Appendix S
Justification for Use of 15 Years of Scottsbluff's Meteorological Data

Hourly wind data were retrieved from the Chadron airport meteorological station for the last 12 years. The purpose of analyzing the Chadron site was to corroborate results from the 15-year Scottsbluff wind data analysis.

A regression analyses for wind parameters at the Scottsbluff meteorological station is presented below with p-values. The objective of the regression analysis is to show that the value of one variable "x" (long-term wind speed or direction frequency) reliably represents or predicts the value of another variable "y" (short-term wind speed or direction frequency). In order to demonstrate that short-term wind patterns reliably represent the longer term wind patterns, the short-term wind frequency values (y) constitute the dependent variable and the long-term values (x) are the independent variable. This recognizes the established convention of assigning the more uncertain quantity to the dependent variable. Each point on the graph represents a specific wind speed class, or a specific wind direction category, depending on the context. Hence, there are six points for the wind speed analysis and 16 points for the wind direction analysis. The "y" value of each point corresponds to the short-term frequency of occurrence of a particular wind speed class or wind direction category. The "x" value of that point corresponds to the long-term frequency of occurrence of that same wind speed class or wind direction category.

If "x" and "y" are similarly distributed, then graphing them as described above will produce a scatterplot of points approximating a straight line with a slope near 1. A linear regression analysis provides a graph, a correlation equation, and an analysis of variance with associated p-value. The equations below show that for Scottsbluff, the wind direction correlation produced a slope of 0.90 and the wind speed correlation produced a slope of 1.01. For Chadron, the wind direction correlation produced a slope of 0.999 and the wind speed correlation produced a slope of 0.983. If "x" and "y" are similarly distributed, the regression analysis will also produce a coefficient of determination (R^2) close to 1. The regression analyses in the figures below show that for Scottsbluff, the wind direction correlation produced an R^2 of 0.968 and the wind speed correlation produced an R^2 of 0.948. For Chadron, the wind direction correlation produced an R^2 of 0.958 and the wind speed correlation produced an R^2 of 0.980. Since the sum of all the "x" values and the sum of all the "y" values are both equal to 1 (inherent to probability distributions), an R^2 close to 1 indicates the individual short-term frequencies closely match their long-term counterparts. Hence, the short and long-term wind speed and direction distributions are similarly distributed, and the demonstration has been made.

Scottsbluff Regression Analysis: 1-Year Directions versus 15-Year Directions

The regression equation is
Scott_ST_WD = 0.967 Scott_LT_WD

Predictor	Coef	SE Coef	T	P
Noconstant				
Scott_LT_WD	0.96694	0.02469	39.17	0.000

S = 0.00759738

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	1	0.088540	0.088540	1533.96	0.000
Residual Error	15	0.000866	0.000058		
Total	16	0.089406			

Scottsbluff Regression Analysis: 1-Year Speeds versus 15-Year Speeds

The regression equation is
Scott_ST_WS = 1.00 Scott_LT_WS

Predictor	Coef	SE Coef	T	P
Noconstant				
Scott_LT_WS	1.00180	0.05990	16.72	0.000

S = 0.0296888

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	1	0.24654	0.24654	279.71	0.000
Residual Error	5	0.00441	0.00088		
Total	6	0.25095			

Chadron Regression Analysis: 1-Year Directions versus 12-Year Directions

The regression equation is
Chad_ST_WD = 0.999 Chad_LT_WD

Predictor	Coef	SE Coef	T	P
Noconstant				
Chad_LT_WD	0.99924	0.02459	40.64	0.000

S = 0.00675646

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	1	0.075404	0.075404	1651.80	0.000
Residual Error	16	0.000730	0.000046		
Total	17	0.076135			

Chadron Regression Analysis: 1-Year Speeds versus 12-Year Speeds

The regression equation is
Chad_ST_WS = 0.983 Chad_LT_WS

Predictor	Coef	SE Coef	T	P
Noconstant				
Chad_LT_WS	0.98330	0.03005	32.72	0.000

S = 0.0135408

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	1	0.19628	0.19628	1070.52	0.000
Residual Error	6	0.00110	0.00018		
Total	7	0.19738			

The following (**Table S-1**) summarizes the linear regression results for both locations. In all cases, the linear correlation between short-term and long-term wind frequencies is strong. All p-values are less than or equal to 0.001, indicating 99.9% confidence in the significance of the regression results.

