

11. Climate Change Adaptation

Preamble

Climate change could have far-reaching and unpredictable environmental, social and economic consequences. As a result of global warming, glaciers have been melting, sea levels have risen, and climate zones are shifting. Climate change is more than a warming trend. Increasing temperatures will lead to changes in many aspects of our weather. Some regions will experience more extreme heat, while others may cool slightly. Flooding, drought, and intense summer heat could result. Violent storms and other extreme weather events could also result from the increased energy stored in our warming atmosphere.

There are two (2) general strategies available to combat the effects 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”.

Realistically, because of considerable maritime risk from climate variability and extreme weather events, Yarmouth will not be able to adequately respond to these threats without incorporating a combination of risk management (“adaptation”), emergency preparedness and response, and greenhouse gas emissions reduction (“mitigation”) actions into its regular activities. The following will review existing provisions of the Town of Yarmouth and lay the foundation for future policy directives.

Mitigation: Integrated Community Sustainability Plan

The Town developed an Integrated Community Sustainability Plan (ICSP) which became effective on April 20th, 2010. The ICSP touches on both “mitigation” as well as “adaption” remedies to minimize the adverse effects of climate change.

The “mitigation” policies of the ICSP attempt to reduce greenhouse gas emissions. The ICSP promotes the development of an efficient

transportation network and the development of alternative transportation modes such as active transportation, transit and carpooling initiatives, and this Municipal Planning Strategy responds to these policies.

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 Town's ICSP also recognizes the importance of increasing the amount of tree foliage as a means of combating greenhouse gases and to this end has adopted a "Green Policy" to help beautify the Town and reduce greenhouse 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.

Adaptation: Sea Level Rise and Storm Surge

In 2013 the Town 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 impacts associated with climate change.

Public and Private Assets at Risk

As documented in the Town's *Municipal Climate Change Action Plan* (MCCAP), storm surge and sea-level rise scenarios predict a worst case sea level rise of 6.13 m by the end of the twenty-first century. In 2010, the Town had an assessment value of roughly \$ 22.8 million below the 6m contour. At the height of the Groundhog Day storm of February 2, 1976 there was a storm-driven surge in the water levels amounting to 4.81m above normal high tide, which demonstrated the economic impacts that storm events can have on investments. Storm events have the ability to severely impact the economy by damaging public and private infrastructure; damaging buildings and supplies; delaying employment opportunities and prolonging the recovery time to pre-storm levels. Adaptation measures are required to minimize these impacts and provide a smoother recovery transition; lowering the financial burden on public and private operations.

The Town has through its Municipal Planning Strategy designated the coastline of the Town as Industrial, Commercial Industrial, Secondary Commercial and Residential on the Generalized Future Land Use Map. Developments along the harbour are regulated through six (6) different zones outlined in Table 11.1 below.

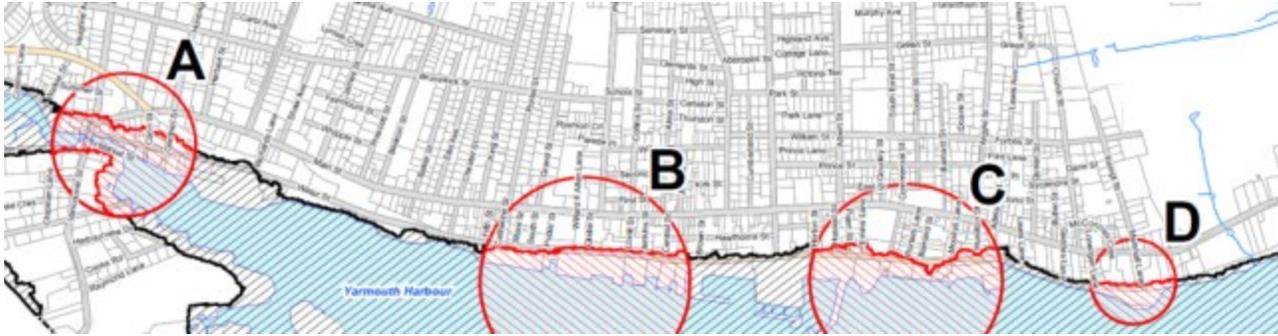
Table 11.1: Zones Regulated under the Climate Change Action Plan Area

