WEST HANTS REGIONAL MUNICIPALITY
Municipal Climate Change Action Plan (MCCAP) Committee Agenda
February 10, 2021 – 10:00am
Virtual Meeting (Zoom)

1.0 Call to Order and Identification of Designates

2.0 Approval of Agenda and Additions

3.0 Approval of Minutes

4.0 Business Arising from the Minutes

5.0 New Business

5.1 Coastal Flood Planning

5.2 GHG Emissions Reports and Recommendation

6.0 Miscellaneous

7.0 Next Meeting Date

WINDSOR / WEST HANTS TOGETHER

WEST HANTS REGIONAL MUNICIPALITY REPORT

Information X	Recommendation ☐	Decision Request ☐	Councillor Activity ☐

To: Members of Municipal Climate Change Action Plan Committee

Submitted by: Saira Shah, Planner

Date: 2021-02-10

Subject: Coastal Flood Planning Options

LEGISLATIVE AUTHORITY

Section 220 (5) (p) (i) of the Municipal Government Act

DECISION REQUEST

Staff request direction from the Municipal Climate Change Action Plan (MCCAP) Committee on developing policies to restrict development in flood prone areas for the plan review.

BACKGROUND

On January 21, 2020 the Municipal Climate Change Action Plan (MCCAP) Committee discussed the potential impact of coastal flooding restrictions on development, (Appendix A). The Committee requested additional information on floodproofing measures, impact on insurance, and how damage would be assessed.

DISCUSSION

Floodproofing Measures

Staff reviewed guides and articles on floodproofing and found a comprehensive guide produced by the New Brunswick Department of Public Safety and Department of Environment and Local Government (Appendix B).

Floodproofing includes any action that reduces the potential for damage to homes and properties caused by standing or flowing water. There are no floodproofing methods that guarantee complete protection.

Dry floodproofing is any action that keeps water out of a building. Some of these actions include the permanent sealing of windows, doors and other openings located below the anticipated flood depth and the application of waterproof coatings or sealants to basement floors and foundation walls. Although dry floodproofing is considered ideal from the property owners' perspective in terms of usable space, deep floodwaters can exert intense weight on the outside of a building, including its foundation and external walls which can cause severe damage.

Wet floodproofing allows water to flow into a building. The water inside and outside the building has the same pressure reducing the risk of damage. Any materials used to construct a portion of the building susceptible to flooding need to be resistant to damage from wetting and drying. There must also be a clear plan for removing water from the space after flooding events. Debris from flooding can cause greater damage by flowing into buildings and colder weather requires planning for potential freezing of the water within the building.

Floodproofing measures can be permanent or temporary. A temporary measure such as building a sandbag barrier would require a person to be on site. A permanent measure does not require action from a person on site as it is built into the construction of the property and is always ready for a potential flood event.

Permanent floodproofing measures would be the best option to regulate development in coastal areas as there are many seasonal properties without year-long residents and climate change will increase the frequency of flooding events. The two main options for permanent floodproofing of an entire building are raising the building above predicted flood levels or building floodwalls and berms.

Raising the building above predicted flood levels can be achieved by placing a building on compacted fill or columns. Fill is a combination of well-graded sands and gravels used to support the building. A large amount of fill may be needed to achieve the desired height and erosion could impact the longevity of the fill or columns. This solution does not ensure safe access to the site during flooding events and could divert flood flow causing higher elevations of flood waters on adjacent properties.

Building floodwalls and berms can keep flood waters away from buildings. Floodwalls need to be made of durable materials that do not allow water to flow through such as masonry and concrete. Berms are soil-based barriers. Floodwalls and berms should not be used in locations where flood waters flow fast and deep. Similarly to raising the building, these barriers can deflect flood flow leading to higher flood risk on adjacent properties and, if there is a sudden failure, greater damage than if the wall or berm had not been constructed.

Hiring a professional engineer is necessary to determine the best options depending on site characteristics. Any new development requirements would specify that approval by a professional engineer is required. Staff would consult with Engineers Nova Scotia when developing new requirements.

<u>Insurance</u>

Staff contacted the Insurance Brokers Association of Nova Scotia to learn more about how coastal flooding is dealt with in terms of insurance coverage and if more restrictive zoning would have an impact on insurance. They referred staff to the Insurance Bureau of Canada as this organization has created several flood maps for the industry.

*A Primer on Severe Weather and Overland Flood Insurance in Canada (*attachment C*)* produced by the Insurance Bureau of Canada in 2019 provides details on different kinds of flooding and how insurance companies assess coverage in flood-prone areas. Coastal flooding is a category of flooding that is considered fairly easy to model and predict but insurance to cover this kind of damage is very new and most providers do not cover coastal flooding. In 2015 insurers started to look for flood mapping that could be used for assessments. They found municipal maps only covered specific areas or kinds of flooding and were outdated or unavailable for insurers to access. To determine risk, Canadian insurers purchase licenses to access flood maps from private-sector companies in the U.K., United States and Czech Republic. A combination of these maps with other data such as the replacement value of a structure and the likely basement contents of a home are used to determine the flood exposure of a particular property. Staff have determined based on this initial assessment that if the Municipality creates a flood zone it is not likely that insurers will use that information to make assessments as they access specific flood maps for their needs from other sources.

<u>Damage Assessment</u>
One of the options discussed by the previous MCCAP Committee is the possibility of allowing a resident to rebuild based on how much damage occurs to their structures. An example would be allowing a resident to rebuild if less than 50% of their home is damaged. To create this requirement the Municipality would have to establish a process to determine what percentage of the structure is damaged.

Staff came across a similar system created by the National Flood Insurance Program in the United States. They suggest defining Substantial Damage as damage of any origin where the cost of restoring the structure to its before damaged condition would equal or exceed 50 percent of the market value of the structure before the damage occurred. Market value can fluctuate but the Municipality has access to the Property Valuation Services assessed value for structures from the previous year. Further discussion with the Finance Department and Property Valuation Services would be needed to determine if this data could be used for this purpose.

In terms of percent of damage based on the value of the structure, insurers typically provide an assessment of damage when a claim is made but coastal flooding is not covered by most insurers. This would not be a reliable option.

Staff looked for individuals that could provide cost estimates for repairs and came across Quantity Surveyors. A Quantity Surveyor provides financial advice on construction projects based on their extensive knowledge of construction methods. Quantity Surveyors can achieve their certification from the Canadian Institute of Quantity Surveyors. The industry is not regulated which means a Quantity Surveyor

does not need the designation from the Canadian Institute of Quantity Surveyors to legally work in that industry. There are four (4) consulting firms in Nova Scotia that have Quantity Surveyors. Staff reached out to several of the surveyors and received responses back from three (3). All the Quantity Surveyors that responded said they can do this kind of cost estimate to determine damage. If designs and building permits are available, it would take a couple of days to develop an estimate of damage. If a design is not available and the structure was built before building permits were required many of the Surveyors mentioned alternative methods such as reviewing properties near-by to find similar structures or using photo evidence such as orthophotos to determine the approximate size and style of the structure. However, this process can be lengthy as the Surveyor is required to do significant research to determine the estimate. The cost for an estimate can range significantly depending on the consulting firm and the amount of research involved to determine the estimate. The general costs provided to staff range from $1,500 for a simple residential building with designs available to $10,000 for a larger residential or commercial building with no designs available.

Staff reviewed alternative approaches to determining damage and found the *Newfoundland and Labrador Provincial Land Use Policy Flood Risk Areas.* This Policy states "Within the floodway, existing buildings or structures damaged beyond economic repair shall not be replaced" unless specific requirements are met. Staff contacted the Provincial Land Use Planning Department to determine how "damaged beyond economic repair" is determined. It is determined by the owner of the structure. If the owner feels that the structure is not worth repairing and wishes to replace the structure they must meet specific requirements such as not increasing the floor area to larger than the original structure, flood proofing the new structure, and not impeding water flows or creating an increased flood risk.

Prince Edward Island does not have a specific damage requirement. They have created a buffer zone of 15 meters along any stream, creek, pond, river, bay, wetland, or coastal water body. No new development or additions and improvements to existing buildings are permitted within the buffer zone. If an existing homeowner experiences extensive damage to their property that requires a building permit, they would have to rebuild the structure outside of the buffer zone. If their entire property is within the buffer zone, they would not be able to rebuild.

New Brunswick does not have a province-wide restriction on development in coastal areas. However, in the *New Brunswick's Flood Risk Reduction Strategy* the fourth action is to develop a Provincial Flood Risk Policy that will set out general principles and minimum requirements to ensure new development will not result in increased flood risk.

NEXT STEPS

In response to this report, the MCCAP Committee may request staff:

- draft amendments for the Plan Review based on the coastal flood planning options presented in the January 21, 2020 report or as specifically revised by direction of MCCAP;

- not draft amendments for the Plan Review to address coastal flooding; or
- provide alternative direction such as requesting further information on a specific topic.

FINANCIAL IMPLICATIONS

The financial implications of this amendment cannot be considered until the amendment is drafted.

ATTACHMENTS

Appendix A 2020-01-21 Coastal Flood Planning Options Information Report

Appendix B New Brunswick Floodproofing Guide

Appendix C A Primer on Severe Weather and Overland Flood Insurance in Canada

Report Reviewed by: _____
Madelyn LeMay, Director of Planning and Development

Appendix A
2020-01-21 Coastal Flood Planning Options
Information Report

MUNICIPALITY OF THE DISTRICT OF WEST HANTS
INFORMATION REPORT

To: Members of Municipal Climate Change Action Plan Committee

Submitted by: _____
Saira Shah, Planner

Date: 01-21-2020

Subject: Coastal Flood Planning Options

Origin

Two (2) projects were completed in 2018-2019 related to coastal flood risk:

- National Disaster Mitigation Program Risk Assessment Study; and
- PLAN 4001/4002 Dalhousie University BCD Honours Studio.

Based on the findings from both studies, staff have considered potential options to restrict buildings in flood prone areas.

Legislative Authority

Municipal Government Act Section 220 *Contents of land-use by-law*

Background

A **structure** in the Land Use By-law (LUB) includes anything that is erected, built, or constructed and include buildings, walls, signs and fences exceeding six feet in height.

A **building** is defined in the LUB as "*any structure, whether temporary or permanent, used or built for the shelter, accommodation or enclosure of persons, animals, material or equipment. Any tent, awning, bin, bunker, platform, vessel or vehicle used for any of the said purposes shall be deemed a building.*"

New restrictions can apply to all buildings or just buildings. This report will focus solely on buildings.

Buildings can be considered in two (2) separate categories in flood prone areas. New buildings are anything that is constructed after restrictions are approved. Existing buildings are anything that is constructed before restrictions are approved. An existing building can remain

on site, but if a flooding event occurs, destroying part or all of the building, restrictions can be applied impacting the landowner's ability to rebuild on the lot.

Staff have developed potential restrictions for existing and new buildings for the Municipal Climate Change Action Plan committee to consider. A comparison of the options is attached as Appendix A.

New Buildings

1. Do not allow any new buildings in flood prone areas
2. Only allow certain buildings to be built in flood prone areas (what would these buildings be? Would the uses permitted in these buildings be permitted as-of-right or by Development Agreement?)
3. Only allow new buildings if floodproofing is incorporated into the building design (a list of floodproofing measures could be determined or experts could be identified that could evaluate floodproofing measures)
4. Keep development controls the same as existing

Existing Buildings

1. Do not allow existing buildings to be rebuilt after flood events
2. Allow existing buildings to be rebuilt but not expand after flood events (could allow landowners to rebuild after any flood event or if 50% of their building remains intact)
3. Allow existing buildings to be rebuilt or expanded if floodproofing is incorporated into the building design (a list of floodproofing measures could be determined or experts could be identified that could evaluate floodproofing measures)
4. Allow existing buildings to be rebuilt after flood events with no restrictions or expanded (i.e. adding a spare bedroom, second floor, etc.) with no restrictions

Discussion

Each option has drawbacks and would require extensive public engagement if major restrictions are placed on property owners. Although the municipality is not liable for flood damage on private properties, the two (2) recent studies showcase the potential impact of coastal flooding. Climate Change will intensify flooding events impacting the communities in flood prone areas.

Prohibit new buildings

In terms of new buildings, not allowing any new buildings in flood prone areas is the easiest option to administer and is the only option that ensures no new infrastructure, properties or residents are impacted by flooding. However, this would be very restrictive and would not allow new residents or businesses to move to these areas of West Hants.

Limit new buildings

To allow for some limited growth, certain uses could be permitted as-of-right or by development agreement in flood prone areas. Council would have to determine which uses would be permitted ensuring vulnerable populations are considered. This option, along with any other option that permits new buildings, would increase the number of buildings that could wash away and destroy other buildings and infrastructure nearby.

Floodproof new buildings
A flood proofing requirement for all new buildings would allow communities in flood prone areas to grow while ensuring residents are aware of the potential risks of building in these areas. Flood proofing may initially increase the cost of development, but it would significantly reduce the costs for the landowner associated with rebuilding after a flooding event. However, flood proofing does not guarantee that no damage will take place to the building and allowing uses that are occupied by vulnerable populations could be a concern during emergency situations.

Although the options are presented separately, the committee can request that staff consider combining options such as limiting the uses permitted in buildings and requiring flood proofing in any new building.

No change for new buildings
If development controls are kept the same as the existing documents, building that is permitted in the existing zone could be built. This could endanger human life if properties or roadways become flooded. As climate change is becoming a prevalent topic, there could be public push back for not acting on climate change issues.

An existing building can remain on site as it was legally permitted when the permit was issued, or it was developed before planning documents were approved. If a flooding event occurs, destroying part or all of the building, the municipality can restrict how and if the building can be rebuilt.

Prohibit rebuilds
The strictest form of restriction is to not allow existing buildings to rebuild after flooding events. This ensures no rebuilt infrastructure and properties are impacted by flooding and decreases the number of buildings that can wash away in future flooding events. There would be a decrease in the population as existing residents may have to leave the community if their homes are damaged. Resale values and insurance could also be impacted by creating a "flood prone" zone that does not allow buildings to be rebuilt.

Limit rebuilds
Another option is to allow existing buildings to be rebuilt after a flooding event, but only to the original footprint size. This option could also be based on how much damage takes place on the site. An example of this could be if less than 50% of the building is impacted by flood damage than the landowner can rebuild, but if more than 50% of the building is damaged, then the landowner is not allowed to rebuild. This prevents expanded footprints (larger buildings) from washing away reducing the amount of material that can destroy other buildings and infrastructure nearby. If a large percentage of the site is damaged during a flood that could indicate that it is an unsafe site for human habitation. However, allowing a building that is damaged 30% to be rebuilt could still pose a risk to human life especially during emergency situations when access to the site may be limited.

Floodproof rebuilds

Floodproofing could be required for any existing building that is rebuilt. Residents would be able to remain in their community and develop their new homes to be more resilient to flooding. However, as mentioned earlier in this report, buildings that have floodproofing can still pose a risk to infrastructure and human life. Floodproofing could also be required only for the sections rebuilt not the remaining building.

No change for rebuilds
Existing buildings could be permitted to be rebuilt or expand with no restrictions. Buildings would not be limited allowing for new growth in these communities and residents would be able to remain in place. The risk to human life and infrastructure would remain the same as existing conditions.

Financial Implications
Any costs associated with flood proofing would be borne by the applicant. If certain uses are permitted by development agreement, the costs of advertising would be borne by the applicant. However, increased staff time would be required to process applications in terms of meetings (Planning Advisory Committee and Council).

There are costs associated with emergency services during flooding events. Restrictions on buildings would decrease the number of people living in flood prone areas which would reduce costs for emergency services.