Table S-1

Location	Frequency Distribution	R^2	Slope	p-value
Chadron	Wind Speed	0.980	0.983	0.000
Chadron	Wind Direction	0.958	0.999	0.000
Scottsbluff	Wind Speed	0.948	1.002	0.001
Scottsbluff	Wind Direction	0.968	0.967	0.000

This demonstrated association between short-term and long-term wind data is not to suggest causation, only relation, which is all that regression analysis can justify. “x” does not cause “y.” In this analysis the independent and dependent variables are related to each other through a third variable “z”, which represents the regional climatic system. “z” causes both “x” and “y,” in this case by the same mechanism.

As seen in **Table S-1** and **Figure S-1**, the Scottsbluff wind direction correlation produced a very high coefficient of determination, or R^2. The p-value of 0.000 indicates virtually no chance that this R^2 value is accidental. In other words, the 1-year distribution of wind directions is strongly correlated with the 15-year distribution, to a high degree of confidence.

The Scottsbluff wind speed correlation produced a very high coefficient of determination, or R^2 (**Figure S-2**). The p-value of 0.001 shown in the regression analysis indicates a 99.9% confidence that this R^2

value is not accidental. In other words, the 1-year distribution of wind speeds is strongly correlated with the 15-year distribution, to a high degree of confidence.

Figures S-3 and **S-4** illustrate strong similarities between the wind roses from the baseline year and the 12-year period from 2001 through 2012 at Chadron. The histograms of short- and long-term wind direction and wind speed distributions in **Figure S-5** and **Figure S-6** further illustrate the similarities between the baseline year and the 12-year period.

The regression analyses for wind parameters at the Chadron meteorological station are also presented. **Figure S-7** shows the wind direction correlation produced a very high coefficient of determination, or R^2. As seen in the regression analysis, the p-value of 0.000 indicates virtually no chance that this R^2 value is accidental. In other words, the 1-year distribution of wind directions is strongly correlated with the 12-year distribution, to a high degree of confidence.

In similar fashion, the wind speed correlation for Chadron produced a very high coefficient of determination, or R^2 (**Figure S-8**). The p-value of 0.000 shown in the regression analysis indicates virtual certainty that this R^2 value is not accidental. In other words, the 1-year distribution of wind speeds is strongly correlated with the 12-year distribution, to a high degree of confidence.

