FINAL WIND DATA REPORT

Mattapoisett
Mattapoisett, Massachusetts

January 19, 2006 – June 29, 2007

Prepared for

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NOTICE AND ACKNOWLEDGEMENTS

This report was prepared by the Renewable Energy Research Laboratory (RERL) at the University of Massachusetts, Amherst in the course of performing work sponsored by the Renewable Energy Trust (RET), as administered by the Massachusetts Technology Collaborative (MTC). The opinions expressed in this report do not necessarily reflect those of MTC or the Commonwealth of Massachusetts, and reference to any specific product, service, process, or method does not constitute an implied or expressed recommendation or endorsement of it.

TABLE OF CONTENTS

TABLE OF FIGURES

EXECUTIVE SUMMARY

All the work presented in this Wind Data Report including installation and decommissioning of the meteorological tower and instrumentation, and the data analysis and reporting was performed by the Renewable Energy Research Laboratory (RERL) at the University of Massachusetts, Amherst.

This report covers wind data measured at a meteorological tower installed in the town of Mattapoisett, MA. Installed on January 20th, 2006, the wind monitoring station was in continuous operation until June 31st, 2007. Two sets of two anemometers and one wind vane were mounted at 49 m (164.1 ft) and 38 m (124.7 ft), and an additional anemometer and vane were mounted at 20 m (65.6 ft).

The data covered by this final report is one calendar year from May 1st, 2006 until April 30th, 2007. Typically, met towers are removed for reuse at other sites after a one year period; however, due to issues with missing data during the beginning of the collection period, additional data was gathered in an attempt to allow for a complete dataset. Due to problems with data collection during the months of October, November, and December the gross data recovery percentage (the actual percentage of expected data received) was 79.98% and the net data recovery percentage (the percentage of expected data which passed all of the quality assurance tests) was 79.27%. RERL Measure Correlate Predict (MCP) analysis has been used to synthesize data for the large gap in the data in order to provide statistics for the year. The mean recorded wind speed for this year was 5.74 m/s (12.8 mph)[1] and the prevailing wind direction was from the south-southwest. Other nearby wind monitoring sites include ORR (5.36 m/s spring quarter 2007) also in the town of Mattapoisett, and Thompson Island (5.9 m/s year 2005) in Boston Harbor.

Additional information about interpreting the data presented in this report can be found in the Fact Sheet, "Interpreting Your Wind Resource Data," produced by RERL and the Massachusetts Technology Collaborative (MTC). This document is found through the RERL website:

http://www.ceere.org/rerl/about_wind/RERL_Fact_Sheet_6_Wind_resource_interpretation.pdf

* 1 m/s = 2.237 mph.

[1] 1m/s=2.237 mph

SECTION 1 - Station Location

The Mattapoisett site is located near the South Shore Marshes Wildlife Management Area in Mattapoisett, MA. Latitude and Longitude are 41° 38.11'N and 70° 50.55'W, respectively, using the NAD 83 datum.

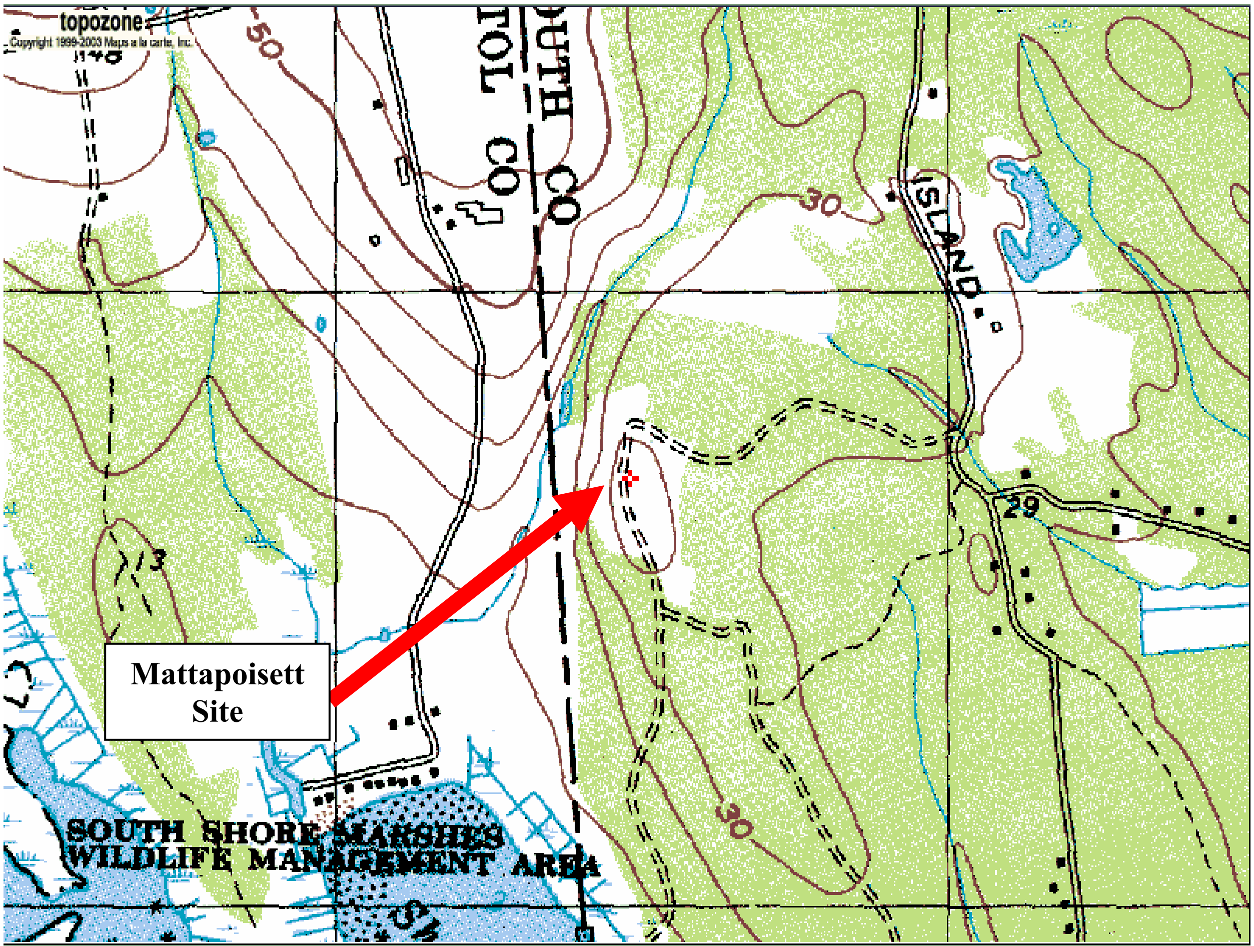

Figure 1 Topographic Map Showing Mattapoisett Site Location--Source Topozone.com

SECTION 2 - Instrumentation and Equipment

The wind monitoring equipment is mounted on a 49 m (164.0 ft) NRG tower. All other monitoring equipment also comes from NRG Systems, and consists of the following items:

