Centre for Climate Change and Adaptation (*Climate School*)

Prince Edward Island Annual Climate Summary 2023

Prepared by Don Jardine, February 2024

Figure 1. St. Peter's Bay, UPEI Climate School in Background, 2023

1 INTRODUCTION

The year 2023 began with a very mild and wet January and ended with a mild, windy and relatively dry month of December. There was below normal precipitation from February to May with temperatures at normal or slightly above normal values. June, July, and August had above normal precipitation with July having the warmest month ever recorded in the province since instrumented records have been kept in the province. The month of August was slightly cooler than normal with above average rainfall then September was 1 to 2 degrees above normal and rainfall varying from above average in West Prince to below average in the rest of the province. October was 3 to 4 degrees above normal with normal precipitation in Prince County and above normal in the rest of the province making harvesting conditions difficult. November was slightly cooler than normal with similar precipitation distribution as the previous month. Harvest conditions continued to be wet with many cereal crops requiring extra drying conditions to improve marketability.

Some new climate stations were launched in the province during the year, one was relaunched with new instrumentation and these are summarized on table 1 with four of them installed jointly with Parks Canada. A few other climate stations were discontinued during the year due to loss of the host site or failure of equipment and include sites at Cape Egmont, West Point and Red Head Harbour.

Table 1: New or Reinstalled Climate Stations on UPEI Network in 2023

Community	Equipment Owner	Host	Land Use	Date Installed	Equipment
Victoria Visser	UPEI	Visser Farms	Agricultural	June 23, 2023	Onset RX3000: Temp, RH, wind, rain, solar rad., soil temp, soil moisture
***North Rustico Harbour**	UPEI, PC	Harbour Authority	Wharf	April 14, 2023	Onset RX3000: Temp, wind, rain, solar rad., water level & temp.
Cavendish	UPEI, PC	PEINP	Park	October 22, 2022	Onset RX3000: Temp, wind, rain, solar rad
Tracadie Harbour	UPEI, PC	Harbour Authority	Wharf	June 16, 2023	Onset RX3000: Temp, wind, rain, solar rad., water level & temp.
South Rustico	UPEI	Private	Residential	June 1, 2023	Davis Vantage Vue, Temp, Wind, Rain
Stanley Bridge	UPEI, PC	Harbour Authority	Wharf	July 27, 2023	Onset RX3000: Temp, wind, rain, solar rad., water level & temp.
Flat River	UPEI	Private	Agricultural	August 25, 2023	Installed Davis Vantage Vue unit.

* Upgraded station

Figure 2: Climate Station at Two Rivers Farm, Flat River in 2023

1.1 CLIMATE STATION DATA

A summary of climate data collected on Prince Edward Island for the year 2023 is provided. Data for this summary was collected from 87 climate stations across the province, listed in Table 2 including the second full year of record for the UPEI Stations installed in 2021.

Table 2: Instrumented Climate Data for the Year 2023

Location	Owner	T_{mean} (°C)	T_{max} (°C)	T_{min} (°C)	Ppt total (mm)	Max Wind Gust (km/h)	Avg. Wind Speed (km/h)	Avg. Annual Rad. (kWh/m^2)
Abney	UPEI	7.7	33.3	-26.4	1151.6	67.0	7.7	124.2
Abram's Village	UPEI	7.6	34.2	-27.0	729.6	85.0	15.3	125.5
Albany	UPEI	7.2	33.0	-26.4	674.4	76.0	13.2	132.2
Alberry Plains	UPEI	7.4	33.1	-26.6	1045.6	93.8	11.5	131.5
Alliston	UPEI	7.4	31.8	-27.2	902.5	62.8	5.5	
Annandale	UPEI	m	30.4	m	m	82.0	m	m
Arlington	UPEI	7.3	36.7	-27.0	867.2	64.9	1.4	112.3

Location	Owner	T_{mean} (°C)	T_{max} (°C)	T_{min} (°C)	Ppt total (mm)	Max Wind Gust (km/h)	Avg. Wind Speed (km/h)	Avg. Annual Rad. (kWh/m^2)
Baltic	UPEI	7.3	34.2	-26.7	746.4	101.0	14.8	150.9
Belmont	UPEI	7.0	30.4	-26.8	800.8	80.6	12.7	141.5
Bideford	MCPEI	m	32.2	-26.5	875.7	90.0	8.6	130.6
Bothwell	UPEI	7.1	28.9	-27.3	790.0	79.5	9.7	n
Brockton	UPEI	m	30.9	m	*	70.8	4.5	n
Brookvale	UPEI	7.9	30.1	-27.3	633.4	84	10.1	115.3
Brudenell	UPEI	7.6	33.7	-26.5	1282.0	82	8.3	126.4
Cable Head E	EC	7.3	29.6	-26.9	1246.3	93	m	n
Cardigan Head	Private	m	30.8	-26.4	*	m	m	n
Ch town Air	NAV Can	7.2	30.7	-27.1	1214.0	85.0	m	n
Ch town VK	Private	8.1	32.2	-26.3	1171.4	72.4	8.0	123.6
Ch town YC	UPEI	7.9	28.8	-25.5	984.2	92.6	11.5	143.4
Darlington	UPEI	m	32.4	m	*	76	8.5	m
Dingwells	UPEI	7.6	30.3	-25.8	904.4	85.3	7.5	n
East Baltic	UPEI	7.8	30.1	-27.4	1041	67	8.5	140.1
East Point	EC	7.3	29.6	-26.9	1052.8	93	m	n
Elmwood	Private	7.2	32.6	-24.1	1204.8	61.0	5.5	n
Fanning Brook	UPEI	7.8	32.3	-25.9	738.6	77.2	7.9	m
Flat River	UPEI	m	30.2	-25.3	786.5	75.6	6.8	n
Fox Island	UPEI	7.5	34.7	-26.2	796.8	75.7	9.0	140.2
Foxley River	UPEI	7.4	34.7	-25.8	566.3	82.1	8.8	n
Georgetown Wharf	UPEI	m	30.0	-24.1	454.4	100	14.7	125.4
Glen Valley	UPEI	7.5	33.2	-27.8	1114.8	72	7.1	104.1
Graham's Pond	UPEI		30.1		675.2	81	11.7	135.6
Graham's Road	UPEI	7.1	33.9	-26.7	935.4	97	14.8	122.2
Grand Tracadie	UPEI	7.5	31.9	-21.0	968.2	63.6	6.5	n
Greenwich	PC	7.8	32.3	-26.4	954.2	81	8.5	136.8
Hampton	UPEI	7.5	30.8	-25.9	896	81	11.6	133
Harrington	EC	7.1	32.0	-27.3	1164.3	126		
Heatherdale	UPEI	7.6	33.0	-27.0	1279.2	87	7.5	122.7
Hog Island	MCPEI	7.6	34.6	-26.4		79	13	142.1
Iona	UPEI	7.5	32.2	-27.2	1201.6	79	8.4	126.5
Johnstons R	UPEI	7.8	33.8	-26.9	1086.4	77	10	132.1
Lennox Island GH	MCPEI	7.6	34.8	-26.9	821.8	67	9.3	139.5
Lennox Island	MCPEI	7.1	30.1	-26.5	543.6	90	16.1	139.4
Little Sands	UPEI	7.7	32.0	-26.1	1041.0	85	10.5	127.9
Lower Freetown	UPEI	7.5	34.1	-26.9	918.0	76.9	10.5	126.9
MacAulay's Wharf	UPEI	m	30.9	-25.6	*	94	15.4	m
Maple Plains	EC	6.6	32.9	-27.0	n	72	m	n
Mt. Vernon	UPEI	7.6	32.8	-27.3	1138.8	83	9.9	134.8
Naufrage	Private	m	30.3	-27.0	m	88.5	m	m
Naufrage Harbour	UPEI	7.6	30.2	-26.3	993.6	83	12.2	125.8
New Glasgow	UPEI	7.2	33.4	-27.7	1016.6	75	8.2	125.3

Location	Owner	T_{mean} (°C)	T_{max} (°C)	T_{min} (°C)	Ppt total (mm)	Max Wind Gust (km/h)	Avg. Wind Speed (km/h)	Avg. Annual Rad. (kWh/m^2)
New Zealand	UPEI	7.0	30.9	-27.5	1081.6	72	10.8	124.6
Newton Rd	UPEI	m	33.3	m	m	78	11.2	m
North Cape	EC	7.0	30.6	-24.5	842.3	110	m	n
North Lake	PEIEMO	7.6	29.5	-25.1	938	113.0	12.2	115.9
North Milton	UPEI	7.4	33.0	-27.0	926.0	84.2	10.2	134.0
North Rustico	PC	7.8	29.7	-26.1	654.6	85	10.8	132.5
Norway Onset	UPEI	m	31.6	m	*	m	m	166.8
Norway VP	UPEI	7.0	30.8	-25.3	722	96.6	14.4	n
Norway VV	UPEI	7.0	30.8	-25.3	675.2	87.7	13.2	n
O'Leary	UPEI	7.0	34.8	-27.4	573	85	10.7	126
Orwell	UPEI	8.0	32.3	-26.4	937.8	83	10.7	126
Pt Prim	UPEI		32.6	-26.3		76	9.0	119.9
Riverdale	UPEI	7.4	33.3	-27.3	1099.8	67	7.1	134.8
Rocky Pt	MCPEI	7.7	31.4	-26.4	604.9	59.5	5.3	m
Savage Harbour	ACS	7.7	29.7	-26.9	1113.0	104.6	12.3	m
Scotchfort	MCPEI	m	31.9	-27.2	598.1	72.4	6.7	m
Shamrock	UPEI	7.1	33.0	-27.7	867.2	86.6	13.8	140
Skinners Pond	UPEI	7.4	30.6	-25.4	1148.8	88	15.5	124
Souris	PEIEMO	7.7	27.5	-24.3	826.8	72	8.1	m
South Rustico	UPEI	m	31.9	m	m	67	m	n
SSide Airport	EC	7.1	32.7	-26.8	930.7	90	m	n
SSide Wharf	PEIEMO	7.6	31.8	-26.3	700	89	5.6	128.2
St. Catherine's	UPEI	7.5	31.1	-26.7	867.0	67.6	6.8	n
St. Peters CS	UPEI	7.6	31.3	-26.8	1096.8	82	10.4	138.8
Stanhope	EC	7.5	29.6	-21.2	1092.6	89	m	n
Stanley Bridge	UPEI	m	29.5	m	*	87	m	m
Stratford	UPEI	7.6	33.7	-26.3	731.6	88	12	158.9
Sturgeon	UPEI	7.5	31.3	-25.9	1205.2	69	7.5	126.0
Tignish Acadian	UPEI	7.3	31.7	-26.3	m	67.6	4.4	128.3
Tignish Wharf	PEIEMO	6.9	31.3	-25.3	747.2	98.6	13.4	m
Tracadie Wharf	UPEI	m	31.5	m	*	88	m	m
Upton	UPEI	7.2	34.2	-26.8	1196.4	53	3.4	150.9
Victoria Visser	UPEI	m	30.2	m	*	76.9	m	m
Victoria Wharf	UPEI	7.7	30.2	-26.0	761.6	88	10.7	127.4
Warren Grove	UPEI	7.6	35.1	-26.2	876.2	70	6.9	125.5
Waterside	UPEI	7.5	31.9	-25.9	m	82	6.0	129.2
West Cape	UPEI	7.2	34.9	-27.0	775.0	87	15	189.6
White Sands	Private	7.3	28.7	-26.6	1190.2	91.7	13.8	n
Winsloe South	UPEI	7.3	33.0	-26.7	1370.2	67.6	3.1	n
York	UPEI	m	34.9	m	m	67.0	m	m

