

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

# Prince Edward Island Annual Climate Summary 2022

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Figure 1. Drone photo Pigot's Point, Savage Harbour, Post Fiona ( photo by UPEI Drone Team)

# 1 INTRODUCTION

The most notable climate event of the year 2022 was the major storm, Post Tropical Storm Fiona, which occurred on September 23rd and 24<sup>th</sup>. It is believed that Fiona may have been the worst storm ever experienced on Prince Edward Island causing the most damage of any previous storm accounts in records going back to the 1700s. This storm caused extensive damage to the forests and woodlots, downed power and communication lines, flooding and displacement of homes and buildings in the coastal zone, severe coastal erosion in several areas, extensive wind damage to homes and buildings, flooding damage to motor vehicles, wave damage to boats, fishing gear, aquaculture operations, crop damage in fields across the province. The power was knocked out to 95% of electrical customers in the province totalling 82,000 customers of Maritime Electric Ltd. Maritime Electric reported that damage to their distribution system was about \$35 million and required crews from across eastern & central Canada, northeast USA to come and help restore the power in the province. This process took over 3 weeks to complete.

The Insurance Bureau of Canada reported that the insured damage to property on PEI was over \$200 million. Damage from the storm in eastern Canada totalled \$650 million making Fiona the 10<sup>th</sup> largest extreme weather event in terms of insured damage and the 10<sup>th</sup> most expensive event in the history of insured assets in Canadian history. Provincial and Federal Government aid programs were initiated to assist farmers, fishers, business owners, residential property owners and the general public as finding food and shelter became a difficult task for many islanders. The shellfish sector received targeted support from the federal government via the Hurricane Fiona Recovery Fund in the amount of up to \$40 million to cover costs to the industry not covered by private insurance or other federal and provincial programs.

Some new climate stations were launched in the province during the year, and these are summarized on table 1. As noted in the table some of these stations were damaged by storms and required partial or complete replacement of sensors and supporting structures. The station at Red Head Harbour was hit hard by Fiona and will be replaced in the early part of 2023.

**Table 1: New or Reinstalled Climate Stations on UPEI Network in 2022**

Community	Equipment Owner	Host	Land Use	Date Installed	Equipment
<b>Lennox Island Greenhouse</b>	MCPEI	Lennox Island Band	Greenhouse	May 13, 2022	Onset RX3000: Temp, wind, rain, solar rad., soil temp
<b>St. Peters Bay</b>	UPEI	Climate School	Institutional / agriculture	May 18, 2022	Onset RX3000: Temp, wind, rain, solar rad.
<b>Cavendish</b>	UPEI	Parks Canada	Park	October 12, 2022	Onset RX3000: Temp, wind, rain, solar rad., RH
<b>Greenwich*</b>	UPEI	Parks Canada	Park	October 26, 2022	Onset RX3000: Temp, wind, rain, solar rad., RH
<b>Charlottetown** Yacht Club</b>	UPEI	CYC	Marina	November 2, 2022	Onset RX3000: Temp, wind, rain, solar rad, water level sensor, water temp
<b>Naufrage***</b>	UPEI	Naufrage Harbour Authority	Harbour	November 9, 2022	Onset RX3000: Temp, wind, rain, solar rad, water level sensor, water temp
<b>Glen Valley **</b>	UPEI	Valleyville Farms	Agricultural (dairy)	December 6, 2022	Onset RX3000: Temp, wind, rain, solar rad

\* Upgraded station

\*\* replaced existing station damaged by Fiona

\*\*\* replaced existing station damaged by storms in December 2021 and January, 2022.



Figure 2: UPEI ACC-3030 Class Installing New Climate and Tidal Station at Naufrage Inner Harbour, Sept. 2022.

## 1.1 CLIMATE STATION DATA

A summary of climate data collected on Prince Edward Island for the year 2022 is provided. Data for this summary was collected from 89 climate stations across the province, listed in Table 2 including a full year of record for the UPEI Stations installed in 2021.

Table 2: Instrumented Climate Data for the Year 2022

Location	Owner	T <sub>mean</sub> (°C)	T <sub>max</sub> (°C)	T <sub>min</sub> (°C)	Ppt total (mm)	Max Wind Gust (km/h)	Avg. Wind Speed (km/h)	Avg. Annual Rad. (kWh/m <sup>2</sup> )
Abney	UPEI	7.9	32.8	-23.1	999.4	85.0	8.1	130.4
Abram's Village	UPEI	7.7	31.7	-22.3	1056.9	123.0	16.7	127.4
Albany	UPEI	7.3	33.0	-24.5	967.0	118.0	13.4	136.9
Alberry Plains	UPEI	7.6	33.6	-25.9	1027.2	132.3	11.5	132.6
Alliston	UPEI	m	32.0	-21.8	m	m	m	n
Annandale	UPEI	m	31.4	-21.0	m	119.0		m
Arlington	UPEI	m	35.9	-24.6	m	89.0		m
Baltic	UPEI	7.5	31.9	-20.6		127.4	15.6	155.3
Belmont	UPEI	7.7	30.7	-20.1	984.6	121.4	13.4	147.4
Bideford	MCPEI	7.3	32.8	-24.0	888.5	99.8	8.4	131.5
Borden	Private	7.5	28.3	-18.6	985.7	99.8	12.7	

Location	Owner	T <sub>mean</sub> (°C)	T <sub>max</sub> (°C)	T <sub>min</sub> (°C)	Ppt total (mm)	Max Wind Gust (km/h)	Avg. Wind Speed (km/h)	Avg. Annual Rad. (kWh/m <sup>2</sup> )
Bothwell	UPEI	7.3	31.9	-19.4	m	92.5	11.4	n
Brockton	UPEI	m	32.4	-23.2	m	72.4		n
Brookvale	UPEI	7.2	30.8	-20.4		125.0	11.4	120.3
Brudenell	UPEI	7.6	33.7	-19.1	1036.2	107.0	8.3	131.4
Cable Head E	EC	m	31.9	-17.5	986*	141.0		n
Cape Egmont	UPEI	7.8	30.7	-19.8	m	99.8	11.8	n
Cardigan Head	Private		33.0	-24.7	m	m	m	n
Ch town Air	NAV Can	7.2	30.9	-23.6	1263.0	140.0		n
Ch town VK	Private	7.5	32.4	-18.8	1118.4	114.3	8.3	134.2
Ch town YC	UPEI	m	30.2	-20.2	m	115.0	11.8	m
Darlington	UPEI	7.5	32.7	-22.1	1070.6	109.0	10.6	134.5
Dingwells	UPEI	7.6	32.4	-23.6	m	83.7	7.6	n
East Baltic	UPEI	7.5	32.1	-21.0	1105.2	136.0	9.2	142.2
East Point	EC	7.5	32.9	-18.5	931.4	149.0		n
Elmwood	Private	m	30.7	-22.8	1366.5			n
Fanning Brook	UPEI	7.9	32.4	-24.3	m	86.9	8.2	n
Flat River	UPEI	8.0	30.7	-23.6	m	75.6	7.0	n
Fox Island	UPEI	7.7	34.6	-22.6	1020.0	103.4	10.0	141.7
Foxley River	UPEI	7.7	32.9	-22.7	m	91.7	9.2	n
Georgetown Wharf	UPEI	8.1	33.4	-17.9	888.0	112.0	15.5	131.5
Glen Valley	UPEI	7.4	31.9	-20.1	m	95.0	11.5	n
Graham's Pond	UPEI	m	32.8	-19.5	m	121.0	13.7	m
Graham's Road	UPEI	7.2	31.8	-20.0	1028.4	133.0	16.0	127.5
Grand Tracadie	UPEI	7.7	31.9	-21.5	902.2	84.9	6.4	n
Greenwich	PC	7.7	31.4	-20.7	m	104.6	9.3	m
Hampton	UPEI	7.7	32.3	-22.3	923.8	109.0	12.6	138.7
Harrington	EC	7.3	33.1	-21.1	1022.0	96.0		n
Heatherdale	UPEI	7.8	33.9	-24.9	1060.6	90.0	7.7	128.1
Hog Island	MCPEI	m	33.1	m	m	109.0	m	
Iona	UPEI	7.8	33.3	-21.5	1009.6	114.0	9.3	130.7
Johnstons R	UPEI	7.9	32.7	-22.9	964.2	115.0	10.1	137.0
Lennox Island GH	MCPEI	m	32.9	m	m	m	m	m
Lennox Island	MCPEI	7.7	31.5	-22.2	874.8	120.0	17.0	151.7
Little Sands	UPEI	7.9	31.6	-18.1	862.4	118.0	11.2	132.4
Lower Freetown	UPEI	7.6	32.6	-24.9	1055.0	137.1	12.1	128.7
MacAulay's Wharf	UPEI	8.2	34.5	-22.1	m	123.0	14.8	132.5
Maple Plains	EC	6.8	31.7	-27.2		97		N
Mt. Vernon	UPEI	7.8	33.3	-19.1	984.6	118.0	10.5	138.6
Naufrage	Private		32.3	-20.4	m	152.9		n
Naufrage Harbour	UPEI	m	m	m	m	m	m	m
New Glasgow	UPEI	7.4	33.4	-21.8	994.0	121.0	9.3	128.8
New Glasgow	Private		31.5	-23.0	1035.1+			N
New Zealand	UPEI	7.2	32.0	-22.2	983.0	105.0	11.1	127.8

Location	Owner	T <sub>mean</sub> (°C)	T <sub>max</sub> (°C)	T <sub>min</sub> (°C)	Ppt total (mm)	Max Wind Gust (km/h)	Avg. Wind Speed (km/h)	Avg. Annual Rad. (kWh/m <sup>2</sup> )
Newton Rd	UPEI	7.6	32.4	-24.6	1044.8	131.0	11.8	135.6
North Cape	EC	7.4	30.8	-18.3	1020.6	136.0	m	n
North Lake	PEIEMO	7.9	32.7	-17.7	m	129.8		119.7
North Milton	UPEI	7.5	31.5	-21.0	1021.8	111.8	10.4	144.4
North Rustico	PC	m	m	m	m	m	m	n
Norway Onset	UPEI		31.6	-18.8	m	95.0		m
Norway VP	UPEI	7.1	31.3	-18.7	m	91.7	14.3	n
Norway VV	UPEI	7.1	31.2	-18.7	m	90.1	14.0	n
O’Leary	UPEI	7.1	32.6	-25.9	867.2	95.0	11.7	131.0
Orwell	UPEI	8.3	33.3	-18.5	878.2	153.0	10.0	134.4
Pt Prim	UPEI	8.2	33.8	-21.7	878.8	126.0	9.2	141.6
Red Head	MCPEI	m	31.8	-20.7	m	137.0	17.9	m
Riverdale	UPEI	7.6	32.3	-24.2	1130.8	102.0	7.0	135.8
Rocky Pt	MCPEI	7.4	31.3	-21.3	m	88.5	5.0	m
Savage Harbour	ACS	7.6	31.8	-20.2	m	107.8	13.1	
Scotchfort	MCPEI	7.1	31.6	-22.4	m	109.4	6.5	
Shamrock	UPEI	7.3	31.7	-21.1	937.6	151.5	11.3	142.9
Skidders Pond	UPEI	m	m	-19.9	m	118.0	16.4	m
Souris	PEIEMO	7.8	30.6	-17.0	870.2	102.2	6.1	134.5
South Lake	Private	7.8	33.1	-19.1	m	74.0	5.5	n
SSide Airport	EC	7.2	30.8	-22.5	1013*	140.0	m	n
SSide Wharf	PEIEMO	7.9	30.8	-22.5	m	105.8	7.4	152.9
St. Catherine’s	UPEI	7.8	30.3	-21.3	m	82.1	6.8	n
St. Peters CS	UPEI	m	32.9	m	m	113.0	m	m
Stanhope	EC	7.5*	31.5	-21.7	1276*	131.0	m	n
Stratford	UPEI	7.8	32.2	-19.0	m	142.0	12.6	142.4
Sturgeon	UPEI	7.7	33.8	-23.7	971.5	107.0	7.0	130.2
Tignish Acadian	UPEI	7.0	32.4	-24.8	m	64.4	5.0	137.4
Tignish Wharf	PEIEMO	7.4	33.4	-18.8	939.0	111.8	14.9	n
Upton	UPEI	7.1	35.1	-26.7	1095.0	75.0	3.5	121.4
Victoria	UPEI	7.8	29.7	-21.5	m	100.0	11.6	130.6
Warren Grove	UPEI	7.7	33.0	-25.0	1036.2	85.0	7.3	133.8
Waterside	UPEI	8.2	34.1	-20.9	m	117.8	11.8	135.5
West Cape	UPEI	7.3	32.3	-18.9	1006.0	117.8	16.5	158.6
West Point	MCPEI	7.3	31.9	-25.9	m	85.3	7.5	129.6
White Sands	Private	7.4	29.7	-18.6	988.4	98.2	14.5	n
Winsloe South	UPEI	7.2	31.0	-20.3	1307.8	95.0	3.7	n
York	UPEI	m	35.1	-22.1	m	94.0	m	m

