Appendix B

Smith Ranch Meteorological Summary

Smith Ranch

Meteorological Data Summary

11/2/2010 - 8/8/2011

Hourly Data

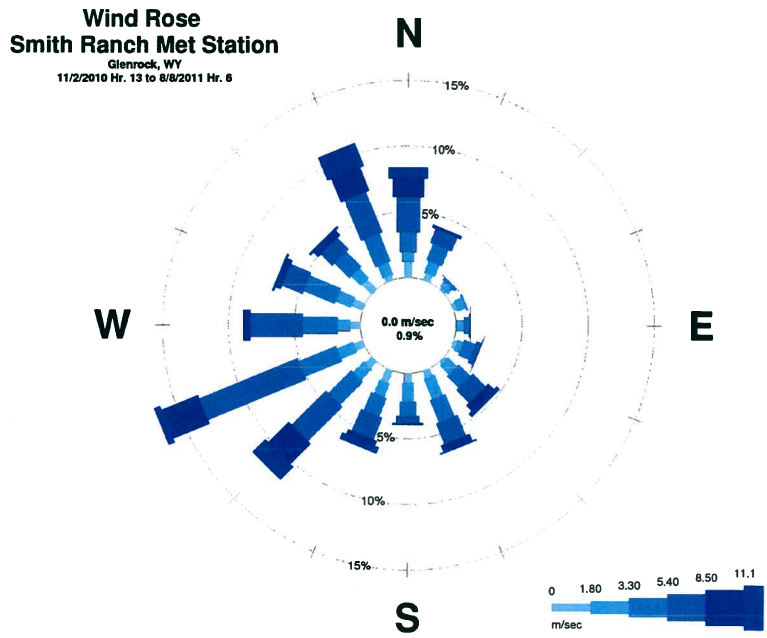
	Average/Total	Max	Min
Wind Speed (m/sec)	5.6	19.4	0.0
Sigma-Theta (°)	0.0	0.0	0.0
Temperature (C)	4.8	34.2	-29.4
10m Temperature (C)			
Relative Humidity (%)	61.0	96.2	8.0
Precipitation (mm)	228.89	12.12	
Solar Radiation (w/m^2)	154.2	1,037.0	

Predominant wind direction was from the WSW sector,
accounting for 16.6% of the possible winds

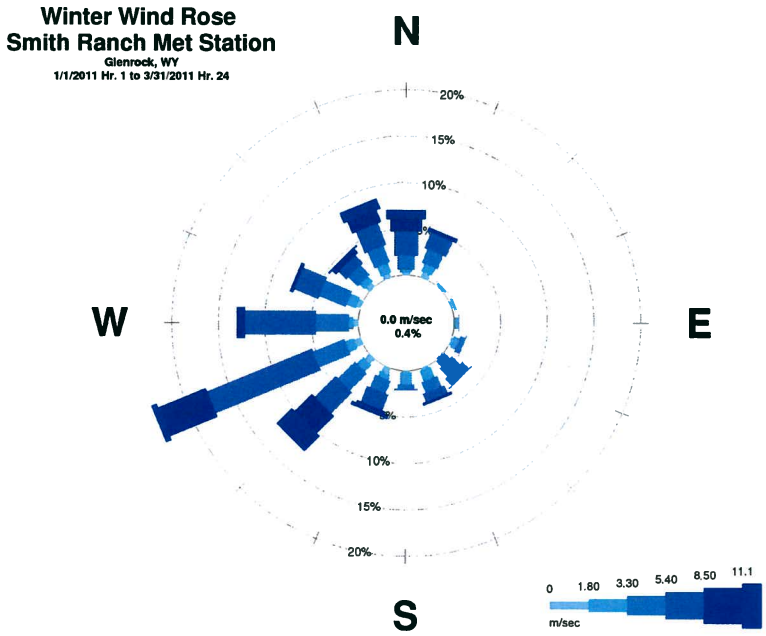
Data Recovery

Parameter	Possible (hours)	Reported (hours)	Recovery
Wind Speed	6689	6686	99.96%
Wind Direction	6689	6686	99.96%
Sigma-Theta	6689	6686	99.96%
Temperature	6689	6686	99.96%
10m Temperature	6689	0	0.00%
Relative Humidity	6689	6686	99.96%
Precipitation	6689	6686	99.96%
Solar Radiation	6689	6686	99.96%

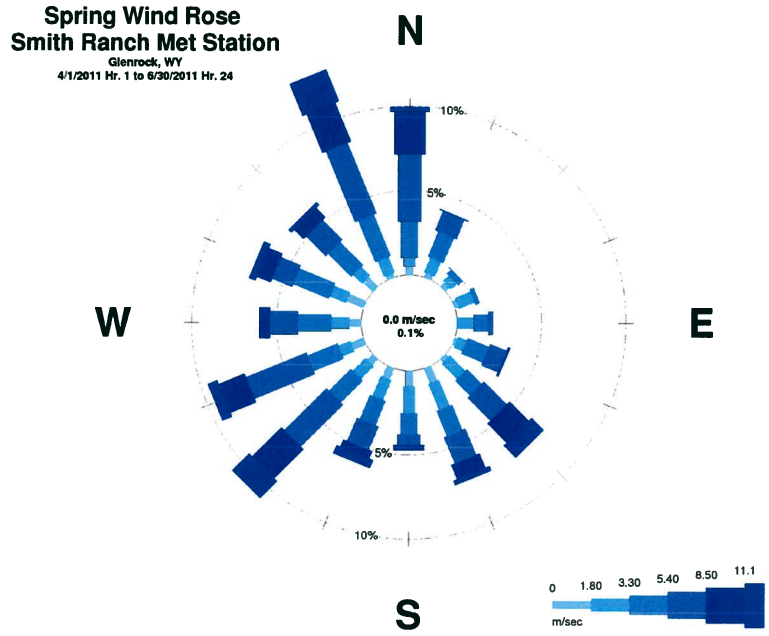
Smith Ranch Figure 2



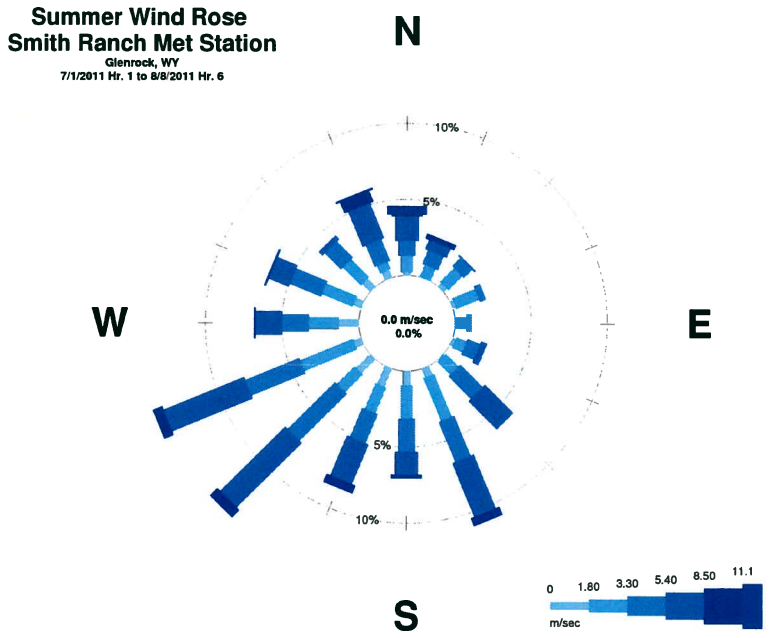
Smith Ranch Figure 3



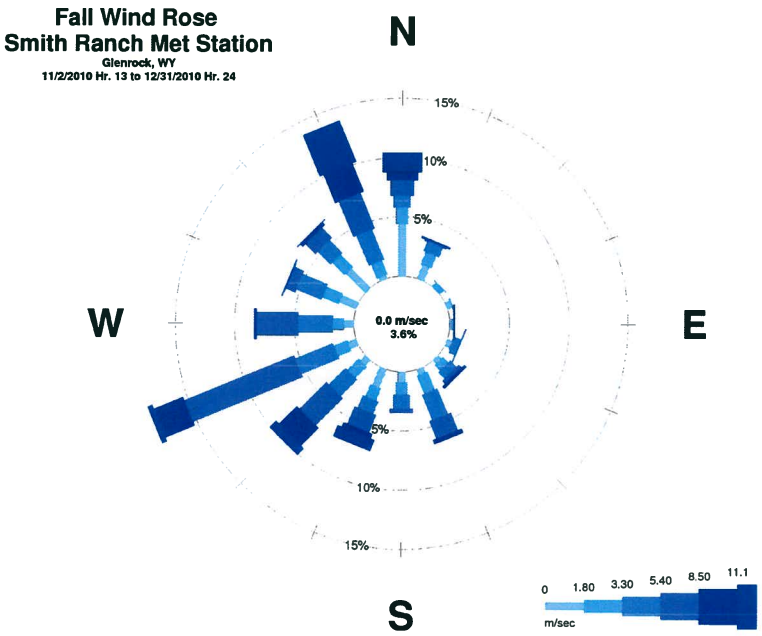
Smith Ranch Figure 4



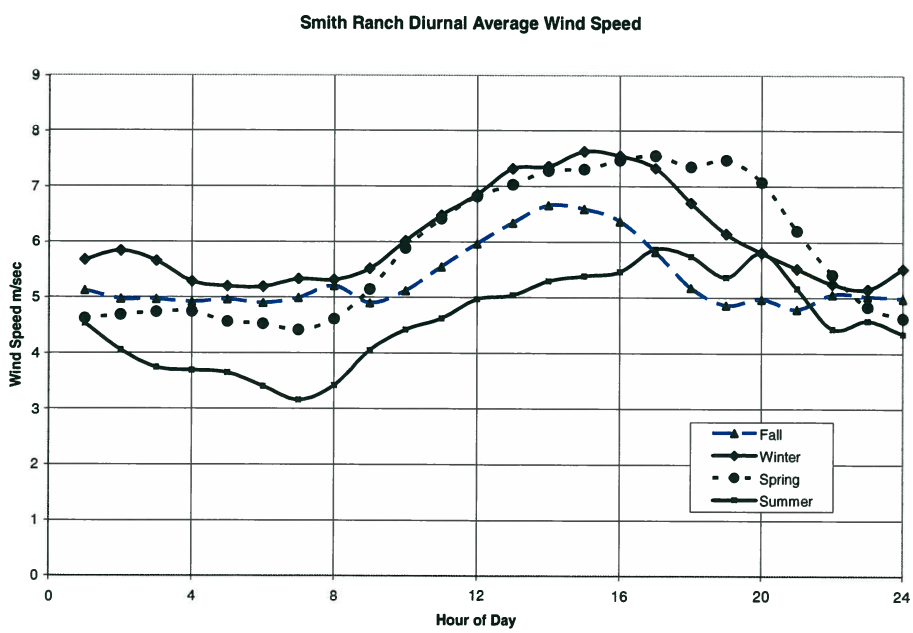
Smith Ranch Figure 5



Smith Ranch Figure 6

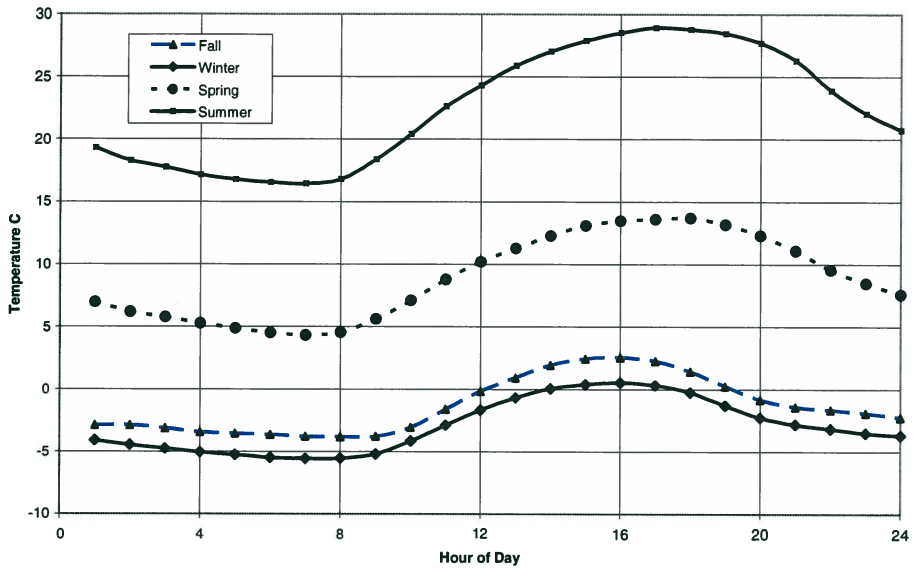


Smith Ranch Figure 7



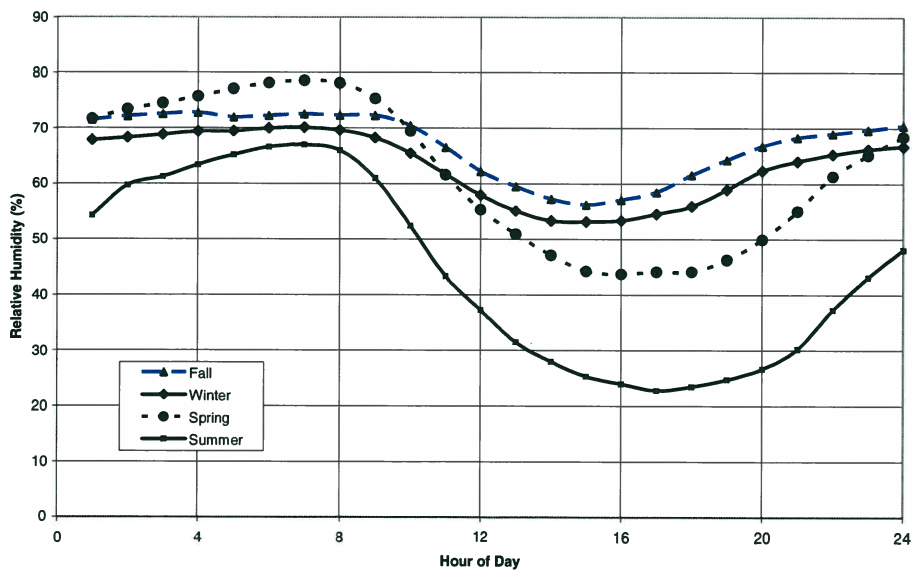
Smith Ranch Figure 8

Smith Ranch Diurnal Average Temperature

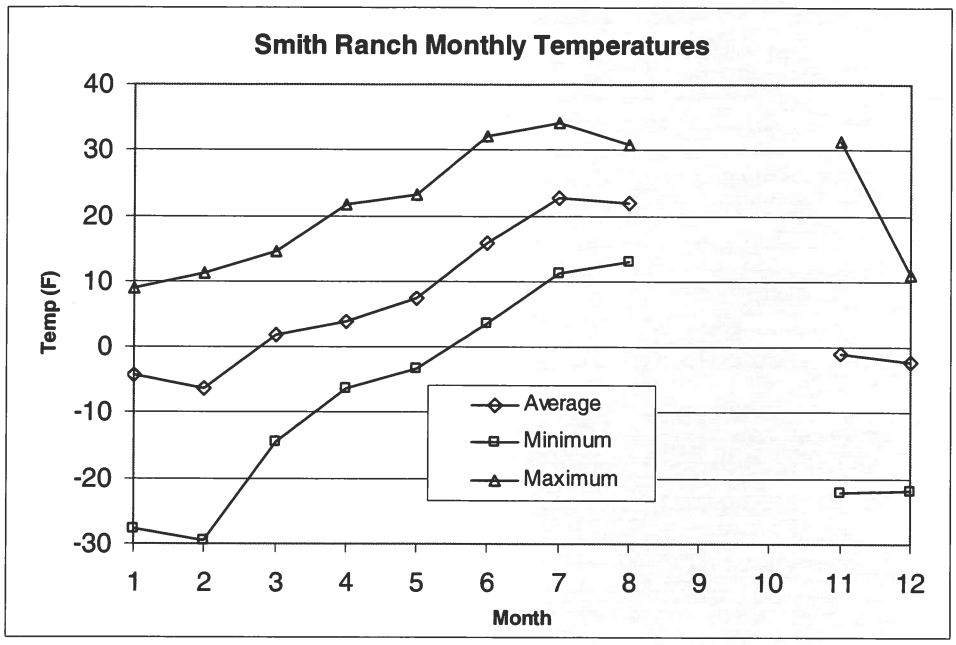


Smith Ranch Figure 9

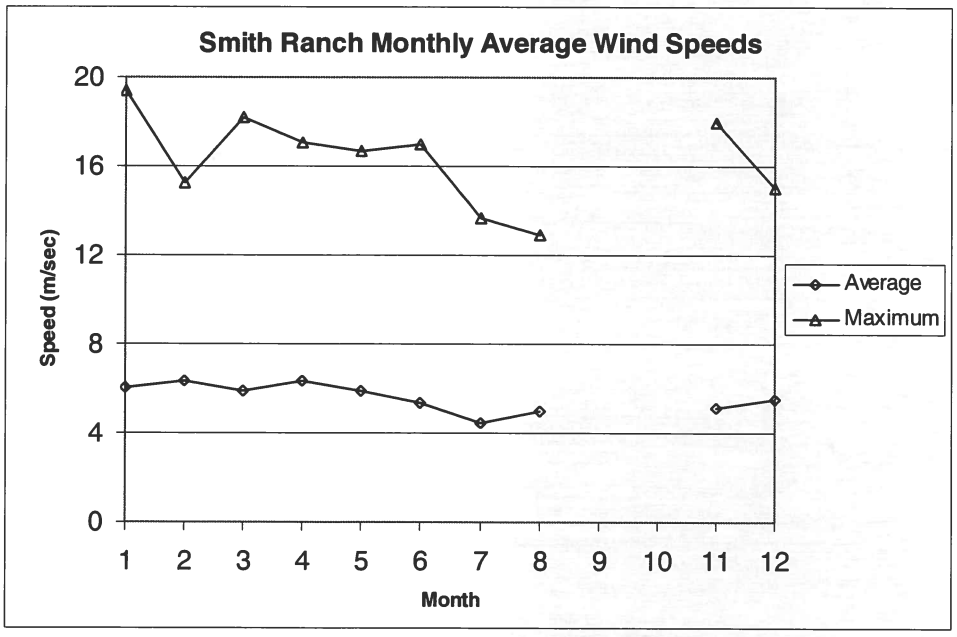
Smith Ranch Diurnal Average Relative Humidity



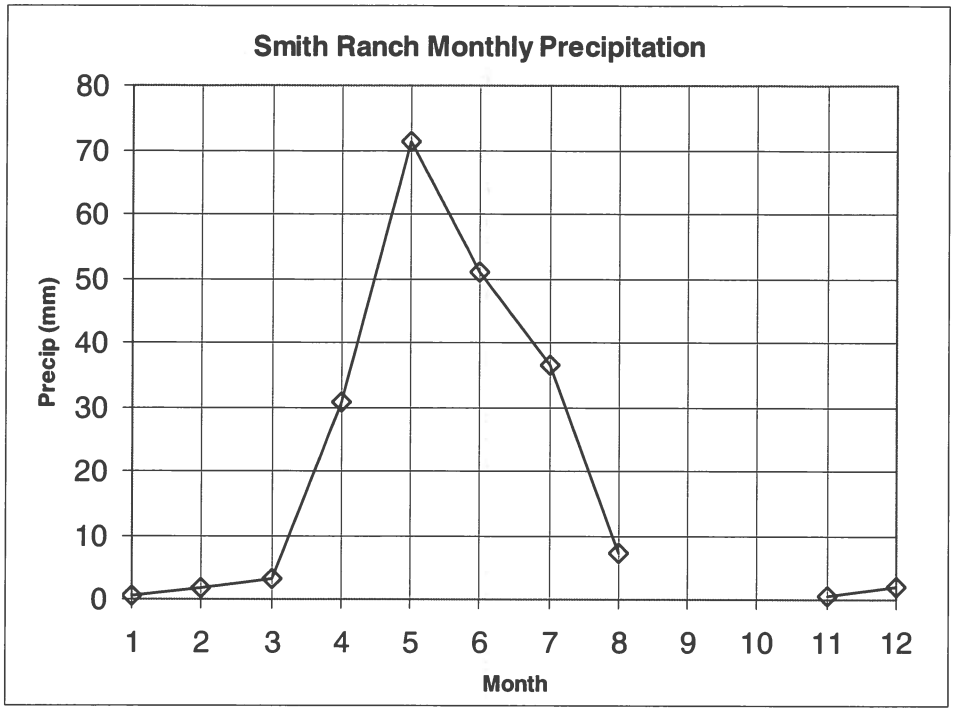
Smith Ranch Figure 10



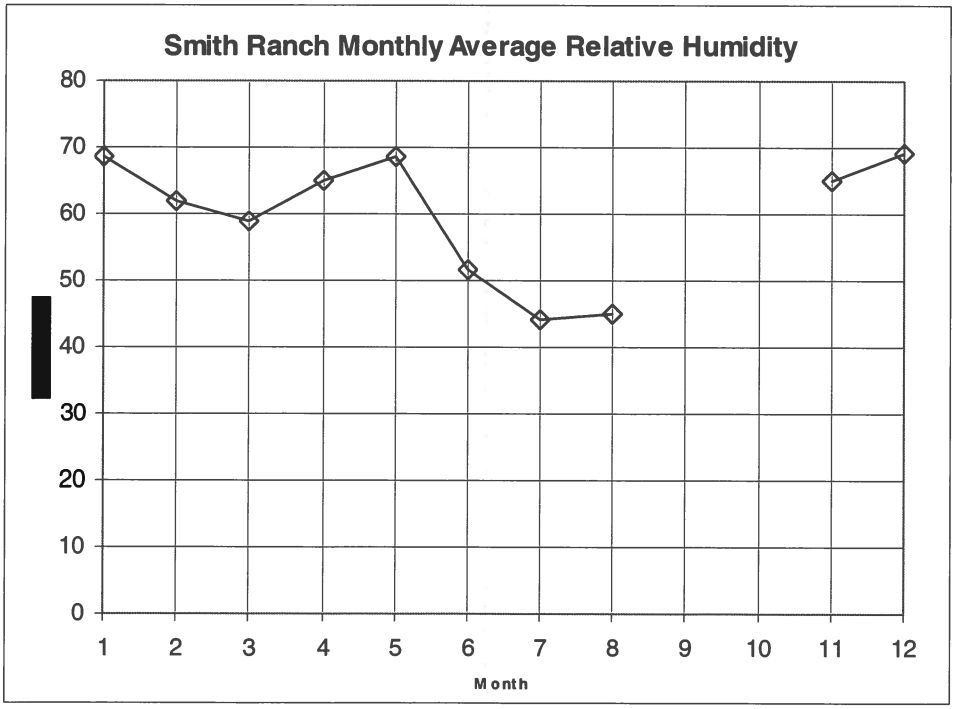
Smith Ranch Figure 11



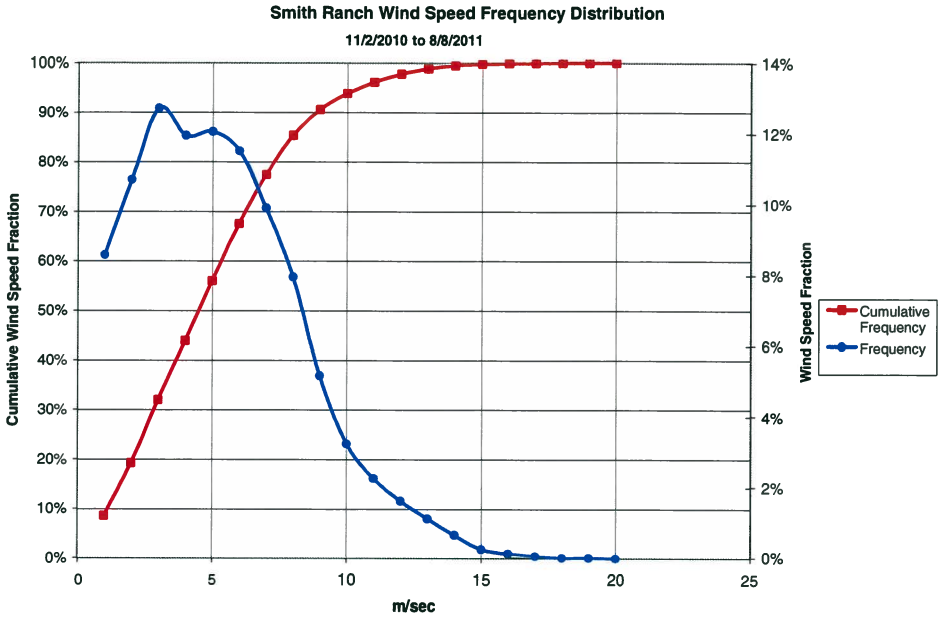
Smith Ranch Figure 12



Smith Ranch Figure 13



Smith Ranch Figure 14



Smith Ranch Table 1

Project-to-Date Wind Data Summary

11/2/2010 1:00:00 PM - 8/8/2011 6:00:00 AM

Hourly Data

		Average	Max	Min
Wind Speed (m/sec)		5.64	19.40	-
Sigma Theta (°)		-	-	-
Wind Direction				
	N	6.22	15.40	-
	NNE	4.36	10.50	0.29
	NE	2.62	5.48	0.80
	ENE	2.37	4.62	0.66
	E	3.55	13.16	0.95
	ESE	4.17	12.05	0.73
	SE	5.71	13.56	0.81
	SSE	4.74	12.46	0.58
	S	3.58	10.69	0.56
	SSW	5.22	18.21	0.06
	SW	6.85	16.99	0.04
	WSW	6.51	16.01	0.11
	W	5.21	10.98	0.16
	WNW	4.60	12.79	0.22
	NW	4.53	15.95	0.23
	NNW	7.31	19.40	0.24

Predominant wind direction was from the WSW sector, accounting for 16.6%

of the winds, the average wind direction was 263°.

Data Recovery

		Possible (hours)	Reported (hours)	Recovery
Wind Speed		6713	6686	99.60%
Sigma Theta		6713	6686	99.60%
Wind Direction		6713	6686	99.60%

Smith Ranch Table 2

Fall Wind Data Summary

11/2/2010 1:00:00 PM - 12/31/2010

Hourly Data

		Average	Max	Min
Wind Speed (m/sec)		5.34	17.99	0.04
Sigma Theta (°)		-	-	-
Wind Direction				
	N	4.65	15.05	0.29
	NNE	2.72	9.33	0.29
	NE	2.50	3.31	1.35
	ENE	1.54	2.84	0.66
	E	4.84	13.16	0.95
	ESE	3.48	12.05	0.83
	SE	4.01	9.51	0.81
	SSE	4.51	10.75	0.58
	S	3.26	7.95	0.61
	SSW	5.24	14.50	0.06
	SW	6.46	14.15	0.04
	WSW	6.42	14.15	0.11
	W	4.77	8.88	0.16
	WNW	3.47	12.38	0.22
	NW	3.41	11.25	0.23
	NNW	8.09	17.99	0.24

Predominant wind direction was from the WSW sector, accounting for 18.5% of the winds, the average wind direction was 273°.

Data Recovery

		Possible (hours)	Reported (hours)	Recovery
Wind Speed		1427	1425	99.86%
Sigma Theta		1427	1425	99.86%
Wind Direction		1427	1425	99.86%

Smith Ranch Table 3

Winter Wind Data Summary

1/1/2011 - 3/31/2011

Hourly Data

		Average	Max	Min
Wind Speed (m/sec)		6.07	19.40	-
Sigma Theta (°)		-	-	-
Wind Direction				
	N	7.09	15.40	-
	NNE	4.90	10.48	0.86
	NE	2.11	3.52	1.55
	ENE	1.77	3.35	0.66
	E	2.59	4.19	1.62
	ESE	3.12	5.72	1.18
	SE	4.49	9.08	1.49
	SSE	4.39	9.96	0.85
	S	3.01	6.28	0.65
	SSW	5.55	18.21	0.43
	SW	7.42	15.25	0.47
	WSW	7.03	14.47	0.43
	W	5.85	10.12	0.45
	WNW	4.96	9.90	0.28
	NW	5.18	15.95	0.54
	NNW	6.77	19.40	0.39

Predominant wind direction was from the WSW sector, accounting for 23.6% of the winds, the average wind direction was 265°.