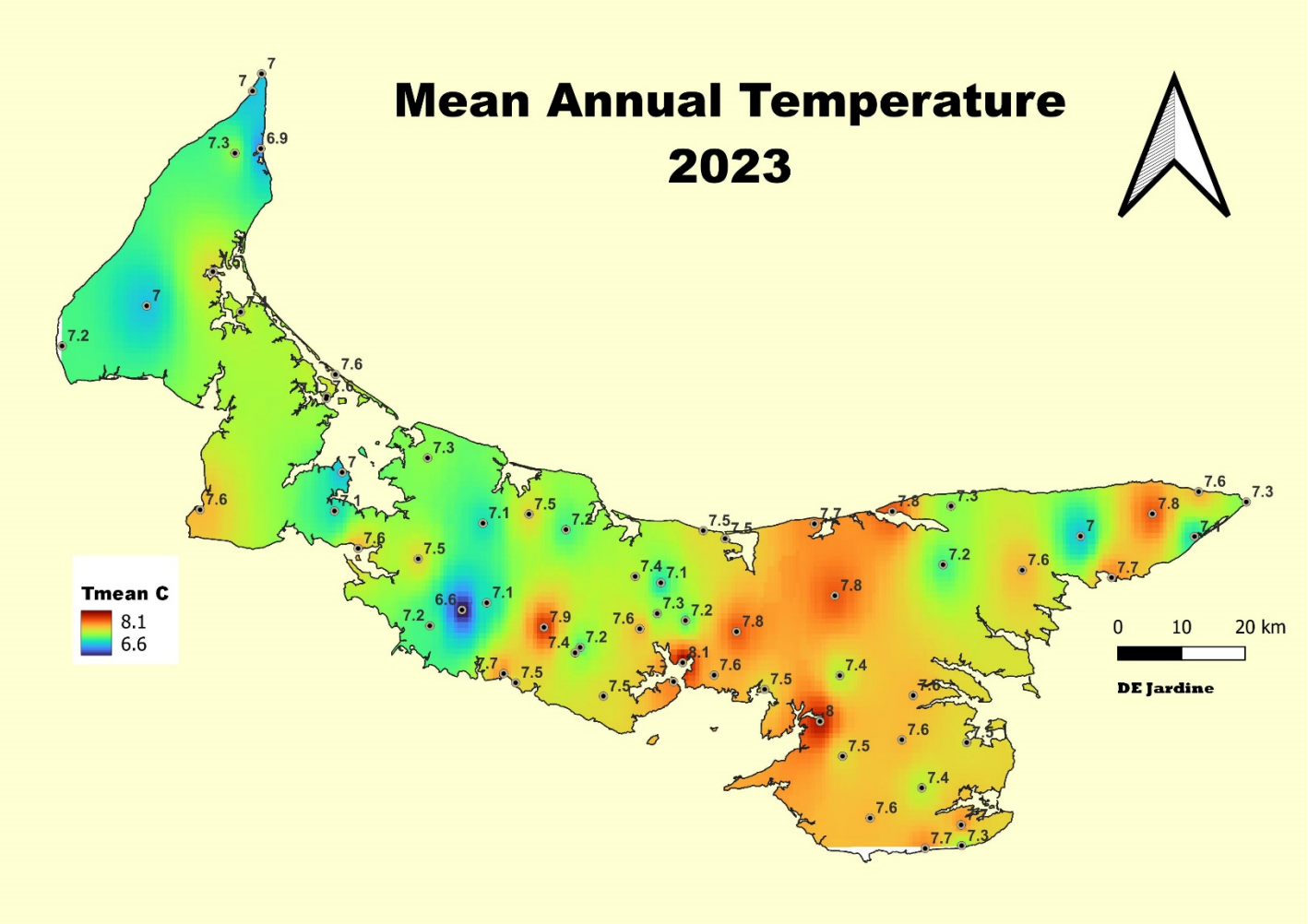
*Partial data either due to power outage, storm damage or non heated automated gauges.

m = data missing (typically measured by the station but not available for this period)

n = not available/ or measured by the station

1.2 TEMPERATURE

The mean annual temperature for PEI is mapped in Figure 3 using interpolation methodology between reporting climate stations. There was a 1.5°C range (6.6 to 8.1°C) for the 64 reporting stations with met the requirement for plotting. This map reveals that the southern and southwestern areas of Queens and Kings counties were warmer overall than other locations with a few local exceptions. The range in average temperature was the same as the previous year with upper and lower temperatures being 0.2°C cooler than the previous year verifying that 2023 was just slightly cooler on average than 2022.



- **Figure 3. Interpolated mean annual temperature, 2023, for 64 Stations across PEI (⁰C).**

The year 2023 was the eighth warmest since 1850,when instrumented temperature records began to be kept in the Charlottetown area, with a mean annual temperature of 7.1°C at the Charlottetown Airport location. Mean annual temperature in Charlottetown from 1850 to 2023 is provided in Figure 4. Seven of the eight warmest years in the history of instrumented climate observation in Charlottetown have occurred since 1998. The temperature reached 20°C on 94 days in Charlottetown, well above the 30-year normal for Charlottetown of 79 days per year. Almost all months had higher than normal mean monthly temperatures with January, July and December having the highest at 3 to 4 degrees above the 30-year normal temperature.

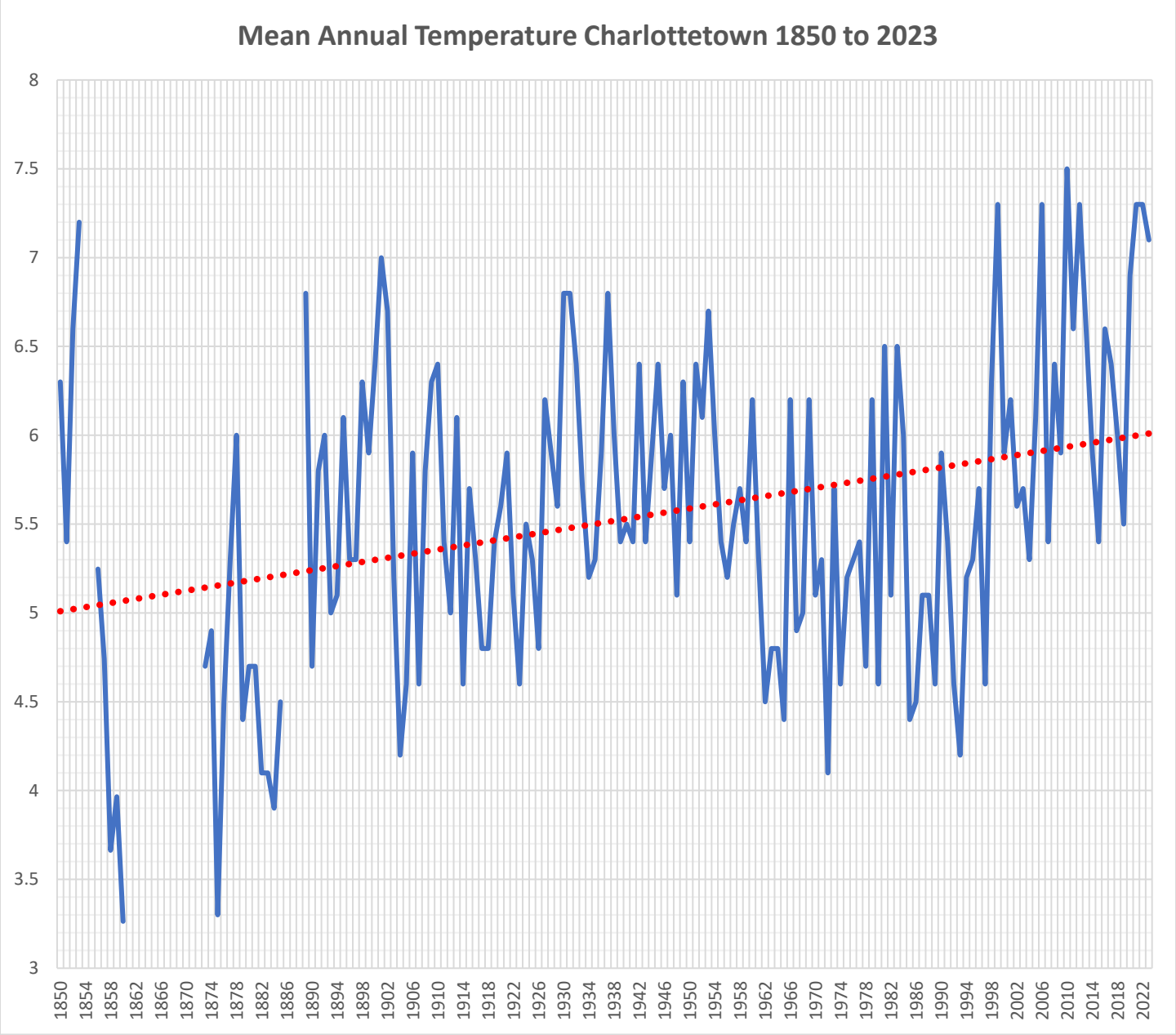


Figure 4. Mean annual temperature in °C at Charlottetown from 1850 to 2023.

The climate normal data compiled in Table 3 were used to determine the deviation from normal values in 2023. This was derived from the climate normal website of Environment and Climate Change Canada (https://climate.weather.gc.ca/climate_normals/). Temperatures in 2023 at the locations on Table 3 were up to 2.2°C higher than the most recently available climate normal data available from Environment and Climate Change Canada.

Table 3– Climate Normal (1981-2010) Annual Temperature Compared to 2023

Site	Normal Mean Temp. C	2023 Mean Temp. C	Difference C
Charlottetown	5.6	7.2	+1.6
Summerside	5.7	7.1	-1.4
Monticello	5.8	7.6	+1.8
O'Leary	5.5	7.0	+1.5
East Baltic	5.6	7.8	+2.2
Alberton	5.5	7.5	+2.0
New Glasgow	5.8	7.2	+1.4

The maximum daily temperature reached a peak of 36.7°C at the Arlington station on June 1, 2023. This same temperature was recorded at Charlottetown on August 19, 1935, and is tied for the highest daily temperature recorded for any date in the history of weather records for the province (Table 4). The minimum daily temperature of -29.0°C for the year was recorded at the Environment Canada Community Collaborative Station at New Glasgow on February 4, 2023.

Table 4. Top seven extreme maximum temperatures ever recorded in the province.

Location	Date	T_{max} (°C)
Charlottetown	August 19, 1935	36.7
Arlington	June 1, 2023	36.7
Alliston	August 12, 1944	36.1
Tignish	May 22, 1977	36.1
Tignish (Acadian)	June 19, 2020	35.9
Arlington Orchard	August 13, 2021	35.9
Arlington Orchard	August 21, 2022	35.9

The UPEI Climate Lab began installing Davis Vantage Pro weather stations at 5 locations in 2013 and 4 of these have been maintained at their original locations up to the present day. Two of these stations at Flat River and Winsloe South have recently replaced the original Vantage Pro unit with a Davis Vantage Vue unit. The accuracy of the temperature sensor according to the manufacturer is +_ 0.3°C. The average annual temperature calculated for these locations for a 10-year period from 2014 to 2023 is provided on Figure 5.

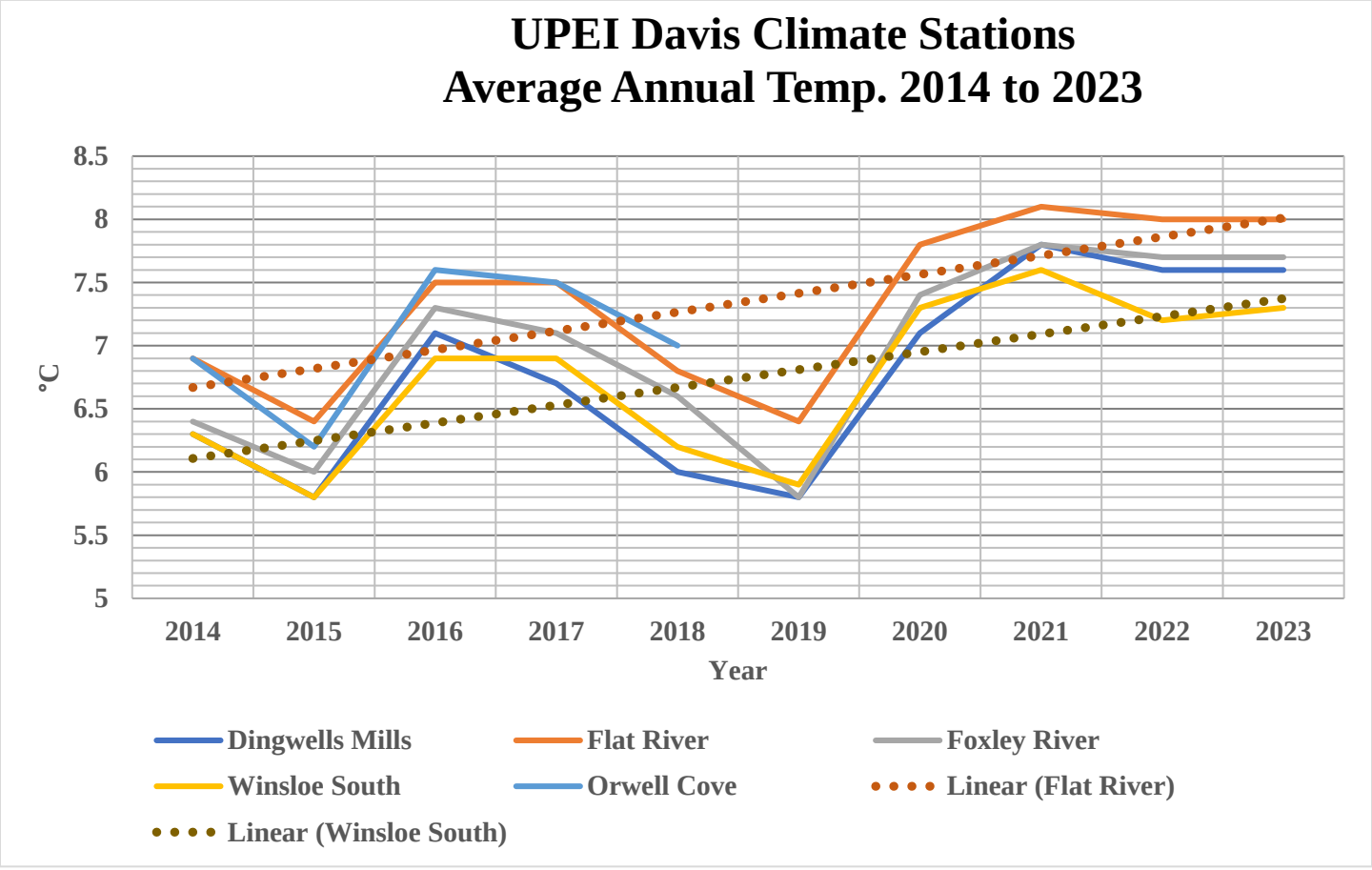


Figure 5: Average Annual Temperature UPEI Davis Stations

The average annual temperature trend for the stations at Flat River and Winsloe South is displayed on Figure 5 and clearly reveals an upward trend of over 1.1°C in the past 10 years.

