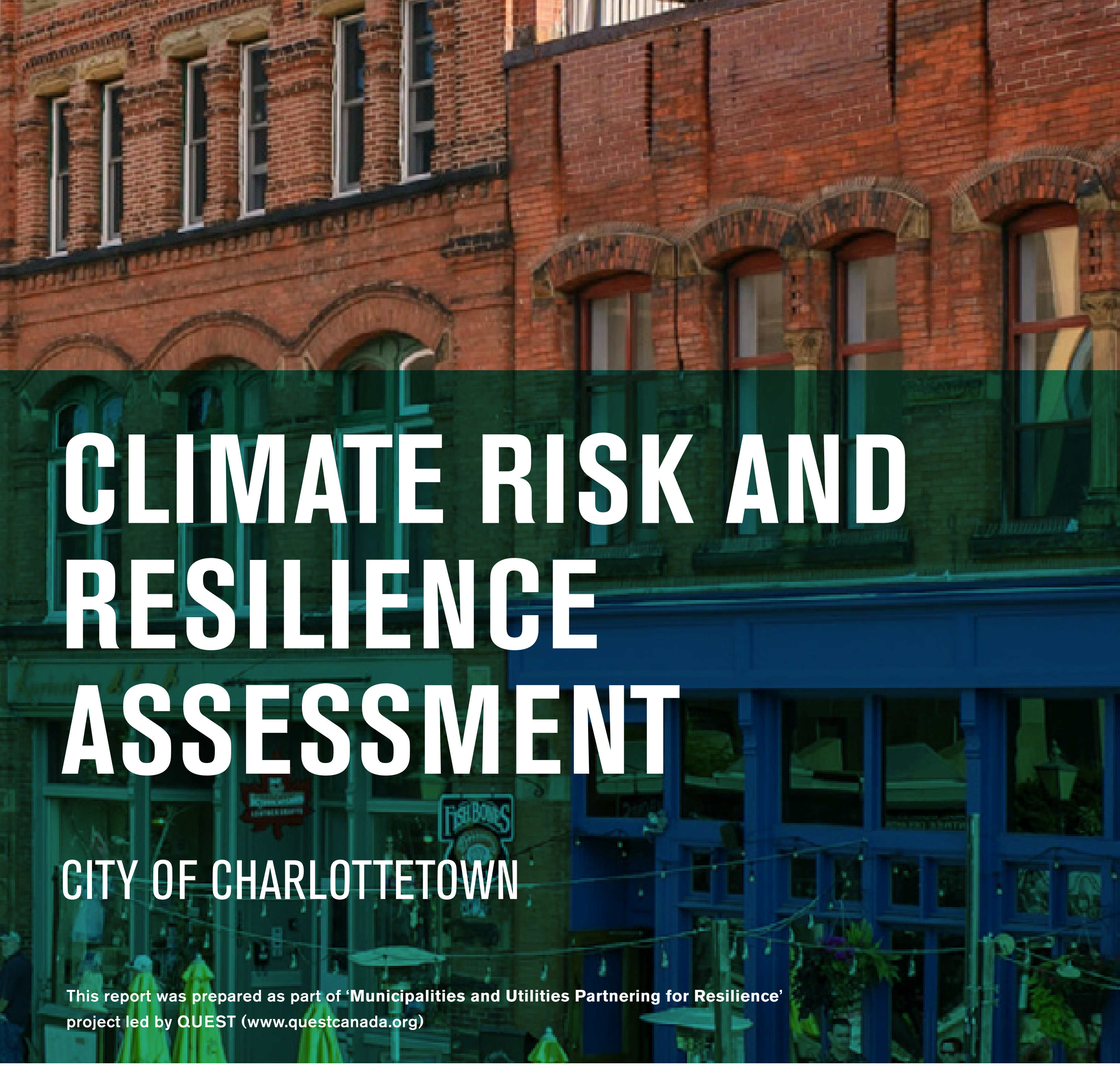

CLIMATE RISK AND RESILIENCE ASSESSMENT

CITY OF CHARLOTTETOWN

This report was prepared as part of **'Municipalities and Utilities Partnering for Resilience'** project led by **QUEST** (www.questcanada.org)

QUEST

FUNDED BY:

FCM FEDERATION OF CANADIAN MUNICIPALITIES FÉDÉRATION CANADIENNE DES MUNICIPALITÉS

Acknowledgements

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Funder

FCM Municipalities for Climate Innovation Program (MCIP), Climate Adaptation Partner Grant

QUEST

QUEST is a national non-government organization that works to accelerate the adoption of efficient and integrated community-scale energy systems in Canada by informing, inspiring, and connecting decision-makers. The organization commissions research, communicates best practices, convenes government, utility, and private-sector leaders, and works directly with local authorities to implement on-the-ground solutions. QUEST recognizes communities that have embraced these principles by referring to them as Smart Energy Communities. Visit us at www.questcanada.org

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Executive Summary

What this Report is About

This report assesses the overall resiliency of the City of Charlottetown to extreme weather events in a context of climate change. The report includes a review of the anticipated impacts of climate change in the decades to come, associated hazards, and an assessment of the resiliency of the community to these events. It identifies assets at risk, areas of strengths and areas of improvement.

This report build on:

- the results of a survey sent to municipal staff representing different departments with the aim to identify policies in place, gaps, and collect other relevant information to prepare the workshop;
- a full-day workshop that consisted of expert guest presentations and three table-top exercises (including a participatory mapping exercise identifying areas subject to specific hazards as well as assets and facilities at risks). The workshop was attended by 17 participants representing diverse stakeholder groups, including utilities, EMOs, staff from various departments and provincial, regional, and/or local organizations.

With these results, QUEST developed an analysis of the municipality's strengths, gaps, and opportunities to improve resilience and adapt to a changing climate. These results will be used to develop tailored recommendations to the City of Charlottetown.

Who This is Intended For

This report is intended to inform the municipal staff and Councilors about:

- the types of hazards associated with increasing extreme weather events
- areas, assets, and facilities at risks
- the level of preparedness of the community to mitigate risks associated with these events.

The report is intended to be used to inform future planning decisions and provides a benchmark to measure and monitor progress in developing and implementing resilience or adaptation strategy (i.e., to determine where improvements were made or may still need to be made).

QUEST appreciates the opportunity to work with your municipality and local stakeholders to help improve resilience and adapt to climate change.

Next Steps

The results contained in this report will be used by QUEST in the second stage of the project to prepare a second workshop and develop a Recommendations Report in 2019 that will improve the City of Charlottetown's capacity to become more resilient and adapt to climate change.

This report and recommendations within will be discussed in a second workshop in 2019 in order to finalize a strategy for each community.

High level summary of Key Findings

Based on climate data as well as results of the pre-survey, first workshop and table-top exercises, the City of Charlottetown is most concerned with atmospheric, hydrological, and geological hazards, as well as power outages, food shortages, and hazardous material spills.

- **Atmospheric hazards** of particular concern include: increasing frequency of ice storms, as well as sea storms and surges, snow storms and wind storms.

- **Hydrological hazards** of particular concern include: coastal flooding, sea level rise, and other forms of flooding (e.g. rainstorm) from increased precipitation, especially in winter and spring.

- **Geological hazard** of particular concern is shoreline erosion**.**

- **Power outages** are a concern, along with potential food shortages. For example, extended outages are possible due to ice loading and extreme weather events on distribution and transmission lines. Food and diesel (for generators) are transported to the city via the Confederation Bridge which is closed several times a year due to extreme weather.

- **Contamination** was identified as a risk to the city's drinking water. Charlottetown's potable water comes from a series of wells located within the Winter River watershed.

Through our consultation with municipal staff, local utilities, and community stakeholders, local strengths and areas for improvement were identified in:

- **Vegetation:**
  - Key Strengths:
    - Tree trimming around wires done by city and Maritime Electric; and
    - Supports bioretention in the community
  - Key Areas for Improvement:
    - Could promote or incentise more bioretention

- **Planning, Organization and Coordination**:
  - Key Strengths:
    - Emergency Response Plan;
    - The City has alliances and mutual aid agreement with local groups, businesses and neighbouring communities for emergency response;
    - Contact tree and an inventory of skills/resources in the community;
    - Sustainability Plan and Community Energy Plan;
    - Climate change is incorporated into the Asset Management Plan and Land Use Plan; and
    - The City plans for assisting the vulnerable population.

    - Key Areas for Improvement
        - Increase collaboration and integrate climate and resilience considerations across all departments and activities. Designate someone responsible;
        - Consider climate change in all capital investment and planning decisions;
        - Improve regulations for housing and development to take projected climate risk into account (e.g. flooding);
        - Discourage development, or apply minimum build requirements/ flood protection measures, for flood-prone areas;
        - Encourage new development or 'Build back better' in low-risk areas; and
        - Enforce new building codes and land use regulations.

- **Communications and Awareness**;
    - Key Strengths:
        - The City has implemented the Charlottetown Alert System;
        - Charlottetown's Mayor and Council understand their roles and responsibilities in emergency communications;
        - Charlottetown has a communication plan for promoting emergency preparedness;
        - Public is aware of where to go in case of emergency;
        - Local radio station and TV station have backup power;
        - HAM radios at City Hall and operators are volunteers;
        - Trunk Mobile Radio for Emergency Responders; and
        - Communication towers in Charlottetown have backup power.
    - Key Areas for Improvement:
        - Develop proactive resilience education strategy
        - Encourage local schools include education and training in disaster risk reduction and emergency preparedness
        - Continue providing ICS training to all staff
- **Energy Infrastructure**:
    - Key Strengths
        - Backup power at City Hall and EMO, lift stations, water treatment, and four emergency shelters;
        - Critical facilities have backup power;
        - Community has some backup generators;
        - Provisions exist to keep fueling stations open during prolonged interruptions; and
        - Flood risk (1 in 100 year events) to power and utility infrastructure has been assessed.

    - Key Areas for Improvement:
        - Ensure back-up power for shelters, cooling centers, animal shelters, banks, schools, and greenhouses. The community has mobile generators, but unclear how many and whether they would be available
        - Food, Medicine, and Diesel fuel supply for backup generators would be interrupted if Confederation bridge closures exceed 52 hours.
        - There are potential opportunities for renewable heat and power to compliment

back-up power (generator) on municipal facilities, critical infrastructure, emergency shelters, etc.
    - Opportunity to work with the utility to understand hazards and reduce risk from prolonged interruptions to power and fuel delivery

- **Water and Wastewater Systems**:
  - Key Strengths:
    - Distributed water system (potable) that is pumped;
    - The stormwater and sewer systems are separated;
    - Backup power for the water and wastewater treatment;
    - Decommissioning a lagoon which is at the water's edge; and
    - There are no known neighbouring land uses contributing to the community's flooding risk.
  - Key Areas for Improvement:
    - Unclear if storm water system can handle 1 in 100 year flood events; and
    - Unclear if the City continues to use ditches, plan retention ponds, promote bioretention etc., to alleviate pressure on the storm water system.

- **Transportation**:
  - Key Strengths:
    - Several main transportation corridors to enter/exit the community;
    - Charlottetown has diesel-powered bus transit; and
    - Generator located next to the Port feeds the grid.
  - Key Areas for Improvement:
    - On a provincial scale, weather can interrupt access to mainland on bridge and ferry;
    - Unclear if there are neighborhoods with only one access road; and
    - The City does not have EV Charging Stations with backup power.
- **Food.**
  - Key Strengths:
    - Local community gardens;
    - At least one local grocery store has backup power; and
    - Charlottetown has 3 to 5 days food supply.
  - Key Areas for Improvement:
    - Unclear how many local greenhouses there are or if they have backup power; and
    - Unclear if there is a strategy for interruptions to food supply.

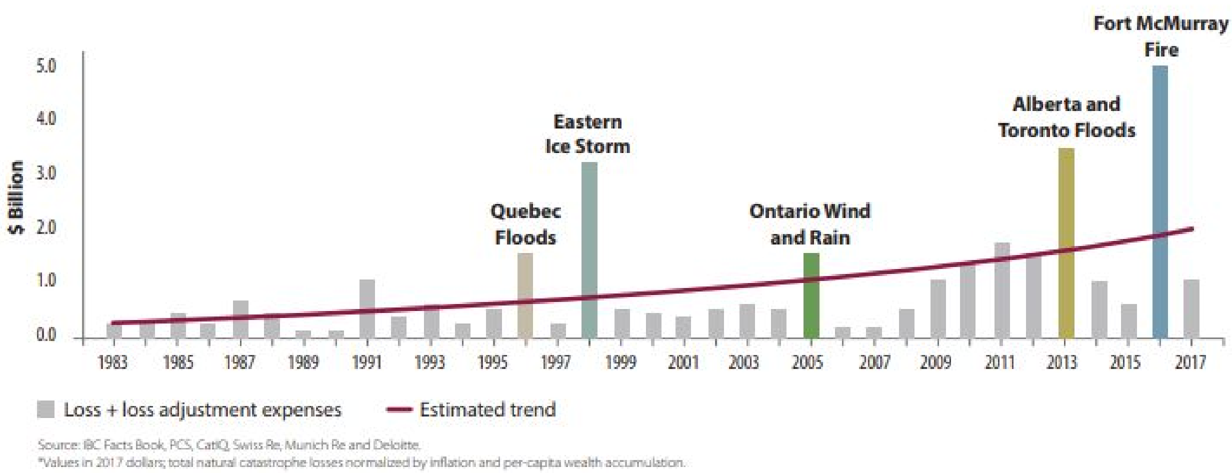
All of the hazards of concern and areas of strength or improvement are described in Section 6: Summary.

0.0 Introduction and Project Presentation

0.1. Climate Changes and Catastrophic Losses in Canada

Municipalities across Canada are already faced with climate change impacts, such as extreme winds, ice storms, flooding, to droughts and forest fires. According to the Insurance Bureau of Canada (IBC), the costs associated with damages to property and infrastructure are rising[1]. Risk exposure may increase with climate change, if GHG emissions continue to rise globally unabated, inevitably requiring municipalities to adapt.

Table 1: Catastrophic Losses in Canada over time



Source: Insurance Bureau of Canada

At the same time, nearly 90 percent of Canadian energy utilities have been significantly impacted by an extreme weather event in the past decade[2]. Both municipal systems and energy distribution systems are essential, interconnected and must work together to maintain the resilience of a community. Reliable energy supply is needed to maintain the essential functions of municipal infrastructure such as water and wastewater treatment, heating and cooling of buildings, operating vehicle fleets, street lighting, powering emergency shelters, etc.; as well as to ensure other critical infrastructure such as health systems, communications infrastructure, transport infrastructure, food production, financial systems, and other systems continue to function. When energy supply is interrupted, especially for prolonged periods, this has a cumulative impact on a community, from impacts on business, to public health and safety, to property and infrastructure.

There is a need for Canadian methods and tools for municipalities and utilities to adapt their systems.

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[1] Several IBC studies assess the increased claims frequency and severity resulting from severe weather and natural disasters.For more information, visit IBC webpage on : http://www.ibc.ca/ns/resources/studies.
[2] QUEST's Resilient Pipes and Wires report

0.2. The Project

This report is part is part of the "**Municipalities and Utilities Partnering for Community Resilience**" project led by QUEST with funding from Natural Resources Canada. The project, supports six municipalities across Canada to develop a climate risk and vulnerability assessment, using a combination of validated tools and methods. This project refers to community resilience in terms of what is in place and what may be needed for a community to mitigate risk from prolonged interruptions to energy supply on essential community services and bounce back from climate impacts or extreme weather. Each community receives an assessment (this report) in 2019 and a set of recommendations for improving community resilience and adapting to climate change, tailored to local context (second report in 2019). All lessons learned will be compiled by QUEST into a final guide in 2019, to be shared with other municipalities across Canada.

0.3. Methodology and data collection

To prepare the workshop, QUEST team conducted a detailed survey, to understand local strengths and weaknesses (current status) - see Section 0.3.1 for details.

QUEST team also collected geospatial data from Federal, Provincial and Municipal open data portals in order to prepare maps of each community, showing land use, flood risk (where available), key infrastructure, that could be used in table-top exercise during workshop 1. See section - 0.3.2 for details of workshop.

In addition, QUEST team compiled climate data projections for each municipal area, including indicators for temperature, precipitation, freeze-thaw, heating degree days and cooling degree days, etc.. This includes projections for 2020, 2050, 2080-2100, using business as usual (RCP 8.5) scenario, where GHG emissions continue to rise at the current rate. This was used to provide context during workshop 1.

Once these data collected and analysed, QUEST team prepared and facilitated a full-day workshop in each community, engaging municipal staff and elected officials, provincial government, energy utilities, and other key local stakeholders. The workshop included presentations on climate change, resilience, emergency preparedness, energy utilities, and insurance trends. The workshops also included three table top exercises.

All these results were then used to prepare an analysis of the strengths and gaps in each community, in relation to each natural hazard (e.g. atmospheric, hydrological, forest fire, etc), with assistance from the Rural Disaster Resilience Portal of Justice Institute of British Columbia. Based on this analysis, QUEST team prepared this report tailored to the local context of each participating community, including a summary of levels of risk and resilience to each natural hazard, and a summary of strengths and areas of improvement. Findings of this report will be used to prepare the second workshop, focusing on recommendations.

Finally, QUEST conducted an orientation webinar and monthly calls with the municipal lead of each of the 6 participating municipalities. This allowed for project coordination, knowledge exchange, discussion of key challenges and opportunities, and review of materials.

0.3.1. The survey

A pre-survey data collection exercise was conducted to gather information about policy, plans and processes in place in the community and was circulated to municipal staff representing all the departments and services prior to the first workshop. The survey was completed to determine potential strengths and areas of improvement in each municipality, including for energy-dependent municipal services.

Description of sector/areas covered: organization, communication, planning / land use, energy for buildings (heat etc), water/wastewater, transportation, vegetation management and food security.
The results of the survey provided context during the first workshop - results were shared with all participants, which led to interactive knowledge sharing and additional information gathering which was captured in this report.

0.3.2. The workshop #1

The workshop included context setting presentations on climate change, resilience, emergency preparedness, energy utilities, and insurance trends, followed by three tabletop exercises. The workshop also included three exercises: a mapping exercise, an exercise using the federally endorsed tool from the UN International Strategy for Disaster Reduction 10 Essentials for Making Cities Resilient, and an action planning exercise.

- An interactive mapping exercise (developed by Spatial Quest): using a map of their community, participants identified hazards, vulnerabilities, strengths/assets, areas for improvement, land use restrictions, transportation improvements etc.. These were denoted using stickers and markers, and items were recorded in a workbook at each table.
- A self-assessment using the UN ISDR 10 Essentials: Participants at each table self-assessed their strengths and weaknesses, and assigned their community a score for each of the 10 Essentials, including for: Organization and Coordination, assigning budget for risk reduction, conducting hazard risk and vulnerability assessment, investing in infrastructure adaptation, assessing the safety of schools and hospitals, applying risk compliant building codes and land use planning principles, ensuring training is in place, protecting ecosystems, developing emergency management capacity, and building back better post-disaster. The results were recorded in a workbook.
- A facilitated action planning exercise: participants identified key needs, goals, and actions on sticky notes and then grouped them by theme.

1.0 Community Profile

1.1 Geography / Location

The **City of Charlottetown** is located in the central part of Prince Edward Island's south shore. It is on the Charlottetown Harbour, which is formed by the confluence of the Hillsborough River, the West River, and the North River. The harbour opens onto the Northumberland Strait. Charlottetown is the capital and the biggest city in Prince Edward Island. Charlottetown was originally incorporated as a city in 1855.

Charlottetown has nearby streams and is a coastal community with low-lying neighborhoods. There has been some erosion around waterways or waterfront. Floodplains have been identified and mapped, but it is unclear how many buildings are affected, or if the City implemented restrictions on building in floodplains or notifies permit applicants. The community does not experience annual river flooding or ice jams but does experience coastal flooding and overland flooding due to rain events.