Data Recovery

		Possible (hours)	Reported (hours)	Recovery
Wind Speed		2160	2160	100.00%
Sigma Theta		2160	2160	100.00%
Wind Direction		2160	2160	100.00%

Smith Ranch Table 4

Spring Wind Data Summary

4/1/2011 - 6/30/2011

Hourly Data

		Average	Max	Min
Wind Speed (m/sec)		5.86	17.06	0.43
Sigma Theta (°)		-	-	-
Wind Direction				
	N	6.77	13.56	0.50
	NNE	4.40	8.64	0.90
	NE	2.55	5.40	0.80
	ENE	2.60	3.86	0.83
	E	3.72	8.11	1.88
	ESE	4.90	9.25	0.73
	SE	6.86	13.56	1.04
	SSE	5.03	12.46	0.63
	S	3.78	10.66	0.56
	SSW	5.22	14.50	0.75
	SW	7.37	16.99	0.80
	WSW	6.35	16.01	0.43
	W	4.86	10.98	0.69
	WNW	5.08	12.79	0.58
	NW	5.25	14.33	0.62
	NNW	7.44	17.06	0.73

Predominant wind direction was from the NNW sector, accounting for 13% of the winds, the average wind direction was 269°.

Data Recovery

		Possible (hours)	Reported (hours)	Recovery
Wind Speed		2184	2183	99.95%
Sigma Theta		2184	2183	99.95%
Wind Direction		2184	2183	99.95%

Smith Ranch Table 5

Summer Wind Data Summary

7/1/2011 - 8/8/2011 6:00:00 AM

Hourly Data

		Average	Max	Min
Wind Speed (m/sec)		4.58	13.69	0.74
Sigma Theta (°)		-	-	-
Wind Direction				
	N	5.79	13.69	1.58
	NNE	4.94	10.50	1.90
	NE	2.93	5.48	0.85
	ENE	2.62	4.62	1.48
	E	3.06	3.74	2.17
	ESE	3.80	7.74	0.97
	SE	4.97	8.02	1.78
	SSE	4.80	10.15	1.28
	S	3.90	10.69	1.13
	SSW	4.74	10.84	0.77
	SW	5.16	9.99	0.89
	WSW	4.90	10.12	1.27
	W	3.89	8.84	0.98
	WNW	4.07	11.65	0.79
	NW	3.13	6.43	0.74
	NNW	5.61	11.56	0.88

Predominant wind direction was from the WSW sector, accounting for 14.4% of the winds, the average wind direction was 229°.

Data Recovery

		Possible (hours)	Reported (hours)	Recovery
Wind Speed		942	918	97.45%
Sigma Theta		942	918	97.45%
Wind Direction		942	918	97.45%

Appendix C

North Butte Meteorological Summary

North Butte

Meteorological Data Summary

12/21/2010 - 6/2/2011

Hourly Data

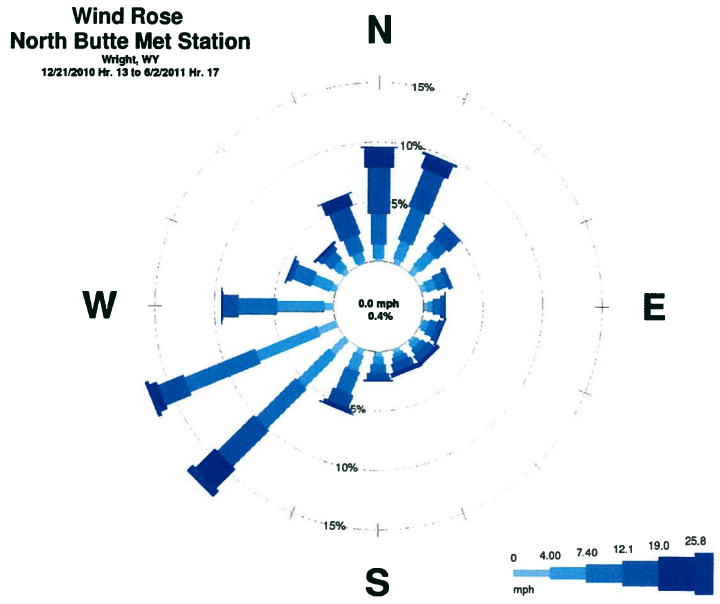
	Average/Total	Max	Min
Wind Speed (mph)	10.7	36.1	0.0
Sigma-Theta (°)	19.4	101.5	0.0
Temperature (C)	0.5	24.0	-28.4
10m Temperature (C)	0.6	24.2	-28.5
Relative Humidity (%)	67.7	100.0	10.7
Precipitation (in)	11.84	0.24	
Solar Radiation (w/m^2)	162.5	1,043.0	

Predominant wind direction was from the SW sector,
accounting for 17.1% of the possible winds

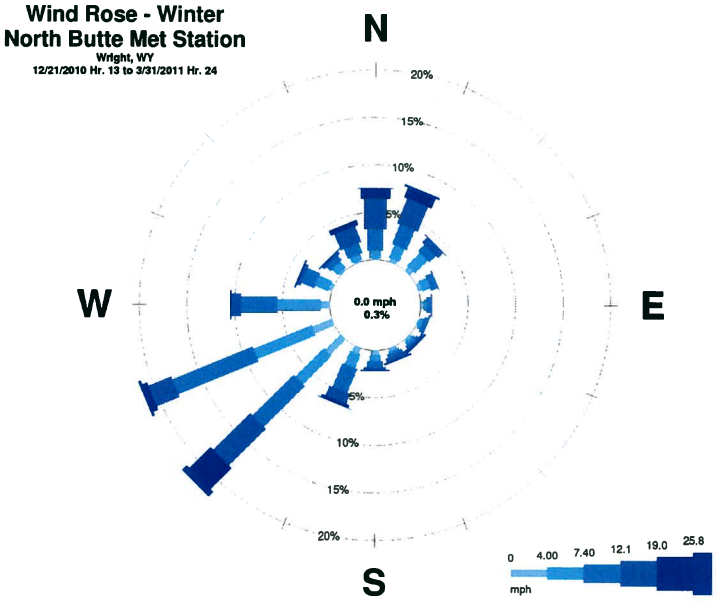
Data Recovery

Parameter	Possible (hours)	Reported (hours)	Recovery
Wind Speed	3916	3872	98.88%
Wind Direction	3916	3872	98.88%
Sigma-Theta	3916	3872	98.88%
Temperature	3916	3872	98.88%
10m Temperature	3916	3872	98.88%
Relative Humidity	3916	3872	98.88%
Precipitation	3916	3872	98.88%
Solar Radiation	3916	3871	98.85%

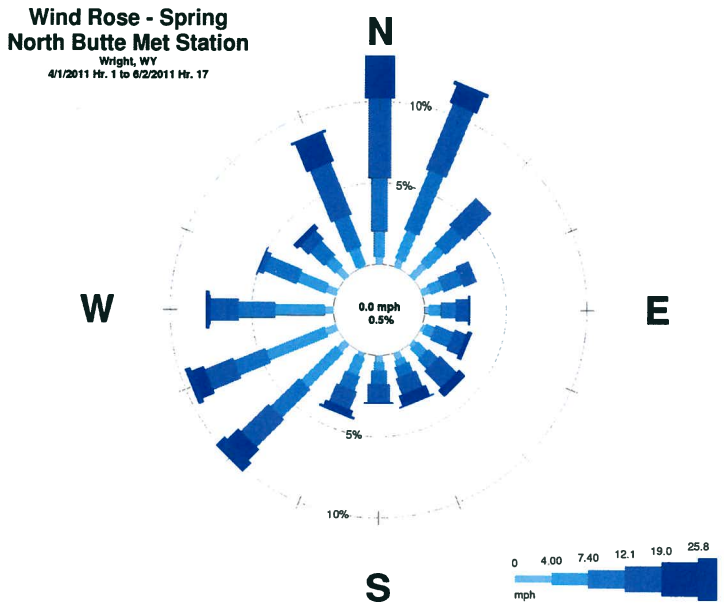
North Butte Figure 2



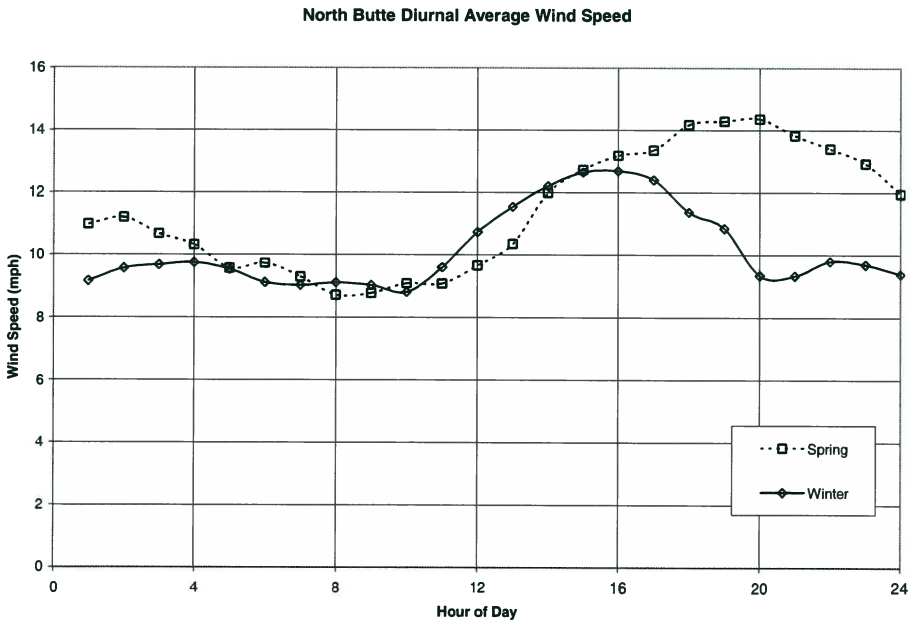
North Butte Figure 3



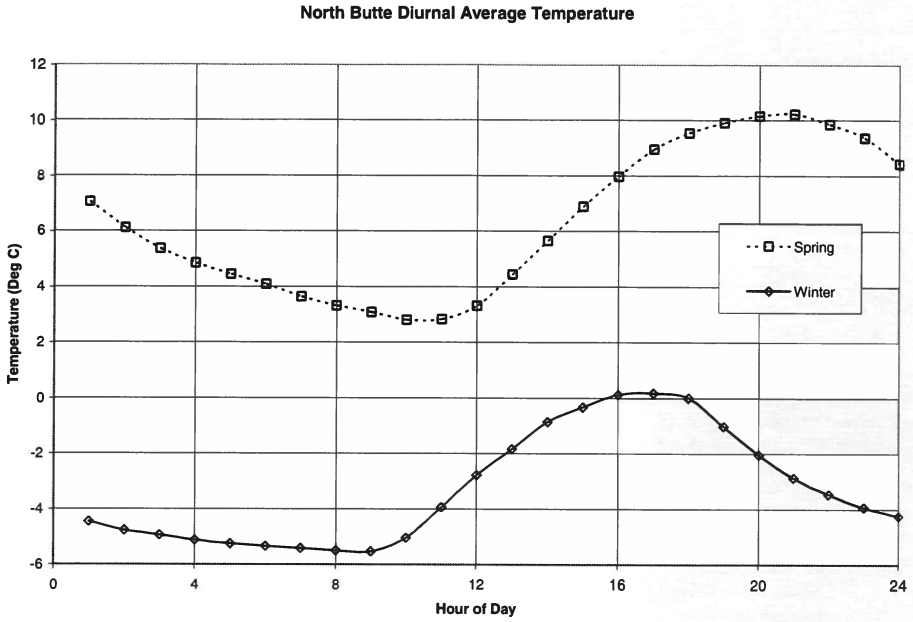
North Butte Figure 4



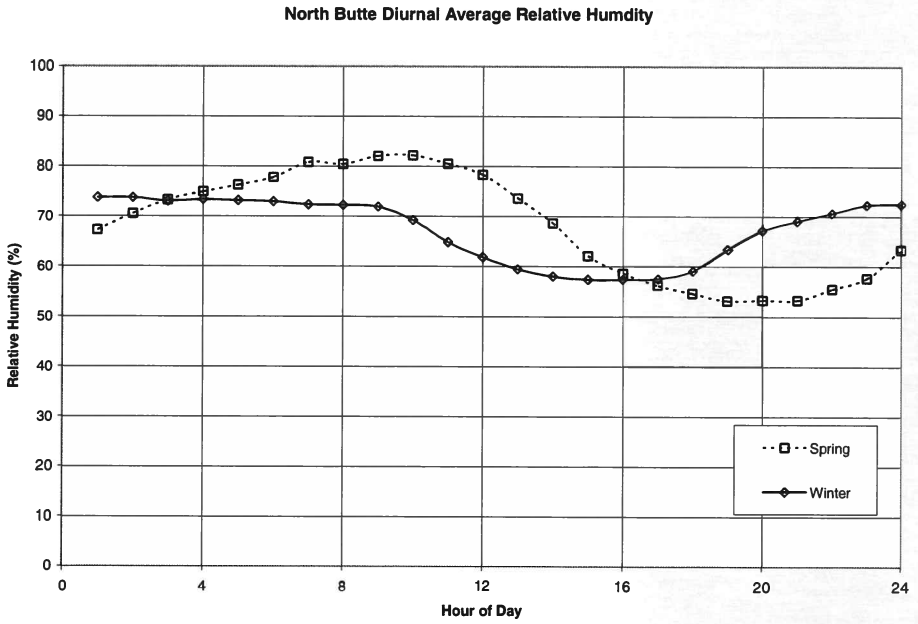
North Butte Figure 5



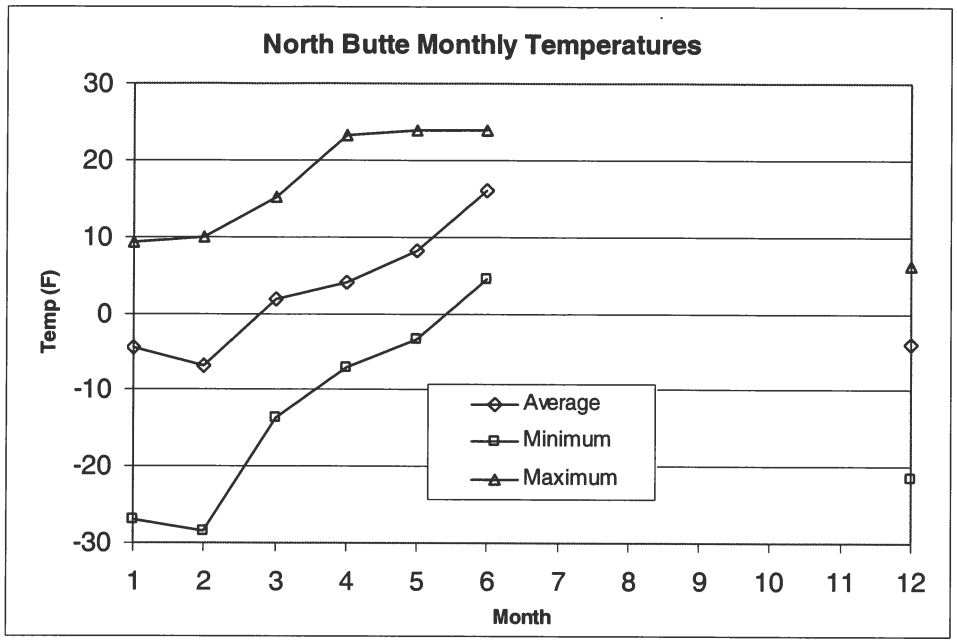
North Butte Figure 6



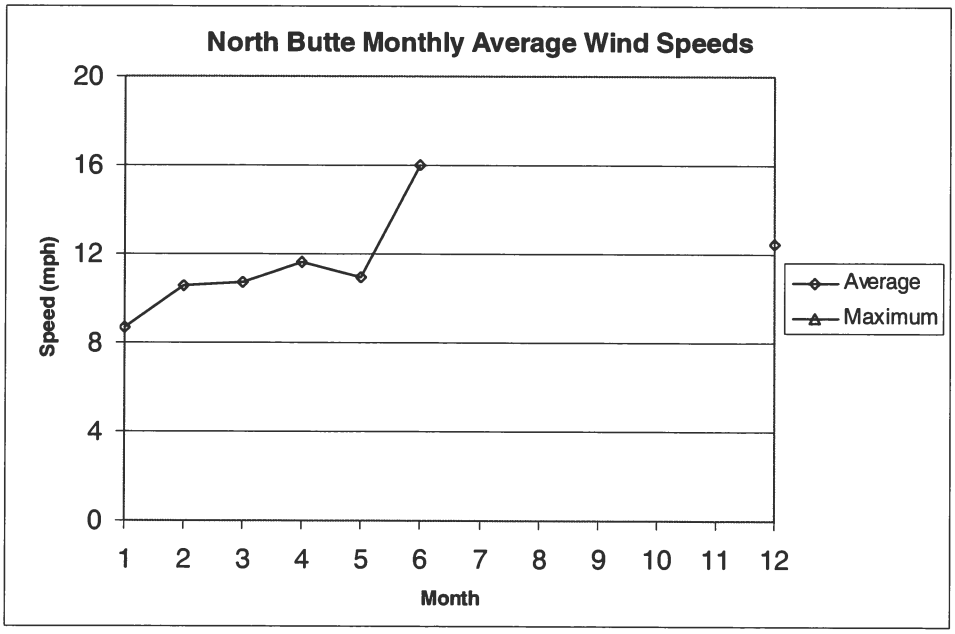
North Butte Figure 7



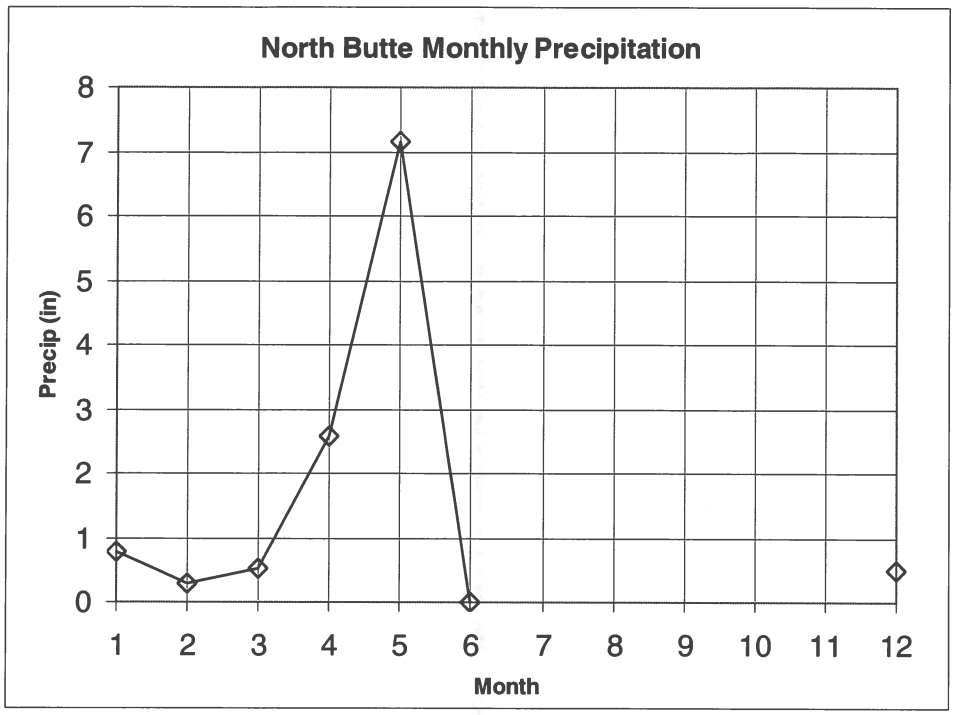
North Butte Figure 8



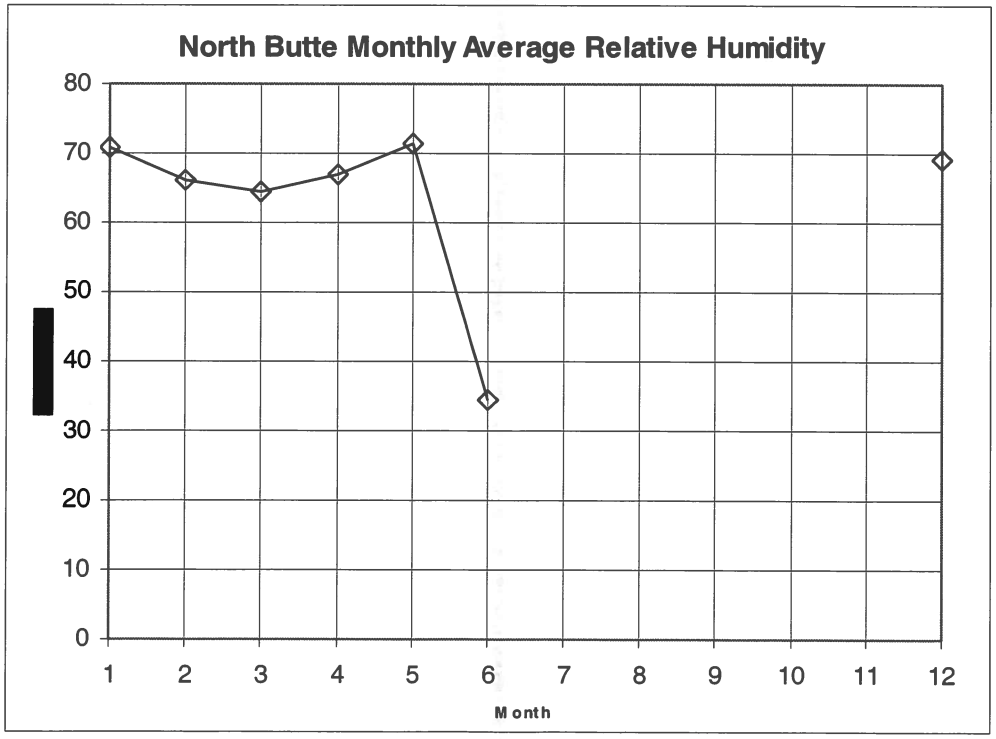
North Butte Figure 9



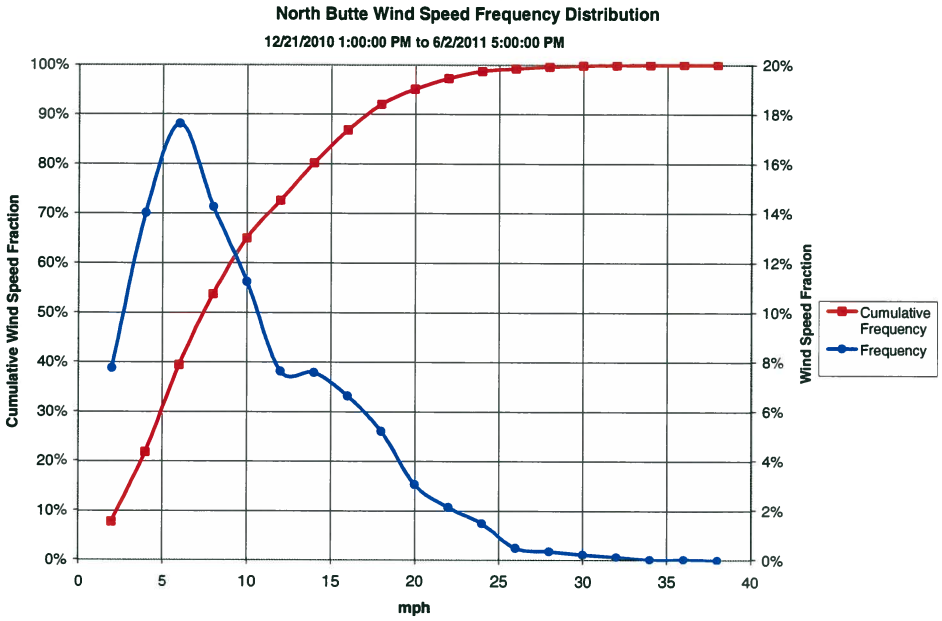
North Butte Figure 10



North Butte Figure 11



North Butte Figure 12



North Butte Table 1

Project-to-Date Wind Data Summary

12/21/2010 1:00:00 PM - 6/2/2011 5:00:00 PM

Hourly Data

		Average	Max	Min
Wind Speed (mph)		10.66	36.11	-
Sigma Theta (°)		19.43	101.50	-
Wind Direction				
	N	13.46	28.66	1.00
	NNE	12.44	29.64	0.95
	NE	8.79	22.17	0.96
	ENE	7.78	18.23	0.92
	E	8.77	20.91	0.88
	ESE	10.19	25.59	1.24
	SE	11.69	22.92	1.50
	SSE	11.45	25.83	1.39
	S	9.31	22.03	1.08
	SSW	10.09	29.18	1.40
	SW	12.25	33.60	-
	WSW	9.07	36.11	0.54
	W	8.28	31.08	1.07
	WNW	8.05	23.32	0.95
	NW	9.09	25.09	0.77
	NNW	13.47	26.43	1.59

Predominant wind direction was from the SW sector, accounting for 17.1% of the winds, the average wind direction was 274°.

Data Recovery

		Possible (hours)	Reported (hours)	Recovery
Wind Speed		3940	3872	98.27%
Sigma Theta		3940	3872	98.27%
Wind Direction		3940	3872	98.27%

North Butte Table 2

Winter Wind Data Summary

12/21/2010 1:00:00 PM - 3/31/2011

Hourly Data

		Average	Max	Min
Wind Speed (mph)		10.19	34.76	-
Sigma Theta (°)		18.46	98.00	-
Wind Direction				
	N	13.14	28.66	2.20
	NNE	12.74	27.24	0.95
	NE	8.12	22.17	1.02
	ENE	6.56	13.15	2.09
	E	6.69	16.11	0.88
	ESE	8.35	19.60	1.72
	SE	9.41	20.79	1.50
	SSE	9.94	21.96	1.88
	S	8.30	20.79	1.94
	SSW	9.52	29.18	1.60
	SW	12.35	33.60	-
	WSW	8.73	34.76	0.54
	W	7.72	21.61	1.07
	WNW	8.43	23.32	2.25
	NW	8.64	19.86	1.62
	NNW	12.48	24.13	1.82

Predominant wind direction was from the WSW sector, accounting for 21.7%

of the winds, the average wind direction was 260°.

Data Recovery

		Possible (hours)	Reported (hours)	Recovery
Wind Speed		2411	2368	98.22%
Sigma Theta		2411	2368	98.22%
Wind Direction		2411	2368	98.22%

North Butte Table 3

Spring Wind Data Summary

4/1/2011 - 6/2/2011

Hourly Data

		Average	Max	Min
Wind Speed (mph)		11.39	36.11	0.77
Sigma Theta (°)		20.97	101.50	4.55
Wind Direction				
	N	13.76	25.78	1.00
	NNE	12.11	29.64	1.59
	NE	9.51	18.58	0.96
	ENE	8.97	18.23	0.92
	E	10.22	20.91	1.06
	ESE	11.27	25.59	1.24
	SE	12.86	22.92	1.74
	SSE	12.57	25.83	1.39
	S	10.51	22.03	1.08
	SSW	11.34	27.71	1.40
	SW	11.91	33.35	2.10
	WSW	10.28	36.11	2.19
	W	9.47	31.08	2.20
	WNW	7.59	19.04	0.95
	NW	9.50	25.09	0.77
	NNW	14.24	26.43	1.59

Predominant wind direction was from the N sector, accounting for 12.8% of the winds, the average wind direction was 320°.