1.3 Heating and Cooling Degree Days

Heating degree days are calculated from daily temperature and are a measure of how cold the temperature was over an entire day and how much heat will be required to bring the temperature up to 18°C to heat an interior space. The higher the total of heating or cooling degree days for a year would result in more energy consumption to heat or cool a home or building. With rising annual temperatures, the number of heating degree days is gradually decreasing over time, and the number of cooling degree days is increasing.

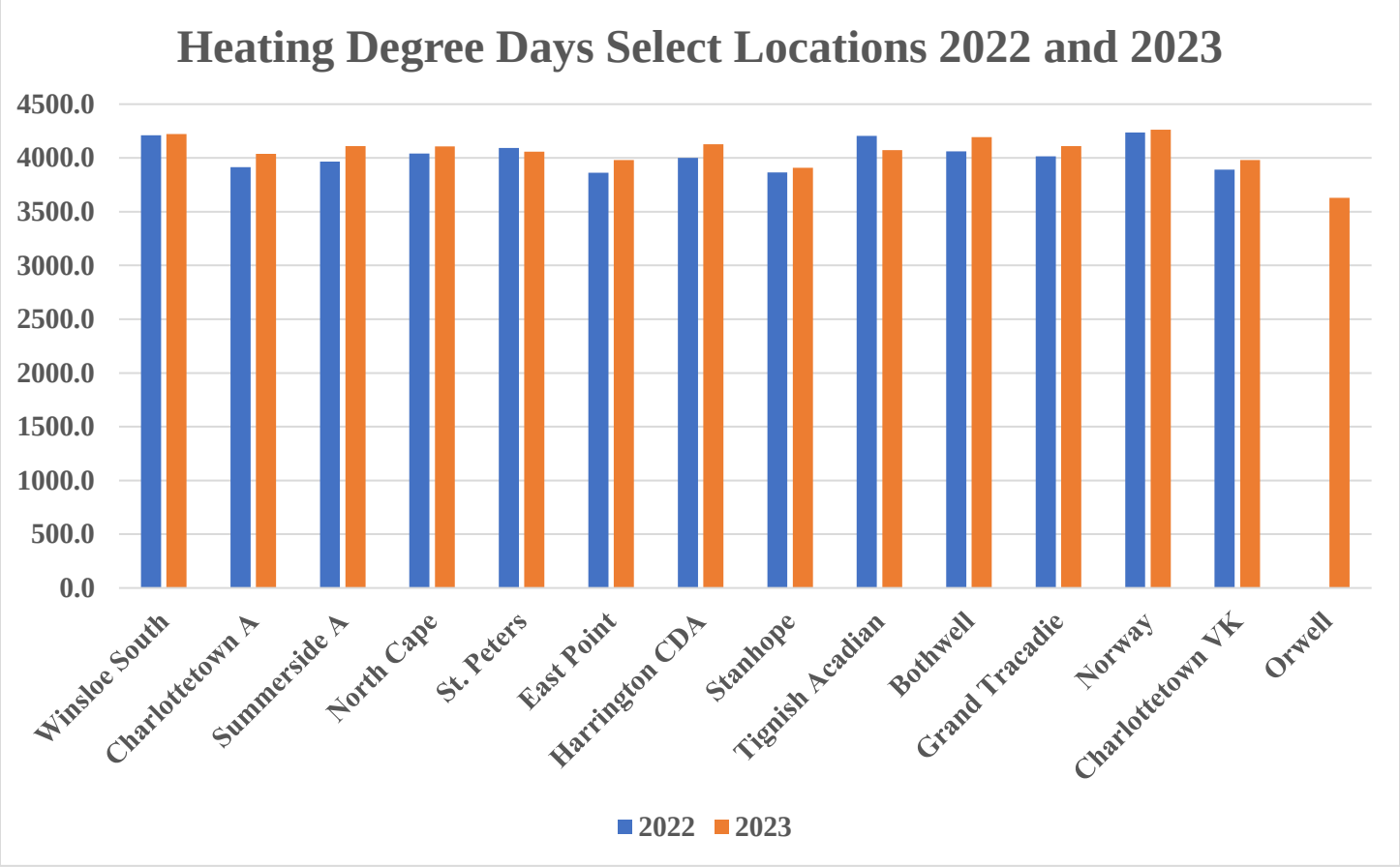


Figure 6: Heating Degree Days at Select Locations

As observed on Figure 6 the station at Orwell has both the lowest heating degree day total for 2023 and this collates with Figure 3 which shows the Orwell area had the highest mean annual temperature in the province for the second consecutive year. The Eastern Kings region is another area which has lower heating degree day totals than other areas of the province as displayed by the heating requirements at East Point and Bothwell locations.

Cooling degree days are calculated similar to heating degree days and use a calculation to determine the amount of cooling required to bring the temperature down to 18°C from the average daily temperature during the warmer days of the year. The cooling degree days have been calculated for select locations in the past 2 years and are shown on Figure 6.

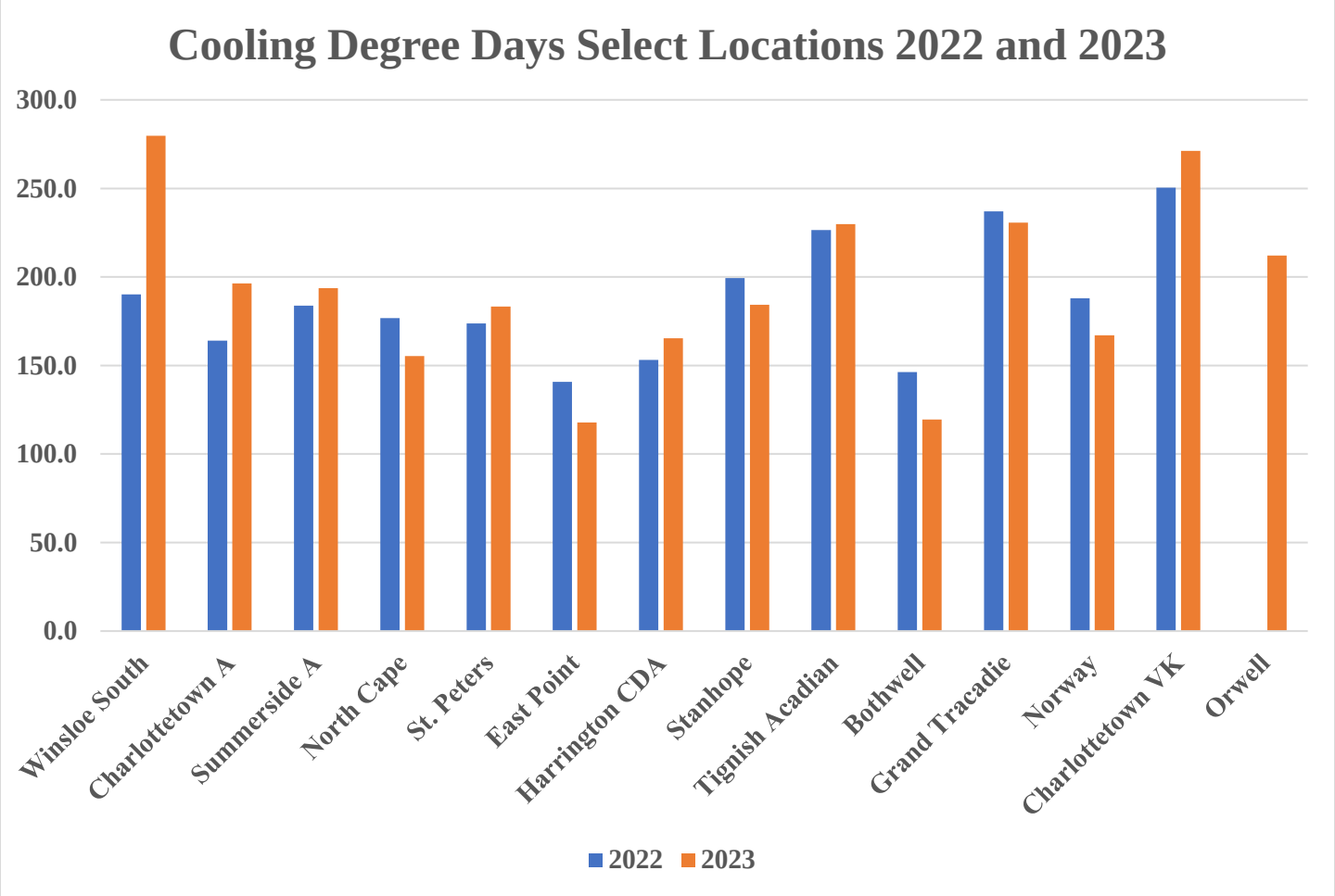


Figure 7: Cooling Degree Days at Select Locations

As observed on Figure 7 the two stations in Eastern Kings County at Bothwell and East Point have the lowest cooling requirements for the past 2 years with stations at Winsloe South and VanKampens Greenhouses in the Charlottetown area showing the highest cooling requirements.

1.4 Growing Degree Days

Growing degree days (GDD) are an important measure of plant growth through the various developmental phases. The GDD index can advise a grower how crops are developmentally and how close they are to being ready for harvest. They are also used to estimate the development of insects during the growing season and give information to enable decision making regarding fertilizer treatment in order to achieve the greatest possible yield or return on individual crops. As the climate gradually warms over time, it will be possible to grow crops which thrive in a warmer climate.

The growing degree days for 2023 were calculated for a number of PEI locations and these are compared with normal values from 1961 to 1990 and 1971 to 2000 as listed on Table 5. The former Charlottetown Canada Department of Agriculture (CDA) Station was located at the Experimental Farm near the intersection of Allen Street and Mount Edward Road. A current day station located at VanKampens Greenhouses on Allen Street is located less than 1 km from the former CDA station location. The GDD in 2023 was over 200 higher (10%) higher than the historical values listed on table 5 at this location. Similar higher values were reported at the 2 other locations with comparable data.

Table 5 PEI Growing Degree Days 2023 Compared to Historical Values at Select Locations.

Location	GDD 2023	GDD 1971 to 2000	GDD 1961 to 1990
Summerside Airport	1909.3	1718.0	1706.0
Charlottetown Airport	1889.3	1651.0	1636.0
Charlottetown CDA /VK	2234.0	1736.6	1718.0

O'Leary		1663.9	1604.0
Monticello		1629.9	1592.0
Maple Plains	1864.3		
Winsloe South	2006.1		
St. Peters (Cable Head East)	1889.7		
East Point	1769.7		
North Cape	1837.0		

From table 5 and figures 8 to 10, it is clear that the trend for growing degrees is upward at Charlottetown, Summerside and Winsloe South in the last 30 years. The trend line shown on Figure 8 shows an increase in growing degree-days from approximately 1640 to 1850 or a 200 degree-day increase in the 33-year period covered in the graph for an average increase of just over 6 degree-days per year. There were two years where the degree-day total reached over 2000 and these were both after the year 2010. An increasing trend is also evident for Summerside and is not as pronounced as the Charlottetown location.

