

**Sailing Climate along the Nova Scotia Coast
In
August - September**

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Introduction and Purpose

Weather is of critical importance to Marine activities. Marine climate describes conditions one would expect drawn from past experiences. Marine climate encompasses not only the average conditions but the range and extremes of weather one would expect.

This paper has been prepared to assemble climatological information to support the bid to host to 2007 World Sailing Championships near Halifax Nova Scotia. The report focuses on the months of August and September and the area from Mahone Bay to Halifax Harbour within 10 km from the coast as shown in Figure 1.

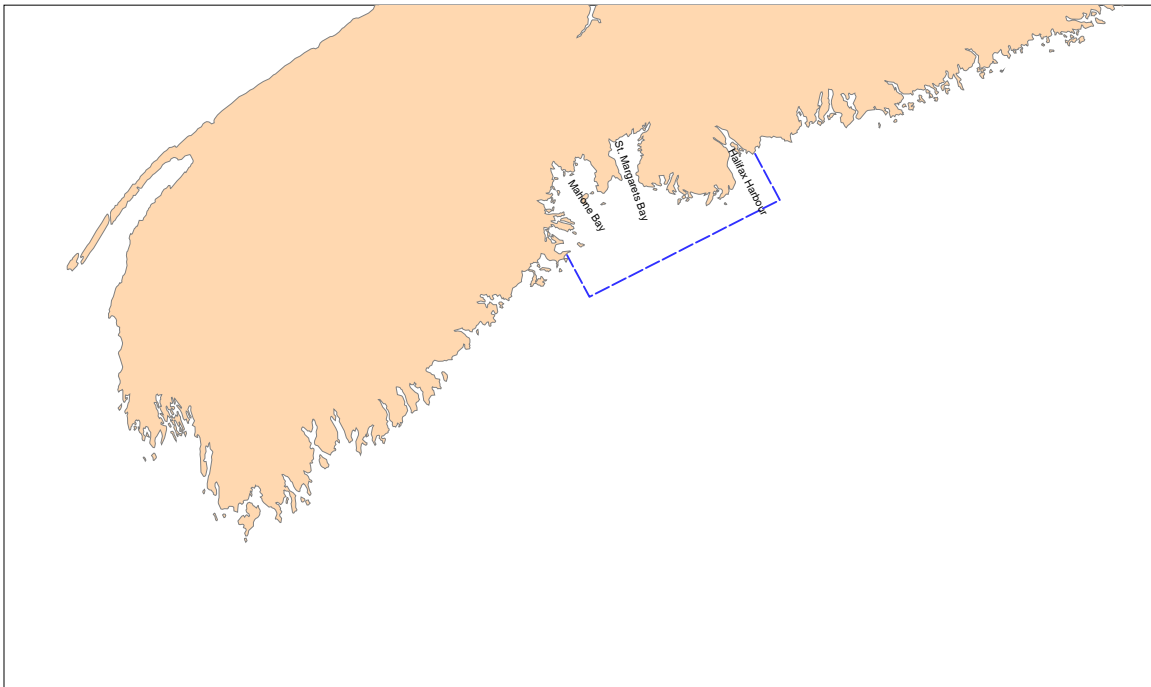


Figure 1: Area of Interest from Mahone Bay to Halifax Harbour

Physical Setting

Nova Scotia is located on the East Coast of North America. The province is virtually surrounded by water bodies; the Bay of Fundy, the Northumberland and Cabot Straits and the Atlantic Ocean.

Ocean Currents

Weather along the Atlantic coast is significantly affected by the ocean currents and resulting water masses. The southward flowing Labrador Current hugs the coastline and keeps relatively cool water along the coast. The Gulf Stream flows in the opposite direction but lies further offshore. The interaction between the weather and these two currents makes the Atlantic coast a favored area for fog. Fog is densest and most persistent in spring. The frequency declines into late summer and fall as coastal waters warm.

Ocean Temperatures

Average ocean temperatures for August and September as shown in Figures 2 and 3 are about 15°C. There can be significant excursions from these averages as eddies from the Gulf Stream bring warm water closer to the coast. Figure 4 shows the actual pattern on September 13-15, 2003. These figures indicate the water temperature in the open ocean. Often the water in shallow bays and harbours is warmer than the ocean at this time of year.

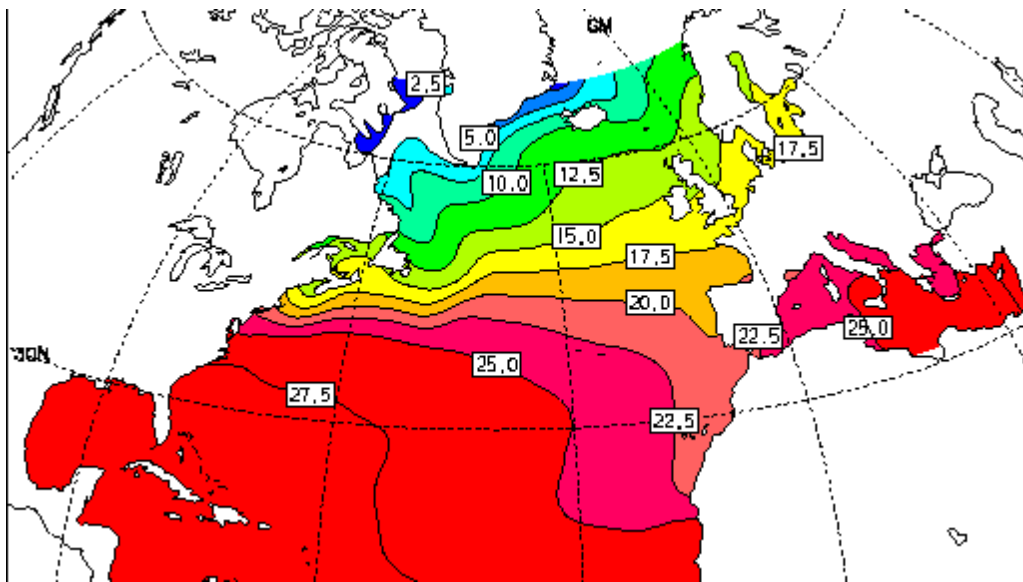


Figure 2: Average Water Temperature in August (Lindau, 2001)

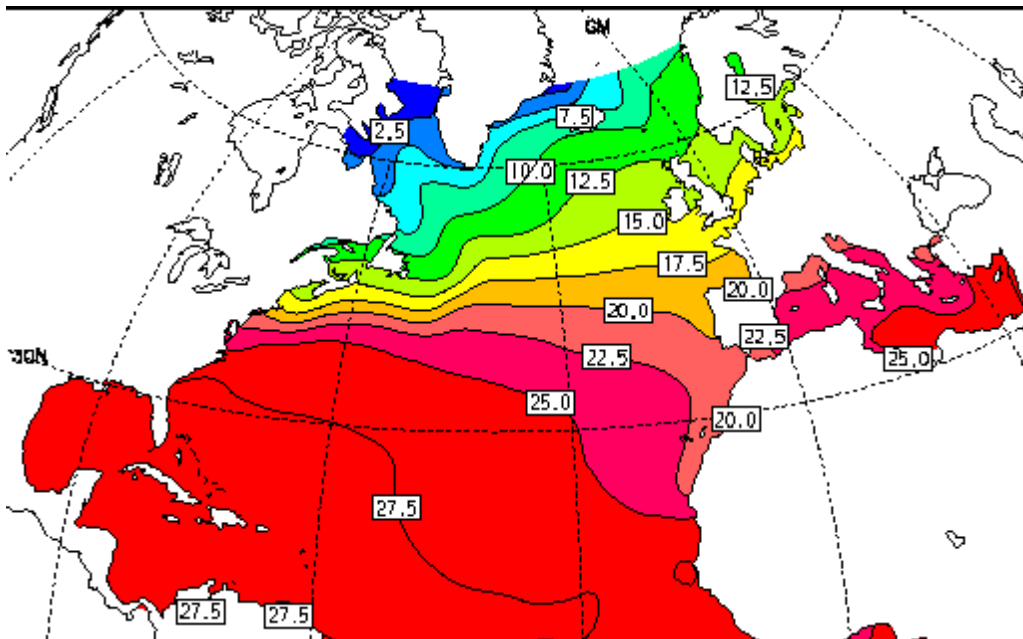


Figure 3: Average Water Temperature in September (Lindau, 2001)