Attachments
Appendix A Restrictions in Flood Prone Areas Comparison

Report Approved by: _____
Madelyn LeMay, Director of Planning and Development

Appendix A
Restrictions in Flood Prone Areas Comparison

New Buildings		
	Pros	*Cons*
1. Do not allow any new buildings in flood prone areas	• Ensures no new infrastructure and properties are impacted by flooding • Ensures new residents are not in locations that may be difficult to access in emergency situations (ex. flooded roadways) • Prevents an increase in the number of buildings that can wash away due to flooding • Coastlines can stay/go back to the natural environment i.e. people would not be using armour rock to protect new buildings	• Very restrictive and would not allow new growth in these areas of West Hants • Extensive public engagement would be required
2. Only allow certain buildings to be built in flood prone areas (what would these buildings be? Would the uses permitted in these buildings be permitted as-of-right or by Development Agreement?)	• Prohibiting buildings that contain vulnerable populations (such as institutional and residential uses) means that in the event of an emergency (ex. flooded roadways), it is less likely that vulnerable groups will be endangered • Buildings that are not considered vulnerable to flooding or would not put human life at risk could be permitted allowing for limited growth	• Could add additional time to process applications in terms of meetings (PAC and Council) if uses are restricted by Development Agreement • The buildings that are permitted could wash away and destroy other buildings and infrastructure nearby • Extensive public engagement would be required

3. Only allow new buildings if floodproofing is incorporated into the building design (a list of floodproofing measures could be determined or experts could be identified that could evaluate floodproofing measures)	• Flood-proofing in buildings would allow the community to grow while ensuring safety for residents • Would ensure residents/developers are well aware of the potential risks of building/constructing in these areas • Could reduce the costs for property owners by ensuring floodproofing measures protect properties	• The development application process may be slightly longer as there would be more requirements to meet before permits could be issued • There would be an added upfront expense for developers to incorporate floodproofing into buildings • Depending on the level of floodproofing this may not guarantee protection • Any building that contains vulnerable populations (such as institutional and residential uses) could be in flood prone areas and pose a concern during emergency situations when access to the site may be limited (ex. flooded roadways) • Floodproofed buildings could still wash away destroy other buildings and infrastructure nearby • Extensive public engagement would be required
4. Keep development controls the same as existing	• There would not be an increase in time to process applications for permits • Buildings would not be limited allowing for new growth in these communities	• New buildings could wash away and destroy other buildings and infrastructure nearby • No floodproofing would be required to protect new buildings from flooding • Any property owner that is permitted to build buildings could endanger human life if flooding takes place on their property or roadways nearby • There could be public push back for not acting on climate change issues

Existing Buildings		
	Pros	*Cons*
1. Do not allow existing buildings to be rebuilt after flood events	• Ensures no rebuilt infrastructure and properties are impacted by flooding • Decreases the number of buildings that can wash away by flooding • Coastlines can go back to the natural environment i.e. people would not be using armour rock to protect their properties	• Very restrictive and would not allow existing residents to return to their communities after flood events • Existing residents would have a property that is difficult to sell which could lead to abandonment of land • There would be a decrease in the population in these areas • Creating a "flood prone" zone with restrictions may cause insurance problems for current buildings on properties within that designated area • Extensive public engagement would be required
2. Allow existing buildings to be rebuilt but not expand after flood events (could allow landowners to rebuild after any flood event or if 50% of their building remains intact)	• Allows residents to stay in their communities • Prevents expanded footprints (larger buildings) from washing away reducing the amount of material that can destroy other buildings and infrastructure nearby	• The buildings that are permitted could wash away and destroy other buildings and infrastructure nearby • Any existing building that contains vulnerable populations could be allowed to be rebuilt in flood prone areas which presents a risk to human life during emergency situations when access to the site may be limited (ex. flooded roadways) • No floodproofing would be required to protect the new buildings from flooding
3. Allow existing buildings to be rebuilt or expanded if floodproofing is incorporated into the building design	• Flood-proofing allows residents to remain safely in their communities • Would ensure residents/developers	• The development application process may be slightly longer as there would be more requirements

(a list of floodproofing measures could be determined or experts could be identified that could evaluate floodproofing measures)	are well aware of the potential risks of building/constructing in these areas	• There would be an added expense for developers to incorporate floodproofing • Depending on the level of floodproofing this may not guarantee protection • Any existing building that contains vulnerable populations (such as institutional and residential uses) would still be permitted in flood prone areas and could pose a concern during emergency situations when access to the site may be limited (ex. flooded roadways) • Floodproofed buildings could still wash away destroying other buildings and infrastructure nearby • Floodproofing would only be required for the rebuilt sections and not the remaining building
4. Allow existing buildings to be rebuilt after flood events with no restrictions or expanded (i.e. adding a spare bedroom, second floor, etc.) with no restrictions	• There would not be an increase in time to process applications for permits • Buildings would not be limited allowing for new growth in these communities	• Expansions to buildings can increase the amount of material that can wash away and destroy other buildings and infrastructure nearby • No floodproofing would be required to protect buildings from flooding • Any property owner that is permitted to expand or rebuild their building could endanger human life if flooding takes place on their property or roadways nearby • There could be public push back for not acting on climate change issues

Floodproofing

Protecting your home and contents against flooding

New Brunswick Department of Public Safety
New Brunswick Department of Environment and Local Government

January 2016
Revised November, 2019

About this Booklet

This booklet has been prepared in order to help you consider ways to protect your home and contents against flooding. It is not a detailed "how to" guide, or a substitute for professional advice but instead is an overview of typical floodproofing measures, intended to help you make informed decisions. References provided at the end of this booklet offer additional information about specific floodproofing methods.

“Floodproofing” means taking actions that reduce the potential for damage to your home and property caused by standing or flowing water. When properly designed and installed, floodproofing measures may reduce the likelihood that a building or its contents will be damaged during a flood, and can reduce the cost of repair if damage does occur, however **there are no floodproofing methods that are guaranteed to completely protect a building and its contents from the effects of flooding.**

The primary purpose of this booklet is to help reduce flood risk for existing buildings in locations that may be affected by flooding. **This booklet does not endorse or support new development that will create or increase risks to life, property or the natural environment in the event of flooding. When all options are available, the best method of reducing risks to people and property is to avoid locations that are susceptible to flooding.**

For additional information on how to avoid flood-prone locations see **Finding Flood Information in New Brunswick** on page 21.

Important Note: The information contained in this booklet is provided for educational purposes only. It is not intended or implied to be a substitute for professional advice. Users of the information contained in this booklet assume full responsibility for its use.

Table of Contents

This document contains internet links that are functional in the web-based version, which can be accessed by visiting www.gnb.ca and following the links to “Departments” > “Environment and Local Government” > “Environment”>”Flooding in New Brunswick”.

Flooding in New Brunswick

The Province of New Brunswick has a long history of flooding, with incidents of varying severity recorded as far back as 1696. The causes include snowmelt, intense or prolonged rainfall, ice jams, and coastal storm surges (high tides combined with low atmospheric pressure on on-shore winds).

Historic settlement patterns have tended to follow riverbanks and ocean shorelines, and some of the most attractive building sites are located in these areas. Unfortunately, many of these properties are located within **flood hazard areas**. Other properties throughout the province are occasionally impacted by localized flooding due to high river, stream or ditch flow, high groundwater levels, local drainage issues, and low elevation. As a result, many New Brunswickers live in areas that may be affected by flooding.

There is both anecdotal and scientific evidence that climate change is affecting the frequency and severity of New Brunswick floods and there appears to be a general upward trend in both the number of documented flood events and the cost of damage resulting from flooding in New Brunswick.

To date, the costs of flood damage to individuals and governments in New Brunswick are conservatively estimated at over half a billion dollars and this does not include indirect costs associated with disruptions to society and the provincial economy. This is a heavy financial burden to bear, and the intangible costs of human anxiety, risk and suffering add to the price New Brunswickers pay each year for flooding.

Flood hazard areas are locations adjacent to lakes, rivers or the ocean, where there is a known potential for flooding. Some, but not all of New Brunswick's flood hazard areas are shown on maps that describe the estimated location, depth and frequency of flooding. In addition, properties throughout the province, may occasionally be impacted by localized flooding even if located outside of a flood hazard area. For additional information see **Finding Flood Information in New Brunswick** on page 21.

Floodproofing offers property owners a way to reduce their vulnerability to flooding.

What is Floodproofing?

Simply put, floodproofing is any temporary or permanent feature of a building or its surroundings that reduces the potential for damage caused by flowing or standing water.

Beyond improvements to building drainage (from roofs, foundations and yards), and improvements to utility connections (back flow prevention valves, etc.), there are two basic floodproofing strategies:

Dry floodproofing is aimed at keeping surface water out of a building. This approach is preferred by most property owners because the contents of the building are kept dry and there is no need for post-flood repair or clean-up inside the building. Unfortunately, this approach is not always feasible. Deep floodwaters, even if ponded or flowing slowly, can exert great weight (hydrostatic pressure) on the outside of a building, including its foundation and external walls. Most buildings are not designed to withstand this pressure and severe structural damage may occur.

Wet floodproofing minimizes potential structural damage due to external water pressure, by allowing water into a building. Having water both inside and outside the building equalizes the water pressure on the walls and floors. Special building materials and features are used to reduce the impacts of wetting on the building's structure and contents.

Remember: When all options are available, the best protection against flood damage is to avoid locations that are susceptible to flooding.

Floodproofing measures can be further subdivided into:

Permanent floodproofing measures that are always in place and require no action by the homeowner in the event of a flood. These are most suitable for areas prone to frequent flooding, seasonal dwellings that are not always occupied and locations where there is often little advance notice of a flood,

and

Contingency floodproofing measures that are put in place temporarily before a flood occurs. They are often employed in areas where flooding takes place infrequently or where there is typically enough advance notice to take action to protect a building and its contents.

This booklet discusses these various approaches to floodproofing and provides some typical examples.

Things to Know Before You Proceed

Before proceeding with any floodproofing options, please consider:

The importance of safe access - The floodproofing techniques described in this booklet may help protect a building and contents from flood damage but they will not ensure that safe access to and from a

property is available during a flood. It is therefore important to consider how a flood will affect movement by people and vehicles (e.g. for evacuation, or access by police, fire and ambulance services). This requires consideration of the anticipated flood depth, the speed that the water will be moving and the distance to the nearest "dry land". A good rule of thumb is to assume that for **ponded (non-flowing) water**, the maximum depth of flooding for safe access by most cars is about 0.3 metres (1 foot); the maximum depth for pedestrian access is about 1.4 metres (5 feet) for adults and 1 metre (3 feet) for children)[a] . **These safe depths decrease as water velocity increases. Even shallow water can sweep a pedestrian or a vehicle away when flowing at high velocity**. Also remember that **it may be difficult to judge the depth and speed of flood waters. Water may appear to be relatively calm even when moving at a high velocity and it may be impossible to see the bottom to determine flood depth**. **Prolonged exposure to cold water could lead to hypothermia.**

A home isolated by flooding on the St. John River

In addition to property access, building accessibility is also an important consideration. Some of the floodproofing measures described in this booklet restrict the use of doors and windows and may require the use of alternate entrances and exits.

Municipal by-laws and permits - As is the case with any construction including modifications to existing buildings, floodproofing must be carried out in accordance with all applicable building code, fire code, local by-law and building permit requirements. For example, the local planning authority (i.e., municipality, regional municipality, rural community, Regional Service Commission or the province as the case may be) may prohibit construction within a flood hazard area or impose specific conditions. For more information contact your local planning authority.

Provincial policies and permits - A *Watercourse and Wetland Alteration Permit* is required prior to fill placement or other activities such as construction, demolition, clearing land, landscaping, etc., within 30 metres of a wetland or watercourse. Additional information is available at:

http://www2.gnb.ca/content/gnb/en/departments/elg/environment/content/wetlands.html

Those considering construction in coastal areas should also consult *New Brunswick's Coastal Areas Protection Policy*:

http://www2.gnb.ca/content/dam/gnb/Departments/env/pdf/Water-Eau/CoastalAreasProtectionPolicy.pdf

a. Ontario Ministry of Natural Resources. Technical Guide - River and Stream Systems: Flood Hazard Limit. Appendix 6 - Floodproofing. (2002)

The importance of doing it right - While some floodproofing techniques can be put in place by a knowledgeable property owner, many require the assistance of qualified people to design and install them. Members of the following associations can provide advice and assistance on floodproofing your home:

Association of Consulting Engineering Companies New Brunswick
http://www.acec-nb.ca/

Association of Professional Engineers and Geologists of New Brunswick
https://www.apegnb.com/

Association of New Brunswick Land Surveyors
http://www.anbls.nb.ca/

Canadian Homebuilder's Association NB
http://www.nbhomebuilders.ca/en/

Permanent Floodproofing Measures

Permanent floodproofing measures are incorporated into the design of a building or building lot. They are permanently in place and require no additional action by property owners or occupants at the time of a flood. Examples are contained in the following sections.

Sewage Connections and Lot Drainage

The following measures will benefit any dwelling, regardless of location with respect to flooding. They focus on addressing issues associated with roof drainage, plumbing, municipal utilities, and lot grading. They include:

- Improved lot grading and channels to direct water away from buildings
- Foundation drains to direct groundwater away from the foundation
- Eaves trough downspouts that are not connected to foundation drains and are extended away from the building wall
- A basement sump pump (with appropriate capacity and stand-by electrical power) connected to a storm sewer or a free-flowing surface outlet. Avoid connecting the sump pump to the sanitary sewer
- Basement window wells (where warranted by site grading), to ensure that window sills are above the adjacent ground surface
- Valves that prevent backflow (from a municipal sewer or septic system) from entering the building. Sewer backups can cause major damage and inconvenience and occur when sewer outlets become flooded and water is forced back through the sewer line into a building. It is important to remember that buildings can be affected even if situated in areas where there is no flooding.

The above measures are described in detail in guidance prepared by the City of Moncton, called *The Homeowner's Guide to Flood Protection* available at:
http://www5.moncton.ca/docs/emergency/Flood_Protection_Manual.pdf

Additional information is also provided in **Floodproofing for Utilities** on page 15.

Dry Floodproofing

Dry floodproofing means closing off or relocating all openings in a building wall or foundation that otherwise might allow flood water to enter a building. For example, windows, doors and other openings located below the anticipated flood depth can be permanently closed in and sealed. Any water-resistant material of sufficient strength can be used (e.g. bricks, concrete blocks, glass bricks, etc.). Once closed in, the openings can no longer be used, so this measure should only be used if the windows and doors are not needed by the building occupants and are not required in order to meet the requirements of the National Building Code and National Fire Code.

Waterproof coatings or sealants can be applied to basement floors and foundation walls to reduce or eliminate seepage. Cracks or gaps can be filled in with sealants and a continuous waterproof membrane can be used to line the outside of the foundation. Membranes may be susceptible to damage when backfill is placed, so proper installation is important. Special attention is also required for any openings

used for utilities such as electricity, telephone, propane, natural gas, sewer and water, to prevent infiltration and leakage into the building.

The above measures can be used in combination with temporary flood shields and watertight doors as described under **Contingency (Temporary) Floodproofing Measures** on page 12.

It's important to know that although it may be technically feasible to seal the openings in external walls and foundations to create a watertight barrier, it's not always a good idea because other parts of the building wall or foundation may still fail during a flood. The structural integrity of even well-built, modern homes may be threatened if saturated ground extends above the basement floor elevation or if the flood level is higher than the top of the foundation. Therefore, **in order to reduce the potential for severe structural damage, expert advice should be obtained before installing closures, sealants and other flood barriers that are integrated into the building walls and foundation. A qualified expert can determine if the walls, foundation and basement floor are strong enough to withstand the weight of water pressing on the building from the outside** (called hydrostatic pressure).

No matter what type of foundation is used, the building should be anchored to prevent flotation or lateral movement in the event of a flood.

Wet Floodproofing

In any location where floodwater is expected to reach the outside of a building or foundation wall, the resultant water pressure can be so severe that foundations can collapse, and buildings can be heaved out of the ground, or off their foundations. Where pervious (sandy) soils allow water to move easily through the ground, this damage could happen even if no water is visible at the surface. In these circumstances, wet floodproofing (purposely allowing the water to enter the building so that the pressures on the interior and exterior of the building are balanced) may help prevent serious structural damage. While the building interior (in particular the basement) will receive some flooding, measures can still be taken to reduce the potential for damage due to wetting of the building structure or contents.

Wet floodproofing requires that openings be provided to all enclosed spaces below the anticipated flood elevation. The idea is to reduce water pressure by letting it enter the enclosed spaces at the same rate that the floodwaters rise outside. The building should also be anchored to prevent lateral movement.

Case Study: The "Spray and Wash" Basement

Last June, a homeowner's basement took in five feet of water. The fully finished basement had to be gutted. If it happens again, cleanup should be much easier. The rebuilt basement now includes metal stairs, polished concrete floors, and walls clad in foam insulation covered with mortar and steel mesh and coated in concrete and sealant.

CBC Calgary, March 20, 2014

When using wet floodproofing it is also important to ensure that any structural materials (beams, subfloors, insulation, framing etc.) and finishing materials (wall coverings, flooring, etc.) that may be exposed to flood waters are resistant to damage from wetting and drying (e.g. swelling and cracking) and can be cleaned once the flooding has subsided. Even materials that will not come into direct contact with flood waters should be capable of resisting moisture and humidity. In general, materials such as untreated wood, particle board, carpeting, corkboard, plaster, regular plywood, gypsum drywall, laminate flooring, linoleum, vinyl wall coverings, non-ceramic floor tiles, etc., should be avoided. Batt and blanket types of insulation such as mineral wool or fibreglass should also be avoided because they will retain water and

trap any floating contaminants. Alternative materials include marine grade plywood, cement board, concrete, glazed clay tile, plastic lumber (with no wood filling), non-absorbent natural or artificial stone or stone veneer with waterproof grouting, steel wall panels, ceramic or concrete tile (with mortar rather than an adhesive), metal doors, closed cell or plastic foam insulation, etc.

When wet floodproofing is employed, the dwelling owner or occupant should also prepare a plan listing vulnerable furnishings and possessions along with a predetermined strategy for removing them quickly to a location above the flood elevation. In addition, provision should be made for dewatering (pumping out and dehumidifying) the basement once the flood is over. Other measures associated with wet floodproofing, including special considerations for electrical services are described under **Floodproofing for Utilities** on page 15.

If a building may be subject to damage from waves, floating ice, or debris during a flood then wet floodproofing is not a good option. Another caution regarding wet floodproofing is that during cold weather, water that enters a building can freeze and expand, causing additional damage. Therefore, **wet floodproofing may not be the best option if other alternatives are available**.

Below Grade Living Space

Basements are the lowest part of a building and are therefore most susceptible to flooding. In early homes, basements were usually not considered as living space and were more often used as storage areas. In modern homes, basements are often finished with wall coverings and flooring and are used as recreation rooms, bedrooms or as fully-equipped apartments.

Finished basements and their contents are highly vulnerable to flood damage. **To avoid risks to life and property, wet floodproofing should not be used to accommodate below grade living space in buildings that may be affected by sudden or rapid flooding.** While dry floodproofing (employing measures to seal off a basement to keep flood water out) might seem to be the best solution, this may not be a feasible option. As previously noted, even if the water is not flowing quickly, the weight of water pressing in on a watertight building wall or foundation could result in significant structural damage.

Raising the Building

Raising a building above the flood level may reduce potential damage to a building and its contents in the event of a flood. For locations where flood hazard maps or sea level predictions are available, the appropriate elevation can be obtained by referring to the past or predicted flood elevations. (See **Finding Flood Information in New Brunswick** on page 21). Even if the flood water is higher than expected and enters the building, the flood damage will be reduced, since the depth of the water and the length of time the building's contents are exposed will be less. Including some extra height above the anticipated flood level offers an additional margin of safety.