Land area in square kilometres: 45 sq. km

1.2 Population Characteristics/Trends

Municipal Staff Size: 475 with seasonal staff
Population Size: 39500
Trend: Steady incline in population. Population percentage change from 2011 to 2016: 7.5%
Average Age of the Population: 42.1
Median Age of the Population: 42.3

Total - Distribution (%) of the population by broad age groups

Age Group	% of population
0 to 14 years	14.8
15 to 64 years	66.3
65 years and over	18.9
85 years and over	2.7

The culture of the area is primarily a mix of English, Irish, and Scottish settlers with the predominant languages being English.

Languages Spoken:

Item	Language	# of people
First Official Language spoken	English	41985

	French	870
Language spoken most often at home	English French Non-official languages	39200 370 3245

Median Income:

Median Income	$
Median after-tax income of one-person households in 2015	27,419
Median after-tax income of two-or-more-person households in 2015	66,286

Highest Education:

Highest Certificate, Diploma, or Degree (population 25 to 64)	# of people
No certificate; diploma or degree	5140
Secondary (high) school diploma or equivalency certificate	9250
Postsecondary certificate; diploma or degree	22470
Apprenticeship or trades certificate or diploma	2110
Trades certificate or diploma	1215
Certificate of Apprenticeship or Certificate of Qualification	890
College; CEGEP or other non-university certificate or diploma	8820
University certificate or diploma below bachelor level	980
University certificate; diploma or degree at bachelor level or above	10565
Bachelor's degree	7080
University certificate or diploma above bachelor level	580
Degree in medicine; dentistry; veterinary medicine or optometry	325
Master's degree	2130
Earned doctorate	455

Type of Dwellings:

Type of Dwellings	# of

	dwellings
Single-detached house	9305
Semi-detached house	1725
Row house	660
Apartment or flat in a duplex	560
Apartment in a building that has fewer than five storeys	6760
Other single-attached house	35
Movable dwelling	425

Age of Dwellings:

Age of Dwellings	# of dwellings
1960 or before	3945
1961 to 1980	5820
1981 to 1990	2610
1991 to 2000	2330
2001 to 2005	1415
2006 to 2010	1800
2011 to 2016	1610
Major repairs needed	945

All of the above data was sourced from Statistics Canada, from their last Census (2016).

1.3 Environmental Characteristics/Trends

Trend: Population is growing and varies seasonally, changes in weather e.g. new max temperatures recorded in past three years. Charlottetown has a humid continental climate. The temperature is moderated by the Gulf of Saint Lawrence with milder temperature extremes. The City's position on the coast leads to frequent and heavy precipitation in the winter. The average precipitation for the year is 1158mm.

1.4 Economic Characteristics/Trends

Charlottetown is the political and administrative centre of the province. The largest employment sector is the public sector. Other major industries include manufacturing, health care and social assistance, retail, accommodation and food services, and education. Two growing industries in Charlottetown are biotechnology and information technology. The region's reputation as a cultural hub attracts tourism.

1.5 Energy Characteristics

The **City is connected to the grid**. On-island wind generation meets approximately 40% of load. The remaining generation and reserve capacity are in New Brunswick. There is a diesel generator that is grid-connected in the city. Oil and gas reach the community by truck and ship. There are local distributors and storage tanks. There are no pipelines, refinery, or oil extraction in the community.

2.0 Key Hazards and Climate Projections

2.1 Introduction

To help with our assessment, QUEST compiled baseline climate information (today's climate) and prepared a forecast of climate indicators specific to your community/region, with the technical assistance of Lansdowne Technologies. The forecast is based on the assimilation of climate data from Environment Canada, weather stations in your area, and 40 global climate models, grouped into three GHG concentration pathways (low, medium, and high/business as usual), with projections for 2020, 2050, 2080 to 2100. These have also been compared against available provincial data for future climate conditions. See modeling method details in the Annex.

Here we present a summary of the climate indicators and projections, for the business as usual scenario (where GHG emissions continue to rise at current rate).

2.2 Current Climate

Charlottetown has a humid continental climate that is moderated partially by Prince Edward Island's location in the Gulf of Saint Lawrence. Winters are somewhat milder than many inland cities at a similar latitude: the January average is −7.7 °C, and lows reach −20 °C or below on an average 7 days per season. However, the coastal position means that winter precipitation, more often as snow, is frequent and at times heavy: the seasonal snow average is 290 centimetres. Spring warming is gradual due to the ocean waters still being cold. Summers are mild, again due to the same maritime moderation: the July high is 23.2 °C. Precipitation averages 1,158 millimetres per year, with the greatest amounts falling in late fall and winter.

2.3 Key Hazards of Concern

Hazards of most concern identified in the pre-workshop survey and in workshop 1 include:

- **Atmospheric** (e.g., wind events, blizzards, ice storms)
- **Hydrologic** (e.g., coastal and inland flooding)
- **Hazardous Material Spills/**Contamination
- **Power Outage**/Fuel Shortages
- **Shoreline erosion**
- **Lyme disease**

Here is an example of recent events provided in the pre-survey:

Type of Hazard	Location	Date/ Duration	Description	Risk of Re-occurring	Power Outage	Cause of Event	Impact on Community
Severe weather events	Charlottetown, PEI	Up to several days	Nor-Easters	High	Yes	Unknown	Temporary Shutdown

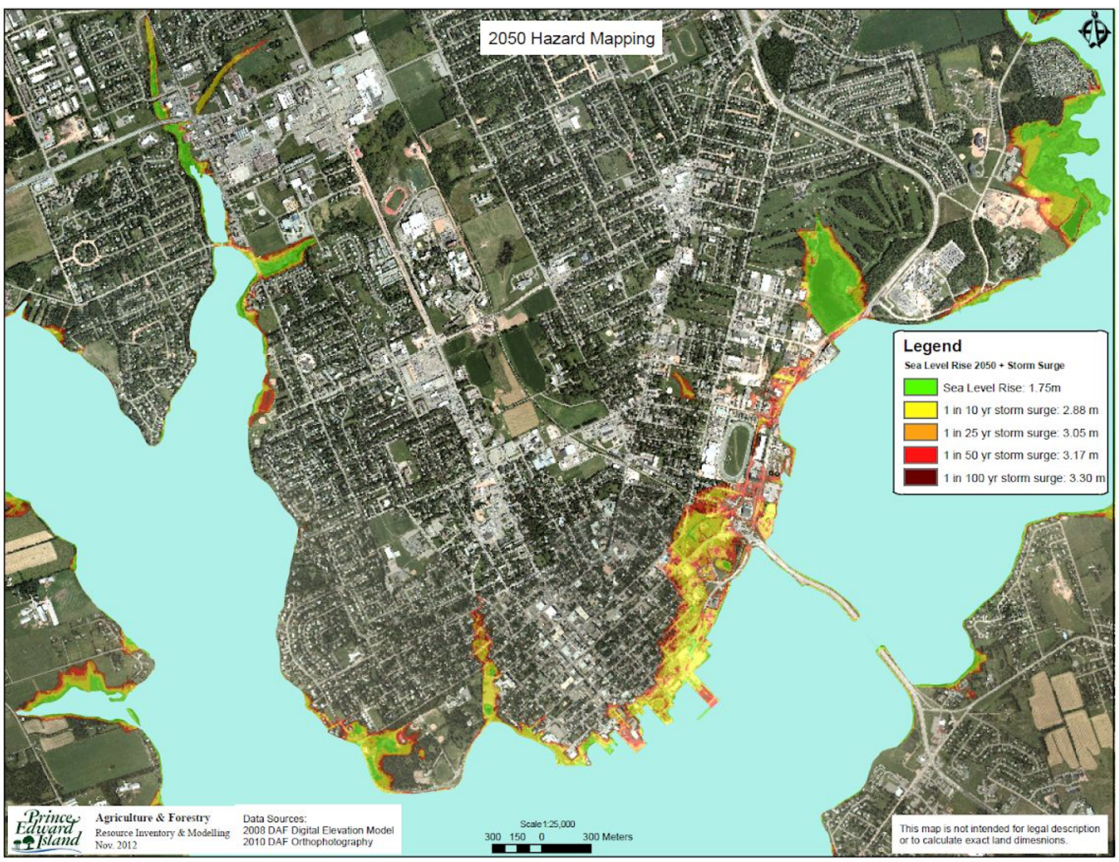
2.4 Climate Projections

See Annex for detailed description of climate indicators, modeling methods, and projections.

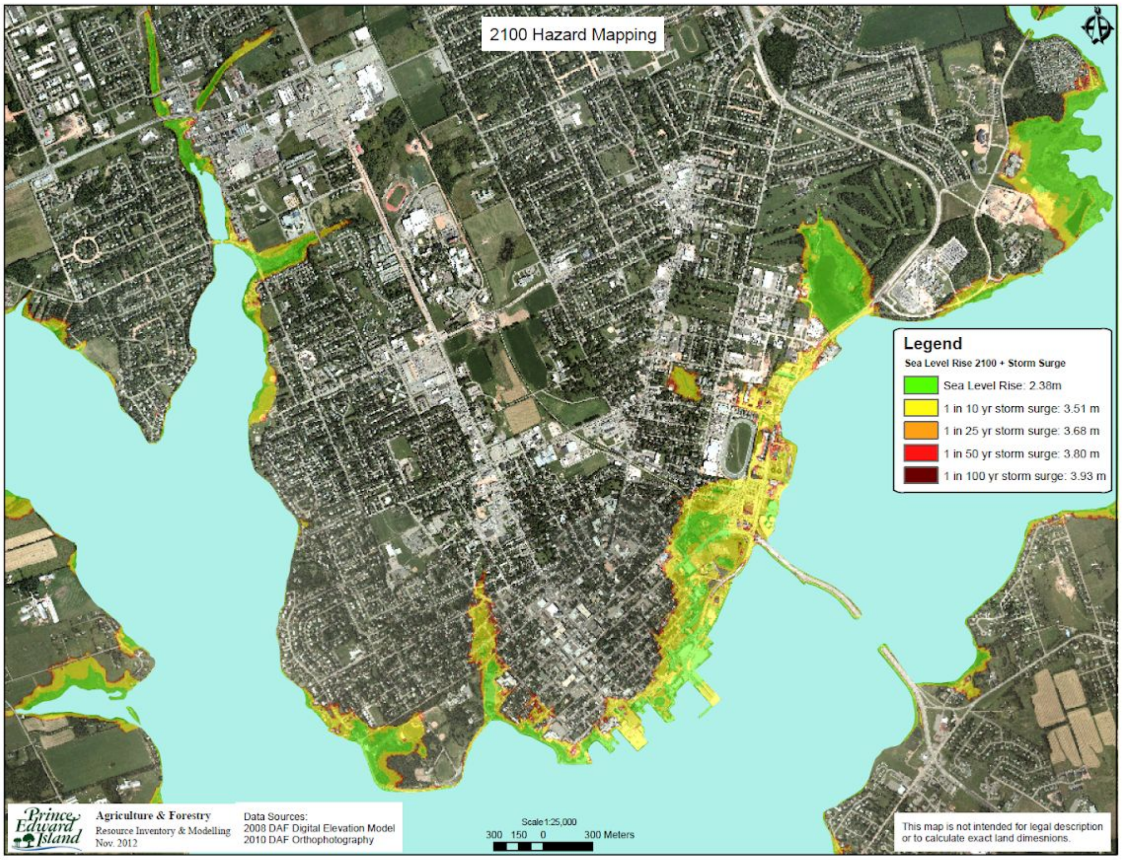
2.4.1 Sea Level Rise and Storm Surge

Sea level rise and storm surge can increase flood potential which can impact community infrastructure in coastal and low-lying areas, such as Charlottetown:

2050 Sea Level Rise and Storm Surge, Hazard Map



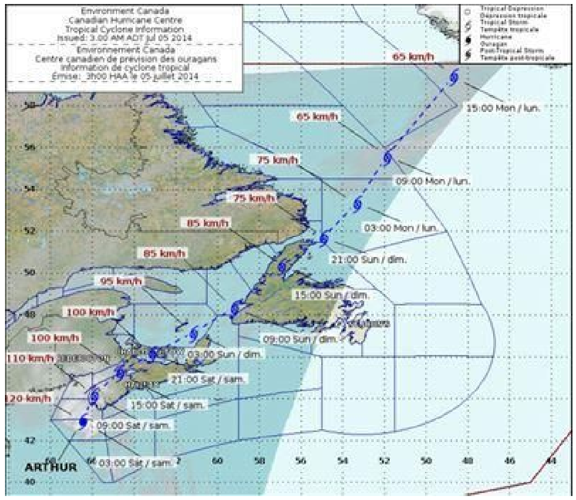
2100 Sea Level Rise and Storm Surge, Hazard Map



Source: Climate Change Secretariat, PEI

On occasion, strong wind and precipitation associated with post-tropical storms, can unleash significant overland flooding, stronger storm surges, breaches of dykes, bridges, causeways, roads and rail, and damage to property and infrastructure. A warmer climate is expected to result in warmer ocean-surface waters. These warmer waters will result in increased levels of humidity resulting in more intense and longer lasting hurricanes and Nor'Easters which may also push further north.

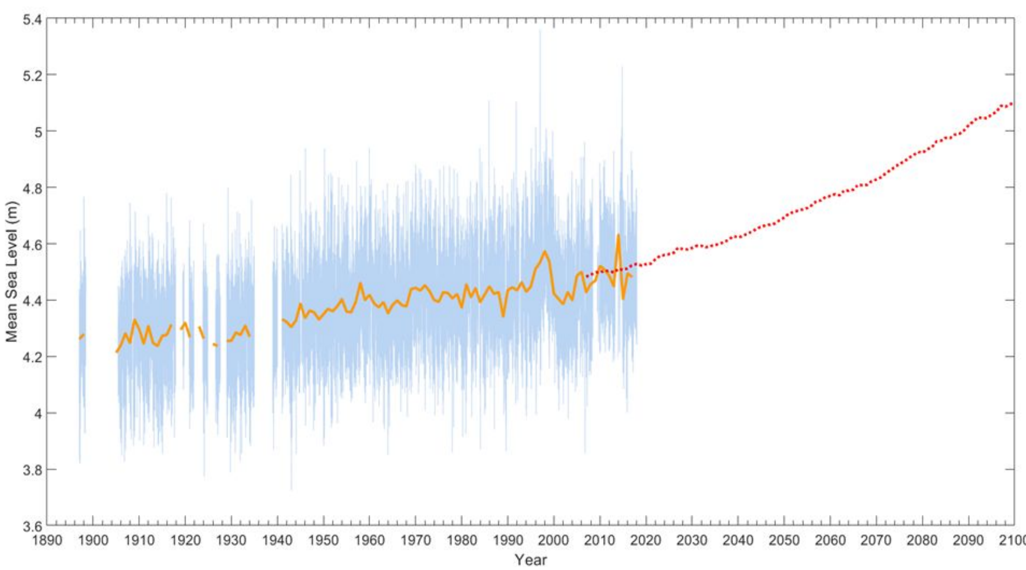
> On Saturday July 5th, 2014, Hurricane Arthur transformed into a potent Post-Tropical storm over the Maritime provinces, damaging homes, power infrastructure, roadways, etc. Total damage cost from Post-Tropical Storm Arthur was approximately $12.5 million.



Source: National Disaster Database

Due to the variety of flood-related risks in PEI which may increase with climate change, it is prudent for municipalities to understand local flood risks and develop risk reduction policies, actions/measures, etc., as part of future land use planning, asset management, infrastructure development, climate adaptation, emergency preparedness, etc.

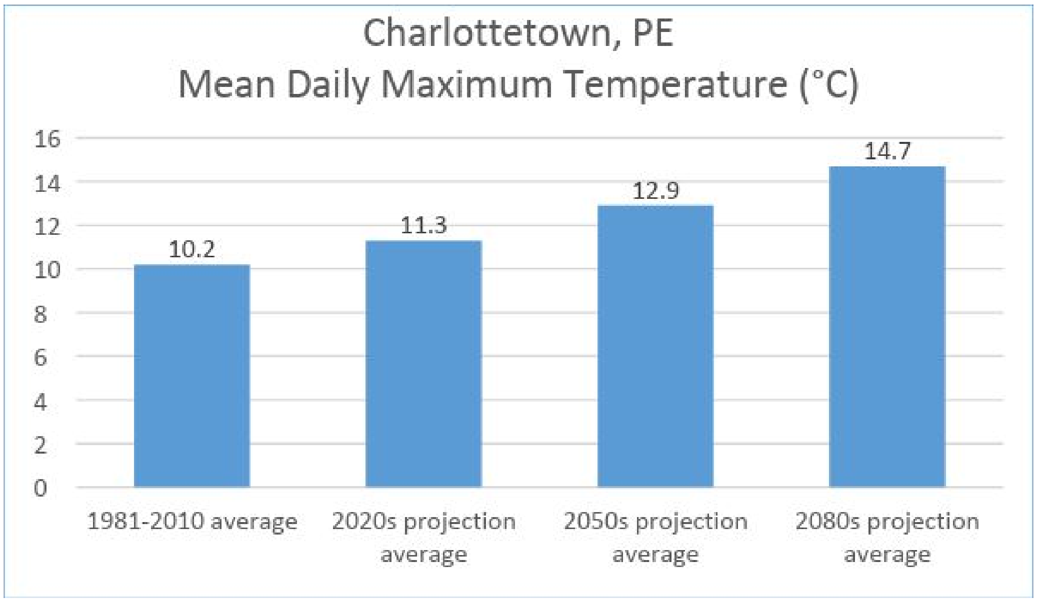
Here is an average Sea Level Rise Graph for PEI, based on IPCC 5th Assessment Report but it does not consider land subsistence or local geographic characteristics.