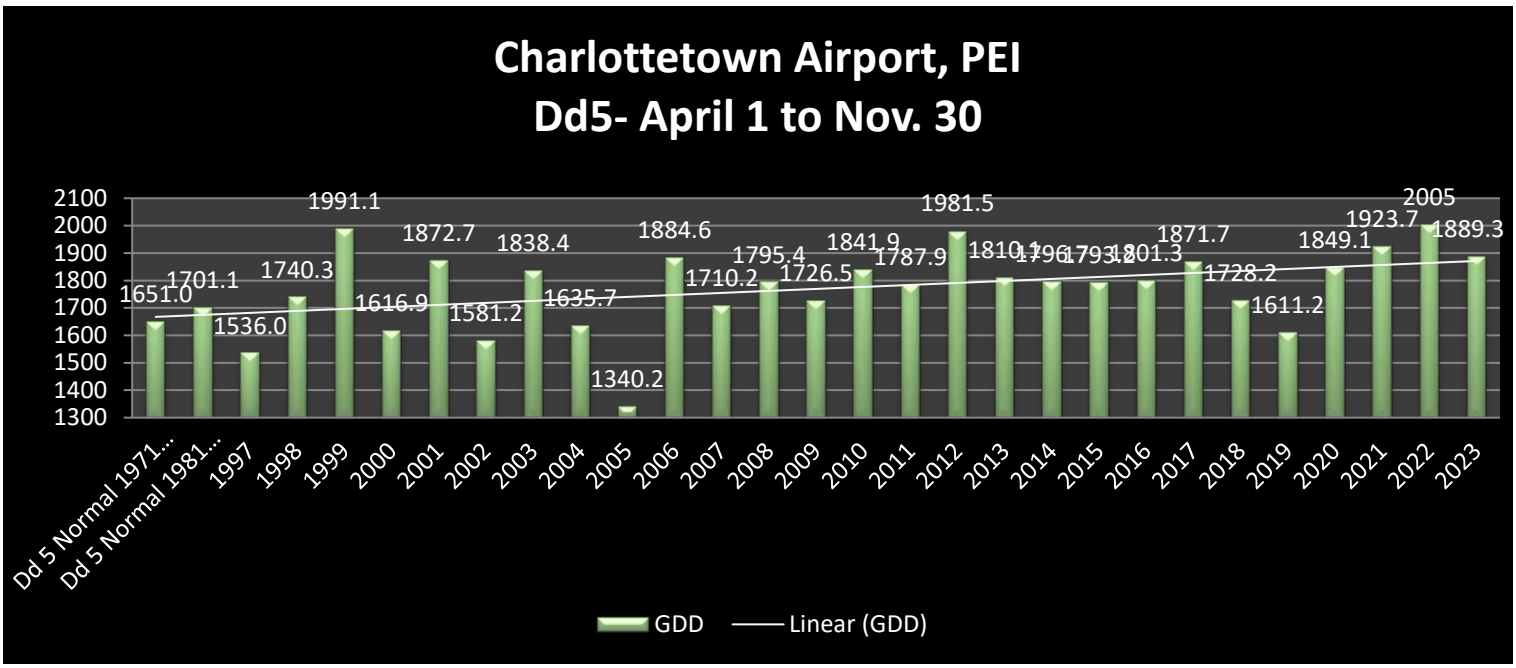


Figure 8: Charlottetown Airport GDD 1989 to 2023.(some surrogate data used for 2012 and 2022 due to missing data)

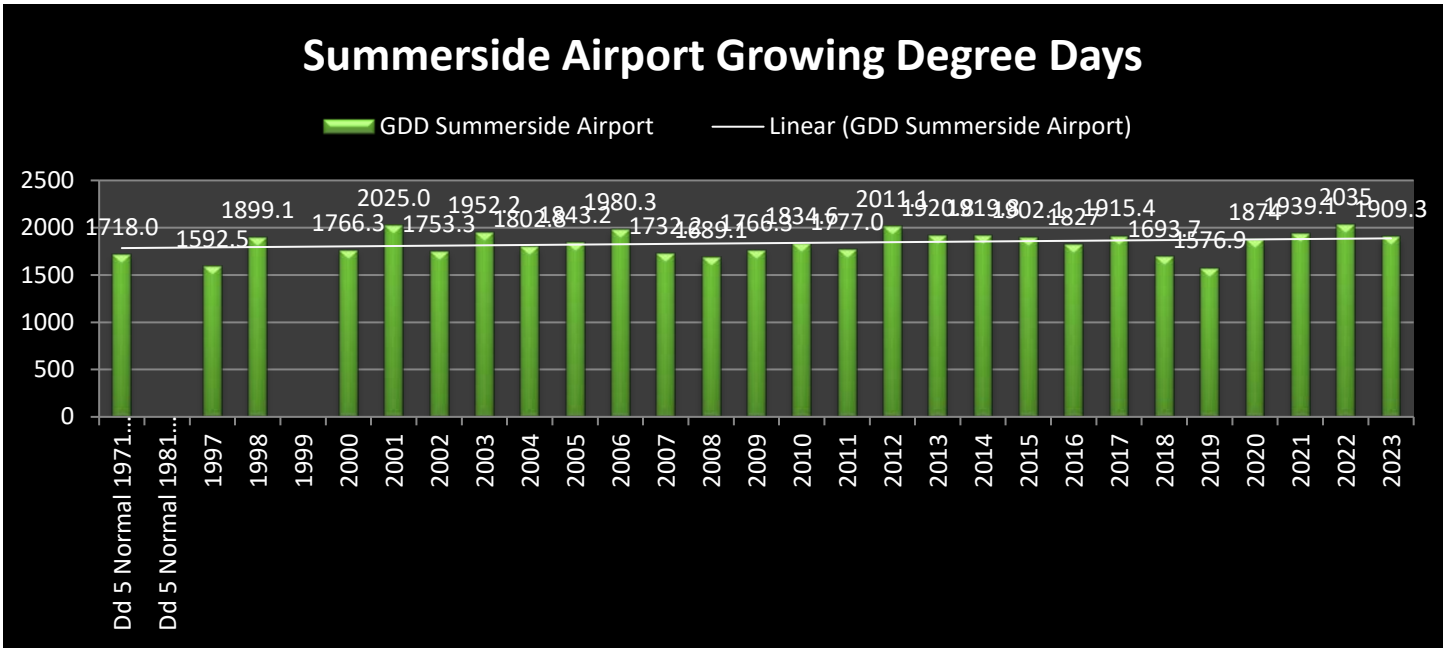


Figure 9: Summerside GDD in Recent Years

The growing degrees days for the past 10 years at Winsloe South is showing an upward trend of approximately 100-degree days for an average of 10-degree days per year. This is in spite of the year 2019 when the number of GDD days dropped significantly.

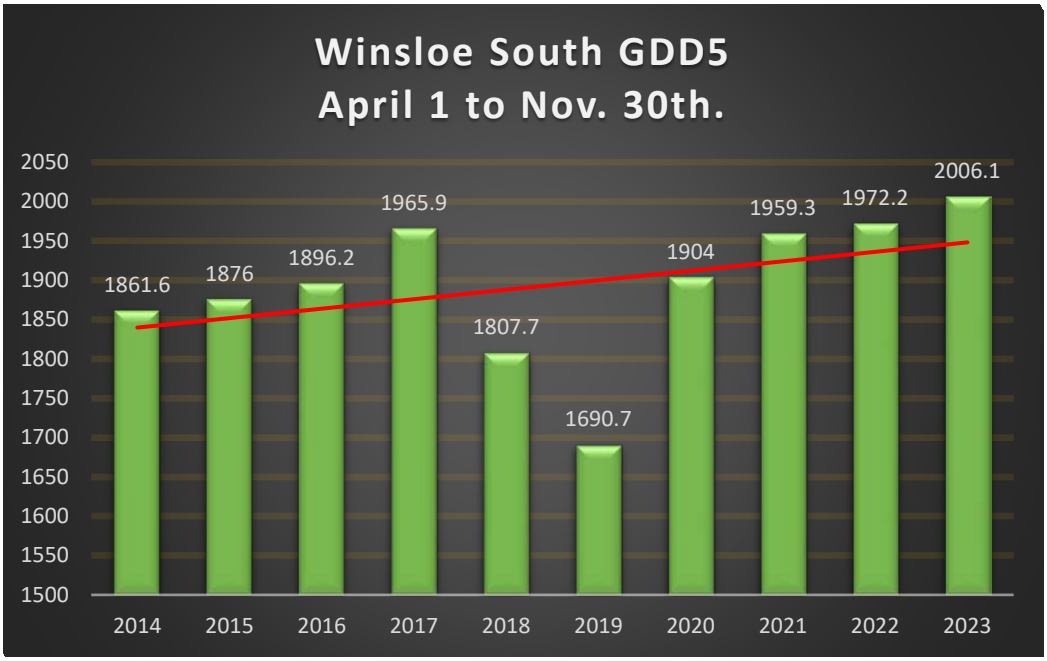


Figure 10: Winsloe South GDD 2014 to 2023

1.5 PRECIPITATION

The total precipitation during the year ranged widely during the year with below normal amounts in western areas of the province including all of Prince County at the 61 stations with sufficient and reliable data. Data from 45 automated stations and 16 Community Collaborative Rain, Hail & Snow Network (CoCoRaHS) observation locations in the province was included in this summary. The CoCoRaHS stations are operated by volunteers who collect and record daily observations using manual methods using a Type B gauge and are considered to be very accurate as found in a study completed by Devine and Mekas, 2007***, "The manual Type B gauge, in service for more than thirty years, was found to***

be the best rain gauge and provided the most accurate values based on all the reported rainfall field experiments with an average bias of only –0.6% compared to the raw pit gauge data".

The higher total precipitation amounts recorded at the CoCoRaHS stations appear to be more reflective of the actual amounts which occurred due to less missing precipitation because of errors inherent in measurement using automated devices especially in the winter months.

Table 6 provides a summary of the annual precipitation measurements for the CoCoHaHS locations on PEI with complete records for the year.

Table 6. CoCoRaHS precipitation amounts at 17 locations in PEI, 2023.

CoCoRaHS Station	Total Precipitation (mm)	Total Snowfall (cm)	Extreme Daily Rain (mm)
CAN-PE-3 Wellington	1088.3	172.4	48.0 (Nov. 19)
CAN-PE-7 Morell	1210.6	375.9	63.0 (July 22)
CAN-PE-10 New London	1116.7	163.1	45.0 (Aug. 12)
CAN-PE-19 Winsloe South	1370.1	273.8	54.4 (June 6)
CAN-PE-20 Bonshaw	1204.8	171.4	54.1 (June 6)
CAN-PE-25	*	*	73.4 (July 22)
CAN-PE-26 – Grand Tracadie	1203.3	165.9	55.9 (June 6)
CAN-PE-43-Glencoe	1282.0	189.4	50.0 (July 4)
CAN-PE-47 Long Creek	1220.0	194.6	48.0 (June 6)
CAN-PE-50-Bedford Corner	1337.0	177.5	56.9 (June 6)
CAN-PE-54- Foxley River	1104.7	192.1	48.8 (July 3)
CAN-PE-66 North Granville	1122.9		51.3 (June 6)
CAN-PE-70 Flat River	1119.8	140.5	49.5 (July 22(
CAN-PE-74 St. Georges	1080.1	149.2	56.9 (June 6)
CAN-PE-75 Fox Island	917.9	*	?
CAN-PE-77 Norway WEICan	952.0	*	?
CAN-PE-78 Bayfield	1367.9	*	56.9 (July 23)

* - incomplete record
n – not measured at this location.

Comparing the totals of total precipitation between CoCoRaHS and instrumented locations reveals that the maximum amount at an instrumented location for 2023 was 1282.0 mm at Brudenell (UPEI) whereas the maximum amount for a CoCoRaHS station of 1370.1 mm at Winsloe South in Queens County. The Charlottetown Airport location is located about 3 km from the Winsloe South station, and it recorded a total of 1214.0 mm for the year which is over 10% less than the Winsloe South CoCoRaHS site.

The highest daily rainfall accumulation occurred on July 22nd at the CoCoRaHS station at Caledonia when 73.4 mm was measured. On the same day a private station at White Sands recorded 64.4 mm which was the second highest reading for any station during the year. June 6th was another very wet day with several stations reporting over 50 mm of rain.

Table 7 – Climate Normal (1981 to 2010) Annual Precipitation vs 2023 at Instrumented Locations

Site	Normal Annual Precipitation (mm)	Total Precipitation 2023 (mm)	Difference in mm
Charlottetown	1158.3	1214 (1370.1)*	+55.7 (+211.8)*
Summerside	1072.9	930.7 (1088.3) *	-142.2 (+15.4)*
Monticello	1170.2	993.6	-176.6
East Baltic	1272.0	1041.0 (1367.9)*	-231.0 (+95.9)*
Alberton	1053.1	917.9	-135.2
New Glasgow	1257.9	1016.6	-241.3

*(CoCoRaHS values in brackets)

The total annual precipitation for the province in 2023 is provided on Figure 11 and displays that total precipitation was below normal in western areas while in Central Queens County to Eastern Kings County the total precipitation was slightly above average for the year.