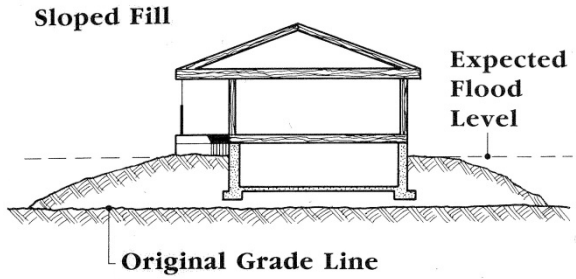
Elevation on Fill

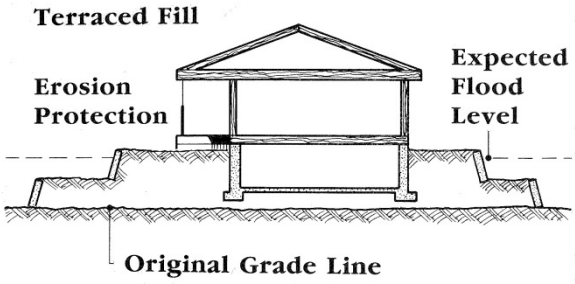
This option means constructing a mound and relocating the building on top of it. Care should be taken in the selection of the fill material Silts and very uniform sands are undesirable as they are difficult to compact. Instead the fill material should include well-graded sands and gravels since they are the most suitable for supporting the weight of buildings. Ensuring proper fill compaction is also important. This is usually addressed by placing the fill in a series of layers or “lifts” and compacting each layer before the next is added.

Placing fill overtop of organic soils can lead to instability. The existing topsoil and subsoil may have to be removed first and replaced with another material (sand, gravel, synthetic materials etc.) to provide the needed bearing capacity. The sides of the fill should be protected against erosion and sloped in such a way as to prevent slumping. The fill should not extend onto adjacent properties, so it is also important to know the location of property boundaries. Retaining a professional engineer and a land surveyor will help ensure that each of the above considerations is adequately addressed.

Elevating an existing building on fill may not be feasible in locations where flood waters flow deep and fast because: a) the required volume and depth of fill will be large; b) the fill may be subject to erosion by flowing water; c) safe access may not be available during a flood and d) the fill may block flood flow, leading to higher flood elevations on adjacent properties. Effective use of this option is therefore generally limited to buildings located near the edges of flood hazard areas. In addition, a Watercourse and Wetland Alteration Permit is required prior to fill placement or other activities such as construction, demolition, clearing land, landscaping, etc., within 30 metres (100 feet) of a wetland or watercourse. **Those considering fill placement in coastal areas should also consult New Brunswick's Coastal Areas Protection Policy.**

The foundation of a building raised on fill may still be subject to flood damage if the basement floor remains below the anticipated flood elevation. Flood water can damage the foundation by exerting pressure on it if the water is able to percolate through the fill. Special foundation design and use of anchors to prevent buoyancy may be required. Construction on a concrete slab placed on top of the fill (i.e. a foundation with no basement) may an option.





The elevation of buildings on fill is often the best protection from flooding. The above diagrams illustrate two methods of fill placement - sloped and terraced.

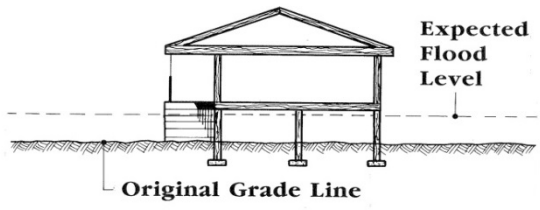
A house on fill, during a St. John River flood

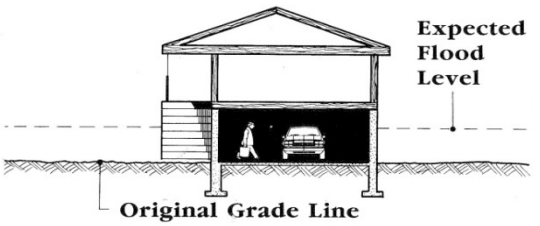
Elevation on a Raised Foundation, Piers or Columns

This option means designing and reconstructing a building foundation that is high enough to ensure that the living area of a building is raised above the anticipated flood level. This requires that the building be separated from its existing foundation, raised on hydraulic jacks, and held by temporary supports while a new or vertically extended foundation is constructed below. This retrofit is typically most feasible for wood frame homes originally built on basement, crawlspace, or open foundations. Masonry homes can be more difficult to lift, primarily because of their design, construction, and weight, but raising these homes may still be possible.

The new foundation can consist either of continuous concrete walls designed to address hydrostatic pressure, or an open foundation comprised of a series of piers, posts, columns, or piles. Regardless of the foundation type, the foundation design should consider issues such as debris loading during a flood event, the position and orientation of the supports, soil conditions, and anchoring, bracing and connection details. Expert advice should be retained to design the foundation and supervise its construction.

Elevating a building on piers and columns instead of a foundation wall may be useful for coastal locations and inland locations exposed to high velocity flow or ice jams, because flowing water, waves, ice and debris may be able to pass under the building without causing impact-related damage. The supporting piers and columns and their footings should be designed to support the building weight and withstand the force of moving water as well as the impact of ice and debris. Mechanically driven piles may be the best solution where erosion is expected to be severe, such as exposed coastal locations. The open area under the building can be used for other purposes such as storage space for low value items.





During construction, buildings can be elevated on piers and columns as a method of floodproofing. The open area under the building can be used for other purposes, such as parking, outside of the flood season.

When planning an elevated foundation, it's important to determine how high the foundation should be. (See **Finding Flood Information in New Brunswick** on page 21). When selecting the appropriate elevation it may be wise to add some extra elevation to account for uncertainties in the water level estimate.

Remember that use of this option is subject to the approval of the planning authority (municipality, regional municipality, rural community, Regional Service Commission of the province as the case may be). **This option does not provide for safe access to a property during a flood. A Watercourse and Wetland Alteration Permit is required prior to fill placement or other activities such as construction, demolition, clearing land, landscaping, etc., within 30 metres of a wetland or watercourse. Those considering elevating a building on a raised foundation in coastal areas should also consult New Brunswick's Coastal Areas Protection Policy.**

A cottage on piers during a flood on Grand Lake

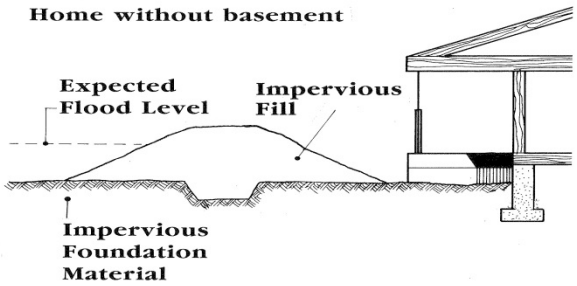
An oceanfront home on piers in Robichaud, New Brunswick

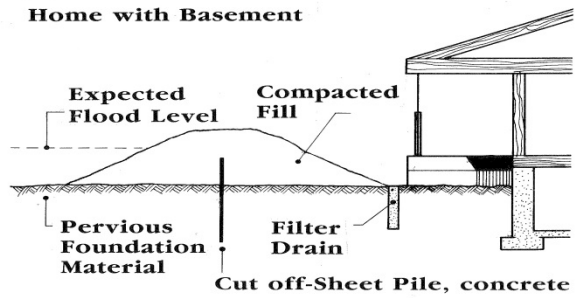
Permanent Floodwalls and Berms

Floodwalls and berms are barriers intended to keep water away from a vulnerable building or structure. This approach requires no change to the building itself and hydrostatic pressure on the building envelope is avoided.

Floodwalls can be constructed of durable, impervious materials such as masonry, concrete or earthen fill. They should be designed for the specific conditions of a particular site including the elevation of the ground relative to the anticipated flood elevation, the soil type, and the pressure that will be exerted by the depth of water outside the barrier.

Ground elevations can be established by field survey from a benchmark of known elevation, while flood elevations can be obtained using the methods described under **Finding Flood Information in New Brunswick** (page 21). The ability of a proposed wall or berm to provide an impervious barrier and resist water pressure should be verified by a professional engineer.





An important consideration in the design of a berm is the ability of the soil to permit the passage of water. If the soil is porous, seepage into the basement of the nearby home is possible. The use of cutoff walls, or blanket drains beneath the berm are one way to prevent such seepage.

Important considerations in the design of floodwalls and berms include the ability of the soil below the barrier to support its weight and resist the passage of water. If the soil is highly pervious (e.g. sandy soil), seepage underneath the berm or floodwall could be a problem and could lead to collapse. A cut-off wall buried beneath the barrier may help control seepage.

Surrounding a building with a flood barrier will be of limited benefit if sewer, water or other drainage pipes continue to allow floodwater a path of entry. If such pipes extend beyond the limits of the barrier, they will have to be equipped with backflow preventers or manually operated shut-off valves. See also **Sewage Connections and Lot Drainage** (Page 5) and **Floodproofing Utilities** (Page 15). Remember that once a valve on a sewer pipe is closed, sewage from the building will be blocked and may overflow if sinks, toilets etc. are used.

Consideration should also be given to drainage of the area within the berm. This means that snow melt and precipitation must be allowed to drain away from the building and through the barrier via pipes or channels that can be closed off during flooding. Finally, driveways or other gaps in the barrier must be blocked when a flood occurs. Sandbags or other equivalent materials can be kept on hand for this purpose (see **Temporary Dikes** on page 13).

As is the case with construction on fill, **the use of floodwalls or berms is not recommended in locations where flood waters flow fast and deep since the wall or berm will have to be high and may be subject to scour and erosion. In addition, the wall or berm may block or deflect flood flow, leading to higher flood elevations on adjacent, unprotected properties. Sudden failure of a flood wall or berm may have greater safety or damage consequences than if the wall or berm had not been constructed**. **Those intending to construct a flood wall or berm should confirm that these features are permitted by the planning authority** (municipality, regional municipality, rural community, Regional Service Commission or the province as the case may be). **A Watercourse and Wetland Alteration Permit is required prior to fill placement or other activities such as construction, demolition, clearing land, landscaping, etc., within 30 metres of a wetland or watercourse. Fill placement within a wetland will generally not be permitted. Those considering construction in coastal areas should also consult New Brunswick's Coastal Areas Protection Policy.**

Relocation

Relocation means moving an existing building that is vulnerable to flooding to a site that is above the flood elevation. If flood risk is severe and alternative locations are available, this may be the most effective floodproofing option. This option involves retaining a specialist contractor to lift an existing building from its foundation and transport it to a new foundation at the new site.

When deciding whether or not relocation is a feasible option, factors to consider include the:

- type of building (the easiest structures to relocate are single story wood frame buildings with a regular, rectangular shape);
- condition of the structure (is it structurally sound so that it can be moved?);
- route between the existing site and the new one (are there low power lines, narrow roads, weight restrictions, tight corners, etc. that will have to be addressed?);
- characteristics of the new site (elevation above flooding, safe access during flooding, ability to provide services such as well and septic system, etc.);
- permits that may be required including building permits and permits for over-size/overmass loads from the Department of Transportation and Infrastructure; and
- relative costs of relocation versus demolition and reconstruction.

Temporary Floodproofing Measures

Temporary floodproofing measures are put into place immediately before a flood and are intended to keep water out of a building for the flood's duration. Contingency measures are sometimes referred to as "active floodproofing" because they require human intervention in advance of a flood. They are therefore only useful if sufficient warning time is available to allow floodproofing measures to be deployed and the building owner or another knowledgeable person is available to put the measures in place. Where possible, floodproofing measures that are permanently in place are preferred.

Flood Shields

Flood shields are removable watertight barriers designed to prevent the passage of water through windows and doors. They consist of panels constructed of a durable, impervious material (usually metal) that can be readily installed and sealed using rubber gaskets or special sealants around the edges.

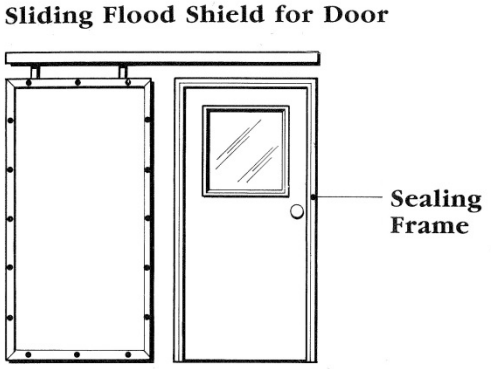
To ensure quick and easy installation during a period of immanent flood risk, flood shields should be stored close to the openings to be sealed, color-coded or numbered as to location and installation priority and held in place by simple, quick connecting fasteners and latching devices.

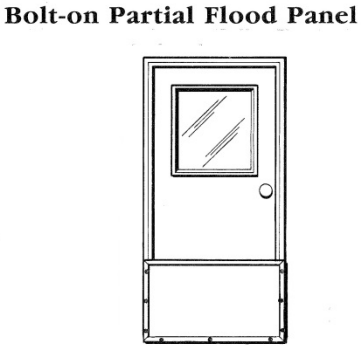
To ensure that flood shields will be effective when installed, periodic inspection and testing is advised.

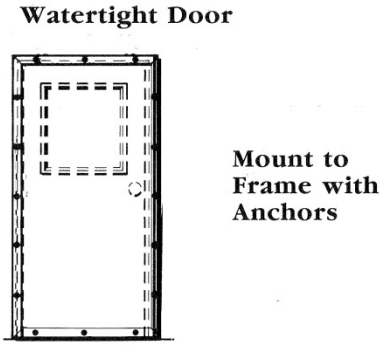
Watertight Doors and Temporary Bulkheads

Watertight doors are permanently installed but are designed to be closed and sealed only during floods. They are heavy and expensive and are generally more suited to commercial and industrial buildings than houses. If anticipated flood elevations will not greatly exceed ground level, bolt-on, partial flood panels or barriers can be installed to protect the bottom portion of a doorway.

It is important to realize that in order to be effective, flood shields and watertight doors must be well-maintained and incorporate smooth, close-fitting surfaces, waterproof gaskets and locking bolts. In







Sliding flood shields, bolt-on flood panels and watertight doors are barriers designed to prevent the passage of water through windows and doors.

general, permanent closures or sealants, or relocating doors and windows above the flood level are more effective measures.

To prevent flood waters from entering through doors and windows a temporary wall or "bulkhead" can be constructed. For example, "tongue and groove" wooden planks can be stacked on top of each other. The temporary wall can be covered by a plastic sheet and supported by a grooved concrete or steel channel attached to the sides of the door or window. A double layer of sandbags placed at the base may help to reduce seepage and provide additional stability.

As is the case for closures and sealants**, expert advice should be obtained to determine if flood shields, watertight doors and bulkheads are feasible options**, based on the anticipated depth of flooding.

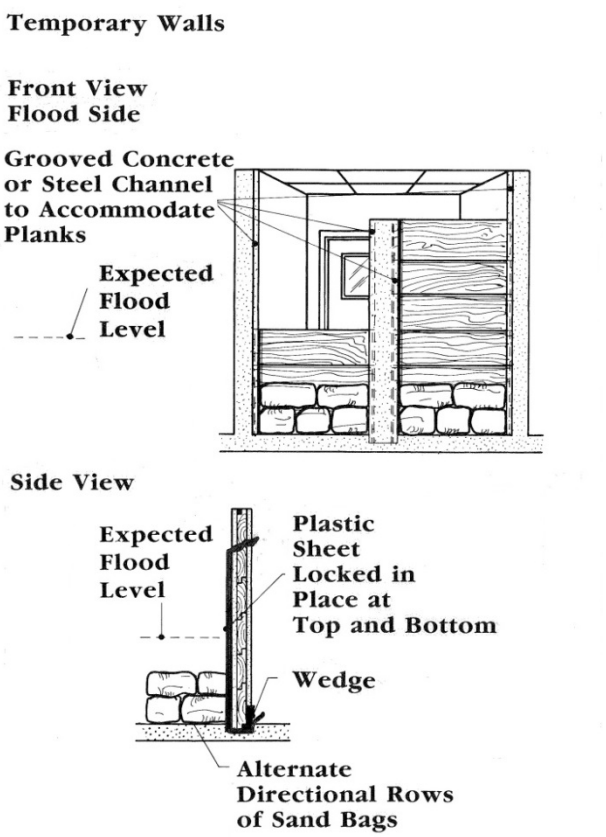
Temporary Dikes

Stacking sandbags to form a barrier against rising floodwaters is a common emergency floodproofing technique. They can be put in place to surround a vulnerable building or can be installed as needed to protect low openings such as basement windows, patio doors, etc. The bags must be strong enough to hold the sand in place and withstand prolonged contact with water. Burlap and plastic bags can be purchased that are specially made to be filled with sand.

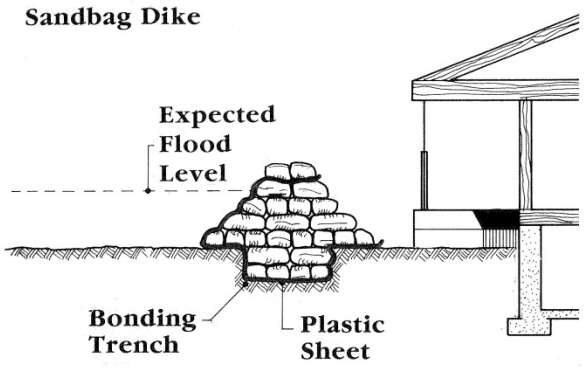
Flood water will exert pressure against the dike so if possible, a trench should be dug to anchor the dike to the ground and prevent it from moving.

Leaving some vacant space within the bags will allow the bags to overlap and mold together under their own weight, locking them in place. In addition, the orientation of the bags should alternate, so that each layer of bags is placed at right angles to the layers above and below. This adds stability to the structure. For added protection, a durable plastic sheet can be placed on the outer side of the dike to prevent the seepage of water through the barrier.

A number of alternatives to sandbags have been devised, including re-usable, anchored, rubber or



Temporary walls constructed from planks, plastic sheets and sandbags can also provide effective protection during flooding. This diagram provides a side view and front view of a temporary wall.



The diagram above illustrates how to construct a sandbag dike quickly and efficiently to form a barrier against rising floodwaters.

rubberized tubes filled with water, interlocking panels designed to hold back flood water and various other modular barriers constructed of high-density materials, anchored in place and filled with sand or water to increase their weight. These may be worthwhile options to consider and may be easier to install than sandbags. If selected, they should be installed in accordance with the manufacturer's recommendations.

