

# TOWN OF YARMOUTH

## CLIMATE CHANGE ACTION PLAN



Dated: August, 2013

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# Town of Yarmouth – Climate Change Action Plan

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**Report:** This report was undertaken by the Town of Yarmouth in partial fulfillment of the Town's requirement pursuant to a Municipal Funding Agreement (MFA) signed on August 19<sup>th</sup>, 2010.

**Project Management:** This report was undertaken by the Climate Change Action Plan Committee for approval by Council of the Town of Yarmouth. Inquiries may be submitted to the Town of Yarmouth c/o The Planning and Development Department, 400 Main Street, Yarmouth, N.S., B5A 1G2.

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**Acknowledgements:** The Town of Yarmouth would like to thank Dalhousie University School of Planning ACAS project team, in particular Patricia Manuel and Eric Rapaport and the Nova Scotia Department of Environment, in particular, Mr. Will Green and Dr. Dan Walmsley. We would also like to thank Dr. Tim Webster from the Applied Geomatics Research Group for his guidance and support throughout the course of this project.

The Town of Yarmouth would also like to thank the members of the Climate Change Action Plan Committee for their guidance and support in the creation of this report.

# CLIMATE CHANGE ACTION PLAN

## **Introduction:**

On November 6<sup>th</sup>, 2009 the Union of Nova Scotia Municipalities and the Province of Nova Scotia signed a Memorandum of Understanding on Climate Change. This memorandum shares a common understanding that climate change is unequivocal and that actions to reduce greenhouse gas emissions and building adaptive capacity in Nova Scotia are essential to addressing climate change challenges and opportunities. The parties acknowledge that each has an important role to play and that municipalities can take direct actions through policy development, land use planning initiatives, emission reductions and the development and implementation of Integrated Community Sustainability Plans and Climate Change Action Plans.

On August 19<sup>th</sup>, 2010 the Town of Yarmouth and the Province of Nova Scotia signed a Municipal Funding Agreement (MFA) requiring the submission of a Climate Change Action Plan. Schedule 9 of the MFA states that the Climate Change Action Plan (CCAP) shall be submitted no later than December 31<sup>st</sup>, 2013 which will include the following:

- a) A description of actions, measures, practices and initiatives undertaken by the municipality in order to reduce community and corporate green house gas emissions.
- b) A description of actions, measures, practices and initiatives undertaken by the municipality in order to adapt and respond to impacts resulting from climate change.
- c) A resolution of municipal council amending an ICSP and a record of public participation.

To help facilitate the development of these adaptation plans, the province has developed a submission template of mandatory content in which this plan has followed.

## Climate Change Action Plan Committee:

The Town of Yarmouth has established a committee to develop its Climate Change Action Plan. Though this plan is a separate and distinct plan from the Town's Integrated Community Sustainability Plan (ICSP), which is part of the Town's Municipal Planning Strategy (MPS), this plan supports the insertion of an appendix amending the Town's Municipal Planning Strategy and Land Use By-law as part of this overall process.

The following table outlines the committee members and the Terms of Reference for the committee are outlined on the following page.

### Climate Change Action Plan Committee Members

<b>Name</b>	<b>Affiliation</b>	<b>E-mail</b>	<b>Phone number</b>
Arthur MacDonald	Town Planner	<a href="mailto:planning@townofyarmouth.ca">planning@townofyarmouth.ca</a>	742-1505
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Tracy Bruce	GIS Tech.	<a href="mailto:gis@townofyarmouth.ca">gis@townofyarmouth.ca</a>	742-1505
Jeff Gushue	CAO	<a href="mailto:cao@townofyarmouth.ca">cao@townofyarmouth.ca</a>	742-8565
Jim Corning	Waterfront Development	<a href="mailto:waterfront@townofyarmouth.ca">waterfront@townofyarmouth.ca</a>	740-1380
Dan Earle	TREPA	<a href="mailto:danearle@eastlink.ca">danearle@eastlink.ca</a>	742-6382
John Sollows	TREPA	<a href="mailto:nhungjohn@eastlink.ca">nhungjohn@eastlink.ca</a>	742-2802 307-0934
Harold Richardson	EMO	<a href="mailto:hrich@ns.sympatico.ca">hrich@ns.sympatico.ca</a>	742-8558 749-6261
John Ryan	PAC Member	<a href="mailto:john@ryan-ins.com">john@ryan-ins.com</a>	748-5056
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**Facilitators:**

<b>Name</b>	<b>Affiliation</b>	<b>E-mail</b>	<b>Phone number</b>
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Patricia Manuel	Dalhousie University	<a href="mailto:patricia.manuel@dal.ca">patricia.manuel@dal.ca</a>	(902) 494-6597
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**TOWN OF YARMOUTH**  
**TERMS OF REFERENCE**  
**CLIMATE CHANGE ACTION PLAN COMMITTEE**

**Purpose:**

The purpose of this Committee is to act as a temporary advisory committee to the Council of the Town of Yarmouth in regards to the development of the Town's Climate Change Action Plan.

**Composition:**

The composition of the Committee is made up of Town staff complete with one (1) councillor, one (1) member of the Planning Advisory Committee at large and one (1) member of the Tusket River Environmental Protection Agency (TREPA).

**Quorum:**

A quorum of the Climate Change Action Plan Committee shall not be required. The intent of the Committee is to develop the plan for Council's consideration. The Committee will meet and review the process of the plan and upon completion, submit the Plan to Council. Upon the acceptance of the Plan by Council the committee will dissolve.

**Duties and Responsibilities:**

To discuss and develop the Town's Climate Change Action Plan. The Committee will be accountable to Council for the delivery of the Climate Change Action Plan by December 31, 2013.

## **Understanding and Identifying Climate Change Issues and Hazards:**

The Town of Yarmouth has partnered with Atlantic Climate Adaptation Solutions Association (ACASA) and Dalhousie University to undertake an analysis of climate change impacts regarding sea-level rise and storm surges along Yarmouth's harbour. Dalhousie University provided the following reports:

### **Part 1**

#### **Introduction and Background**

Patricia Manuel, Eric Rapaport, Michaela Cochran, Jonathan Critchley, J. Alec Johnston, Justin Muise, & Zoë Wollenberg

### **Part 2**

#### **Section 1: Future Sea Level Rise and Extreme Water Level Scenarios for Yarmouth, Nova Scotia**

Jonathan Critchley, Justin Muise, Eric Rapaport & Patricia Manuel

#### **Section 2: Physical Infrastructure at Risk of Flooding due to Sea Level Rise and Extreme Water Levels in Yarmouth, Nova Scotia**

Justin Muise, Jonathan Critchley, Eric Rapaport & Patricia Manuel

#### **Section 3: Social Asset Identification and Climate Change Impact Risk Mapping in Yarmouth, Nova Scotia**

Michaela Cochran, Zoë Wollenberg, Patricia Manuel & Eric Rapaport

#### **Section 4: Incorporating Social Value into Climate Change Adaptation Planning in Yarmouth, Nova Scotia**

Zoë Wollenberg, Eric Rapaport & Patricia Manuel

#### **Section 5: Social Vulnerability to Climate Change in Yarmouth, Nova Scotia**

Michaela Cochran, Patricia Manuel & Eric Rapaport

#### **Section 6: Exploring Capacity for Adaptation in the Town of Yarmouth, Nova Scotia**

J. Alec Johnston, Patricia Manuel & Eric Rapaport

The Town of Yarmouth has also partnered with Dalhousie University in a “Mentor” project to help the Climate Change Action Plan Committee develop their plan based on the “Municipal Climate Change Action Plan” template developed by the Department Service Nova Scotia and Municipal Relations (SNSMR). This project produced the following report:

**Municipal Climate Change Adaptation Plan (MCCAP) Guide  
Book Mentor Project, Town of Yarmouth, Final Report**  
Patricia Manuel, Arthur MacDonald & Eric Rapaport

As part of the Town’s participation in the ACAS program, the Town produced a power point presentation that was presented during the ACASA Conference in Halifax on March 6, 2012. A similar presentation was also made at the Nova Scotia Municipal Public Work Director’s Conference in Yarmouth on June 8<sup>th</sup>, 2012. In addition, a “Case Study” outlining the Town’s participation in the ACAS program was submitted to ACAS:

**Nova Scotia Atlantic Climate Adaptation Solutions Project,  
Municipality Climate Adaptation Case Study Report, Town of  
Yarmouth**  
Arthur MacDonald

LiDAR mapping, provided to the Town through the ACAS program, helped facilitate the development of this Climate Change Action Plan. This information provided land contour elevations that enabled Dr. Tim Webster, from the Applied Geomatics Research Group, to develop Lidar Digital Elevation Model’s (DEM’s) based on climate change storm surge and sea-level rise impact scenarios for the Town of Yarmouth. He submitted the following report to ACAS:

**Lidar processing and Flood Risk Mapping for Coastal Areas in  
the District of Lunenburg, Town and District of Yarmouth,  
Chignecto Isthmus and Minas Basin**  
Dr. Tim Webster, Kevin McGuigan and Candace MacDonald,  
Applied Geomatics Research Group.

The Town has experienced coastal flooding and in-land flooding due to severe weather events. One only has to refer to the 1976 Ground Hog Day Storm which has been used as the bench mark storm for the ACAS research team. Water Street floods a few times a year due to high tides, storm surge events and intense rainfall events, but soon diminishes thereafter. It is also not uncommon for basements along Water Street to flood during these events. Actions to relieve these events have been reactionary rather than proactive mediation. A review of the Town’s Emergency Measures Plan will provide insights as to whether the Town is prepared and has adequate resources to manage the next event. Fortunately these

events do not drastically impact the Town and as high tide is replaced by low tide, the majority of the lands return to their previous state with minimal permanent damage.

Climate change impacts from warmer climate conditions, rainfall intensities, wind intensities, sea-level rise and storm surge events, will all have an impact. Though our growing season is expected to increase, drought will also become a regional concern not only for agricultural purposes but also with regards to the Public Water Utility’s ability to sustain an adequate quality and quantity of potable water to service its customers. Power outages are anticipated to increase due to wind and ice storm affects, hampering the Town’s ability to rebound from these events. The economy will also suffer as many of our industries along the waterfront are susceptible to the impacts of climate change. Not only will support infrastructure along the waterfront be affected, the fishing industry will also be affected due to warmer waters and acidity levels impacting the catch volumes as well as the quality of the catch. Public health and safety issues are also recognized as concerns. A matrix analyzing the severity, frequency and area impacts of the climate change hazards is outlined below:

Hazard:	Severity:			Frequency:			Area:		
	Severe	Moderate	Low	Often	Sometime	Rarely	Large	Medium	Small
Sea Level Rise	x			x			x		
Land Erosion		x			x			x	
Flooding	x			x			x		
Landslides			x			x			x
Storm Surge	x			x			x		
Hurricanes & Wind	x				x		x		
Forest Fires			x			x			x
Drought		x			x		x		
Insect/Disease		x			x			x	

**Climate Change Hazard Impact Matrix**

Climate change will have limited opportunities. The region as a whole may benefit through a longer growing season as temperatures rise, and the power generated from wind power may increase, however both of these will have their limitations as drought is also anticipated to increase and having too much wind may negatively affect wind turbine productivity levels. The region may experience opportunities in the fisheries and agricultural sectors; however the transformation to these new environmental conditions may cause severe growing pains as industries adapt to climate change. Tourism opportunities may increase as fall and spring tourism seasons are extended due to warming temperatures, however these benefits may be repressed due to other factors such as limited vacation schedules.

Warmer weather conditions may provide opportunities to redirect snow plowing budgets to other projects. It will also reduce sanding and salting and the associated environmental impacts. However an increase in freeze thaw cycles will require further road maintenance. Warmer temperature may also reduce green house gases by increasing plant life photosynthesis and reducing harmful carbon emissions due to lesser demand for heat, though these savings may be outweighed by increases in cooling (air conditioning) needs.

### **Identifying Affected Locations:**

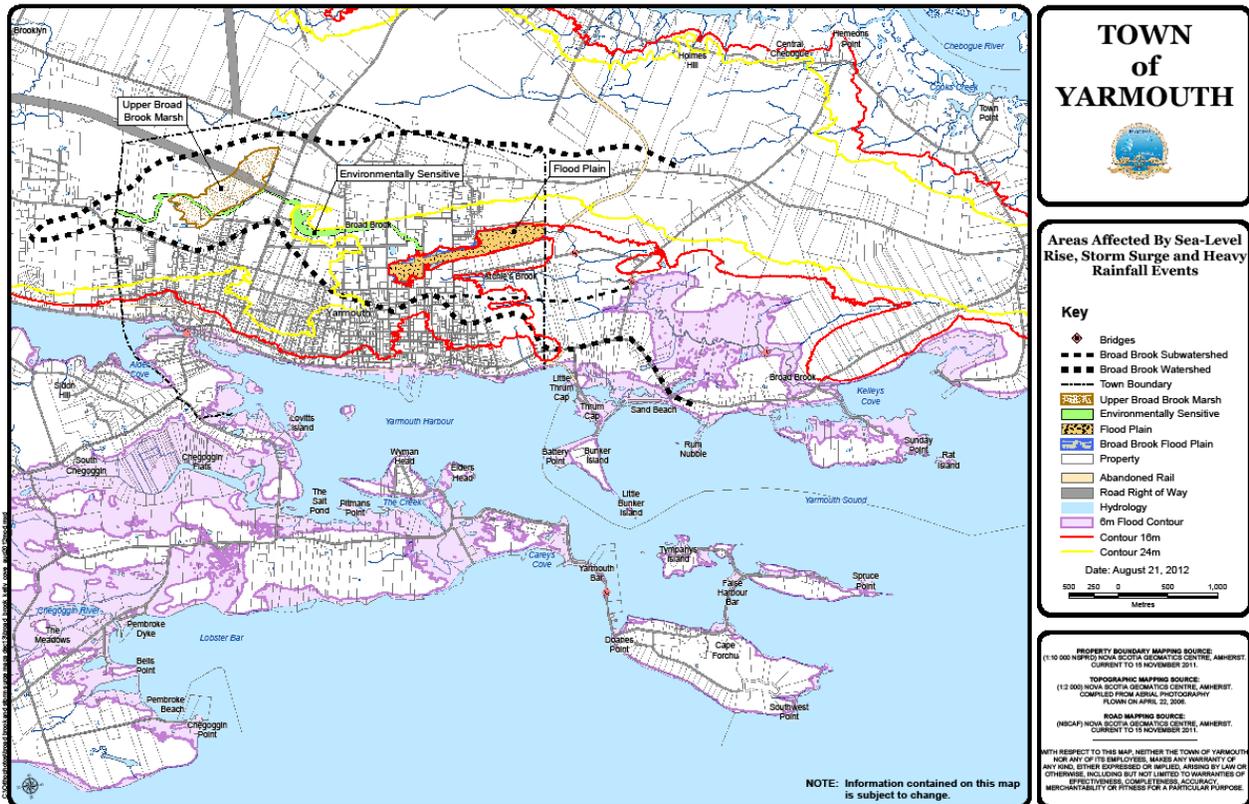
As outlined in the Dalhousie reports, the entire coastline of the Town of Yarmouth will be affected by sea-level rise and storm surge events associated with climate change. In addition, as these events also coincide with heavy rain fall events, the Town will also be impacted from surface run-off events, in particularly, the Town’s primary waterway, Broad Brook, will be severely affected. Though the Town has taken steps to protect the floodplain areas of Broad Brook and has developed an Environmentally Sensitive (A-S) zone along the length of the Brook, the intensity and duration of these events will strain this natural water system. The overall rainfall amounts are anticipated to decrease however, the intensity of these short period rainfall events will increase by sixteen (16%) percent. Please refer to the Yarmouth Climate Change Table in Appendix “B”, page 57. A matrix outlining climate change hazards and their affected locations is provided below:

<b>Hazard:</b>	<b>Affected Locations:</b>
Sea Level Rise	Entire Coastline including the lake’s system
Land Erosion	Regional Implications
Flooding	Entire Coastline including the lake’s system plus in-land rivers and streams (Broad Brook)
Landslides	Regional Implications
Storm Surge	Entire Coastline including the lake’s system
Hurricanes & Wind	Entire Town
Forest Fires	Regional Implications
Drought	Regional Implications
Insect/Disease	Regional Implications – Rodent Infestation

**Climate Change Hazard Impact Matrix - Affected Areas**

The following map outlines the areas affected by sea-level rise, storm surge and heavy rainfall events (Map 1: Appendix “A”). The Town will experience surface flooding events throughout Town due to the limited number of independent storm sewers. It is recommended that a study of the Town’s natural watershed boundaries (Map 8: Appendix “A”) and storm sewer systems be undertaken based on climate change scenarios to determine the weakest areas of the system and help prioritize an action plan to minimize any potential future impacts. As a majority of the Town’s sewers are combined sanitary and storm sewers, an analysis of the impacts of climate change on the Town’s Waste Water Treatment facility should also be undertaken. An impact analysis on the harbour, lake system and Broad Brook

should also be taken to identify and prioritize areas that pose concerns and develop a plan to minimize any potential impacts. A Hazards and Impacts Map (Map 4: Appendix “A”) and a Climate Change Assessment Value Impact Map (Map 5: Appendix “A”) are attached in Appendix “A”



(Source: Town of Yarmouth – Map 1: Appendix “A”)

### Climate Change Policies:

**CC-1 It shall be the intention of Council to consider undertaking a Town wide inventory of climate change risks and conduct a risk assessment to develop and implement strategies for alleviating the adverse affects of climate change impacts.**

**CC-2 It shall be the intention of Council to consider undertaking an Infrastructure Vulnerability Assessment to identify and minimize climate change impacts.**

**CC-3 It shall be the intention of Council to consider undertaking a study to identify and minimize climate change impacts on Yarmouth’s roadways.**

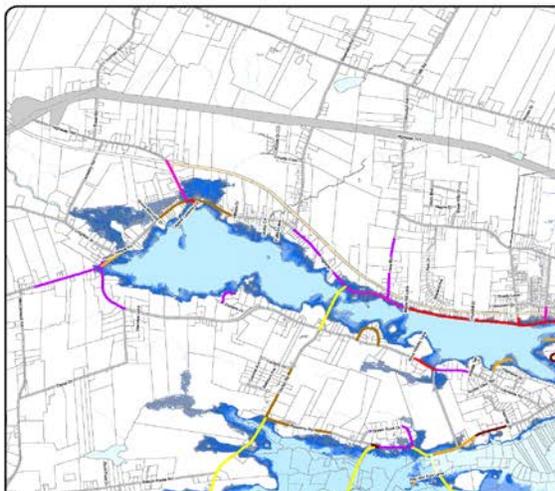
**CC-4 It shall be the intention of Council to consider undertaking a Storm Water Management Plan to identify and minimize climate change impacts related to storm surges and intense rainfall events.**

**CC-5 It shall be the intention of Council to consider undertaking a study to identify and minimize climate change impacts on Yarmouth’s harbour, the lake system and Broad Brook.**

**CC-6 It shall be the intention of Council to consider undertaking a study to identify and minimize climate change impacts on the Town’s Waste Water Treatment Facility.**

**Identifying Affected Key Facilities and Infrastructure:**

According to the ACAS reports, the worst case 100 year storm scenario will result in a 6.03m CGVD28 sea-level rise storm surge event (*6.13m CGVD28* Correction from HHWLT of 2.85m from the Richards Daigle Report rather than the HHLWT of 2.75m used in the Dalhousie Reports). Therefore any facility/infrastructure located below this level along the Town’s coastline will be affected. In-land flooding will accompany these events and impact facilities/infrastructure along the Broad Brook watershed area and impact smaller streams such as Archie’s Brook. Places will become isolated and cut-off as roadways flood and washout, hampering emergency response times for those located within these areas. The map below outlines roads that may be impassible at various storm surge events.



(Source: Town of Yarmouth – Map 2: Appendix “A”)

Storm surge and sea level rise will impact infrastructure along Water Street and will, as of a result, impact services well beyond Water Street. For example, the power grid disruptions along Yarmouth’s harbour may pose electrical problems

well beyond Water Street. One of the major problems during the Ground Hog Day Storm of February 2, 1976, was the loss of power which affected the Water Utility’s ability to maintain adequate water pressure, leaving the Town without water services. Today, the Water Utility has a back-up generator, in case a similar event occurs.

Storm surge and sea level rise impacts on the Milton Bridge will pose problems with transportation links to and from the Yarmouth Regional Hospital as well as sewer and water service disruptions and possible contamination if there is a break in the lines under the Milton Bridge.

Flooding of the Town’s Waste Water Treatment Facility will back up sanitary and storm water flows well beyond Water Street not to mention the environmental risks associated with untreated water flowing directly into Yarmouth’s Harbour.

As storm surges are usually combined with intense rain-fall events, the Town will experience in-land flooding which will compound the affects along Yarmouth’s harbour as the storm sewer outfalls into the harbour and lake systems will exceed their normal capacity level to handle the flows.

Storm events may wash out Bunker Island Road and change the sediment deposit patterns throughout Yarmouth’s harbour affecting sea transportation links to and from Town wharf facilities. Therefore, it is important to consider the impacts beyond the “point of impact”.

A matrix outlining key facilities and their related concerns is provided below:

<b>Key Facilities:</b>	<b>Concerns:</b>
<b>Sanitary Sewer System</b>	
Wastewater Treatment Plant 1 Water Street	Plant Building – 1 Water Street Sanitary collector lines Untreated surplus entering harbour Municipal sewage pumping stations Anticipated increase in treatment costs Anticipated increase in maintenance costs Decrease in Plant’s expected lifespan
<b>Storm Sewer System:</b>	
	Catch basins Manholes Culverts Storm collector lines Outfalls (contamination & erosion)
<b>Potable Water System:</b>	
Water Treatment Facility 1046 Lake George Road	Plant Building – 1046 Lake George Road Contamination concerns (water distribution lines and private laterals)

	Anticipated increase in treatment costs Anticipated increase in maintenance costs Decrease in Plant's expected lifespan
<b>Municipal Buildings:</b>	
	Wind and water damage
<b>Municipal Infrastructure:</b>	
	Streets, traffic lights and street lighting Milton Dam (redeveloped 2012) Milton Bridge (sewer, water & access concerns) Hospital (sewer, water & access concerns) Schools Airport Ferry Terminal R.C.M.P. building – 233 Water Street Utilities – power, cable, telephone, internet Bob Hartlin Trail – Clock Tower Park Killam's Wharf and Marina Public Wharfs Emergency plan – RCMP, EMO & Fire
<b>Private Infrastructure:</b>	
	Residential and commercial buildings Fish plants, freezer plants and lobster pound Dominion Textile Plant West Nova Fuels Plant – 211 Water Street Bulk Plant – 166 Water Street School Board Building -79 Water Street RCMP Building – 233 Water Street Sweeney Museum -110 Water Street Rudders Restaurant- 96 Water Street Waterview Machine Works – 86 Water Street Private Wharfs Ice Plant – 80 Water Street

Some of the key facilities that will require up-grades are outlined in the following matrix:

<b>Key Facilities:</b>	<b>Up-grades:</b>
Water Street	Flooding along Water Street currently occurs and will intensify. A study to minimize these impacts should be undertaken to identify the weakest areas and implement safeguards to minimize their impacts. Riprap, sea-walls and retention ponds may be needed at strategic locations.
Milton Dam	Milton Dam has been identified as a concern and was redeveloped in 2012.
Milton Bridge	Milton Bridge (Vancouver Street bridge) is a critical facility as it serves as the primary access route to the regional hospital. Not only will access be impacted but also sewer and water services may be affected, essentially

	cutting off these services from the residents on the western side as well as the hospital. Environmental concerns may be realized as the gravity fed sewer line becomes exposed to Yarmouth's harbour. The hospital should undertake a study of alternate sewer and water services as a back-up system during these events.
RCMP – 233 Water Street	The new location for the RCMP at 233 Water Street may be affected. An emergency plan should be developed to maintain this critical service during these events.
Waste Water Treatment Facility – 1 Water Street	The Town's Waste Water Treatment Facility will be undertaking a major up-grade in the next 30 years. It is important that these up-grades take into consideration climate change impacts with regard to sea-level rise, storm surges and impacts associated with increases in storm water volumes.
Storm Water Infrastructure	The Town's storm water system (combined and not combined) is inadequate to address the impacts anticipated. These events will exceed the capacity of the system and cause general flooding, environmental concerns and impacts on the Waste Water Treatment facility. A study of these impacts is required to identify the weakest areas and help prioritize a plan to minimize these anticipated impacts.
Private Buildings:	The most vulnerable buildings: Waterview Machine Works – 86 Water Street Killams Wharf and Marina – 90 Water Street Office Building – 514 Water Street Bulk Plant – 166 Water Street Domtex Building - 236 Water Street Public and private wharfs Scotia Gardens Sea-foods/ Sweeney's Museum IMO Foods Rudder's Restaurant

**CC-7 It shall be the intention of Council to support the South West District Health Authority, the RCMP and EMO in their efforts to undertake an emergency management plan to minimize the potential impacts associated with climate change.**

The emergency management plan outlined in Policy CC-7 should address an alternant sewer and water service for the Yarmouth Regional Hospital in case the lines are breached at the Milton Bridge during a severe storm event. Water is an essential service especially for dialysis patients and is critical for the effective operations of the health centre. Therefore it is extremely important for the Hospital to provide an alternative source of potable water during these events. The plan should also determine an alternate transportation route in case the Milton Bridge is unusable. Communication of the Milton Bridge breach is essential for all first responders and the proper communication to all advising of an alternative route could help save lives, as lowering the travel time to hospital services is critical.

The Town RCMP are relocating their offices to 233 Water Street. During storm events, their offices may not be accessible. Therefore, they are developing a plan with the County RCMP Department to use the facilities at 156 Starrs Road as a back-up location.

### **Infrastructure: Waste Water Treatment Facility; Sanitary and Storm Sewers**

The Town's Waste Water Treatment Facility located at 1 Water Street directly abuts Yarmouth's harbour on the south end of Water Street. During heavy rainfall events, the amount of sanitary and combined storm water exceeds the carrying capacity of the system discharging untreated effluent directly into Yarmouth's Harbour. As storm surges will usually occur during heavy rain events, the Waste Water Treatment Facility is impacted from two directions; from land, due to an increase in storm surface run-off; and from the sea, due to storm surges. It is recommended that Council consider undertaking a study to determine the affects climate change (storm surges and sea-level rise) may have on the Waste Water Treatment Facility. The study should also consider the impacts of untreated overflows and suggest alternative procedures/mechanisms to minimize their potential environmental impacts. One (1) alternative would be to separate the combined sanitary storm sewers to minimize the effects of storm surface run-off on the plant's operations. The Town's Integrated Community Sustainability Plan recommends separation of the sanitary and storm systems as outlined in Policy 8.38 outlined below:

*8.38 It shall be the intent of Council to undertake a storm water/sanitary sewer separation program to minimize the amount of storm water treatment, thereby lowering the overall cost of treatment, and becoming more efficient and sustainable by freeing up the waste water treatment plant's capacity.*

In order to minimize the environmental impacts associated with these storm events, the Town's Integrated Community Sustainability Plan recommends the installation of stormceptors at strategic storm sewer outfall points. Policy 8.48 is outlined below:

*8.48 It shall be the intention of Council to require that any public work projects install a stormceptors or equivalent device to remove storm water pollutants prior to discharge into the Broad Brook waterway system or into Yarmouth's harbour.*

As sea level rises the sewer system along Water Street will be increasingly susceptible to storm surges causing the system to be, at times, completely submerged. Portions of the sewer system will be working at diminished capacity or not working at all due to blockage from debris or due to the water amounts exceeding the system's carrying capacity. As storm surges usually come during heavy rainfall events, the flooding of internal areas will compound these issues and hamper or prolong relief measures. As the Town primarily has a combined sanitary and storm sewer system, it is recommended that back flow preventers be installed at strategic locations to safeguard public and private developments from the adverse affects associated with these events.

**CC-8 It shall be the intention of Council to consider undertaking as part of their Infrastructure Vulnerability Assessment pursuant to Policy CC-2 a plan to manage infrastructure and draft recommendations for alleviating the risks and vulnerabilities associated with the impacts of climate change on the Town's infrastructure.**

**CC-9 It shall be the intention of Council to consider undertaking as part of their Storm Water Management Plan pursuant to Policy CC-4 a plan to implement safeguards, such as, but not limited to, back flow preventers; storm drainage holding ponds; and, other similar devises.**

### **Infrastructure: Potable Water Supply**

The Town's potable water supply system comes from the Lake George watershed and services the Town and portions of the Municipality through a water distribution system. In order to safe guard the system from salt water intrusions and contamination, the water distribution system may need to be shut-off or capped at strategic locations. These locations should be identified and be readily accessible during storm surge events.

As climate change will increase the intensity of storm rainfall events, surface runoff contamination into the Lake George watershed will be an issue that may require better erosion controls to be implemented in the watershed. The increase of surface runoff contaminations into the watershed may also increase the water

treatment needs to maintain an adequate supply of potable water during these events. It is recommended that the Town undertake a study and implement a manual to safeguard the water system during these events.

**CC-10 It shall be the intention of Council to consider undertaking, as part of their Infrastructure Vulnerability Assessment pursuant to Policy CC-2, a plan to manage the Town’s water supply and distribution system and draft recommendations for alleviating the risks and vulnerabilities associated with the impacts of climate change.**

### **Infrastructure: Street Development and Maintenance**

Climate change will have an impact on Town resources as the costs associated with street development and maintenance will increase as the affects of climate change intensifies. Increases in the frequency and intensity of storm events along with increases in the frequency of the freeze thaw cycles will affect equipment, supplies (sand, salt and asphalt) and manpower. Climate change impacts will need to be considered in the development and maintenance of streets. Roadway sub-base, asphalt thickness and culvert size are just a few examples of roadway specifications that may require up-grading in light of climate change impacts.

**CC-11 It shall be the intention of Council to consider undertaking as part of their study pursuant to Policy CC-3 a plan to develop street specifications for the development and maintenance of Town streets in light of the affect of climate change impacts.**

### **Emergency Measures: Power Grid**

Nova Scotia Power is responsible for maintaining an adequate level of service to its customers. A major storm surge with its accompanying winds and rain will cause wide spread power outages for an extended period of time. It is recommended that Council advise Nova Scotia Power and the Emergency Measures Organization of their concerns and advise them to develop a plan to minimize the impacts of a power disruption during these events.

**CC-12 It shall be the intention of Council to advise Nova Scotia Power and the Emergency Measures Organization of their concerns regarding power outages and life safety issues associated with climate change events and to recommend that they consider the development of a plan to minimize climate change impacts.**

### **Social Implications: Who will be affected?**

As part of the ACAS project, the School of Dalhousie has undertaken a “Social Vulnerability of Social Assets at Risk” study and has identified Yarmouth South as

the most vulnerable segment of the Town's population. Unfortunately, this area is also prone to local flooding associated with heavy rainfall events as the water makes its way through the Broad Brook watershed system. It is not uncommon for the roadways of South East Street and Argyle Street to be flooded and such flooding will only increase in occurrence as climate change impacts intensify. Upgrades to the storm water system throughout Yarmouth South should be made a priority to minimize these impacts and alternative evacuation routes should be developed in case these roadways become unusable.

