Climate Research Lab

Prince Edward Island Annual Climate Summary 2016

Figure 1–Storm Surge, North Rustico, November 27, 2016

Background

The UPEI Climate Research Lab is in the process for establishing a meso-network of climate stations located in key locations across the province. This can help reduce model uncertainties in temperature and precipitation variances and to provide reference ground truth data to aid in the evaluation of climate model simulations and to enable assessment of micro-climate environments in the province. More localized data from these stations will be of assistance to those who depend on high quality climate data to make more informed decisions.

In 2016 the UPEI Climate Research Lab expanded its network of climate monitoring stations by adding 3 new stations in geographic areas without a pre-existing climate station. The first one is a new UPEI station located at Acadian Machine

Works in Tignish (UP18) and is equipped with Davis Vantage Pro 2 plus equipment which has instrumentation to measure temperature, precipitation, barometric pressure, relative humidity, wind direction, wind speed, solar radiation and UV Index. Two new private stations were also added to the network. The first one is at an organic vegetable farm at Hope River (UP19) and the second is at a residential home and observatory located at Mill Cove (UP20).

The data collected is being compiled in a database called COADE, which in addition to climate data also stores coastal erosion and tide logger data. This database is not yet available to the public.

Table 1 – UPEI Climate Lab Climate Stations including some PEI Dept. of Agriculture Stations

ID Code	Map ID	Community	Lat.	Long.	Date Installed	Equipment
IPRINCEE4	UP20	Millcove	46.37400	-63.03508	24-Apr-12	Davis Vantage Vue
IPRINCEE11	UP9	Winsloe South	46.229	-63.177	13-Sep-13	Davis Vantage Pro 2
IPRINCEE13	UP12	Flat River	46.9836	-62.851	06-Nov-13	Davis Vantage Pro 2
IPRINCEE14	UP11	Orwell Cove	46.131	-62.867	13-Nov-13	Davis Vantage Pro 2
IPRINCEE15	UP2	Foxley River	46.7208	-64.0356	20-Nov-13	Davis Vantage Pro 2
IPRINCEE16	UP15	Dingwells Mills	46.359	-62.431	14-Nov-13	Davis Vantage Pro 2
IPRINCEE17	UP14	Cardigan Head	46.2461	-62.66833	01-Nov-14	Davis Vantage Pro 2
IPRINCEE19	UP17	White Sands	45.970	-62.558	25-Nov-14	Davis Vantage Pro2+
IPRINCEE21	UP8	St. Catherine's	46.182	-63.286	25-Jun-15	Davis Vantage Vue
IPRINCEE22	UP13	Alliston	46.052	-62.638	25-Jun-15	Davis Vantage Vue
IPRINCEE26	UP4	Cape Egmont	46.4067	-64.118742	10-Sep-15	Davis Vantage Pro 2+
IPRINCEE27	UP7	Hampton	46.2003	-63.4652	11-Sep-15	Davis Vantage Pro 2+
IPRINCEE28	UP1	Brockton	46.80649	-64.21685	23-Sep-15	Davis Vantage Pro 2+
IPRINCEE30	UP5	Glen Valley	46.34884	-63.439941	06-Oct-15	Davis Vantage Pro 2+
IPRINCEE31	UP16	East Point	46.43554	-62.018632	16-Jul-15	Davis Vantage Vue
IPRINCEE32	UP10	Fanning Brook	46.32419	-62.8141	05-Nov-15	Davis Vantage Pro 2+
IPEBORDE2	UP6	Borden - Carleton	46.248	-63.687	26-Jan-95	Davis Vantage Pro 2+
IPRINCEE 35	UP19	Hope River	46.43816	-63.40707	10-May-16	Ambient Weather WS-1001
IPRINCEE36	UP18	Tignish	46.9453	-64.0516	02-May-16	Davis Vantage Pro2+
Remote	UP3	Arlington	46.52964	-63.927503	30-Jun-15	Davis Vantage Vue

The location of all stations listed on tables 1 and 2 is provided on the map labelled figure 2. As shown on the map, the stations are located throughout the province and can be expected to provide a reasonable distribution of climate conditions across the province. There are still some gaps in the network such at the West Point / West Cape area.

Figure 2 - Map showing locations of climate stations as of Dec. 31, 2016

Data Summary

Data was compiled from eighteen (18) Climate Stations managed or monitored by the UPEI Climate Research Lab and from eleven (11) other climate stations in the province. The data from the eleven other stations was obtained from the Environment Canada Climate Archives website or from the Agriculture Canada, AgWeather Atlantic website. A summary of the data obtained is provided in table 2.

Table 2 – UPEI 2016 Annual Climate Station Summary for 29 Stations across PEI

Climate Station Name	Map ID	Type of Site	Tmean ^{0}C	Tmax ^{0}C	Tmin ^{0}C	Annual PPT (mm)	Avg. Wind Speed kn/h	Max. Wind Speed km/h	Max. Daily PPT (mm)	Max. PPT Date
Alliston/Peters Road	EC7	manual	7.5	29.0	-19.5	1245.3	-	-	88.1	Oct. 10
Alliston (CNP)	UP13	auto	6.9	29.6	-19.4	844.4	6.1	70.8	62.0	Oct. 10
Arlington	UP3	auto	6.6	29.3	-21.8	673.9	2.5	72.4	26.2	Oct. 10
Baltic	AC1	auto	6.8	29.3	-19.8	-	14.9	58.9	39.6	Oct. 10
Borden	UP6	auto	7.2	28.5	-15.8	757.5	14.0	94.9	46.3	Oct. 10
Brockton	UP1	auto	6.6	29.7	-23.1	616.2	5.7	74.0	22.1	Dec. 1
Cape Egmont	UP4	auto	6.8	27.7	-18.8	519.2	12.2	90.1	31.2	Oct. 10
Cardigan Head	UP14	auto	6.4	29.9	-21.7	-	-	-	81.5	Oct. 10
Ch'town Airport	EC6	auto	6.6	28.1	-20.2	1073.4	-	98.0	60.0	Oct. 10
Dingwells	UP15	auto	7.1	*30.0*	-20.0	1017.0	6.6	172.2	87.1	Oct. 10
East Point	EC9	auto	6.3	27.4	-19.3	809.2	22.3	109.0	38.9	Nov. 27

East Point (N)	UP16	remote	6.5	27.1	-19.6	856.5	9.2	96.6	102.0	Oct. 10
Elmwood	EC5	auto	6.8	28.8	-20.1	707.7	8.4	75.6	23.9	Oct. 22
Fanning Brook	UP10	auto	7.3	29.1	-19.2	897.9	8.4	75.6	73.4	Oct. 10
Flat River	UP12	auto	7.5	29.1	-17.8	872.9	8.4	99.8	74.7	Oct. 10
Foxley River	UP2	auto	7.0	30.2	-21.0	761.1	9.2	88.5	38.0	Mar. 29
Glen Valley	UP5	auto	6.5	27.9	-19.9	529.3	14.5	96.5	57.9	Oct. 10
Hampton	UP7	auto	6.5	26.7	-21.0	493.2	13.0	96.5	29.4	Aug. 17
Harrington	AC2	auto	6.5	28.8	-19.8	1026.2	15.0	93.0	57.8	Oct. 10
Maple Plains	EC4	auto	6.0	29.9	-24.0	-	11.6	57.6	47.2	Oct. 10
New Glasgow	EC3	manual	6.9	28.5	-21.0	1140.4	-	-	41.0	Nov. 27
North Cape	EC1	auto	6.1	30.0	-17.7	1015.5	24.9	107.0	37.1	July 28
Orwell Cove	UP11	auto	7.6	29.1	-17.6	741.8	8.4	83.7	61.2	Oct. 10
St. Catherines	UP8	auto	7.1	29.2	-19.3	702.2	7.4	70.8	43.4	Oct. 10
St. Peter's	EC9	auto	6.9	29.5	-19.3	868.6	15.7	96.0	75.3	Oct. 10
Summerside	EC2	auto	6.6	28.9	-20.5	740.0	18.6	95.0	29.9	Oct. 10
Tignish	UP18	auto	-	30.6	-	-	-	-	52.1	Sept. 1
White Sands	UP17	auto	7.2	28.5	-17.7	831.4	14.1	98.1	58.7	Oct. 10
Winsloe South	UP9	auto	6.9	29.1	-19.3	971.5	3.9	67.6	77.5	Oct. 10