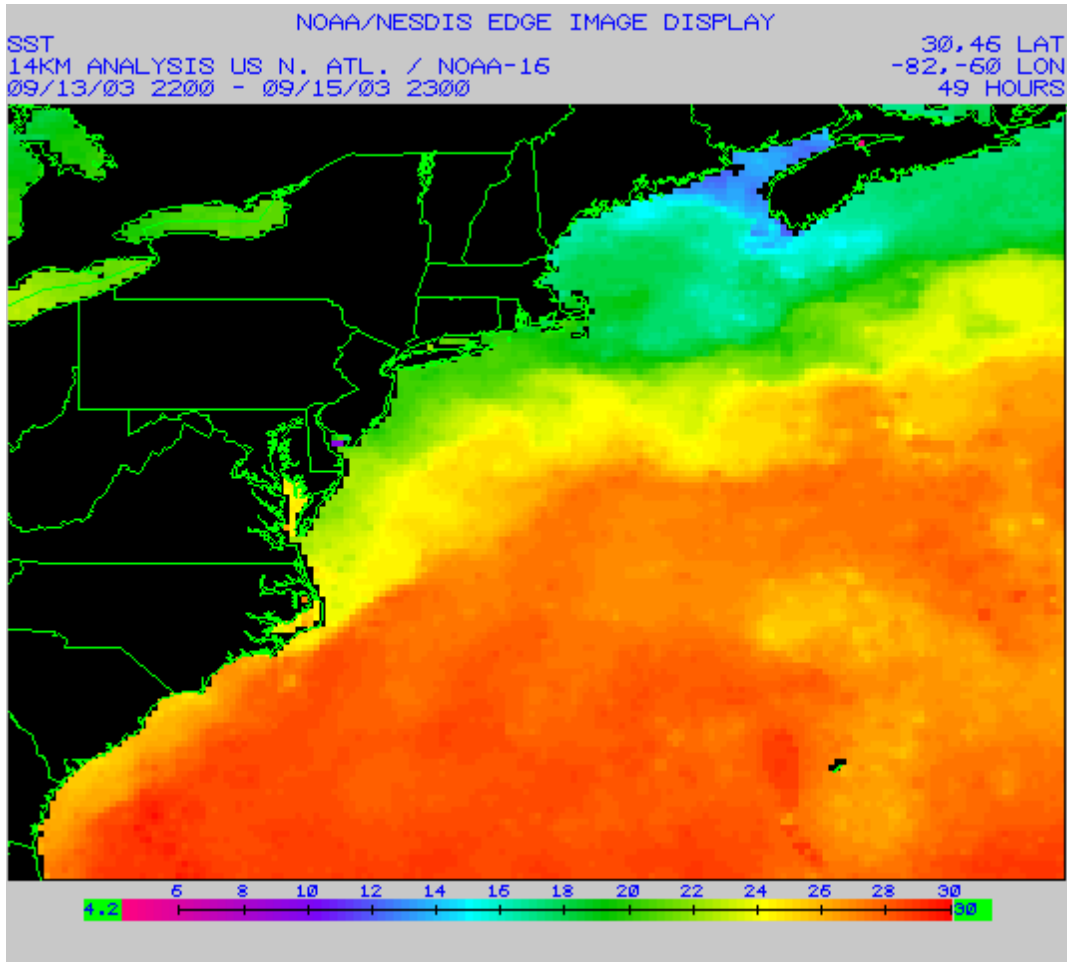


Figure 4: Actual Water Temperature on September 13, 2003 (NOAA, 2003)

Data Sources

Compiling information on the Marine climate of coastal Nova Scotia requires reference to a variety of sources. For this report I've used information that is available from existing sources and I have produced analyses using data at particular points.

Data sources for marine climate include:

- Halifax Harbour buoy
- Shearwater Airport
- Sandy Cove
- Western Head
- Beaver Island
- Hindcast wind and wave data Grid Point (GP 5315)

These locations are illustrated in Figure 5.

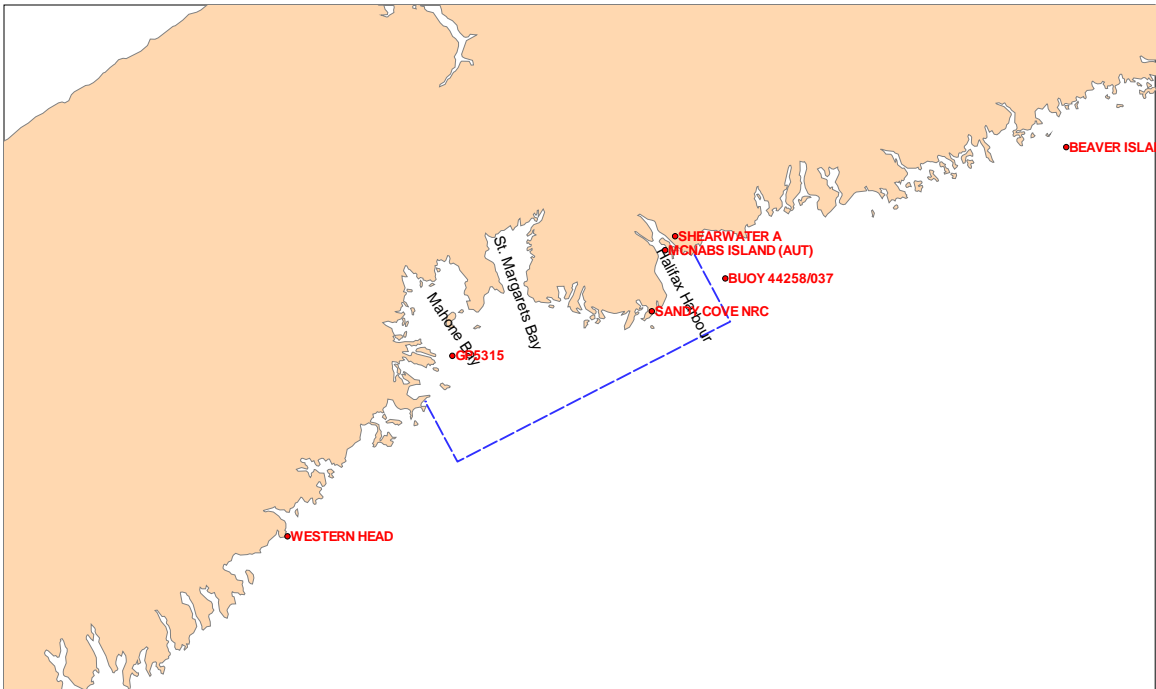


Figure 5: Location Map

Winds

Wind Direction

During August and September the prevailing winds are southwest. Wind roses for several coastal locations and the Halifax Harbour buoy illustrate the wind climate. The individual wind roses are in Appendix A. They have been superposed on a coastal map in Figure 6. The influence of local topography on prevailing direction is apparent when comparing the Halifax Harbour locations (McNab's Island and Shearwater) with data from more exposed areas. Funneling effects cause the winds to be aligned with the harbour.

Near the coast winds can change direction (and speed) during the day due to sea breezes. The seabreeze effect extends to about 10 Km offshore, however this is very dependent on the weather conditions of the day. Near-shore winds are also affected by a number of other factors which are particular to the time of year and the coastline. Bowyer (1995) provides an excellent explanation of the effects due to friction, sea and land breezes, cornering, convergence, funneling and cliff effects.