Figure S-1: Scottsbluff 1-Year Directions versus 15-Year Directions

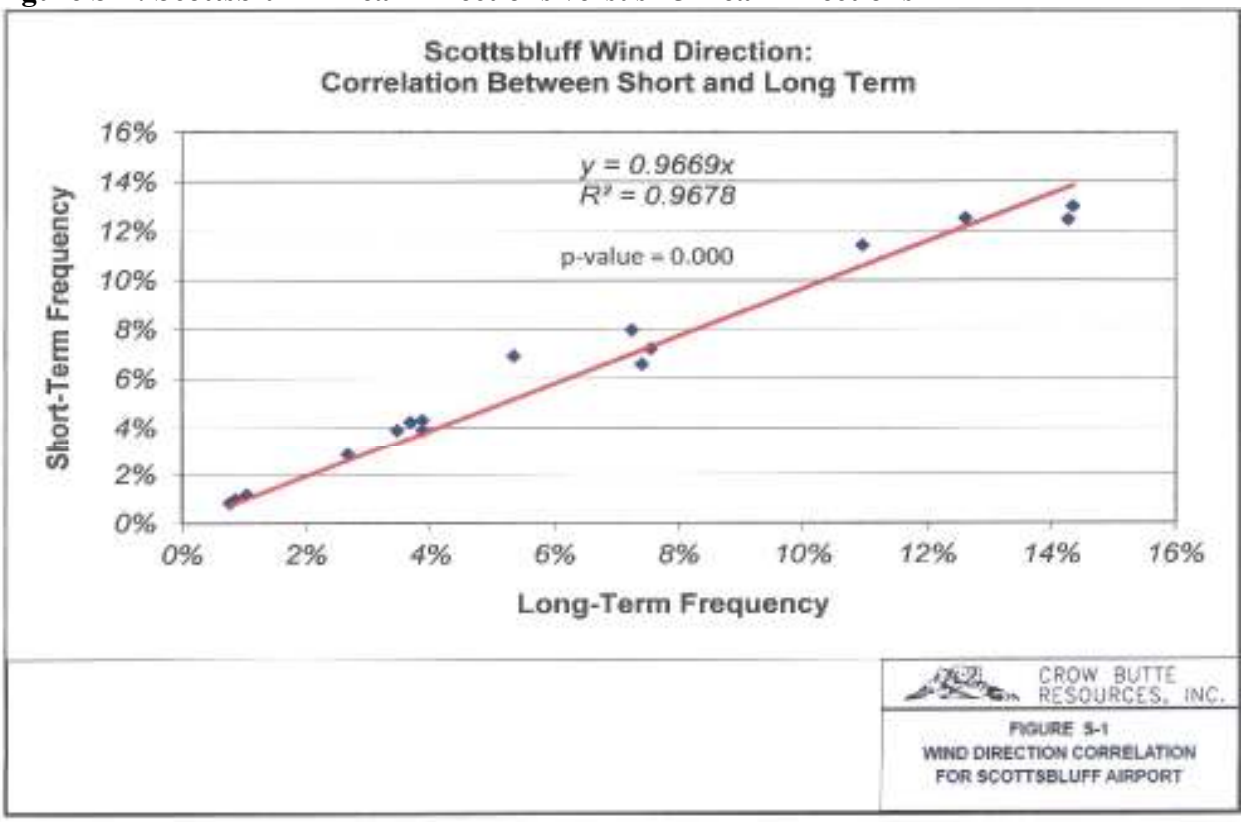

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Figure S-2: Scottsbluff 1-Year Speeds versus 15-Year Speeds

