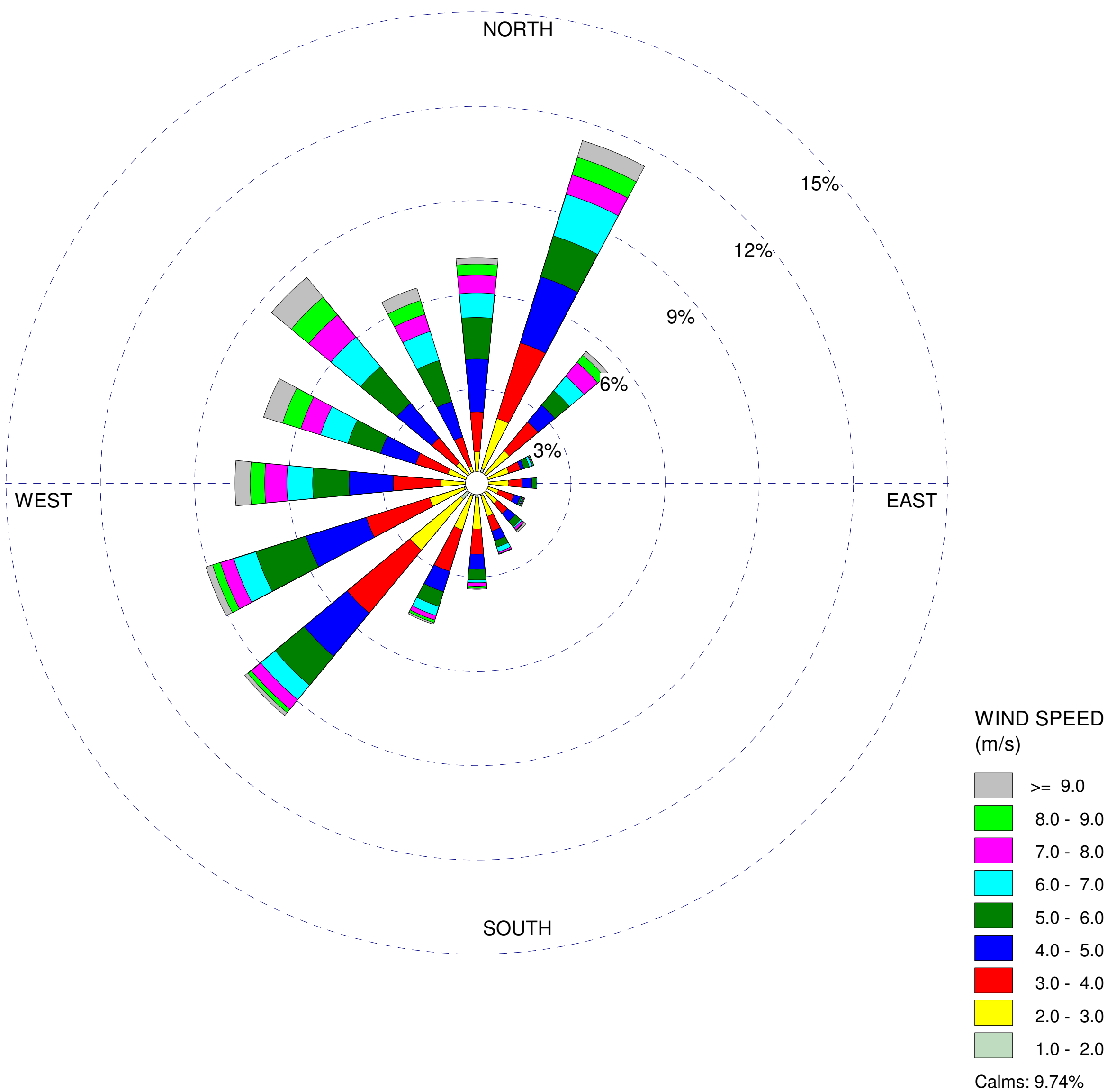
COMMENTS:	DATA PERIOD: **Start Date: 10/1/2004 - 00:00** **End Date: 10/31/2013 - 23:00**	COMPANY NAME: **URS**	
		MODELER: **LMB**	
	CALM WINDS: **10.09%**	TOTAL COUNT: **7438 hrs.**	
	AVG. WIND SPEED: **4.09 m/s**	DATE: **4/18/2014**	

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

Newark Liberty International Airport
November Windrose

DISPLAY:
Wind Speed
Direction (blowing from)



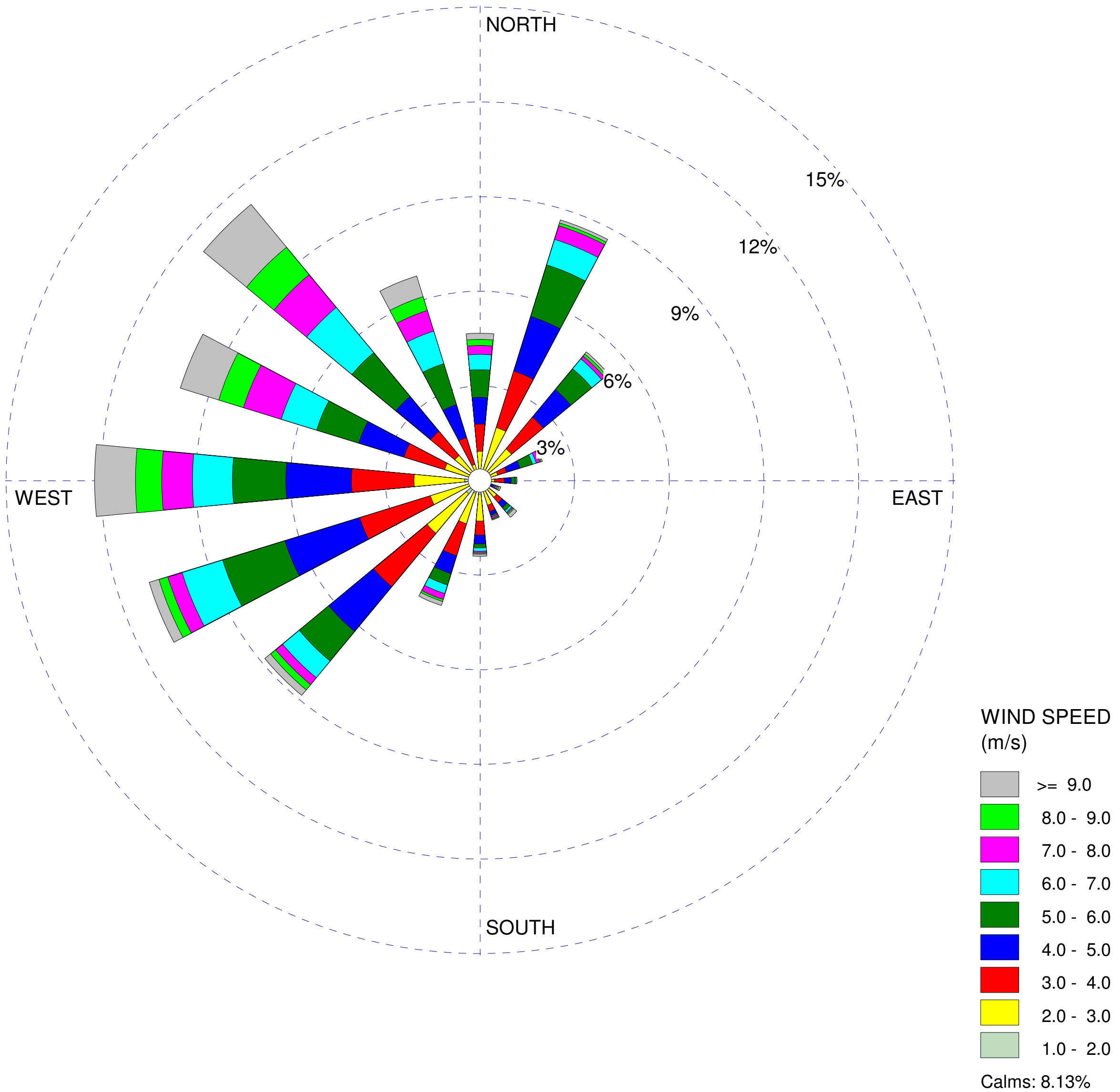
COMMENTS:	DATA PERIOD: **Start Date: 11/1/2004 - 00:00** **End Date: 11/30/2013 - 23:00**	COMPANY NAME: **URS**	
		MODELER: **LMB**	
	CALM WINDS: **9.74%**	TOTAL COUNT: **7199 hrs.**	
	AVG. WIND SPEED: **4.19 m/s**	DATE: **4/17/2014**	

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

Newark Liberty International Airport
December Windrose

DISPLAY:
Wind Speed
Direction (blowing from)



COMMENTS:

DATA PERIOD:

Start Date: 12/1/2004 - 00:00
End Date: 12/31/2013 - 23:00

COMPANY NAME:

URS

MODELER:

LMB

CALM WINDS:

8.13%

TOTAL COUNT:

7442 hrs.

AVG. WIND SPEED:

4.56 m/s

DATE:

4/17/2014

WRPLOT View - Lakes Environmental Software

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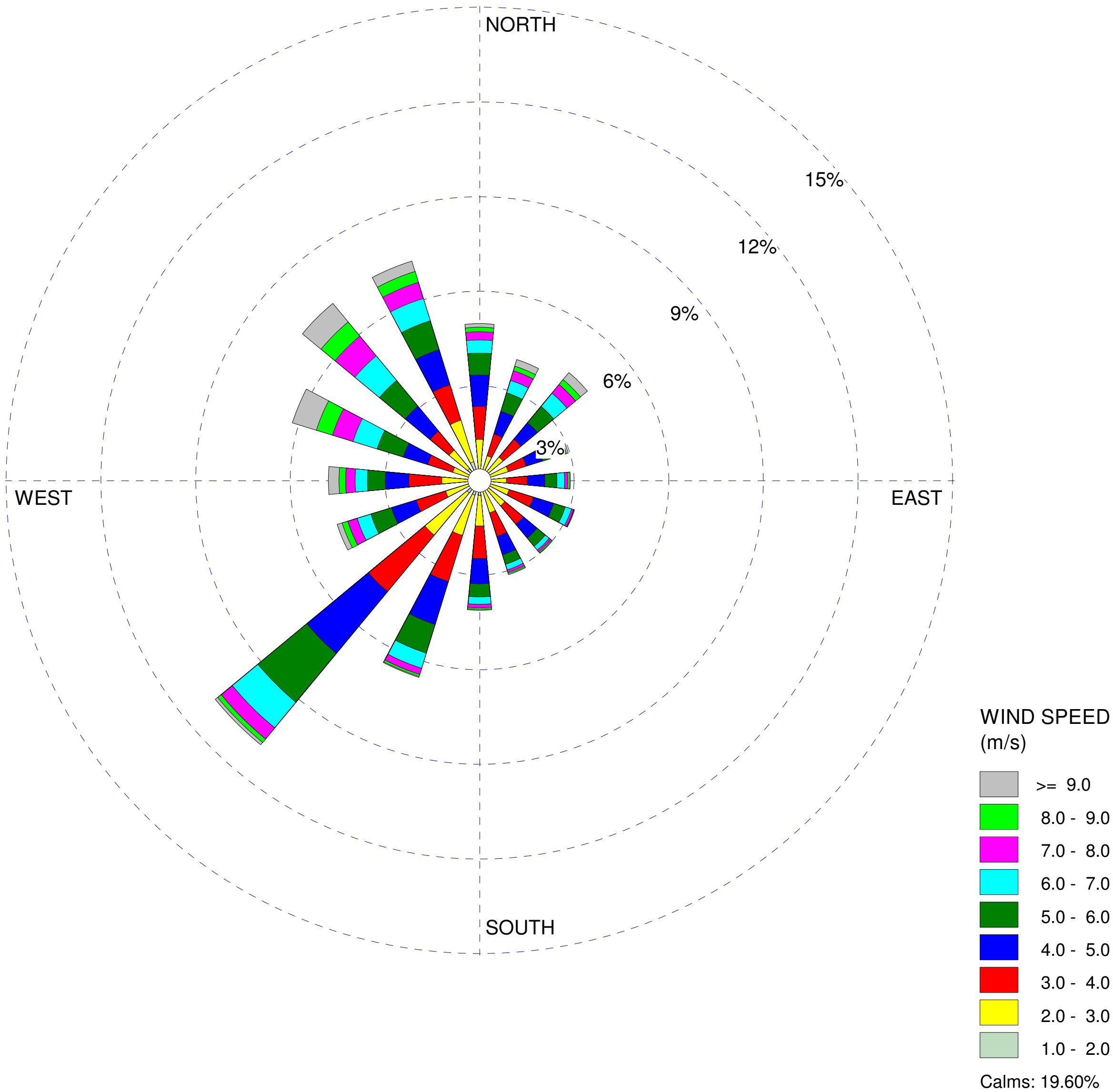
WIND ROSE PLOT:

Francis S. Gabreski Airport, Westhampton
Annual Windrose

DISPLAY:
Wind Speed
Direction (blowing from)



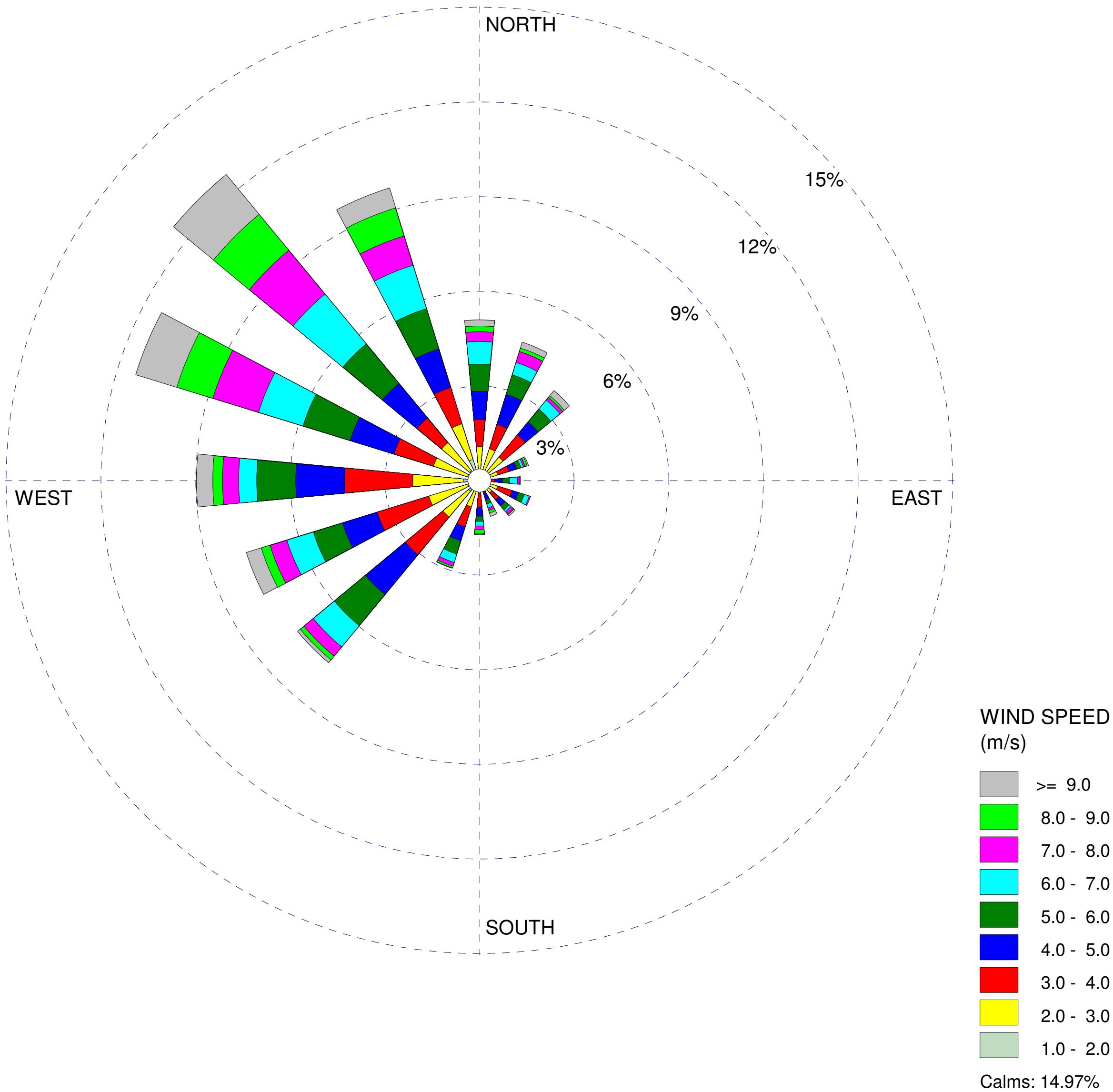
COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 1/1/2004 - 02:00 **End Date: 12/31/2013 - 23:00**	**URS**	
		MODELER: **LMB**	
	CALM WINDS: **19.60%**	TOTAL COUNT: **86619 hrs.**	
	AVG. WIND SPEED: **3.62 m/s**	DATE: **4/15/2014**	

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

Francis S. Gabreski Airport, Westhampton
January Windrose

DISPLAY:
Wind Speed
Direction (blowing from)



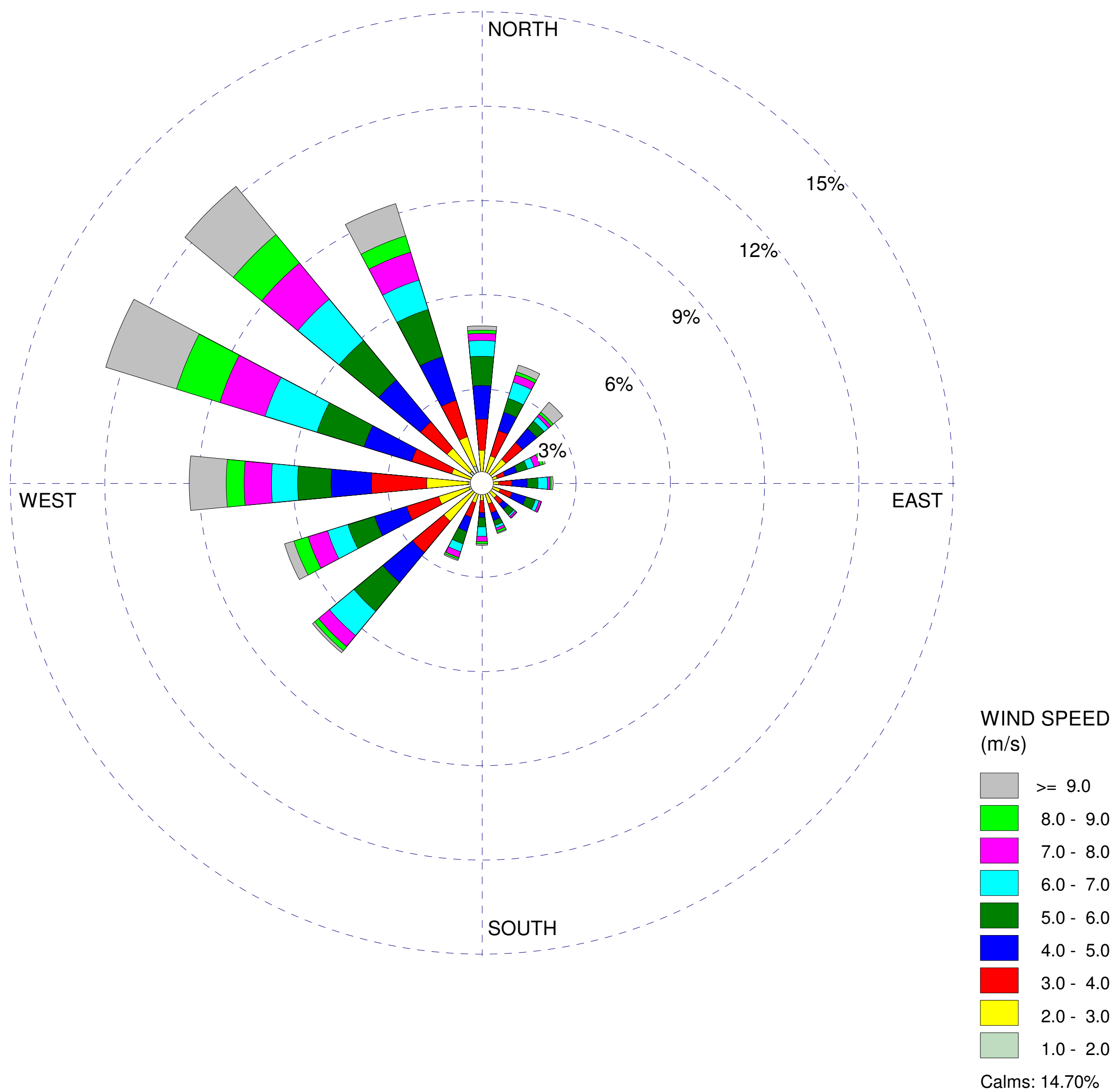
COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 1/1/2004 - 02:00 **End Date: 1/31/2013 - 23:00**	**URS**	
		MODELER: **LMB**	
	CALM WINDS: **14.97%**	TOTAL COUNT: **7139 hrs.**	
	AVG. WIND SPEED: **4.19 m/s**	DATE: **4/18/2014**	

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

Francis S. Gabreski Airport, Westhampton
February Windrose

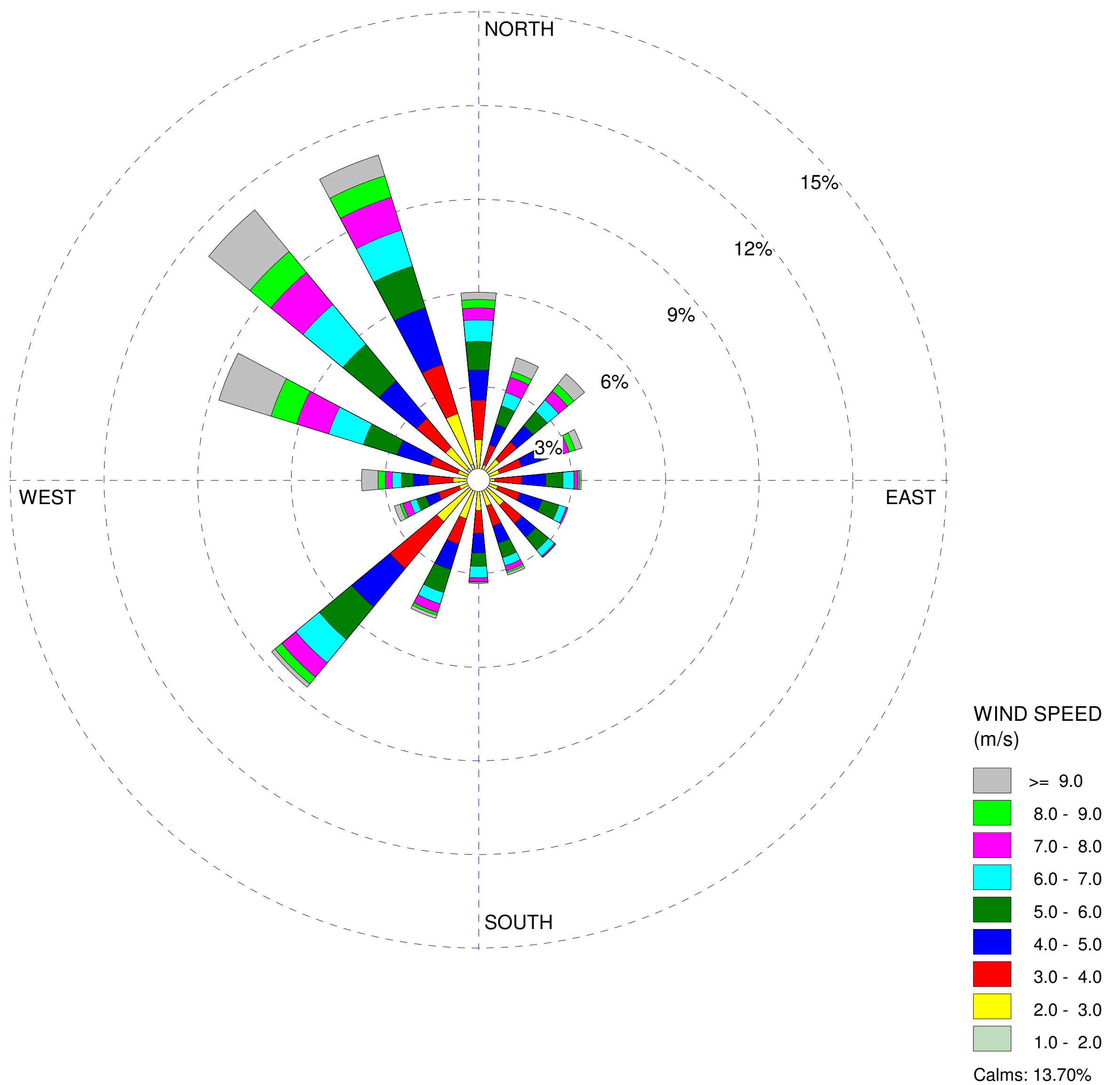
DISPLAY:
Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 2/1/2004 - 00:00 **End Date: 2/28/2013 - 23:00**	**URS**	
		MODELER: **LMB**	
	CALM WINDS: **14.70%**	TOTAL COUNT: **6664 hrs.**	
	AVG. WIND SPEED: **4.39 m/s**	DATE: **4/18/2014**	

WIND ROSE PLOT:
Francis S. Gabreski Airport, Westhampton
March Windrose

DISPLAY:
Wind Speed
Direction (blowing from)



COMMENTS:

DATA PERIOD:
Start Date: 3/1/2004 - 00:00
End Date: 3/31/2013 - 23:00

COMPANY NAME:
URS

MODELER:
LMB

CALM WINDS:
13.70%

TOTAL COUNT:
7377 hrs.

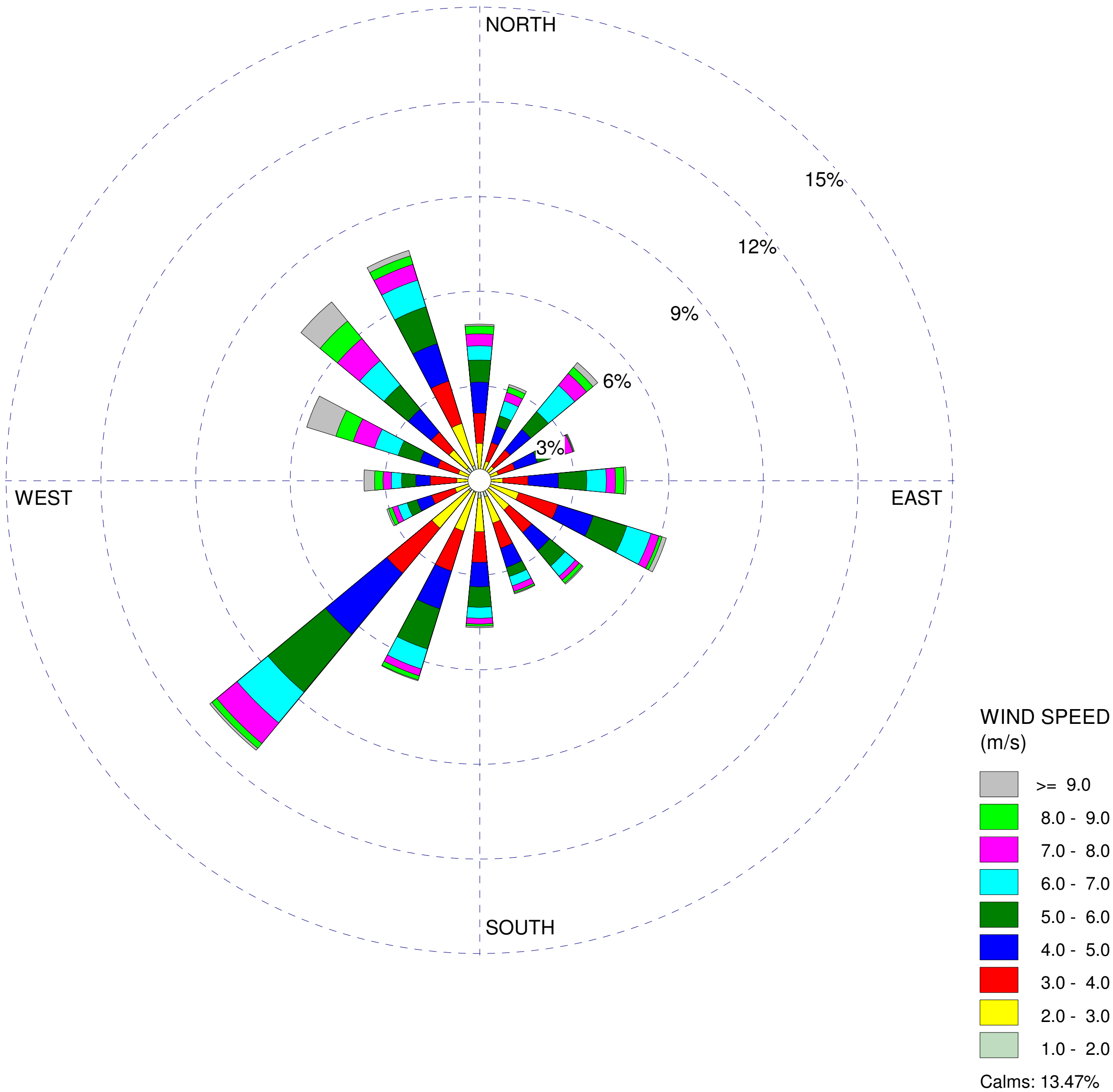
AVG. WIND SPEED:
4.28 m/s

DATE:
4/18/2014

WIND ROSE PLOT:

Francis S. Gabreski Airport, Westhampton
April Windrose

DISPLAY:
Wind Speed
Direction (blowing from)



COMMENTS:

DATA PERIOD:

Start Date: 4/1/2004 - 00:00
End Date: 4/30/2013 - 23:00

COMPANY NAME:

URS

MODELER:

LMB

CALM WINDS:

13.47%

TOTAL COUNT:

7131 hrs.

AVG. WIND SPEED:

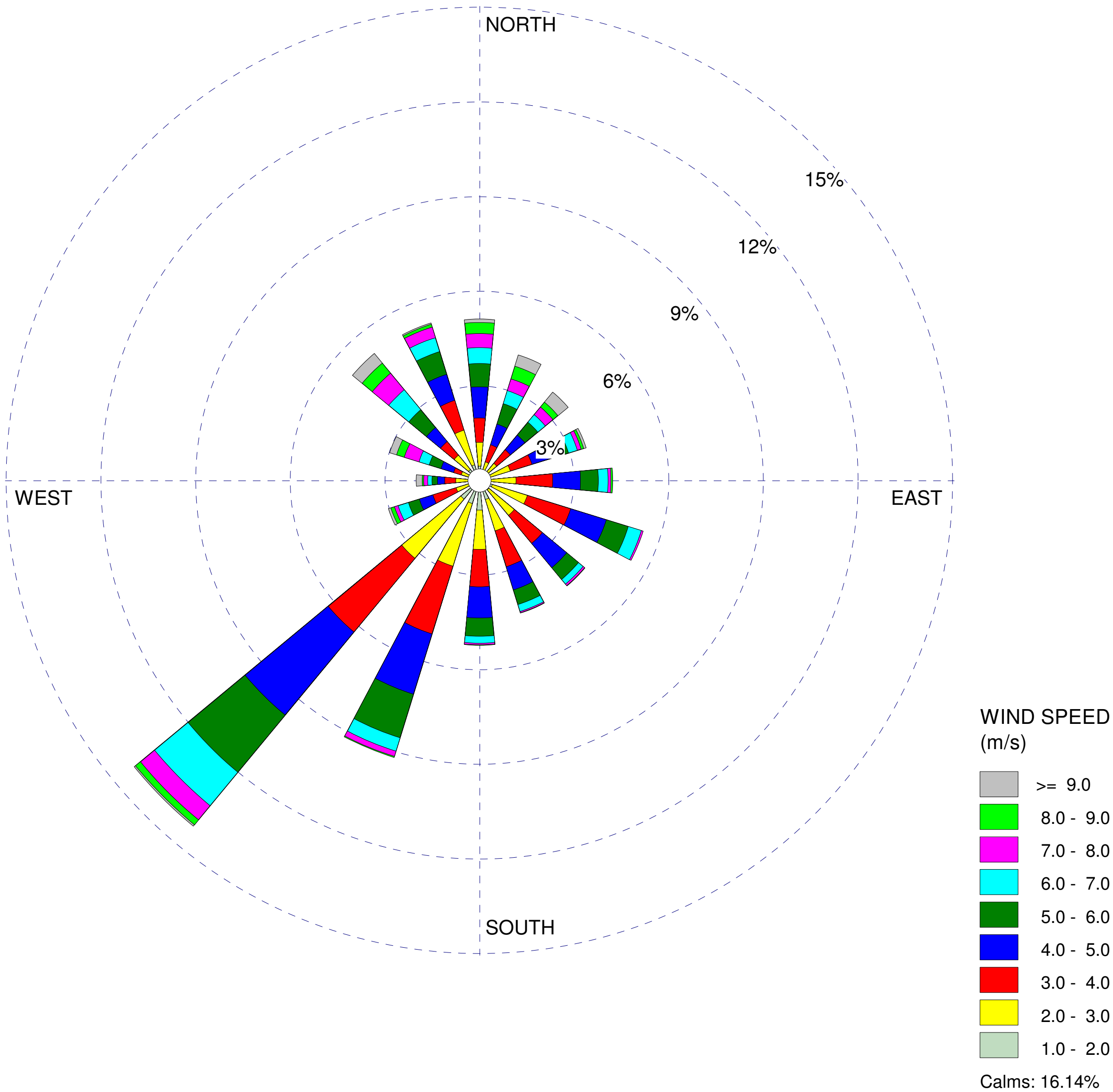
3.99 m/s

DATE:

4/18/2014

WIND ROSE PLOT:
Francis S. Gabreski Airport, Westhampton
May Windrose

DISPLAY:
Wind Speed
Direction (blowing from)

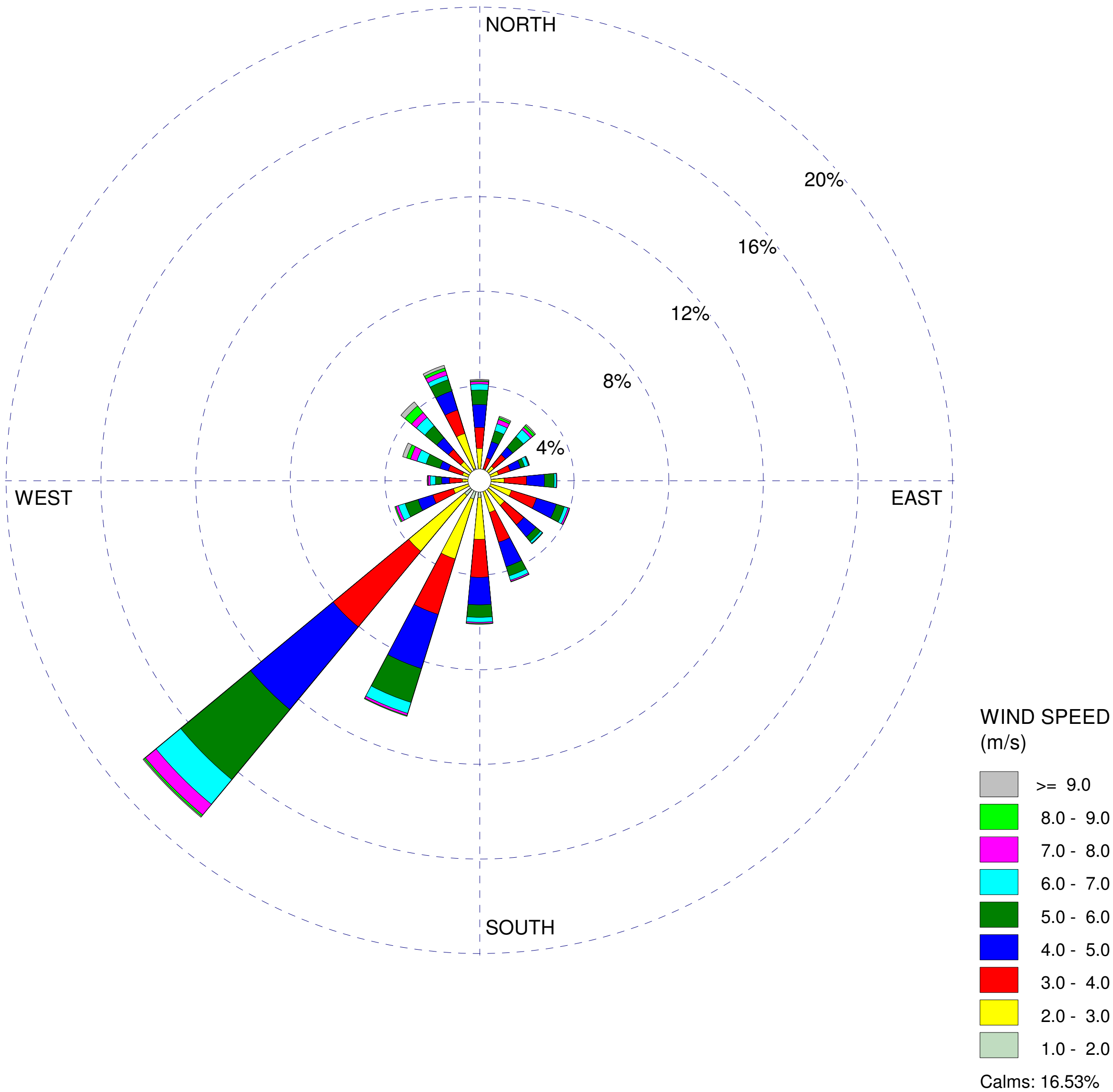


COMMENTS:	DATA PERIOD: **Start Date: 5/1/2004 - 00:00** **End Date: 5/31/2013 - 23:00**	COMPANY NAME: **URS**
		MODELER: **LMB**
	CALM WINDS: **16.14%**	TOTAL COUNT: **7421 hrs.**
	AVG. WIND SPEED: **3.47 m/s**	DATE: **4/18/2014**

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:
Francis S. Gabreski Airport, Westhampton
June Windrose

DISPLAY:
Wind Speed
Direction (blowing from)