Na = Not available

The mean monthly temperature variation from the 30 year normal for 28 climate stations, which operated for the full year and another 3 stations which operated for part of the year, is provided in table 3. The colour scheme shows the months when the temperature varied from 30 year climate normal values. The normal for each station were taken from the nearest station listed on the Environment Canada weather archive website. The average temperature for 2016 for all 28 stations on PEI was 1.1^{0}C above normal with a range of 0.3 degrees Celsius above normal at Maple Plains to 1.9 degrees Celsius above normal at Orwell Cove. The first two months of the year were the warmest when compared to normal temperatures and these were followed by the fall months which ranged from 1 to 3 degrees above normal. The spring and summer months had temperatures which ranged from slightly below normal in April with the other months having slightly above normal.

The mean or average annual temperature for 28 climate stations on PEI is plotted on Figure 3. There was a 1.6 degree Celsius range for the 28 reporting stations as displayed on this figure. This map reveals that the eastern Queens and Southern Kings and Queens areas were somewhat warmer than the rest of the province with a few exceptions at Borden-Carleton, Foxley River, St. Catherines and Dingwells Mills areas.

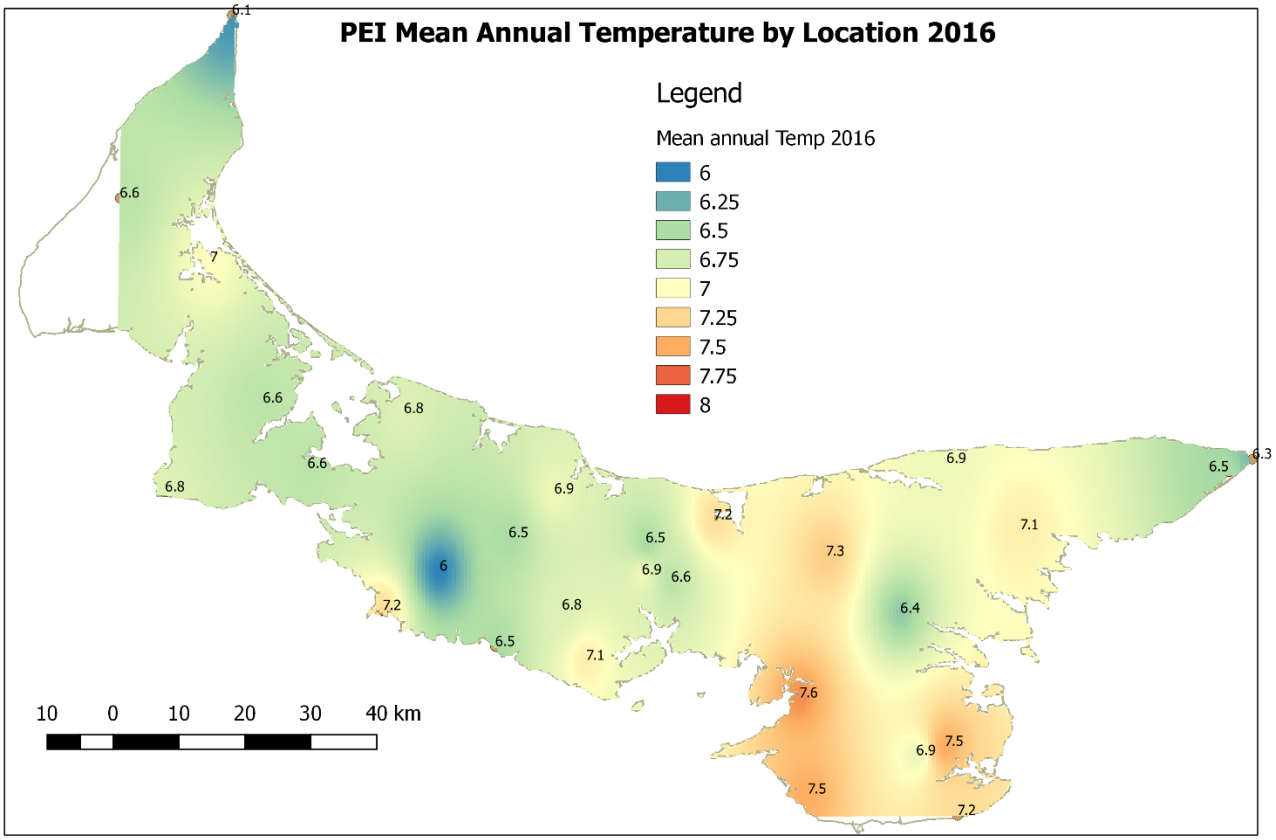

Figure 3 - PEI Mean Annual Temperature, 2016- 28 Stations in ^{0}C

Table 3 – Mean Monthly and Annual Temperature Variation from 30 Year Normal – PEI Climate Stations 2016 ^{0}C