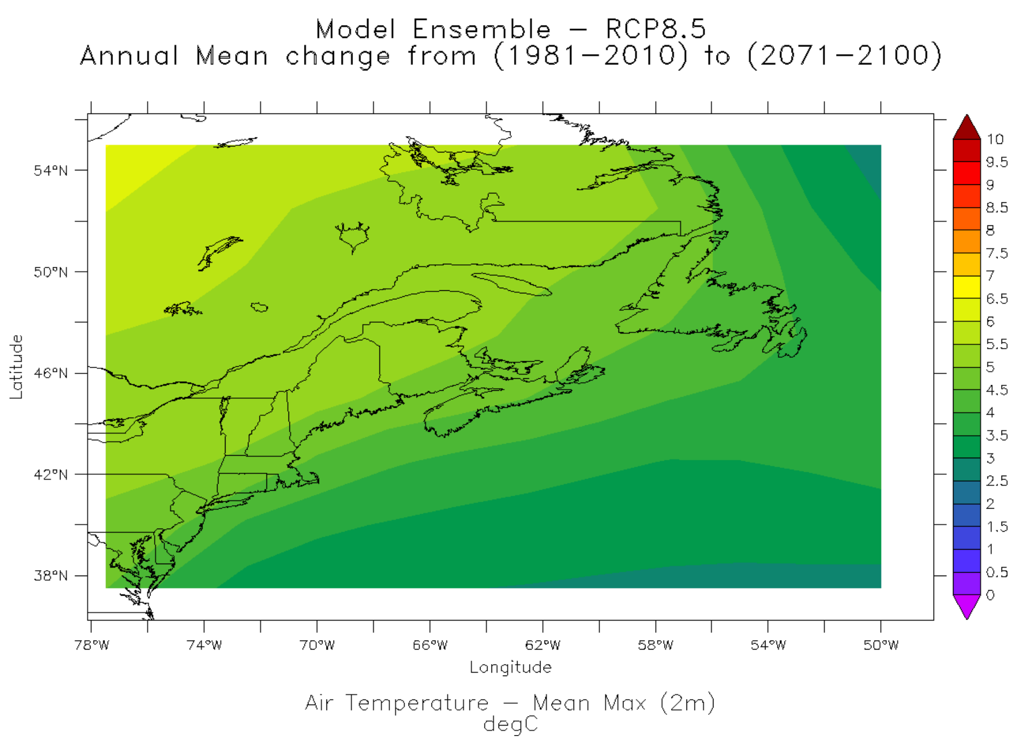


2.4.2 Temperature (Max, Min, Mean, Days above 30°C and under -24°C)

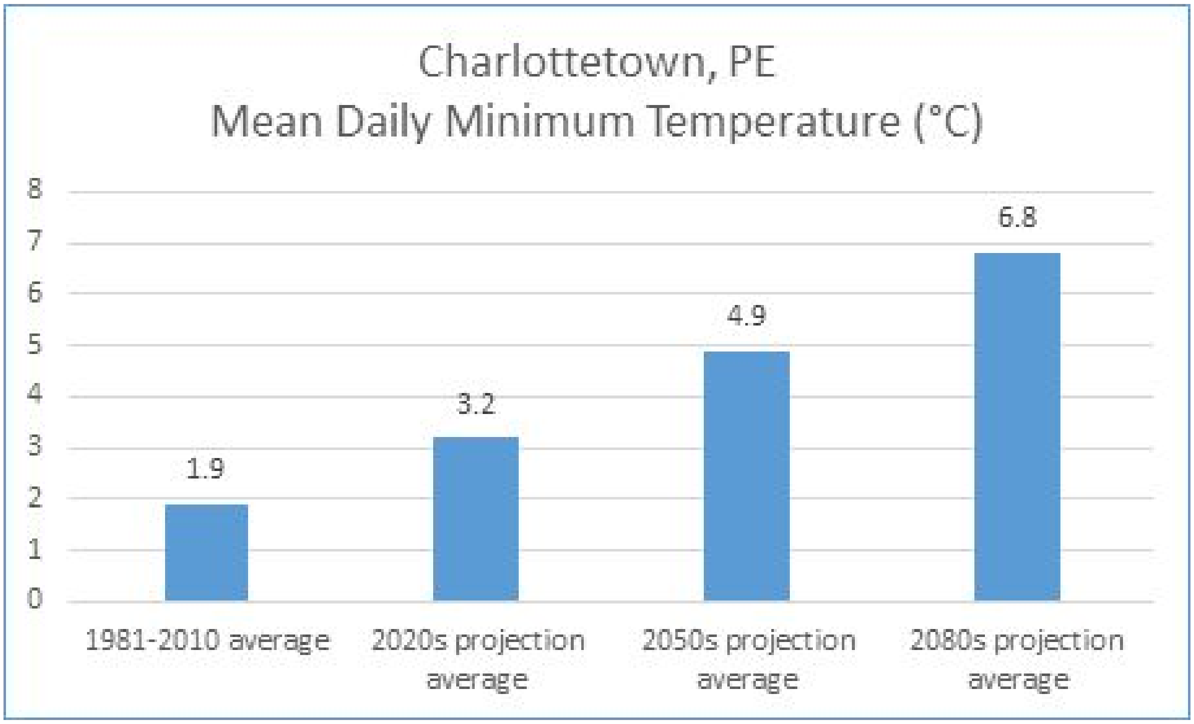
For temperature, climate variables are presented showing values and trends in maximum, minimum and mean temperature. As demonstrated in the Charts below, mean maximum and mean minimum temperatures are expected to increase by 4.5 degrees Celsius by 2100. As well, with climate change it is expected that there will be increase in the number of days above 30°C and heat waves during the summer and may lead to more freeze-thaw events in the winter.

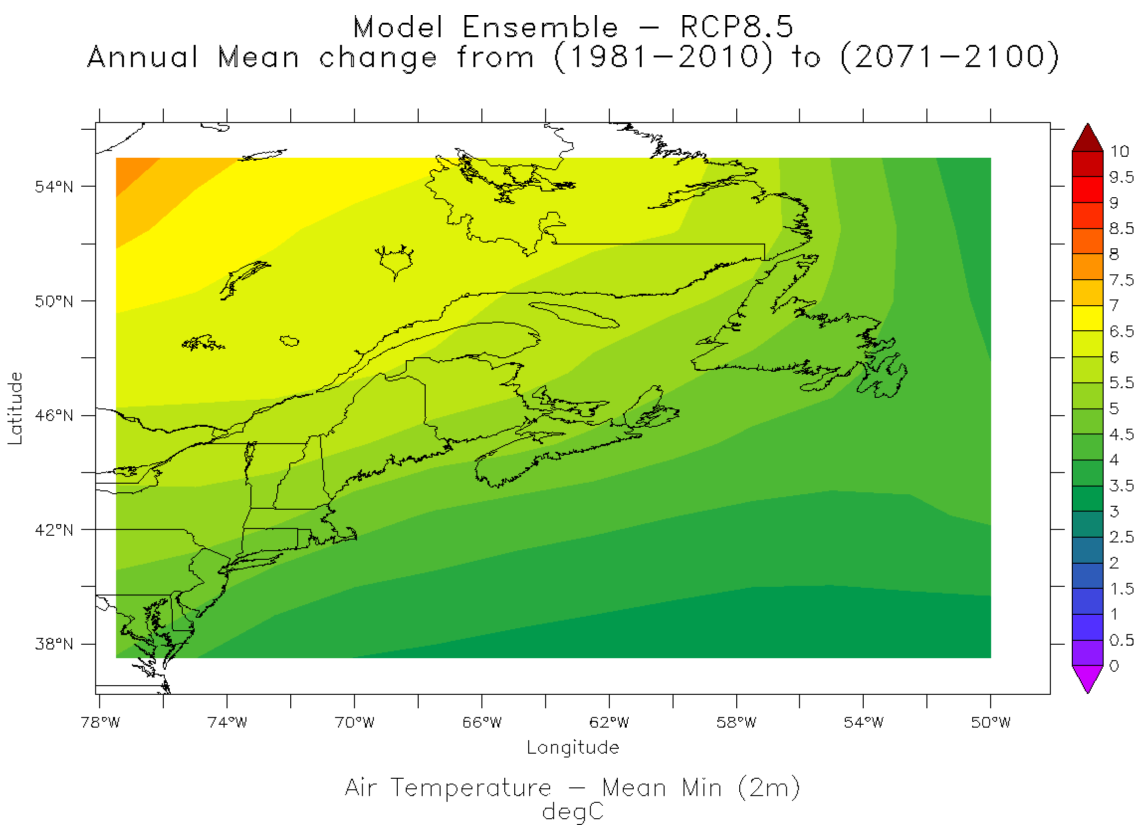
Maximum Temperature



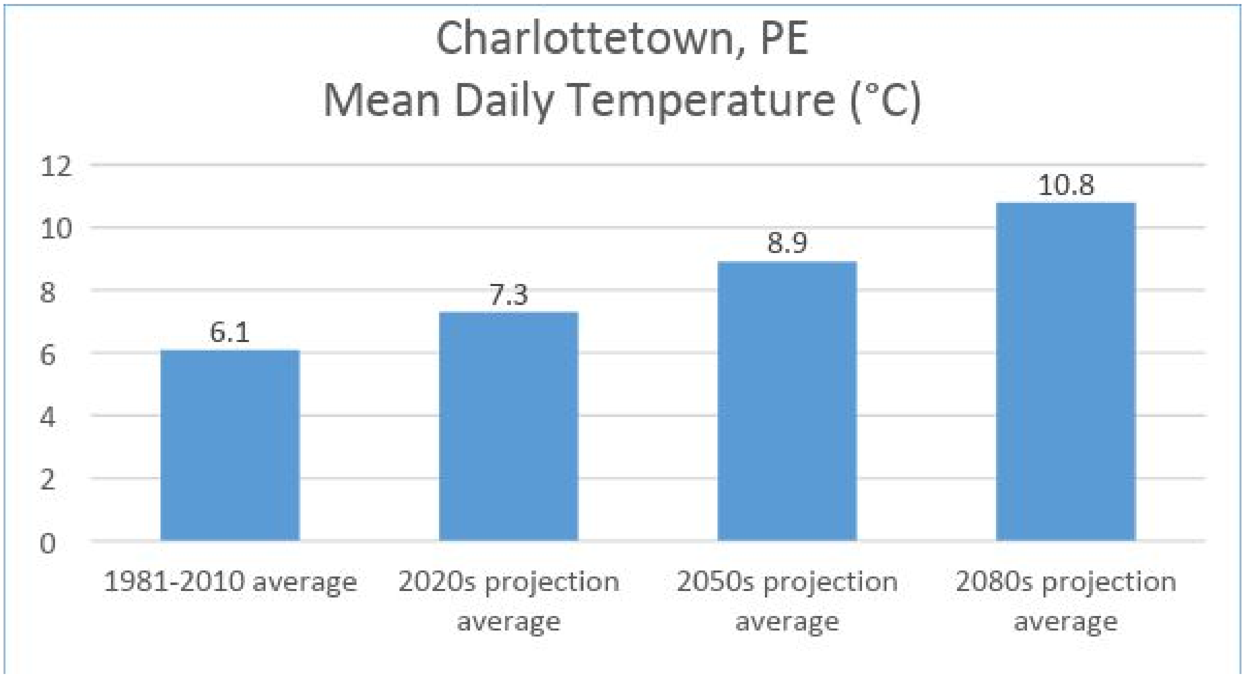


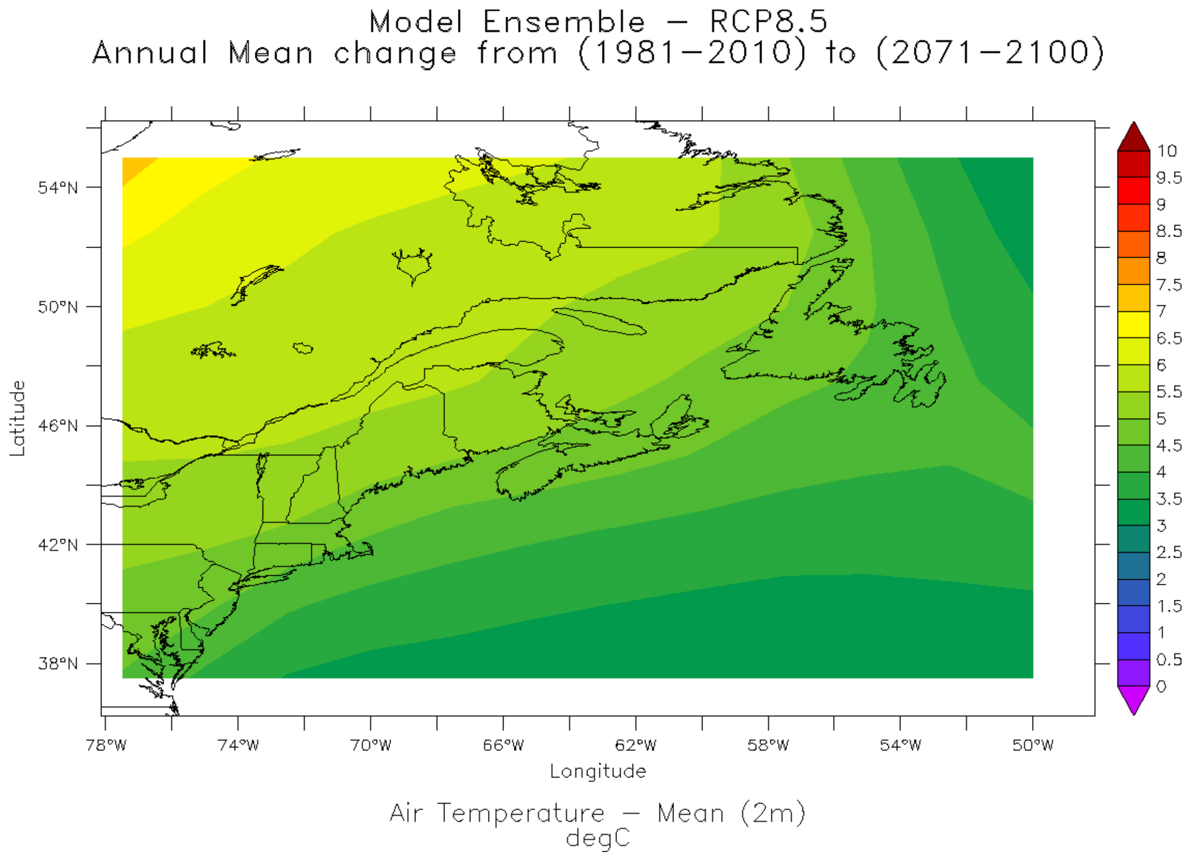
Minimum Temperature



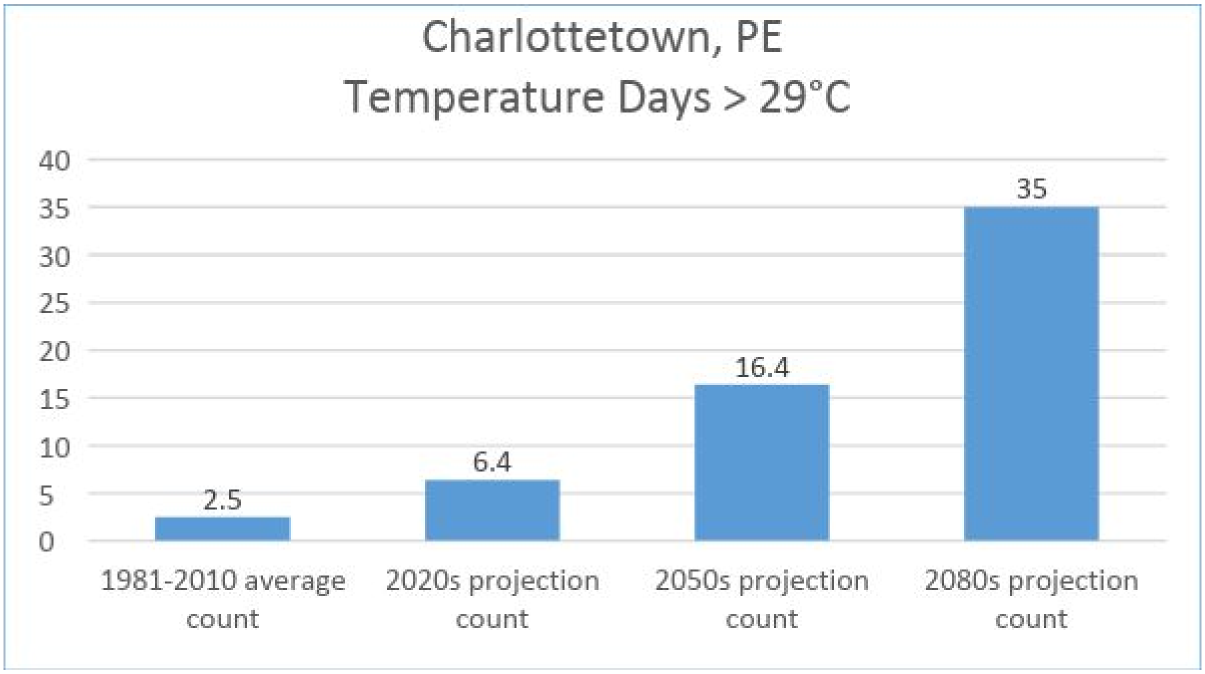


Mean Temperature

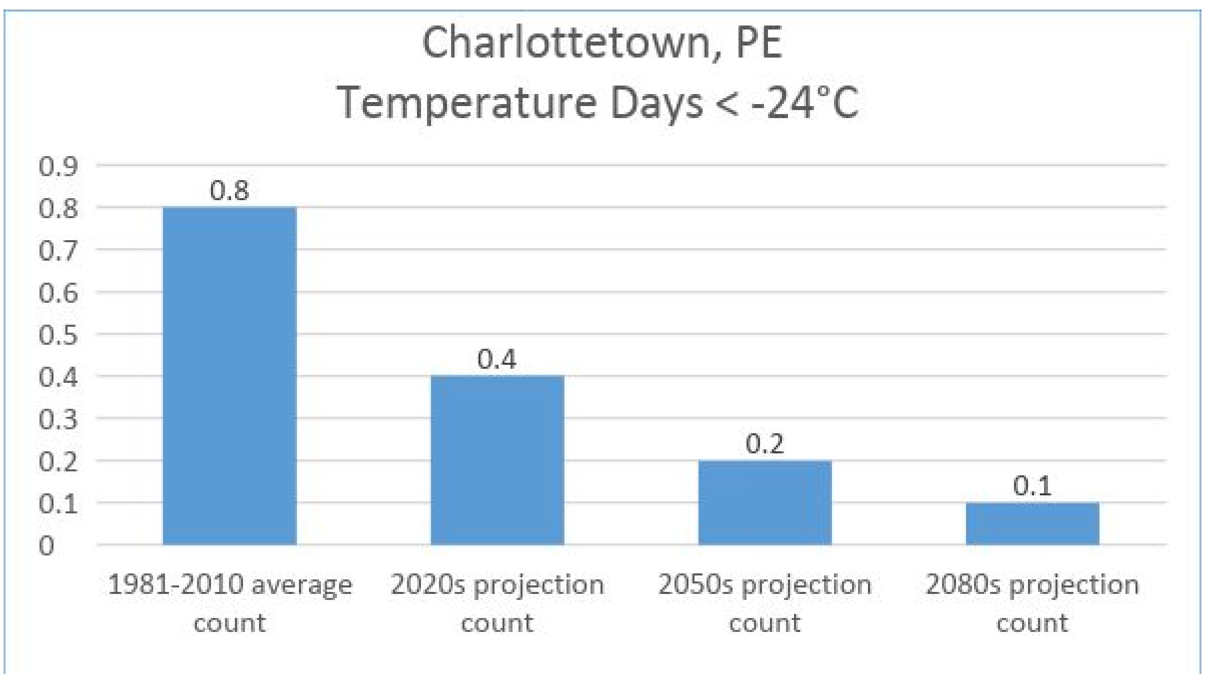



Model Ensemble – RCP8.5
Annual Mean change from (1981–2010) to (2071–2100)
54°N
50°N
46°N
42°N
38°N
Latitude
78°W
74°W
70°W
66°W
62°W
58°W
54°W
50°W
Longitude
10
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Air Temperature – Mean (2m)
degC