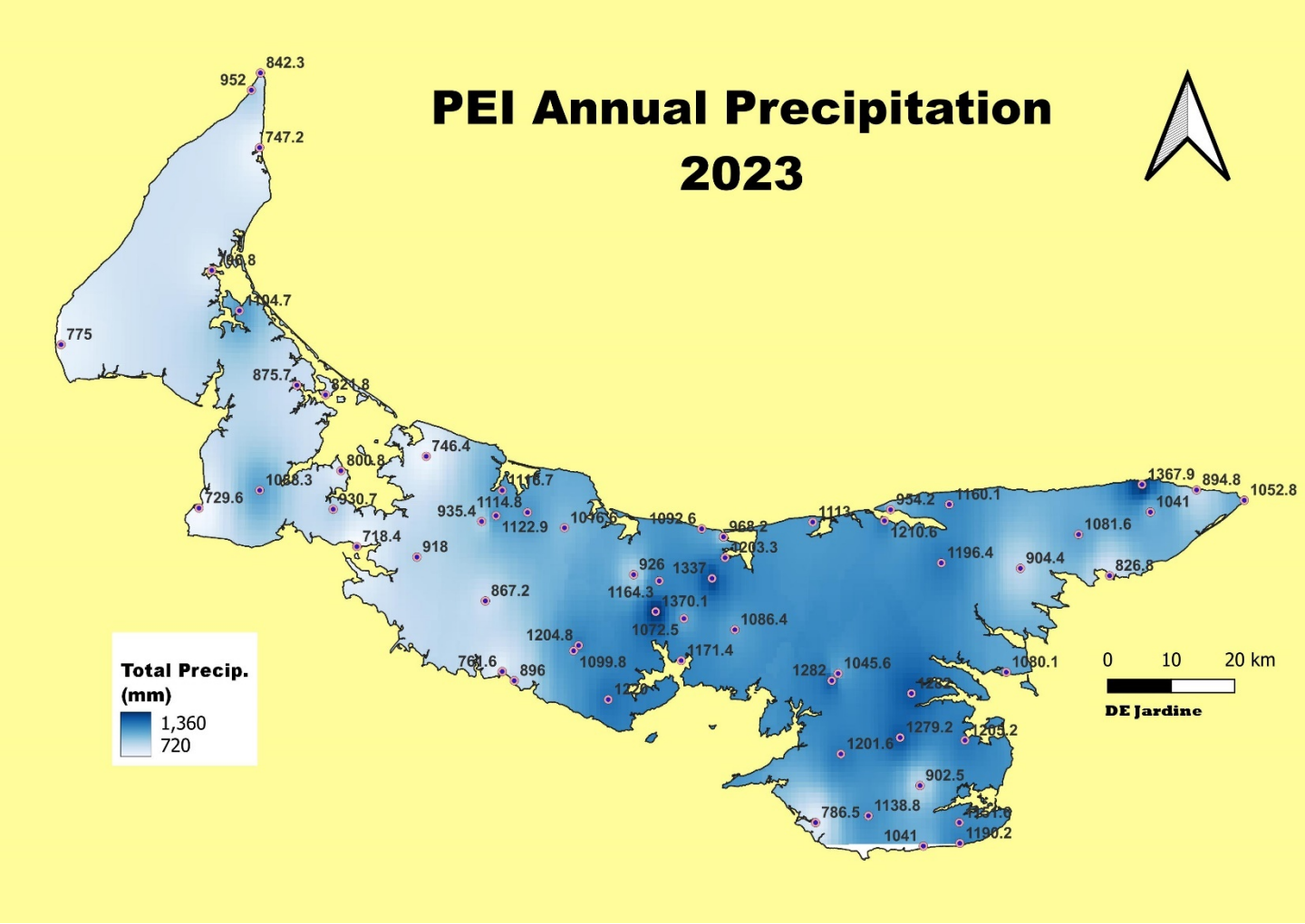


Figure 11. Interpolated annual precipitation for 61 stations across PEI.

The amounts of snow, rain, and total precipitation at Charlottetown from 1872 to 2023 are provided in Figure 12. The amount of rain and total precipitation are trending upward over the period or record with the amount of snowfall revealing a very slight increase with time. Mean annual rainfall and total precipitation totals for 2023 were similar to the previous year but snowfall amounts were somewhat lower than 2022.

When the data for Charlottetown is plotted for the past 35 years (1989 to 2023) as presented in Figure 13, the increasing trend for rainfall and total precipitation is still evident however the trend for snowfall is actually decreasing. This may reflect a slightly shorter winter season with a result of lesser amounts of snowfall over time.

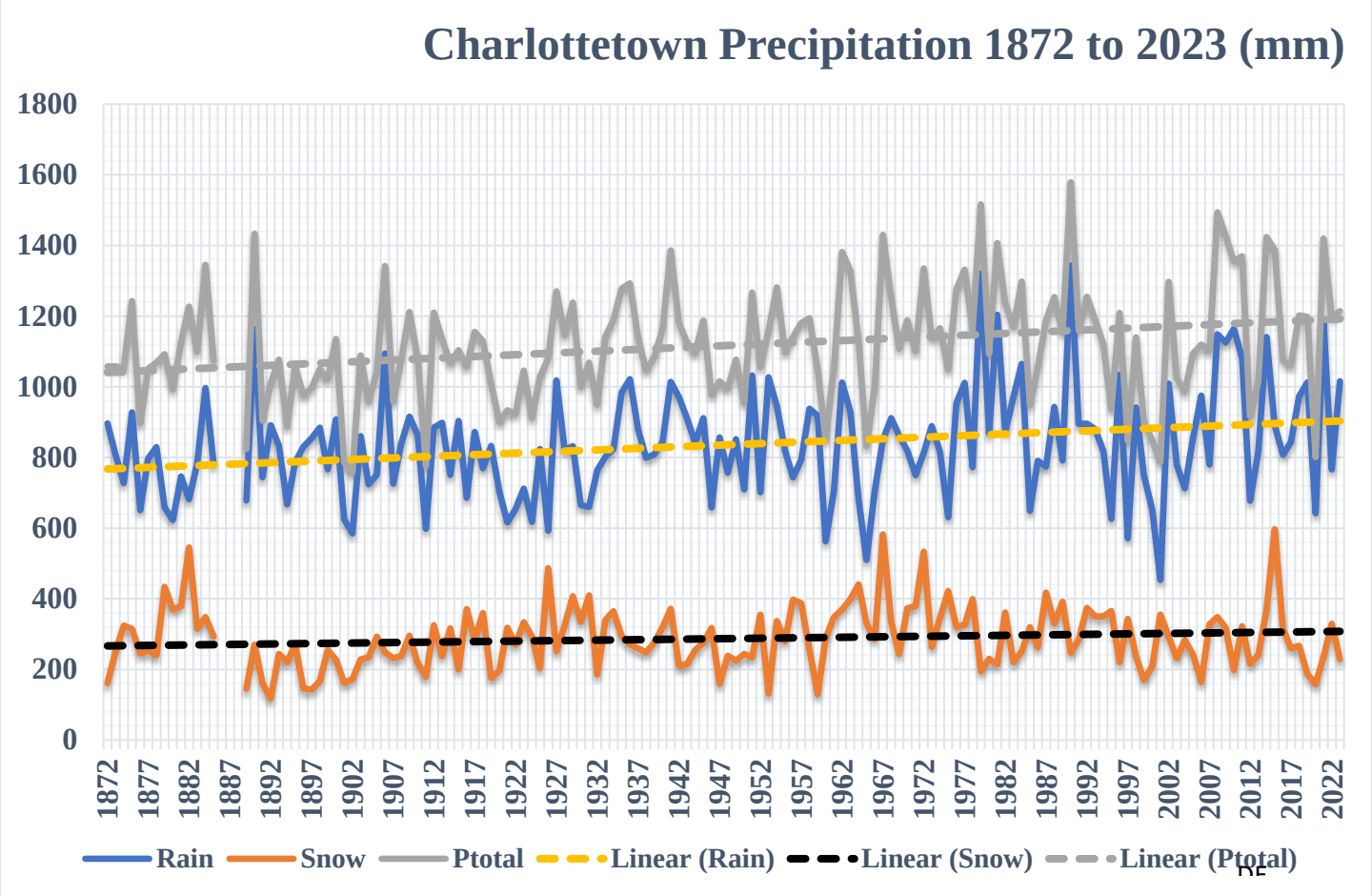


Figure 12. Annual precipitation at Charlottetown Since 1872.

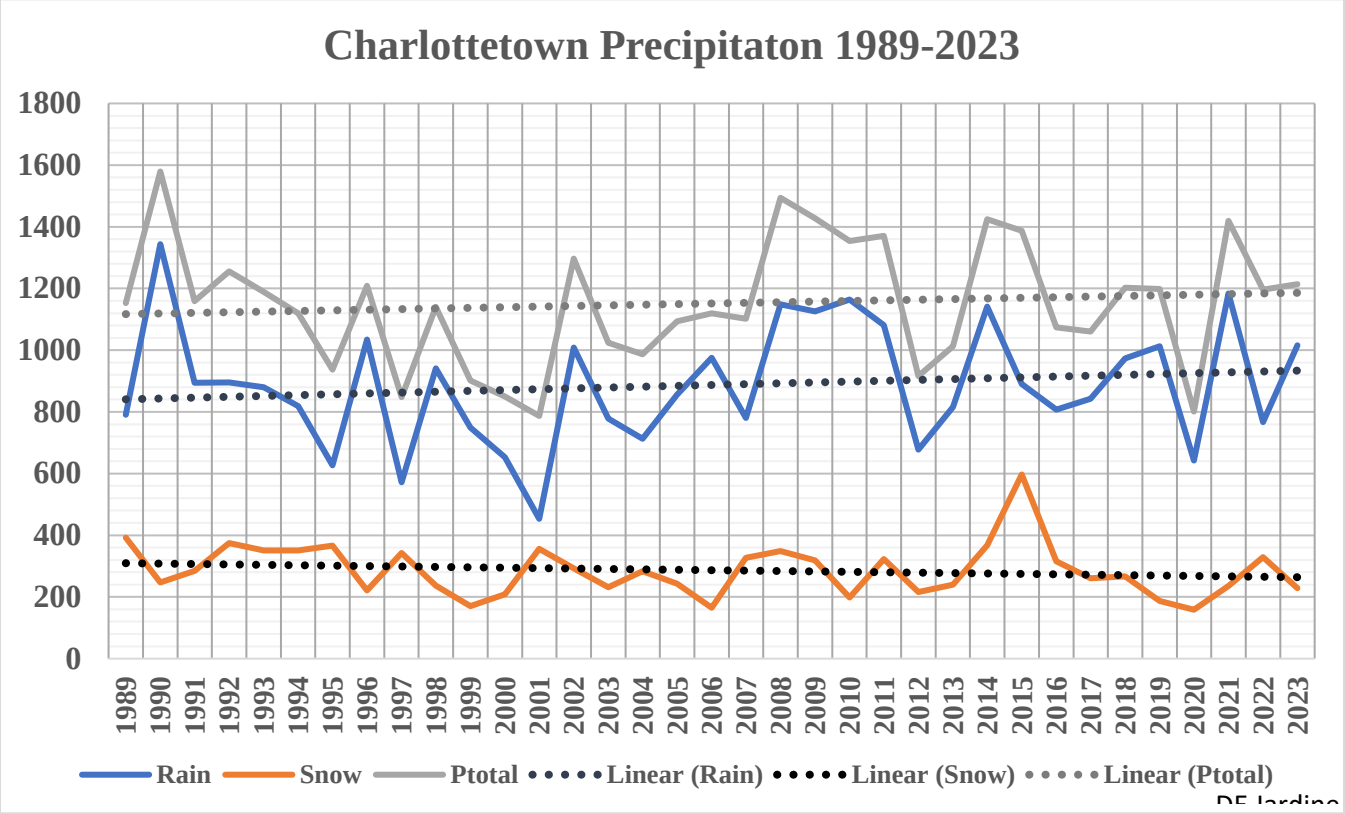


Figure 13: Charlottetown Precipitation 1989 to 2023

1.6 WIND

The areas with the highest peak wind gusts listed on table 1 during the year are shown on Figure 14 in a light to dark yellow colour. Areas with the lowest peak wind gusts are shown in a dark gray to black shade and includes an area southwest of Charlottetown and other scattered areas across the province. There were no major tropical storms that occurred in 2023 which caused any significant damage or coastal flooding. The peak wind gust of 126 km/h was recorded at Harrington on January 23, 2023.