Senior's, the physical and mentally challenged and the very young are also vulnerable. Yarmouth Association for Community Residential Options (YACRO), the Town's largest provider for housing the physically and mentally challenged, has developed their own emergency management plan in case of emergencies. However, there needs to be better coordination between vulnerable groups and EMO to help minimize the adverse affects of climate change impacts. One way could be the development of a Vulnerable Registry (City Watch Program) that will assist first responders in the delivery of their services. In 2012 EMO has initiated the development of the City Watch program which will enable citizens to register so that first responders are prepared for their particular circumstance in time of need.

The Town has several great volunteer organizations that can help in a crisis. Many of these organizations are associated with the Emergency Measures Organization (EMO), such as but not limited to, Ground Search and Rescue, Home Care, VON, Red Cross, St. John's Ambulance, Volunteer Fire Department, R.C.M.P. and Community Police Organizations. It is recommended that the EMO's Emergency Response Plan be reviewed in light of climate change impacts.

Climate change impacts will affect people employed along the waterfront as they may lose income and work opportunities due to the impacts of sea-level rise and storm surge events. It is important in the aftermath of these events to enable these waterfront facilities to rebound as soon as possible to allow those affected to regain their employment opportunities.

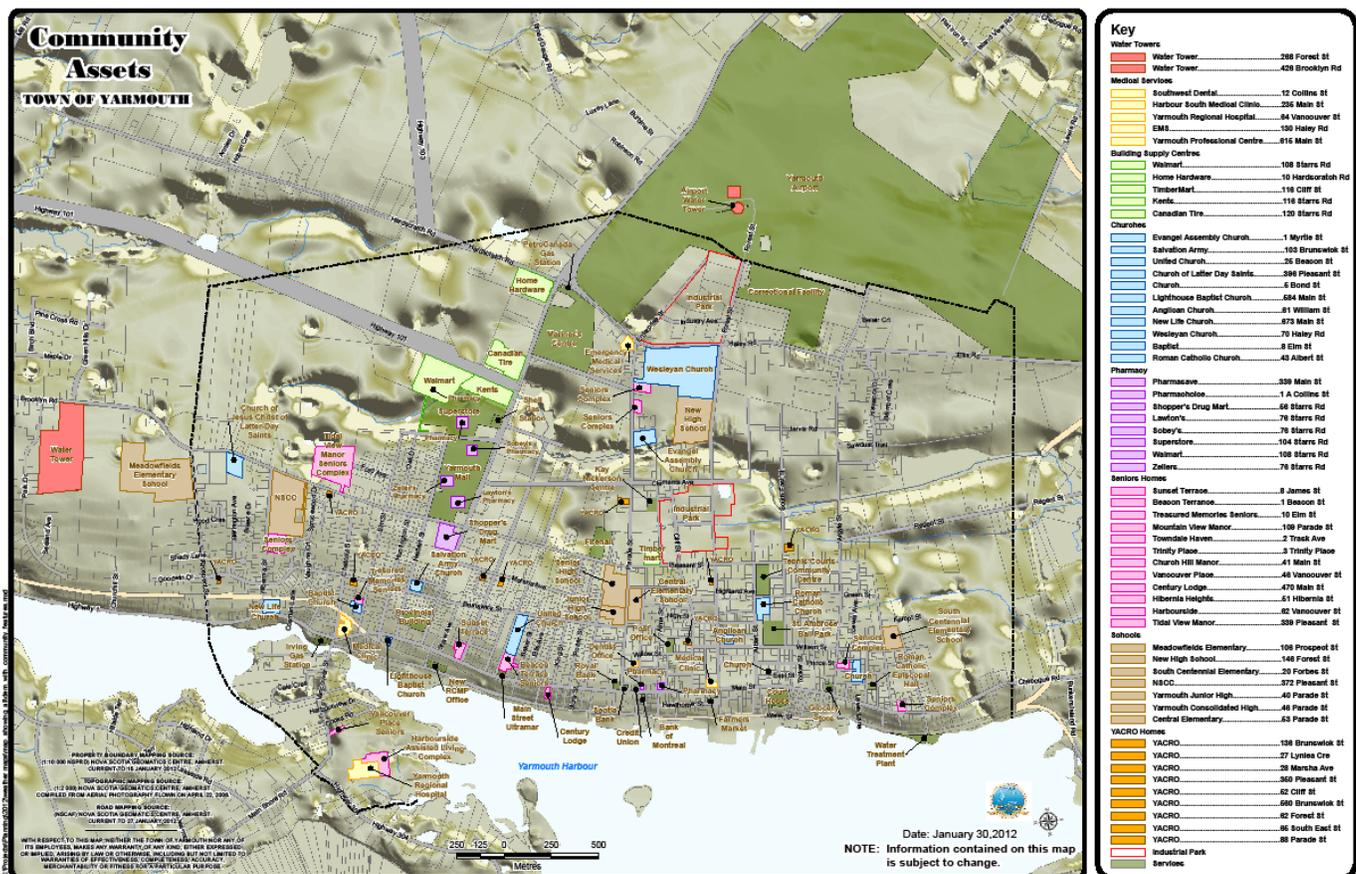
Along with impacting employment opportunities, cultural, social and heritage sites along Water Street will also be affected due to storm surges and sea-level rise events. These include Killam's Wharf, Rudder's Restaurant, the Sweeney's Fisheries Museum, the Lost to the Sea Memorial, Milton Clock Tower Park and the Hartlin Trail system. The Broad Brook Recreational Facility along Forest Street will also be impacted during heavy rainfall events.

**CC-13 It shall be the intention of Council to support EMO in undertaking a Climate Change Emergency Plan to identify and help prioritize an action plan to minimize potential impacts on the most vulnerable segments of our community in light of the climate change**

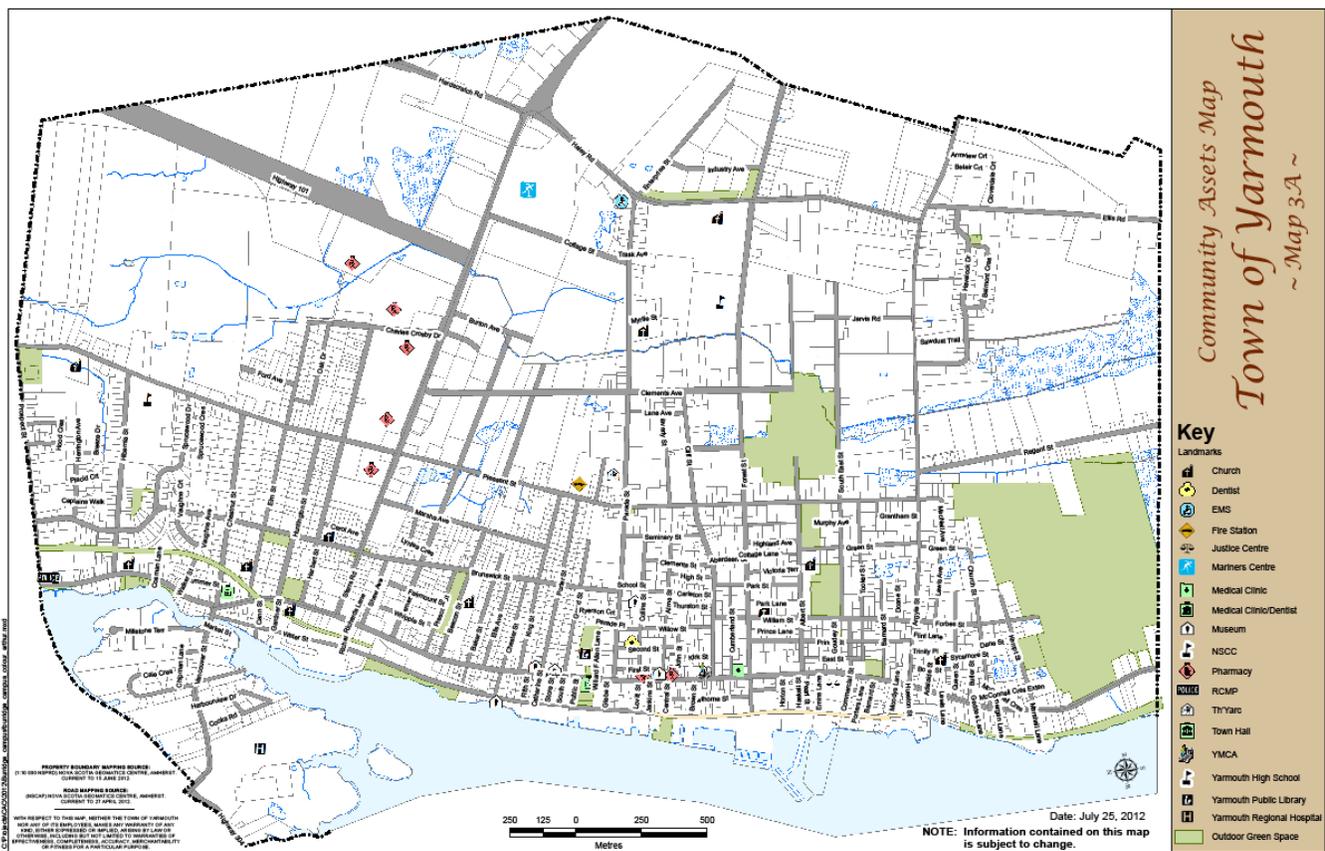
impacts associated with storm surges, sea-level rise and intense rainfall events.

## Social Review of Municipal Planning Strategy:

Chapter 7, “Social and Cultural Environments” of the Town’s Municipal Planning Strategy outlines Council’s intentions with regard to social and cultural policies. Chapter 10 of the Municipal Planning Strategy also addresses social and cultural policies as part of the Town’s Integrated Community Sustainability Plan (ICSP). In Chapter 7, Council recognizes the importance of education; recreation; tourism; heritage; and, cultural facilities. In Chapter 10, Council recognizes the importance of maintaining and enhancing the cultural and social fabric of the area. They aim to create a liveable “green” community that is healthy and safe for all residents. A Community Assets Map is outlined below showing key community services and vulnerable segments of our community.



(Source: Town of Yarmouth – Map 3: Appendix “A”)



(Source: Town of Yarmouth – Map 3A: Appendix “A”)

### Economic Implications:

The Town’s ICSP recognizes the fisheries, regional health services and regional administration and commerce facilities as the core business sectors of the community. Climate change will have a definite impact on the fisheries and affect the operations of the Yarmouth Regional Health Centre. Climate change impacts on the Yarmouth Regional Health Centre can be mitigated through an emergency plan to ensure the hospital remains accessible with adequate services including, but not limited to, sewer, water, power, internet, telephone, emergency communication, staffing and equipment.

The fishing industry’s impacts, due to warming waters, are beyond the Town’s ability to mitigate. However, the Town and business leaders can adapt to changing opportunities associated with warmer waters and protect and enhance the built environments that support the fishing industry. Protecting Yarmouth’s waterfront will have a financial impact on town’s resources. However, it is recognized that proactive investments into the preservation of these facilities will be significantly less than the costs attributed to the fishing industry if climate change impacts are not considered.

South West Nova has already experienced concerns in the quality of landed lobsters. Warmer water has attributed to an increase in the number of soft shelled

lobsters, lowering the landed price and impacting the regional economy. Since coastal water temperatures are anticipated to continue to increase, steps should be taken to address this reality and there may be an opportunity to diversify the industry into new products and new markets.

**CC-14 It shall be the intention of Council to support the built environment along Yarmouth’s Harbour by incorporating planning provisions that safeguard developments from the adverse affects of climate change.**

**CC-15 It shall be the intention of Council to support economic development organizations in diversifying and adapting to climate change impacts with special attention to fishing and marine related industries.**

**Sustainability - Fiscally Responsible:**

The Town is responsible to ensure that these provisions are implemented in a timely, fiscally responsible fashion and that such provisions do not adversely affect, in an unnecessary or over burdened fashion, the continued growth and prosperity of the local economy.

**CC-16 It shall be the intention of Council to develop and manage municipal infrastructure and community assets in light of climate change with the aim of ensuring sustainable economical, social, cultural, environmental and fiscal responsible governance.**

A matrix outlining key economic generators, their climate change impacts and their economic implications is outlined below:

<b>Key Economic Generators</b>	<b>Economic Implications:</b>
<b>Agricultural: Impacts</b>	
Intense Rain Fall Events: Increased Surface Run-off (too much water)	Impacts on the quality and quantity of products. May cause an increase in production costs due to new infrastructure requirements to handle increases in surface run-off. May cause loss of crops and nutrients in the soils, thereby impacting production costs.
Drought Conditions	Impacts on the quality and quantity of products. May cause an increase in production costs due to new infrastructure requirements such as new irrigation facilities. May cause loss of crops and nutrients in the soils, thereby impacting production costs.
Warming Climate and Extended Growing Season	May develop new products and by-products due to changes in climate conditions. May negatively affect existing agricultural activities.

<b>Fisheries: Impacts</b>	
Sea-Level Rise and Storm Surge Impacts	Financial implications on fishery or marine related infrastructure such as wharves, boats and buildings.
Water Temperature and Acidity Conditions	Impacts on the quality and quantity of sea-food products. For example soft shelled lobsters.
Intense Rain Fall Events: Increased Sewage Outflows	Impacts on the quality and quantity of products. Untreated sewage - environmental implications – closing of the clamming or blood worm industry.
<b>Forestry: Impacts</b>	
Intense Storm Events: Wind	Impacts on the quality and quantity of products.
Intense Rain Fall Events: Surface Run-off	Surface run-off implications. An increased cost in production causes increased costs to consumers.
Increased surface run-off in the Lake George Watershed	Increased costs in managing forest areas in the Lake George Watershed area to minimize surface run-off contamination on the Town's potable water supply.
Drought Conditions	Slow growth implications. Impacts on the quality and quantity of products.
Climate Change – New Species	Insect infestation – species/pests domination concerns.
Warmer Climate and Extended Growing Season	May develop new products and by-products due to changes in climate conditions. May negatively affect existing agricultural activities.
<b>Tourism: Impacts</b>	
Warmer Climate and Extended Tourism Season	Expanded tourism shoulder seasons potential. Promotion as “Vancouver’s East Coast”.
Intense Storm Events	Damage to tourism infrastructure such as trails, parks, historic sites and monuments.  Tourism Promotion - Visit the site of the 1976 Groundhog Day Storm.
Sea-Level Rise and Storm Surge Events	Limited access to Cape Forchu and other tourism related areas. Cut-off due to storm surges and sea-level rise – road washouts.
<b>Manufacturing &amp; Industry: Impacts</b>	
Storm Surges and Wind Damage	Damaged products and/or production delays. Damaged production facilities especially along Water Street may entirely wipe out an industry.  Implications regarding access, power shortages and manpower shortages.  Damage to production facilities will impact not only the businesses but also those employed.
<b>Transportation: Impacts</b>	
Climate Changes – Freeze thaw cycles	Impacts on road maintenance and up-grades to access people and products.
Intense Storm Events	Impacts on maintenance and up-grades to

	<p>Yarmouth Airport, concerns related to drainage and high winds causing delays and cancellations.</p> <p>Impacts on maintenance and up-grades to the Ferry Terminal and the Harbour. Dredging the harbour from silt build-up.</p>
<b>Services: Impacts</b>	
Sea-Level Rise and Storm Surges	Access to the Yarmouth Hospital will be impacted if Milton Bridge is damaged due to a storm surge.
Intense Rain Fall Events	<p>Access to people will be an issue as roadways are washed away due to flooding.</p> <p>Increased maintenance and up-keep costs on sanitary, storm and water services and roadways.</p> <p>Government services may be impacted due to accessibility impacts.</p> <p>Wind, ice storms, storm surges and sea-level rise may impact the delivery of telephone, power, cable, internet, water, and radio/television communication services.</p>

### **Environmental Implications:**

During storm events, the Town will experience sea-level rise, storm surges and an influx of surface water run-off, particularly along Broad Brook and into the Town’s combined sanitary and storm sewer systems. These events will impact the operations of the Town’s waste water treatment facility on Water Street. There is a real potential for untreated sewage to flow directly into Yarmouth’s harbour impacting environmental areas surrounding the harbour. It is recommended that further research be undertaken to clearly define these impacts and determine mitigation techniques to minimize any environmental impacts associated with this potential.