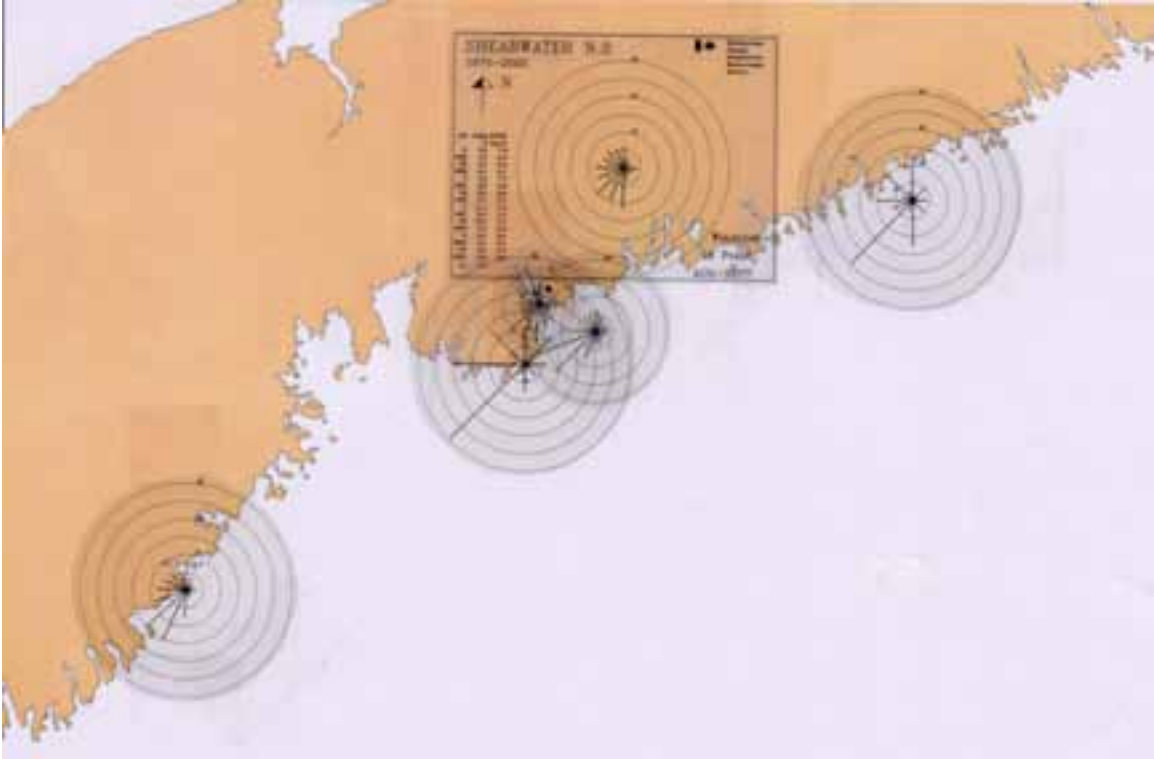


Figure 6: Wind Climate Along the Coast of Nova Scotia

Wind Speed

The average wind speed at weather stations in a coastal area depends how the location is exposed to the wind. For the locations shown in Figure 6, the average August/September speeds are:

Average Wind Speed (Knots)

Western Head	6.9
Sandy Cove	8.0
McNab's Island	9.1
Shearwater	6.4
Buoy 44258	8.7
Beaver Island	11.5

For the Southwest Shore marine area the mean speed is 10.5 knots. The distribution of wind speed in August and September is shown in Figures 8 and 9. 70% of the time the wind speed is between 5 and 15 knots.

The wind speeds indicated here are averages over 24 hours. The strongest winds typically occur in the afternoon at about 3 PM when mixing in the atmosphere reaches its maximum. Figure 7 shows the effect nicely.

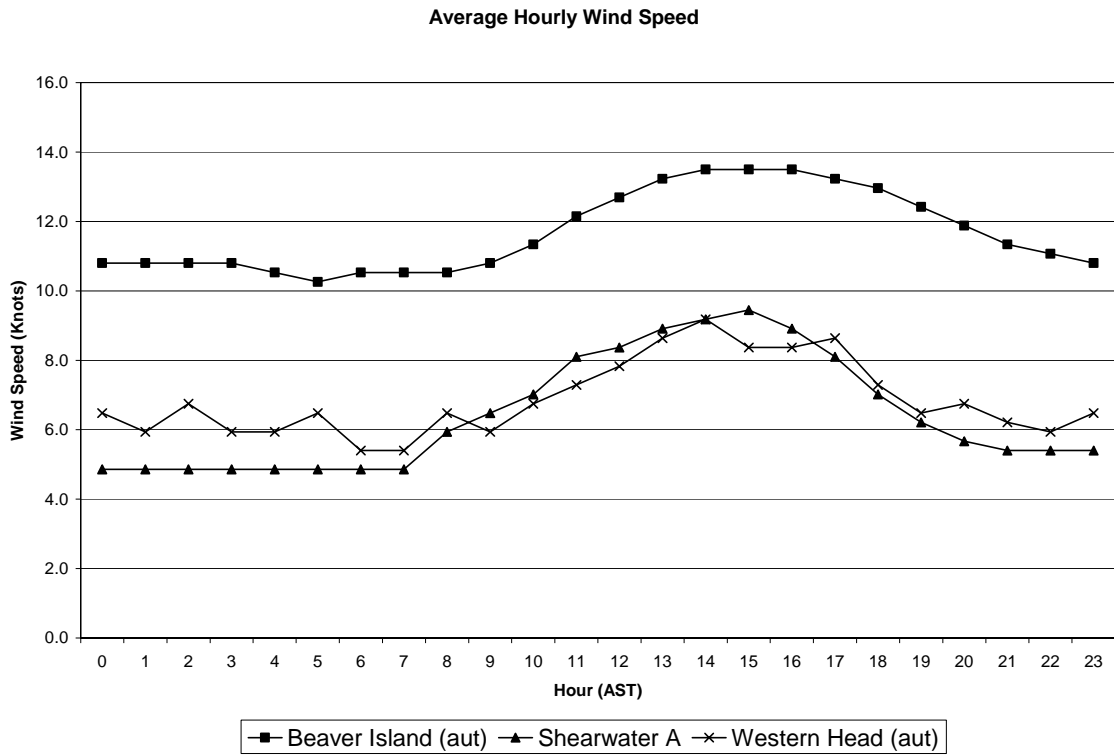


Figure 7: Diurnal Wind Speed at 3 Nova Scotia Coastal Locations

Monthly Wind Statistics

Southwestern Shore Wind Speed Frequencies

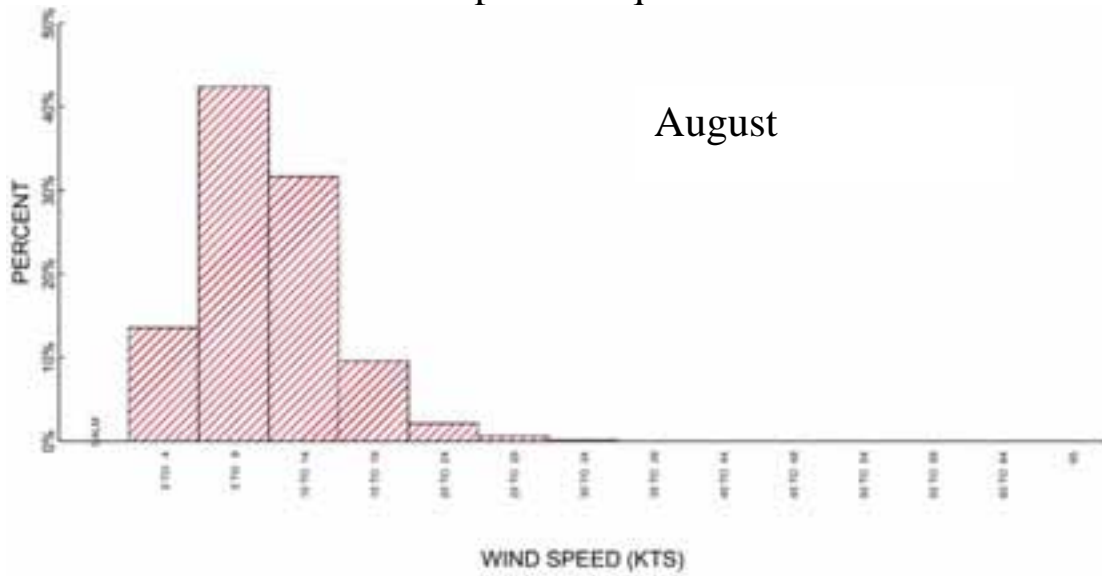


Figure 8: Distribution of wind speeds in August

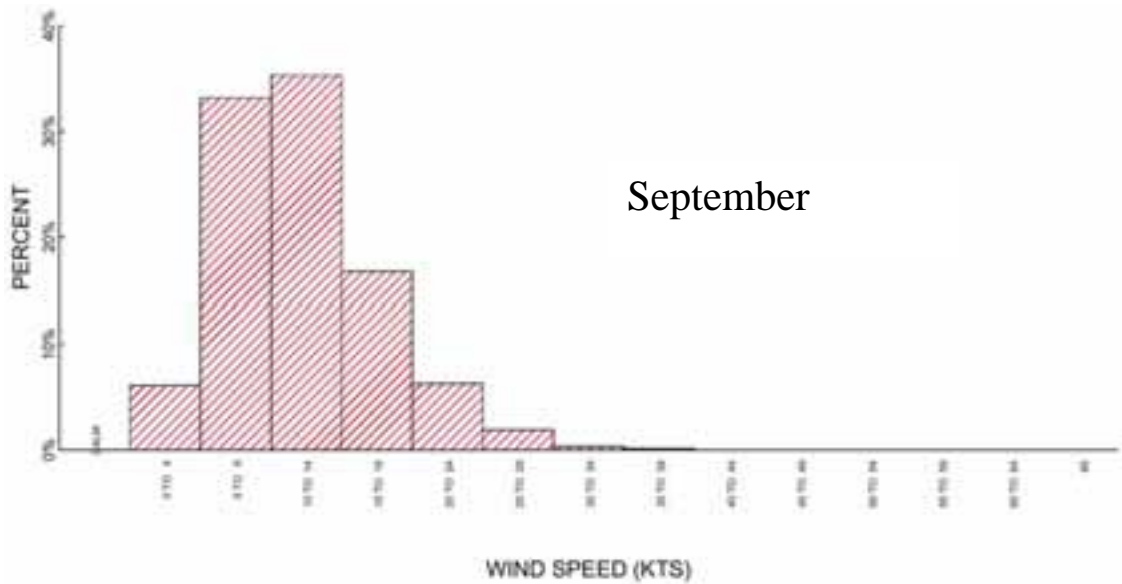


Figure 9: Distribution of Wind Speeds in September

Waves

Waves are generated either locally by the wind or else they propagate from far away as swell.