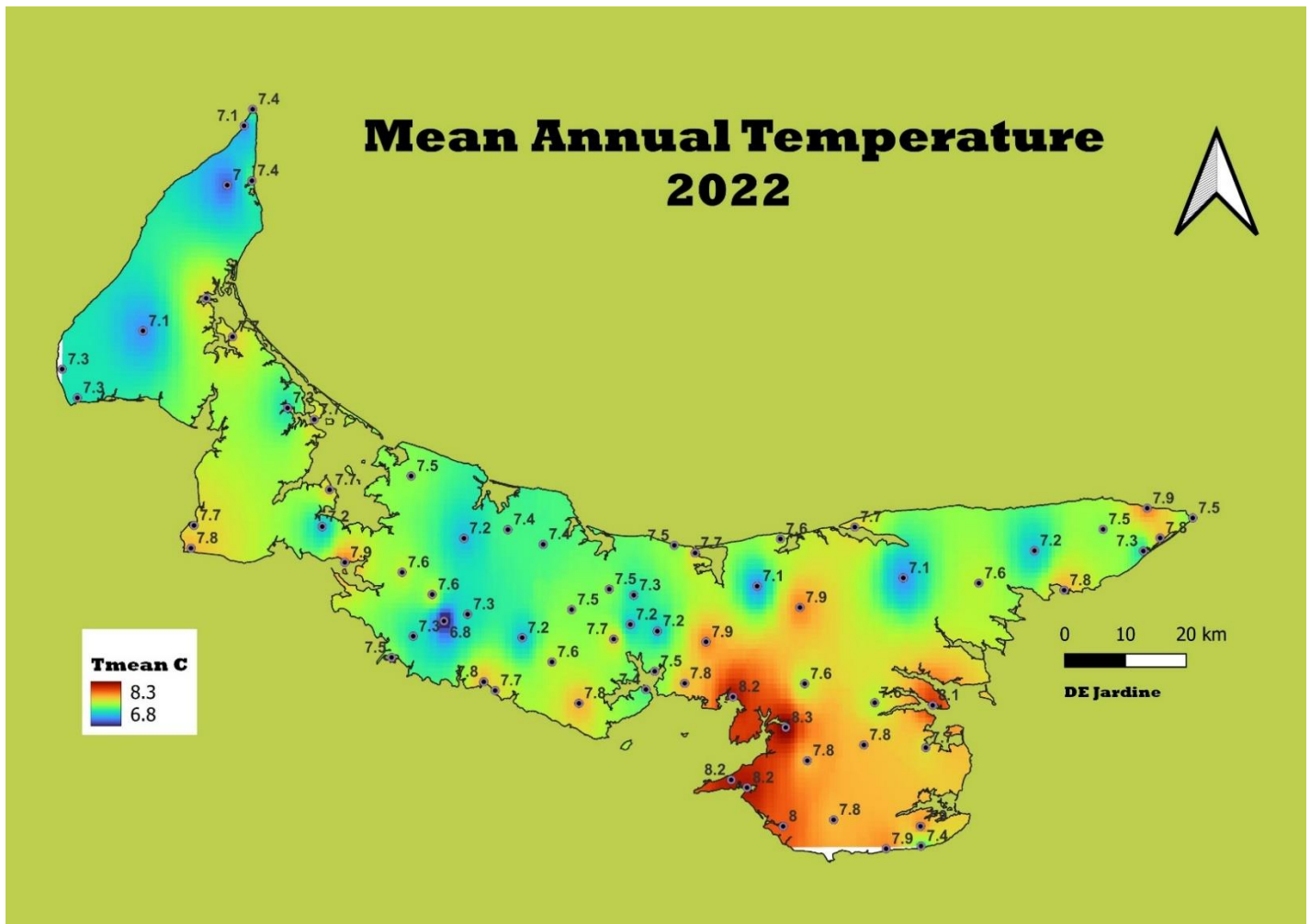
\*Partial data either due to power outage, storm damage or non heated automated gauges.

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

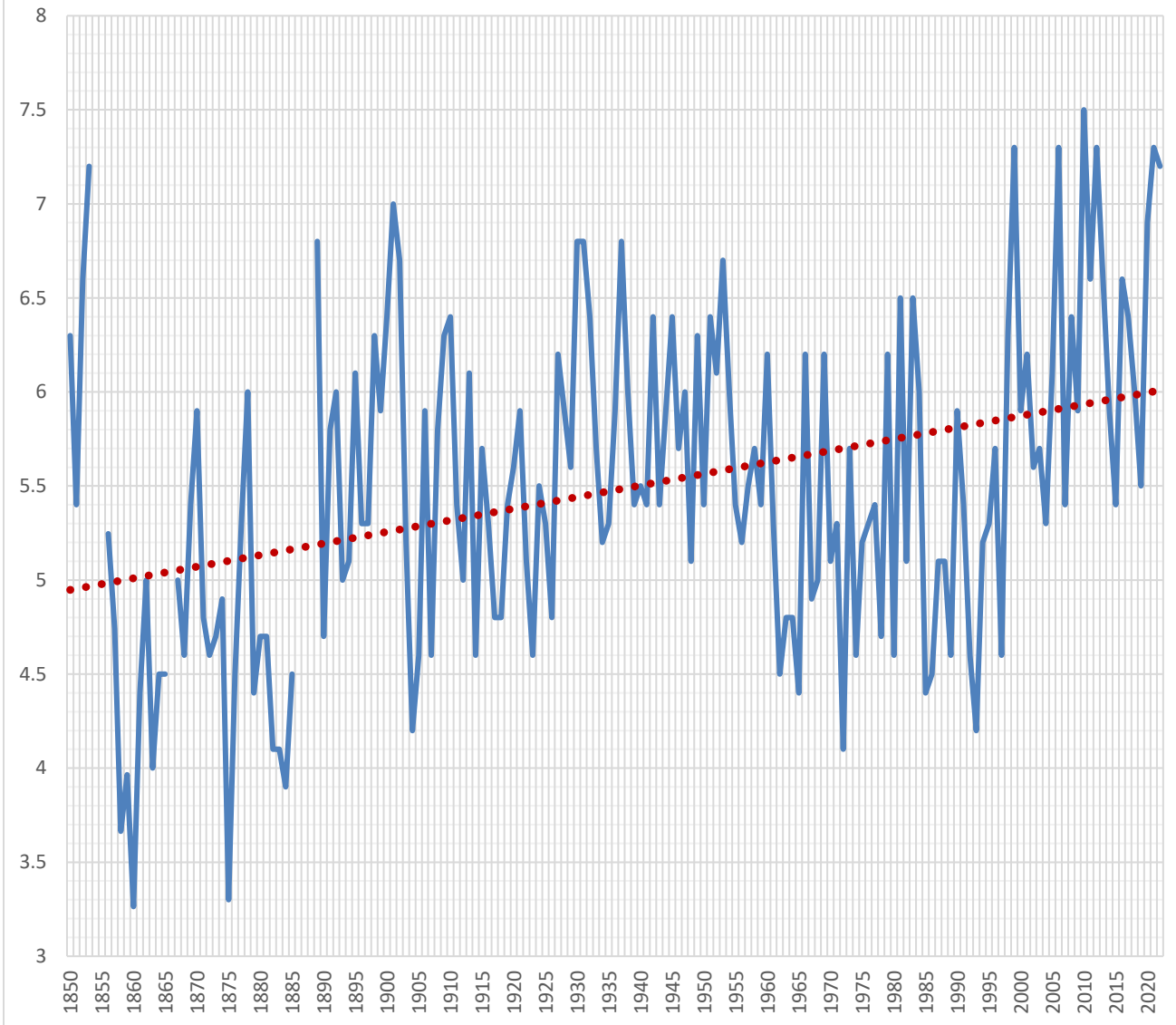
The mean annual temperature for PEI is mapped in Figure 3 using interpolation between reporting climate stations. There was a 1.5°C range (6.8 to 8.3°C) for the 71 reporting stations with met the requirement for plotting. This map reveals that the southern and southwestern areas of Queens and Kings counties were warmer overall than other locations with a few local exceptions.



- **Figure 3. Interpolated mean annual temperature, 2022, for 71 Stations across PEI (°C).**

The year 2022 tied with the year 1853 as the sixth warmest year since 1850, when instrumented temperature records began to be kept in the Charlottetown area, with a mean annual temperature of 7.2°C at the Charlottetown Airport location. Mean annual temperature in Charlottetown from 1850 to 2022 is provided in Figure 4. The five warmest years in the history of instrumented climate observation in Charlottetown have occurred since 1998. The temperature reached 20°C on 92 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 October and November having the highest at 3 to 4 degrees above the 30-year normal temperature.

## Mean Annual Temperature Charlottetown 1850 to 2022



**Figure 4. Mean annual temperature in °C at Charlottetown from 1850 to 2022.**

The maximum daily temperature reached a peak of 35.9°C at the Arlington station on August 21<sup>st</sup>, 2022. This same temperature was recorded at Tignish in 2020, Arlington in 2021, and is tied for the fourth highest daily temperature recorded for any date in the history of weather records for the province (Table 3). The minimum daily temperature of -27.2°C for the year was recorded at the Environment Canada Station at Maple Plains on January 22<sup>nd</sup>.

**Table 3. Top five extreme maximum temperatures ever recorded in the province.**

Location	Date	T <sub>max</sub> (°C)
<b>Charlottetown</b>	August 19, 1935	36.7
<b>Alliston</b>	August 12, 1944	36.1
<b>Tignish</b>	May 22, 1977	36.1
<b>Tignish (Acadian)</b>	June 19, 2020	35.9
<b>Arlington Orchard</b>	August 13, 2021	35.9
<b>Arlington Orchard</b>	August 21, 2022	35.9

### 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. The mean temperature for a day is compared to the benchmark which is set at 18.0°C. If the mean temperature for a day falls below 18.0 then it requires a heat source to bring the room temperature back to the benchmark. So, a mean temperature for a day of 17.0 would be equal to 18.0-17.0= 1.0 degree days.

For cooling degree days, the opposite is true. If the mean temperature for a day is 19.0°C then this would be equal to one cooling degree day. A cooling source such as an air conditioner or heat pump would be required to bring the temperature down to the benchmark temperature of 18.0°C. 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.