Environmental impacts along Yarmouth’s harbour, the lake system and Broad Brook will intensify as the volume of surface contaminants increases due to increased rainfall runoff. The Town’s ICSP outlines sustainable environmental policies that should be implemented and monitored over time.

**CC-17 It shall be the intention of Council to consider undertaking an Intense Rainfall Event Analysis complete with a Digital Elevation Model (DEM) to determine the impacts on infrastructure and developments with a aim of developing safeguards to minimize climate change impacts.**

The following matrix outlines a list of hazardous materials:

<b>Business:</b>	<b>Location:</b>	<b>Type of Materials:</b>
Irving Oil Bulk Plant	271 Bunkers Island Road	Furnace and diesel fuel
Ultramar Bulk Plant	20 Prospect Street	Furnace, diesel and gasoline fuel
Suncor Energy Bulk Plant	166 Water Street	Furnace and diesel fuel
Gateway Fuels	241 Pleasant Street	Gasoline and diesel
Bluewave Energy	11 Industry Avenue	Furnace fuel, diesel and gasoline
Scotia Garden Seafood	112 Water Street	Anhydrous Ammonia
Canadian Tire	120 Starrs Road	Mixture of hazardous material
Home Hardware	138 Starrs Road	Mixture of hazardous material
Main Street Ultramar	509 Main Street	Mixture of hazardous material
Petro Canada	168 Haley Road	Mixture of hazardous material
Starrs Road Shell	100 Starrs Road	Mixture of hazardous material
Starrs Road Irving	65 Starrs Road	Mixture of hazardous material
Main Street Irving	632 Main Street	Mixture of hazardous material
Downtown Service Centre	81 Main Street	Mixture of hazardous material
West Nova Fuels	211 Water Street	Mixture of hazardous material
Haskell Steel	10 Haskell Street	Mixture of hazardous material
West Nova Industries	160 Starrs Road	Mixture of hazardous material
Waterview Machine Works	66 Water Street	Mixture of hazardous material
Nova Welding Supplies	28 Clements Avenue	Mixture of hazardous material
Waste Water Treatment Plant	1 Water Street	Chlorine

A matrix outlining environmental concerns and their environmental implications is provided below:

<b>Environmental Concerns:</b>	<b>Environmental Implications:</b>
<b>Oil and Gas Bulk Plants Facilities:</b>	
Irving Oil Bulk Plant 271 Bunkers Island Road	Significant potential to be impacted by storm surges and sea-level rise. Environmental impacts along Yarmouth's Harbour could be severe. Economic impacts on the fishing industry, the clam digging industry and the blood worm industries due to contamination. Washing out of the Bunkers Island Road could deposit sediments throughout Yarmouth's harbour, impacting its environment and impacting fishing and marine related industries and water related tourism industries (ferry-sightseeing tours).
Ultramar Bulk Plant 20 Prospect Street	Spills should be contained on-site. However if the spill exits the site, there is a potential to environmentally impact Lake Milo. Low potential.
Suncor Energy Bulk Plant 166 Water Street	Significant potential to be impacted by storm surges and sea-level rise. Environmental impacts along Yarmouth's Harbour could be severe. Economic impacts on the fishing industry, the clam digging industry and the blood worm industries due to contamination.
Gateway Fuels 241 Pleasant Street	Spills should be contained on-site. However if the spill exits the site, there is a potential to environmentally impact the Broad Brook watershed system. Low potential.
Blue Wave Energy 11 Industry Avenue	Spills should be contained on-site. No sensitive environments should be affected.
West Nova Fuels Plant 211 Water Street	Spills should be contained on-site. However, during storm surges and sea-level rise there is a moderate potential to

	impact Yarmouth's Harbour.
<b>Ports and Harbours:</b>	
Yarmouth's Harbour	Yarmouth's Harbour could be affected due to hazardous material contamination, surface run-off contamination and raw sewage. Economic impacts on the fishing industry, marine related industries, the clam digging industry and the blood worm industries as well as water related tourism industries (ferry-sightseeing tours).
<b>Retention Ponds:</b>	
Super Store Retention Pond	May impact the Broad Brook Watershed system. However, the run-off is filtered through a stormceptor prior to discharge.
Hill Side Estates	May impact Lake Milo during severe rainfall events.
<b>Pests and Diseases:</b>	
Ticks and mosquitoes	It is anticipated that ticks and mosquitoes will have an impact, but the extent is unknown.
Rodent Infestation	It is anticipated that rodents will move to higher ground during these sea-level rise/storm surge/intense rainfall events impacting areas normally free of rodents.
<b>Fish and Wildlife:</b>	
Fish Habitat	It is anticipated that fish habitat (warming waters and acidity levels) will be impacted due to climate change, but the extent is unknown.
<b>Parks and Protected Areas:</b>	
Hartlin Waterfront Trail	It is anticipated that the Hartlin Trail will be impacted during storm surges and sea-level rise events.
Killam's Wharf and Marina	Killam's Wharf and Marina is located directly on Yarmouth's harbour (part of the Hartlin Trail) and will be impacted during storm surges and sea-level rise events. Wharf facilities will be in danger due to storm surge, sea-level rise and high wind impacts (wave run-up).
Milton Clock Tower Park	Milton Clock Tower Park is part of the Hartlin Trail and will be impacted during storm surges and sea-level rise events.
Sealed Landers Park	Sealed Landers Park is along Lake Milo and may be impacted due to storm surge and sea-level rise events as well as from surface run-off due to intense rainfall events - though to a lower extent then the Hartlin Trail or Milton Clock Tower Park.
Milton Dam Park	Milton Dam Park will be impacted during storm surge and sea-level rise events. Its location at the head of Yarmouth's Harbour is very vulnerable.
Milo Boat Club	Milo Boat Club is located along Lake Milo and may be impacted due to storm surge and sea-level rise events. Wharf facilities may be in danger with increased water levels and winds - though to a lower extent then the Hartlin Trail or Milton Clock Tower Park. The usefulness of the Milo Boat Club as a recreational facility could be lost if the Milton Dam breaks.
Broad Brook Recreational Complex	Broad Brook Recreational Complex is vulnerable to intense rainfall events. The ballpark facilities may be destroyed depending upon the severity of the storm event. The Wal-

	mart wetland restoration project (2012) should help to minimize the impacts of these events.
Broad Brook Watershed	The Broad Brook Watershed area will experience an increase in contamination levels due to an increase in surface run-off pollutants.
<b>Sensitive Habitats:</b>	
Yarmouth's Harbour	Yarmouth's Harbour will be impacted due to storm surge and sea-level rise events.
Broad Brook	Broad Brook will be impacted due to heavy rainfall events.
<b>Coastal Erosion:</b>	
Yarmouth's Harbour	Erosion from storm surge and sea-level rise events will undermine wharves and buildings along the harbour.

### **Municipal Cooperation:**

It is important to realize that climate change impacts do not respect municipal boundary lines and that cooperation with adjacent and nearby municipalities will be required to combat the adverse affects of climate change.

**CC-18 It shall be the intention of Council to consider working cooperatively with the Municipality of the District of Yarmouth to minimize climate change impacts, especially on those aspects that have a joint interest, such as, but not limited to, Bunker's Island Road, the Irving Bulk Plant (Bunker's Island), protection of the lake system (Lake Milo, Second Lake and Doctor's Lake), access to the Yarmouth Regional Hospital and regional emergency management (EMO) facilities and services.**

### **Priorities for Adaptation:**

When considering priorities it is important to rank the priorities in relevant importance to the community. This can be done in a number of different ways that is unique to each community. The following matrix outlines the ranking values based upon the relevant importance of the project.

<b>Relevant Importance:</b>	<b>Assigned Ranking:</b>	<b>Number Value:</b>
Legislated or Regulatory Compliance Requirements	High	5
Public Safety: Occupational health and safety	High	5
Impact on Natural Environment (Severe)	High	5
Impact on Natural Environment (Not Severe)	Medium	3

Impact on Municipal Services: (Non Public Safety)	Low	1
Replacement of Asset Pending: (Non Public Safety)	Low	1
Impact on Private Infrastructure and Buildings below the 6m CGVD28 contour: Wharves, Boats – Waterfront Businesses	High	5
Impact on Private Infrastructure and Buildings above the 6m CGVD28 contour: Buildings (Commercial, Industrial, Residential)	Medium	3
Impact of Cost versus Benefit: Implementing lower obtainable objectives (easier, less expensive) first – then consider higher obtainable objectives (harder, more expensive)	Medium	3
Funding Opportunities	Medium	3
Partnerships (Gov't and/or NGO's)	Medium	3

<b>Relevant Importance:</b>	<b>Assigned Ranking:</b>	<b>Waste Water Plant</b>	<b>Milton Dam</b>	<b>Milton Bridge (sewer/water)</b>	<b>Storm Sewers Broad Brook</b>	<b>Sea-walls/Riprap Retention Ponds</b>	<b>Legislative Amendments</b>
Legislated or Regulatory Compliance Requirements	High	5			5		
Public Safety: Occupational Health and Safety	High	5	5	5	5	5	5
Impact on Natural Environment (Severe)	High	5	5	5	5	5	
Impact on Natural Environment (Not Severe)	Medium						3
Impact on Municipal Services: (Non Public Safety)	Low	1		1	1	1	
Replacement of Asset Pending: (Non Public Safety)	Low	1	1	1			
Impact on Private Infrastructure and Buildings below the 6m CGVD28 contour: Wharves, Boats – Waterfront Business	High	5	5	5		5	
Impacts on Private Infrastructure and Buildings above the 6m CGVD28 contour: Buildings (Commercial, Industry, Residential)	Medium				3		3
Impact of Cost versus Benefit:	Medium	3	3	3	3	3	3
Funding Opportunities	Medium	3	3	3	3	3	
Partnerships (Gov't and/or NGO's)	Medium	3	3	3	3	3	
<b>Assigned Values Totals:</b>		<b>31</b>	<b>25</b>	<b>26</b>	<b>28</b>	<b>25</b>	<b>14</b>

<b>Projects Priorities Summary:</b>	<b>Ranking:</b>
<b>Waste Water Plant</b>	<b>31</b>
<b>Storm Sewers – Broad Brook</b>	<b>28</b>
<b>Milton Bridge</b>	<b>26</b>
<b>Sea-walls/Riprap Retention Ponds</b>	<b>25</b>
<b>Milton Dam (completed 2012)</b>	<b>25</b>
<b>Legislative Amendments</b>	<b>14</b>

### **Legislative Amendments: Municipal Planning Strategy (ICSP) and Land Use By-law:**

The Town developed an Integrated Community Sustainability Plan (ICSP) which became effective on April 20<sup>th</sup>, 2010. The ICSP was incorporated within the Town’s Municipal Planning Strategy and will be reviewed upon the review of the Municipal Planning Strategy on an on-going basis. There are two (2) remedies to combat the affects of climate change:

- (1) We can reduce the greenhouse gas emissions that cause climate change and its unwanted impacts. This is referred to as “mitigation”.
- (2) We can be prepared for changes in our climate by taking steps that will help us to cope with likely impacts. This is referred to as “adaptation”.

The ICSP touches on both “mitigation” as well as “adaptation” remedies to minimize the adverse affects of climate change.

The “mitigation” policies of the ICSP attempt to reduce greenhouse gas emissions that cause climate change and its unwanted impacts. The ICSP promotes the development of an efficient transportation network and the development of alternative transportation modes such as active transportations, transit and car pooling initiatives. These policies are copied below:

*8.20 It shall be the intention of Council to promote the efficiency of the transportation networks in an effort to reduce greenhouse gases and develop Charles Crosby Drive and Clements Avenue as “collector” classified streets and the “Yarmouth North Connector” as an “arterial” limited access highway.*

*8.24 It shall be the intention of Council to undertake a study in partnership with adjacent municipalities on the feasibility of undertaking a transit authority to provide a transit service throughout the tri-county area with connections to transit services beyond, in an effort to reduce carbon dioxide emissions and to conserve energy.*

*8.25 It shall be the intention of Council to cooperate with adjacent municipalities and community organizations in the creation of “car pooling” initiatives and “park and ride” facilities at strategic locations throughout the tri-county area.*

*8.26 It shall be the intention of Council in partnership with the Municipality of the District of Yarmouth to undertake and develop an “Active Transportation and Connectivity Plan”.*

*8.27 It shall be the intention of Council to review the Town’s Subdivision By-law in light of sustainable initiatives such as “green” infrastructure facilities and active transportation specifications pursuant to the Active Transportation and Connectivity Plan.*

*8.28 It shall be the intention of Council to design and construct public streets in such a fashion to accommodate a lineal bike lane with a minimum width of 1.5 m (4.92 ft.).*

*8.29 It shall be the intention of Council to include in the Subdivision By-law street specifications requiring developers to design and construct street right-of-ways in such a fashion to provide a parking lane with a minimum width of 3 m (9.84 ft.) along one (1) side of the street, and a bike lane with a minimum width of 1.5 m (4.92 ft.) along the other side of the street.*

*8.30 It shall be the intention of Council to consider the development and/or enhancement of pedestrian, bicycle, and/or transit access in development proposals and their integration within the community’s framework.*

*8.31 It shall be the intention of Council to support the Bikes for Kids program administered by local community organizations where old bikes are donated, refurbished and redistributed for kids.*

*8.32 It shall be the intention of Council to consider the establishment of a “Bike and Ride Program” administered through the Department of Leisure Services where bikes can be picked up and dropped off at bike distribution centres throughout the Town.*

The ICSP also outlined Council's intention to reduce the Town's carbon footprint. An energy audit was completed in 2010 and the Town is undertaking steps to reduce its carbon footprint by installing energy efficient lighting throughout its facilities; developing a "green" fleet of vehicles; and, installing LED street lighting throughout the Town. The Memorandum of Understanding between UNSM and the province recommends an increase in the overall energy efficiency of municipal operations by 20% over 2008 levels by 2020. The ICSP policies are outlined below:

*8.43 It shall be the intention of Council to undertake an energy audit of the Town's operations and implementing the recommendations when deemed appropriate, timely and financially beneficial.*

*8.45 It shall be the intention of Council to undertake a study of their operational fleet in an effort to reduce carbon dioxide emissions as well as energy consumption and implement a Municipal Green Fleet Transition Plan.*

The Town's ICSP recognizes the importance of increasing the Town's foliage as a means of combating green house gases and to this end has adopted a policy outlining their intention to implement a "Green Policy" to help beautify the Town and reduce green house gases. The ICSP also promotes the establishment of community gardens as a means of creating local food produce, effectively reducing the amount of shipped produce that has a high carbon footprint. Council has also developed a policy outlining their intention to promote clearer air, clearer water and the lowering of green house gas emissions. These policies are outlined below:

*8.58(A) It shall be the intention of Council to continue its efforts to increase the foliage throughout Town by implementation of its Green Policy in an effort to beautify the Town and reduce green house gases.*

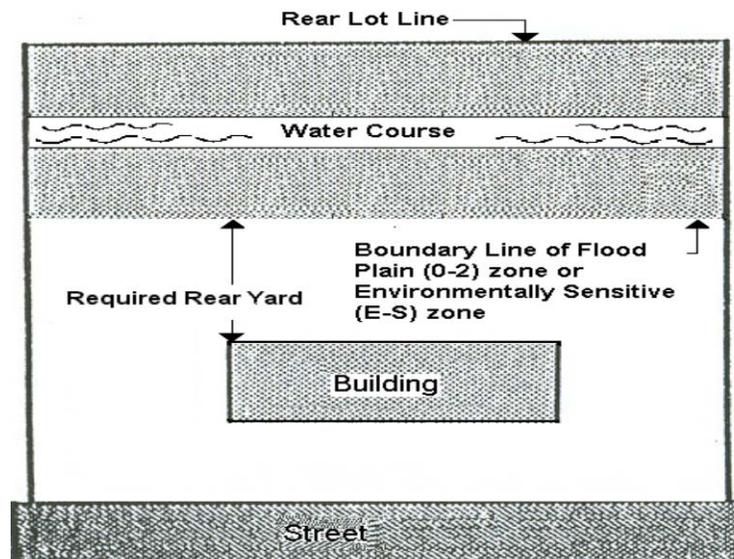
*8.58(B) It shall be the intention of Council to support and promote the development of community gardens with the aim of creating additional open green space; with the aim of creating a more liveable social community environment; and, as a way of developing and promoting the use of local produce as a means of becoming more self reliant and less dependent on produce from away effectively reducing the community's carbon footprint.*

*8.78 It shall be the intention of Council to promote cleaner air, cleaner water and the lowering of green house gas emissions through the minimization of preventable pollutants and the protection of the natural environment in an effort to sustain the community.*

The Town currently has developed “adaptation” safeguards for development proposals along Broad Brook. These include a prohibition of development in the Floodplain (O-2) zone and the Environmentally Sensitive (E-S) zone as well as special set-back requirements measured from the Environmentally Sensitive (E-S) zone boundary rather than the property line to ensure that developments maintain an appropriate distance away from the Broad Brook. Part 5.35 and Part 5.36 of the Land Use By-law are provided below:

### **5.35 Adjacent Yard Requirements: Floodplain (O-2) Zone & Environmentally Sensitive (E-S) Zone**

Notwithstanding anything else in this By-law, no development permit shall be issued for any building or structure on lands located adjacent to the Floodplain (O-2) zone or the Environmentally Sensitive (E-S) zone unless the required yard set-back is measured from the nearest main wall of any building or structure to the boundary line of the Floodplain (O-2) zone or the Environmentally Sensitive (E-S) zone.