Waves have been measured at two points in the area by buoys (buoy 44258 and buoy C037). In addition hindcast waves have been calculated as part of the AES40 database (Oceanweather). The AES40 wave climate is representative of deepwater waves without the influence of shallow water or proximate coastlines. The buoy measurements represent what was actually measured, albeit for shorter period.

Buoy 44258 – Halifax Harbour

Figure 10 illustrates the frequency distribution of wave heights off Halifax Harbour during August and September for the years 2001 to 2003 from the present buoy 44258. The mean wave height recorded by this buoy in August and September is 0.94 m. The maximum of 3.7 m was recorded on September 12, 2002 wind hurricane "Gustav" passed in nearby.

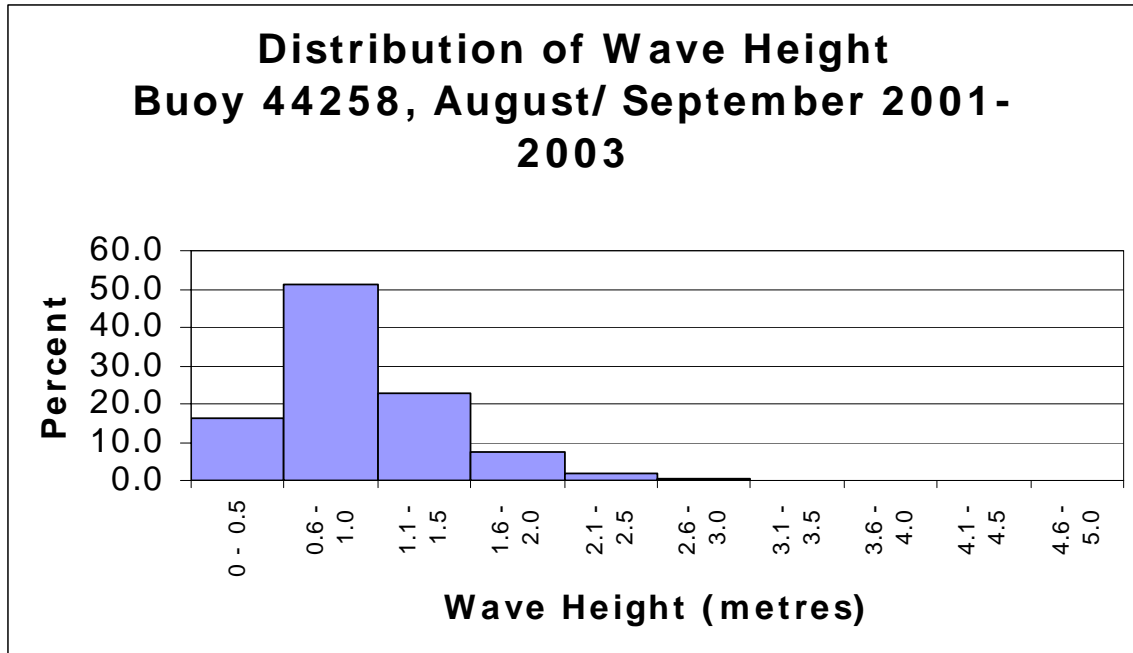


Figure 10: Wave Height Distribution at Halifax Harbour Buoy 44258

Buoy MEDS C037 – Halifax Harbour

Buoy C037 was moored in approximately the same location from 1971 to 2001. The wave height climatology from this buoy is shown in Figure 11. It is essentially the same as buoy 44258. The most common wave height class is 0.6 to 1.0 m. Waves are in the 0.6 to 1.5 m range about 75% of the time.

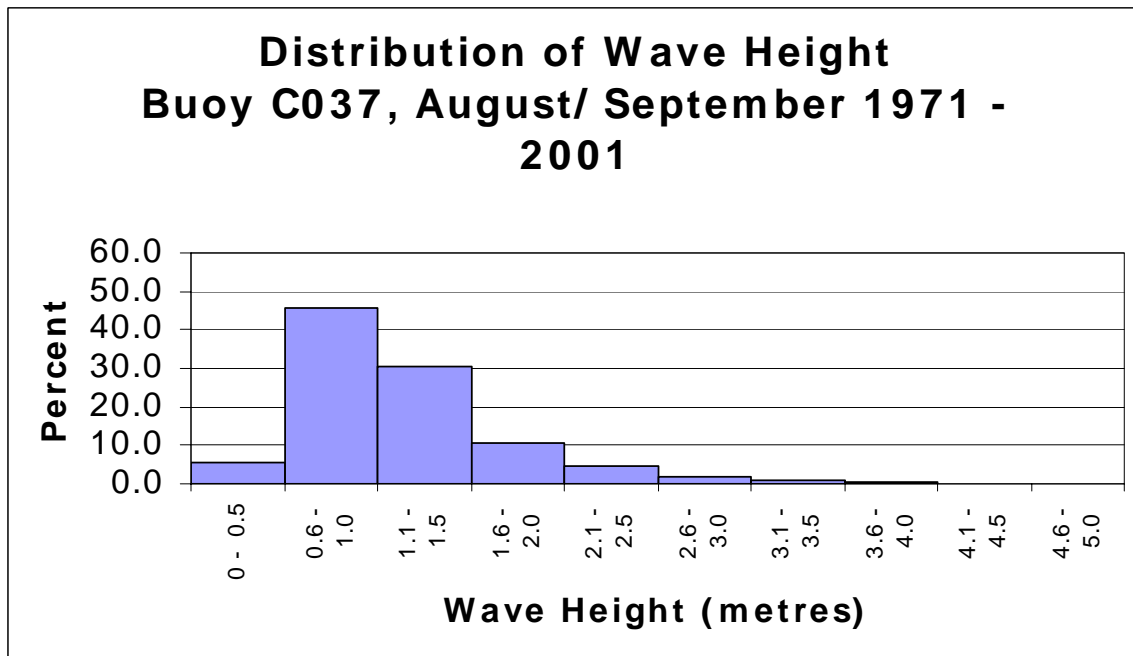


Figure 11: Wave Height Distribution at Halifax Harbour Buoy C037

Hindcast Waves – AES40

The AES40 wave climatology for a grid point located near Mahone Bay is shown in Figure 12. 77% of these waves are between 0.6 and 1.5 m. The average wave height of the data set is a bit higher at 1.2 m. The long-term extreme is 6.3 m on August 16, 1971. This corresponded to the passage hurricane Beth.

