Municipality of the
District of Barrington

Municipal Climate Change Adaptation Plan

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1. Climate Change in Nova Scotia

Observational evidence dating back to the 1950s, coupled with modern empirical research, is demonstrating a radical change in climatic extremes across the globe.[i] Most notably, global temperatures are rising and reaching all-time highs. Caused by both natural processes and human activities, global warming is resulting in the increased frequency and severity of global weather-related events. Sea levels are rising, ocean currents are shifting, and regional precipitation events are becoming increasingly drastic and unpredictable.[ii] These rapid and volatile climatic changes are likely the cause of many of today's natural disasters, such as severe drought and extreme storms.

The potential impacts of climate change are far-reaching for both humans and our natural environments. Humans are becoming more exposed and vulnerable to climate change as our economies, infrastructure, social services, and health care are impacted by the threat and reality of natural disasters. Additionally, climate change is affecting our natural landscapes and wildlife that inhabit them.[iii]

In Atlantic Canada, we are beginning to see the real effects of climate change. Atlantic Canada's natural coastal landscape and ocean-side communities are becoming increasingly vulnerable and impacted by the effects of sea level rise, storm surge, and coastal erosion and flooding. Coastal risks are real, and their impacts are potentially severe.

Nova Scotia's coastal areas are home to approximately 70% of the province's population. Furthermore, a majority of Nova Scotia's infrastructure and industry is located in coastal communities.[iv] According to *Nova Scotia's Climate Change Action Plan*, Nova Scotia can expect to see warmer average temperatures, higher sea levels, more extreme rainfalls, and more frequent and extreme storms. Higher ocean water temperatures may impact the biodiversity of Nova Scotia's marine animals and resources, landscapes may be damaged, and several native plant and wildlife species may not be able to survive the new climatic conditions. On the human scale, Nova Scotia's very old and very young may become vulnerable to the health effects of air pollution and heat waves, and local economies and buildings may become threatened by extreme climactic shifts. Climate change poses significant risk to all Nova Scotians.[v]

'Adaptation Planning' has become an important method through which municipalities can identify actual and anticipated climate change impacts. Through exploring how a municipality and its assets may be impacted by climactic events, a municipality may then prepare actions and priorities aimed at protecting and preserving the future safety of its communities.

Determining Impacts

Climate change adaptation planning is a highly localized endeavour that takes the findings from global and regional climate models and translates the predicted changes in order to determine what impacts may occur to local assets.[vi] Impacts to local assets - such as municipal infrastructure, social services and natural landscapes - are not only predicted, but often observed from historical evidence and experience.

Governance

In accepting the challenge and commitment to reduce the potentially harmful impacts of climate change, the Municipality of the District of Barrington has prepared this *Climate Change Adaptation Plan*.

There are many elements that influence the preparedness and responsiveness of an adaptive community: in recognizing that there is a need to balance resource management, infrastructure development and upkeep, and personal understanding of individual environmental impacts, Barrington must take an active role in developing adaptive and preventative climate change policies.

The importance of Municipal governance and leadership in this regard is essential. This *Plan* must represent an effort to further incorporate the policies and strategies set forth in the MPS and ICSP in order to reduce and minimize the potentially harmful consequences of climate change. Conversely, the adaptive actions set forth in this *Plan* should identify potential opportunities that may result from climate change.

WHAT IS ADAPTATION?

Adaptation – Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory, autonomous and planned adaptation.

Anticipatory Adaptation – Adaptation that takes place before impacts of climate change are observed (also referred to as *proactive adaptation*).

Autonomous Adaptation – Adaptation that does not constitute a conscious response to climate stimuli but is triggered by ecological changes in natural systems and by markets or welfare changes in human systems (also referred to as *spontaneous adaptation*).

Planned Adaptation – Adaptation that is the result of a deliberate policy decision, based on an awareness that conditions have changed or are about to change and that action is required to return to, maintain, or achieve a desired state.

Source: Adapting to Climate Change in Ontario, 2009

Barrington's Climate Change Adaptation Vision

Through adaptive planning and preparation, the Municipality of Barrington will continually strive to become a more sustainable and resilient community to the effects of climate change. In accepting that climate change is everyone's concern, Barrington will foster a mentality that promotes a Municipal-wide responsibility for adaptation strategies. Barrington will be proactive in the implementation of adaptive policy and will strive to become a leader in sustainable planning practices.

Continuing Action

Barrington understands that its assets and values extend beyond the physical environment. When considering both the causes and effects of climate change, Barrington will approach adaptation planning from a variety of Municipal perspectives, including, but not limited to, the built, social, economic, environmental and political domains.

The following 'Foundation Principles' were endorsed by Barrington Council in 2009, and shall continue to serve as guidance for Climate Change Adaptation Planning:

Economy: We will take action to enhance and support our local and regional economy and ensure that future economic development is balanced with social, environmental and cultural concerns.

Natural Environment: We will strive to protect ecological diversity and prevent damage to our natural assets including our coastal areas, beaches, rivers, lakes, forests, streams and wetlands.

Resources: We will reduce pollution and waste and minimize our consumption of non-renewable resources so that these resources remain for future generations.

People & Communities: We will work together to maintain and improve the quality of life for all our residents so that they can meet their basic needs.

ADAPTATION APPROACHES

Preserve and enhance lands for natural resource and habitat values (e.g., the preservation of land surrounding wetlands and beaches to allow for their inland migration as the seas rise).

Avoid developing in areas considered at moderate to high risk to a hazard. Avoidance measures are typically limited in application to future development or redevelopment (e.g., setbacks, zoning that aligns land use with flood risk).

Protect areas considered at moderate to high risk to a hazard from development. Avoidance measures are typically limited in application to future development or redevelopment.

Accommodate climate change effects by adapting land-based structures and activities to tolerate an impact (e.g. warning and evacuation protocols, rolling easements).

Managed Retreat is defined as any strategic decision to withdraw, relocate or abandon private or public assets that are at risk of being impacted by coastal hazards.

The Municipal Climate Change Action Plan Assistant – Learning From Others

2. Project Framework

Project Methodology

Project work was organized into the following phases as recommended by SNSMR:

1. *Establishment of a Project Team*
2. *Municipal Assets & Climate Change Events Identification*
3. *Change Risks Impacts Assessment*
4. *Climate Change Action and Adaptation Planning*

1. Project Team

As per SNSMR requirements, a Climate Change Adaptation Committee (CCAC) was formed in order to guide the development and implementation of the project deliverables. Barrington's Planning Advisory Committee (PAC), whose membership consists of Municipal staff members, community Council members, and engaged citizens, functioned as the CCAC. The CCAC's responsibility was to provide expertise and historical knowledge on local climate change issues and hazards, as well as to provide adaptation strategies for future policy implementation. Additionally, the Planning Team from GENIVAR Inc. added professional expertise in helping to identify actual and anticipated climate change issues in order to help develop a set of adaptation action priorities.

2. Municipal Assets & Climate Change Hazards Identification

The Project Team reviewed and identified various municipal assets based on their ecological, economic, and social importance. Organized into five different categories as identified in Figure 1 below, these assets were then mapped and overlaid with climate change hazard mapping to see where the impacts of climate change may be most drastically felt.

***BUILT** (municipal infrastructure, roads, bridges, pump stations, buildings, power lines)*
***ECONOMIC** (fish plants, fisheries, mink farming, agriculture, private enterprise, tourism)*
***CULTURAL & SOCIAL** (churches, schools, community centres, waterfront, volunteerism)*
***NATURAL** (ecosystems and parks, wetlands, trails, beaches, air quality, wildlife)*
***SERVICE** (EMO, SAR, fire, police, health & medical care, telecommunications, evacuation)*

Figure 1 – Municipal Asset Categories

It is generally understood that there are five key climate change hazards that have and are likely to continue to impact the Municipality of Barrington. These hazards are listed in Figure 2 below:

Sea Level Rise	Storm Events	Erosion	Flooding	Extreme Temperatures

Figure 2 – Climate Change Hazards

These hazards were mapped on a Municipal scale and assessed in terms of their level of threat against local assets. The images on the following page represent excerpts from the climate change mapping exercises carried out by the Project team.