Hot Days



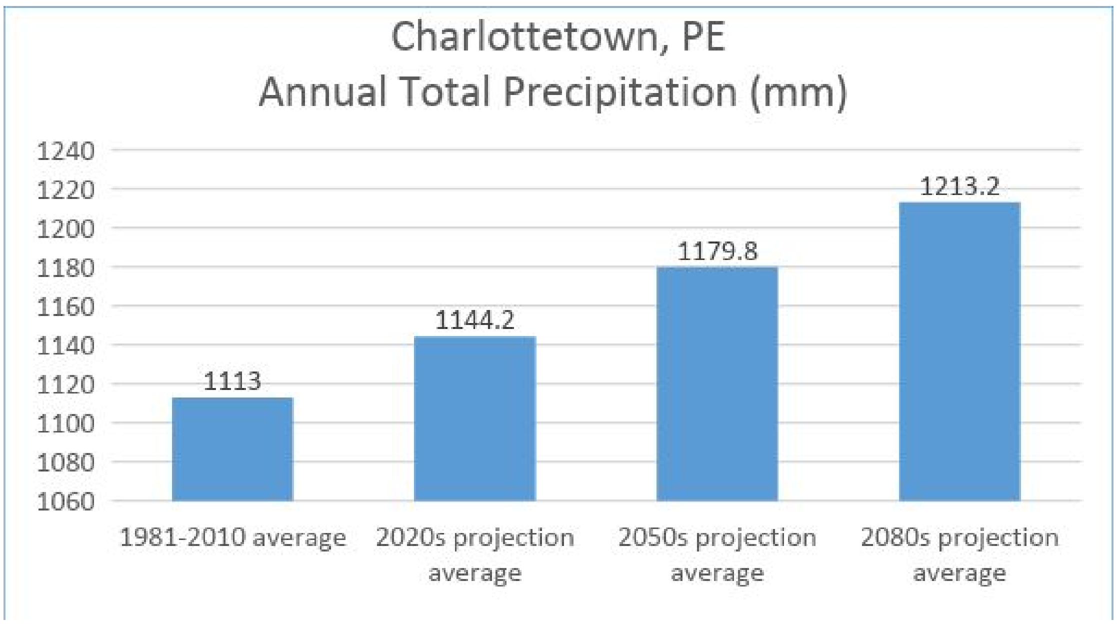
Cold Days



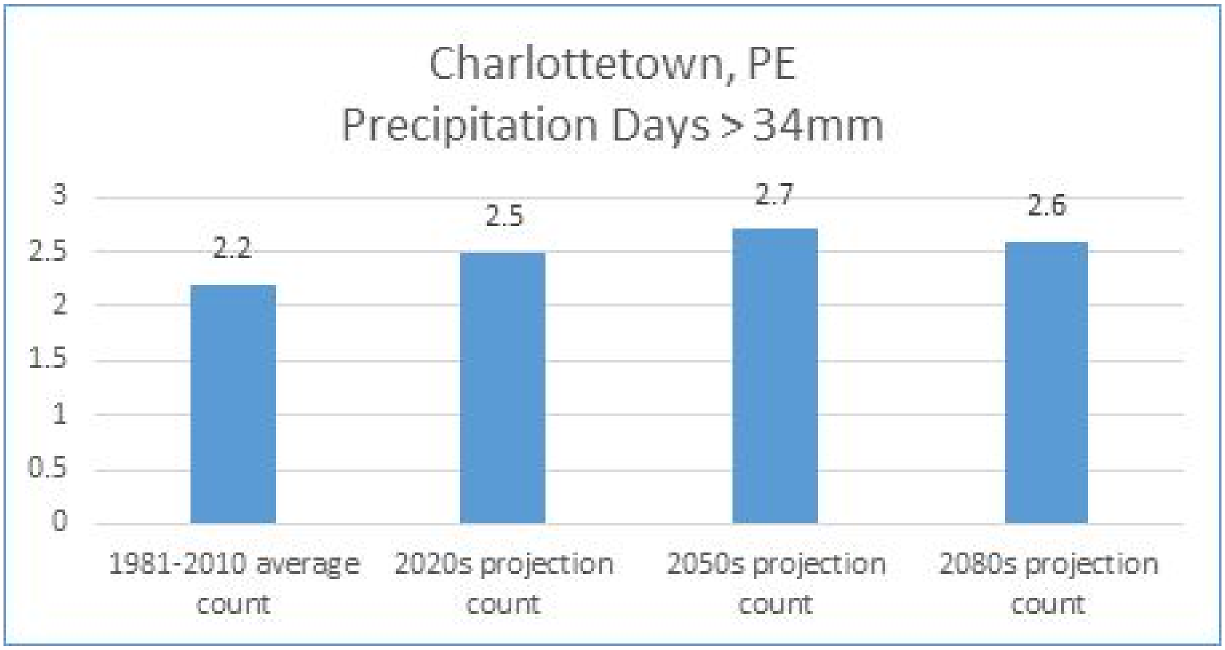
2.4.3 Precipitation

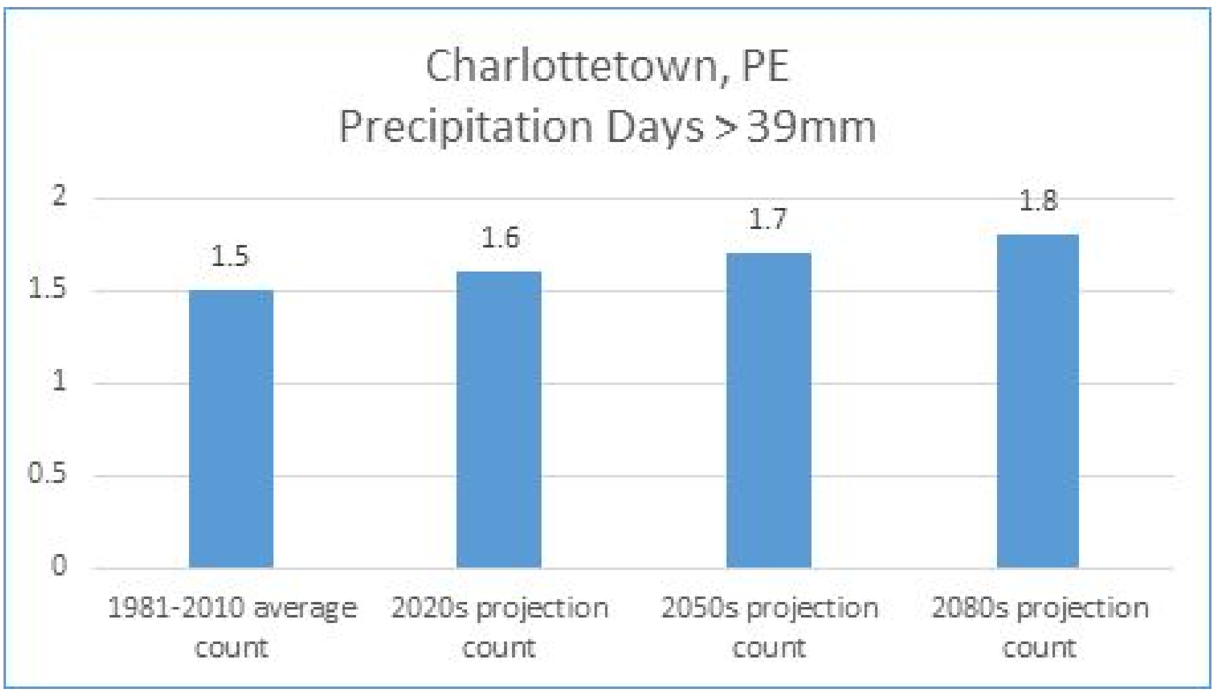
For precipitation, climate variables are presented showing values and trends in total and maximum precipitation. As the charts and maps below demonstrate, Charlottetown will experience an increase in total annual precipitation by about 100 mm. It should also be noted that climate change is expected to increase the severity and frequency of extreme rain events, with increased total accumulations over 24 to 48 hours. These events are difficult to model due to complex weather and climate factors but should be considered in future planning decisions.

Total Precipitation



Precipitation Days

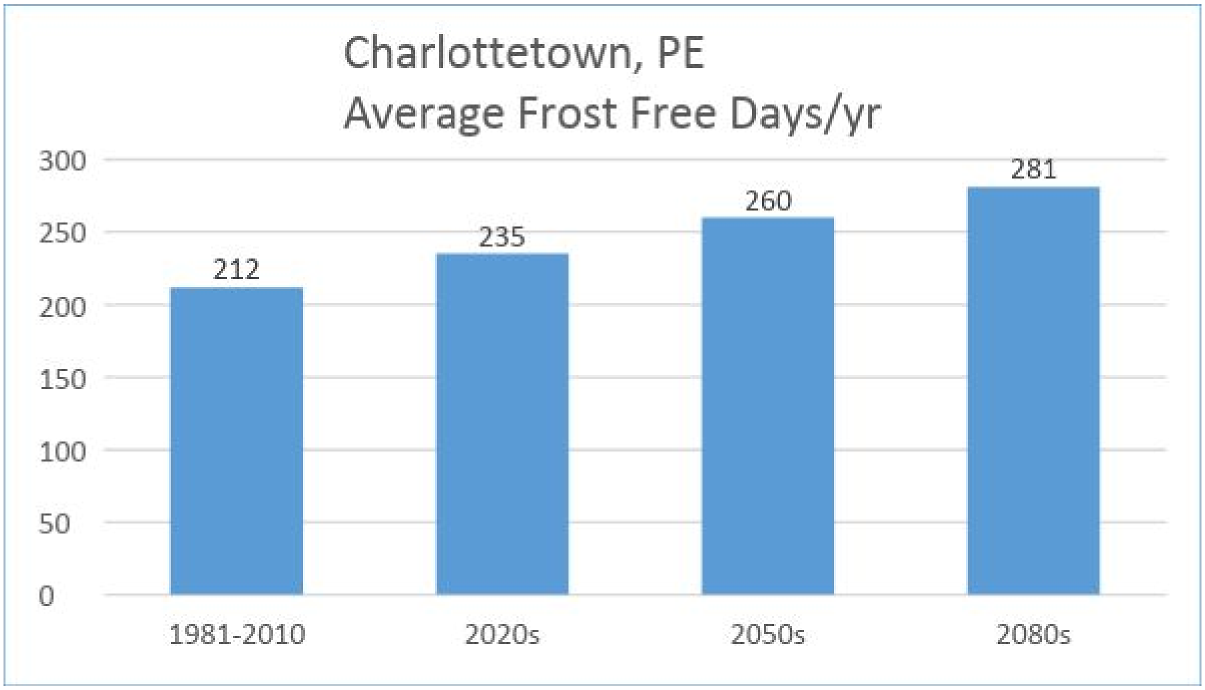




2.4.4 Frost Profile

For the Frost Profile, climate variables are presented showing the values and trends in total number of frost-free days. As the graph indicates below, the City of Charlottetown will experience an increase of 69 frost-free days by 2100, for a total of 281 frost-free days.

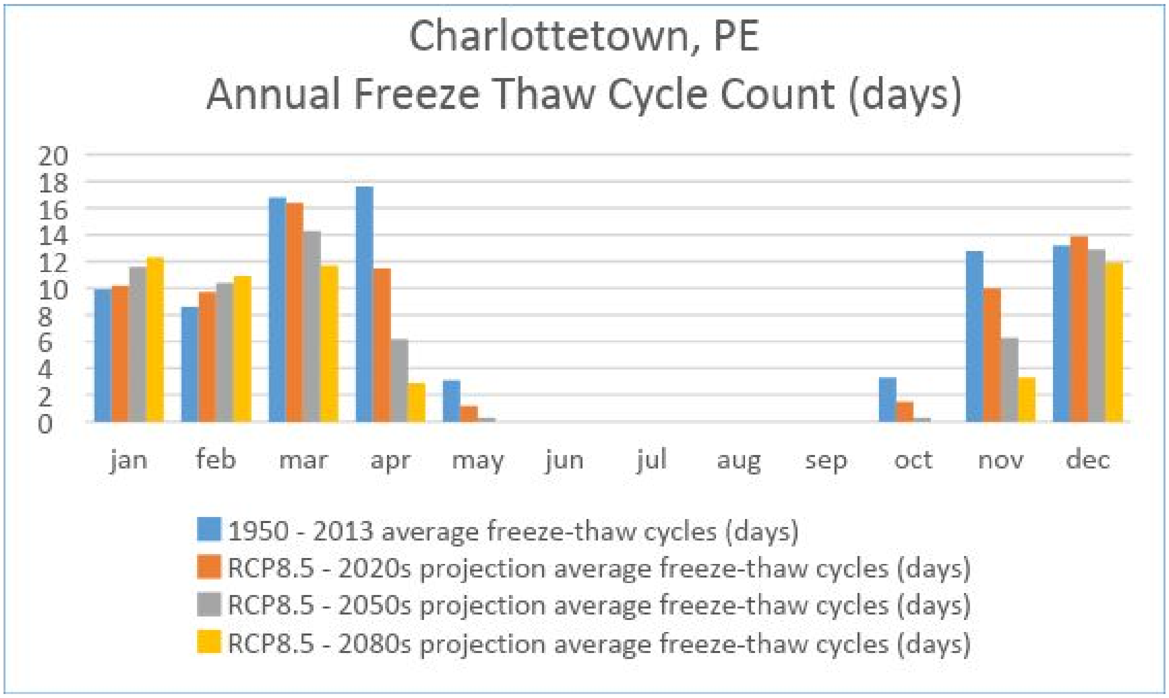
Frost-Free Days

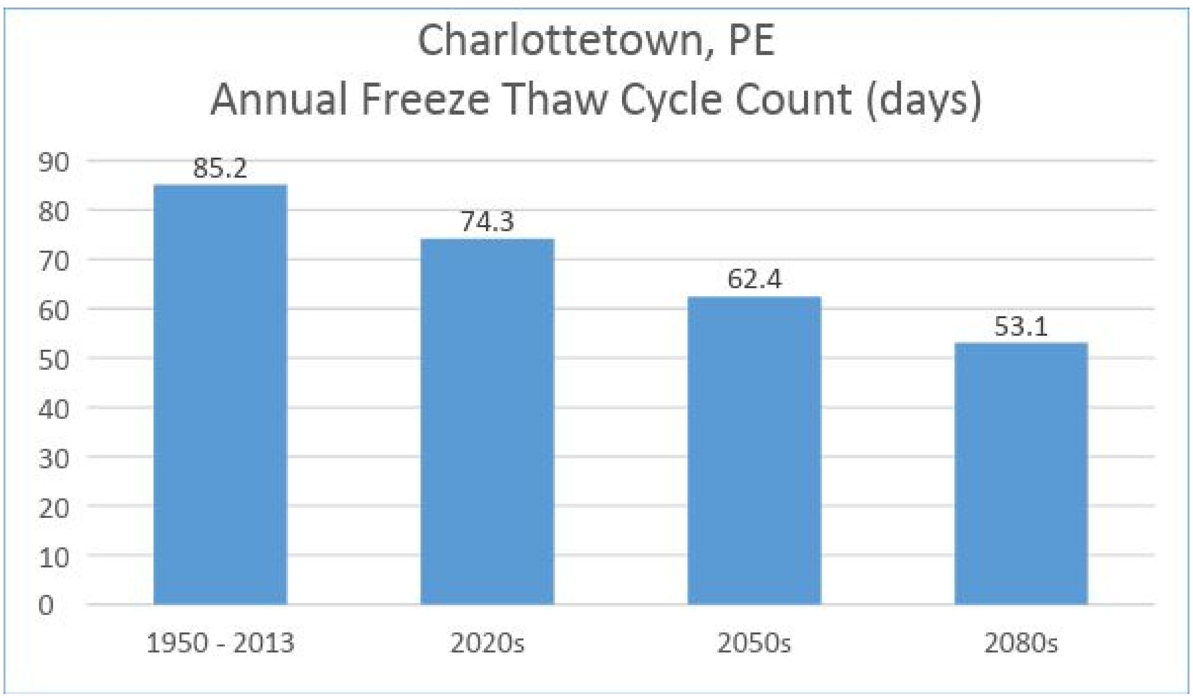


2.4.5 Freeze-Thaw Profile

For the Freeze-Thaw Profile, climate variables are presented showing the values and trends in total number of days with freeze-thaw cycles by month and annually. As the graphs demonstrate below, the City of Charlottetown will experience a 38% decrease in annual freeze-thaw cycles but will experience more freeze-thaw cycles during January and February. This has important implications for adaptation in the winter time.

Freeze-Thaw Cycle



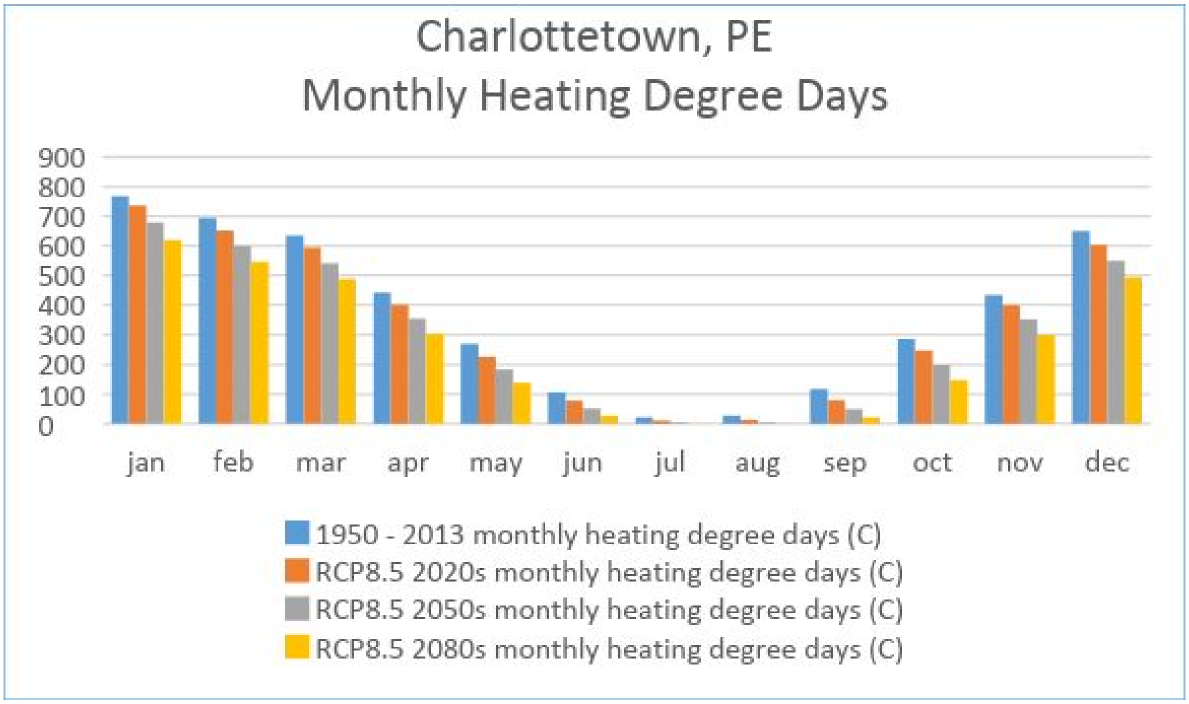


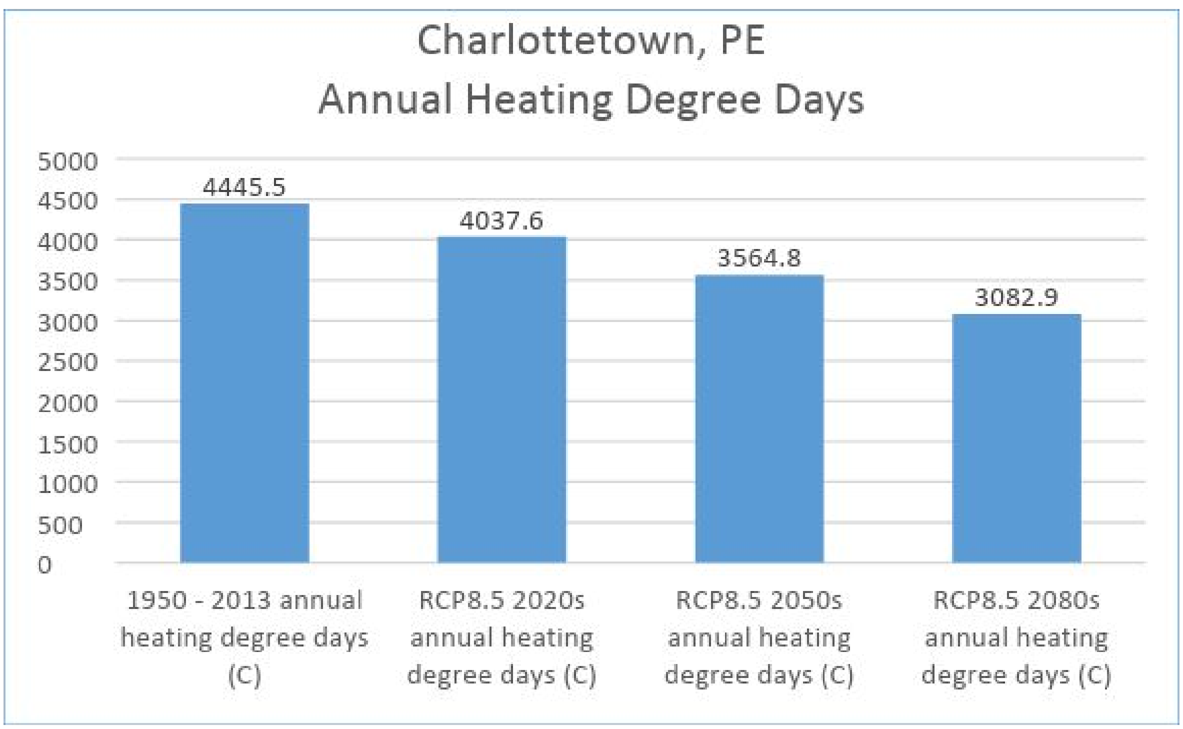
2.4.6 Heating/Cooling Degree Days

For the Heating / Cooling Degree Days Profile, climate variables are presented showing the values and trends in total number of heating days and cooling days by month, and for each projection period. As the charts demonstrate below, Charlottetown will experience a decrease in the number of heating degree days and an increase in the number of cooling degree days.

