



SWAN HILLS TREATMENT CENTRE

METEOROLOGY ANNUAL REPORT FOR 2024

APPROVAL No.: 00001744

PREPARED BY:

VEOLIA WASTE SERVICES ALBERTA INC.

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1. INTRODUCTION

The meteorological monitoring program was established during the Swan Hills Treatment Centre (SHTC) construction phase and continues to date. Background air quality monitoring was conducted to establish conditions in the existing airshed and determine meteorological patterns in the area. Continuing monitoring through start-up and operation allowed for assessment of potential air quality impacts. Based on an assessment of air quality information collected until 1995, the continuous air quality portion of the Monitoring Program was terminated at the end of 1995. Meteorological data in support has been collected thereafter.

The location of the monitoring site was chosen based on dispersion modeling results outlined in Chapter 3, Appendix A of the Alberta Air Monitoring Directive (2016). The present site was established in July 1993 based on dispersion patterns from expanded SHTC facilities. Refer to the Annual Air Monitoring Report for 2024 results. Figure 1-1 for a site plan of the SHTC that shows the location of the air monitoring station and locations of the fugitive emissions monitoring.

The meteorological monitoring site is located on the SHTC property approximately 850 m southeast of the FBD Incinerator stack outside the fenced process area. The area of this clearing is approximately 0.25 ha. Trees up to 15 m high grow within 35 m of the tower on the north and south sides. Lands to the east decrease in elevation into a valley.

The station consists of various monitors, associated analyzers and data storage attached to a 30 m freestanding tower located 10 m east of the shelter. Monitoring is conducted according to Alberta Environment guidelines as detailed in the Air Monitoring Directive.

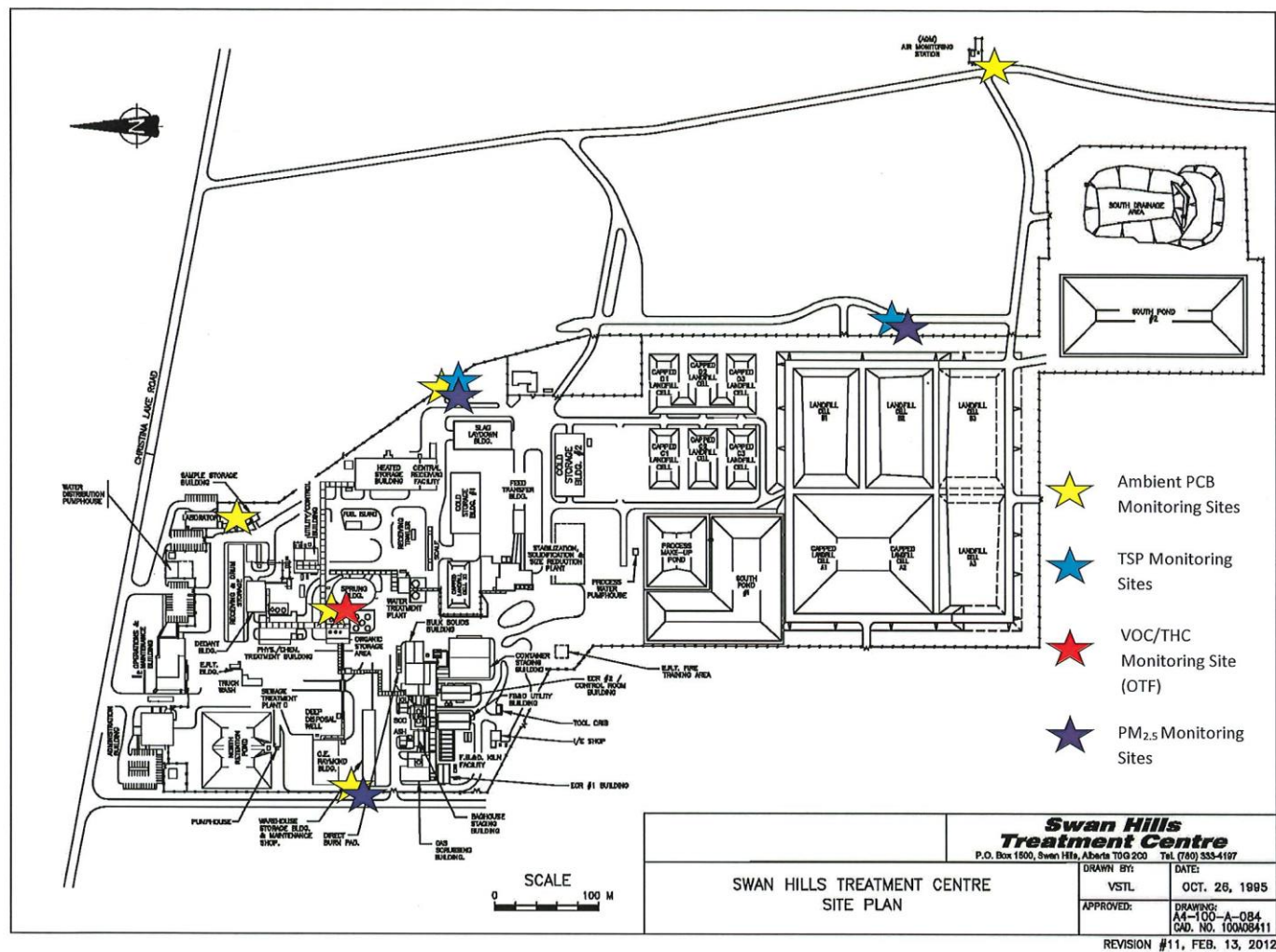


Figure 1-1: Site Diagram

2. METHODOLOGY

Instrumentation to measure horizontal wind speed and direction at 10 and 30 m is mounted on a 30 m tower. Temperature is measured at 2 and 10 m. Relative humidity is measured at 2 m and vertical wind velocity is measured at 30 m. All instrumentation was replaced in April 2017 and is serviced by Bureau Veritas Canada.

An ICIS (Integrated Control and Instrumentation System) data acquisition system controls the data recording. Each channel is scanned every 4 seconds (the duration of an "Instantaneous" value). Data is reported as missing if <90% of responses are present within an hour interval. Measurement channels include some or all of the following for each instrument:

- 1-hr, 5-min and 1-min averages;
- Instantaneous minimum within the hour;
- Instantaneous maximum within the hour;
- Standard deviation within the hour.

3. SUMMARY OF METEOROLOGICAL PARAMETERS

3.1. Ambient Temperature

The overall ambient temperature remained within the historical range in 2024. The average monthly temperature recorded at the AQM Station ranged between -11.9°C and 18.1°C at 2m, and -11.4°C and 18.3°C at 10m. The one-hour maximum, average and minimum temperatures recorded in 2024 at the AQM Station were 27.8°C , 2.7°C and -38.1°C at 2m, and 31.8°C , 3.0°C , and -37.7°C at 10m respectively. Refer to Section 4 for ambient temperature data.

3.2. Wind Speed/Direction

The predominant wind direction in 2024 was from the west-northwest, northwest at both 10m and 30m, which is typical for the Swan Hills region. Average wind speeds at the 10 m and 30 m levels were 12.7 km/hr and 17.3 km/hr respectively, which are similar to observations from previous years. Refer to Section 5 for wind speed/direction data and Section 6 for windroses. (Note that tables 5-1 & 5-2 displayed temperature at 2m in the monthly Avg (Deg) column in the reports prepared prior to 2021. This has been corrected to display the hourly average wind speed direction in degrees at 10m and 30m. This did not affect the data presented in the windroses.)

3.3. Precipitation

The total annual precipitation in 2024 was 582.3 mm, which was less than 2023. Refer to Section 7 for 2024 precipitation data.

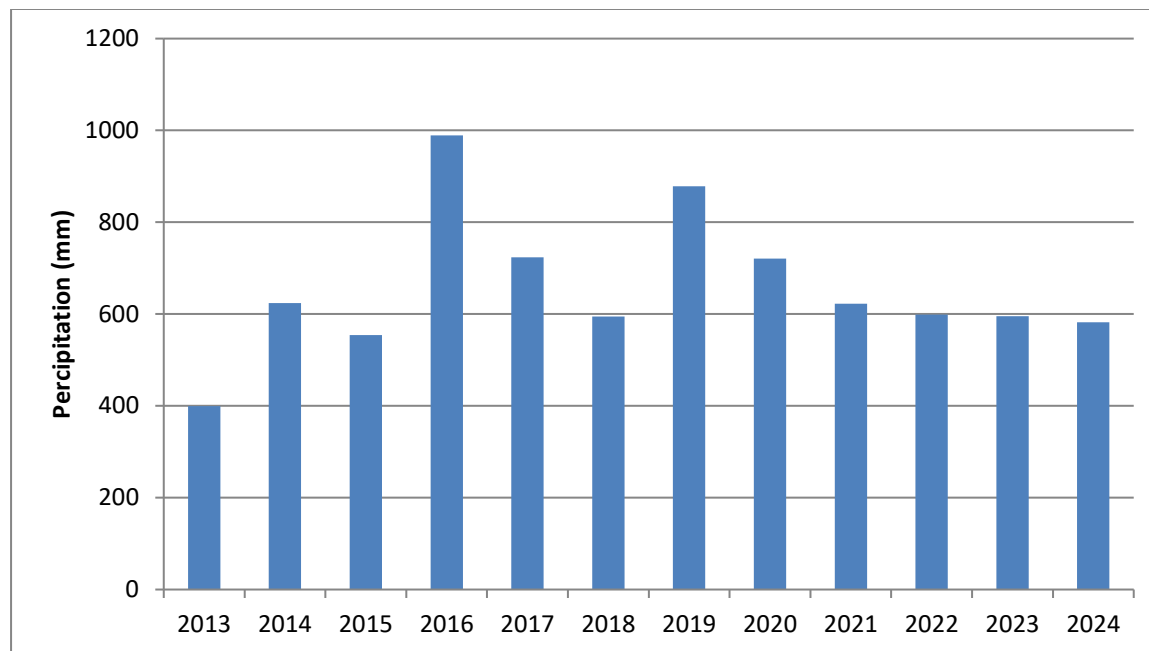


Figure 3-1: Total Annual Precipitation

3.4. Barometric Pressure

The overall barometric pressure remained within the historical range in 2024. The average monthly barometric pressure recorded at the AQM Station ranged between 665 mmHg and 672 mmHg. The one-hour maximum, average and minimum barometric pressure recorded in 2024 at the AQM Station were 682 mmHg, 667 mmHg and 648 mmHg, respectively. Refer to Section 8 for barometric pressure data.

3.5. Relative Humidity

The overall relative humidity remained within the historical range in 2024. The average monthly relative humidity recorded at the AQM Station ranged between 52.0 % and 80.0 %. The one-hour maximum, average and minimum relative humidity recorded in 2024 at the AQM Station were 99.0 %, 65.5 % and 7.9 %, respectively. Refer to Section 9 for relative humidity data.

4. AMBIENT TEMPERATURE

4.1. Data Summary

In 2024 ambient temperatures were monitored at the AQM station serviced by Bureau Veritas Canada at a height of 2m and 10m.

Data is summarized in tables' 4-1 and 4-2, and Figures 4-1 to 4-4.

Table 4-1: Ambient Temperature Summary at the SHTC (2m)

Month	Hourly		Daily		Monthly	Cumulative Frequency Distribution (%)							
	Min (°C)	Max (°C)	Min (°C)	Max (°C)	Average (°C)	< -30 °C	-31 to -20°C	-21 to -10°C	-9 to 0 °C	1 to 10°C	11 to 20°C	21 to 30°C	> 30 °C
January	-38.1	13.0	-35.4	9.0	-11.9	10.48	14.78	31.32	22.45	20.43	0.81	0.00	0.00
February	-28.4	11.3	-22.4	6.1	-6.0	0.00	7.33	24.14	44.97	23.42	0.14	0.00	0.00
March	-29.2	20.0	-25.3	10.3	-5.7	0.00	10.22	24.06	34.68	28.49	2.55	0.00	0.00
April	-13.5	16.5	-4.5	10.0	2.9	0.00	0.00	1.39	36.25	55.97	6.39	0.00	0.00
May	-2.2	22.7	0.8	17.1	7.8	0.00	0.00	0.00	6.48	69.64	23.21	0.67	0.00
June	-1.4	24.0	2.3	18.2	10.7	0.00	0.00	0.00	1.81	55.00	40.56	2.64	0.00
July	0.0	0.0	9.4	25.5	18.1	0.00	0.00	0.00	0.00	9.54	61.56	27.96	0.94
August	6.0	25.3	10.9	18.3	14.5	0.00	0.00	0.00	0.00	17.07	74.87	8.06	0.00
September	0.6	27.8	3.4	21.5	11.8	0.00	0.00	0.00	0.42	47.78	44.03	7.78	0.00
October	-8.1	20.3	-6.2	13.9	3.2	0.00	0.00	0.00	35.75	55.65	8.60	0.00	0.00
November	-24.5	15.7	-22.0	9.4	-6.6	0.00	5.56	29.72	49.03	14.17	1.53	0.00	0.00
December	-28.1	9.5	-21.6	6.8	-6.1	0.00	6.18	31.32	34.81	27.69	0.00	0.00	0.00
Annual	-38.1	27.8	-35.4	25.5	2.7								

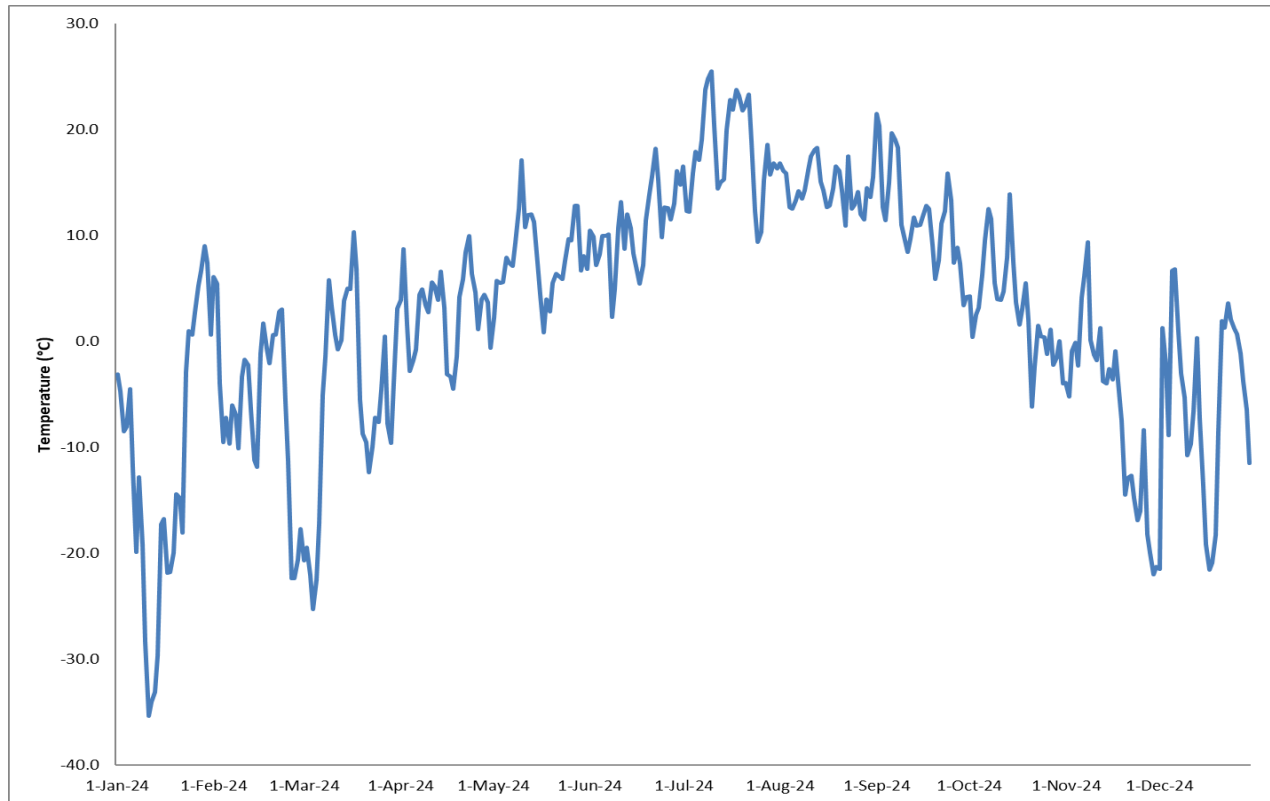


Figure 4-1: Average Daily Ambient Temperature (2m)

