Wyandotte Municipal Services
Community Wind Energy Project
Wind Resouce Summary

MONTHLY REPORT

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Black & Veatch Project: 144374

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Contents

1.0 Introduction 1-1

2.0 Met Tower Locations 2-1

3.0 Met Tower Operational Status 3-2

4.0 Data Collection Summary 4-1

5.0 Production Estimate Summary 5-1

Tables

Table 3-1. Met Tower Sites and Equipment Summary 3-8
Table 4-1. Wind Data Collection Summary. 4-1
Table 5-1. Production Estimates. 5-1

Figures

Figure 2-1. Met Tower locations and Land Control Status. 2-1
Figure 4-1. Monthly Average Low Level Wind Speeds. 4-1

1.0 Introduction

This report was prepared by Black & Veatch in the course of performing a wind energy assessment campaign for Wyandotte Municipal Services' study of wind energy development options. The development area is located in Wyandotte, Michigan, near the United States border with Canada. The duration of this report is from the time when each of the towers was commissioned to the end of September, 2007. This report covers a brief summary of wind data measured at two meteorological towers and an update of their operational status. Wind energy production estimates for the GE 1.5MW xle, Vestas V80 1.8MW and Vestas V90 3.0MW, wind turbine models are also included in this report to provide information on the developing level of performance for the project.

2.0 Met Tower Locations

The meteorological tower locations, their proximity to the international border and a national wildlife refuge are presented in Figure 2-1. The project is located in a densely populated urban environment with various sized structures throughout the local area. The tower sites are generally free from obstructions within 1,000 – 2,000 feet, with the nearest buildings no more than 2-3 stories tall.

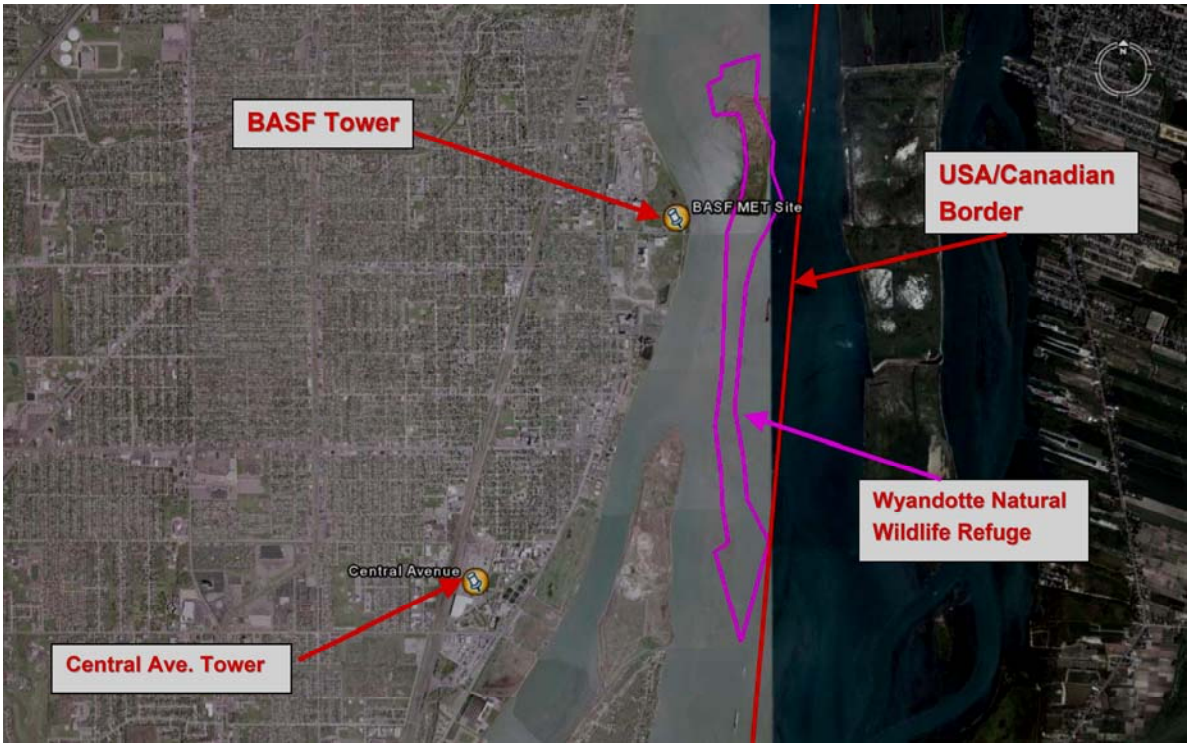

Figure 2-1. Met Tower locations.