Municipal Assets and Hazards Mapping

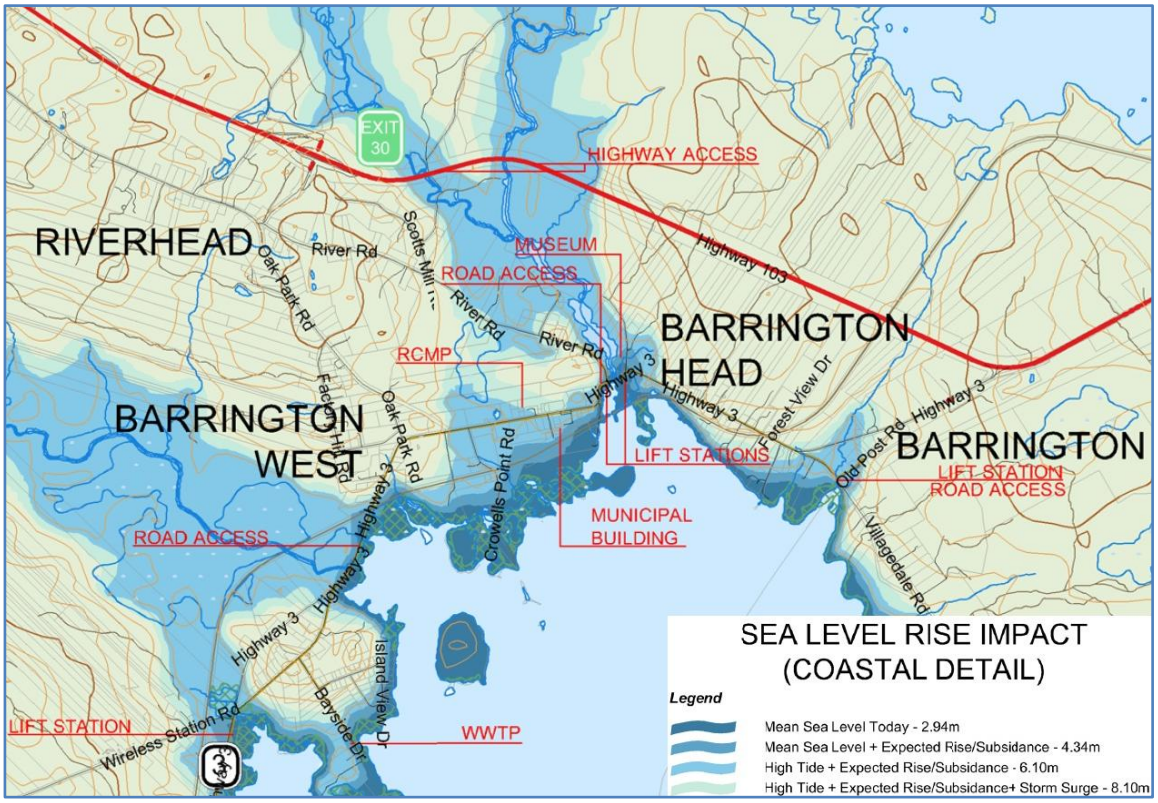


Figure 3:
Sea Level Rise Impact Map: (Appendix B)

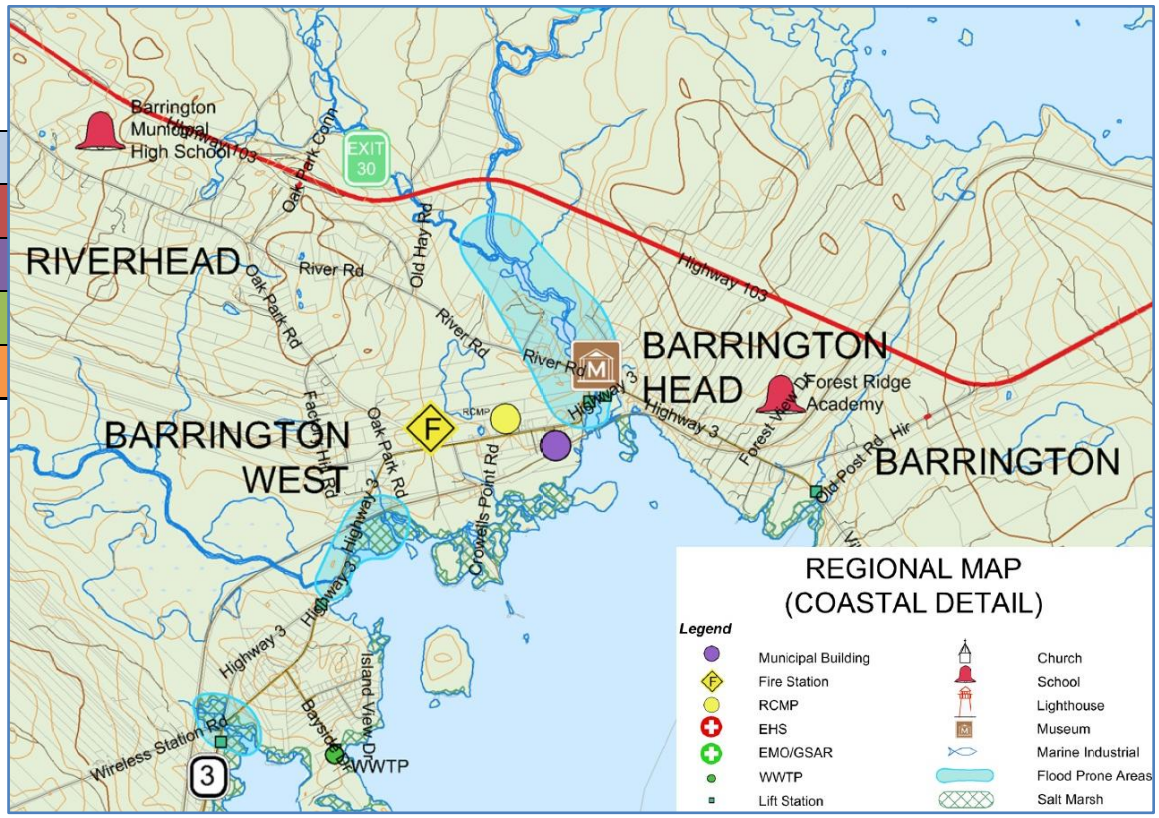


Figure 4:
Municipal Assets Identification Map: (Appendix A)

3. Climate Change Risks and Impacts Assessment

Following the mapping exercise, the Project Team identified and assessed actual and anticipated climate change impacts against Municipal Assets. Each impact was given a 'risk rating' of either 'High', 'Medium', or 'Low', intended to guide the development of prioritized actions. 'Risk', as prescribed in this *Plan*, refers to the vulnerability of each asset against climate change impacts. Given the sensitivity of each impact on particular assets, and predicting plausible adaptive capacity, vulnerability, or risk, was ranked as follows:

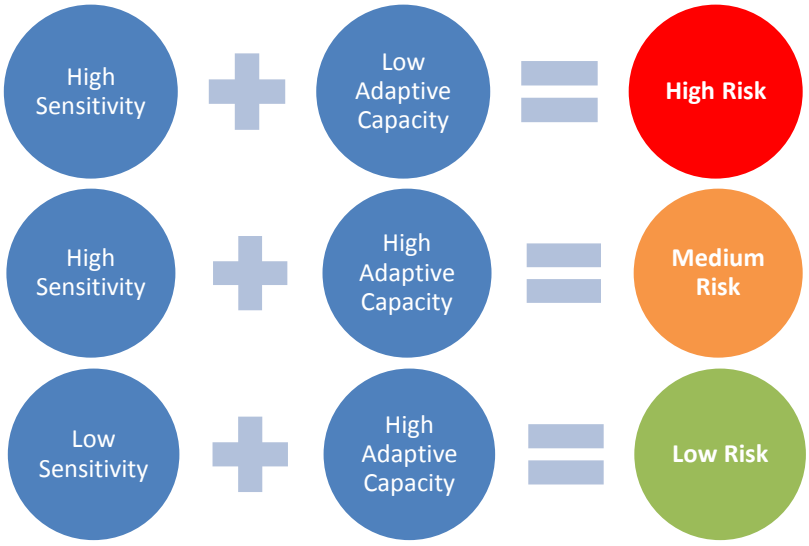


Figure 5: Risk Assessment Calculation[vii]

4. Adaptation Planning: Prioritizing Actions

Incorporating local knowledge with an understanding of existing and theorized best practices, the Project Team developed a set Climate Change Action Strategies for each Municipal Asset category. Table 1 provides examples of the actions outlined in this *Plan.*

Table 1 – PRIORITIZED ACTIONS, Built Asset Category (excerpt)

Action		Priority
B-1	Proactive pruning of trees to protect/reduce damage to property and electrical power lines due to severe storm events	Short Term
B-2	Promote permeable surfaces for parking areas and buildings to reduce runoff from heavy rainfall	Short Term

The intent was to create a set of actions that may influence actual policy and bylaw change. In addition, these actions have been ranked on either a 'Short Term, 'Medium Term', or 'Long Term' basis. The priority level is intended to determine the immediacy or latency of potential policy action.