Data Recovery

		Possible (hours)	Reported (hours)	Recovery
Wind Speed		1512	1504	99.47%
Sigma Theta		1512	1504	99.47%
Wind Direction		1512	1504	99.47%

North Butte Table 3 (cont.)

Stability Class	Wind Direction	Wind Speed (mph) - One Year (Calm = 1.22%)						Row Total
		< 3	4 - 7	8 - 12	13 - 18	19 - 24	> 24	
A	N	0.000545	0.002583					0.003127
	NNE	0.001361	0.002841					0.004202
	NE	0.001634	0.002066					0.003700
	ENE	0.001089	0.002066					0.003155
	E	0.000545	0.001550					0.002094
	ESE	0.000817	0.001808					0.002625
	SE	0.000272	0.002324					0.002597
	SSE	0.001089	0.001808					0.002897
	S	0.001634	0.001808					0.003442
	SSW	0.001906	0.002841					0.004747
	SW	0.002451	0.004907					0.007358
	WSW	0.002723	0.004649					0.007372
	W	0.000817	0.004132					0.004949
	WNW	0.001361	0.002066					0.003428
	NW	0.002723	0.001291					0.004014
	NNW	0.001089	0.002324					0.003413
B	N			0.001550				0.001550
	NNE		0.001808	0.001033				0.002841
	NE	0.000545	0.000258	0.000258				0.001061
	ENE	0.000272	0.000517	0.000258				0.001047
	E		0.000517	0.000775				0.001291
	ESE		0.000517	0.001291				0.001808
	SE		0.000258	0.000517				0.000775
	SSE			0.000775				0.000775
	S	0.000272		0.000517				0.000789
	SSW		0.000517	0.001550				0.002066
	SW		0.002583	0.003616				0.006198
	WSW	0.000545	0.002841	0.002066				0.005452
	W		0.001808	0.003099				0.004907
	WNW		0.001808	0.001291				0.003099
	NW			0.000775				0.000775
	NNW		0.000775	0.002066				0.002841
C	N		0.001033	0.004907	0.002841			0.008781
	NNE		0.000517	0.003874	0.001291			0.005682
	NE		0.001291	0.001033	0.000258			0.002583
	ENE		0.000775	0.001550	0.000517			0.002841
	E		0.000258	0.000775	0.000517			0.001550
	ESE			0.001808	0.000517			0.002324
	SE		0.000258	0.001291	0.000258			0.001808
	SSE			0.001291	0.001808			0.003099
	S		0.000517	0.001291	0.000258			0.002066
	SSW		0.002583	0.003099	0.000517			0.006198
	SW	0.000545	0.003099	0.009039	0.001808			0.014491
	WSW	0.001089	0.005682	0.008523	0.001291			0.016585
	W		0.003099	0.006198	0.001033			0.010331
	WNW		0.002324	0.003874	0.000517			0.006715
	NW		0.001033	0.001033	0.000517			0.002583
	NNW			0.003099	0.001033			0.004132

North Butte Table 3 (cont.)

Stability Class	Wind Direction	Wind Speed (mph) - One Year						Row Total
		< 3	4 - 7	8 - 12	13 - 18	19 - 24	> 24	
D	N		0.002066	0.016012	0.037707	0.014979	0.003616	0.074380
	NNE		0.003874	0.019112	0.035899	0.010331	0.003357	0.072572
	NE		0.004132	0.010847	0.013430	0.001291		0.029700
	ENE	0.000272	0.001291	0.006198	0.004390			0.012152
	E		0.000258	0.004132	0.003874	0.000775		0.009039
	ESE		0.001033	0.002841	0.003874	0.001033	0.000517	0.009298
	SE			0.002841	0.005424	0.004907		0.013171
	SSE			0.002066	0.005165	0.003874	0.000258	0.011364
	S		0.000258	0.004132	0.006457	0.001808		0.012655
	SSW		0.002324	0.011880	0.010847	0.003616	0.001291	0.029959
	SW	0.000272	0.010847	0.035640	0.041322	0.023760	0.010847	0.122690
	WSW	0.000272	0.019886	0.051653	0.026343	0.005682	0.003874	0.107710
	W		0.012397	0.029184	0.012138	0.001291	0.001033	0.056043
	WNW		0.004649	0.012397	0.003874	0.001291		0.022211
	NW		0.000775	0.006973	0.004390	0.002066	0.000258	0.014463
	NNW		0.001033	0.008781	0.022986	0.011880	0.001033	0.045713
E	N		0.001033	0.003099				0.004132
	NNE		0.002066	0.004649				0.006715
	NE	0.000817	0.003616	0.001291				0.005724
	ENE		0.001550	0.001033				0.002583
	E	0.000272	0.000775	0.000258				0.001305
	ESE			0.001033				0.001033
	SE			0.000517				0.000517
	SSE	0.000272	0.000258	0.000775				0.001305
	S		0.000517	0.001033				0.001550
	SSW		0.000258	0.000517				0.000775
	SW	0.000817	0.004132	0.001550				0.006499
	WSW	0.001361	0.008264	0.006973				0.016599
	W	0.000272	0.006973	0.001550				0.008795
	WNW		0.001808	0.001550				0.003357
	NW		0.000517	0.001291				0.001808
	NNW		0.000775	0.001550				0.002324
F	N	0.001906	0.003099					0.005005
	NNE	0.002178	0.003357					0.005536
	NE	0.003267	0.004390					0.007658
	ENE	0.001906	0.002841					0.004747
	E	0.001361	0.001550					0.002911
	ESE	0.000817	0.001033					0.001850
	SE	0.001361	0.002583					0.003944
	SSE	0.001361	0.001808					0.003169
	S	0.002723	0.002066					0.004789
	SSW	0.001906	0.004649					0.006555
	SW	0.004901	0.009556					0.014457
	WSW	0.006807	0.009814					0.016621
	W	0.004629	0.005940					0.010569
	WNW	0.002451	0.002324					0.004775
	NW	0.001634	0.002841					0.004475
	NNW	0.001089	0.001550					0.002639

North Butte Table 4

Stability Class	Wind Direction	Wind Speed (mph) - Winter (Calm = 0.6%)						Row Total
		< 3	4 - 7	8 - 12	13 - 18	19 - 24	> 24	
A	N		0.001403					0.001403
	NNE	0.000971	0.000935					0.001906
	NE	0.001456	0.002338					0.003794
	ENE	0.000971	0.001870					0.002841
	E	0.000485	0.001403					0.001888
	ESE	0.000971	0.001403					0.002373
	SE	0.000485	0.000935					0.001420
	SSE		0.001870					0.001870
	S	0.001941	0.002338					0.004279
	SSW	0.001456	0.000935					0.002391
	SW	0.001456	0.003740					0.005196
	WSW	0.002912	0.003740					0.006652
	W	0.000485	0.003740					0.004225
	WNW		0.000935					0.000935
	NW	0.001456	0.001403					0.002859
	NNW	0.000971	0.002338					0.003308
B	N			0.000935				0.000935
	NNE		0.001403	0.000468				0.001870
	NE							
	ENE		0.000468					0.000468
	E		0.000468	0.000468				0.000935
	ESE		0.000468	0.001403				0.001870
	SE			0.000468				0.000468
	SSE			0.000468				0.000468
	S	0.000485						0.000485
	SSW		0.000935	0.000468				0.001403
	SW		0.001870	0.002805				0.004675
	WSW	0.000485	0.001870	0.001403				0.003758
	W		0.002338	0.003740				0.006078
	WNW		0.000468	0.000935				0.001403
	NW			0.000935				0.000935
	NNW		0.000468	0.000935				0.001403
C	N			0.003740	0.002338			0.006078
	NNE		0.000468	0.002338	0.000468			0.003273
	NE		0.001403					0.001403
	ENE		0.000935	0.001403	0.000468			0.002805
	E			0.000468				0.000468
	ESE			0.001403	0.000935			0.002338
	SE		0.000468	0.000935				0.001403
	SSE			0.001403	0.000935			0.002338
	S		0.000935	0.001403	0.000468			0.002805
	SSW		0.002805	0.002805	0.000468			0.006078
	SW	0.000971	0.001870	0.008415				0.011256
	WSW	0.000971	0.006078	0.009350	0.000935			0.017334
	W		0.001870	0.004675	0.001403			0.007948
	WNW		0.002338	0.003740				0.006078
	NW		0.000935	0.000935				0.001870
	NNW			0.001870	0.001403			0.003273

North Butte Table 4 (cont.)

Stability Class	Wind Direction	Wind Speed (mph) - Winter (Calm = 0.6%)						Row Total
		< 3	4 - 7	8 - 12	13 - 18	19 - 24	> 24	
D	N		0.002338	0.016363	0.029453	0.009350	0.001403	0.058906
	NNE		0.004675	0.015428	0.031323	0.004675	0.000935	0.057036
	NE		0.005143	0.011220	0.008415	0.000935		0.025713
	ENE	0.000485	0.001870	0.005610	0.001403			0.009368
	E			0.004208	0.001870			0.006078
	ESE		0.001870	0.000468	0.001870	0.000468		0.004675
	SE			0.001403	0.002338	0.001870		0.005610
	SSE			0.001403	0.004675	0.001403		0.007480
	S		0.000468	0.002805	0.002805	0.001870		0.007948
	SSW		0.003740	0.016363	0.011220	0.002805	0.000468	0.034596
	SW		0.015428	0.052828	0.050491	0.030388	0.011688	0.160823
	WSW	0.000485	0.024778	0.081814	0.028518	0.004208	0.002805	0.142608
	W		0.015895	0.039738	0.009350	0.001870		0.066854
	WNW		0.003740	0.013090	0.003273	0.001870		0.021973
	NW			0.005143	0.004208	0.001403		0.010753
	NNW			0.007948	0.017765	0.007013		0.032726
E	N		0.000935	0.003740				0.004675
	NNE		0.002338	0.005610				0.007948
	NE		0.005143	0.002338				0.007480
	ENE		0.001870	0.001403				0.003273
	E	0.000485	0.000468					0.000953
	ESE							
	SE			0.000468				0.000468
	SSE	0.000485		0.000468				0.000953
	S		0.000468	0.000468				0.000935
	SSW			0.000935				0.000935
	SW	0.000485	0.004675	0.001403				0.006563
	WSW	0.001941	0.011220	0.010753				0.023914
	W	0.000485	0.008883	0.000935				0.010303
	WNW		0.000468	0.001403				0.001870
	NW		0.000935	0.000468				0.001403
	NNW		0.000935	0.001870				0.002805
F	N	0.001941	0.003740					0.005682
	NNE	0.002912	0.002805					0.005717
	NE	0.003398	0.003273					0.006670
	ENE	0.002427	0.002805					0.005232
	E	0.001941	0.000935					0.002877
	ESE	0.000971	0.000468					0.001438
	SE	0.001456	0.003273					0.004729
	SSE	0.001456	0.001870					0.003326
	S	0.002427	0.002338					0.004764
	SSW	0.003398	0.006078					0.009475
	SW	0.006310	0.013558					0.019868
	WSW	0.009707	0.013558					0.023265
	W	0.007766	0.006545					0.014311
	WNW	0.002427	0.001870					0.004297
	NW	0.001941	0.003273					0.005214
	NNW	0.001941	0.002338					0.004279

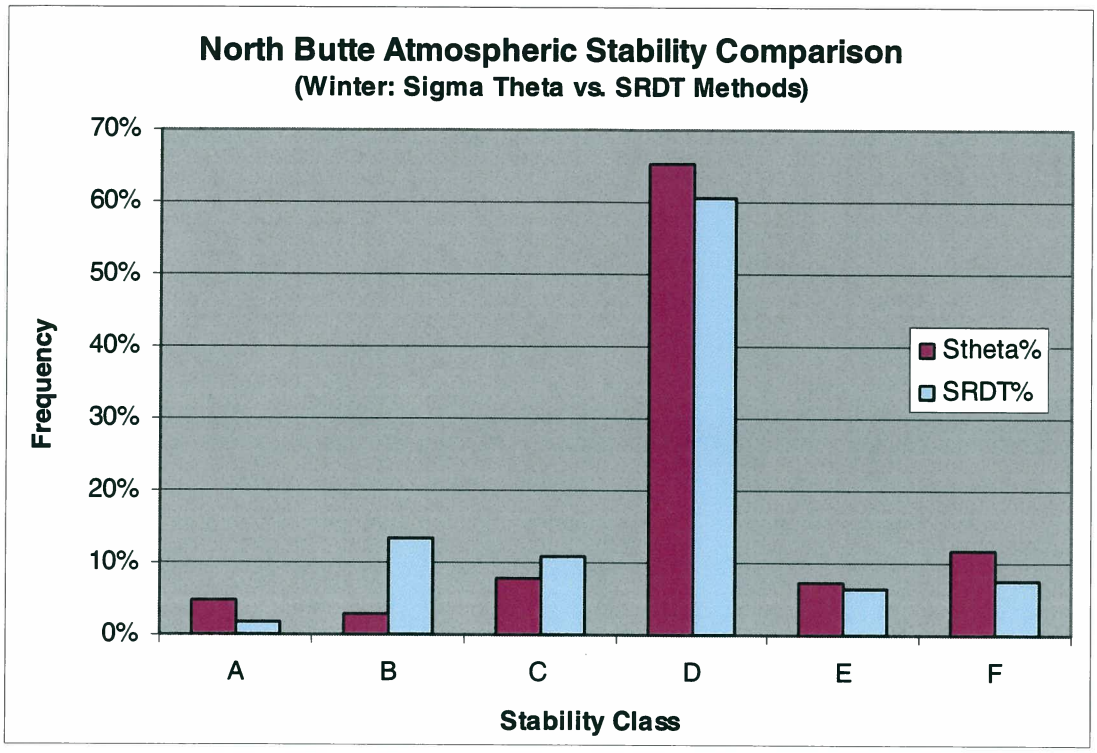
North Butte Table 5

Stability Class	Wind Direction	Wind Speed (mph) - Spring (Calm = 0.82%)						Row Total
		< 3	4 - 7	8 - 12	13 - 18	19 - 24	> 24	
A	N	0.001436	0.004654					0.006090
	NNE	0.002153	0.005984					0.008137
	NE	0.002153	0.001330					0.003483
	ENE	0.001436	0.002660					0.004095
	E	0.000718	0.001995					0.002712
	ESE	0.000718	0.002660					0.003377
	SE		0.004654					0.004654
	SSE	0.002871	0.001995					0.004866
	S	0.001436	0.001330					0.002765
	SSW	0.002871	0.005984					0.008855
	SW	0.003589	0.006649					0.010238
	WSW	0.001436	0.006649					0.008085
	W	0.001436	0.004654					0.006090
	WNW	0.003589	0.003989					0.007578
	NW	0.005024	0.001330					0.006354
	NNW	0.001436	0.002660					0.004095
B	N			0.002660				0.002660
	NNE		0.002660	0.000665				0.003324
	NE	0.001436	0.000665	0.000665				0.002765
	ENE	0.000718	0.000665	0.000665				0.002048
	E		0.000665	0.001330				0.001995
	ESE		0.000665	0.001330				0.001995
	SE		0.000665	0.000665				0.001330
	SSE			0.001330				0.001330
	S			0.000665				0.000665
	SSW			0.003324				0.003324
	SW		0.003989	0.004654				0.008644
	WSW		0.004654	0.003324				0.007979
	W		0.001330	0.001995				0.003324
	WNW		0.003989	0.001330				0.005319
	NW			0.000665				0.000665
	NNW		0.001330	0.003989				0.005319
C	N		0.002660	0.007314	0.003989			0.013963
	NNE		0.000665	0.006649	0.002660			0.009973
	NE		0.001330	0.002660	0.000665			0.004654
	ENE		0.000665	0.001995	0.000665			0.003324
	E		0.000665	0.001330	0.001330			0.003324
	ESE			0.002660				0.002660
	SE			0.001995	0.000665			0.002660
	SSE			0.001330	0.003324			0.004654
	S			0.000665				0.000665
	SSW		0.001330	0.003324	0.000665			0.005319
	SW		0.003989	0.010638	0.003989			0.018617
	WSW	0.001436	0.005984	0.007979	0.001330			0.016728
	W		0.005319	0.009309	0.000665			0.015293
	WNW		0.001995	0.004654	0.001330			0.007979
	NW		0.001330	0.001330	0.001330			0.003989
	NNW			0.005319	0.000665			0.005984

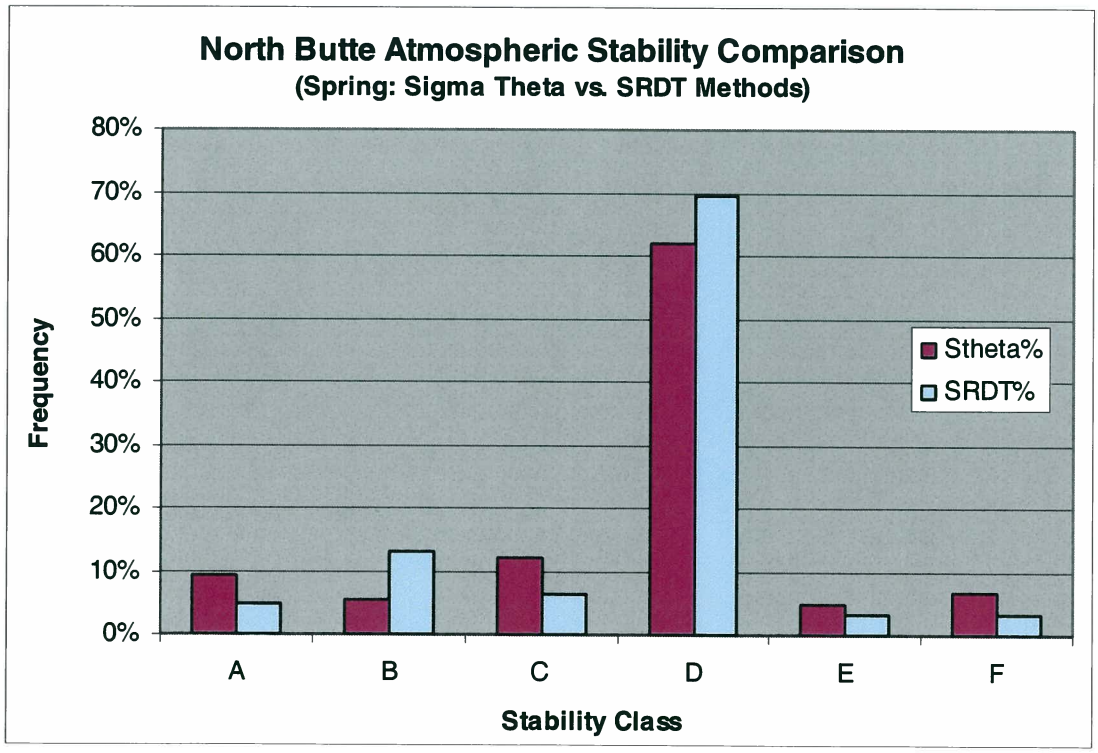
North Butte Table 5 (cont.)

Stability Class	Wind Direction	Wind Speed (mph) - Spring (Calm = 0.82%)						Row Total
		< 3	4 - 7	8 - 12	13 - 18	19 - 24	> 24	
D	N		0.001995	0.016622	0.049867	0.021941	0.005984	0.096410
	NNE		0.003324	0.026596	0.044548	0.011968	0.001995	0.088431
	NE		0.003324	0.011968	0.022606	0.001330		0.039229
	ENE		0.000665	0.007979	0.009309			0.017952
	E		0.000665	0.004654	0.007314	0.001995		0.014628
	ESE			0.006649	0.007314	0.001995	0.001330	0.017287
	SE			0.005319	0.010638	0.009973		0.025931
	SSE			0.002660	0.006649	0.007979	0.000665	0.017952
	S			0.005984	0.011303	0.001995		0.019282
	SSW			0.005984	0.009973	0.004654	0.001995	0.022606
	SW		0.003324	0.009309	0.021941	0.009309	0.008644	0.052527
	WSW		0.013298	0.009309	0.018617	0.007979	0.003989	0.053191
	W		0.006649	0.015293	0.015957	0.000665	0.002660	0.041223
	WNW		0.003989	0.012633	0.003324	0.000665		0.020612
	NW		0.001330	0.009973	0.005319	0.003324	0.000665	0.020612
	NNW		0.002660	0.011303	0.032580	0.020612	0.002660	0.069814
E	N		0.001330	0.002660				0.003989
	NNE		0.000665	0.003989				0.004654
	NE	0.002153	0.001995					0.004148
	ENE		0.001330	0.000665				0.001995
	E		0.001330	0.000665				0.001995
	ESE			0.002660				0.002660
	SE			0.000665				0.000665
	SSE		0.000665	0.001330				0.001995
	S		0.000665	0.001995				0.002660
	SSW							
	SW	0.000718	0.002660	0.001995				0.005372
	WSW		0.001330	0.001995				0.003324
	W		0.004654	0.001330				0.005984
	WNW		0.001995	0.001995				0.003989
	NW			0.002660				0.002660
	NNW		0.000665	0.001330				0.001995
F	N	0.002153	0.002660					0.004813
	NNE	0.001436	0.003989					0.005425
	NE	0.003589	0.005319					0.008908
	ENE	0.001436	0.003324					0.004760
	E	0.000718	0.002660					0.003377
	ESE	0.000718	0.001995					0.002712
	SE	0.001436	0.001995					0.003430
	SSE	0.001436	0.001330					0.002765
	S	0.002153	0.001330					0.003483
	SSW		0.000665					0.000665
	SW	0.002153	0.004654					0.006808
	WSW	0.002871	0.004654					0.007525
	W	0.000718	0.005984					0.006702
	WNW	0.002153	0.002660					0.004813
	NW	0.001436	0.001995					0.003430
	NNW		0.000665					0.000665

North Butte Figure 13



North Butte Figure 14



North Butte

Meteorological Data Summary

12/21/2010 - 1/5/2012

Hourly Data

	Average/Total	Max	Min
Wind Speed (mph)	10.1	37.4	0.0
Sigma-Theta (°)	21.0	101.5	0.0
Temperature (C)	6.9	35.3	-28.4
10m Temperature (C)	7.1	35.3	-28.5
Relative Humidity (%)	58.5	100.0	7.4
Precipitation (in)	174.40	7.11	
Solar Radiation (w/m^2)	185.7	1,043.0	

Predominant wind direction was from the WSW sector,
accounting for 18.1% of the possible winds

Data Recovery

Parameter	Possible (hours)	Reported (hours)	Recovery
Wind Speed	9113	9001	98.77%
Wind Direction	9113	8996	98.72%
Sigma-Theta	9113	9001	98.77%
Temperature	9113	9001	98.77%
10m Temperature	9113	9001	98.77%
Relative Humidity	9113	9001	98.77%
Precipitation	9113	9001	98.77%
Solar Radiation	9113	9000	98.76%

North Butte

Meteorological Data Summary

12/21/2010 - 1/5/2012

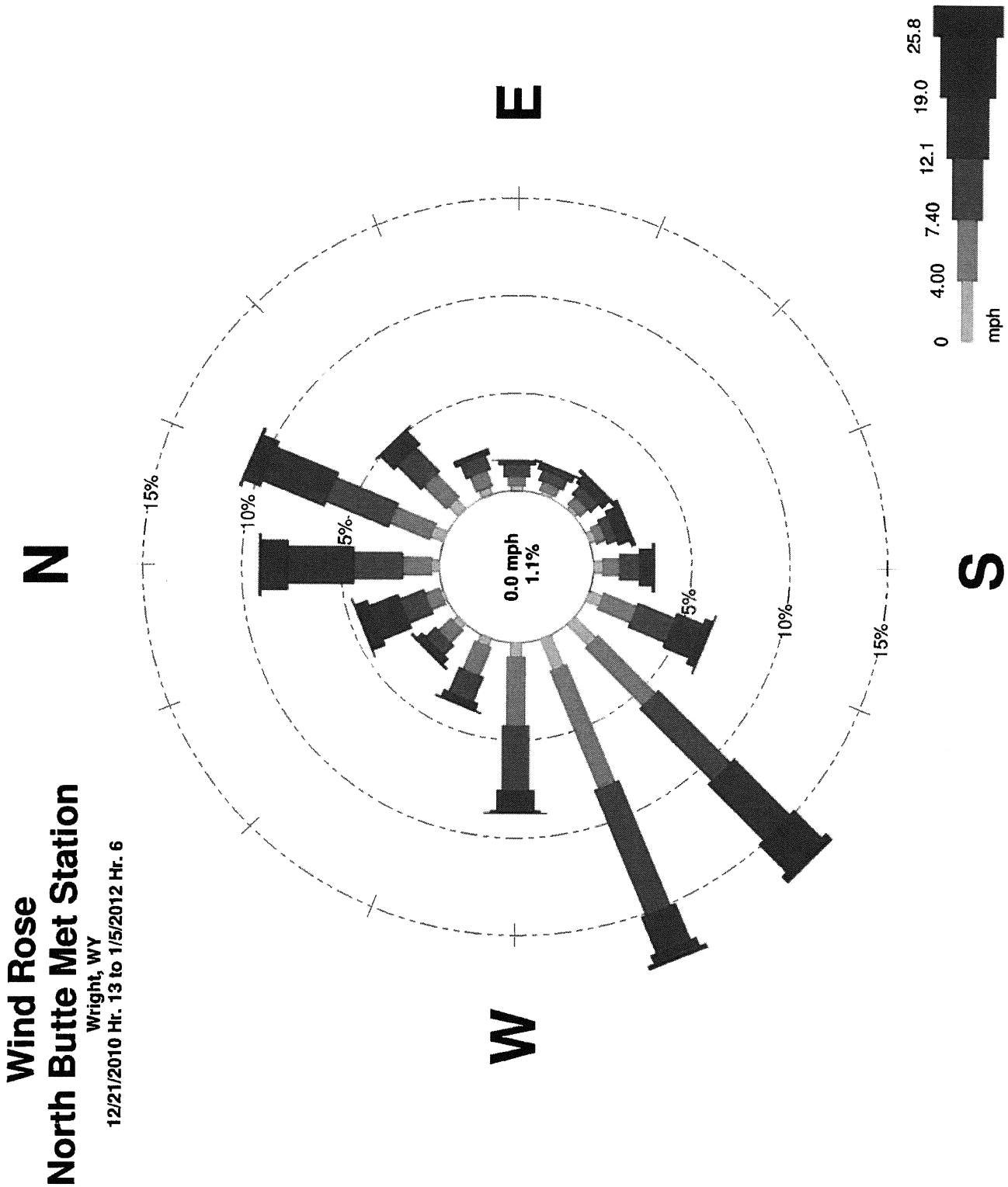
Hourly Data

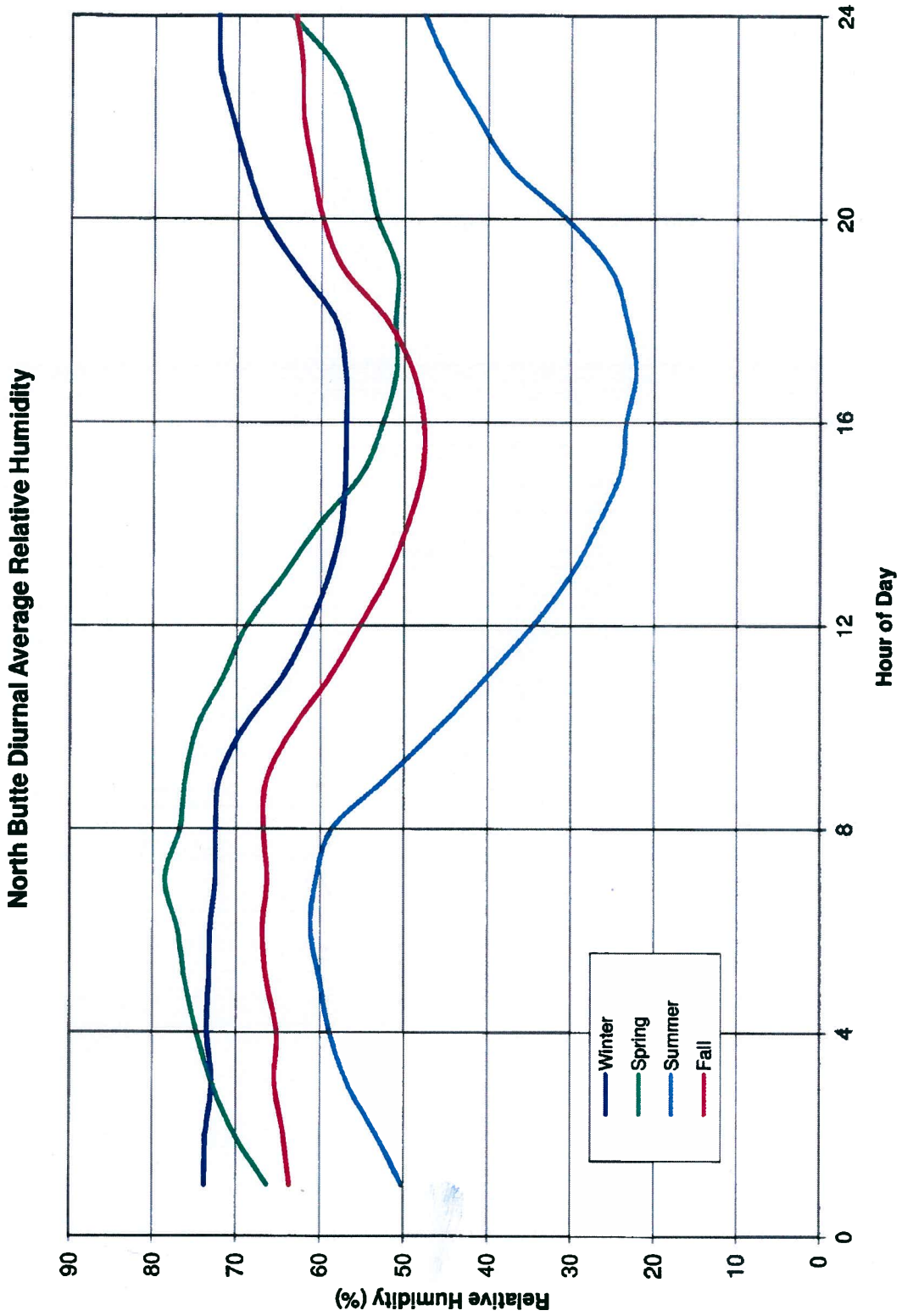
	Average/Total	Max	Min
Wind Speed (mph)	10.1	37.4	0.0
Sigma-Theta (°)	21.0	101.5	0.0
Temperature (C)	6.9	35.3	-28.4
10m Temperature (C)	7.1	35.3	-28.5
Relative Humidity (%)	58.5	100.0	7.4
Precipitation (in)	174.40	7.11	
Solar Radiation (w/m^2)	185.7	1,043.0	