- Symphonie Data Logger
- Electrical enclosure box
- 5 – #40 Anemometers, standard calibration (Slope - 0.765 m/s, Offset – 0.349 m/s). Two anemometers are located at 49 m (160.8 ft), two at 38 m (124.7 ft) and one at a height of 20 m (65.6 ft).
- 3 - #200P Wind direction vanes. They are located at heights of 49 m (160.8 ft), 38 m (124.7 ft) and 20 m (65.6 ft) each.
- 5 – Sensor booms, 54" length
- Lightning rod and grounding cable
- 1 - #110S Temperature sensor mounted at approximately 3 m (9.8 ft)
- Shielded sensor wire

The data from the Symphonie logger is mailed to the Renewable Energy Research Laboratory at the University of Massachusetts, Amherst on a regular basis. The logger samples wind speed and direction once every two seconds. These data are then combined into 10-minute averages and, along with the standard deviation for those 10-minute periods, are put into a binary file. These binary files are converted to ASCII text files using the NRG software BaseStation®. These text files are then imported into a database software program where they are subjected to quality assurance (QA) tests prior to using the data.

SECTION 3 - Data Summary

A summary of the wind speeds and wind directions measured during the reporting period is included in Table 1. Table 1 includes the mean wind speeds measured at each measurement height, the maximum instantaneous wind speed measured at each measurement height and the prevailing wind direction measured at each measurement height. These values are provided for each month of the reporting period and for the whole reporting period.

Table 1. Wind Speed and Direction Data Summary

Date	Mean Wind Speed	Max Wind Speed	Prevailing Wind Direction	Mean Wind Speed	Max Wind Speed	Prevailing Wind Direction	Mean Wind Speed	Max Wind Speed	Prevailing Wind Direction
Height Units	**49 m [m/s]**	**49 m [m/s]**	**49 m**	**38 m [m/s]**	**38 m [m/s]**	**38 m**	**20 m [m/s]**	**20 m [m/s]**	**20 m**
May 2006	5.63	14.1	202.5	5.07	12.8	202.5	3.85	9.9	202.5
June 2006	5.42	14.3	202.5	4.9	12.9	202.5	3.51	9	202.5
July 2006	5.51	14.1	202.5	5.08	12.9	202.5	3.45	8.6	202.5
Aug 2006	4.84	14.6	225	4.39	13.1	202.5	3.02	8.2	225
Sept 2006	5.02	13.9	225	4.55	13	202.5	3.10	8.6	225
Oct 2006**	6.18	--	--	5.54	--	--	4.00	--	--
Nov 2006**	5.09	--	--	4.45	--	--	3.16	--	--
Dec 2006**	5.90	--	--	5.36	--	--	3.97	--	--
Jan 2007	6.34	15.7	315	5.84	14.3	315	4.66	12.3	315
Feb 2007	6.38	16	270	5.9	15.2	270	4.87	13.3	270
Mar 2007	6.89	15.6	202.5	6.33	14.9	202.5	4.90	12.9	202.5
Apr 2007	5.77	19.7	22.5	5.36	17.2	22.5	4.15	12.8	22.5
May 2006 – Apr 2007	**5.74**	**--**	**--**	**5.23**	**--**	**--**	**3.88**	**--**	**--**

** RERL MCP has been used to synthesize mean wind speed data for these months.

Wind data statistics in the table are reported when more than 90% of the data during the reporting period are valid. Because the amount of valid data is very low for the months of October, November, and December, the RERL MCP method has been used to synthesize data in order to provide statistics for these months.

MCP algorithms are used to predict the wind resource at a site where a minimal measurement has been conducted (know as target site) using data from another meteorologically similar site (known as the reference site). The two data requirements for the reference site are that (1) there must be some concurrent data between target and reference site in order to establish a relationship between the wind resource at the two sites, and that (2) there must be valid data for the period over which a prediction for the target site wind resource is being performed.

MCP analysis using approximately 6 months of concurrent data from the nearby wind monitoring site at Old Rochester Regional high school (ORR) also in the town of Mattapoisett, MA has been used to synthesize ten-minute wind speed data for each of the three measuring heights (49 m, 38 m, and 10 m). The ORR site uses an instrumentation setup that is identical to the Mattapoisett site. The synthesized data has been used to fill in the gap in wind speed data between October 3rd and December 15th, 2006. The mean wind speed estimate, wind speed estimate standard deviation (i.e. the uncertainty in the mean wind speed estimate), and 95% confidence interval for mean wind speed for the MCP estimated data for all heights is shown in Table 1.

Table 2. MCP Synthesized Data Statistics Summary

Height [m]	Mean Wind Speed Estimate [m/s]	Estimate Standard Deviation [m/s]	95% Confidence Interval [m/s—m/s]
50	5.79	0.0297	5.73—5.84
38	5.15	0.052	5.05—5.26
20	3.71	0.056	3.60—3.82

No measurement of wind speed or direction can be perfectly accurate. Wind speed measurement errors occur due to anemometer manufacturing variability, anemometer calibration errors, the response of anemometers to turbulence and vertical air flow and due to air flows caused by the anemometer mounting system. Every effort is made to reduce the sources of these errors. Nevertheless, the values reported in this report have an expected uncertainty of about ± 2% or ± 0.2 m/s, whichever is greater. Wind direction measurement errors occur due to sensor measurement uncertainty, tower effects, boom alignment measurement errors and twisting of pipe sections during the raising of a pipe tower. Efforts are also made to reduce these errors, but the reported wind directions are estimated to have an uncertainty of +/- 5 degrees.