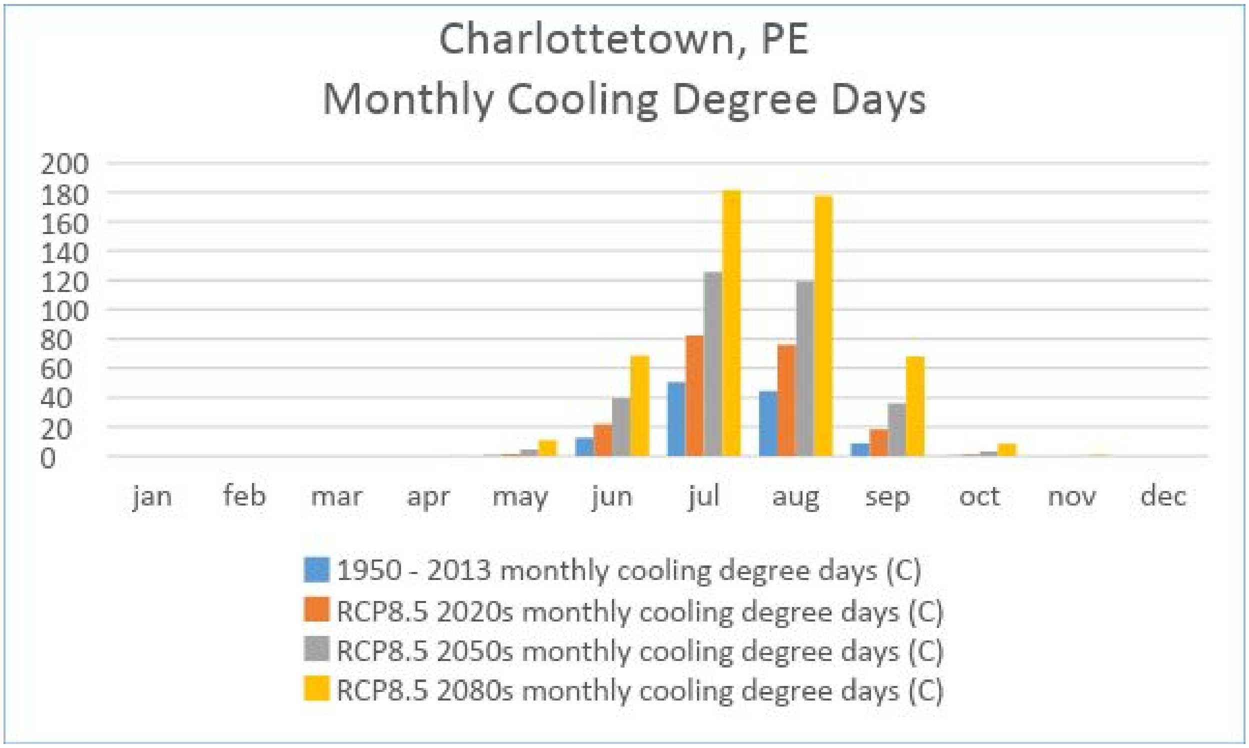
This has important implications for agriculture, electricity production, and provision of shelters for heating/cooling vulnerable populations during prolonged outages.

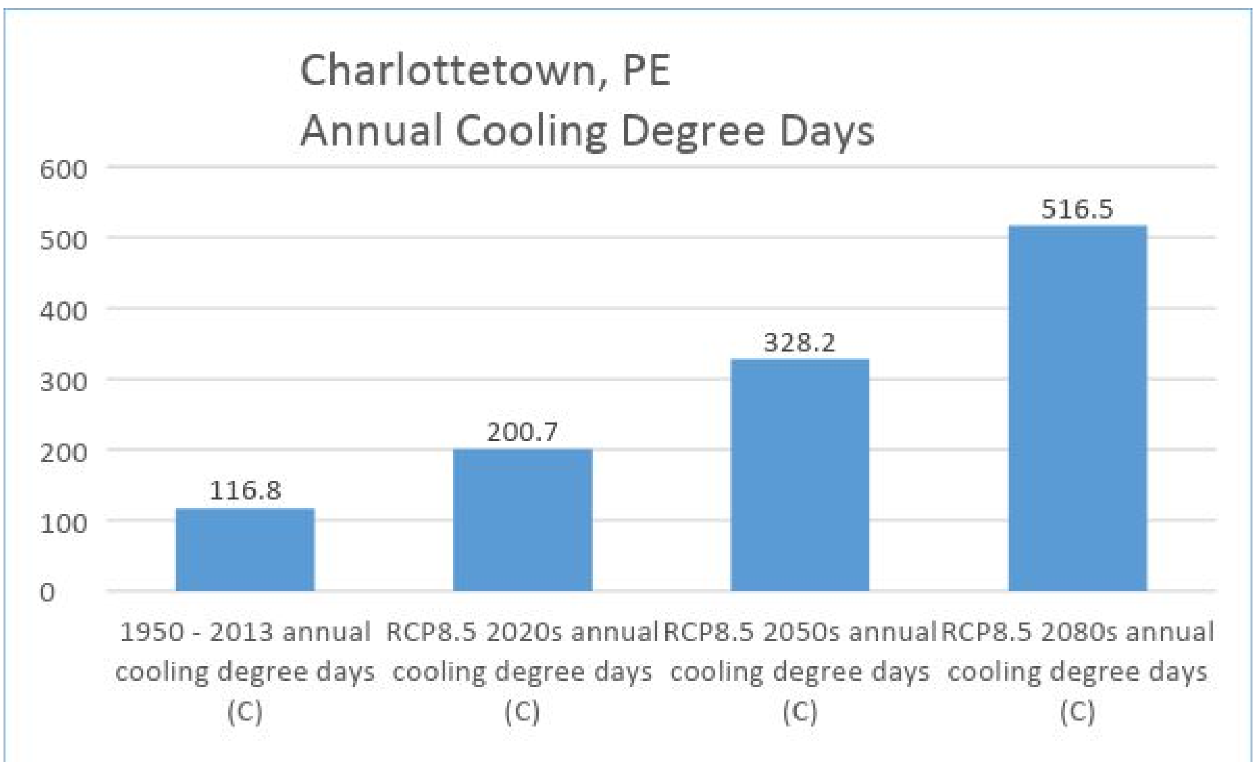
Heating Degree Days





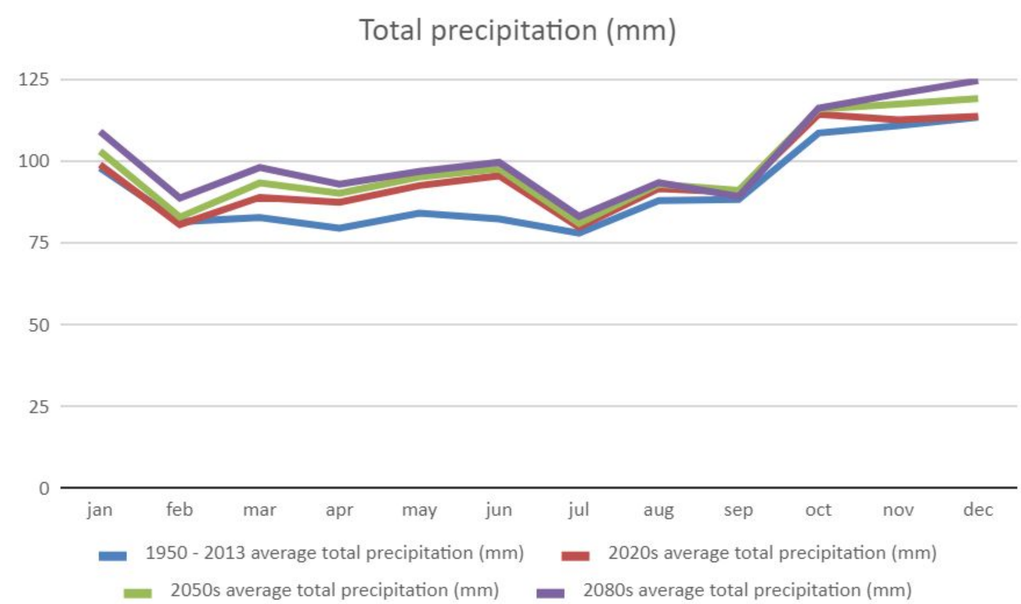
Cooling Degree Days

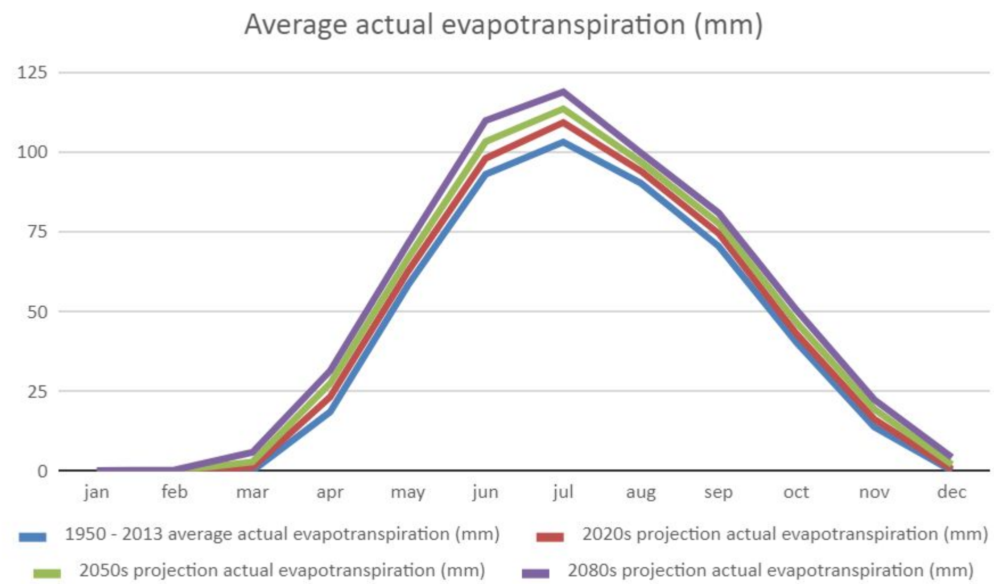


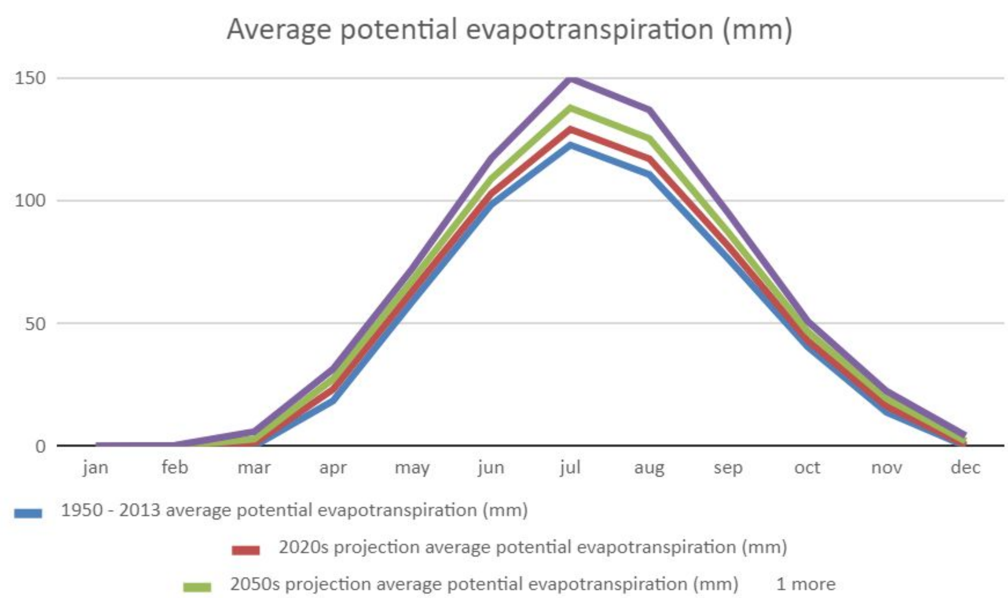


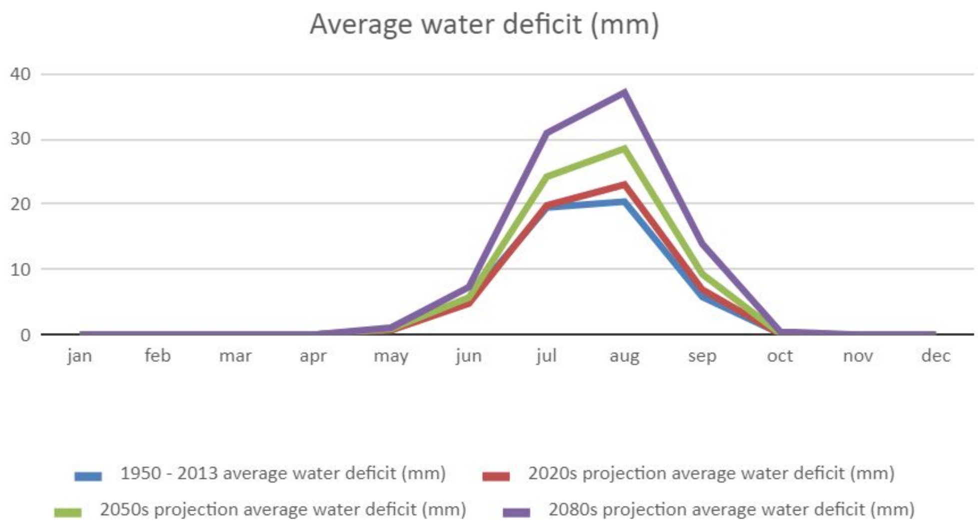
2.4.7 Water Balance

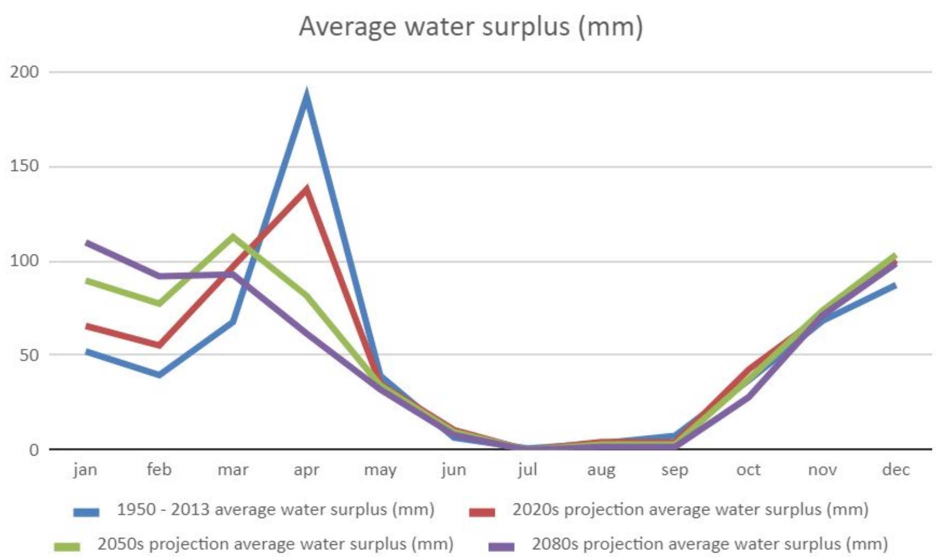
For the Water Balance Profile, climate variables are presented showing the values and trends in historical and future water balance - including total precipitation and evapotranspiration. As the graph below indicates, the City of Charlottetown will experience an increase in water balance over the winter months, and a decrease in the water balance of the summer months. This can have implications in the summer for agriculture (drought), potable water supply, electricity production (less hydro), forest fires (dryer summer conditions), and changes in flora and fauna, as well as increase local flood risk and require stormwater attenuation during winter and early spring.




Average actual evapotranspiration (mm)
125
100
75
50
25
0
jan
feb
mar
apr
may
jun
jul
aug
sep
oct
nov
dec
1950 - 2013 average actual evapotranspiration (mm)
2020s projection actual evapotranspiration (mm)
2050s projection actual evapotranspiration (mm)
2080s projection actual evapotranspiration (mm)


Average potential evapotranspiration (mm)
150
100
50
0
jan
feb
mar
apr
may
jun
jul
aug
sep
oct
nov
dec
1950 - 2013 average potential evapotranspiration (mm)
2020s projection average potential evapotranspiration (mm)
2050s projection average potential evapotranspiration (mm)
1 more





- **Historical water surplus: 596.15mm**
- **Historical water deficit: 51.93mm**
- **Projected RCP 8.5 2020s water surplus: 623.60mm**
- **Projected RCP 8.5 2020s water deficit: 55.33mm**
- **Projected RCP 8.5 2050s water surplus: 625.08mm**
- **Projected RCP 8.5 2050s water deficit: 68.77mm**
- **Projected RCP 8.5 2080s water surplus: 597.04mm**
- **Projected RCP 8.5 2080s water deficit: 90.83mm**

2.4.8 Summary Table of All Climate Variables

	1981-2010 Average	2020s Projection Average	2050s Projection Average	2080s Projection Average
Average Frost-Free Days/yr	212	235	260	281
Annual Freeze- Thaw Cycle Count (days)	85.2	74.3	62.4	53.1
TMAX(°C) -Spring	7.6	8.7	10.2	11.9
TMIN(°C) -Spring	-0.8	0.3	1.9	3.7
TMEAN(°C) -Spring	3.4	4.5	6.1	7.8
TMAX-(°C) Summer	22.1	23.3	24.9	26.8
TMIN(°C) -Summer	12.8	14	15.6	17.5
TMEAN(°C) -Summer	17.5	18.7	20.3	22.2
TMAX(°C) -Fall	12.7	13.8	15.4	17.2
TMIN(°C) -Fall	5.1	6.3	7.9	9.8
TMEAN(°C) -Fall	8.9	10	11.7	13.5
TMAX(°C) -Winter	-1.6	-0.4	1.2	2.9
TMIN(°C) -Winter	-9.4	-7.9	-5.9	-3.8
TMEAN(°C) -Winter	-5.5	-4.1	-2.4	-0.5
TMAX >29(°C)	2.5	6.4	16.4	35
TMIN<-24(°C)	0.8	0.4	0.2	0.1
Cooling Degree Days	116.8	200.7	328.2	516.5
Heating Degree Days	4445.5	4037.6	3564.8	3082.9
Annual Precipitation (mm)	1113	1144.2	1179.8	1213.2
Annual # of days with Precipitation >34mm	2.2	2.5	2.7	2.6
Annual # of days with Precipitation >39mm	1.5	1.6	1.7	1.8

See Annex for data sources and methodology.

3.0 Pre-Survey Results (Municipality)

3.1 Introduction:

The purpose of the pre-survey was to determine where the municipality sees its strengths and potential areas for improvement, across a variety of energy-dependent services in their communities. Each municipal lead (staff) completed the survey before the first workshop. The results of the survey provided context during the first workshop. Results were shared with all participants which led to interactive knowledge sharing and additional information gathering. The participants' inputs are captured below.

3.2 Summary of Results:

3.2.1 Level of Awareness **of climate change in the community**: moderate

3.2.2 Resilience is: Community preparedness to have reliable affordable access to food, water, energy, transport, sewer, or other vital services, to be able to adapt in the face of change, and more effectively recover from events through proactive measures. The ability to bounce back.