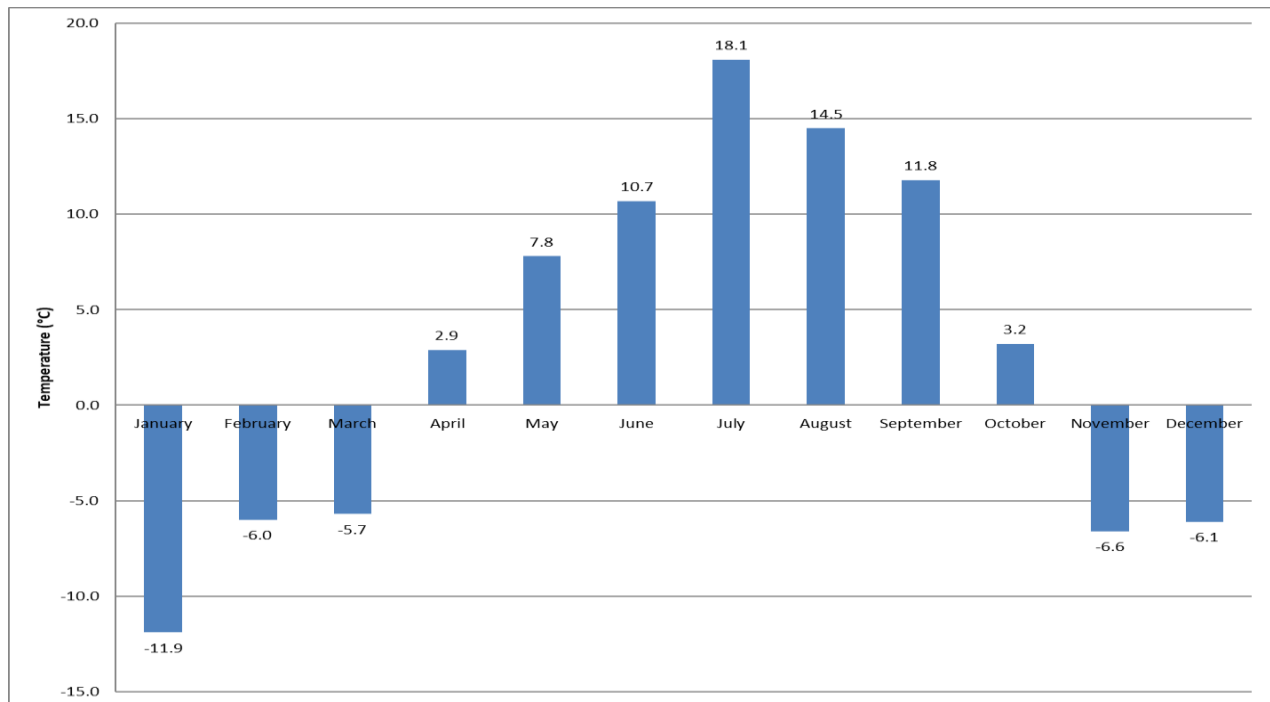


Figure 4-2: Average Monthly Temperature (2m)

Table 4-2: Ambient Temperature Summary at the SHTC (10m)

Month	Hourly		Daily		Monthly	Cumulative Frequency Distribution (%)							
	Min (°C)	Max (°C)	Min (°C)	Max (°C)	Average (°C)	< -30 °C	-31 to -20°C	-21 to -10°C	-9 to 0 °C	1 to 10°C	11 to 20°C	21 to 30°C	> 30 °C
January	-37.7	13.2	-35.2	9.4	-11.4	9.27	14.38	32.39	20.16	22.04	1.88	0.00	0.00
February	-26.0	11.2	-22.3	7.7	-5.5	0.00	7.04	21.98	43.68	27.01	0.29	0.00	0.00
March	-29.0	19.2	-25.2	10.7	-5.5	0.00	10.08	23.92	34.01	29.70	2.28	0.00	0.00
April	-10.2	16.2	-4.1	10.3	3.1	0.00	0.00	0.42	32.64	61.53	5.42	0.00	0.00
May	-1.0	21.7	0.6	17.1	7.8	0.00	0.00	0.00	5.53	72.74	21.19	0.54	0.00
June	-0.5	22.9	2.0	18.3	10.7	0.00	0.00	0.00	1.53	55.00	42.08	1.39	0.00
July	8.1	31.8	9.3	26.2	18.3	0.00	0.00	0.00	0.00	7.53	63.58	28.90	0.00
August	7.1	24.5	10.8	19.5	14.8	0.00	0.00	0.00	0.00	11.56	81.32	7.12	0.00
September	1.2	27.3	3.8	21.7	12.3	0.00	0.00	0.00	0.00	44.72	47.22	8.06	0.00
October	-7.9	20.2	-6.3	14.2	3.5	0.00	0.00	0.00	31.85	58.60	9.54	0.00	0.00
November	-24.1	16.0	-21.9	9.6	-6.5	0.00	5.14	30.00	48.33	15.00	1.53	0.00	0.00
December	-25.0	9.9	-21.3	7.3	-5.7	0.00	5.91	31.32	31.85	30.91	0.00	0.00	0.00
Annual	-37.7	31.8	-35.2	26.2	3.0								

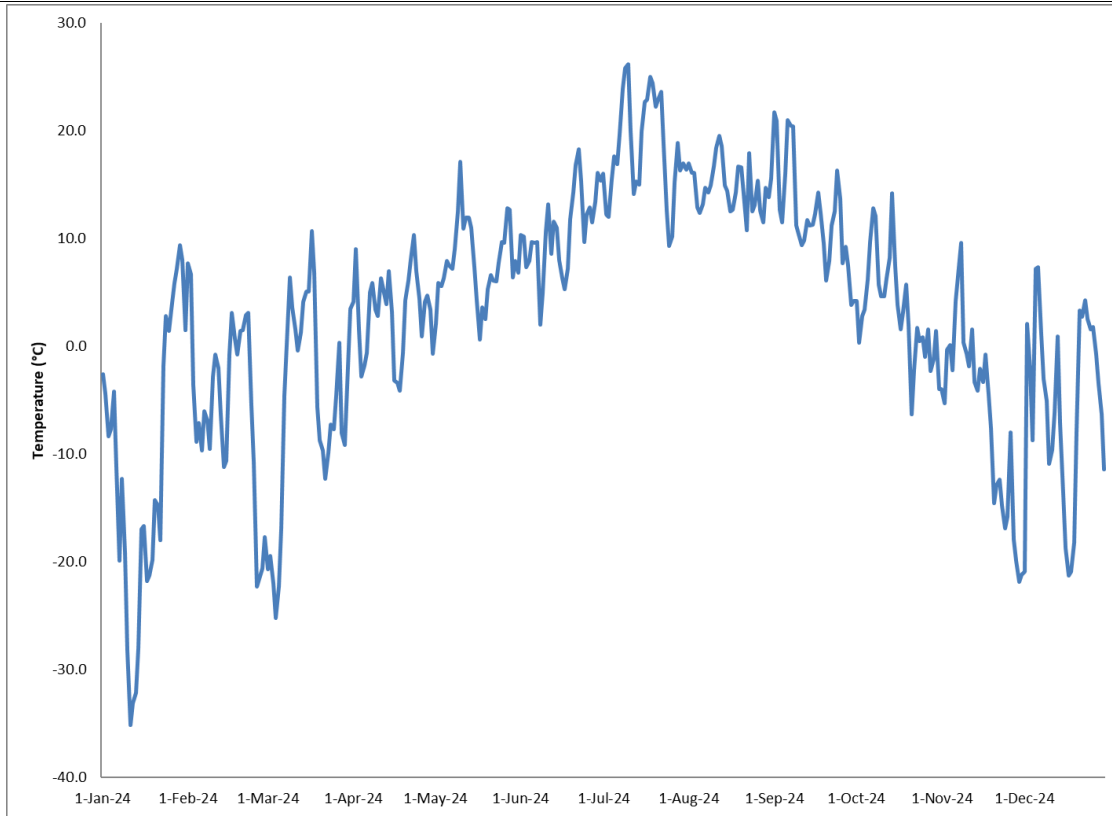


Figure 4-3: Average Daily Ambient Temperature (10m)

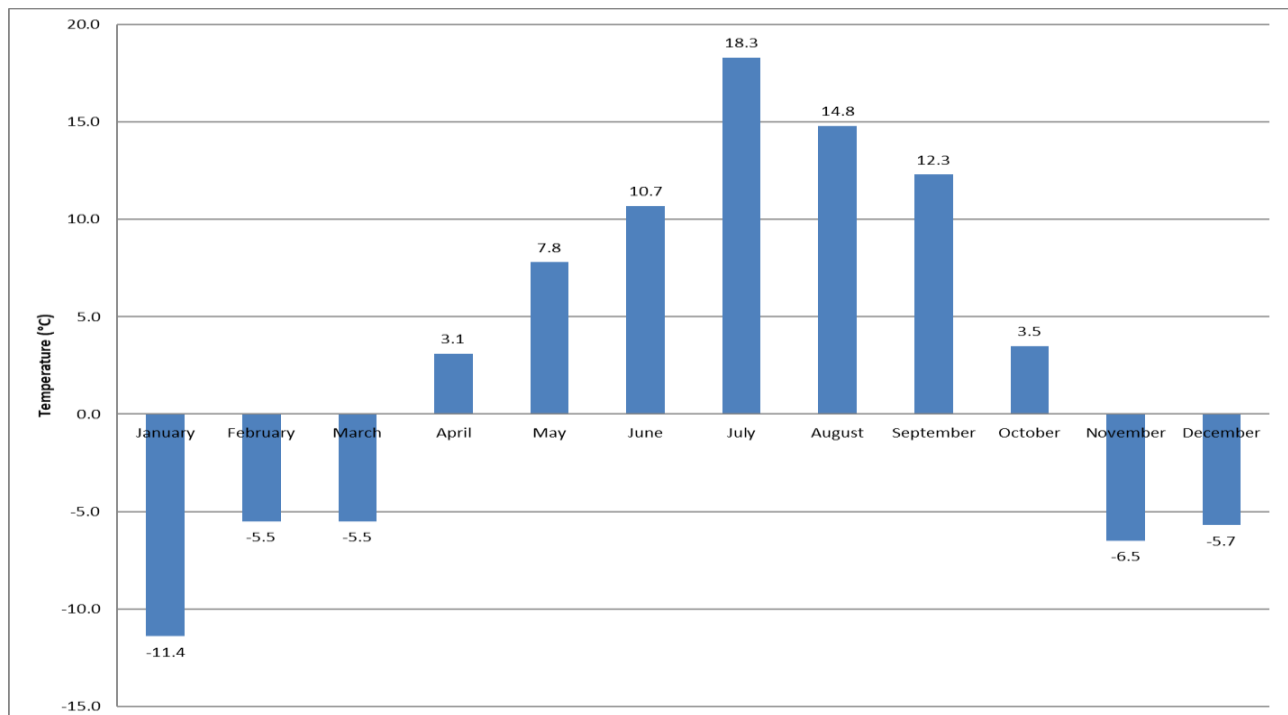


Figure 4-4: Average Monthly Temperature (10m)

5. WIND SPEED AND DIRECTION

In 2024 wind speed and direction were monitored at the AQM station serviced by Bureau Veritas Canada at a height of 10m and 30m.

Data is summarized in tables 5-1 and 5-2. Windroses are in Section 6.

Table 5-1: Wind Speed Summary at the SHTC (10m)

Month	Monthly	Hourly		Daily		Monthly	Cumulative Frequency Distribution (%)						
	Average (Deg)	Min	Max (kph)	Min (kph)	Max (kph)	Average (kph)	0 K ph	1 - 5 Kph	6 - 11 Kph	12 - 19 Kph	20 - 28 Kph	29 - 38 Kph	>39 Kph
January	239	0.1	42.7	1.6	31.9	12.2	1.3	30.6	26.2	20.2	15.2	5.5	0.9
February	258	0.5	50.9	3.1	36.3	13.9	0.9	26.4	27.6	20.7	12.8	8.6	3.0
March	222	0.6	54.1	4.1	28.3	12.0	0.4	30.5	31.3	22.6	9.9	2.8	2.4
April	249	0.8	43.0	4.2	30.6	14.8	0.3	24.6	22.8	19.9	23.8	8.1	0.7
May	245	0.4	48.6	3.0	35.6	14.5	0.3	28.1	18.9	21.5	22.8	6.5	2.0
June	235	0.1	42.9	3.2	32.1	12.8	1.7	30.0	25.1	18.8	16.4	7.6	0.4
July	251	17.0	99.0	3.7	31.4	13.8	0.5	24.9	24.2	23.1	21.2	5.1	0.9
August	215	0.4	37.4	2.4	24.0	8.7	2.2	48.3	26.1	13.0	7.9	2.6	0.0
September	263	0.5	46.1	3.9	27.1	12.5	0.8	20.9	34.4	28.1	12.4	2.6	0.8
October	247	0.4	44.7	3.8	29.3	13.6	0.4	22.8	24.8	29.0	16.8	4.8	1.4
November	216	0.3	43.0	2.2	21.2	9.5	2.4	45.3	23.3	17.6	6.3	4.6	0.6
December	248	0.0	43.6	2.8	27.5	14.2	1.1	26.9	25.4	17.1	19.0	9.3	1.3
Annual		0	99.0	1.6	36.3	12.7							

Table 5-2: Wind Speed Summary at the SHTC (30m)

Month	Monthly	Hourly		Daily		Monthly	Cumulative Frequency Distribution (%)						
	Average (Deg)	Min	Max (kph)	Min (kph)	Max (kph)	Average (kph)	0 K ph	1 - 5 Kph	6 - 11 Kph	12 - 19 Kph	20 - 28 Kph	29 - 38 Kph	>39 Kph
January	235	0.3	49.6	2.7	35.5	16.2	0.3	18.7	22.0	25.3	21.2	9.8	2.7
February	251	2.0	59.2	4.3	42.4	17.8	0.1	11.1	25.3	30.9	16.4	9.3	6.9
March	218	1.2	62.1	9.4	32.0	16.7	0.0	5.9	30.0	37.5	18.8	3.6	4.2
April	240	1.1	50.3	7.6	34.6	19.2	0.0	6.4	23.1	26.7	26.0	14.7	3.2
May	236	2.5	55.2	7.2	40.7	19.0	0.0	5.3	24.0	28.9	25.2	12.0	4.6
June	222	0.8	50.5	7.4	39.0	18.4	0.1	6.9	21.8	34.3	22.4	9.3	5.1
July	244	0.0	359.0	6.4	38.3	19.0	0.0	6.2	19.4	33.9	24.2	13.4	3.0
August	198	2.1	47.2	7.1	31.0	14.5	0.0	10.3	37.2	32.0	12.8	6.3	1.3
September	228	1.3	57.4	8.3	34.7	17.5	0.0	5.3	22.0	42.1	19.1	10.2	1.4
October	192	0.7	52.2	6.4	35.3	18.3	0.1	5.9	20.7	39.4	20.3	9.7	3.9
November	162	0.0	51.9	0.0	26.7	12.7	8.8	17.1	31.3	23.8	11.3	5.6	2.4
December	210	1.1	51.4	4.7	32.6	18.3	0.0	12.5	21.5	27.6	19.4	14.1	5.0
Annual		0	359.0	0.0	42.4	17.3							