3.0 Met Tower Operational Status

The meteorological equipment in use on the project site is presented in Table 3-1, all equipment is present; however, both wind direction sensors on the BASF tower have malfunctioned.

- Wind Vane at 59 meters – Stopped functioning August 24, 2007
- Wind Vane at 29 meters – Stopped functioning March 24, 2007

These sensor malfunctions are likely due to electrostatic discharge (ESD). Although these towers and instruments were installed with proper grounding equipment, the magnitude of an ESD event (such as a lightning strike) is unpredictable and can affect sensors and loggers despite significant grounding protection. The data from the loggers can provide valuable insight to when these events occur, and in some cases the extent of the damage caused. In the case of the BASF tower, it appears that the equipment has been subjected to one or more significant ESD events that have affected both of the wind vanes. While the data from this logger has provided clues to as to what happened, field testing is required to determine the extent of the damage and what equipment will need to be replaced.

Both of Wyandotte Municipal Services' towers were configured with redundant wind speed and direction sensors. These sensors aid the wind resource analysis in several ways, such as reducing the effects of tower shadowing and sensor data validation. However, this configuration was also developed so that a loss of a sensor (such as a wind vane or an anemometer) would not necessitate immediate action, thus reducing the frequency of required maintenance. Also, the close proximity of these towers and the high correlation of the wind direction, temperature and air pressure data also permits one tower's data to fill in the time series "gap" of another. Due to this relationship, the repair of the BASF wind direction sensors is not necessary at this time. The wind direction data collected from the Central Ave tower will be used to fill in the "gap" in the wind direction data at the BASF site until a time when another sensor malfunction (such as the 60m anemometer) necessitates lowering the tower to replace the damaged instruments.

3.1 Met Tower Maintenance Recommendations

As we have seen from this last year, the towers in this area are subject to strong, and potentially damaging, winter storms. As such, Black & Veatch has arranged, with the permission of Wyandotte Municipal Services, for a meteorological tower technician to visit the met tower sites to perform the following preventive maintenance:

- Tower Straightening/Inspection
- Guy Wire Tension Adjustment
- Anchor Inspection
- PV Panel Cleaning
- Logger operational inspection and maintenance
- Memory Card Data Download and Clearing

While this preventative maintenance will help to ensure that the towers operate well through the winter, Black & Veatch recommends that local personnel perform visual inspections after any major storms or icing events that may occur during the winter season to prevent or minimize any possibility of data loss. Please contact Black & Veatch with any new developments from the visual inspection process as soon as possible. The visual inspections combined with the Black & Veatch weekly data screening will ensure dataset integrity.

Table 3-1. Met Tower Sites and Equipment Summary.		
Met Tower Number:	02539	02540
Met Tower Name:	BASF	Central Avenue
Type:	60m Tubular; 8”- 6- 4.5” O.D	60m Tubular; 8”- 6 - 4.5” O.D
Manufacturer	Ohmega	Ohmega
Data Transfer Method	CDMA Modem	CDMA Modem
Wind Speed Sensor Type	NRG #40	NRG #40
Monitoring Heights Orientation	60m, 30m, 10m; SE&NW	60m, 30m, 10m; SE&NW
Wind Direction Sensor Type	NRG #200P	NRG #200P
Monitoring Heights & Orientation	49m, 29m; SW	49m, 29m; SW
Sensor Boom Length	60.5”	60.5”
Sensor Boom O.D	1.0”	1.0”
Sensor Rise above Boom	22”	22”
Temperature Sensor		SWI
Monitoring Height		3m
Pressure Sensor		Setra 276
Monitoring Height		3m
Latitude (WGS84):	42º 13' 6" N	42º 11' 21.42" N
Longitude (WGS84):	83º 8' 33.06" W	83º 9' 46.86" W
Elevation (meters):	174	175
Installation date:	March 21, 2007	December, 22 2006
Dataset Ongoing?	Yes	Yes
Last Maintenance Date:		

