



Wind Resource Summary for Lamar Site

Colorado Anemometer Loan Program

Monitoring Period: 12/8/2006 – 01/11/2008

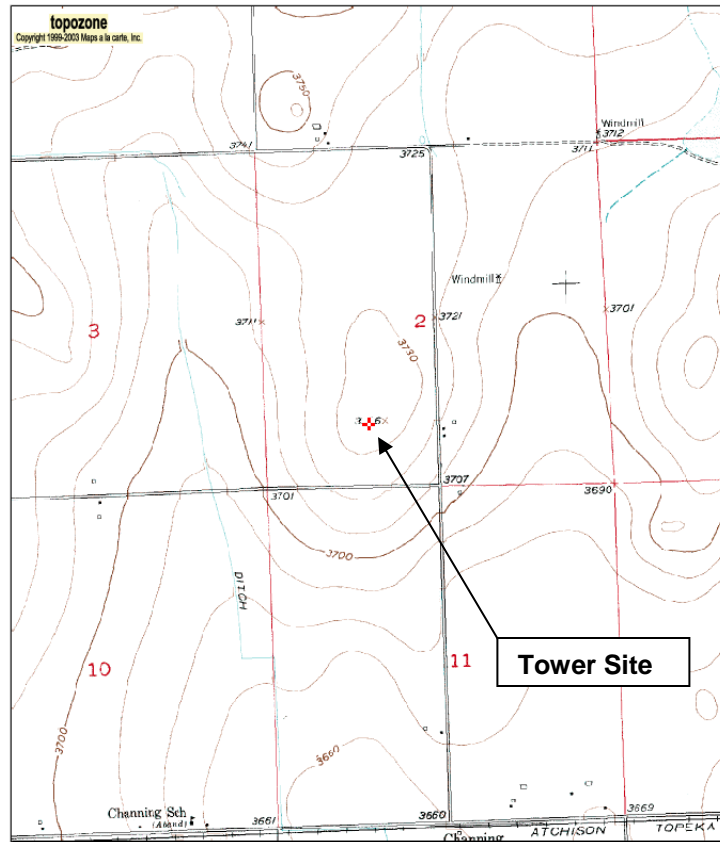
Report Date: February 1, 2008

Site Description:

The site is located about 5 miles north and 3 miles east of Lamar. The tower was placed on top of a hill in a pasture with native grass.

Note: Wind direction data appears to be suspect since the wind vane indicates that the wind was from the WSW direction during the entire data collection time period.

Table with 2 columns: LOCATION DETAILS and values for Latitude, Longitude, Township, Range, Section, Elevation, Tower Type, Tower Height, Vane Offset, Direction Basis, Mag. Declination.



Scale bar: 0 to 1.5 km / 0 to 1 mi. Coordinates: 38° 9.65'N, 102° 33.18'W (NAD83/WGS84). USGS May Valley (CO) Quadrangle. Projection is UTM Zone 13 NAD83 Datum.

M=7.958 G=1.513

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Wind Resource Summary

All analysis performed using Windographer 1.13

Data Properties	
Data Set Starts:	12/8/2006 13:10
Data Set Ends:	1/11/2008 9:50
Data Set Duration:	13.1 months
Length of Time Step:	10 minutes
Elevation (ft.):	3,734
Calm threshold (mph):	0
Wind Power Coefficients	
Power Density at 50m:	281 W/m ²
Wind Power Class:	2 (marginal)
Wind Power Coefficients	
Power Law Exponent:	0.14
Surface Roughness:	0.01 m
Roughness Class:	0.78
Roughness Description:	Rough Pasture

Height above ground (m)	20
Mean wind speed (mph)	11.58
Median wind speed (mph)	10.2
Min wind speed (mph)	0.61
Max wind speed (mph)	69.6
Mean power density (W/m ²)	191
Mean energy content (kWh/m ² /yr)	1,673
Energy pattern factor	2.509
Weibull k	1.698
Weibull c (mph)	13
1-hr autocorrelation coefficient	0.832
Diurnal pattern strength	0.126
Hour of peak wind speed	18
Mean turbulence intensity	0.161
Standard deviation (mph)	7.18
Coefficient of variation (%)	62
Frequency of calms (%)	0
Actual observations	57,436
Missing observations	0
Data completeness (%)	100