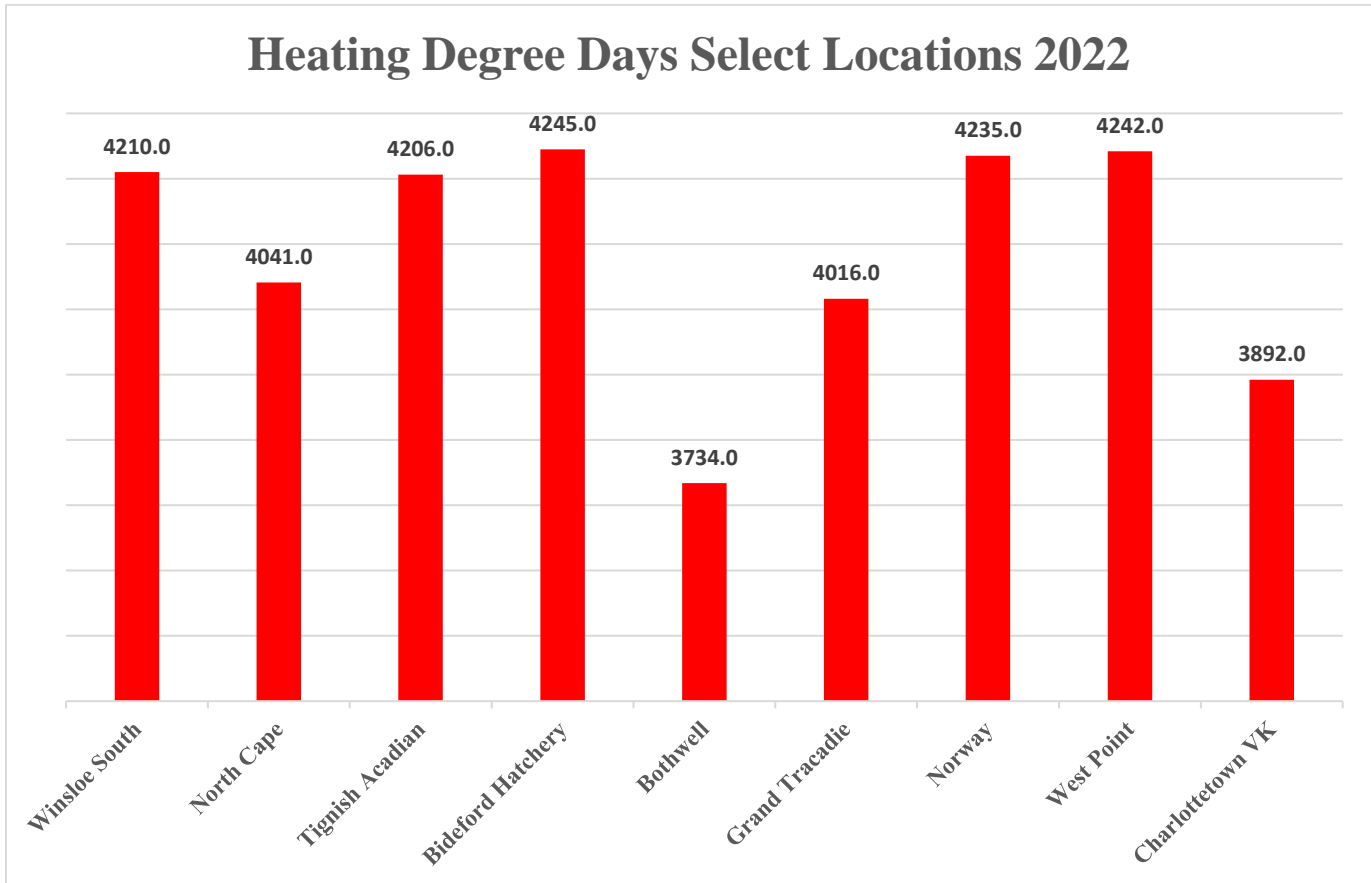
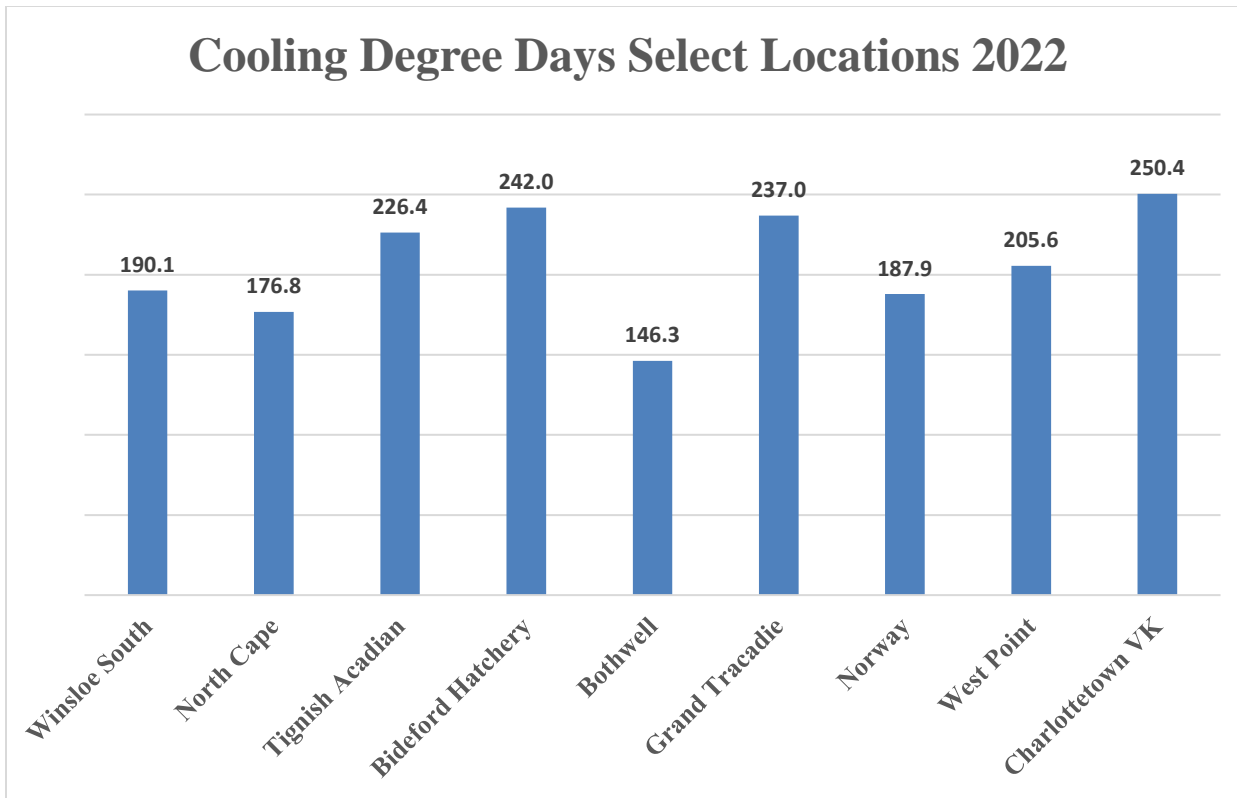


Figure 5: Heating Degree Days at Select Locations

As observed on Figures 5 and 6, the station at Bothwell has both the lowest heating degree day and cooling degree day totals for 2022. One possible explanation for this is due to the geographic location of Bothwell in Eastern Kings County where the province narrows subjecting the area to the cooling influences of water from the Gulf of St. Lawrence and Northumberland Strait on 3 sides in the summer and the warming influences of these water bodies during the fall and winter months especially when there are ice free conditions as the result of a warming climate and resultant higher sea water temperatures.



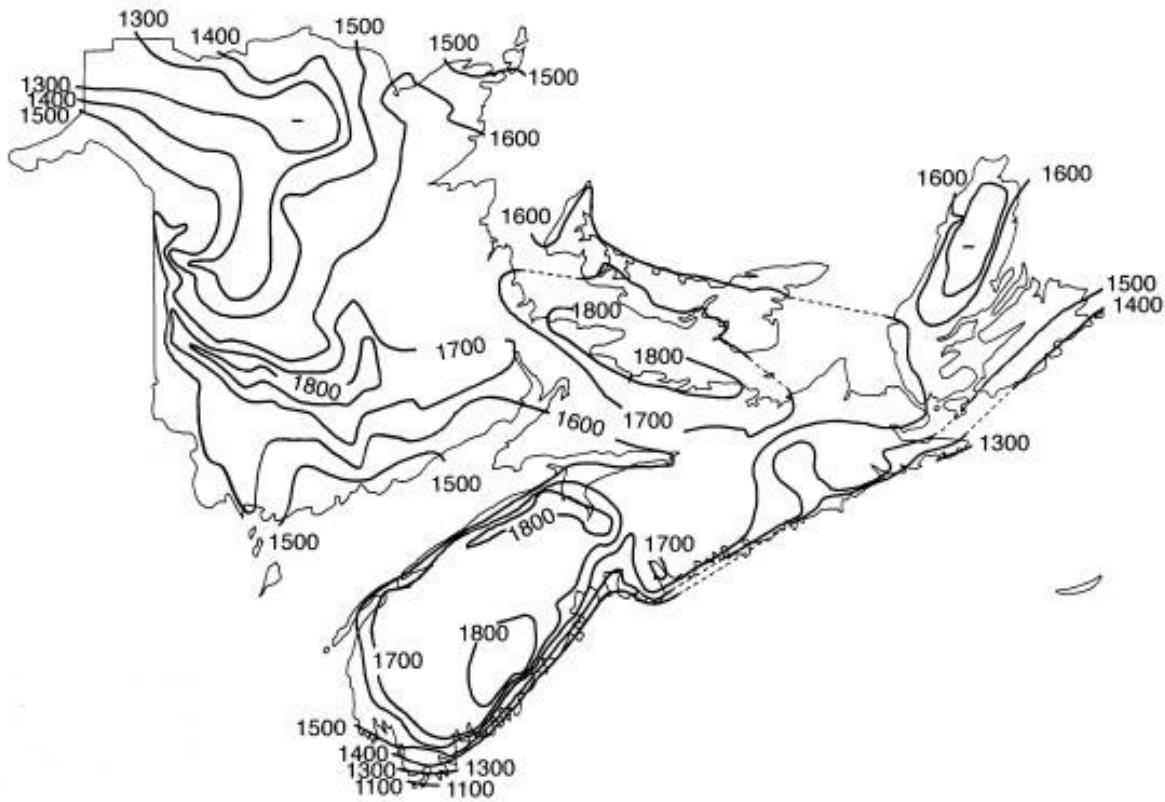


**Figure 6: Cooling Degree Days at Select Locations**

### 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 old 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.

A previous study of growing degree days in Atlantic Canada was conducted by Gordon and Bootsma and this was published in 1993. Data from 8 locations on PEI was used in the study and the map from their report shown on Figure 7 and it reveals the growing degree days available ranged from 1600 to less than 1800 on Prince Edward Island.



**Figure 7: Growing Degree Day Map for the Maritime Provinces, 1993 from Gordon & Bootsma**

The growing degree days for 2022 were calculated for a number of PEI locations as listed on Table 4.

**Table 4 PEI Growing Degree Days 2022 at Select Locations.**

<b>Location</b>	<b>Number of GDDs</b>
<b>Summerside Airport</b>	2035
<b>Charlottetown Airport</b>	2005
<b>Tignish Acadian Machine Works</b>	2050
<b>Bothwell</b>	1974
<b>Winsloe South</b>	1972.2
<b>Grand Tracadie</b>	2128
<b>West Point</b>	2110
<b>North Cape</b>	2014.3

From 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 Winsloe South but is not as pronounced as the Charlottetown location.