4.0 Data Collection Summary

Black & Veatch receives raw data from the met towers on a daily basis and reviews the wind data on a weekly basis. All data is validated through a process of visual inspections of the time series data, along with the comparison of wind speed measurements at different heights on the same tower and between towers. Wind speed data between each met tower's anemometers at the upper two measurement heights were used to derive the power law exponents, or shear exponents, for each tower on a 10-minute basis. The wind shear exponent represents the rate at which winds speeds will change with height. Only wind speeds greater than 4 meters per second were used to perform this calculation. These shear values were then used to create an 80m (hub height) dataset. These monthly averages for each tower are summarized in Table 4-1.

The observed pattern of variation in the monthly wind speeds for the lower level sensors of each met tower are shown in Figure 4-1. Also plotted on the chart is the long term monthly average wind speeds observed at the Detroit Airport (call sign DTW). The average wind speeds for each tower have a strong correlation to each other and with the reference stations. From this data, it appears that the wind speed averages follow the general trend of the nearby long term reference stations. September is observed as being the lowest wind speed time of the year, which is consistent with normal season conditions in the region. The strong correlation also indicates that wind resource averages will also likely increase in the subsequent months.

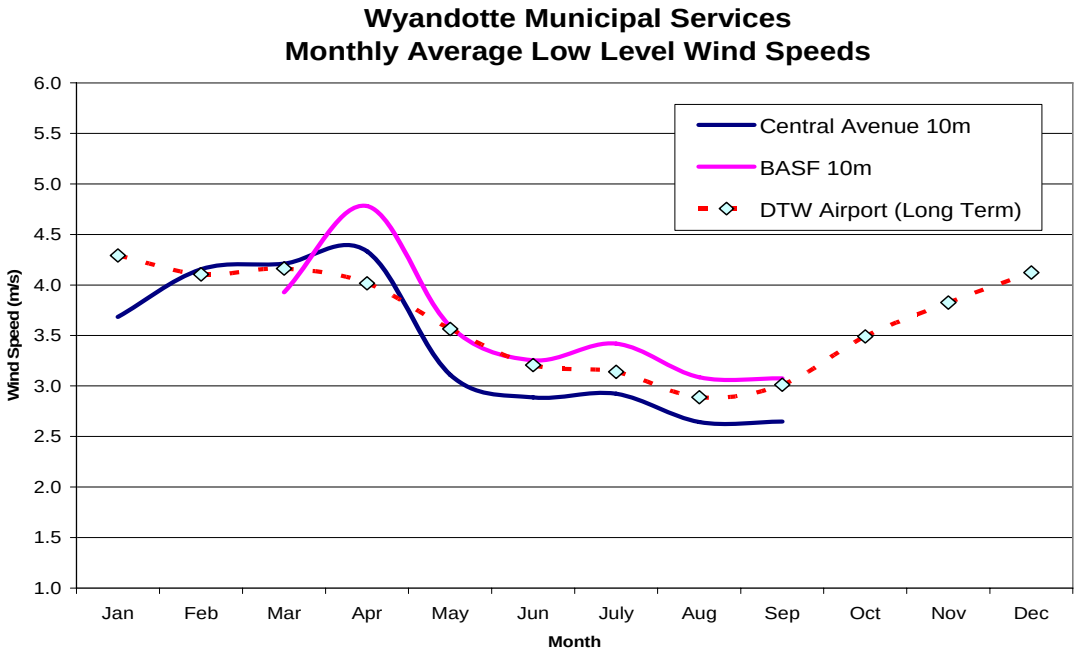

Figure 4-1. Monthly Average Low Level Wind Speeds.

Table 4-1. Wind Data Collection Summary.