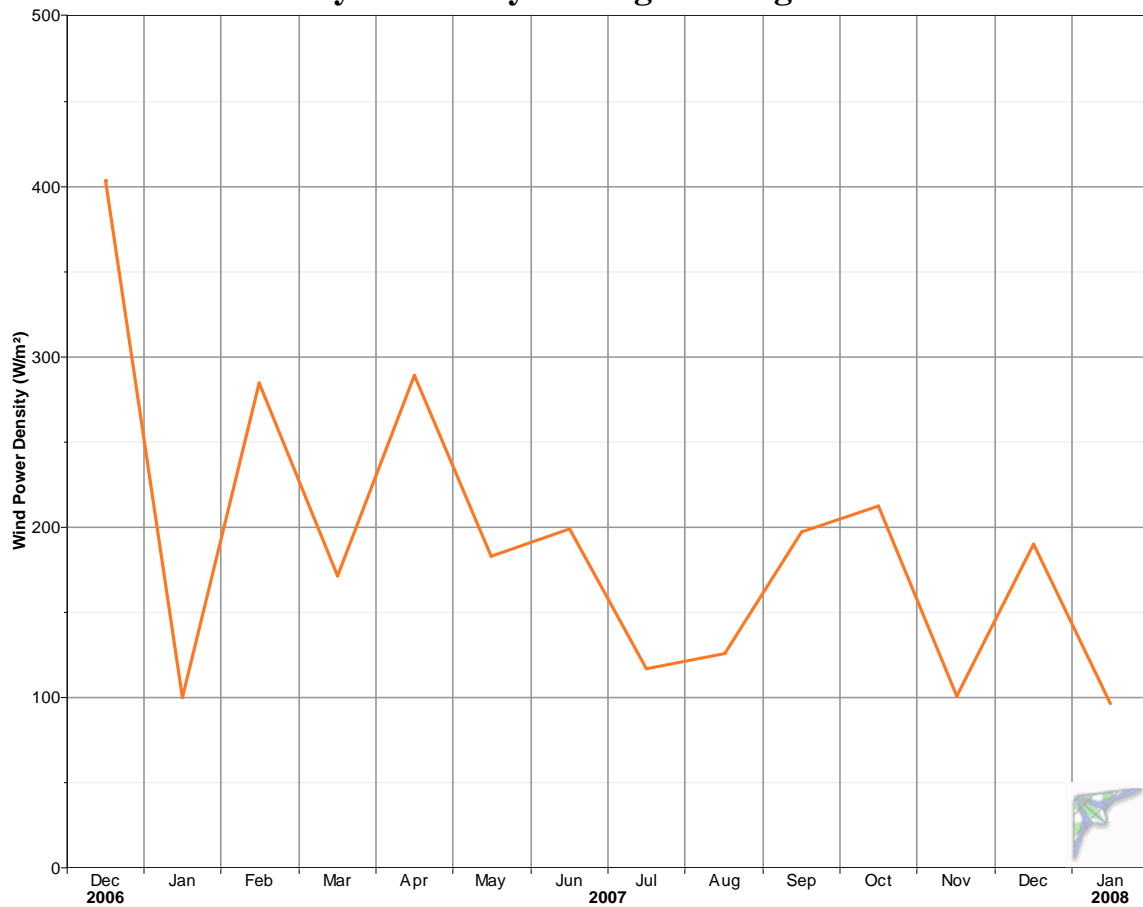
Note: Air temperature was not measured during the measuring period so air density taken to be 1.097 kg/m³ throughout the period

Annual Average Wind Resource Statistics – Speed and Direction

Hour of Day	Average Wind speed mph	Wind Power Density W/m ²	Hour of Day	Average Wind speed mph	Wind Power Density W/m ²
0.5	10.93	163.81	12.5	12.2	240.1
1.5	10.93	148.94	13.5	12.3	235.0
2.5	10.63	137.07	14.5	12.4	232.2
3.5	10.28	132.11	15.5	12.8	244.6
4.5	10.21	131.62	16.5	13.1	248.9
5.5	10.12	136.10	17.5	13.4	247.4
6.5	9.88	130.39	18.5	13.0	235.9
7.5	10.09	139.86	19.5	12.7	216.6
8.5	10.68	173.82	20.5	12.5	208.2
9.5	11.13	191.63	21.5	12.2	190.0
10.5	11.63	216.42	22.5	11.6	176.0
11.5	11.95	230.28	23.5	11.4	176.2








Direction Sector Midpoint degrees	Frequency percent	Direction Sector Midpoint degrees	Frequency percent
0	0	180	0
10	0	190	0
20	0	200	1.957
30	0	210	0
40	0.0017	220	4.6574
50	0	230	0
60	0.1828	240	39.726
70	0	250	0
80	0.0871	260	40.4972
90	0	270	0
100	0	280	0
110	0.5676	290	6.3601
120	0	300	0
130	1.1439	310	0.7452
140	0	320	0
150	1.4573	330	0.3064
160	0	340	0
170	2.286	350	0.0244