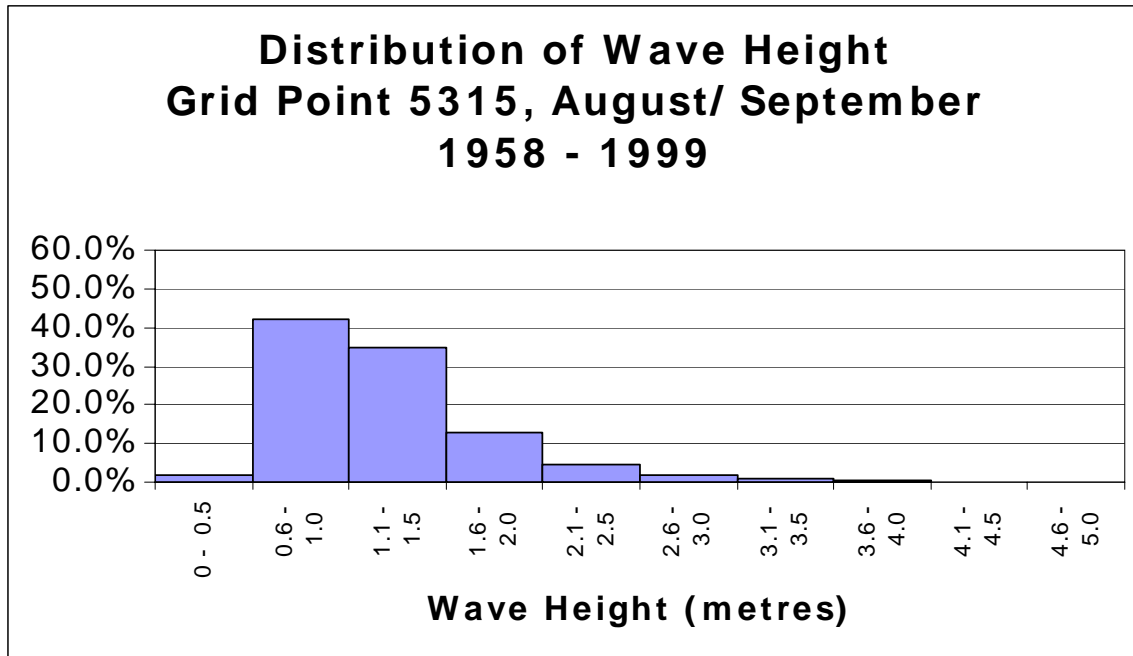


Figure 12: Wave Height Distribution at Grid Point 5315

Summary – Wave Heights

The three data sets of wave data near coastal Nova Scotia tell essentially the same story. The longest record of actual measured wave data is that of buoy C037, so I favor these data as the best source for coastal applications.

Visibility, Cloudiness, Temperature and Precipitation

General climate is described by the statistics compiled for Shearwater A, Nova Scotia. In this section details are provided on the visibility climatology. Climate statistics for other parameters which have been developed for the 1971 to 2000 period are also presented.

Visibility

In August and September visibility is sometimes reduced by fog. Fog banks which form offshore typically move into the harbors and coastal areas late in the day. Figure 13 shows the percent of time by month that visibility is 1 km or less at Shearwater. Fog becomes less frequent in late summer as the offshore water warms. Fog prevails 6.5% of the time in Halifax Harbour during August -September. The median duration of a fog episode is about three hours. The longest during the 1971 to 2000 period was 22 hours (August 2, 1973).

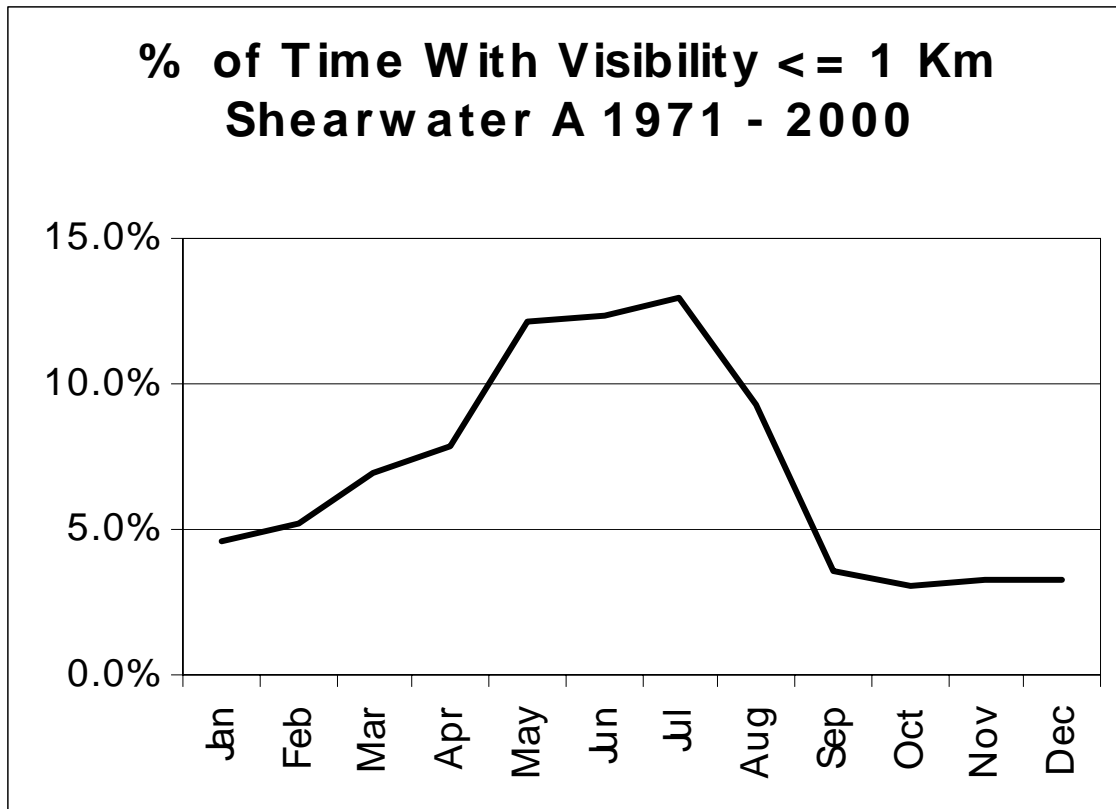


Figure 13: Visibility Climate at Shearwater

Other Climate Parameters

Table 1: Climate Normals for Shearwater Airport 1971 - 2000

	August	September
Temperature		
Daily Maximum (°C)	22.4	18.9
Daily Minimum (°C)	14.0	10.4
Daily Mean (°C)	18.2	14.7
Extreme Maximum (°C)	32.4	33.3
Extreme Minimum (°C)	5.6	-0.5
Precipitation		
Rainfall (mm)	96.9	100.1
Snowfall (cm)	0.0	0.0
Total Precipitation (mm)	96.9	100.1
Extreme Daily Rainfall (mm)	184.9	90.8
Days With		
Measurable Rainfall	10.8	11.8
Fog	11.4	5.9
Thunderstorms	1.6	0.8
Bright Sunshine (hours)		
	224.6	181.5

Reference: Environment Canada (2003)

Tropical Cyclones

August-October is the period when storms of tropical origin (tropical cyclones) are most likely to influence the weather along the Nova Scotia coastline, although the hurricane season runs from June to November each year. The Canadian Hurricane Centre monitors all existing and potentially forming tropical cyclones in the North Atlantic and issues detailed information statements as required.

Tropical cyclones are classified according to the strength of the maximum wind in the storm. The Canadian Hurricane Centre records all tropical cyclones passing through its area of responsibility, including all such storms which have transitioned from their tropical stage to extratropical. Other datasets typically exclude the extratropical stage; however, these storms are an important component to the climatology in Canada and its territorial waters.

During the 100-year period 1900-1999, all tropical cyclones potentially threatening the area of interest (Mahone Bay to Halifax Harbour) with gale force winds during August or September were catalogued and summarized in Table 2. These storms are deemed as ones which traversed the following marine areas shown in Figure 14: Fundy, Grand Manan, Lurcher, Browns Bank, Southwestern Shore, Lahave Bank, Eastern Shore, and Sable.

On average, a tropical cyclone threatens the area of interest with gale force winds once every 2½ years. Figure 14 shows the frequency of tropical cyclone by day for all storms moving into the Canadian Hurricane Centre’s response zone. It can be assumed that these dates are applicable to the area of interest. Note the peaks in the 3rd week of August and the 3rd week of September. (Bowyer, 2004)

Table 2: August-September Tropical Cyclones Threatening Area of Interest (1900-1999)

	Aug.	Sept.	Total
Gale Force (34-47 knots)	2	5	7
Storm Force (48-63 knots)	1	4	5
Category 1 Hurricane Force (64-82 knots)	8	17	25
Category 2 Hurricane Force (83-95 knots)	3	0	3
Category 3 Hurricane Force (96-113 knots)	0	0	0
Category 4 Hurricane Force (114-135 knots)	0	0	0
Category 5 Hurricane Force (> 135 knots)	0	0	0
TOTALS	14	26	40

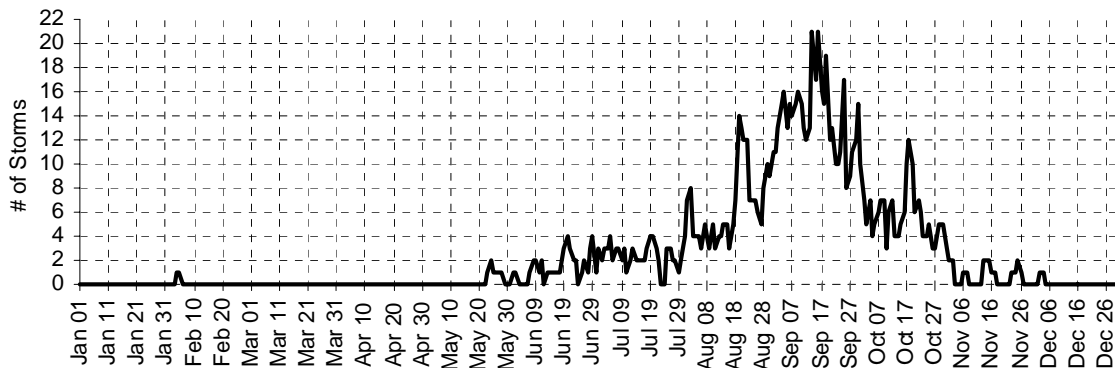


Figure 14: Tropical Cyclone Frequency by Day for the Canadian Hurricane Centre's Response Zone

Marine Weather Forecasting

“Climate is what you expect. Weather is what you get”.