| ZONE | DESCRIPTION |
|--|--|
| Residential Holding (R-H) | Baker’s Island |
| Health Campus (H-C) | Yarmouth Regional Hospital |
| Low Density Residential (R-1) | Harbourview Drive area |
| Open Space (O-1) | Market Street Park/Clock Tower Park |
| Waterfront Industrial (M-2) | Domtex and Industrial Areas |
| Waterfront Commercial Industrial (WCI-5) | Across from Central Business District |
| Waterfront Mixed Use (WMU) | North End of Water Street – Old Cotton Mill |

The Yarmouth area has been identified as a high risk area for storm surges associated with climate change impacts. Policy 10.28 of the Municipal Planning Strategy and 5.38 of the Land Use By-law automatically zones newly in-filled lands along Yarmouth Harbour. The setbacks for developments in the Waterfront Commercial Industrial (WCI-5) Zone and the Waterfront Industrial (M-2) Zone against the harbour are waived, enabling the issuance of Development Permits above the high water mark to the harbour edge. It is important to note that municipal jurisdiction ends at the ordinary High Water Mark (HWM). Those developments below the ordinary High Water Mark (HWM) are under federal jurisdiction and as such cannot be regulated pursuant to municipal regulations.

To address climate change impacts on developments, Council has created an overlapping “Climate Change Storm Surge and Sea Level Rise Sensitive Area Map” that will encompass the designations and zones outlined above. It adds more stringent requirements on development than the underlying zoning. This map is shown in Figure 11.1 and in Schedule “G” of the Land Use By-law. For development proposals inside the Climate Change Storm Surge and Sea Level Rise Sensitive Area, the more stringent requirement will prevail, ensuring that developments adhere to the more restrictive provision.

Figure 11.1 Climate Change Storm Surge and Sea Level Rise Sensitive Area Map (excerpt)



Notes: Areas circled are deemed to be extremely sensitive due to the amount of investment or for other reasons. These areas are: A: Head of Yarmouth Harbour (businesses and Milo Lake Dam); B: North of Killam Wharf (marine industries and commercial development); C: south of Ferry Terminal (fish plants); D: below Marsha Lane (Sewage Treatment Plant)

Developments located within the “Climate Change Storm Surge and Sea Level Rise Sensitive Area” as identified on the “Climate Change Storm Surge and Sea Level Rise Sensitive Area Map” will be subject to minimum building grade elevations and minimum set-back provisions from the ordinary High Water Mark (HWM) to safe guard developments from the adverse effects of storm surges and sea level rise. The following are Council’s policies in this regard:

Policy 11.1 It shall be the intent of Council to include in the Land Use By-law a “Climate Change Storm Surge and Sea Level Rise Sensitive Area Map.”

Policy 11.2 It shall be the intention of Council to amend the “Climate Change Storm Surge and Sea Level Rise Sensitive Area” when information regarding impacts are better studied.

Policy 11.3 It shall be the intention of Council that where any provision of the Land Use By-law conflicts with any provisions governing the “Climate Change Storm Surge and Sea Level Rise Sensitive Area” that the higher or more stringent provision shall prevail.

Policy 11.4 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 (HWM), and minimum standards related to the elevation and minimum separation standards from the HWM of any hazardous materials whether contained in a building or not.

Policy 11.5 It shall be the intention of Council to include in the Land Use By-law a clarification that the minimum climate change building grade elevations and minimum separation standards from the HWM are not subject to variance procedures of the *Municipal Government Act*. Therefore, they cannot be reduced through the variance procedures of the *Municipal Government Act*.

Policy 11.6 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 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 grade elevation standards and minimum separation standards from HWM as prescribed in the Land Use By-law.