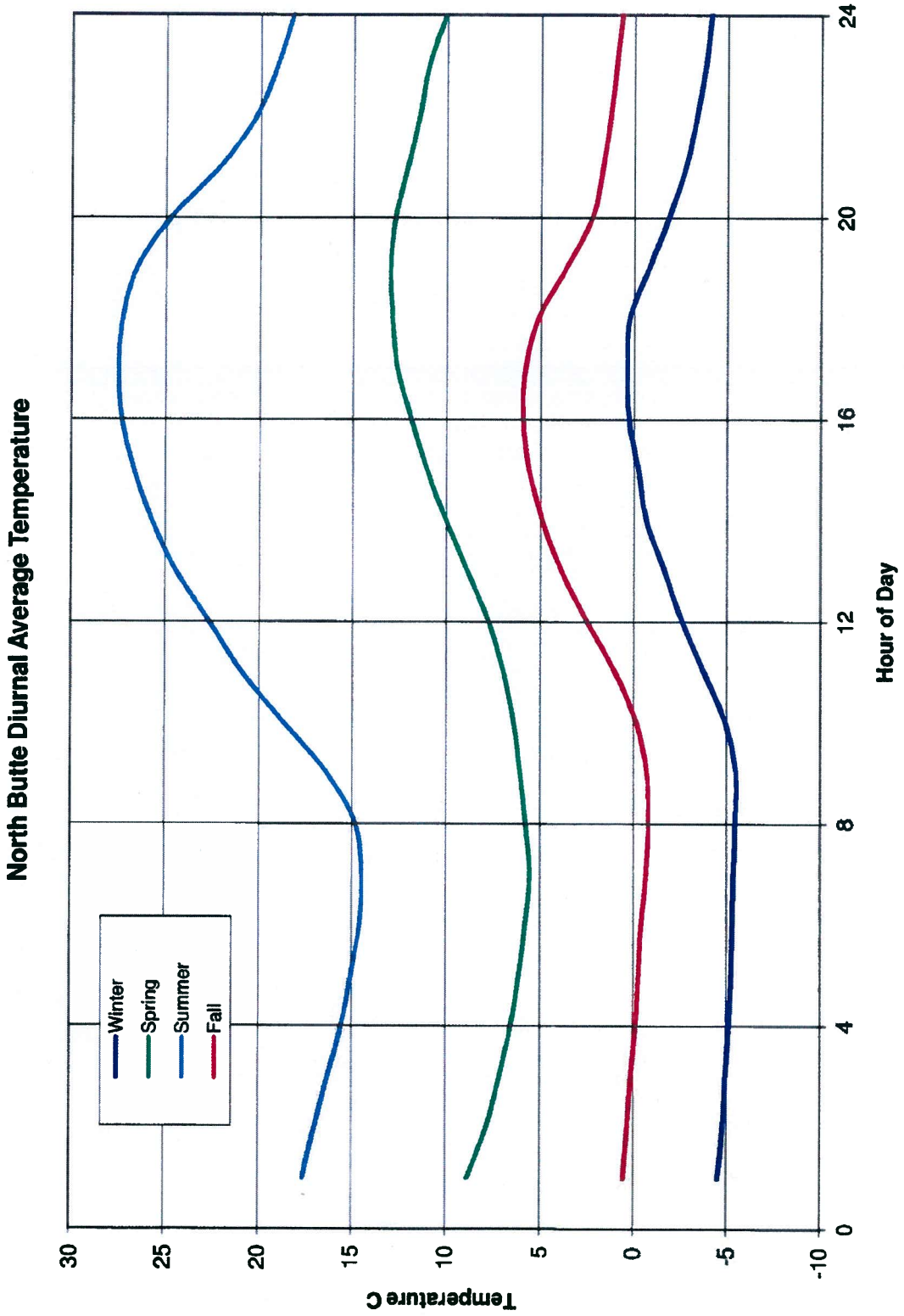
Predominant wind direction was from the WSW sector,
accounting for 18.1% of the possible winds

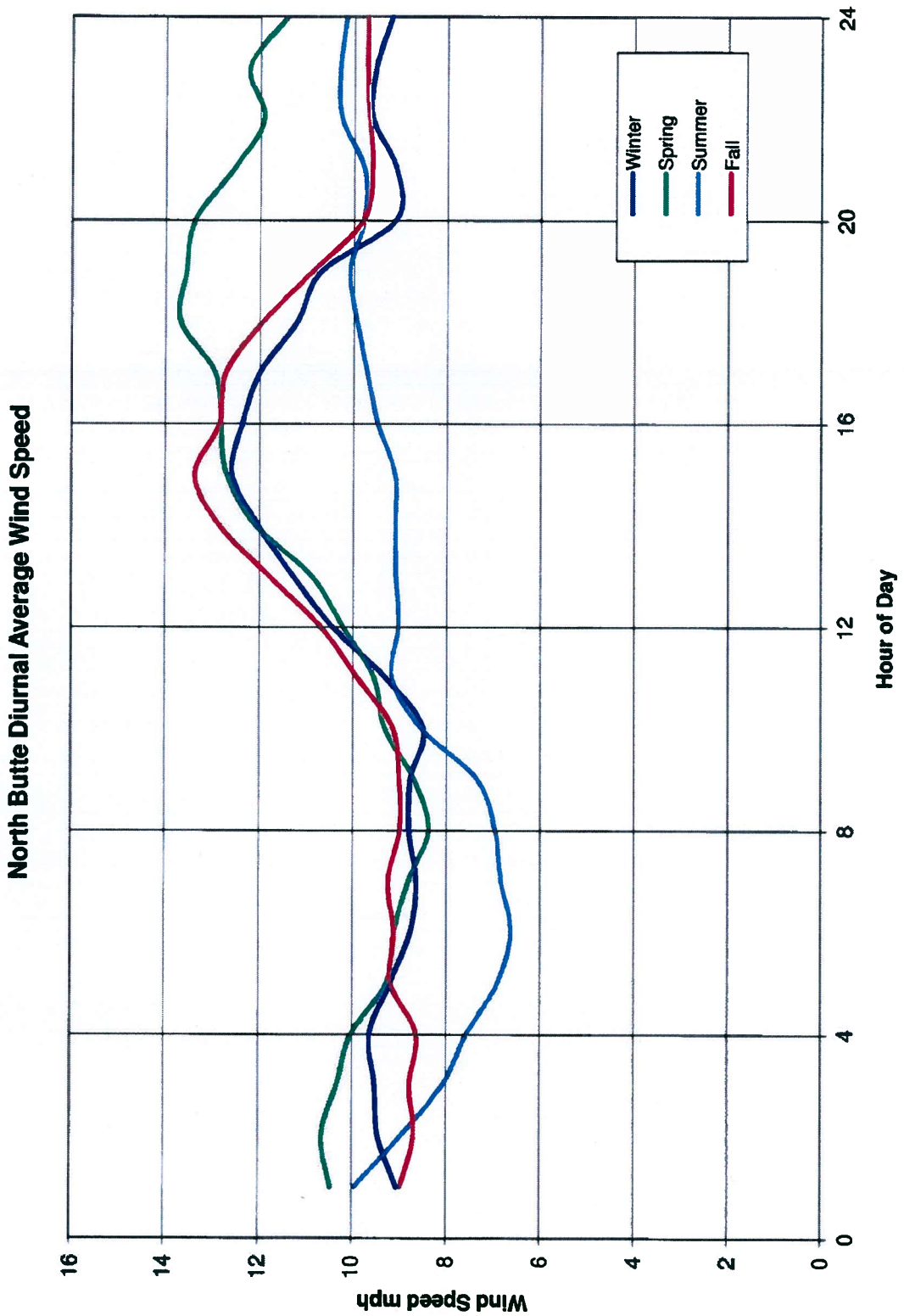
Data Recovery

Parameter	Possible (hours)	Reported (hours)	Recovery
Wind Speed	9113	9001	98.77%
Wind Direction	9113	8996	98.72%
Sigma-Theta	9113	9001	98.77%
Temperature	9113	9001	98.77%
10m Temperature	9113	9001	98.77%
Relative Humidity	9113	9001	98.77%
Precipitation	9113	9001	98.77%
Solar Radiation	9113	9000	98.76%


Wind Rose
North Butte Met Station
Wright, WY
12/21/2010 Hr. 13 to 1/5/2012 Hr. 6
N
E
S
W
15%
10%
5%
0.0 mph
1.1%
0
4.00
7.40
12.1
19.0
25.8
mph


North Butte Diurnal Average Relative Humidity
Relative Humidity (%)
90
80
70
60
50
40
30
20
10
0
0
4
8
12
16
20
24
Hour of Day
Winter
Spring
Summer
Fall


North Butte Diurnal Average Temperature
Winter
Spring
Summer
Fall
Temperature C
30
25
20
15
10
5
0
-5
-10
0
4
8
12
16
20
24
Hour of Day


North Butte Diurnal Average Wind Speed
Wind Speed mph
16
14
12
10
8
6
4
2
0
0
4
8
12
16
20
24
Hour of Day
Winter
Spring
Summer
Fall

Stability Class	Wind Direction	Wind Speed (mph) - One Year (Calm = 0.33%)						Row Total
		< 3	4 - 7	8 - 12	13 - 18	19 - 24	> 24	
A	N	0.001196	0.002885					0.004081
	NNE	0.001316	0.003001					0.004316
	NE	0.001914	0.003231					0.005145
	ENE	0.001316	0.002193					0.003508
	E	0.000718	0.001847					0.002564
	ESE	0.001196	0.002077					0.003273
	SE	0.000718	0.002424					0.003141
	SSE	0.001316	0.002077					0.003393
	S	0.002272	0.003462					0.005735
	SSW	0.002631	0.00554					0.008171
	SW	0.003109	0.004732					0.007841
	WSW	0.00287	0.006347					0.009218
	W	0.001196	0.005193					0.006389
	WNW	0.001435	0.003578					0.005013
	NW	0.001316	0.002308					0.003624
	NNW	0.001076	0.002308					0.003384
B	N		0.002077	0.000462				0.002539
	NNE	0.00012	0.004039	0.000231				0.004390
	NE	0.000239	0.001269	0.000462				0.001970
	ENE	0.000239	0.000923	0.000115				0.001278
	E		0.001616	0.000231				0.001847
	ESE		0.001269	0.000231				0.001500
	SE		0.000923	0.000115				0.001039
	SSE	0.00012	0.001616	0.000462				0.002197
	S	0.00012	0.00277	0.000115				0.003005
	SSW	0.00012	0.003462	0.000231				0.003813
	SW	0.000478	0.00704	0.000577				0.008095
	WSW	0.000598	0.006001	0.000231				0.006830
	W	0.00012	0.005424	0.000115				0.005659
	WNW		0.003001	0.000115				0.003116
	NW		0.001731	0.000115				0.001847
	NNW		0.002424	0.000231				0.002654
C	N		0.000923	0.007155				0.008078
	NNE	0.00012	0.000923	0.005655				0.006698
	NE		0.000923	0.003001				0.003924
	ENE		0.000577	0.001616				0.002193
	E		0.000346	0.001154				0.001500
	ESE			0.001385				0.001385
	SE		0.000115	0.001962				0.002077
	SSE		0.000231	0.002539				0.002770
	S		0.000692	0.003001				0.003693
	SSW	0.000239	0.003462	0.006117				0.009818
	SW	0.000837	0.006463	0.011887				0.019187
	WSW	0.000718	0.009002	0.008771				0.018490
	W	0.000359	0.003462	0.006578				0.010399
	WNW		0.001616	0.003808				0.005424
	NW		0.000692	0.001731				0.002424
	NNW		0.000346	0.003808				0.004155

Stability Class	Wind Direction	Wind Speed (mph) - One Year (Calm = 0.33%)						Row Total
		< 3	4 - 7	8 - 12	13 - 18	19 - 24	> 24	
D	N	0.000239	0.00854	0.023312	0.027351	0.00704	0.000692	0.067175
	NNE	0.000359	0.015811	0.030237	0.023774	0.003924	0.000577	0.074681
	NE		0.00854	0.013964	0.004847	0.000115	0.000115	0.027582
	ENE	0.00012	0.003462	0.004616	0.001847			0.010045
	E		0.001847	0.003116	0.001962	0.000231		0.007155
	ESE		0.001269	0.003116	0.002654	0.000462		0.007501
	SE		0.001039	0.004155	0.004962	0.000462		0.010617
	SSE		0.000923	0.003693	0.004732	0.001269		0.010617
	S		0.001616	0.006694	0.004962	0.000462		0.013733
	SSW	0.00012	0.004385	0.014426	0.010502	0.002539	0.000231	0.032203
	SW	0.000478	0.026659	0.037738	0.032198	0.012233	0.002885	0.112192
	WSW	0.001316	0.04974	0.039123	0.012579	0.00277	0.001616	0.107144
	W	0.000239	0.025389	0.016734	0.005193	0.000692	0.000346	0.048595
	WNW	0.00012	0.006463	0.006347	0.002308	0.000231		0.015469
	NW		0.002654	0.003808	0.00277	0.000692		0.009925
	NNW		0.002885	0.011425	0.014772	0.003462	0.000231	0.032776
E	N	0.00012	0.003693	0.000923				0.004736
	NNE	0.000478	0.004732	0.003001				0.008211
	NE	0.000598	0.004039	0.001039				0.005676
	ENE	0.00012	0.002077					0.002197
	E	0.00012	0.000577	0.000115				0.000812
	ESE		0.001269					0.001269
	SE		0.000808					0.000808
	SSE	0.000239	0.001154					0.001393
	S	0.00012	0.001962					0.002082
	SSW	0.00012	0.001269	0.000346				0.001735
	SW	0.001196	0.00554	0.001039				0.007774
	WSW	0.002033	0.012349	0.003001				0.017382
	W	0.001196	0.005078	0.000577				0.006851
	WNW	0.00012	0.00277	0.000462				0.003351
	NW	0.00012	0.001962	0.000115				0.002197
	NNW		0.001616	0.000115				0.001731
F	N	0.00287	0.00427					0.007140
	NNE	0.005262	0.004732					0.009994
	NE	0.004305	0.00427					0.008575
	ENE	0.002751	0.002424					0.005174
	E	0.001435	0.0015					0.002935
	ESE	0.000837	0.001039					0.001876
	SE	0.001555	0.001616					0.003170
	SSE	0.001794	0.000808					0.002602
	S	0.002272	0.001616					0.003888
	SSW	0.004664	0.003347					0.008011
	SW	0.007295	0.006924					0.014220
	WSW	0.010285	0.009579					0.019864
	W	0.005143	0.006117					0.011259
	WNW	0.002631	0.003116					0.005747
	NW	0.001914	0.002539					0.004452
	NNW	0.000957	0.001731					0.002688

Stability Class	Wind Direction	Wind Speed (mph) - Winter (Calm = 0.28%)						Row Total
		< 3	4 - 7	8 - 12	13 - 18	19 - 24	> 24	
A	N	0.000481	0.000935					0.001416
	NNE	0.000961	0.000935					0.001896
	NE	0.001442	0.002338					0.003779
	ENE	0.001922	0.000935					0.002857
	E	0.000961	0.000935					0.001896
	ESE	0.000961	0.001403					0.002364
	SE	0.000961	0.000468					0.001429
	SSE		0.001870					0.001870
	S	0.001922	0.002338					0.004260
	SSW	0.001442	0.000935					0.002377
	SW	0.001922	0.003273					0.005195
	WSW	0.002883	0.003740					0.006623
	W	0.000481	0.003740					0.004221
	WNW	0.000481	0.000468					0.000948
	NW	0.001442	0.001403					0.002844
	NNW	0.000961	0.002338					0.003299
B	N		0.000468	0.000468				0.000935
	NNE		0.001870					0.001870
	NE							
	ENE		0.000468					0.000468
	E		0.000935					0.000935
	ESE		0.001403	0.000468				0.001870
	SE		0.000468					0.000468
	SSE			0.000468				0.000468
	S	0.000481						0.000481
	SSW		0.001403					0.001403
	SW	0.000481	0.003740	0.000468				0.004688
	WSW	0.000961	0.002805					0.003766
	W		0.006078					0.006078
	WNW		0.000935	0.000468				0.001403
	NW		0.000935					0.000935
	NNW		0.001403					0.001403
C	N		0.000935	0.005143				0.006078
	NNE		0.000468	0.002805				0.003273
	NE		0.001403					0.001403
	ENE		0.001870	0.000935				0.002805
	E		0.000468					0.000468
	ESE			0.002338				0.002338
	SE		0.000468	0.000935				0.001403
	SSE		0.000468	0.001870				0.002338
	S		0.000935	0.001870				0.002805
	SSW		0.002805	0.003273				0.006078
	SW	0.000961	0.005610	0.004675				0.011246
	WSW	0.000961	0.010285	0.006078				0.017324
	W		0.003740	0.004208				0.007948
	WNW		0.002805	0.003273				0.006078
	NW		0.000935	0.000935				0.001870
	NNW		0.000468	0.002805				0.003273

Stability Class	Wind Direction	Wind Speed (mph) - Winter (Calm = 0.28%)						Row Total
		< 3	4 - 7	8 - 12	13 - 18	19 - 24	> 24	
D	N		0.008415	0.022440	0.024310	0.003740		0.058906
	NNE		0.012623	0.020570	0.021973	0.001870		0.057036
	NE		0.011220	0.009818	0.004675			0.025713
	ENE	0.000481	0.004208	0.004675				0.009363
	E		0.002338	0.002805	0.000935			0.006078
	ESE		0.002338		0.002338			0.004675
	SE			0.001870	0.003740			0.005610
	SSE		0.000468	0.003740	0.002805	0.000468		0.007480
	S		0.000468	0.004208	0.003273			0.007948
	SSW	0.000481	0.009350	0.015428	0.008883	0.000468		0.034609
	SW	0.000481	0.035531	0.052828	0.048621	0.018233	0.005143	0.160836
	WSW	0.000481	0.065451	0.057036	0.015428	0.002805	0.001403	0.142603
	W		0.038336	0.023843	0.004208	0.000468		0.066854
	WNW	0.000481	0.010753	0.007480	0.002338	0.000935		0.021986
	NW		0.002805	0.005143	0.002805			0.010753
	NNW		0.001403	0.013090	0.016830	0.001403		0.032726
E	N		0.002338	0.002338				0.004675
	NNE	0.000481	0.004208	0.003273				0.007961
	NE		0.006545	0.000935				0.007480
	ENE		0.003273					0.003273
	E	0.000481	0.000468					0.000948
	ESE							
	SE		0.000468					0.000468
	SSE	0.000481	0.000468					0.000948
	S		0.000935					0.000935
	SSW			0.000935				0.000935
	SW	0.001922	0.003740	0.000935				0.006597
	WSW	0.003844	0.016363	0.003740				0.023947
	W	0.001922	0.007948	0.000468				0.010337
	WNW		0.001403	0.000468				0.001870
	NW		0.001403					0.001403
	NNW		0.002805					0.002805
F	N	0.001922	0.003740					0.005662
	NNE	0.003364	0.002338					0.005701
	NE	0.003844	0.002805					0.006649
	ENE	0.002403	0.002805					0.005208
	E	0.002403	0.000468					0.002870
	ESE	0.000961	0.000468					0.001429
	SE	0.001922	0.002805					0.004727
	SSE	0.003364						0.003364
	S	0.002883	0.001870					0.004753
	SSW	0.006247	0.003273					0.009520
	SW	0.010572	0.009350					0.019922
	WSW	0.012494	0.010753					0.023247
	W	0.009131	0.005143					0.014273
	WNW	0.003364	0.000935					0.004299
	NW	0.001922	0.003273					0.005195
	NNW	0.001922	0.002338					0.004260

Stability Class	Wind Direction	Wind Speed (mph) - Spring (Calm = 0.60%)						Row Total
		< 3	4 - 7	8 - 12	13 - 18	19 - 24	> 24	
A	N	0.001961	0.005039					0.007000
	NNE	0.002451	0.005039					0.007490
	NE	0.002942	0.000916					0.003858
	ENE	0.001471	0.003207					0.004677
	E	0.000981	0.002290					0.003271
	ESE	0.001961	0.002290					0.004252
	SE	0.000981	0.003207					0.004187
	SSE	0.003922	0.001832					0.005755
	S	0.002451	0.002749					0.005200
	SSW	0.003432	0.005955					0.009387
	SW	0.003922	0.005955					0.009877
	WSW	0.002942	0.006413					0.009355
	W	0.001471	0.004581					0.006052
	WNW	0.002942	0.004123					0.007064
	NW	0.003432	0.002749					0.006180
	NNW	0.001961	0.002290					0.004252
B	N		0.002749					0.002749
	NNE		0.003207	0.000458				0.003665
	NE	0.000981	0.001832					0.002813
	ENE	0.000981	0.001374					0.002355
	E		0.001832					0.001832
	ESE		0.001374					0.001374
	SE		0.001374					0.001374
	SSE		0.002290	0.000916				0.003207
	S		0.001832					0.001832
	SSW		0.003207					0.003207
	SW		0.008246	0.001374				0.009620
	WSW	0.000490	0.005497	0.000458				0.006445
	W		0.004581					0.004581
	WNW		0.004581					0.004581
	NW		0.000916					0.000916
	NNW		0.003665	0.000458				0.004123
C	N		0.002749	0.010994				0.013743
	NNE		0.001832	0.008246				0.010078
	NE		0.002290	0.004123				0.006413
	ENE		0.000458	0.003207				0.003665
	E		0.000458	0.002290				0.002749
	ESE			0.002290				0.002290
	SE			0.002290				0.002290
	SSE		0.000458	0.006413				0.006871
	S		0.000916	0.002290				0.003207
	SSW	0.000490	0.004581	0.007329				0.012400
	SW	0.000490	0.007329	0.012368				0.020188
	WSW	0.001471	0.007787	0.009620				0.018878
	W	0.000490	0.005497	0.005497				0.011484
	WNW		0.001832	0.004581				0.006413
	NW		0.000916	0.002290				0.003207
	NNW		0.000458	0.004581				0.005039