3. Climate Change and Barrington

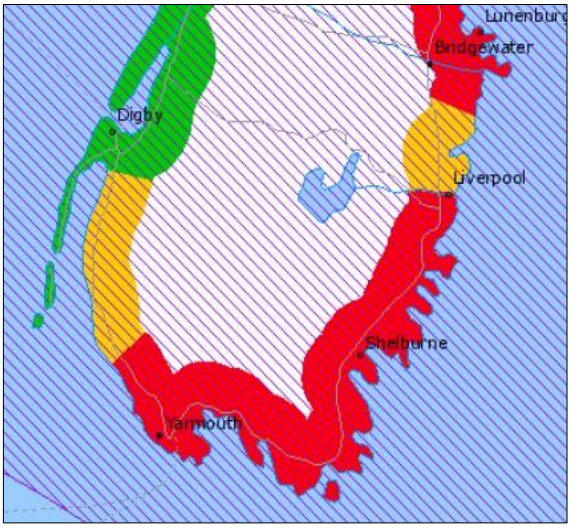
Actual and Anticipated Climate Change Issues

Sea Level Rise – According to recent reports, the present rates of sea level rise in Nova Scotia are higher than the global mean.[viii] It is anticipated that Nova Scotia will see a total sea level rise of 70 to 140 cm over the next century.

Figure 5 depicts the sensitivity of Nova Scotia's coastline to the anticipated sea level rises.[ix] As is shown in ***red***, the Municipality of Barrington is expected to experience high coastal sensitivity. Sensitivity here means the degree to which a coastline may experience physical changes as a result of sea level rise.

Anticipated sea level rise is determined by a number of factors: global temperatures, tides, subsidence, and storm surge. Therefore, in order to assess and map the potential impacts resulting from sea level rise, historical and projected data must be coupled to develop a sequence of sea level rise scenarios.

Figure 6 depicts possible sea level rise scenarios along Barrington's coastline. This high-level assessment layers four possible sea level rise scenarios over topographical data to show areas vulnerable to anticipated sea levels. The severity of sea level rise is denoted by the shades of blue over inland areas. (Refer to **Appendix B** for complete Sea Level Rise map)



Coastal Sensitivity to Sea-level Rise
Low (0 - 4.9)
Moderate (5.0 - 14.9)
High (15 and up)
Present-day Submerging of Coasts
Present day submerging areas

Figure 5 – Coastal Sensitivity to Sea Level Rise

(Note that elevation data for the Sea Level Rise Impact Map is derived from 1:10,000 Provincial topographical mapping and, therefore, several assumptions have been made to accommodate the generality of the elevation data. It is recommended that more detailed topographic mapping be carried out along Barrington's coastline to capture more accurate contour/elevation data.)

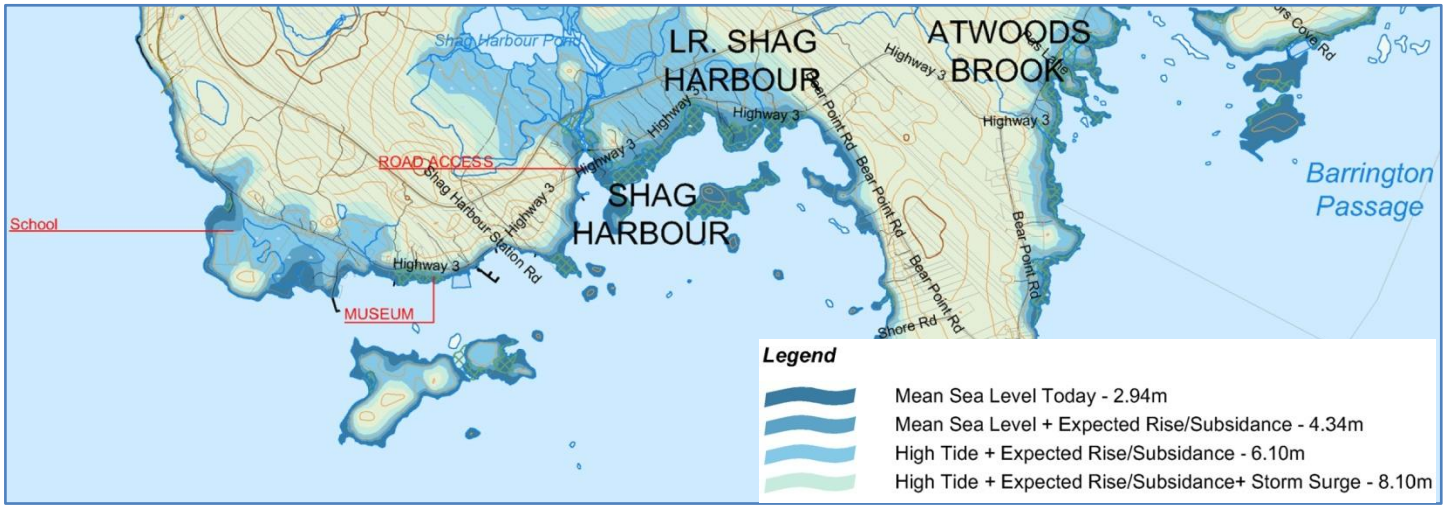
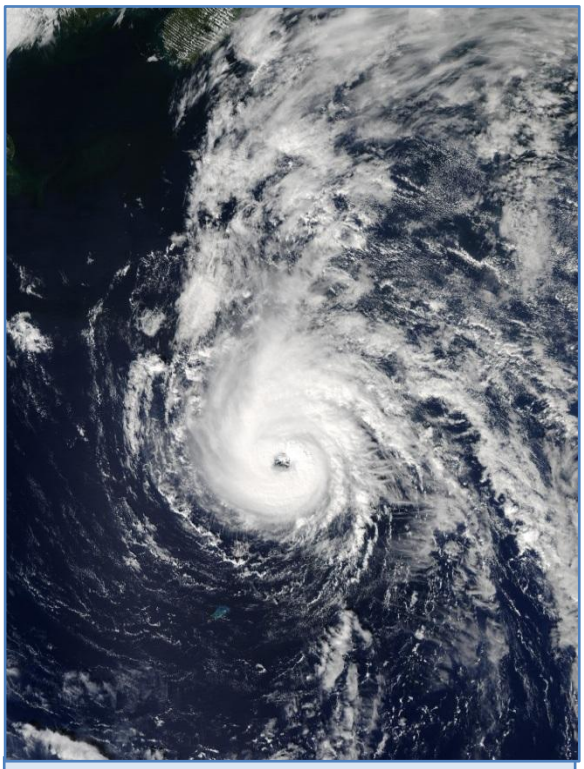


Figure 6 – Sea level Rise Impact Map (Appendix B - excerpt)



Hurricane Juan, 2003

This image, taken from a NASA satellite, shows Hurricane Juan approaching Nova Scotia from the South-Atlantic. The southern tip of Nova Scotia can be seen in the upper portion of this photo.

Source: http://visibleearth.nasa.gov/view.php?id=68664

The Winds of Change

Analysis of model simulations suggests that for each 1°C increase in tropical sea surface temperatures, hurricane surface wind speeds will increase by 1 to 8% and core rainfall rates by 6 to 18%.

Source: Weather and Climate Extremes in a Changing Climate, 2008.

As is more clearly shown in **Appendix B**, Barrington is particularly vulnerable to the effects of sea level rise in low-lying areas such as beaches, estuaries, and wetlands. Many of Barrington's historical, cultural and ecological assets are located in these areas as well, which may be damaged or lost as a result of rising sea levels.