Wind Power Density – Monthly Average During Measurement Period



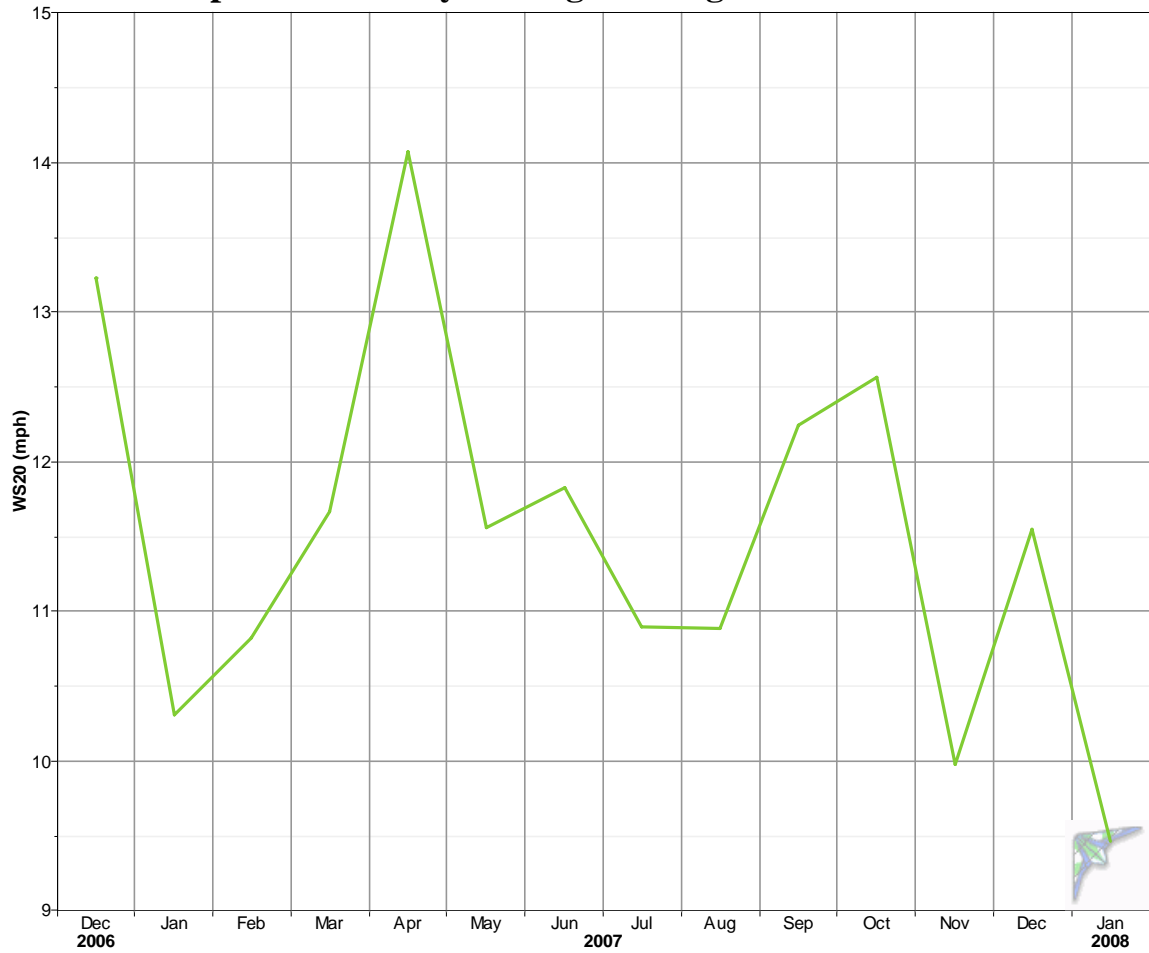
For reference, the table below provides a summary of the wind power classifications from the U.S. DOE's Colorado Wind Resource Map available at:

http://www.eere.energy.gov/windandhydro/windpoweringamerica/maps_template.asp?stateab=co