Storm Surge/Sea-Level Rise Event Analysis

Climate change will affect coastal developments. Not only are storm intensities anticipated to increase, but the mean sea level will rise due to climate change and subsidence. Historically, the decadal trend has seen a 4.1cm increase in sea-levels. Nova Scotia’s coastline is sinking (2cm per decade, part of the decadal 4.1cm trend); causing many of our coastal communities to be more vulnerable to sea level rise and coastal flooding. It is anticipated that by 2100 the predicted relative sea-level rise will increase between 1m and 1.73m, accelerated from historical trends due to climate

change impacts.

This strategy recognizes the need for a precautionary approach to minimize negative impacts of rising sea levels. The Overton Sea Level Monitoring Station has been in place for a number of years and it is clear that mean sea level, as measured at the gauge, has been rising continuously over the years. Global warming will accelerate sea-level rise and coupled with changes in storm intensities will create serious consequences for coastal and nearby properties.

The Town, working in cooperation with the Nova Scotia Atlantic Climate Adaptation Solutions Project, gathered scientific data on Yarmouth’s sea level rise to help incorporate climate change adaptation measures into policies. The intent was to select appropriate development standards to minimize the effects of climate change on our built environments.

The Nova Scotia Atlantic Climate Adaptation Solutions Project developed a series of models outlining the effects of storm surges and sea-level rise on Yarmouth’s harbour. The predicted twenty-five (25) year and one hundred (100) year storm scenarios are outlined in Table 11.2 below.

Table 11.2: 25- and 100-Year Storm Scenarios for Yarmouth Harbour

| 25 Years | | 100 Years | |
|------------------|---------------------------|------------------|---------------------------|
| <i>Scenarios</i> | <i>Rise Above CGVD 28</i> | <i>Scenarios</i> | <i>Rise Above CGVD 28</i> |
| Y1-A25 | 0.17m | Y1-A | 1.40m |
| Y1-B25 | 3.99m | Y2-A | 1.79m |
| Y1-C25 | 4.51m | Y1-B | 5.22m |
| | | Y2-B | 5.61m |
| | | Y1-C | 5.74m |
| | | Y2-C | 6.13m |

Note: CGVD28 --Canadian Geodetic Vertical Datum of 1928. Until 2013 this was the standard geodetic vertical datum as maintained by Natural Resources Canada (NRCan). In that year NRCan established a new geodetic datum (CGVD2013); however NRCan advises it will continue to publish heights at benchmarks in CGVD28 for the foreseeable future. For readers information, Canadian Geodetic Vertical Datum of 1928 (CGVD28, land elevation vertical datum) is based on the Yarmouth CDCGVD28 offset of 2.31 m.

Source: Atlantic Climate Adaptation Solutions Project (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. Some values have been adjusted for errors.

Infrastructure at Risk

According to the climate change scenarios outlined above, the one hundred (100) year storm scenario predicts a worst case of 6.03m CGVD28 (6.13m CGVD28) and any infrastructure at or below this level is considered to be at risk. The “Climate Change Storm Surge and Sea Level Rise Sensitive Area Map” identifies the areas below the six (6m) metres CGVD28 level. The Town needs to develop plans to mitigate and adapt to these 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 dependent buildings should be treated differently than non-water dependent buildings:
 - Non-water dependent buildings should have a larger set-back from the water’s edge and have a higher minimum building grade elevation than water dependent 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.

Table 11.3: Main Buildings (Non-Water Dependent)

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

Table 11.4: Accessory Buildings (Non-Water Dependent)

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

Table 11.5: Main Buildings (Water Dependent)

| Time Period | Minimum Building Grade Elevation | Minimum Building Set-back |
|--------------------|---|----------------------------------|
| Present - 2050 | 4.6m CGVD28 | Waived from HWM |
| 2051 - 2100 | 5.2m CGVD28 | Waived from HWM |

Table 11.6: Accessory Buildings (Water Dependent)

| Time Period | Minimum Building Grade Elevation | Minimum Building Set-back |
|--------------------|---|----------------------------------|
| Present - 2050 | 4.4m CGVD28 | Waived from HWM |
| 2051 - 2100 | 5.0m CGVD28 | Waived from HWM |