6. WINDROSES

6.1. Monthly Windroses (10m)

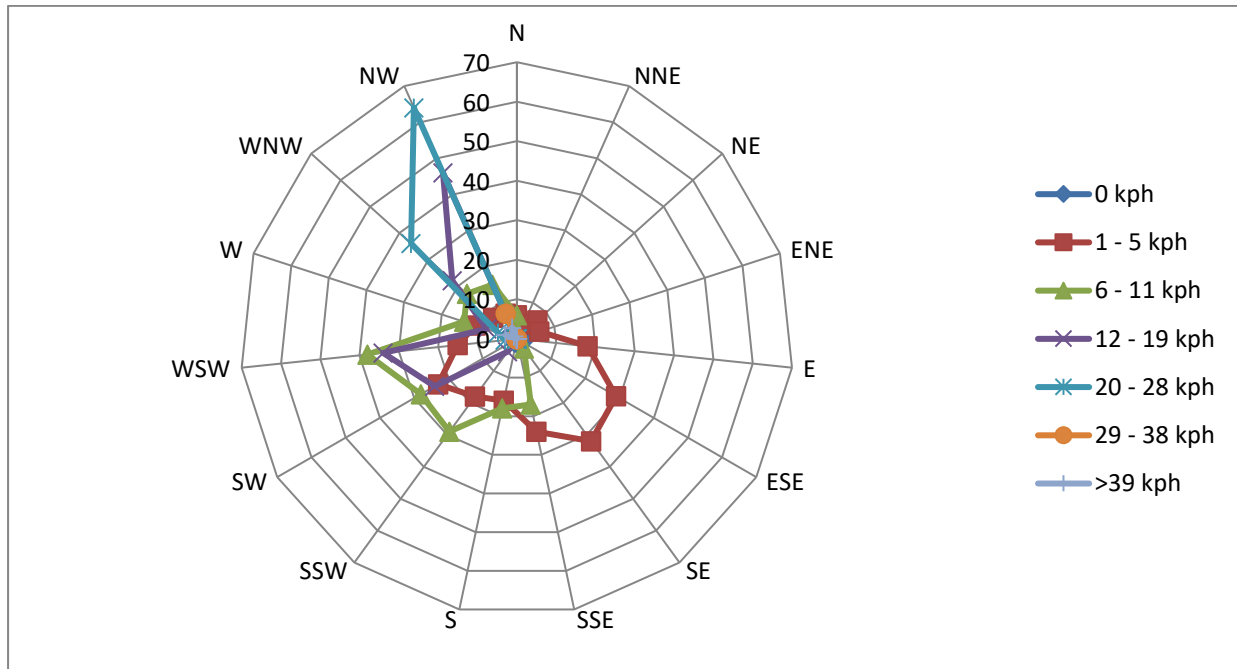


Figure 6-1: January Windrose (1 hour Average, 10m)

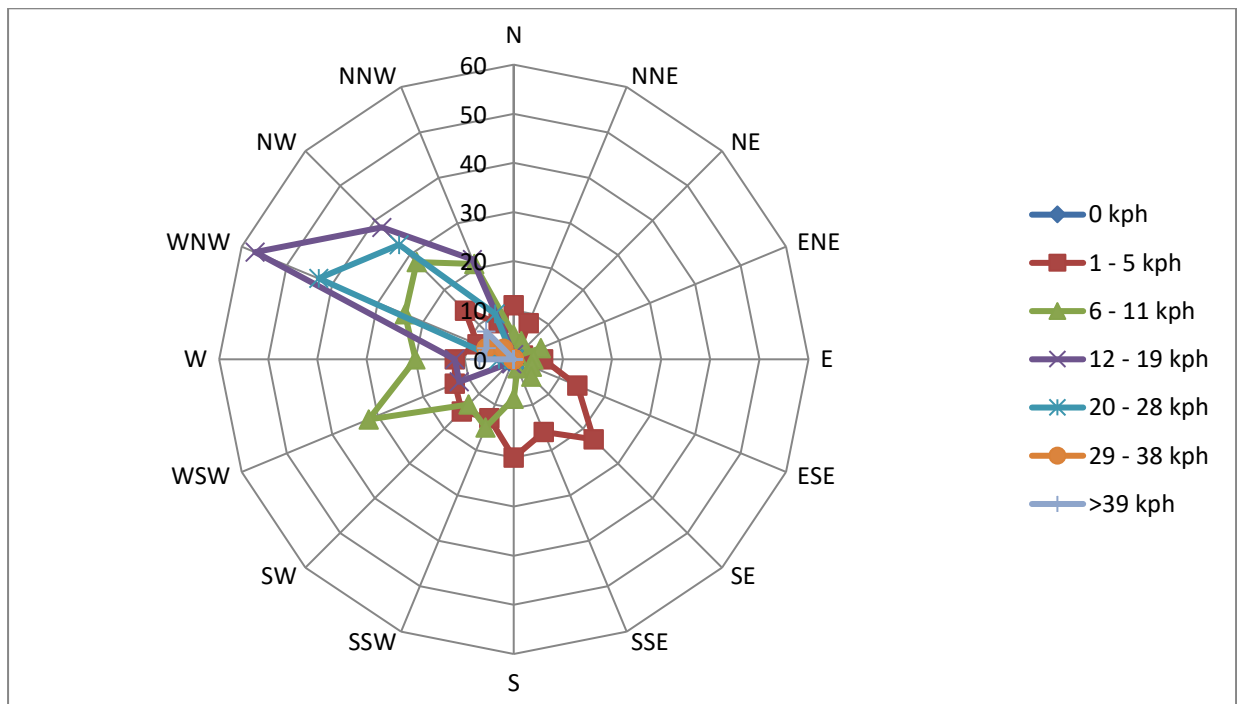


Figure 6-2: February Windrose (1 hour Average, 10m)

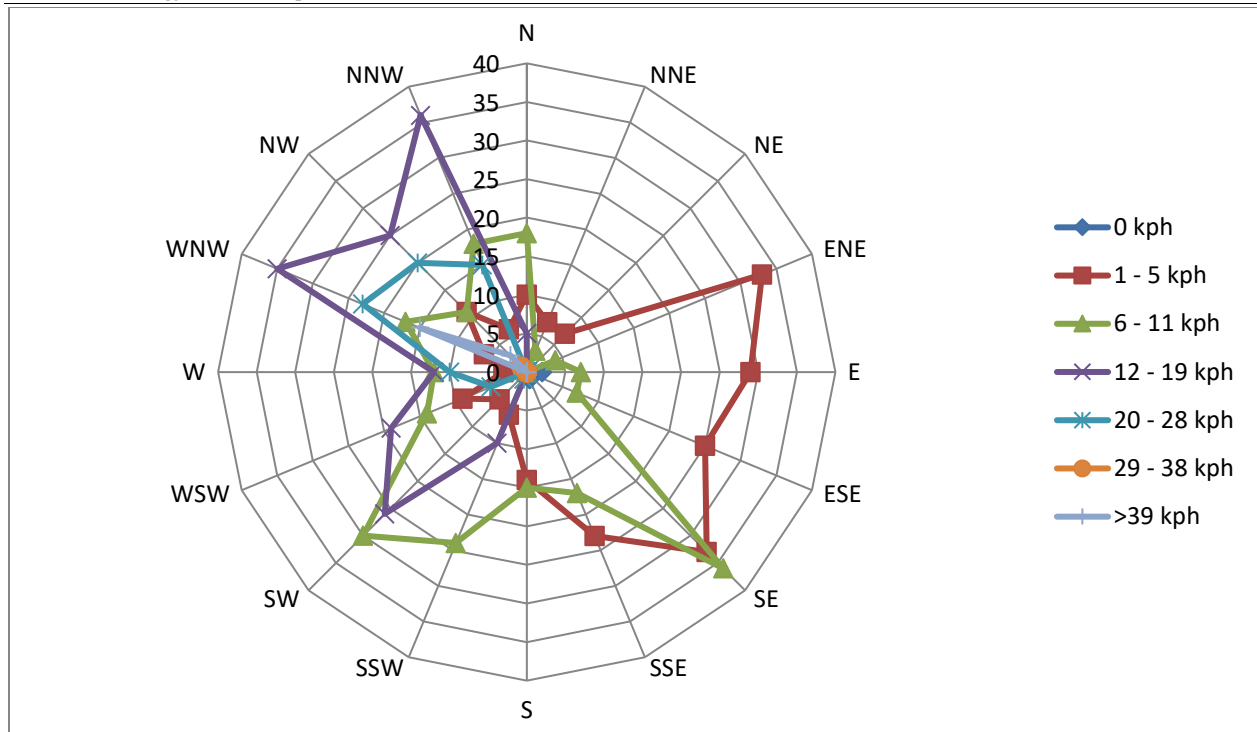


Figure 6-3: March Windrose (1 hour Average, 10m)

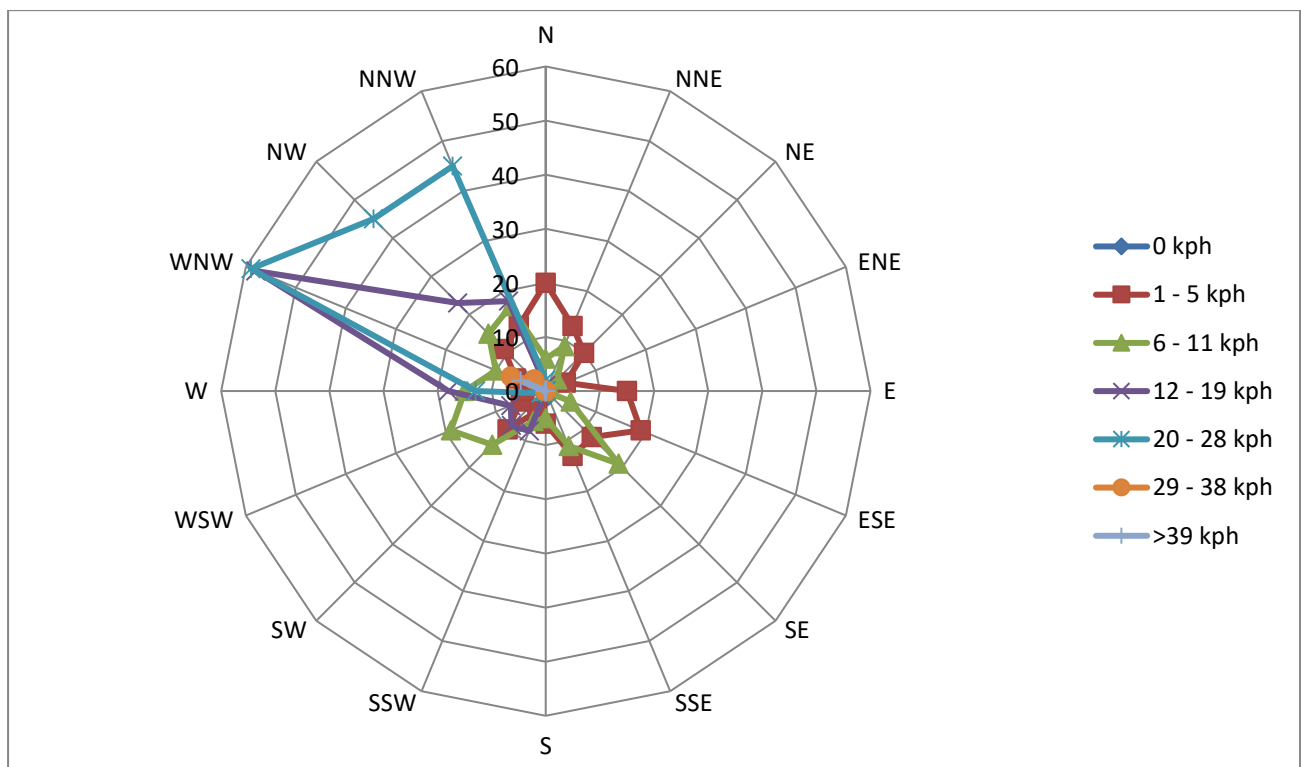


Figure 6-4: April Windrose (1 hour Average, 10 m)

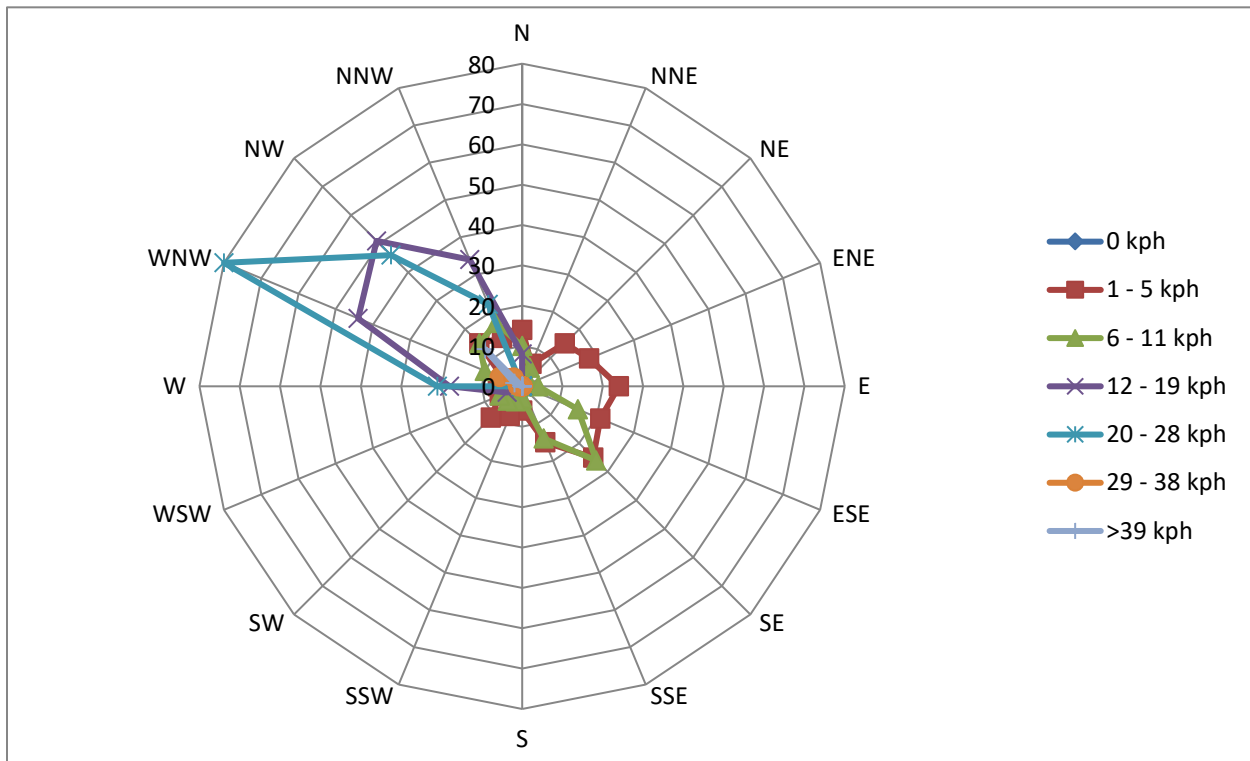


Figure 6-5: May Windrose (1 hour Average)

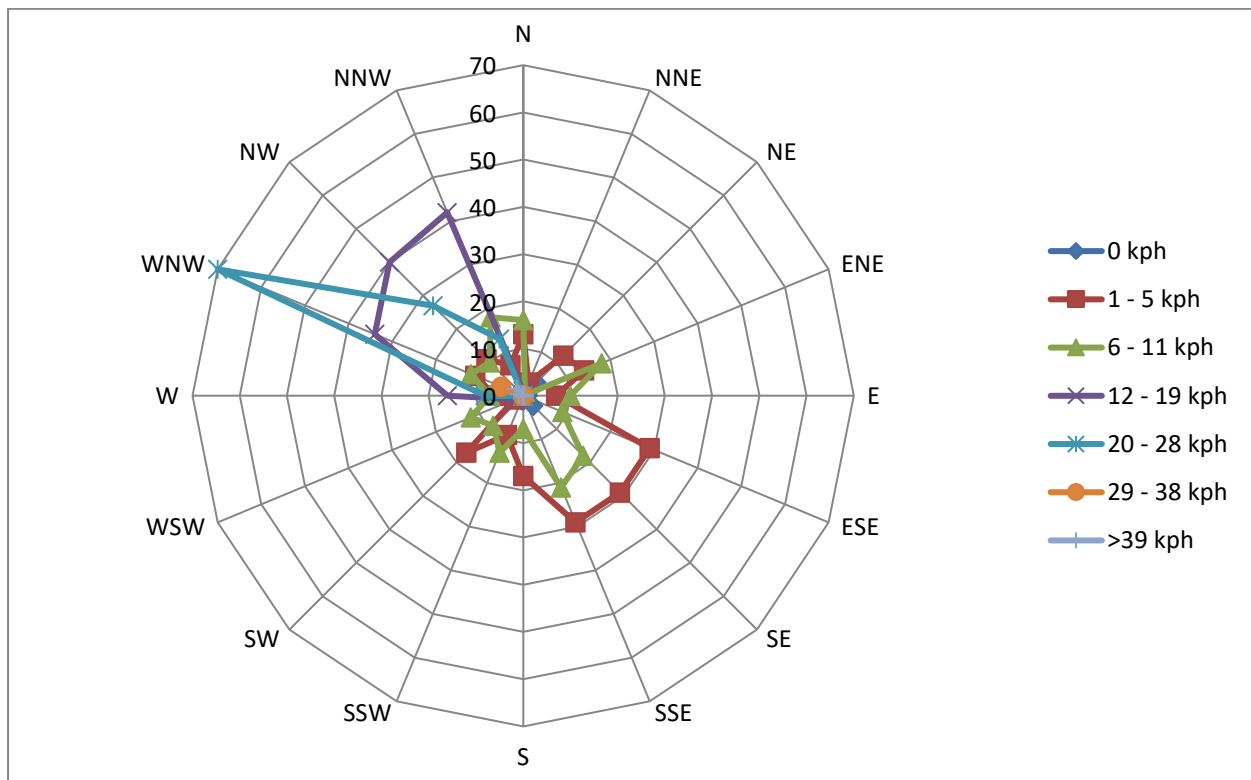


Figure 6-6: June Windrose (1 hour Average, 10m)