A summary of the turbulence intensity and mean wind shear measured at each measurement height during the reporting period is included in Table 3. These values are provided for each month of the reporting period and for the whole reporting period. Turbulence Intensity is calculated by dividing the standard deviation of the wind speed by the mean wind speed and is a measure of the gustiness of a wind resource. Lower turbulence results in lower mechanical loads on a wind turbine. Turbulence intensity varies with wind speed. The average turbulence intensity presented in Table 3 is the mean turbulence intensity when the wind speed at each measurement height is between 10 and 11 m/s.

Shear coefficients provide a measure of the change in wind speed with height. When data at multiple heights are available, shear coefficients, α, have been determined. They can be used in the following formula to estimate the average wind speed, $U(z)$, at height z, when the average wind speed, $U(z_r)$, at height z_r is known:

$$U(z)=U(z_r)\left(\frac{z}{z_r}\right)^{\alpha}$$

The change in wind speed with height is a very complicated relationship related to atmospheric conditions, wind speed, wind direction, time of day and time of year. This formula will not always provide the correct answer at any given site. Nevertheless the calculated shear coefficient, based on measurements at two heights, can be used to characterize the degree of increase in wind speed with height at a site.

The mean wind shear coefficient that is provided here is calculated based on the mean wind speeds in Table 1, where z_{low} and z_{high} are the heights of the higher and lower mean wind speeds used in the calculation and $U(z_{low})$ and $U(z_{high})$ are the mean wind speeds at the two heights.

$$\alpha = \log\left(\frac{U(z_{high})}{U(z_{low})}\right) \Big/ \log\left(\frac{z_{high}}{z_{low}}\right)$$

Table 3. Shear and Turbulence Intensity Data Summary

Date	Turbulence Intensity at 10 m/s	Turbulence Intensity at 10 m/s	Turbulence Intensity at 10 m/s	Mean Wind Shear Coefficient, α
Height Units	**49 m [-]**	**38 m [-]**	**20 m [-]**	**Between 49 m and 38 m [-]**
May 2006	0.171	0.170	--	0.413
June 2006	0.139	0.186	--	0.392
July 2006	0.122	0.148	--	0.320
Aug 2006	0.122	0.144	--	0.383

Sept 2006	0.149	0.148	--	0.387
Oct 2006 **	--	--	--	0.429
Nov 2006 **	--	--	--	0.531
Dec 2006 **	--	--	--	0.378
Jan 2007	0.155	0.163	0.219	0.326
Feb 2007	0.182	0.192	0.221	0.309
Mar 2007	0.162	0.167	0.220	0.332
Apr 2007	0.204	0.235	0.222	0.289
May 2006 -Apr 2007	--	--	--	0.369

SECTION 4- Capacity Factor

The capacity factor of a wind turbine at a given site depends on the hub height, wind speed distribution at the hub height, the wind turbine power curve and any assumptions about down time and losses due to wake effects from upwind wind turbines, etc. If the hub height wind speed is estimated from data at lower heights, then the capacity factor will also depend on the estimated wind shear and the wind speeds measured at lower heights. No simple estimate of capacity factor at a site could take all of these effects and choices into account. Nevertheless, an estimate of the capacity factor of a wind turbine at this site is provided here to help the reader understand the order of magnitude of the wind resource at this site.

The estimates assume a hub height of 80 m, a 1.5 MW wind turbine with a rotor diameter of 77 m and the mean wind speed at the highest measurement height and the mean wind shear at the site, in order to determine the mean hub height wind speed. The capacity factor (CF) is then estimated from (see G.M. Masters, Renewable and Efficient Electric Power Systems, Wiley, 2004):

$$CF = (0.087) U_{hub} - \frac{P_{rated}}{D^2}$$

where U_{hub} is the mean annual hub height wind speed in m/s (in this case estimated at 6.88 m/s), P_{rated} is the rated power of the wind turbine in kW and D is the diameter of the rotor in meters. Based on this equation, the estimated capacity factor of a wind turbine at this site would be about 0.35.

SECTION 5- Graphs

This report contains several types of wind data graphs. Unless otherwise noted, each graph represents data from one calendar year (May 1st, 2006 to April 30th, 2007). The following graphs are included:

- Time Series – 10-minute average wind speeds are plotted against time. This graph includes all of the collected data.
- Wind Speed Distribution – A histogram plot giving the percentage of time that the wind is at a given wind speed.
- Monthly Average – A plot of the monthly average wind speed over a 12-month period. This graph shows the monthly trends in the wind speed.
- Diurnal – A plot of the average wind speed for each hour of the day.
- Turbulence Intensity – A plot of turbulence intensity as a function of wind speed. Turbulence intensity is calculated as the standard deviation of the wind speed divided by the wind speed and is a measure of the gustiness of a wind resource. Lower turbulence results in lower mechanical loads on a wind turbine.
- Wind Rose – A plot, by compass direction showing the percentage of time that the wind comes from a given direction and the average wind speed in that direction.

Immediately obvious in the Wind Speed Time-Series graph (figure 3) are the large gaps in the data. The gap from October 3rd until December 15th has been filled with data synthesized via MCP using the RERL algorithm (the red colored data). MCP data has been used in the creation of the most of the graphs in this report; specifically: Time Series, Wind Speed Distribution, Monthly Average Wind Speed, and Diurnal Average Wind Speed plots. Turbulence Intensity and Wind Rose plots have been created using the observed data from the year of May 1st 2006 until April 30th 2007. Figure 3 shows that the wind speed was between 5 m/s and 6 m/s (11.2 mph 13.4 mph) about 17% of the time. Figure 4 shows that the monthly average wind speeds were generally above 5 m/s (11.2 mph). Figure 5 shows that the wind speed was generally higher during the midday hours. Figure 6 shows that the site turbulence intensity at 49 m was generally below 0.3 (for the existing data from the yearly dataset). Figure 7 shows that though the highest average wind speeds were from the southwest: 6.53 m/s (14.6 mph), the wind speeds were fairly well distributed across the compass rose; and shows that the wind blew primarily from the south-southwest (for the existing data from the yearly dataset).