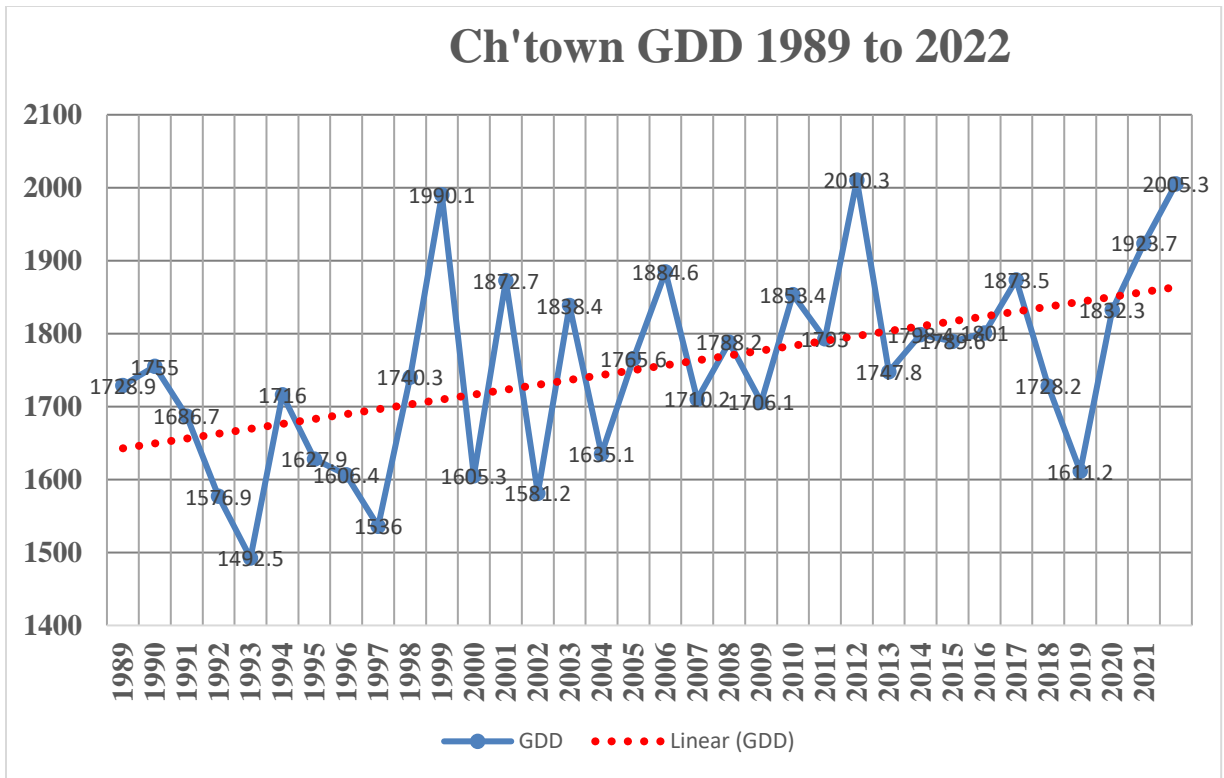


Figure 8: Charlottetown Airport GDD 1989 to 2022. (some surrogate data used for 2012 and 2022 due to missing data)

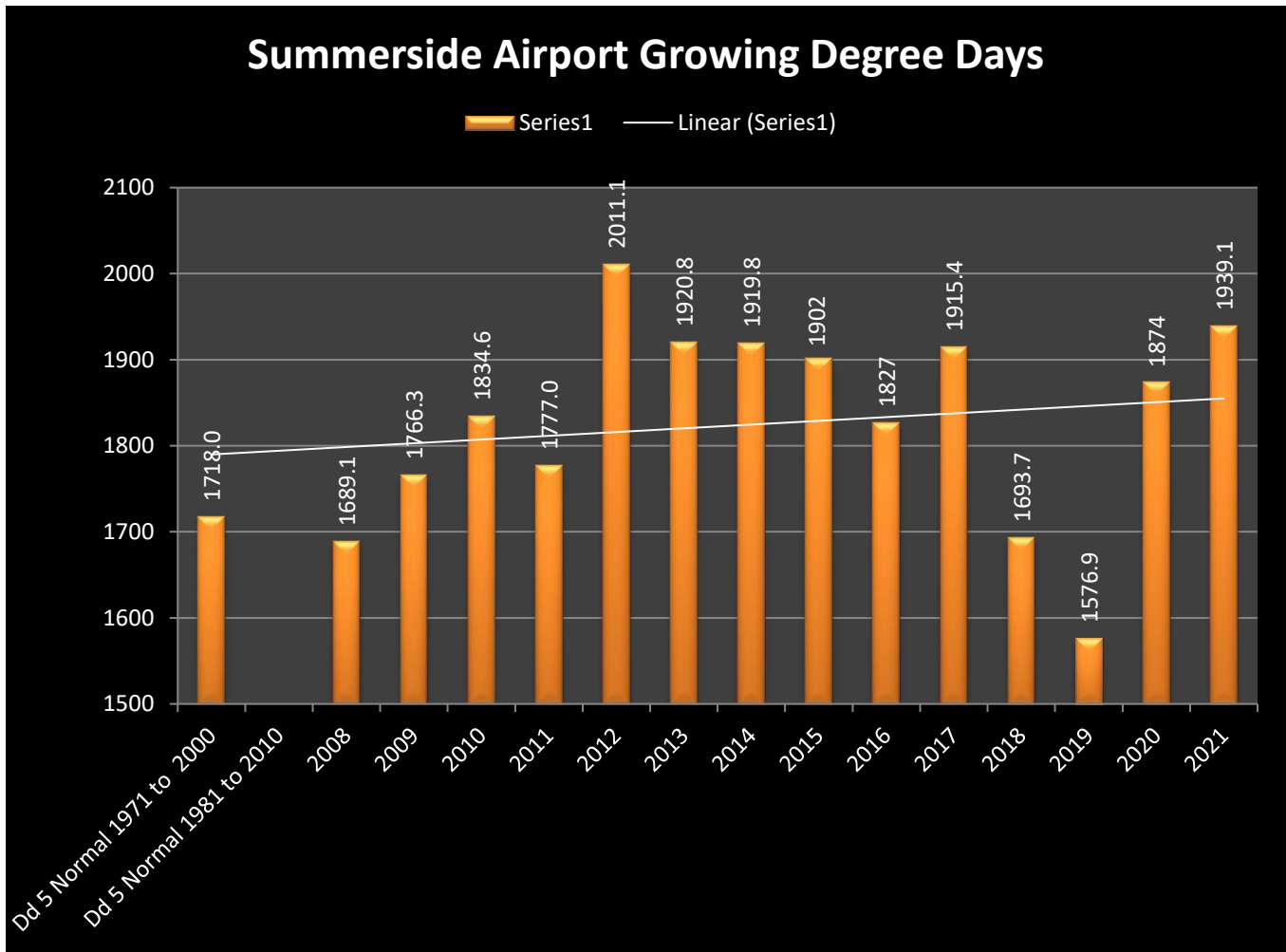


Figure 9: Summerside GDD in Recent Years

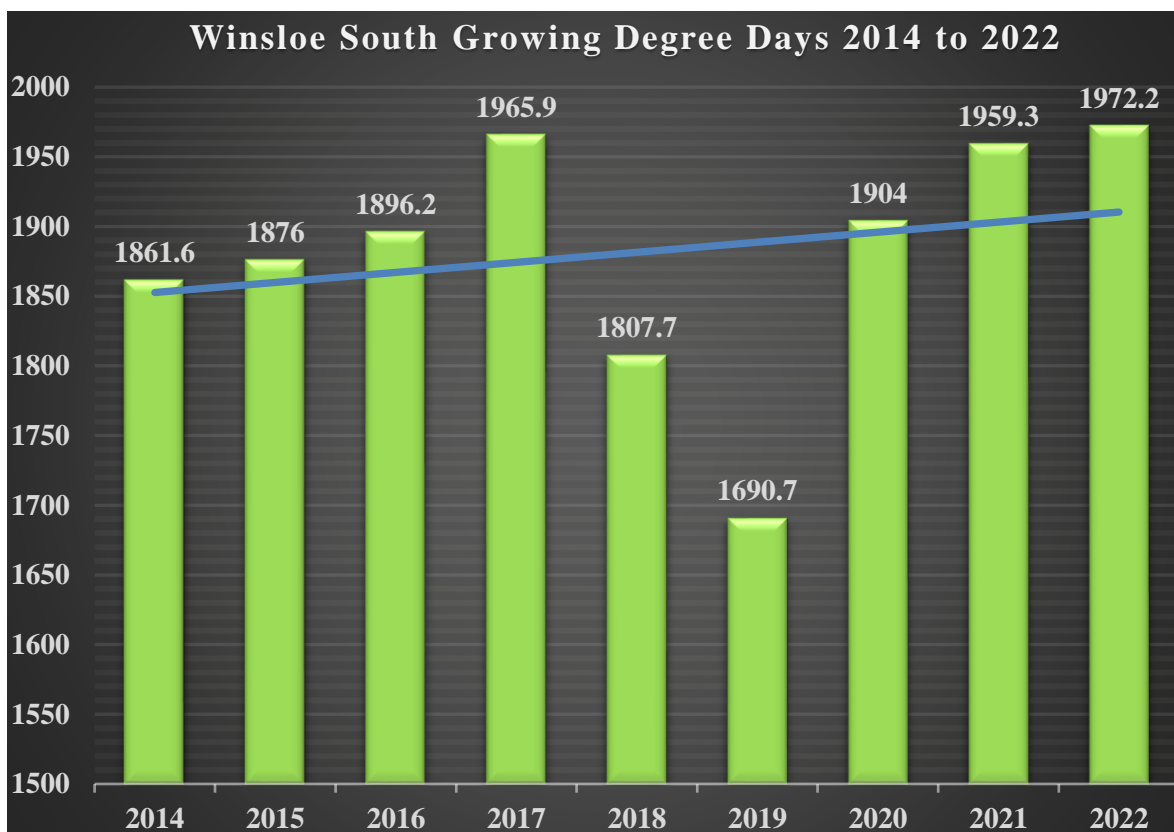


Figure 10: Winsloe South GDD 2014 to 2022

## 1.5 PRECIPITATION

Total precipitation amounts were calculated for 21 Community Collaborative Rain, Hail & Snow Network (CoCoRaHS) observation locations in the province. These 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”*.

These amounts are provided in Table 5 and are included in the distribution map shown in Figure 11.

**Table 5. CoCoRaHS precipitation amounts at 21 locations in PEI, 2022.**

CoCoRaHS Station	Total Precipitation (mm)	Total Snowfall (cm)	Extreme Daily Rain (mm)
CAN-PE-1 Stratford	815.9*	45.7*	65.8 on Sept. 24th
CAN-PE-3 Wellington	1350.5	237.0	73.2 on Sept. 24 <sup>th</sup>
CAN-PE-7 Morell	1210.6	375.9	*
CAN-PE-10 New London	1249.2	238.5	59.4 Sept. 24 <sup>th</sup>
CAN-PE-13 Bedeque	1097.0	105.6	64.5 Sept. 24 <sup>th</sup>
CAN-PE-19 Winsloe South	1308.1	370.5	68.3. Sept. 24th
CAN-PE-20 Bonshaw	1366.5	289.4	65.3 on Sept. 24th
CAN-PE-23 Borden	658.5*	n	*
CAN-PE-25 – Caledonia	1164.0	312.5	43.9 Feb. 9th
CAN-PE-26 – Grand Tracadie	1171.3	120.1	63.8 on Sept. 24 <sup>th</sup>
CAN-PE-38 Chepstow	1276.9	n	107.2 on Sept. 24th
CAN-PE-43-Glencoe	1157.1	287.9	77.7 on Sept. 24th
CAN-PE-46- Iris	1069.4	62.0	76.5 on Sept. 24th

<b>CAN-PE-47 Long Creek</b>	1137.8	279.7	42.4 on July 7th
<b>CAN-PE-50-Bedford Corner</b>	1385.7	267.2	67.6 on Sept. 24th
<b>CAN-PE-54- Foxley River</b>	1315.5	286.0	35.8 on Feb. 5th
<b>CAN-PE-66 North Granville</b>	1237.3	n	62.0 on Aug. 9th
<b>CAN-PE-70 Flat River</b>	1044.5	78.8*	73.4 on Sept. 24th
<b>CAN-PE-74 St. Georges</b>	966.7	266.3	44.2 Feb. 9th
<b>CAN-PE-75 Fox Island</b>	1097.2	n	39.1 on Sept. 23rd
<b>CAN-PE-77 Norway WEICan</b>	797.7*	14.7*	*

\* - incomplete record

n – not measured at this location.

The climate normal data compiled in Table 6 were used to determine the deviation from normal values in 2022. This was derived from the climate normal website of Environment and Climate Change Canada

([https://climate.weather.gc.ca/climate\\_normals/](https://climate.weather.gc.ca/climate_normals/)).

**Table 6 – Climate Normal Annual Temperature & Precipitation Data for PEI Climate Stations (1981 to 2010)**

Site	Normal Mean Temp. C	Normal Annual Precipitation (mm)
<b>Charlottetown</b>	5.6	1158.3
<b>Summerside</b>	5.7	1072.9
<b>Monticello</b>	5.8	1170.2
<b>O’Leary</b>	5.5	1147.8
<b>East Baltic</b>	5.6	1272.0
<b>Alberton</b>	5.5	1053.1
<b>New Glasgow</b>	5.8	1257.9

Figure 11 displays the total annual precipitation for 46 stations across the province, including the 17 CoCoRaHS stations (Table 4), and 29 automated stations with sufficient and reliable data (Table 2). Total precipitation for the west Prince County area was somewhat below normal, but eastern Prince County, Queens County, and Kings County ranged from normal to higher than normal compared with the values listed in Table 6. The average annual precipitation in Charlottetown from 1872 to 2022 in Figure 12 confirms that total precipitation was greater than 200 mm above normal in 2022 and the trend lines for total annual rainfall and total precipitation (snow and rain) have been gradually increasing since 1872.