Similarly, a number of Barrington's Municipal infrastructures, roads, and industries are located along the coast in areas possibly affected by sea level rise. According to the *Sea Level Rise Impacts Map*, 11 lift stations, 2 Waste Water Treatment Plants (WWTP), 3 museums, numerous roads and bridges, the Municipal Building, schools and the RCMP station are all impacted by potential sea level rise scenarios. Furthermore, all coastal marine related industrial activities are assumed to be impacted by sea level rise.

Given the number of islands and peninsulas located within the Municipality, there is also the danger of loss of land and isolation due to permanent or temporary sea level rise scenarios. As indicated on the *Sea Level Rise Impacts Map*, Cape Negro, Baccaro Point, Cape Sable Island, Barrington West and Forbes Point may all become flooded and separated due to sea level rise. Emergency response measures and evacuation scenarios should be revised to reflect these potential scenarios.

Sea level rise will also likely result in more severe coastal impacts when combined with other climate change threats, including storm surge, coastline erosion and flooding. Regardless of the severity of sea level rise over the next one hundred years, Barrington is likely to see impacts on a number of coastal assets.

Storm Events – Atlantic Canada is primarily affected by two main types of severe storm events: the tropical cyclone (hurricanes) and the extra-tropical cyclone (Nor'easters). As a result of increasing tropical sea surface temperatures, Atlantic Canada is likely to experience more storm events with larger peak wind speeds and heavier precipitation levels.[x]

Over the next century, data projections suggest that the Barrington region is expecting to see more hot days, more precipitation, and an increase in the intensity of precipitation events.[xi] Both coastal and inland areas are susceptible to the threat of storm events, and recent events such as Hurricane Juan (2003) and Tropical Storm Sandy (2012) demonstrate the immediate and long term impacts.

Whether expected or unexpected, high winds, high waves, heavy rains and heavy snows, may have detrimental impacts on short and long-term well-being of Barrington's populations and Municipal assets. Severe storms may have serious ecological, physical and economic impacts for many of Barrington's municipal assets such as, but not limited to, infrastructure, buildings, environmental resources and health care services.

Coupled with the reality of rising sea-levels and the frequency of coastal storm events, Barrington's coastal areas are becoming increasingly vulnerable to storm surge. And, as global temperatures continue to rise, the frequency of these events is also likely to increase.

Flooding – According to the CCAC, flooding is a common occurrence in Barrington, both in coastal areas as well as inland. The level of severity varies, although it was concluded that the frequency of flooding over roads and in coastal lowlands has increased over the past few decades. Flooding can cause road washouts, required emergency response evacuation, and damage to physical and ecological landscapes.

Reference to the Municipal Assets & Climate Change Identification Map in **Appendix A** demonstrates where flood prone areas have been witnessed in the past, and where they are likely to occur again in the future. Not including coastal areas susceptible to flooding as a result of sea level rise, the CCAC we able to identify nine areas prone to flooding, all of which have direct impacts on municipal roads or other assets. Figure 7 represents an excerpt of this Map showing the area along Highway 3 susceptible to flooding.

Erosion – Coastal erosion is often the result of severe storm surges whereby large waves, driven by high winds and low pressure systems, pile onshore. The negative biophysical effects include land instability, changes to natural landscapes and ecosystems, and salt water seepage into freshwater aquifers.[xii] Coastal erosion may also lead to individual or municipal property damage to buildings or infrastructure.

There are already several areas along Barrington's coastline that erosion and beach migration. The Municipality's coastal wetland

Storm Surge: the difference between the observed water level and the predicted astronomical tide

Storm Surge Return Period: the average time between occurrences of an event exceeding a giving level

Source: *The Municipal Climate Change Action Plan Assistant – Learning From Others*

http://www.farmzone.com/news/storm_watch_stories3&stormfile=maritimes_brace_for_more_sto_041011?ref=ccbox_news_topstories

Figure 7 – Flood Prone Areas (Appendix A)

areas are visibly experiencing damage and alteration due to swells and rising tides, and several beach areas are experiencing migration, such as: Clam Point, North East Point, the Hawk, Sandhills Beach, Crow Neck and Blanche Cove Island Bar. Coupled with the threat of anticipated climate change hazards, coastal erosion sensitivity is likely to increase.

Erosion is also a risk to non-coastal lands. Heavy precipitation events may lead to flooding, thus causing erosion to lands adjacent rivers, lakes and wetlands. There are six identified watersheds influencing Barrington, and erosion impacting one area of a watershed could cause serious damages to natural ecosystems and wildlife in an adjacent watershed system.

Changing Temperatures – Average annual temperatures are expected to rise. Rising temperatures can have severe impacts on both humans and ecological systems. Extreme heat can threaten the lives of the elderly and very young populations. Stroke, exhaustion or dehydration can become very real threats if services and infrastructures are not prepared to respond to emergency situations. Moreover, increased temperatures can facilitate the spread of mosquito and tick-borne diseases as invasive pest populations thrive in warmer climates.

Warmer temperatures also directly influence precipitation patterns causing more severe and unpredictable weather patterns. Analysis of model simulations suggests that for each 1°C increase in tropical sea surface temperatures, hurricane surface wind speeds will increase by 1 to 8% and core rainfall rates by 6 to 18%.[xiii] Droughts can threaten livestock and agricultural industries, while severe storms can threaten lives and damage ecosystems.

According to recent data projections, the Barrington region is expected to see annual average temperatures rise to 10.6°C by 2080, up approximately 2.5°C from today's average. By 2080 the Barrington region is also likely to experience increased precipitation levels (mm) especially in the winter and spring months when freeze-thaw cycles are most likely to impact roads and other infrastructures. The Table below presents predicted average temperatures (°C) and annual precipitation levels (mm) in the Municipality over the next 60 years:

Table 3: Climate Change and Temperature Scenario data for South-West Nova Scotia Region

Parameter	1980s	2020s		2050s		2080s	
	Value	**Value**	**SD**	**Value**	**SD**	**Value**	**SD**
Temperature - Annual	6.9	8.1	0.4	9.3	0.6	10.6	1.0
Winter	-2.1	-0.8	0.6	0.7	0.8	2.1	1.1
Spring	5.0	6.0	0.4	7.1	0.7	8.3	1.1
Summer	15.7	16.7	0.4	17.9	0.7	19.1	1.0
Autumn	9.3	10.4	0.4	11.5	0.6	12.8	0.9
Precipitation - Annual	1275.1	1310.1	31.3	1320.9	36.3	1360.1	47.4
Winter	370.5	388.5	14.7	397.8	19.0	419.5	24.3
Spring	310.9	321.2	13.2	325.8	17.6	338.6	23.2
Summer	255.9	260.2	15.2	259.4	20.1	259.7	33.3
Autumn	337.8	341.9	15.4	341.5	16.2	349.1	25.1

Source: Richards & Daigle, *Scenarios and Guidance for Adaptation to Climate Change and Sea-Level Rise – NS and PEI Municipalities*, 2011[xiv]
Yarmouth, Climate Station Yarmouth A (id: 8206500) @ 43.83N 66.09W, CHS site Yarmouth

4. Sector Review

Overview

In order to better understand the threat of climate change, we need to recognize the interconnectivity of Barrington's physical, economic, social and ecological assets. The effects of climate change on one Municipal Asset are likely to have effects on another. In understanding that climate change is a legitimate reality and concern for the entire Municipality, the Municipality may then begin thinking about proactive adaptation measures through which the effects of climate change can be better managed.

The following chapter has been broken down into the following five sections, each describing how climate change hazards are anticipated to impact the associated asset, and each section identifying potential climate change adaptation strategies:

***BUILT** (municipal infrastructure, roads, bridges, pump stations, buildings, power lines)*
***ECONOMIC** (fish plants, fisheries, mink farming, agriculture, private enterprise, tourism)*
***CULTURAL & SOCIAL** (churches, schools, community centres, waterfront, volunteerism)*
***NATURAL** (ecosystems and parks, wetlands, trails, beaches, air quality, wildlife)*
***SERVICE** (EMO, SAR, fire, police, health & medical care, telecommunications, evacuation)*

The Adaptation Actions in the following sections range from education programs to engineering solutions and from land use policy interventions to recommending new environmental studies. What is important to consider, though, is that no action should be considered in isolation: no action is a singular solution to a problem, and no asset functions in isolation from the rest of the Municipality. Rather, each action should function as a strategic tool intended to help make the entire community, as a whole, more resilient to climate change as its potential impacts.