	Jan	Var. from Normal	Feb	Var. from Normal	Mar	Var. from Normal	Apr	Var. from Normal	May	Var. from Normal	Jun	Var. from Normal	July	Var. from Normal	Aug	Var. from Normal	Sep	Var. from Normal	Oct	Var. from Normal	Nov	Var. from Normal	Dec	Var. from Normal	Year	Var. from Normal
Alliston	-4.1	3.6	-2.8	4.5	-2.3	0.8	2.8	-0.3	10	0.8	14.5	0	19	0.3	18.7	0	15.2	1.1	10	1.7	5.3	2.4	-3	0.3	6.9	1.2
Alliston /Peters Rd	-4	3.7	-2.6	4.7	-1.9	1.2	3	-0.1	10.5	1.3	15.2	0.7	19.9	1.2	19.4	0.7	16.1	2	10.7	2.4	5.2	2.3	-1.1	1.6	7.5	1.8
Arlington	-4.6	4	-5.1	2.6	-2.8	0.4	2.8	-0.1	10	0.6	15	0.2	19	0.4	18.9	0.5	15.3	1	9.7	1.5	4.4	2	-3.5	0.5	6.6	1.1
Baltic	-4.6	3.1	-3.5	3.4	-3	-0.1	2.5	-0.5	9.7	0.2	14.8	0.1	18.9	-0.3	18.8	0.2	15.7	1.6	10.2	1.8	4.8	2.2	-3.2	0.6	6.8	1.1
Borden	-3.8	3.9	-3.3	3.6	-2.2	0.7	2.7	-0.3	9.7	0.2	14.5	0.2	19.2	0	19.3	0.7	16.3	2.2	11.1	2.7	5.3	2.7	-2.2	1.6	7.2	1.5
Brockton	-4.5	3.7	-4.1	3.6	-3.2	0.1	2.7	0.3	9.7	1	14.8	0.3	18.7	0	18.9	0.3	15.3	0.9	10	1.6	4.5	1.9	-3.2	0.3	6.6	1.1
Cape Egmont	-4.3	3.4	-3.9	3	-2.7	0.2	2.6	-0.4	9.4	-0.1	14.2	-0.5	18.5	-0.7	19.1	0.5	15.9	1.8	10.5	2.1	5	2.4	-2.9	0.4	6.8	1.1
Cardigan Head	-3.8	3.1	-4.9	2.1	-1.8	1	2.5	0.1	9.7	1.3	14.5	0	17.7	0.3	18.1	-0.3	14.7	0.4	9.1	0.5	4.3	0.9	-3.1	-0.7	6.4	0.6
Ch'town Airport	-5	2.6	-3.7	3.6	-3.1	0	2.2	-0.9	9.7	0.5	14.6	0.1	18.9	0.2	18.7	0	15.3	1.2	9.8	1.5	4.6	1.7	-3.3	0	6.6	0.9
Dingwells	-3.4	3.5	-2.7	4.3	-2.1	0.7	2.6	0.2	9.7	1.1	14.4	0.4	19.2	0.7	18.7	0.3	15.4	1.1	10.1	1.5	5.8	2.4	-2.3	0.1	7.1	1.3
East Point	-3.4	3.4	-2.9	3.9	-2.8	0.1	1	-1.4	7.8	-0.5	12.8	-0.8	17.7	-0.5	18.4	0.4	15.8	1.7	7.2	-1.2	4.9	2.7	-1.1	1.4	6.3	0.7
East Point Winery	-3.3	3.5	-2.9	3.9	-2.8	0.1	0.9	-1.5	7.4	-0.9	12.5	-1.1	18	-0.2	18.5	0.5	15.7	1.7	10.4	2	5.6	2.4	-1.8	0.7	6.5	0.9
Elmwood	-4.4	3.3	-3	4.3	-2.8	0	2.8	-0.3	9.9	0.7	14.6	0	18.8	0	18.4	-0.4	15.4	1	10	1.5	4.9	1.9	-3.2	0.1	6.8	1.1
FanningBrook	-3.6	4.1	-2.4	4.9	-2	1.1	3.1	0	10.3	1.1	15.1	0.6	19.3	0.6	18.8	0.5	15.5	1.4	10.4	2.1	5.6	2.7	-2.5	0.8	7.3	1.6
Flat River	-2.8	4.9	-2.1	5.2	-1.4	1.7	3.5	0.4	10.2	1	14.7	0.2	19	0.3	18.8	0.1	15.7	1.6	10.5	2.2	5.7	2.8	-1.5	1.8	7.5	1.8
Foxley River	-3.8	4.8	-3.7	4	-2.5	0.7	3.3	0.4	10	0.6	15.4	0.6	19.4	0.8	19.5	1.1	15.9	1.6	10.6	2.4	5.3	3	-2.2	1.3	7.3	1.8
Glen Valley	-4.9	2.8	-3.5	3.8	-3.1	-0.3	2.3	-0.8	9.4	0.2	15.2	-1	18.4	-0.4	18.2	-0.4	15.1	0.7	10	1.5	4.4	1.4	-3.4	-0.1	6.5	0.7
Hampton	-4.4	3.3	-3.6	3.3	-2.7	0.2	1.9	-1.1	9	-0.5	13.7	-1	18.2	-1	18.4	-0.2	15.4	1.3	10.5	2.1	5	2.4	-3.9	-0.1	6.5	0.8
Harrington	-5.1	2.6	-3.8	3.5	-3.1	0	2.2	-0.9	9.5	0.3	14.6	0.1	18.9	0.2	18.7	0	15.3	1.2	9.9	1.6	4.7	1.8	-3.4	-0.1	6.5	0.8
Hope River													19.1	-0.3	18.9	0.3	15.8	1.4	11.1	2.6	6.5	3.5	-1.9	1.4	*	*
Maple Plains	-5	2.7	-4.1	3.2	-3.1	-0.2	2.1	-0.9	9.6	0.1	14.2	-0.5	18.1	-1.1	17.8	-0.8	14.5	0.6	8.7	0.3	3.6	1	-3.9	-0.1	6.0	0.3
Mill Cove																			10.2	1.7	5.1	2.2	-2.7	0.6	*	*
New Glasgow	-4.6	3.1	-3.3	4	-2.4	0.4	3.2	0.1	10	0.8	15.2	-0.4	19	0.2	18.5	-0.1	15.6	1.2	10.1	1.6	4.9	1.9	-2.9	0.4	6.9	1.1
North Cape	-4	4.2	-4.1	3.6	-3.7	-0.4	1.3	-1.1	8.2	-0.5	13.5	-1	16.7	-2	17.5	-1.1	14.1	-0.3	10.8	2.4	5.1	2.5	-2.4	1.1	6.1	0.6
Orwell Cove	-3.2	4.5	-2	5.3	-1.5	1.6	3.6	0.5	10.5	1.3	15	0.5	19.4	0.7	19.2	0.5	15.9	2	10.7	2.4	5.7	2.8	-2	1.3	7.6	1.9
St. Catherines'	-4	3.7	-2.9	4.4	-2.1	1	3	-0.1	10	0.8	14.7	0.2	19.1	0.4	19	0	15.9	1.8	10.6	2.3	5.2	2.3	-2.3	1	7.2	1.5
St. Peter's	-4	2.9	-3	4	-2.8	0	2.2	-0.2	9.5	0.9	14	0	18.6	0.1	18.9	0.5	15.5	1.2	10.1	1.5	5.2	1.8	-2	0.4	6.9	1.1
Summerside	-5.1	2.6	-4.1	2.8	-3.2	-0.3	2.7	-0.3	10	0.5	14.6	-0.1	18.6	-0.6	19	0.4	15.5	1.4	10.1	1.7	4.7	2.1	-3.5	0.3	6.6	0.9
Tignish									9.6	0.9	14.7	0.2	18.7	0	18.7	0.1	15	0.6	9.6	1.2	4.5	1.9			*	*
White Sands	-3	4.3	-2.3	5	-1.8	1.3	2.3	-0.8	9	-0.2	13.8	-0.7	18.6	-0.1	19	0.7	16	1.9	10.6	2.3	6	3.1	-1.5	1.8	7.2	1.5
Winsloe South	-4.1	3.6	-3	4.3	-2.3	0.8	2.8	-0.3	9.9	0.7	14.6	0.1	19	0.3	18.7	0	15.5	1.4	10.2	1.9	4.8	1.9	-2.9	0.4	6.9	1.2
Average	-4.1		-3.3		-2.5		2.5		9.6		14.5		18.7		18.7		15.5		10.1		5.1		-2.6		6.8	

The climate normal data used in table 3 to determine the variation in 2016 was derived from Environment Canada data from sites on PEI. The values used to calculate variation from the 30 year normal is provided in Table 4.

Table 4 – Climate Normal Data for PEI Climate Stations (1981 to 2010)

Site	Normal Mean Temp. C	Normal Annual Precip. mm	Reference stations
Charlottetown	5.6	1158.3	AC2, EC6, EC7, UP8-13, UP17
Summerside	5.7	1072.9	AC1, EC2, EC4, UP4, UP6, UP7
Monticello	5.8	1170.2	EC9, UP10, UP14, UP15
O'Leary	5.5	1147.8	UP2, UP3
East Baltic	5.6	1272.0	EC3, UP16
Alberton	5.5	1053.1	EC1, UP1, UP18
New Glasgow	5.8	1257.9	EC3, UP5

The monthly precipitation variation from the 30 year normal for stations which reported data during the year across PEI is provided in table 5. Months which have below normal precipitation are shown with a minus sign and the colour varies from yellow to red with yellow being below normal and red being above normal. Months which are blank either had incomplete data or the heater on the rain gauge was not working during the winter months thus snow and ice pellet water equivalent amounts are not included in the totals. This included the stations at Alliston (CNP), Arlington, Baltic, Cardigan Head, East Point (N), Maple Plains, St. Catherines and Tignish so the total annual precipitation at these stations is low due to frozen rain gauges and tipping buckets during the winter months and precipitation amounts could not be recorded using the equipment available.