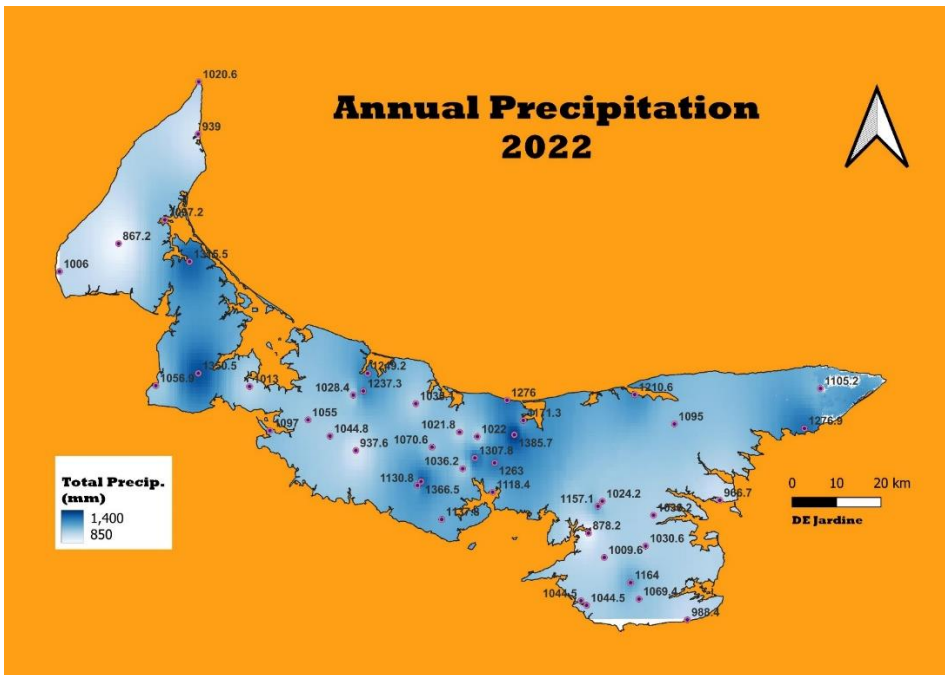


Figure 11. Interpolated annual precipitation for 46 stations across PEI.

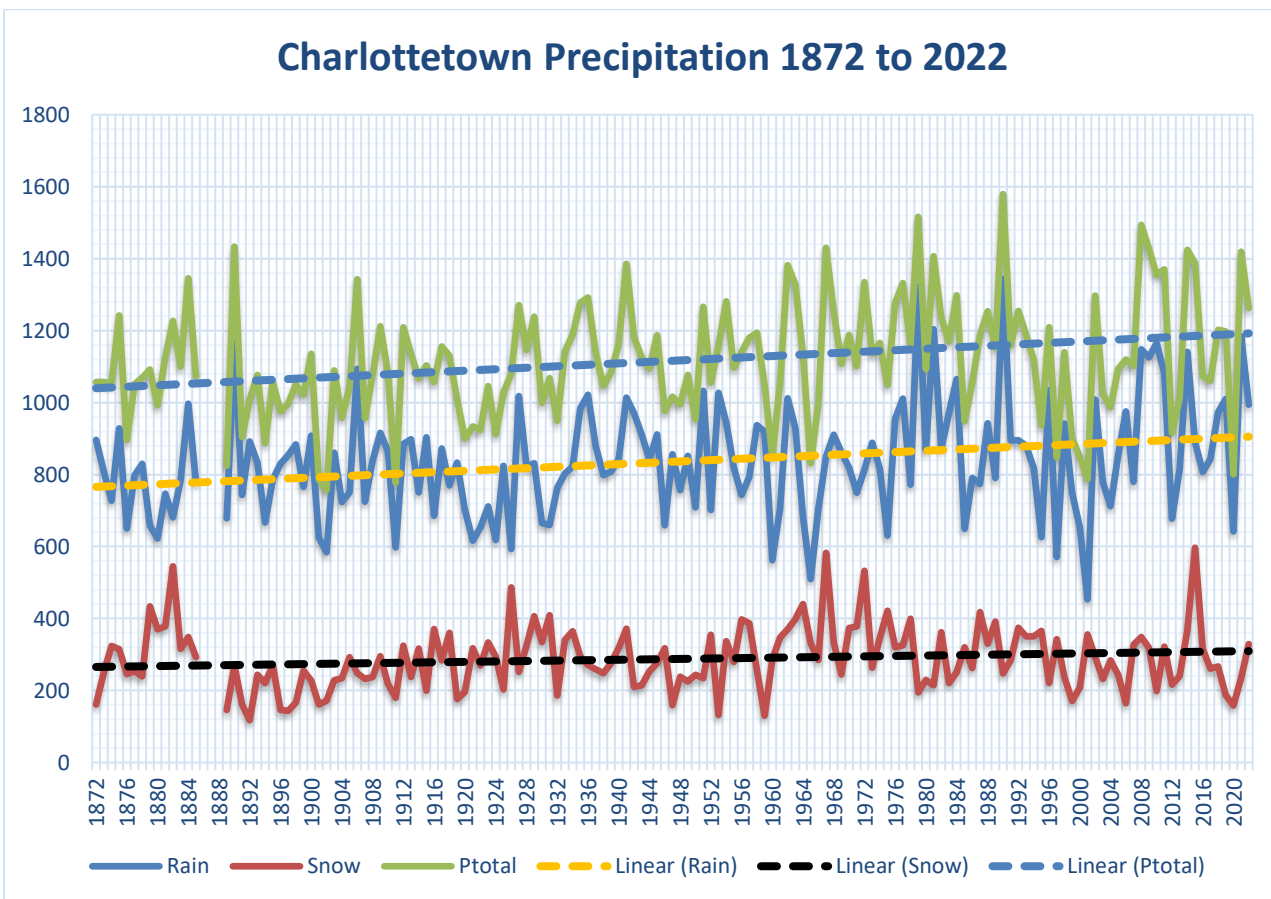


Figure 12. Annual precipitation at Charlottetown Since 1872.

Mean annual rainfall and total precipitation totals for 2022 were about 100 mm less than the previous year but snowfall amounts were nearly 100 cm higher than 2021.

## 1.6 WIND

The major wind event of 2022 was Post Tropical Storm Fiona on September 23<sup>rd</sup> and 24<sup>th</sup> with wind gusts over 150 km/h reported from some stations. The PEI Energy Corporation recorded the highest peak gust of 169.9 km/h on a wind tower at East Point, 82 m above the ground in the early morning (2:00) of September 24<sup>th</sup>. The areas with the highest peak wind gusts listed on table 1 during the year are shown on Figure 13 in a light to dark green colour. Areas with the lowest peak wind gusts are shown in a brownish shade and includes many sections of Prince County west of Miscouche.

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 6 locations listed on table 1 which have an average annual wind speed of at least 16.0 km/h.

- Red Head Harbour .....17.9 km/h (Data missing after Fiona)
- Lennox Island Wharf .....17.0 km/h
- Abram’s Village Wharf..... 16.7 km/h
- West Cape MacLennan Farm.....16.5 km/h
- Skinner’s Pond Wharf.....16.4 km/h
- Graham’s Road Mull Na Beinne Farms...16.0 km/h

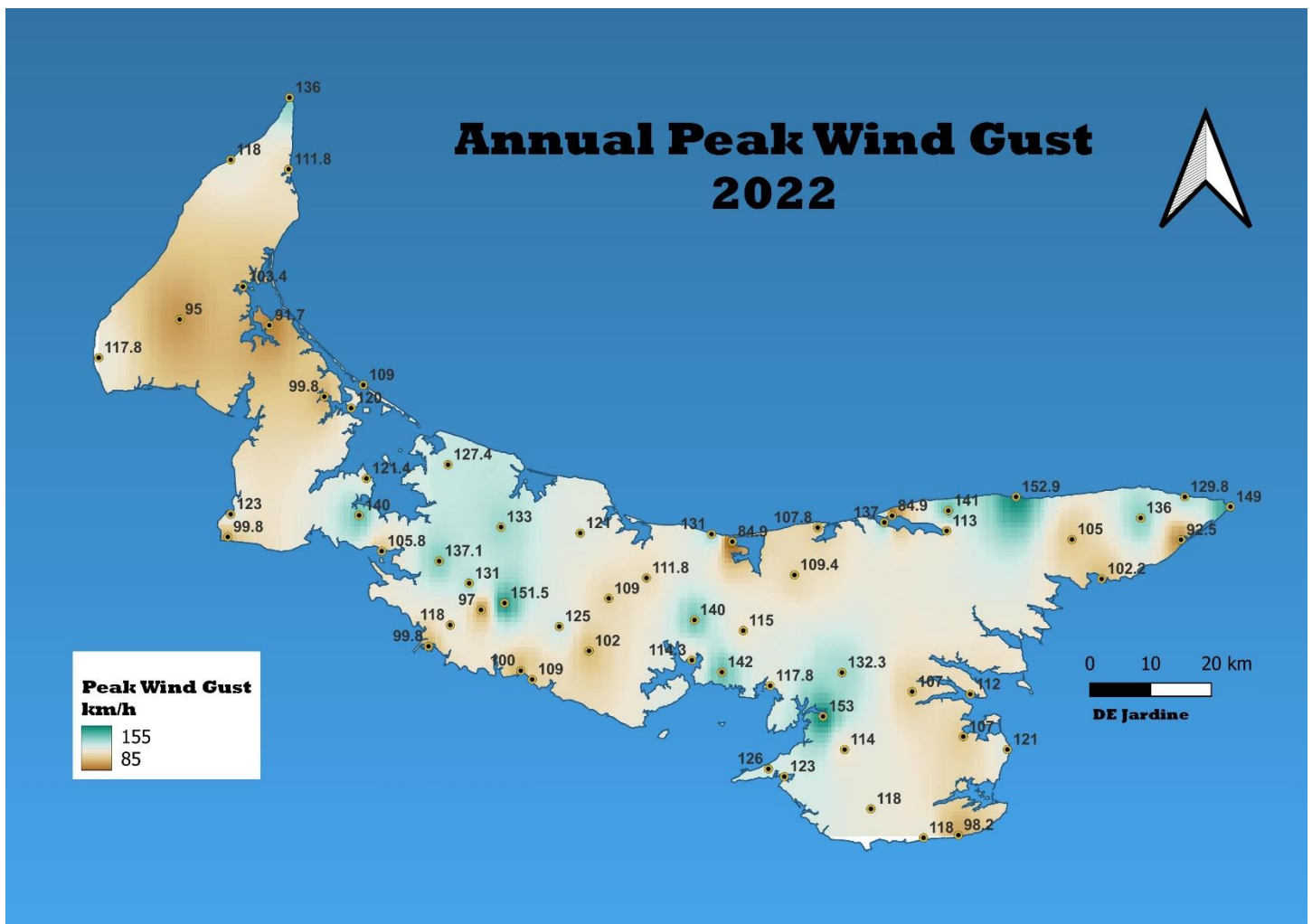


Figure 13: Peak Wind Gust Reported in 2022

## 1.7 SEA WATER LEVELS

Water level data relative to local datum (top of pipe) for stations equipped to monitor sea level and sea water temperature are presented in Figures 14. There were significant storm surge events during two storms in January and also during Post Tropical Storm Fiona in late September and the impacts of these on monthly peak water levels in evident in Figure 14.