Marine weather forecasts are issued (in French and English) four times daily by the Meteorological Service of Canada’s Maritimes Weather Center in Halifax, NS. Forecasts are issued for the areas shown in Figure 15. Warnings, amendments and tropical storm information are issued as required. Sea state forecasts are issued twice-daily. The marine forecast for Halifax Harbour and Approaches is issued and broadcast with the regular Marine forecast. This special forecast is also available on an automatic telephone answering device (ATAD) at 902-426-9191. The boundaries of the Maritimes Marine forecast areas are shown in Figure 15. Marine weather information is distributed by several methods including:

- Internet at www.weatheroffice.ec.gc.ca
- Canadian Coast Guard radio
- Broadcast News
- Various public and private radio and TV outlets
- Automatic Telephone Answering Device at 902-426-9600
- Personal telephone consultation 1-900-565-5555 (\$2.99 per minute).

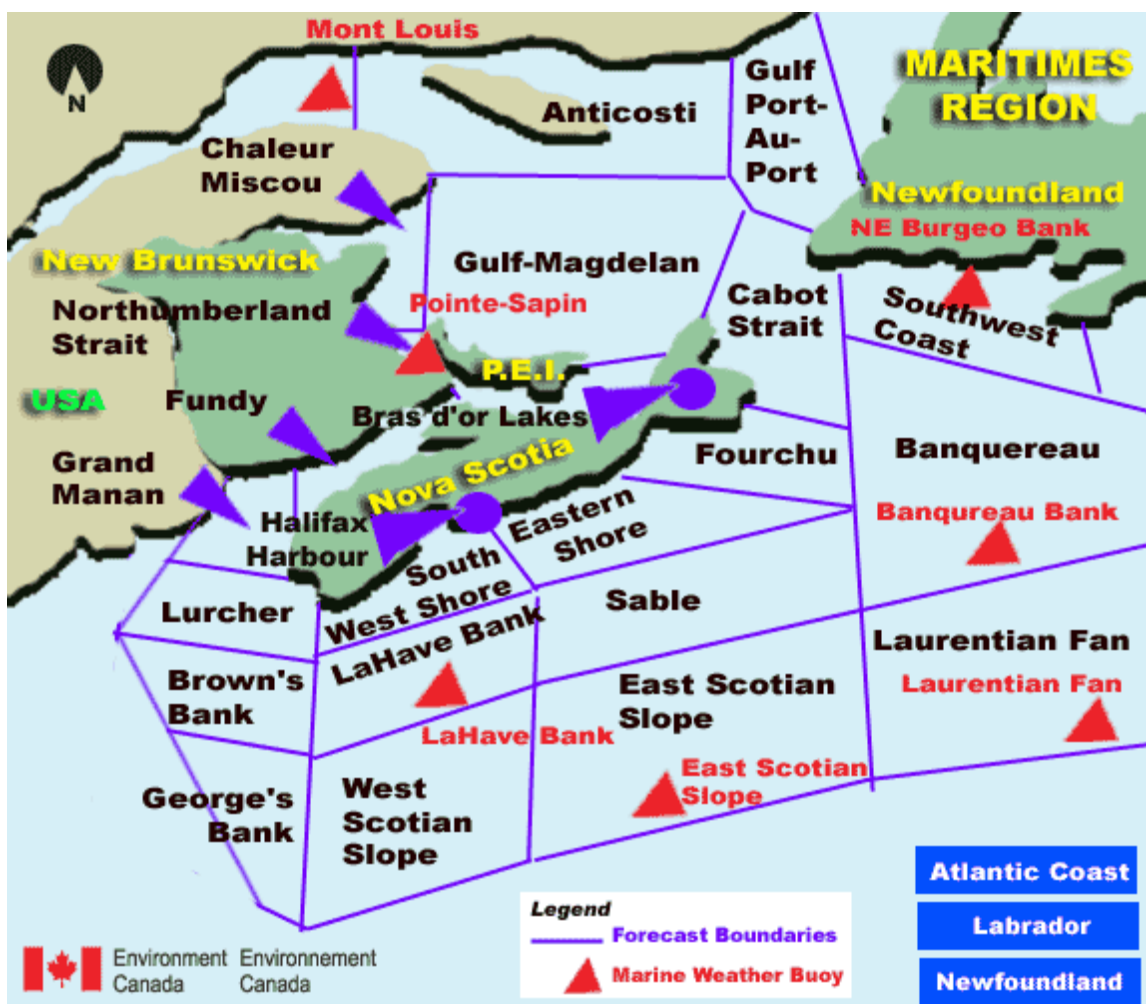


Figure 15: Marine Forecast Areas around Nova Scotia

An example of a typical Marine forecast from the Internet service follows. The safety of mariners is enhanced by keeping abreast of the current Marine forecast.



South Western Shore

Environment Canada Weather Forecast

Marine Forecast issued for Southwestern shore.

Issued: 10.00 AM ADT Thursday 18 September 2003.

Synopsis:

A high pressure system over southern Québec will move to lie over Nova Scotia by Friday morning. Moderate to strong west to northwest winds over Gulf of St Lawrence waters today will diminish as the high approaches. Elsewhere light to moderate winds are expected.

Strengthening southeasterlies over southwestern waters are expected on Friday due to a trough of low pressure to the west of the district.

Small craft are warned that winds of 20 knots or more are forecast for coastal waters of Lurher Cabot strait and Anticosti.

Hurricane information. At 9 AM ADT hurricane Isabel was located at latitude 33.8 north longitude 71.5 west which is about 90 nautical miles or 165 kilometres south southeast of Cape Hatteras.

Maximum sustained winds are estimated at 90 knots or 167 km/h and central pressure is 955 millibars. Isabel is moving northwest at 16 knots or 30 km/h. Some moderate surf from this system is occurring over the atlantic coast of Nova Scotia caused by moderate southerly swells. Otherwise no impacts are expected in the Maritimes marine district.

Forecast:

Winds northeast 10 to 15 knots veering to easterly 10 to 15 Friday morning and to southeast 10 to 15 Friday evening. Good visibility.

Little temperature change.

Outlook for Saturday...Light to moderate southerlies.