### **5.36 Broad Brook Upper Marsh**

(1) Schedule "B" of this By-law identifies the Upper Marsh of Broad Brook. No development permit shall be issued for any permitted use on lands located within the marsh lands identified on Schedule "B" unless the minimum elevation at building grade exceeds 28.96m (95 ft) above mean sea level. In addition, any use including, but not limited to, accessory uses, outdoor storage or displays and parking lots on lands located within Upper Marsh as identified on Schedule "B" shall also be established on a grade that exceeds 28.96m (95 ft.) above mean sea level.

(2) Notwithstanding anything contained in this part, a Municipal development permit may be issued for development within "Upper Marsh" which does not conform with the minimum elevations prescribed above provided that a study by a qualified engineer has identified such other development standards to ensure that the development will not be subject to flooding or subsidence.

The Town's Integrated Community Sustainability Plan also addresses issues with regard to Broad Brook:

*8.48 It shall be the intention of Council to require that any public work projects install a stormceptors or equivalent device to remove storm water pollutants prior to discharge into the Broad Brook waterway system or into Yarmouth's harbour.*

The Town's Integrated Community Sustainability Plan also addresses issues with regard to the Town's Waste Water Treatment facility:

*8.38 It shall be the intent of Council to undertake a storm water/sanitary sewer separation program to minimize the amount of storm water treatment, thereby lowering the overall cost of treatment, and becoming more efficient and sustainable by freeing up the waste water treatment plant's capacity.*

As previously stated, the Town has partnered with the Atlantic Climate Adaptation Solutions Association (ACASA), a joint venture with the Nova Scotia Department of Environment (NSDE) and Natural Resources Canada to study the effects of storm surge and sea-level rise events associated with climate change. This is in line with Policy 8.49 of the Town's ICSP and its regional approach with the Municipality of the District of Yarmouth to develop a storm surge adaptation plan as part of this Climate Change Adaption Study. The corresponding policies of the ICSP are outlined below:

*8.49 It shall be the intention of Council to undertake a Climate Change Adaptation Study to identify potential impacts from sea-level rise and storm surges through a risk assessment and to implement safe guards to minimize the effects of climate change along Yarmouth's waterfront.*

*8.76 It shall be the intention of Council to cooperate with adjacent and nearby municipalities with regards to the following:*

...

*(3) A collaborative regional approach to enhance the region's capabilities to adapt to climate change through the use of shared knowledge and mapping/modeling resources to help anticipate climate change impacts and coordinated planning and development of appropriate emergency measures;*

... .

The Town of Yarmouth intends, as part of this process, to incorporate climate change policies into their Municipal Planning Strategy and implement these policies through Land Use By-law provisions. These amendments will help minimize climate change impacts on developments associated with sea-level rise and storm surge events. Amendments to the Town's Municipal Planning Strategy and Land Use By-law are outlined in Appendix "C" of this report.

In the Waterfront Industrial (M-2) zone, Part 24.5 of the Land Use By-law enables the minimum rear yard set-backs to be waived where they directly abut Yarmouth's harbour. In addition, Part 20.3 of the Land Use By-law enables the minimum rear yard set-backs of developments located in the Waterfront Commercial Industrial (WCI-5) zone to be waived where they directly abut Yarmouth's harbour. The Open Space (O-1) zone does not specify any minimum set-back standards. Though the Low Density Residential (R-1) zone, the Institutional (I-1) zone and the Residential Holding (R-H) zone specifies minimum set-back provisions, the majority of the lands along the harbour fall under the Waterfront Commercial Industrial (WCI-5) zone and the Waterfront Industrial (M-2) zone which waive set-back requirements enabling developments right up to the harbour's edge, and in some cases beyond the water's edge making them very vulnerable to storm surges and sea-level rise impacts. This may be a necessary evil as working waterfronts require the ability to develop buildings, structures and uses adjacent to the channel to service marine related industries. However, as a precaution, Council should consider the feasibility of requiring certain developments to undertake a storm surge/sea-level rise vulnerability assessment if located below the minimum vertical elevation standards as prescribed under the Land Use By-law.

**CC-19 It shall be the intention of Council to include in the Land Use By-law special provisions within the "Climate Change Storm Surge and Sea Level Rise Sensitive Area" which supersede any other Land Use By-law provisions with regards to the following: minimum climate change building grade elevations, minimum wharf grade elevations, minimum separation standards from the ordinary high water mark, and minimum standards related to the elevation and minimum separation standards from the ordinary high water mark of any hazardous materials whether contained in a building or not.**

**CC-20 It shall be the intention of Council to include in the Land Use By-law a provision requiring any additions to any building or any additions to any wharves located within the "Climate Change Storm Surge and Sea Level Rise Sensitive Area" which does not conform with the minimum climate change building grade elevation and/or minimum separation standards from the High Water Mark (HWM) requirements prescribed in the Land Use By-law to undertake a study (a storm surge/sea-level rise vulnerability assessment) by a qualified engineer identifying such other development standards that ensures that the development will not be subject to flooding or subsidence caused by climate change impacts. The change in use of any building shall be exempt from this requirement provided there are no additions and**

provided the building does not include the storage of any hazardous materials. Any storage of any new hazardous materials whether contained in a building or outside any building shall be required to meet the minimum climate change building elevations and minimum separation standards from the ordinary High Water Mark (HWM) requirements as prescribed in the Land Use By-law.

The following matrix outlines the concerns regarding storm surges/sea-level rise and intense rain fall events. These concerns are not in any particular order of importance:

	<b>Storm Surge/Sea-level Rise:</b>
<b>Concern:</b>	Fishing industry – boats, wharfs, supplies, access and egress are vulnerable.
<b>Concern:</b>	Buildings (including Ice Plant, Ferry Terminal, Waterview Machine Works, Rudders Restaurant, Surcor Energy Bulk Plant, Waste Water Treatment Facility and others) along Water Street are vulnerable, particularly those below the 6m CGVD28 contour.
<b>Concern:</b>	Private and Public Infrastructure – roads, sewer, water, power, telephone, cable, internet, Milton Bridge (sewer/water), Milton Dam, Ferry Terminal, Killam’s Wharf and Marina, Scotia Gardens Seafoods/Sweeney’s Museum, Rudder’s Restaurant, Private and Public Wharfs, IMO Foods, Lobster Pound, emergency boat ramp and Hartlin’s Trail are vulnerable.
<b>Concern:</b>	Residential developments, particular those below the 6m CGVD28 contour (Millstone Terrace, Lake Milo Main Street Area, Vancouver Street, Market Street Area) and Hospital – access and egress concerns with sewer and water concerns.
<b>Concern:</b>	Hospital - access and egress concerns; and, potable water concerns.
<b>Concern:</b>	Environmental concerns, impacts on Yarmouth’s harbour and the lake system, in particular, Lake Milo.

	<b>Intense Rain Fall Events:</b>
<b>Concern:</b>	Coastal flooding concerns identified under Storm Surge and Sea-level rise matrix above.
<b>Concern:</b>	In-land flooding - Buildings along Broad Brook - Access and egress concerns (cut-off) - Emergency response concerns
<b>Concern:</b>	In-land flooding - Sanitary and storm sewer back-ups
<b>Concern:</b>	In-land flooding - Environmental contamination concerns

The following matrix outlines the effects regarding storm surges/sea-level rise and intense rain fall events and their action priority ranking:

<b>Effects on Town</b>	<b>Storm Surge and Sea-level Rise</b>	<b>Action Priority Ranking</b>
<b>Social</b>	Access and egress of people along the waterfront is a concern – Emergency Evacuation Plan.	High
	Impacts on social assets such as the Hartlin Trail, Killam’s Marina, Sweeney’s Museum, Rudder’s Restaurant, Public Wharf’s, Milton Dam Park and Clock Tower Park.	High
	Impacts on Yarmouth Regional Hospital with regard to access and egress, operational issues, power and water services. Access to supplies and manpower.	High
<b>Economic</b>	Fishing Industry could be severely affected by storm surge damage to wharves and associated infrastructure.	High
	Economic production (Fish Plants et al.) and employment along the waterfront will be disrupted.	High
	Damage to ferry infrastructure.	High
<b>Environmental</b>	Contamination from fuel and other petroleum products stored along the waterfront could occur during floods and extreme storm events.	High
	Increased contaminates from storm sewer outlets and pumping stations. Over-flow of untreated sewer from Waste Water Treatment Facility impacting Yarmouth’s harbour.	High
	Breach of Milton Bridge, disruption in sewer and water services, especially to the hospital; access and egress issues; and, sanitary sewer breach at bridge.	High
Breach of Milton Dam would cause severe environmental issues related to fish habitat.	High	

<b>Infrastructure</b>	Culverts and catch basins may be designed too small to handle new volumes associated with climate change impacts or become blocked by debris causing flooding and road washouts. Road washouts may cause disruptions in transportation and hamper access and egress activities (emergency response issues).	High
	Sanitary and storm sewers may be hampered causing buildings to flood (need for back-flow preventers) as well as impacts on the Waste Treatment Facility and associated environment impacts on Yarmouth's harbour.	High
	Power, telephone, cable, internet (communications) disruptions will occur.	High
<b>Other</b>	Shoreline riprap (sea-walls) will require modifications and maintenance to accommodate storm surges and rising sea-levels.	High

<b>Effects on Town</b>	<b>Intense Rain Fall Events</b>	<b>Action Priority Ranking</b>
<b>Social</b>	Access and egress of people along Broad Brook is a concern – Emergency Evacuation Plan.	Medium
	Impacts on recreational facilities such as trails, Broad Brook Recreational Complex and the Yarmouth Golf and Country Club.	Medium
<b>Economic</b>	Localized surface flooding and flooding in buildings, back-up of sanitary sewer systems – need for back-flow preventers.	Medium
<b>Environmental</b>	Increased contaminates from storm sewer outlets – need for stormceptors.	High
<b>Infrastructure</b>	Culverts and catch basins may be designed too small to handle new volumes associated with climate change impacts or become blocked by debris causing flooding and road washouts. Road washouts may cause disruptions in transportation and hamper access and egress activities (emergency response issues).	High

## Moving Towards Adaptation:

The following matrix outlines adaptation options worthy of consideration regarding storm surges/sea-level rise and intense rain fall events and are not in any particular order of importance:

	<b>Adaptation Options Under Consideration - Storm Surges</b>
<b>Action:</b>	Amendments to MPS/LUB to safeguard developments from storm surges and sea level rise impacts.
<b>Action:</b>	Undertake Waste Water Treatment Plant study to minimize the effects of storm surges and sea level rise.
<b>Action:</b>	Up-grades to Milton Bridge (sewer/water) to consider the effects of storm surges and sea level rise.
<b>Action:</b>	Undertake and implement plan to safeguard Water Street developments, such as up-grades to shoreline riprap (seawalls) and creation of retention ponds in strategic locations along Water Street. Plan should consider options (protect, accommodate, retreat, avoid) and their cost benefit.
<b>Action:</b>	Undertake study and implement environmental safeguards for storm sewer outfalls into Yarmouth's harbour and the Lake system (Stormceptor Program).
<b>Action:</b>	Revise Emergency Management Plan in light of storm surges and sea level rise impacts associated with climate change.
<b>Action:</b>	Work cooperatively with the Municipality of the District of Yarmouth in minimizing storm surge and sea level rise impacts along our coastline.

	<b>Adaptation Options Under Consideration - Intense Rainfall</b>
<b>Action:</b>	Amendments to Subdivision By-law to incorporate "green" infrastructure standards.
<b>Action:</b>	Undertake study and implement environmental safeguards for storm sewer outfalls into Broad Brook, Yarmouth's harbour and Lake Milo (Stormceptor Program).
<b>Action:</b>	Undertake Intense Rainfall Event Impact Study complete with Digital Elevation Models based on intense rainfall event scenarios.
<b>Action:</b>	Develop and implement a Storm Water Management Plan and a Lot Grading By-law.
<b>Action:</b>	Revise Emergency Management Plan in light of flooding impacts associated with climate change along the Broad Brook watershed system.
<b>Action:</b>	Work cooperatively with the Municipality of the District of Yarmouth in minimizing intense rain fall impacts along Broad Brook, Yarmouth's harbour and Lake Milo, Second Lake and Doctor's Lake.