Table 11.7: Hazardous Materials (Oil, Gas, Propane, etc.) whether contained in a building or not - (Non-Water Dependent)

| Time Period | Minimum Building Grade Elevation | Minimum Building Set-back |
|--------------------|---|----------------------------------|
| Present - 2050 | 4.8m CGVD28 | 6.1m (20 ft.) from HWM |
| 2051 - 2100 | 5.4m CGVD28 | 6.1m (20 ft.) from HWM |

Table 11.8: Hazardous Materials (Oil, Gas, Propane, etc.) whether contained in a building or not - (Water Dependent)

| Time Period | Minimum Building Grade Elevation | Minimum Building Set-back |
|--------------------|---|----------------------------------|
| Present - 2050 | 4.8m CGVD28 | Waived |
| 2051 - 2100 | 5.4m CGVD28 | Waived |

It should be noted that the above minimum building grade elevations will not ensure that buildings will not be impacted by storm surges, 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 in such a fashion to minimize the impacts on adjacent and nearby developments.

In addition to the minimum climate change building grade elevations any non-water dependent main building greater than 185.8m² (2,000 sq. ft.) in gross floor area shall have a building grade elevation equal to or greater than the directly abutting Water Street elevation.

For clarity, this provision shall only apply to those lots directly abutting Water Street and may be determined by the average elevation along the lineal length of Water Street that directly abuts the property.

Policy 11.7 It shall be the intention of Council to include in the Land Use By-law a minimum climate change building grade elevation for any non-water dependent main building greater than 185.8m² (2,000 ft²) in gross floor area that is equal to or greater than the directly abutting Water Street elevation within the Climate Change Storm Surge and Sea Level Rise Sensitive Area. For clarity, this provision shall only apply to those lots directly abutting Water Street and the elevation level may be determined by the average elevation along the lineal length of Water Street that directly abuts the property.

Policy 11.8 It shall be the intention of Council to include in the Land Use By-law a provision requiring slab on grade construction or a higher floor elevation above grade and a prohibition on any basement or sub-basement construction (other than foundation supports for upper levels) or any floor elevation below the minimum climate change building grade elevation within the Climate Change Storm Surge and Sea Level Rise Sensitive Area.

In order to minimize the effects of hazardous materials associated with Bulk Petroleum Storage Facilities, Service Stations and Gas Bars it is the intention of Council to prohibit the development of new such non-water dependent uses in the Climate Change Storm Surge and Sea Level Rise Sensitive Area as shown on the Climate Change Storm Surge and Sea Level Rise Sensitive Area Map, Schedule "G". Existing facilities at 166 Water Street and 632 Main Street will be identified as "existing" pursuant to Schedule "C" of the

Land Use By-law and will have the ability to continue to exist as permitted uses.

Policy 11.9 It shall be the intention of Council to include a provision in the Land Use By-law prohibiting the establishment of non-water dependent Bulk Petroleum Storage Facilities, Service Stations and Gas Bars in the Climate Change Storm Surge and Sea Level Rise Sensitive Area as shown on the Climate Change Storm Surge and Sea Level Rise Sensitive Area Map, Schedule “G”, and to treat existing facilities located at 166 Water Street and 632 Main Street as “existing” pursuant to Schedule “C” of the Land Use By-law.

The policies outlined in this Chapter are intended to be implemented through a series of By-laws and regulations such as, but not limited to, the Subdivision By-law and the Land Use By-law. Other policies, due to their very nature, will be incorporated into other documents such as the Emergency Measures Organization Plan or through the development of new plans, By-laws or regulations. From time to time it will be necessary to amend policies and By-law provisions to reflect changing priorities and circumstances. To this end, it shall be the intention of Council to amend the Town’s Land Use By-law to be reasonably consistent with the intent of the Municipal Planning Strategy as it relates to Climate Change impacts.

Policy 11.10 It shall be the intention of Council to consider climate change impacts when reviewing the Municipal Planning Strategy and up-date the Town’s Land Use By-law so that it is reasonably consistent with the intent of climate change policies.