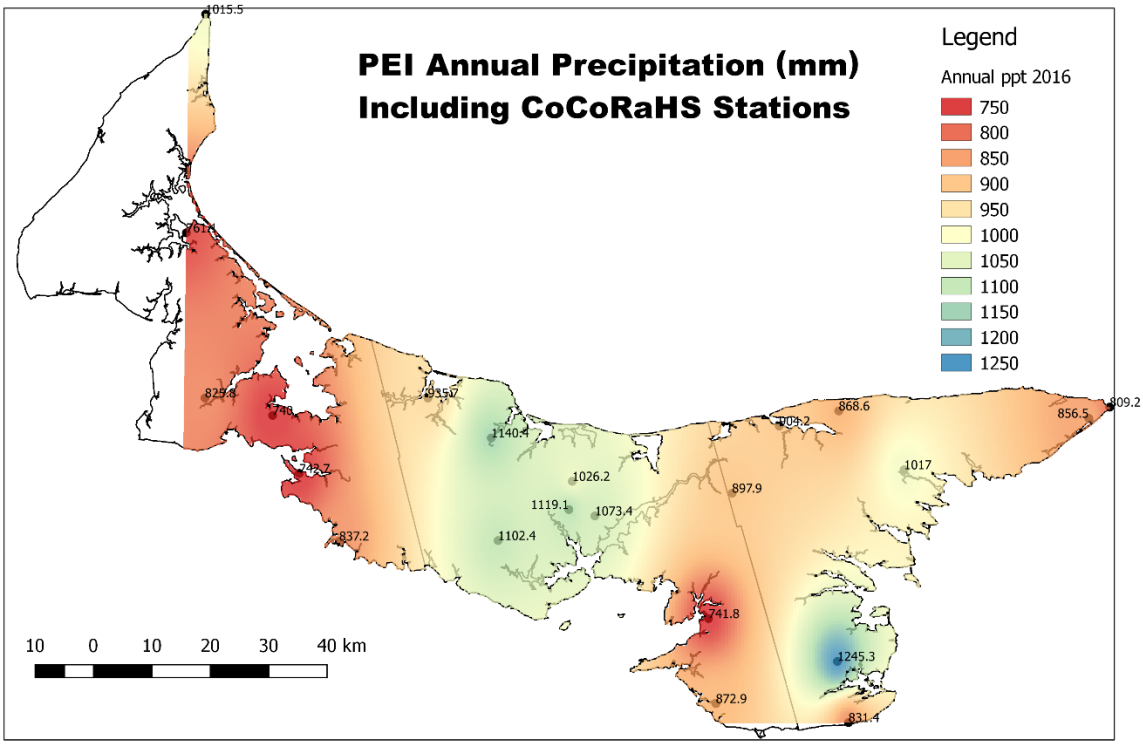

Figure 4 - Annual Precipitation - 22 Stations

Table 5 – Mean Monthly Precipitation Variation from 30 Year Normal – PEI Climate Stations 2016 (mm)

	Jan	Var. from Normal	Feb	Var. from Normal	Mar	Var. from Normal	Apr	Var. from Normal	May	Var. from Normal	Jun	Var. from Normal	July	Var. from Normal	Aug	Var. from Normal	Sep	Var. from Normal	Oct	Var. from Normal	Nov	Var. from Normal	Dec	Var. from Normal	Year	Var. from Normal
Alliston					54.6	-31.7	57.9	-25.8	69.8	-21.2	53.6	-45.2	64.8	-15.1	115.3	19.6	119	23.1	150.6	38.4	57.7	-54.8	49.8	-68.3	793.1	-365.2
Alliston /Peters Rd	84.9	-16.1	81.9	-1.3	101.4	15.1	93.7	10	92.9	1.9	67.9	-30.9	76.6	-3.3	141.7	46	100.6	4.7	190.3	78.1	100.6	-11.9	112.8	-5.3	1245.3	87.0
Arlington							41.2	-45	61.4	-41.5	53.6	-31.2	44	-52	55.4	-32.3	62.6	-39.2	111.2	11.6	81.6	-30.5	63	-43.5	574.0	-573.8
Baltic									64.3	-30.6	53.4	-37.9	27.5	-46.6	76.9	-15.8	71.5	-25.2	131.6	43.9	91.2	-6.5			516.4	
Borden			33	-41.9	61	-18.4	55.1	-29.1	84.3	-10.6	63.8	-27.5	64.2	-10.2	106.6	13.9	72.6	-24.1	105.4	17.7	54.6	-43.1	48.3	-52	748.9	-324.0
Brockton	16.8	-79.6	47	-27.5	80.3	-0.6	21.8	-58.3	46.7	-46	82	-0.1	29.5	-50.2	59.4	-20.3	68.8	-22.8	55.4	-40.7	53.1	-46	55.4	-38.3	616.2	-436.9
Cape Egmont	20.4	-75.8	45.4	-29.5	77.2	-2.2	24.8	-61.4	58	-36.9	65.6	-25.7	53.4	-20.7	94	1.3	43.9	-52.8	81.5	-6.2	70.9	-26.8	56.6	-43.7	691.7	-381.2
Cardigan Head	46.5	-54.4					69.6	-17.2	59.4	-30.7	11.2	-79.5	30	-49.3			83.8	-5.1	162.2	47.2	60.4	-54.6	94.2	-23.4	617.3	-552.9
Ch'town Airport	61.6	-39.4	93	9.8	79.7	-6.6	85	1.3	70.5	-20.5	64.8	-34	72	-7.9	120.4	24.7	61.2	-34.7	150.2	38	110.2	-2.3	104.8	-13.3	1073.4	-84.9
Dingwells	75.9	-25	85.9	4.2	87.4	0.4	82.8	-4	48.5	-41.6	38.6	-52.1	56.9	-22.4	95	6.1	74.4	-14.5	168.9	53.9	99.3	-15.7	103.1	-14.5	1016.7	-153.5
East Point	28.6	-87.5	59.2	-32.1	73.4	-22.3	62.3	-30.4	59.1	-34	59.6	-41.3	42	-44.6	61.5	-42.1	80.7	-34			109.7	-16.3	95.7	-33.2	731.8	-540.2
East Point Winery	21.8	-99			50.5	-45.2	64.3	-28.4	55.3	-37.7	64.6	-36.3	57	-29.6	78.2	-25.4	75.8	-38.9	181.8	59.3	109.7	-16.3	94.6	-34.3	853.6	-418.4
Elmwood	19.3	-100.7	37.1	-49.7	57.1	-38.5	55.6	-40	65	-33.3	72	-26.3	81.5	-6	71.4	-16.1	37.1	-70.3	84.6	-37.1	125.5	-3.8	59.4	-73.1	765.6	-492.3
FanningBrook	59.2	-41.8	62.7	-20.5	68.6	-17.7	60.5	-23.2	35.3	-55.7	29.5	-69.3	50.3	-29.6	83.8	-11.9	53.8	-42.1	207	94.8	108.2	-4.3	79	-39.1	897.9	-260.4
Flat River	46.2	-54.8	59.7	-23.5	64	-22.3	51.3	-32.4	57.9	-33.1	53.1	-45.7	66.5	-13.4	100.6	4.9	107.2	11.3	143.5	31.3	76.2	-36.3	46.7	-71.4	872.9	-285.4
Foxley River	9.1		38.9	-42.9	83.3	-6.1	27.7	-58.5	41.7	-61.2	85.9	1.1	64.3	-31.7	68.8	-18.9	58.2	-43.6	94.5	-5.1	63	-49.1	106.9	0.4	742.3	-405.5
Glen Valley	15.8	-104.2	38	-48.8	67	-28.6	57.4	-38.2	67.6	-31.7	63.4	-32.9	39.2	-39.6	84.8	-2.7	52.1	-55.3	143	21.3	67.1	-62.2	50.5	-82	745.9	-512.0
Hampton	16.7	-79.5	47.7	-27.2	61.7	-17.7	56.3	-27.9	66	-28.9	32.7	-58.6	72.6	-1.5	82.4	-10.3	82.7	-14			56.4	-41.3			575.2	-497.7
Harrington	78.1	-22.9	62.8	-20.4	87.8	1.5	73.5	-10.2	57	-34	72	-26.8	39.4	-40.5	134.8	39.1	68	-27.9	136.2	24	123.7	11.2	92.9	-25.2	1026.2	-132.1
Hope River																			129.5	7.8	66.8	-62.5			196.3	
Maple Plains									68.2	-26.7	72.2	-19.1	51.8	-28.1	101.4	8.7	67.4	-29.3	143	55.3	94.8	-2.9			598.8	-474.1
Mill Cove																			111	-10.7	111.4	-17.9	65.5	-52.6	287.9	
New Glasgow	52.3	-67.7	109.6	22.8	62.4	-33.2	90	-5.6	81.6	-16.7	70.2	-28.1	45	-33.6	113.8	26.3	73.2	-34.2	193.6	71.9	161.9	32.6	86.8	-45.7	1140.4	-117.5
North Cape	30.2	-89.9	68.5	-6	109.6	28.7	56.4	-23.7	108.5	15.8	133	50.9	66.6	-13.1	85.3	5.6	64.7	-26.9	102.9	6.8	86.6	-12.5	103.2	9.5	1015.5	-37.6
Orwell Cove	31.5	-69.5	40.9	-42.3	63.8	-22.5	50.2	-33.5	62.7	-28.3	32.3	-66.5	48.5	-31.4	92.7	-3	81.8	-14.1	119.1	6.9	69.8	-42.7	48.5	-69.6	741.8	-416.5
St. Catherines'					58.4	-27.9	48.8	-34.9	64.5	-26.5	49.5	-49.3	62	-17.9	76.2	-19.5	72.7	-23.2	111.3	-0.9	56.1	-56.4	44.7	-73.4	644.2	-514.1
St. Peter's	60.4	-40.5	75.1	-6.6	94.6	7.6	64.5	-22.3	48.3	-41.8	47.3	-43.4	52.4	-26.9	74.9	-14	79.1	-9.8	166.3	51.3	100.6	-14.4	62.1	-55.5	925.6	-244.6
Summerside	17.5	-78.7	53.2	-21.7	83.2	3.8	42.8	-41.4	62.2	-32.7	56.7	-34.6	60.3	-13.8	82.8	-9.9	48.7	-48	102	14.3	70	-27.7	61	-39.3	740.4	-332.5
Tignish									90.9	-1.8	119.4	37.3	47.8	-31.9	64.3	-15.4	93.7	2.1	84.8	-11.3	81.4	-17.7			582.3	-470.8
White Sands	27.6	-73.5	48.8	-34.4	55.1	-31.2	57.8	-25.9	75.2	-15.8	49.8	-49	51.8	-28.1	79.8	-15.9	94	-1.9	122.9	10.7	114.6	2.1	54.1	-64	831.5	-326.8
Winsloe South	49	-52	60.2	-23	75.9	-10.4	62.7	-21	69.1	-21.9	69.1	-29.7	56.4	-23.5	115.8	20.1	61	-34.9	150.9	38.7	141.7	29.2	76.2	-41.9	988.0	-170.3
Average	39.5		59.5		73.3		58.2		65.2		61.6		54.3		89.9		72.8		132.2		89.5		73.7		72.5	-336.9