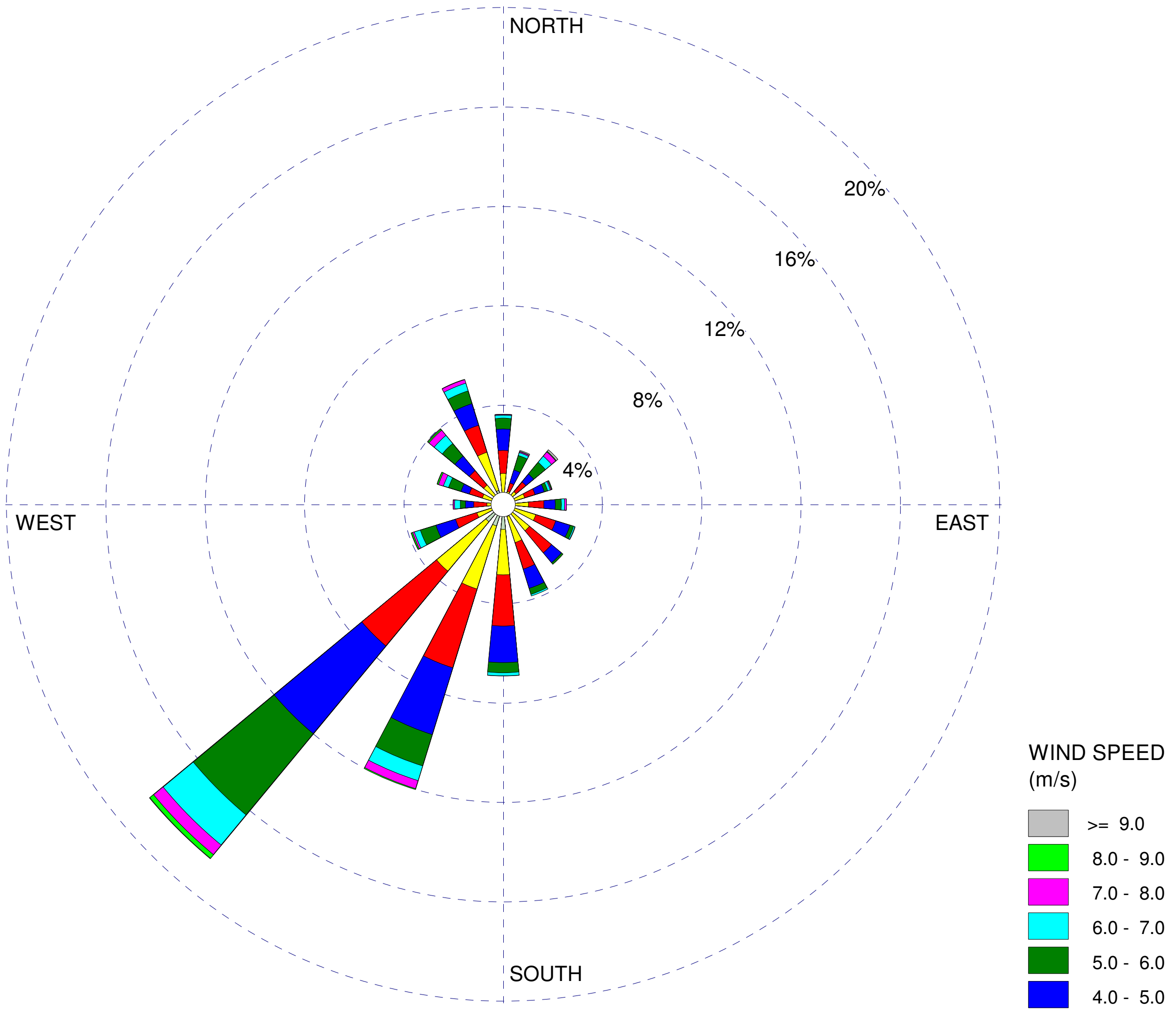


COMMENTS:	DATA PERIOD: **Start Date: 6/1/2004 - 00:00** **End Date: 6/30/2013 - 23:00**	COMPANY NAME: **URS**
		MODELER: **LMB**
	CALM WINDS: **16.53%**	TOTAL COUNT: **7142 hrs.**
	AVG. WIND SPEED: **3.19 m/s**	DATE: **4/18/2014**

WIND ROSE PLOT:

Francis S. Gabreski Airport, Westhampton
July Windrose

DISPLAY:
Wind Speed
Direction (blowing from)



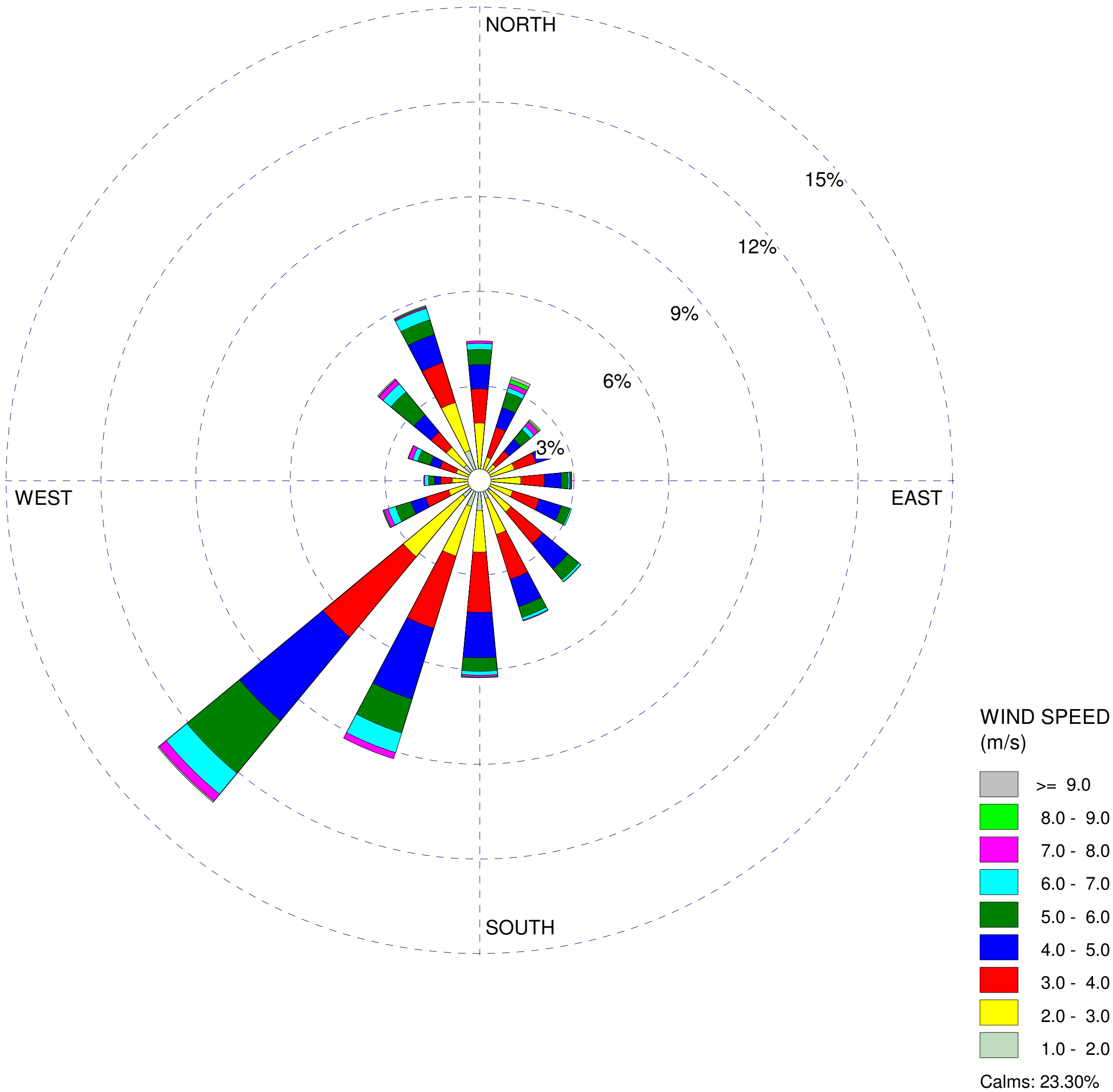
COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 7/1/2004 - 00:00 **End Date: 7/31/2013 - 23:00**	**URS**	
		MODELER: **LMB**	
	CALM WINDS: **18.90%**	TOTAL COUNT: **7351 hrs.**	
	AVG. WIND SPEED: **2.98 m/s**	DATE: **4/18/2014**	

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

Francis S. Gabreski Airport, Westhampton
August Windrose

DISPLAY:
Wind Speed
Direction (blowing from)



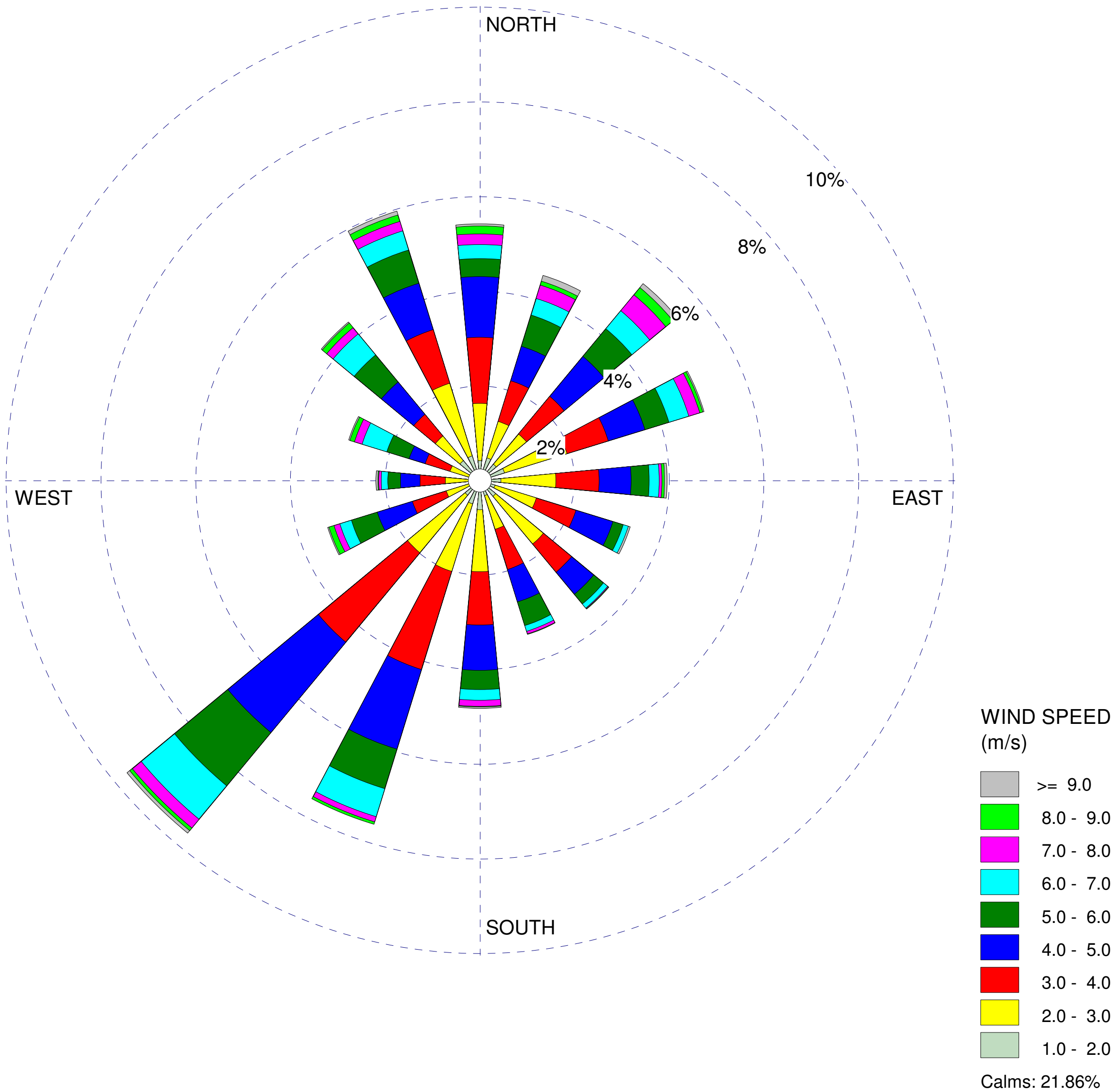
COMMENTS:	DATA PERIOD: **Start Date: 8/1/2004 - 00:00** **End Date: 8/31/2013 - 23:00**	COMPANY NAME: **URS**
		MODELER: **LMB**
	CALM WINDS: **23.30%**	TOTAL COUNT: **7304 hrs.**
	AVG. WIND SPEED: **2.70 m/s**	DATE: **4/18/2014**

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

Francis S. Gabreski Airport, Westhampton
September Windrose

DISPLAY:
Wind Speed
Direction (blowing from)

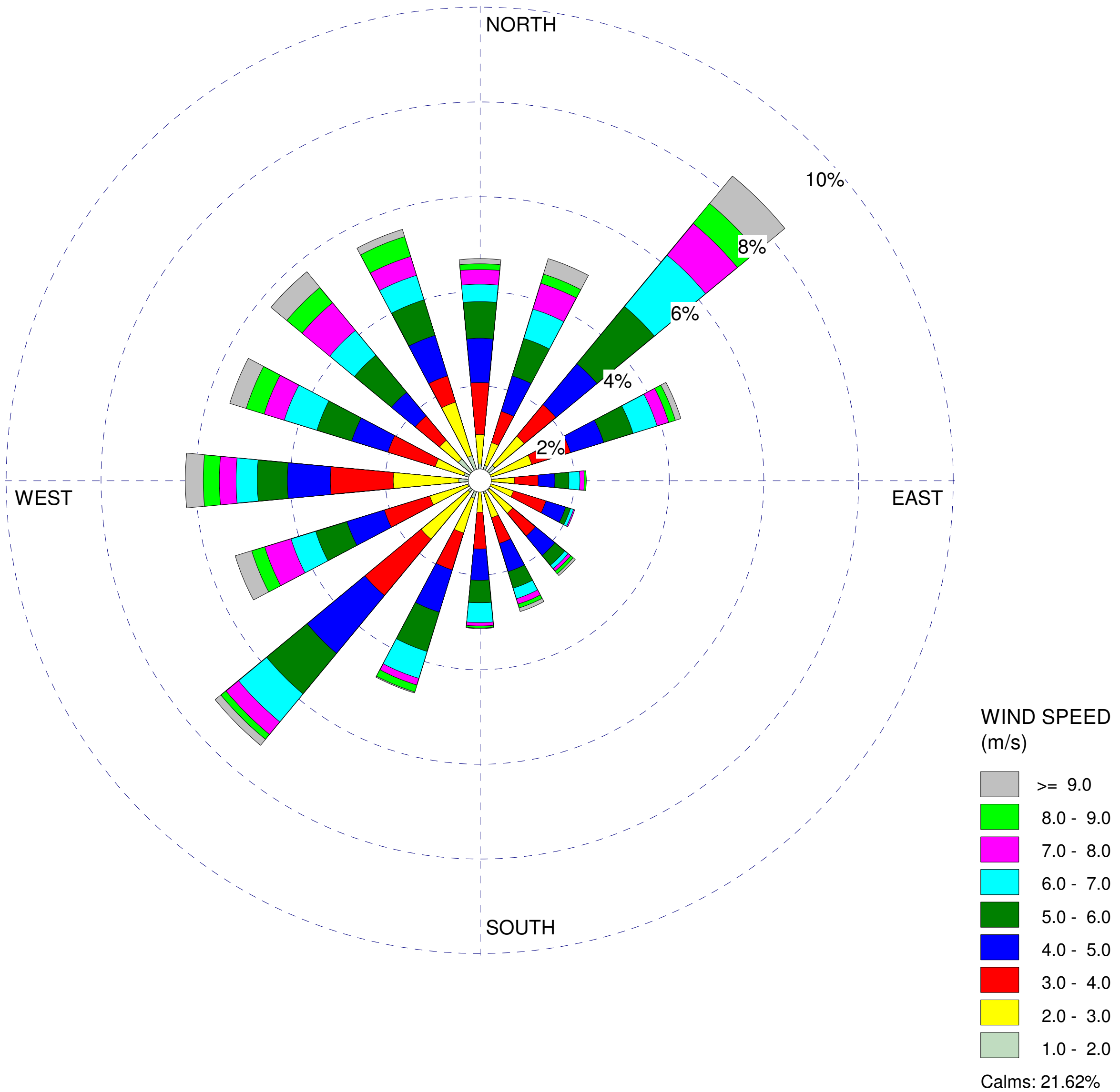


COMMENTS:	DATA PERIOD: **Start Date: 9/1/2004 - 00:00** **End Date: 9/30/2013 - 23:00**	COMPANY NAME: **URS**
		MODELER: **LMB**
	CALM WINDS: **21.86%**	TOTAL COUNT: **7117 hrs.**
	AVG. WIND SPEED: **2.97 m/s**	DATE: **4/18/2014**

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:
Francis S. Gabreski Airport, Westhampton
October Windrose

DISPLAY:
Wind Speed
Direction (blowing from)



COMMENTS:

DATA PERIOD:

Start Date: 10/1/2004 - 00:00
End Date: 10/31/2013 - 23:00

COMPANY NAME:

URS

MODELER:

LMB

CALM WINDS:

21.62%

TOTAL COUNT:

7397 hrs.

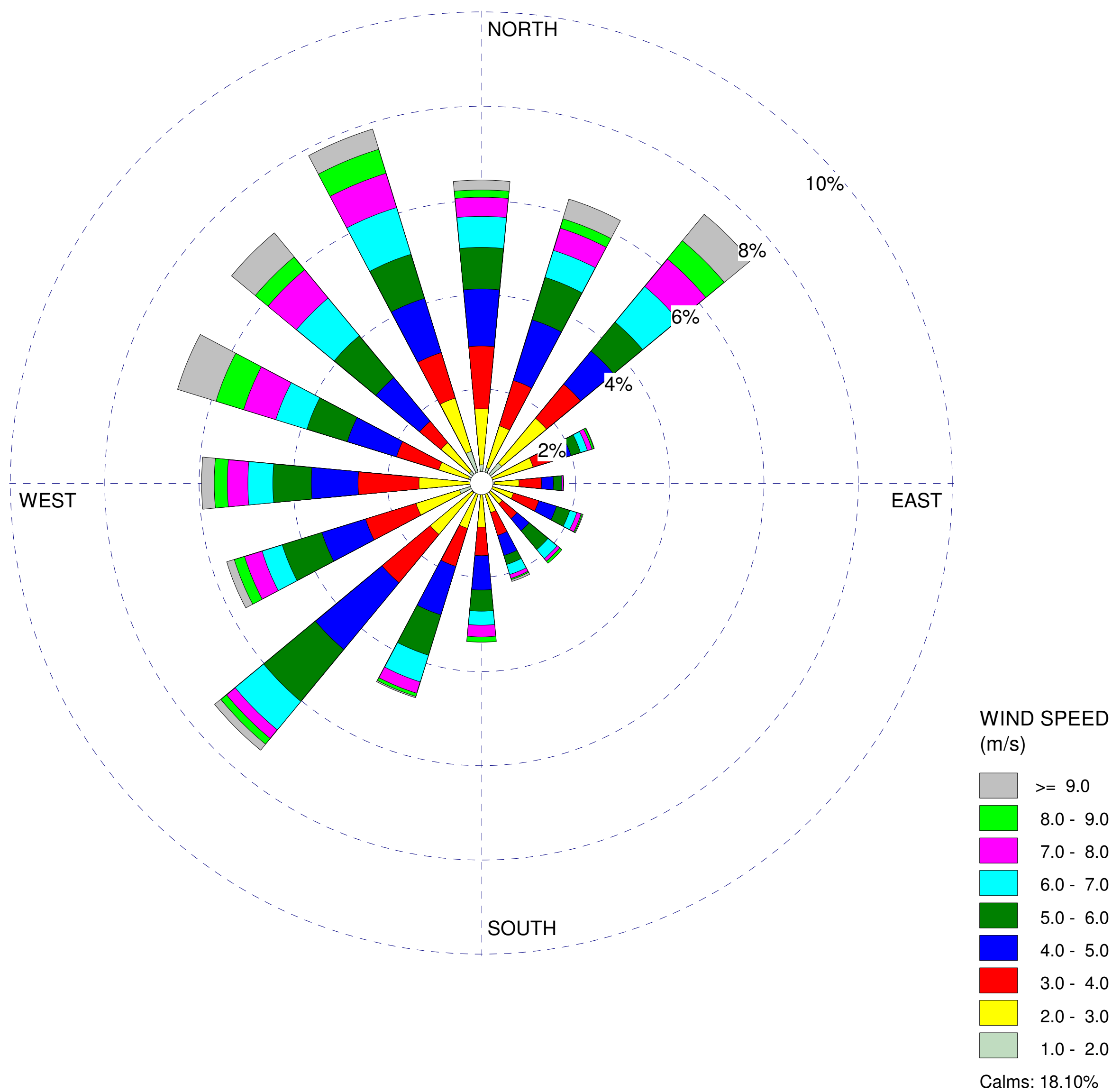
AVG. WIND SPEED:

3.56 m/s

DATE:

4/18/2014

WIND ROSE PLOT:	DISPLAY:
Francis S. Gabreski Airport, Westhampton **November Windrose**	**Wind Speed** **Direction (blowing from)**

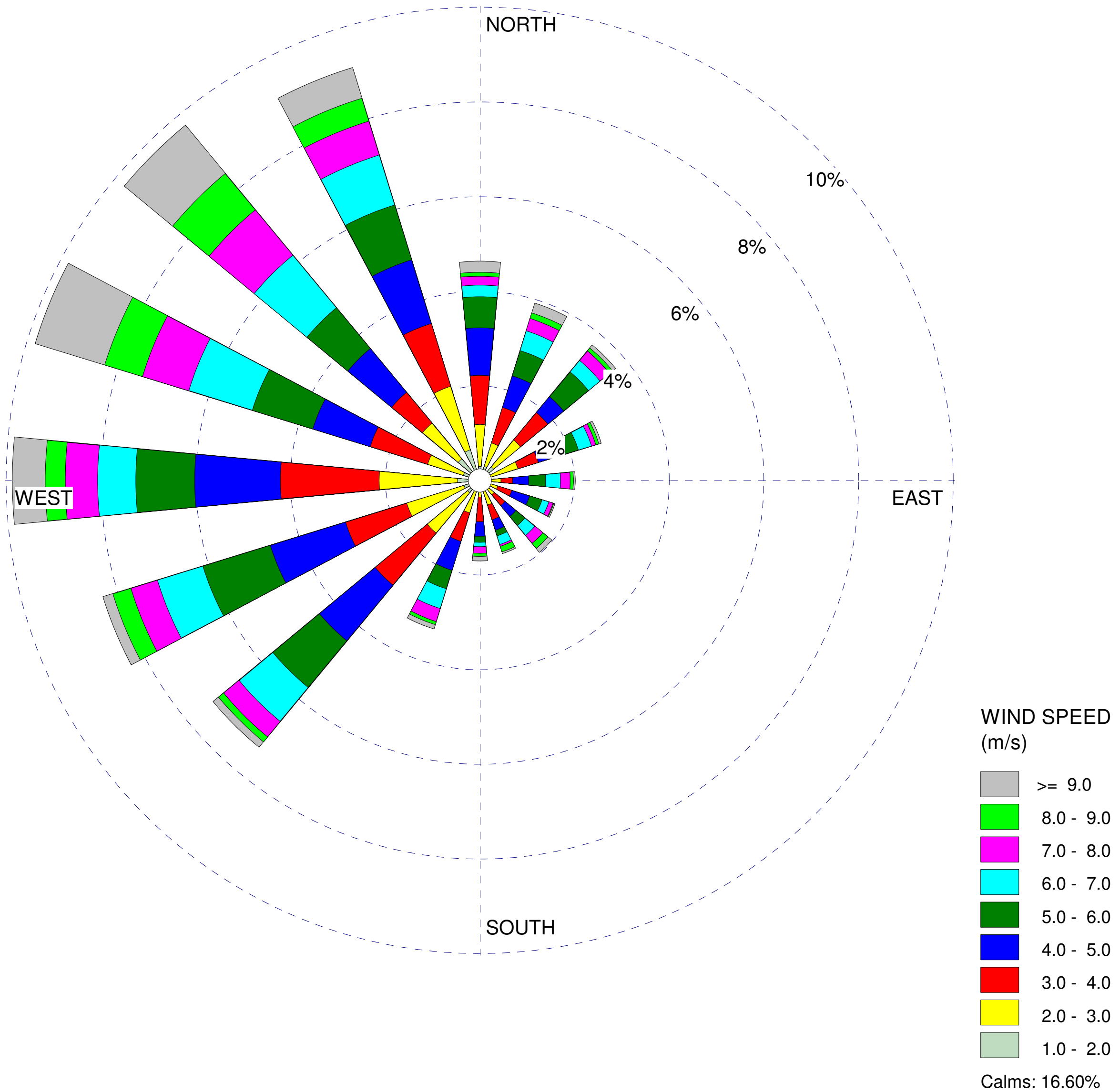


COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 11/1/2004 - 04:00 **End Date: 11/30/2013 - 23:00**	**URS**	
		MODELER: **LMB**	
	CALM WINDS: **18.10%**	TOTAL COUNT: **7151 hrs.**	
	AVG. WIND SPEED: **3.77 m/s**	DATE: **4/18/2014**	

WIND ROSE PLOT:

Francis S. Gabreski Airport, Westhampton
December Windrose

DISPLAY:
Wind Speed
Direction (blowing from)



COMMENTS:

DATA PERIOD:

Start Date: 12/1/2004 - 00:00
End Date: 12/31/2013 - 23:00

COMPANY NAME:

URS

MODELER:

LMB

CALM WINDS:

16.60%

TOTAL COUNT:

7353 hrs.

AVG. WIND SPEED:

4.05 m/s

DATE:

4/18/2014

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Appendix C: Temperature Distributions

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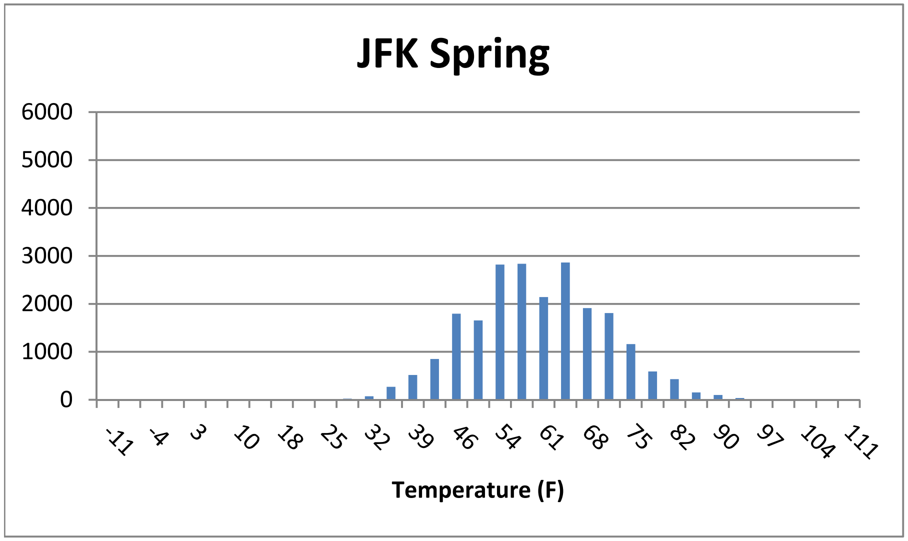
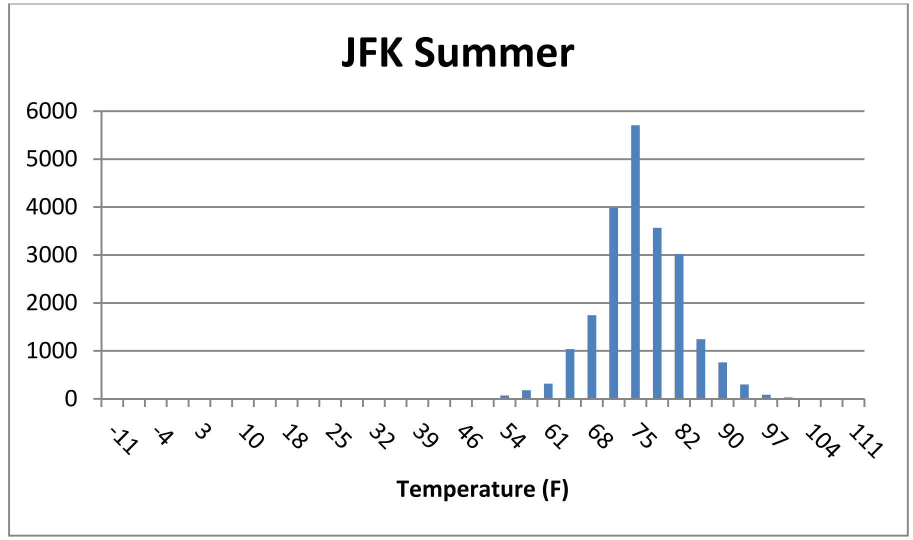
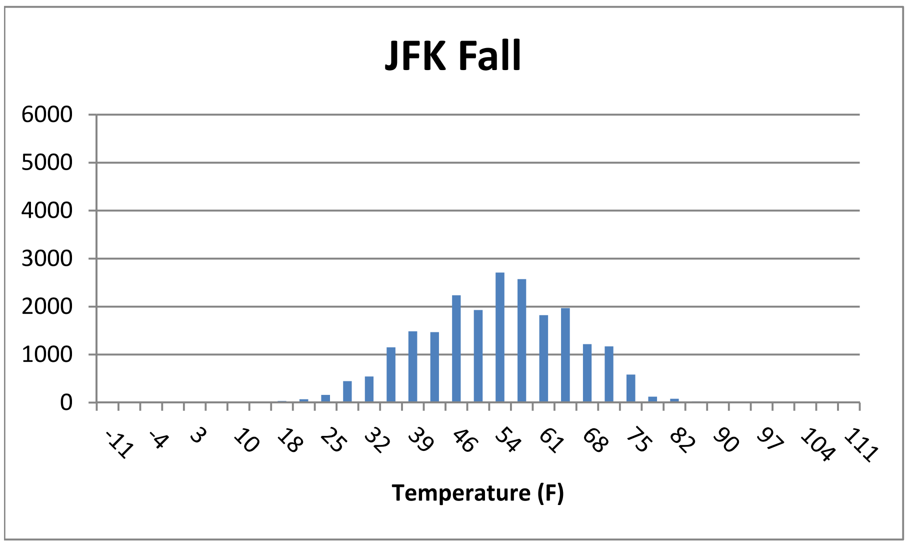
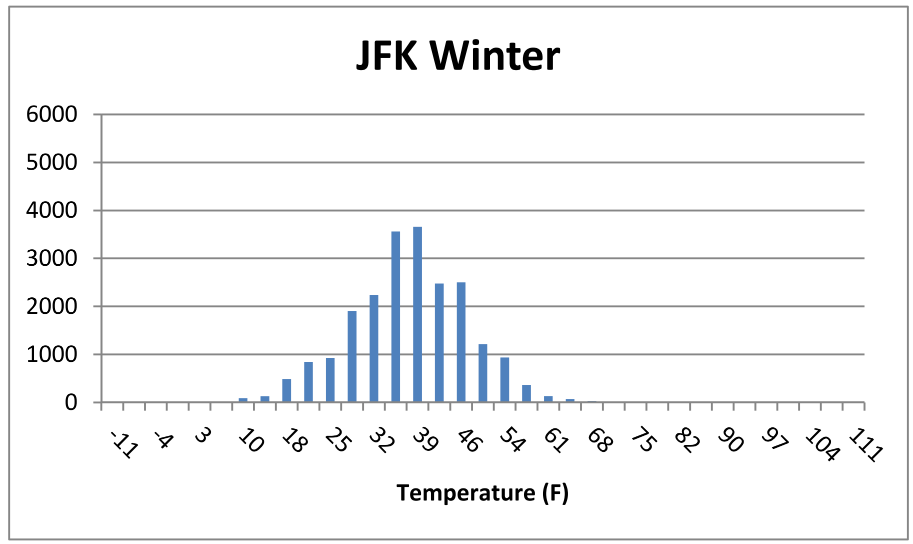
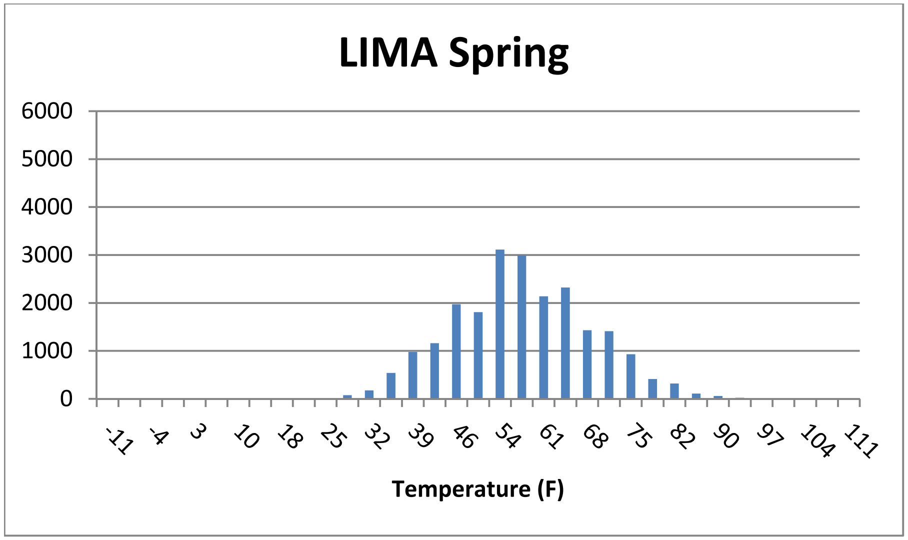
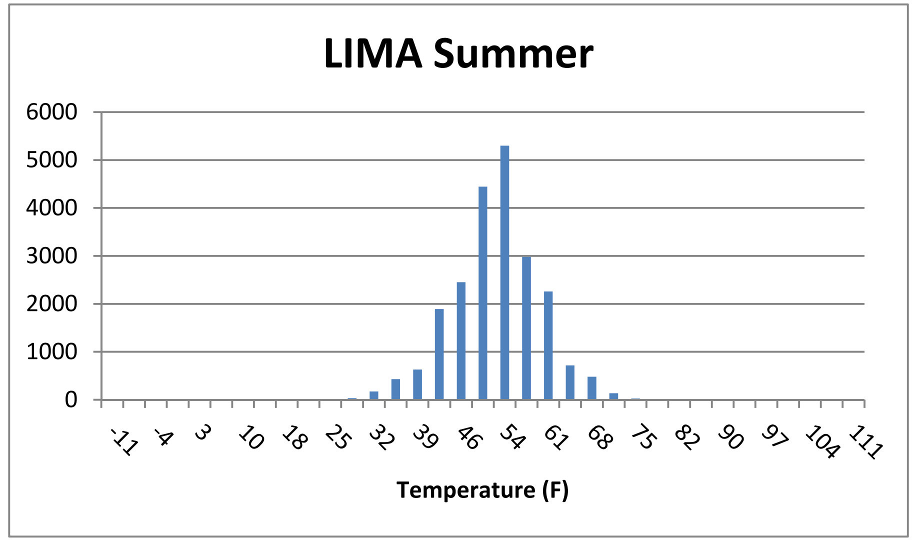

JFK Spring
6000
5000
4000
3000
2000
1000
0
-11 -4 3 10 18 25 32 39 46 54 61 68 75 82 90 97 104 111
Temperature (F)

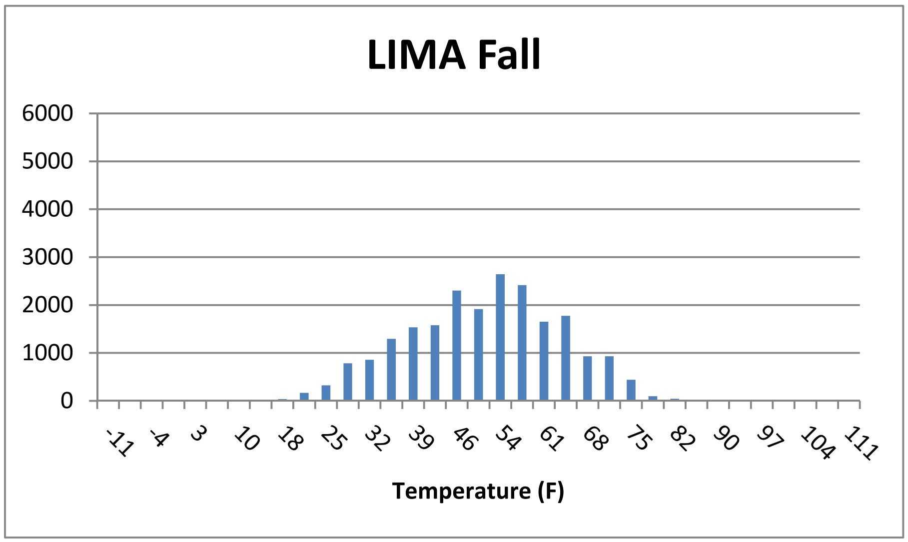

JFK Summer
6000
5000
4000
3000
2000
1000
0
-11 -4 3 10 18 25 32 39 46 54 61 68 75 82 90 97 104 111
Temperature (F)

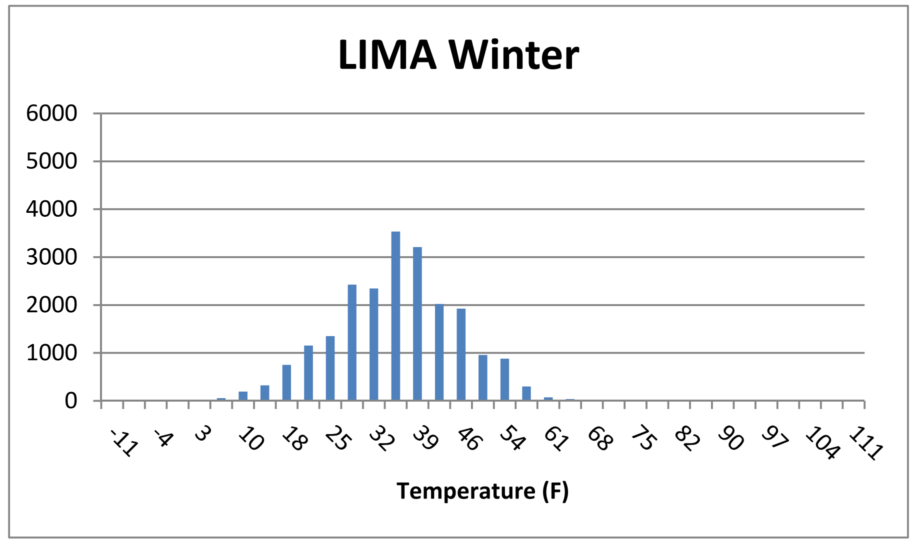

JFK Fall
6000
5000
4000
3000
2000
1000
0
-11 -4 3 10 18 25 32 39 46 54 61 68 75 82 90 97 104 111
Temperature (F)

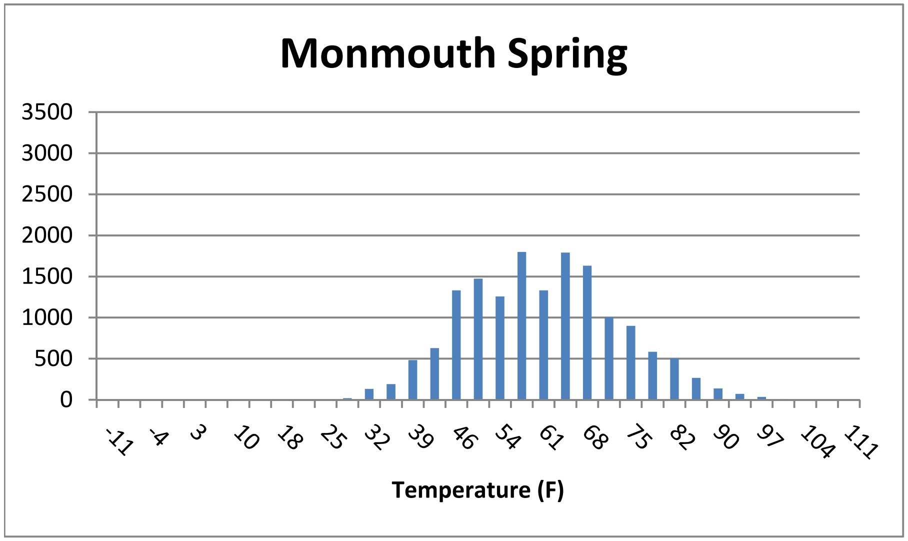

JFK Winter
6000
5000
4000
3000
2000
1000
0
-11 -4 3 10 18 25 32 39 46 54 61 68 75 82 90 97 104 111
Temperature (F)