	Year	2007												Average To Date	
	Month	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	m/s	mph
60m Average Wind Speed (m/s)	Central Ave	5.7	6.1	6.4	6.3	4.7	4.3	4.3	4.1	4.2				**5.1**	11.6
	BASF				6.4	5.0	4.5	4.6	4.3	4.5				**4.9**	11.1
80m Average Wind Speed (m/s)	Central Ave	6.1	6.5	6.9	6.8	5.2	4.7	4.6	4.4	4.6				**5.5**	12.6
	BASF				6.8	5.4	5.0	5.0	4.6	5.0				**5.3**	12.0
80m Max Average Wind Speed (m/s)	Central Ave	16.1	18.1	16.9	18.0	17.4	15.1	15.2	16.3	13.7				**16.3**	37.0
	BASF				18.0	18.2	18.5	15.9	14.0	15.2				**16.6**	37.7
80m Max 3-sec Wind Gust (m/s)	Central Ave	25.0	26.8	27.0	25.9	33.8	21.6	24.9	32.4	21.0				**33.8**	76.7
	BASF				25.0	31.5	24.7	27.0	26.5	23.4				**31.5**	71.5
30m to 60m Average Wind Shear	Central Ave	0.263	0.245	0.217	0.285	0.257	0.305	0.285	0.233	0.242				**0.259**	
	BASF				0.194	0.240	0.259	0.237	0.224	0.315				**0.245**	
Average Turbulence Intensity @ 15 m/s	Central Ave	16.7%	17.1%	17.6%	15.9%	34.8%		18.6%	35.1%	0.0%				**19.5%**	
	BASF				16.7%		11.9%	17.5%						**15.3%**	
Average Temperature (ºC)	Central Ave	-0.5	-6.7	4.4	8.4	16.7	9.7	23.5	24.7	20.2				**11.2**	
	BASF														
Average Air Density (kg/m^3)	Central Ave	1.270	1.300	1.250	1.225	1.198	1.254	1.166	1.162	1.184				**1.223**	
	BASF														

Notes:
- All wind speed values in meters per second (m/s) unless otherwise indicated. 1m/s = 2.24 mph.
- 80 meter wind speed data is estimated from 60 meter data and measured wind shear between 60 and 30 meters.

5.0 Production Estimate Summary

The wind energy production estimates in Table 5-1 display the likely performance for several turbine models that have operational characteristics conducive for the wind resource observed at this project area. These production estimates incorporate an assumed 15 percent project loss and are based on power curves matching the observed air densities at each met tower site. These results are preliminary, based on a simple spreadsheet lookup function on a time-series basis. A more comprehensive wind energy estimate conforming to industry standards will need to be provided after a year of data has been collected to accurately estimate production.

Table 5-1. Production Estimates.

	Year	2007												Average To Date
	Month	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	
Est. GE 1.5 xle Gross Capacity Factor	Central Ave	28.7%	29.6%	36.4%	34.3%	18.9%	15.4%	13.4%	11.4%	12.7%				**22.3%**
	BASF				34.5%	20.6%	19.1%	16.1%	14.4%	16.0%				**20.1%**
GE 1.5 xle Production Estimate (MWh)	Central Ave	251.0	269.8	368.3	337.4	176.0	128.3	120.3	99.1	113.4				**207.1**
	BASF				333.8	194.7	154.8	147.3	124.0	144.5				**183.2**
Est. V82 1.65 Gross Capacity Factor	Central Ave	26.7%	27.8%	34.2%	32.3%	17.3%	13.8%	12.0%	10.0%	11.3%				**20.6%**
	BASF				32.4%	18.9%	17.5%	14.7%	13.0%	14.6%				**18.5%**
V82 1.65 MW Production Estimate (MWh)	Central Ave	256.9	278.6	380.5	349.7	176.9	127.0	118.6	95.8	110.9				**210.5**
	BASF				345.6	196.6	155.8	147.6	122.6	145.1				**185.6**
Est. V90 3.0 MW Gross Capacity Factor	Central Ave	18.6%	20.3%	25.1%	24.3%	11.9%	10.0%	8.4%	7.1%	8.1%				**14.9%**
	BASF				24.2%	12.9%	12.3%	10.2%	9.0%	10.1%				**13.1%**
V90 3.0 MW Production Estimate (MWh)	Central Ave	325.3	369.7	508.1	479.1	221.8	166.6	151.4	123.6	143.9				**276.6**
	BASF				468.3	244.8	199.0	186.0	154.9	182.0				**239.2**

Notes:

- Wind Turbine Production estimates are preliminary, a more comprehensive wind energy estimate will be provided after 1 year of data collection is complete.
- Capacity factor changes due to updating power curve to match recorded air density.
- An assumed loss factor of 15 percent is applied to production values.
- Capacity factor changes due to updating turbine model to match appropriate wind characteristics.