Sheet1 Sheet2 Sheet3

Total precipitation amounts were calculated for seven (7), Community Collaborative Rain, Hail & Snow Network (CoCoRaHS) stations in the province. These stations are operated by volunteers who collect and record observations using manual methods. These amounts are provided in table 6 and the results included on the distribution map shown on figure 4.

Table 6 - CoCoRaHS Stations – 2016 Measured Annual Precipitation in mm.

Station ID	Locality	Latitude	Longitude	Total Precipitation in mm
CAN-PE-3	Wellington	46.466721	-63.989196	829.8
CAN-PE-7	Morell	46.427407	-62.708696	904.2
CAN-PE-10	New London	46.469849	-63.492019	935.2
CAN-PE-13	Bedeque	46.352066	-63.777329	742.7
CAN-PE-19	Winsloe South	46.2923584	-63.1727104	1119.1
CAN-PE-20	Elmwood	46.2508	-63.3342	1102.4
CAN-PE-23	Borden-Carleton	46.248177	-63.68515	837.2

Vegetable and fruit growers are interested in the number of frost free days in various regions of the province and a few apple and grape growing farms have climate stations and these are included in summary table 7, which shows the number of frost free days, where the temperature was equal to or below 0 degrees Celsius. Data from three (3) PEI Department of Agriculture and Fisheries climate stations at Dover, Souris Line Road and Tyne Valley has also been included. There is an interest in growing more alternative crops in the province and access to good climate data is key to helping growers make decisions on crops which would thrive in the micro climate in their areas. Table 7 provides a summary of the number of frost free days at 32 climate stations across the province. The stations with the lowest number of frost free days are located in valleys or low lying areas such as Maple Plains and Cardigan Head. On the other hand, stations located near the coast have their temperature moderated due to being located in proximity to large water bodies such as Northumberland Strait or the Gulf of St. Lawrence. This also moderates the time of an autumn frost occurring and this is evident at North Cape, Borden-Carleton and White Sands.

Table 7 -Prince Edward Island Climate Stations Frost Free Period – 2016 (Temp. =<0^{0}C)

Station	Date of Last Spring Frost	Date of First Fall Frost	Frost Free Days
Alliston CNP	May 13, 2016	October 27, 2016	165
Arlington	May 13, 2016	October 4, 2016	143
Baltic	May 13, 2016	November 12, 2016	182
Borden-Carleton	April 30, 2016	December 4, 2016	219
Brockton	May 13, 2016	November 6, 2016	176
Cape Egmont	April 29, 2016	November 27, 2016	180
Cardigan Head	June 2, 2016	October 3, 2016	121
Charlottetown Airport	June 2, 2016	October 15, 2016	133
Dingwells Mills	June 2, 2016	October 4, 2016	122
Dover – PEI Agr.	June 2, 2016	October 3, 2016	142
East Point (EC)	May 13, 2016	October 11, 2016	150
East Point (Newman)	May 13, 2016	November 7, 2016	178
Elmwood	May 13, 2016	October 4, 2016	143
FanningBrook	June 2, 2016	October 4, 2016	122
Flat River	May 13, 2016	October 4, 2016	143
Foxley River	May 10, 2016	November 12, 2016	185
Glen Valley	April 30, 2016	November 28, 2016	180
Hampton	May 13, 2016	October 4, 2016	143

Harrington CDA	May 13, 2016	October 28, 2016	166
Maple Plains	June 2, 2016	September 29, 2016	118
New Glasgow	June 2, 2016	October 4, 2016	122
North Cape	April 29, 2016	November 26, 2016	210
Orwell Cove	May 13, 2016	October 4, 2016	143
Peters Road	May 13, 2016	October 28, 2016	166
Souris Line Road – PEI Agr.	June 2, 2016	October 15, 2016	143
St. Catherines	May 13, 2016	October 28, 2016	166
St. Peters	June 2, 2016	October 16, 2016	134
Summerside	May 13, 2016	October 27, 2016	165
Tignish	June 2, 2016	October 3, 2016	122
Tyne Valley – PEI Agr.	May 13, 2016	October 3, 2016	142
White Sands	May 1, 2016	November 28, 2016	178
Winsloe South	May 13, 2016	October 28, 2016	166

The data from Table 7 was plotted on a base map of Prince Edward Island using the open source GIS program called QGIS and the results are provided on Figure 5. The growing season ranged from 118 days at Maple Plains to 219 days at Borden-Carleton. The map suggests that several areas had over 180 frost free days and these were located in the northwest section of Queens County, East Prince area, Foxley River and North Cape. Areas located in valleys or low lying areas tend to have the shortest frost free time period. Figure 5 also revealed an area between O'Leary and West Cape where there currently isn't a climate station where the number of frost free days could not calculated using the interpolation method in QGIS.