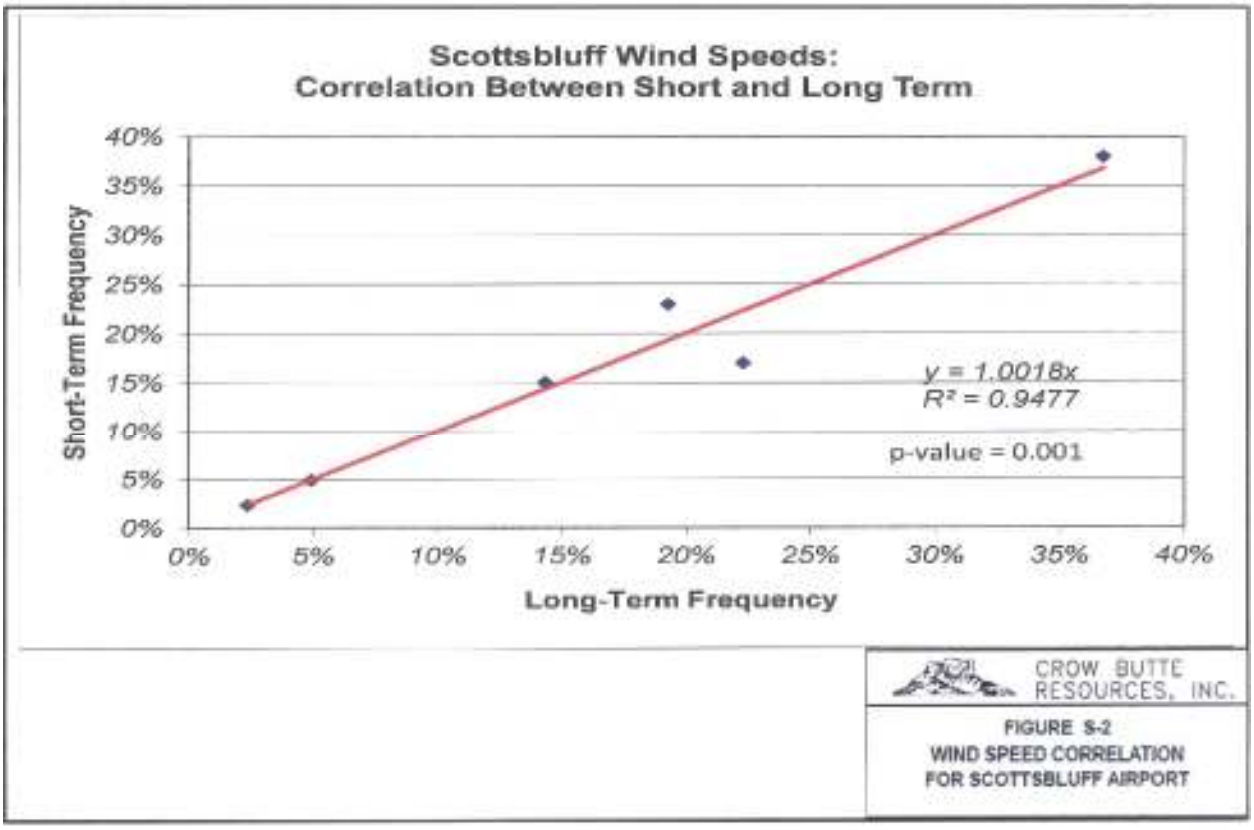

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Figure S-3: Chadron Baseline-Year Wind Rose