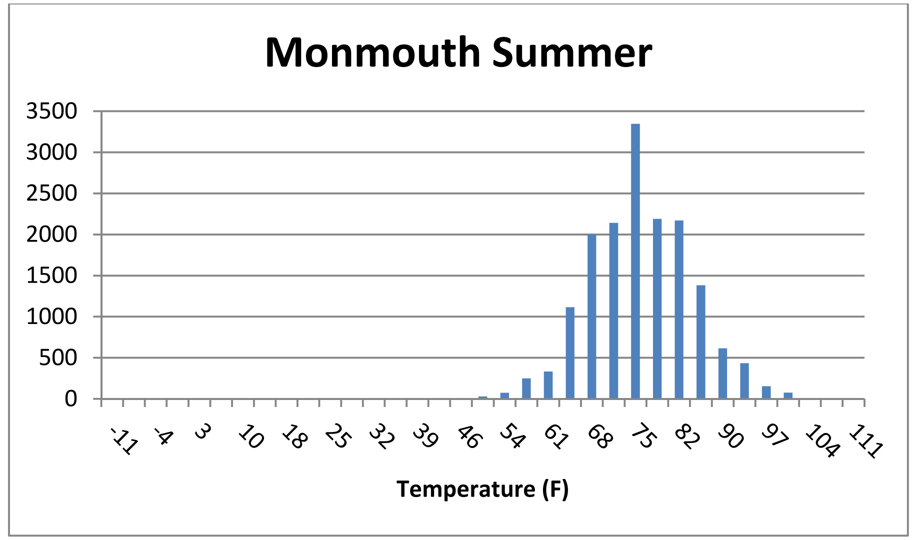

LIMA Spring
6000
5000
4000
3000
2000
1000
0
-11 -4 3 10 18 25 32 39 46 54 61 68 75 82 90 97 104 111
Temperature (F)

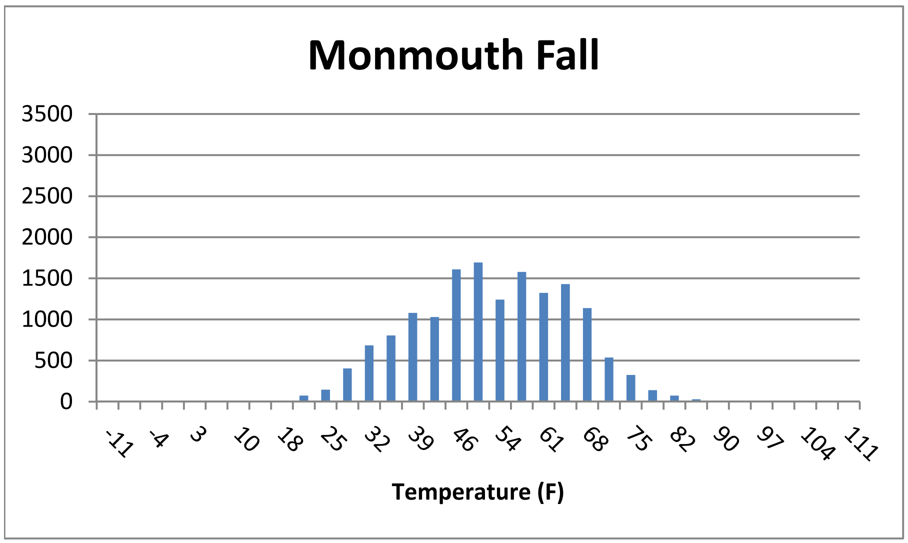

LIMA Summer
6000
5000
4000
3000
2000
1000
0
-11 -4 3 10 18 25 32 39 46 54 61 68 75 82 90 97 104 111
Temperature (F)

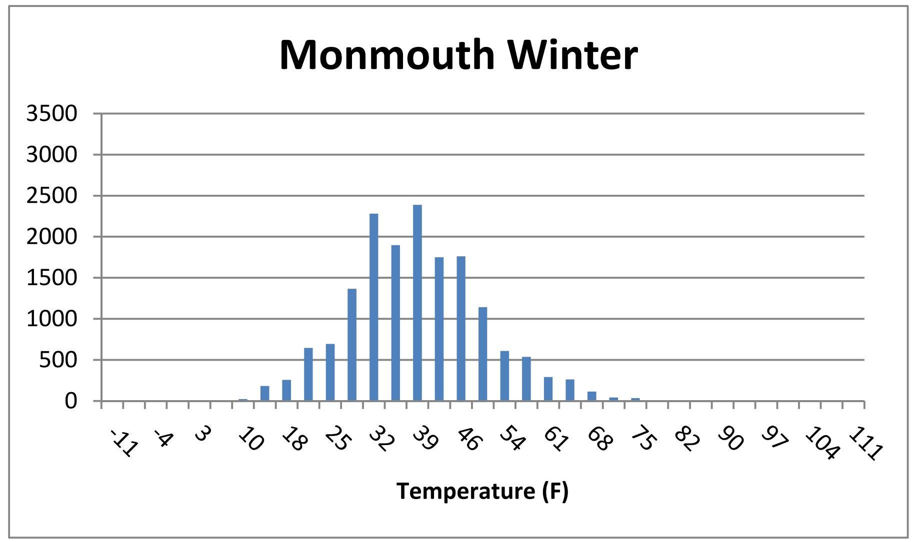

LIMA Fall
6000
5000
4000
3000
2000
1000
0
-11 -4 3 10 18 25 32 39 46 54 61 68 75 82 90 97 104 111
Temperature (F)

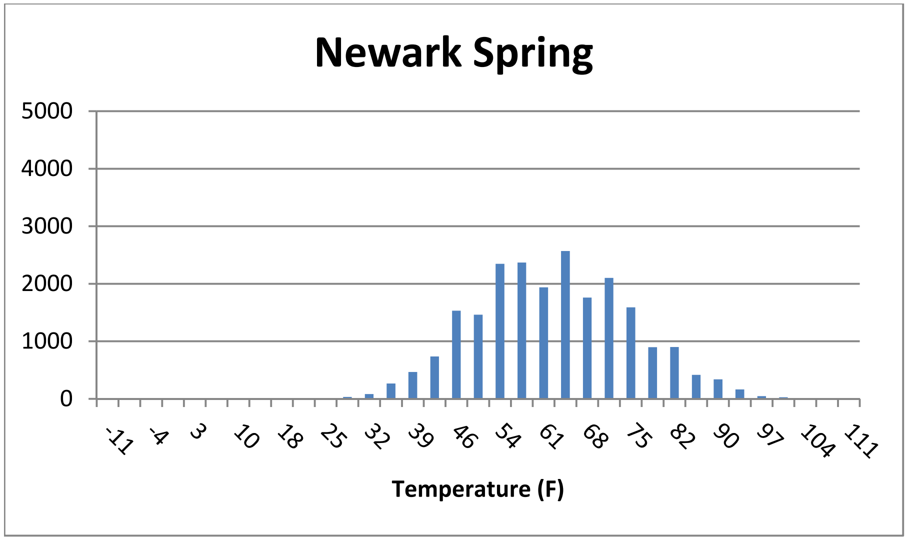

LIMA Winter
6000
5000
4000
3000
2000
1000
0
-11 -4 3 10 18 25 32 39 46 54 61 68 75 82 90 97 104 111
Temperature (F)

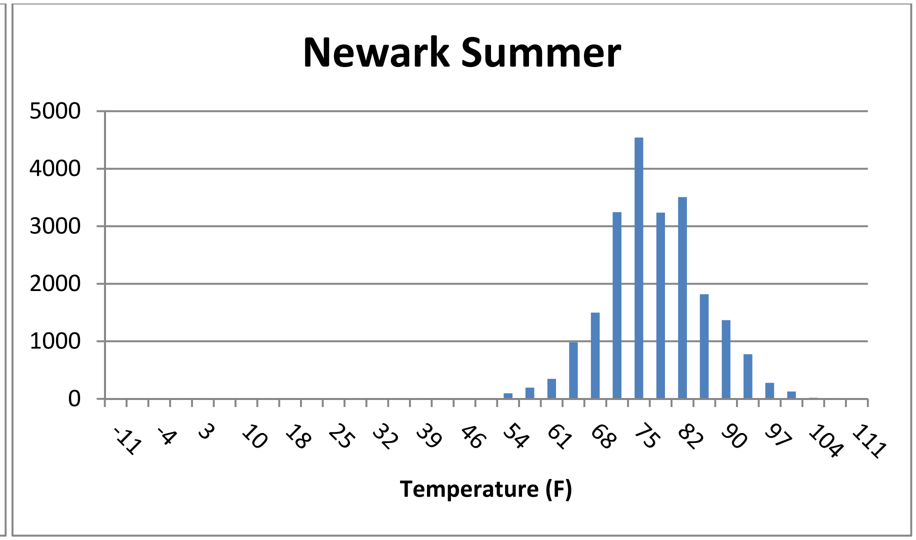

Monmouth Spring
3500
3000
2500
2000
1500
1000
500
0
-11 -4 3 10 18 25 32 39 46 54 61 68 75 82 90 97 104 111
Temperature (F)

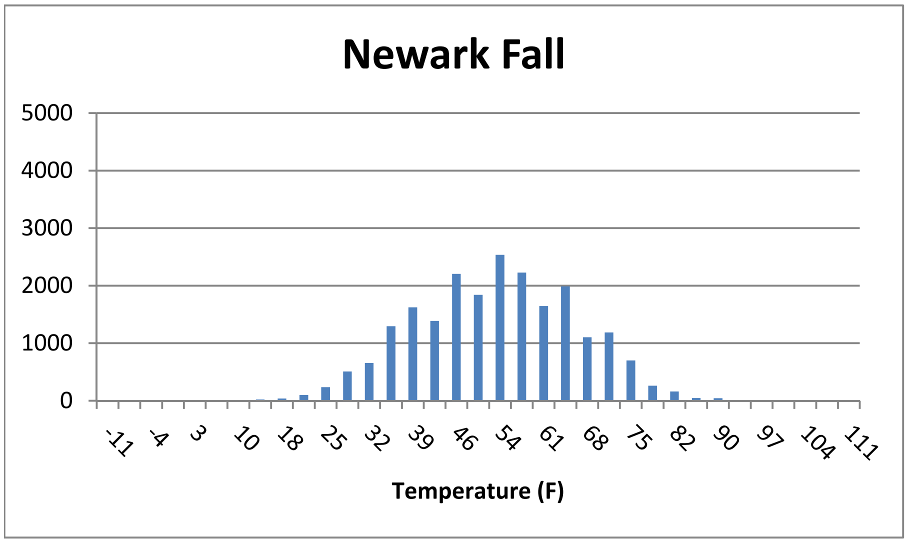

Monmouth Summer
3500
3000
2500
2000
1500
1000
500
0
-11 -4 3 10 18 25 32 39 46 54 61 68 75 82 90 97 104 111
Temperature (F)

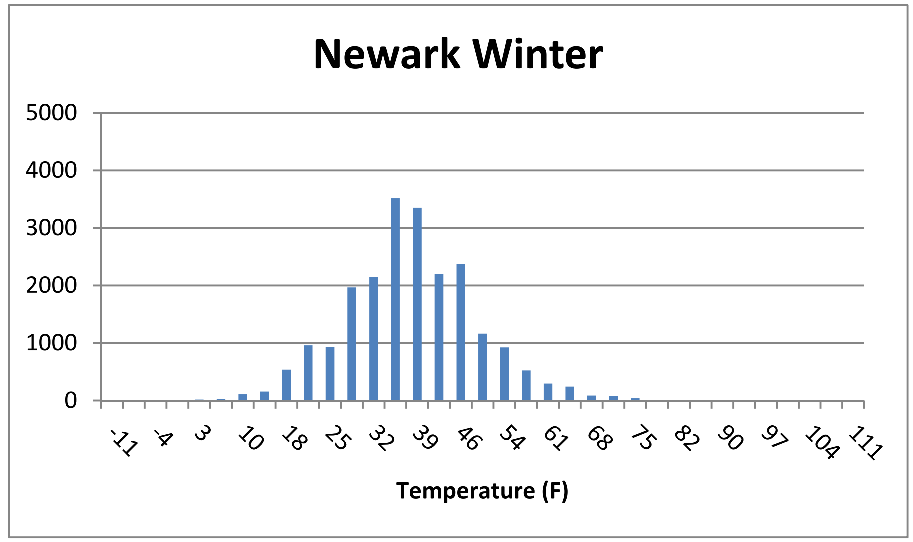

Monmouth Fall
3500
3000
2500
2000
1500
1000
500
0
-11 -4 3 10 18 25 32 39 46 54 61 68 75 82 90 97 104 111
Temperature (F)

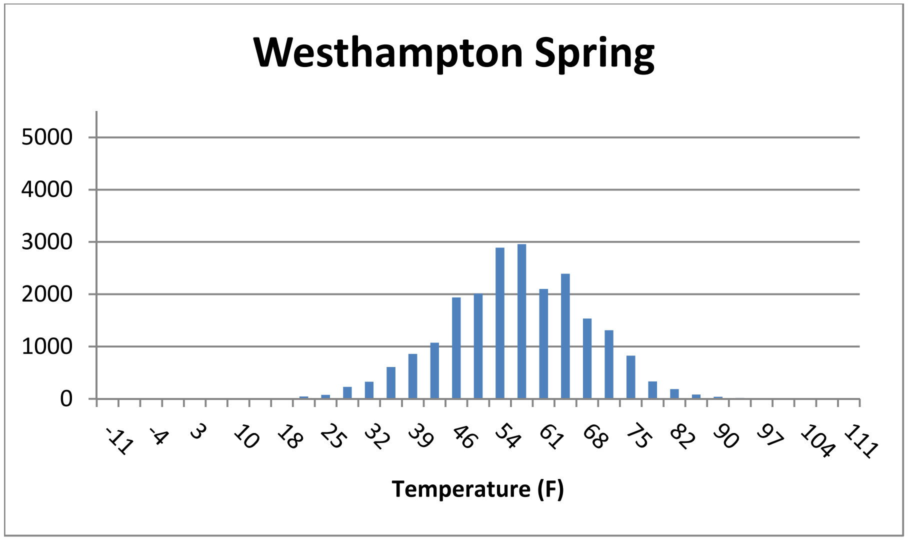

Monmouth Winter
3500
3000
2500
2000
1500
1000
500
0
-11 -4 3 10 18 25 32 39 46 54 61 68 75 82 90 97 104 111
Temperature (F)

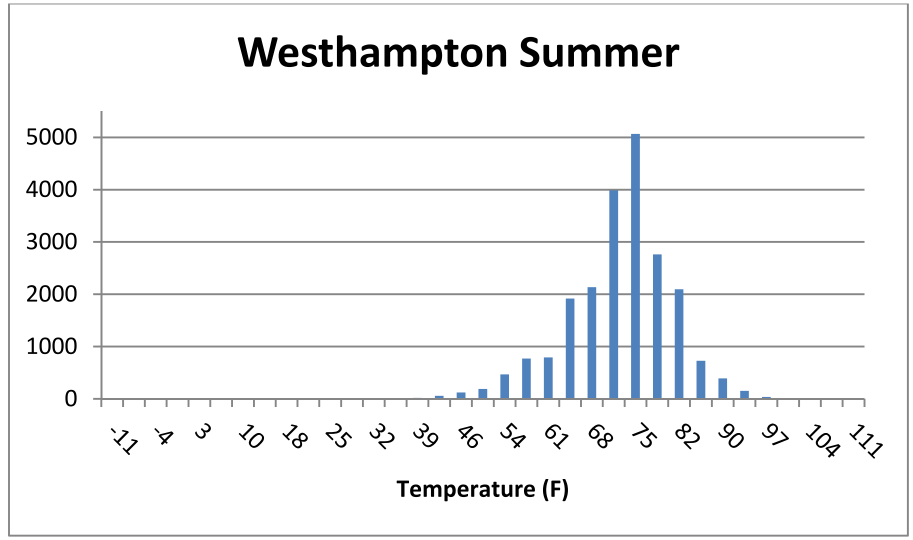

Newark Spring
5000
4000
3000
2000
1000
0
-11 -4 3 10 18 25 32 39 46 54 61 68 75 82 90 97 104 111
Temperature (F)

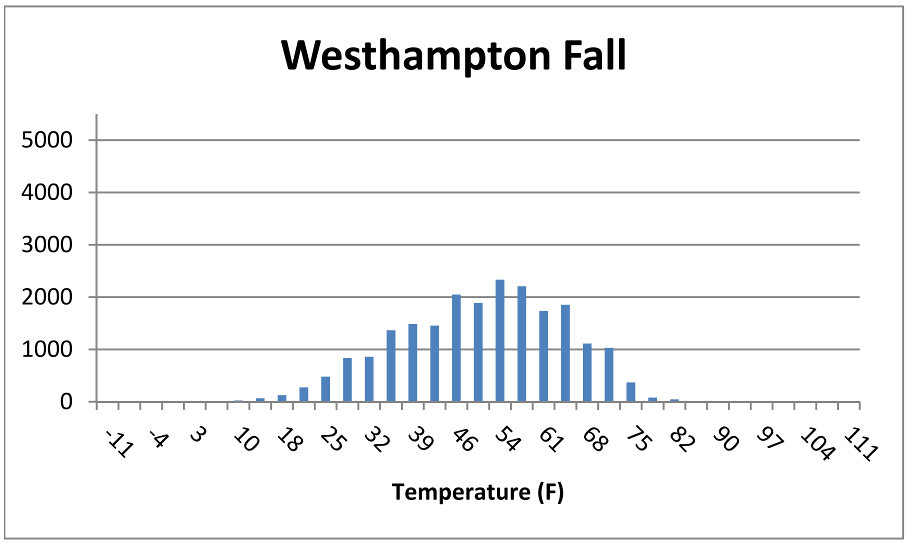

Newark Summer
5000
4000
3000
2000
1000
0
-11 -4 3 10 18 25 32 39 46 54 61 68 75 82 90 97 104 111
Temperature (F)

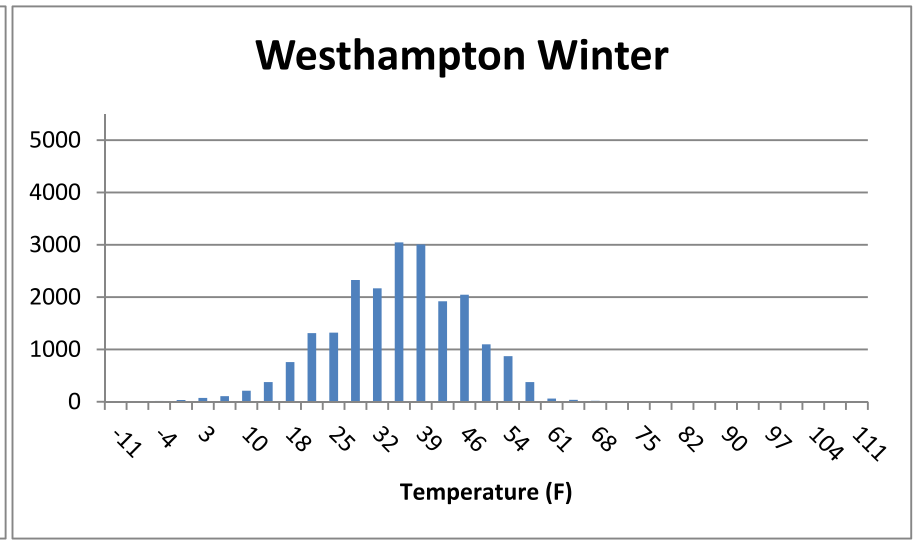

Newark Fall
5000
4000
3000
2000
1000
0
-11 -4 3 10 18 25 32 39 46 54 61 68 75 82 90 97 104 111
Temperature (F)


Newark Winter
5000
4000
3000
2000
1000
0
-11 -4 3 10 18 25 32 39 46 54 61 68 75 82 90 97 104 111
Temperature (F)


Westhampton Spring
5000
4000
3000
2000
1000
0
-11 -4 3 10 18 25 32 39 46 54 61 68 75 82 90 97 104 111
Temperature (F)


Westhampton Summer
5000
4000
3000
2000
1000
0
-11 -4 3 10 18 25 32 39 46 54 61 68 75 82 90 97 104 111
Temperature (F)


Westhampton Fall
5000
4000
3000
2000
1000
0
-11 -4 3 10 18 25 32 39 46 54 61 68 75 82 90 97 104 111
Temperature (F)


Westhampton Winter
5000
4000
3000
2000
1000
0
-11 -4 3 10 18 25 32 39 46 54 61 68 75 82 90 97 104 111
Temperature (F)

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Appendix D: Common Weather Conditions

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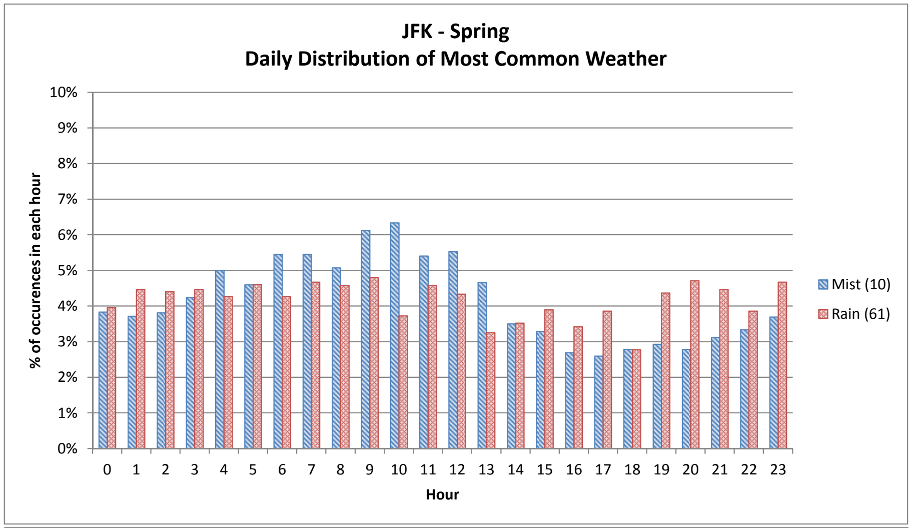
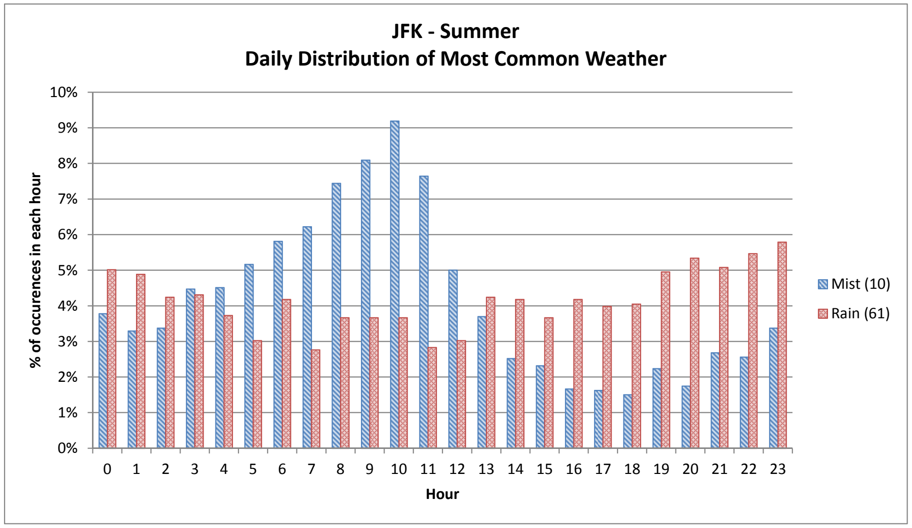
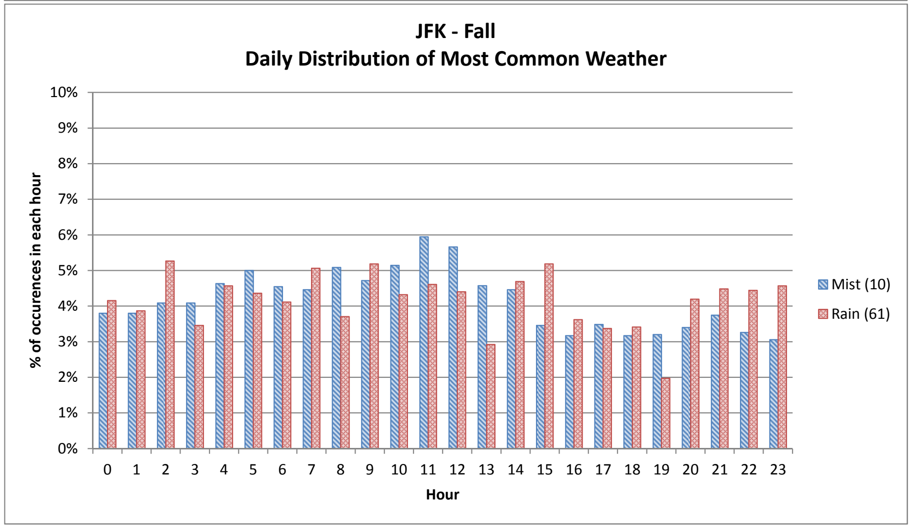
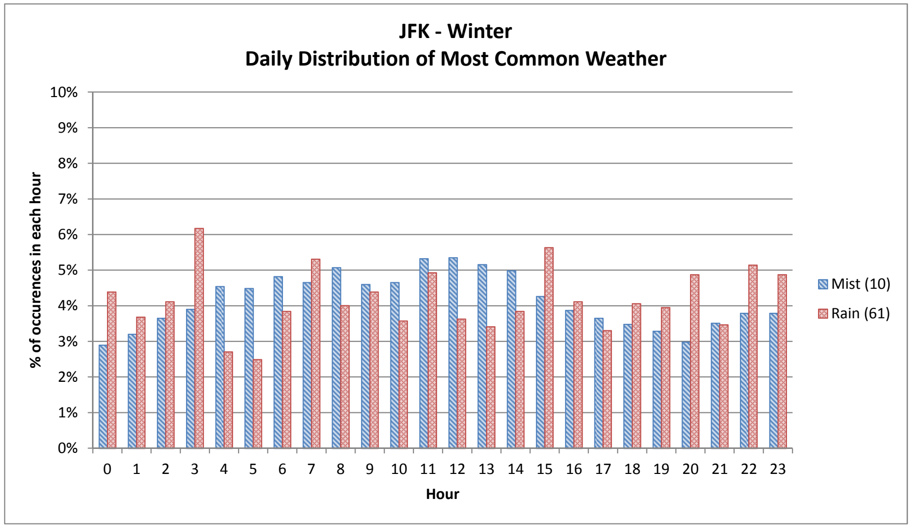
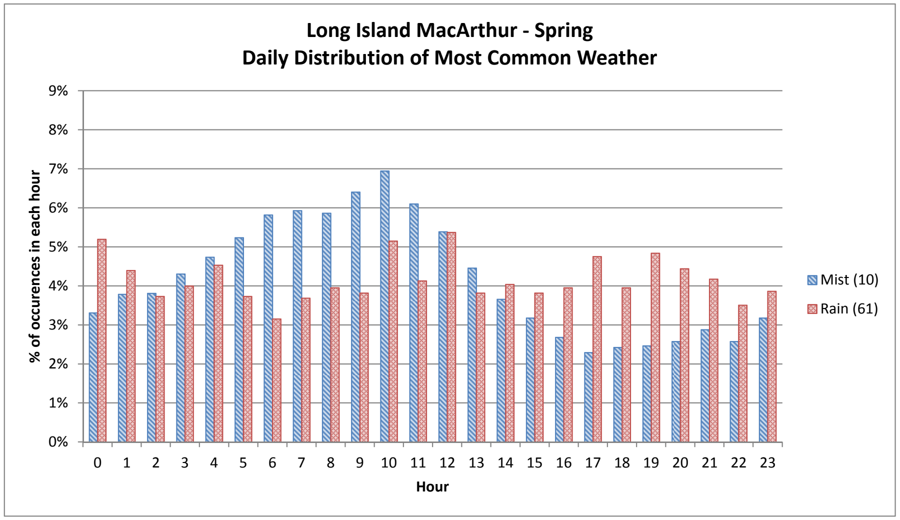
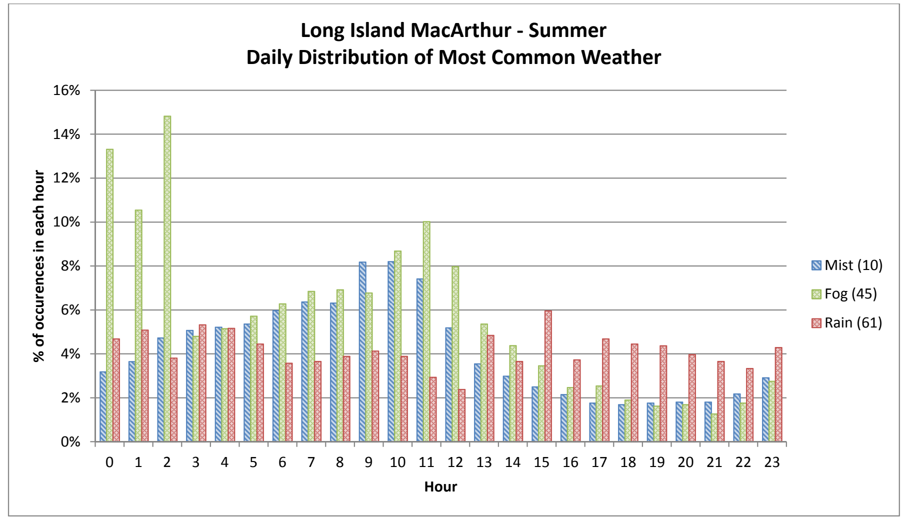

JFK - Spring
Daily Distribution of Most Common Weather
% of occurences in each hour
Hour
Mist (10)
Rain (61)

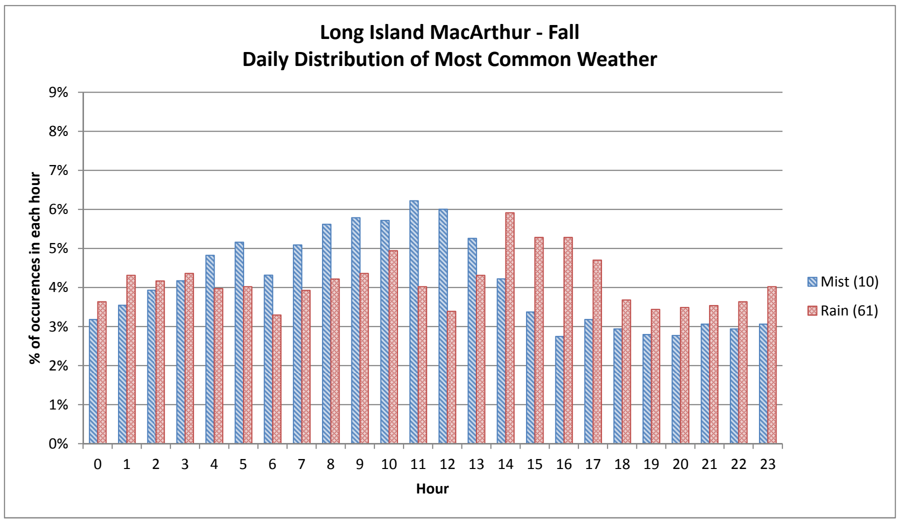

JFK - Summer
Daily Distribution of Most Common Weather
% of occurences in each hour
Hour
Mist (10)
Rain (61)

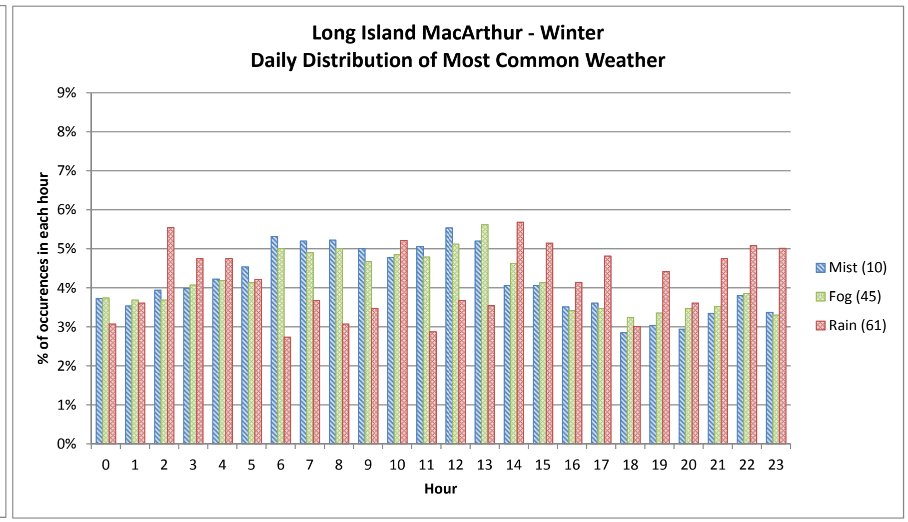

JFK - Fall
Daily Distribution of Most Common Weather
% of occurences in each hour
Hour
Mist (10)
Rain (61)

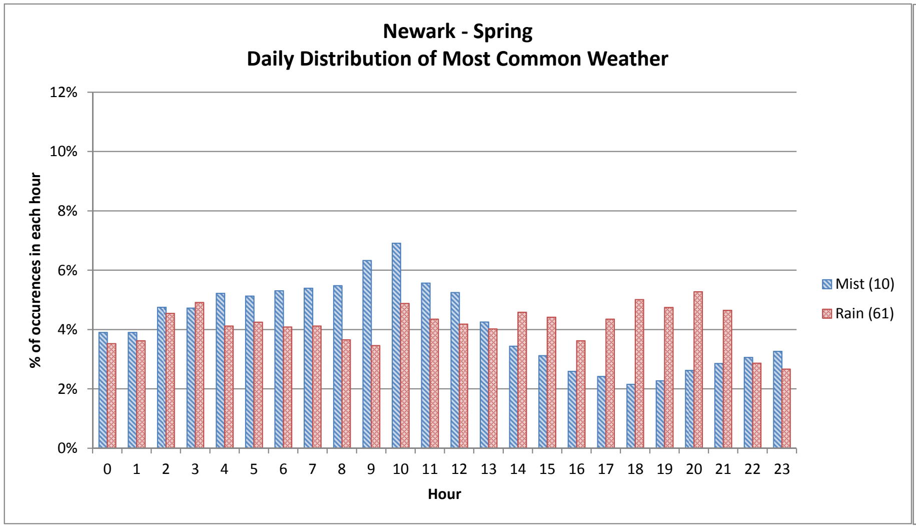

JFK - Winter
Daily Distribution of Most Common Weather
% of occurences in each hour
Hour
Mist (10)
Rain (61)

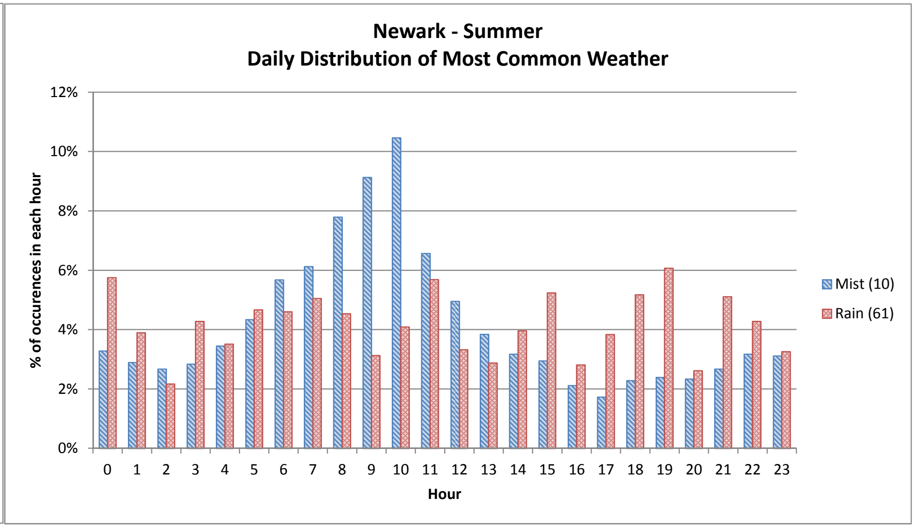

Long Island MacArthur - Spring
Daily Distribution of Most Common Weather
% of occurences in each hour
Hour
Mist (10)
Rain (61)

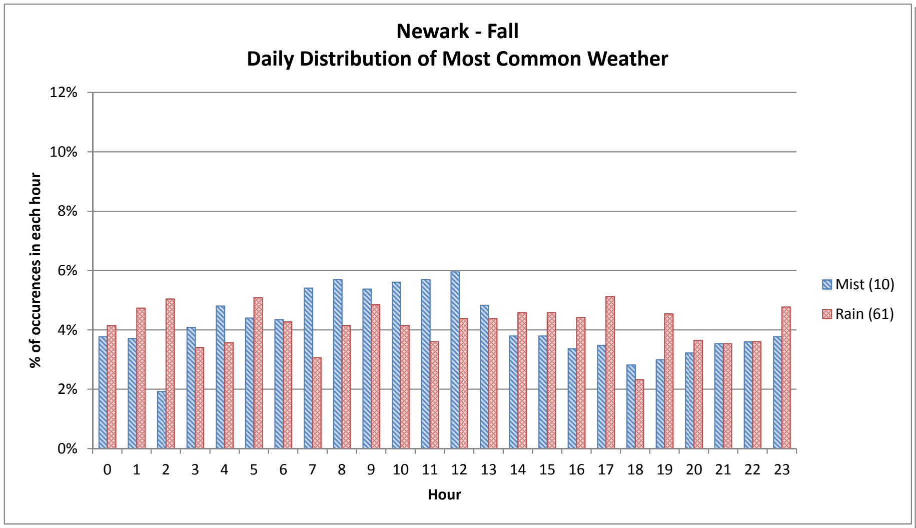

Long Island MacArthur - Summer
Daily Distribution of Most Common Weather
% of occurences in each hour
Hour
Mist (10)
Fog (45)
Rain (61)

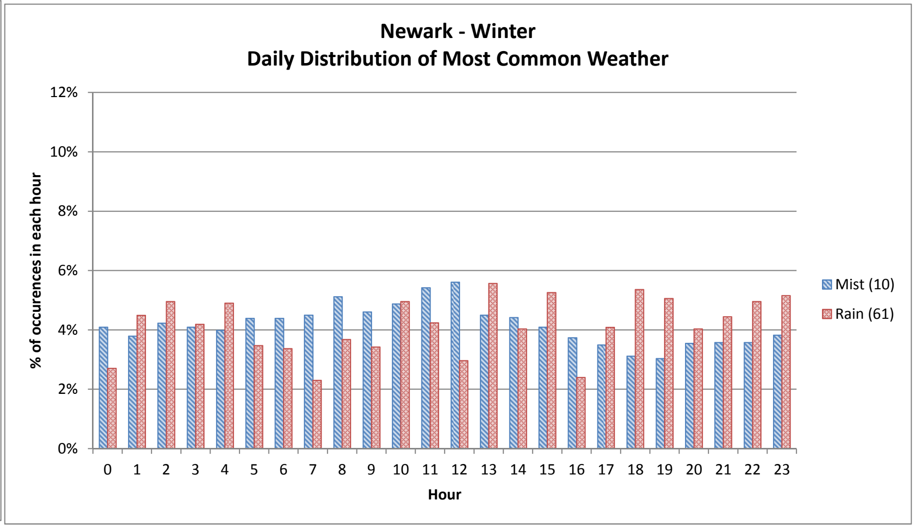

Long Island MacArthur - Fall
Daily Distribution of Most Common Weather
% of occurences in each hour
Hour
Mist (10)
Rain (61)