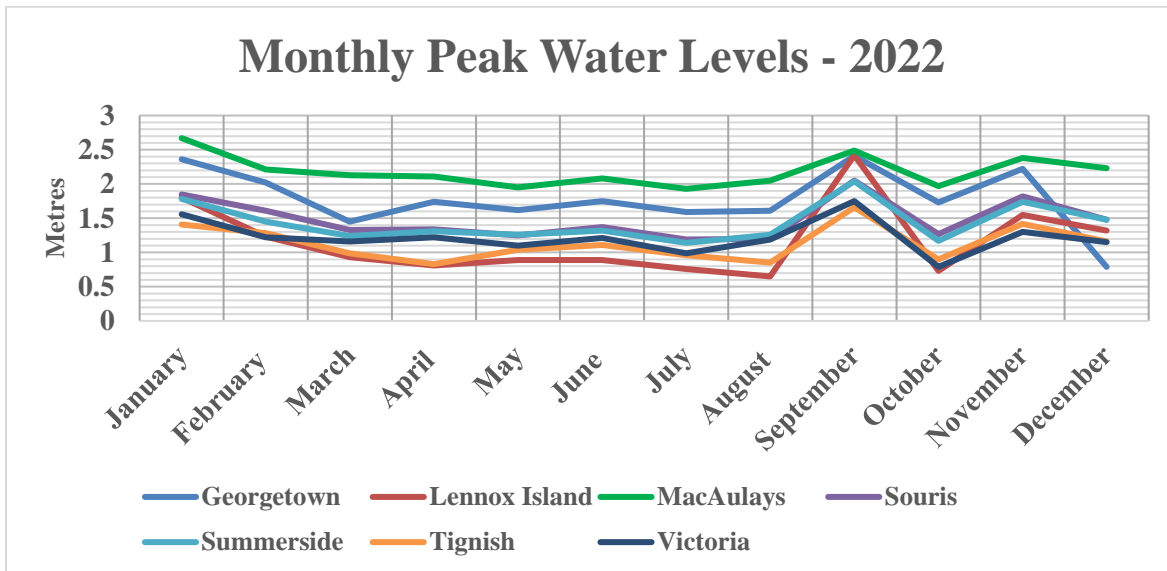


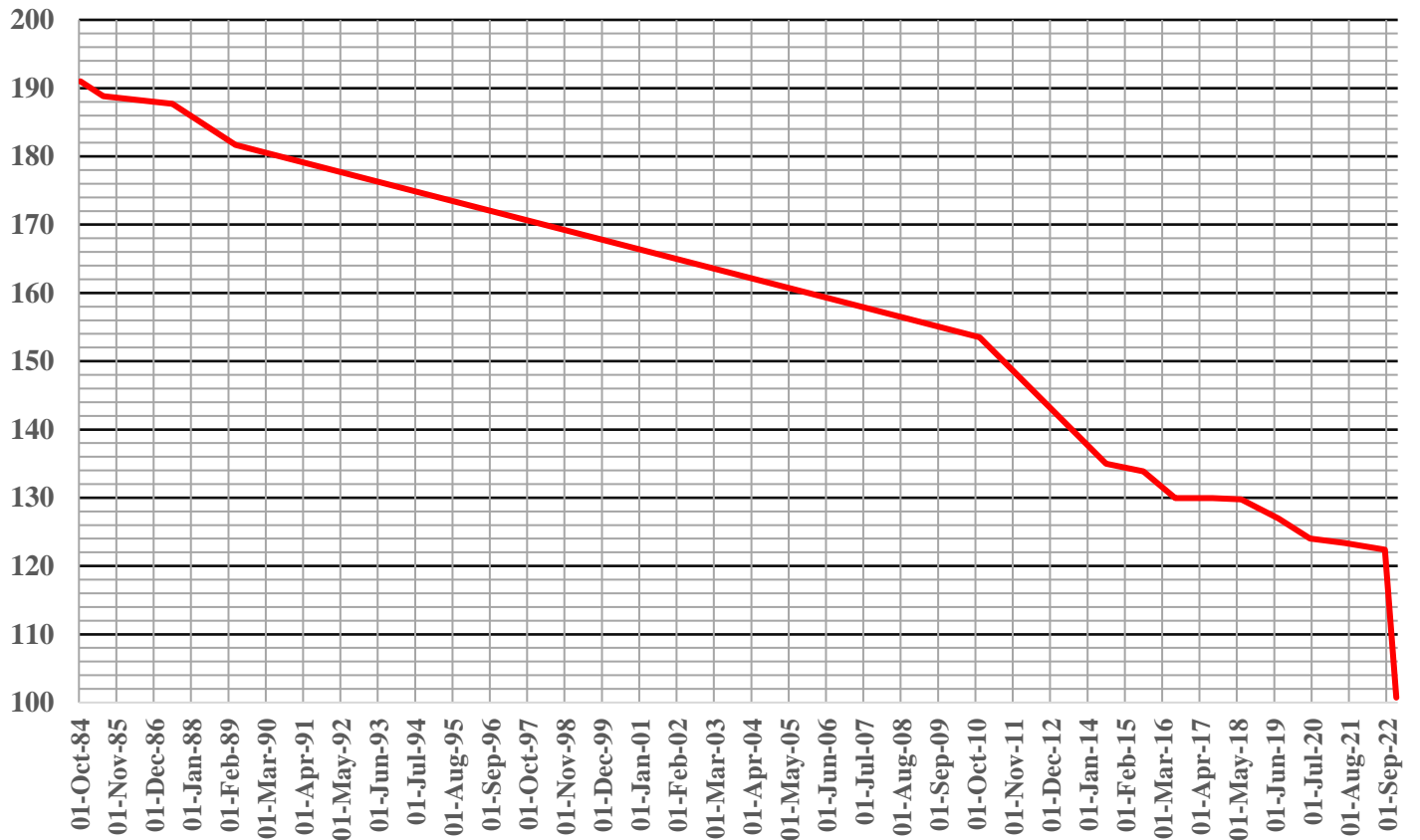
Figure 14: Monthly Peak Water Levels Select Locations

The storm surge from Fiona resulted in extreme erosion on coastal areas which are exposed to wave action from a northerly quadrant. The storm surge reach was the highest that has been observed in recent memory and this includes the surge from Post Tropical Storm Dorian. Shoreline protection structures of all types were overtopped, and many were severely damaged or compromised. The erosion in many coastal areas was the worst ever observed and with losses of shoreline over 10 metres in many areas with the worst reported at Ebbsfleet at 26 metres.

One area where the UPEI School of Climate Change and Adaptation has been measuring shoreline erosion with peg line and drone measurements is at Pigot's Point in the Savage Harbour area. At one location on Vespa Lane peg line measurements which are measured on the ground, have been collected from the north east corner of a cottage to the edge of the cliff beginning in 1984. Two measurements were taken in 2022, pre and post Fiona. The observations recorded over the years is shown on Figure 15.