Built

Like most coastal communities in Nova Scotia, a majority of Barrington's homes, offices, Municipal services and infrastructures are located in proximity to the ocean. Coastal communities are not only threatened by sea level rise (reference to Appendix B highlights the vulnerability of Barrington's road networks and Municipal Waste Water System to potential sea level rise), but by the potential increase in number and severity of storm events that can cause serious damage to persons and property.

In fact, in 2007 Environment Canada reported that a 25% increase in peak wind gust can generate a 650% increase in building damage claims.[xv] High winds, heavy rainfall and storm surge can threaten the integrity of the built landscape as well as the safety of those who live, work and play in these environments. Weathering of the built environment can also occur via biological (mold), chemical (corrosion), thermal (freeze-thaw) or mechanical agents (wind-driven rain); all of which may be directly linked to climate change events and shifts.

Furthermore, according to the ICSP the most important Built assets to the Municipality are the heritage buildings. These include museums, archives, lighthouses, and fishing communities. Several museums and coastal communities are directly impacted by sea level rise, and are likely to be affected by other climate change related events should proactive protective measures not be taken.

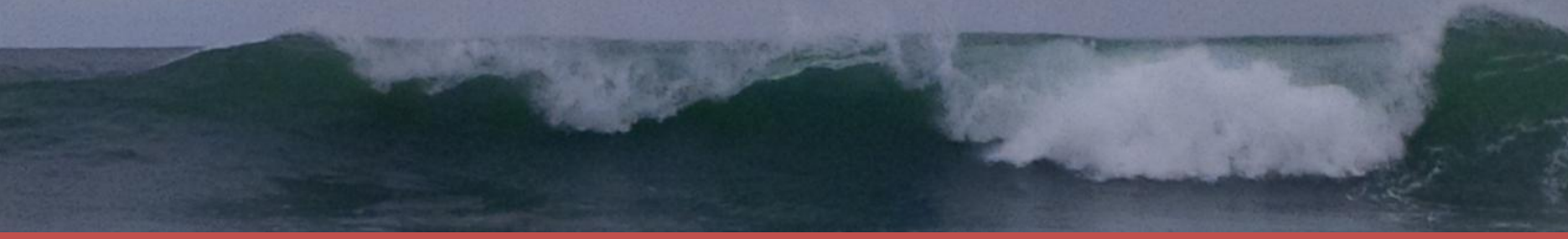
Despite the potential risks, built assets do provide significant opportunity for adaptation. Given that built assets are usually intended to have long operational lifetimes – Municipal infrastructures, for example – actions taken today may significantly reduce the likelihood of severe future damages.

IMPACTS ASSESSMENT

Hazard	Potential Impacts	Risk
Sea Level Rise	Loss of potable water due to saltwater intrusion into private wells	High
	Corrosion and damage to sewer pump stations due to saltwater intrusion	High
	Buildings in sea level rise impact areas may become damaged and unlivable	Medium
Erosion	Landslides may damage public infrastructure and private property	Medium
	Roads and bridges may washout limiting access to coastal communities	Medium
Flooding	Flooding may lead to wastewater system overflows and backups	High
Storm Events	Increased surface water flooding on roads and bridges due to pooling	Medium
	Physical damage to buildings, power lines and coastal structures	Medium
Extreme Temperatures	Extreme heat can cause water supply shortages & higher bacterial re-growth	Medium
	Extreme temperatures shifts can decrease road surface durability	Low

PRIORITIZED ACTIONS

Action		Priority
B-1	Proactive pruning of trees to protect/reduce damage to property and electrical power lines due to severe storm events	Short Term
B-2	Promote permeable surfaces for parking areas and buildings to reduce runoff from heavy rainfall	Short Term
B-3	Promote rain barrels for private dwellings	Short Term
B-4	Introduce coastal setbacks for buildings / wells	Medium Term
B-5	Increase the size of future storm sewers and culverts to handle greater volumes of runoff; regular monitoring of Wastewater facilities	Medium Term
B-6	Identify high priority Municipal and Heritage buildings and for structural upgrades – Eco-friendly retrofits	Medium Term
B-7	Future expansions of Municipal infrastructures should be built outside of the sea-level rise impact areas (Appendix B)	Long Term



Economic

The National Round Table on the Environment and the Economy (NRTEE) found that world-wide greenhouse gas emissions and subsequent climate change impacts could, in turn, have an economic impact on Canada of $5 billion annually by 2020 and between $21 and $43 billion annually by 2050. [xvi]

Although it is difficult to determine what these macro-economic implications will look like for individual municipalities, communities must begin to consider the big picture. Local economic activity is unequivocally linked all other Province and National economic sectors. Flooding and damage to roads may restrict the movement of goods and services to and from the Municipality; shifts in marine temperatures may threaten aquaculture habitats and fisheries, and therefore production; and marine dependent businesses may be threatened by the increased likelihood of storms and severe surge.

Business risks are community risks as each unit depends on local services and infrastructure to run efficiently. Impacts to businesses from climate change can be categorized into physical and operational impacts such as decreased availability or increased price of critical materials; regulatory and legal risks such as new land use zoning or building changes; financing risks such as access to capital for businesses at high risk to climate change; market changes; and reputational risks. [xvii]

The Municipality is encouraged to promote sustainable and adaptive business practices in the community. Barrington should be committed to raise awareness about the risks of climate change, and also the potential benefits. Eco-tourism and green-business ventures should be explored in order to attract tourism and eco-friendly markets.

IMPACTS ASSESSMENT

Hazard	Potential Impacts	Risk
Sea Level Rise	Higher tides can pull land/industry-based toxins into the ocean	High
	Shipbuilding, fisheries, and aquaculture facilities may be damaged / repairs	Medium
Erosion	Coastal businesses may be damaged by landslides and wash-outs	Medium
	Loss of buildable land and economic investment opportunities	Medium
Flooding	Goods entering/exiting communities may be restricted due to flooded roads	High
	Building in flood risk areas may require higher insurance fees / lower taxes	Medium
Storm Events	Increased resources required to respond and clean-up during and following severe storm events	Medium
	Sever rain may cause Mink farm runoffs to enter adjacent ecosystems	Medium
Extreme Temperatures	Increased sea temperatures threatens aquaculture habitats & resources	High
	Invasive species compete with indigenous species for resources	Medium

PRIORITIZED ACTIONS

Action		Priority
E-1	Investigate Municipal opportunities for sustainable energy projects	Short Term
E-2	Encourage private industries to consider climate change hazards and adaptation strategies	Medium Term
E-3	Develop eco-tourism marketing strategy	Medium Term

Cultural and Social

Climate change events can impact a community's social assets from a number of perspectives: physically, climate change can damage social gathering places, historic assets, and cultural resources; and, emotionally, climate change events can be draining on people's perceptions of the world around them.

Extreme cold and hot temperatures can inhibit one's ability to enjoy daily activities; severe storms can damage personal property; and, loss of recreational and physical environments can diminish a person's ability to enjoy their community and its assets.

Physically, the most effective climate change adaptation strategies are often engineering and construction solutions. Physical interventions offer immediate and long term protection and prevention. Renovations to existing structures, restorations to physical landscapes, and other conservation strategies present proactive adaptation opportunities.

Socially, there is opportunity to empower community groups to become leaders in climate change adaptation planning and environmental awareness. Barrington has identified the general public as its most important social asset: volunteers, professionals, young people, and community groups. These groups should be encouraged to lead the charge in implementing climate change adaptation actions.

Many of the actions identified throughout this plan are simple, personal strategies: improving landscaping, introducing residential rain barrels, and refurbishing historical assets. Community groups can also lead the charge in investigating marketing strategies for eco-tourism and businesses.