Floodproofing for Utilities

If the utilities serving a building are damaged, even a structurally sound residence may be rendered uninhabitable after a flood due to unsafe or unsanitary conditions. This risk can be reduced by incorporating floodproofing features into the services contained in existing buildings. This is particularly important when furnaces and other vulnerable facilities are located in a basement and when wet floodproofing is being employed. When floodproofing building utilities, primary consideration should be given to preventing flood waters from contacting the components that are most susceptible to water damage.

Some potential measures are included in Table 1 (below) and described in more detail in references contained in **Additional Information on Floodproofing** at the end of this booklet.

Case Study: The "Upside-Down House"

When a property was badly damaged by flooding, a local builder saw an opportunity. "You have to find unique spots for the mechanical equipment that normally you would cram in a basement". The basement has no windows and contains only piping and ductwork. A small upstairs room houses one of two furnaces — designed to force air down rather than up — complete with sound insulation.

The Medicine Hat News, September 4, 2014

Remember:

- All measures and modifications must adhere to the all applicable provisions of the National Building Code and National Fire Code.
- Building, locating, relocating, demolishing or altering a building or structure typically requires a permit.
- Check with your local planning authority for specific requirements and restrictions.

Table 1: Some Common Methods of Floodproofing Utilities

Floodproofing Measure	Advantages	Disadvantages
Electrical Services Locate electrical panels, light switches, meters, service entries and electrical outlets above the anticipated flood elevation. Install separate, waterproof circuits for outlets, switches, and lighting components that must be located below the flood level and install separate circuits for emergency flood equipment (e.g. pumps and generators).	1. Elevated circuitry is completely protected from damage. 2. May avoid costly "behind the wall" failures in the event of a flood.	1. Not always easily adaptable to existing buildings.
If wiring must be located below the flood elevation, install it within a small diameter plastic pipe (conduit) to facilitate future replacement and repair of wiring.	1. May avoid costly "behind the wall" failures.	1. Not always easily adaptable to existing buildings.

Heating, Ventilating and Air Conditioning (HVAC) Systems Elevate all components (external units, internal units, thermostats, controls and ducting). For example, subject to all applicable Building Code and Fire Code requirements, major components of the heating system can be elevated on a platform, strapped to the basement ceiling or located on the main floor. Lateral or in-line furnaces are also available that fit into the ductwork. External heat pump condensers can be placed on elevated platforms or attached to the building wall above the anticipated flood elevation. If forced air ducting cannot be relocated above the flood elevation, then make sure the ducts below the flood elevation are easily accessible and can be taken apart for cleaning after the flood event. (Sediment and contaminants in the ducts can be circulated through the HVAC system if it is operated with dirty ducts).	1. No human intervention needed.	1. May be difficult and expensive to introduce into existing buildings.
Locate heating or cooling system components in waterproof utility enclosures. Depending on the anticipated flood depth, low barriers or curbs rather than complete enclosures may be sufficient.		1. May be difficult and expensive to introduce into existing buildings. 2. The requirement to access the components for servicing may limit the effectiveness of the enclosure. 3. In some applications, the enclosure is normally open and must be closed and sealed before the flood arrives.
Incorporate quick release/disconnect features into the design of the equipment to allow rapid removal of vulnerable components.	1. Potentially allows rapid shut down and relocation of vulnerable components.	1. May not be feasible for all components or may require custom-designed components. 2. Requires human intervention to remove and relocate vulnerable components in advance of a flood.
Water Supply and Sewers Install back-flow prevention valves on sewage pipes.	1. Valves function automatically to prevent sewage from backing up into the building when flooding occurs.	1. Valve requires testing and maintenance. 2. Once a valve on a sewer pipe is closed, drainage from the building will be blocked and may overflow if sinks, toilets etc. are used

Eliminate gravity drains below the anticipated flood level.	1. Prevents sewage from backing up when flooding occurs. 2. Potentially useful if flow prevention valves on sewer lines are not feasible.	1. A pump and generator are required. 2. May not be technically feasible or permitted especially for hook-ups to municipal sewers.
Install a waterproof well casing to prevent surface water from entering the well. Protect the well top from scour and impact damage.	1. Helps prevent contamination of water supply by bacteria and other pollutants during a flood.	
If possible, ensure that the septic system is located above the anticipated flood elevation. If this is not possible, install a watertight cap (e.g. bolted with neoprene gasket) to keep surface water out of the septic tank and install a valve to prevent sewage backflow during a flood.	1. May prevent sewage backflow from entering to building.	1. Sewage system may be inoperable during the flood. 2. Buoyancy forces on underground septic tanks located below the flood elevation may lead to damage and failure of the septic system.
Fuel Supply Install shutoff valves, waterproof fill caps, and make sure tank vents extend above the anticipated flood level. If evacuation is necessary, close fuel valves before leaving the site.	1. Reduces risk of fire and explosion. 2. Prevents building damage and pollution due to fuel leaks. 3. Adaptable to most buildings.	1. Minor post-flood maintenance may be required.
If oil and propane storage tanks cannot be located above the flood elevation, brace and anchor them to prevent flotation, separation of fuel lines/pipes, and damage to tanks and fuel lines (due to scour, erosion, and impact from floating debris).	1. Reduces risk of fire and explosion. 2. Prevents building damage and pollution due to fuel leaks. 3. Adaptable to most buildings.	1. Minor post-flood maintenance may be required.

Note: The information contained in the above table was obtained from: 1) United States Federal Emergency Management Agency. Protecting Building Utilities from Flood Damage, (Chapters 3 and 4) (1999); and 2) Canada-New Brunswick Flood Damage Reduction Program. Floodproofing - Protect Your Home Against Flooding (1989).

Household Hazardous Materials

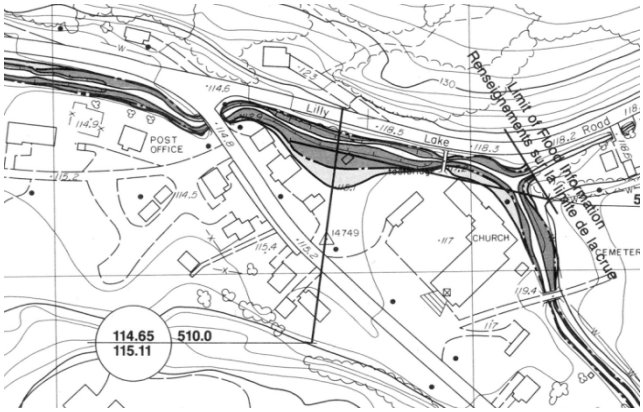
Some household materials are potentially hazardous to the environment and human health. These products should therefore be securely stored to prevent their release during a flood. To reduce the risk of contamination:

- Clearly identify and label contents of, drums, or other containers, especially when materials are placed in other than their original containers;
- Place your name and address on larger fuel and propane tanks to facilitate identification of their contents and their return if they become displaced;
- Store drums and containers in areas that are least susceptible to flood waters. When possible, keep them in fenced enclosures, cabinets, or storerooms;
- Minimize the amounts and types of materials kept on site. Purchase only what you need;
- If time permits dispose of household hazardous waste materials prior to a flood, at a household hazardous waste collection centre. For more information on how to dispose of household hazardous waste materials, contact your local Solid Waste Commission.

How to Proceed

1. Learn as much as you can about flooding in your community and at your property location. (See **Finding Flood Information in New Brunswick** on page 21). The depth and velocity of flooding are major factors in choosing floodproofing measures; some methods may be inappropriate if the depth and velocity of flooding are excessive. Other important factors to consider include the expected duration of the flooding.

2. Learn more about floodproofing options. This booklet provides a general overview of available options. Additional information can be obtained from the references provided at the end of this booklet. Experts from the Associations listed on page 4 can also provide information and advice.



A portion of a New Brunswick Flood Hazard Map

3. Investigate the physical condition of the building and the property. The function, condition and use of a building have a direct bearing on the need for floodproofing, and whether it is technically and economically practical. Four characteristics of your home that are particularly important in floodproofing are:
1) construction type (wood frame, brick etc.);
2) foundation type (slab on grade, poured concrete foundation, concrete block, etc.)
3) lowest floor elevation and foundation height; and
4) the building's age and state of repair.

4. **Consider any site conditions that may limit the feasibility of certain floodproofing measures.** These include the size slope and drainage of the property. Other factors to consider include: the type and location of sewer, water, gas and other piped services, the location of the electrical entry, the location of property boundaries, and any applicable by-laws that may affect the types of work that can be carried out on a property. Consideration must also be given to the safety of people in the building and to the structure should floodproofing measures fail.

5. Evaluate the costs and benefits of floodproofing. Determine the cost of floodproofing your property and weigh it against the cost of flood damage. You should also consider the personal danger and hardship you and your family may face if you do not floodproof. When making this evaluation bear in mind that **while flood insurance is available for some commercial customers in Canada, most residential insurance policies do not cover damage caused by flooding**. Damage caused by sewer backup, maybe be available but only as an extra endorsement that typically must be specifically requested by the homeowner.

The Province may make disaster financial assistance available following a flood, but this decision is based on the severity of the flood and is not a guaranteed source of funding for homeowners. If assistance is offered, not all types of damage are eligible.

6. Consult with your local planning authority and provincial officials. Remember that the proposed work must comply with all applicable building code, fire code, by-law and building permit requirements. Some planning authorities may prohibit construction within a flood hazard area. In addition, any applicable provincial permits must be obtained. For example, a Watercourse and Wetland Alteration Permit is required prior to fill placement or other activities such as construction, demolition, clearing land, landscaping, etc., within 30 metres (100 feet) of a wetland or watercourse. Those considering construction in coastal areas should also consult New Brunswick's Coastal Areas Protection Policy.

7. Select an appropriate method of floodproofing. Always seek expert advice about the best way to floodproof your home because improper floodproofing selection and design can put people and property at risk.

8. Plan your floodproofing project and hire experts to do the work. Use a licensed, bonded, and insured contractor. Before hiring a contractor, be sure to check references.

9. Know the extent of the remaining flood risk, because it can't be eliminated entirely.

Finding Flood Information in New Brunswick

Flood Hazard Maps and Flood Level Predictions

In New Brunswick, flood hazard maps have been prepared for a number of areas that are known to be at risk of flooding. The maps describe the extent and anticipated frequency of flooding and can be used to obtain flood depths at specific locations. New Brunswick's flood hazard maps can be viewed and downloaded at:

http://www2.gnb.ca/content/gnb/en/departments/elg/environment/content/flood.html

In addition, predicted sea levels have been calculated for all of coastal New Brunswick, taking into account the effects of high tides, storm surges and future sea level rise. This information is available in Updated Sea-Level Rise and Flooding Estimates for New Brunswick Coastal Sections (2014). https://atlanticadaptation.ca/en/islandora/object/acasa%3A731

Some coastal communities have prepared coastal flood hazard maps. Check with your local planning authority.

Other Sources of Information

Not all of New Brunswick's flood-prone locations have been identified on flood hazard maps and properties throughout the province may occasionally be impacted by localized flooding due to high water levels in rivers, streams and ditches, high groundwater levels, local drainage issues, and low elevation. Other potential sources of flood information include local planning authorities, media reports, historical records contained in public libraries and your own personal experience. Long-term residents can also be excellent sources of information on the history of flooding in your area. Predictions based on site-specific calculations performed by an engineering consultant can also be used as a guide.

Flood Warnings and Forecasts

For flood warnings and forecasts along the Saint John River, visit:
http://www2.gnb.ca/content/gnb/en/news/public_alerts/river_watch.html

Real time water level elevations are available from Environment Canada for selected rivers throughout New Brunswick at:
http://wateroffice.ec.gc.ca/

Public Alerts are issued by Environment Canada for abnormally high water levels and high waves (storm surge or storm tide) caused by storms, which have the potential to cause coastal flooding:
http://weather.gc.ca/warnings/index_e.html?prov=nb

Contact Information

For additional assistance contact:

Emergency Assistance - Police, Fire, Ambulance
Call 911

NB Emergency Measures Organization
1-800-561-4034

River Watch Flood Advisories (St John River and major tributaries)
1-888-561-4048 or
http://www2.gnb.ca/content/gnb/en/news/public_alerts/river_watch.html

Road Conditions, Traffic Advisories
511 or 1-800-561-4063 or
http://www2.gnb.ca/content/gnb/en/departments/dti/highways_roads/content/511.html

To Report Spills or Environmental Emergencies
1-800-565-1633

Additional Information on Floodproofing

More information about floodproofing options is available from the following sources. The internet links contained in this list are subject to change, as websites are typically revised from time to time. These references are provided for information only and have not been endorsed or evaluated by the Government of New Brunswick.

Canada Mortgage and Housing Corporation. Practical Measures for the Prevention of Basement Flooding Due to Municipal Sewer Surcharge [English]
http://publications.gc.ca/site/eng/475635/publication.html

Centre Européen de Prévention du Risque d'Inondation. Le bâtiment face à l'inondation - Diagnostiquer et réduire sa vulnérabilité - Guide méthodologique [French]
http://www.cepri.net/tl_files/pdf/guidevulnerabilite.pdf

Centre Européen de Prévention du Risque d'Inondation. Le bâtiment face à l'inondation - Vulnérabilité des ouvrages [French]
http://www.cepri.net/tl_files/pdf/aidememoire.pdf

City of Moncton. The Homeowner's Guide to Flood Protection [English]
http://www5.moncton.ca/docs/emergency/Flood_Protection_Manual.pdf

Credit Valley Conservation. Technical Guidelines for Floodproofing [English]
http://www.creditvalleyca.ca/wp-content/uploads/2011/09/007-Technician-Guidelines-for-Floodproofing.pdf

Institute for Catastrophic Loss Reduction. Handbook for Reducing Basement flooding [English]
http://www.iclr.org/images/Basement_Flood_Handbook_-_ICLR_-_2009.pdf

Institute for Catastrophic Loss Reduction. Best Practices for Reducing the Risk of Future Damage to Homes From Riverine and Urban Flooding : A Report on Recovery and Rebuilding in Southern Alberta [English]
http://www.iclr.org/images/Alberta_flood_risk_2013_PDF.pdf

Mission des sociétés d'assurances pour la connaissance et la prévention des risques naturels. Mémento pratique du particulier Risque « inondations » [French]
http://www.veauchette.fr/IMG/pdf/Memento_Inondations.pdf

Ontario Ministry of Natural Resources . Technical Guide - River and Stream Systems : Flood Hazard Limit. Appendix 6 - Floodproofing [English]
http://www.renaud.ca/public/Environmental-Regulations/MNR%20Technical%20Guide%20Flooding%20Hazard%20Limit.pdf

République Français. Ministère de l'égalité des Territoires et du Logement. Référentiel de travaux de prévention du risque d'inondation dans l'habitat existant. [French]
http://www.mementodumaire.net/wp-content/uploads/2012/08/referentielInondation.pdf

République Français. Direction régionale de l'Équipement de Bretagne. Rendre son habitation moins vulnérable aux inondations - Guide à l'usage des propriétaires. [French]
http://www.cepri.net/tl_files/pdf/guidedrebretagnepropritaires.pdf

République Français. Inondations: Guide d'évaluation de la Vulnérabilité des Bâtiments Vis-A-Vis de L'inondation. [French]

https://www.ecologique-solidaire.gouv.fr/sites/default/files/Inondations%20-%20Guide%20d%E2%80%99%C3%A9valuation%20de%20la%20vuln%C3%A9rabilit%C3%A9%20des%20b%C3%A2timents%20vis-%C3%A0-vis%20de%20l%E2%80%99inondation%20-%20Novembre%202005.pdf

United States Federal Emergency Management Agency. Homeowner's Guide to Retrofitting. Chapter 7 - Floodproofing. [English]
https://www.fema.gov/media-library/assets/documents/480?id=1420

United States Federal Emergency Management Agency. Coastal Construction Manual: Principles and Practices of Planning, Siting, Designing, Constructing, and Maintaining Residential Buildings in Coastal Areas. [English]
https://www.fema.gov/media-library/assets/documents/3293

United States Federal Emergency Management Agency. Home Builder's Guide to Coastal Construction.[English]
https://www.fema.gov/media-library/assets/documents/6131

United States Federal Emergency Management Agency. Technical Bulletin 7-93, Wet Floodproofing Requirements.[English]
https://www.fema.gov/media-library/assets/documents/3503?id=1720

United States Federal Emergency Management Agency. Protecting Building Utility Systems from Flood Damage, (Chapters 3 and 4) [English]
https://www.fema.gov/media-library/assets/documents/3729?id=1750

United States Federal Emergency Management Agency. Elevated Residential Structures.[English]
https://www.fema.gov/media-library/assets/documents/3289

Appendix C
A Primer on Severe Weather and Overland Flood Insurance in Canada

IBC BAC | Insurance Bureau of Canada
Bureau d'assurance du Canada

A Primer on Severe Weather and Overland Flood Insurance in Canada

About Insurance Bureau of Canada (IBC)

IBC represents Canada's private property and casualty insurers. Insurers in Canada write over $59.6 billion in direct premiums for private auto, home and commercial insurance. IBC's members account for approximately 86% of this premium volume. In 2017, the insurance industry contributed over $9.4 billion in taxes and levies in Canada.

Introduction

Every day in every community, Canadians face risk of harm from climate change; some face more risk than others. Every uptick in insurance claims costs or government disaster assistance payouts represents hundreds or thousands of lives disrupted, precious possessions lost and human suffering. Insurers see themselves as partners with governments and individual Canadians in a whole-of-society approach to managing risk, including those risks brought on by our changing climate. We all have a role to play in ensuring that everyone is prepared and protected.