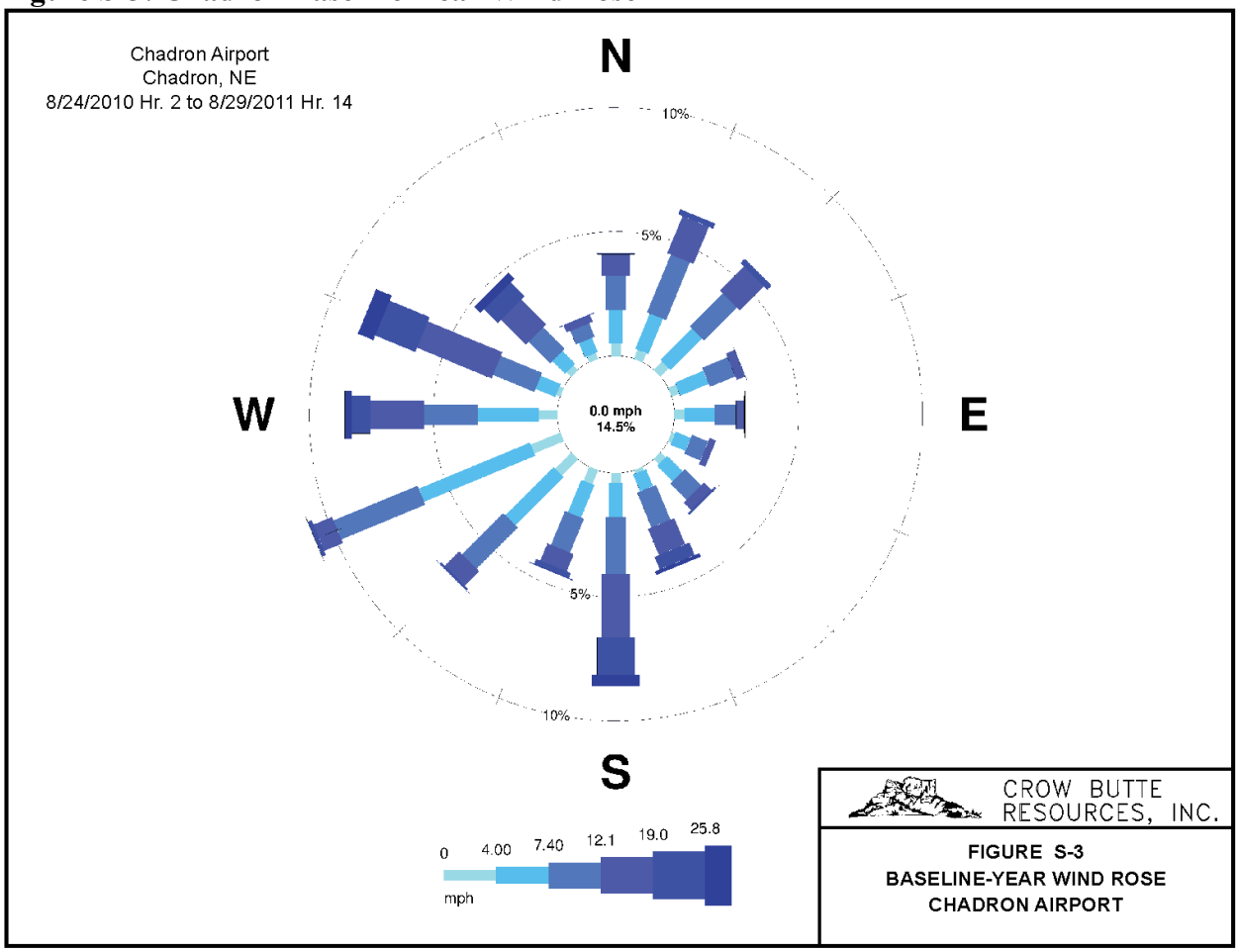

Figure S-4: Chadron 12-Year Wind Rose

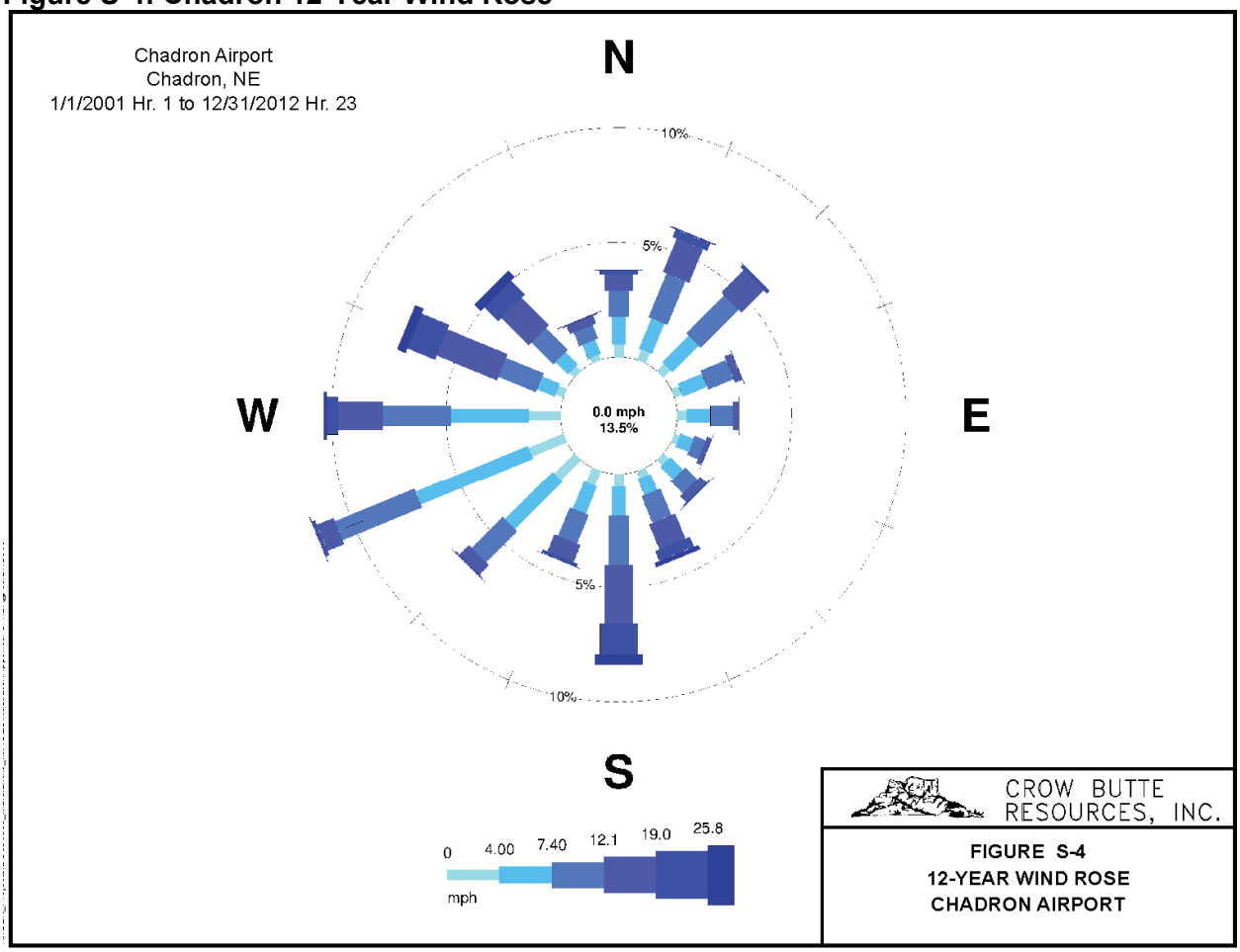

Figure S-5: Chadron Wind Direction Distributions