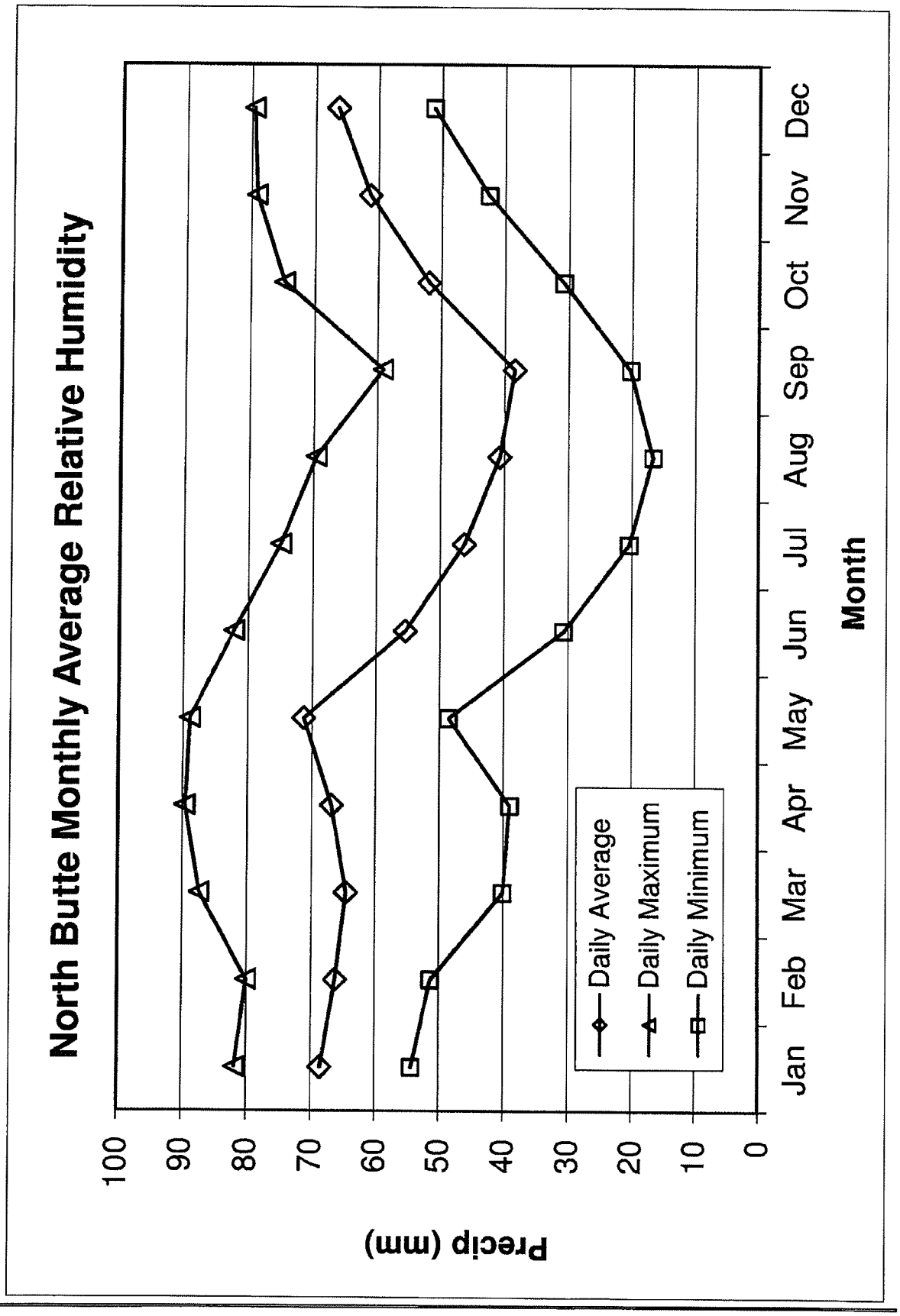
Stability Class	Wind Direction	Wind Speed (mph) - Spring (Calm = 0.60%)						Row Total
		< 3	4 - 7	8 - 12	13 - 18	19 - 24	> 24	
D	N		0.005955	0.034814	0.040311	0.010994	0.000458	0.092533
	NNE		0.011452	0.038479	0.029317	0.005039	0.000916	0.085204
	NE		0.007329	0.019240	0.008246			0.034814
	ENE		0.003665	0.007787	0.004123			0.015575
	E		0.002749	0.004581	0.005955	0.000458		0.013743
	ESE		0.002290	0.005497	0.006871	0.001374		0.016033
	SE		0.001374	0.005497	0.012368	0.001832		0.021072
	SSE		0.000916	0.003665	0.007329	0.003665		0.015575
	S		0.000916	0.008246	0.005039	0.000916		0.015117
	SSW		0.000916	0.010536	0.012368	0.002749	0.000458	0.027027
	SW	0.000490	0.008704	0.019698	0.019698	0.009162	0.003207	0.060958
	WSW	0.001961	0.017407	0.013743	0.015117	0.003665	0.005039	0.056931
	W	0.000490	0.013284	0.010536	0.010536	0.002290	0.001374	0.038511
	WNW		0.007329	0.009162	0.001832			0.018323
	NW		0.004581	0.006413	0.004581	0.002290		0.017865
	NNW		0.003207	0.018323	0.025195	0.006871		0.053596
E	N		0.003665	0.000458				0.004123
	NNE		0.005039	0.000458				0.005497
	NE	0.001471	0.001832	0.000458				0.003761
	ENE		0.002290					0.002290
	E		0.001374					0.001374
	ESE		0.002290					0.002290
	SE		0.000916					0.000916
	SSE		0.001832					0.001832
	S	0.000490	0.003207					0.003697
	SSW		0.000916					0.000916
	SW	0.000490	0.003207	0.000916				0.004613
	WSW	0.000981	0.005039					0.006019
	W	0.000490	0.004123					0.004613
	WNW		0.004123	0.000916				0.005039
	NW		0.002290	0.000458				0.002749
	NNW		0.001832					0.001832
F	N	0.002942	0.002290					0.005232
	NNE	0.004412	0.004581					0.008993
	NE	0.003922	0.005955					0.009877
	ENE	0.001961	0.002290					0.004252
	E	0.000981	0.001832					0.002813
	ESE	0.000490	0.001832					0.002323
	SE	0.001471	0.001374					0.002845
	SSE	0.001961	0.001832					0.003793
	S	0.001961	0.000916					0.002877
	SSW	0.001471	0.000458					0.001929
	SW	0.004903	0.004581					0.009484
	WSW	0.004903	0.005497					0.010400
	W	0.002942	0.005039					0.007981
	WNW	0.003432	0.002749					0.006180
	NW	0.001471	0.001832					0.003303
	NNW		0.001832					0.001832

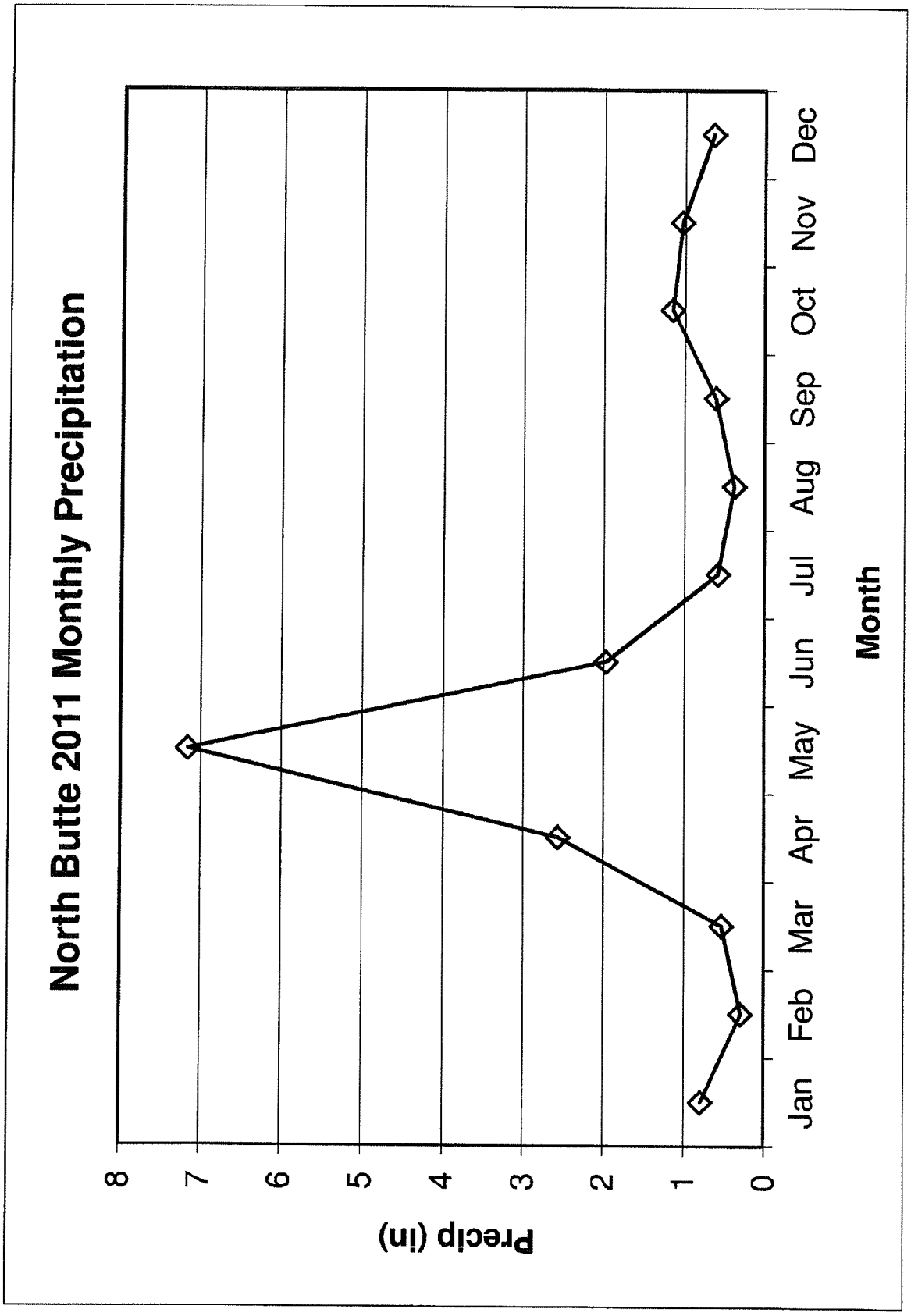
Stability Class	Wind Direction	Wind Speed (mph) - Summer (Calm = 0.14%)						Row Total
		< 3	4 - 7	8 - 12	13 - 18	19 - 24	> 24	
A	N	0.001379	0.004984					0.006363
	NNE	0.001379	0.004984					0.006363
	NE	0.001838	0.008156					0.009994
	ENE	0.001379	0.004531					0.005910
	E	0.000919	0.004078					0.004997
	ESE	0.001838	0.004531					0.006369
	SE	0.000919	0.004531					0.005450
	SSE	0.000919	0.004078					0.004997
	S	0.003676	0.007250					0.010926
	SSW	0.002757	0.012234					0.014991
	SW	0.004136	0.007250					0.011386
	WSW	0.002298	0.010421					0.012719
	W	0.002757	0.008609					0.011366
	WNW	0.001838	0.006797					0.008635
	NW	0.000460	0.004531					0.004991
	NNW	0.000460	0.003172					0.003631
B	N		0.004531	0.001359				0.005890
	NNE	0.000460	0.009968	0.000453				0.010881
	NE		0.002719	0.001812				0.004531
	ENE		0.001812	0.000453				0.002266
	E		0.002719	0.000453				0.003172
	ESE		0.002266	0.000453				0.002719
	SE		0.001812	0.000453				0.002266
	SSE	0.000460	0.003625					0.004084
	S		0.007703	0.000453				0.008156
	SSW	0.000460	0.007250	0.000906				0.008615
	SW	0.000919	0.012234					0.013153
	WSW	0.000460	0.008609	0.000453				0.009522
	W	0.000460	0.009515	0.000453				0.010428
	WNW		0.004531					0.004531
	NW		0.003625	0.000453				0.004078
	NNW		0.004078	0.000453				0.004531
C	N			0.007703				0.007703
	NNE	0.000460		0.009062				0.009522
	NE			0.005890				0.005890
	ENE			0.001812				0.001812
	E		0.000453	0.001812				0.002266
	ESE			0.000906				0.000906
	SE			0.004531				0.004531
	SSE			0.000453				0.000453
	S		0.000453	0.005890				0.006343
	SSW	0.000460	0.004078	0.009062				0.013600
	SW	0.000919	0.004531	0.018124				0.023574
	WSW	0.000460	0.009062	0.014952				0.024474
	W	0.000460	0.003172	0.008609				0.012240
	WNW		0.001812	0.005890				0.007703
	NW		0.000906	0.002266				0.003172
	NNW			0.004078				0.004078

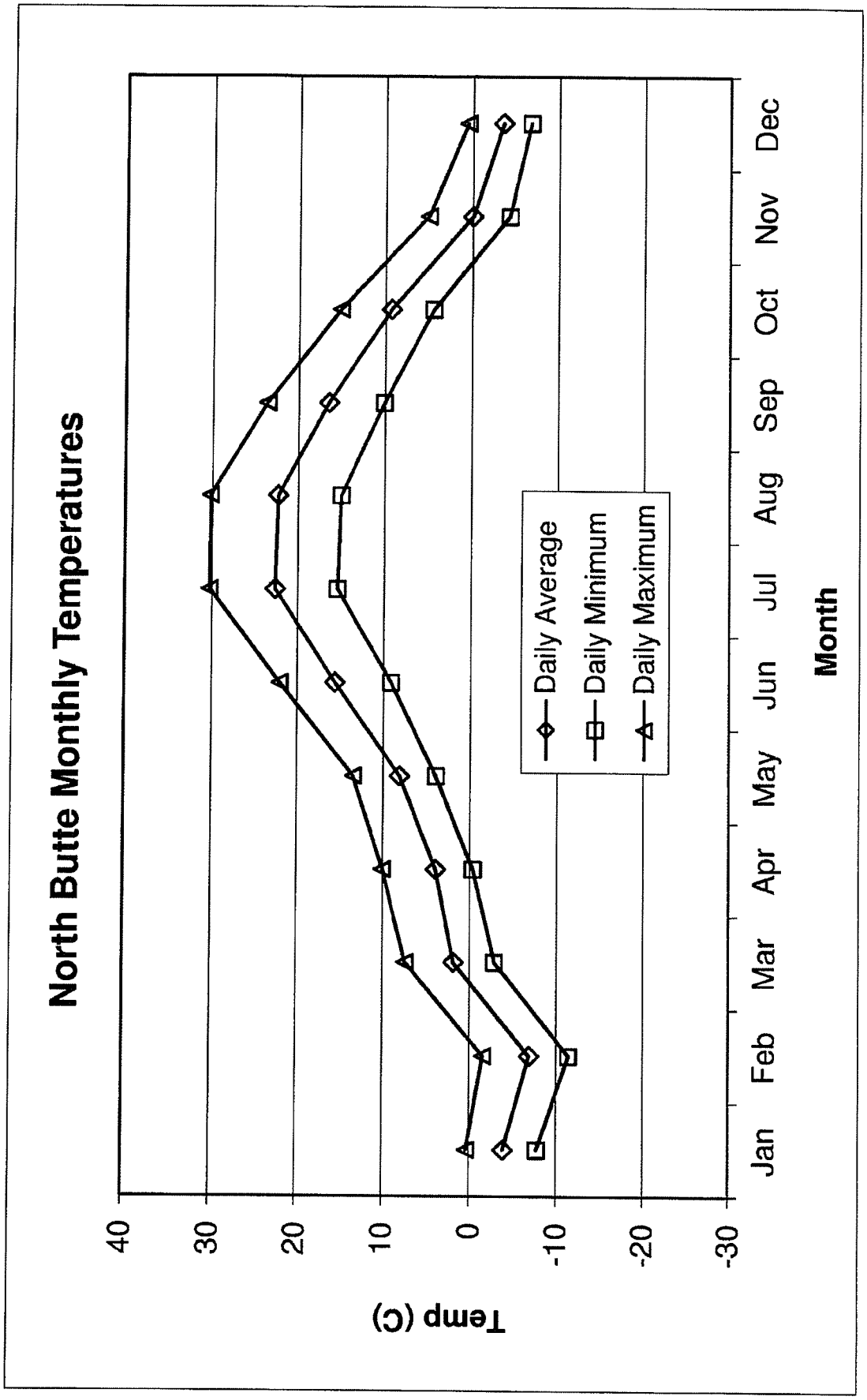
Stability Class	Wind Direction	Wind Speed (mph) - Summer (Calm = 0.14%)						Row Total
		< 3	4 - 7	8 - 12	13 - 18	19 - 24	> 24	
D	N	0.000460	0.008609	0.021749	0.015859	0.002719	0.001812	0.051207
	NNE	0.000460	0.023108	0.038967	0.022655	0.003172	0.000453	0.088815
	NE		0.010421	0.020390	0.004531	0.000453		0.035795
	ENE		0.004078	0.005437	0.003172			0.012687
	E		0.001359	0.004984	0.000906	0.000453		0.007703
	ESE		0.000453	0.005437	0.001359	0.000453		0.007703
	SE		0.002266	0.009062	0.003625			0.014952
	SSE		0.001812	0.006797	0.008156	0.000906		0.017671
	S		0.001812	0.010421	0.009968	0.000906		0.023108
	SSW		0.003172	0.009515	0.006797	0.000453		0.019937
	SW	0.000460	0.024921	0.014952	0.010874	0.001359		0.052566
	WSW	0.000460	0.043951	0.021749	0.006343	0.000906		0.073409
	W	0.000460	0.009968	0.008609	0.002719			0.021755
	WNW		0.001812	0.004078	0.002266			0.008156
	NW		0.000906	0.000906	0.001359	0.000453		0.003625
	NNW		0.002266	0.004531	0.003625	0.000906	0.000453	0.011781
E	N		0.005890	0.000453				0.006343
	NNE	0.000460	0.006797	0.005437				0.012693
	NE	0.000460	0.004984	0.001812				0.007256
	ENE		0.002266					0.002266
	E		0.000453					0.000453
	ESE		0.002266					0.002266
	SE		0.001812					0.001812
	SSE		0.000906					0.000906
	S		0.002719					0.002719
	SSW	0.000460	0.000906	0.000453				0.001819
	SW	0.000460	0.005890					0.006350
	WSW	0.001379	0.010874	0.003172				0.015425
	W	0.001379	0.002719	0.000453				0.004550
	WNW			0.000453				0.000453
	NW		0.001359					0.001359
	NNW		0.000453					0.000453
F	N	0.004136	0.007703					0.011839
	NNE	0.005055	0.009968					0.015023
	NE	0.005515	0.006343					0.011858
	ENE	0.004136	0.002719					0.006855
	E	0.001379	0.002719					0.004097
	ESE	0.001379	0.001359					0.002738
	SE	0.002757	0.002266					0.005023
	SSE	0.000919	0.000906					0.001825
	S	0.002298	0.001812					0.004110
	SSW	0.003676	0.002719					0.006395
	SW	0.005055	0.004078					0.009133
	WSW	0.011029	0.014952					0.025982
	W	0.005055	0.007703					0.012758
	WNW	0.000460	0.002719					0.003178
	NW	0.001838	0.001359					0.003197
	NNW	0.000460	0.001359					0.001819

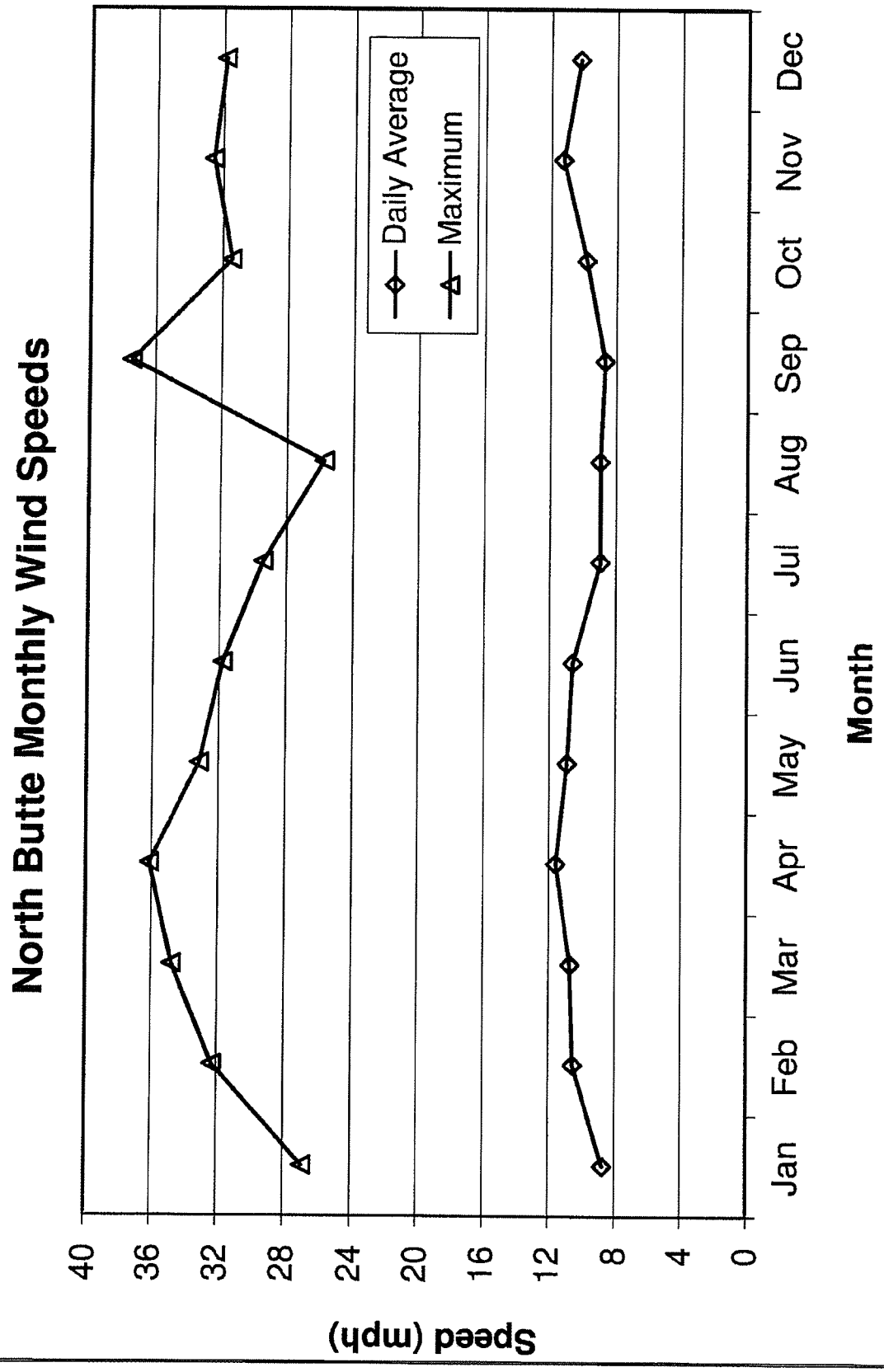
Stability Class	Wind Direction	Wind Speed (mph) - Fall (Calm = 0.33%)						Row Total
		< 3	4 - 7	8 - 12	13 - 18	19 - 24	> 24	
A	N	0.000971	0.000468					0.001439
	NNE	0.000486	0.000936					0.001422
	NE	0.001457	0.001404					0.002861
	ENE	0.000486						0.000486
	E							
	ESE							
	SE		0.001404					0.001404
	SSE	0.000486	0.000468					0.000954
	S	0.000971	0.001404					0.002376
	SSW	0.002914	0.002809					0.005723
	SW	0.002428	0.002341					0.004769
	WSW	0.003399	0.004682					0.008081
	W		0.003745					0.003745
	WNW	0.000486	0.002809					0.003295
	NW		0.000468					0.000468
	NNW	0.000971	0.001404					0.002376
B	N		0.000468					0.000468
	NNE		0.000936					0.000936
	NE		0.000468					0.000468
	ENE							
	E		0.000936	0.000468				0.001404
	ESE							
	SE							
	SSE		0.000468	0.000468				0.000936
	S		0.001404					0.001404
	SSW		0.001873					0.001873
	SW	0.000486	0.003745	0.000468				0.004699
	WSW	0.000486	0.007022					0.007508
	W		0.001404					0.001404
	WNW		0.001873					0.001873
	NW		0.001404					0.001404
	NNW		0.000468					0.000468
C	N			0.004682				0.004682
	NNE		0.001404	0.002341				0.003745
	NE			0.001873				0.001873
	ENE			0.000468				0.000468
	E			0.000468				0.000468
	ESE							
	SE							
	SSE			0.001404				0.001404
	S		0.000468	0.001873				0.002341
	SSW		0.002341	0.004682				0.007022
	SW	0.000971	0.008427	0.012172				0.021570
	WSW		0.008895	0.004213				0.013109
	W	0.000486	0.001404	0.007959				0.009849
	WNW			0.001404				0.001404
	NW			0.001404				0.001404
	NNW		0.000468	0.003745				0.004213

Stability Class	Wind Direction	Wind Speed (mph) - Fall (Calm = 0.33%)						Row Total
		< 3	4 - 7	8 - 12	13 - 18	19 - 24	> 24	
D	N	0.000486	0.011236	0.014045	0.029026	0.010768	0.000468	0.066029
	NNE	0.000971	0.015918	0.022472	0.021067	0.005618	0.000936	0.066982
	NE		0.005150	0.006086	0.001873		0.000468	0.013577
	ENE		0.001873	0.000468				0.002341
	E		0.000936					0.000936
	ESE			0.001404				0.001404
	SE		0.000468					0.000468
	SSE		0.000468	0.000468	0.000468			0.001404
	S		0.003277	0.003745	0.001404			0.008427
	SSW		0.004213	0.022472	0.014045	0.006554	0.000468	0.047753
	SW	0.000486	0.037921	0.064607	0.050562	0.020599	0.003277	0.177452
	WSW	0.002428	0.073034	0.065075	0.013577	0.003745		0.157859
	W		0.040730	0.024345	0.003277			0.068352
	WNW		0.006086	0.004682	0.002809			0.013577
	NW		0.002341	0.002809	0.002341			0.007491
	NNW		0.004682	0.009831	0.013577	0.004682	0.000468	0.033240
E	N	0.000486	0.002809	0.000468				0.003763
	NNE	0.000971	0.002809	0.002809				0.006589
	NE	0.000486	0.002809	0.000936				0.004231
	ENE	0.000486	0.000468					0.000954
	E			0.000468				0.000468
	ESE		0.000468					0.000468
	SE							
	SSE	0.000486	0.001404					0.001890
	S		0.000936					0.000936
	SSW		0.003277					0.003277
	SW	0.001942	0.009363	0.002341				0.013647
	WSW	0.001942	0.017322	0.005150				0.024414
	W	0.000971	0.005618	0.001404				0.007994
	WNW	0.000486	0.005618					0.006104
	NW	0.000486	0.002809					0.003295
	NNW		0.001404	0.000468				0.001873
F	N	0.002428	0.003277					0.005705
	NNE	0.008255	0.001873					0.010128
	NE	0.003885	0.001873					0.005757
	ENE	0.002428	0.001873					0.004301
	E	0.000971	0.000936					0.001908
	ESE	0.000486	0.000468					0.000954
	SE							
	SSE	0.000971	0.000468					0.001439
	S	0.001942	0.001873					0.003815
	SSW	0.007284	0.007022					0.014306
	SW	0.008741	0.009831					0.018572
	WSW	0.012626	0.007022					0.019648
	W	0.003399	0.006554					0.009953
	WNW	0.003399	0.006086					0.009485
	NW	0.002428	0.003745					0.006173
	NNW	0.001457	0.001404					0.002861


North Butte Monthly Average Relative Humidity
Precip (mm)
100
90
80
70
60
50
40
30
20
10
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month
Daily Average
Daily Maximum
Daily Minimum

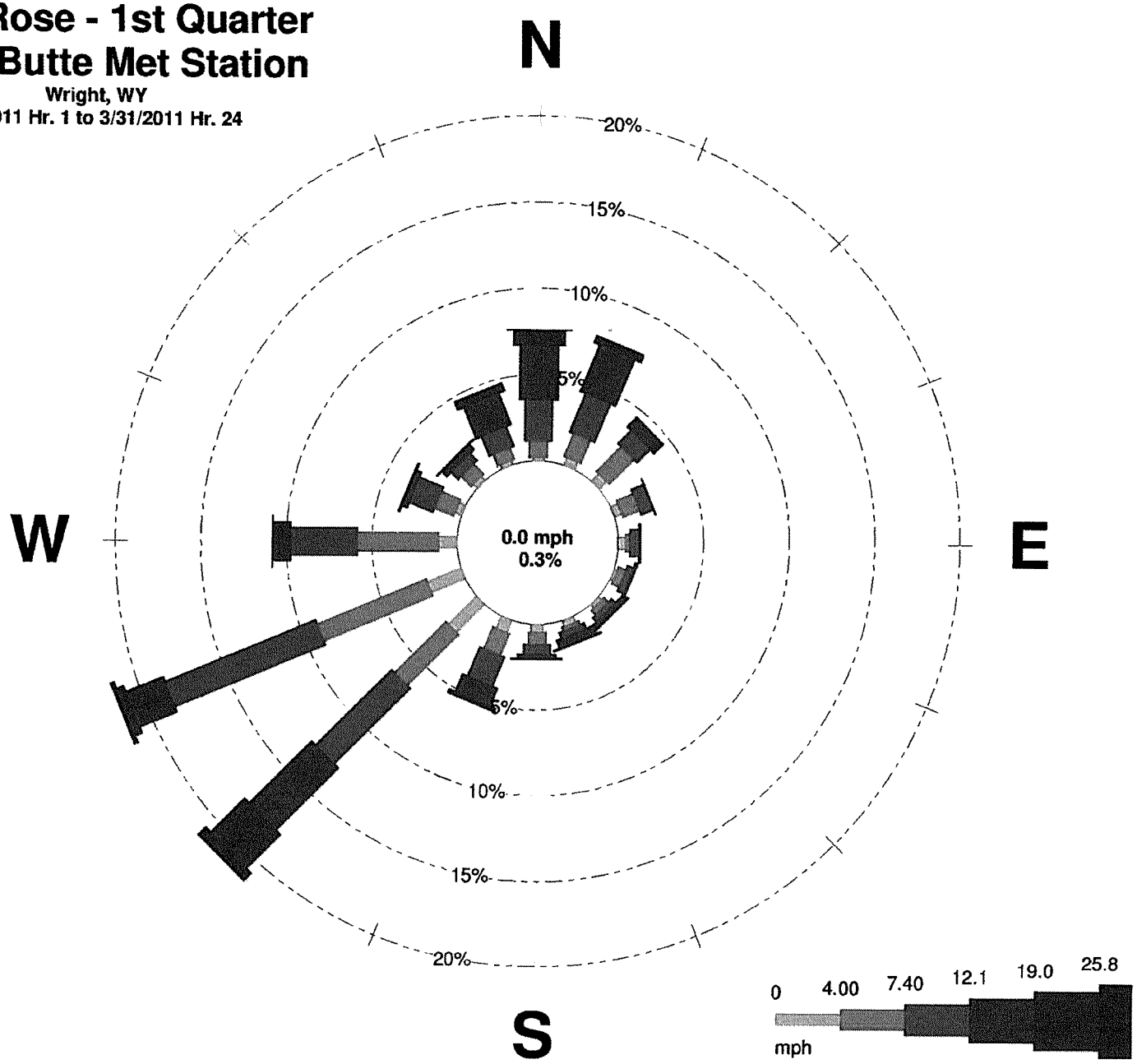

North Butte 2011 Monthly Precipitation
Precip (in)
0
1
2
3
4
5
6
7
8
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month