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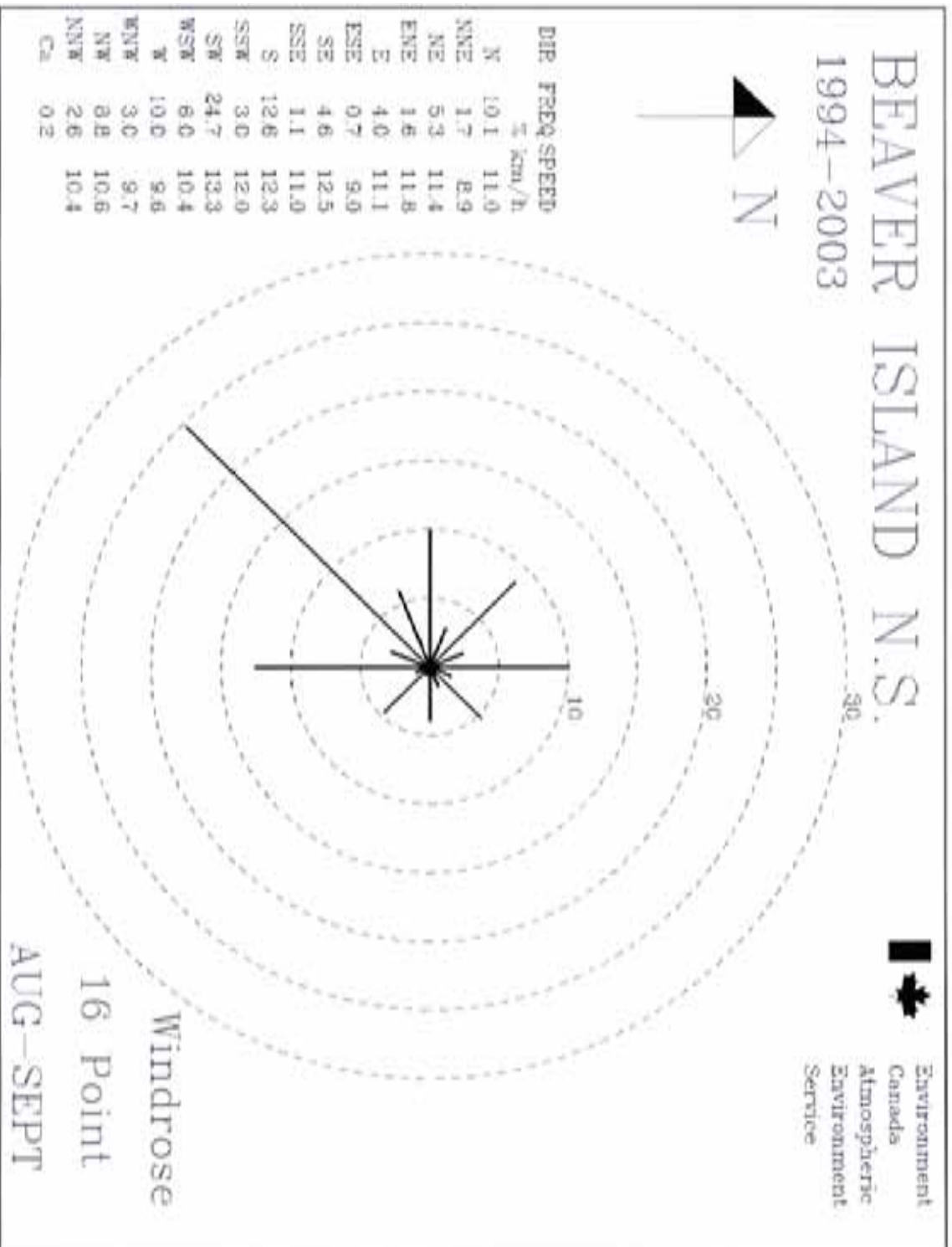
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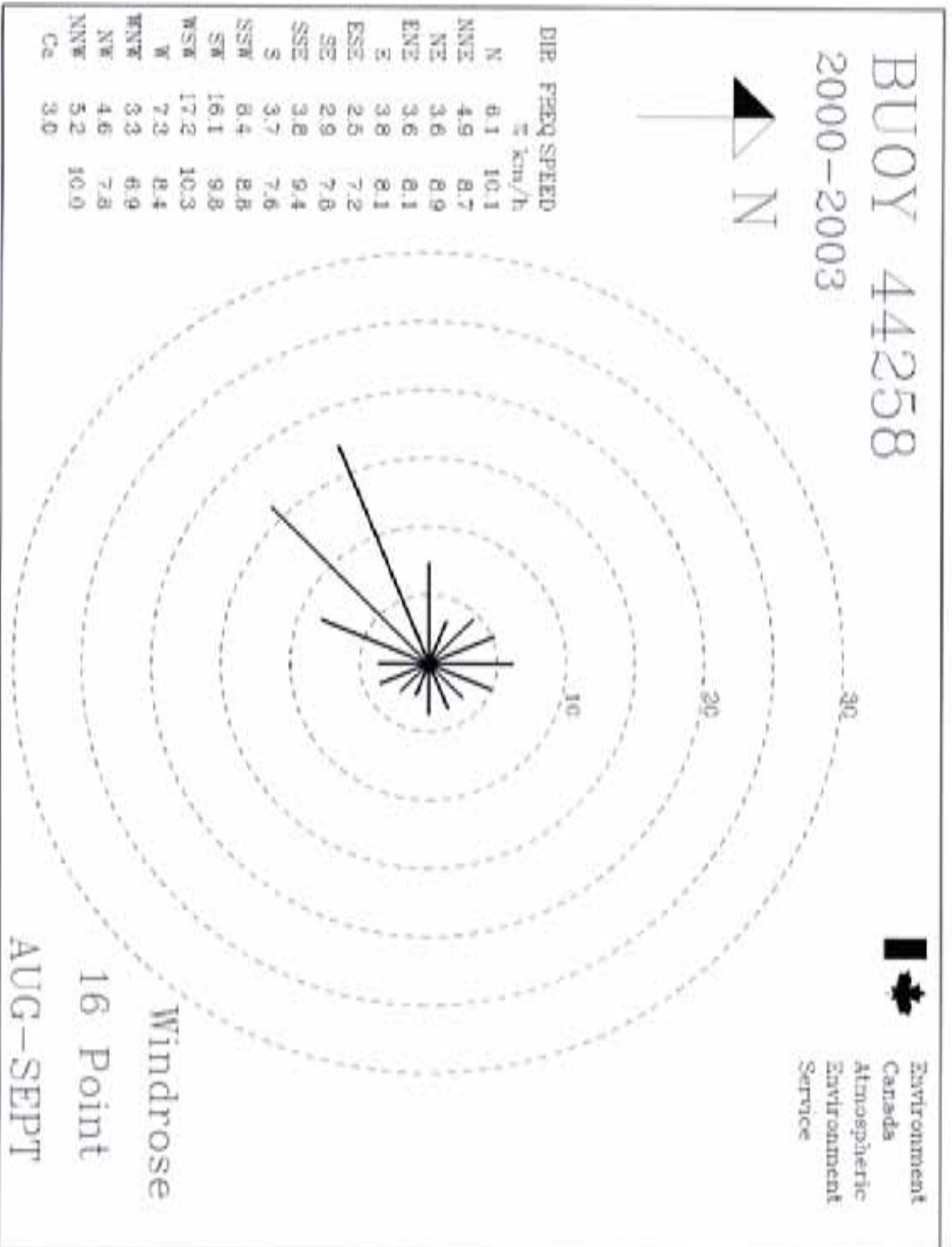
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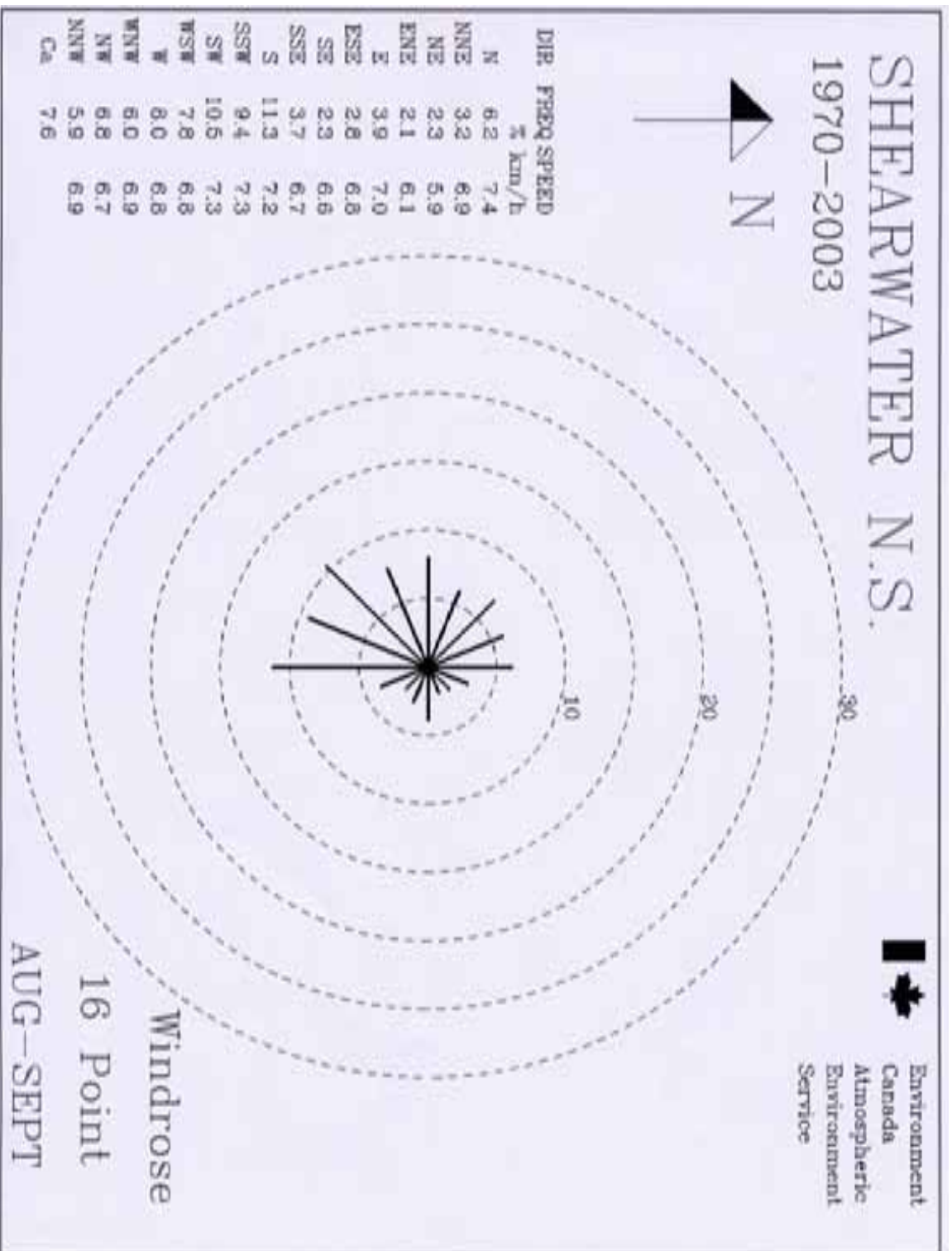
Appendix A – Wind Roses