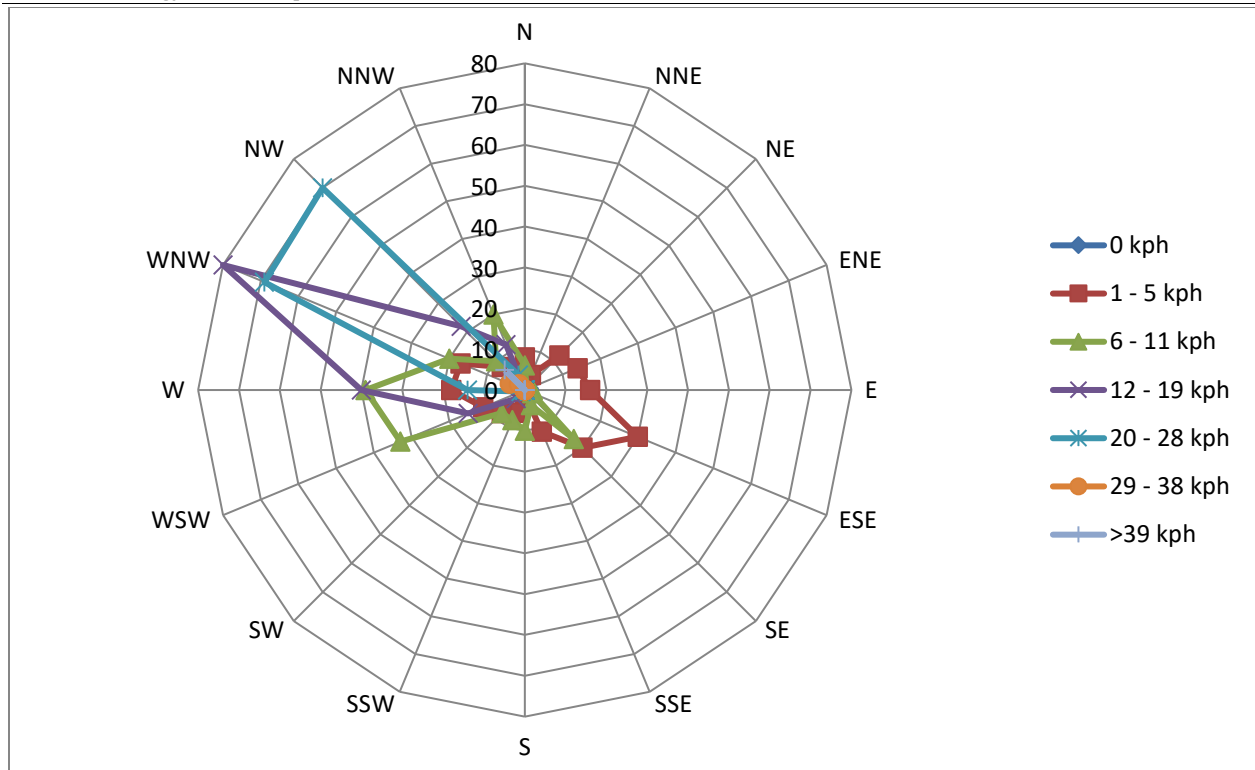


Figure 6-7: July Windrose (1 hour Average, 10m)

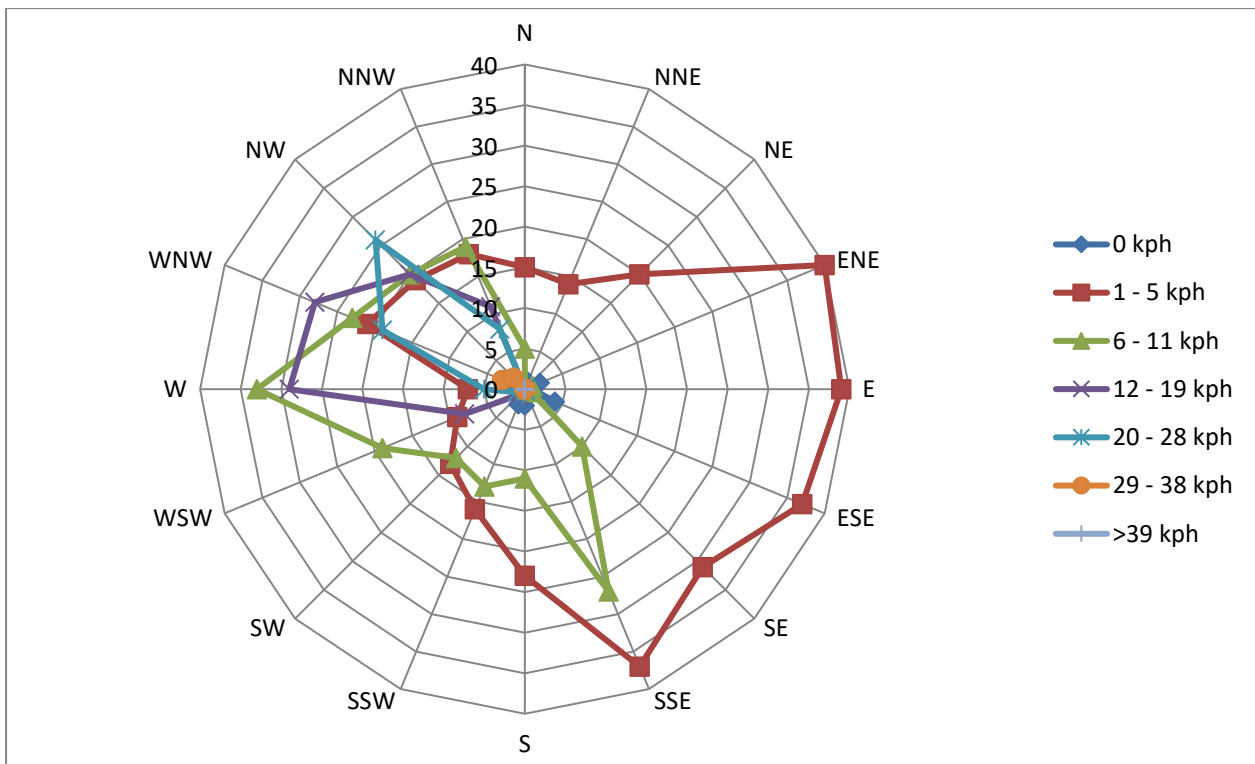


Figure 6-8: August Windrose (1 hour Average, 10m)

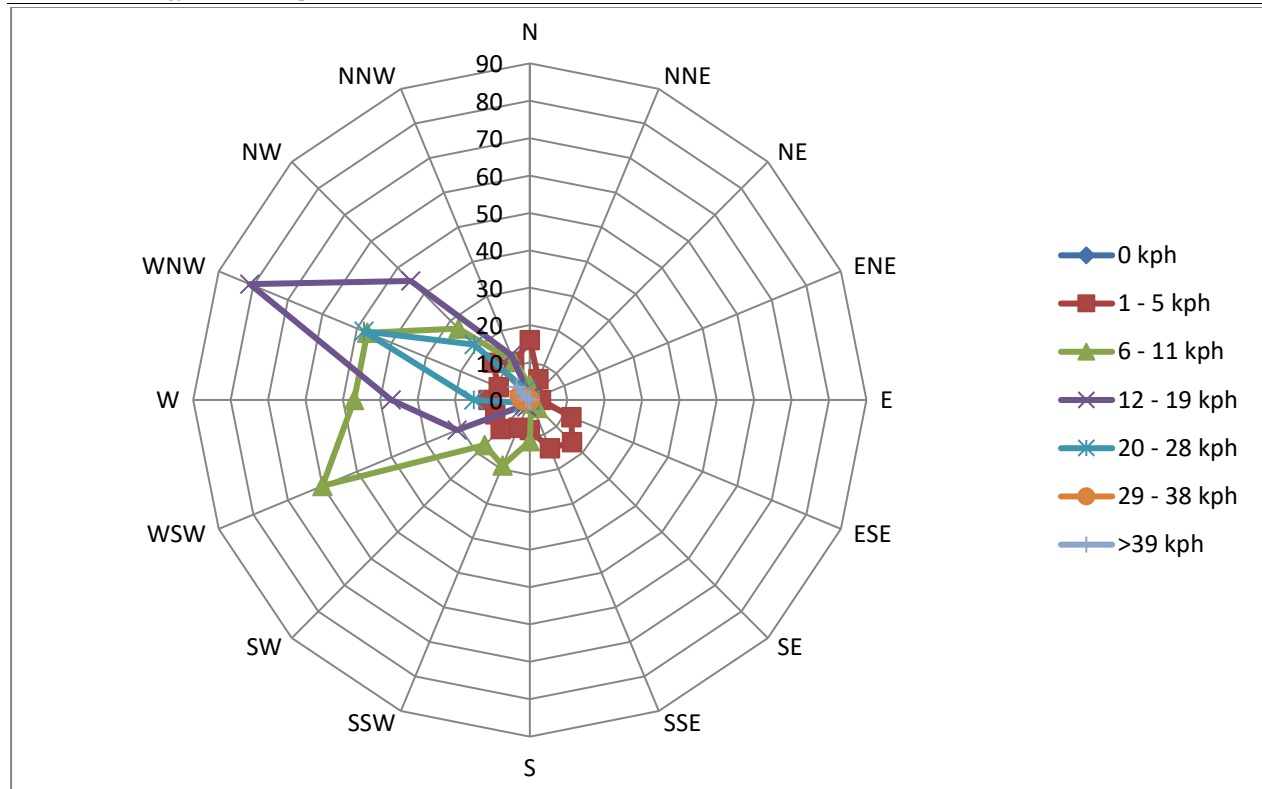


Figure 6-9: September Windrose (1 hour Average, 10m)

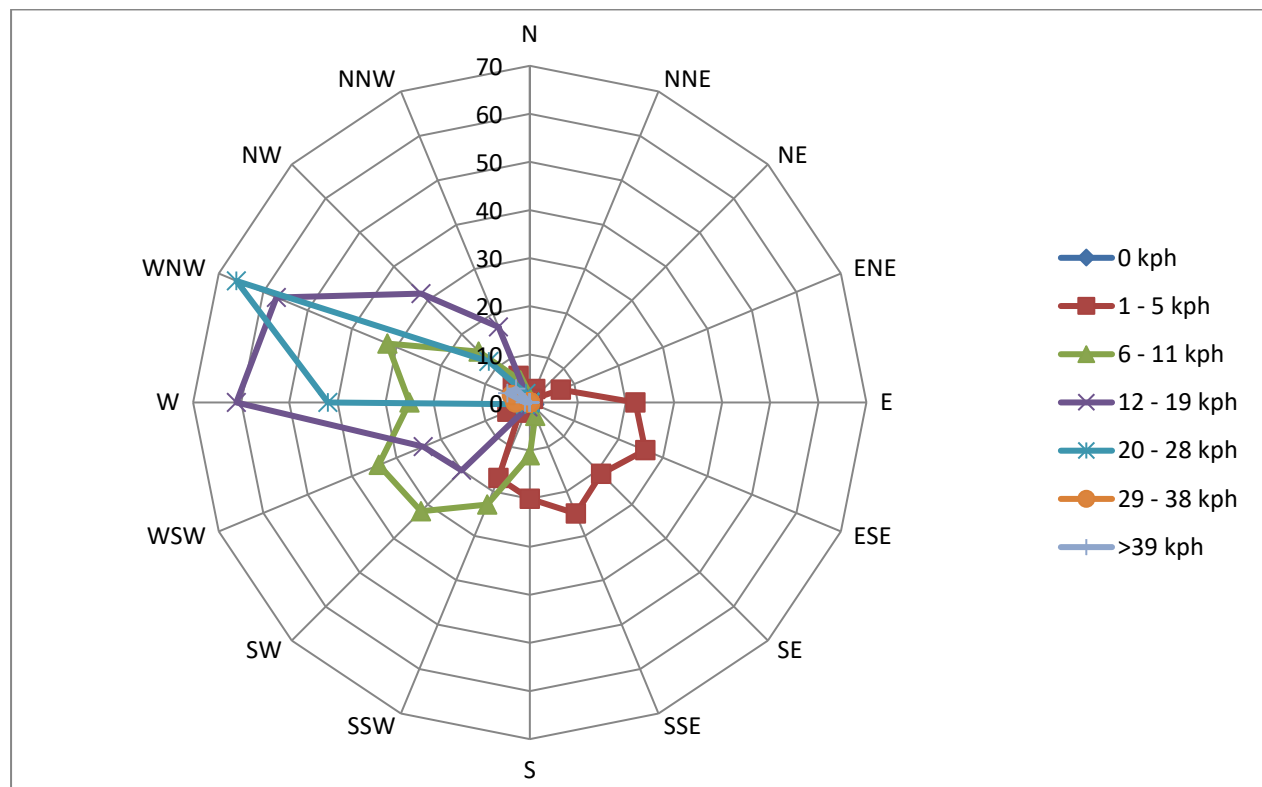


Figure 6-10: October Windrose (1 hour Average, 10m)

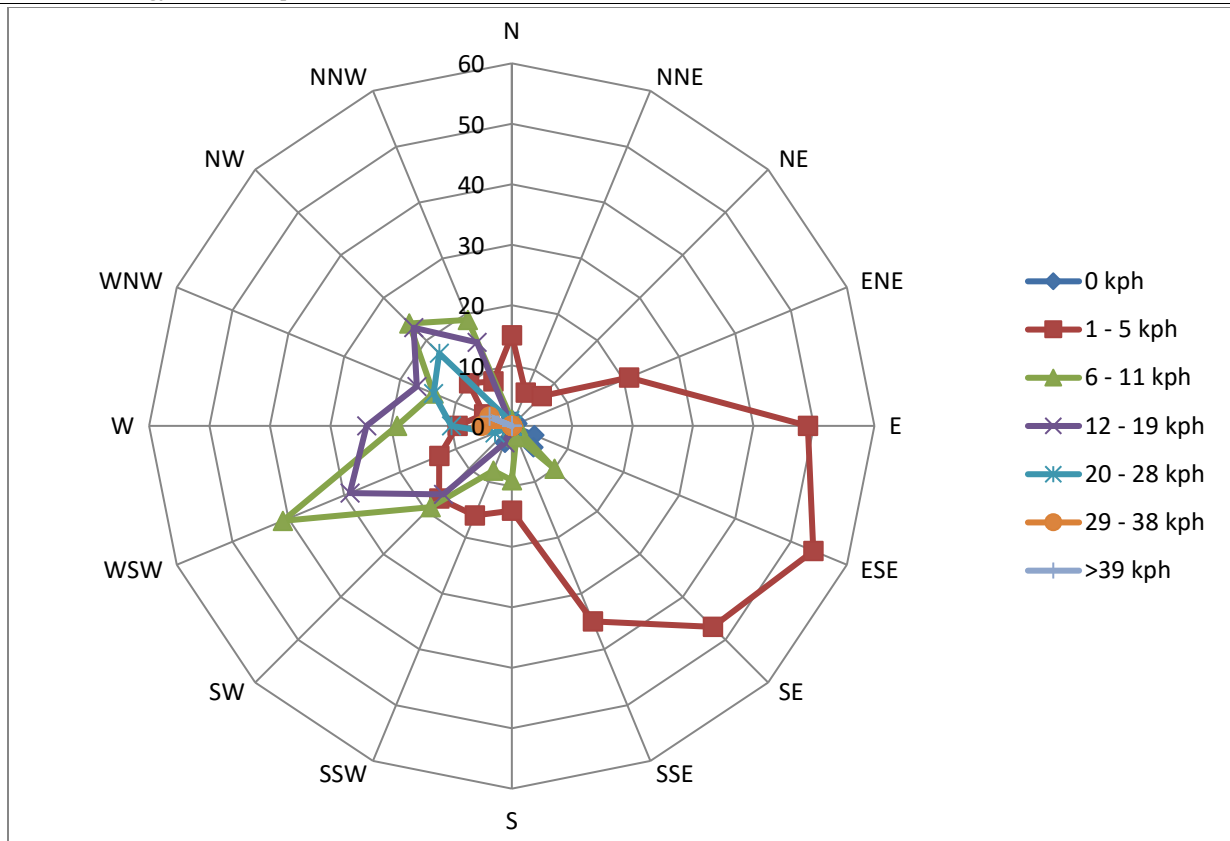


Figure 6-11: November Windrose (1 hour Average, 10m)