Average wind speeds provide information about the windiest locations in the province and this information is listed on table 1. Unfortunately, average wind speed data is not readily available for the Government of Canada Meteorological stations. There are 5 locations listed on table 1 which have an average annual wind speed of at least 15.0 km/h and these include:

Lennox Island Wharf: 16.1
Skinners Pond: 15.5
MacAulay's Wharf: 15.4
Abram's Village Wharf: 15.3
West Cape: 15.0

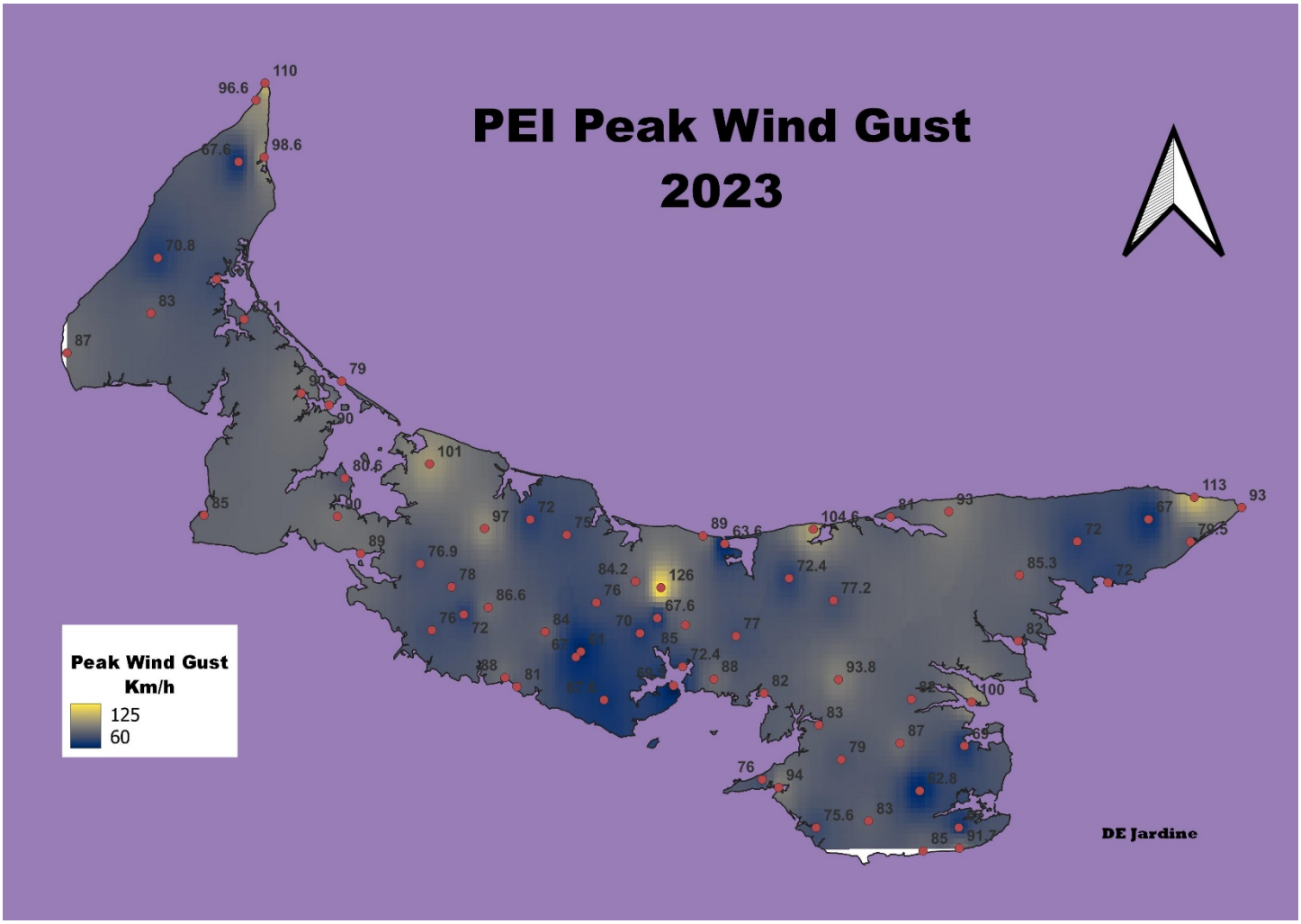


Figure 14: Peak Wind Gust Reported in 2023

1.7 Sea Water Levels

The Charlottetown tidal gauge maintained by Fisheries and Oceans Canada since 1911 had a mean annual sea level of 1.915 m for 2023, which is shown in Figure 15 along with other mean annual sea levels going back to the beginning of the measurement period. The 2023 average value for Charlottetown is the highest ever measured at this location and the trend line clearly shows a steady rise in sea level over the years. The peak water level measured at Charlottetown for 2023 was 3.59 m, CGVD28 recorded on January 27th at 02:50 AST.

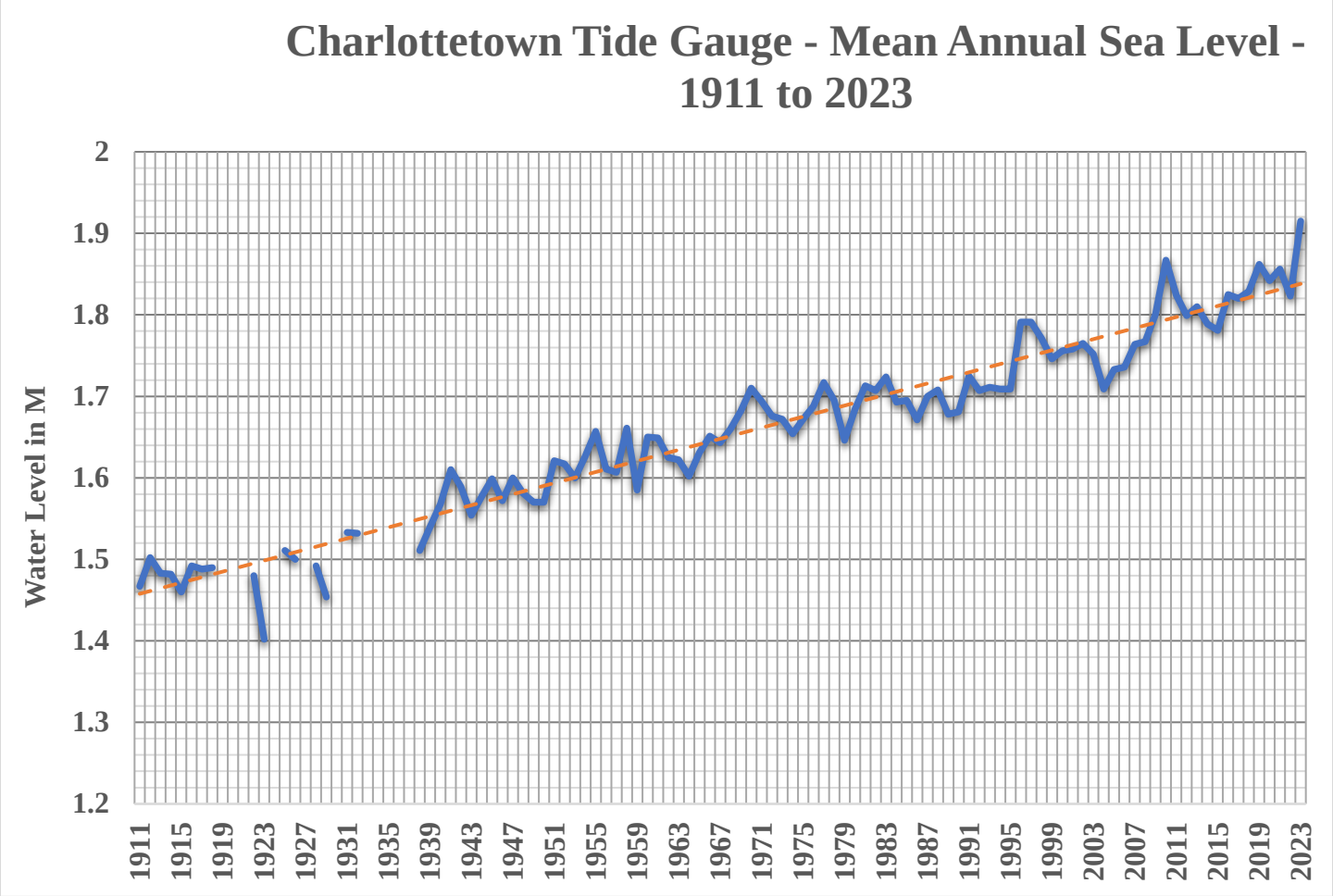


Figure 15: Mean Annual Sea Level at Charlottetown Station 1700 (DFO)

The trend line on Figure 15 reveals the sea level at the Charlottetown DFO tidal station has risen by 38 cm since 1911 which over the 112- year period averages 0.34 cm or 0.13 inches per year. The decadal sea level rise shows a more pronounced increase beginning in the 2010s decade as observed on Figure 16.

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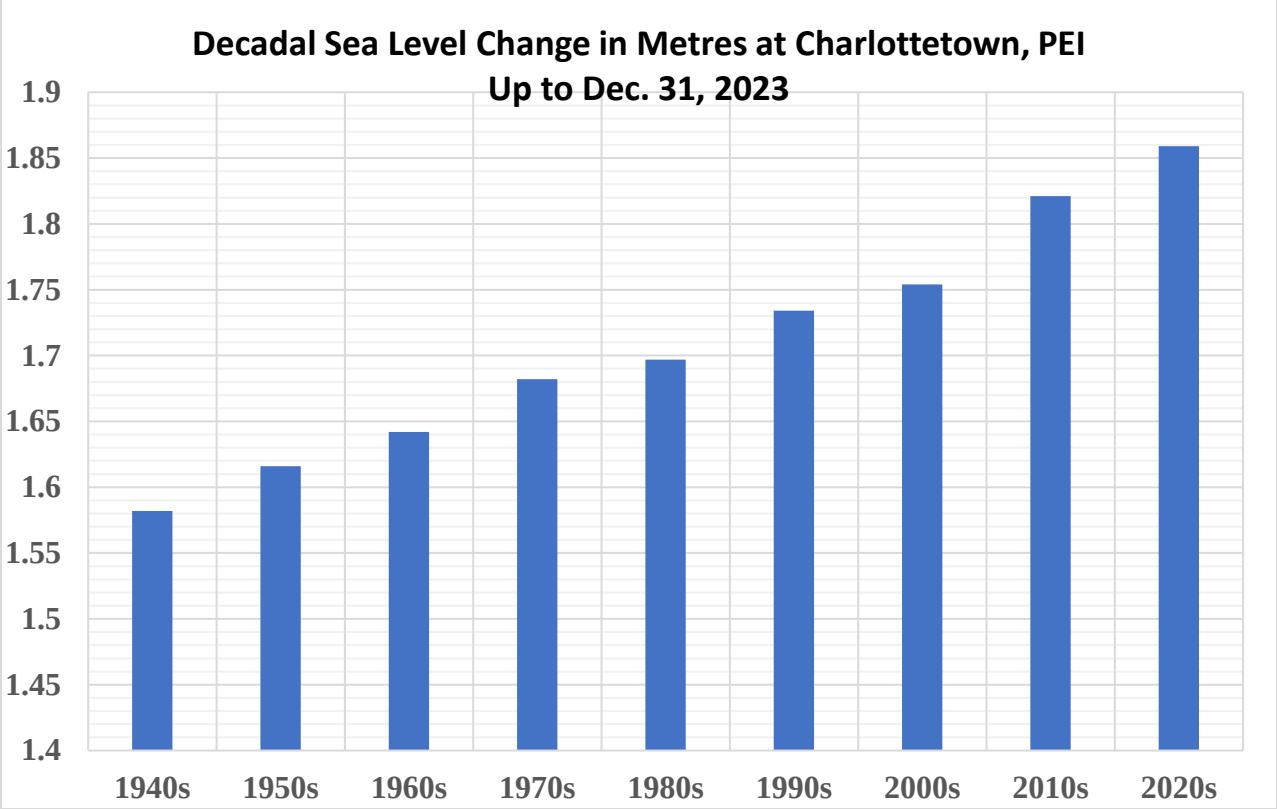

Figure 16: Decadal SLR at Charlottetown Since the 1940s

Water level data for 8 tidal observation stations equipped to monitor sea level are presented in Figure 17. There were no significant storm surge events with the highest water levels occurring in January. The lowest peak water levels were observed in May and September at these locations.