Data for the wind speed histograms, monthly and diurnal average plots, and wind roses are included in APPENDIX B.

Wind Speed Time Series

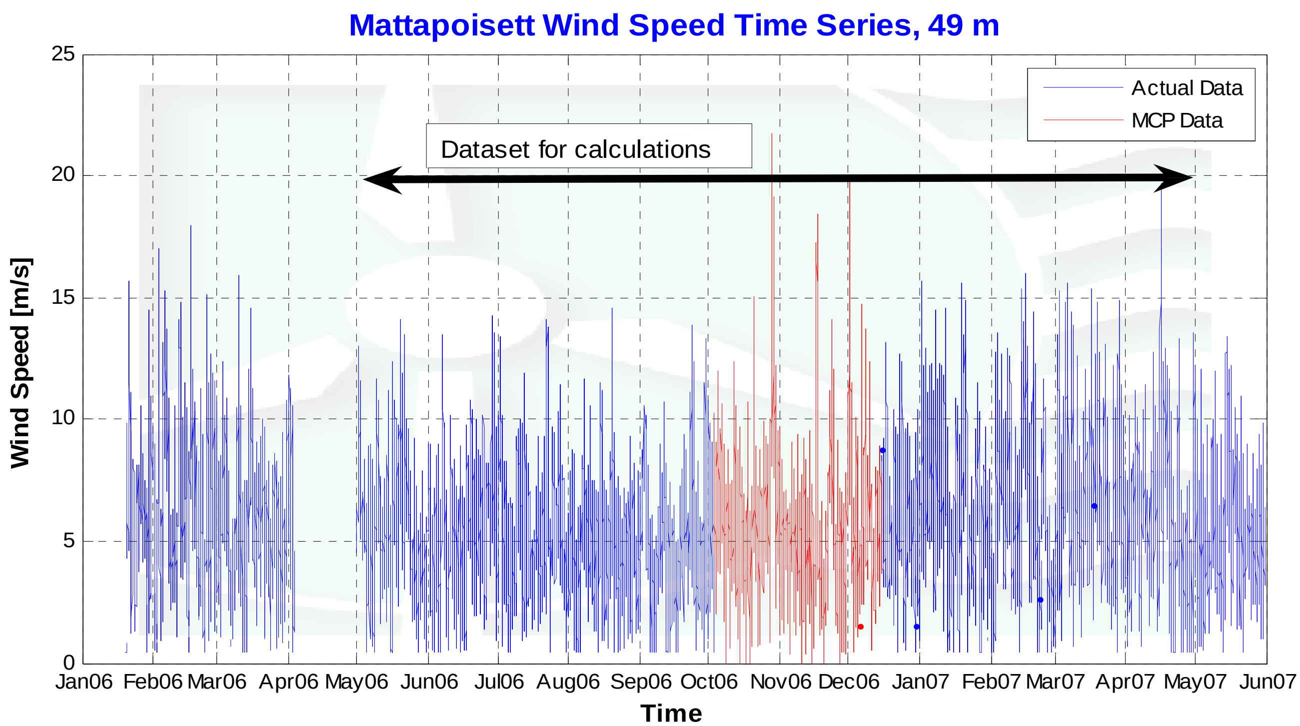

Figure 2 - Wind Speed Time Series, January 19, 2006 through June 1st, 2007

Wind Speed Distributions

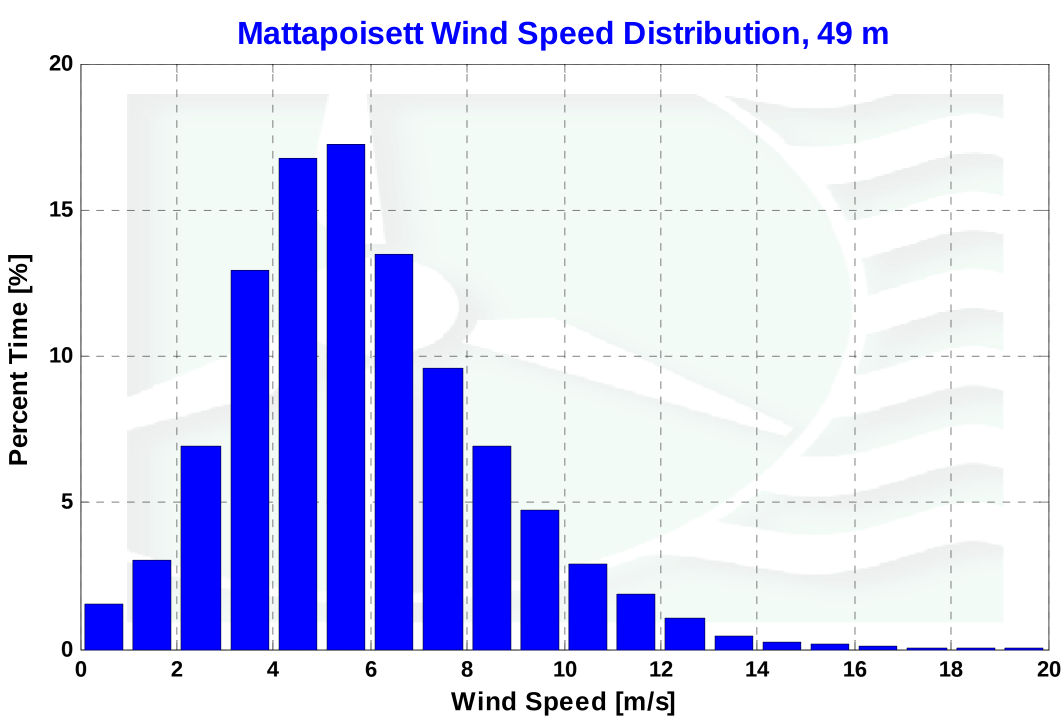

Figure 3 - Wind Speed Distribution, May 1, 2006 through April 30, 2007

Monthly Average Wind Speeds

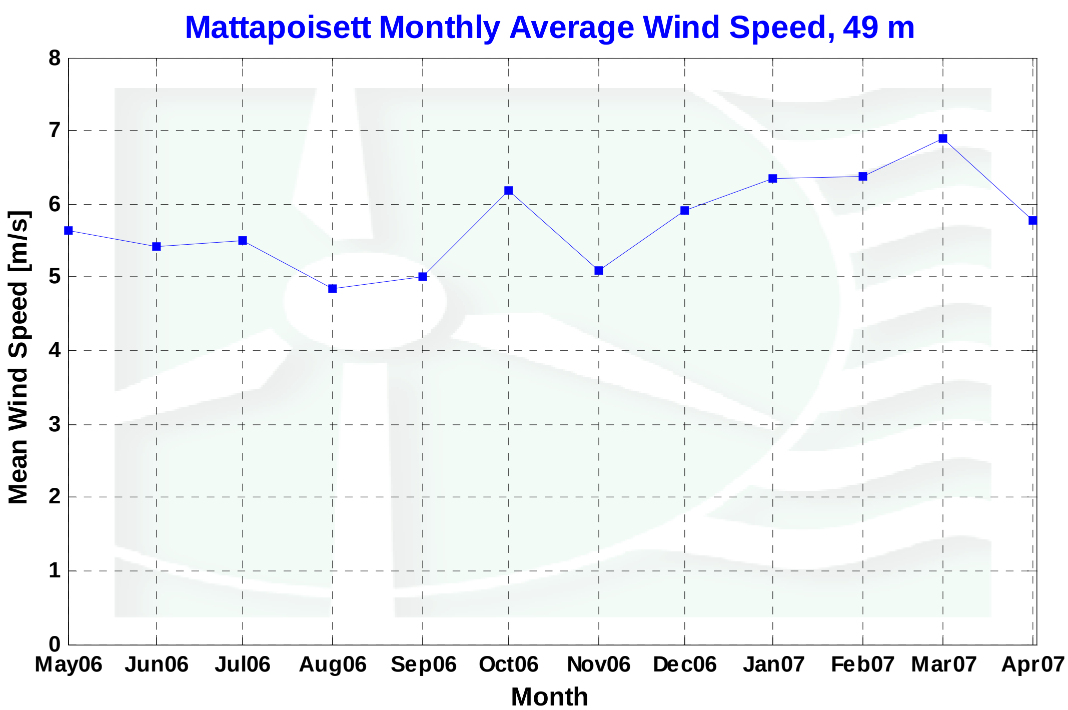

Figure 4 - Monthly Average Wind Speed

Diurnal Average Wind Speeds

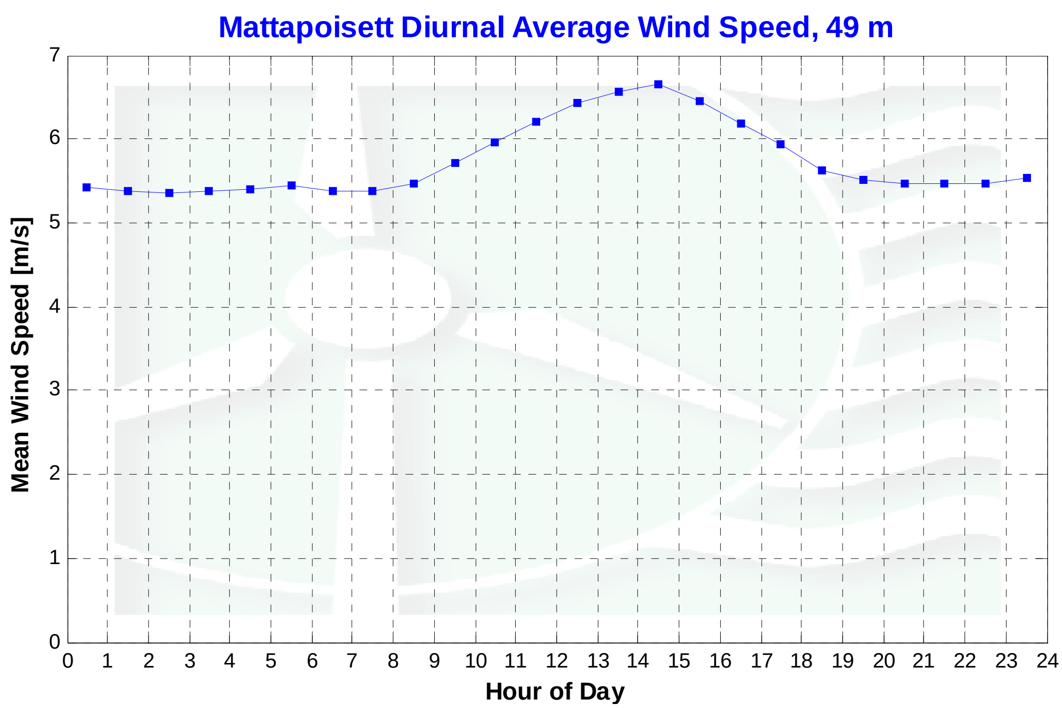

Figure 5 - Diurnal Average Wind Speed, May 1, 2006 through April 30, 2007