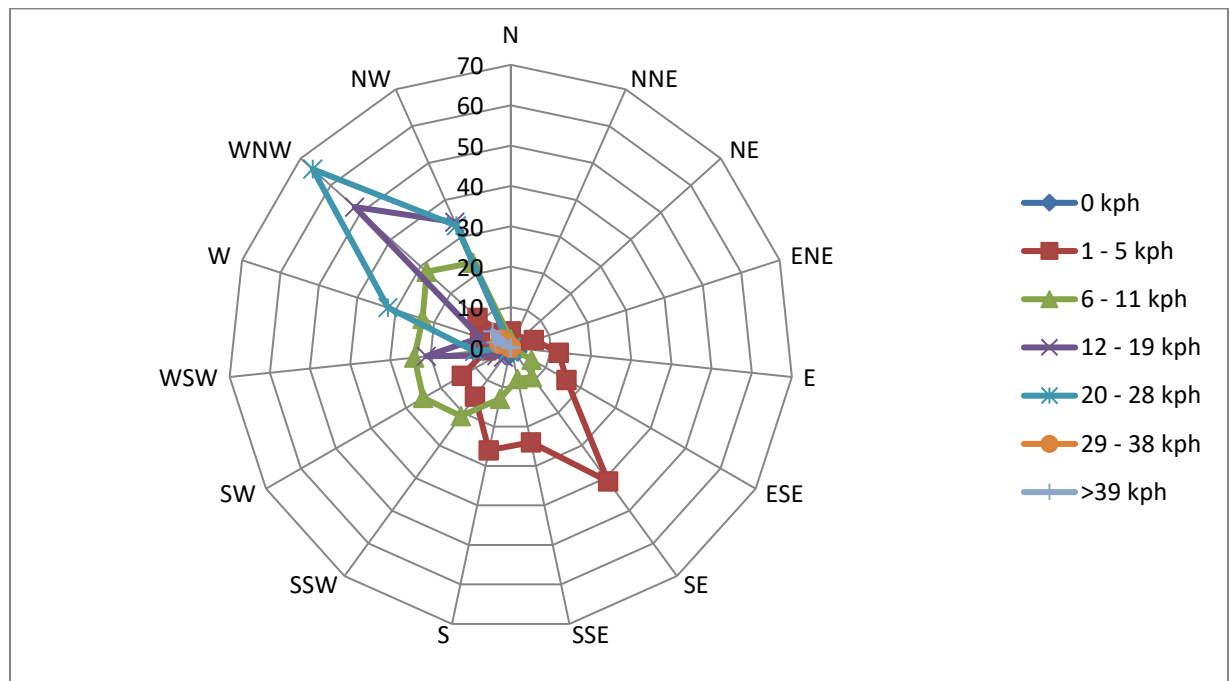


Figure 6-12: December Windrose (1 hour Average, 10m)

6.2. Monthly Windroses (30m)

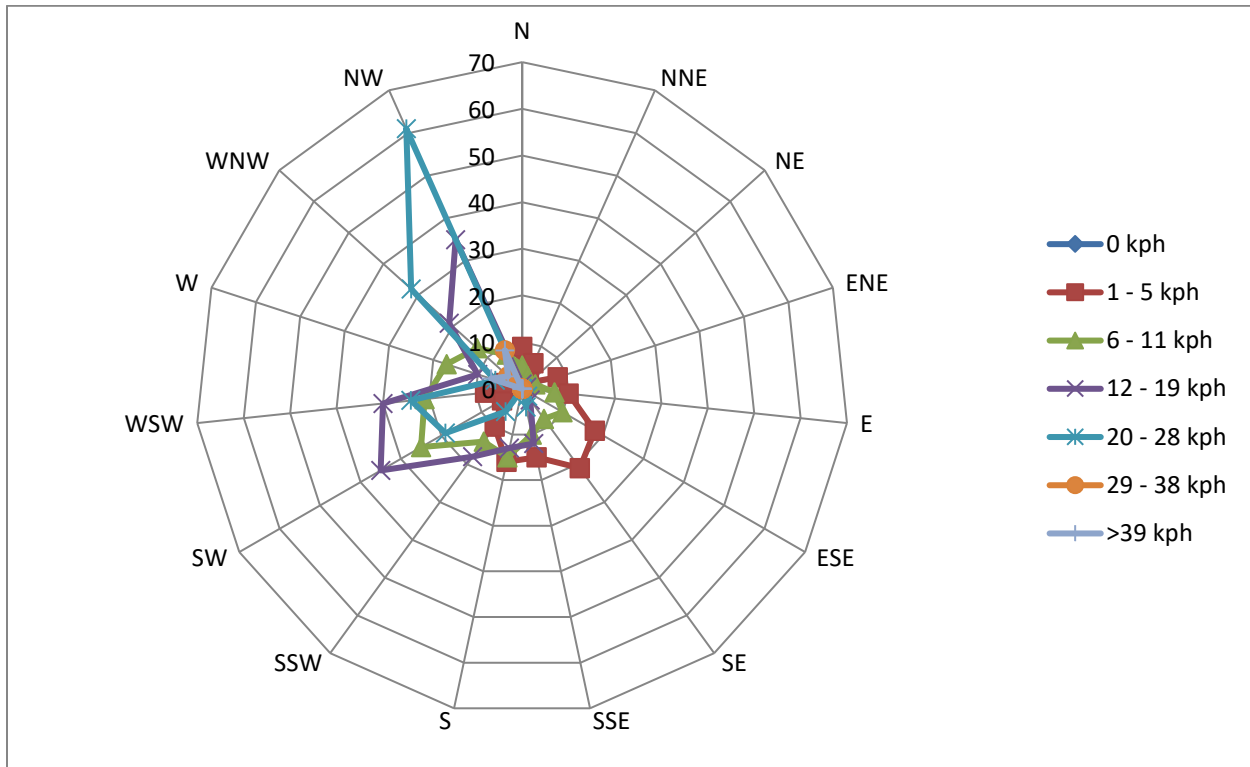


Figure 6-13: January Windrose (1 hour Average, 30m)

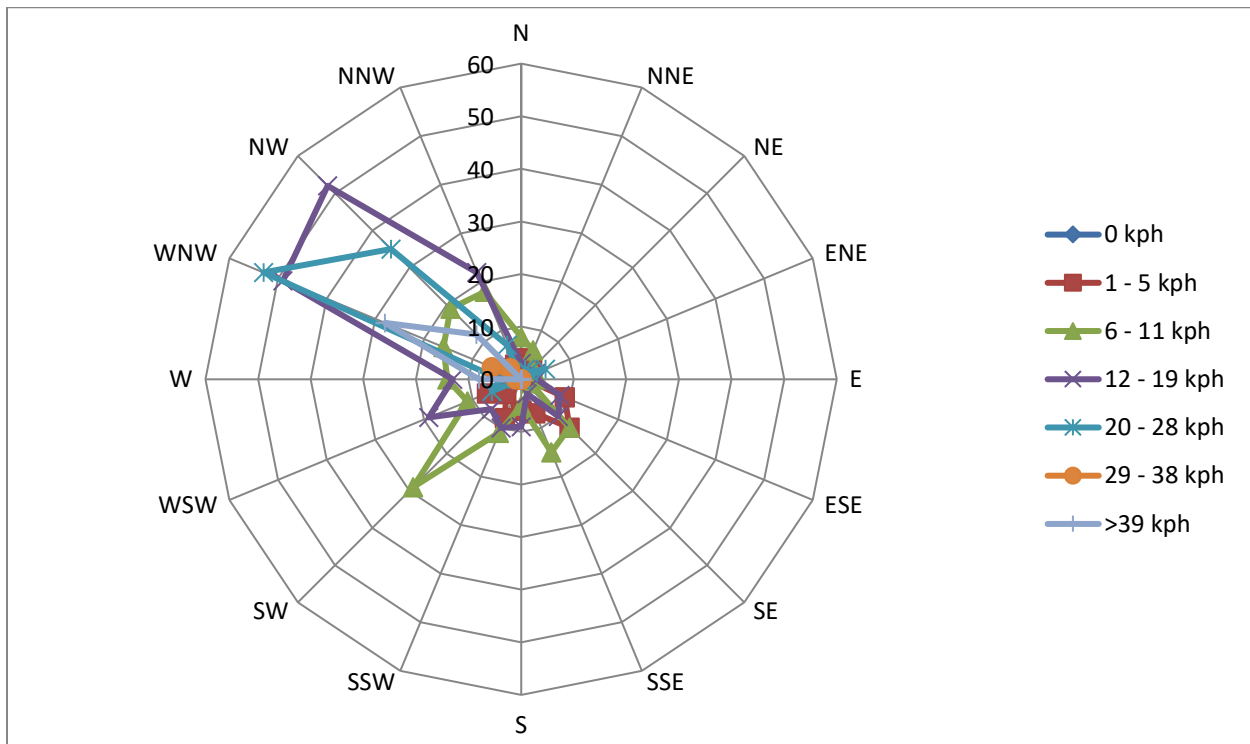


Figure 6-14: February Windrose (1 hour Average, 30m)

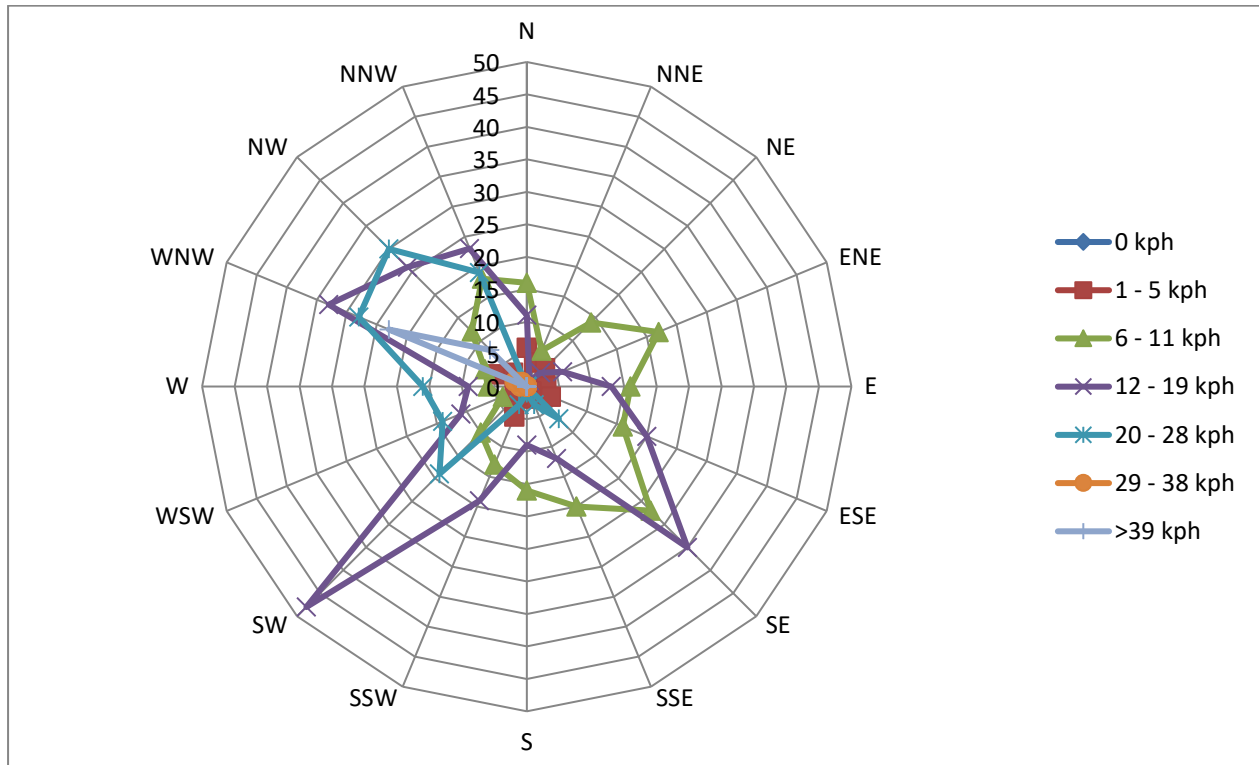


Figure 6-15: March Windrose (1 hour Average, 30m)

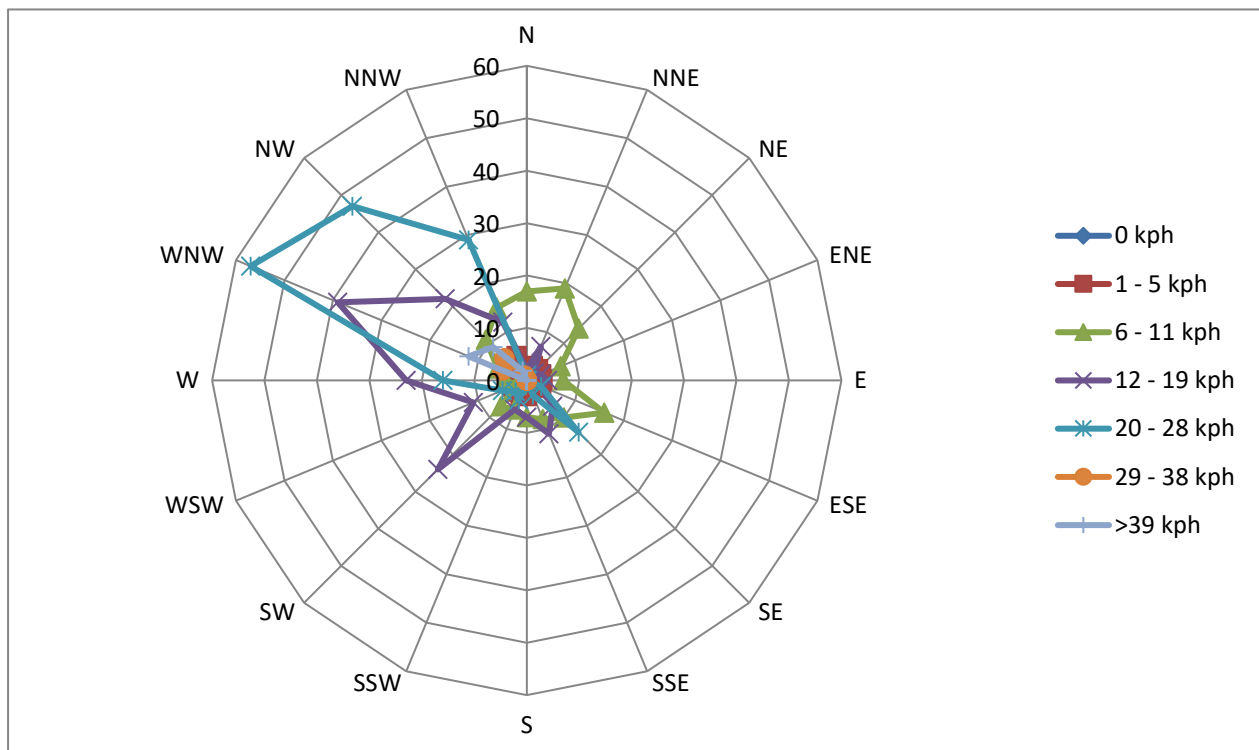


Figure 6-16: April Windrose (1 hour Average, 30m)