3.2.3 Key Drivers:

a) **Reduce or avoid cost** (i.e., economic sustainability);
b) **Reduce local vulnerabilities** (i.e., lower risk to public health and safety, infrastructure etc.);
c) **Update official plans;**
d) **Access funding** for projects;
e) **Educate the public.**

3.2.4 Strengths and Areas for Improvement:

Area	Strength	May Need Improvement
Vegetation Wildlife	Charlottetown has a contractor for tree trimming around wires and Maritime Electric also does to ensure reliability of electrical systems. The City uses ditches, retention ponds, etc, to handle large flows. The City encourages bio-retention in the community: there are locations with permeable pavement (e.g., Simmons Arena), trees and shrubs, community	It is unclear *how* the City protects natural buffers it is unclear how much water the entire network can handle.

	gardens, some green roof tops and rainwater collection/rain garden.	
Planning	Charlottetown has an Emergency Response Plan updated and it was exercised in 2018. The EM Plan considers future climate risk (it is an 'all hazard' plan) and considers impact of prolonged outages. The City has obtained copies of EM Plans for local schools, hospital or nursing homes; however, ERPs are the responsibility of each facility. The City has alliances with local groups and neighboring communities (e.g., for emergency response). Mutual aid agreements in place for fire service. Around 42 MOUs established with businesses and community groups. The City has a contact tree and an inventory of skills and resources in the community. The City has regular contact with government, utility, and UPEI, including for climate adaptation. The City has implemented Charlottetown Alert System. Charlottetown has a Sustainability Plan and Community Energy Plan. Climate change is incorporated in to the asset management plan and land use plan.	It is unclear if the City has a climate adaptation 'plan', or to what degree it has implemented adaptation measures to date. While nobody is currently responsible for resilience planning, the respondent felt it should be led by Manager of Planning & Heritage and involve other staff. The City is in need of access to funding. There is a bonusing program for increased density if meeting city needs (green roof included).

	The City plans for assisting vulnerable peoples (e.g., with disabilities).	
Communications	Mayor and Council understand their roles and responsibilities to communicate with the public before, during, and after an event. The City has a communication plan for promoting emergency preparedness. The City has communicated to the public where to go in case of emergency. Local radio station and tv station have back-up power. There are HAM radios at City Hall, and operators are volunteers. The City has Trunk Mobile Radio for Emergency Responders. There is back-up power for communication towers.	
Energy Infrastructure	The City has back-up power at City Hall and EMO, lift stations, water treatment, and four emergency shelters. The hospital, senior community care facilities, grocery stores, and fuel storage facility all have back-up power. Conducted cost analysis involving upgrading or installing back-up power in 23 buildings. The community has some back-up generators, but there is no explicit count in the community.	It is unclear if animal shelters, banks, schools, all shelters, greenhouses have back-up. A risk is that diesel fuel supply for back-up generators is interrupted when Confederation bridge closures exceed 52 hours.

	The City has provisions to keep fueling stations open during prolonged interruptions. The City has identified alternate sources of fuel (for generators) in case of interruptions. Flood risk (1 in 100 year events) to electrical/utility infrastructure has been assessed. There is 40 MW permanent district heat, and 1.2 MW in electricity production which is primarily used by the Waste-To-Energy District Heat system. The City is looking to increase it to 3 MW, and supply grid. Currently provides heat to key facilities such as: University of PEI, schools, Civic Centre, Fire Hall, Town Hall, Conference Centre, Mall and Plaza.	
Water and Sewage	The city has a distributed water system (potable) that is pumped. The City has separated stormwater and sewer systems, and is using ditches, ponds, etc., to handle large flows and alleviate pressure on stormwater system. The City has back-up power for water and wastewater treatment. The City is decommissioning a lagoon which is at the water's edge, but entrances are above 1 in 100 year flood events. Sewage outflow pipe discharges below sea-level.	It is unclear if storm water system can handle 1 in 100 year flood events Needs better understanding how much water entire network can handle

	There are no known neighboring land uses contribute to the community's flooding risk.	
Transportation	The City has a few main transportation corridors to enter/exit the community The City has bus transit (diesel powered), a potential resilience asset. The City has a Port. There is a generator located next to the Port, for the Grid, but unclear if Port Authority has other generators.	On a provincial scale, weather can interrupt access to mainland on bridge and ferry - somewhat frequent but usually short duration. It is unclear if there are neighborhoods, with only one access road. The City does not have EV Charging Stations with back-up power.
Food	Food is delivered by truck and there are local community gardens. One and a half local grocery stores have back-up power. The City knows they have 3 to 5 days food supply.	It is unclear how many local greenhouses or if they have back-up power. It is unclear if there is a strategy for interruptions to food supply.

4.0 Workshop 1 Results

4.1 Introduction

Goal: to engage municipal staff, utilities, and community stakeholders to discuss local climate risks and vulnerabilities, and identify areas for improvement, with the help of QUEST facilitator and several table-top exercises/tools. The day included presentations, interactive discussion, table-top exercises, and knowledge sharing among diverse stakeholders. Results from the workshop are summarized below. A list of participants is included in the Annex.

4.2 Summary of Presentations:

Presentations were delivered by QUEST facilitators as well as the PEI Emergency Measures Organization and PEI Department of Communities, Land and Environment. The presentations were delivered throughout the morning session, to provide context for climate change adaptation and resilience building at the community scale.

QUEST provided an overview of the project, goals of the workshop, and pre-survey results. PEI Department of Communities, Land and Environment (Climate Change Secretariat) provided an overview of climate change indicators and predicted impacts. PEI Emergency Measures Organization provided a presentation on resilience in emergency and disaster management.

Participants engaged in discussion/Q&A, following each presentation. In summary, participants were aware of climate change but learned more about future impacts and their potential severity.

4.3 Results of Exercises:

4.3.1 The 10 Essentials Exercise

The 10 Essentials for Disaster Risk Reduction (also known as Making Cities Resilient), was developed by UN ISDR (International Strategy for Disaster Reduction) and endorsed by the Government of Canada. It provides a high-level framework to determine strengths and weaknesses in a community to be able to better target efforts at improving resilience. The framework was tailored for use as a table-top exercise.

Goal:

Enable participants to determine whether the community is strong and where improvements may be needed.

Overview:

Participants discussed each Essential at their tables and answered questions for each Essential, and then assigned a score. Scoring:

1 = In Place, Functioning Well
2 = Something in Place, Can be Improved
3 = Nothing in Place
4 = Not sure/need more information

After 45 minutes of discussion, a participant at each table shared three highlights from their table-top discussion with the rest of the group:

A. Where is the community strongest;
B. Where is it doing well but needs improvement;
C. Where is nothing in place and needs attention.

Each table submitted their workbook to QUEST. The scores and responses are summarized below:

Summary of Results:

1. **Put in place Organisation and Coordination, clarify everyone's roles and responsibilities:**

   Score: The average score was **1.75** = indicating things are functioning well and some improvements may be made.

   Comments:

   - Local organizations (including local government, utilities) are equipped with some capacities (knowledge, experience and official mandate) for disaster risk reduction and climate change adaptation, but there is room for improvement.
   - Partnerships exist between the municipality, private sector, energy utilities, and other local authorities to reduce risk but there is room for improvement.

2. **Assign budget for Disaster Risk Reduction:**

   Score: The average score was **2.38** = indicating there is very little in place and there is need for improvement

   Comments:

   - The local government has limited access to adequate financial resources to carry out risk reduction activities. (e.g., climate adaptation, flood risk reduction). Provincial and Federal funding is available.
   - The local government allocates some financial resources to carry out risk reduction activities, including climate adaptation and effective disaster response and recovery.
   - Few economic incentives are established for investing in disaster risk reduction for households and businesses (e.g., reduced insurance premiums for households, tax

holidays for businesses).

- Local business associations, such as chambers of commerce and similar, provided little financial support to small enterprises for business continuity during and after disasters. Charlottetown is a small community and the people are well-connected with each other.

3. **Update Hazard/risk assessment to inform plans:**
   Score: The average score was **1.95** = indicating there is something in place but it can be improved
   Comments:
   - The Community has given some consideration to future climate change projections and impacts, when conducting risk assessment, when updating Emergency Plans, and when making infrastructure and land use planning decisions. Specific plans include the Official Plan, Waterfront Plan, Coldwater Study, and CADC.
   - The Community somewhat considers impacts of hazards on municipal services, from the viewpoint of maintaining reliable energy (power, heat, or cooling). The community works with the utility to understand hazards and reduce risk from prolonged interruptions to power and fuel delivery. Charlottetown has back up generators at a number of sites. Warming centres have a 3-day supply.
   - The local government communicates some information on local hazard trends and risk reduction measures to the community via their Communication Strategy. They issue warnings of pending hazards, but could be more proactive.
   - It is unclear if local government risk assessments are linked to, and supportive of, risk assessments from neighbouring local authorities and provincial government risk management plans. The community in general is well-linked to the provincial government.
   - Disaster risk assessments are incorporated into some local development planning, such as lot grading plans.

4. **Invest in and maintain infrastructure to cope with climate change:**
   Score: The average score was **2** = indicating there is something in place but it can be improved
   Comments:
   - Some regulations for housing and development infrastructure take disaster risk (including climate related risks) into account. Storm design was increased to account for the changing climate.
   - The measures being taken to protect critical public facilities and infrastructure from damage during disasters could be improved. Examples include designing to new standards, backup generation, and waterfront treatment plant.

5. **Assessing safety of schools and health facilities:**
   Score: The average score was **2.42** = indicating there is very little in place and there is need for improvement
   Comments:
   - Local schools, hospitals and health facilities did not receive special attention for ‘all hazard’ risk assessments from the City. These institutions are responsible for themselves. EMO checks in with them. Schools, hospitals, and health facilities could be

used as shelters.

- Hospitals are under provincial jurisdiction and they do have measures to remain operational during disasters. There are no known measures for schools.
- Provincial government is responsible for having programs in place to assess schools, hospitals and health facilities for maintenance, compliance with building codes, general safety, weather-related risks etc. Local government has building permit construction program in place.

6. **Apply risk compliant building regulations and land use planning principles:**
Score: The average score was **2.13** = indicating there is something in place but there is need for improvement
Comments:
- Risk-sensitive land use regulations, building codes, and health and safety codes are in place but are not a major focus. Minimum requirements are set.
- Very few existing regulations (e.g., land use plans, building codes, etc.) support disaster risk reduction in your local authority. There are plans to make improvements in this area. There is a regulation for foundation height.

7. **Ensure education programmes and training in place:**
Score: The average score was **2.5** = indicating there is very little in place and there is need for improvement
Comments:
- The EMO and Province provide some training in risk reduction for local officials and community leaders.
- It is not known if local schools and colleges include courses, education or training in disaster risk reduction (including climate-related risks) as part of the educational curriculum.
- Residents are minimally aware of evacuation plans/drills for evacuations when necessary. There is no official program in place.

8. **Protect ecosystems and natural buffers to mitigate floods, storm surges and other hazards:**
Score: The average score was **2.25** = indicating there is something in place but there is need for improvement
Comments:
- The local government works with watershed groups to support the restoration, protection and sustainable management of ecosystems services (e.g., coastal zones, wetlands, water resources, river basins, fisheries, etc.).
- The private sector or civil society has a low-level of participation in the implementation of environmental and ecosystems management plans. Watershed groups give input to the City. There is a Brook Trout Management Plan in place.

9. **Develop EM capacity/early warning**:
Score: The average score was **1.75** = indicating things are functioning well and some improvements may be made.
Comments:

- It is unclear if early warning centres are established, adequately staffed and well resourced (power back ups, equipment redundancy etc.). There is an EMC plan and warnings from the Environment Canada.
- The local government has an EMC plan. They have EMO and regular meetings.
- Training drills and rehearsals are carried out somewhat regularly with the participation of relevant government, non-governmental, local leaders and volunteers. They are not always carried out annually.
- Key resources are available for effective response, such as emergency supplies, emergency shelters, identified evacuation routes and contingency plans.

10. **Place needs of survivors at centre of re-build, Build back better:**
    Score: The average score was **2.25** = indicating there is something in place but there is need for improvement.
    Comments:
    - The local government has access to resources but does not have well-developed expertise to assist victims of psycho-social (psychological, emotional) impacts of disasters.
    - Disaster risk reduction measures are somewhat integrated into post-disaster recovery and rehabilitation activities (i.e., build back better, livelihoods, rehabilitation). Measures could be better developed. The City has required higher elevations/flood rebuilds.

What we heard: (during plenary)

i. **Where is the community strongest:**
   Essential 1: Organization and Communication;
   Essential 9: Early Warning;
   Essential 3: Update hazard/risk assessment;
   Essential 4: Adaptation;

   Other:
   - We are a small community, work together, and are more self-reliant.
   - We have good understanding of Roles and Responsibilities.
   - We protect natural watercourses but could do more.
   - We have well established EMO. There are provisions for the waterfront, making inroads with the watershed groups to protect rivers and streams.
   - We incorporate climate change into plans, to guide property development along waterfront.
   - We have regular contact with Utility.

ii. **Where it may need improvement:**
   Essential 7: Education Programs;
   Essential 5: Schools and health facilities;
   Essential 2: Budget, Funding Sources;
   Essential 10: Rebuild with needs of survivors, social services, recovery volunteers;

- Although they exist, it was perceived that not enough social and health services are available locally to deal with effects of post-disaster. There are no programs in regard to people with trauma, psycho social impacts.
- We need to work better with developers, and advance Regulations.
- There is low experience with some disaster types - we are proactive not reactive.
- May need to communicate better with public about climate hazards, how to prepare, and where to go in case of emergency (especially among vulnerable population).
- We are in position of improving on each of the 10 Essentials, moving forward significantly. However, there is no money available for some of the necessary adaptations. Sometimes you need to have a disaster to stimulate action - the old adage "don't waste a good disaster" but should be more proactive.
- Advice given by planners is optionally taken rather than enforced, regulation is required.

iii. **Other:**

- Not in the City's mandate to deal with schools, hospitals, nursing homes. Hospitals resilience and emergency planning is the responsibility of the Province.
- EMO ensures preparedness at schools.

4.3.2 Map Exercise

Goal:

Provide participants with a hands-on resilience-building mapping experience to enable them to share knowledge, discuss resiliency in a local context, apply basic techniques for identifying risks and vulnerabilities in a spatial context, as well as planning local adaptation and resilience measures.

Overview:

Participants discussed the probability (**P**) and consequence (**C**) of various types of climate hazards, drew and denoted hazards, risks and opportunities to improve resiliency on a large map on the table in front of them. Dot stickers, markers, colour/design code legend enabled participants to denote these opportunities and discuss various aspects/viewpoints.

Summary of Results:

i. **Key Hazards of Concern**

# of tables selecting high, medium or low risk:

Risk Level: HIGH MEDIUM LOW

	P	C	P	C	P	C	Result
1. Atmospheric hazards	2			2			High probability and medium consequence
2. Hydrological hazards	1		1			2	Medium to high probability and low consequence, of rainfall related flood events, but higher risk and consequence from sea level rise

3. Power and Water Outages, Fuel Shortages	1		1			2	Medium to high probability and low consequence
4. Contamination and Pollution			1	1	1	1	Medium to low probability and medium to low consequence
5. Forest Fires					2	2	Low probability and low consequence
6. Earthquakes					2	2	Low probability and low consequence
7. Food Shortages					2	2	Low probability and low consequence
8. Geological hazards (e.g. erosion, landslides, land subsidence)	1				1	2	Diverse views on probability and low consequence
9. Dam Failure and Structural Collapse				1	2	1	Low probability and medium to low consequence
10. Other hazards e.g. Hazardous Material Spills			1	1	1	1	Medium to low probability and medium to low consequence

These results agree somewhat with the pre-survey results, indicating the highest probability and consequence from Atmospheric, Hydrological, Outages, Geological Hazards, and Contamination/Material Spills. None of the groups considered any of the hazards to be high probability *and* high consequence. Hazards were indicated on table-top map using yellow stickers - (see map images further below).

The results in the previous table can also be visualized as follows, in order to prioritize areas for climate adaptation and resilience building.

Probability			
High		**Atmospheric** **Hydrological**	
Medium	**Power Outage** **Geological Hazards (e.g. erosion, landslide)**	**Contamination** **Hazardous Materials Spills**	
Low	**Forest Fire** **Earthquakes** **Food Shortage**	**Structural Failure**	

	Low Medium High Consequence

ii. Vulnerabilities

Using a red marker and stickers, the participants identified potential local vulnerabilities. **These are listed here:**

a) Flood zone;
b) Wastewater treatment plant;
c) Hillsborough Bridge;
d) North River Causeway;
e) Energy from waste plant;
f) Maritime Electric Downtown Generation;
g) Charlottetown Wharf;
h) Oil and gas pipeline;
i) VP boardwalk;
j) Sobeys Groceries Superstore;
k) Stratford;
l) Hospital;
m) Seniors residences;
n) Pumping stations;
o) Harbour storm surge;
p) Power outage;
q) WWTP flooded;
r) Irving Energy - Allen St;
s) Fertilizer storage – water;
t) Sherwood Business Park;
u) Bio-medical chemical production;
v) Andrews dam.

iii. Strengths/Assets

Using Green Stickers, the participants identified local assets that serve as strengths in terms of resilience. **These are listed here:**

a) EMO Communications Control;
b) Confederation Centre;
c) Power generation back up;
d) District heat;
e) Superstore grocery with generator;
f) City Works;
g) T3 Transit;
h) Esso – fuel;
i) West Royalty Civic Centre Shelter;

j) Hillsborough Park;
k) Red Cross offices (bedding support);
l) Atlantic CAT equipment;
m) Trius transit;
n) City Fire;
o) Island Emergency Services (ambulance);
p) PEI Energy systems.

iv. Alternate Sources of Power/Heat

Using Yellow, Red, and Green star-shaped stickers, participants identified ***potential*** sources of renewable heat and power for back-up, for use in key facilities to improve their resilience. **These are listed here:**

a) Enwave District Energy;
b) 100kW solar – pumping;
c) 100kW solar – reservoir;
d) Biogas heating;
e) Jean Canfield Office Building Federal;
f) Asphalt plant;
g) WWTP solar;
h) Water reservoir solar field;
i) Former landfill solar farm;
j) Queens Arms Inn has biomass furnace;
k) Micro-hydro at WWTP outfall.

In some communities there is the opportunity for District Energy (blue circle):
Potential for district heat identified at Charlottetown Pollution Control Centre.

v. Possible Improvements

Using a purple marker, participants identified areas where resilience improvements/adaptation needs to take place. **These are listed here:**

a) Wastewater treatment plant;
b) Irving oil tanks;
c) Hillsborough Bridge;
d) North River Causeway;
e) Charlottetown Port;
f) Energy Recover Centre – WWTP;
g) Build a bigger Andrews pond;
h) Lock at Harbour entrance;
i) Move urban propane storage;
j) Hold stormwater on Agriculture Canada land.

vi. Bio-Retention and Green Infrastructure improvements

Using a green marker, participants identified areas to add green infrastructure.

a) Participants identified a potential for green infrastructure in the Ellen's Creek area, the Belvedere Golf and Winter Club area, and the area between Kensington Road and Strawberry Lane.

vii. **Zones to discourage development, or apply minimum build requirements**

Using a red marker, participants identified areas to discourage development.
These are listed here:

a) Along the shore.

viii. **Zones to encourage development or 'Build back better':**

Using a green marker, participants identified areas to encourage development and build back better. **These are listed here:**

a) East Royalty area.

ix. **Transportation improvements**

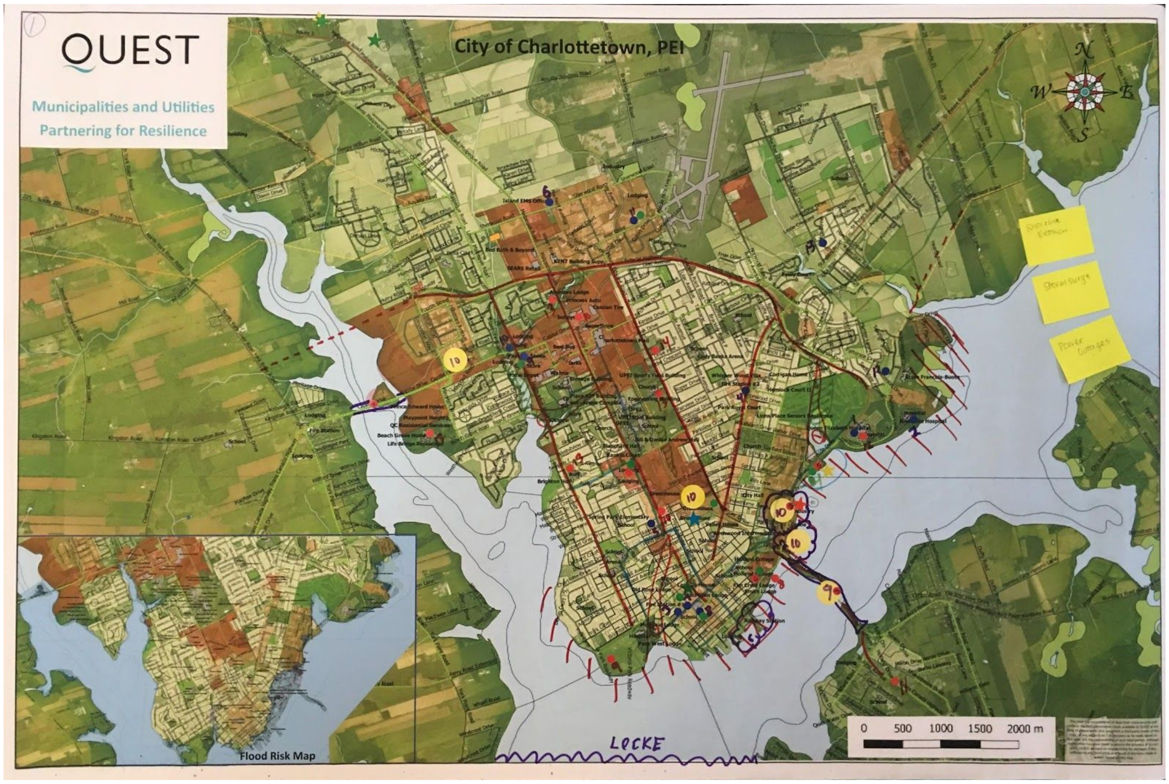
Using a red marker, participants identified existing primary and alternate emergency routes.