Scientific Data and Insurance Data Tell Us the Weather is Changing

- Insurance Bureau of Canada (IBC), which represents Canada's home, auto and business insurers, is a key national voice on the economic costs of climate change and is leading the national conversation on the many ways that Canadians can adapt to climate change to reduce their risk.
- Climate change is costing Canadian taxpayers, governments and businesses billions of dollars each and every year.
- Costs are rising because of the increase in the severity and frequency of extreme weather events as well as the increased number of Canadians living in harm's way.
- Insurers rely on their own data on insured losses as well as scientific data to understand how a warming climate is affecting their customers.
- Climate scientists tell us that a warming climate will increase precipitation. Although precipitation trends are harder to observe and measure than temperature trends, there is strong evidence of increased annual precipitation in Canada.[1] Increased winter precipitation can lead to larger snowpacks which, when combined with spring rainfall and rapidly warming spring temperatures, has led to widespread flooding in eastern Canada in recent years.
- Insured-loss data shows an increase in water-related damage as a result of precipitation over the last four decades. Factors such as increasing population and changes in how we use homes (e.g., finished basements) also cause increases in insured losses – but it is clear that our changing climate is having an impact as well.

What we know about severe weather

1. Severe weather is on the rise

The Government of Canada has reported that "Canada has become wetter in recent decades."[2]

This increase fits with the projections of climate scientists worldwide who have predicted that a warming planet will result in more extreme weather events. David Phillips, Senior Climatologist at Environment and Climate Change Canada (ECCC), puts it this way: "Canada is a more dangerous place to live nowadays than it was even 25 years ago."[3]

Trends in Canada are similar to trends observed in the United States. The 2018 National Climate Assessment Report written by the U.S. Global Change Research Program states that:

> *"Since 1980, the number of extreme weather-related events per year costing the American people more than one billion dollars per event has increased significantly (accounting for inflation), and the total cost of these extreme events for the United States has exceeded $1.1 trillion. Improved understanding of the frequency and severity of these events in the context of a changing climate is critical."*[4]

Insurers in Canada have also reported larger catastrophic weather events per year across the country since 1983, including a big jump in the number of events since 2011. A catastrophic weather event is defined as an event that results in $25 million or more in insured losses (see Chart 1).

Property and casualty insurance payouts from extreme weather have more than doubled every five to ten years since the 1980s. Costs have been rising because of the increase in the severity and frequency of extreme weather events as well as the increase in the number of Canadians living in harm's way and the increasing number of homes that have finished basements.

Chart 1 – Large Catastrophic Weather Events in Canada

Source: 1983 to 2007: IBC, PCS Canada, Swiss Re and Deloitte
Source: 2008 to 2018: CatIQ
Events included when 2008 $ 25 million limit adjusted by GDP, Population
Perils: Flood, Water, Rain, Storm, Snow, Ice, Hail, Wind, Tornado, Hurricane

2. Rates of precipitation are increasing

There is compelling data to show an increase in annual precipitation over time in Canada.[5] One credible dataset that indicates an increase in extreme precipitation is the Actuaries' Climate Index, which is a monitoring tool and objective indicator of the frequency of extreme weather. It captures temperature and precipitation across North America, including Canada, and shows an increase in extreme precipitation events since the fall of 2013.[6] (See Chart 2.)

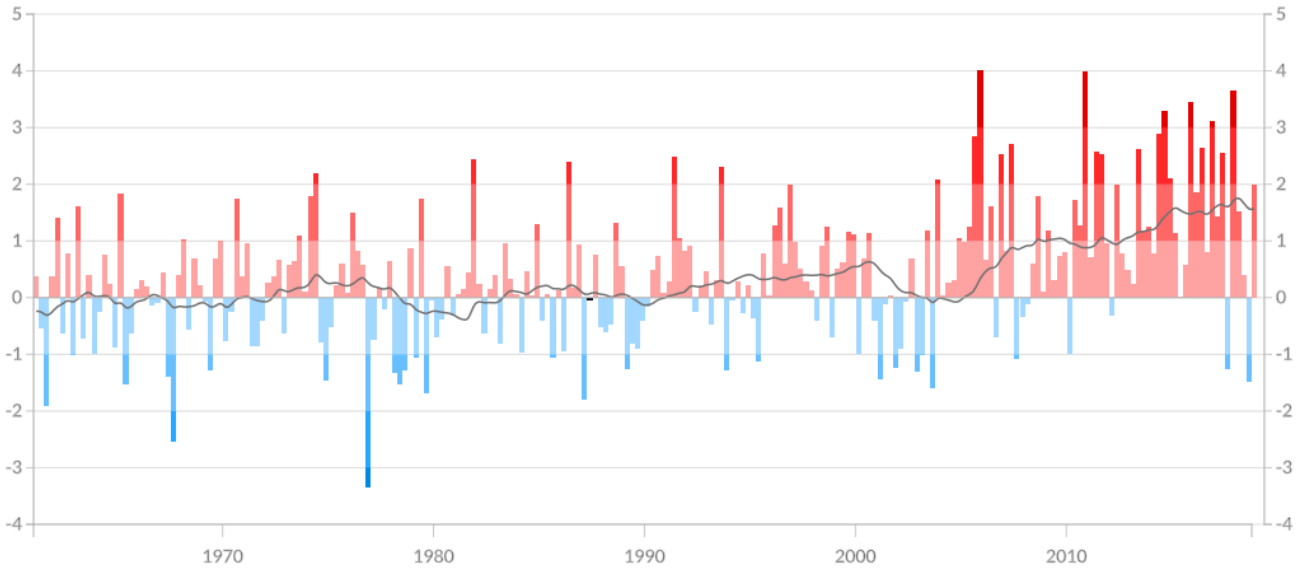
Recent observational evidence indicates that extreme rainfall events are occurring repetitively in locations across Canada. These events are identified through insurance claims data aggregated by an independent third party, Catastrophe Indices and Quantification Inc. (Cat IQ), which insurers use to determine overall insurance trends related to catastrophic losses in Canada.

Cat IQ records extreme rainfall events based on significant losses totaling $10 million to $25 million and catastrophic claims losses above $25 million. These numbers do not reflect losses to public infrastructure and under-represent residential overland flood losses because these were largely uninsurable until 2016 and are still not widely insured.

These extreme rainfall events are also reflected in trends in federal disaster financial assistance payments, which have registered a remarkable increase in payouts due largely to public infrastructure losses resulting from flooding events over the past decade. In Ontario alone, significant or catastrophic extreme rainfall events have occurred multiple times in the following municipalities:

London	• August 2011 • September 2014 • June 2015 • July 2016 • June 2018
Windsor	• July 2014 • September 2014 • August 2016 • August 2017
Cornwall	• September 2010 • August 2016 • October 2017
Peterborough	• April 2014 • May 2017 • June 2018
Vaughan	• August 2011 • June 2013
Richmond Hill	• May 2013 • July 2013
Adjala-Tosorontio	• June 2017 • June 2018

Chart 2 – Extreme Precipitation Index for Canada



(Source: Actuaries Climate Index – http://actuariesclimateindex.org/explore/regional-graphs/)

Canada has seen a shift in precipitation and the trend has been upward. Some of the largest changes have taken place in British Columbia and Atlantic Canada.

In addition to looking at general precipitation trends, it also matters whether the precipitation is rain or snow. Severe weather events can take place year-round in Canada, but the type of precipitation involved will differ from season to season. In parts of Canada, winter precipitation has been increasing, leading to more flood hazards come springtime. Winter precipitation can lead to larger snowpacks which, when combined with spring rainfall and rapidly warming spring temperatures, lead to widespread flooding.

Equally, geography is a factor, with different parts of Canada being affected by different types of extreme events more frequently.

Increasing trends in precipitation intensity have been observed in over two-thirds of the Northern Hemisphere. Due to its location, Canada is also experiencing more frequent extreme heat events, which can lead to higher precipitation.[7]

3. Challenges posed by rainfall data

Climate scientists and others rely on rainfall gauge data from ECCC as observational data about precipitation trends. Rainfall gauge data in Canada shows an annual increase of overall precipitation, but there is difficulty in capturing extreme events unless they occur in the precise location where the measuring instrument (a rain bucket) is located. Given that there are fewer than 200 of these instruments to cover a country of 9.9 million square kilometres, it is not surprising that for Canada

as a whole, observational evidence of changes in extreme precipitation is lacking.[8] Famously, one of the most severe rainstorms on record occurred on August 19, 2005, and caused widespread flooding over the northern portions of the City of Toronto. However, the ECCC rain gauge at Pearson airport registered little rain relative to the municipal gauges across the city. That was because the bulk of the storm simply bypassed the airport.

Unfortunately, the ECCC rainfall gauge program was a victim of budget cuts in the 1990s, which affected the consistency of its data. Currently, ECCC is updating how it collects precipitation data, but the challenge of tracking intense localized events will likely remain.

Because rain gauge data has limitations, other data sources, such as radar signatures of past storm events, are being considered as alternatives. However, radar data has also been shown to have limitations when used to track rainfall. For example, radar underestimated the amount of rainfall during the Toronto Flood on July 8, 2013.[9]

It may be useful to look to U.S. observational data of heavy/intense rainfall events because the dense observation network in the U.S. is statistically more likely to capture extreme events. For example, observations in the 2014 U.S. National Climate Assessment report indicate an increase in the trend of heavy rainfall over the past 30 to 50 years.[10] Several scientific studies that include both the United States and Canada have noted that precipitation levels change at the U.S.-Canada border, which would indicate a difference in measuring rather than in precipitation levels.[11]

Finally, insurer loss data can also help to complete the picture – particularly since insurer data tends to be more recent than other data sources.

4. Changing precipitation trends can be attributed to climate change

Canada's 2014 science assessment report is clear that changing precipitation trends can be attributed to climate change.

> *"Warming of the global climate over the past century is unequivocal. It is evident in global atmospheric and oceanic temperature data, and from changes in a variety of other physical indicators, including declines in snow and ice cover".*[12]

These declines in snow and ice cover are already being experienced in Canada, as indicated in the Canada in a Changing Climate report (2014) and in chapter 5 of Canada's Changing Climate Report (2019).

A number of studies state that calculating and attributing large-scale regional precipitation trends to climate change is often difficult.

In the future, event attribution science may provide a more concrete connection between single large-scale extreme weather events and climate change. Both the southern Alberta floods of 2013 and the Fort McMurray wildfire of 2016 were observed to have been more severe than they would have been without climate change as a factor.[13]

5. Flooding is the dominant climate peril facing Canada today

Federal Environment Minister Catherine McKenna recently stated that "the one-in-100-year flood" is happening much more frequently.[14] According to the 2017 study *Climate Change, Floods, and Municipal Risk Sharing in Canada:*

> *"Flooding is currently the most costly hazard for urban properties. Water related losses have become the principal source of property claims, surpassing both fire and theft."*

According to the Canada in a Changing Climate report, wildfire and drought risk will increase due to the increase in severity of heatwaves. Climate change will also cause more intense rainfalls that will increase the risks faced by urban areas.[15]

6. Common definitions of water damage (sewer backup, overland flooding and seepage)

The following are common ways that water can enter a home or business. Insurers may offer optional coverage for these perils.

Sewer BackUp

Sewer backup (SBU) occurs when, for example, the water table rises or when urban sewer pipes become pressurized during a storm. The buildup of pressure causes water to reverse back up through the main outflow pipe in the house to emerge through drains in showers, sinks or toilets. This type of damage can be prevented through installation of a backflow prevention valve on the main outflow drain in a house.

Overland Flooding

Overland flooding usually occurs when bodies of fresh water, such as rivers and other watercourses, overflow onto dry land and cause damage. It can also happen when there is an intense rain storm and water accumulates rapidly, exceeding the ability of local stormwater drainage systems to divert it. In either case, water runs over the surface of the ground and through doors and basement windows into homes. Overland flooding events can last weeks and the prolonged exposure to water can cause structural damage to buildings. Contaminants from local landfills, oil tanks and septic fields can enter homes and render homes unlivable. Fungus and mold can seed behind drywall during a flood event, flourish later and cause health issues if not removed. Reconstruction can take over a year and often requires homeowners to find alternative living arrangements for a lengthy period of time.

Seepage

Water seeping through foundations or seams in the building, intended to be watertight. It is typically not a sudden event, whereas overland water or flooding is water that suddenly enters through doors and windows.

Water and Sewer Lines

Some insurers are providing protection for the water and sewer lines connected to homes, in the event that they leak, break, tear, rupture or collapse.

7. Different types of overland floods - fluvial, pluvial, coastal and tsunami - and their causes

FLUVIAL FLOODING can occur when water levels rise in lakes and rivers due to rain or extensive volumes of melted snow, and/or overflow of dams and channels. Fluvial risk is often predictable and can be modelled and mapped based on flood return intervals across discrete geographies; for example, floodplains. Insurance for homeowners in areas at risk of fluvial floods may be unaffordable or unavailable and will likely remain so in the absence of mitigating measures that can bring the risk down to insurable levels. (Bringing these properties to insurable levels may involve physically moving homes and businesses to safer settings through the government purchase of properties – a practice known internationally as "strategic retreat.")

PLUVIAL OR SURFACE WATER FLOODING occurs when heavy rainfall creates a flood event independent of an overflowing body of water. There are two common causes of pluvial flooding.

1) Intense rain saturates and overwhelms an urban drainage system so that the water flows out into streets and nearby structures (often through the sewage system, causing sewer backup)

2) Rainfalls on hillsides that are unable to absorb the water, causing run-off or flowing water.

Hillsides where there have been recent forest fires are common sources of pluvial floods, as are communities on hillsides. Pluvial flooding can happen in any urban area – even in higher-elevation areas that lie above coastal and river floodplains. As a consequence, pluvial risk is less predictable and can affect anyone. Flood coverage is available in many areas for pluvial flooding.

COASTAL OR SURGE FLOODING is produced when high winds from hurricanes and other storms push water onshore. This is the leading cause of coastal flooding and often the greatest threat associated with a tropical storm. In this type of flood, water overwhelms low-lying land and often causes devastating loss of life and property. Coastal risk can be generally modelled and predicted. Insurance for this peril is in its infancy and still very limited. Canadians living along coastal areas may be eligible for this type of coverage.

TSUNAMIS result in water damage and coverage has historically been available to commercial property policyholders under optional flood coverage. To date, as insurers start offering optional residential overland flood coverage, we are not aware of any personal property insurers who have developed optional flood coverage that includes tsunami.

8. How insurers use flood maps to accurately assess risk

Governments across Canada rely on insurers to increase the availability and affordability of overland flood insurance to reduce taxpayer-funded disaster assistance payouts. But until 2015, insurers lacked access to reliable flood maps to price overland risk across the country.

Maps can effectively communicate flood hazard. For urban planning and infrastructure deployment purposes, municipalities often rely on **flood hazard maps**. These maps show flooding extents and depths for given return periods, such as the annual probability of occurrence. In Canada, flood hazard maps are usually based on detailed engineering studies for 1- to 2-kilometre sections of rivers. They typically show fluvial (riverine) flooding only; they do not consider pluvial (rainfall), coastal, ice jam and

other types of flooding. As a result, they are also often referred to as "floodplain maps." In many areas of Canada, flood hazard maps are either unavailable or outdated.

To underwrite risk, insurers require access to maps that show all potential sources of overland flooding (fluvial, pluvial and coastal). For this reason, Insurance Bureau of Canada (IBC) invested heavily to develop comprehensive flood hazard and vulnerability maps covering all scenarios. After a global search, IBC selected a leading private-sector flood modeller from the U.K.

Today, Canadian insurers purchase licences to access such maps from competing private-sector companies in the U.K., United States and Czech Republic. Insurers then combine these maps with other data – such as the replacement value of a structure, the likely basement contents of a home and other property-specific details – to determine the flood exposure of a particular property. The availability and pricing of insurance for a particular location is based on this analysis and may vary from insurer to insurer depending on their internal analysis and appetite for risk.

IBC is working with Natural Resources Canada to improve input data on terrain modelling to increase the accuracy of flood maps. It is also working with the Canadian Water Network and municipalities across the country to ensure that private-sector flood maps reflect investments made in flood defences, including the protection or restoration of natural infrastructure.

9. Making flood mapping information available to home and business owners

At their annual meeting in May 2018 and again in January 2019, the Federal/Provincial/Territorial Ministers of Emergency Management discussed ongoing work, led by Natural Resources Canada on the development of an accessible, public information tool that would help Canadians inform themselves of their personal flood risk.

Such a tool or mechanism is foundational in any effort to reduce flood risk in Canada. International experience demonstrates that citizens are not motivated to take the necessary steps to protect themselves from flooding until they are aware of their personal risk. Furthermore, international research conducted at the University of Waterloo in Ontario found that consumers must be contacted repeatedly to become informed about their flood risk.

Canadians will not normally seek out flood risk information if they are not aware of its relevance. For this reason, a single authoritative source detailing flood risk must be designed to also feed the same information to realtors, mortgage lenders and mortgage insurers. In this way, consumers will be presented with the same risk details over and over again, prompting them to make risk-informed decisions. IBC is working with Public Safety Canada and Natural Resources Canada to design and launch such a flood risk portal in 2020.

Index

1 Canada in a Changing Climate Report (Chapter 4), authored by the Government of Canada

2 Canada in a Changing Climate: Sector Perspectives on Impacts and Adaptation, authored by the Government of Canada

3 CatIQ Connect Conference: February 4, 2019

4 U.S. Global Change Research Program, 2018. Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II

5 Canada's Changing Climate Report (Section 4.3), authored by the Government of Canada

6 http://actuariesclimateindex.org/explore/regional-graphs/ & http://actuariesclimateindex.org/about/

7 Simonovic, S. P., Schardong, A., & Sandink, D. (2016). Mapping extreme rainfall statistics for Canada under climate change using updated intensity-duration-frequency curves. Journal of Water Resources Planning and Management, 143(3), 04016078

8 Simonovic, S. P., Schardong, A., & Sandink, D. (2016). Mapping extreme rainfall statistics for Canada under climate change using updated intensity-duration-frequency curves. Journal of Water Resources Planning and Management, 143(3), 04016078 & https://www.tandfonline.com/doi/pdf/10.1080/07055900.2018.1514579?needAccess=true

9 https://ams.confex.com/ams/28SLS/webprogram/Manuscript/Paper300219/SLS2016_Sillsetal_2013TorontoFlood_ExtendedAbstract.pdf & https://www.weather.gov/media/cle/GLOMW2018/29%20-%20Knott-GLOMW-2018.pdf

10 https://nca2014.globalchange.gov/report

11 https://docs.assets.eco.on.ca/reports/climate-change/2018/Climate-Action-in-Ontario-Appendix-D.pdf & https://journals.ametsoc.org/doi/full/10.1175/BAMS-D-16-0060.1 & Canada's Changing Climate Report (Section 4.3.2.1)

12 https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/earthsciences/pdf/assess/2014/pdf/Chapter2-Overview_Eng.pdf

13 Canada's Changing Climate Report (Chapter 4 and pg. 183) (Government of Canada) & https://link.springer.com/article/10.1007/s00382-016-3239-8 & https://bulletin.cmos.ca/did-anthropogenic-climate-change-increase-the-chance-of-an-extreme-wildfire-in-the-fort-mcmurray-area/ authored by the Government of Canada.