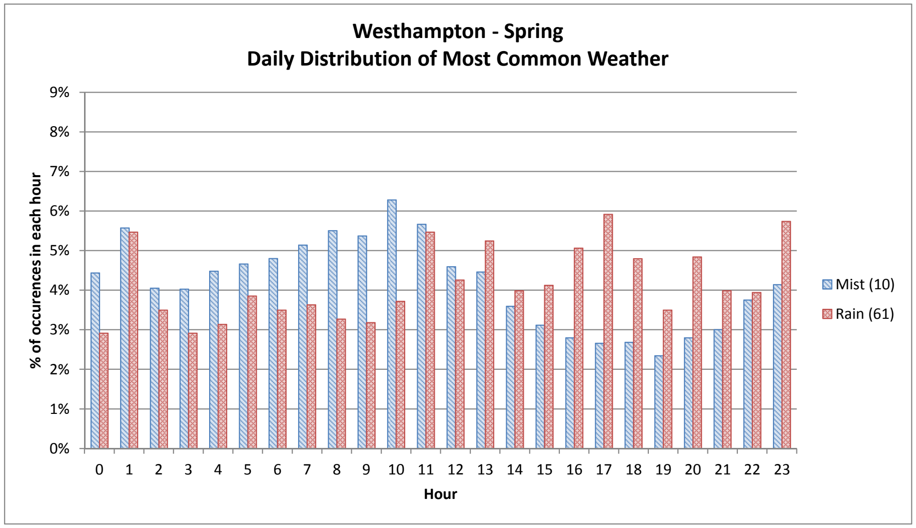

Long Island MacArthur - Winter
Daily Distribution of Most Common Weather
% of occurences in each hour
Hour
Mist (10)
Fog (45)
Rain (61)

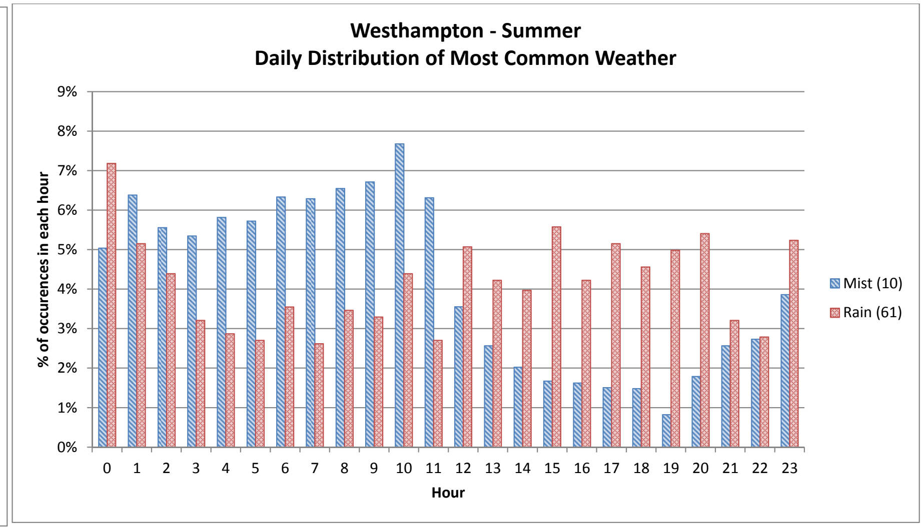

Newark - Spring
Daily Distribution of Most Common Weather
% of occurences in each hour
Hour
Mist (10)
Rain (61)

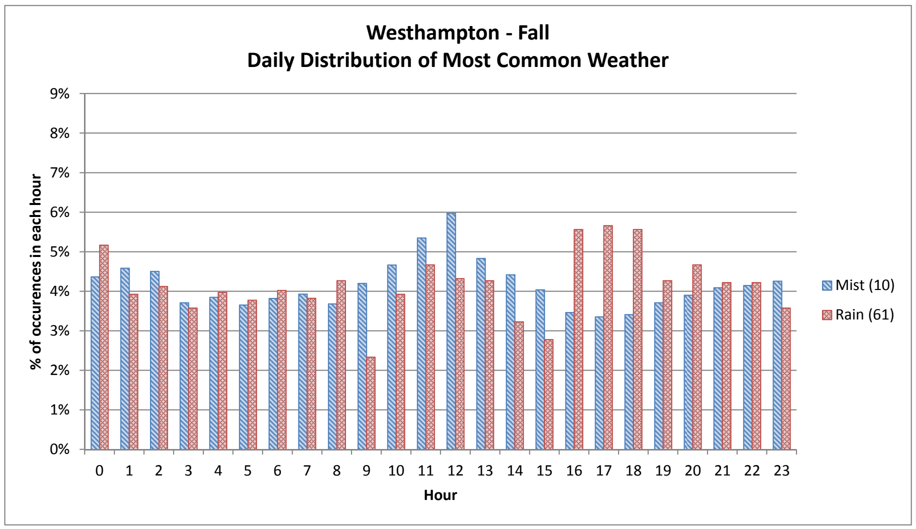

Newark - Summer
Daily Distribution of Most Common Weather
% of occurences in each hour
Hour
Mist (10)
Rain (61)

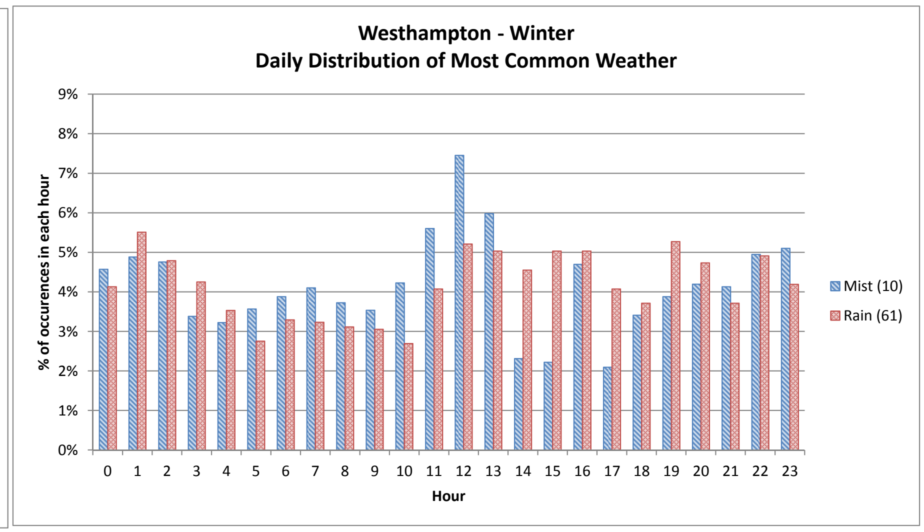

Newark - Fall
Daily Distribution of Most Common Weather
% of occurences in each hour
Hour
Mist (10)
Rain (61)


Newark - Winter
Daily Distribution of Most Common Weather
% of occurences in each hour
Hour
Mist (10)
Rain (61)


Westhampton - Spring
Daily Distribution of Most Common Weather
% of occurences in each hour
Hour
Mist (10)
Rain (61)


Westhampton - Summer
Daily Distribution of Most Common Weather
% of occurences in each hour
Hour
Mist (10)
Rain (61)


Westhampton - Fall
Daily Distribution of Most Common Weather
% of occurences in each hour
Hour
Mist (10)
Rain (61)


Westhampton - Winter
Daily Distribution of Most Common Weather
% of occurences in each hour
Hour
Mist (10)
Rain (61)

Appendix E: Baseline Viewsheds (10-meter DEM)

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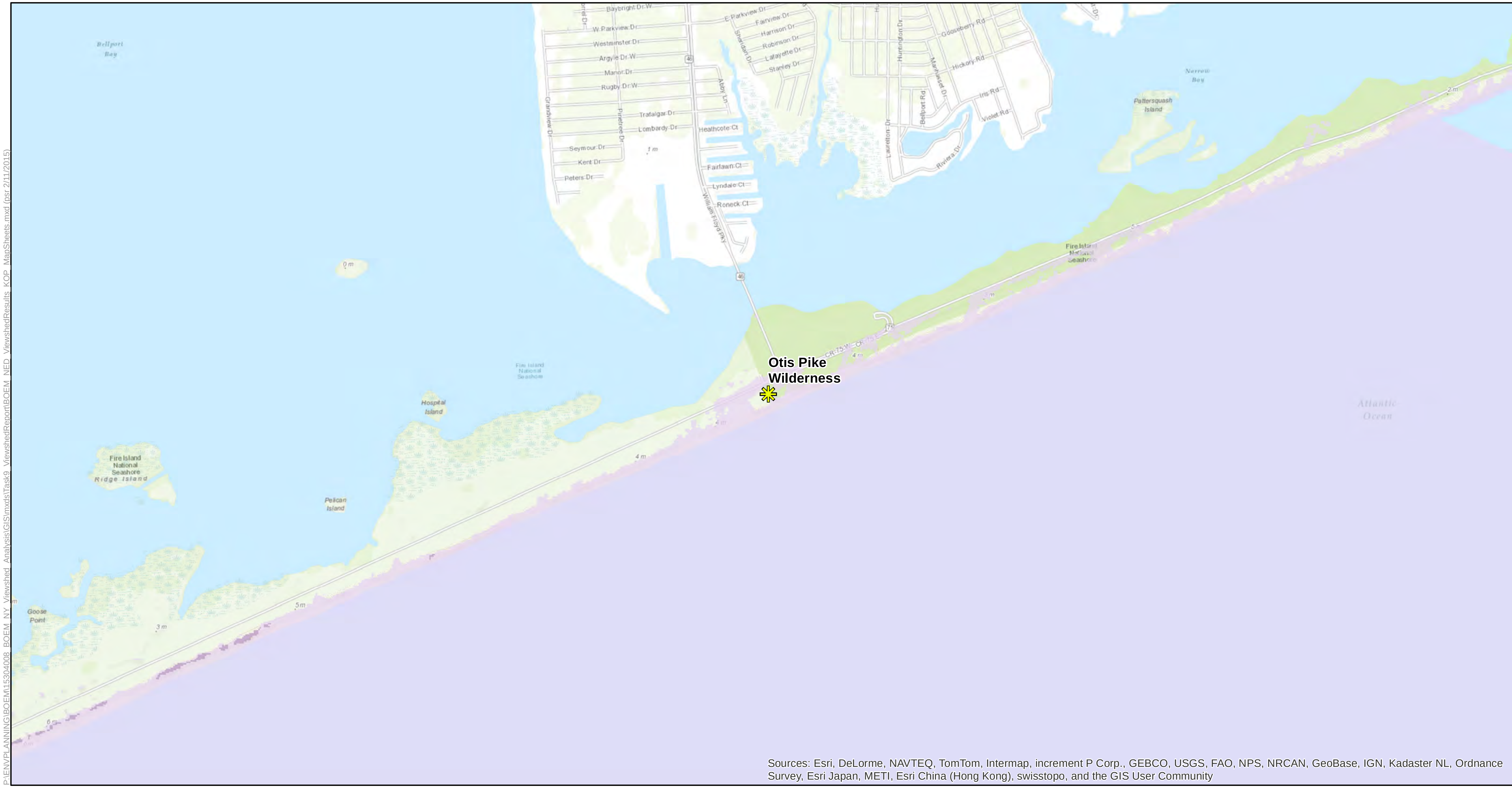

Legend

Key Observation Point Location

Digital Elevation Model Viewshed

Tip of Blade

Hub and Blade

0 0.25 0.5 1
Kilometers

0 0.25 0.5 1
Nautical Miles

0 0.25 0.5 1
Miles

Otis Pike Wilderness Baseline Viewshed based on 10 Meter Digital Elevation Model

NY Renewable Energy Viewshed Project

Coordinate System: NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983

URS

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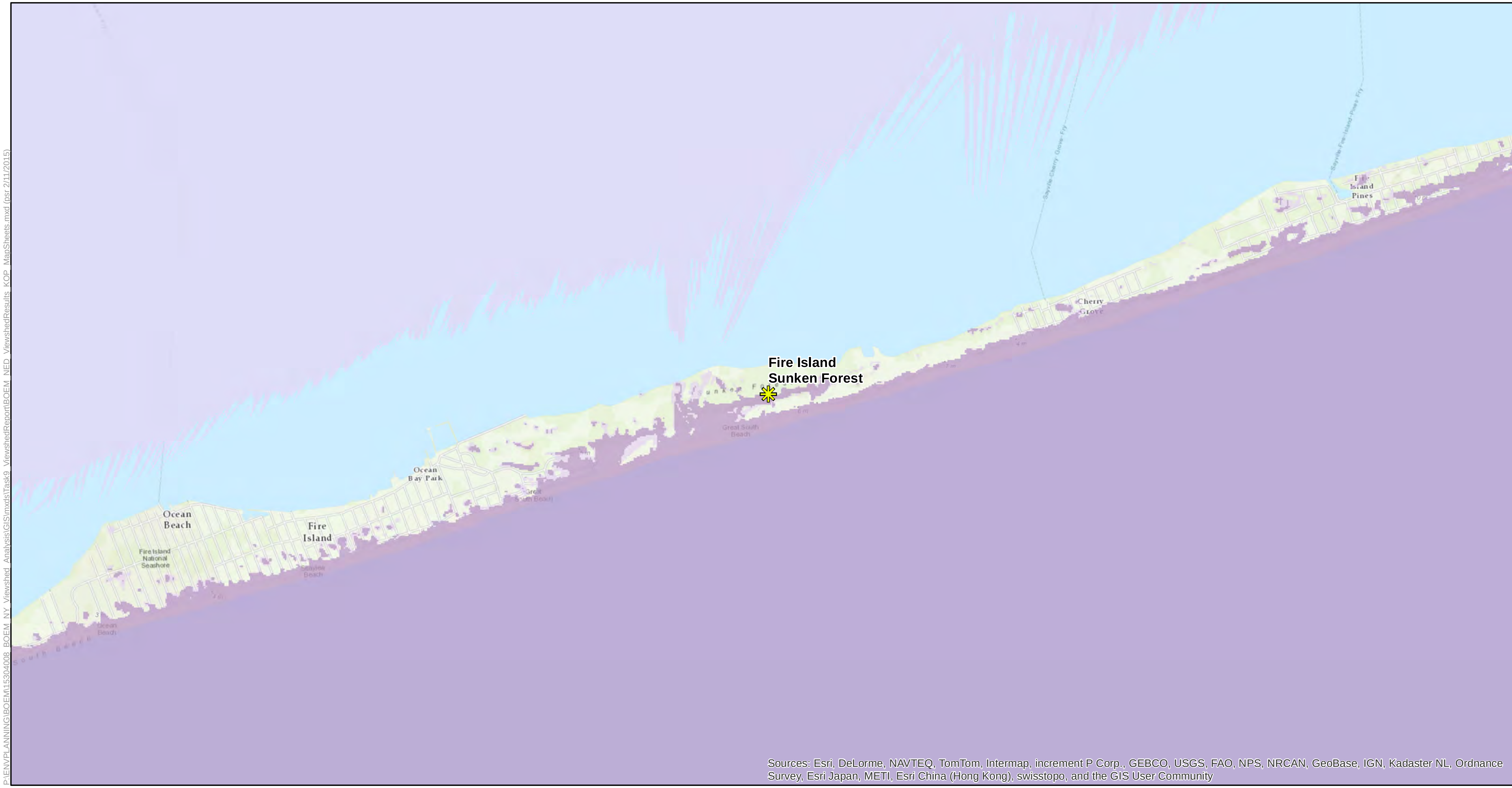
Bureau of Ocean Energy Management



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Legend

Key Observation Point Location

Digital Elevation Model Viewshed

Tip of Blade

Hub and Blade

0 0.25 0.5 1
Kilometers

0 0.25 0.5 1
Nautical Miles

0 0.25 0.5 1
Miles

Fire Island Sunken Forest Baseline Viewshed based on 10 Meter Digital Elevation Model

NY Renewable Energy Viewshed Project

Coordinate System: NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983

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Legend

Key Observation Point Location

Digital Elevation Model Viewshed

- Tip of Blade
- Hub and Blade

N

0 0.25 0.5 1
Kilometers

0 0.25 0.5 1
Nautical Miles

0 0.25 0.5 1
Miles

Coordinate System: NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983

Fire Island Lighthouse Baseline Viewshed based on 10 Meter Digital Elevation Model

NY Renewable Energy Viewshed Project

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Legend

Key Observation Point Location

Digital Elevation Model Viewshed

Tip of Blade

Hub and Blade

0 0.25 0.5 1 Kilometers

0 0.25 0.5 1 Nautical Miles

0 0.25 0.5 1 Miles

Jacob Riis Baseline Viewshed
based on 10 Meter Digital Elevation Model

NY Renewable Energy Viewshed Project

Coordinate System: NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983

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Legend

Key Observation Point Location

Digital Elevation Model Viewshed

- Tip of Blade
- Hub and Blade

N

0 0.25 0.5 1
Kilometers

0 0.25 0.5 1
Nautical Miles

0 0.25 0.5 1
Miles

Breezy Point Baseline Viewshed
based on 10 Meter Digital Elevation Model

NY Renewable Energy Viewshed Project

Coordinate System: NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983

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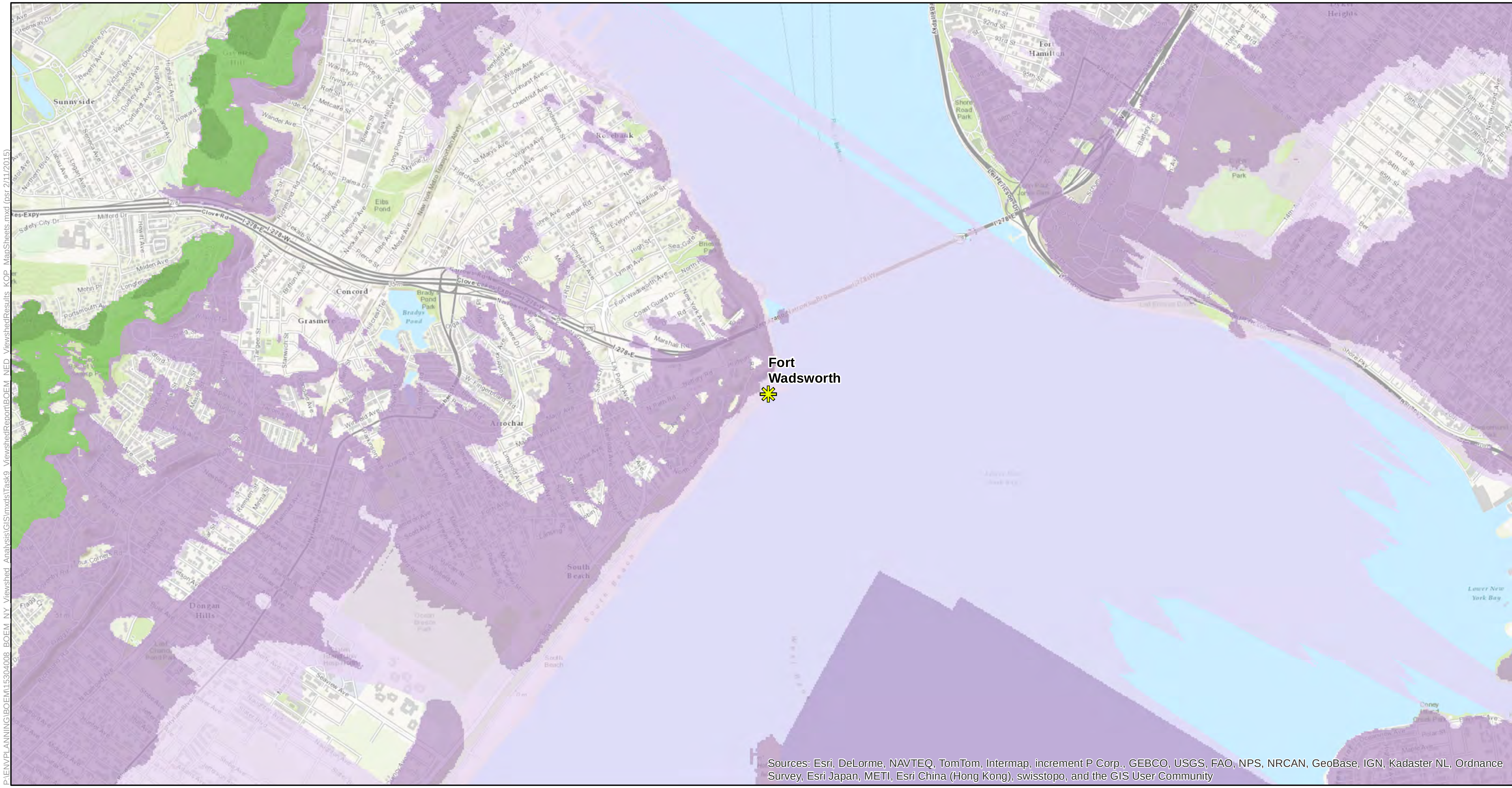

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Legend

Key Observation Point Location

Digital Elevation Model Viewshed

- Tip of Blade
- Hub and Blade
- Entire Turbine
- Substation

0 0.25 0.5 1
Kilometers

0 0.25 0.5 1
Nautical Miles

0 0.25 0.5 1
Miles

Fort Wadsworth Baseline Viewshed
based on 10 Meter Digital Elevation Model

NY Renewable Energy Viewshed Project

Coordinate System: NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983

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Sources: Esri, DeLorme, NAVTEQ, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, and the GIS User Community

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Legend

Key Observation Point Location

Digital Elevation Model Viewshed

- Tip of Blade
- Hub and Blade

N

0 0.25 0.5 1
Kilometers

0 0.25 0.5 1
Nautical Miles

0 0.25 0.5 1
Miles

Great Kills Baseline Viewshed based on 10 Meter Digital Elevation Model

NY Renewable Energy Viewshed Project

Coordinate System: NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983

URS

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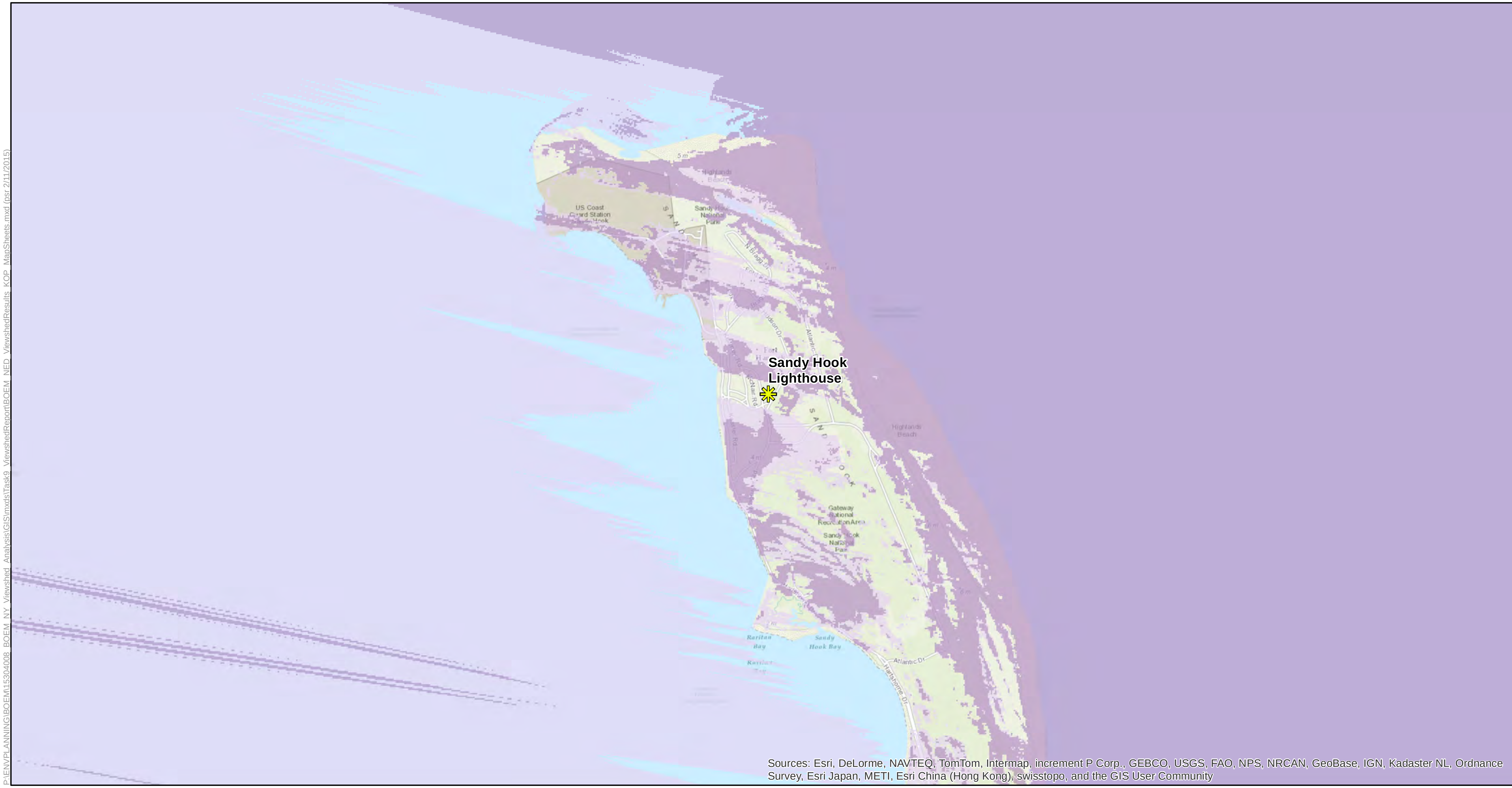

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Legend

Key Observation Point Location

Digital Elevation Model Viewshed

Tip of Blade

Hub and Blade

0 0.25 0.5 1
Kilometers

0 0.25 0.5 1
Nautical Miles

0 0.25 0.5 1
Miles

Sandy Hook Lighthouse Baseline Viewshed based on 10 Meter Digital Elevation Model

NY Renewable Energy Viewshed Project

Coordinate System: NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983

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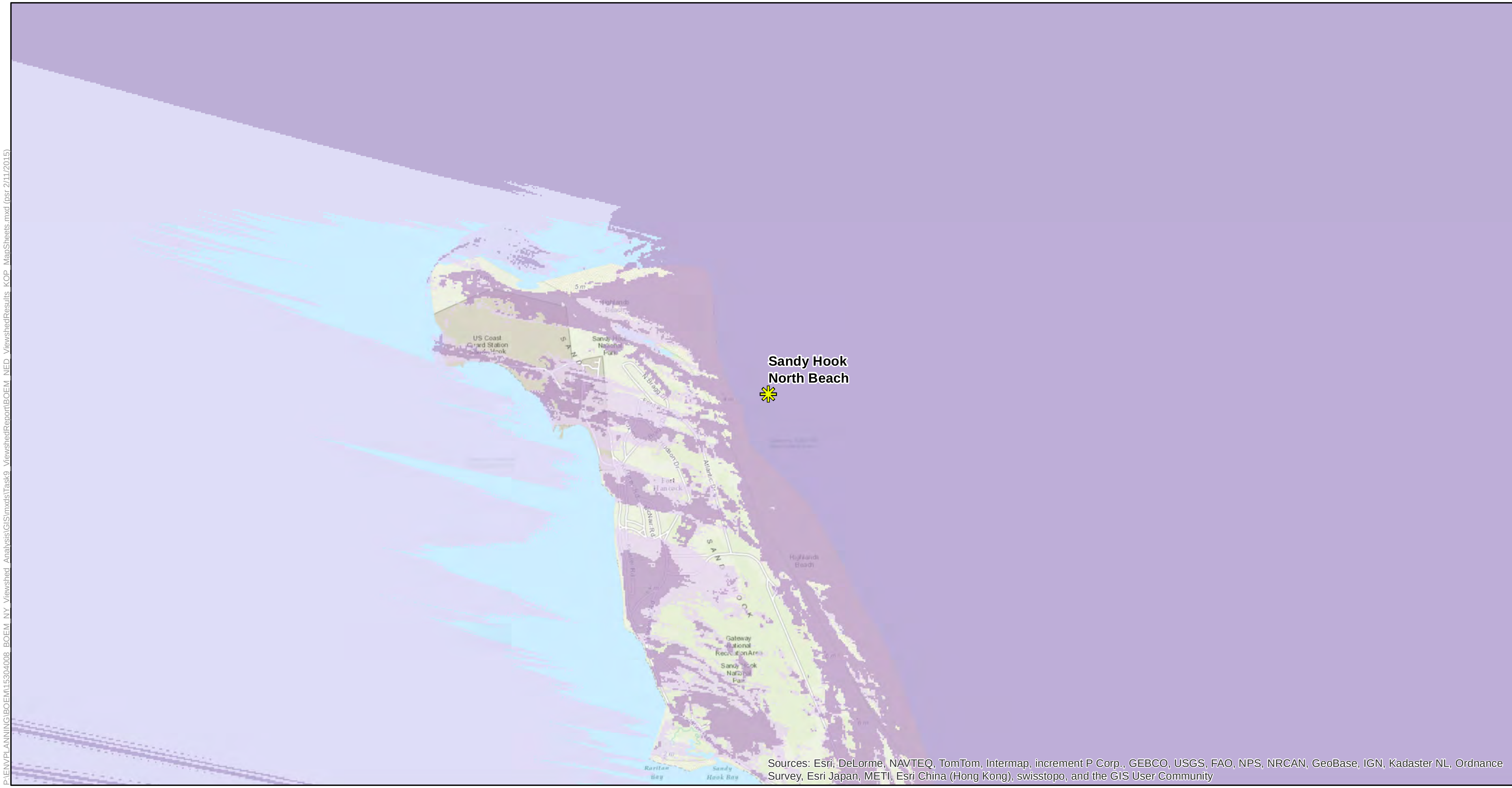

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Legend

Key Observation Point Location

Digital Elevation Model Viewshed

Tip of Blade

Hub and Blade

0 0.25 0.5 1
Kilometers

0 0.25 0.5 1
Nautical Miles

0 0.25 0.5 1
Miles

Sandy Hook North Beach Baseline Viewshed based on 10 Meter Digital Elevation Model

NY Renewable Energy Viewshed Project

Coordinate System: NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983

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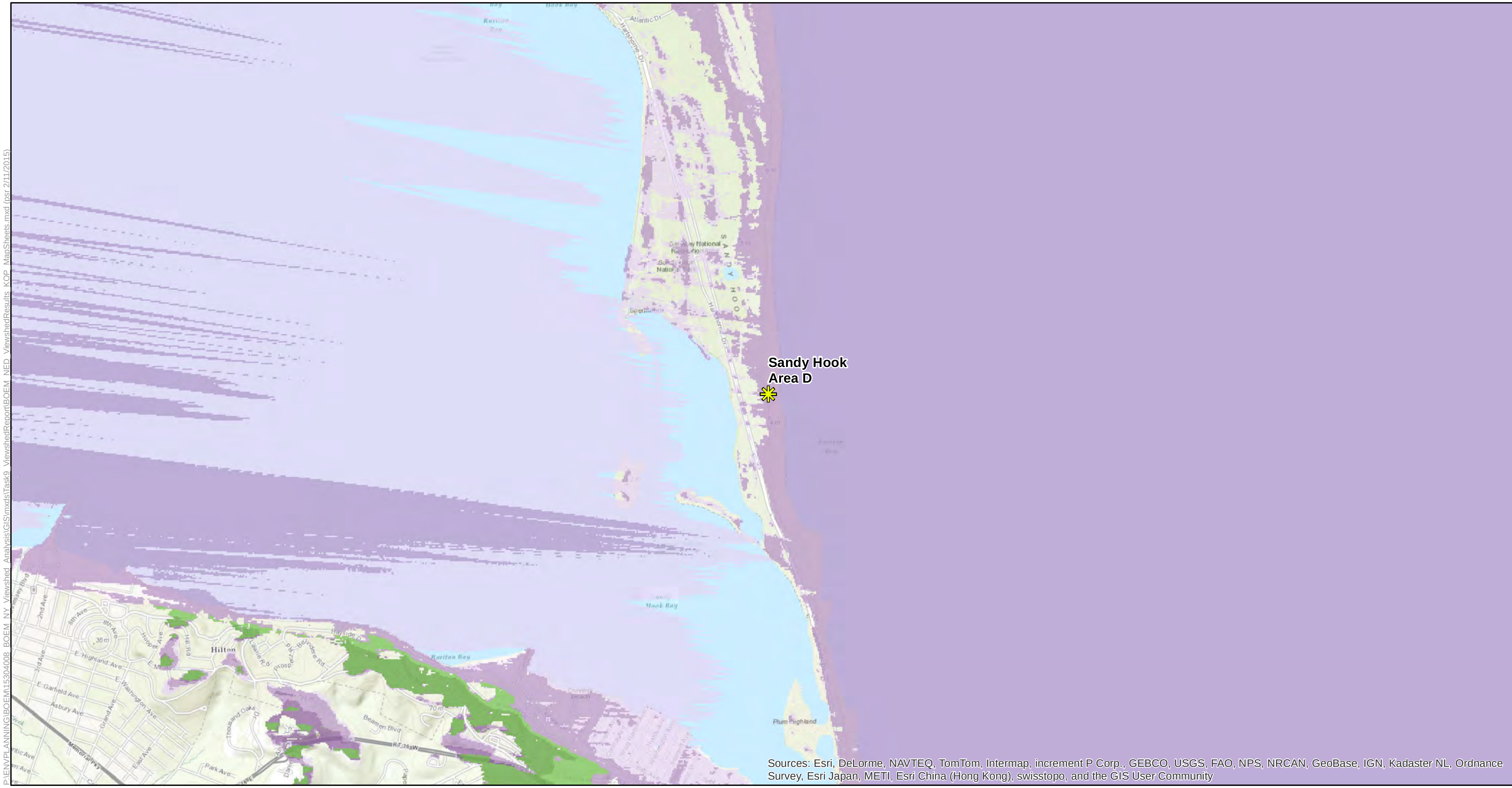

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Legend

Key Observation Point Location

Digital Elevation Model Viewshed

- Tip of Blade
- Hub and Blade
- Entire Turbine
- Substation

URS

N

0 0.25 0.5 1
Kilometers

0 0.25 0.5 1
Nautical Miles

0 0.25 0.5 1
Miles

Sandy Hook Area D Baseline Viewshed based on 10 Meter Digital Elevation Model

NY Renewable Energy Viewshed Project

Coordinate System: NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983

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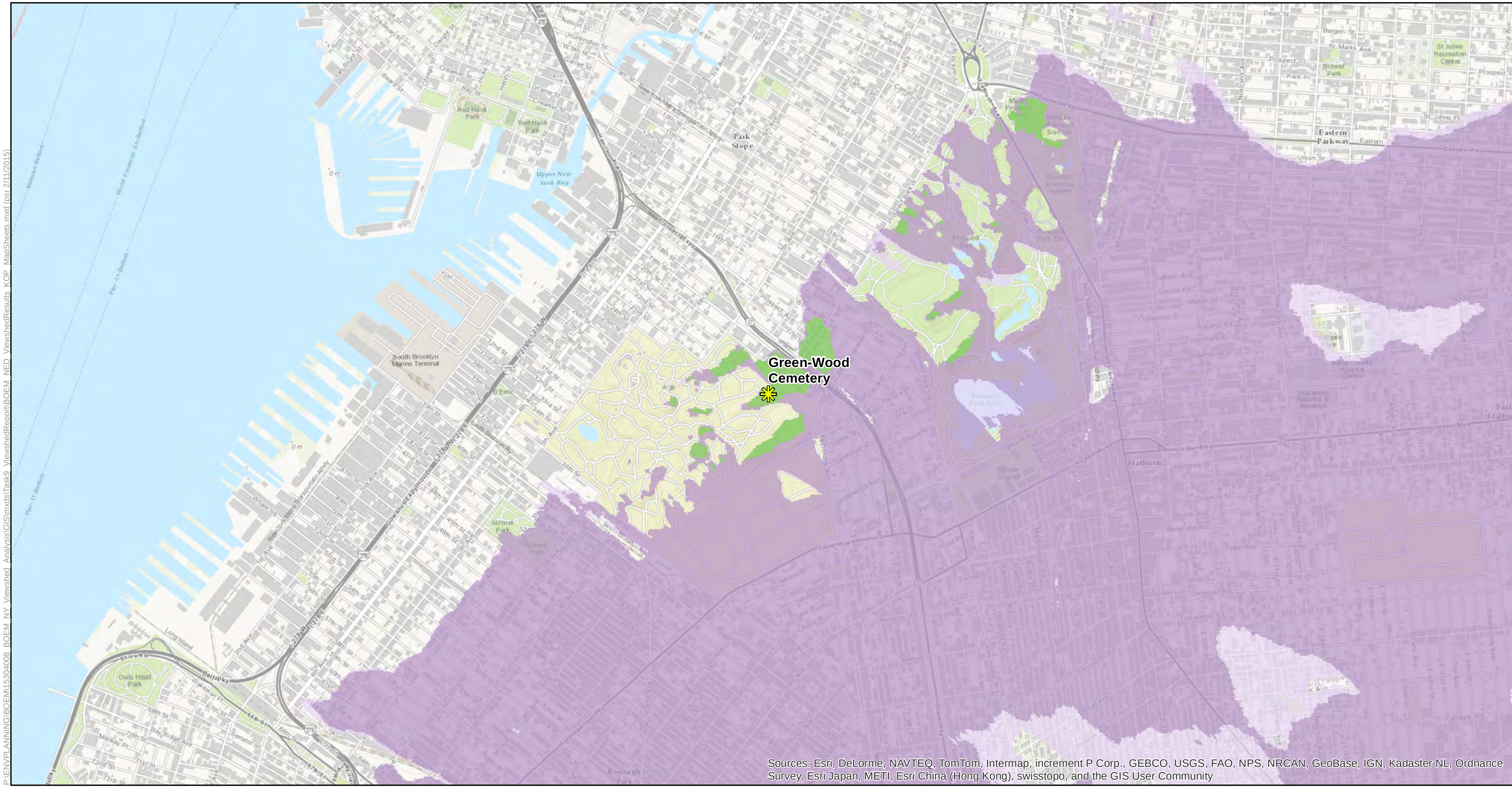

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Legend

Key Observation Point Location

Digital Elevation Model Viewshed

- Tip of Blade
- Hub and Blade
- Substation

0 0.25 0.5 1
Kilometers

0 0.25 0.5 1
Nautical Miles

0 0.25 0.5 1
Miles

Green-Wood Cemetery Baseline Viewshed based on 10 Meter Digital Elevation Model

NY Renewable Energy Viewshed Project

Coordinate System: NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983

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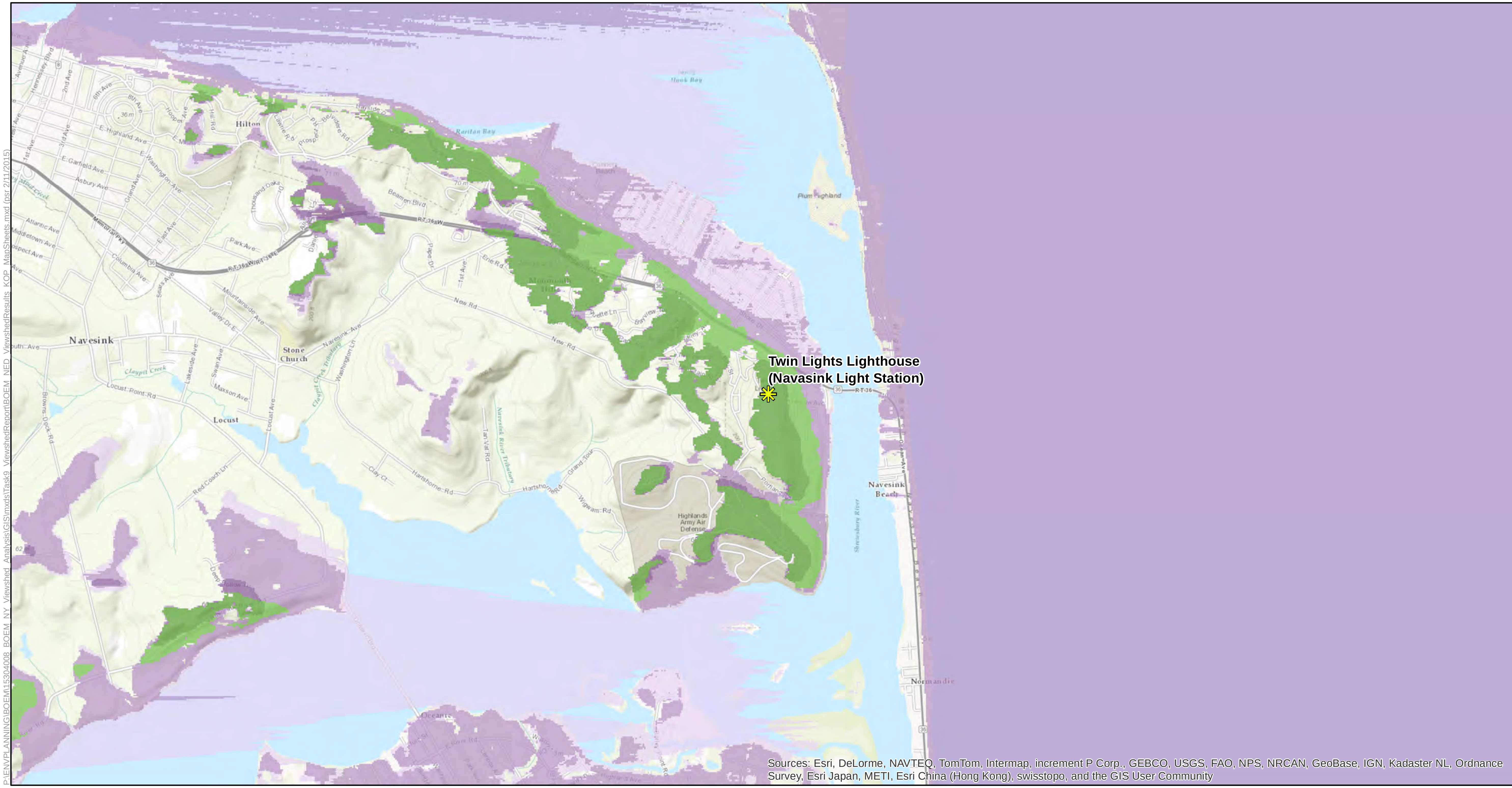