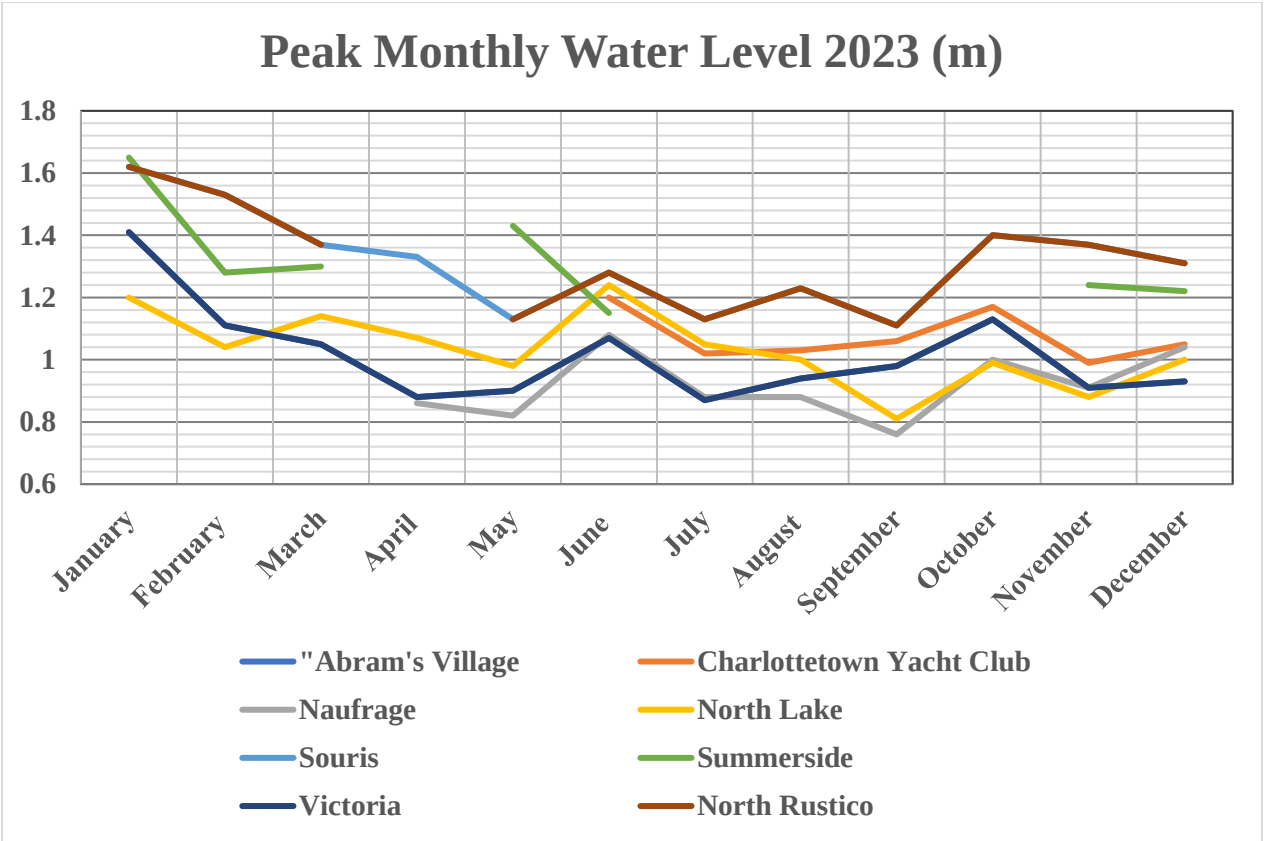

Figure 17: Monthly Peak Water Levels Select UPEI and PEI EMO Locations

1.8 Sea Water Temperature

Sea water temperature is being monitored at a number of harbours around the province with instruments supplied and installed by UPEI, the Mi'kmaq Confederacy of PEI and PEI Emergency Measures Organization. Average near shore surface sea water temperatures ranged from a low of -2.4°C at Skinners Pond Wharf and Charlottetown Yacht Club in February to a high of 23.7°C at Summerside Marine Terminal in July. The average monthly sea water temperatures for eleven locations are presented in Figure 18 with the highest readings observed in July and August and the coldest in February and March.

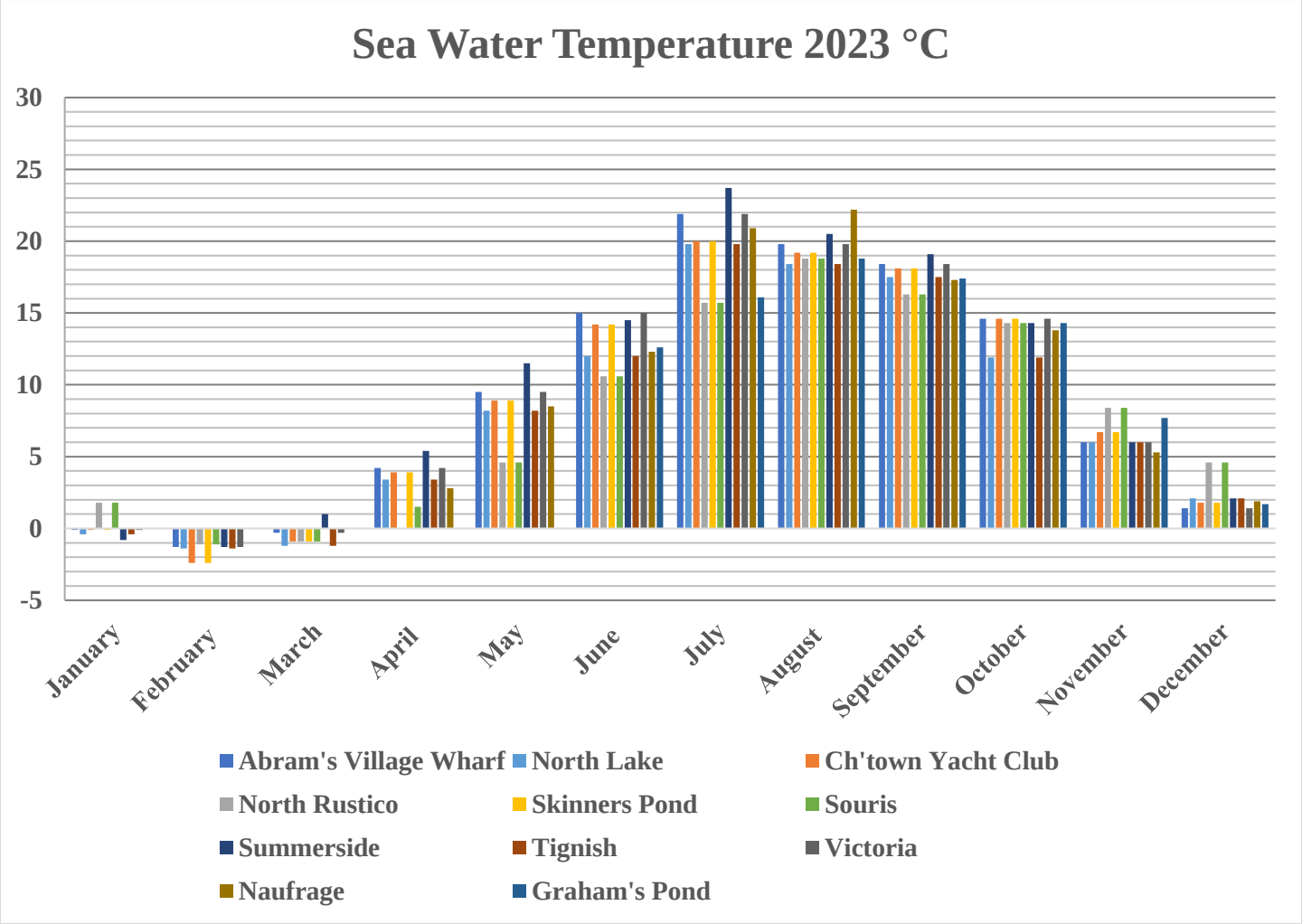

Figure 18: Sea Water Temperature 2023

1.9 Solar Radiation

Many climate stations monitored by the UPEI Climate Research Lab measure the amount of solar radiation generated via a silicon pyranometer sensor. The average yearly solar radiation in kilowatt hours per square metre of surface area (kWh/m^2) was calculated for most of the stations reporting this parameter in 2023 is listed on table 2. The results for stations reporting for the full year are provided in Figure 19 and reveal that the amount of solar radiation on a yearly basis is quite uniform across the province but there were a few areas like West Cape with higher solar radiation values and other areas like sections of western Queens County which had lower values. The variations can be attributed to variable cloud cover, fog conditions or shading of sensors in some areas. For instance, a station is located in a wooded or treed area would have less high angle sun exposure for the early morning and late afternoon hours.

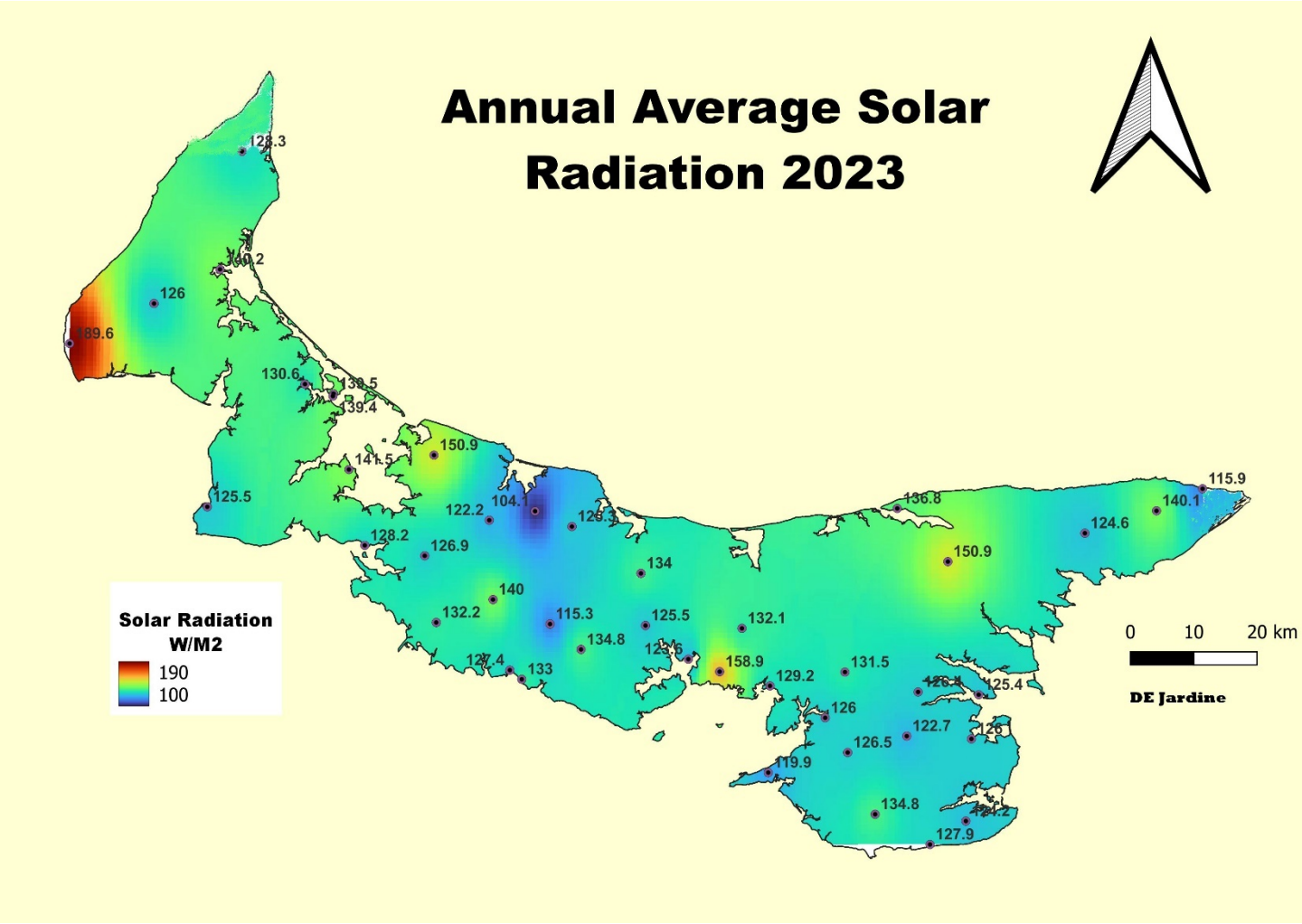

Figure 19: Average Annual Solar Radiation at Locations Across the Province

The average annual solar radiation values for the past two years at 35 locations across the province are plotted on Figure 20. For most locations the average annual solar radiation is slightly lower in 2023 that the previous year with a few exceptions such as West Cape & Upton where the 2023 value is clearly higher than the previous year. The reasons for these exceptions are not clear and may be attributed to sensor location, less cloudiness in these areas or possibly sensor errors.