IMPACTS ASSESSMENT

Hazard	Potential Impacts	Risk
Sea Level Rise	Loss of historical and cultural sites such as Baccaro Point and Hawks Point	High
	Damage and loss to fish plants, wharfs, waterfront, beaches, and tourism	High
Erosion	Beach migration at significant sites such as North East Point and Sand Hills	High
	Potential damage to Municipal properties and cultural/community facilities	Medium
Flooding	Damage and / or loss of the CNR Trail system; other coastal trails	Medium
Storm Events	Increased volume and severity of storms could lead to school cancellations	Medium
	Increased maintenance costs and decrease in use of outdoor playing fields	Low
Extreme Temperatures	Warmer temperatures combined with storm events could cause power outages at important recreational facilities	Medium

PRIORITIZED ACTIONS

Action		Priority
C-1	Develop adaptation strategies for important Social Assets (identify repairs and protective measures)	Medium Term
C-2	Encourage the preservation, maintenance and enhancement of land having inherent natural, biological and recreational value.	Medium Term
C-3	Educate youth and volunteer committees on Adaptation Measures and Climate Change risks	Medium Term
C-4	Promote social activism within the Volunteer community and the promotion of grass-roots Adaptation Strategies	Short Term

Natural

Barrington hosts an abundance of natural resources and environmentally sensitive areas. Beaches, forests, coastal wetlands, and wildlife habitats make up a significant portion of the Municipality's natural landscape. These assets help maintain environmental diversity as well as the integrity of important economic and social resources.

There are also six provincially and nationally identified species at risk located in the Municipality: 3 birds (the Roseate Tern, Piping Plover and Harlequin Duck), 1 mammal (the Moose) and 2 plants (the Thread-Leaved Sundew and the Tubercled Spike-rush). Damage to and loss of natural habitats may threaten already vulnerable wildlife species and cause irreplaceable harm. As such, the Municipality should continue to support conservation efforts and programs aimed at protecting natural landscape and biodiversity.

According to the ICSP, beaches and the natural coastline are the Municipality's most important natural assets. A variety of protective and adaptive measures are identified in the ICSP, several of which are currently being explored.

The Municipality should continue its efforts to identify and regulate environmentally sensitive areas. The use of protective zoning bylaws on coastal wetlands, for example, highlights a good example of adaptive planning practice. Efforts should also be focused on promoting active and healthy living in the community. Protecting beaches and trails encourage residents to experience the natural environment and encourage growth within tourism sectors.

IMPACTS ASSESSMENT

Hazard	Potential Impacts	Risk
Sea Level Rise	Coastal flooding and loss of natural ecosystems; forced animal migration	High
	Loss of beaches, wetlands, wildlife, protected species, and tourism	High
	Saltwater intrusion into fresh water systems	High
Erosion	Shoreline erosion may affect and damage natural habitats and ecosystems	Medium
	Coastal beaches, parks, trails and other amenities may become dangerous	Medium
Flooding	Loss of wetlands and low-lying areas; destruction of habitats	High
Storm Events	Physical damage to forests, coastlines, parks, trails	Medium
Extreme Temperatures	Shift in temperature patterns may lead to invasive species and pests	Medium
	Threat of forest fires may increase with longer, drier and hotter heat waves	Medium
	Loss of plants and animal species	Medium

PRIORITIZED ACTIONS

Action		Priority
N-1	Discourage development in and adjacent to low-lying, environmentally sensitive areas	Short Term
N-2	Promote private and municipal landscaping using drought-resistant plants	Short Term
N-3	Improve flood-prone riverbanks by planting vegetation to manage erosion runoff into rivers	Medium Term
N-4	Investigate coastal, wetland, and watercourse restoration projects for sensitive areas	Medium Term
N-5	Promote active transportation and outdoor recreation activities; educate residents on the importance and significant environmental features	Medium Term

With respect to Municipal services, climate change adaptation must focus on preparedness. Should a disastrous event occur, the Municipality and its residents should be well-informed of procedures and protocols designed to keep people safe and responsive to impending threats.

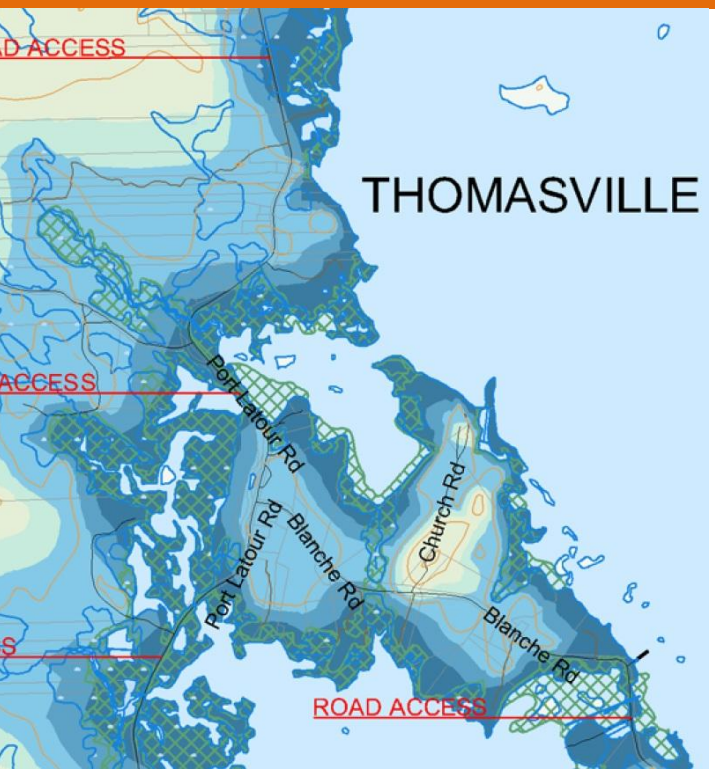
It is the Municipality's responsibility to be proactive to climate change events, and to anticipate threats to both human life and the physical environment. The risks associated with climate change must be anticipated on all levels, including, but not limited to the following events:

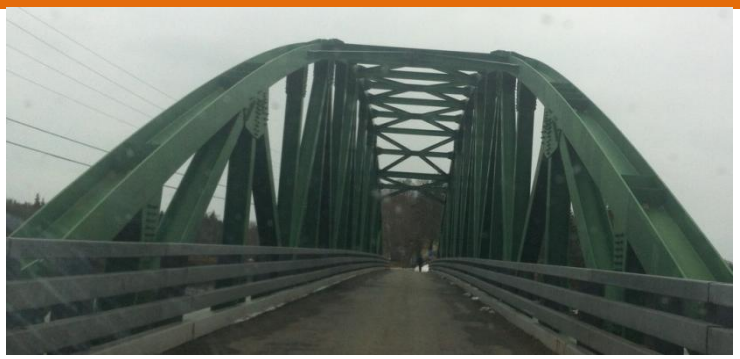
- Animal Diseases
- Extreme Precipitation Events
- Localized and Flash Flooding
- Heat Waves & Freezing Temperatures
- Human Diseases and Pandemics
- Landslides
- Forest Fires
- Telecommunication Failure

The Municipality of Barrington currently hosts an RCMP detachment, five fire stations, an Emergency Measures Operation (EMO) / Ground Search and Rescue (GSAR) station, and an Emergency Health Services (EMS) station. The PAC has supported that emergency response measures are coordinated through the various service providers, who are prepared to respond to hazards, risks and vulnerabilities associated with climate change.