North Butte Monthly Temperatures
Temp (C)
40
30
20
10
0
-10
-20
-30
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month
Daily Average
Daily Minimum
Daily Maximum


North Butte Monthly Wind Speeds
Daily Average
Maximum
Speed (mph)
40
36
32
28
24
20
16
12
8
4
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

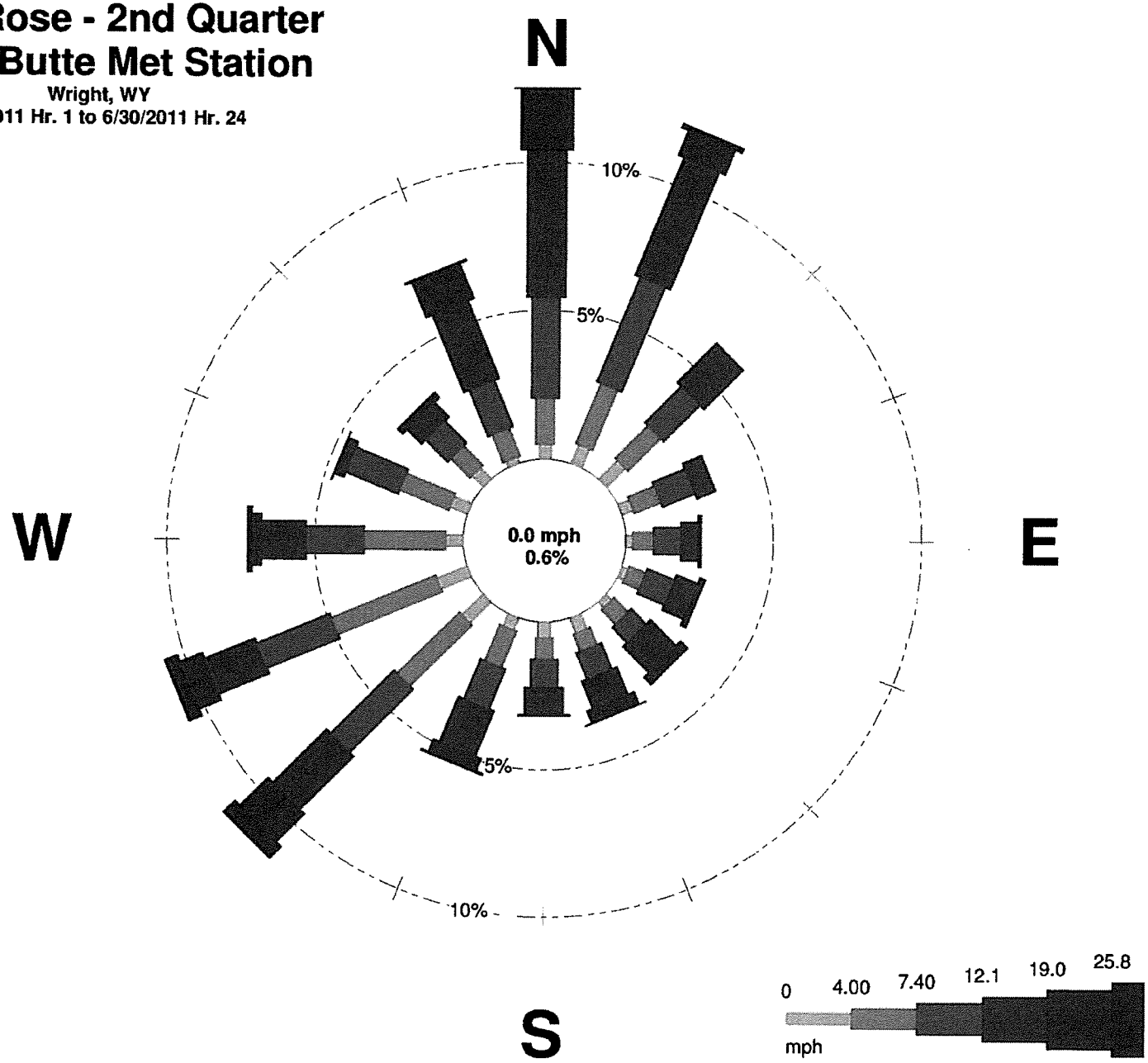
Wind Rose - 1st Quarter
North Butte Met Station

Wright, WY
1/1/2011 Hr. 1 to 3/31/2011 Hr. 24



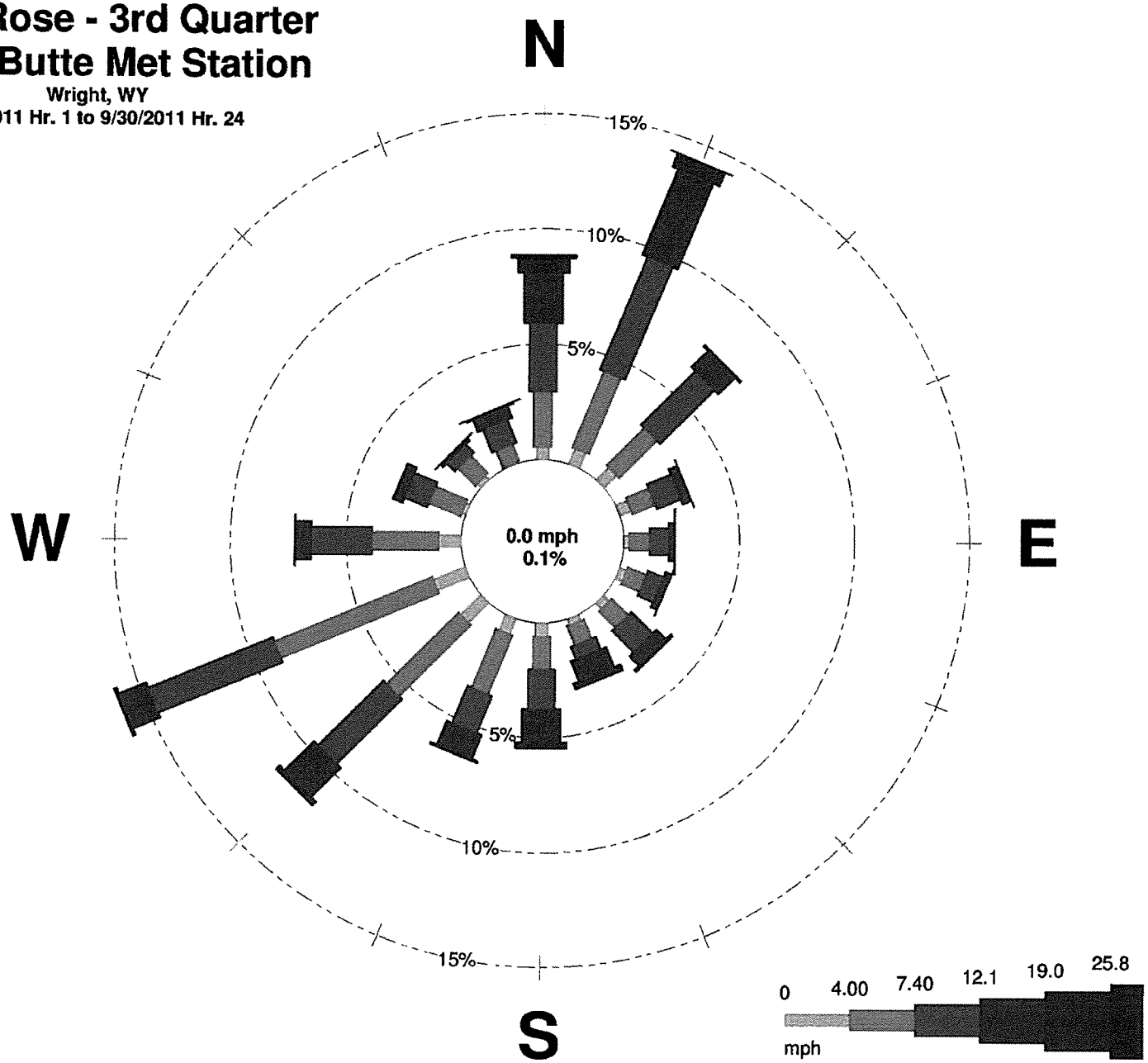
Wind Rose - 2nd Quarter
North Butte Met Station

Wright, WY
4/1/2011 Hr. 1 to 6/30/2011 Hr. 24



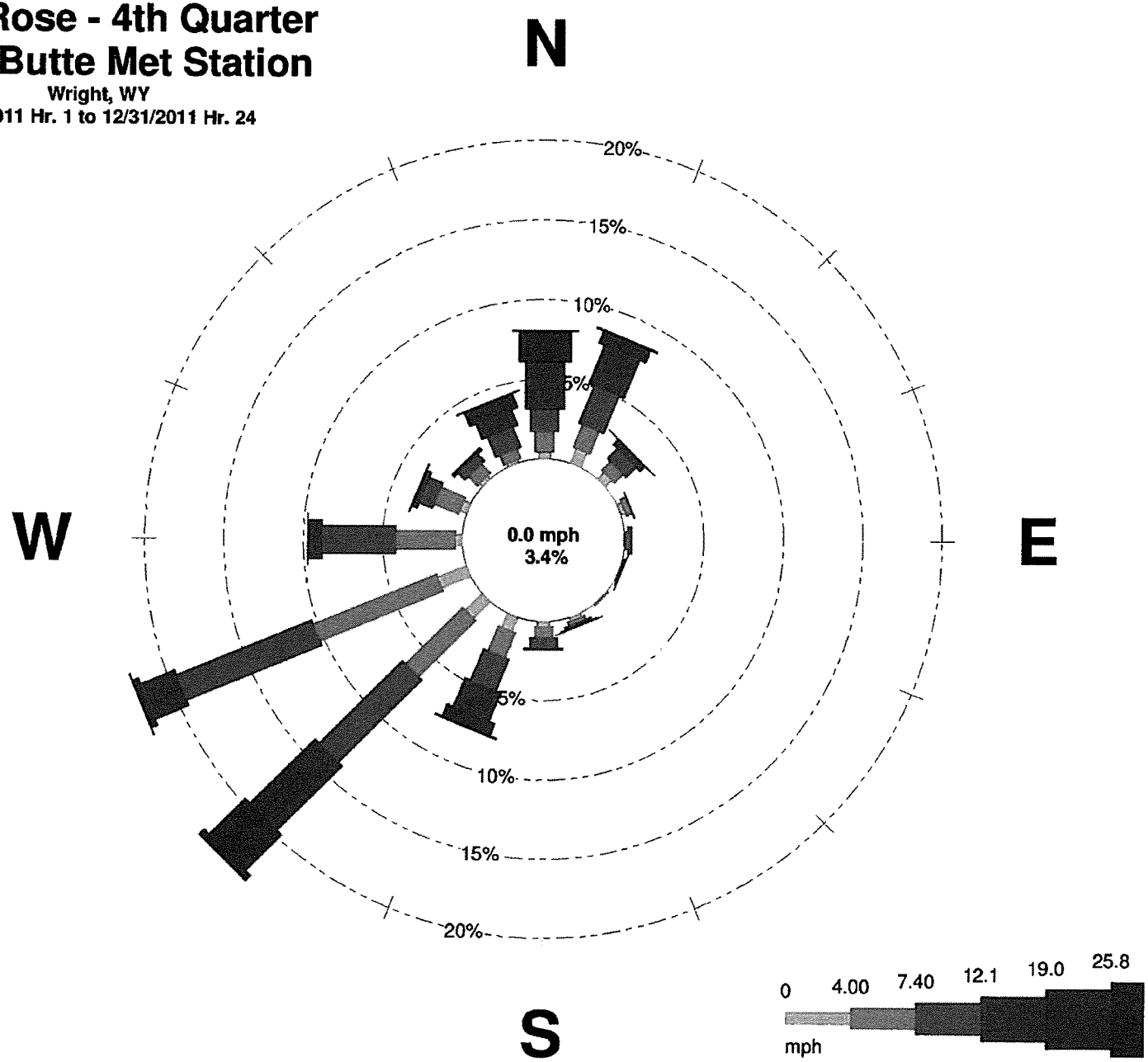
Wind Rose - 3rd Quarter
North Butte Met Station

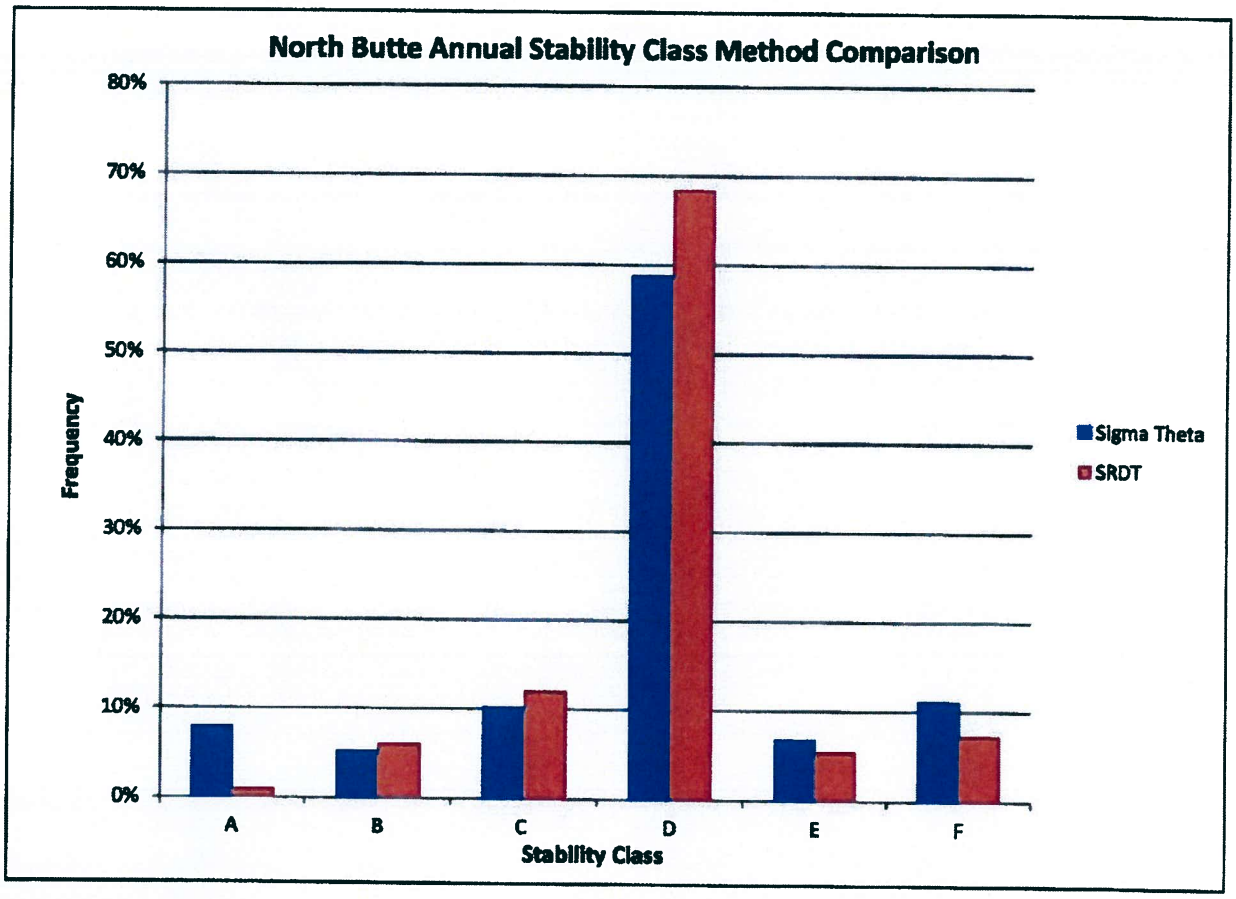
Wright, WY
7/1/2011 Hr. 1 to 9/30/2011 Hr. 24

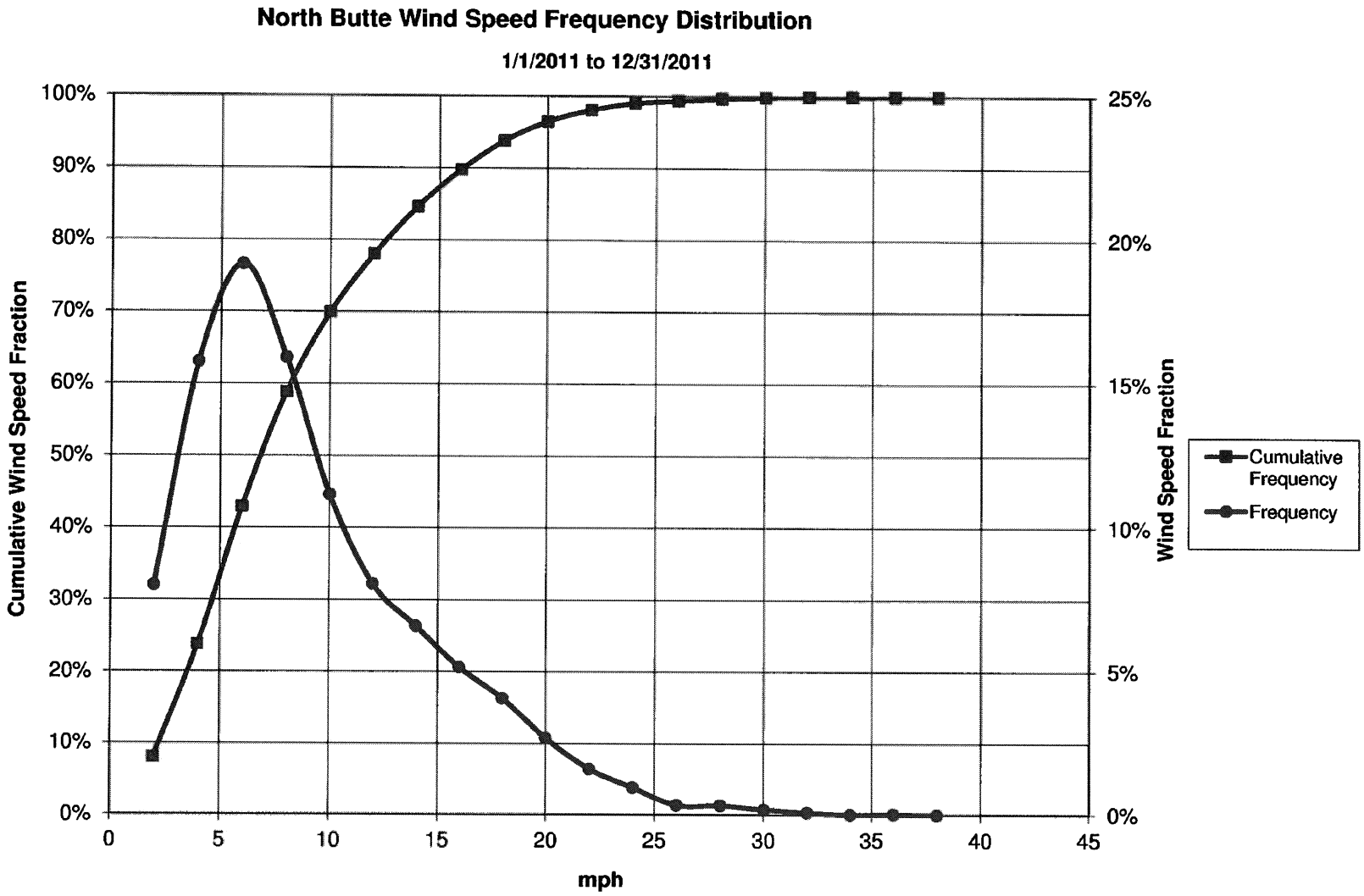


Wind Rose - 4th Quarter
North Butte Met Station

Wright, WY
10/1/2011 Hr. 1 to 12/31/2011 Hr. 24




North Butte Annual Stability Class Method Comparison
80%
70%
60%
50%
40%
30%
20%
10%
0%
Frequency
A
B
C
D
E
F
Stability Class
Sigma Theta
SRDT


North Butte Wind Speed Frequency Distribution
1/1/2011 to 12/31/2011
Cumulative Wind Speed Fraction
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
5
10
15
20
25
30
35
40
45
mph
25%
20%
15%
10%
5%
0%
Wind Speed Fraction
Cumulative Frequency
Frequency

North Butte

Wind Data Summary

1/1/2011 - 12/31/2011

Hourly Data

	Average	Max	Min
Wind Speed (mph)	10.01	37.41	-
Sigma Theta (º)	21.05	101.50	-
Wind Direction			
N	12.67	37.41	1.00
NNE	11.08	29.71	0.95
NE	8.56	29.01	0.89
ENE	7.60	20.27	0.92
E	8.48	27.04	0.37
ESE	9.49	25.59	1.24
SE	10.30	22.92	1.02
SSE	10.54	25.83	0.68
S	9.07	23.50	0.78
SSW	9.97	31.43	1.12
SW	11.34	33.60	-
WSW	8.57	36.11	0.54
W	8.21	31.08	0.96
WNW	7.90	23.32	0.42
NW	8.51	25.09	0.77
NNW	12.70	31.84	0.72

Predominant wind direction was from the WSW sector, accounting for 17.8% of the winds, the average wind direction was 269°.

Data Recovery

	Possible (hours)	Reported (hours)	Recovery
Wind Speed	8760	8670	98.97%
Sigma Theta	8760	8670	98.97%
Wind Direction	8760	8665	98.92%

North Butte

Wind Data Summary

1/1/2011 - 3/31/2011

Hourly Data

	Average	Max	Min
Wind Speed (mph)	9.94	34.76	-
Sigma Theta (º)	18.48	97.20	-
Wind Direction			
N	12.63	26.90	2.20
NNE	11.50	25.63	0.95
NE	8.08	18.52	1.02
ENE	6.56	13.15	2.09
E	6.89	16.11	0.94
ESE	8.35	19.60	1.72
SE	9.41	20.79	1.50
SSE	10.08	21.96	1.88
S	8.36	20.79	1.94
SSW	9.40	24.95	1.60
SW	12.20	33.60	-
WSW	8.59	34.76	0.54
W	7.65	21.61	1.07
WNW	8.66	23.32	2.25
NW	8.67	19.86	1.62
NNW	12.40	24.13	1.82

Predominant wind direction was from the WSW sector, accounting for 21.7% of the winds, the average wind direction was 261°.

Data Recovery

	Possible (hours)	Reported (hours)	Recovery
Wind Speed	2160	2139	99.03%
Sigma Theta	2160	2139	99.03%
Wind Direction	2160	2139	99.03%

North Butte

Wind Data Summary

4/1/2011 - 6/30/2011

Hourly Data

	Average	Max	Min
Wind Speed (mph)	11.04	36.11	0.72
Sigma Theta (º)	21.65	101.50	4.55
Wind Direction			
N	13.30	29.42	1.00
NNE	11.61	29.64	1.49
NE	9.29	18.58	0.96
ENE	8.73	18.23	0.92
E	10.03	21.40	1.06
ESE	11.04	25.59	1.24
SE	12.29	22.92	1.07
SSE	11.11	25.83	1.39
S	9.45	23.50	1.08
SSW	11.24	27.71	1.40
SW	11.65	33.35	1.11
WSW	10.30	36.11	2.07
W	9.75	31.08	0.96
WNW	7.58	19.04	0.95
NW	9.40	25.09	0.77
NNW	13.55	26.43	0.72

Predominant wind direction was from the N sector, accounting for 12.6% of the winds, the average wind direction was 308°.

Data Recovery

	Possible (hours)	Reported (hours)	Recovery
Wind Speed	2184	2183	99.95%
Sigma Theta	2184	2183	99.95%
Wind Direction	2184	2183	99.95%

North Butte

Wind Data Summary

7/1/2011 - 9/30/2011

Hourly Data

	Average	Max	Min
Wind Speed (mph)	8.86	37.41	0.68
Sigma Theta (º)	26.31	101.20	4.20
Wind Direction			
N	10.79	37.41	2.44
NNE	10.27	28.85	2.05
NE	8.40	21.59	1.13
ENE	7.79	20.27	1.62
E	8.16	27.04	1.14
ESE	8.29	24.57	2.18
SE	9.00	20.32	1.02
SSE	10.96	21.85	0.68
S	9.70	21.68	1.37
SSW	8.38	21.30	1.48
SW	8.53	23.72	1.01
WSW	7.56	23.08	1.36
W	7.57	20.95	1.71
WNW	8.22	15.92	3.44
NW	7.40	22.37	2.06
NNW	10.15	27.66	3.24

Predominant wind direction was from the WSW sector, accounting for 16.1% of the winds, the average wind direction was 276°.

Data Recovery

	Possible (hours)	Reported (hours)	Recovery
Wind Speed	2208	2207	99.95%
Sigma Theta	2208	2207	99.95%
Wind Direction	2208	2207	99.95%

North Butte

Wind Data Summary

10/1/2011 - 12/31/2011

Hourly Data

	Average	Max	Min
Wind Speed (mph)	10.21	32.55	0.37
Sigma Theta (º)	17.56	93.90	4.02
Wind Direction			
N	13.82	28.30	1.21
NNE	11.33	29.71	1.53
NE	8.15	29.01	0.89
ENE	5.28	10.98	2.15
E	6.33	9.57	0.37
ESE	8.70	14.31	3.99
SE	6.01	7.01	5.11
SSE	7.32	19.93	0.88
S	7.37	15.93	0.78
SSW	10.82	31.43	1.12
SW	11.84	32.55	0.95
WSW	8.45	26.92	1.32
W	8.15	19.23	2.02
WNW	7.27	19.75	0.42
NW	7.91	16.99	2.80
NNW	13.18	31.84	1.24

Predominant wind direction was from the SW sector, accounting for 24.1% of the winds, the average wind direction was 259°.

Data Recovery

	Possible (hours)	Reported (hours)	Recovery
Wind Speed	2208	2141	96.97%
Sigma Theta	2208	2141	96.97%
Wind Direction	2208	2136	96.74%

Appendix D

North Butte Site and Regional Meteorological Comparison

Appendix D
North Butte Site and Regional Meteorological Comparison

The Antelope Coal Mine wind rose data are presented in **Figures 2 through 6**. The derivation in wind rose data between the North Butte Remote Satellite from the Antelope wind rose is attributed to topography-driven spatial differences due to a secondary modal, north-northwest wind swirling around North Butte and hitting the North Butte weather station from the north-northwest. Despite the topography-driven spatial differences between the on-site and the Antelope wind roses, the baseline-year data collected at the North Butte station is considered to represent the long-term conditions because it does so at Antelope Coal Mine, and the topography does not change from year to year. Both wind speed and wind direction correlated very strongly between the short-term (North Butte) and the long-term (Antelope). The average and maximum monthly and diurnal average wind speeds are presented in **Figures 7 and 8**. A comparison of wind class and monthly wind speed was made between the Antelope Mine and the North Butte Remote Satellite. The comparison data are presented in **Figures 13 and 14**. Antelope Mine wind speed and direction for the baseline year (2011) were compared to the 25-year average for this station (**Figures 20 and 21**). Data collected during the baseline year (2011) compare well to the 25-year average with regression coefficients (R^2 values) of 0.98 and 0.95 for wind speed and direction (**Figures 22 and 23**). Finally, the stability class distributions for North Butte and Antelope are quite similar as shown on **Figure13.**

Average monthly temperatures at the Antelope Mine range from -4°C (25°F) in December and January to 22°C (72°F) in July (**Figure 10**). Recorded monthly temperatures range from -40°C (-40°F) in December to over 38°C (100°F) in July. The daily diurnal temperature curves for each of the four seasons are presented in **Figure 8**. Average monthly temperatures for the Antelope Mine and North Butte Satellite were completed and the data are presented in **Figure 15**. On average, the baseline year temperatures at the North Butte Remote Satellite compare very closely long-term Antelope temperatures.