Turbulence Intensities

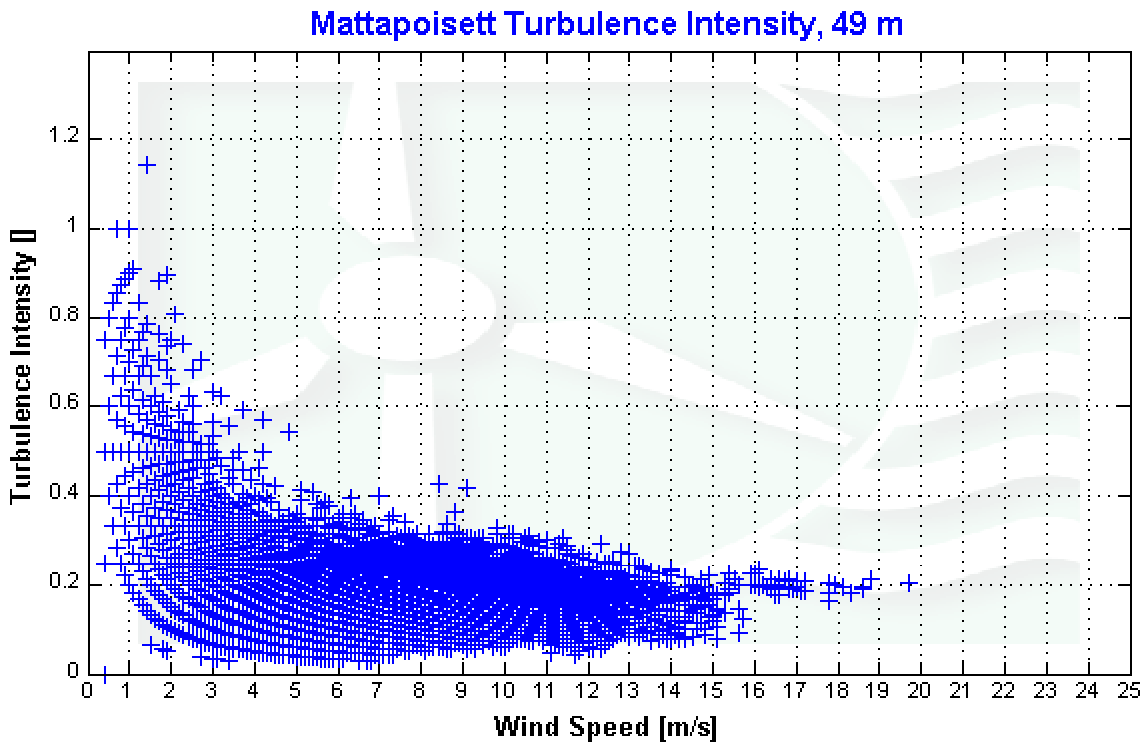

Figure 6 - Turbulence Intensity, May 1, 2006 through April 30, 2007

Wind Roses

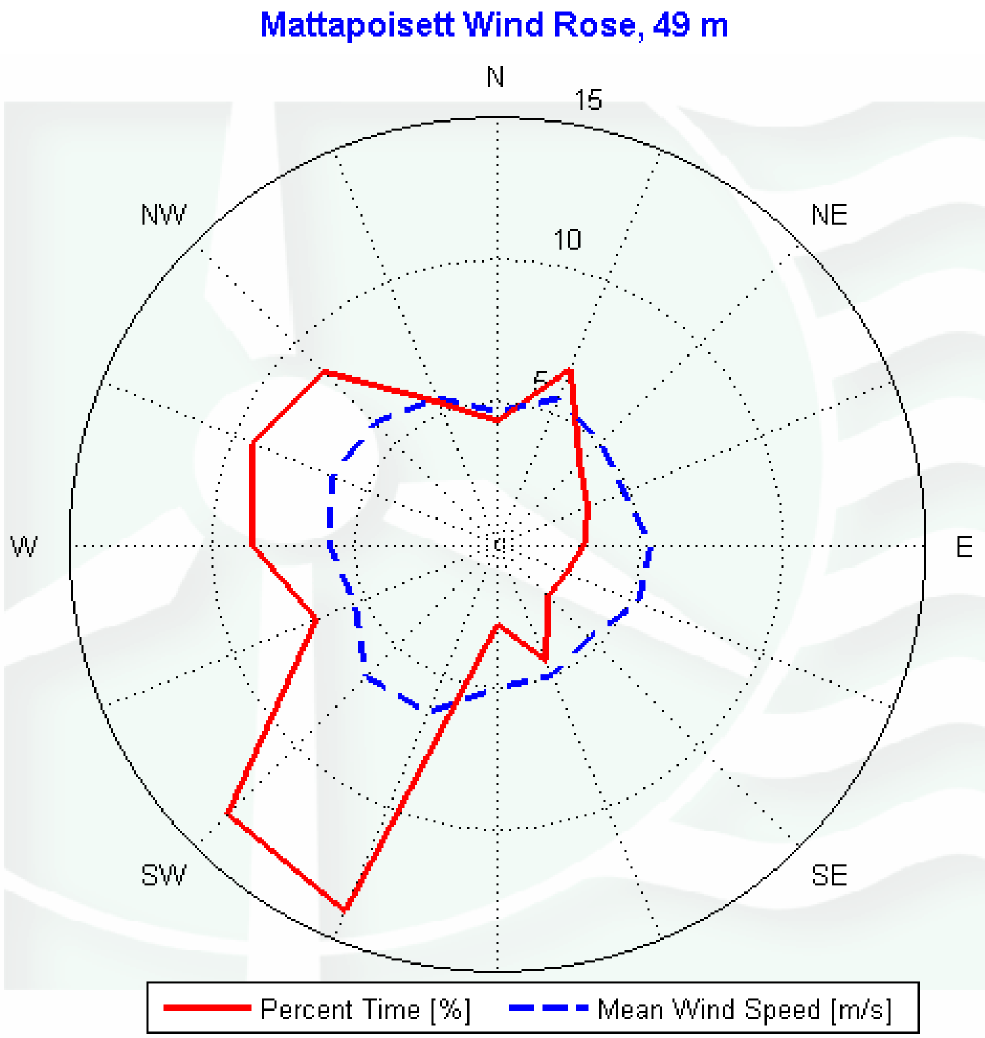

Figure 7 - Wind Rose, May 1, 2006 through April 30, 2007

SECTION 6 - Significant Meteorological Events

Except for a storm affecting both Mattapoisett and ORR with high winds over a three-day period starting October 27th, there were no major meteorological events that would have caused notable fluctuations in wind speed measurements during the year. Though no data exists from Mattapoisett during the storm, its effect can be observed in the MCP synthesized data.

Source: http:\\wunderground.com\history\airport\KORE

SECTION 7 - Data Collection and Maintenance

Although there are a few short duration sensor-icing events, that have caused minor data loss, there are two large gaps in the data that have differing causes. The first large gap from about April 3rd until May 1st (2006) was caused by corruption of the main and backup databases that the RERL maintains using the NRG BaseStation® software. The second large gap from about October 3rd until December 15th (2006) appears to have been caused by failure of the logger battery.