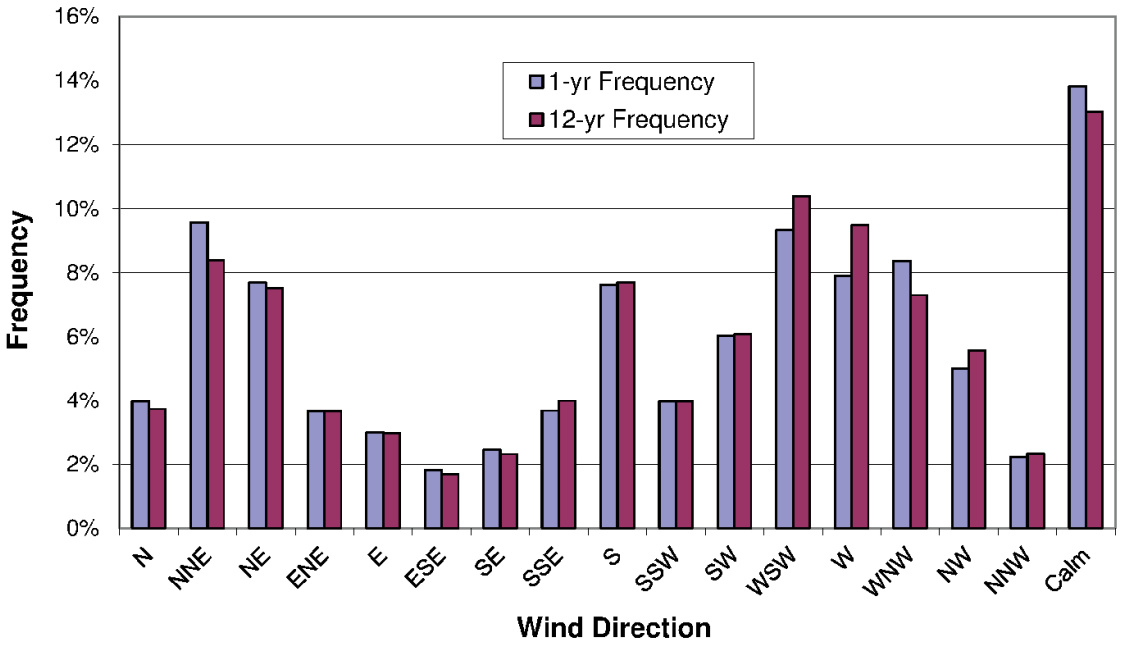

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FIGURE S-5
CHADRON AIRPORT
WIND DIRECTION DISTRIBUTION

Figure S-6: Chadron Wind Speed Distributions