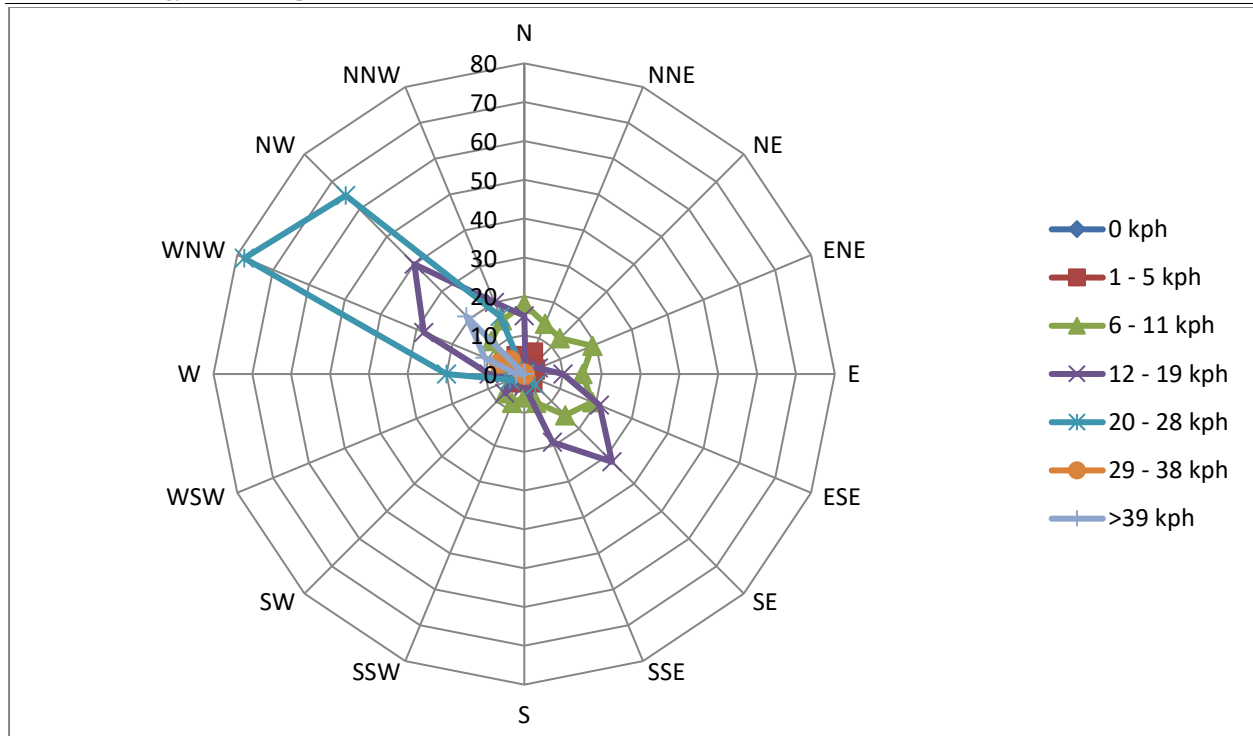


Figure 6-17: May Windrose (1 hour Average, 30m)

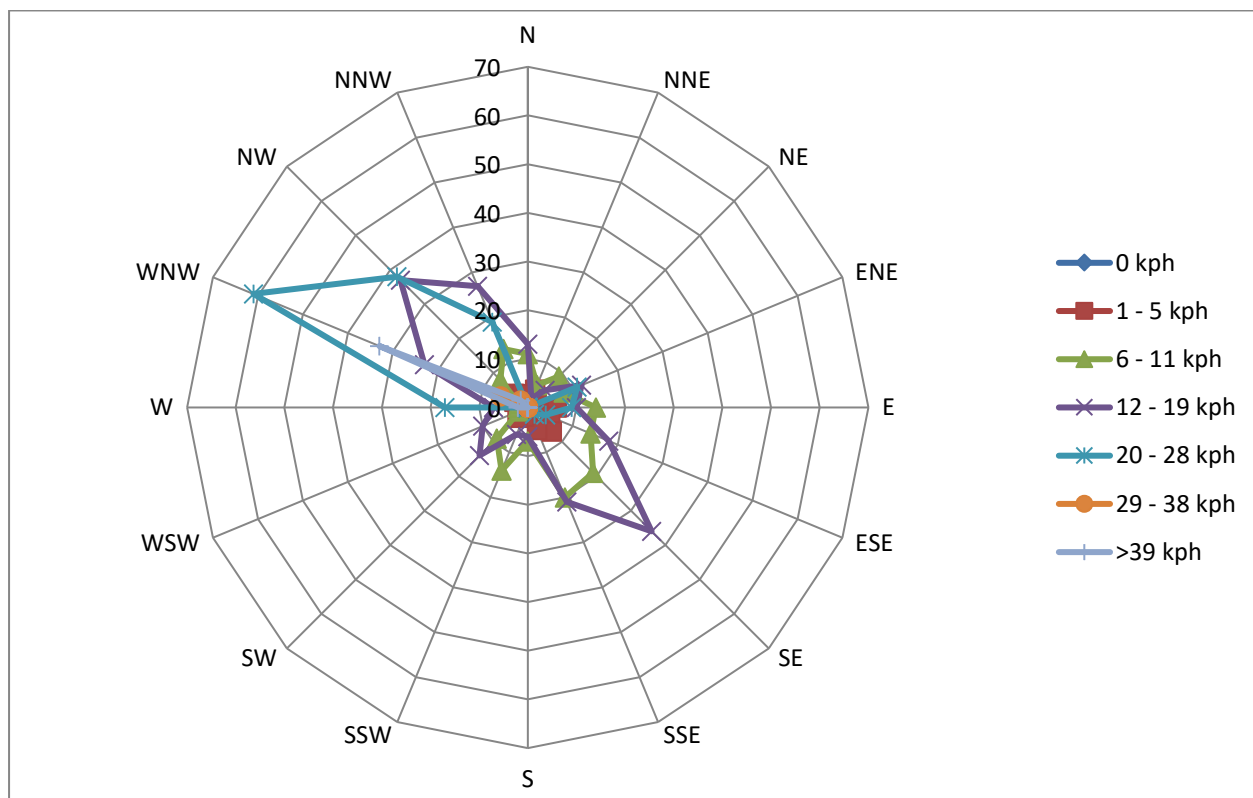


Figure 6-18: June Windrose (1 hour Average, 30m)

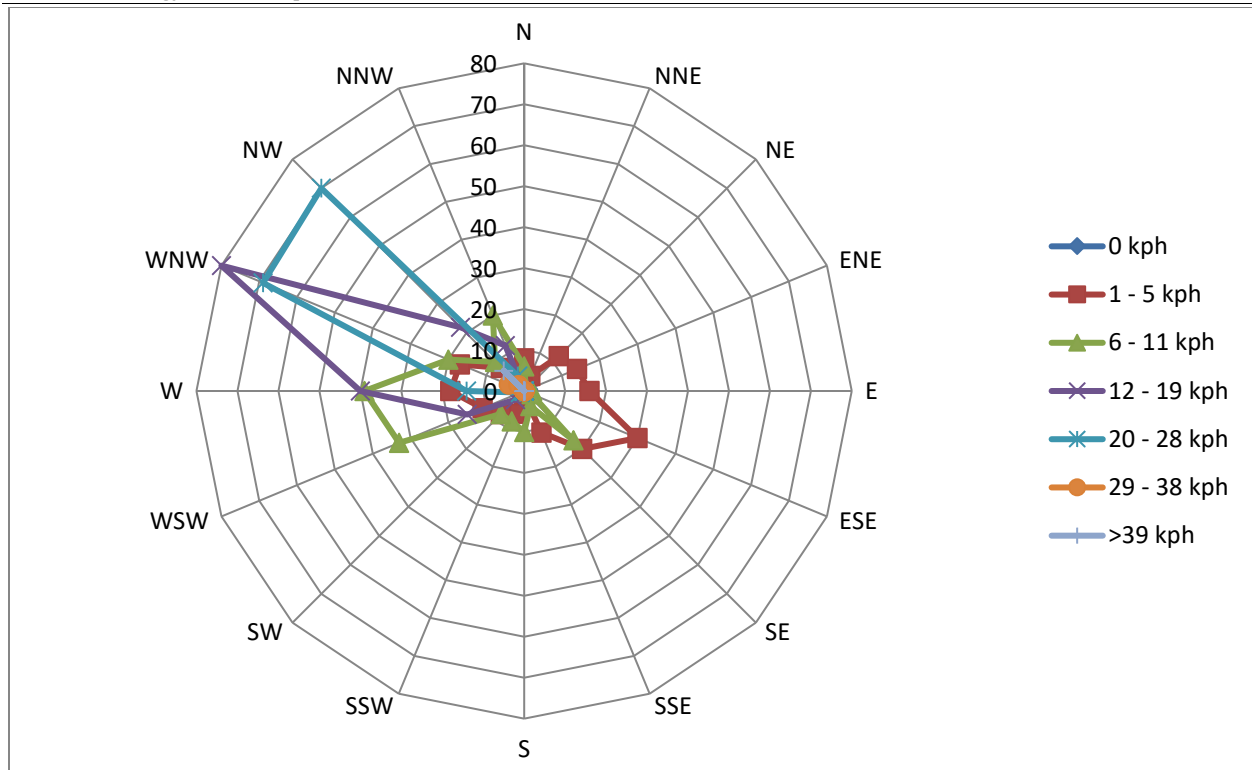


Figure 6-19: July Windrose (1 hour Average, 30m)

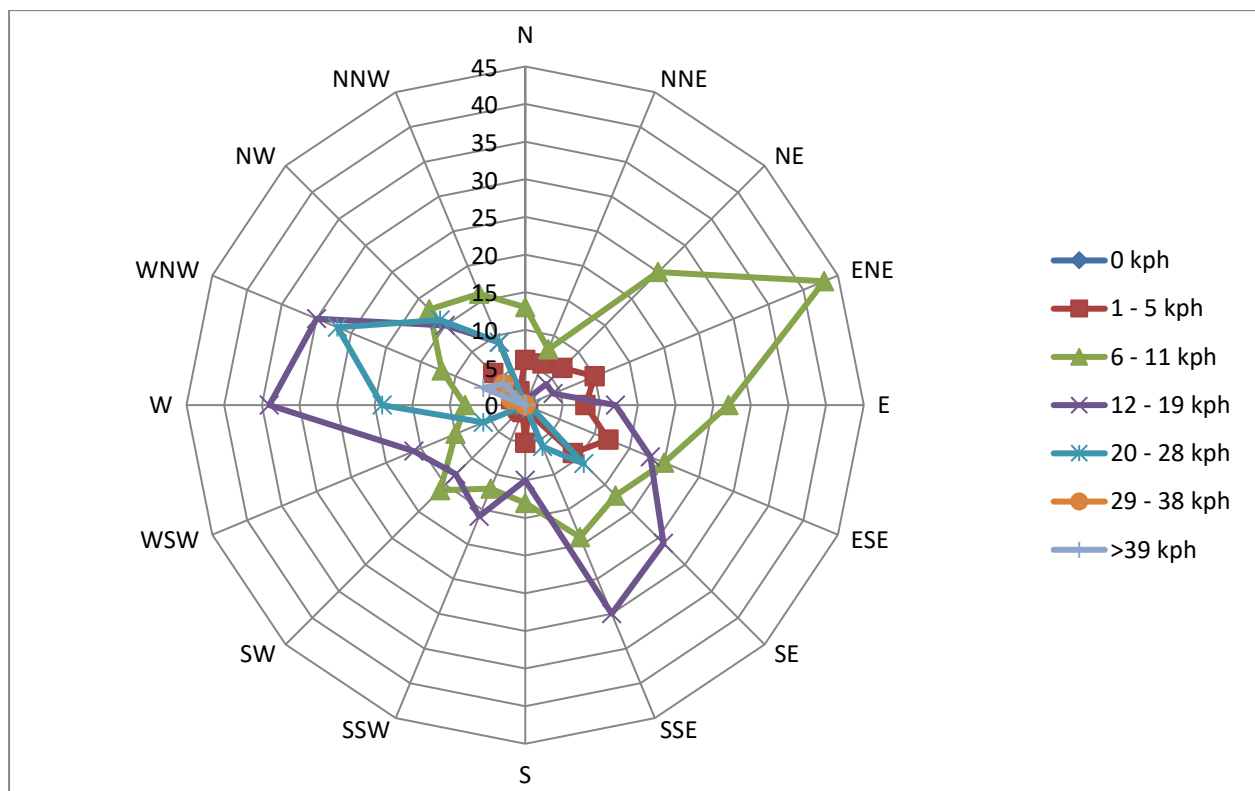


Figure 6-20: August Windrose (1 hour Average, 30m)

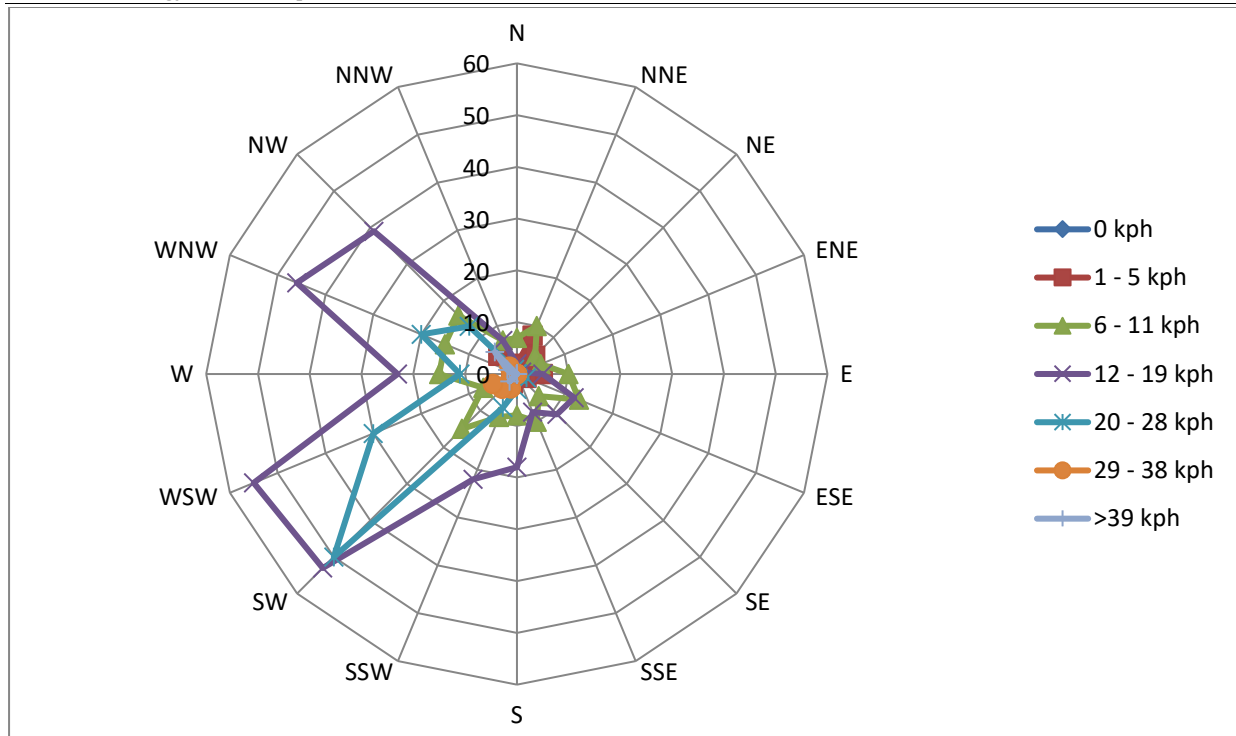


Figure 6-21: September Windrose (1 hour Average, 30m)