Because the North Butte station does not have the capability to monitor relative humidity, precipitation or snowfall, regional stations within close proximity were utilized to examine these data. Monthly average relative humidity at the Wyodak Mine east of Gillette is presented in **Figure 16**. Relative humidity ranges from 75% in the winter (December to February) to 45% in August. The Antelope Mine precipitation data for the year indicates that the area precipitation ranges from less than 1.3 centimeters (less than 0.5 inch) during January, February, November, and December to more than 4 centimeters (1.5 inches) during the months of May through July (**Figure11**). Average monthly snowfall at the Gillette weather station ranges from 25 centimeters (10 inches) in March to less than 2.5 centimeters (1 inch) in September, and June through August are generally snow free (**Figure 17**). A graph of heating, growing and cooling degree days in Gillette are presented in **Figure 19**. This data is considered to be representative of the North Butte Remote Satellite because of the proximity of these two stations to the North Butte location.

Monthly pan evaporation data from the Gillette weather station was compared to the monthly evapotranspiration data collected at the North Butte Remote Satellite and is presented in **Figure 18**. With a few minor variations during the spring and summer months, the evaporation data compares well between the two sites.

Based on the 12 months of data collected at the North Butte Remote Satellite and the above comparison of site data to regional long-term data, Cameco considers that the regional long-term data is representative of local site climatological conditions.

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Figure 1 – Antelope Mine Meteorological Summary

Antelope Mine

Meteorological Data Summary

1/1/1997 - 12/31/2011

Hourly Data

	Average/Total	Max	Min
Wind Speed (mph)	11.3	50.7	0.0
Sigma-Theta (°)	16.0	82.0	0.0
Temperature (F)	47.1	102.1	-33.8
Precipitation (in)	157.12	1.48	
Bar. Pressure (in Hg)	25.3	25.9	20.0

Predominant wind direction was from the W sector,
accounting for 15.2% of the possible winds

Data Recovery

Parameter	Possible (hours)	Reported (hours)	Recovery
Wind Speed	131472	124667	94.82%
Wind Direction	131472	124680	94.83%
Sigma-Theta	131472	124680	94.83%
Temperature	131472	127327	96.85%
Precipitation	131472	126443	96.17%
Bar. Pressure	131472	86725	65.96%