Legend

Key Observation Point Location

Digital Elevation Model Viewshed

- Tip of Blade
- Hub and Blade
- Entire Turbine
- Substation

0 0.25 0.5 1
Kilometers

0 0.25 0.5 1
Nautical Miles

0 0.25 0.5 1
Miles

Twin Lights Lighthouse (Navasink Light Station)
Baseline Viewshed
based on 10 Meter Digital Elevation Model

NY Renewable Energy Viewshed Project

Coordinate System: NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983

URS

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Legend

Key Observation Point Location

Digital Elevation Model Viewshed

- Tip of Blade
- Hub and Blade
- Entire Turbine
- Substation

0 0.25 0.5 1
Kilometers

0 0.25 0.5 1
Nautical Miles

0 0.25 0.5 1
Miles

Jones Beach Baseline Viewshed
based on 10 Meter Digital Elevation Model

NY Renewable Energy Viewshed Project

Coordinate System: NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983

URS

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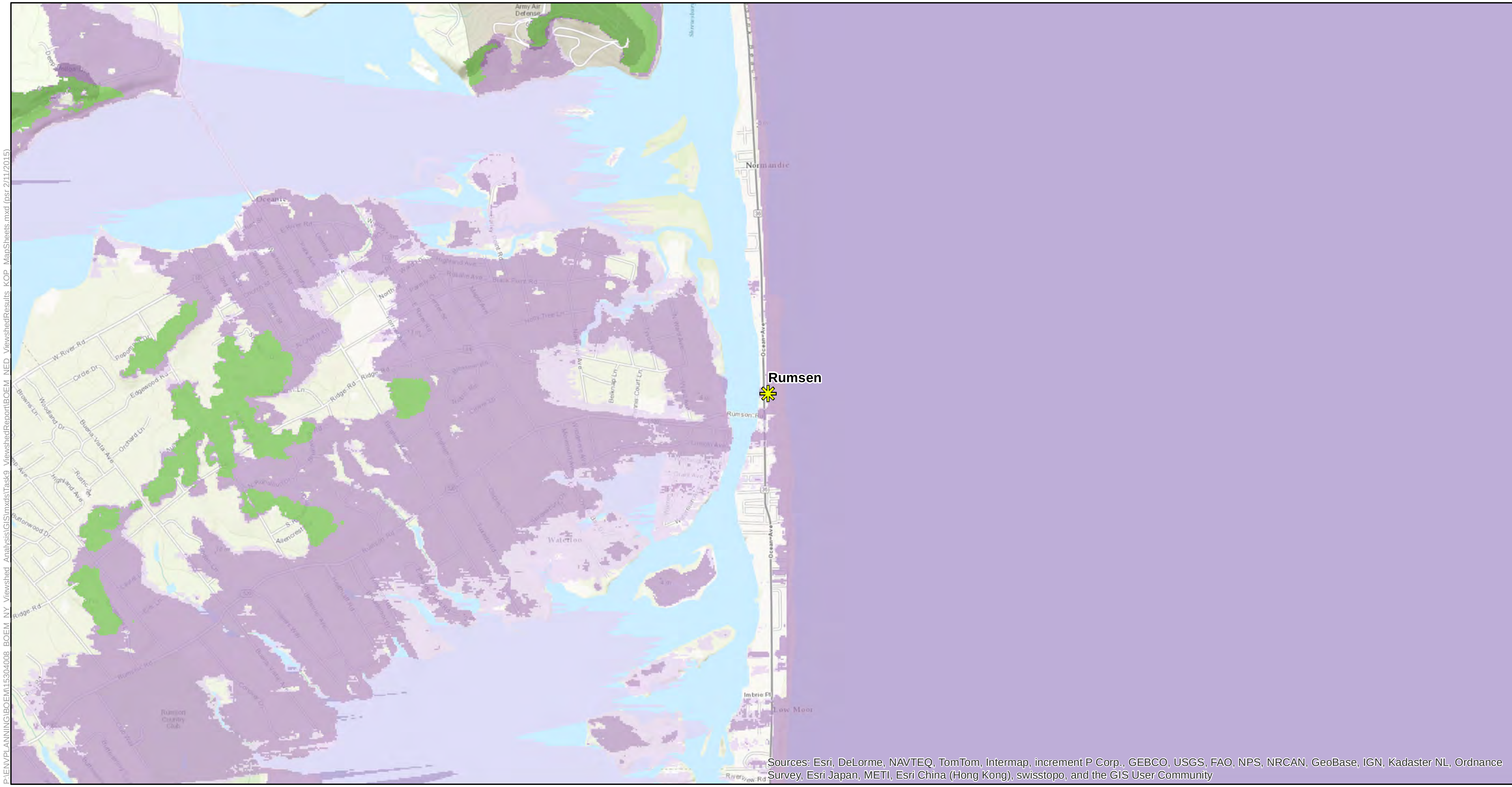

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Legend

Key Observation Point Location

Digital Elevation Model Viewshed

- Tip of Blade
- Hub and Blade
- Entire Turbine
- Substation

0 0.25 0.5 1
Kilometers

0 0.25 0.5 1
Nautical Miles

0 0.25 0.5 1
Miles

Rumsen Baseline Viewshed
based on 10 Meter Digital Elevation Model

NY Renewable Energy Viewshed Project

Coordinate System: NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983

URS

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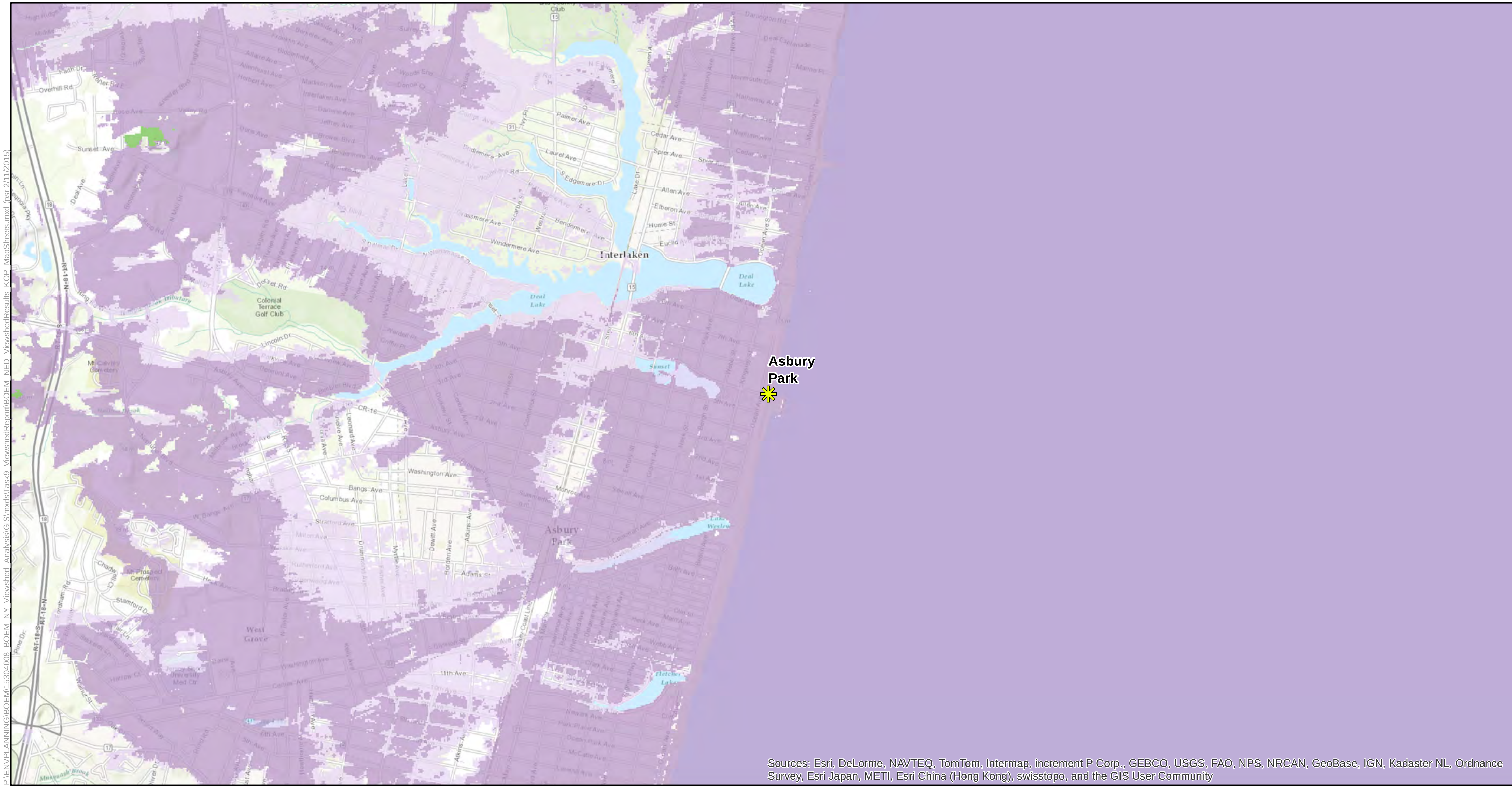

Sources: Esri, DeLorme, NAVTEQ, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, and the GIS User Community

Legend

Key Observation Point Location

Digital Elevation Model Viewshed

- Tip of Blade
- Hub and Blade
- Substation

URS

N

0 0.25 0.5 1
Kilometers

0 0.25 0.5 1
Nautical Miles

0 0.25 0.5 1
Miles

Asbury Park Baseline Viewshed based on 10 Meter Digital Elevation Model

NY Renewable Energy Viewshed Project

Coordinate System: NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983

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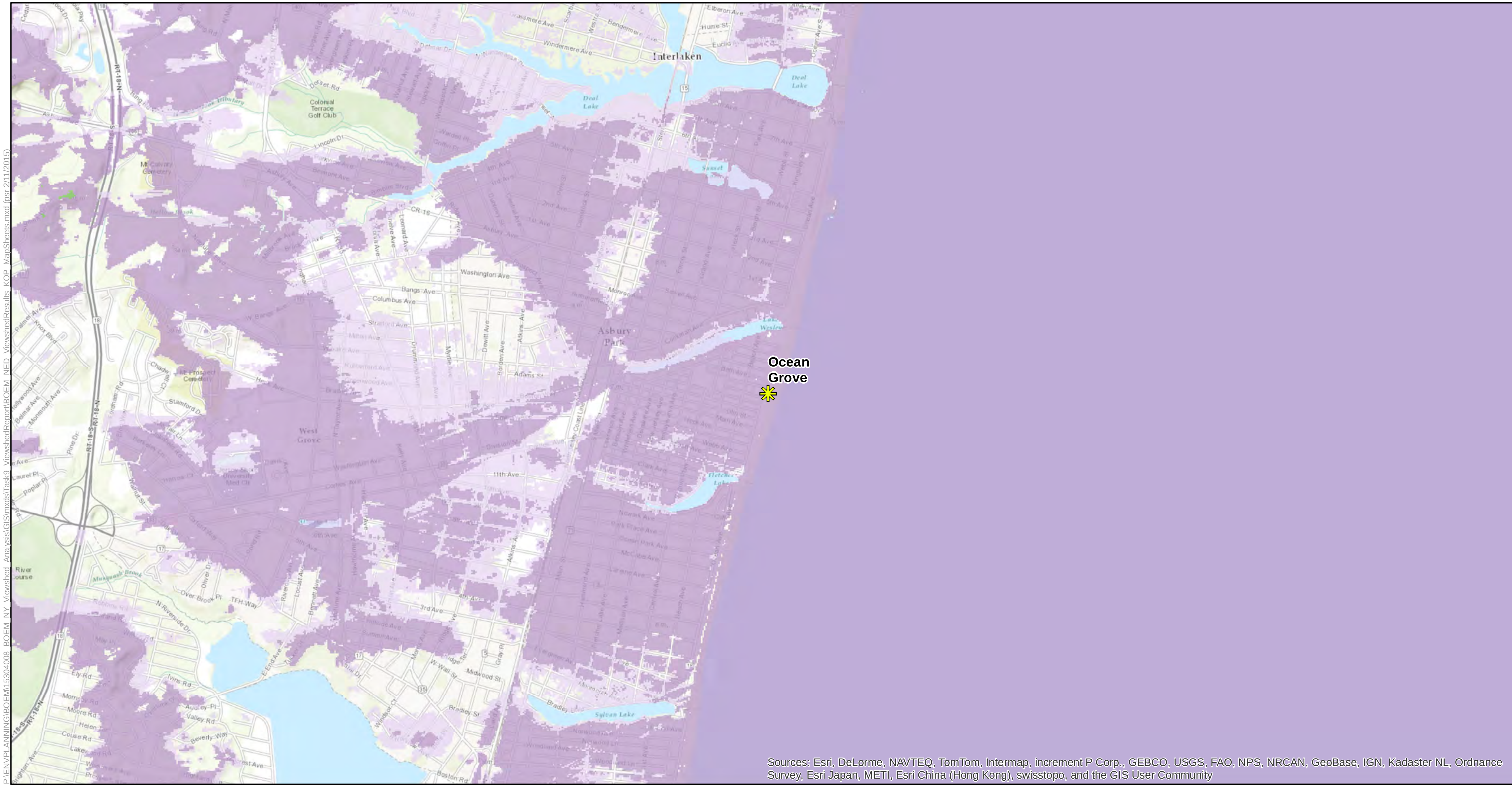

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Legend

Key Observation Point Location

Digital Elevation Model Viewshed

- Tip of Blade
- Hub and Blade
- Substation

URS

0 0.25 0.5 1
Kilometers

0 0.25 0.5 1
Nautical Miles

0 0.25 0.5 1
Miles

Ocean Grove Baseline Viewshed
based on 10 Meter Digital Elevation Model

NY Renewable Energy Viewshed Project

Coordinate System: NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983

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Appendix F: Top of Canopy Viewsheds

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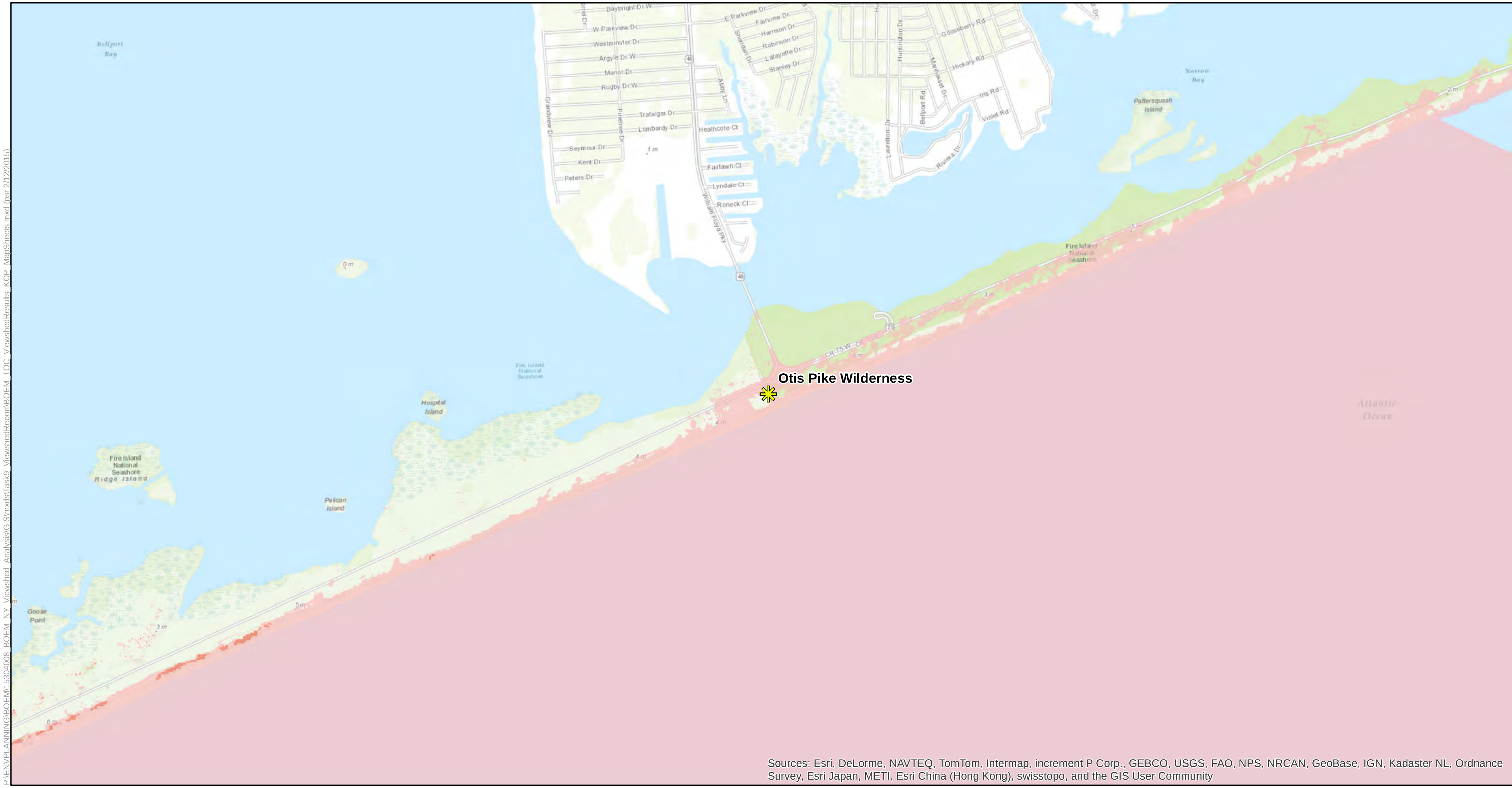

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Legend

Key Observation Point Location

Top of Canopy Viewshed

Tip of Blade

Hub and Blade

0 0.25 0.5 1
Kilometers

0 0.25 0.5 1
Nautical Miles

0 0.25 0.5 1
Miles

Otis Pike Wilderness Viewshed based on the Top of Canopy Elevation Model

NY Renewable Energy Viewshed Project

Coordinate System: NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983

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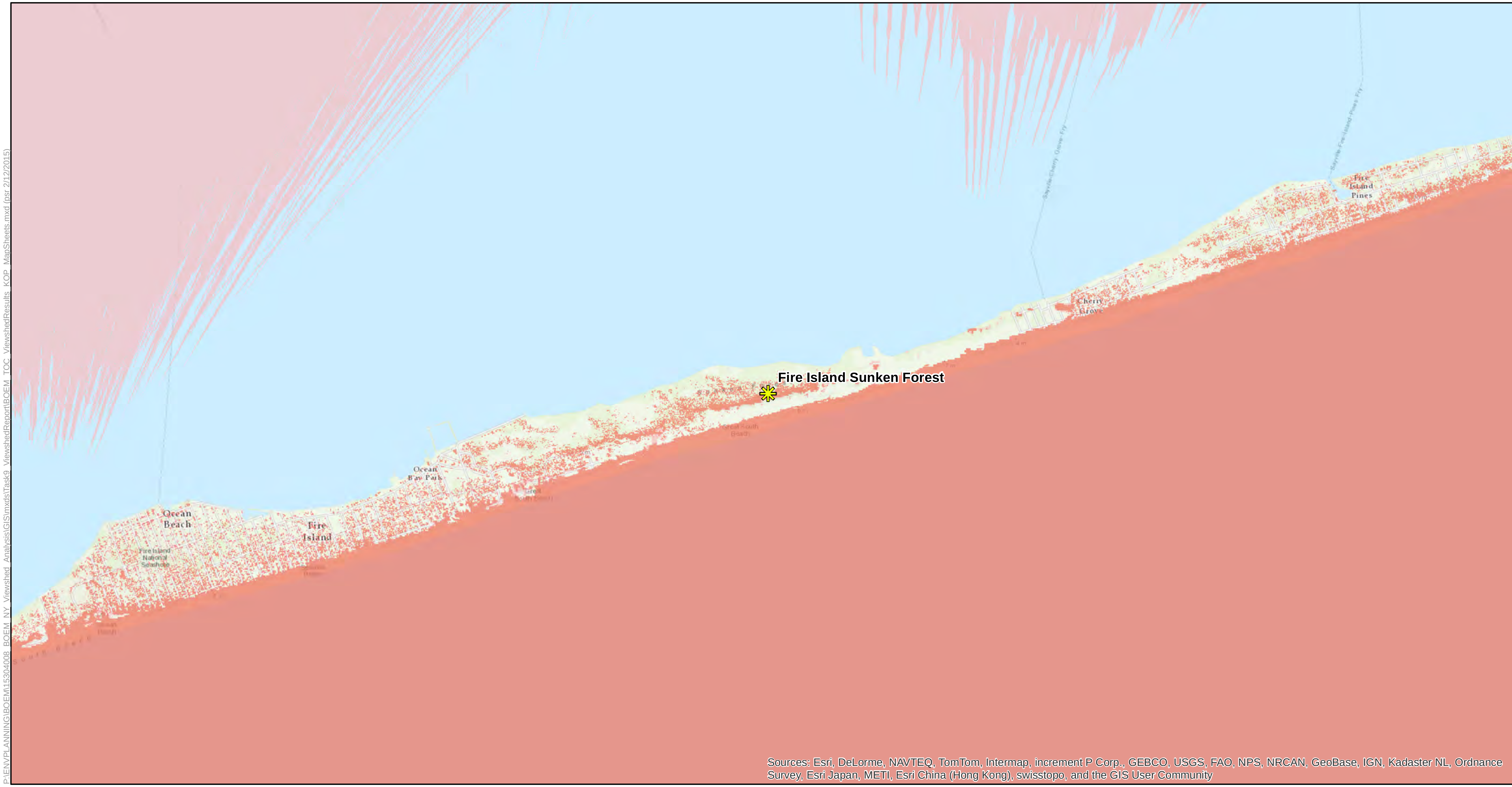

Legend

Key Observation Point Location

Top of Canopy Viewshed

Tip of Blade

Hub and Blade

N

0 0.25 0.5 1
Kilometers

0 0.25 0.5 1
Nautical Miles

0 0.25 0.5 1
Miles

Fire Island Sunken Forest Viewshed based on the Top of Canopy Elevation Model

NY Renewable Energy Viewshed Project

Coordinate System: NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983

URS

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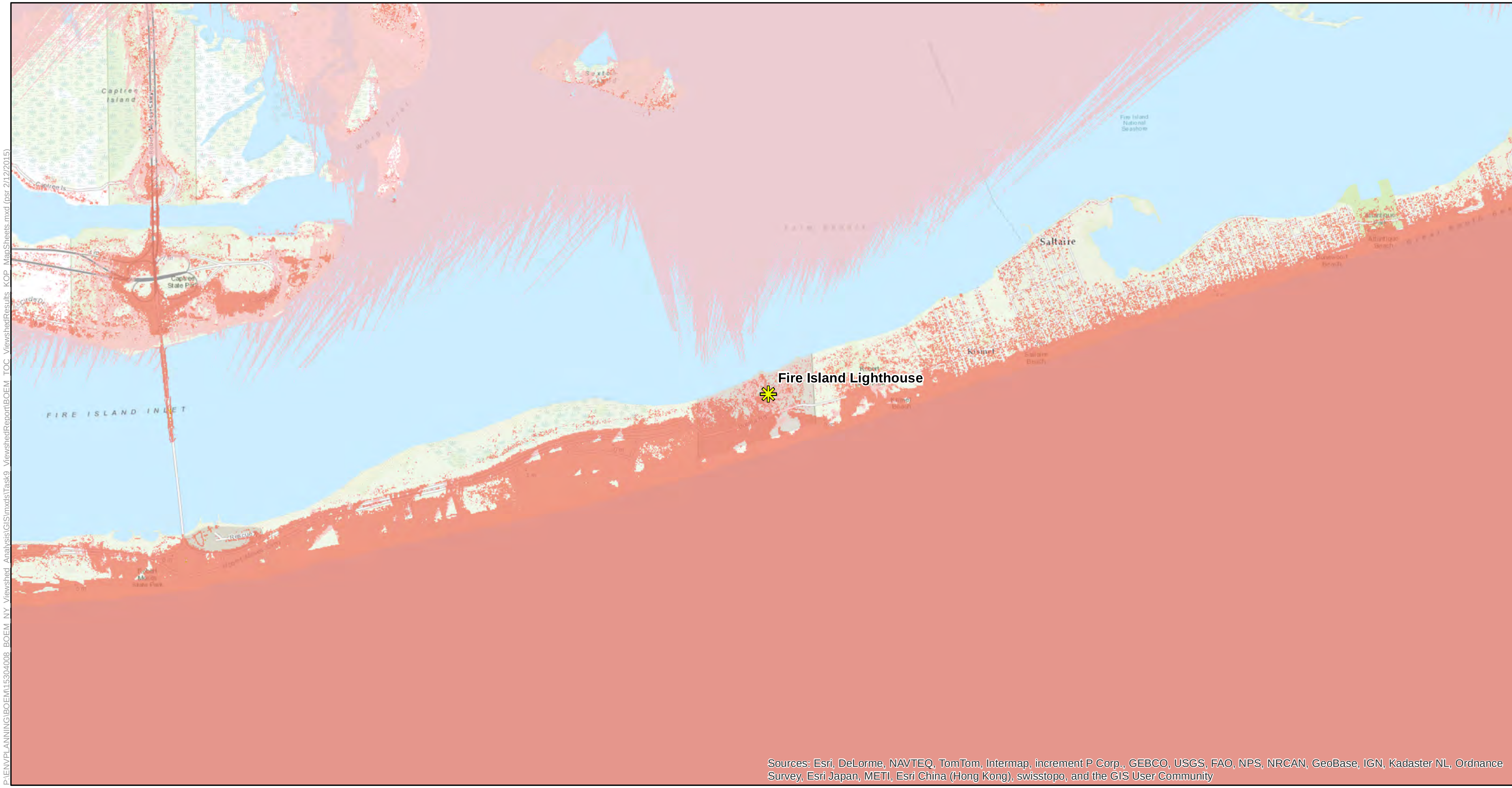

Legend

Key Observation Point Location

Top of Canopy Viewshed

- Tip of Blade
- Hub and Blade
- Entire Turbine
- Substation

URS

N

0 0.25 0.5 1
Kilometers

0 0.25 0.5 1
Nautical Miles

0 0.25 0.5 1
Miles

Fire Island Lighthouse Viewshed based on the Top of Canopy Elevation Model

NY Renewable Energy Viewshed Project

Coordinate System: NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983

BOEM
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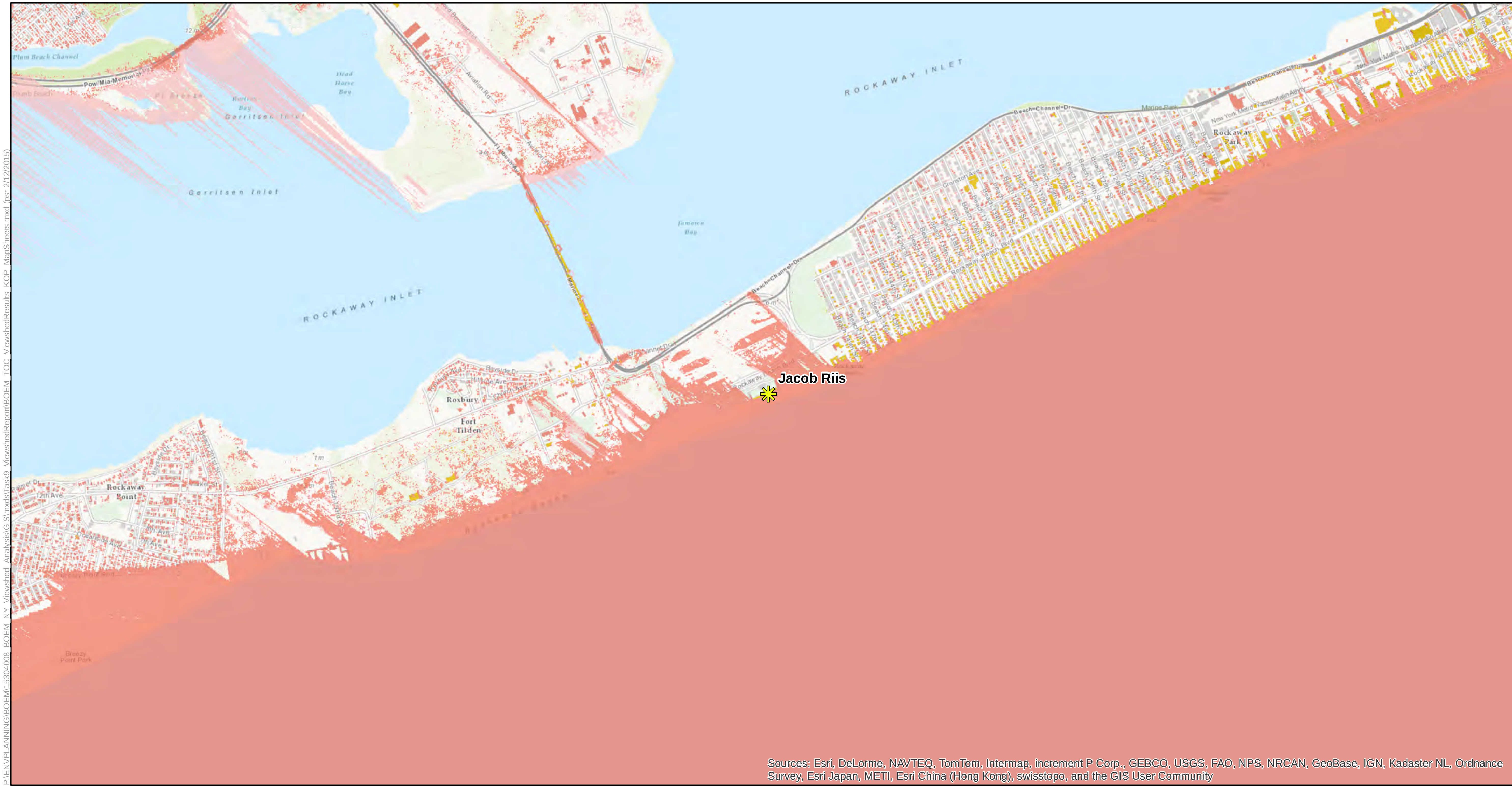

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Legend

Key Observation Point Location

Top of Canopy Viewshed

- Tip of Blade
- Hub and Blade
- Entire Turbine
- Substation

0 0.25 0.5 1
Kilometers

0 0.25 0.5 1
Nautical Miles

0 0.25 0.5 1
Miles

Coordinate System: NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983

Jacob Riis Viewshed based on the Top of Canopy Elevation Model

NY Renewable Energy Viewshed Project

URS

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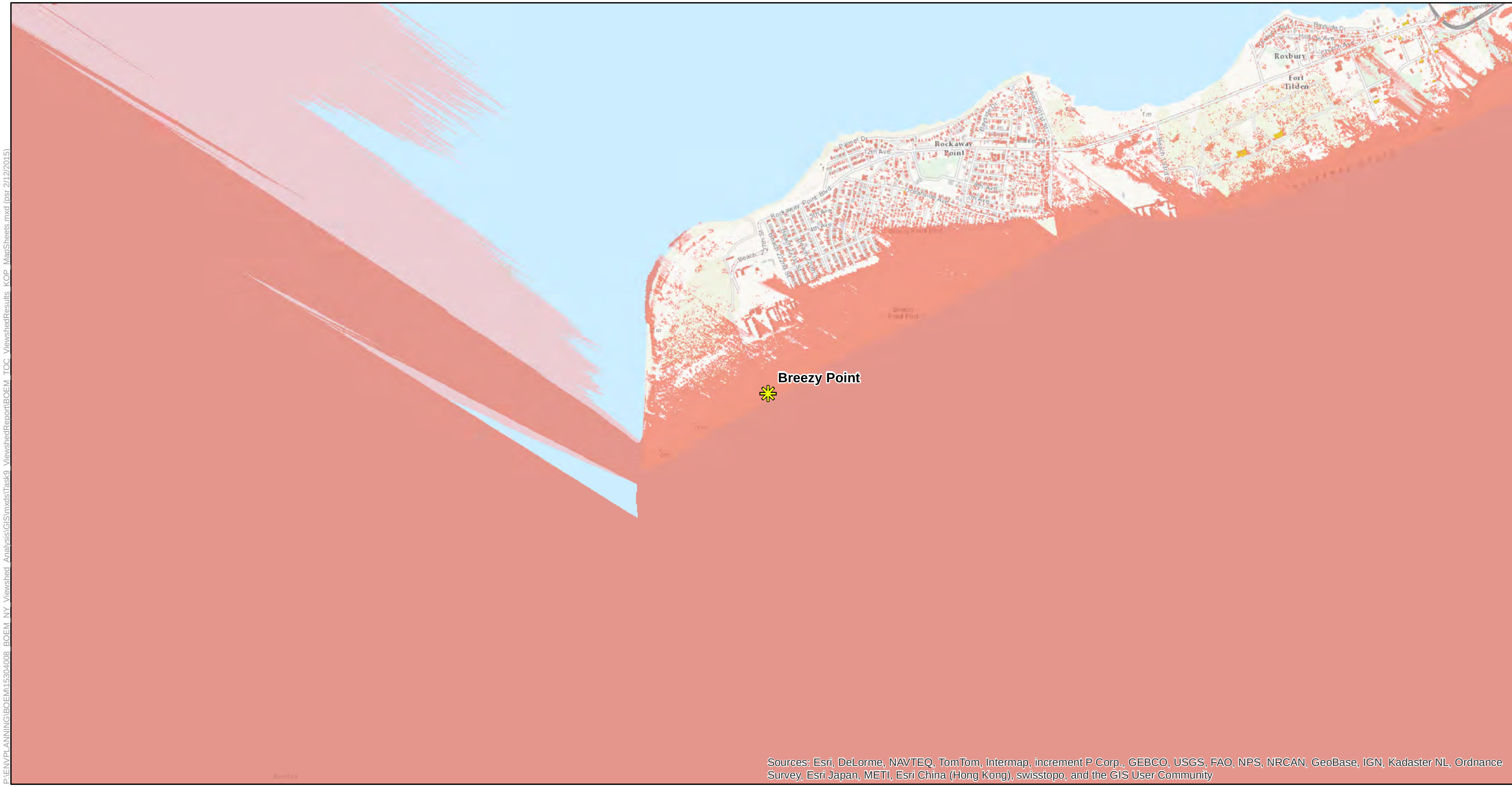

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Legend

Key Observation Point Location

Top of Canopy Viewshed

- Tip of Blade
- Hub and Blade
- Substation

N

0 0.25 0.5 1
Kilometers

0 0.25 0.5 1
Nautical Miles

0 0.25 0.5 1
Miles

Breezy Point Viewshed based on the Top of Canopy Elevation Model

NY Renewable Energy Viewshed Project

Coordinate System: NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983

URS

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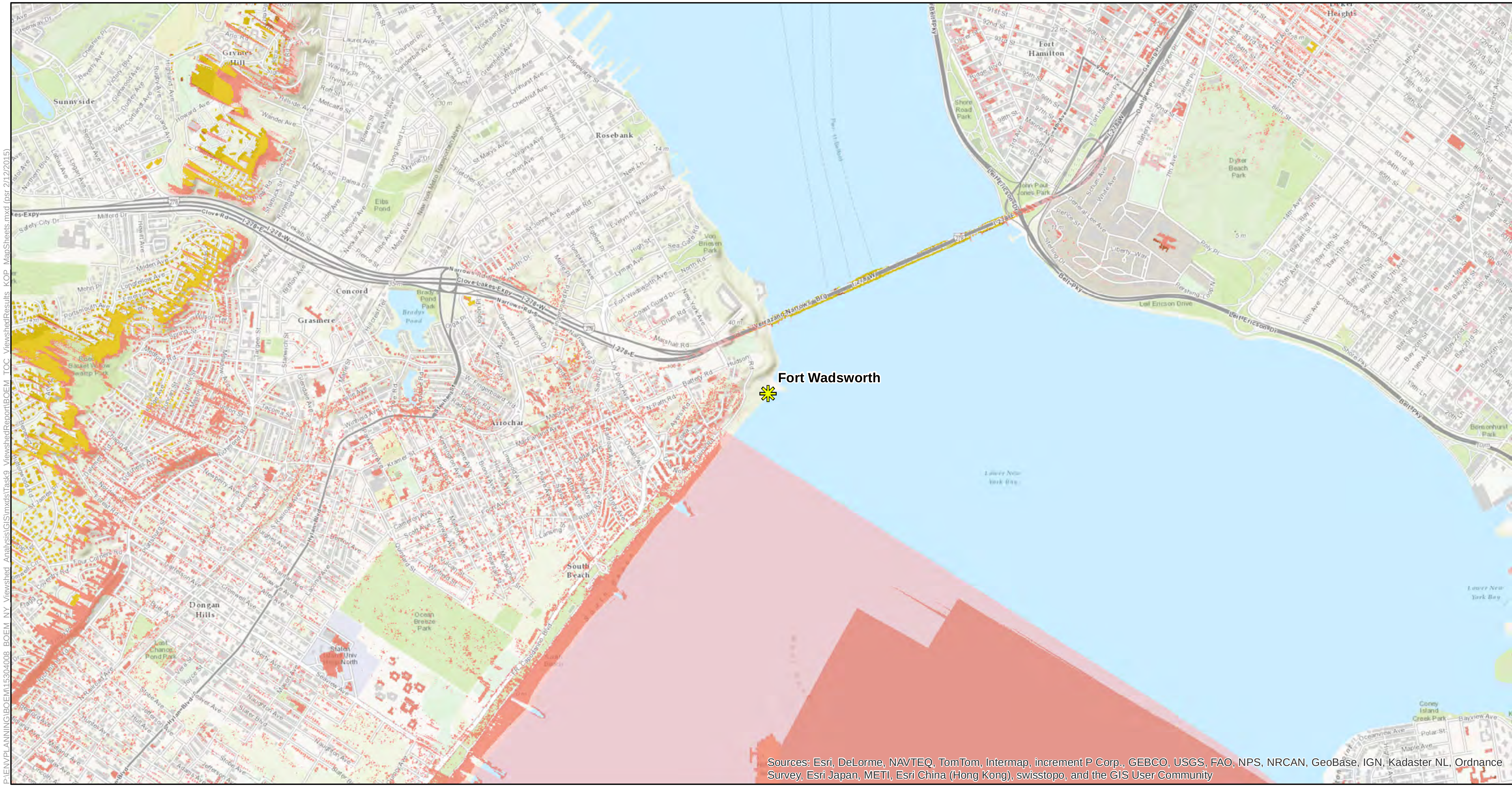