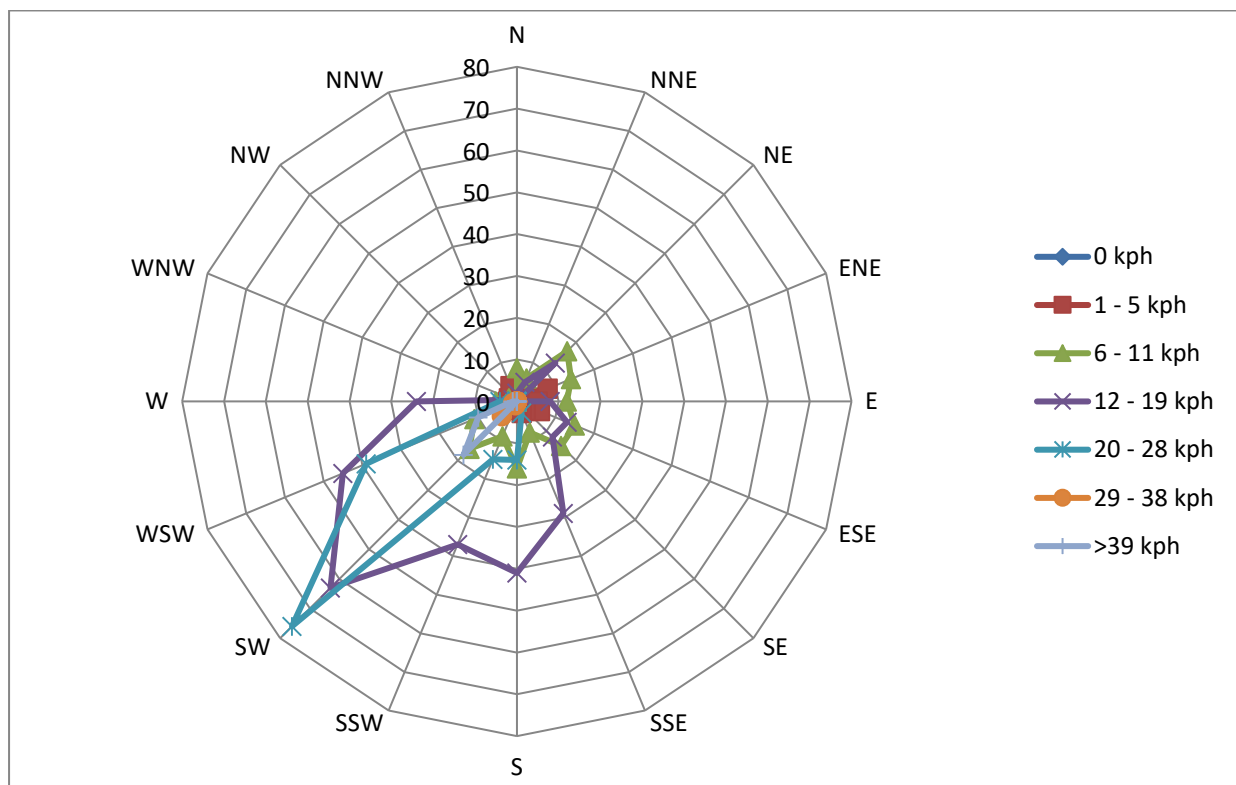


Figure 6-22: October Windrose (1 hour Average, 30m)

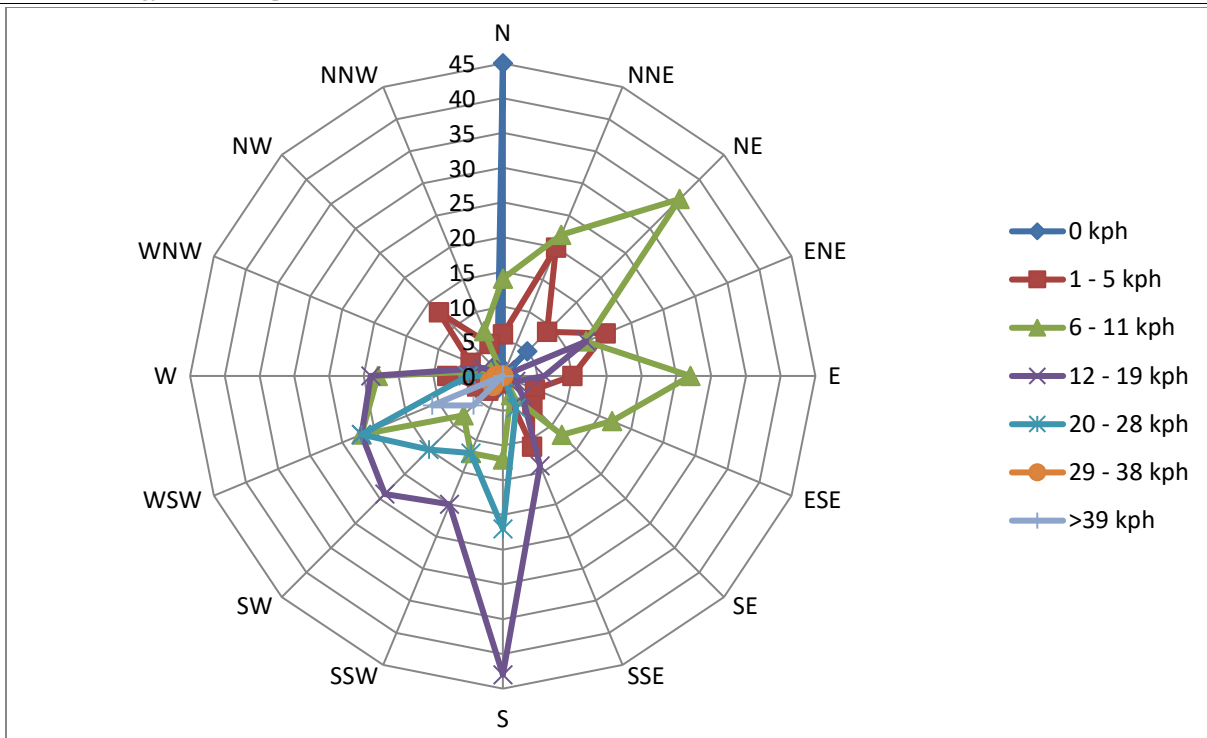


Figure 6-23: November Windrose (1 hour Average, 30m)

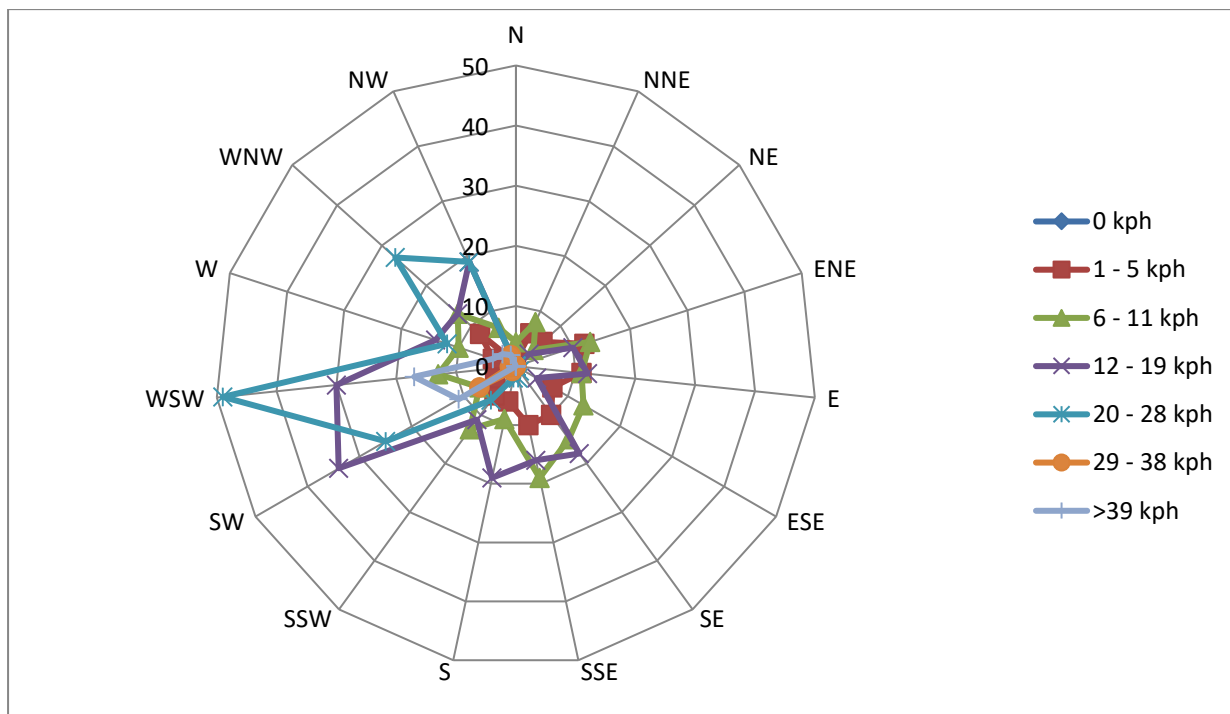


Figure 6-24: December Windrose (1 hour Average, 30m)

6.3. Annual Windrose (10m)

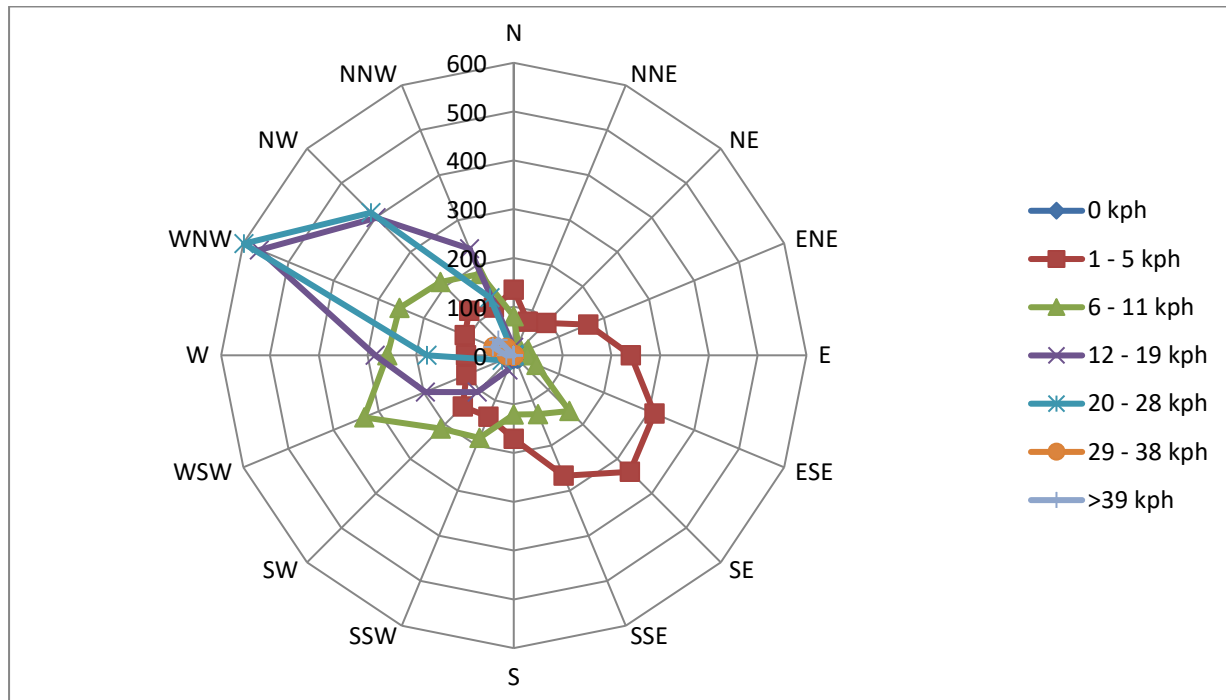


Figure 6-25: Annual Windrose (1 hour Average, 10m)

6.4. Annual Windrose (30m)

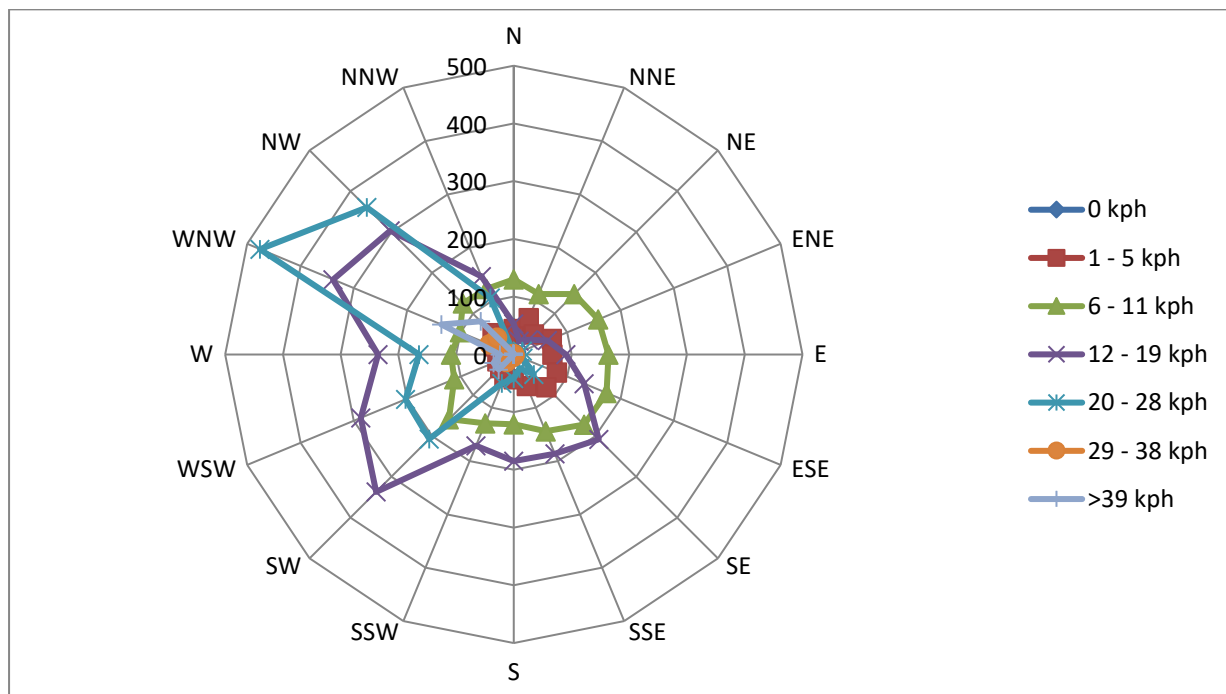


Figure 6-26: Annual Windrose (1 hour Average, 30m)

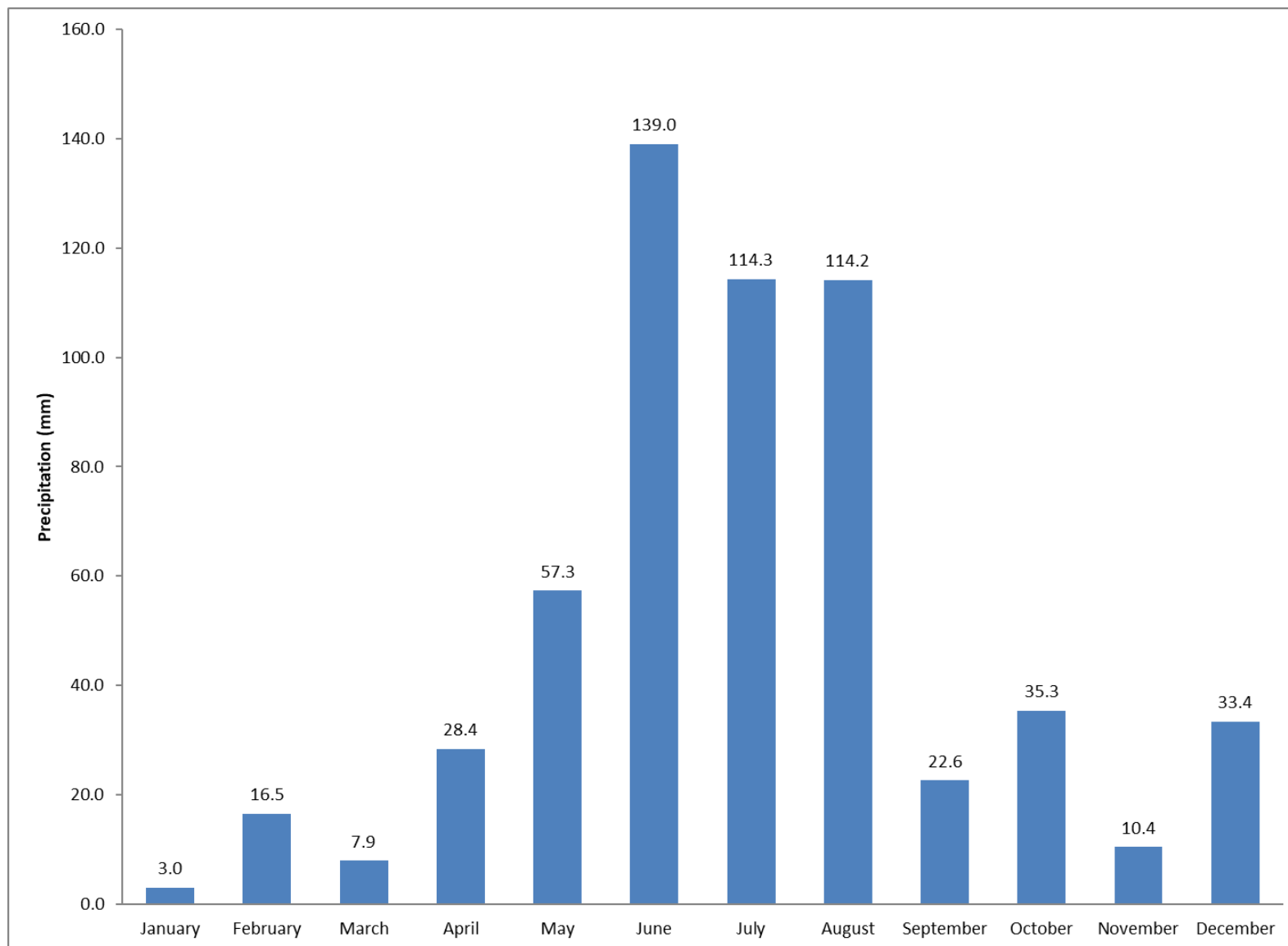
7. PRECIPITATION

In 2024 precipitation was monitored at the AQM station serviced by Bureau Veritas Canada at a ground level.