14 https://globalnews.ca/news/5206116/100-year-floods-canada-increasing/

15 Canada's Changing Climate Report, authored by the Government of Canada, 2019 (pg. 5)

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WINDSOR / WEST HANTS TOGETHER

WEST HANTS REGIONAL MUNICIPALITY REPORT

Information ☐	Recommendation x	Decision Request ☐	Councillor Activity ☐

To: Members of Municipal Climate Change Action Plan Committee

Submitted by: _____
Saira Shah, Planner

Date: February 10, 2021

Subject: GHG Inventory Report

LEGISLATIVE AUTHORITY

Council Resolution to Join the FCM-ICLEI (Local Governments for Sustainability) Partners for Climate Protection Program. (September 11, 2018)

RECOMMENDATION

In order to submit the inventory report to complete milestone 1 of the Partners for Climate Protection (PCP) program, staff recommends that the Municipal Climate Change Action Plan (MCCAP) Committee forward a positive recommendation by passing the following motion:

MCCAP Committee recommends that Council complete milestone 1 of the PCP program by submitting the report attached as Appendix A to the MCCAP Committee dated February 10, 2021 to the PCP program.

BACKGROUND

In September 2018, the former Municipality of the District of West Hants (West Hants) joined the PCP program. The PCP program is a five (5) step milestone process that assists municipalities to develop and implement an action plan to reduce greenhouse gas (GHG) emissions at the corporate (Municipal) and broader community level (residential, commercial, etc.). The PCP program is managed and delivered by the FCM (Federation of Canadian Municipalities) and ICLEI (International Council for Local Environmental Initiatives). The West Hants Regional Municipality (WHRM) continues to be a member of this program.

Milestone 1 of the PCP program involves the Municipality developing a GHG emissions inventory to track emissions and energy spending over a certain time period. This information is used to develop a business-as-usual forecast to determine what emissions the Municipality is likely to produce if no actions are implemented. To Complete Milestone 1, the Municipality must submit a report which includes:

- a summary of the community and corporate inventory;
- the emission intensity values or coefficient values for all energy types, including electricity;
- a summary of data sources;
- a description of assumptions made regarding data; and
- a 10-year business-as-usual emissions forecast.

In 2019 West Hants received $60,000 from the Low Carbon Communities Program and $8,400 from the Labour and Advanced Education Co-op Program to hire WSP Canada Inc. and students Casey Parker and Courtney Smith to complete a GHG inventory of corporate and community emissions. Due to the consolidation of the Town of Windsor (Windsor) and West Hants, a regional inventory could not be completed until after April 1, 2020. An inventory was developed for West Hants with the intention to incorporate Windsor data to develop a regional inventory at a later date. WHRM approved in the 2020-2021 budget to hire a student to complete the regional inventory. Casey Parker completed the regional inventory attached as Appendix A. Based on the requirements outlined in the PCP program, staff recommend submitting the report prepared by Casey Parker to complete Milestone 1 of the PCP program.

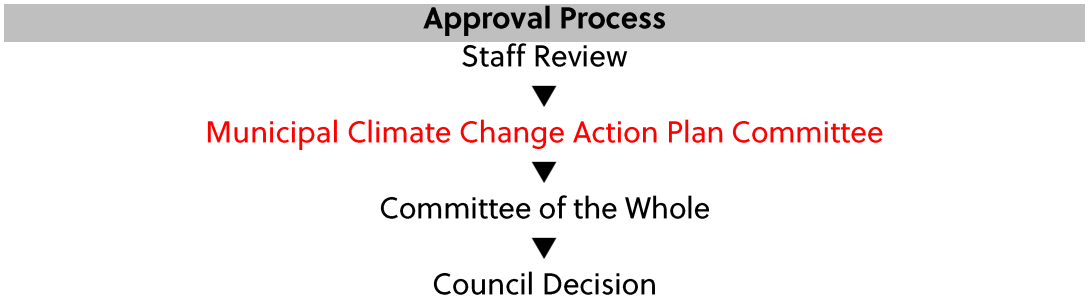
DISCUSSION

The corporate inventory was developed based on the 2018/2019 fiscal year, which spans from April 1st, 2018 to March 31st, 2019. It includes all emissions from Municipal services and operations. The community inventory is for the 2016 calendar year based on all emissions resulting from key activity sectors within the Municipalities boundaries including residential, commercial, agricultural, and industrial uses. The year 2016 was chosen for the community inventory as much of the data relies on Statistics Canada which produced its last census in 2016.

The highest emissions in the corporate inventory are from the water and waste water treatment sectors (50%) while the highest emissions in the community inventory are from the residential sector accounting for 31% of total community emissions.

Details on the findings are included in the report attached as Appendix A.

NEXT STEPS



FINANCIAL IMPLICATIONS

There are no financial implications associated with submitting the report to complete Milestone 1.

ALTERNATIVES

In response to the application, MCCAP Committee may:

- refuse the proposed recommendation; or
- provide alternative direction such as requesting further information on a specific topic.

ATTACHMENTS

Appendix A Regional Corporate and Community Greenhouse Gas Inventory

Report Reviewed by: _____

Madelyn LeMay, Director of Planning and Development

REGIONAL CORPORATE AND COMMUNITY GREENHOUSE GAS INVENTORY

WEST HANTS REGIONAL MUNICIPALITY

WEST HANTS, NOVA SCOTIA

OCTOBER 2020

REGIONAL CORPORATE AND COMMUNITY GHG INVENTORY

WEST HANTS REGIONAL MUNICIPALITY,

NOVA SCOTIA

OCTOBER 2020

WEST HANTS REGIONAL MUNICIPALITY

76 MORISON DRIVE

WINDSOR, NS

CANADA

ACKNOWLEDGEMENTS

This project was conducted at the West Hants Regional Municipality, under direct guidance of Planner, Saira Shah. The development of the West Hants and Windsor Inventories was completed by two Dalhousie University students and aided by consultants at WSP, in order to meet the requirements of the Partners for Climate Protection (PCP) program. The results of the inventories were merged to create a Regional Inventory. The corporate inventory was achievable due to the contributions from various municipal departments. The community inventory was achievable due to the contributions from Statistics Canada, Access Nova Scotia, and numerous agriculture organizations.

PRODUCTION TEAM

WEST HANTS REGIONAL MUNICIPALITY, NOVA SCOTIA

Planner _____ Saira Shah (June 2019 - November 2020)

Sustainability Planner (Student) _____ Casey Parker (June 2019 - November 2020)

Sustainability Planner (Student) _____ Courtney Smith (June - August 2019)

WSP CANADA INC. (WSP) (July 2019 - March 2020)

SUMMARY

This report highlights the result of the Corporate and Community Emissions Inventories for the West Hants Regional Municipality. The Inventories were developed in order to meet the requirements of Milestone 1 of the Partners for Climate Protection Program. The Corporate Inventory is for the 2018/2019 fiscal year, which spans from April 1st, 2018 to March 31st, 2019. It encompasses all emissions resulting from municipal services and operations, in which the Municipality has direct control over. The Community Inventory is for the 2016 calendar year and encompasses all emissions resulting from key activity sectors within the municipalities boundaries. The results are summarized in Table 1, below, where the Corporate Inventory resulted in 3,530 tCO_2 eq (tonnes of carbon dioxide equivalent). and the Community Inventory, 286,480 tCO_2 eq. Based on the results of the Inventories, an emissions forecast for 2030 was developed. This business-as-usual forecast showed a 44% reduction of corporate emissions and 41% reduction of community emissions.

Table 1 - Summary of Emissions from the Corporate and Community Inventory

REGIONAL CORPORATE INVENTORY (2018/2019)		**REGIONAL COMMUNITY INVENTORY (2016)**	
Activity Sector	**GHG Emissions (tCO_2 eq.)**	**Activity Sector**	**GHG Emissions (tCO_2 eq.)**
Water & Wastewater Treatment	1,772	*Residential*	90,502
Buildings	1,387	*Transportation*	87,189
Vehicle Fleet	192	*Commercial & Institutional*	59,562
Lighting	100	*Industrial*	32,657
Solid Waste	53	*Agricultural*	12,782
Staff Business Travel	26	*Solid Waste*	3,787
Total	**3,530**	***Total***	**286,480**

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1.0 INTRODUCTION

Municipalities are responsible for approximately 44% of Canada's greenhouse gas emissions. This comes as a result of providing daily and weekly services such as water, transit, waste management, streetlighting and infrastructure[1]. In order to combat this, municipalities across the country are undergoing the Partner's for Climate Protection (PCP) Program to take action to reduce these emissions by developing and implementing local action plans and establishing emissions reduction targets[2]. The PCP Program is managed and delivered by FCM (Federation of Canadian Municipalities) and ICLEI (Local Governments for Sustainability Canada) and has an active national network of over 350 municipalities[3].

The development of a greenhouse gas emissions inventory is the foundation of a local action plan, as it allows the municipalities to effectively quantify their emissions. This is essential in the identification of energy-intensive activities and sectors, as well as the determination of action items with the purpose of offsetting emissions. In September 2018, the West Hants Regional Municipality joined the PCP Program. In order to meet the first milestone of the program, a corporate and community inventory was developed for Municipality of the District of West Hants (West Hants) by Courtney Smith, Casey Parker, and WSP in 2019. WSP produced an Inventory Report on the West Hants results in February 2020. Due to the consolidation of the Town of Windsor (Windsor) and West Hants, a regional inventory could not be completed until after April 1, 2020. This report explores the results of the Regional inventories, while following the general outline used in the WSP Inventory Report for West Hants.

The following sub-sections provide an overview of the West Hants Regional Municipality and the Partner's for Climate Protection Program.

1.1 WEST HANTS REGIONAL MUNICIPALITY

The Planning and Development Department of the West Hants Regional Municipality developed a series of nine (9) background reports that cover West Hants and Windsor. The background reports were prepared for the Municipal Planning Strategy review and provide a solid overview of the Regional Municipality. The results from the reports are summarized below.

[1] (Union of Nova Scotia Municipalities, 2011)
[2] (WSP, 2020)
[3] (Federation of Canadian Municipalities, n.d.)

Location

The West Hants Regional Municipality is a rural municipality located in Nova Scotia, approximately 50 minutes north-west of Halifax. The Municipality is composed of three (3) former municipal units: West Hants, The Town of Hantsport (Hantsport), and Windsor. Hantsport became a part of West Hants in 2015, and Windsor and West Hants consolidated in 2020.

Population

Hants County has experienced an average population growth of 4.7%/year from 1966 to 2016 (Census). Hants County is composed of four Census regions: East Hants, West Hants, Windsor and Hantsport. Of the total annual population growth, West Hants has seen an increase of 4% per year, Windsor has had several periods of population decline but has ultimately remained constant, and Hantsport has experienced population decline since 1976. In 2016, the populations of West Hants and Windsor were 15,368 and 3,648, respectively.

Population projections for the next 35 years were made based on the historic populations for both West Hants and Windsor. Three different scenarios were analyzed: low migration, average migration and high migration. The average scenario projects a population increase in West Hants to 18,120 in 2036 before declining to 14,117 in 2056. The average scenario for Windsor projects an insignificant decrease over time, with a population of 2,362 in 2056.

Housing

The predominant type of housing in West Hants is single unit dwellings. In 2016, this style of housing was the choice of 89% of the residents. The Town of Windsor is slightly more diverse, with a significant number of apartment complexes.

In West Hants, approximately 67 permits are issued each year for new residential development. Most residential development between 2009 and 2016 was single unit dwellings (65%). The second largest category was mini and mobile homes, at 26% of the total residential development.

Agriculture

The agriculture industry provides great land-use and economic opportunity within the Municipality. On average, West Hants issues approximately 18 permits for agriculture uses each year. Between 2007 and 2016, it appeared that agriculture development was focused in five main locations: Upper Burlington, Scotch Village, Falmouth, Upper Falmouth, and Windsor Forks. Agricultural development in Windsor is much less significant, with an average of one (1) permit issued per year.

Economic Development

Nova Scotia is considered a service-based economy, with 81% of the population working in the service sector in 2012. The remaining 19% consists of other primary industries, utilities, construction and manufacturing. In 2011 the largest industries in West Hants were construction, retail trade, and health care. Combined, these three (3) industries made up 39% of employment. Additionally, in West Hants, the forestry and gypsum industries have been profitable, despite sales declining over the past few years. However, this is not the case in Windsor. Industrial development is not the main economic driver for the former Town. Instead, the economic drivers are the retail trade and health care industries.

Public Transportation

There are three (3) public transportation options available in the region: dial-a-ride, The Windsor Senior Citizen Bus Society, and Kings Transit. Dial-a-ride provides door-to-door transportation on an as-needed basis to residents that do not have access to a vehicle or may be unable to drive. Their organization consists of eight (8) volunteers that use their personal vehicles, however they also have access to two wheelchair accessible vans. Lastly, the Windsor Senior Citizen Bus Society provides days trips for residents of local senior homes with a 36-passenger bus.

1.2 PARTNERS FOR CLIMATE PROTECTION

Partners for Climate Protection works with a network of over 350 Canadian municipalities to reduce greenhouse gas emissions and take action to fight climate change. The program is administered by FCM and ICLEI. The program guides municipalities to take action through a five-step Milestone Framework, as seen below:

Milestone 1: Create a Baseline Emissions Inventory and Forecast

Milestone 2: Set Emissions Reduction Targets

Milestone 3: Develop a Local Action Plan

Milestone 4: Implement the Local Action Plan

Milestone 5: Monitor Progress and Report Results

In order to fulfill the requirements of Milestone 1, a Corporate and Community Emissions Inventory must be developed. The Corporate Inventory highlights the emissions resulting from municipal services. This includes facilities and operations such as buildings, lighting, water and wastewater, solid waste and transportation. The Community Inventory highlights the emissions within the Municipality from residential, commercial, and industrial buildings, solid waste, and transportation..

2.0 METHODOLOGY

2.1 STANDARDS AND GUIDING DOCUMENTS

Various standards and guiding documents were utilized to develop the Corporate and Community Inventory. Some of the key documents include the following:

- *PCP Protocol: Canadian Supplement to the International Emissions Analysis Protocol* (2014);
- *Global Protocol for Community-Scale Greenhouse Gas Emissions Inventories* (2014);
- *IPCC: Guidelines for National Greenhouse Gas Inventories* (2006);

2.2 BASELINE YEAR

The baseline year for the Corporate Inventory was chosen to be the 2018/2019 fiscal year. This was selected due to increased data availability and accuracy compared to previous years. Therefore, it would ensure that the inventory results would paint a more realistic portrait of the emissions within the West Hants Regional Municipality.

The baseline year for the Community Inventory was chosen to be the 2016 calendar year. This year was chosen because the development of the inventory relied heavily on data collected from government sources, such as Statistics Canada's Census data, with the most recent data coming from 2016.

2.3 GEOGRAPHIC BOUNDARIES

The inventories encompass all emissions within the West Hants Regional Municipality. As of April 1st, 2020, the Municipality consists of West Hants, Hantsport, and Windsor.

2.4 OPERATIONAL BOUNDARIES

As previously mentioned, the Corporate Emissions Inventory encompasses all emissions resulting from municipal services and operation. All operations and services are under the direct influence of the municipal government. The purpose of the inventory is to help identify the energy-intensive sectors. The municipal government will then be able to develop action items (these could include measures such as equipment upgrades or policies) to reduce their negative impact on the environment. However, it is important to note that not all services provided within the West Hants Regional Municipality are under the Municipality's' direct control. Some of the frequently contracted services that the Municipality has limited influence over includes police services, fire protection services, solid waste collection and management, and winter road maintenance. The Municipality has slightly more influence on waste management services which is why it is required for the Corporate and Community Inventories (despite the landfill being owned and operated by GFL Environmental Inc.).

The Community Emissions Inventory encompasses the emissions resulting from significant activities within the West Hants Regional Municipality. The Municipality has very limited influence over said significant activities as they are not carried out by the municipal unit. However, the purpose of the community inventory is to understand the contribution that the region as a whole is making to climate change. This insight will allow the local government to engage the community in plans and policies to encourage residents to lessen their negative impacts on the environment.

2.5 GREENHOUSE GASES

The resulting emissions from the Corporate and Community Inventories are expressed in units of tCO_2 equivalent (eq.). This represents a combination of the three principal greenhouse gases: carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). The Global Warming Potential (GWP) for each individual greenhouse gas was used to assess their individual impacts. The GWP's were obtained from the *National Inventory Report 1990-2018 – Greenhouse Gas Sources and Sinks in Canada* and are summarized in Table 2.

Table 2 - Global Warming Potentials for the Greenhouse Gases Included in the Inventories

Greenhouse Gas	Formula	100-Year GWP
Carbon Dioxide	CO_2	1
Methane	CH_4	25
Nitrous Oxide	N_2O	298

2.6 REPORTING REQUIREMENTS

In order to meet the requirements of the PCP Protocol for the Corporate Inventory, the inventory must contain the five (5) main activity sectors. However, additional activity sectors may be included to provide a stronger representation. The inclusion of additional sectors is considered optional and is solely based on the availability of data. The activity sectors incorporated in the West Hants Regional Municipalities' Corporate Inventory are highlighted in Table 3. It can be seen that the five main activity sectors were included, with the addition of one optional activity sector. Staff business travel was incorporated into the inventory due to the fact that the data was available and easy to access.