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Legend

Key Observation Point Location

Top of Canopy Viewshed

- Tip of Blade
- Hub and Blade
- Entire Turbine
- Substation

0 0.25 0.5 1
Kilometers

0 0.25 0.5 1
Nautical Miles

0 0.25 0.5 1
Miles

Fort Wadsworth Viewshed based on the Top of Canopy Elevation Model

NY Renewable Energy Viewshed Project

Coordinate System: NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983

URS

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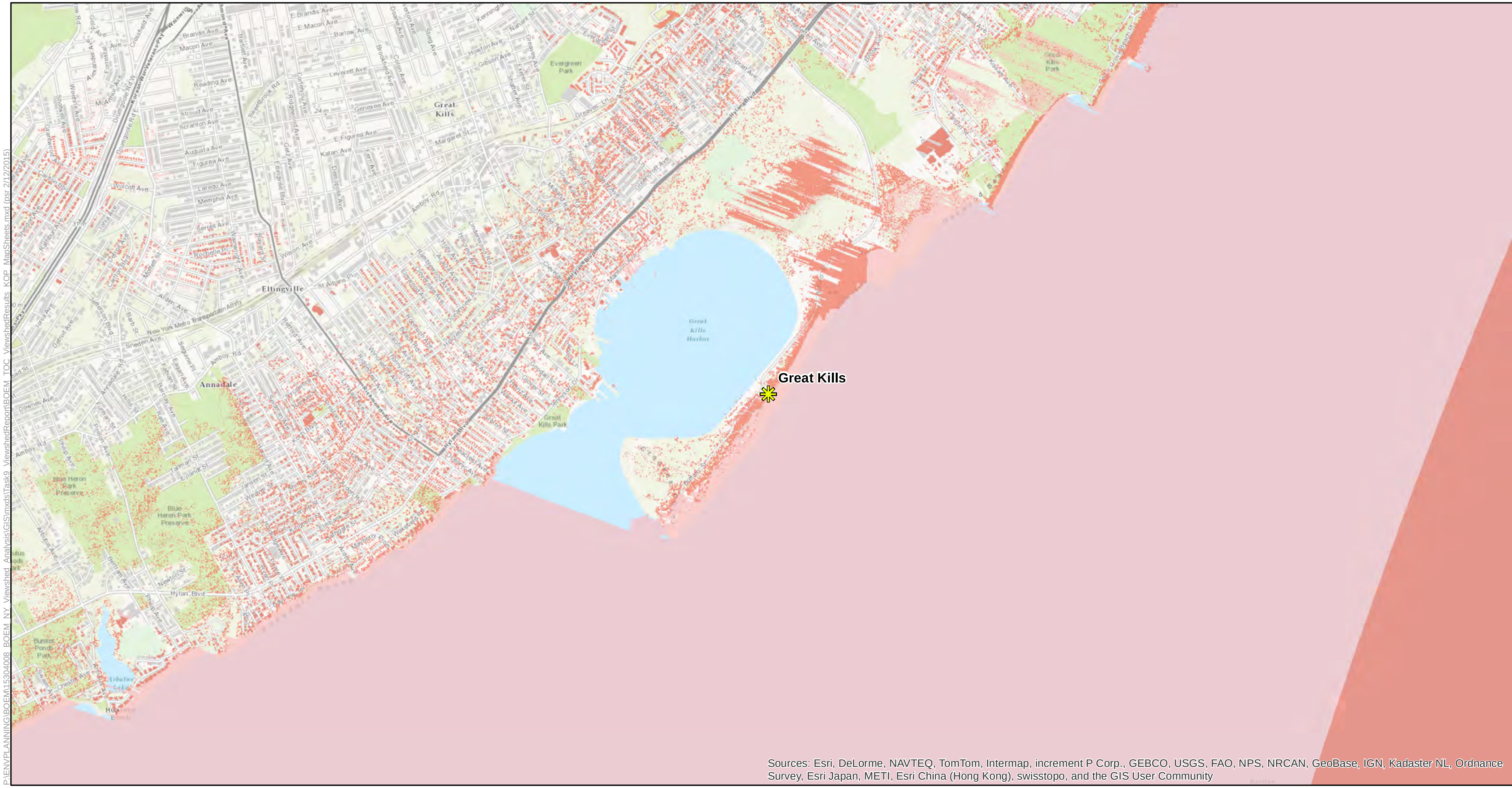

Legend

Key Observation Point Location

Top of Canopy Viewshed

Tip of Blade

Hub and Blade

0 0.25 0.5 1
Kilometers

0 0.25 0.5 1
Nautical Miles

0 0.25 0.5 1
Miles

Coordinate System: NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983

Great Kills Viewshed based on the Top of Canopy Elevation Model

NY Renewable Energy Viewshed Project

URS

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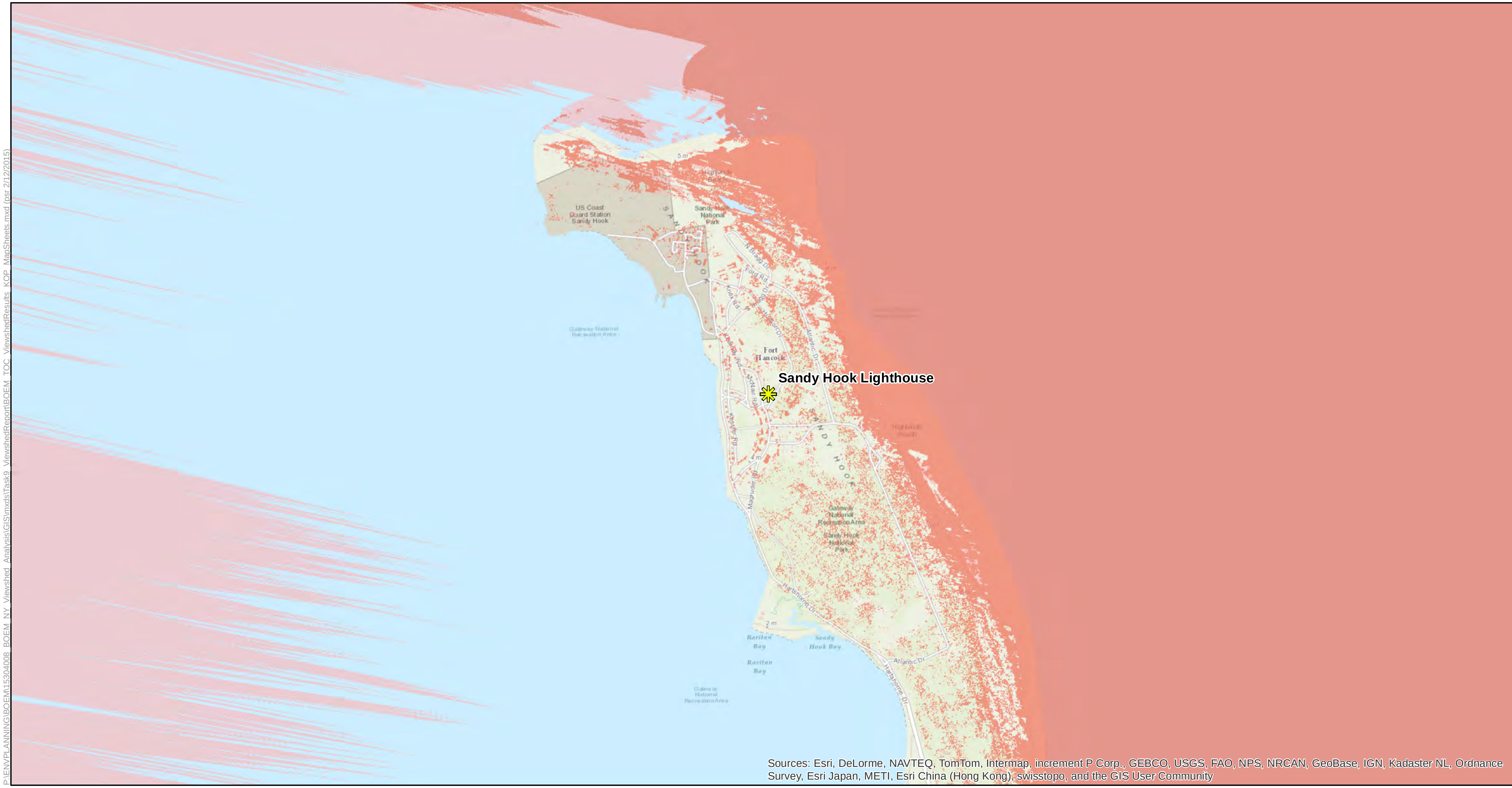
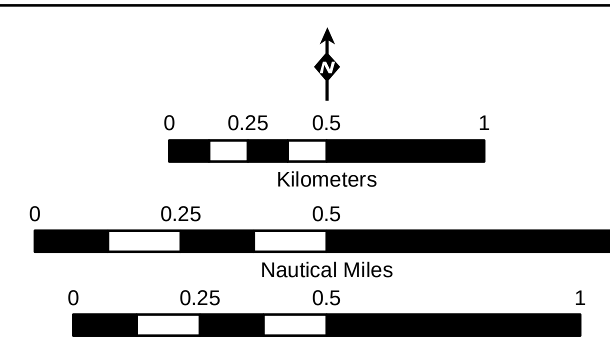


Legend

Key Observation Point Location

Top of Canopy Viewshed

- Tip of Blade
- Hub and Blade
- Substation



Sandy Hook Lighthouse Viewshed based on the Top of Canopy Elevation Model

NY Renewable Energy Viewshed Project

Coordinate System: NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983

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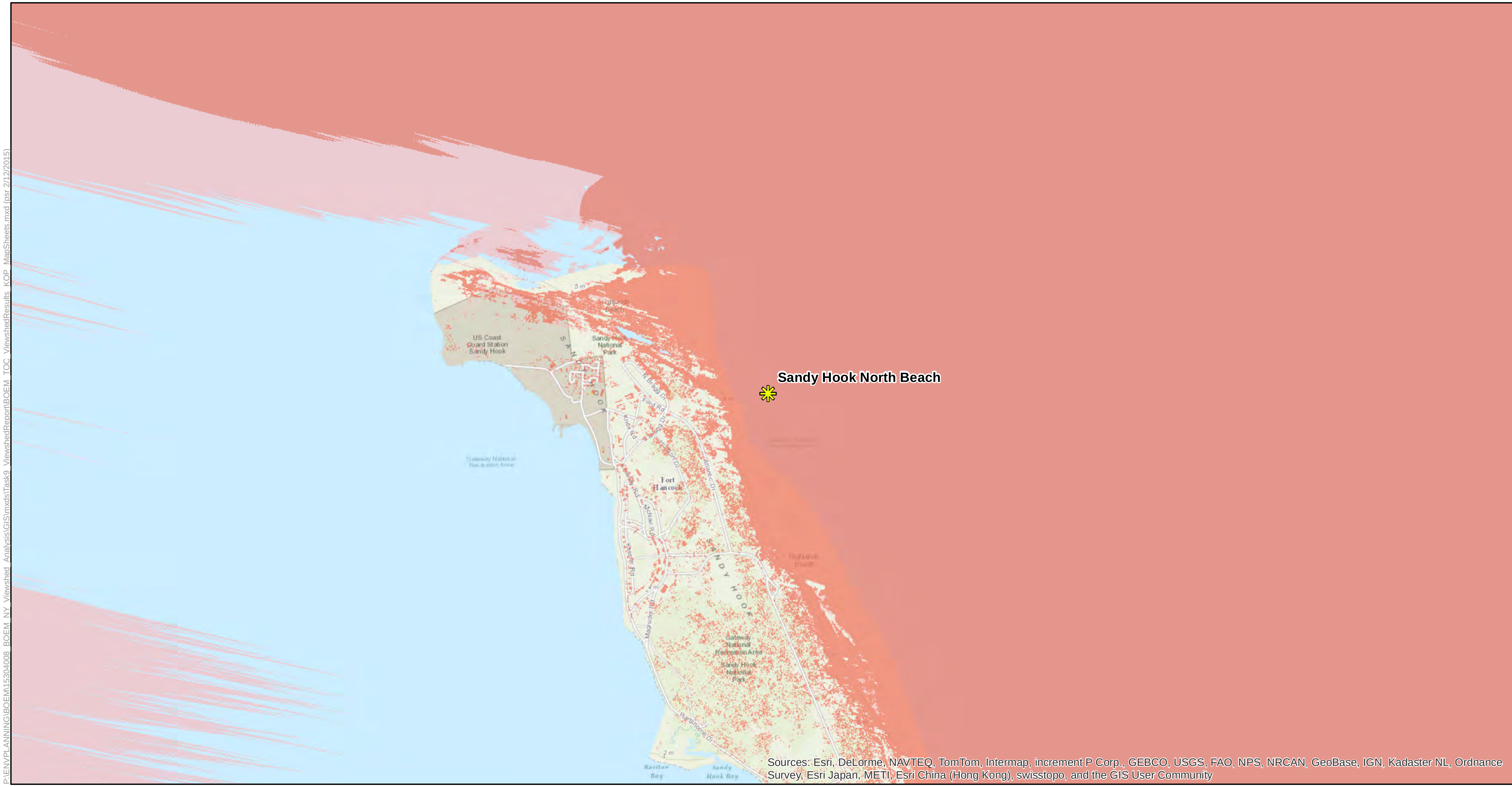

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Legend

Key Observation Point Location

Top of Canopy Viewshed

- Tip of Blade
- Hub and Blade
- Substation

0 0.25 0.5 1
Kilometers

0 0.25 0.5 1
Nautical Miles

0 0.25 0.5 1
Miles

Sandy Hook North Beach Viewshed based on the Top of Canopy Elevation Model

NY Renewable Energy Viewshed Project

Coordinate System: NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983

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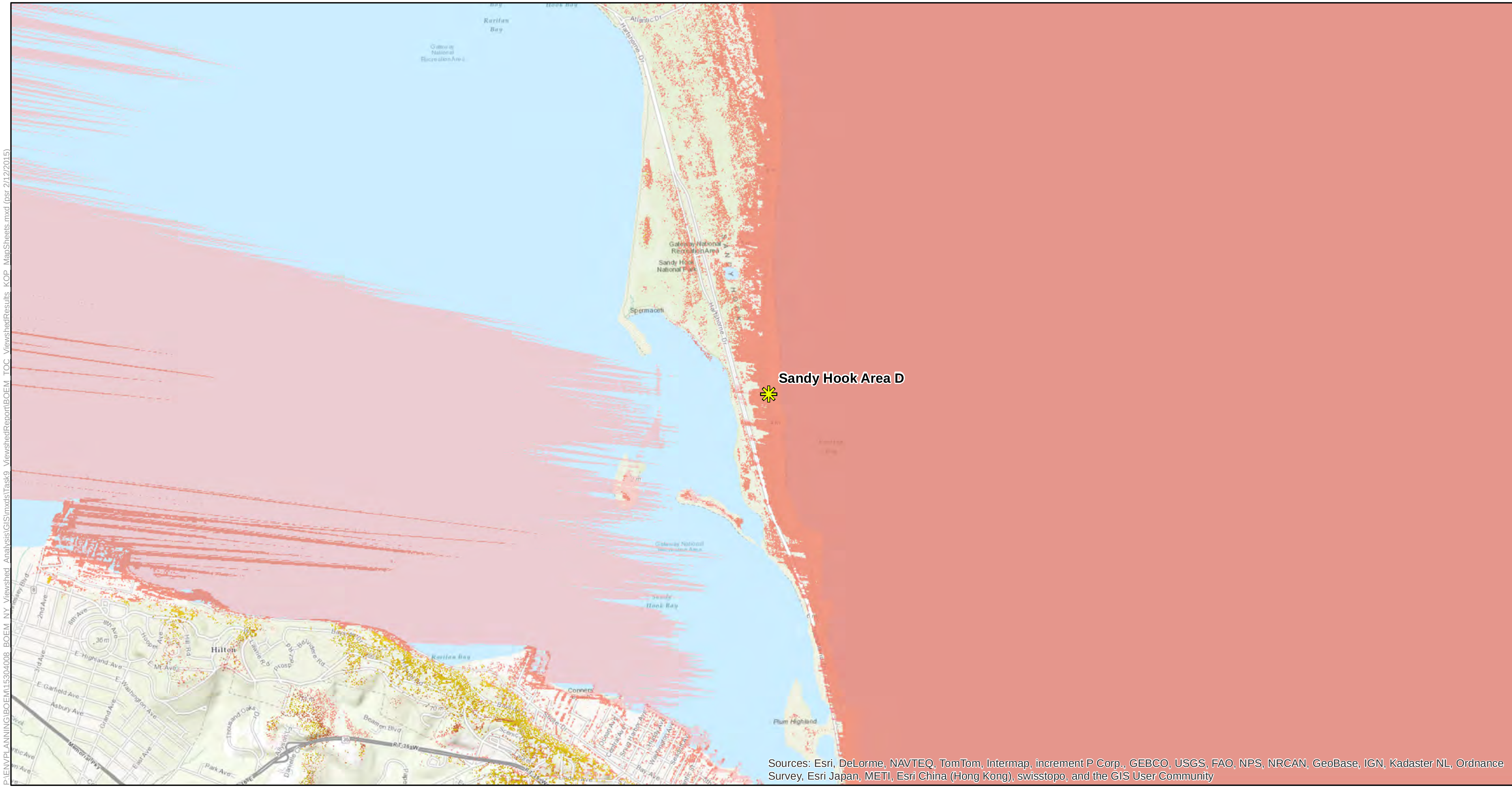

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Legend

Key Observation Point Location

Top of Canopy Viewshed

- Tip of Blade
- Hub and Blade
- Entire Turbine
- Substation

Kilometers: 0, 0.25, 0.5, 1

Nautical Miles: 0, 0.25, 0.5, 1

Miles: 0, 0.25, 0.5, 1

Sandy Hook Area D Viewshed based on the Top of Canopy Elevation Model

NY Renewable Energy Viewshed Project

Coordinate System: NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983

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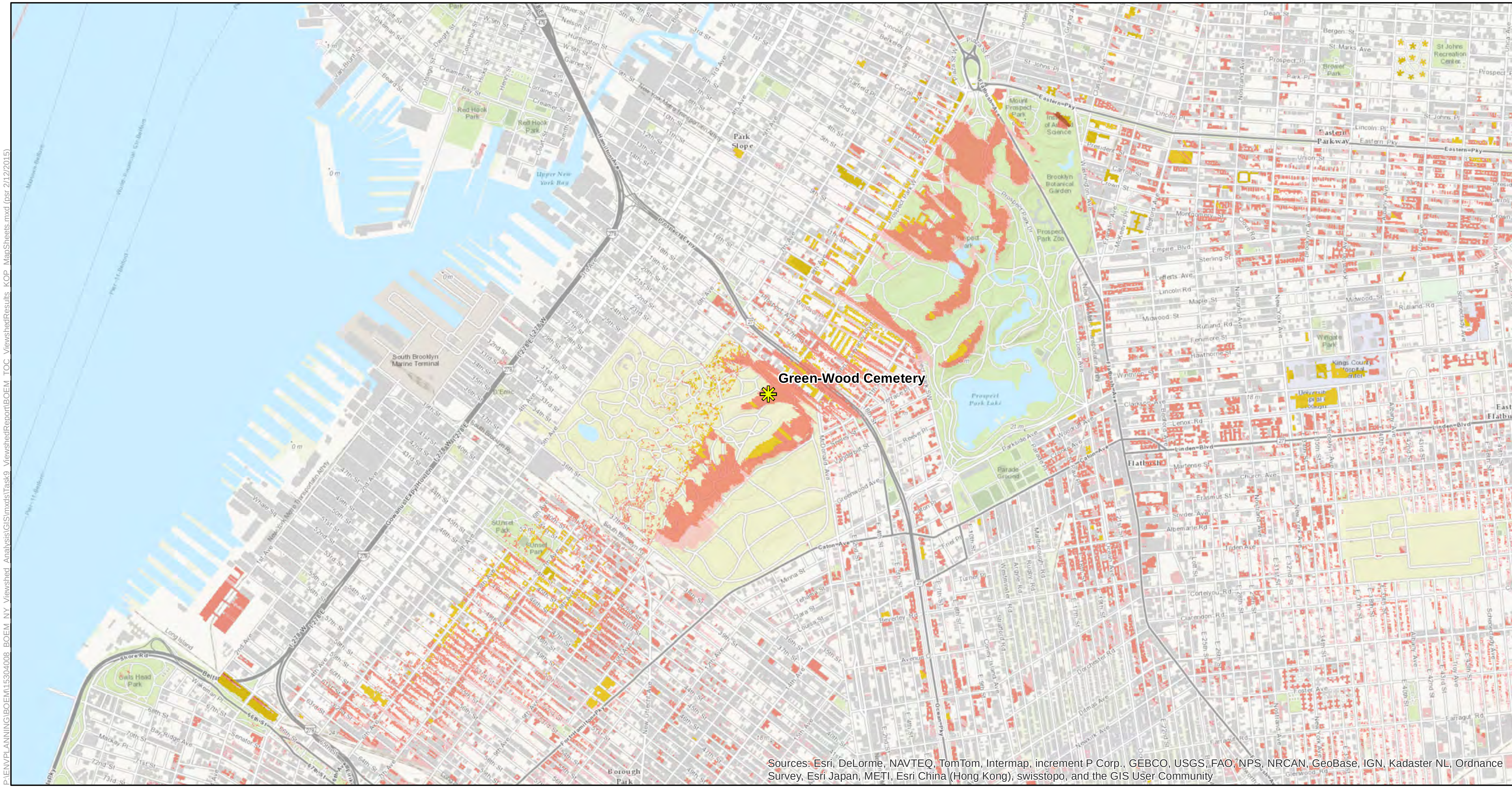

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Legend

Key Observation Point Location

Top of Canopy Viewshed

- Tip of Blade
- Hub and Blade
- Entire Turbine
- Substation

0 0.25 0.5 1
Kilometers

0 0.25 0.5 1
Nautical Miles

0 0.25 0.5 1
Miles

Green-Wood Cemetery Viewshed based on the Top of Canopy Elevation Model

NY Renewable Energy Viewshed Project

Coordinate System: NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983

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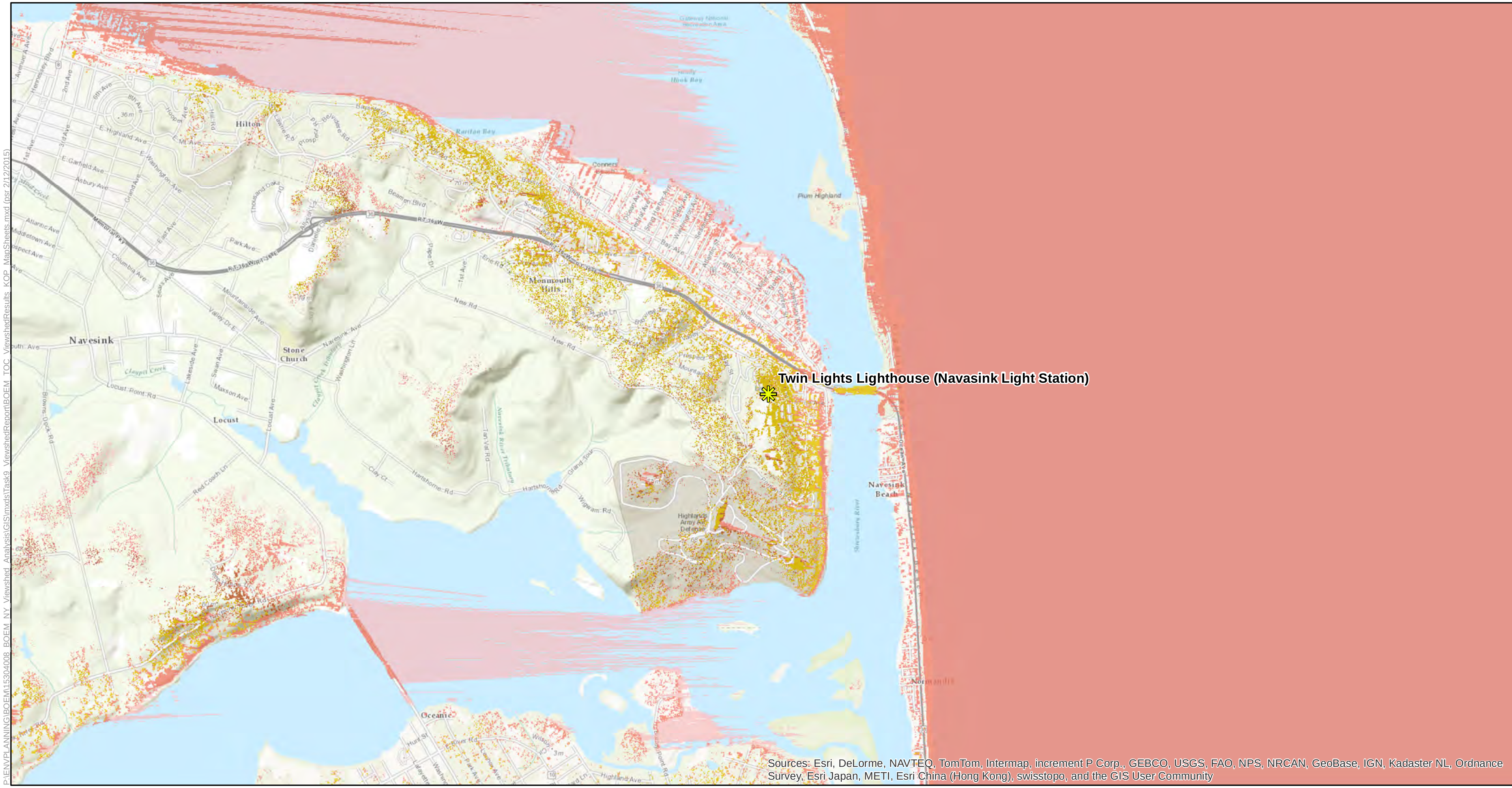

Sources: Esri, DeLorme, NAVTEQ, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, and the GIS User Community

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Legend

Key Observation Point Location

Top of Canopy Viewshed

- Tip of Blade
- Hub and Blade
- Entire Turbine
- Substation

0 0.25 0.5 1
Kilometers

0 0.25 0.5 1
Nautical Miles

0 0.25 0.5 1
Miles

Twin Lights Lighthouse (Navasink Light Station)
Viewshed based on the Top of Canopy Elevation Model

NY Renewable Energy Viewshed Project

Coordinate System: NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983

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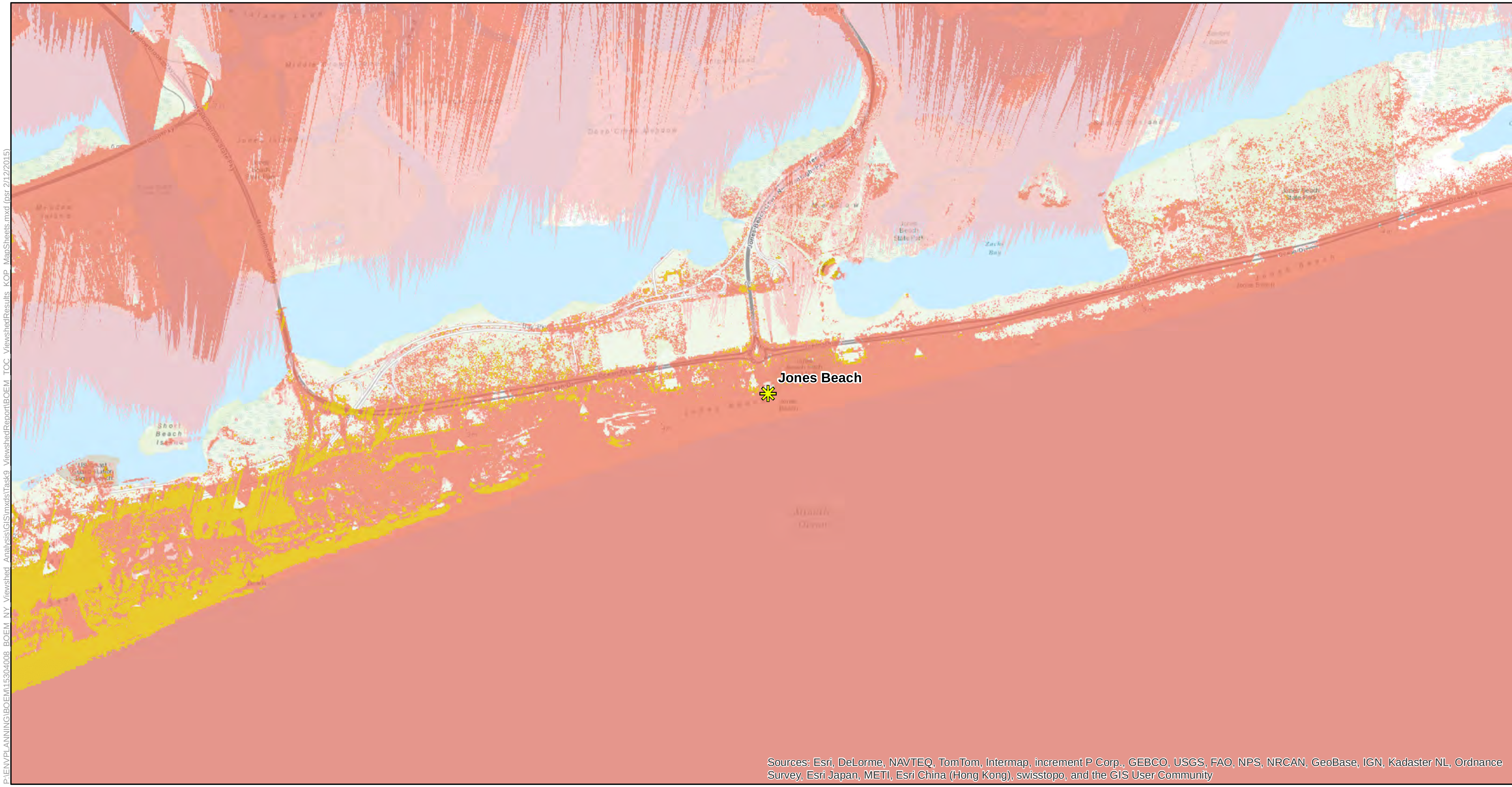

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Legend

Key Observation Point Location

Top of Canopy Viewshed

- Tip of Blade
- Hub and Blade
- Entire Turbine
- Substation

N

0 0.25 0.5 1
Kilometers

0 0.25 0.5 1
Nautical Miles

0 0.25 0.5 1
Miles

Coordinate System: NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983

Jones Beach Viewshed based on the Top of Canopy Elevation Model

NY Renewable Energy Viewshed Project

URS

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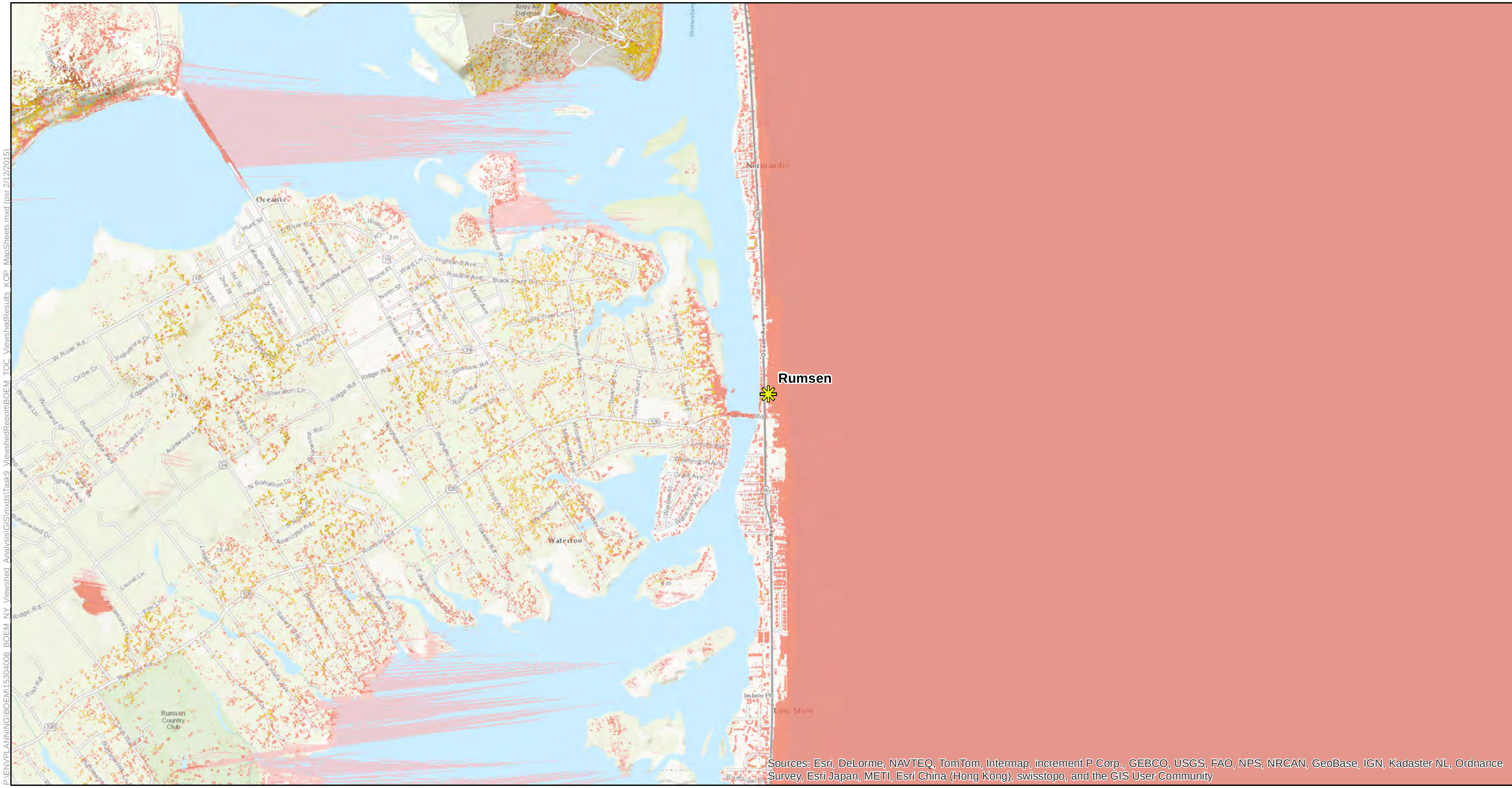

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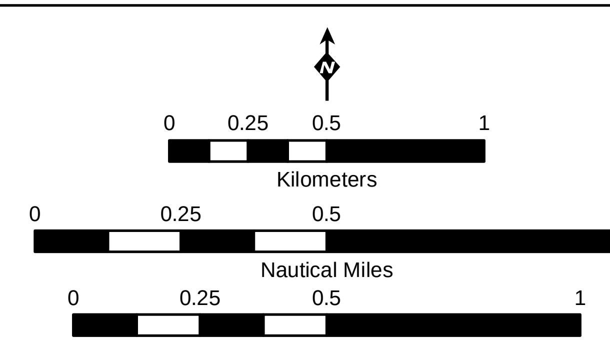
Legend

Key Observation Point Location

Top of Canopy Viewshed

- Tip of Blade
- Hub and Blade
- Entire Turbine
- Substation



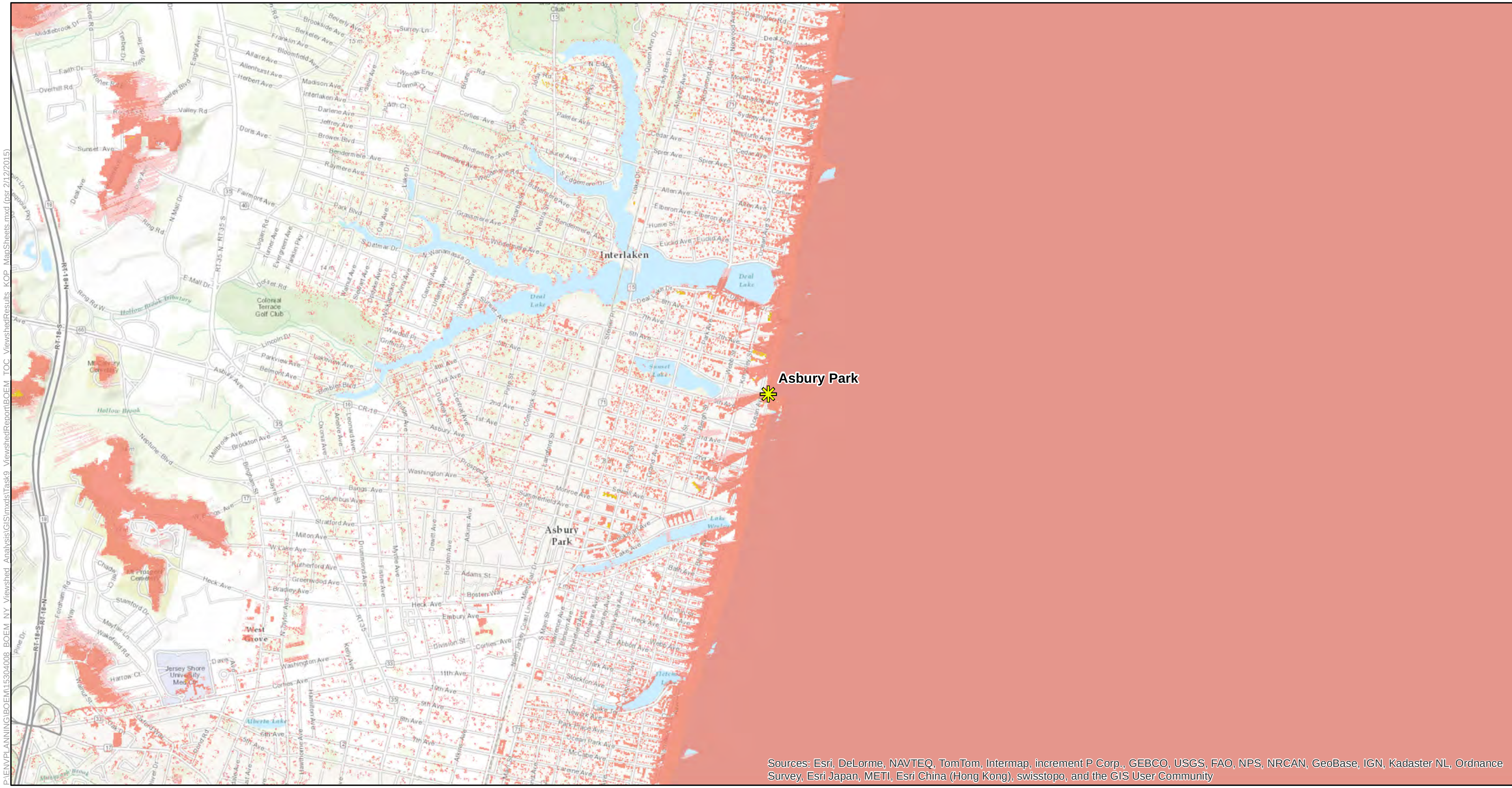
Rumsen Viewshed based
on the Top of Canopy Elevation Model