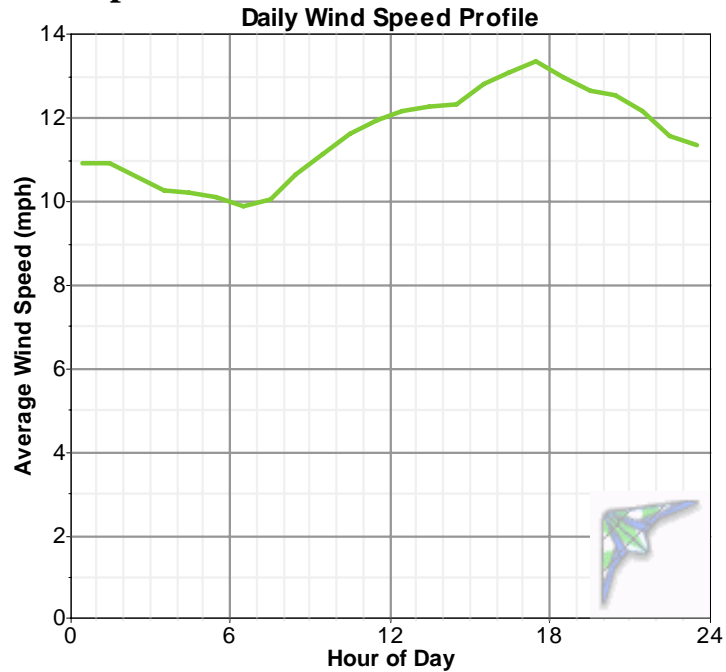
Wind Power Classification				
Wind Power Class	Resource Potential	Wind Power Density at 50 m W/m ²	Wind Speed ^a at 50 m m/s	Wind Speed ^a at 50 m mph
	1 Poor	0 - 200	0.0 - 5.9	0.0 - 13.2
	2 Marginal	200 - 300	5.9 - 6.7	13.2 - 15.0
	3 Fair	300 - 400	6.7 - 7.4	15.0 - 16.6
	4 Good	400 - 500	7.4 - 7.9	16.6 - 17.7
	5 Excellent	500 - 600	7.9 - 8.4	17.7 - 18.8
	6 Outstanding	600 - 800	8.4 - 9.3	18.8 - 20.8
	7 Superb	> 800	> 9.3	> 20.8

^a Wind speeds are based on a Weibull k of 2.0 at 1500 m elevation.

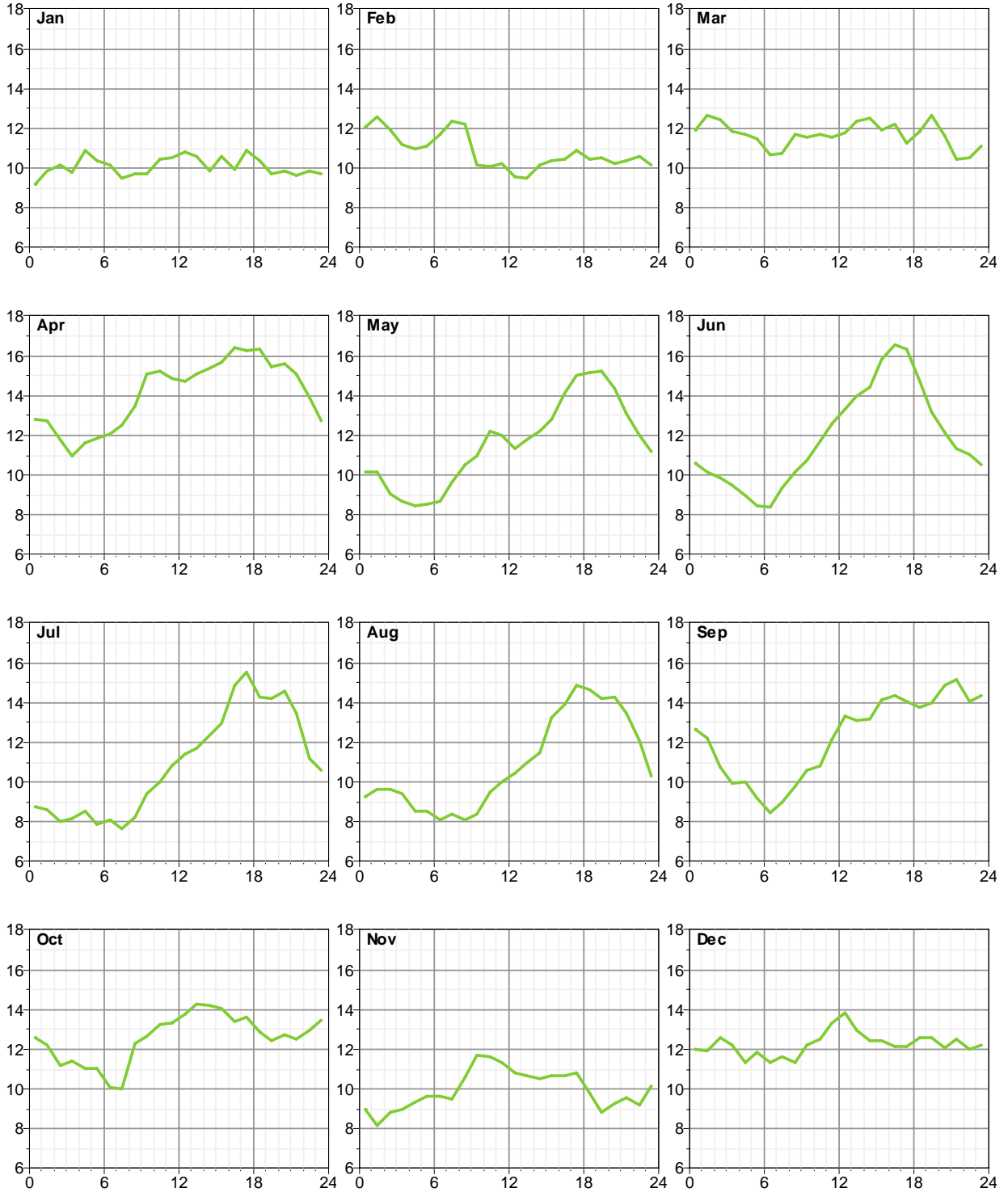
Wind Speed – Monthly Average During Measurement Period