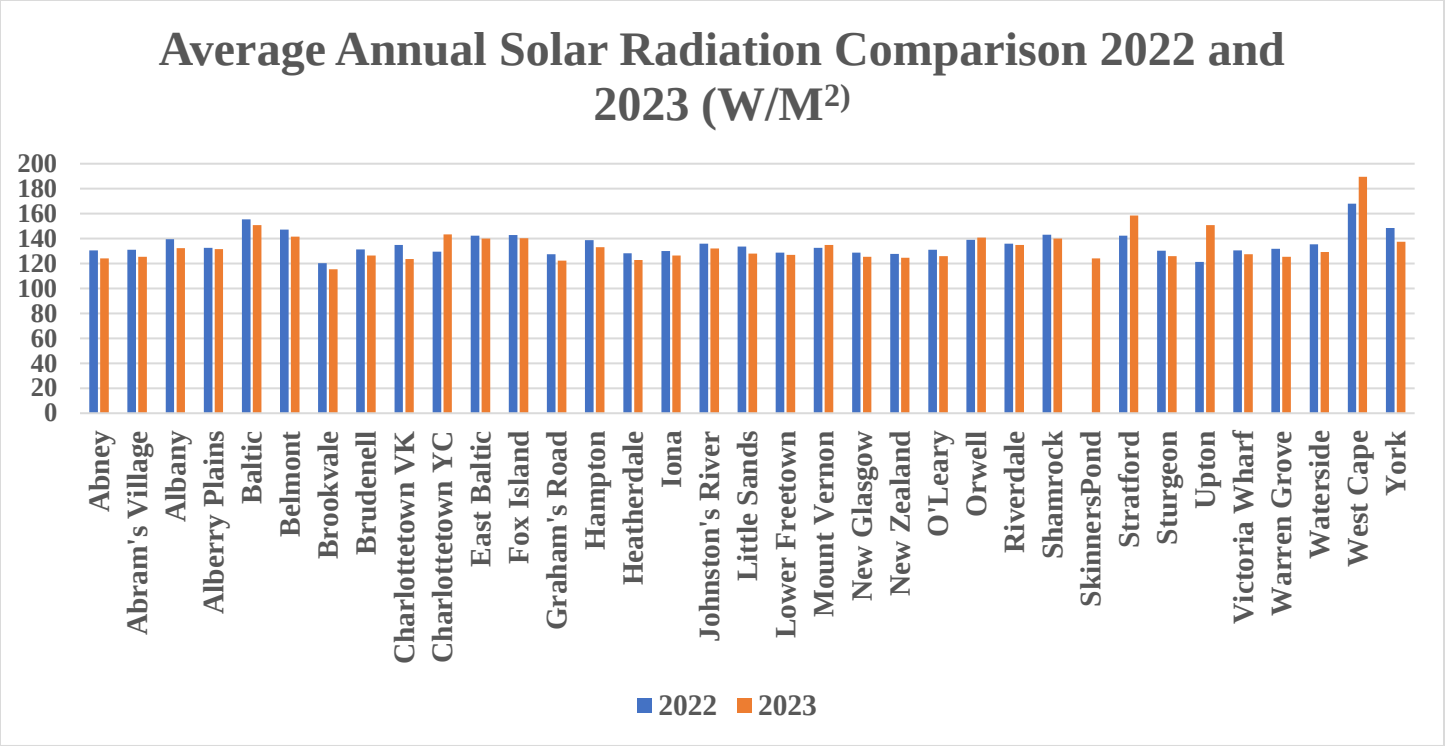

Figure 20: Average Annual Solar Radiation 2022 and 2023

1.10 Significant Climate Events

There were some significant weather and phenological events recorded during the year, which are reported in Table 7. There were no severe storm events with Post-Tropical Storm Lee being the worst of the hurricane season and it caused only minor damage compared to Fiona which occurred in September 2022.

Table 7. Significant Weather or Phenological Events in 2023.

Date	Event	Measurement	Winds	Description	Area(s) Impacted
Jan. 1st	Heavy rain	26 mm		New Years day was very wet.	Montague & area
Jan. 23rd	Peak Wind gust for the year		126 km/h	Heavy snow and west	Harrington and area.
Jan. 27th	Peak Annual Water Level	3.57 m @ 02:50 AST	--	At Charlottetown Tide Gauge Stn 1700	Charlottetown Harbour
Jan. 31st	Warmest Jan. in PEI History	+0.1°C avg. at South Lake; -2.1°C at Ch'town		A wet month with 179.8 mm total precip. at Ch'town	Entire province
Feb.. 4th	Extreme Cold weather	-29°C at New Glasgow		Very cold day across the province	Entire province
March 13th	First sighting Red Winged Blackbird	-	-	First sighting of the year.	Winsloe South
March 22, 2023	First sighting Common Grackle	-	-	First sighting of the year	Winsloe South
March 31st	Dry month	43.4 mm		Summerside	Western PEI
April 30th	Very dry month	17.4 mm		Summerside	Western PEI

May 31st	Very dry month	33.0 mm		Summerside	Western PEI
June 1st	Very hot day	+36.7°C at Arlington	--	Very warm day across the province	Entire province
June 9th	Purple lilacs in bloom	-	-	First blooms of the year.	Winsloe South.
July 31st	Extremely warm month	+21.9 avg. monthly temp. Ch'town Airport		Warmest July ever recorded on PEI since records began.	Entire province.
August 31st	Above normal rain	154.6 mm		Ch'town Airport	Most of the province.
Sept. 16-17th	Post-tropical storm Lee	Up to 32 mm of rain	Gusting to 85 km/h	The storm shut down the ferries at Wood Islands & Souris with some power outages	Entire province but slightly worse in the western areas.
Oct. 30th	Heavy frost	-1.0°C at Winsloe South	Low	Grass & roof covered with frost. First heavy frost of the fall.	Charlottetown area.
Nov. 30th	Cold month			Below normal temperatures during the month.	Entire province.
Dec. 18th & 19th	Extreme high temperature	+15.0°C at Cavendish	101 km/h	Peak high winds at Baltic in Prince Co	Entire province
December 25th	Green Christmas	No snow on the ground	-	No accumulated snow	Charlottetown area

The annual climate extremes considering all reporting stations listed in this summary are shown in Table 8.

Table 8. Prince Edward Island Climate Stations Climate Extremes for 2023.

Parameter	Extreme Value	Date Observed	Station
Daily T_{max}	36.7°C	June 1st	Arlington
Daily T_{min}	-29.0°C	February 4th	New Glasgow (EC)
Highest Annual T_{mean}	8.1°C		Charlottetown (VK)
Lowest Annual T_{mean}	6.6°C		Maple Plains (EC)
Max Wind Gust	126 km/h	January 23	Harrington (EC)
Max. Daily Ppt	73.4 mm	July 22	Caledonia (CoCo)
Highest Total Annual Ppt	1370.1 mm		Winsloe South (CoCo)
Highest Total Annual Snowfall	375.9 cm		Morell (CoCo)

The first spring sighting of a Red Winged Blackbird at Winsloe South occurred on March 13th when one was observed in the backyard of a residential property. This was the earliest sighting of this species at the Winsloe South location since records began in 2010. The trend line displayed on Figure 21 for the past 14 years shows that this species is migrating earlier during this time period.

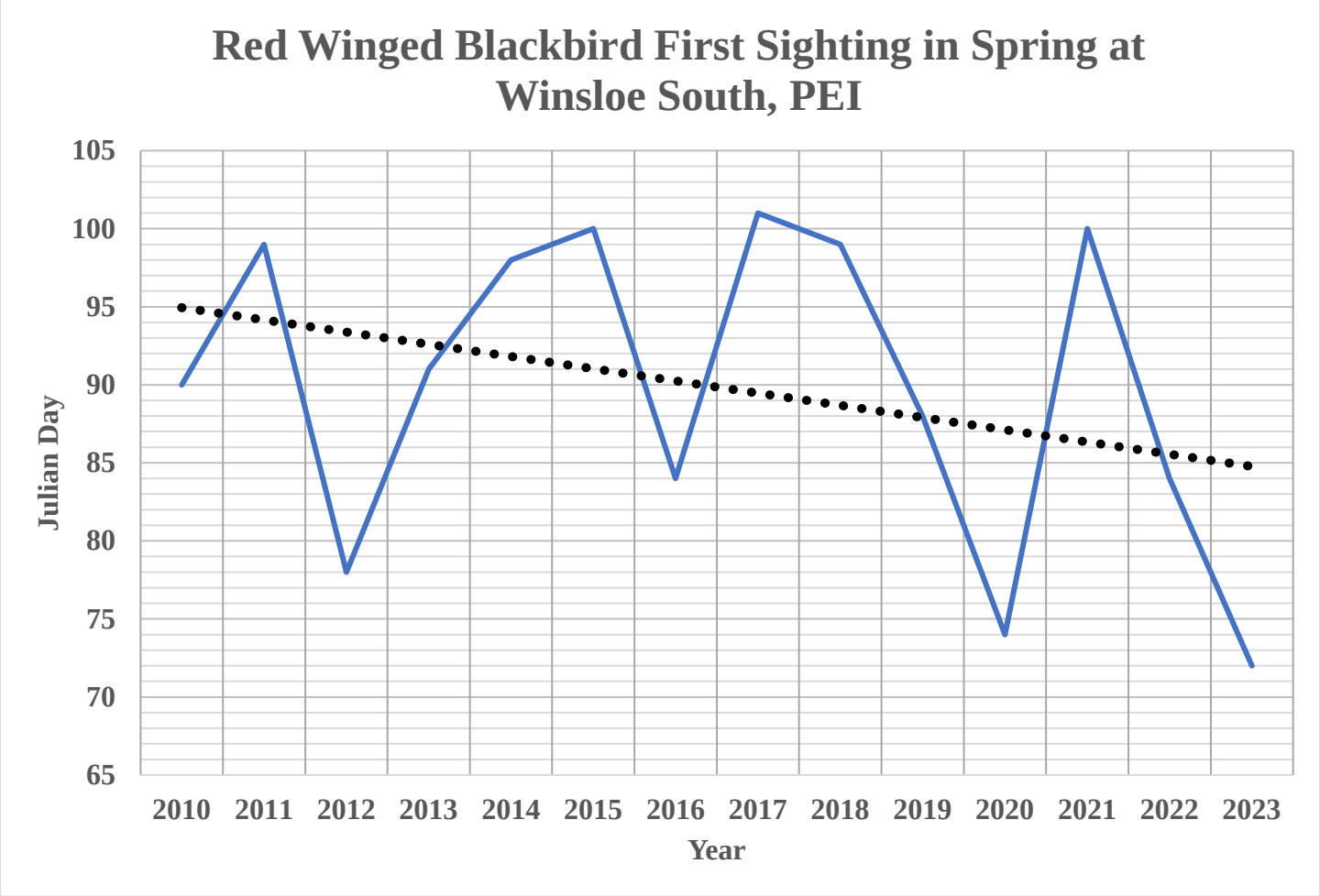

Figure 21: First Spring Sighting of a Red Winged Blackbird at Winsloe South

1.11 Discussion & Summary

The year 2023 had a mixture of weather experiences for the residents of the province. Table 9 provides a monthly summary of the weather for the year.

Table 9 - Annual Climate Summary, 2023

Month	Temperature °C	Precipitation	Highest Average Wind Km/h	Peak Wind Gust -Km/h	Other
January	+5 to 6	Normal in the west, much above in the east.	19.7	126	Warmest January in PEI history
February	Slightly below normal	Below normal	19.6	113	Extreme low for the year -27.8 C
March	Slightly above normal	Below normal	16.3	76	Above normal snowfall
April	Slightly above normal	Below normal	21.3	82	A dry month.
May	Normal	Below normal	18.4	89	Very dry month.
June	Normal to slightly above normal	Above normal	15.6	76	Good growing conditions. No late frost.
July	+4 to 5	Above normal	13.3	83	Warmest July ever recorded at Charlottetown

August	Normal	Above normal	17.9	89	Lots of cloud cover during the month
September	+1 to 2	Below normal east of Portage, above normal west	16.3	91.7	One of warmest Octobers in PEI history. Poor harvest conditions.
October	+2 to 3	Normal in Prince County, above normal elsewhere	15.6	86.0	Snow on 1 day, Oct. 30th.
November	-1 to 2	Below normal in Prince County, normal to above normal elsewhere.	23.0	87.0	Poor harvest conditions, low snowfall, windy
December	+2 to 3	Below normal with higher amounts in the east.	21.7	101	Green Christmas day, no major snow events, windy.

As evident on Table 9 the temperature for most months was above normal with January, July, October, and December being much above normal with extreme high average monthly temperatures being set in January and July. The late winter and early spring precipitation totals were much below normal, but the late spring and early summer months had well above normal precipitation. These conditions made it difficult for farmers and others who depend on the land and soil conditions to make their livelihood to adjust to the highly variable growing and harvest conditions.
This report contains a number of indications that our climate is warming as time marches onward .

- January and July had record high average monthly temperatures (170 years of record) .
- The extreme high temperature for the province was matched on June 1st well before the beginning of summer.
- The number of growing degree days is increasing with time.
- The number of heating degree days is decreasing with time.
- The number of cooling degree days is increasing with time.
- Mean sea level at Charlottetown was the highest in 2023 since records began in 1911.
- The first sighting of Red Winged Blackbirds is gradually getting earlier since 2010.

1.12 Sources:

Canadian Hydrographic Service (DFO), Bedford, NS, January, 2024.
CBC News, Sept. 17, 2023.
CoCoRaHS Volunteer Observers, 2023.
Community Collaborative Rain, Hail & Snow Network, https://www.cocorahs.org/ViewData/, 2023
Devine, K.A, & Mekis, E. 2008, Field accuracy of Canadian rain measurements, Atmosphere-Ocean, 46:2, 213-227, DOI: 10.3137/ao.460202
Environment Canada Historical Climate Data, 2023.
Personal communication with many individuals at various locations, 2023
UPEI, MCPEI, PEIEMO, Climate Data Records 2023

Analyses and report by D.E. Jardine, UPEI Climate School, February 2, 2024