NY Renewable Energy Viewshed Project

Coordinate System: NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983

URS

BOEM Bureau of Ocean Energy Management



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Legend

Key Observation Point Location

Top of Canopy Viewshed

- Tip of Blade
- Hub and Blade
- Entire Turbine
- Substation

URS

N

0 0.25 0.5 1
Kilometers

0 0.25 0.5 1
Nautical Miles

0 0.25 0.5 1
Miles

Asbury Park Viewshed based on the Top of Canopy Elevation Model

NY Renewable Energy Viewshed Project

Coordinate System: NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983

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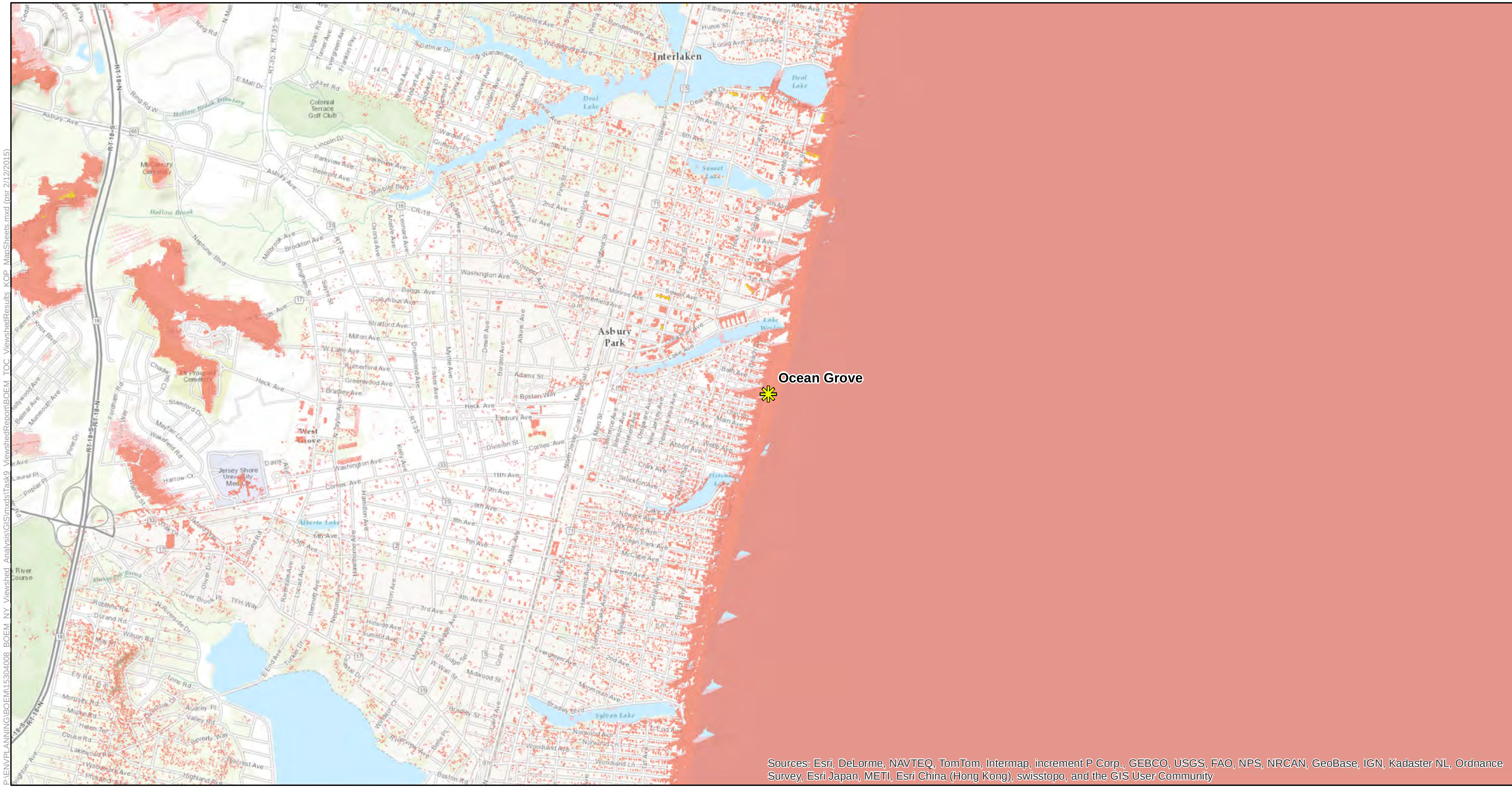

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Legend

Key Observation Point Location

Top of Canopy Viewshed

- Tip of Blade
- Hub and Blade
- Entire Turbine
- Substation

N

0 0.25 0.5 1
Kilometers

0 0.25 0.5 1
Nautical Miles

0 0.25 0.5 1
Miles

Ocean Grove Viewshed based on the Top of Canopy Elevation Model

NY Renewable Energy Viewshed Project

Coordinate System: NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983

URS

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Appendix G: Number of Turbines within KOP Viewsheds

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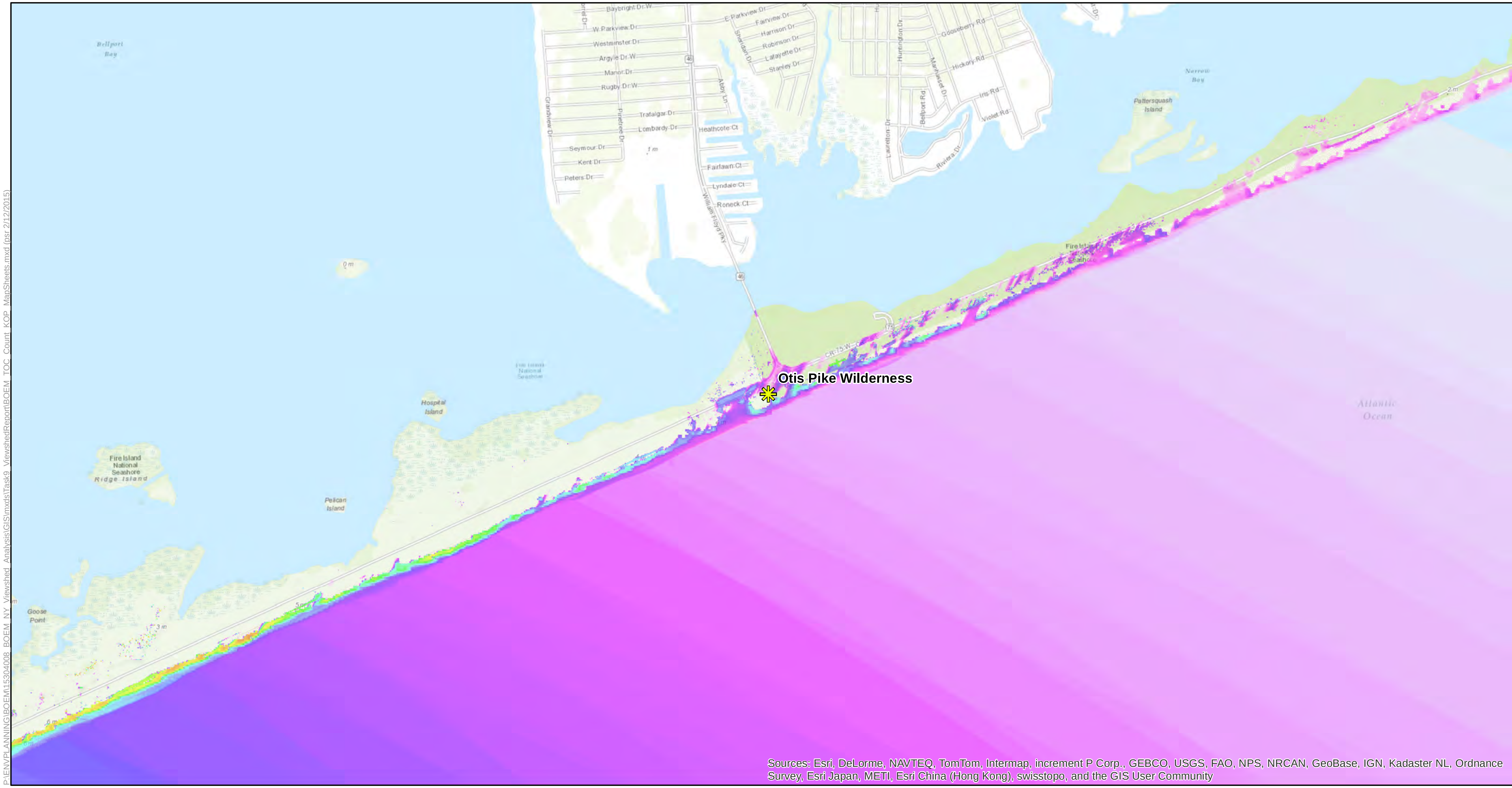

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Legend

Key Observation Point Location

Approximate Number of Turbines in Top of Canopy Viewshed

High : 134

Low : 0

N

0 0.25 0.5 1
Kilometers

0 0.25 0.5 1
Nautical Miles

0 0.25 0.5 1
Miles

Otis Pike Wilderness Approximate Number of Turbines in Potentially Seen based on Top of Canopy Elevation Model

NY Renewable Energy Viewshed Project

Coordinate System: NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983

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Legend

Key Observation Point Location

Approximate Number of Turbines in Top of Canopy Viewshed

High : 134

Low : 0

0 0.25 0.5 1
Kilometers

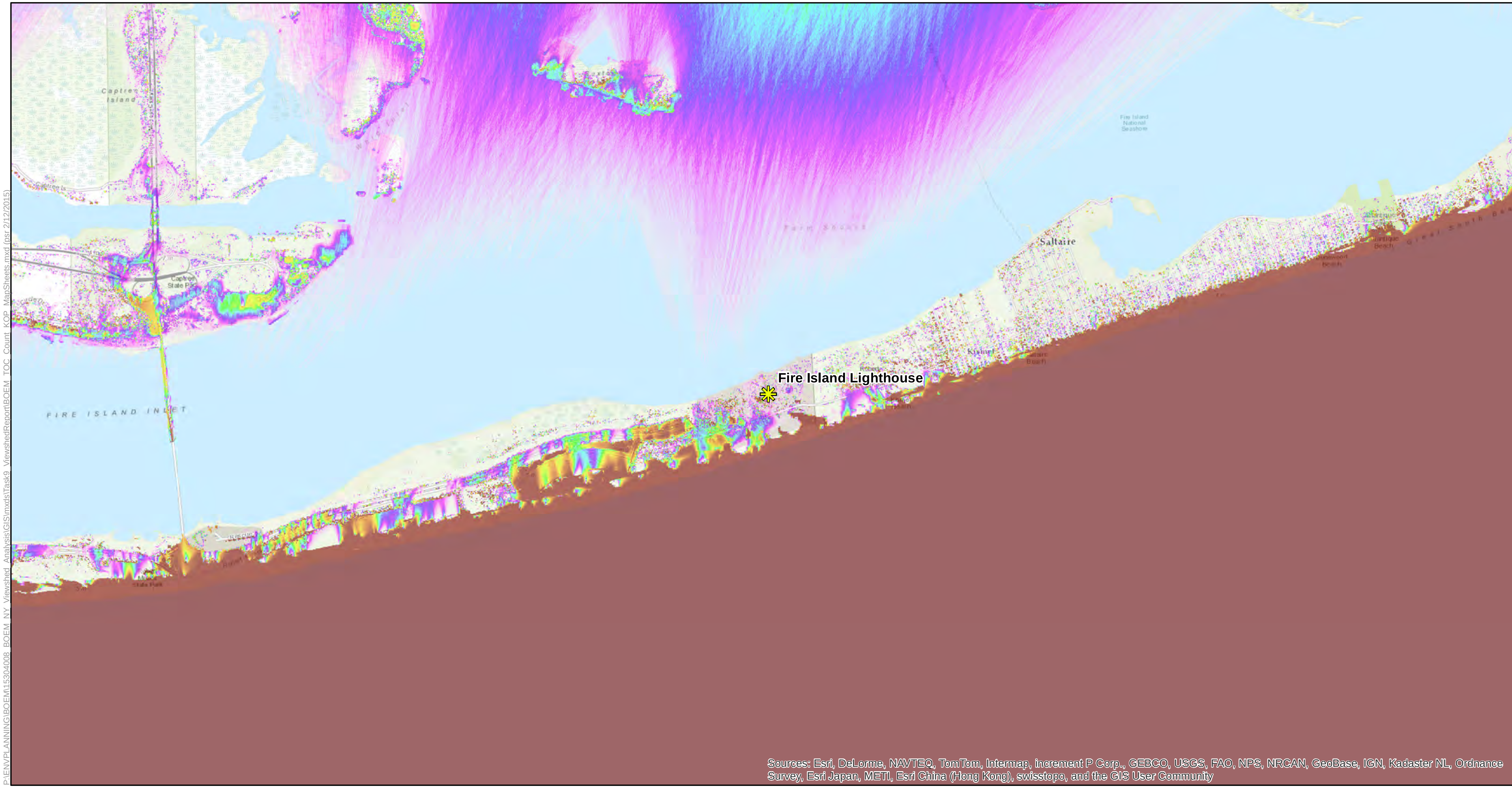
0 0.25 0.5 1
Nautical Miles

0 0.25 0.5 1
Miles

Fire Island Sunken Forest Approximate Number of Turbines in Potentially Seen based on Top of Canopy Elevation Model

NY Renewable Energy Viewshed Project

Coordinate System: NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983



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Legend

Key Observation Point Location

Approximate Number of Turbines in Top of Canopy Viewshed

High : 134

Low : 0

0 0.25 0.5 1
Kilometers

0 0.25 0.5 1
Nautical Miles

0 0.25 0.5 1
Miles

Fire Island Lighthouse Approximate Number of Turbines in Potentially Seen based on Top of Canopy Elevation Model

NY Renewable Energy Viewshed Project

Coordinate System: NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983

URS

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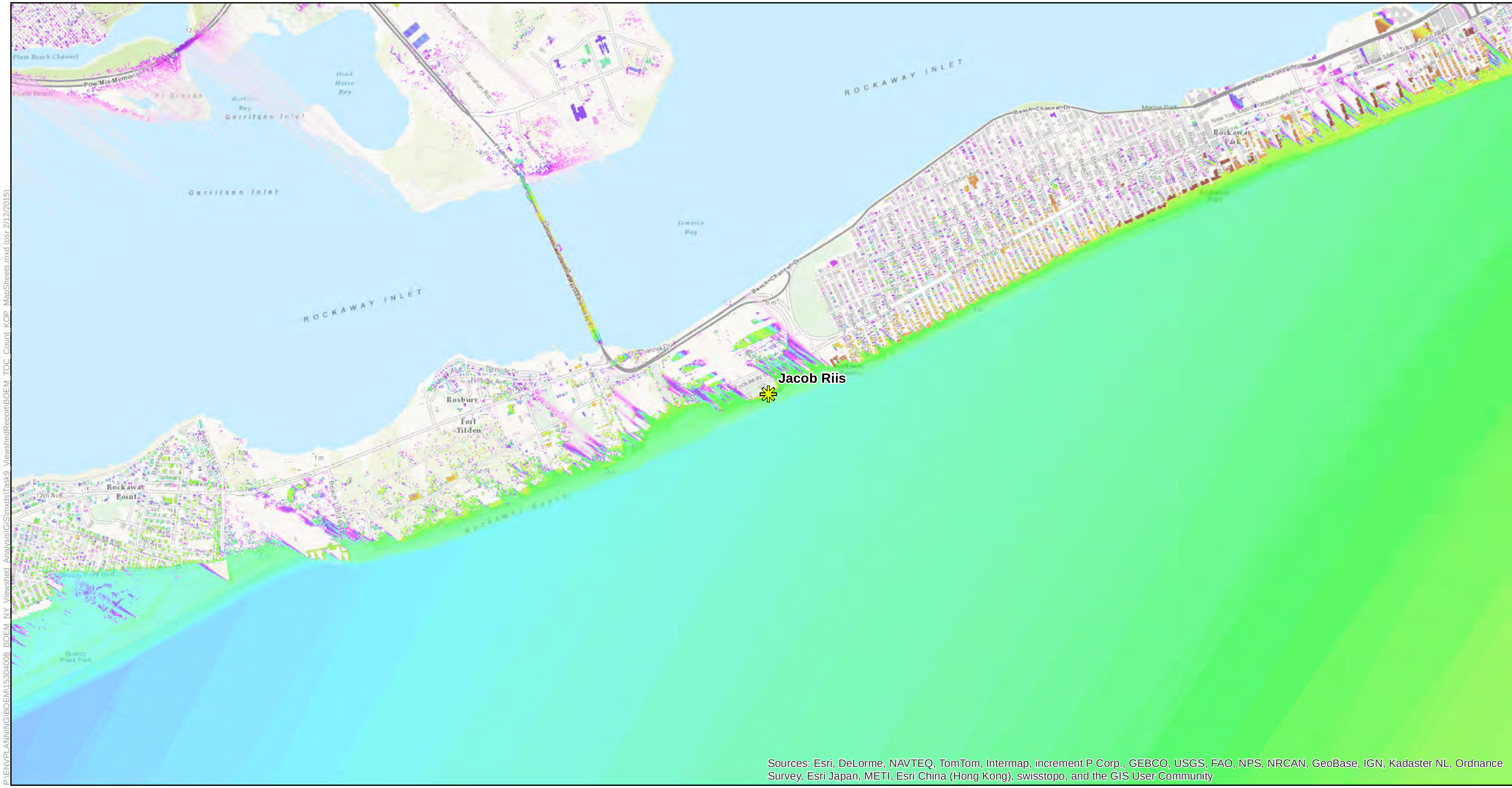
Bureau of Ocean Energy Management



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Legend

Key Observation Point Location

Approximate Number of Turbines in Top of Canopy Viewshed

High : 134

Low : 0

0 0.25 0.5 1
Kilometers

0 0.25 0.5 1
Nautical Miles

0 0.25 0.5 1
Miles

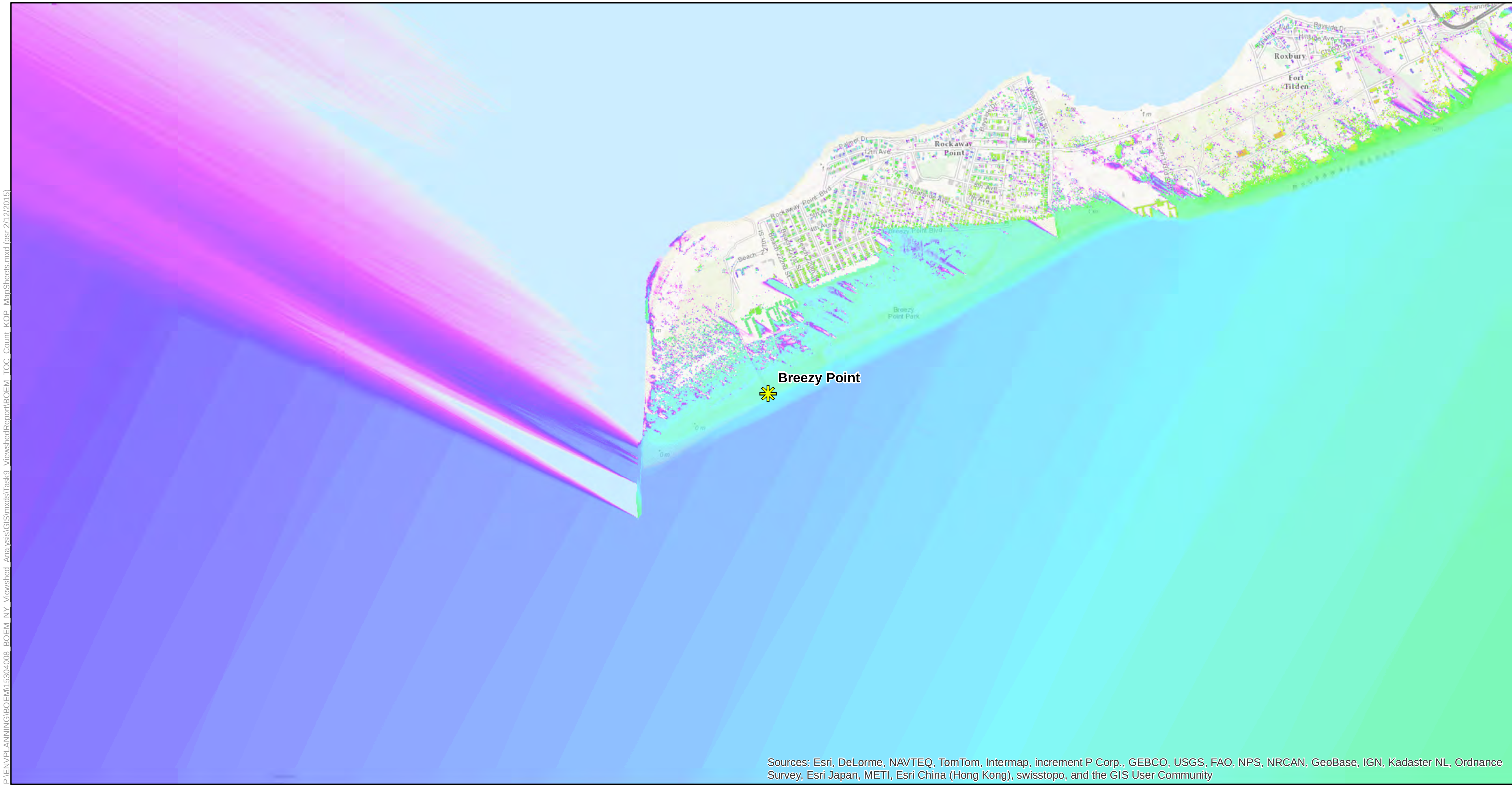
Jacob Riis Approximate Number of Turbines in Potentially Seen based on Top of Canopy Elevation Model

NY Renewable Energy Viewshed Project

Coordinate System: NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983

URS

BOEM
Bureau of Ocean Energy Management



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Legend

Key Observation Point Location

Approximate Number of Turbines in Top of Canopy Viewshed

High : 134

Low : 0

0 0.25 0.5 1
Kilometers

0 0.25 0.5 1
Nautical Miles

0 0.25 0.5 1
Miles

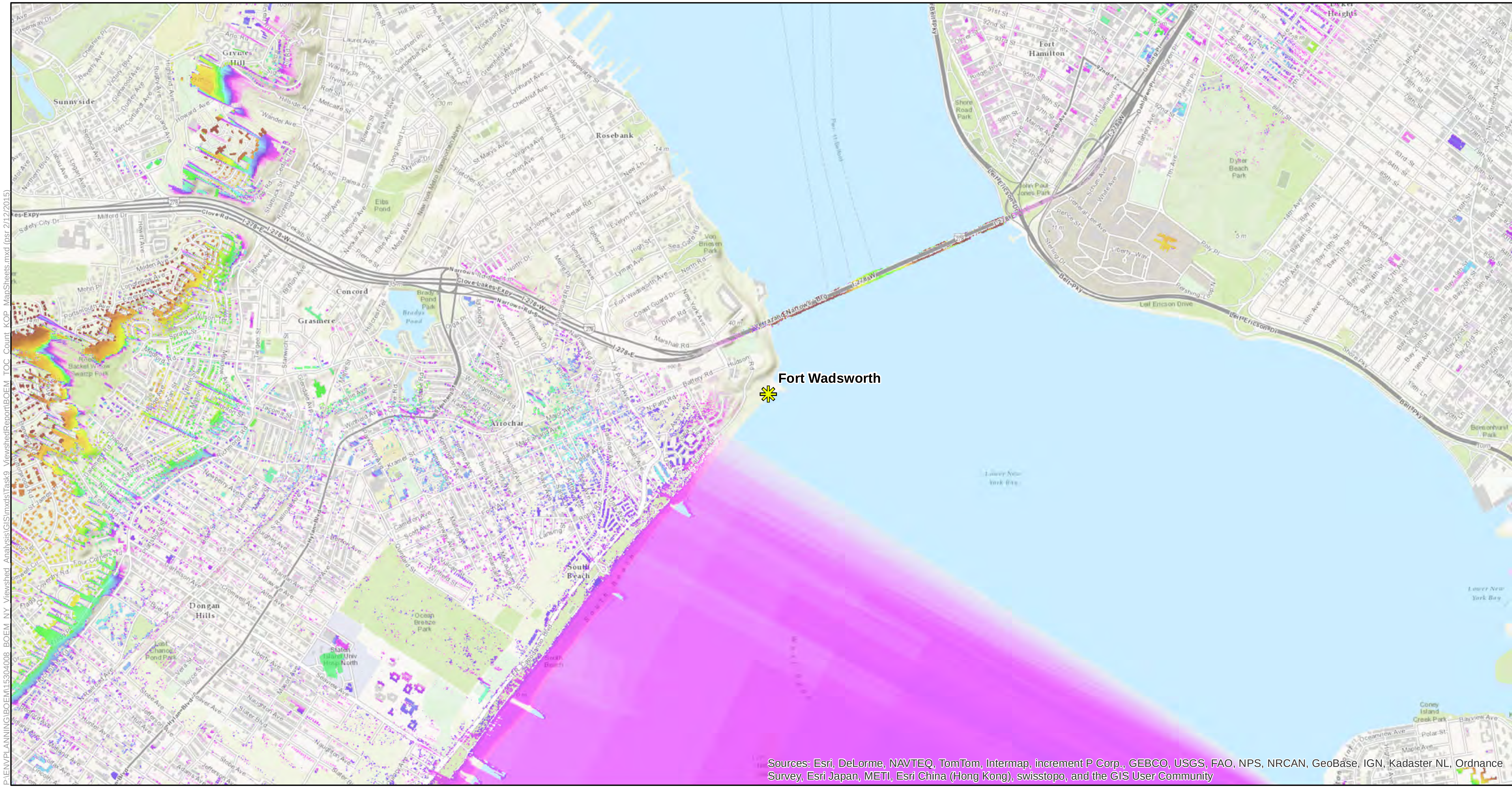
Breezy Point Approximate Number of Turbines in Potentially Seen based on Top of Canopy Elevation Model

NY Renewable Energy Viewshed Project

Coordinate System: NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983

URS

BOEM Bureau of Ocean Energy Management



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Legend

Key Observation Point Location

Approximate Number of Turbines in Top of Canopy Viewshed

High : 134

Low : 0

0 0.25 0.5 1
Kilometers

0 0.25 0.5 1
Nautical Miles

0 0.25 0.5 1
Miles

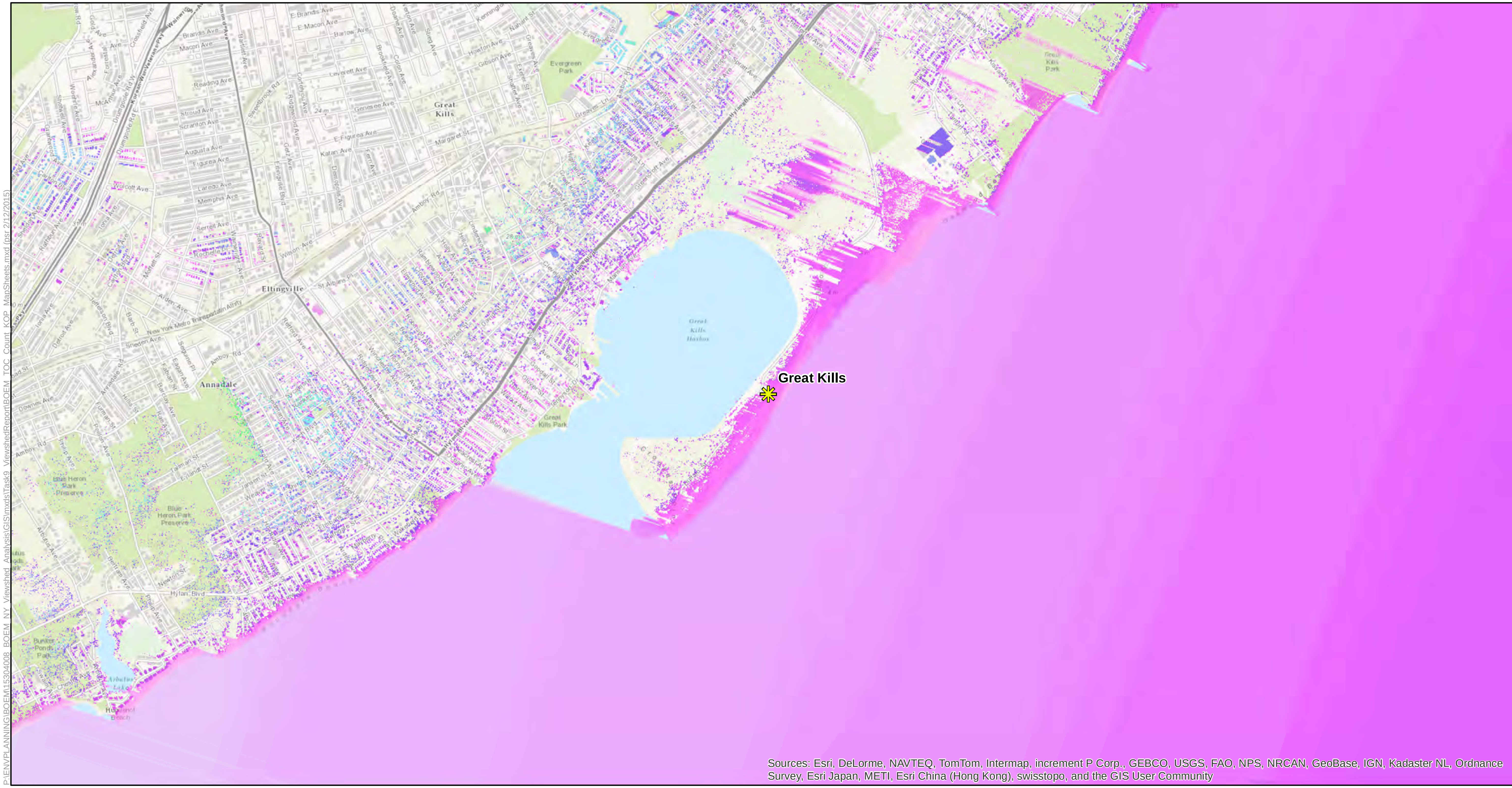
Fort Wadsworth Approximate Number of Turbines in Potentially Seen based on Top of Canopy Elevation Model

NY Renewable Energy Viewshed Project

Coordinate System: NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983

URS

BOEM
Bureau of Ocean Energy Management



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Legend

Key Observation Point Location

Approximate Number of Turbines in Top of Canopy Viewshed

High : 134

Low : 0

Kilometers: 0, 0.25, 0.5, 1

Nautical Miles: 0, 0.25, 0.5, 1

Miles: 0, 0.25, 0.5, 1

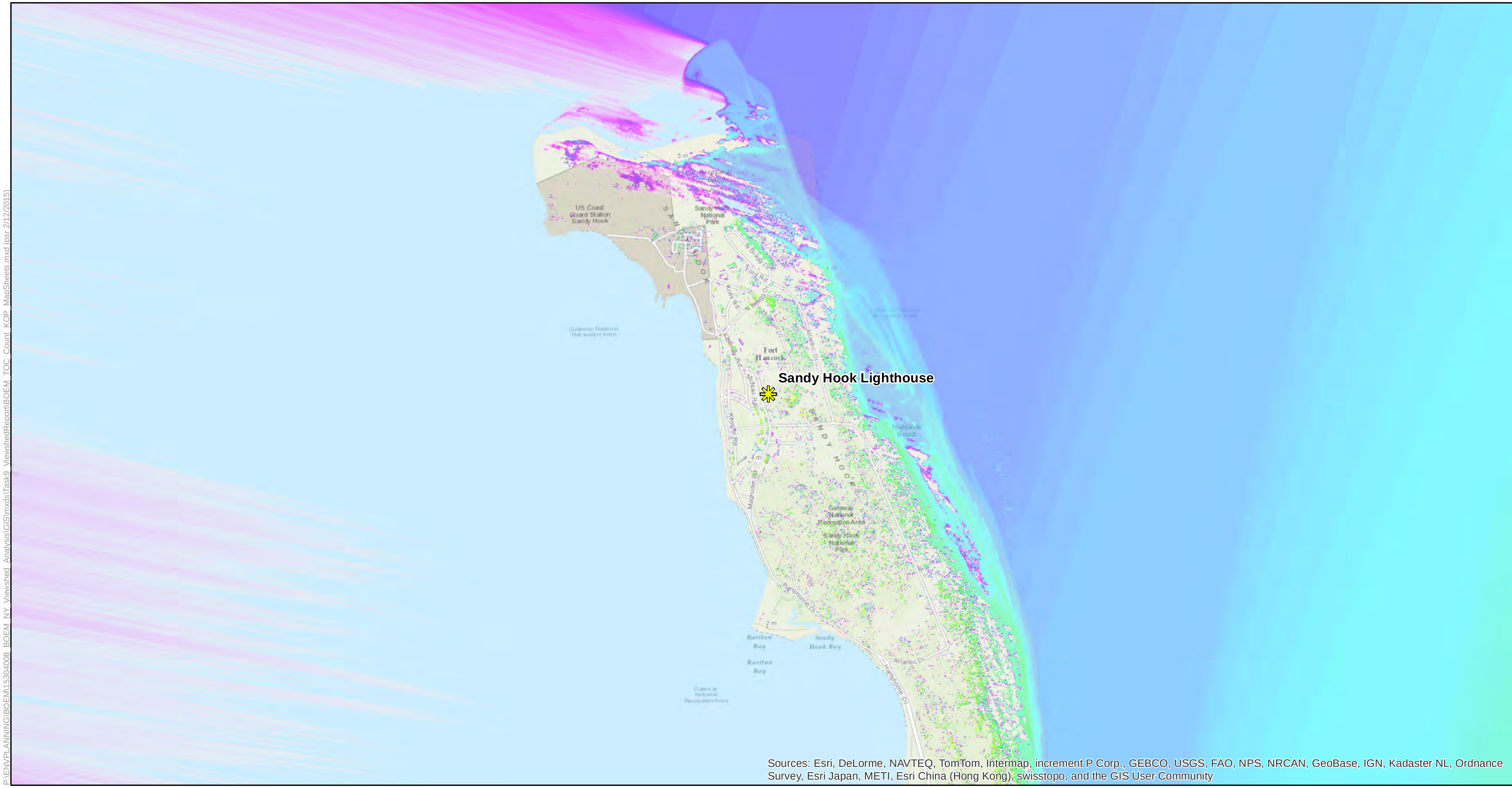
Great Kills Approximate Number of Turbines in Potentially Seen based on Top of Canopy Elevation Model

NY Renewable Energy Viewshed Project

Coordinate System: NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983

URS

BOEM Bureau of Ocean Energy Management



Sources: Esri, DeLorme, NAVTEQ, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, and the GIS User Community

Legend

Key Observation Point Location

Approximate Number of Turbines in Top of Canopy Viewshed

High : 134

Low : 0

N

0 0.25 0.5 1
Kilometers

0 0.25 0.5 1
Nautical Miles

0 0.25 0.5 1
Miles

Sandy Hook Lighthouse Approximate Number of Turbines in Potentially Seen based on Top of Canopy Elevation Model

NY Renewable Energy Viewshed Project

Coordinate System: NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983

URS

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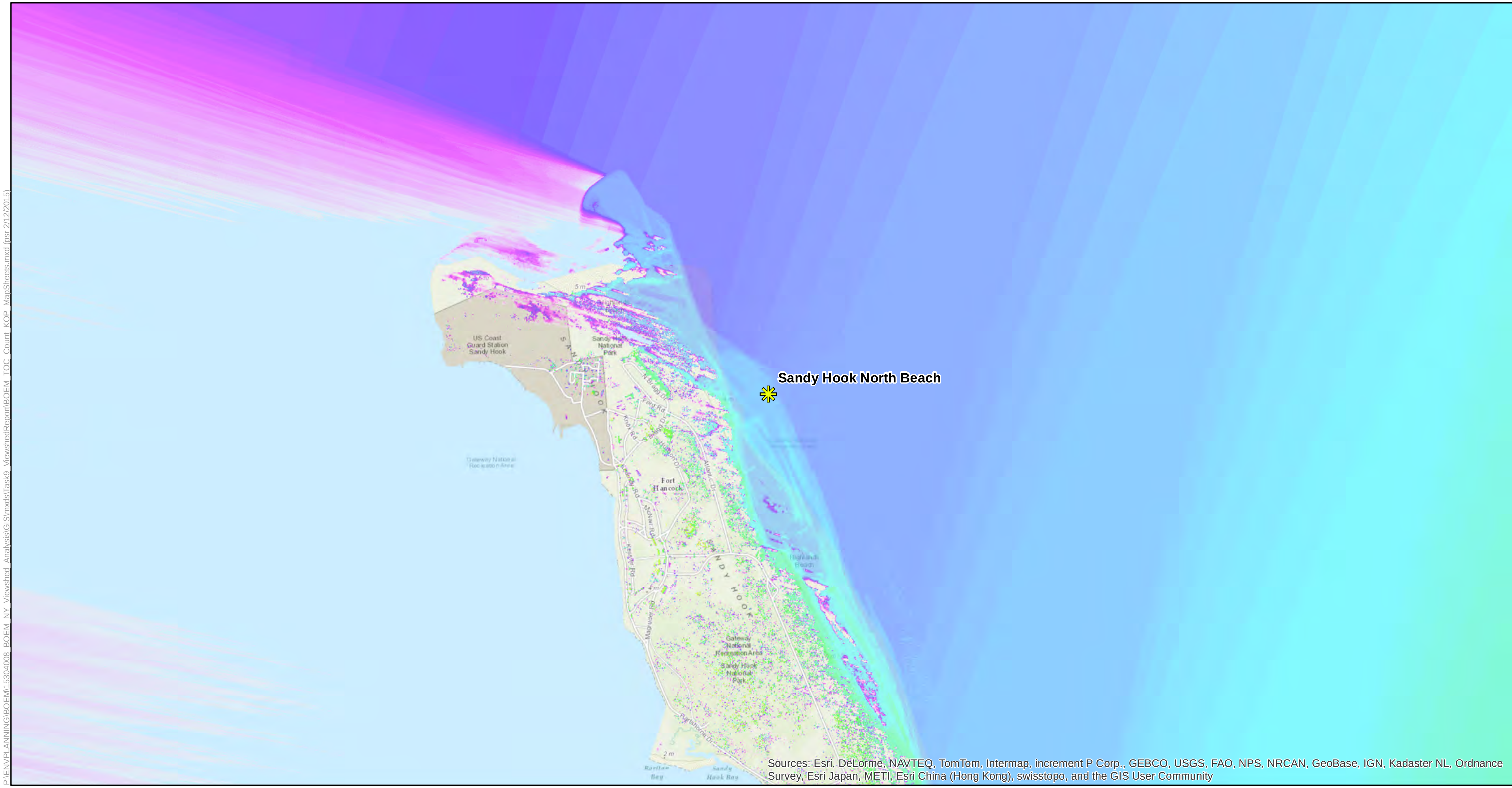