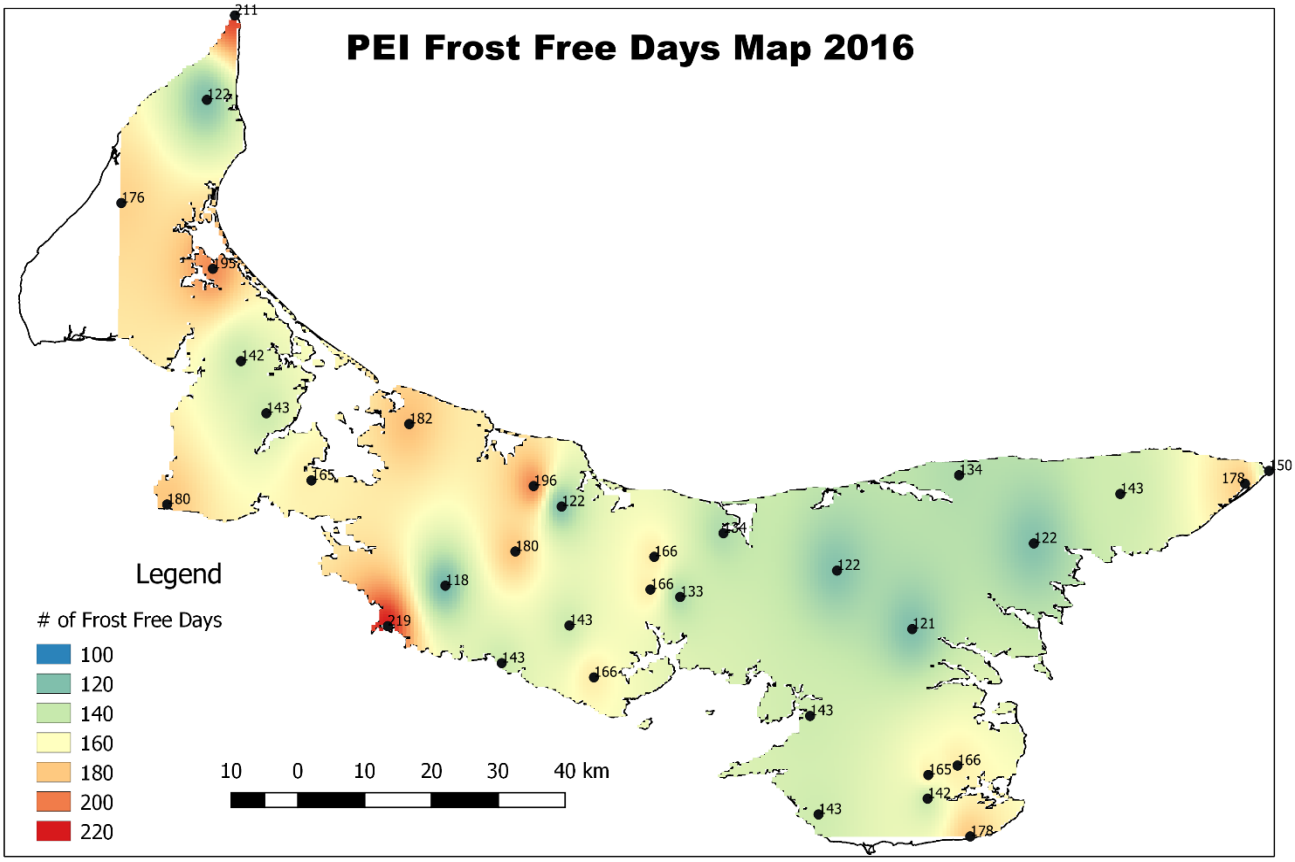

Figure 5 - PEI Frost Free Days 2016

There were a number of significant storm and phenological events recorded during the year which are reported on table 8. Storm events can result in significant damage and the table outlines some of the damage which occurred during the year.

Table 8- Significant Weather or Phenological Events in 2016

Date	Event	Measurement	Winds	Damage	Areas Impacted
January 11	Mild day	Temperature up to 11 ^{0}**C**		None	Mild across the province.
February 5	Snow storm	Up to 30 cms of snow		Thunder and lightning reported in Cornwall	Snow across the province.
February 13	Appearance of American Robin	First sighting in the area.			Ellen's Creek
February 25	High maximum T	14.9 ^{0}**C**		Late winter thaw	Fanningbrook
February 29	Golf Course			Sure sign of an	French River

	Opened			early spring.	
March 29	Rain and snow storm	Over 30 mm of rain and up to 5 cm of snow	Gusting to 90 km/h		Most areas of the province
April 10	Snow storm	30 cm of snow		Church services cancelled	Most of the province
April 22	Spring peepers	Heard singing			Winsloe South
May 27	Thunderstorm	12 mm of rain		Storm lasted 2 hours	Charlottetown Area
June 2	Heavy Frost	-2.3 ^{0}**C**		Early vegetables and small fruit blossoms	Cardigan Head
June 12	Thunderstorm	15.7 mm in < 1 hour			Charlottetown area
July 24	Two major thunderstorms with heavy rain	At Montague 100mm of rain in 1.5 hrs; at Elmwood 75 mm of rain in 1.5 hrs	No major winds	Waste Watch carts carried into Montague River; lightning struck swimming pool and power line insulators at Elmwood; Fish killed at Elmwood	Montague and Elmwood. Both storms classified as 1:200 year events based on IDF curves.
August 18	Thunderstorm	15 mm of rain in <1 hour		No damage	Charlottetown area
October 4	Heavy frost			Vegetation impacted.	Widespread across PEI
October 10	Heavy rain and storm surge. Remnant of Hurricane Matthew.	102 mm of rain at East Point	Winds up to 80 km/h	Storm surge flooded wharves and some coastal areas. Several trees were blown down.	North Rustico and north shore areas
October 22	Heavy rain	34 mm of rain	High winds		Charlottetown area
November 27	First snow of the year. Nor'easter.	18 cm of snow	Winds gusting to 90 km/h	Langley seawall at West Point Lighthouse undermined by storm surge	Coastal areas.
November 30	Snow storm	Over 20 cms of snow	Light winds	School and office closures.	Entire province
December 16	Nor'easter with storm surge	Surge reached 1.8 m geodetic in Charlottetown	Winds over 100 km/h. A gust of 155 km/h reported from the Confederation Bridge.	Flooding at Ch'town Yacht Club. Light pole anchor cracked on Confederation Bridge	Charlottetown and North Shore areas

December 30	Nor'easter with storm surge		Winds over 100 km/h	Siding blew off house in Summerfield; some roof shingles blown off.	Entire province

Discussion

The year stated out with above normal temperatures for the first two months. The winter was mild with normal snowfall amounts. The spring months were normal in temperature with below normal precipitation up to the month of July. This resulted in near drought conditions in some areas although crop yields for the most part were not severely impacted. Apple yields were the highest observed in over 10 years at some orchards in the province. Many farmers expected their potato crop yields to be below average but it appears that much needed rain in August and September resulted in a higher yield than expected. Two major thunderstorms on July 24th at Elmwood and Montague caused some local damage including lightning strikes on power lines, Waste Watch carts ending up floating in the Montague River and some fish died in a tributary to the Clyde River.