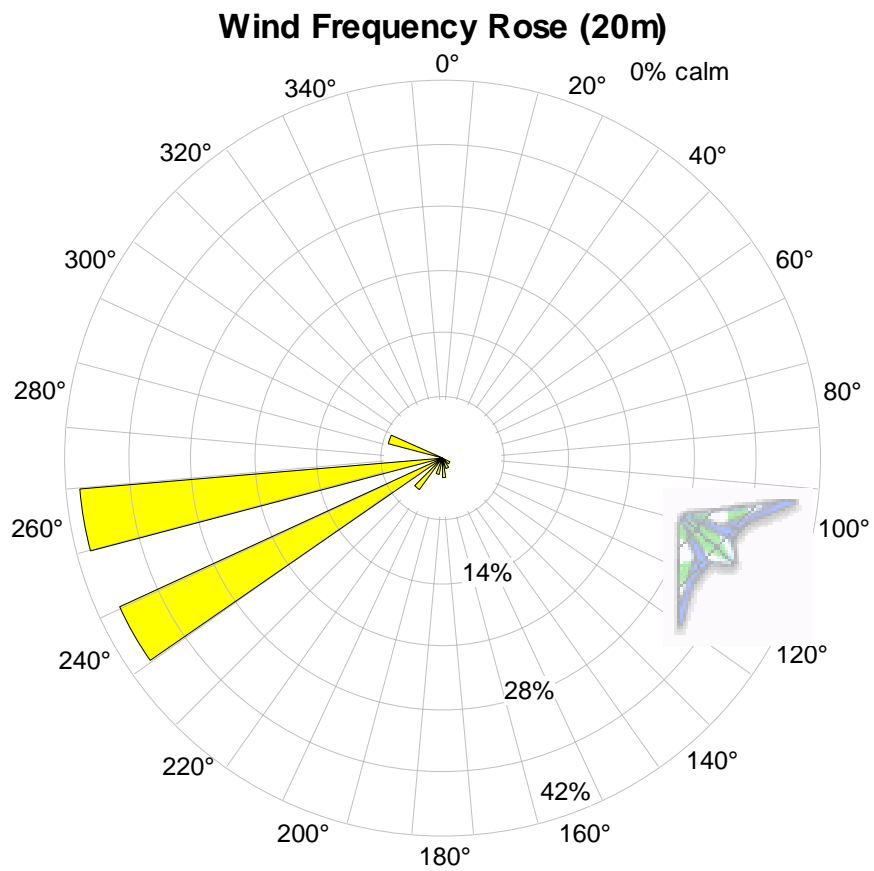
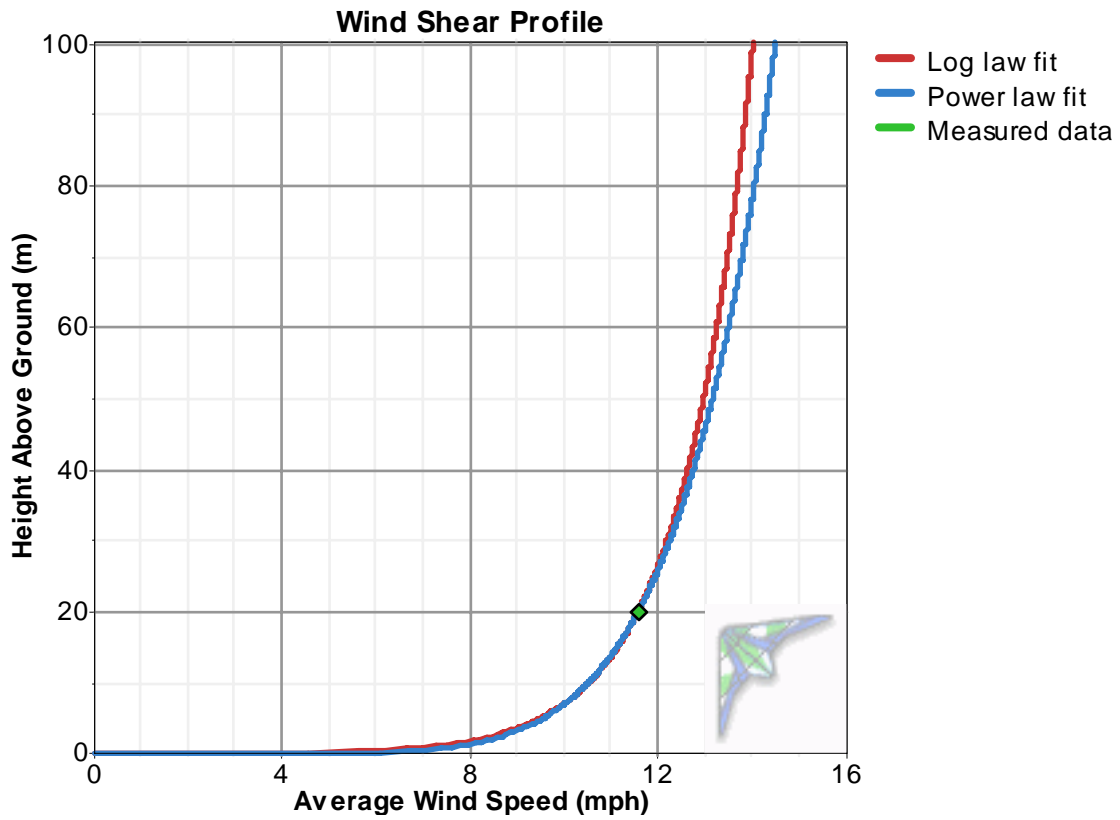