Legend

Key Observation Point Location

Approximate Number of Turbines in Top of Canopy Viewshed

High : 134

Low : 0

0 0.25 0.5 1
Kilometers

0 0.25 0.5 1
Nautical Miles

0 0.25 0.5 1
Miles

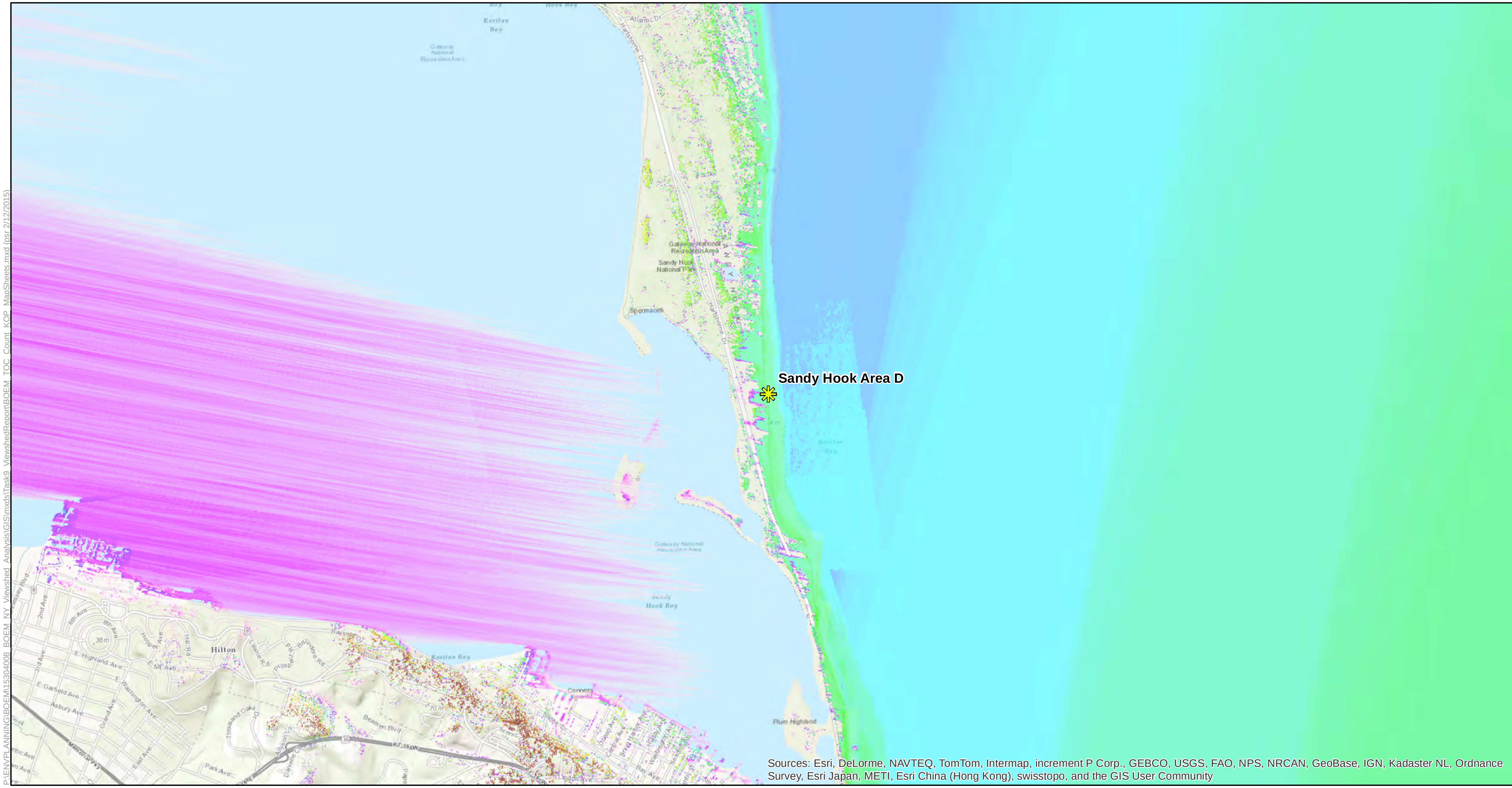
Sandy Hook North Beach Approximate Number of Turbines in Potentially Seen based on Top of Canopy Elevation Model

NY Renewable Energy Viewshed Project

Coordinate System: NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983

URS

BOEM Bureau of Ocean Energy Management



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Legend

Key Observation Point Location

Approximate Number of Turbines in Top of Canopy Viewshed

High : 134

Low : 0

0 0.25 0.5 1 Kilometers

0 0.25 0.5 1 Nautical Miles

0 0.25 0.5 1 Miles

Sandy Hook Area D Approximate Number of Turbines in Potentially Seen based on Top of Canopy Elevation Model

NY Renewable Energy Viewshed Project

Coordinate System: NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983

URS

BOEM Bureau of Ocean Energy Management

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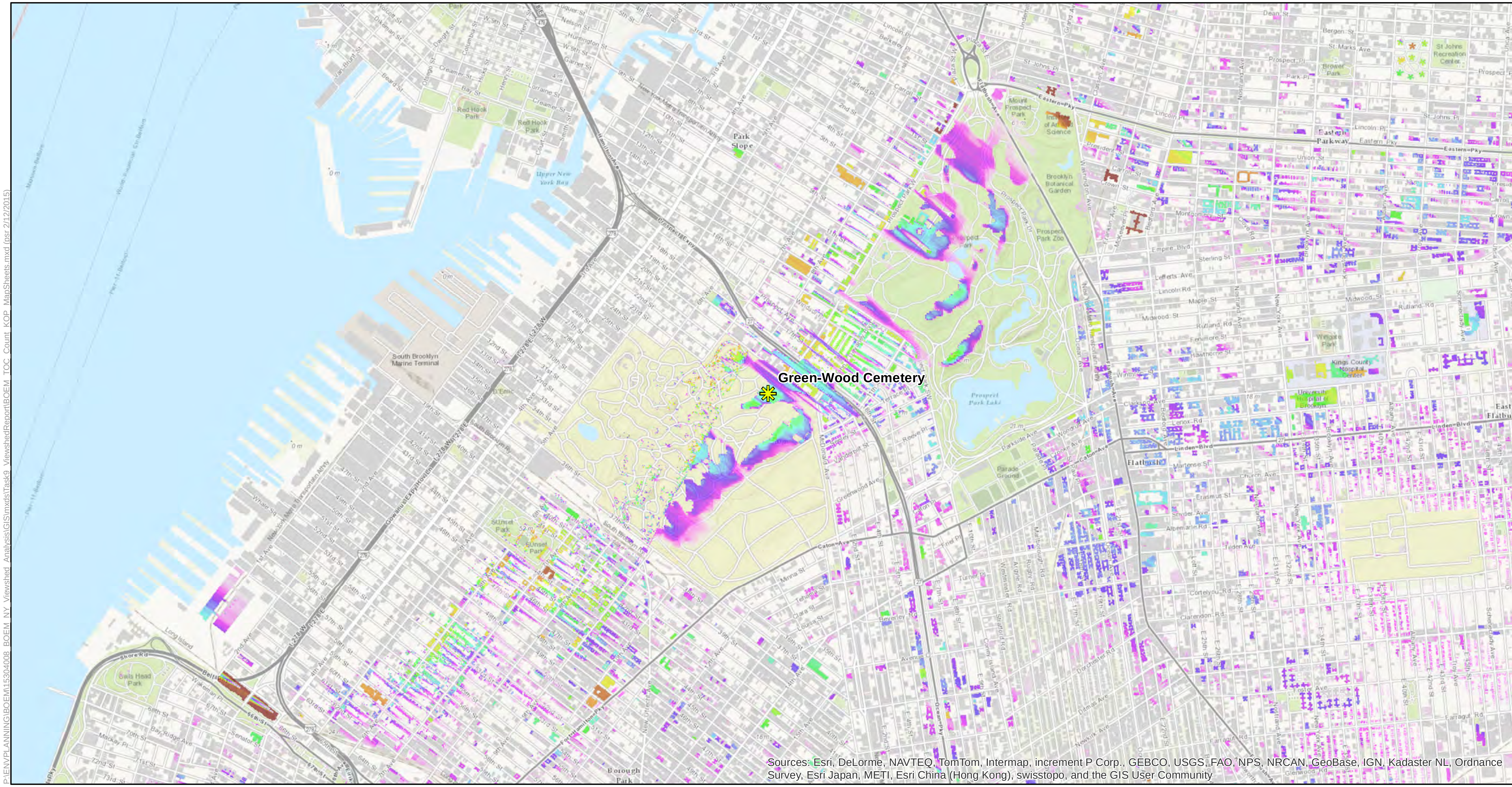


Legend

Key Observation Point Location

Approximate Number of Turbines in Top of Canopy Viewshed

High : 134

Low : 0

0 0.25 0.5 1
Kilometers

0 0.25 0.5 1
Nautical Miles

0 0.25 0.5 1
Miles

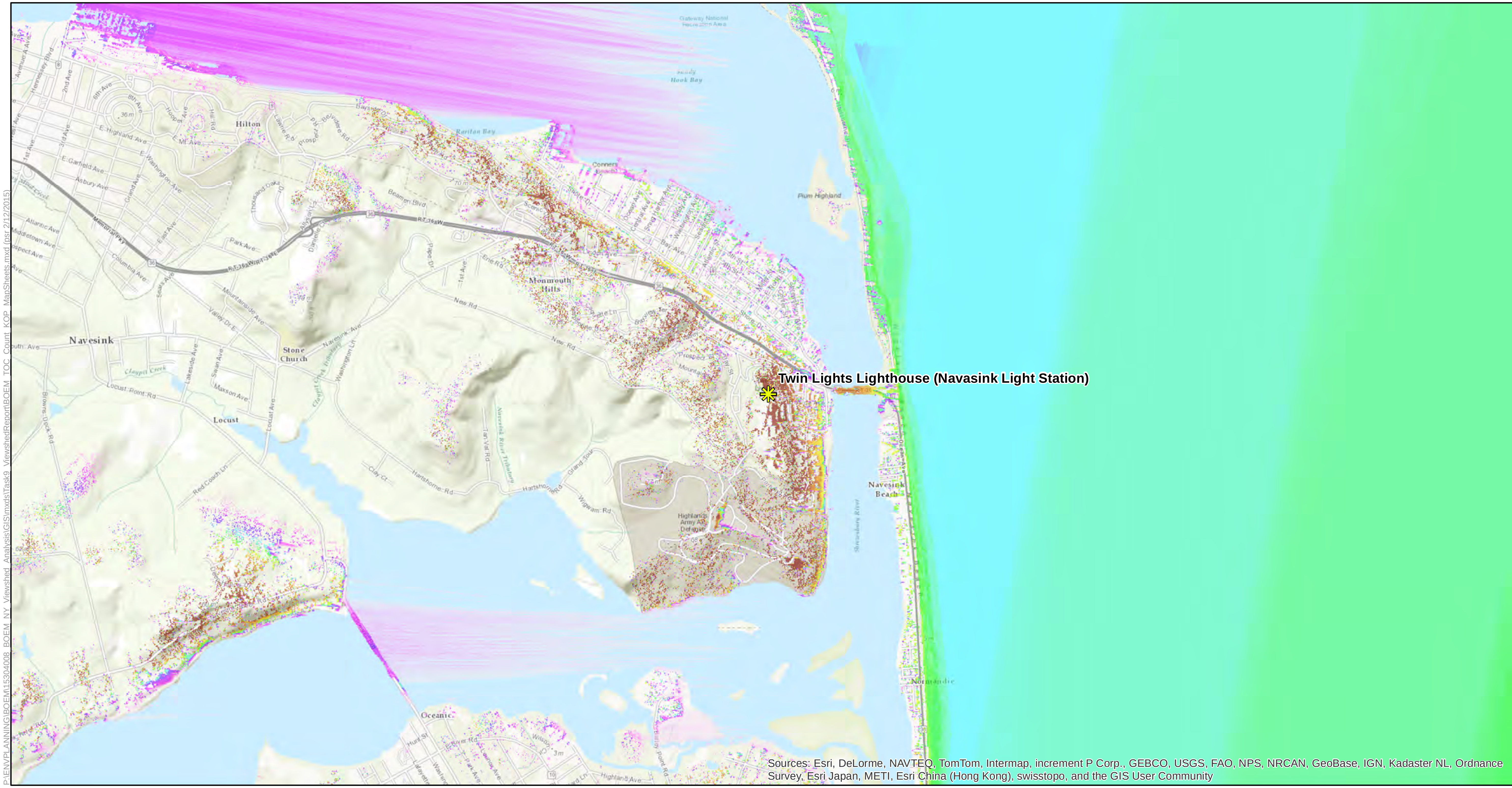
Green-Wood Cemetery Approximate Number of Turbines in Potentially Seen based on Top of Canopy Elevation Model

NY Renewable Energy Viewshed Project

Coordinate System: NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983

URS

BOEM Bureau of Ocean Energy Management



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Legend

Key Observation Point Location

Approximate Number of Turbines in Top of Canopy Viewshed

High : 134

Low : 0

0 0.25 0.5 1 Kilometers

0 0.25 0.5 1 Nautical Miles

0 0.25 0.5 1 Miles

Twin Lights Lighthouse (Navasink Light Station)
Approximate Number of Turbines in Potentially Seen based on Top of Canopy Elevation Model

NY Renewable Energy Viewshed Project

Coordinate System: NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983

URS

BOEM Bureau of Ocean Energy Management

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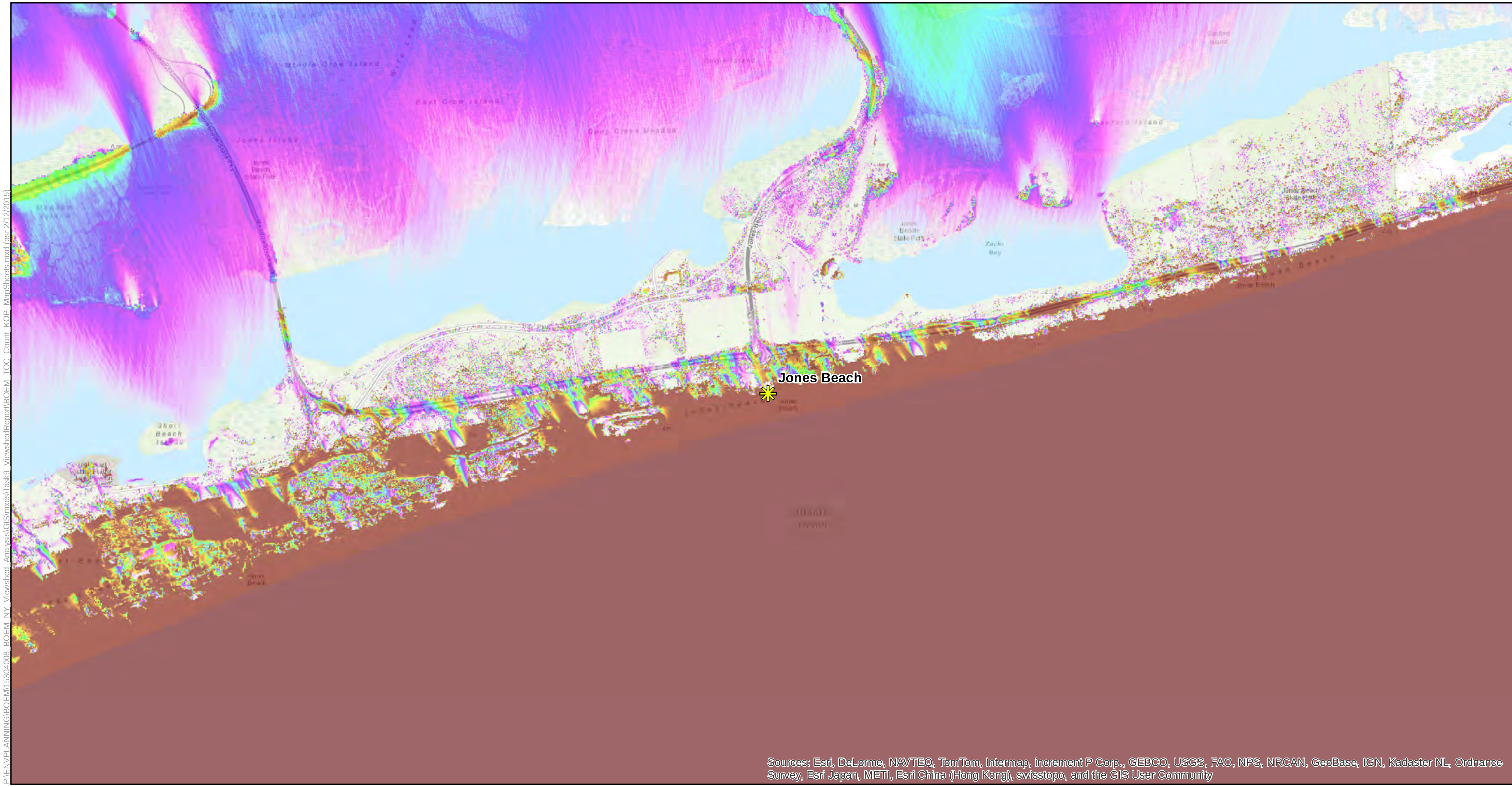


Legend

Key Observation Point Location

Approximate Number of Turbines in Top of Canopy Viewshed

High : 134

Low : 0

N

0 0.25 0.5 1
Kilometers

0 0.25 0.5 1
Nautical Miles

0 0.25 0.5 1
Miles

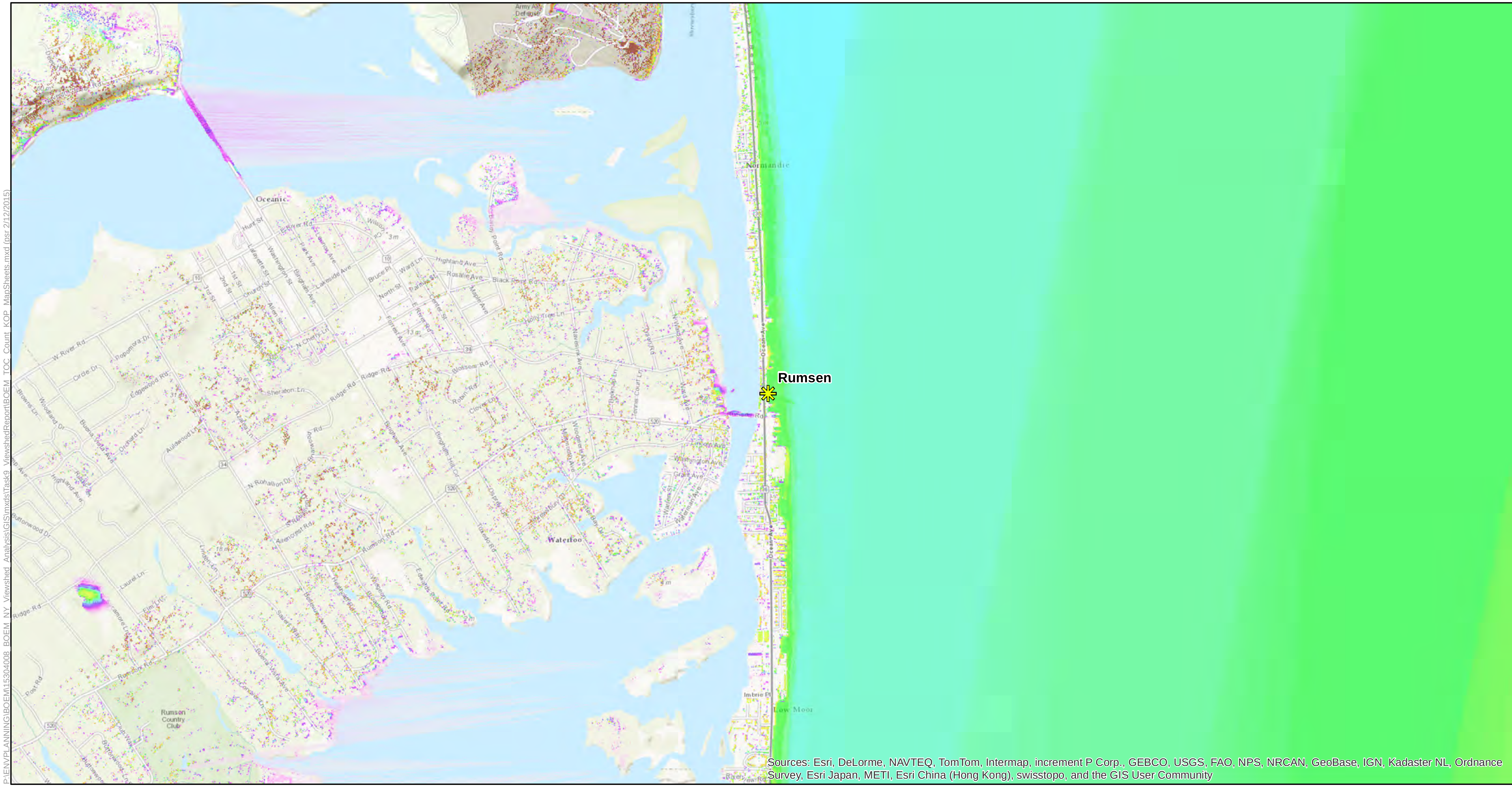
Jones Beach Approximate Number of Turbines in Potentially Seen based on Top of Canopy Elevation Model

NY Renewable Energy Viewshed Project

Coordinate System: NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983

URS

BOEM
Bureau of Ocean Energy Management



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Legend

Key Observation Point Location

Approximate Number of Turbines in Top of Canopy Viewshed

High : 134

Low : 0

Kilometers: 0, 0.25, 0.5, 1

Nautical Miles: 0, 0.25, 0.5, 1

Miles: 0, 0.25, 0.5, 1

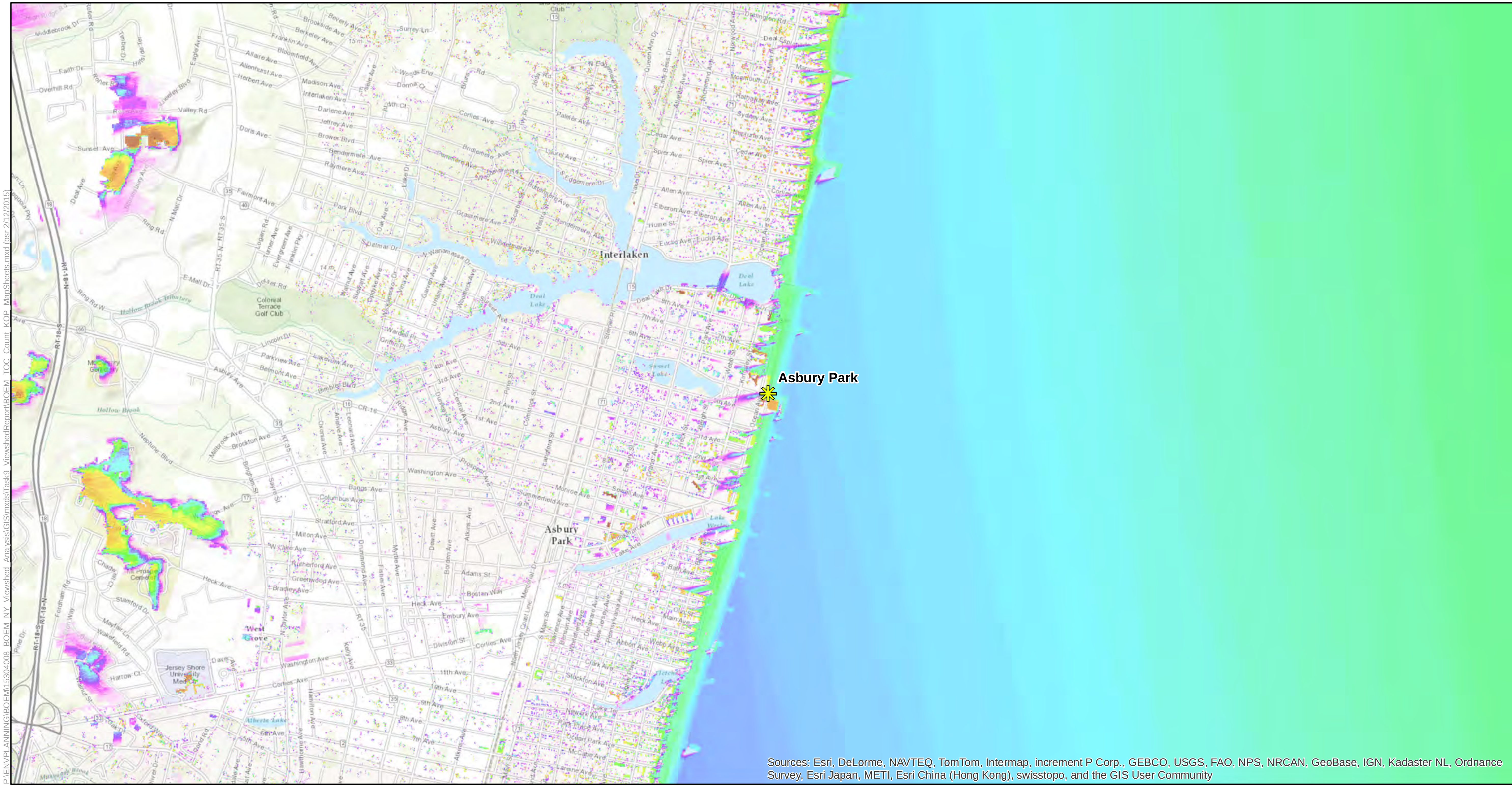
Rumsen Approximate Number of Turbines in Potentially Seen based on Top of Canopy Elevation Model

NY Renewable Energy Viewshed Project

Coordinate System: NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983

URS

BOEM Bureau of Ocean Energy Management



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Legend

Key Observation Point Location

Approximate Number of Turbines in Top of Canopy Viewshed

High : 134

Low : 0

N

0 0.25 0.5 1
Kilometers

0 0.25 0.5 1
Nautical Miles

0 0.25 0.5 1
Miles

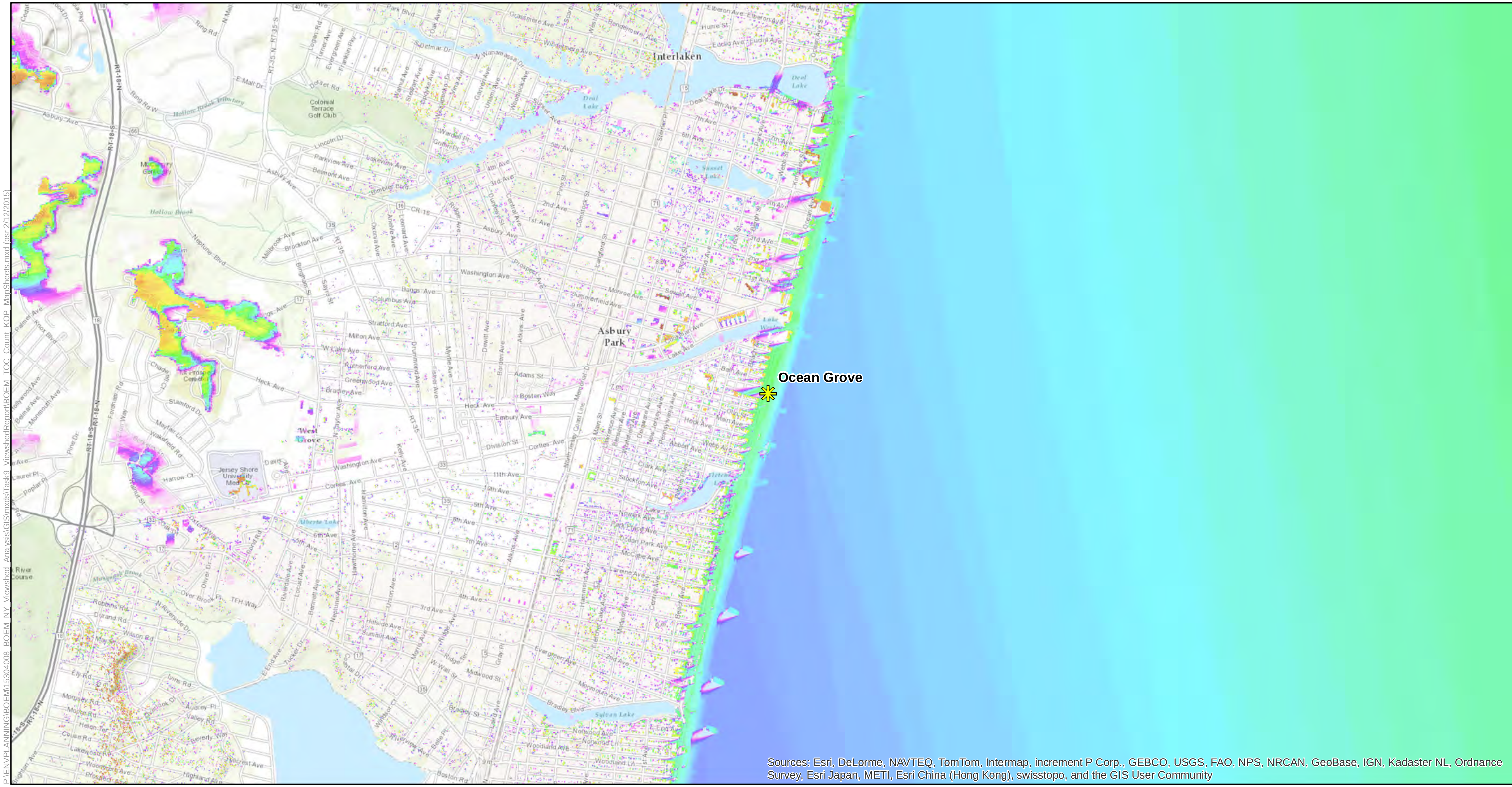
Asbury Park Approximate Number of Turbines in Potentially Seen based on Top of Canopy Elevation Model

NY Renewable Energy Viewshed Project

Coordinate System: NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983

URS

BOEM
Bureau of Ocean Energy Management



Legend

Key Observation Point Location

Approximate Number of Turbines in Top of Canopy Viewshed

High : 134

Low : 0

0 0.25 0.5 1 Kilometers

0 0.25 0.5 1 Nautical Miles

0 0.25 0.5 1 Miles

Ocean Grove Approximate Number of Turbines in Potentially Seen based on Top of Canopy Elevation Model

NY Renewable Energy Viewshed Project

Coordinate System: NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983

URS

BOEM
Bureau of Ocean Energy Management

Appendix H: Single Frame Simulations

H1 Spring
H2 Summer
H3 Fall
H4 Winter

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H1 Spring

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In response to stakeholder interest regarding visual impacts from potential future renewable energy development within the New York Call Area, BOEM has undertaken a project to develop visual simulations of a hypothetical wind energy facility on the Outer Continental Shelf offshore Long Island, New York. The purpose of this study is to characterize the potential onshore visibility of offshore wind turbines from locations along the coasts of New York and New Jersey under different seasons, times of day and weather conditions.

BOEM is not currently considering the approval of a specific project within the Call Area; therefore, the visual simulations illustrate a *hypothetical project*. The *hypothetical project* was designed to represent a commercially-scaled and technically feasible scenario that is consistent with industry trends regarding operating capacity, wind turbine size, spacing and configuration. Per BOEM's guidelines, project-specific visual simulations would be prepared by a lessee and submitted with its construction and operations plan. See *Guidelines for Information Requirements for a Renewable Energy Construction and Operations Plan* at http://www.boem.gov/National-and-Regional-Guidelines-for-Renewable-Energy-Activities/.

A series of accurate and realistic visual simulations of a hypothetical, commercial-scale wind energy facility within the New York Call Area were created from photographs and video taken at sixteen Key Observation Points located in New York and New Jersey. The simulations were further informed by a meteorological conditions assessment and a GIS-based viewshed analysis. A detailed description of the methods and supporting information used to create the visual simulations is provided in the Compendium Report accompanying the simulations.

Visual Simulation Overview

This appendix includes visual simulations of the Hypothetical Project prepared using photographs taken at each Key Observation Point. A cover sheet is provided for each Key Observation Point and includes:

- Base Photographic Documentation
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- Turbine Information
- Image Preview
- Context Map
- Viewing Instructions

The cover sheet is then followed by an existing conditions photograph (showing the view with no turbines simulated); simulations of the turbines under different weather and lighting

conditions; and a wireframe simulation. Wireframe images depict turbines placed to scale within the image and with proper coloration but with no meteorological conditions or lighting added. Consequently, the turbines in those images appear more distinct and apparent than they might when viewed under actual weather and lighting conditions. These images overstate visibility, as such conditions are unlikely in a real-world scenario; however, they serve to orient the viewer to the location of the simulated turbines and illustrate the scale and height of the turbines from the distance of the specific Key Observation Point.

Viewing Instructions

Viewing instructions are provided on each simulation. The visibility of the turbines on images projected on a computer screen will depend on the scale at which the image is being viewed. Simply put, zooming in on the image may overstate visibility. Conversely, zooming out or observing the image at full-screen will minimize the visibility of turbines. To view the simulations properly, adjust the zoom until the scale bar on the simulation measures four inches. Scaling the simulation in this manner will ensure that turbines – and other natural features in the view frame – are portrayed at an accurate scale and will ensure the field of view is similar to that experienced by an observer standing at the KOP. Once property scaled the images should be viewed from a distance of 11.2 inches.

Meteorological Visibility

Understanding the distinction between the visibility metrics provided in Section 2.0 of this report and the actual expected visibility of the turbines illustrated by the photosimulations is central to this visibly assessment. "Maximum Visibility" and "Average Predicted Visibility" refer to the definition of visibility provided in Section 2.0 of the Compendium Report: "the greatest distance at which an observer can just see a black object viewed against the horizon sky" (Malm 1999). "Average Visibility" metrics refer to the average distance at which a black object would be visible on the horizon based on the relationship between visibility and humidity. Please see Section 2 for more information.

Actual Visibility

As discussed in Section 7 of the Compendium Report, the actual visibility of the offshore wind turbines as shown in the photo simulations will depend on a variety of factors, such as contrast of the turbines against the backdrop of the horizon, existing lighting and how it falls on the turbines, the degree of atmospheric haze, and observer characteristics. The simulations depict the appearance of light grey turbines under proper lighting and meteorological conditions (e.g., haze), consistent with those recorded at the time the photograph was taken. There is thus very little visual contrast between the color and distinction in form of the turbines as they "blend" with the color of the horizon. Please see Section 7 for more information.

H2 Summer

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In response to stakeholder interest regarding visual impacts from potential future renewable energy development within the New York Call Area, BOEM has undertaken a project to develop visual simulations of a hypothetical wind energy facility on the Outer Continental Shelf offshore Long Island, New York. The purpose of this study is to characterize the potential onshore visibility of offshore wind turbines from locations along the coasts of New York and New Jersey under different seasons, times of day and weather conditions.

BOEM is not currently considering the approval of a specific project within the Call Area; therefore, the visual simulations illustrate a *hypothetical project*. The *hypothetical project* was designed to represent a commercially-scaled and technically feasible scenario that is consistent with industry trends regarding operating capacity, wind turbine size, spacing and configuration. Per BOEM's guidelines, project-specific visual simulations would be prepared by a lessee and submitted with its construction and operations plan. See *Guidelines for Information Requirements for a Renewable Energy Construction and Operations Plan* at http://www.boem.gov/National-and-Regional-Guidelines-for-Renewable-Energy-Activities/.

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conditions; and a wireframe simulation. Wireframe images depict turbines placed to scale within the image and with proper coloration but with no meteorological conditions or lighting added. Consequently, the turbines in those images appear more distinct and apparent than they might when viewed under actual weather and lighting conditions. These images overstate visibility, as such conditions are unlikely in a real-world scenario; however, they serve to orient the viewer to the location of the simulated turbines and illustrate the scale and height of the turbines from the distance of the specific Key Observation Point.

Viewing Instructions

Viewing instructions are provided on each simulation. The visibility of the turbines on images projected on a computer screen will depend on the scale at which the image is being viewed. Simply put, zooming in on the image may overstate visibility. Conversely, zooming out or observing the image at full-screen will minimize the visibility of turbines. To view the simulations properly, adjust the zoom until the scale bar on the simulation measures four inches. Scaling the simulation in this manner will ensure that turbines – and other natural features in the view frame – are portrayed at an accurate scale and will ensure the field of view is similar to that experienced by an observer standing at the KOP. Once property scaled the images should be viewed from a distance of 11.2 inches.

Meteorological Visibility

Understanding the distinction between the visibility metrics provided in Section 2.0 of this report and the actual expected visibility of the turbines illustrated by the photosimulations is central to this visibly assessment. "Maximum Visibility" and "Average Predicted Visibility" refer to the definition of visibility provided in Section 2.0 of the Compendium Report: "the greatest distance at which an observer can just see a black object viewed against the horizon sky" (Malm 1999). "Average Visibility" metrics refer to the average distance at which a black object would be visible on the horizon based on the relationship between visibility and humidity. Please see Section 2 for more information.

Actual Visibility

As discussed in Section 7 of the Compendium Report, the actual visibility of the offshore wind turbines as shown in the photo simulations will depend on a variety of factors, such as contrast of the turbines against the backdrop of the horizon, existing lighting and how it falls on the turbines, the degree of atmospheric haze, and observer characteristics. The simulations depict the appearance of light grey turbines under proper lighting and meteorological conditions (e.g., haze), consistent with those recorded at the time the photograph was taken. There is thus very little visual contrast between the color and distinction in form of the turbines as they "blend" with the color of the horizon. Please see Section 7 for more information.

H3 Fall

In response to stakeholder interest regarding visual impacts from potential future renewable energy development within the New York Call Area, BOEM has undertaken a project to develop visual simulations of a hypothetical wind energy facility on the Outer Continental Shelf offshore Long Island, New York. The purpose of this study is to characterize the potential onshore visibility of offshore wind turbines from locations along the coasts of New York and New Jersey under different seasons, times of day and weather conditions.

BOEM is not currently considering the approval of a specific project within the Call Area; therefore, the visual simulations illustrate a *hypothetical project*. The *hypothetical project* was designed to represent a commercially-scaled and technically feasible scenario that is consistent with industry trends regarding operating capacity, wind turbine size, spacing and configuration. Per BOEM's guidelines, project-specific visual simulations would be prepared by a lessee and submitted with its construction and operations plan. See *Guidelines for Information Requirements for a Renewable Energy Construction and Operations Plan* at http://www.boem.gov/National-and-Regional-Guidelines-for-Renewable-Energy-Activities/.

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Viewing Instructions

Viewing instructions are provided on each simulation. The visibility of the turbines on images projected on a computer screen will depend on the scale at which the image is being viewed. Simply put, zooming in on the image may overstate visibility. Conversely, zooming out or observing the image at full-screen will minimize the visibility of turbines. To view the simulations properly, adjust the zoom until the scale bar on the simulation measures four inches. Scaling the simulation in this manner will ensure that turbines – and other natural features in the view frame – are portrayed at an accurate scale and will ensure the field of view is similar to that experienced by an observer standing at the KOP. Once property scaled the images should be viewed from a distance of 11.2 inches.

Meteorological Visibility

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Actual Visibility

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H4 Winter

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In response to stakeholder interest regarding visual impacts from potential future renewable energy development within the New York Call Area, BOEM has undertaken a project to develop visual simulations of a hypothetical wind energy facility on the Outer Continental Shelf offshore Long Island, New York. The purpose of this study is to characterize the potential onshore visibility of offshore wind turbines from locations along the coasts of New York and New Jersey under different seasons, times of day and weather conditions.

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Actual Visibility

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Appendix I: TrueView™ Photomontages

In response to stakeholder interest regarding visual impacts from potential future renewable energy development within the New York Call Area, BOEM has undertaken a project to develop visual simulations of a hypothetical wind energy facility on the Outer Continental Shelf offshore Long Island, New York. The purpose of this study is to characterize the potential onshore visibility of offshore wind turbines from locations along the coasts of New York and New Jersey under different seasons, times of day and weather conditions.

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Visual Simulation Overview

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- Base Photographic Documentation
- Camera Information
- Sun and Weather Information
- Turbine Information
- Context Map
- Viewing Instructions

Viewing Instructions

Viewing instructions are provided on each simulation. The visibility of the turbines on images projected on a computer screen will depend on the scale at which the image is being viewed. Simply put, zooming in on the image may overstate visibility. Conversely, zooming out or observing the image at full-screen will minimize the visibility of turbines. To view the simulations properly, adjust the zoom until the scale bar on the simulation measures four inches. Scaling the simulation in this manner will ensure that turbines – and other natural features in the view frame – are portrayed at an accurate scale and will ensure the field of view is similar to that experienced by an observer standing at the KOP. Once property scaled the images should be viewed from a distance of 19.7 inches.

Appendix J: Video Simulations

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The Department of the Interior Mission

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the sound use of our land and water resources, protecting our fish, wildlife and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island communities.

The Bureau of Ocean Energy Management

The Bureau of Ocean Energy Management (BOEM) works to manage the exploration and development of the nation's offshore resources in a way that appropriately balances economic development, energy independence, and environmental protection through oil and gas leases, renewable energy development and environmental reviews and studies.