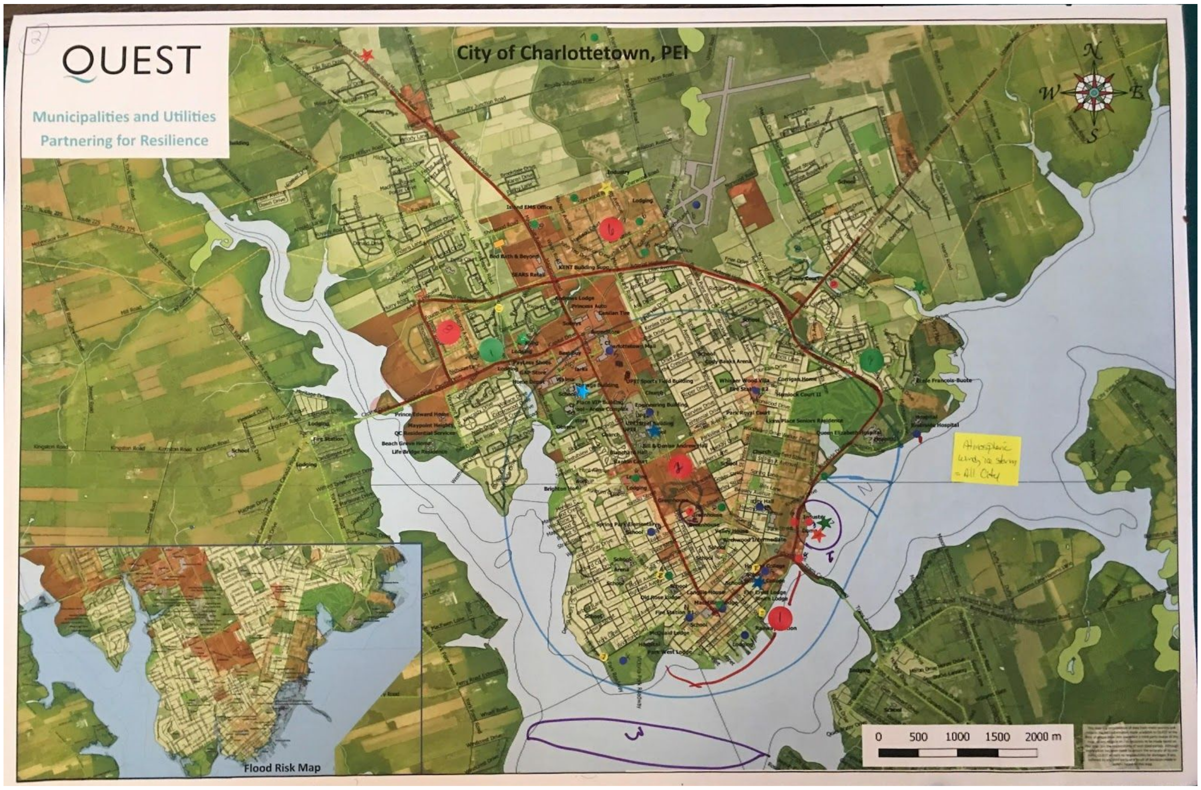
x. **Community Engagement and Muster Points**

Using Blue stars, participants identified potential muster points and places to engage the community to build awareness. **These are listed here:**

b) Orlebar Park;
c) UPEI;
d) Charlottetown Rural High School;
e) Holland College.

xi. Map Images




QUEST
Municipalities and Utilities
Partnering for Resilience
City of Charlottetown, PEI
Atmospheric
Windy, ice storm
= All City
0 500 1000 1500 2000 m
Flood Risk Map


Island EMS Office
Lodging
Bed Bath & Beyond
KENT Building Supp
SEARS Retail
Andrews Lodge
Princess Auto
Canadian Tire
Sobeys
SuperStore
Charlottetown Mall
Payless Shoes
GAP Store
Home Depot
Prince Edward Home
Maypoint Heights
QC Residential Services
Beach Grove Home
Life Bridge Residence
Fire Station
UPEI Sports Field Building
Engineering Building
Whisper Wood Villa
Corrigan Home
Hemlock Court II
Park Royal Court
Lions Place Seniors Residence
Queen Elizabeth Hospital
Riverside Hospital
Ecole Francois-Buote
Atmospheric
Windy, ice storm
= All City
Bill & Denise Andrew Hall
Blanchard Hall
Rankin Court
Brighton Home
Spring Park Elementary
Greenhouse
Valley House
Birchwood Intermediate
City Hall
College
Elm Croft Lodge
Smith Lodge
Langille House
Old Rose Lodge
Fire Station #1
McQuaid Lodge
Hospital
Park West Lodge
Lodging
School

Disclaimer: This exercise was originally developed by Spatial Quest, to support NB Municipalities to understand local hazards, risks, vulnerabilities, strengths, and opportunities for improving resilience or climate adaptation, in a spatial context. Adapted or use by QUEST, for the Municipalities and Utilities Partnering for Resilience project. Maps were produced with best available data at the time. Decisions based on map information should be taken into context - and QUEST will not take responsibility for any damages caused by decisions made based on these maps.

4.3.3 Action Planning Exercise

Goal:

Provide participants with an opportunity to discuss the most significant findings of the day, and each present their ideas for key areas for improvement, related needs, and potential actions.

Overview:

Participants were asked a series of questions. For each question, they wrote their answers on a sticky-note. These sticky-notes were arranged onto panels by theme. The responses are summarized here:

Summary of Results:

i. **What is the greatest need/goal for Charlottetown?**
   - Storm surge protection x2, Future planning for sea-level rise x1, A plan of action for addressing risk on the waterfront x1;
   - Improve Planning Regulations on development (storm-water net runoff);
   - Planning risk assessments (probability and consequence) for key infrastructure / developments;
   - Improved Public Engagement;
   - Knowledge of potential devastation, need for more information.

ii. **What is needed?**
   - Prioritize Hazards, i.e., storm surge defense (breakwater at mouth of Hillsborough River leading into Charlottetown) x2;
   - Have a regional plan to protect Charlottetown harbour and entire waterfront, not just one specific location, such as implementing a Seawall, Locke System or Berms;
   - Require zero or small % increase stormwater runoff for new development;
   - Hire consultant to perform/administer workshop on identifying high risk areas and develop mitigations;
   - Collaborative planning for infrastructure improvements;
   - In depth studies, realistic outcomes;
   - Provide information to the public.

iii. **Who is needed/who should lead the action?**
   - Funding acquisition x2, Cooperative funding, need funding and buy-in from all levels of government x2 and other agencies/businesses;
   - Provincial/Municipal policy to identify work as a priority;
   - Coordinating body to bring together stakeholders (CADC or ?);
   - Strategic Plan;
   - Increase action to reduce stormwater – Council resolve to enact regulations;
   - Improve public knowledge – pay now on development (e.g., put in retaining pond) or later on infrastructure improvements through taxes;

- Information such as flood mapping to be shared;
- Improved means to share information.

iv. What will you do differently after today?

- Become more informed;
- Strive to better champion of issue/effect, and educate others;
- Continue dialog with provincial/municipal governments and stakeholders;
- Look closer at ICIP and existing EOI, support effort to build buy-in at Council level;
- Be more vigilant in identifying assets/properties of concern and adapting appropriately;
- Continue to promote / push the importance of building infrastructure for future conditions, think further ahead when planning upgrades to infrastructure, take climate into consideration in planning infrastructure investment;
- First responders are often reactive, but highly involved in all aspects of catastrophes. Relies on other agencies for planning for events.

v. General Notes:

- Overland flooding is short lived, not frequent. Due to small watersheds, excess water drains reasonably quickly;
- There are cases where homes are built above 1 in 100 year flood levels, but are isolated when flood happens, because surrounding development is not to 1 in 100 year flood levels;
- There is a cost pass-off from federal & provincial governments to citizenry, to municipal, to federal DFAA;
- Need improved regulations and land use policy, adoption of national building code;
- Discussed pros/cons of including a flood risk assessment in zoning information;
- Where there is prevalence of flooding in at risk areas there is little change post recovery;
- Professions are looking at their specific role and there isn't a holistic approach that may consider all of the aspects of flooding;
- Some people who might be buying an at-risk property may not know or have the resources to know whether their property is at risk;
- May need something on the permit/ deed to signify risk;
- Disaster mitigation adaptation fund – Charlottetown put in a few expressions of interest (15), including to protect harbour from Sea level rise.

5.0 RDRP Hazard, Risk, Resilience

Following the 1st workshop, QUEST's team used the Disaster Resilience Portal of JIBC to dive deeper into climate risk and resilience assessment for each hazard type identified above as high risk/consequence. For each hazard type, the team examined aspects of risk, strengths of the community, and any gaps identified, using a detailed set of questions. This analysis uncovered areas of high risk and low resilience, which are summarized in the table below. Note - even though the community may be highly resilient to certain hazards, there may still be specific opportunities for improvement.

Category	Hazard	Low risk	Mid Risk	High Risk	Low Resilience	Mid Resilience	High Resilience
Atmospheric	Blizzards		✔				✔
	Snow Storms			✔			✔
	Heat Waves			✔		✔	
	Hurricanes			✔	✔		
	Ice Storms			✔	✔		
	Sea Storms and Surges			✔	✔		
	Wind Storms		✔			✔	
	Hail Storms		✔				✔
Hydrological	Sea Level Rise			✔	✔		
	Flash Flood	✔				✔	
	Ice Jam	✔				✔	
	Local Flood		✔				✔
	Rain Storm		✔			✔	
	Snowmelt flood		✔			✔	
Contamination/Spills	Gas leaks and explosions	✔					✔

	Oil leaks	✔					✔
	Other explosions	✔					✔
	Hazardous material spills (on site, on land, road, rail and marine)		✔				✔
Power, Water, and Food Shortages	Power Outages		✔			✔	
	Water Outages		✔				✔
	Food Shortages		✔			✔	
Fires	Brush, Bush and Grass Fires	✔				✔	
	Forest Fires/Wildfires	✔				✔	
	Wildland/Urban Interface fires	✔				✔	

Detailed aspects of risk and community resilience/weaknesses, for each hazard type, are included in a separate annex.

6.0 Summary of Results

Summary Key Hazards

Based on the climate projects and community discussion above, we found strong concern for Atmospheric, Hydrological, Outages, Contamination/Material Spills, and Geological. The level of risk for each hazard sub-type was further assessed using RDRP tools – these detailed aspects of risk and community resilience/weaknesses for each hazard type are included in a separate annex.

- **Atmospheric hazards** of particular concern include: Increasing frequency of ice storms as well as sea storms and surges, snow storms and wind storms, and increased potential for heat waves, and tropical storms or hurricanes.

- **Hydrological hazards** of particular concern include: coastal flooding, sea level rise, and other forms of flooding (e.g., rainstorm) from increased precipitation, especially in winter and spring.

- **Power outages** are a concern, along with potential food shortages. For example, extended outages due to ice loading on distribution and transmission lines and extreme weather events. Food and diesel (for generators) are transported to the city via the Confederation Bridge which is closed several times a year due to extreme weather.

- **Contamination** was identified as a risk to the City's drinking water. Charlottetown's potable water comes from a series of wells located within the Winter River watershed.

- **Geological hazard** of particular concern is shoreline erosion**.**

Summary of Key Strengths / Things in Place

Based on the information contained in this report, below is a summary in bullet form of the key areas of strength in the community. This includes all the inputs gathered through the pre-survey, climate projections, table-top exercises (10 essentials, mapping, and action planning), as well as RDRP. More detailed aspects of risk and community strengths and weaknesses for each hazard type are included in a separate annex.

Vegetation

- The City has a contractor for tree trimming around wires and Maritime Electric also does to ensure reliability of electrical systems.
- Charlottetown has locations with permeable pavement (e.g. Simmons Arena), trees and shrubs, community gardens, some green roof tops and rainwater collection/rain gardens.
- The City uses ditches, retention ponds, etc, to handle large flows.
- The local government works with watershed groups to support the restoration, protection and sustainable management of ecosystems services (e.g., coastal zones, wetlands, water resources, river basins, fisheries, etc.).

Planning, Organization and Coordination

- The City has an Emergency Response Plan updated and it was exercised in 2018.
- The City has obtained copies of EM Plans for local schools, hospital or nursing homes; however, ERPs are the responsibility of each facility.
- The City has alliances with local groups and neighbouring communities (e.g., for emergency response). Mutual aid agreements in place for fire service. Around 42 MOUs established with businesses and community groups.
- Charlottetown has a contact tree and an inventory of skills/resources in the community.
- Charlottetown has regular contact with government, utility, and UPEI..
- The local government allocates some financial resources to carry out risk reduction activities, including climate adaptation and effective disaster response and recovery.
- Charlottetown has a Sustainability Plan and Community Energy Plan.
- Climate change is incorporated into the Asset Management Plan and Land Use Plan.
- The City plans for assisting vulnerable people (e.g., people with disabilities).
- Charlottetown is a small community and the people are well-connected with each other.
- The Community has given some consideration to future climate change projections and impacts, when conducting risk assessment, when updating Emergency Plans, and when making infrastructure and land use planning decisions. Specific plans include the Official Plan, Waterfront Plan, Coldwater Study, and CADC.
- The Community somewhat considers impacts of hazards on municipal services, from the viewpoint of maintaining reliable energy (power, heat, or cooling). The community works with the utility to understand hazards and reduce risk from prolonged interruptions to power and fuel delivery. Charlottetown has back up generators at a number of sites. Warming centres have a 3-day supply.
- The local government communicates some information on local hazard trends and risk reduction measures to the community via their Communication Strategy. They issue warnings of pending hazards, but could be more proactive.
- It is unclear if local government risk assessments are linked to, and supportive of, risk assessments from neighbouring local authorities and provincial government risk management plans. The community in general is well-linked to the provincial government.
- Disaster risk assessments are incorporated into some local development planning, such as lot grading plans.
- Some regulations for housing and development infrastructure take disaster risk (including climate related risks) into account. Storm design was increased to account for the changing climate.
- The measures being taken to protect critical public facilities and infrastructure from damage during disasters could be improved. Examples include designing to new standards, backup generation, and waterfront treatment plant.
- Risk-sensitive land use regulations, building codes, and health and safety codes are in place but are not a major focus. Minimum requirements are set.
- Very few existing regulations (e.g., land use plans, building codes, etc.) support disaster risk reduction in your local authority. There are plans to make improvements in this area.
- The EMO and Province provide some training in risk reduction for local officials and community leaders.
- Key resources are available for effective response, such as emergency supplies,

emergency shelters, identified evacuation routes and contingency plans.

Communications and Awareness

- Charlottetown's Mayor and Council understand their roles and responsibilities to communicate with the public before, during, and after an event.
- The City has implemented the Charlottetown Alert System.
- Charlottetown has a communication plan for promoting emergency preparedness.
- The public is aware of where to go in case of emergency.
- Local radio station and TV station have backup power.
- There are HAM radios at City Hall, and operators are volunteers.
- The City has Trunk Mobile Radio for Emergency Responders.
- Communication towers in Charlottetown have backup power.

Energy Infrastructure

- The City has backup power at City Hall and EMO, lift stations, water treatment, and four emergency shelters.
- The hospital, senior community care facilities, grocery stores, and fuel storage facility all have backup power. Conducted cost analysis involving upgrading or installing backup power in 23 buildings.
- The community has some backup generators, but there is no explicit count in the community.
- There are provisions to keep fueling stations open during prolonged interruptions and the City has identified alternate sources of fuel (for generators) in case of interruptions.
- The flood risk (1 in 100 year events) to electrical/utility infrastructure has been assessed.
- There is 40 MW permanent district heat, and 1.2 MW in electricity production which is primarily used by the Waste-To-Energy District Heat system. Looking to increase to 3 MW, and supply grid. Currently provides heat to key facilities such as: University of PEI, schools, Civic Centre, Fire Hall, Town Hall, Conference Centre, Mall and Plaza.

Water and Sewage

- Charlottetown has a distributed water system (potable) that is pumped.
- The stormwater and sewer systems are separated.
- Charlottetown has backup power for the water and wastewater treatment.
- The City is decommissioning a lagoon which is at the water's edge, but entrances are above 1 in 100 year flood events. The sewage outflow pipe discharges below sea-level.
- There are no known neighbouring land uses contributing to the community's flooding risk.

Transportation

- There are several main transportation corridors to enter/exit the community.
- The City has a Port.
- Charlottetown has diesel-powered bus transit.
- There is a generator located next to the Port which feeds the grid.

Food

- Food is delivered to Charlottetown by truck and there are local community gardens.
- At least one local grocery store has backup power.

- Charlottetown has 3 to 5 days food supply.

Summary of Areas for Improvement

Based on the information contained in this report, below is a summary in bullet form of the areas where things may be improved, are missing or needed. This includes all the inputs gathered through the pre-survey, climate projections, table-top exercises (10 essentials, mapping, and action planning), as well as RDRP. More detailed aspects of risk and community strengths/weaknesses, for each hazard type, are included in a separate annex. Recommendations will be made based on these findings at a second workshop in 2019 - Participants will then discuss actions/strategies suitable to the community and determine priorities:

Vegetation

- It is unknown how Charlottetown encourages bioretention.
- The private sector or civil society has a low-level of participation in the implementation of environmental and ecosystems management plans.

Planning, Organization and Coordination

- No individual or group is currently responsible for resilience planning.
- Charlottetown is in need of resilience improvement funding.
- There is a bonusing program for increased density if meeting city needs (green roof included),
- The local government has limited access to adequate financial resources to carry out risk reduction activities. (e.g., climate adaptation, flood risk reduction). Provincial and Federal funding is available.
- Few economic incentives are established for investing in disaster risk reduction for households and businesses (e.g., reduced insurance premiums for households, tax holidays for businesses).
- The local government has access to resources but does not have well-developed expertise to assist victims of psycho-social (psychological, emotional) impacts of disasters.
- Disaster risk reduction measures are somewhat integrated into post-disaster recovery and rehabilitation activities (i.e., build back better, livelihoods, rehabilitation). Measures could be better developed. The City has required higher elevations/flood rebuilds.