Figure 2 – Antelope Mine Year-Round Wind Rose

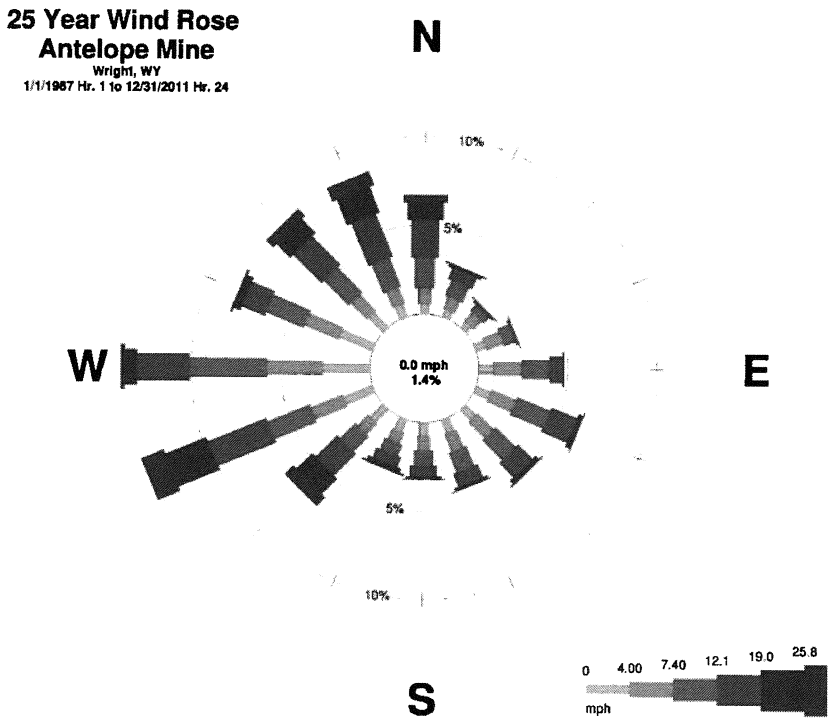


Figure 3 – Antelope Mine 1st Quarter Wind Rose

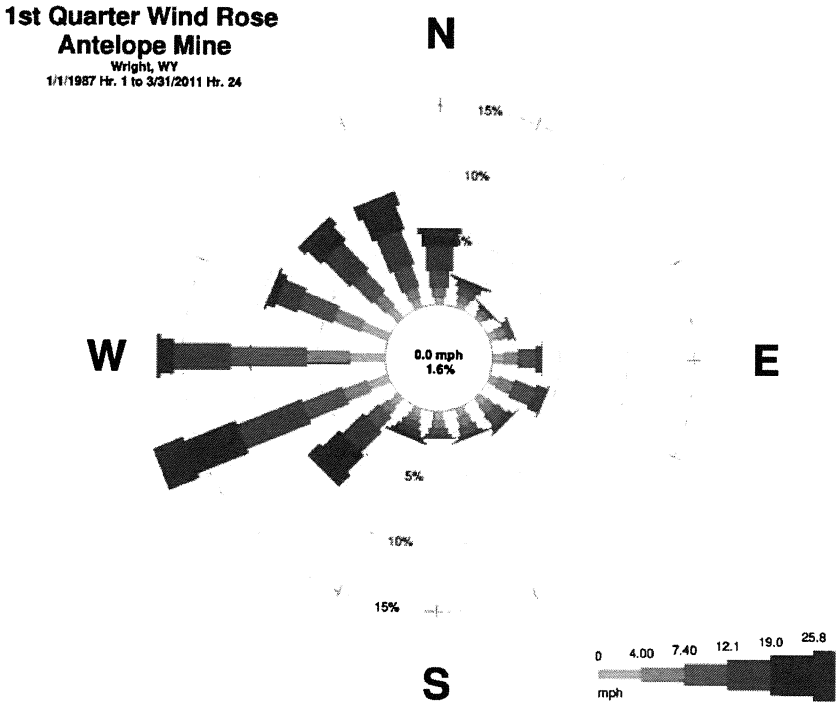


Figure 4 – Antelope Mine 2nd Quarter Wind Rose

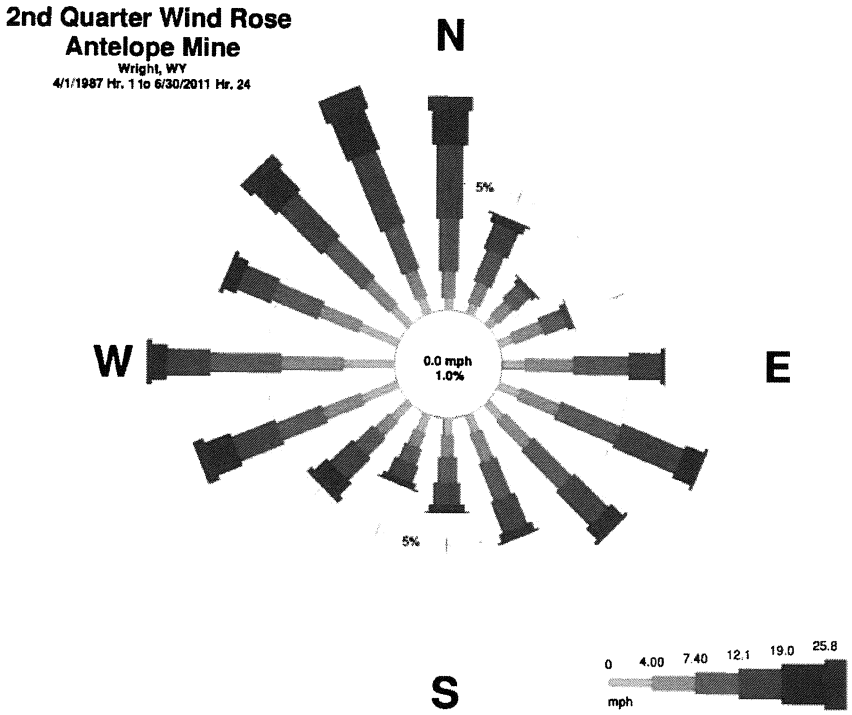


Figure 5 – Antelope Mine 3rd Quarter Wind Rose

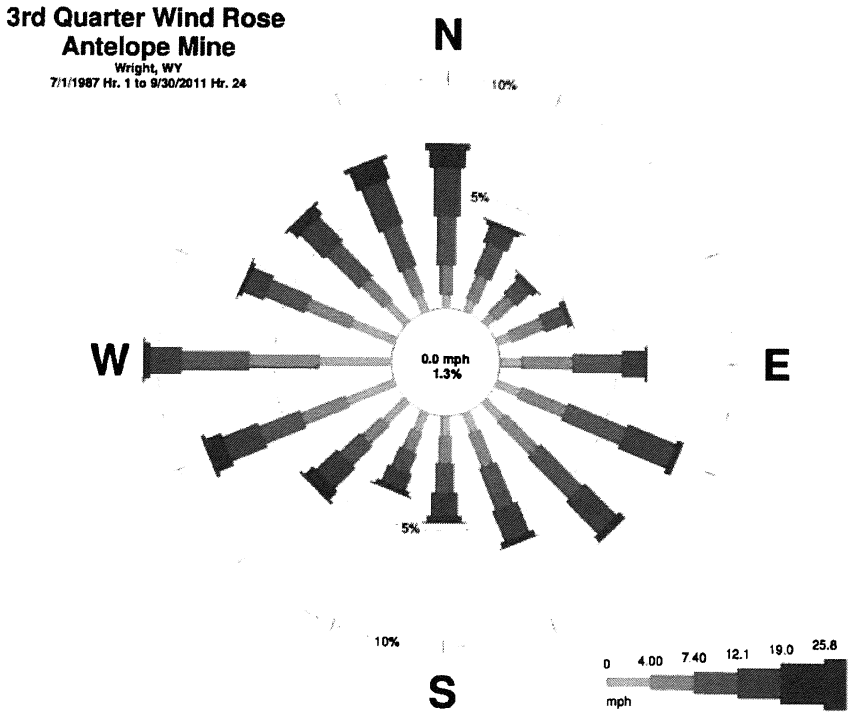


Figure 6 – Antelope Mine 4th Quarter Wind Rose

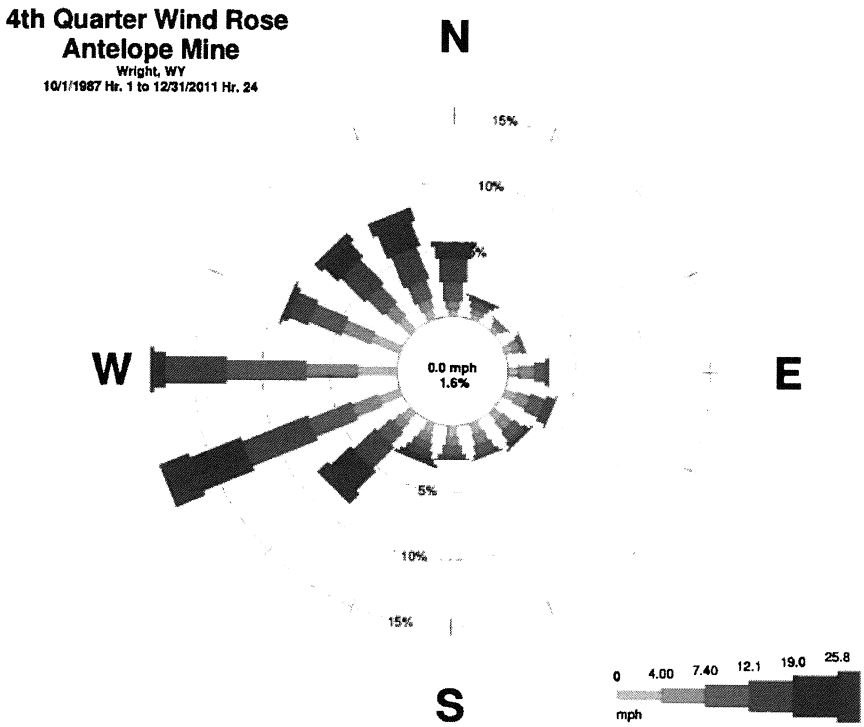


Figure 7 – Antelope Mine Diurnal Wind Speed

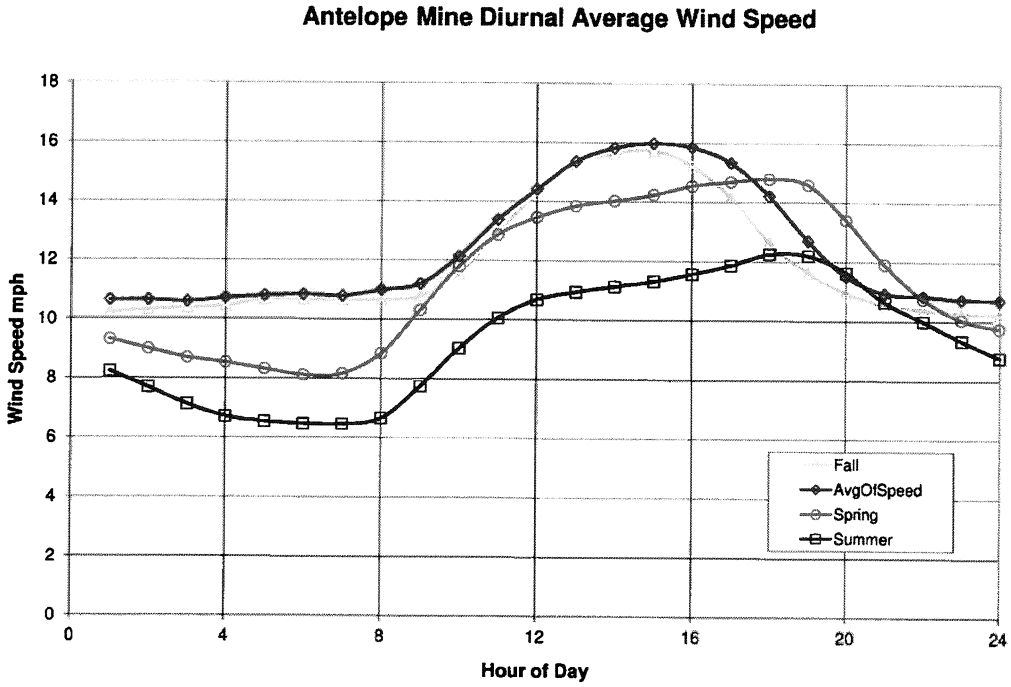


Figure 8 – Antelope Mine Diurnal Temperature

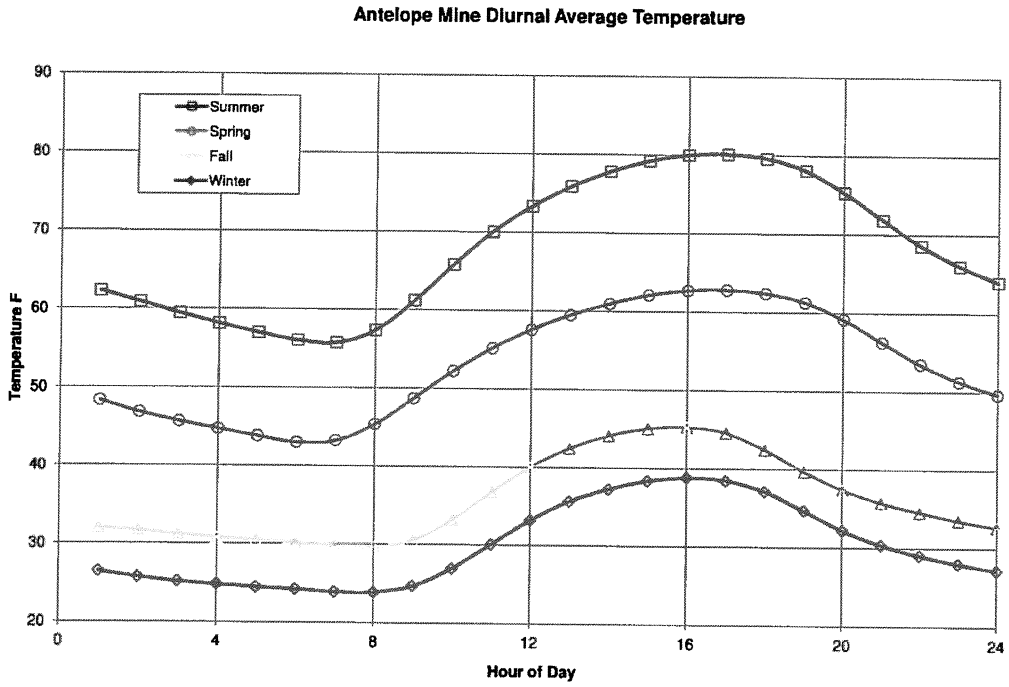


Figure 9 – Antelope Mine Wind Speed Distribution

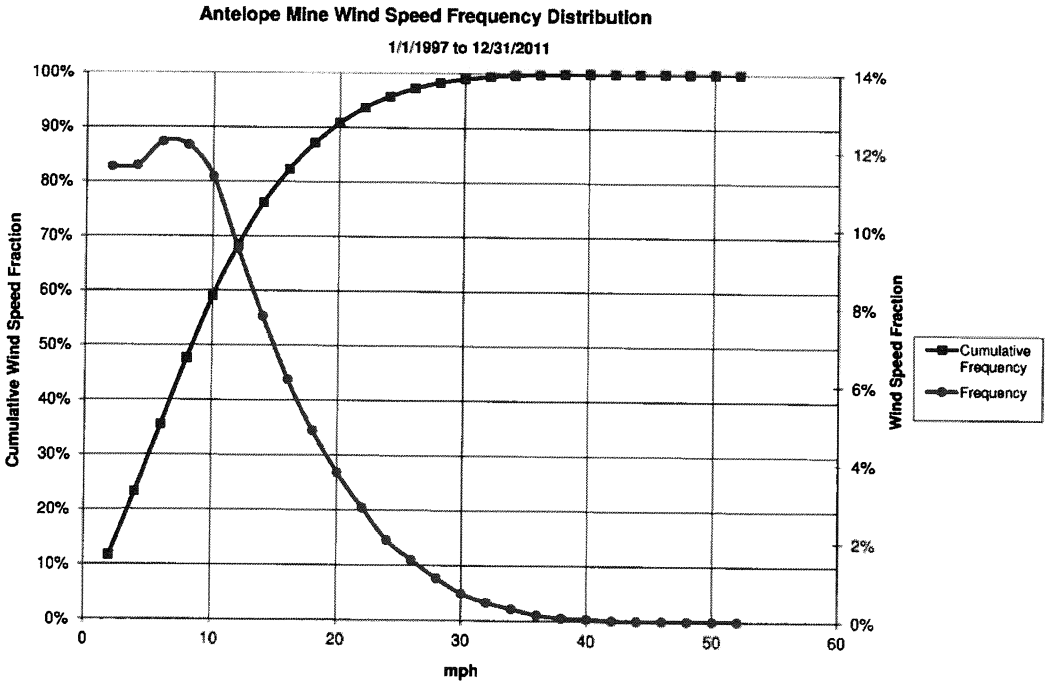


Figure 10 – Antelope Mine Temperature Statistics

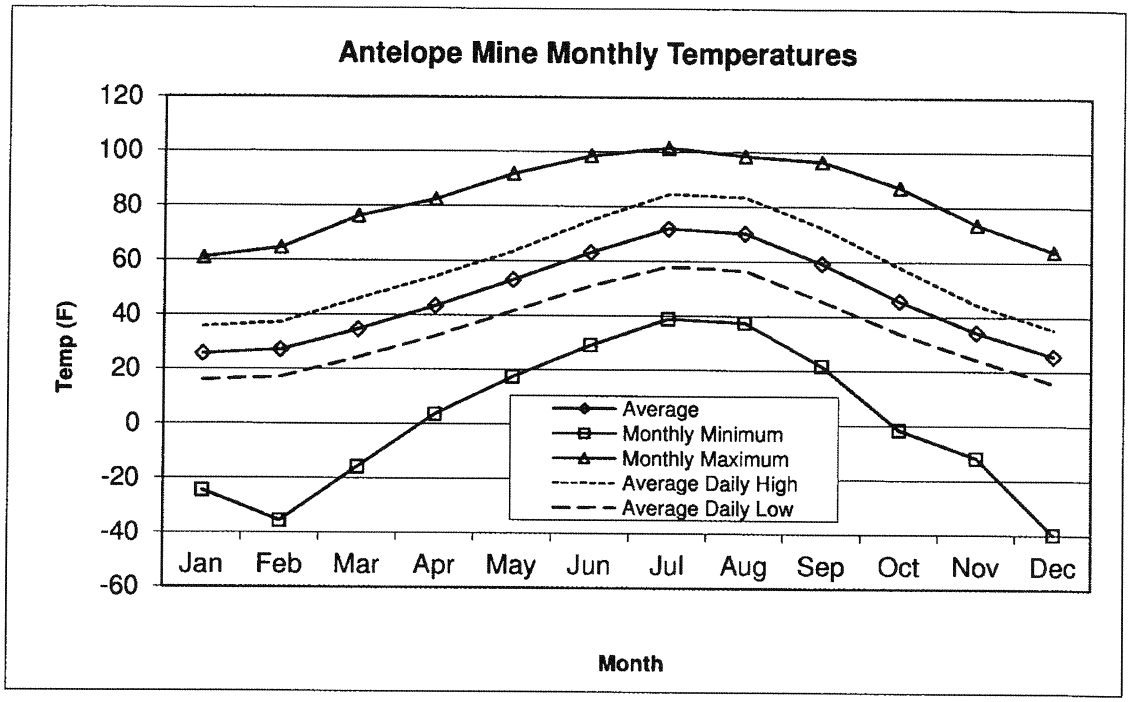


Figure 11 – Antelope Mine Precipitation Statistics

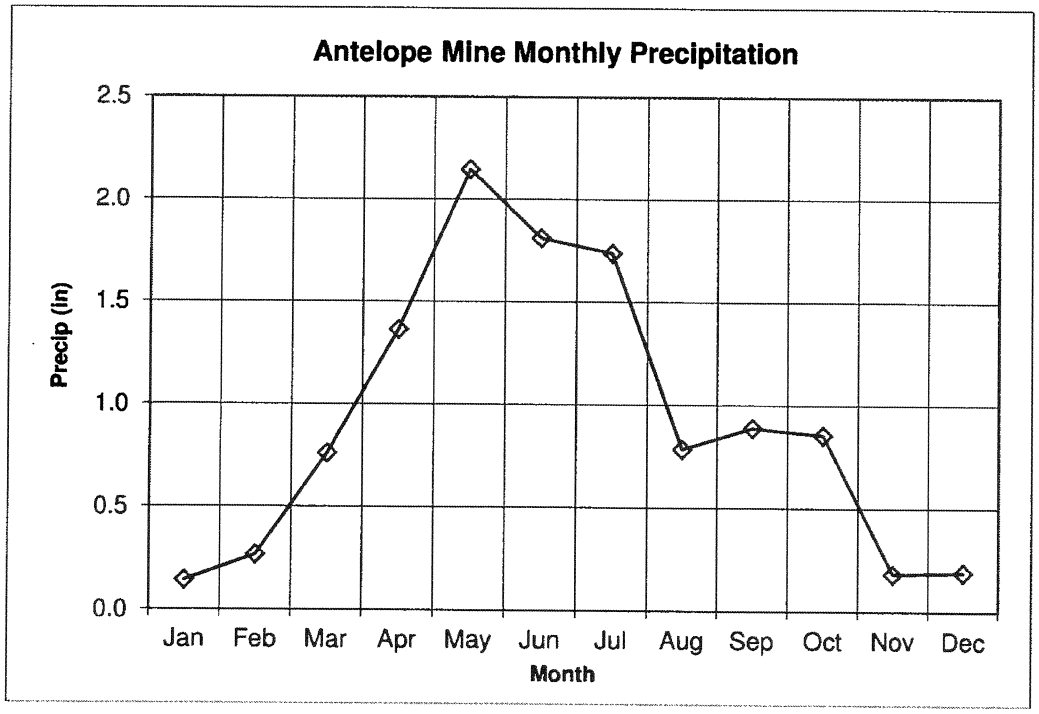


Figure 12 – Antelope Mine Wind Speed Statistics

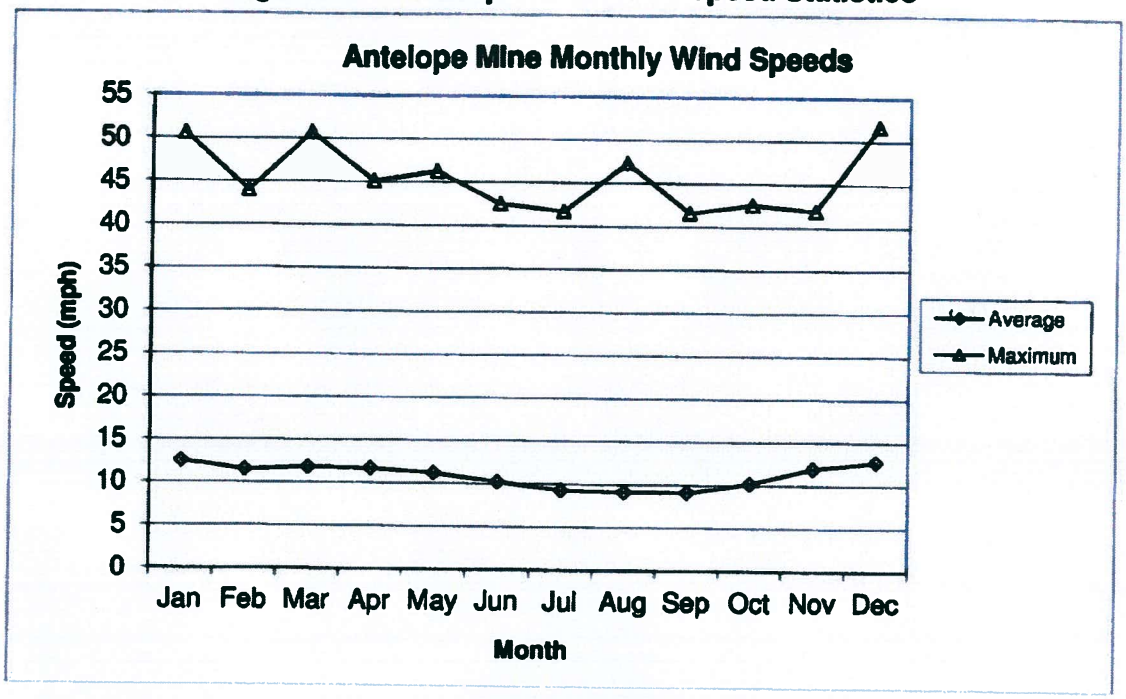


Figure 13 – Stability Class Comparison

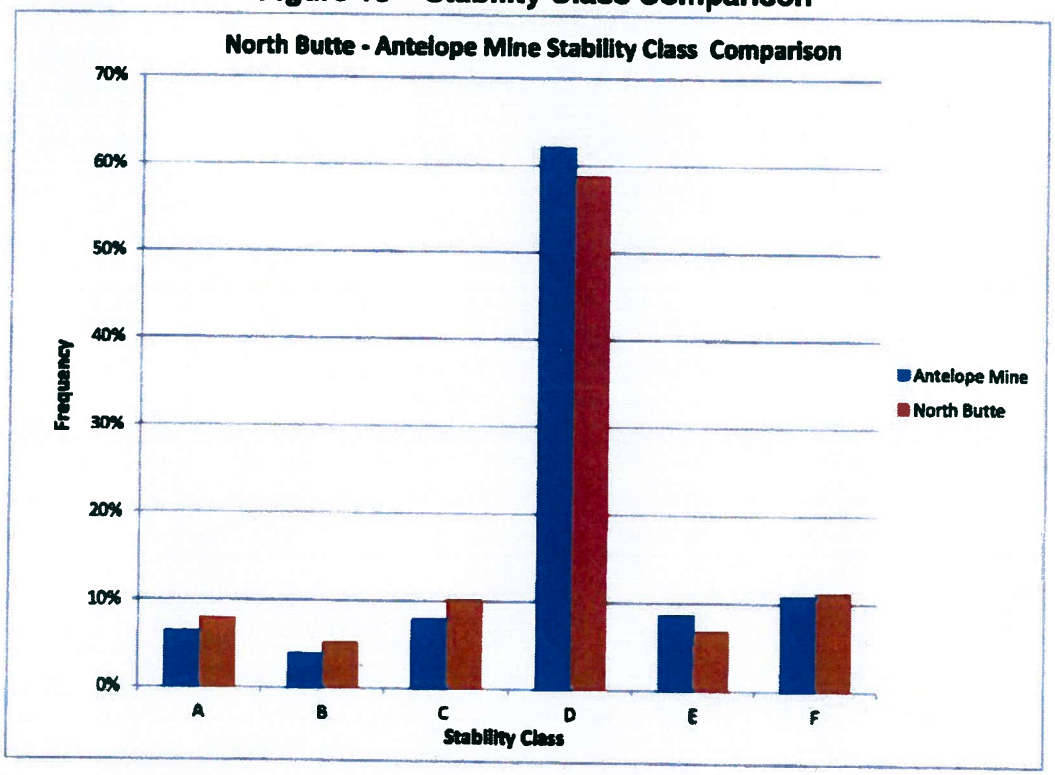


Figure 14 –Wind Speed Comparison

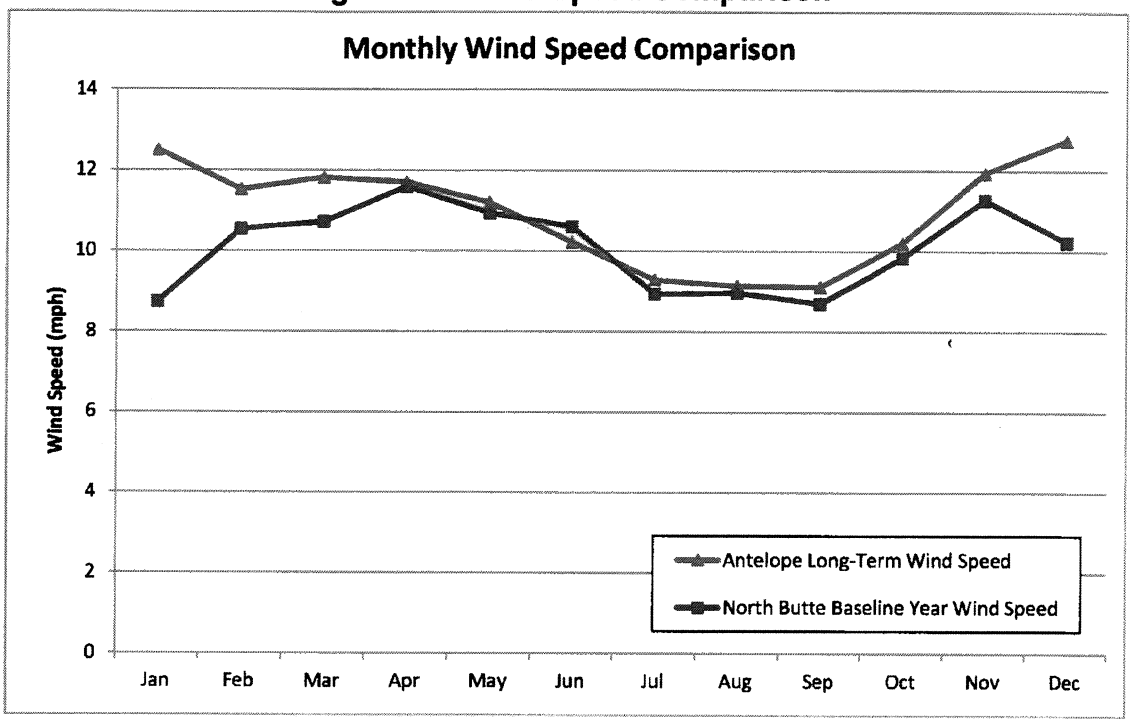


Figure 15 – Temperature Comparison

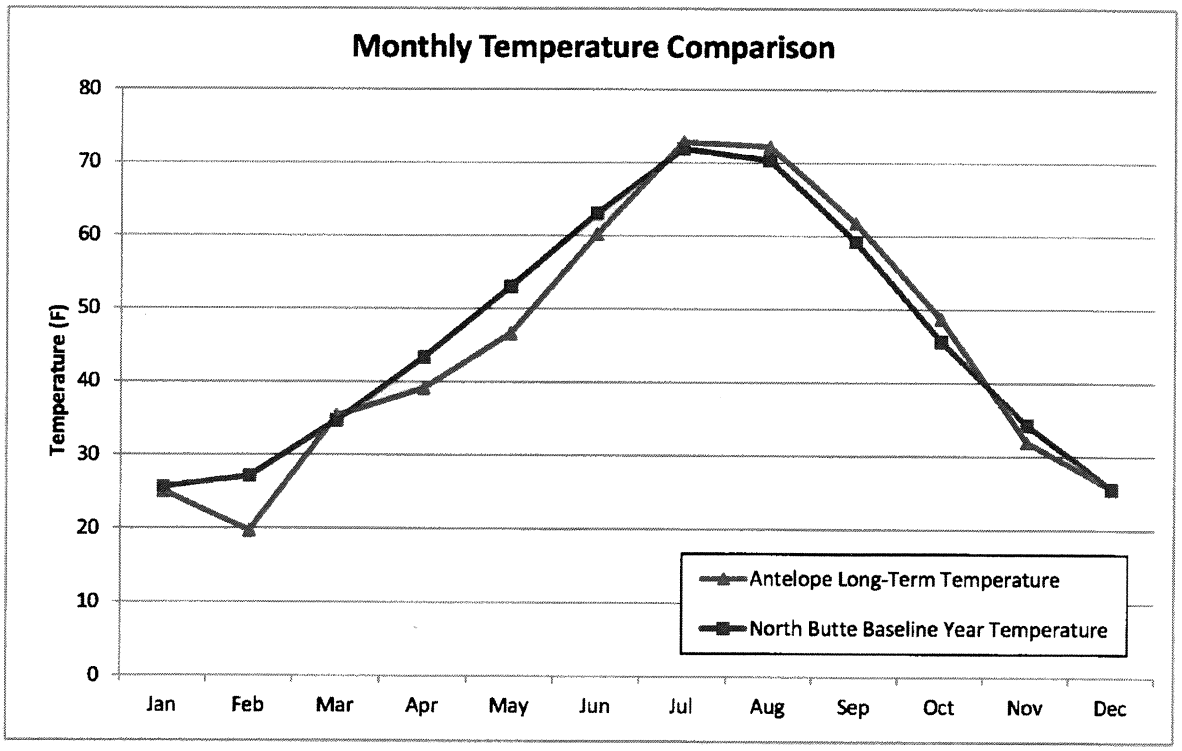


Figure 16 – Regional Relative Humidity

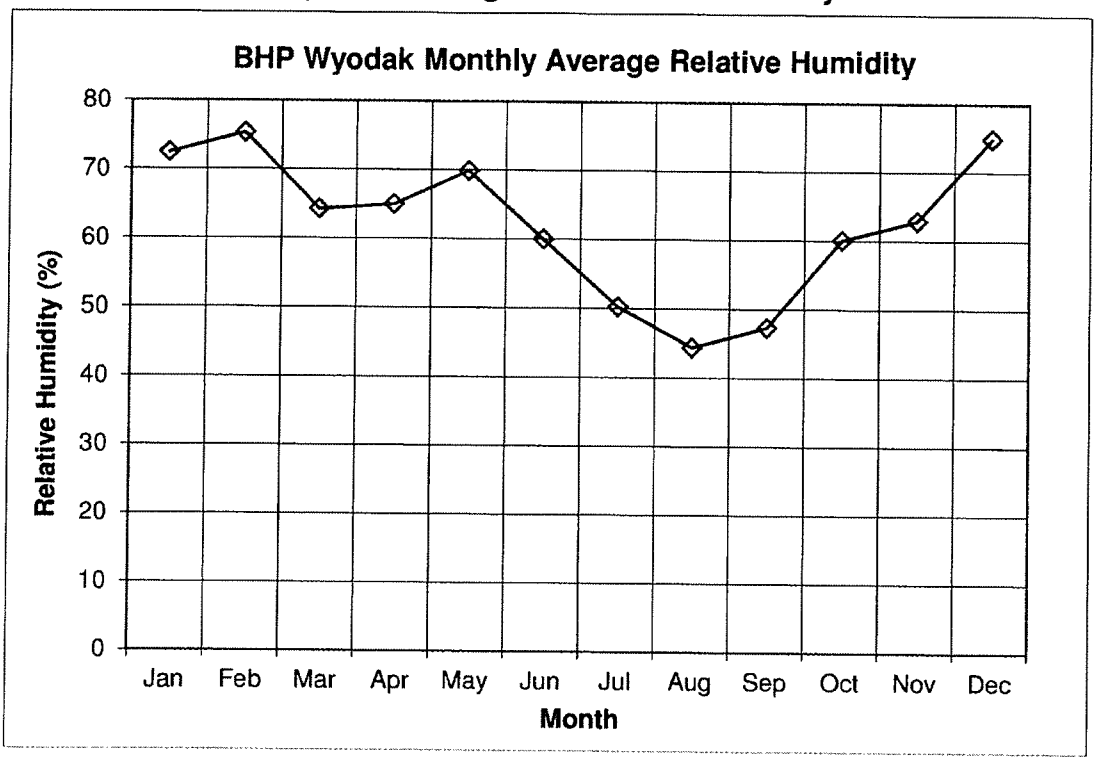


Figure 17 – Regional Snowfall

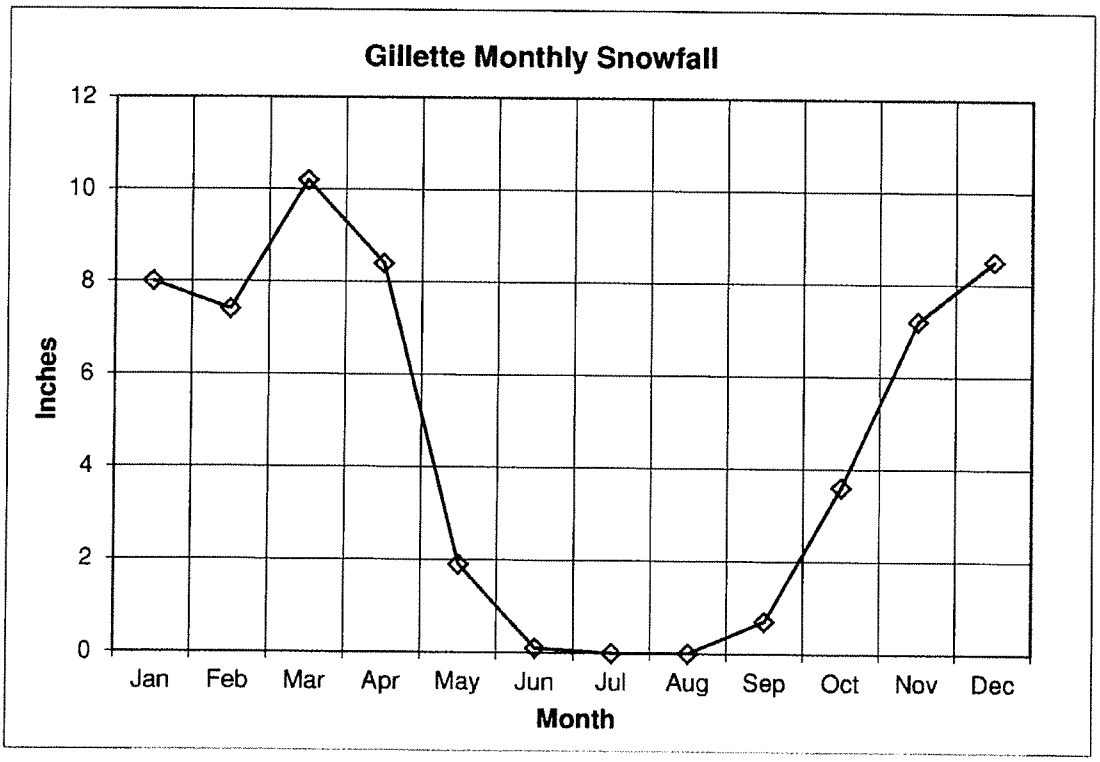


Figure 18 – Regional Evaporation

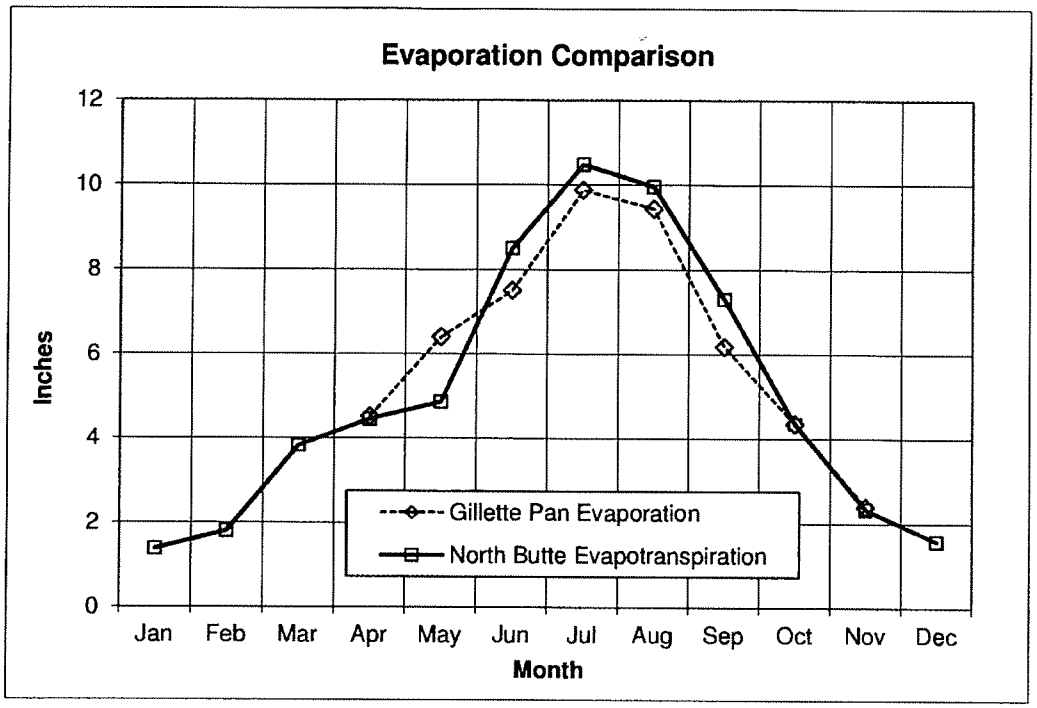


Figure 19 – Regional Degree-Days

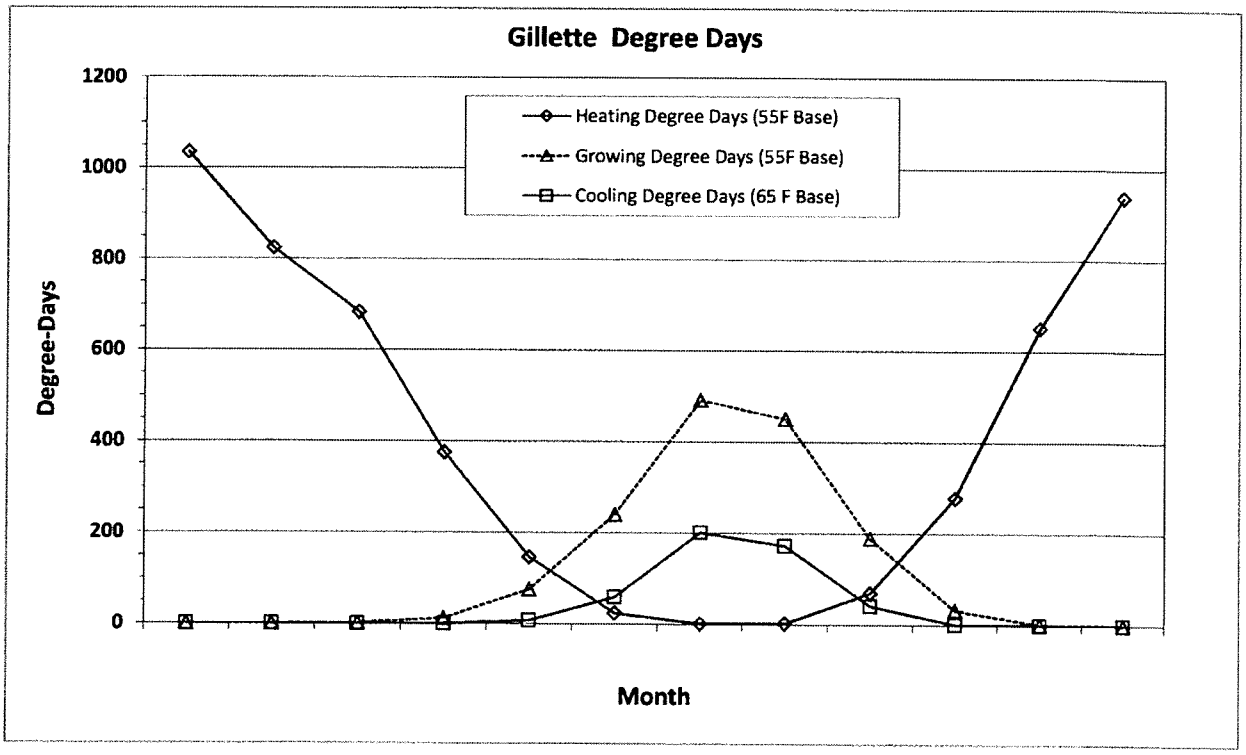


Figure 20 – Antelope Mine Wind Speed Distributions

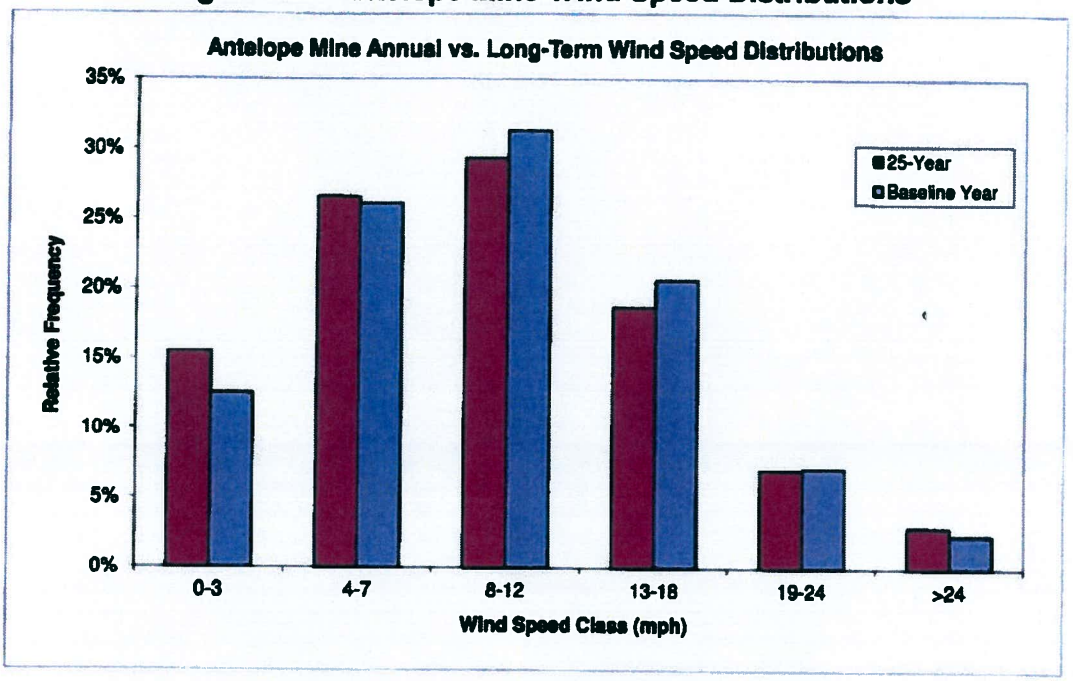


Figure 21 – Antelope Mine Wind Direction Distributions

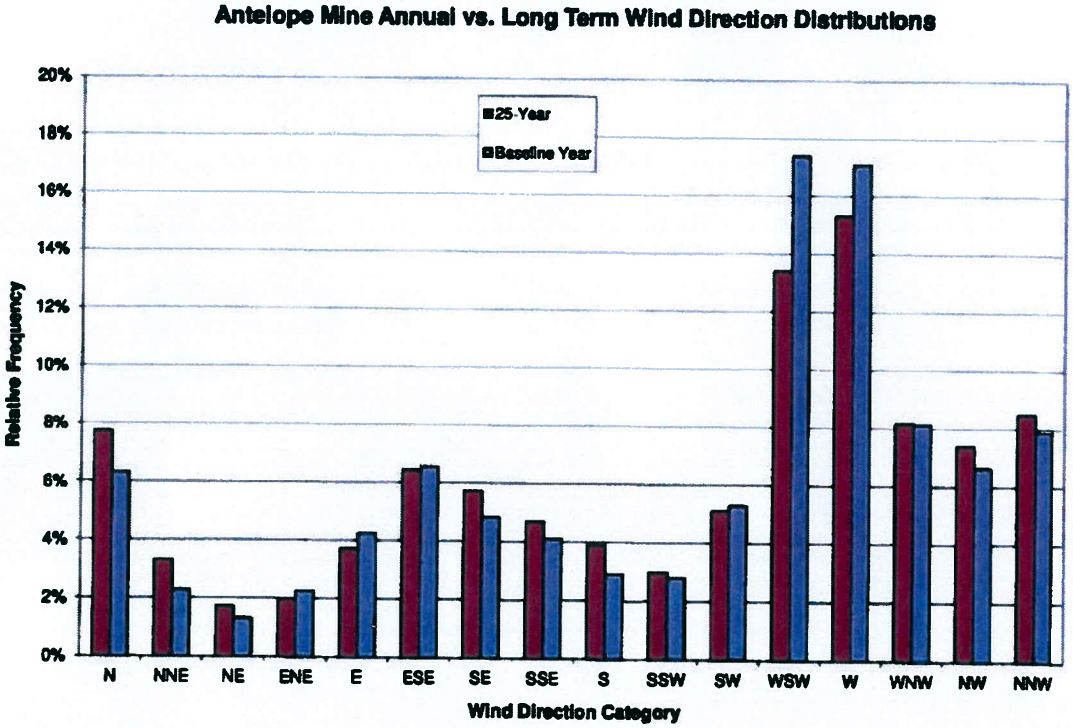


Figure 22 – Antelope Wind Speed Regression Analysis

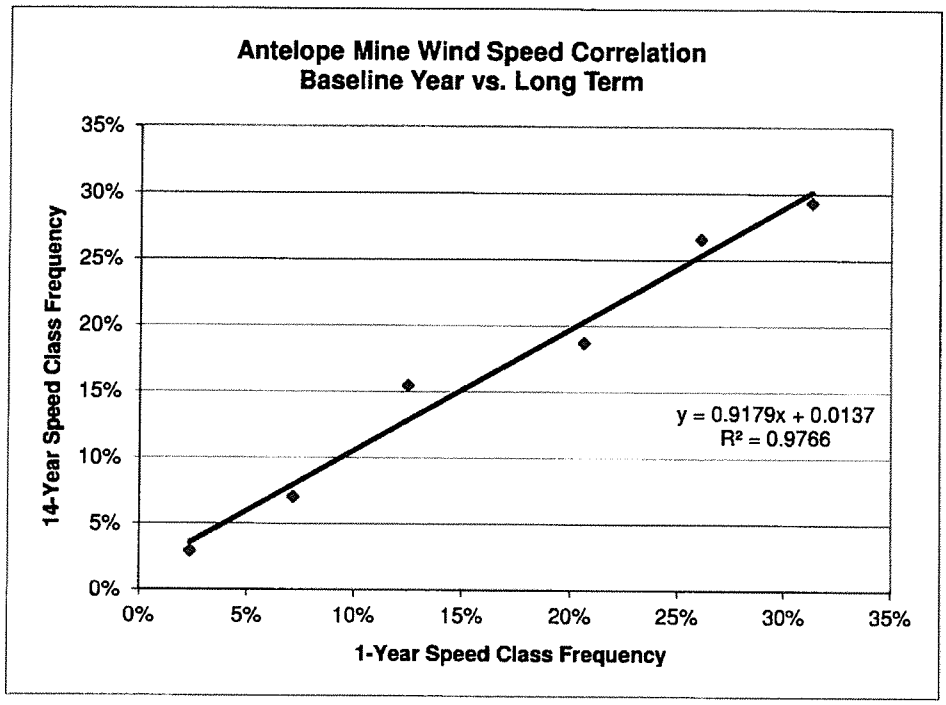
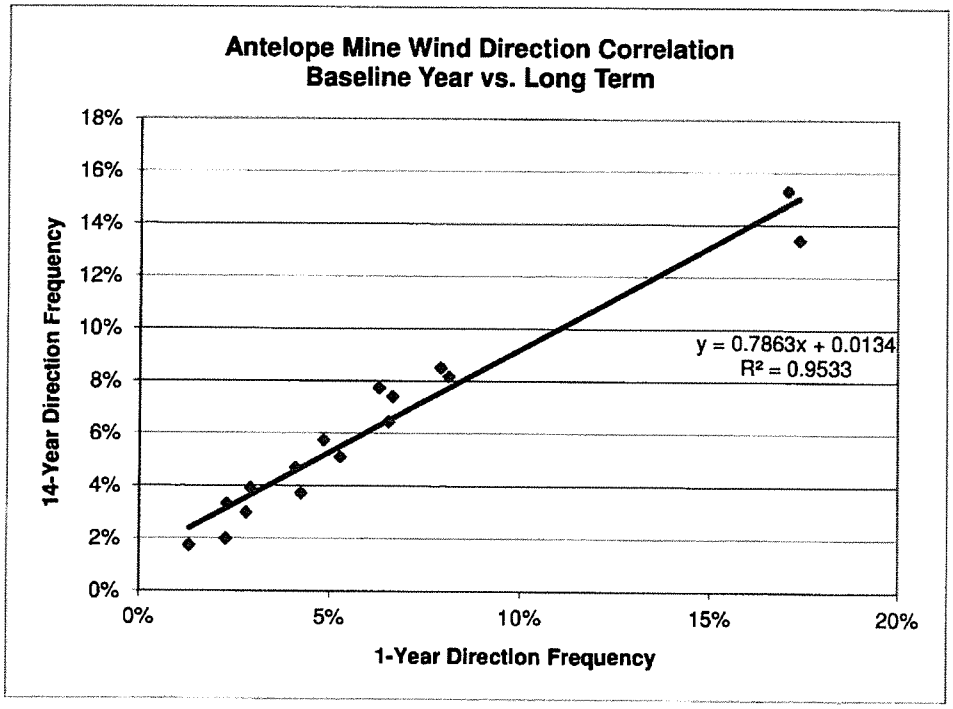


Figure 23 – Antelope Wind Direction Regression Analysis



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