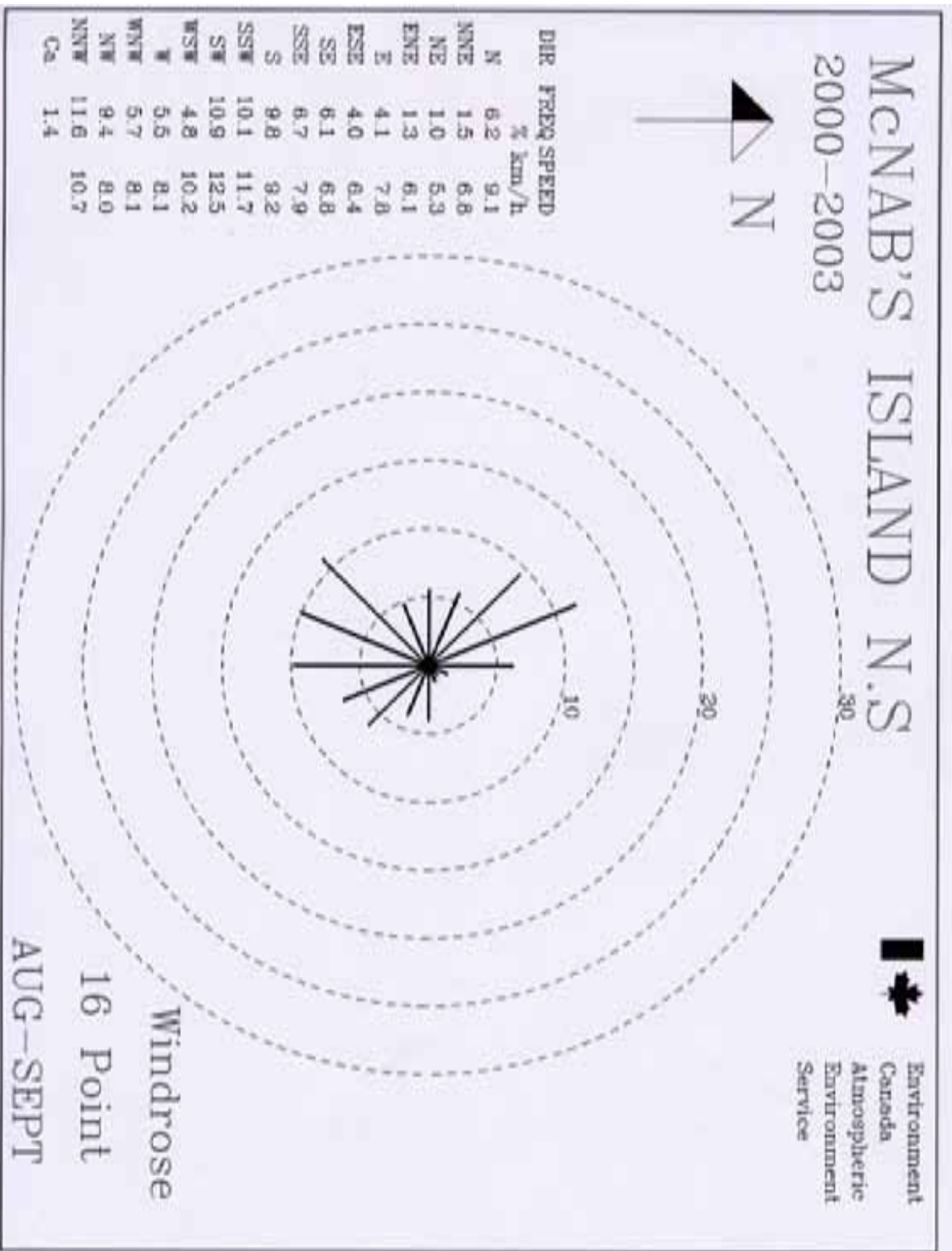
Appendix A – Wind Roses



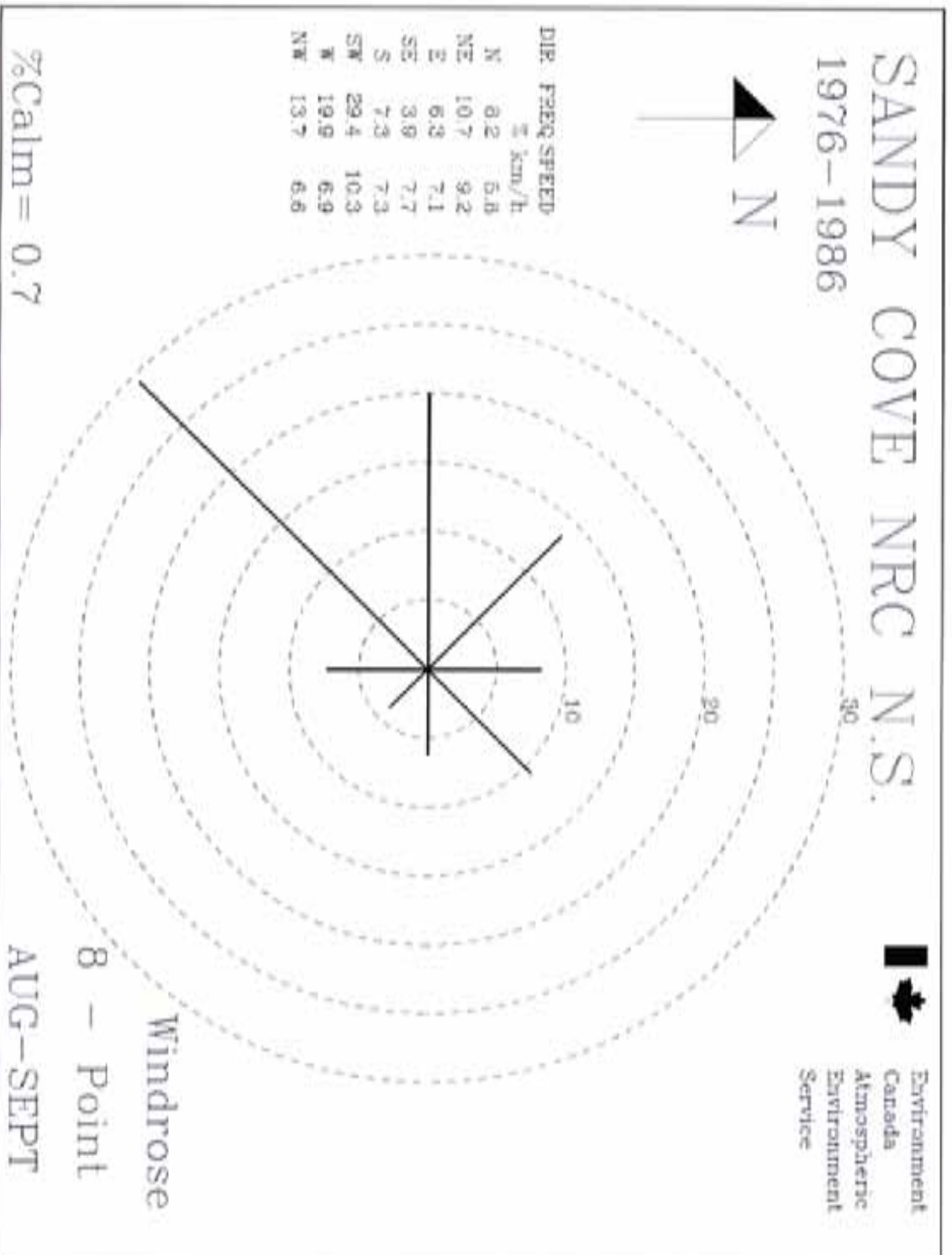
Appendix A – Wind Roses



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