Data is summarized in Table 7-1 and Figure 7-1.

Table 7-1: Precipitation

Month	Hourly		Daily		Monthly	Cumulative Frequency Distribution (%)									
	Min (mm)	Max (mm)	Min (mm)	Max (mm)	Total (mm)	0.0 - 0.5 mm	0.6 - 1.0 mm	1.1 - 1.5 mm	1.6 - 2.0 mm	2.1 - 2.5 mm	2.6 - 3.0 mm	3.1 - 3.5 mm	3.6 - 4.0 mm	> 4.1 mm	
January	0.0	1.0	0.0	2.0	3.0	99.60	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
February	0.0	2.1	0.0	6.1	16.5	98.99	0.57	0.29	0.00	0.14	0.00	0.00	0.00	0.00	
March	0.0	6.1	0.0	6.9	7.9	99.73	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.13	
April	0.0	1.6	0.0	8.2	28.4	99.73	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.13	
May	0.0	3.4	0.0	19.4	57.3	95.81	2.03	0.95	0.41	0.41	0.00	0.41	0.00	0.00	
June	0.0	23.6	0.0	33.2	139.0	90.42	4.17	2.36	1.11	0.69	0.00	0.42	0.28	0.56	
July	0.0	10.1	0.0	67.5	114.3	95.03	1.34	0.54	0.54	0.67	0.13	0.27	0.40	1.08	
August	0.0	20.2	0.0	29.1	114.2	94.35	2.02	1.48	0.40	0.27	0.27	0.27	0.00	0.94	
September	0.0	2.8	0.0	4.9	22.6	97.91	1.39	0.28	0.28	0.00	0.14	0.00	0.00	0.00	
October	0.0	5.3	0.0	11.6	35.3	97.72	0.81	0.54	0.54	0.13	0.00	0.13	0.00	0.13	
November	0.0	0.8	0.0	2.2	10.4	99.72	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
December	0.0	2.3	0.0	9.9	33.4	97.58	1.48	0.67	0.13	0.13	0.00	0.00	0.00	0.00	
Annual	0.0	23.6	0.0	67.5	582.3										

**Figure 7-1: Total Precipitation by Month**

8. BAROMETRIC PRESSURE

In 2024 barometric pressure was monitored at the AQM station serviced by Bureau Veritas Canada at a ground level.

Data is summarized in Table 8-1 and Figure 8-1.

Table 8-1: Barometric Pressure

Month	Hourly		Daily		Monthly	Cumulative Frequency Distribution				
	Min (mmHg)	Max (mmHG)	Min (mmHg)	Max (mmHG)	Average (mmHg)	641 - 650	651 - 660	661 - 670	671 - 680	> 681
January	653.0	681.0	655.7	678.5	666.4	0.0	10.3	65.1	24.3	0.3
February	650.0	676.0	652.7	675.0	664.8	0.6	20.0	62.9	16.5	0.0
March	654.0	676.0	655.8	674.8	666.6	0.0	13.2	61.4	25.4	0.0
April	658.0	682.0	661.8	680.8	667.6	0.0	0.6	79.9	15.0	4.6
May	659.0	678.0	659.4	676.4	666.8	0.0	8.4	77.7	13.9	0.0
June	655.0	675.0	657.3	673.9	667.5	0.0	7.2	66.1	26.7	0.0
July	661.0	678.0	662.5	677.3	669.8	0.0	0.0	50.1	49.9	0.0
August	660.0	679.0	662.0	678.0	671.6	0.0	0.9	32.9	66.1	0.0
September	658.0	679.0	658.5	677.8	667.7	0.0	4.4	72.2	23.3	0.0
October	655.0	676.0	658.5	675.3	667.0	0.0	8.5	69.5	22.0	0.0
November	648.0	676.0	650.6	675.2	666.0	1.9	14.6	56.7	26.8	0.0
December	653.0	677.0	654.3	675.2	666.0	0.0	22.7	49.1	28.2	0.0
Annual	648.0	682.0	650.6	680.8	667.3					

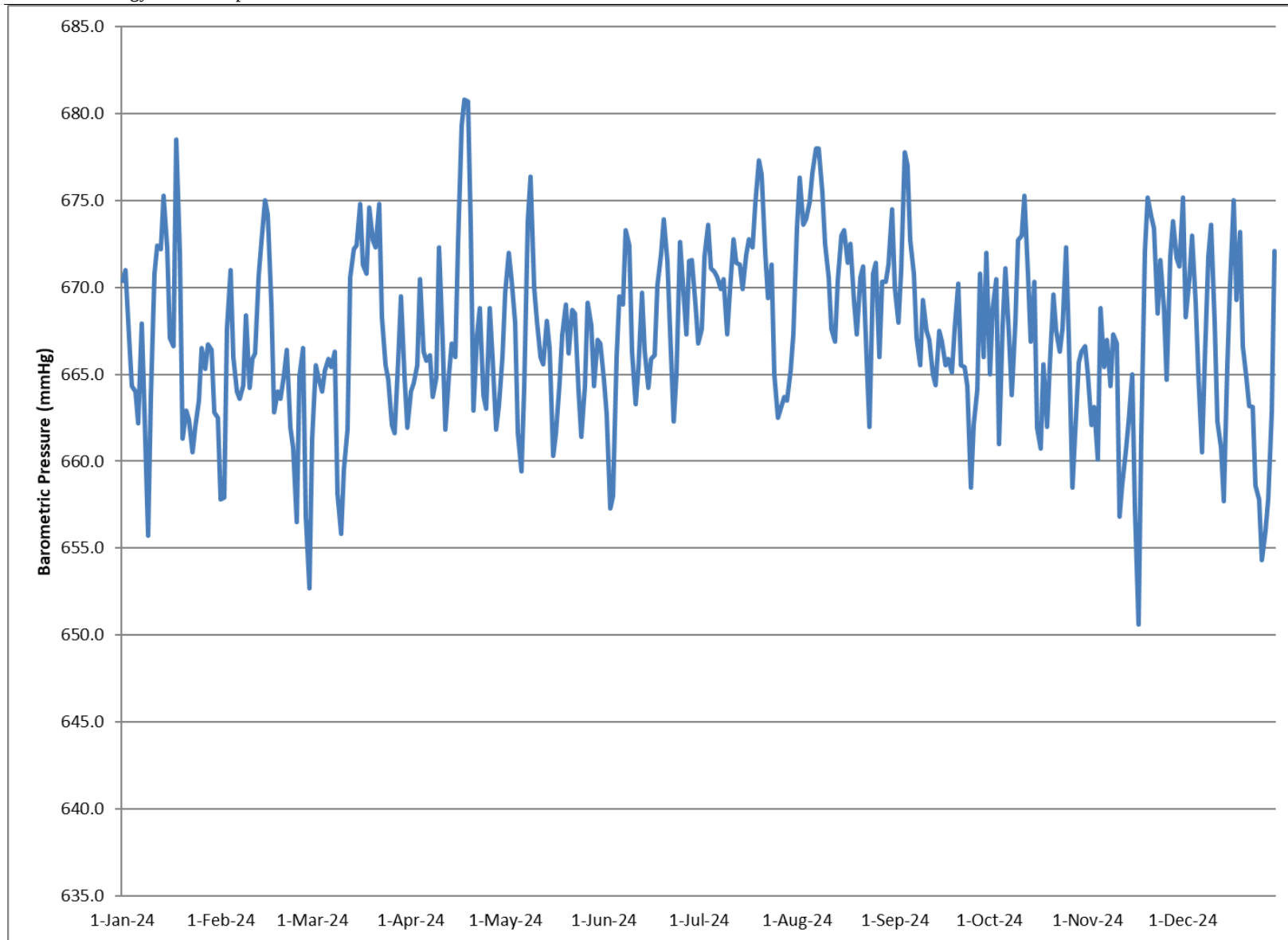


Figure 8-1: Average Daily Barometric Pressure

9. RELATIVE HUMIDITY

In 2024 relative humidity was monitored at the AQM station serviced Bureau Veritas Canada at a ground level.

Data is summarized in Table 9-1 and figures 9-1 and 9-2.

Table 9-1: Relative Humidity

Month	Hourly		Daily		Monthly	Cumulative Frequency Distribution (%)									
	Min (%RH)	Max (%RH)	Min (%RH)	Max (%RH)	Average (%RH)	0 - 10	11 - 20	21 - 30	31 - 40	41 - 50	51 - 60	61 - 70	71 - 80	81 - 90	91 - 100
January	29.0	94.0	43.7	90.1	70.2	0.00	0.00	0.40	2.42	9.81	10.35	20.56	31.32	21.51	3.63
February	8.0	93.0	21.8	89.9	59.1	0.29	3.88	9.05	10.34	11.21	12.64	13.36	21.70	16.09	1.44
March	14.0	91.0	36.2	83.1	62.1	0.00	1.61	4.84	9.14	12.90	13.17	16.40	25.54	16.13	0.27
April	9.0	97.0	22.7	87.5	52.0	0.56	8.75	15.97	13.33	14.17	10.28	9.17	8.61	11.11	8.06
May	12.0	98.0	27.3	93.2	60.4	0.00	3.10	10.53	14.44	12.69	9.45	8.50	8.91	18.08	14.30
June	19.0	99.0	38.1	92.4	63.8	0.00	0.56	9.17	11.53	11.39	12.64	11.67	11.53	14.72	16.81
July	7.9	30.9	27.8	96.6	57.7	0.00	1.75	7.93	13.17	20.30	14.65	11.96	10.62	9.54	10.08
August	26.0	99.0	49.3	98.2	72.2	0.00	0.00	1.21	6.59	12.10	14.65	13.71	10.75	11.42	29.57
September	19.0	97.0	41.0	82.7	62.6	0.00	0.14	3.47	11.53	14.44	18.33	15.69	11.81	16.81	7.78
October	26.0	99.0	47.6	96.2	69.2	0.00	0.00	0.54	7.12	9.81	18.01	21.10	9.68	14.25	19.49
November	31.0	99.0	57.0	97.9	80.0	0.00	0.00	0.00	1.39	3.47	5.69	10.56	23.06	30.14	25.69
December	32.0	99.0	44.1	94.2	76.5	0.00	0.00	0.00	2.15	7.53	8.87	6.99	25.40	34.27	14.78
Annual	7.9	99.0	21.8	98.2	65.5										

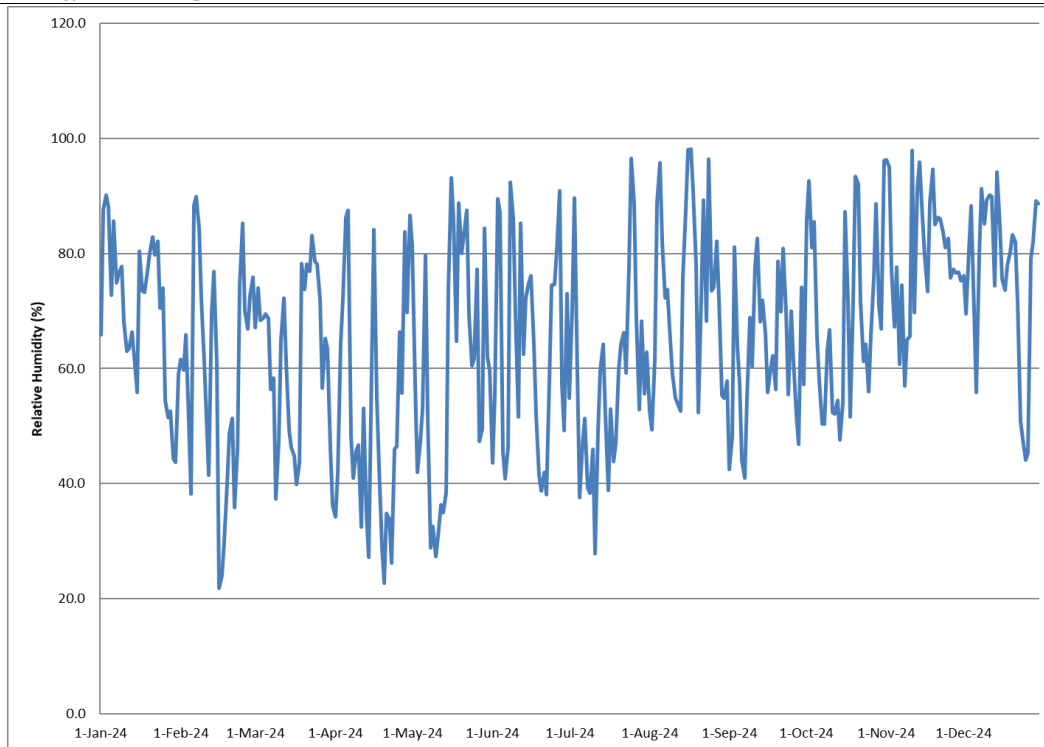


Figure 9-1: Average Daily Relative Humidity

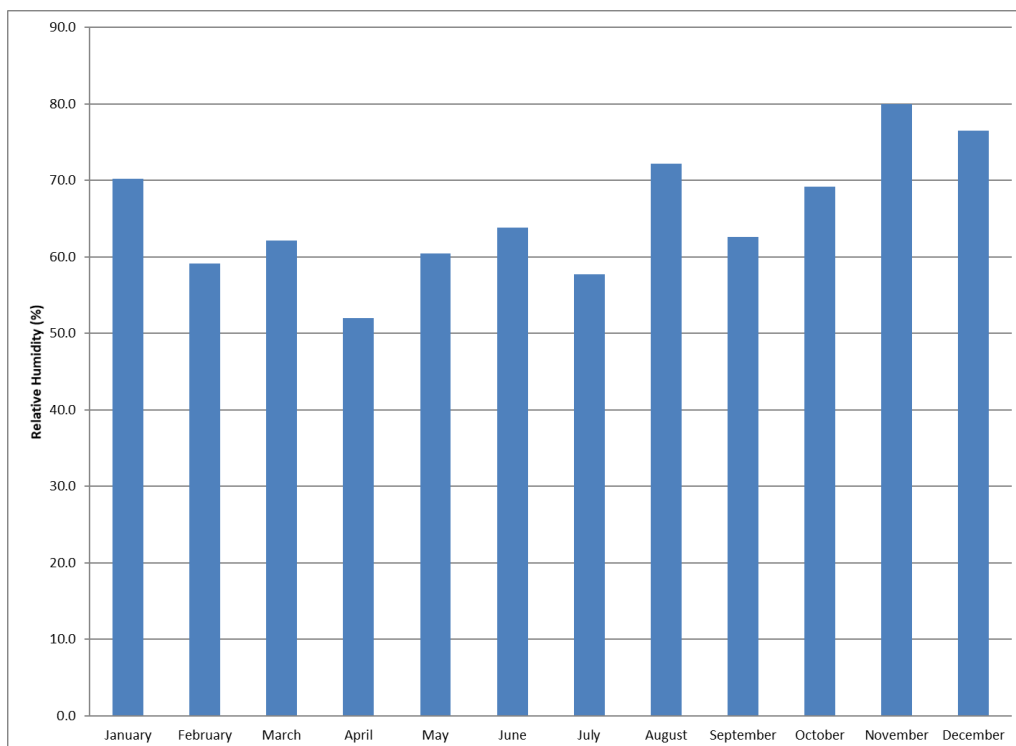


Figure 9-2: Average Monthly Relative Humidity