IMPACTS ASSESSMENT

Hazard	Potential Impacts	Risk
Sea Level Rise	EMO evacuation routes may be temporarily or permanently cut-off	High
	Loss of beaches and trails have a detriment to personal health and activity	Low
Erosion	Damaged roads and access points may disrupt service response time	Medium
Flooding	Flooded roads may disrupt service response time	Medium
	Access to mobility opportunities, such as Sou-West Transit, may be limited	Low
Storm Events	Increased public safety risks on streets due to damage to trees, power lines and other infrastructures	High
	Emergency management capacity may need to cater to more frequent and extreme weather related events	Medium
	Increased volume of third-party liability claims against the Municipality for negligent wrongdoing, and damage costs to Municipal property and services	Low
Extreme Temperatures	Extreme heat can cause respiratory illnesses to vulnerable populations	Medium
	Increase in ozone-related health impacts such as skin burns and infections	Medium
	Increased likelihood of insect and water-borne diseases	Medium





PRIORITIZED ACTIONS

Action		Priority
S-1	Work with Emergency Response and Health Care services to educate residents on safety and evacuation measures specific to climate change events (ex. What to do if flooding blocks road access' and evacuation routes)	Short Term
S-2	Educate community members and work with community health care agencies to prevent illness and death during periods of extreme heat or cold	Medium Term
S-3	Encourage tree planting in more urban areas (i.e. around parking lots and shopping centres) to increase canopy coverage, provide shade and to reduce heat island effects	Medium Term
S-4	Provide summer heat escape areas (cooling zones) for residents and tourists in time of extreme heat	Long Term

5. Implementation

Action vs. Inaction

In total, 23 actions have been identified in this Plan. Whether implemented in the short, medium or long-term future - or not at all - the Municipality, like the rest of the world, must consider whether or not to commit itself to action:

BUILT ACTIONS

Action		Priority
B-1	Proactive pruning of trees to protect/reduce damage to property and electrical power lines due to severe storm events	Short Term
B-2	Promote permeable surfaces for parking areas and buildings to reduce runoff from heavy rainfall	Short Term
B-3	Promote rain barrels for private dwellings	Short Term
B-4	Introduce coastal setbacks for buildings / wells	Medium Term
B-5	Increase the size of future storm sewers and culverts to handle greater volumes of runoff; regular monitoring of Wastewater facilities	Medium Term
B-6	Identify high priority Municipal and Heritage buildings and for structural upgrades – Eco-friendly retrofits	Medium Term
B-7	Future expansions of Municipal infrastructures should be built outside of the sea-level rise impact areas (Appendix B)	Long Term

ECONOMIC ACTIONS

Action		Priority
E-1	Investigate Municipal opportunities for sustainable energy projects	Short Term
E-2	Encourage private industries to consider climate change hazards and adaptation strategies	Medium Term
E-3	Develop eco-tourism marketing strategy	Medium Term

CULTURAL ACTIONS

Action		Priority
C-1	Develop adaptation strategies for important Social Assets (identify repairs and protective measures)	Medium Term
C-2	Encourage the preservation, maintenance and enhancement of land having inherent natural, biological and recreational value.	Medium Term
C-3	Educate youth and volunteer committees on Adaptation Measures and Climate Change risks	Medium Term
C-4	Promote social activism within the Volunteer community and the promotion of grass-roots Adaptation Strategies	Short Term

NATURAL ACTIONS

Action		Priority
N-1	Discourage development in and adjacent to low-lying, environmentally sensitive areas	Short Term
N-2	Promote private and municipal landscaping using drought-resistant plants	Short Term
N-3	Improve flood-prone riverbanks by planting vegetation to manage erosion runoff into rivers	Medium Term
N-4	Investigate coastal, wetland, and watercourse restoration projects for sensitive areas	Medium Term
N-5	Promote active transportation and outdoor recreation activities; educate residents on the importance and significant environmental features	Medium Term

SOCIAL ACTIONS

Action		Priority
S-1	Work with Emergency Response and Health Care services to educate residents on safety and evacuation measures specific to climate change events (ex. What to do if flooding blocks road access' and evacuation routes)	Short Term
S-2	Educate community members and work with community health care agencies to prevent illness and death during periods of extreme heat or cold	Medium Term
S-3	Encourage tree planting in more urban areas (i.e. around parking lots and shopping centres) to increase canopy coverage, provide shade and to reduce heat island effects	Medium Term
S-4	Provide summer heat escape areas (cooling zones) for residents and tourists in time of extreme heat	Long Term

6. Conclusion

Climate change adaptation planning is a risk assessment: do the benefits of action today outweigh the potential risks of the future? Table 4 simplifies this assessment by presenting four possible scenarios resulting from either action or inaction:

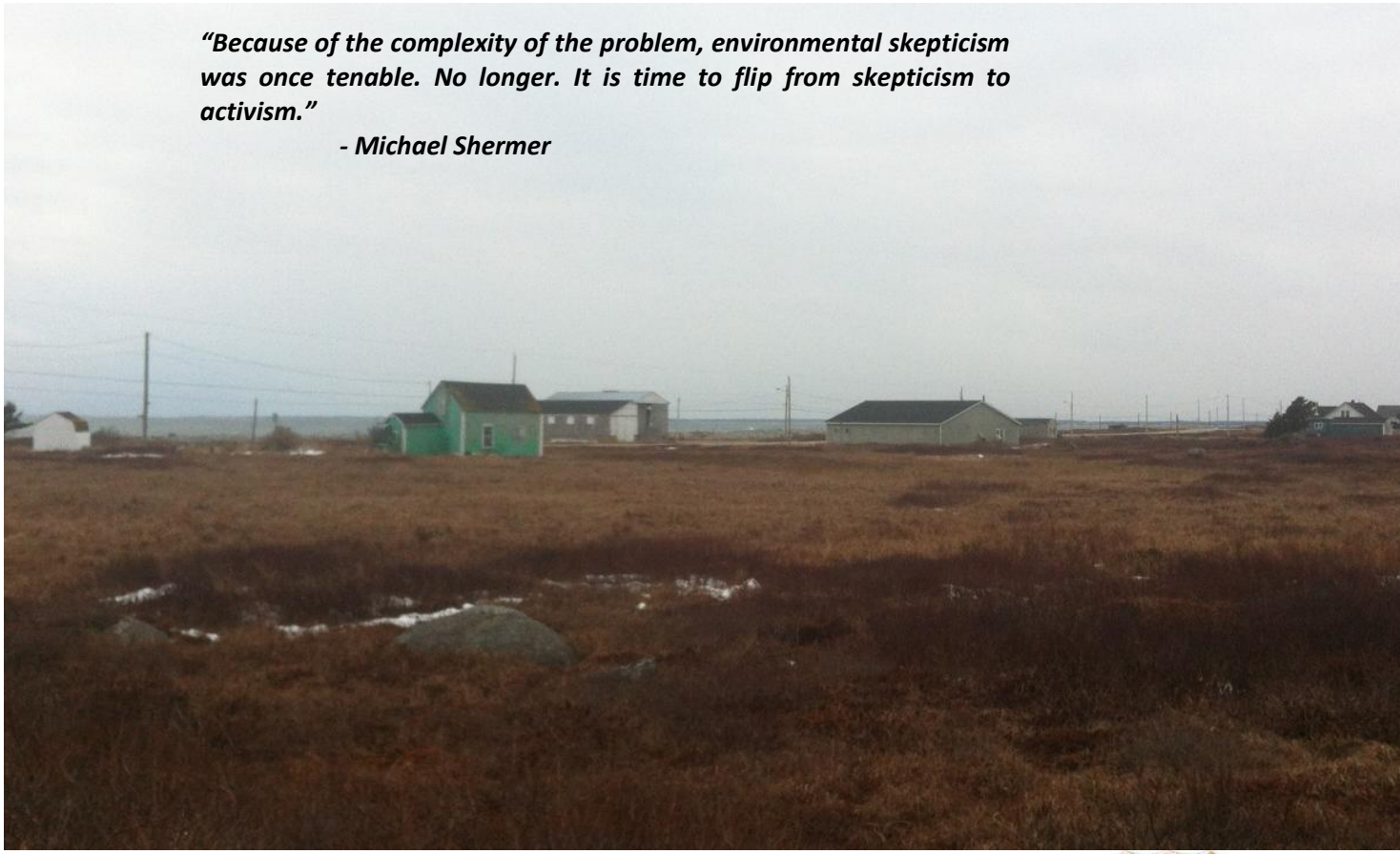
Table 4: Climate Change Risk Assessment

Climate Change	*Action*	*Inaction*
Vulnerable	*Protection and Adaptation*	*Crisis and Disaster*
Not Vulnerable	*Environmental Awareness*	*Neutral*

If climate change is real, and if in fact the Municipality is truly vulnerable, action today could result in nothing less than preparedness and protection. However, if the Municipality chooses to do nothing, the end result could be crisis and disaster.

On the other hand, climate change may not be real nor the Municipality vulnerable. If so, action today would result in environmental awareness and encourage eco-friendly initiatives, whereas inaction would produce a status quo result.

The Municipality of the District of Barrington is left with the decision: action or inaction?