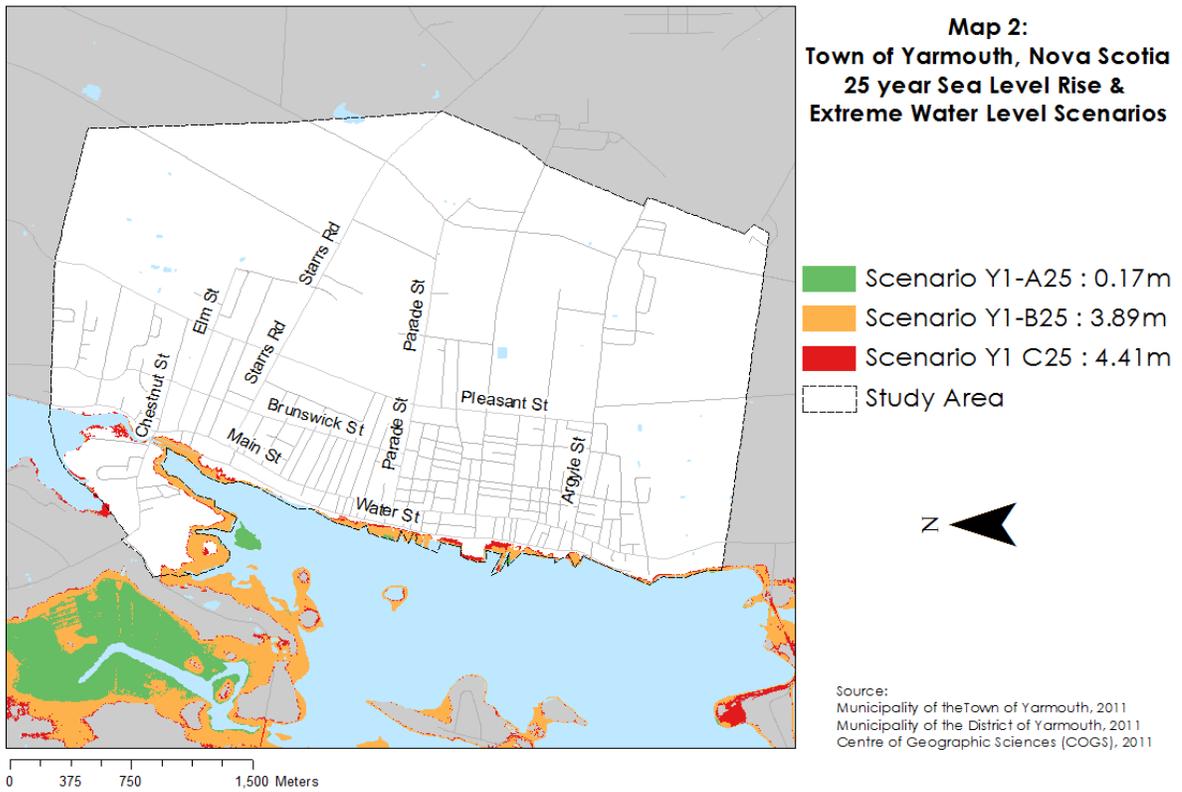
The following matrix outlines adaptation projects. The projects are ranked in order of importance but not necessarily in order of implementation. For example, it is extremely important to safeguard the Town Waste Water Treatment Plant and was given a Ranking of #1; however the redevelopment of the Waste Water Treatment Plant will not be undertaken until it is time for its refurbishment in the 2040's.

<b>Locations:</b>	<b>Ranking:</b>	<b>Projects:</b>	<b>Time Frame:</b>
Waste Water Treatment Facility	#1	2040 – Refurbishment.	2040
Suncor Bulk Plant (166 Water Street)	#2	Purchase 166 Water Street and relocate business.	2050
Milton Bridge (sewer, water and access concerns)	#3	Milton Bridge (Sewer and Water) Protection. Alternative access to hospital.	2030
514 Water Street	#4	Purchase 514 Water Street and remove the building and purchase additional lands 500 Water Street, 270 Water Street and 258 Water Street for Waterfront park. (In keeping with plan to safeguard Water Street developments identified under “Actions”.)	2050
Waterview Machine Works	#5	Relocate/Riprap Protection. Raise Grade Levels.	2040
Riprap shoreline Protection to the 6m CGVD28 contour at strategic locations along the waterfront	#6	Install riprap along shoreline.	2040
North End Water Street		Riprap Protection.	2050
Scotia Garden’s Seafoods And IMO Foods Limited		Riprap Protection.	2040
Water Street	#7	Implement Water Street Drainage Plan - Retention ponds.	2050
Sanitary Sewer Lift Stations	#8	Undertake study and Implement – Issues with capacity of Water Street sanitary and storm sewer systems.	2050

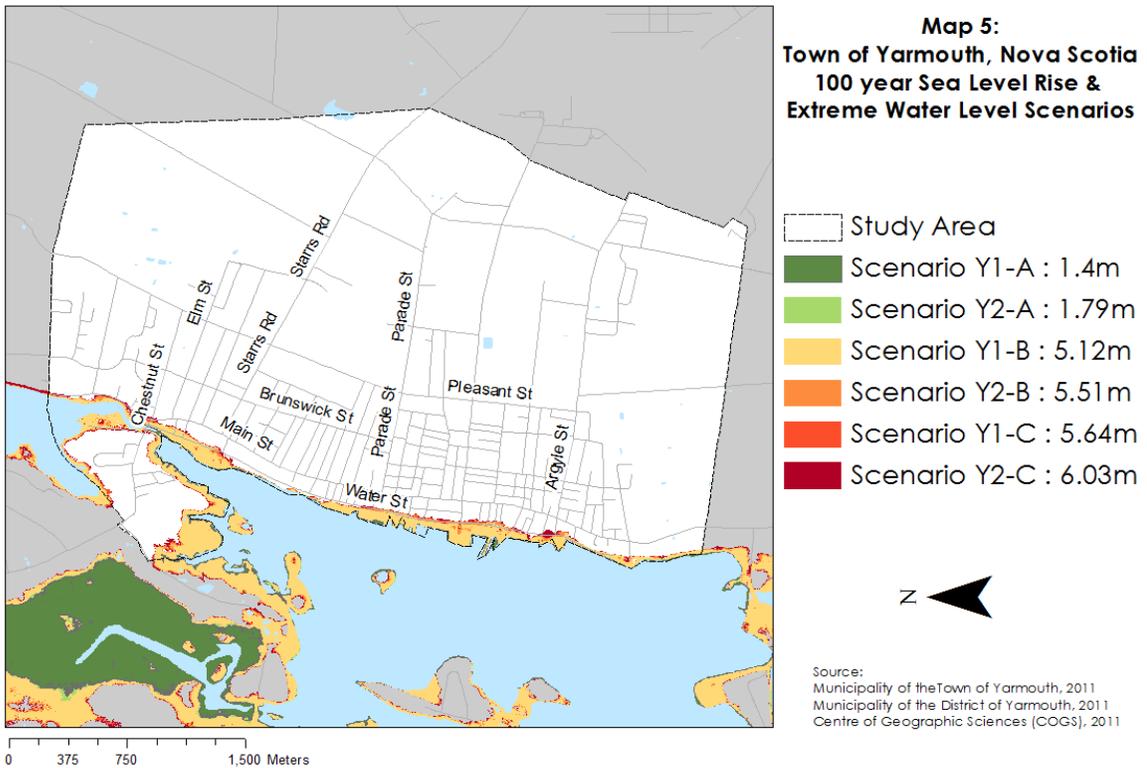
### **Amendments to Municipal Planning Strategy and Land Use By-law**

Dalhousie University undertook a study of storm surge and sea level rise scenarios and infrastructure at risk. The study outlined twenty five (25) year and one hundred (100) year storm scenarios with the following results:

<b>Scenario:</b>	<b>25 Year:</b>	<b>Scenario:</b>	<b>100 Year:</b>
<b>Y1-A25</b>	0.17m CGVD28	<b>Y1-A</b>	1.40m CGVD28
		<b>Y2-A</b>	1.79m CGVD28
<b>Y1-B25</b>	3.89m CGVD28	<b>Y1-B</b>	5.12m CGVD28
		<b>Y2-B</b>	5.51m CGVD28
<b>Y1-C25</b>	4.41m CGVD28	<b>Y1-C</b>	5.64m CGVD28
		<b>Y2-C</b>	6.03m CGVD28



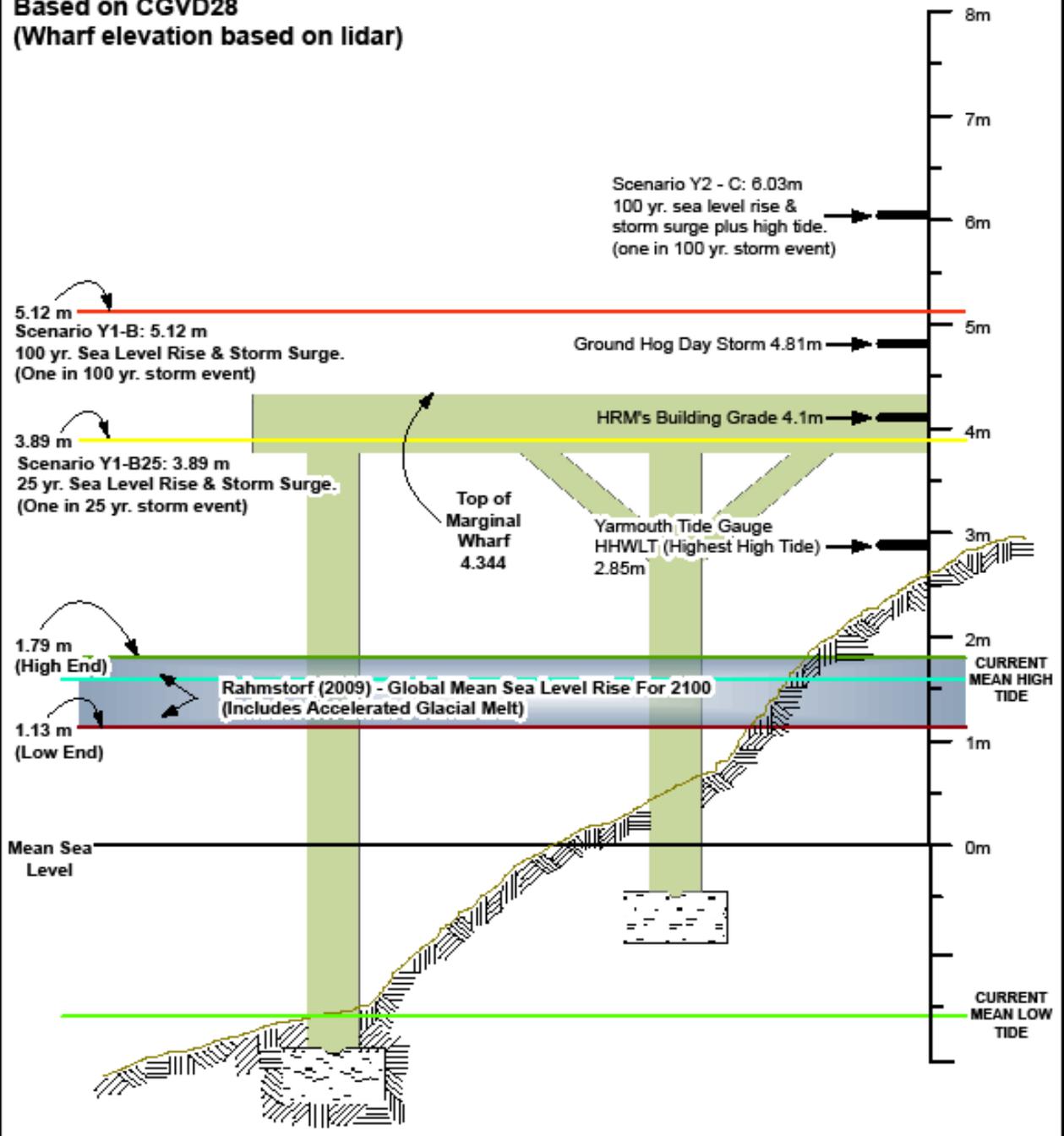
Source: ACASA, Yarmouth: A Case Study in Climate Change Adaptation. Part 2 – Section 1, Future Sea Level Rise and Extreme Water Level Scenarios for Yarmouth, Nova Scotia; Jonathan Critchley, Justin Muise, Eric Rapaport and Patricia Manuel, School of Planning, Dalhousie University, Halifax, N.S.



Source: ACASA, Yarmouth: A Case Study in Climate Change Adaptation. Part 2 – Section 1, Future Sea Level Rise and Extreme Water Level Scenarios for Yarmouth, Nova Scotia; Jonathan Critchley, Justin Muise, Eric Rapaport and Patricia Manuel, School of Planning, Dalhousie University, Halifax, N.S.

# Town of Yarmouth

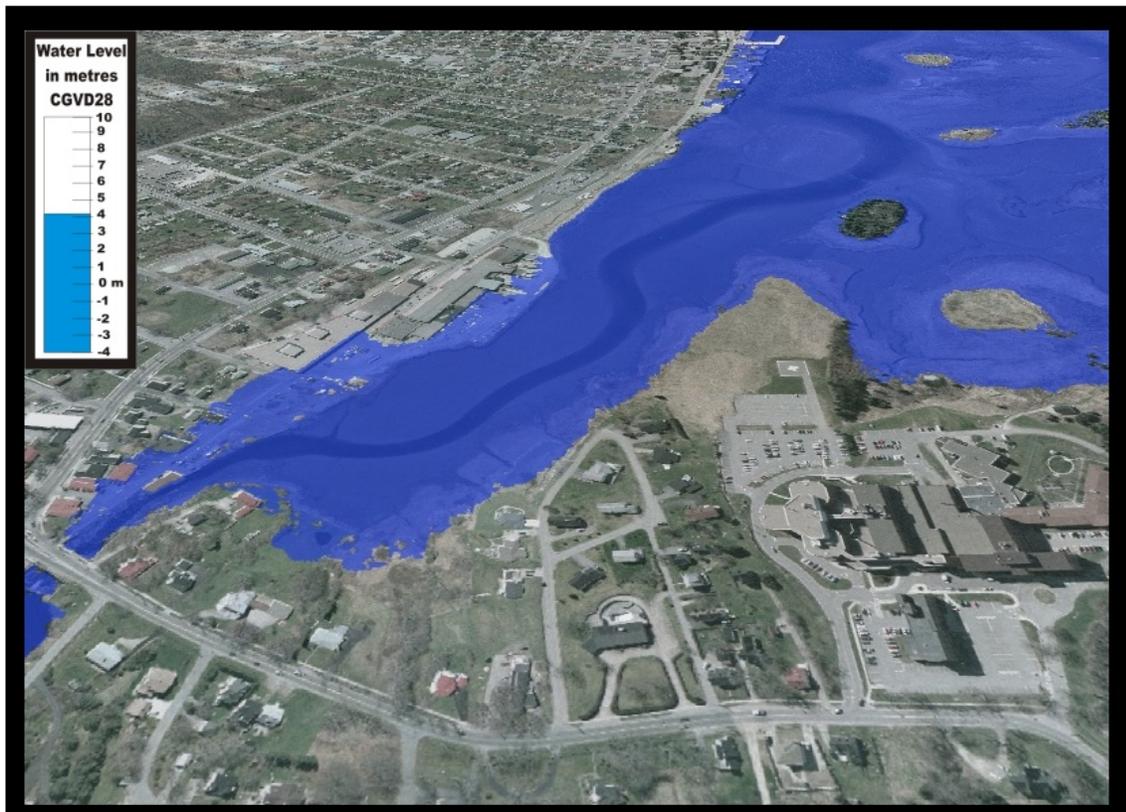
Based on CGVD28  
(Wharf elevation based on lidar)



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**CROSS - SECTION:** **SCALE: 1:50**

Source: Town of Yarmouth



Source: Lidar processing and Flood Risk Mapping for Coastal Areas in the District of Lunenburg, Town and District of Yarmouth, Chignecto Isthmus and Minas Basin  
 Dr. Tim Webster, Kevin McGuigan and Candace MacDonald, Applied Geomatics Research Group.



Source: Lidar processing and Flood Risk Mapping for Coastal Areas in the District of Lunenburg, Town and District of Yarmouth, Chignecto Isthmus and Minas Basin  
 Dr. Tim Webster, Kevin McGuigan and Candace MacDonald, Applied Geomatics Research Group.

The implementation of minimum building grade elevations should strike a balance between safeguarding developments from the adverse affects of storm surges and sea-level rise and the economic desires of developers and the needs of users along Yarmouth’s working waterfront. Water dependent uses that need to be adjacent to the waterfront need safeguard standards that are different than non-water dependent uses. Non-water dependent uses should be stepped back further from the water’s edge and elevated higher to minimize any adverse affects. It is also important to understand that the science of predicting sea-level rise and storm surge impacts will improve over time and planning provisions will need to adapt to new information as it becomes available.

The following table proposes a two (2) phase implementation procedure:

<b>Time Period:</b>	<b>Minimum Building Grade Elevation:</b>
<b>Present - 2050</b>	<b>4.8m CGVD28</b> (Ground Hog Day Storm 4.81m CGVD28)
<b>2051 - 2100</b>	<b>5.4m CGVD28</b>

It should be noted that the above minimum building grade elevations will not ensure that buildings will not be impacted by storm surges, especially since the scenarios did not factor in the impacts of wave run-up, however they should help to minimize their impacts. Storm drainage systems along Water Street should be up-graded and oversized to provide an avenue for surface water to exit the street right-of-way and adjoining lots in such a fashion to minimize their impacts.