SECTION 8 - Data Recovery and Validation

All raw wind data are subjected to a series of tests and filters to weed out data that are faulty or corrupted. Definitions of these quality assurance (QA) controls are given below under Test Definitions and Sensor Statistics. These control filters were designed to automate the quality control process and used many of the previous hand-worked data sets made at UMass to affect a suitable emulation. The gross percentage of data recovered (ratio of the number of raw data points received to data points expected) and net percentage (ratio of raw data points which passed all QA control tests to data points expected) are shown below.

Gross Data Recovered [%]	79.975
Net Data Recovered [%]	79.265

Test Definitions

All raw data were subjected to a series of validation tests, as described below. The sensors tested and the parameters specific to each sensor are given in the Sensor Performance Report which is included in APPENDIX A. Data which were flagged as invalid were not included in the statistics presented in this report.

MinMax Test: All sensors are expected to report data values within a range specified by the sensor and logger manufacturers. If a value falls outside this range, it is flagged as invalid. A data value from the sensor listed in Test Field 1 (TF1) is flagged if it is less than Factor 1 (F1) or greater than Factor 2. This test has been applied to the following sensors (as applicable): wind speed, wind speed standard deviation, wind direction, temperature, and solar insolation.

$$F1 > TF1 > F2$$

MinMaxT Test: This is a MinMax test for wind direction standard deviation with different ranges applied for high and low wind speeds. A wind direction standard deviation data value (TF1) is flagged either if it is less than Factor 1, if the wind speed (TF2) is less than Factor 4 and the wind direction standard deviation is greater than Factor 2, or if the wind speed is greater than or equal to Factor 4 and the wind direction standard deviation is greater than Factor 3.

$$(TF1 < F1)$$
$$\text{or } (TF2 < F4 \text{ and } TF1 > F2)$$
$$\text{or } (TF2 \geq F4 \text{ and } TF1 > F3)$$

Icing Test: An icing event occurs when ice collects on a sensor and degrades its performance. Icing events are characterized by the simultaneous measurements of near-zero standard deviation of wind direction, non-zero wind speed, and near- or below-freezing temperatures. Wind speed, wind speed standard deviation, wind direction, and wind direction standard deviation data values are flagged if the wind direction standard deviation (CF1) is less than or equal to Factor 1 (F1), the wind speed (TF1) is greater than Factor 2 (F2), and the temperature (CF2) is less than Factor 3 (F3). To exit an icing event, the wind direction standard deviation must be greater than Factor 4.

$$CF1 \leq F1 \text{ and } TF1 > F2 \text{ and } CF2 < F3$$

CompareSensors Test: Where primary and redundant sensors are used, it is possible to determine when one of the sensors is not performing properly. For anemometers, poor performance is characterized by low data values. Therefore, if one sensor of the pair reports values significantly below the other, the low values are flagged. At low wind speeds (Test Fields 1 and 2 less than or equal to Factor 3) wind speed data are flagged if the absolute difference between the two wind speeds is greater than Factor 1. At high wind speeds (Test Fields 1 or 2 greater than Factor 3) wind speed data are flagged if the absolute value of the ratio of the two wind speeds is greater is greater than Factor 2.

$$[\ TF1 \leq F3 \text{ and } TF2 \leq F3 \text{ and } \mathrm{abs}(TF1 - TF2) > F1\ ]$$
$$\text{or } [\ (TF1 > F3 \text{ or } TF2 > F3) \text{ and } (\mathrm{abs}(1 - TF1 / TF2) > F2 \text{ or } \mathrm{abs}(1 - TF2 / TF1) > F2)\ ]$$

Sensor Statistics

A summary of the results of the data collection and filtering are given in the Sensor Performance Report which is included in APPENDIX A. The following categories of information, tabulated for each sensor, are included in that report.

Expected Data Points: the total number of sample intervals between the start and end dates (inclusive).

Actual Data Points: the total number of data points recorded between the start and end dates.

% Data Recovered: the ratio of actual and expected data points (this is the *gross data recovered percentage*).

Hours Out of Range: total number of hours for which data were flagged according to MinMax and MinMaxT tests. These tests flag data which fall outside of an expected range.

Hours of Icing: total number of hours for which data were flagged according to Icing tests. This test uses the standard deviation of wind direction, air temperature, and wind speed to determine when sensor icing has occurred.

Hours of Fault: total number of hours for which data were flagged according to CompareSensors tests. These tests compare two sensors (e.g. primary and redundant anemometers installed at the same height) and flag data points where one sensor differs significantly from the other.

% Data Good: the filter results are subtracted from the gross data recovery percentage to yield the *net data recovered percentage*.

APPENDIX A - Sensor Performance Report

Test Definitions

Test Order	TestField1	TestField2	TestField3	CalcField1	Calc Field2	Calc Field3	TestType	Factor1	Factor2	Factor3	Factor4
1							TimeTest Insert	0	0	0	0
2	Etmp2aDEGC						MinMax	-30	60	0	0
3	Etmx2aDEGC						MinMax	-30	60	0	0
4	Etmn2aDEGC						MinMax	-30	60	0	0
5	EtmpSD2aDEGC						MinMax	-30	60	0	0
10	Anem49aMS						MinMax	0	90	0	0
11	Anem49bMS						MinMax	0	90	0	0
12	Anem38aMS						MinMax	0	90	0	0
13	Anem38bMS						MinMax	0	90	0	0
14	Anem20aMS						MinMax	0	90	0	0
20	AnemSD49aMS						MinMax	0	4	0	0
21	AnemSD49bMS						MinMax	0	4	0	0
22	AnemSD38aMS						MinMax	0	4	0	0
23	AnemSD38bMS						MinMax	0	4	0	0
24	AnemSD20aMS						MinMax	0	4	0	0
30	Vane49aDEG						MinMax	0	359.9	0	0
31	Vane38aDEG						MinMax	0	359.9	0	0
32	Vane20aDEG						MinMax	0	359.9	0	0
50	Turb49zNONE						MinMax	0	2	0	0
51	Turb38zNONE						MinMax	0	2	0	0
52	Turb20ZNONE						MinMax	0	2	0	0
60	Wshr0zNONE						MinMax	-100	100	0	0
200	VaneSD49aDEG	Anem49yMS					MinMaxT	0	100	100	10
201	VaneSD38aDEG	Anem38yMS					MinMaxT	0	100	100	10
202	VaneSD20aDEG	Anem20aMS					MinMax	0	100	100	10
300	Anem49aMS	AnemSD49aMS	Vane49aDEG	VaneSD49aDEG	Etmp2aDEGC		Icing	0.5	1	2	10
301	Anem49bMS	AnemSD49bMS	Vane49aDEG	VaneSD49aDEG	Etmp2aDEGC		Icing	0.5	1	2	10
302	Anem38aMS	AnemSD38aMS	Vane38aDEG	VaneSD38aDEG	Etmp2aDEGC		Icing	0.5	1	2	10
303	Anem38bMS	AnemSD38bMS	Vane38aDEG	VaneSD38aDEG	Etmp2aDEGC		Icing	0.5	1	2	10
304	Anem20aMS	AnemSD20aMS	Vane20aDEG	VaneSD20aDEG	Etmp2aDEGC		Icing	0.5	1	2	10
400	Anem49aMS	Anem49bMS					CompareSensors	1	0.25	3	0
401	Anem38aMS	Anem38bMS					CompareSensors	1	0.25	3	0
500	Amax49aMS						MinMax	0	90	0	0
501	Amax49bMS						MinMax	0	90	0	0
502	Amax38aMS						MinMax	0	90	0	0
503	Amax38bMS						MinMax	0	90	0	0
504	Amax20aMS						MinMax	0	90	0	0