A map of the rainfall amounts during the July 24th storm at Elmwood is provided in Figure 6. The rainfall amounts in the core area of the storm were obtained from private, manual rain gauges with one CoCoRaHS station (CAN-PE-20) near the core area. The private gauges were examined to ascertain the accuracy of the recorded readings. Subsequent testing of these manual gauges compared to the Type B rain gauges used at the CoCoRaHS stations revealed these private gauges underestimate rainfall amounts by about 20%. The rainfall amounts in the Montague area on the same day were also obtained from private, manual gauges as there were no Environment Canada, Agriculture PEI, UPEI or other automated rain gauges in the area.

These two events affirm the need for additional climate stations in the province to enable measurement of precipitation amounts from these cumulonimbus cloud events in localized areas. These storms can cause significant damage to crops, flooding and damage infrastructure such as roads, culverts and buildings and it is difficult to do a proper assessment without accurate, reliable data.

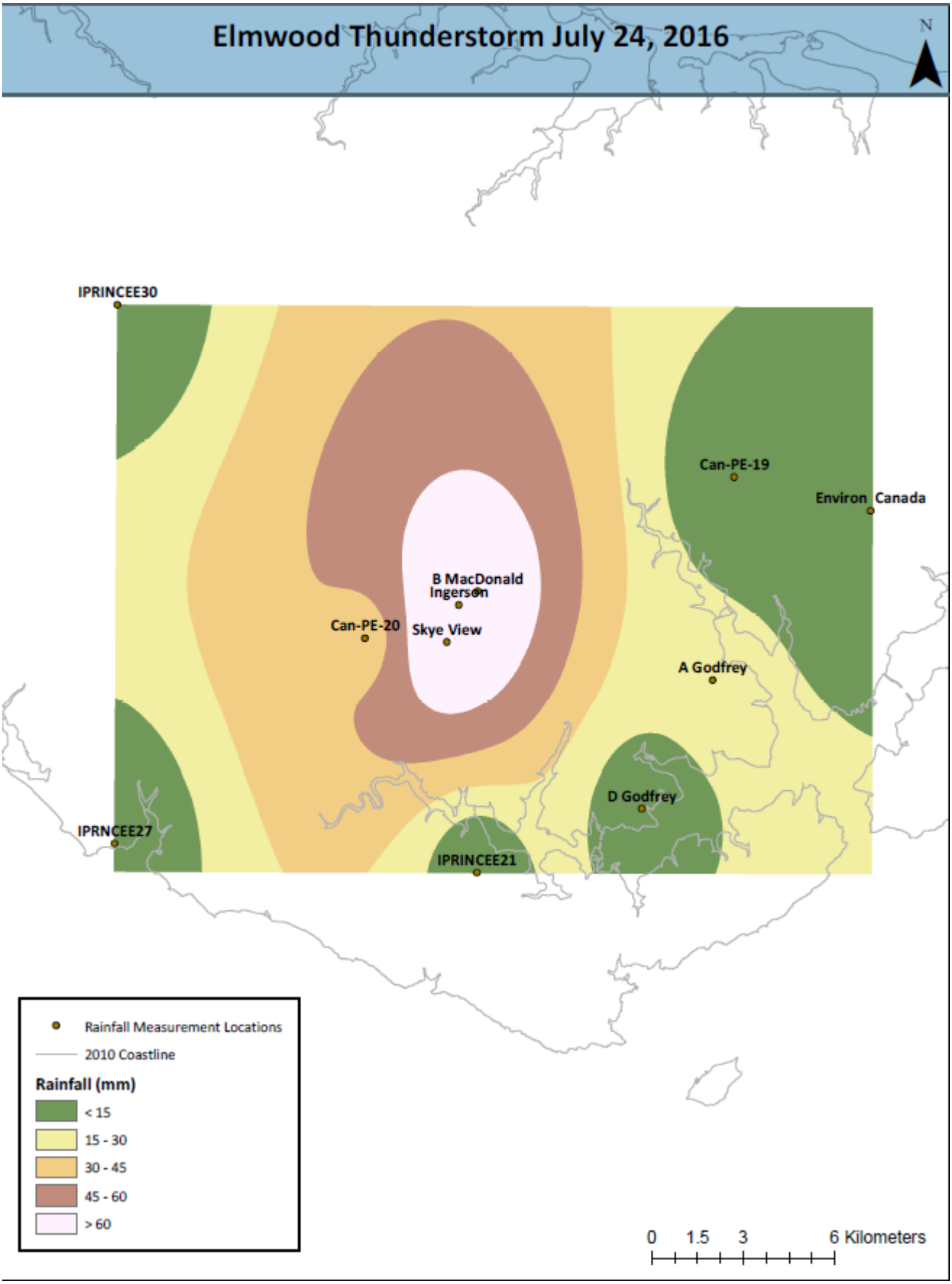

Figure 6 - Rainfall Map of Thunderstorm at Elmwood on July 24, 2016 – Map by Evan MacDonald

The remnants of Hurricane Matthew over the Thanksgiving Weekend on October 9 and 10th resulted in over 100 mm of rain falling in some sections of the province and this caused a few delays in crop harvesting.

Three storm surge events on November 27th, December 16th and December 30th caused some minor flooding in some areas of the province including Charlottetown and North Rustico. The UPEI Climate Lab and the PEI Watershed Alliance installed some water level or tide monitoring gauges at Lower Darnley Wharf, Covehead Wharf and at the Charlottetown Yacht Club. A graph of the water levels recorded at Darnley Wharf from September 15th to December 21st is represented on Figure 7.

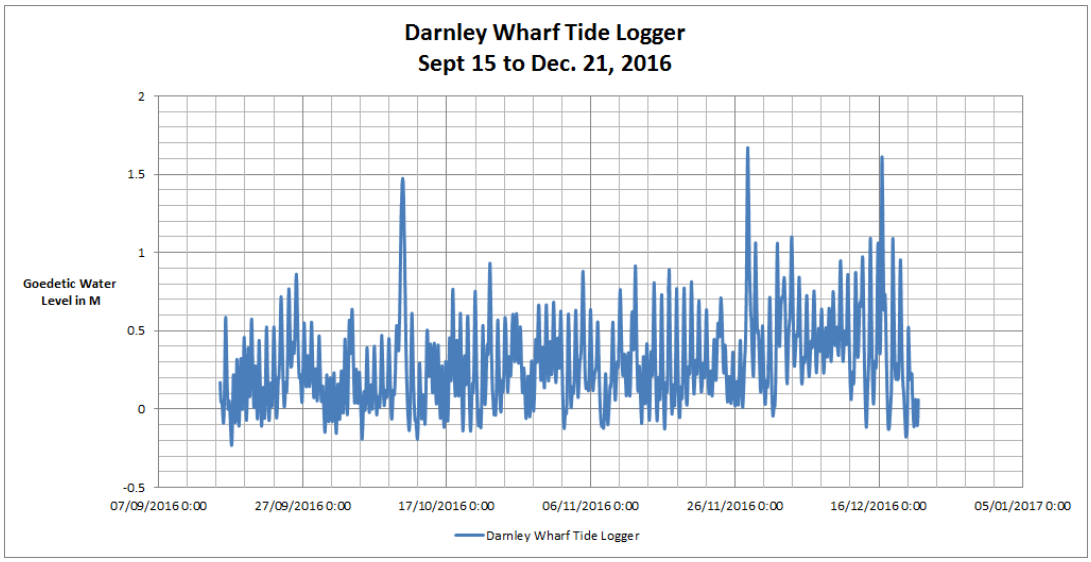

Figure 7 - Darnley Wharf Tide Log 2016

An Op-Ed article in the Charlottetown Guardian on January 4, 2017 by Dr. Adam Fenech and Don Jardine, outlined some of the top weather stories of the year for the province.