Daily Wind Speed Profile – Total For Measurement Period

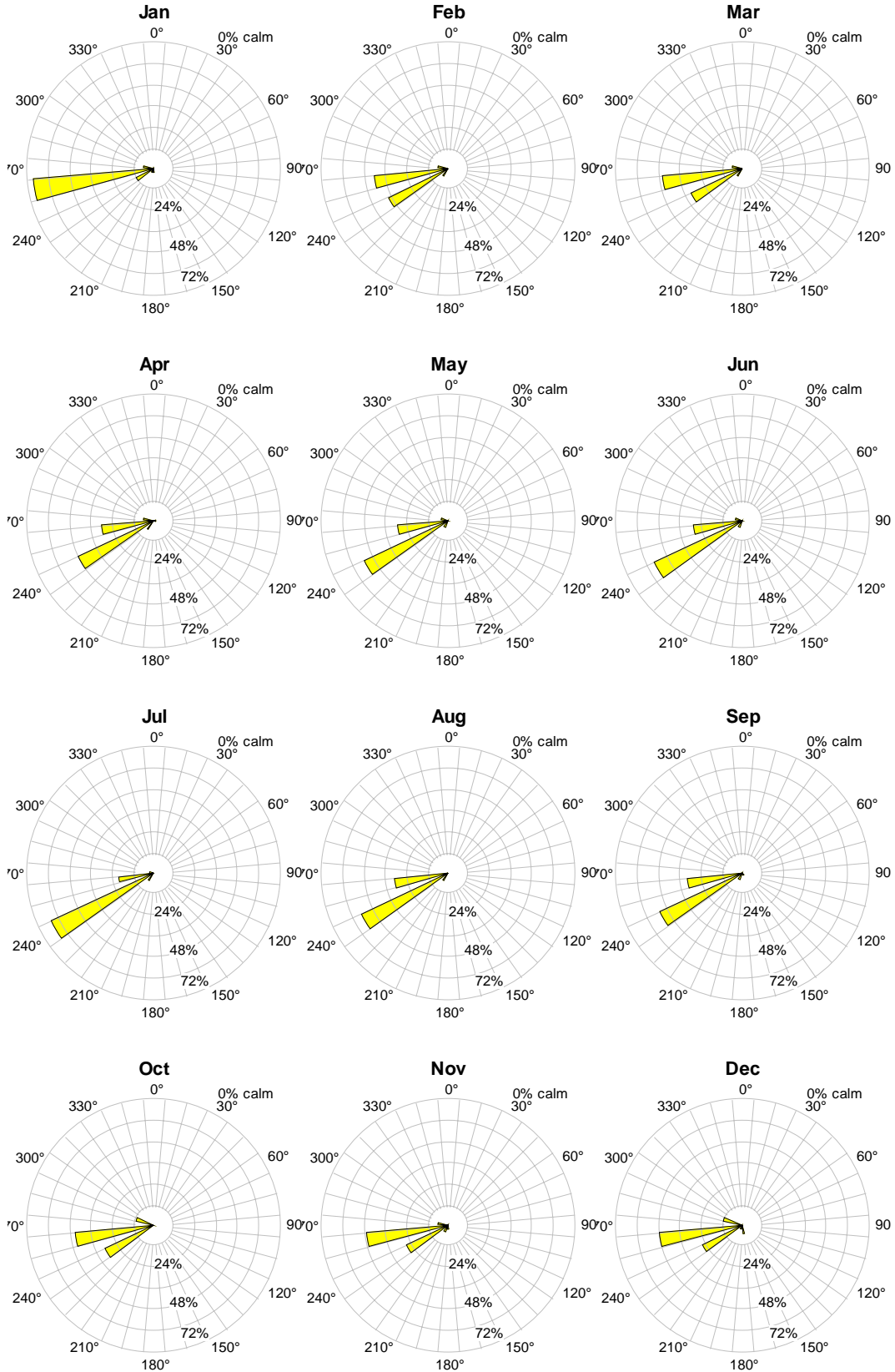


Hourly Wind Speed – By Month

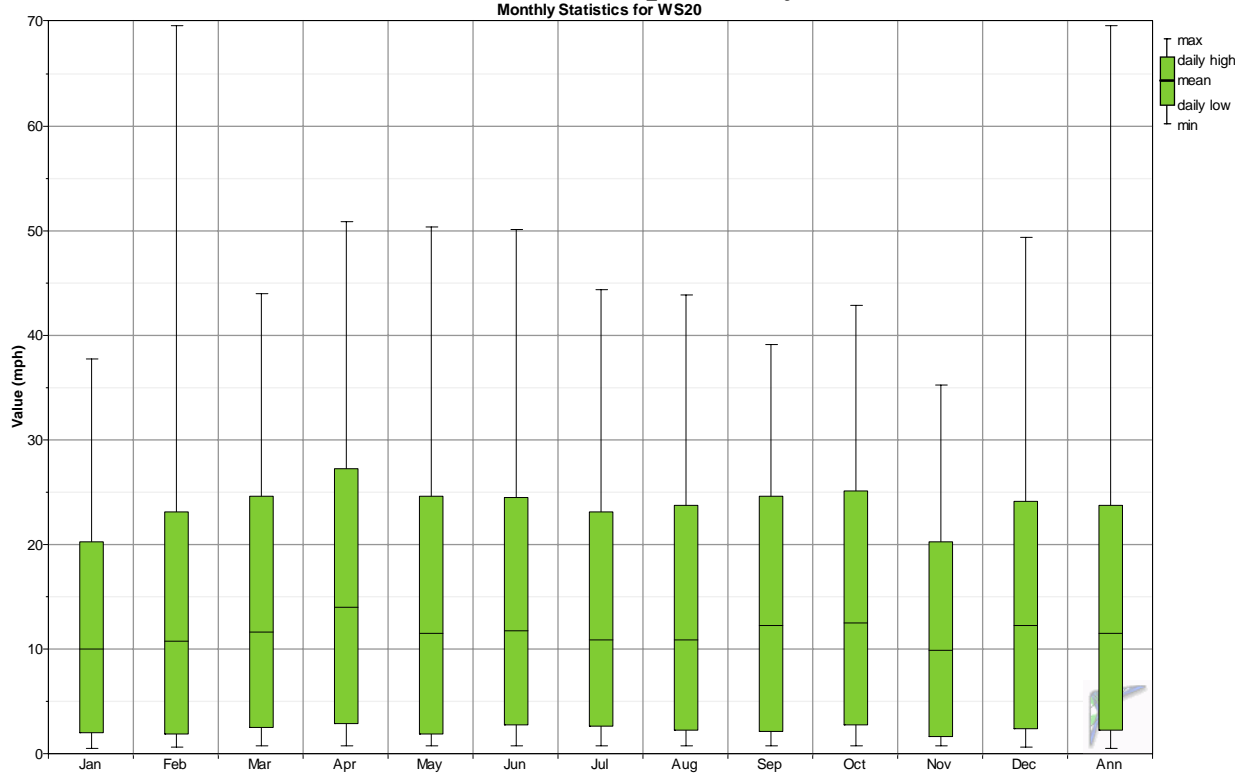




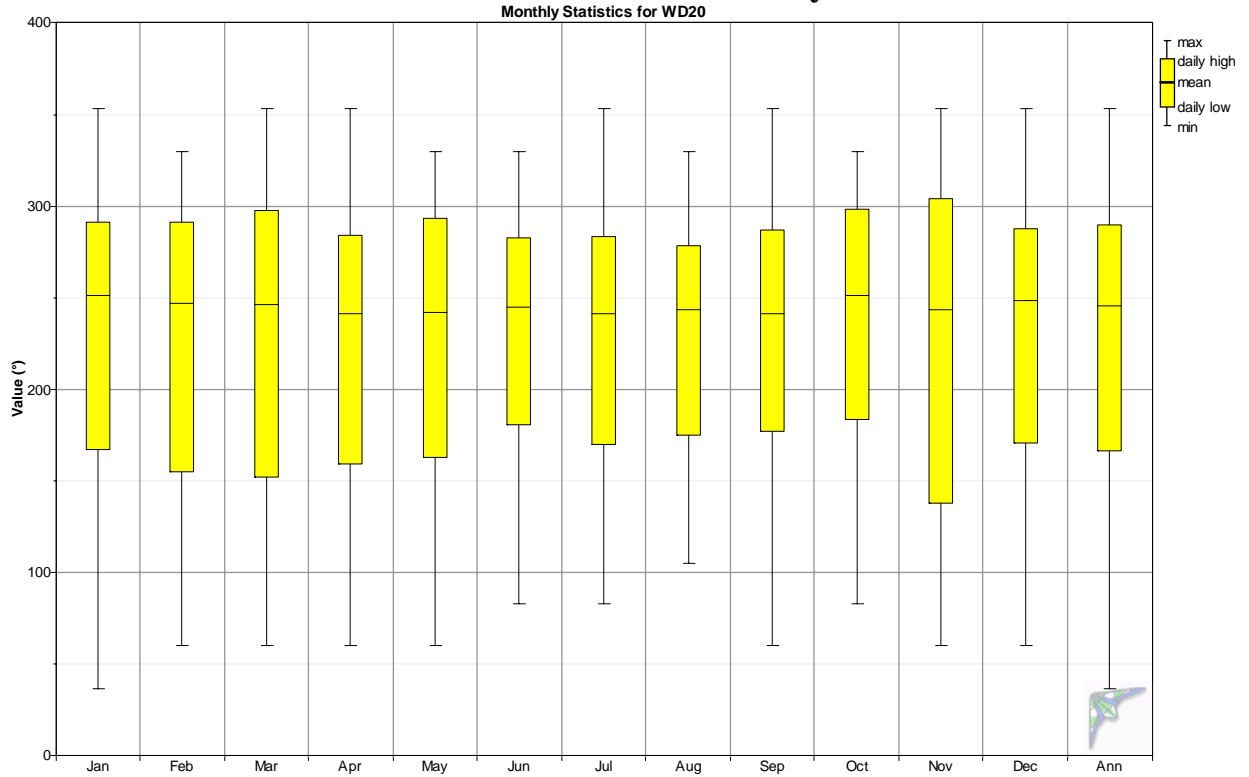
Wind Direction – By Month (All Years)



Box Plot for Wind Speed – By Month



Box Plot for Wind Direction – By Month



Estimated Wind Turbine Performance

The wind resource data from this site was compared against typical small wind turbines at 20m tower height to project the total energy production