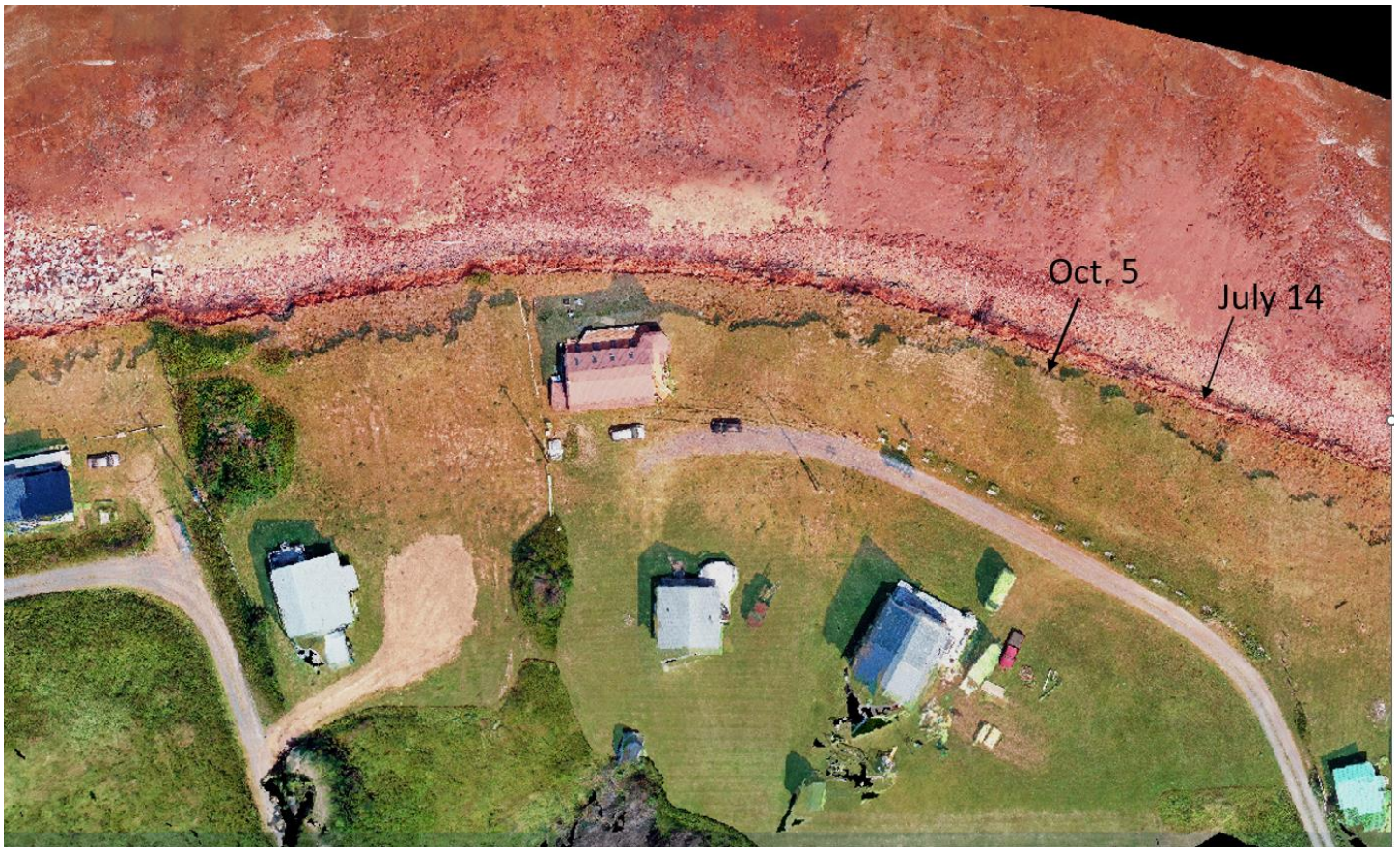


## Peg Line Shoreline Erosion Measurements 35 Vespa Lane Distance to Cliff (feet) 1984 to 2022



**Figure 15: Peg Line Shoreline Erosion Measurements at Pigot's Point**

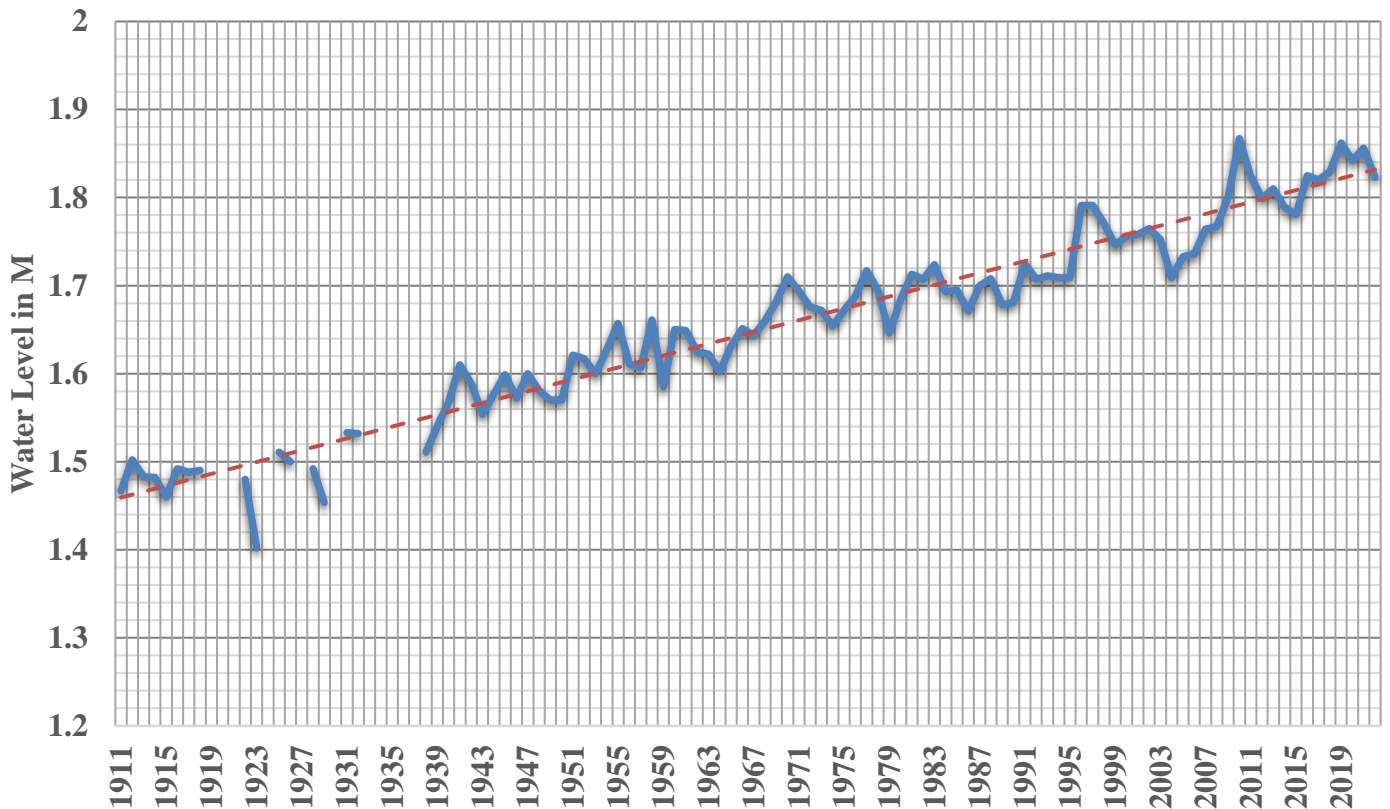
It is clear from Figure 15 that the land lost as a result of Fiona (6.6 m or 21.7 feet) was excessive and it contributes 24% of the land lost to the sea at this location since October of 1984 in a single storm event. The change is clearly evident on Figure 16 which overlays two drone photos taken in the area. The first photo was taken on July 14, 2022 and the overlay was taken on October 5, 2022 about 11 days after Fiona had hit the area. It is evident from this graphic that the erosion rate is along variable along the coast in the area. There were some reports from cottage owners in the area that some properties lost 15 metres (50 feet) of coastline and one of these areas is shown in the cover photo for this report, which included an area where a Living Shoreline was destroyed.. This figure also reveals the cottage closest to the cliff in the center was left on the edge of the cliff after the storm subsided and a lot of materials used to protect the shoreline such as concrete slabs was scattered like debris along the beach area. The scattering of shoreline protection materials installed prior to the storm is also evident in the cover photo.



**Figure 16: Overlay Drone Photos of Vespa Lane Area, Pigot's Pt. (photos courtesy of UPEI Drone Team)**

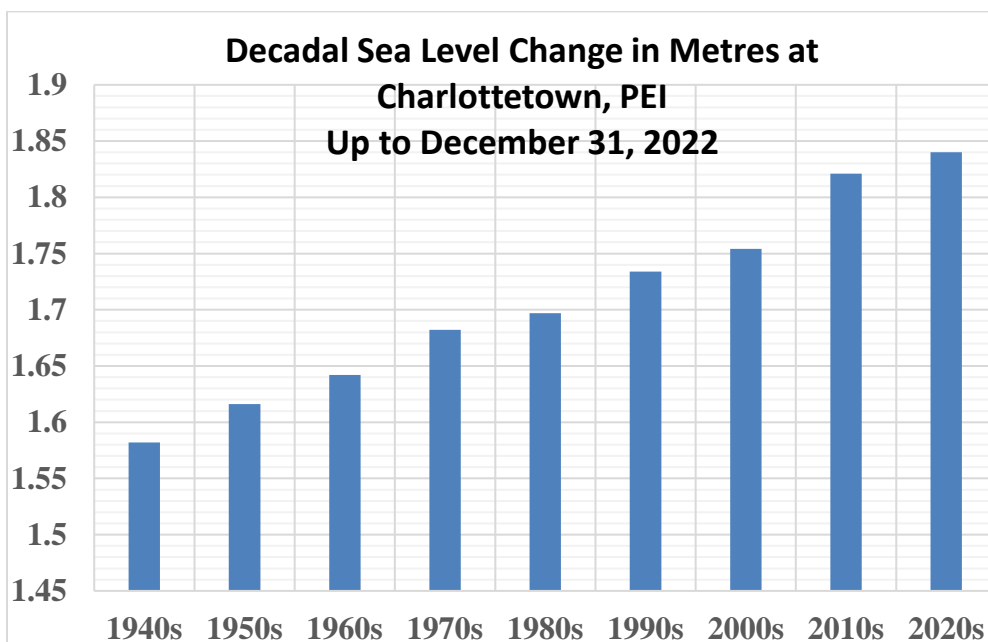
The Charlottetown tidal gauge maintained by the Department of Fisheries and Oceans since 1911 had a mean annual sea level of 1.823 m for 2022, which was among the highest for this station since the station commenced operating (Figure 17). The peak water level at Charlottetown for 2022 was 3.515 m, recorded on January 8<sup>th</sup> at 02:00 hours which was during a winter storm surge. The peak water level at this station during Fiona was 3.2 m at 07:15 on September 24<sup>th</sup> confirming that storm surge from Fiona was not as high as in coastlines facing a northerly quadrant.

## Charlottetown Tide Gauge - Mean Annual Sea Level - 1911 to 2022



**Figure 17: Average Annual Sea Level at Charlottetown (Station 1700)**

The sea level at Charlottetown has risen by 37 cm since 1911 which over the 111- year period averages 0.33 cm per year. The decadal sea level rise shows a more pronounced increase beginning in the 2010s decade as observed on Figure 18.



**Figure 18: Decadal SLR at Charlottetown Since the 1940s**

## 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 surface sea water temperatures ranged from a low of -1.3°C at Lennox Island in February to a high of 22.5°C at Lennox Island in August. The average monthly sea water temperatures for ten locations are presented in Figure 19.

The highest sea water temperatures occurred in August with the lowest temperatures during the winter months of February and March.

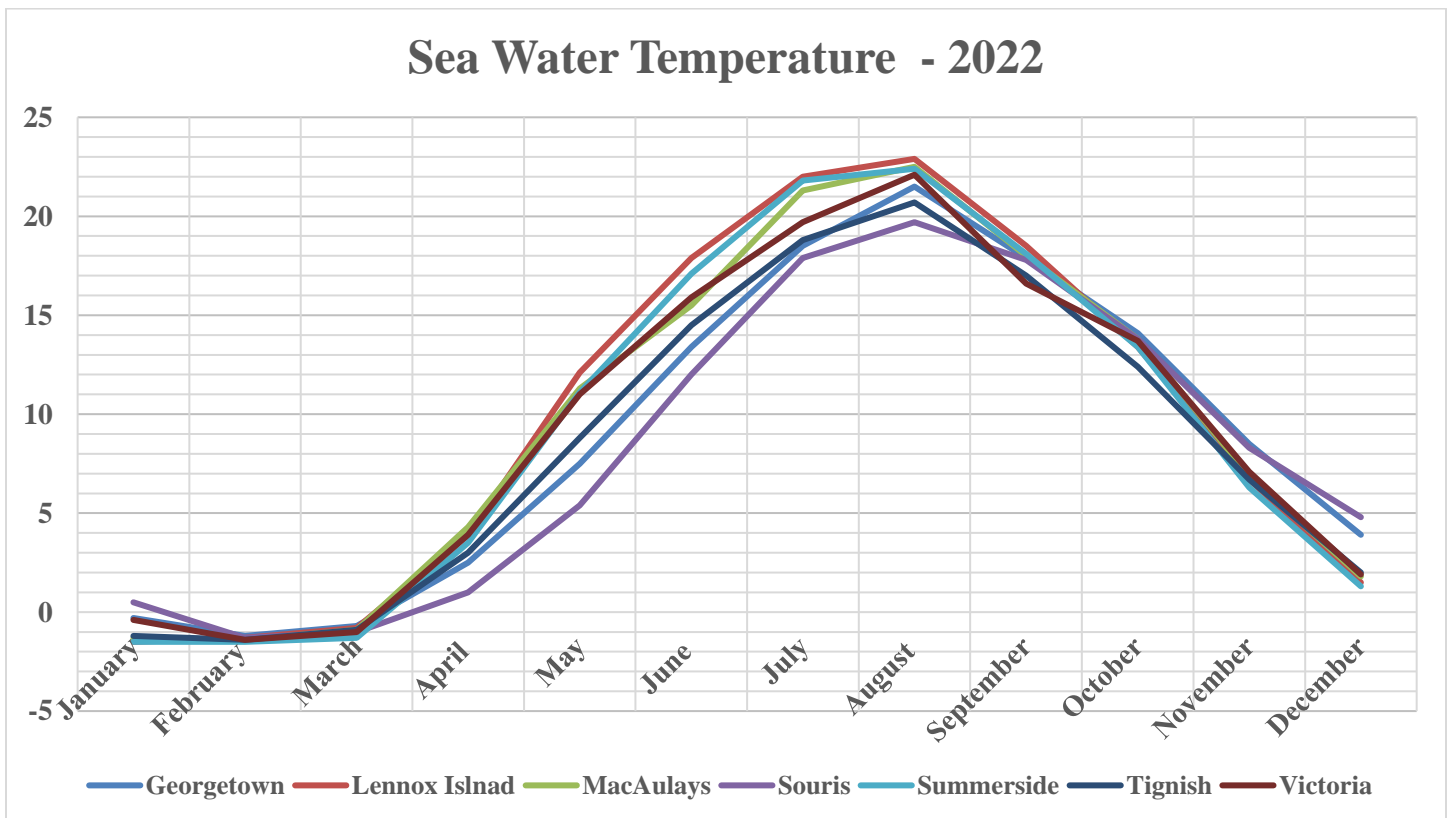


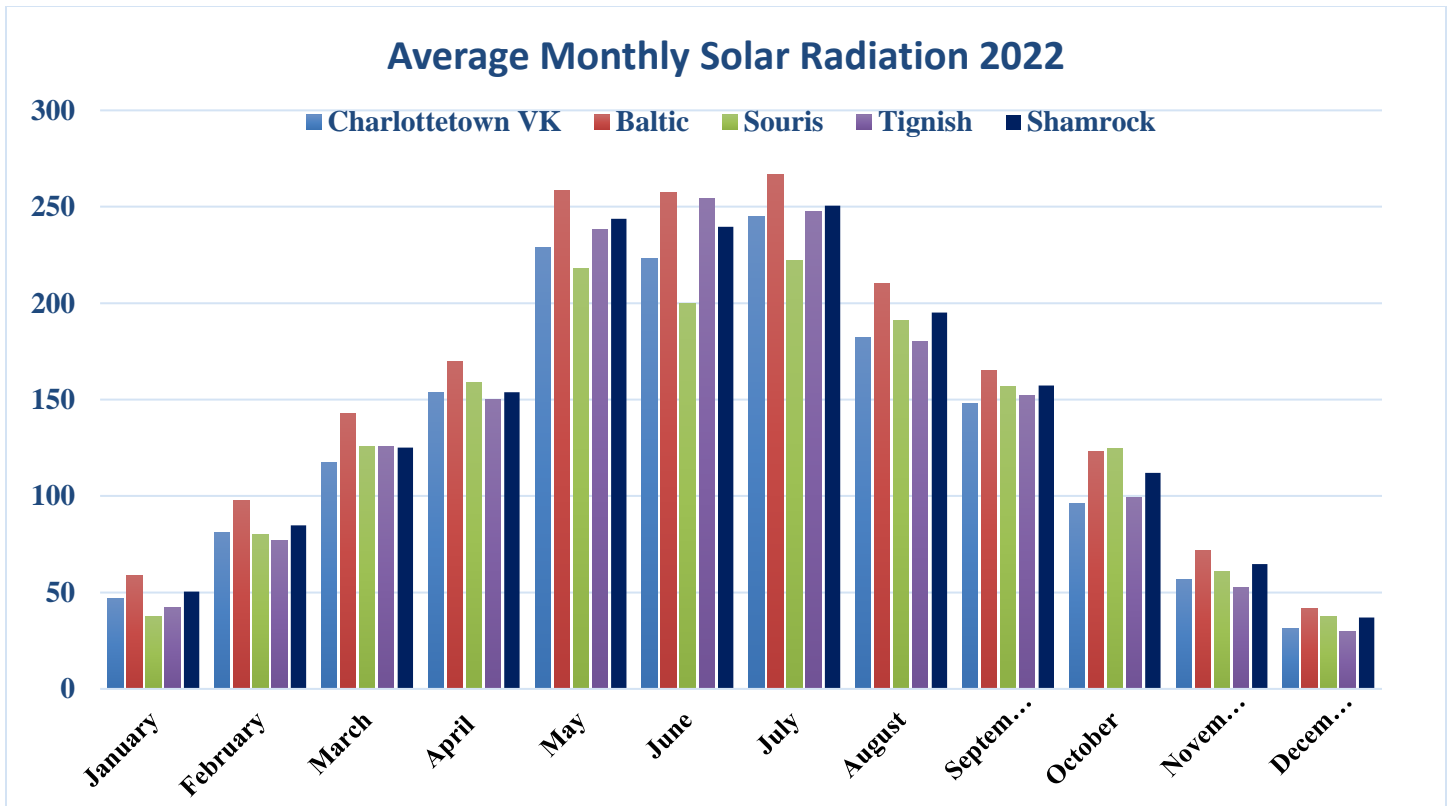
Figure 19. 2022 Average monthly sea surface water temperatures for tidal stations across PEI.