Number 1 – Global Warm Temperatures

Global temperatures soared toward a record high in 2016, coming after a full year of record temperatures in 2015. The United Nations' World Meteorological Organization (WMO) reported global temperatures, boosted by the El Nino phenomenon, 1.2°C above pre-industrial levels. The WMO said 16 of the 17 hottest years on record have occurred this century with the only exception being 1998, which was also an El Nino year. El Nino is a temporary change of climate that happens every few years when winds shift in the Pacific Ocean along the equator, warming the water more than usual. These El Nino events trigger changing weather patterns globally.

These types of global average temperatures have regional impacts. Temperatures in the Arctic were almost 30°C warmer than average just before Christmas Day. Ocean buoys recorded temperatures near the North Pole of 0°C or warmer, with media outlets reporting temperatures in the Arctic as being warmer than in Thunder Bay, Ontario. This wasn't an isolated event as Arctic temperatures were unusually warm for the last few months of 2016. The warmer temperatures are a sign that climate change is happening and is part of a changing world. It underscores the need to quickly reduce the emissions of carbon dioxide and other greenhouse gases blamed for warming the planet.

Number 2 – Hit-and-Miss Summer Precipitation

In July, a storm ran across Prince Edward Island wreaking havoc in isolated areas, but left no trace of its existence in the official records as the rain missed falling where any weather stations operated by Environment and Climate Change Canada exist. There are nine weather stations across PEI operated by Environment and Climate Change Canada, but according to Canadian government officials, it's unlikely the Island will be getting more because they are "quite

expensive and generally the network fills the basic need." This results in gaps across the Island where extreme weather events can occur and be missed by the official Environment Canada network of weather stations.

For an hour on July 24, a small storm cell hit an area just north of Montague dropping over 75 millimetres, and over 100 millimetres in some places. Some Waste Watch carts were washed to the Montague River by the flooding waters; portions of Brook Street and Patrick Street were washed out or damaged; a concrete barrier at the boat launch area of the Montague Marina was damaged; many homes had flooded basements; the Queens Road ditches overflowed and caused flooding of the road; and one person was observed kayaking in the ditch of the Queens Road, which was completely dry before the storm. The rainfall was so isolated that even the weather stations operated by the Climate Lab at the University of Prince Edward Island at Cardigan Head, Flat River, Orwell Corner, and Alliston reported no rainfall during this storm event.

Another similar storm cell of about 6-10 kilometres wide hit the Elmwood area the same day dropping over 75 millimetres of rain in one hour in many areas. The rain was very intense, pelting down with some force, including some hail reported on the most westerly parts of the area. Thunder and lightning were intense especially on the eastern end of the Wynn Road where a swimming pool and power pole insulators were damaged by lightning strikes. This hit-and-miss rainfall points out the need for more weather stations across Prince Edward Island to provide a dense network able to capture these types of extreme weather events for our records, and more importantly, for Islander insurance claims.

Number 3 – See-Saw Winter Temperatures

Winter temperatures see-sawed between cold snaps and record-breaking warm temperatures through much of the first two months of 2016. A winter snowstorm on January 29 was followed days later with temperature highs of 9°C, about 12 to 14 degrees Celsius warmer than normal. Temperatures then see-sawed between –6°C the following day, back up to 9°C by the end of the week, and then down again by the weekend to –7°C accompanied by another significant snowstorm. By the end of February, another cold spell was quickly broken by record-setting warm temperatures on February 25 of 12°C eclipsing the previous record of 7.9°C from 1996. All of these unusual see-saw temperatures had their impact.

- Firefighters in St. Eleanor's had to put out a grass fire as a result of the soaring February temperatures for the first time in at least 30 years. The fire was quite small and it took firefighters ten minutes using a few brooms and shovels to extinguish.
- The annual Jack Frost Festival held at the Charlottetown Event Grounds delayed opening due to the warm and wet weather. Workers trucked in snow and covered their snow structures with tarpaulins to slow the melting.
- Outdoor skating rinks took a hit thanks to the surging temperatures, turning many into what looked like giant puddles. Rinks maintained by the cities of Charlottetown and Summerside all closed during the warm conditions.
- The golf course at French River is usually the first on the Prince Edward Island to open, and they did so in February of 2016, the earliest ever for the course. The grass on the French River course is organic, pesticide-free, and not as tender as other golf courses, allowing it to risk frost damage.

Summary

The mean annual temperature and precipitation totals for 2015 were close to normal for the province. There was considerable variation from the normal in some months with February and March being much colder than normal but December, August and September being much warmer than normal. Snowfall amounts for the winter of 2014/15 were the highest for the period of record beginning in 1873 when Prince Edward Island joined Confederation. The snow event on February 15 and 16th resulted in an accumulation of 86.8 cm of snow which is the maximum ever recorded in the province and eclipsed the previous record for a snow storm set during White Juan in 2004.

Late spring planting and a lack of rainfall during the months of May and July shortened the growing season and slowed the growth of some farm crops reducing yields at harvest time. Harvesting of mussels during the winter was impeded due to heavy snow and poor ice conditions.

The climate extremes for the year for all reporting stations listed in this summary are shown on Table 9.

Table 9 -Climate Extremes Prince Edward Island Climate Stations 2016

Parameter	Extreme Value	Date Observed	Station
Daily Tmax (C)	30.6	June 19, 2016	Tignish
Daily Tmin (C)	-24.0	February 13, 2016	Maple Plains
Highest Annual Tmean	7.6		Orwell Corner
Lowest Annual Tmean	6.0		Maple Plains
Max Wind Gust (km/h)	172.2	October 10, 2016	Dingwells Mills
Max. Daily Ppt (mm)	102.0	October 10, 2016	East Point (Newman)
Highest Annual Ppt (mm)	1245.3		Peters Road (Alliston)
Highest Annual Snowfall (cm)	289.2		Charlottetown Airport

A high temperature record was set for the month of November on November 5th +- when the temperature reached 22.6 C at the UPEI Climate Station at Fanning Brook and also at Foxley River. The previous high for the month of November was 22.5 C at New Glasgow in 1982. The peak wind event at the IWMC Drop-Off Centre at Dingwells Mills at 7:00pm on October 10th was investigated. Site staff reported debris was scattered about the site, televisions stacked on pallets were blown over, and some fish pans were blown away. The wind direction vane on the Davis Vantage Pro Anemometer mounted on the top of the roof of the scale-house was also loosened on its spindle and had to be repaired. This is the only time site staff could recall this type of wind damage since the site opened in 2001.

Figure 8 - New climate station at Cape Egmont, September, 2015

Sources:

Environment Canada Climate Data Archives

WUnderground.com

CoCoRaHS.org/Canada

AgraWeather Atlantic Website

Michael Radvanyi, Peters Road

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Charlottetown Guardian, January 4, 2017

CBC News, various stories

Joseph MacIsaac and Wanda Downe, Dingwells Mills Drop-Off Centre

D. Jardine, UPEI Climate Research Lab, February 17, 2016.