Similarly, the PCP Protocol requires the inclusion of the five (5) main activity sectors for the Community Inventory. These activity sectors are slightly different as the inventory analyzes the community as a whole. The activity sectors incorporated in the West Hants Regional Municipality's Community Inventory are highlighted in Table 4. Here, agriculture was included as an optional activity sector due to the prevalence of farming in the Municipality.

Table 3 - Summary of Activity Sectors Included in the Corporate Emissions Inventory

Corporate Activity Sector	PCP Requirements
Buildings	Required
Street Lighting	Required
Vehicle Fleet	Required
Water & Wastewater Treatment	Required
Solid Waste	Required
Staff Business Travel	Optional

Table 4 - Summary of Activity Sectors Included in the Community Emissions Inventory

Community Activity Sector	PCP Requirements
Residential Energy Consumption	Required
Commercial/Institutional Energy Consumption	Required
Industrial Energy Consumption	Required
Road Transportation	Required
Solid Waste	Required
Agriculture	Optional

2.7 DATA COLLECTION & QUANTIFICATION

The Corporate Emissions Inventory was developed using the *UNSM Corporate Energy and Emissions Spreadsheet*. Various updates were made to the document since its original version in 2007. This includes updates made by WSP in 2019, during the development of the initial Corporate Inventory for West Hants. The original version was created by Stantec Inc. and was based on the International Council for Local Environmental Initiative's (ICLEI) *Inventory Quantification Support Spreadsheet.*

The Community Emissions Inventory was developed using the *Community Quantification Support Spreadsheet*. This document was built by WSP in 2019. It was also highly influenced by ICLEI's *Inventory Quantification Support Spreadsheet*, of which was designed specifically for members of the Partners for Climate Protection program.

Data collected for each of the previously identified activity sectors of the Corporate Inventory are highlighted in Table 5 and the Community Inventory in Table 6. The corresponding method of quantification and data source is also identified in the respective tables. The Inventories heavily relied on Canada's National Inventory Report (NIR) 1990-2018 for emission factors and Statistic Canada's 2016 Census Data to scale down various data requirements. The emission factors utilized for each activity sector are summarized in Appendix A. Additionally, all data sources can be found in the *Corporate Energy and Emissions Spreadsheet* and the *Community Quantification Support Spreadsheet.*

Table 5- Data Requirement and Quantification Methodology for the Corporate Inventory

Data Required by Activity Sector	Method of Quantification	Data Source
Buildings		
Emissions from electricity consumption	Quantity of electricity used (kWh) x Emission factor	*Quantity of Electricity* – NS Power invoices *Emission Factor* – NIR Table A13-4 Electricity Generation and GHG Emission Details for Nova Scotia
Emissions from stationary fuel consumption	Quantity of fuel used (L) x Emission factor	*Quantity of Fuel* – Fuel provider invoice *Emission Factor* – NIR Table A6-4 Emission Factors for Refined Petroleum Products
Street Lighting		
Emissions from electricity consumption	Quantity of electricity used (kWh) x Emission factor	*Quantity of Electricity* – NS Power invoices *Emission Factor* – NIR Table A13-4 Electricity Generation and GHG Emission Details for Nova Scotia
Vehicle Fleet		
Emissions from motor fuel consumption	Quantity of fuel used (L) x Emission factor	*Quantity of Fuel* – Fuel provider invoice *Emission Factor* – NIR Table A6-13 Emission Factors for Energy Mobile Combustion Sources
Water & Wastewater Treatment		
Emissions from electricity consumption	Quantity of electricity used (kWh) x Emission factor	*Quantity of Electricity* – NS Power invoices *Emission Factor* – NIR Table A13-4 Electricity Generation and GHG Emission Details for Nova Scotia
Emissions from stationary fuel consumption	Quantity of fuel used (L) x Emission factor	*Quantity of Fuel* – Fuel provider invoice *Emission Factor* – NIR Table A6-4 Emission Factors for Refined Petroleum Products
Solid Waste		
Emissions from disposal of corporate solid waste	Methane Commitment Model (using quantity of waste landfilled and composition of waste stream)	*Quantity of Waste Landfilled* – Estimated based on size of container, frequency of collection and typical size of load *Composition of Waste Stream* – Based on Divert NS waste audit in 2017
Emissions from composting of organics	Quantity of Organics x Emission Factor	*Quantity of Organics* – Estimated based on size of container, frequency of collection and typical size of load *Emission Factor* – 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 5, Waste – Biological Treatment of Waste
Staff Business Travel		
Emissions from motor fuel consumption	Quantity of kilometers traveled x Fuel Rate x Emission Factor	*Quantity of KM travelled* – From employee expense forms *Fuel Rate* – Oak Ridge National Laboratory (2017), Transportation Energy Data Book: Edition 36, Table 4.1 Summary Statistics for Cars, 1970-2015 *Emission Factor* – NIR Table A6-13 Emission Factors for Energy Mobile Combustion Sources

Table 6 - Data Requirement and Quantification Methodology for the Community Inventory

Data Required by Activity Sector	Method of Quantification	Data Source
Residential		
Emissions from electricity consumption	Quantity of electricity used (kWh) x Emission factor	*Quantity of Electricity* – NRCAN Comprehensive Energy Use Database, Residential Sector, Nova Scotia, Table 1 – Secondary Energy Use and GHG Emissions by Energy Source *# of Dwellings* – Statistics Canada 2016 Census Data, for Nova Scotia and West Hants Regional Municipality *Emission Factor* – NIR Table A13-4 Electricity Generation and GHG Emission Details for Nova Scotia
Emissions from stationary fuel consumption	Quantity of fuel used (L) x Emission factor	*Quantity of Fuel* – NRCAN Comprehensive Energy Use Database, Residential Sector, Nova Scotia, Table 1 – Secondary Energy Use and GHG Emissions by Energy Source *# of Dwellings* – Statistics Canada 2016 Census Data, for Nova Scotia and West Hants Regional Municipality *Emission Factor* – NIR Table A6-4 Emission Factors for Refined Petroleum Products
Commercial/Institutional		
Emissions from electricity consumption	Quantity of electricity used (kWh) x Emission factor	*Quantity of Electricity* – NRCAN Comprehensive Energy Use Database, Commercial/Institutional, Atlantic, Table 1 – Secondary Energy Use and GHG Emissions by Energy Source *Employment in Service Sector* – Statistics Canada 2016 Census Data, for Atlantic Region and West Hants Regional Municipality *Emission Factor* – NIR Table A13-4 Electricity Generation and GHG Emission Details for Nova Scotia
Emissions from stationary fuel consumption	Quantity of fuel used (L) x Emission factor	*Quantity of Fuel* – NRCAN Comprehensive Energy Use Database, Commercial/Institutional, Atlantic, Table 1 – Secondary Energy Use and GHG Emissions by Energy Source *Employment in Service Sector* – Statistics Canada 2016 Census Data, for Atlantic Region and West Hants Regional Municipality *Emission Factor* – NIR Table A6-4 Emission Factors for Refined Petroleum Products
Industrial		
Emissions from electricity consumption	Quantity of electricity used (kWh) x Emission factor	*Quantity of Electricity* – NRCAN Comprehensive Energy Use Database, Industrial Sector – Aggregated Industries, Atlantic, Table 1 – Secondary Energy Use and GHG Emissions by Energy Source *Employment in Industry Sector* – Statistics Canada 2016 Census Data, for Atlantic Region and West Hants Regional Municipality

		Emission Factor – NIR Table A13-4 Electricity Generation and GHG Emission Details for Nova Scotia
Emissions from stationary fuel consumption	Quantity of fuel used (L) x Emission factor	*Quantity of Fuel* – NRCAN Comprehensive Energy Use Database, Industrial Sector – Aggregated Industries, Atlantic, Table 1 – Secondary Energy Use and GHG Emissions by Energy Source *Employment in Industry Sector* – Statistics Canada 2016 Census Data, for Atlantic Region and West Hants Regional Municipality *Emission Factor* – NIR Table A6-4 Emission Factors for Refined Petroleum Products
Road Transportation		
Emissions from motor fuel consumption	Quantity of fuel used (L) x Emission factor	*Quantity of Fuel* – Statistics Canada. Table 23-10-066-01 Sales of Fuel Used for Road Motor Vehicles, Annual (x 1,000) *# of Registered Vehicles* – Access Nova Scotia *Emission Factor* – NIR Table A6-13 Emission Factors for Energy Mobile Combustion Sources
Solid Waste		
Emissions from disposal of community solid waste	Methane Commitment Model (using quantity of waste landfilled and composition of waste stream)	*Quantity of Waste Landfilled* – From Cogmagun Landfill records *Composition of Waste Stream* – Based on Divert NS waste audit in 2017
Emissions from composting of organics	Quantity of Organics x Emission Factor	*Quantity of Organics* – From composting facility records *Emission Factor* – 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 5, Waste – Biological Treatment of Waste
Agriculture		
Emissions from Enteric Fermentation	Livestock Headcount x Emission Factor	*Cattle Headcount* – Statistics Canada. Table 32-10-0424-01 Cattle and calves on census day *Swine Headcount* – Statistics Canada. Table 32-10-0426-01 Pigs on census day *Emission Factor* – IPCC Volume 4 Chapter 10 – Tier 1 Method
Emissions from Manure Management	Livestock Headcount x Emission Factor	*Cattle Headcount* – Statistics Canada. Table 32-10-0424-01 Cattle and calves on census day *Swine Headcount* – Statistics Canada. Table 32-10-0426-01 Pigs on census day *Emission Factor* – IPCC Volume 4 Chapter 10 – Tier 1 Method

3.0 CORPORATE EMISSIONS INVENTORY

The following sub-sections summarize the results from the baseline Corporate Emissions Inventory for the West Hants Regional Municipality.

3.1 SUMMARY

The total corporate emissions for the 2018/2019 fiscal year were 3,530 tCO_2 eq. The total emissions were broken down by sector and can be seen in Figure 1. The majority of the emissions resulting from municipal operations come from the water and wastewater system. They make up 50.2% of the overall profile. The second largest emissions source is buildings, resulting in 39.3%. The solid waste, street lighting and staff business travel emissions are almost negligible, as together they make up exactly 5% of the overall profile.

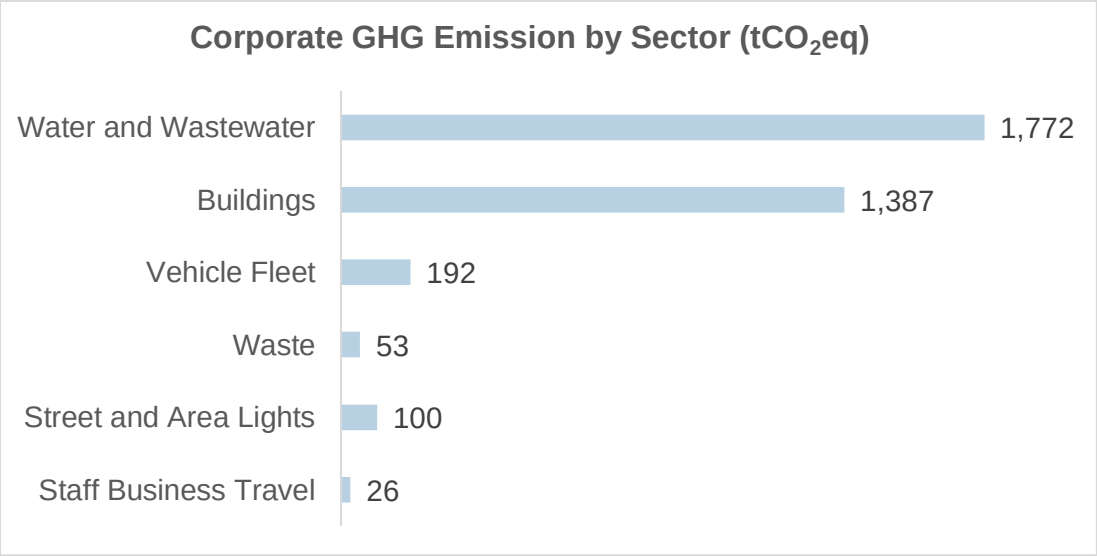

Figure 1 - Summary of Corporate GHG Emissions by Sector

The total emissions were also broken down by energy type, in Figure 2. However, this excludes the emissions from the solid waste section of the inventory, as it is the only sector where the method of quantification does not depend on an energy source. The energy source resulting in the largest amount of emissions was electricity (84.6%). This is largely due to the fact that the electricity in Nova Scotia comes mostly from natural gas and solid fuel, resulting in increased emissions factors. The remainder of energy sources used include propane, diesel, gasoline and light fuel oil. The resulting emissions from the light fuel oil make up 6.4% of the overall profile. The remainder of the energy sources each represent below 4% of emissions. The emissions for

natural gas, district energy, wood waste/pulp liquor and heavy fuel oil were all zero, as these types of energy were not used for municipal operations. Therefore, these sources were excluded from the graph.

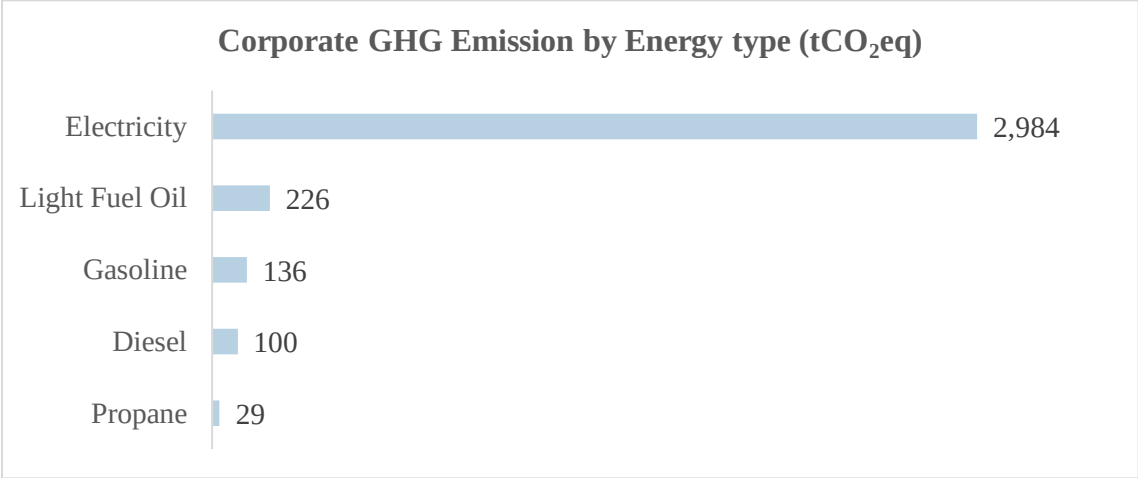

Figure 2 - Summary of Corporate GHG Emissions by Energy Type

3.2 BUILDINGS

The calculation of emissions resulting from municipally-owned buildings was based on electricity and fuel use. The required data was obtained from the energy provider bills. The one electricity provider was Nova Scotia Power. The fuel oil, however, was received from multiple providers: Irving Energy, West Nova Fuels and Oulton Fuel's Ltd. The energy use by source and the resulting emissions for each building owned and operated by the Municipality can be found in Table 7. The total emissions for the 2018/2019 fiscal year were 1,387 tCO_2 eq. The W.B. Stephens Building at 100 King St. in Windsor, results in the largest amount of emissions (19%). The building had the largest electricity consumption, at 285,060 kWh, and also required light fuel oil for heating purposes. The Municipal Building (76 Morison Drive) and Brooklyn Fire Station/Civic Centre are each responsible for the second largest contribution, at 12% of the overall emissions profile.

Table 7 - Summary of Energy Use and Emissions from Municipal Buildings

Building	Electricity Use (kWh)	Light Fuel Oil Use (L)	Gasoline Use (L)	Diesel Use (L)	Total GHG (tCO_2 eq)	% of Profile
W.B. Stephens Building – 100 King Street	285,060	18,154			267	19.2%
Brooklyn Fire Station & Civic Centre – 955 Highway 215	215,040				163	11.8%
Municipal Building – 76 Morison Drive	211,380			329	162	11.7%
Ice Plant - 239 Wentworth Road	164,400				125	9.0%
Hants County Courthouse – 240 King Street	26,160	22,250			81	5.9%
Arena – 239 Wentworth Road	103,200				78	5.7%
Hants Memorial Community Centre – 78 Thomas Street	55,400	10,450			71	5.1%
Town Hall – 20 Main Street	52,430		5,215	1,290	55	4.0%
Library – 195 A Albert Street	66,840				51	3.7%
Hantsport Fire Department – 5 Oak Street	39,086	7,689			51	3.7%
56 Park Drive	32,225	9,223			50	3.6%
Public Works Shed – 19 Chittick Avenue	18,597	11,876			47	3.4%
Hants Aquatic Centre – 306 Stannus Street	50,375				38	2.8%
Ball Field (Recreation Centre) – 54 Ball Park	28,274				21	1.5%
Hants Aquatic Centre Pumphouse – 306 Stannus Street	28,091				21	1.5%
Brooklyn Station 2 – 5984 Highway 14/Tongue Hill Garage	24,480				19	1.3%
Library – 10 Main Street	23,294				18	1.3%
Police Station – 3 Oak Street	12,222	2,020			15	1.1%
Park Drive	17,813				14	1.0%
Hantsport Music Fest – 10 Foundry Road	16,744				13	0.9%
Construction Trailer – 20 Pleasant Street	8,806				7	0.5%
Recreation Centre – 156 Eldridge	8,012				6	0.4%
Maplewood Cemetery	5,626				4	0.3%
Bandstand Walkway	3,709				3	0.2%
72 Ivey Lane	4,191				3	0.2%
Coach House – 6 King St Ext	4,148				3	0.2%
Total	**1,505,917**	**81,661**	**5,215**	**1,619**	**1,387**	**100%**

3.3 STREET LIGHTING

The lighting sector includes all streetlights, cameras and fire alarms owned and operated by the Municipality. The emissions resulting from the lighting sector were based on electricity consumption. While this information was not directly available from the electricity provider, Nova Scotia Power, it was estimated based on the wattage of each fixture, the hours of operation per day, and the days of operation per year. The electricity and resulting emissions for each lighting system are summarized in Table 8, with the total emissions being 100 tCO_2 eq.