In light of the above, the following principles for implementing minimum standards have been developed:

**1) Main buildings should be treated differently than accessory buildings:**

Main buildings should have a larger set-back from the water’s edge and have a higher minimum building grade elevation than accessory buildings.

**2) Water dependant buildings should be treated differently than non-water dependant buildings:**

Non-water dependant buildings should have a larger set-back from the water’s edge and have a higher minimum building grade elevation than water dependant buildings.

**3) Minimum standards should be implemented over a period of time and adjusted as new information regarding sea-level rise and storm surge events become available.**

4) Minimum grade level standards should be introduced for storage of hazardous material such as, but not limited to, oil, gas and propane.

5) Developments along Water Street should not be built to a grade elevation below the grade elevation of the directly abutting street grade elevation.

**Main Buildings (Non-Water Dependent):**

<b>Time Period:</b>	<b>Minimum Building Grade Elevation:</b>	<b>Minimum Building Set-back:</b>
<b>Present - 2050</b>	<b>4.8m CGVD28</b>	<b>7.6m (25ft.) from HWM</b>
<b>2051 - 2100</b>	<b>5.4m CGVD28</b>	<b>7.6m (25ft.) from HWM</b>

**Accessory Buildings (Non-Water Dependent):**

<b>Time Period:</b>	<b>Minimum Building Grade Elevation:</b>	<b>Minimum Building Set-back:</b>
<b>Present - 2050</b>	<b>4.6m CGVD28</b>	<b>3.05m (10ft.) from HWM</b>
<b>2051 - 2100</b>	<b>5.2m CGVD28</b>	<b>3.05m (10ft.) from HWM</b>

**Main Buildings (Water Dependent):**

<b>Time Period:</b>	<b>Minimum Building Grade Elevation:</b>	<b>Minimum Building Set-back:</b>
<b>Present - 2050</b>	<b>4.6m CGVD28</b>	<b>Waived from HWM</b>
<b>2051 - 2100</b>	<b>5.2m CGVD28</b>	<b>Waived from HWM</b>

**Accessory Buildings (Water Dependent):**

<b>Time Period:</b>	<b>Minimum Building Grade Elevation:</b>	<b>Minimum Building Set-back:</b>
<b>Present - 2050</b>	<b>4.4m CGVD28</b>	<b>Waived from HWM</b>
<b>2051 - 2100</b>	<b>5.0m CGVD28</b>	<b>Waived from HWM</b>

**Hazardous Materials (Oil, Gas, Propane, etc.) whether contained in a building or not - (Non-Water Dependant):**

<b>Time Period:</b>	<b>Minimum Grade Elevation:</b>	<b>Minimum Set-back:</b>
<b>Present - 2050</b>	<b>4.8m CGVD28</b>	<b>6.1m (20ft.) from HWM</b>
<b>2051 - 2100</b>	<b>5.4m CGVD28</b>	<b>6.1m (20ft.) from HWM</b>

**Hazardous Materials (Oil, Gas, Propane, etc.) whether contained in a building or not - (Water Dependant):**

<b>Time Period:</b>	<b>Minimum Grade Elevation:</b>	<b>Minimum Set-back:</b>
<b>Present - 2050</b>	<b>4.8m CGVD28</b>	<b>Waived from HWM</b>
<b>2051 - 2100</b>	<b>5.4m CGVD28</b>	<b>Waived from HWM</b>

\* **HWM** means the Ordinary High Water Mark as defined in the Land Use By-law.

## **Conclusion:**

Upon review of climate change impacts, the Town of Yarmouth needs to focus on areas along Yarmouth's waterfront that are most vulnerable to storm surges and sea-level rise. Studies have suggested that developments below the 6m CGVD28 contour elevation are vulnerable to these impacts. A Consolidated Storm Surge Map (Map 6 – Appendix "A") and a Sea Level Rise Map (Map 7 and Map 7A – Appendix "A") are enclosed in Appendix "A". The importance of the local fishing industry is paramount and safeguards are required to minimize their climate change impacts. Wharves, boats, buildings and storage of hazardous materials need to be protected. Minimum development standards will be implemented through the Town's Municipal Planning Strategy and Land Use By-law to safeguard new developments from the impacts of storm surge and sea-level rise. These standards are incorporated as amendments to the Town's Municipal Planning Strategy and Land Use By-law as outlined in the Appendix "C" of this report.

The Town's Waste Water Treatment Facility is located below the 6m CGVD28 contour elevation and is due for a major retrofit in the next twenty five (25) to thirty (30) years. Concerns regarding the building, its operations and environmental overflows have been identified and should be addressed in any retrofit redevelopment of the facility. The Town should continue with its sanitary storm sewer separation program to reduce the amount of waste water treatment and consequently the amount of untreated overflows entering the harbour.

The Milton Dam renovations have been completed (2012). The Milton Bridge (Vancouver Street) has also been identified as a concern with regards to access to the regional hospital and surrounding areas. If the bridge washes out, concerns have been raised with regards to the impacts on sewer and water services in case of a break, leaving the area west of the bridge without adequate services. There is also a potential for contamination if the sewer collection line is damaged during a severe weather event. If the bridge washes out an alternative route to the hospital will be required. Emergency plans need to adapt to minimize these potential impacts.

Intense rainfall events will impact the Broad Brook Watershed system causing localized flooding and impacts on municipal infrastructure such as culverts, storm sewer outfalls and roadways. During these events certain areas will become isolated (cut-off) and emergency plans need to adapt and plan for these events.

The conclusion of this Climate Change Action Plan is not the end, but rather the beginning of the planning process for a sustainable Climate Change Action Plan. As new information arises, the plan will be updated to address changing circumstances. Therefore, the Plan will be reviewed and up-dated periodically as new information and new circumstances deem warranted.

## Climate Change Action Initiatives

A description of actions, measures, practices and initiatives undertaken by the Town in order to reduce community and corporate green house gas emissions:

### **1) Transportation:**

Council is committed to implementing policies of the Integrated Community Sustainability Plan (ICSP) to promote the efficiency of the transportation network in an effort to reduce greenhouse gases; to consider the establishment of a transit authority; to help facilitate “car pooling” initiatives and “park and ride” facilities; to further develop the active transportation plan; to support local active transportation community groups; and, to undertake amendments to the Towns’ Subdivision By-law to encourage “green” infrastructure facilities.

Council will consider the feasibility of adopting a corporate and community anti-idling By-law/Policy.

### **2) Community and Corporate Energy Consumption:**

Council is committed to considering the recommendations of the Towns’ Energy Audit in an effort of reducing its carbon footprint by reducing green house gas emissions.

Council will consider encouraging and educating the corporate sector to reduce their own carbon footprint and reduce green house gas emissions.

That Council is committed to considering a study of their operational vehicle fleet in an effort to reduce green house gas emissions and consider the implementation of a Municipal Green Fleet Transition Plan.

### **3) Greenery and the Natural Environment:**

Council is committed to increasing the Towns’ foliage by considering implementing a “Green Policy” in an effort to beautify the Town and reduce green house gases and heat islands.

Council is committed to supporting community gardens as a means of reducing the community’s carbon footprint by increasing local food production.

Council is committed to promoting clearer air, clearer water and lowering green house gas emissions through the minimization of preventable pollutants and the protection of the natural environment as a means to reduce the community’s carbon footprint.

## Climate Change Action Initiatives

A description of actions, measures, practices and initiatives undertaken by the Town in order to adapt and respond to impacts resulting from climate change:

### 1) Municipal Planning Strategy and Land Use By-law Amendments:

As outlined in this report.

### 2) Municipal Subdivision By-law – Lot Grading By-law:

Council is committed to review its Subdivision By-law to incorporate sustainable “green” infrastructure standards and other sustainable attributes as a means of addressing the impacts of Climate Change.

Council is committed to adopting a Lot Grading By-law to address issues of surface run-off in light of the anticipated impacts associated with Climate Change.

### 3) Collaborative Regional Approach:

Council is committed to working with adjacent municipalities, regional organizations and community groups to share knowledge and expertise in a joint effort to mitigate the effects of Climate Change.

### 4) Emergency Measures Organization:

Council is committed to working with the Joint Emergency Measures Organization and support groups to help anticipate and minimize the impacts of Climate Change.

Council is committed to working with Operational Services and the Emergency Measures Organization to undertake a risk assessment and develop a plan to minimize the adverse affects of storm events in order to maintain an adequate level of service.

Council is committed to working with Operational Services, Emergency Measures and Nova Scotia Power with respect to power outages and life safety issues associated with storm surge/sea level rise events along Water Street and develop a plan to minimize potential adverse affects associated with Climate Change.

Council is committed to working with Operational Services, Emergency Measures, Emergency Health Services and the RCMP to minimize the adverse affects of Climate Change, in particular any concerns regarding potential damage to the Milton Bridge (sewer and water impacts) due to storm surge/sea-level rise events and developing an alternative route and/or temporary crossing to maintain the transportation link to the Yarmouth Regional Hospital.

### 5) Risk Assessment:

Council is committed to developing a Town wide inventory of climate change risks and vulnerabilities and conduct a risk assessment to prioritize potential impacts; to assess mitigation or adaptation measures; and, to develop and implement strategies for alleviating the adverse affects of Climate Change.

**6) Waste Water Treatment Facility:**

**Council is committed to developing a plan to address storm surge/sea-level rise impacts on the Town's Waste Water Treatment Facility and to consider undertaking a study of the potential impacts on Yarmouth harbour's coastal environments with regards to untreated over-flows during peak storm events.**

**7) Towns' Infrastructure:**

**Council is committed to developing a plan to address storm surge/sea-level rise impacts on the Town's infrastructure (sanitary and storm sewer systems, water systems and roadways (including road culverts)) and to consider undertaking a study to identify the risks and actions required to minimize the effects by implementing safeguards such as, but not limited to, back-flow preventers, storm drainage holding (retention) ponds and similar devices.**

**Council is committed to considering the implementation of a Storm Water Management Plan in light of Climate Change impacts and undertake a study on the impacts of intense rainfall events associated with climate change impacts with particular attention on the Broad Brook watershed system; the lake system; and, Yarmouth's harbour.**

**Council is committed to developing a plan to minimize the affect of climate change impacts along inland waterways (Broad Brook) by undertaking a Climate Change Intense Rainfall event analysis.**

**Council is committed to establishing a fiscal responsible management program for the maintenance and up-keep of Town's streets to maintain an adequate level of service in light of climate change impacts.**

**8) Cooperation with adjacent and nearby municipalities:**

**Council is committed to cooperating with adjacent and nearby municipalities to combat the adverse affects of climate change.**

# **Appendix “A”**

## **Associated Climate Change Maps**

- 1) Areas Affected By Sea-Level Rise, Storm Surge and Heavy Rainfall Events: Map 1.**
- 2) Roads Affected by Various Storm Surge Heights: Map 2.**
- 3) Roads Affected by Various Storm Surge Heights: 2m, 4m and 6m Contour Elevations: Map 2A.**
- 4) Roads Affected by Various Storm Surge Heights: 3m, 5m and 7m Contour Elevations: Map 2B.**
- 5) Community Assets: Map 3.**
- 6) Community Assets: Map 3A.**
- 7) Hazards and Impacts: Map 4.**
- 8) Climate Change Assessment Value Impact: Map 5.**
- 9) Consolidated Storm Surge Map: 2m, 4m and 6m Contour Elevations: Map 6.**
- 10) Sea Level Rise – 4.5m Contour: Map 7.**
- 11) Sea Level Rise – 6m Contour: Map 7A.**
- 12) Town of Yarmouth Watershed Areas: Map 8. - Watershed Area Maps: Area 1 through Area 10.**

# **Appendix “B”**

## **Associated Climate Change Tables**

<b>Extreme Total Sea Level Tables and Plausible Bound Water Levels Tables.....</b>	<b>51</b>
<b>Global Sea Level Rise Projection Tables .....</b>	<b>52</b>
<b>Sea Level Rise and Extreme Water Level Scenarios for 2025, 2055, 2085 and 2100 .....</b>	<b>53</b>
<b>Water Levels and Relative Sea Level Rise Estimates for the Years 2025, 2055, 2085, 2100 in Yarmouth (in CGVD28) .....</b>	<b>54</b>
<b>Understanding Dalhousie’s 25 &amp; 100 Year Sea Level Rise Scenarios .....</b>	<b>55</b>
<b>The Probability of Experiencing a Storm of a Given Size in a Lifetime of 70 Years Table .....</b>	<b>56</b>
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<b>Summary of Richards and Daigle Climate Scenario Guidelines .....</b>	<b>58</b>

## Extreme Total Sea Level Tables and Plausible Bound Water Levels Tables:

Table B-10 Yarmouth HHWLT 5.16 (CD), Return Period levels taken directly from Yarmouth tide gauge.

### Extreme Total Sea Level (metres CD) - Yarmouth

Return Period	Residual	Level 2000	Level 2025	Level 2055	Level 2085	Level 2100
10- Year	0.68+-0.10	5.84+-0.10	5.99+-0.13	6.27+-0.25	6.67+-0.46	6.90+-0.58
25- Year	0.75+-0.10	5.91+-0.10	6.06+-0.13	6.34+-0.25	6.74+-0.46	6.97+-0.58
50- Year	0.81+-0.10	5.96+-0.10	6.12+-0.13	6.40+-0.25	6.80+-0.46	7.03+-0.58
100- Year	0.87+-0.10	6.02+-0.10	6.18+-0.13	6.46+-0.25	6.86+-0.46	7.09+-0.58

Richards, W., and R. Daigle. 2011. Scenarios and Guidance for Adaptation to Climate Change and Sea-Level Rise – NS and PEI Municipalities. August 2011. ACAS report prepared for the Climate Change Directorate, NS Environment. Available at: [http://atlanticadaptation.ca/ns\\_projects](http://atlanticadaptation.ca/ns_projects)

### Extreme Total Sea Level (metres CGVD28) - Yarmouth

Return Period	Residual	Level 2000	Level 2025	Level 2055	Level 2085	Level 2100
10- Year	0.68+-0.10	3.54+-0.10	3.68+-0.13	3.96+-0.25	4.36+-0.46	4.59+-0.58
25- Year	0.75+-0.10	3.60+-0.10	3.75+-0.13	4.03+-0.25	4.43+-0.46	4.66+-0.58
50- Year	0.81+-0.10	3.65+-0.10	3.81+-0.13	4.09+-0.25	4.49+-0.46	4.72+-0.58
100- Year	0.87+-0.10	3.71+-0.10	3.87+-0.13	4.15+-0.25	4.55+-0.46	4.78+-0.58

Conversion Factor from CD to CGVD28: Minus 2.31m

Table B-22 Plausible Upper Bound water levels for year 2100 calculated as the sum of: current HHWLT, predicted sea-level rise plus error bar, and the maximum storm surge recorded to date.

Site:	HHWLT (m) (CD)	Sea-level Rise (2100) + Error Bar (m)	Maximum Storm Surges to Date (See Note 1)	Plausible Upper Bound Water Level (m) (CD) by Year 2100 (See Note 2)
Yarmouth	5.16	1.54	1.49	8.19

Richards, W., and R. Daigle. 2011. Scenarios and Guidance for Adaptation to Climate Change and Sea-Level Rise – NS and PEI Municipalities. August 2011. ACAS report prepared for the Climate Change Directorate, NS Environment. Available at: [http://atlanticadaptation.ca/ns\\_projects](http://atlanticadaptation.ca/ns_projects)

Site:	HHWLT (m) (CGVD28)	Sea-level Rise (2100) + Error Bar (m)	Maximum Storm Surges to Date (See Note 1)	Plausible Upper Bound Water Level (m) (CGVD28) by Year 2100 (See Note 2)
Yarmouth	2.85	1.54	1.49	5.88

Conversion Factor from CD to CGVD28: Minus 2.31m

HHWLT plus Sea-Level Rise = 4.39 m CGVD28 by the Year 2100.