potential. The table below lists the turbines considered, the estimated turbine costs, and the expected turbine performance:

Turbine	Rotor Diameter <i>meters</i>	Rotor Power <i>kW</i>	Hub Height <i>meters</i>	Hub Height Wind Speed <i>mph</i>	Time At Zero Output <i>percent</i>	Time At Rated Output <i>percent</i>	Average Net Power Output <i>kW</i>	Average Net Energy Output <i>kWh/yr</i>	Average Net Capacity Factor <i>%</i>
Bergey Excel-R/120V	6.7	7.5	20	11.58	27.1	3.3	1.23	10,735	16.3
Bergey Excel-S/60	6.7	10	20	11.58	13.4	2.1	1.38	12,080	13.8
Bergey XL.1	2.5	1	20	11.58	4.5	5.0	0.19	1,661	19.0
Southwest Skystream 3.7	3.7	1.8	20	11.58	25.5	0.0	0.35	3,089	19.6
Southwest Whisper 500	4.5	3	20	11.58	27.0	4.1	0.62	5,393	20.5

Note that the costs do *not* include the costs for the tower or labor for installation.



These turbines are not recommended or endorsed. Landowners interested in installing a turbine are encouraged to contact a wind equipment dealer or a wind developer for design assistance and equipment recommendations.