## 1.9 SOLAR RADIATION

Harnessing the radiant energy emitted by the sun is being widely practised across Prince Edward Island by the installation of solar panels. Photovoltaic (PV) energy technology is used in solar panels to capture the sun's energy as this energy creates electrical charges in the internal electrical field which results in the flow of electricity from the individual PV cells.

Solar energy is essential for plant growth as plants use sunlight as an energy source for photosynthesis and plant development with resulting crop yields. Radiant energy is also important for calculation of evapotranspiration of moisture from the soil for agricultural applications.

Many climate stations monitored by the UPEI Climate Research Lab measure the amount of solar radiation generated via a silicon pyranometer sensor. The average monthly solar radiation in kilowatt hours per square metre of surface area ( $\text{kWh/m}^2$ ) was calculated for most of the stations reporting this parameter and is listed on table 2. The results for a selection of stations are provided in Figure 20 and reveal that the months of May, June and July provided the most radiant energy while December and January provided the lowest solar energy output.

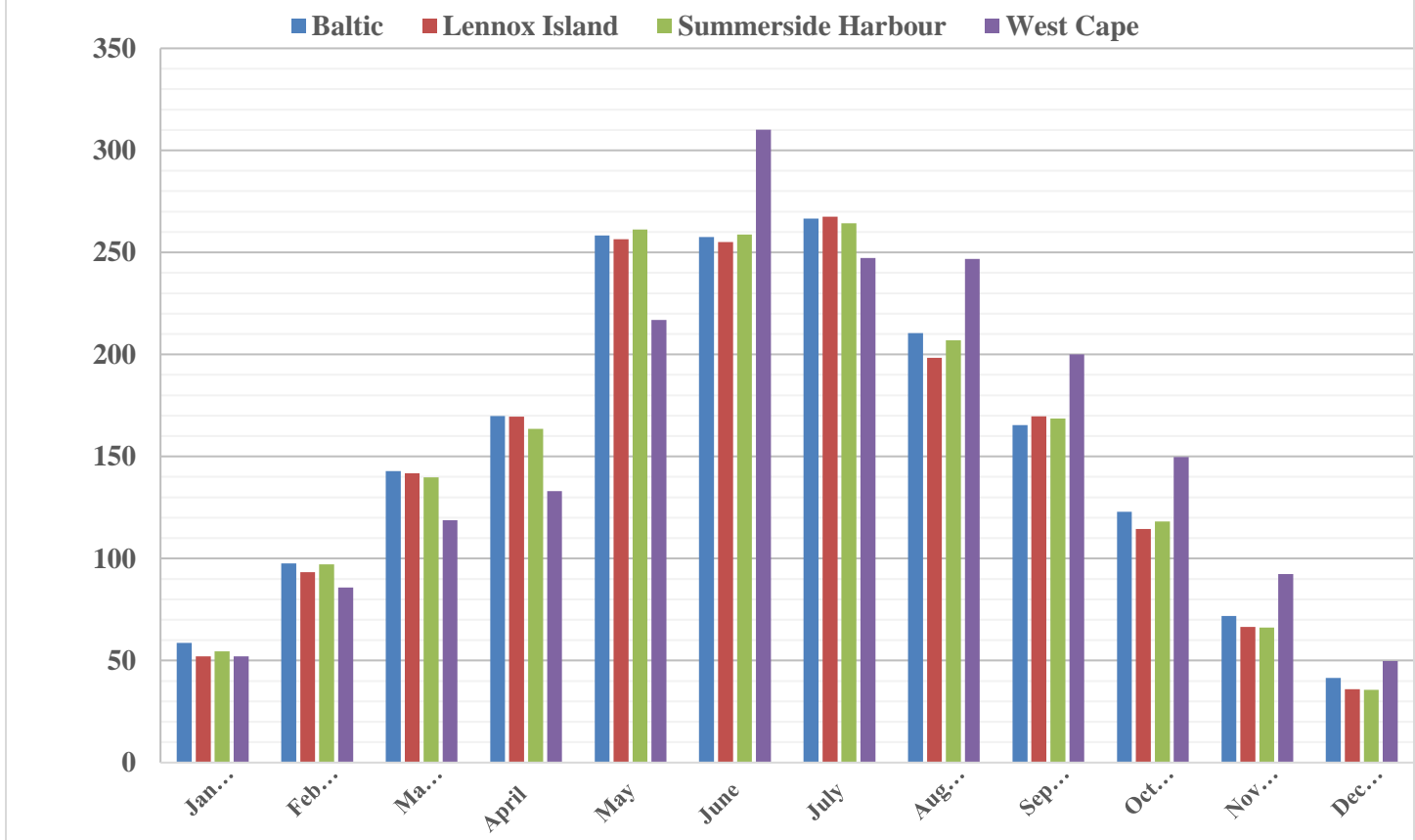


**Figure 20: Average Monthly Solar Radiation at Selected Locations Across the Province**

There were four stations which recorded an average monthly solar radiation above 150 kWh/m<sup>2</sup> and these were Baltic, Lennox Island, Summerside Harbour and West Cape. These are plotted on Figure 21. There were 3 stations with an average monthly solar radiation under 125 kWh/m<sup>2</sup> and these were North Lake, Brookvale, and Upton. The variations can be attributed to variable cloud cover, fog conditions or shading of sensors in some areas. For instance, the Upton station is located in a wooded area and would have less high angle sun exposure for the early morning and late afternoon hours.

As expected, December which has the winter equinox or day with least amount of sunlight, is the month with the least amount of solar radiation and is closely followed by January. The months with the highest average solar radiation are May, June and July.

## Stations with Highest Average Monthly Solar Radiation (kWh/m<sup>2</sup>)



**Figure 21: Stations with Highest Average Monthly Solar Radiation**

### 1.10 SIGNIFICANT CLIMATE EVENTS

There were a number of significant storm and phenological events recorded during the year, which are reported in Table 7. Storm events can result in significant damage and this table outlines some of the damage that occurred during the year.

**Table 7. Significant Weather or Phenological Events in 2022.**

Date	Event	Measurement	Winds	Description	Area(s) Impacted
Jan, 7-8 <sup>th</sup>	Snowstorm & Surge	32 cm of snow on 7 <sup>th</sup> and 5.4 cm on the 8 <sup>th</sup> .	101km/h	High water levels in north & southerly harbours,	Mainly north coastal area
Jan. 14-15 <sup>th</sup>	Snowstorm & surge	13 cm of snow on the 14 <sup>th</sup> & 33 cm on the 15 <sup>th</sup>	91 km/h	High water levels in north shore harbours,	Mainly north coastal area
January 16 <sup>th</sup>	Harbour Frozen	Visual	-	Charlottetown Harbour frozen over	Hillsborough River area.
April 4 <sup>th</sup>	Snowstorm	22 cm of snow		Snow occurred from 9am to 4pm	Charlottetown Area
April 23 <sup>rd</sup>	Potatoes planted			G. Visser and Sons plants first potatoes	Roseberry
May 7 <sup>th</sup>	Phenology	Dandelion		First dandelion	Winsloe South
May 8 <sup>th</sup>	Phenology	-4.6°C		Heavy frost in the early am.	Winsloe South
May 12 <sup>th</sup>	Phenology			Cut grass for first time	Winsloe South

May 13 <sup>th</sup>	Forest Fire Danger	Fire Weather Index (FWI), extreme		Extremely high due to over a week of dry weather	West Prince County
June 2 <sup>nd</sup>	Phenology			Purple and white lilacs in bloom	Winsloe South
Sept. 23, 24	Post Tropical Storm Fiona	Wind, rain, storm surge	Over 150 km/h in some areas.	Severe damage across most of the province due to trees blown down, powerlines damaged, severe coastal erosion and storm surge flooding.	Entire north shore area and many inland locations across the province.
October 3 <sup>rd</sup>	Frost	0°C		Patchy frost with 50 to 75% coverage	Charlottetown area.
November 15 <sup>th</sup>	Ice	-0.1°C		Thin layer of ice in water barrel.	Winsloe South
December 23	Windstorm	High winds and storm	Some gusts over 100 km/h	3400 customers without power. Confederation bridge closed to all traffic	Entire province.
December 25	Green Christmas	No snow on the ground at 08:00	---	None	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 2022.**

Parameter	Extreme Value	Date Observed	Station
Daily T <sub>max</sub>	35.9°C	August 21st	Arlington
Daily T <sub>min</sub>	-27.2°C	January 22 <sup>nd</sup>	Maple Plains
Highest Annual T <sub>mean</sub>	8.3°C	2022	Orwell
Lowest Annual T <sub>mean</sub>	6.8°C	2022	Maple Plains
Max Wind Gust	169.9 km/h	September 24 <sup>th</sup>	East Point Wind Farm at 82 m above the ground
Max. Daily Ppt	107.2 mm	September 24 <sup>th</sup>	Chepstow
Highest Total Annual Ppt	1385.7 mm	2022	Bedford Corner (CoCoRaHS)
Highest Total Annual Snowfall	375.9 cm	2022	Morell (CoCoRaHS)

## 1.11 DISCUSSION

As mentioned in section 2.1, the year 2022 was one of the warmest in the history of annual climate records for the province. Precipitation was slightly higher than normal across most of the province, except for the west Prince area, where it was somewhat less than normal. Post Tropical Storm Fiona was the biggest weather story of the year, if not, in the history of the province.

The main weather stories for the year were.

1. Post Tropical Fiona on September 23 and 24<sup>th</sup>. Extensive damage to buildings, trees, crops, fishery, and coastal flooding particularly in north facing coastlines.
2. Temperatures well above normal for several months resulting in the 6<sup>th</sup> warmest year at Charlottetown since 1850.
3. Major snowstorm and storm surge of January 7<sup>th</sup> and 8<sup>th</sup>. This was the first major winter storm of the season. The photo in Figure 22 was taken by Nellie Haldane, UPEI Climate School student after the January 7<sup>th</sup> and 8<sup>th</sup>, 2022 storm. The highest water level in Charlottetown for 2022 was recorded during this storm.
4. Major snowstorm and storm surge of January 14 and 15<sup>th</sup>.

5. Excellent harvest weather after Fiona, although it was very dry in some areas impacting the potato harvest. Excellent crop yields.



**Figure 22. Naufrage Harbour Climate Station Coated by Ice During Jan. 8<sup>th</sup> storm, Jan,11, 2022 (photo by Nellie Haldane)**

### **1.12 SOURCES:**

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Government of Canada, 2023, [ACOA provides targeted support to shellfish sector following Hurricane Fiona damages - Canada.ca.](#)

Personal communication with many individuals at various locations, 2022

Saltwire News, 2022, “PEI getting hit with second major snowstorm of 2022, Jan. 13, 2022

UPEI, MCPEI, PEIEMO, Climate Data Records 2022

Whorley, K. , DFO, CHS, Bedford, NS, January 25, 2023.

**Analyses and report by D.E. Jardine, UPEI Climate Centre, January 28, 2023.**