HHWLT plus Sea-Level Rise plus Storm Surge = 5.88 m CGVD28 by the Year 2100.

Note 1. Storm surge values taken from tide gauge to site relationship as in Tables B 3 to B 23 (without % adjustments) with maximum surge values known for the respective CHS tide gauge data.

Note 2. The storm surge estimates do not include any increases from the current historical values due to future changes, such as potentially an increase in strength of storms.

## Global Sea Level Rise Projection Tables:

Source: ACASA, Yarmouth: A Case Study in Climate Change Adaptation. Part 2 – Section 1, Future Sea Level Rise and Extreme Water Level Scenarios for Yarmouth, Nova Scotia; Jonathan Critchley, Justin Muise, Eric Rapaport and Patricia Manuel, School of Planning, Dalhousie University, Halifax, N.S. (From Appendix “A”, Page 17).

**Global sea level rise projections based on different assumptions such as inclusion or exclusion of the full effects of glacial melt. The ranges in sea level rise shown for each projection are based on the United Nation International Panel on Climate Change Emissions scenarios:**

<b>IPCC (2007)</b> Global Sea Level by 2090-2099 (excludes accelerated Glacial Melt)	<b>Rahmstorf (2007)</b> Global Sea Level rise from 1990-2100 (excludes accelerated Glacial Melt)	<b>Rahmstorf &amp; Vermeer (2009)</b> Global Sea Level rise from 1990-2100 (includes accelerated Glacial Melt)
0.26 - 0.59 m	0.50 - 1.40 m	1.13 - 1.79 m

**Sea level rise upper limit projections adjusted to 25 and 100 year time frame and based on different assumptions such as inclusion or exclusion of glacial melt:**

<b>IPCC (2007)</b> Global Sea Level by 2100	<b>Rahmstorf (2007)</b> Global Sea Level by 2025 (Daigle, 2011)	<b>Rahmstorf (2007)</b> Global Sea Level by 2100	<b>Rahmstorf &amp; Vermeer (2009)</b> Global Sea Level by 2100
0.57 m*	0.14 m**	1.3 m	1.69 m***

\* Estimate does not include glacial melting.

\*\* Prorated non-linear (polynomial) increase of Rahmstorf (2007) 100-year global sea-level rise.

\*\*\* The melting of polar ice caps is predicted to reduce the gravitational pull on the nearby ocean resulting in water migrating away from the poles, potentially changing the earth's tilt (Mitrovica, 2009). This change could lead to some areas of the globe experiencing sea levels higher or lower than projected. These impacts are not included in the estimates.

### Local subsidence projections for Yarmouth by 2025 and 2100:

<b>Local Subsidence by 2025 (Daigle 2011)</b>	<b>Local Subsidence By 2100 (Daigle 2011)</b>
0.03 m*	0.10 m

\* Linear increase of local subsidence (25% of 0.10 m/century)

### Water levels for Yarmouth:

<b>Higher High Water at Large Tide (HHWLT)</b>	<b>100 Year Return Period Storm Surge Water Levels</b>	<b>Storm Surge Recorded During Benchmark Storms</b>
2.75 m	0.97 m	1.49 m - 1976 Groundhog Day Storm recorded in Yarmouth

## Sea Level Rise and Extreme Water Level Scenarios for 2025, 2055, 2085 and 2100:

Source: ACASA, Yarmouth: A Case Study in Climate Change Adaptation. Part 2 – Section 1, Future Sea Level Rise and Extreme Water Level Scenarios for Yarmouth, Nova Scotia; Jonathan Critchley, Justin Muise, Eric Rapaport and Patricia Manuel, School of Planning, Dalhousie University, Halifax, N.S. (From Appendix “A”, Page 17).

### Extreme Water Level Estimates for Yarmouth (CGVD28) for Storm Surge Return Periods of 25, 50 and 100 years for Years 2025, 2050, 2085, and 2100. Return Period Surge Heights Extracted from Yarmouth Tide Gauge Database):

Storm Surge Return Period	Storm Surge Height	Extreme Water Level 2025*	Extreme Water Level 2055*	Extreme Water Level 2085*	Extreme Water Level 2100*
10 Year Storm Surge Return Period	0.78 m	3.70 m	4.08 m	4.66 m	4.93 m
25-Year Storm Surge Return Period	0.85 m	3.77 m	4.15 m	4.73 m	5.00 m
50 Year Storm Surge Return Period	0.91 m	3.83 m	4.21 m	4.79 m	5.06 m
100 Year Storm Surge Return Period	0.97 m	3.89 m	4.27 m	4.85 m	5.12 m

### Extreme Sea Level Table:

Source: Richards, W., and R. Daigle. 2011. Scenarios and Guidance for Adaptation to Climate Change and Sea-Level Rise – NS and PEI Municipalities. August 2011. ACAS report prepared for the Climate Change Directorate, NS Environment. Available at: [http://atlanticadaptation.ca/ns\\_projects](http://atlanticadaptation.ca/ns_projects)

	2000	2025	2055	2085	2100
<b>Total Sea Level Rise (m)</b>		0.15 ± 0.03	0.43 ± 0.15	0.83 ± 0.36	1.06 ± 0.48
<b>Extreme TSL - 10 Yr Ret Period</b>	5.84 ± 0.10	5.99 ± 0.13	6.27 ± 0.25	6.67 ± 0.46	6.90 ± 0.58
<b>Extreme TSL - 25 Yr Ret Period</b>	5.91 ± 0.10	6.06 ± 0.13	6.34 ± 0.25	6.74 ± 0.46	6.97 ± 0.58
<b>Extreme TSL - 50 Yr Ret Period</b>	5.96 ± 0.10	6.12 ± 0.13	6.40 ± 0.25	6.80 ± 0.46	7.03 ± 0.58
<b>Extreme TSL - 100 Yr Ret Period</b>	6.02 ± 0.10	6.18 ± 0.13	6.46 ± 0.25	6.86 ± 0.46	7.09 ± 0.58

## Water Levels and Relative Sea Level Rise Estimates for the Years 2025, 2055, 2085, 2100 in Yarmouth (in CGVD28):

Source: ACASA, Yarmouth: A Case Study in Climate Change Adaptation. Part 2 – Section 1, Future Sea Level Rise and Extreme Water Level Scenarios for Yarmouth, Nova Scotia; Jonathan Critchley, Justin Muise, Eric Rapaport and Patricia Manuel, School of Planning, Dalhousie University, Halifax, N.S. .

Local Subsidence by 2025	Local Subsidence by 2100	Global Sea Level Rise by 2025 (Rahmstorf et al. 2007)	Global Sea Level Rise by 2100 (Rahmstorf et al. 2007)	Higher High Water at Large Tide	Relative Sea Level Rise by 2025*	Relative Sea Level Rise by 2055*	Relative Sea Level Rise by 2085*	Relative Sea Level Rise 2100*
0.03 m	0.10 m	0.14 m	1.3 m	2.75 m	0.17 m**	0.55 m***	1.13 m****	1.40 m

\* Relative Sea Level Rise is the combination of Local Subsidence and Rahmstorf et al. (2007) Global Sea Level Rise.

\*\* Includes linear increase of local subsidence (25%) + prorated non-linear (polynomial) increase of Rahmstorf et al. (2007) 100-year global sea level rise.

\*\*\* Includes linear increase of local subsidence (55%) + prorated non-linear (polynomial) increase of Rahmstorf et al. (2007) 100-year global sea level rise.

\*\*\*\* Includes linear increase of local subsidence (85%) + prorated non-linear (polynomial) increase of Rahmstorf et al. (2007) 100-year global sea level rise.

Community	Tide Gauge Location	Chart Datum minus CGVD28 (Lidar) relationship	Predicted Higher High Water Large Tide (HHWLT) m CGVD28	Benchmark Storm & Water Level CGVD28 From Tide Gauge (TG) or GPS	Projected Relative Sea-Level Rise by 2100 (min., Max) m
Town of Yarmouth	Yarmouth	2.31	2.85	Groundhog Day Feb. 2, 1976  3.36 m (TG)  4.81 m (GPS)	1m – 1.73m

Source: Lidar processing and Flood Risk Mapping for Coastal Areas in the District of Lunenburg, Town and District of Yarmouth, Chignecto Isthmus and Minas Basin

Dr. Tim Webster, Kevin McGuigan and Candace MacDonald, Applied Geomatics Research Group.(Table 2, Page 40).

**Higher High Water Large Tide (HHWLT)** means the average of the highest high waters, one from each of 19 years of predictions.

# Understanding Dalhousie's 25 & 100 Year Sea Level Rise Scenarios:

## 25 Year Sea Level Rise Scenarios:

Three (3) 25 Year Sea Level Rise scenarios were based on Rahmstorf et.al. (2007) projections and are broken down as follows:

**Y1-A25** - Local subsidence + Predicted incremental Global Sea Level Rise.  
- 0.03 + 0.14m  
- 0.17m CGVD28

**Y1-B25** - Combines Y1-A25 with HHWLT and 100 Year Return Period Storm Surge Water Level (1% chance of happening in any given year).  
- 0.17m + 2.75m\* + 0.97m  
- 3.89m CGVD28

\* Note: The Dalhousie Reports were completed prior to Richards-Daigle Report. The Richards-Daigle Report has the HHWLT at 2.85m therefore the Y1-B25 value should be 3.99m CGVD28.

**Y1-C25** - Combines Y1-A25 with HHWLT and Bench Mark Storm Surge Levels (1976 Ground Hog Day Storm).  
- 0.17m + 2.75m\* + 1.49m  
- 4.41m CGVD28

\* Note: The Dalhousie Reports were completed prior to Richards-Daigle Report. The Richards-Daigle Report has the HHWLT at 2.85m therefore the Y1-B25 value should be 4.51m CGVD28.

## 100 Year Sea Level Rise Scenarios:

Six (6) 100 Year Sea Level Rise scenarios were based on Rahmstorf et. al. (2007) projections and Rahmstorf et. al. (2009). Three (3) scenarios were based only on thermal expansions of the oceans where as the remaining three (3) scenarios were based on glacial melt and ice sheet contributions. As there is clear evidence of glacial melt, only the glacial melt scenarios (Y2) are broken down as follows:

**Y2-A** - Local subsidence + Predicted incremental Global Sea Level Rise.  
- 0.10m + 1.69m  
- 1.79m

**Y2-B** - Combines Y2-A with HHWLT and 100 Year Return Period Storm Surge Water Level (1% chance of happening in any given year).  
- 1.79 + 2.75m\* + 0.97m  
- 5.51m CGVD28

\* Note: The Dalhousie Reports were completed prior to Richards-Daigle Report. The Richards-Daigle Report has the HHWLT at 2.85m therefore the Y2-B value should be 5.61m CGVD28.

**Y2-C** - Combines Y2-A with HHWLT and Bench Mark Storm Surge Levels (1976 Ground Hog Day Storm).  
- 1.79m + 2.75m\* + 1.49m  
- 6.03m CGVD28

\* Note: The Dalhousie Reports were completed prior to Richards-Daigle Report. The Richards-Daigle Report has the HHWLT at 2.85m therefore the Y2-C value should be 6.13m CGVD28.

**The probability of experiencing a storm of a given size in a lifetime of 70 years Table:**

<b>Size of Storm</b>	<b>Chance of occurrence in any year</b>	<b>Probability of experiencing the given storm once in a lifetime (70 years)</b>	<b>Probability of experiencing the given storm twice in a lifetime (70 years)</b>
<b>1 in 10</b>	<b>10%</b>	<b>99.9%</b>	<b>99.3%</b>
<b>1 in 20</b>	<b>5%</b>	<b>97%</b>	<b>86.4%</b>
<b>1 in 50</b>	<b>2%</b>	<b>75.3%</b>	<b>40.8%</b>
<b>1 in 100</b>	<b>1%</b>	<b>50.3%</b>	<b>15.6%</b>
<b>1 in 200</b>	<b>0.5%</b>	<b>29.5%</b>	<b>4.9%</b>

**Source: New South Wales (NSW) Australia Floodplain Development Manual 2005.**

## Yarmouth Climate Table:

Source: Richards, W., and R. Daigle. 2011. Scenarios and Guidance for Adaptation to Climate Change and Sea-Level Rise – NS and PEI Municipalities. August 2011. ACAS report prepared for the Climate Change Directorate, NS Environment. Available at: [http://atlanticadaptation.ca/ns\\_projects](http://atlanticadaptation.ca/ns_projects)

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

	1980s	2020s	2050s	2080s
Heating Degree Days	4038.7	3663.0	3267.4	2892.9
Cooling Degree Days	21.0	49.8	106.0	189.4
Hot Days (Tmax > 30)	0.0	0.1	0.2	0.9
Very Hot Days (Tmax > 35)	0.0	0.0	0.0	0.0
Cold Days (Tmax < -10)	1.5	0.6	0.1	0.1
Very Cold Days (Tmax < -20)	0.0	0.0	0.0	0.0
Growing Degree Days > 5	1619.5	1858.6	2146.7	2466.8
Growing Degree Days > 10	707.2	869.6	1070.2	1294.2
Growing Season Length (days)	201.0	219.4	235.1	250.9
Corn Heat Units (CHU)	2329.3	2725.8	3144.8	3586.4
Corn Season Length (days)	153.9	169.7	183.6	196.4
Freeze Free Season (days)	234.6	255.9	276.5	294.4
Days With Rain	129.3	141.0	145.4	149.2
Days With Snow	50.3	50.3	41.8	34.3
Freeze-Thaw Cycles - Annual	88.7	78.9	65.5	53.5
Winter	45.7	45.3	41.9	38.3
Spring	29.0	23.2	17.1	11.6
Summer	0.0	0.0	0.0	0.0
Autumn	14.0	10.5	6.6	3.6
Water Surplus (mm)	846.9	770.9	739.0	718.6
Water Deficit (mm)	36.3	40.0	47.8	56.0
Δ Intensity Short Period Rainfall (%)	0	5	9	16

## Summary of Richards and Daigle Climate Scenario Guidelines:

Source: The Municipal Climate Change Action Plan Assistant – Learning From Others; By Elemental Sustainability Consulting Ltd., Prepared For Service Nova Scotia and Municipal Relations, Canada – Nova Scotia Infrastructure Secretariat, 2011 (Page 21).

Climate elements or indices	Projected change	Seasonal notes
Temperature	Increase	Winter warming the most
Precipitation	Increase	Greatest increase in moisture will likely come in winter
Heating Degree Days	Fewer	Warmer winter and shoulder season temperatures are likely to reduce the requirement for heating in the Maritimes
Cooling Degree Days	More	Warmer summer temperatures are likely to increase cooling demand, but the effect will vary by municipality
Hot Days (over 30° C) and Very Hot Days (over 35° C)	Slightly more	Na
Cold Days (< -10° C) and Very Cold Days (< -20° C)	Fewer	Na
Growing Degree Days	Substantial increase	Affects the choice in varieties of perennials we should be planting
Growing Season Length (Freeze Free Season)	Longer	Likely to increase by 1 to 2 months by 2100
# of Days with Rain and Days with Snow	Increase	More rain in winter—snow days turning to rain days
# of Times Passing Through Freeze-Thaw Cycle	Decrease	The number of freeze-thaw cycles in winter stays nearly the same or increases, and decreases in shoulder seasons
Water Surplus	Depends on municipality	Overall, changes are slight and poorly timed
Water Deficit	Increase	Increased summer water deficits
Change in Intensity Short Period Rainfall	Increase in Intensity (amount and duration)	Unknown

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