Communications and Awareness

- More education and engagement is needed. Develop proactive resilience education strategy
- Encourage local schools include education and training in disaster risk reduction and emergency preparedness
- Inform residents of evacuation routes, priority of power restoration, preparedness, etc
- Continue to provide ICS training to all staff

Energy

- No official cooling centers (with back-up power) identified for hot days / heat waves
- Unknown if animal shelters, banks, schools, and greenhouses have backup power

- Food, Medicine, and Diesel fuel supply for backup generators would be interrupted if Confederation bridge closures exceed 52 hours.
- The community has mobile generators, but unclear how many and whether they would be available
- There are potential opportunities for renewable heat and power to compliment back-up power (generator) on municipal facilities, critical infrastructure, emergency shelters, etc.
- Opportunity to work with the utility to understand hazards and reduce risk from prolonged interruptions to power and fuel delivery

Water and Sewage

- It is unclear if storm water system can handle 1 in 100 year flood events and if the City is using ditches, ponds, etc., to alleviate pressure on stormwater system.

Transportation

- On a provincial scale, weather can interrupt access to mainland on bridge and ferry – somewhat frequent but usually for a short duration.
- It is unclear if there are neighborhoods, with only one access road.
- The City does not have EV Charging Stations with backup power.

Food

- It is unclear how many local greenhouses or if they have backup power.
- It is unclear if there is a strategy for interruptions to food supply.

7.0 Conclusion

This report concludes that the **City of Charlottetown** is doing well in several areas and has identified key areas for improvement, in order to mitigate expected climate change impacts.

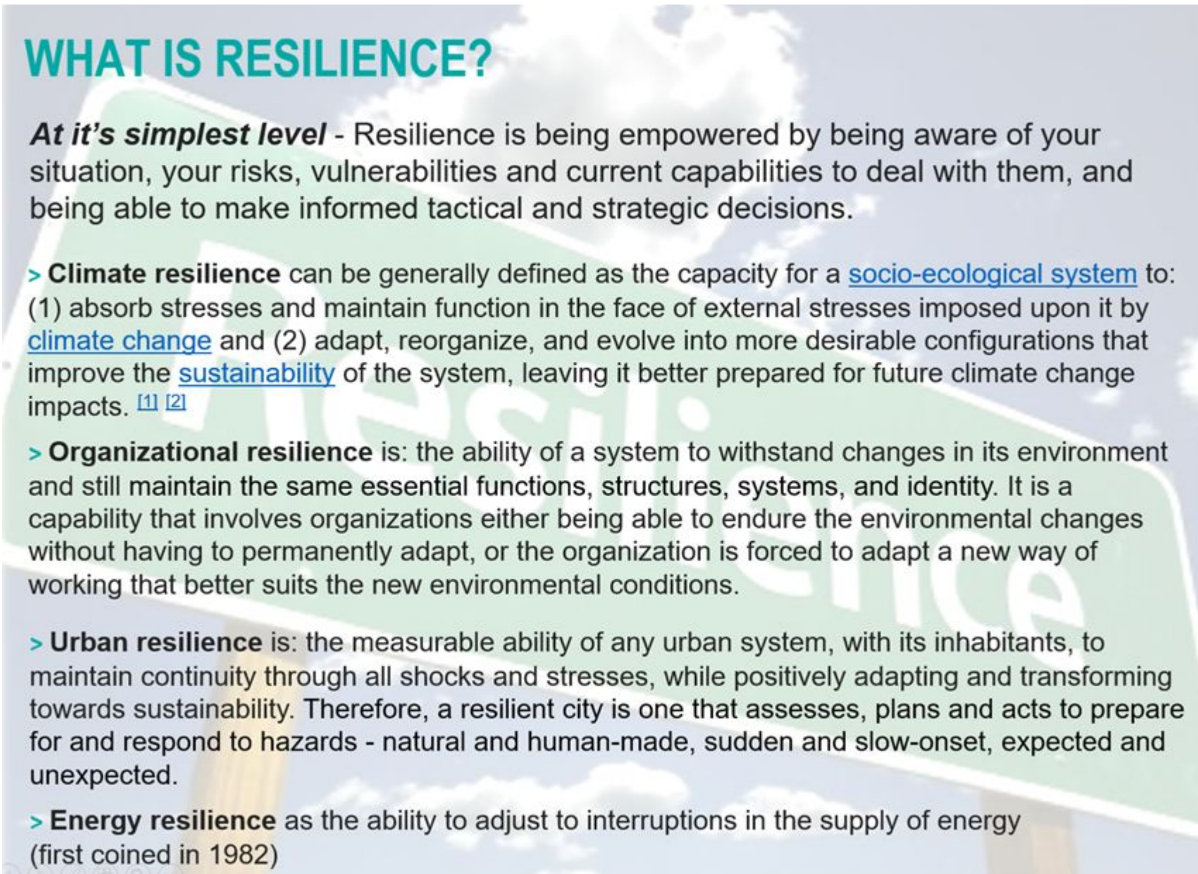
The results of this Climate Risk and Resilience Assessment will be used by QUEST to generate recommendations tailored for the City of Charlottetown and the results will be presented at the second workshop in 2019.

These results can also be used by the community while planning future initiatives to improve resilience and adapt to climate change.

Based on feedback received, the process of engaging municipal staff, energy utilities, and other community stakeholders went very well and helped to inform this initial qualitative assessment. A detailed engineering assessment is outside the scope of this project and many still be required.

8.0 Annexes

1. Definitions of Resilience



source: Wikipedia

2. Climate Data Introduction

Below are the historical and future trends of relevant temperature, precipitation and complex climate variables. This climate analytics information will be used by QUEST project team members as input to the risk and resilience assessment phase of the project and as part of the final project report. Supporting climate data spreadsheets are provided separately.

Historical and projected climate data and maps for this report were extracted from the Climate Change Hazards Information Portal (CCHIP). The climate data for each community was extracted into spreadsheets and relevant data was used to develop the climate data summaries for each community.

CCHIP provides customized climate and climate change outputs based on geographical area, sector, theme and timeframe of interest. The portal draws on data from thousands of locations and multiple sources to provide information such as: temperature and precipitation normals and extremes; trends and frequencies of temperature and precipitation at relevant thresholds; key statistics on other extreme weather (e.g., lightning, windstorms, and tornadoes); and climate change projections from international and domestic government sources

The Climate Change weather station data from each location or closest to it and the nearest gridded climate data set from the NRCan and ECCC generated CANGRID dataset were used. The following applies to projected climate data:

- Projection periods include the 2020s (2011 – 2040), 2050s (2041 – 2070), and 2080s (2071 – 2100);
- Projections use a baseline period of 30 years, from 1981 – 2010;
- Projections use the suite of CMIP5 climate models from modeling centres around the globe; and
- Projected variables use up to 40 models to generate future values, with the specific number of models dependent on the variable and future scenario specified.

Using the suite of models allows for the calculation of percentiles around the multi-model mean, giving an estimate of model uncertainty.

Historical Climate Data

Data Coverage

CCHIP uses historical data from Environment and Climate Change Canada (ECCC) and Natural Resources Canada (gridded data). Daily data are available for analysis, but full availability varies among stations depending upon what was originally collected.

The ECCC Climate Data Archive for its historical data (hundreds of stations over various periods of record) was used. The data provided by ECCC is provided 'as-is' and is vetted by that organization. Errors or omissions in the ECCC dataset may therefore also be present in the dataset, although effort has been made to recheck values in the database.

Additionally, high-resolution (10km by 10km) peer-reviewed and vetted gridded observed data that cover the entire Canadian landmass (particularly useful in areas with poor ECCC station coverage) is provided. The gridded dataset is known as CANGRD and was developed in a collaboration between Natural Resources Canada and ECCC.

General Background

Official Intergovernmental Panel on Climate Change (IPCC) assessments predominantly rely on international research centres to contribute Global Climate Model (GCM) projection information. CCHIP uses GCM projection data from the same set of models. The most recent assemblage of GCM projections was provided for the IPCC 5th assessment of 2013 (AR5). In this assessment, 40 GCMs were used with multiple runs per model, resulting in approximately 75 projection estimates from which to calculate possible future conditions. Maximum, minimum and mean temperature are standard output variables from these GCMs, as is precipitation.

With increased computing power, a greater number of atmospheric phenomena have been incorporated into GCMs, and the models' spatial and temporal resolutions have improved. There has also been a large increase in the availability of model outputs and the ability to produce projections of future climate based upon an 'ensemble' of many models. These two factors give us a generally greater level of confidence in the projected values of climate parameters. CCHIP uses all available AR5 model runs (many models have more than a single projection available), and these are used together with baseline climate observations to generate measures of future conditions (described in the 'methodology' section of this document). The use of multiple models to generate a 'best estimate' of climate change is preferred over a single model outcome. Research has indicated that the use of multi-model ensembles is preferable to the selection of a single or few individual models since each model can contain inherent biases and weaknesses.

Uncertainty

The use of many model estimates allows for the calculation of central tendencies as well as the range of future values. Based on the 'spread' of these models, different characterizations of uncertainty can be provided. Simply put: a variable which shows less spread among many models is more reliable than a variable which has a very large range of projected outcomes. This is critical in the consideration of uncertainty. Charts below with model projections, plots and tables of the full range of all model run projections. The top horizontal bar is the highest model value, the bottom horizontal bar is the lowest model value, the box represents the range of 50% of the models with the top being the 75th percentile value, the bottom being the 25th percentile value.

Assumptions Regarding Rate of Warming

A new initiative in the IPCC AR5 was the introduction of RCPs (Representative Concentration Pathways). They represent a range of possible projection outcomes which depend upon different emission rate assumptions which generate different degrees of atmospheric warming. The lowest RCP 2.6, represents an increase of 2.6 W/m2 to the system, while the highest RCP 8.5 represents an increase of 8.5 W/m2 of energy. This range encompasses the best estimate of what is possible under a small perturbation situation (2.6) and under a large increase in warming (8.5). Both the 4.5 (moderate) and 8.5 (high) projected change are presented as future emission pathways and the resulting projections are based on these two alternatives. It is unknown which of the RCPs will apply in the future. However, it is important to note that historically, the GHG emissions have followed the highest (8.5) pathway. In the absence of a meaningful global agreement on GHG reduction, this trend is expected to continue which would support this pathway going forward.

RCP levels illustration

Projection Methodology

The 'Delta Approach'

The Delta Approach is one of several methods which can be used to obtain downscaled projections of future climate. It is perhaps the simplest approach, the easiest to understand, and has been widely used for impacts and adaptation studies. Is has also been shown to compare well with the accuracy of other approaches. When this method is coupled with the use of many models to generate projections, it generally provides more useful information than when a single or small set of models are used, regardless of their spatial or temporal resolution.

In the past, model data were difficult to obtain and process, making it challenging to use the delta approach together with a large ensemble of models. Modern data storage capacity and computing power allow the delta approach to be applied using outputs from all 40 GCMs and all model runs used in the IPCC AR-5.

The following 5 steps summarize the process for providing future estimates of climate variables:

1. Obtain for each parameter a baseline climate condition (or 'average' climate) for the user-specified station or CANGRD cell. Currently, the conditions for the most recent 1981-2010 period are used to define the baseline period of record.

2. Using the ensemble of all available CMIP5 models ('CMIP5 ensemble'), obtain the model average climate for the same historical period. For many of the 39 GCMs included, outputs are considered for multiple model runs when they were available. For our ensemble procedure, we first average all runs per model to obtain a model average value, then the individual model values are averaged to obtain the CMIP5 ensemble average.

   Before obtaining the average of all models, however, the model outputs are regridded according to a common resolution, since different modeling centres use different grid alignments and dimensions. This regridding uses a scale representative of the resolution of the GCMs, in this case approximately 200 by 200 km, matching the grid dimensions of the popular NCAR reanalysis. This is done using a process of linear interpolation to obtain the regridded datasets.

3. The CMIP5 ensemble future climate is obtained for the chosen station location or CANGRID cell for each of the required future periods. The model averaging procedure to obtain the ensemble average follows the same procedure as outlined in item (2) above. In this case, for three 30-year future periods starting in the year 2011 and ending in the year 2100. This provides average future conditions as projected by all GCMs for the: 2020s (2011 to 2040), 2050s (2041 to 2070), and 2080s (2071 to 2100).

4. The difference (or 'delta') between the CMIP5 baseline and CMIP5 future periods are then obtained, representing the change in the specified climate condition (the 'climate change signal'). Three climate deltas are produced, one each between the baseline (1981-2010) and the 2020s, 2050s, and 2080s respectively.

5. The final step is to apply this delta value to the station or gridded baseline period value. This has the effect of correcting for any difference (or bias) between the true measured baseline climate and the CMIP5 baseline climate. After applying the delta to the baseline, we have a projected climate average for each of the future periods, along with some information on the 'spread' of the model projections. We can approximate uncertainty by considering the spread of the projections, with smaller ranges suggesting more confidence in the projected value(s) than a wide projection range.

Climate Statistics

Frost Profile

The probability of frost profile is the daily probability of the occurrence of frost, i.e. when minimum temperature is less than 0°C, averaged over the 30-year period. It is expressed as the percentage of the number of days during the period when minimum temperature is less than 0°C and for plotting purposes, a five-day running mean has been applied to the data. An indication of the length of the freeze-free season is also given, i.e. the number of days during the year when the daily mean temperature is greater than 0°C.

Cooling and Heating, Growing Degree Days

Degree days are the accumulated departures of temperature above or below a particular threshold value, with these values selected to be of relevance to particular sectors, e.g. energy and agriculture. For example, a threshold temperature of 18°C is used as an indication of space heating or cooling requirements. For space heating, if the mean temperature is below 18°C then the departure from this threshold value is calculated and summed for all days on which the mean temperature is below the threshold value. For space cooling, the temperature departures are accumulated if the mean temperature on a particular day is above the 18°C threshold value.

Freeze-Thaw Cycle (Monthly)

Freeze-thaw cycles represent the average number of days per period indicated when the daily maximum temperature equals or exceeds 0°C AND the daily minimum temperature is less than 0°C. The freeze-thaw cycle and its associated effects on water/ice formation can have significant effects on built environment deterioration.

Accumulated Precipitation

The accumulated precipitation profile (in mm) indicates the progression of precipitation over a calendar year. Snow is converted to mm of water equivalent. The mean accumulation, maximum and minimum years for the period are shown as coloured lines. In addition, as an indication of extremes, diamonds indicate the progression of precipitation if either the maximum or minimum values of each month are summed for the period in question.

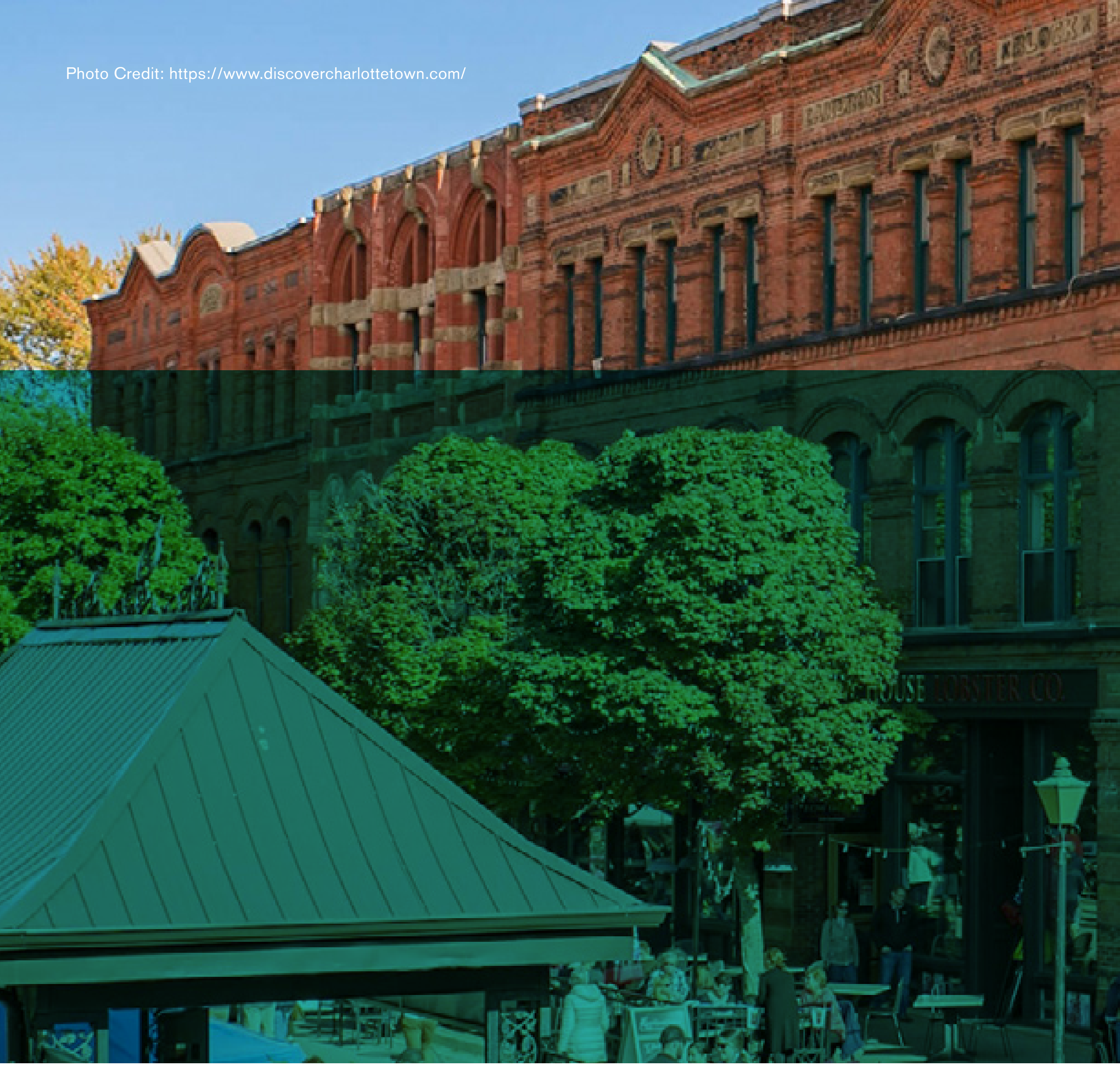
Water Balance

Monthly total precipitation, averaged over the 30-year period, is the rainfall amount plus the measured snowfall water equivalent. Actual and potential evapotranspiration values are also indicated. These have been derived an empirical method that computes changes in water storage as a function of monthly mean temperature, total precipitation, latitude (for day length) and soil texture (for water holding capacity).

Water deficit and surplus are calculated from the potential and actual evapotranspiration values. Water deficit is the amount by which the available moisture fails to meet the demand for water and is computed by subtracting the potential evapotranspiration from the actual evapotranspiration for the period in question. Water surplus is the excess remaining after the evaporation needs of the soil have been met (i.e. when actual evapotranspiration equals potential evapotranspiration) and soil storage has been returned to the water holding capacity level.

3. List of Workshop Participants (17)

a. Tanya Mullaly, PEI EMO;
b. Kurt Wootton, IBC;
c. Chris Watts, Charlottetown Police;
d. Peter Nishimura, PEI CC Secretariat;
e. Paul Johnston, Manager of Infrastructure and Asset Management, City of Charlottetown;
f. Frank Quinn, Manager of Parks and Recreation, City of Charlottetown;
g. Scott Adams, Manager of Public Works, City of Charlottetown;
h. Randy MacDonald, Fire Chief, City of Charlottetown;
i. Steven Stewart, Superintendent of Waste Water Treatment Plant, City of Charlottetown;
j. Richard MacEwen, Manager of Water & Sewer, City of Charlottetown;
k. Alex Forbes, Manager of Planning & Heritage, City of Charlottetown;
l. Chris MacDougall, Enwave-PEI Energy Systems;
m. James Coons, QUEST;
n. Eddie Oldfield, QUEST;
o. Jacqui Scaman, Intern, City of Charlottetown;
p. Wayne Long, Events Development Officer, City of Charlottetown;
q. Ramona Doyle, Manager of Environment & Sustainability, City of Charlottetown



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