"Because of the complexity of the problem, environmental skepticism was once tenable. No longer. It is time to flip from skepticism to activism."

- Michael Shermer

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APPENDIX A

MUNICIPAL ASSETS &
CLIMATE CHANGE INDENTIFICATION MAP

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APPENDIX B

SEA LEVEL RISE IMPACT MAP

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APPENDIX C

SERVICE NOVA SCOTIA & MUNICIPAL RELATIONS

RISK ASSESSMENT TABLE

Climate Change Adaptation Plan

Municipal Asset	Sea Level Rise		Precipitation (extreme event)				Extreme Wind		Flooding		Temperature				Erosion		Earthquake		Total	Risk
			Snow		Rain						High		Low							
Water System																				
Water Source (Wells, Surface Water, Other)	H	3	M	2	M	2	L	1	M	2	L	1	L	1	M	2	N	0	**14**	**M**
Water Treatment Plant	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	**0**	**L**
Water Storage Facilities	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	**0**	**L**
Water Pumping Facilities	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	**0**	**L**
Water Distribution System	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	**0**	**L**
Individual Water Service Lines	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	**0**	**L**
Total	**3**		**2**		**2**		**1**		**2**		**1**		**1**		**2**		**0**		**14**	
Sanitary Sewer System																				
Wastewater Treatment Plant	H	3	M	2	M	2	L	1	M	2	L	1	L	1	M	2	N	0	**14**	**M**
Buildings	H	3	M	2	M	2	L	1	M	2	L	1	L	1	M	2	N	0	**14**	**M**
Wastewater Gravity Sewer	H	3	M	2	M	2	N	0	M	2	L	1	L	1	M	2	N	0	**13**	**M**
Wastewater Pressure Sewer (Forcemain)	H	3	M	2	M	2	N	0	M	2	L	1	L	1	M	2	N	0	**13**	**M**
Pumping Stations	H	3	M	2	M	2	L	1	M	2	L	1	L	1	M	2	N	0	**14**	**M**
Total	**15**		**10**		**10**		**3**		**10**		**5**		**5**		**10**		**0**		**68**	
Storm Sewer System																				
Catchbasins	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	**0**	**L**
Manholes	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	**0**	**L**
Pipes	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	**0**	**L**
Total	**0**		**0**		**0**		**0**		**0**		**0**		**0**		**0**		**0**		**0**	
Municipal Buildings																				
Buildings	M	2	M	2	M	2	M	2	M	2	M	2	M	2	M	2	N	0	**16**	**M**
Total	**2**		**2**		**2**		**2**		**2**		**2**		**2**		**2**		**0**		**16**	

Municipal Asset	Sea Level Rise		Precipitation (extreme event)				Extreme Wind		Flooding		Temperature				Erosion		Earthquake		Total	Risk
			Snow		Rain						High		Low							
Landfills/Solid Waste Facilities																				
Flooding	L	1	L	1	L	1	L	1	L	1	L	1	L	1	L	1	N	0	**8**	**L**
Access Road	L	1	L	1	L	1	L	1	L	1	L	1	L	1	L	1	N	0	**8**	**L**
Leachate Collection	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	**0**	**L**
Leachate Treatment	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	**0**	**L**
Buildings	L	1	L	1	L	1	L	1	L	1	L	1	L	1	L	1	N	0	**8**	**L**
Total	**3**		**3**		**3**		**3**		**3**		**3**		**3**		**3**		**0**		**24**	
Dams																				
Flooding	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	**0**	**L**
Control Gates	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	**0**	**L**
Access Road	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	**0**	**L**
Fish Passage	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	N	0	**0**	**L**
Total	**0**		**0**		**0**		**0**		**0**		**0**		**0**		**0**		**0**		**0**	
Roads																				
Bridges	M	2	L	1	L	1	L	1	L	1	M	2	M	2	M	2	N	0	**12**	**M**
Traffic Signals	M	2	L	1	L	1	L	1	L	1	L	1	L	1	L	1	N	0	**9**	**L**
Street Lighting	M	2	L	1	L	1	L	1	L	1	L	1	L	1	L	1	N	0	**9**	**L**
Signs	M	2	L	1	L	1	L	1	L	1	L	1	L	1	L	1	N	0	**9**	**L**
Culverts	L	1	L	1	L	1	N	0	L	1	L	1	L	1	L	1	N	0	**7**	**L**
Sidewalks	L	1	L	1	L	1	N	0	L	1	L	1	L	1	M	2	N	0	**8**	**L**
Local Roads	M	2	L	1	L	1	N	0	M	2	L	1	M	2	M	2	N	0	**11**	**M**
Collectors	M	2	L	1	L	1	N	0	M	2	L	1	M	2	M	2	N	0	**11**	**M**
Total	**14**		**8**		**8**		**4**		**10**		**9**		**11**		**12**		**0**		**76**	

*Please note all of the drop boxes must be filled in for each of the asset classes

Risk Assessment Adaptation Measures - Water System

Water System	Water Source (Wells, Surface Water, Other)	Water Treatment Plant	Water Storage Facilities	Water Pumping Facilities	Water Distribution System	Individual Water Service Lines
Sea Level Rise	**X**					
Extreme Snow						
Extreme Rain						
Extreme Wind						
Flooding						
High Temp						
Low Temp						
Erosion						
Earthquake						
Impacts	Saltwater intrusion into private wells					
	Loss of potable drinking water					
Possible Adaptation Measures	Future wells should be built outside of the sea-level rise impact areas					
	Introduce coastal setbacks for private water systems					
	Promote rain barrels for private dwellings					

Risk Assessment Adaptation Measures - Sanitary Sewer System

Sanitary Sewer System	Wastewater Treatment Plant	Buildings	Wastewater Gravity Sewer	Wastewater Pressure Sewer (Forcemain)	Pumping Stations
Sea Level Rise	X	X	X	X	X
Extreme Snow					
Extreme Rain					
Extreme Wind					
Flooding					
High Temp					
Low Temp					
Erosion					
Earthquake					
Impacts	Destruction and/or damage to system	Destruction and/or damage to system	Destruction and/or damage to system	Destruction and/or damage to system	Destruction and/or damage to system
Possible Adaptation Measures	Locate expansions outside of impact areas	Locate expansions outside of impact areas	Locate expansions outside of impact areas	Locate expansions outside of impact areas	Locate future expansions outside of impact areas
			Introduce quarterly I/I flow monitoring studies	Introduce quarterly I/I flow monitoring studies	Introduce quarterly I/I flow monitoring studies

Risk Assessment Adaptation Measures - Storm Sewer System

Storm Sewer System	Catchbasins	Manholes	Pipes
Sea Level Rise			
Extreme Snow			
Extreme Rain			
Extreme Wind			
Flooding			
High Temp			
Low Temp			
Erosion			
Earthquake			
Impacts			
Possible Adaptation Measures			

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Risk Assessment Adaptation Measures - Municipal Buildings

Municipal Buildings	Buildings
Sea Level Rise	
Extreme Snow	
Extreme Rain	
Extreme Wind	
Flooding	
High Temp	
Low Temp	
Erosion	
Earthquake	
Impacts	
Possible Adaptation Measures	

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Risk Assessment Adaptation Measures - Landfills

Landfills/Solid Waste Facilities	Flooding	Access Road	Leachate Collection	Leachate Treatment	Buildings
Sea Level Rise					
Extreme Snow					
Extreme Rain					
Extreme Wind					
Flooding					
High Temp					
Low Temp					
Erosion					
Earthquake					
Impacts					
Possible Adaptation Measures					

Risk Assessment Adaptation Measures - Dams

Dams	Flooding	Control Gates	Access Road	Fish Passage
Sea Level Rise				
Extreme Snow				
Extreme Rain				
Extreme Wind				
Flooding				
High Temp				
Low Temp				
Erosion				
Earthquake				
Impacts				
Possible Adaptation Measures				

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Risk Assessment Adaptation Measures - Roads

Roads	Bridges	Traffic Signals	Street Lighting	Signs	Culverts	Sidewalks
Sea Level Rise						
Extreme Snow						
Extreme Rain						
Extreme Wind						
Flooding						
High Temp						
Low Temp						
Erosion						
Earthquake						
Impacts						
Possible Adaptation Measures						

Local Roads	Collectors

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