510	Amin49aMS						MinMax	0	90	0	0
511	Amin49bMS						MinMax	0	90	0	0
512	Amin38aMS						MinMax	0	90	0	0
513	Amin38bMS						MinMax	0	90	0	0
514	Amin20aMS						MinMax	0	90	0	0
520	Vmax49aDEG						MinMax	0	359.9	0	0
521	Vmax38aDEG						MinMax	0	359.9	0	0
522	Vmax20aDEG						MinMax	0	359.9	0	0
530	Vmin49aDEG						MinMax	0	359.9	0	0
531	Vmin38aDEG						MinMax	0	359.9	0	0
532	Vmin20aDEG						MinMax	0	359.9	0	0

Sensor Statistics

Sensor	Expected Data Points	Actual Data Points	% Data Recovered	Hours Out of Range	Hours of Icing	Hours of Fault	% Data Good
Anem49aMS	52560	42035	79.975	0.167	75.5	8.5	79.014
AnemSD49aMS	52560	42035	79.975	0.167	75.5	8.5	79.014
Anem49bMS	52560	42035	79.975	0.167	76.5	72.333	78.274
AnemSD49bMS	52560	42035	79.975	0.167	76.5	72.333	78.274
Anem38aMS	52560	42035	79.975	0	46.333	1.333	79.431
AnemSD38aMS	52560	42035	79.975	0	46.333	1.333	79.431
Anem38bMS	52560	42035	79.975	0.167	46.333	2.5	79.416
AnemSD38bMS	52560	42035	79.975	0.167	46.333	2.5	79.416
Anem20aMS	52560	42035	79.975	0	53.333	0	79.366
AnemSD20aMS	52560	42035	79.975	0	53.333	0	79.366
Vane49aDEG	52560	42035	79.975	0.833	76.5	0	79.092
VaneSD49aDEG	52560	42035	79.975	0.833	76.5	0	79.092
Vane38aDEG	52560	42035	79.975	1.333	46.333	0	79.431
VaneSD38aDEG	52560	42035	79.975	1.333	46.333	0	79.431
Vane20aDEG	52560	42035	79.975	1	53.333	0	79.355
VaneSD20aDEG	52560	42035	79.975	1	53.333	0	79.355
Etmp2aDEGC	52560	42035	79.975	0	0	0	79.975
EtmpSD2aDEGC	52560	42035	79.975	0	0	0	79.975
Anem49yMS	52560	42035	79.975	0.167	75.5	0	79.111
AnemSD49yMS	52560	42035	79.975	0.167	75.5	0	79.111
Anem38yMS	52560	42035	79.975	0	46.333	0	79.446
AnemSD38yMS	52560	42035	79.975	0	46.333	0	79.446
Total	**1156320**	**924770**	**79.975**	**7.667**	**1192**	**169.333**	**79.265**

APPENDIX B - Plot Data

Wind Speed Distribution Data

Bin Center Wind Speed [m/s]	Percent of Time [%]
0.5	1.53
1.5	3.05
2.5	6.89
3.5	12.93
4.5	16.77
5.5	17.22
6.5	13.46
7.5	9.57
8.5	6.91
9.5	4.73
10.5	2.93
11.5	1.89
12.5	1.02
13.5	0.46
14.5	0.26
15.5	0.16
16.5	0.10
17.5	0.06
18.5	0.03
19.5	0.02
20.5	0
21.5	0
22.5	0
23.5	0
24.5	0

Monthly Average Wind Speed Data

Date	10 min Mean [m/s]
May-06	5.63
June-06	5.42
July-06	5.51
Aug-06	4.84
Sept-06	5.02
Oct-06	6.18 **
Nov-07	5.09 **
Dec-07	5.90 **
Jan-07	6.34
Feb-07	6.38
Mar-07	6.89
Apr-07	5.77

Diurnal Average Wind Speed Data

Hour of Day	Average Wind Speed [m/s]
0.5	5.43
1.5	5.39
2.5	5.36
3.5	5.38
4.5	5.39
5.5	5.44
6.5	5.37
7.5	5.37
8.5	5.47
9.5	5.71
10.5	5.97
11.5	6.20
12.5	6.42
13.5	6.55
14.5	6.64
15.5	6.46
16.5	6.18
17.5	5.94
18.5	5.63
19.5	5.52
20.5	5.46
21.5	5.47
22.5	5.47
23.5	5.53

Wind Rose Data

Direction	Percent Time [%], 49 m	Mean Wind Speed [m/s], 49 m
N	4.37	4.68
NNE	6.24	5.55
NE	4.16	5.09
ENE	2.93	4.80
E	2.53	5.37
ESE	2.44	5.34
SE	2.34	4.58
SSE	4.37	4.99
S	2.83	5.03
SSW	13.16	6.39
SW	13.20	6.53
WSW	7.08	5.41
W	8.17	5.91
WNW	10.32	6.28
NW	9.85	6.06
NNW	6.00	5.56