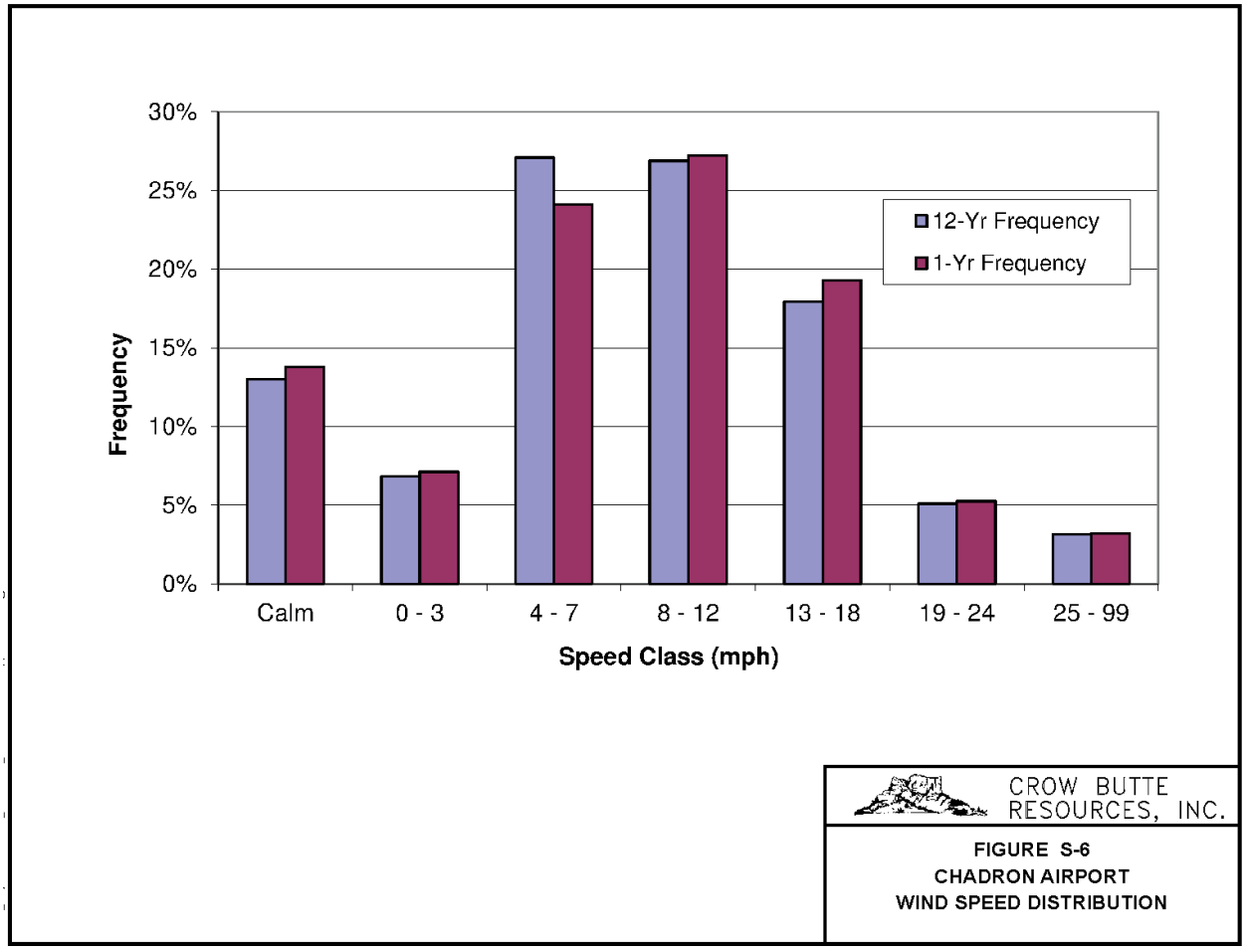

Figure S-7: 1-Year Directions versus 12-Year Directions

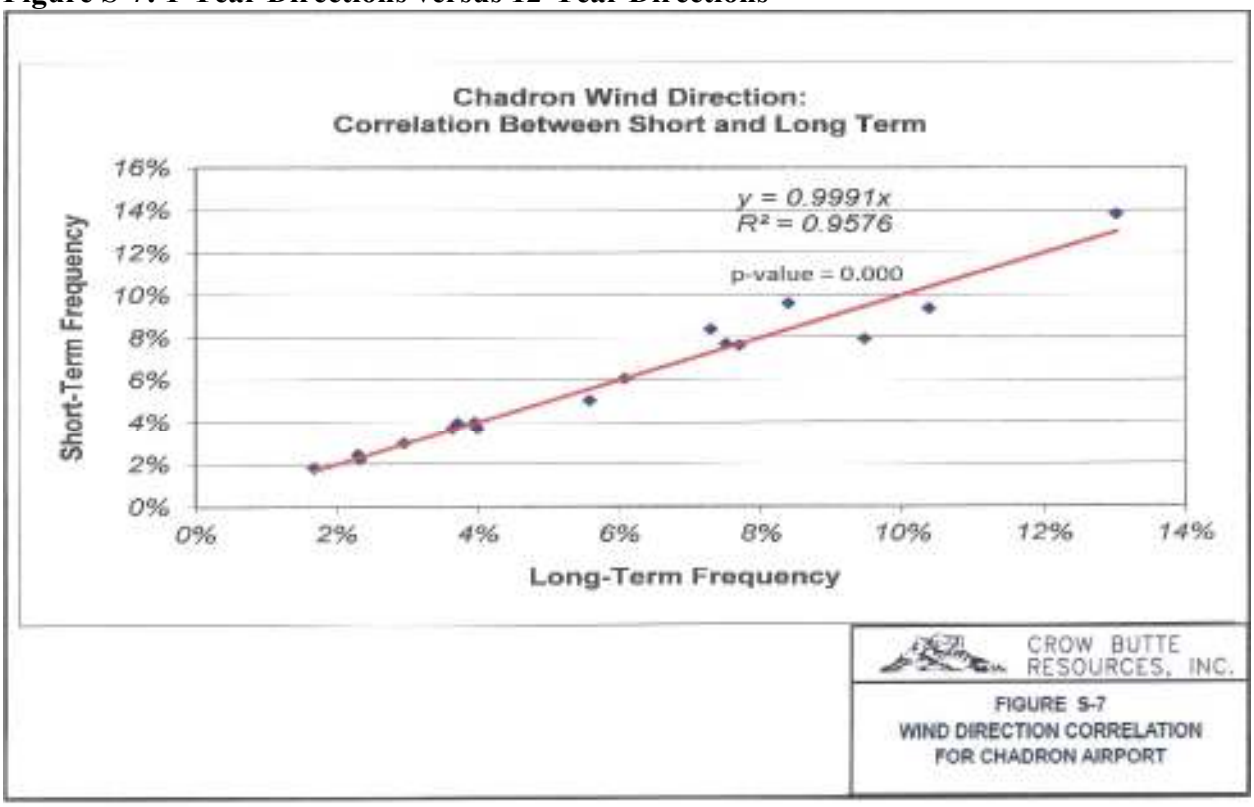

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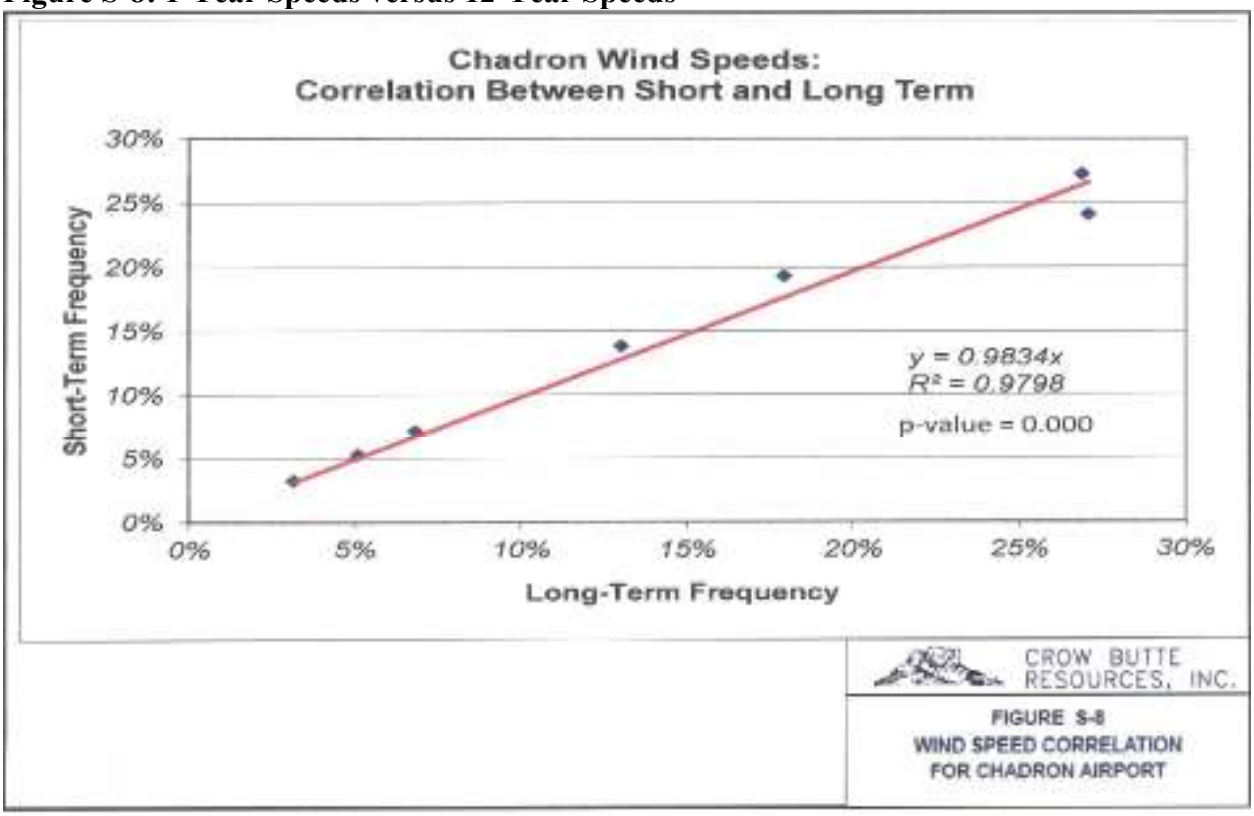
Figure S-8: 1-Year Speeds versus 12-Year Speeds



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