Table 8 - Summary of Electricity Use and Emissions from Lighting

Lighting System Name	Type of Light	Electricity Use (kWh)	Total GHG (tCO_2 eq)
Streetlights Throughout Windsor	LED	63,273.48	48.08
Streetlights Throughout West Hants	LED	48,902.70	37.17
Wentworth Rd.	High Pressure Sodium	8,541.00	6.49
Clover Lane	Decorative	3,942.00	3.00
Wentworth Rd.	Metallic Additive	1,752.00	1.33
Falmouth Mini Park	LED	1,204.50	0.92
54 Ball Park	LED	963.60	0.73
Irishman Road	LED	240.90	0.18
Courthouse	LED	240.90	0.18
Brooklyn Fire Department	LED	240.90	0.18
2 Main St.	LED	240.90	0.18
10 Main St.	LED	240.90	0.18
Cottage Lane	40W Camera	175.20	0.13
Willow St.	40W Camera	175.20	0.13
Willow St. #cameras	40W Camera	175.20	0.13
Prince St.	40W Camera	175.20	0.13
Avon St.	40W Camera	175.20	0.13
Tannery Rd.	40W Camera	175.20	0.13
Main St. #cameras	40W Camera	175.20	0.13
School St.	40W Camera	175.20	0.13
Fire Alarm	N/A	13.61	0.01
Total		**131,199**	**100**

3.4 VEHICLE FLEET

The emissions from the municipal-owned vehicles were calculated based on the fuel used. The result also includes the quantification of tools and equipment. Fuel usage was obtained from the fuel receipts collected for each vehicle or piece of equipment. The results can be seen in Table 9. The gasoline usage was slightly higher than that of the diesel. The total corresponding emissions were 2,648 tCO_2 eq.

Table 9 - Summary of Fuel Use and Emissions from Vehicle Fleet

Vehicle Group Name / Department	Gasoline Use (L)	Diesel Use (L)	Total GHG (tCO_2 eq)
Public Works	25,642	27,244	135
Recreation	6,294	44	15
Water Utility	5,253	0	12
Other Tools[4]	114	3,189	9
Fire	0	2,662	7
Planning & Development	2,407	0	6
Recreation Other/Mowers/Trimmer	903	950	5
Administration	803	0	2
Cemetery	667	0	2
Total	**42,082**	**34,089**	**192**

3.5 STAFF BUSINESS TRAVEL

Similarly to the vehicle sector, the emissions for staff business travel were calculated based on the fuel use. This was determined through the employee expense forms, where staff are required to record the kilometers travelled for work purposes in personal vehicles. The kilometers were converted to fuel usage using the fuel efficiency for a light-duty gasoline vehicle. All staff-owned vehicles were assumed to be light-duty and fuelled by gasoline as this level of detail was not known. The gasoline usage and resulting emissions were organized by department, as seen in Table 10. The total gasoline used was 11,102 L, with the largest contribution coming from the

[4] The '*Other Tools'* category includes tools such as jugs, pressure washer, welder, plate tamper, lawnmowers, tractors, etc.

Public Works department. The total emissions resulting from staff business travel was 25.91 tCO_2 eq.

Table 10 - Summary of Fuel Use and Emissions from Staff Business Travel

Department	Gasoline Use (L)	Total GHG (tCO_2 eq)
Public Works	3,305.49	7.72
Region 6	2,012.94	4.70
Recreation	1,775.93	4.15
Councillors	1,254.92	2.93
Administration	931.20	2.17
Finance	747.13	1.74
Planning & Development	719.61	1.68
Summer Staff	354.82	0.83
Total	**11,102.00**	**25.91**

3.6 WATER & WASTEWATER TREATMENT

Similarly to the buildings sector, the emissions for water and wastewater facilities were based on the energy use. This information was obtained from energy provider invoices. The energy used to power the water and wastewater facilities were electricity, propane and an insignificant amount of diesel. This can be seen in Table 11, where the facilities are arranged by type: water treatment plant, wastewater treatment plant, and lift station. The three water treatment plants contributed 666 tCO_2 eq. The wastewater treatment plant at 48 Falmouth Connector made the largest individual contribution at 385 tCO_2 eq. The total emissions from all facilities was 1,772 tCO_2 eq.

Table 11 - Summary of Energy Use and Emissions from Water & Wastewater Treatment

Facility	Electricity Use (kWh)	Propane Use (L)	Diesel Use (L)	Total GHG (tCO_2 eq)
Water Treatment Plant				
786 Windsor Back Rd.	370,080			281
242 Eldridge Rd.	279,300			212
2160 Bishopville Rd.	187,440	18,955	324	173
Wastewater Treatment Plant				
48 Falmouth Connector	506,880			385

293 Wentworth Rd.	45,720		380	36
Lift Stations				
3 Lagoon Dr.	442,925			337
33 Colonial Dr.	123,700			94
Panuke Rd.	41,075			31
144 Water St.	34,375			26
124 Across Gabriel	25,200			19
99 Francis St.	22,460			17
905 Mountain Rd.	17,950			14
126 Halewood	17,575			13
708 Bowman Rd.	16,650			13
138 Payzant Dr.	15,550			12
1201 Hillcrest Dr.	14,250			11
422 Back Rd.	12,525			10
133 Dewolfe's Crossing	9,350			7
326 Ball Field	7,650			6
140 Meadow	6,850			5
33 Irven	6,800			5
Willow St.	6,270			5
531 College Rd.	5,975			5
Crossley Court	5,925			5
407 Windsor Back Rd.	5,375			4
2078 Highway 1 Falmouth	5,300			4
120 Green	5,200			4
115 Woodmans Corner	5,125			4
Tremain Crescent	5,075			4
22 Wilewood	4,515			3
19 Chittick Ave.	4,300			3
421 Windsor Back Rd.	3,750			3
96 Ivey Lane	3,591			3
152 Highway #1	3,550			3
Alexander Dr.	3,432			3
244 Wentworth Rd.	3,310			3
604 Green Lane	2,625			2
Prince St.	2,175			2
305 Town Rd.	1,980			2
126 Mapleton	1,925			1
Wentworth/Cole	1,758			1
Main St.	1,711			1
Palmeter Dr.	1,625			1
2 Main St.	314			0
20B Pleasant St.	217			0
Total	**2,289,328**	**18,955**	**876**	**1,772**

3.7 SOLID WASTE

Calculations for corporate waste emissions were based on the annual tonnage of waste. The amount of waste leaving all corporate-owned buildings was not available. Therefore, the quantity was estimated based on the garbage container capacity, frequency of pick up, and the typical filling rate at each site. For facilities that do not rent or own garbage containers, the estimate was based on the number of bags collected per pick up, the frequency of pick up, and the typical filling rate of each bag. The bag size and typical filling rate of each bag were assumed to be 90L (the average size of a large garbage bag) and 75%, respectively. This information was available for slightly over half of the corporate-owned buildings, leaving a large amount of uncertainty. The resulting emissions were 53 tCO_2 eq. and can be seen in Table 12. Compost tonnage information was unavailable as all organics are transported outside of the Municipality and building staff do not record tonnage.

Table 12 - Summary of Tonnage and Emissions for Corporate Waste

	Tonnage	**Emissions (tCO_2 eq)**
Solid Waste	38.35	53
Compost	Not Recorded	N/A

4.0 COMMUNITY INVENTORY

The following sub-sections summarize the results from the baseline Community Emissions Inventory for the West Hants Regional Municipality.

4.1 SUMMARY

The total reported community emissions for the 2016 calendar year was 286,480 tCO_2 eq. The total emissions by sector can be seen below in Figure 3. The residential sector makes up the largest majority of emissions, at 32%. The on-road transportation sector is a close second, at 30% of the total emissions. The emissions resulting from community waste only make up 1% of the emissions profile, making it nearly negligible.

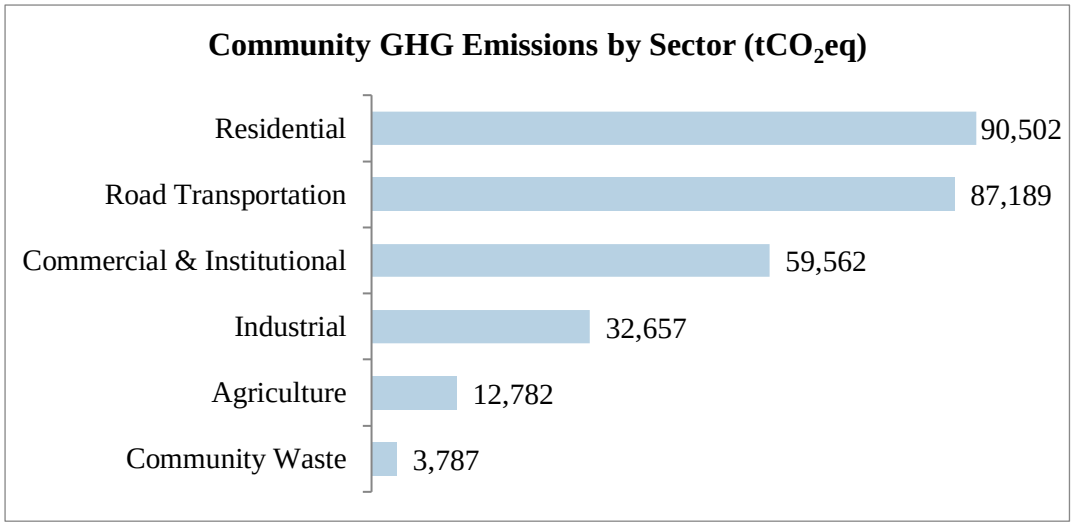

Figure 3 – Summary of Community GHG Emissions by Sector

The results from the inventory were further broken down by energy type. This can be seen in Figure 4. Electricity use in residential, commercial and industrial buildings resulted in the largest amount of emissions. It makes up 48% of the total emissions profile. Gasoline, light fuel oil and diesel also made significant contributions, making up 22%, 12% and 8% of the profile, respectively. The main uses of these three energy sources were for on-road transportation and building heating. Propane was the least-used type of fuel, with approximately negligible impacts on the overall greenhouse gas profile. It is also important to note that natural gas and district energy were excluded from the graph as they are not used in the region.

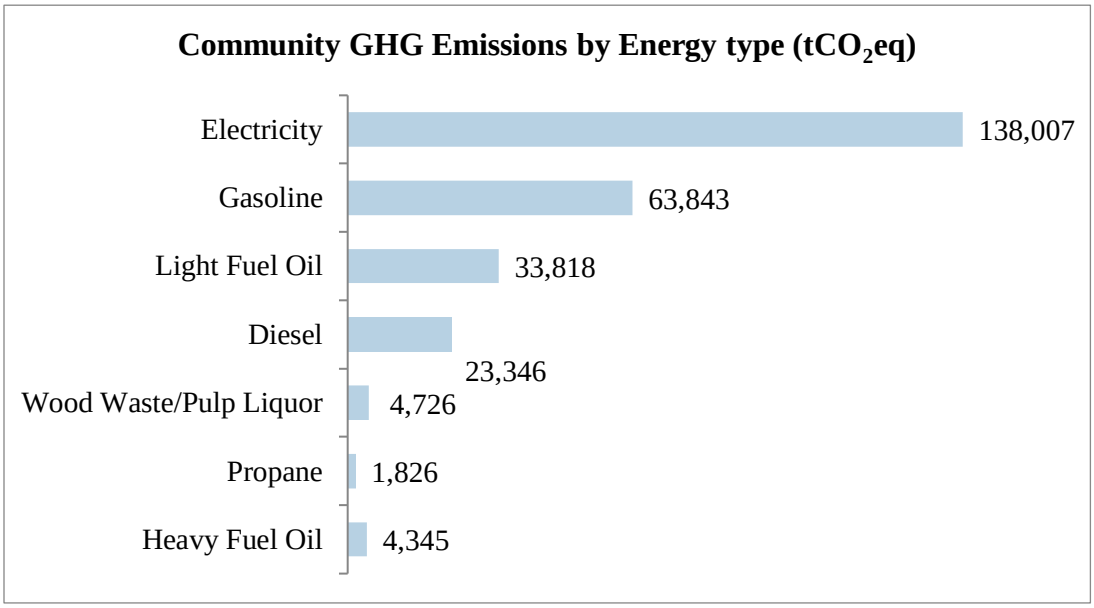

Figure 4 - Summary of Community GHG Emissions by Energy Type

4.2 RESIDENTIAL

In order to calculate the emissions, the energy use at all residential buildings within the West Hants Regional Municipality was required. This information was not available at the local level, so the Provincial energy use was scaled down using two methods. The first method used the number of private dwellings. The number of private dwellings occupied by usual residents in Nova Scotia and in West Hants Regional Municipality was obtained by Statistics Canada's local census data from 2016. In the second method, the Provincial energy use was scaled down by population. The population was also available from Statistics Canada. These values can be seen in Table 13. The ratios for both data sets are similar, with the Municipality's population making up 2.06% of the total Nova Scotia population and the number of private dwellings in the Municipality making up 1.99% of the total in Nova Scotia.

Table 13 - Population and Dwelling Statistics for the Residential Sector

Local Census Data (2016)	Nova Scotia	West Hants Regional Municipality	Ratio
Population	923,598	19,016	0.0206
Private dwellings occupied by usual residents	401,990	8,012	0.0199

The calculated energy use in West Hants Regional Municipality using the number of private dwellings was 839,089 GJ. This can be seen in Table 14. The energy use from each fuel type was multiplied by the appropriate emission factor in order to quantify the resulting emissions. The total emissions in the residential sector were 90,502 tCO_2 eq. Electricity usage made up 72.0% of the total emissions. The emissions calculated by scaling down energy use by population were slightly higher, at 93,491 tCO_2 eq. However, this result is not as accurate as the first method since it does not consider that many residents may not live alone.

Table 14 - Summary of Energy Use and Emissions from the Residential Sector

Fuel Type	Energy Use (GJ) – Nova Scotia	Energy Use (GJ) - WHRM	Total GHG (tCO_2 eq) - WHRM	Breakdown
Electricity	15,900,000	316,900	65,140.65	72.0%
Light Fuel Oil	13,900,000	281,025	20,192	22.3%
Wood Waste/Pulp Liquor	11,600,000	231,198	4,602	5.1%
Propane	500,000	9,965	569	0.6%
Natural Gas	200,000	0	0	0.0%
District Energy	0	0	0	0.0%
Total	**42,000,000**	**839,089**	**90,502**	**100.0%**

4.3 COMMERCIAL & INSTITUTIONAL

In order to calculate the emissions, the energy use at all commercial/institutional buildings within the West Hants Regional Municipality was required. This information was not available at the local level, so the Atlantic energy use was scaled down by the employment in the service sector. The employment in the service sector was obtained from Statistics Canada's 2016 census data. It was collected for each of the four provinces that make up the Atlantic Region and West Hants Regional Municipality, as seen in Table 15. The ratio for 'NS/Atlantic' shows that 41.19% of employment in the service sector in the Atlantic Region comes from Nova Scotia. This was used to calculate the total energy use in the Province. This was further scaled to reflect the energy use in West Hants Regional Municipality using the 'Regional/NS' ratio. However, this method of quantification does not provide an exact snapshot of the commercial and institutional emissions resulting within the Municipality as the employment data obtained from Statistics Canada does

not take into consideration that people employed within the Municipality may not be residents. Additionally, it does not take into consideration the percentage of each industry in the service sector or the local industry operations.

Table 15 - Employment Statistics for the Commercial/Institutional Sector

Local Census Data (2016)	Employment in Service Sector	Ratio Regional/NS	Ratio NS/Atlantic
Nova Scotia	374,715	0.0162	0.4119
New Brunswick	291,445		
Prince Edward Island	57,160		
Newfoundland and Labrador	186,495		
West Hants Regional Municipality	6,075		

The calculated energy use in the Municipality in 2016 was 396,625 GJ. The energy use from each fuel type was multiplied by the appropriate emission factor in order to quantify the resulting emissions. The resulting emissions were 59,562 tCO_2 eq. Similarly to the Residential sector, electricity made up the majority of the resulting emissions. It contributed 80.9% of the total emissions profile. Light fuel oil was the second largest source, making up 16.2%. District energy and wood waste/pulp liquor were not present in neither West Hants Regional Municipality, nor the Atlantic Region. Natural gas was utilized in Nova Scotia, however, not within the Municipality.

Table 16 - Summary of Energy Use and Emissions from the Commercial/Institutional Sector

Fuel Type	Energy Use (GJ) – Atlantic	Energy Use (GJ) – Nova Scotia	Energy Use (GJ) - WHRM	Total GHG (tCO_2 eq) - WHRM	Breakdown
Electricity	35,100,000	14,500,000	234,369	48,175.87	80.9%
Light Fuel Oil	11,900,000	4,900,000	133,544	9,621	16.2%
Propane	3,300,000	1,400,000	22,035	1,275	2.1%
Heavy Fuel Oil	1,000,000	400,000	6,677	508	0.9%
Natural Gas	8,100,000	3,300,000	0	0	0.0%
District Energy	0	0	0	0	0.0%
Wood Waste/ Pulp Liquor	0	0	0	0	0.0%
Total	**59,000,000**	**24,000,000**	**396,625**	**59,562**	**100.0%**

4.4 INDUSTRIAL

In order to calculate the emissions, the energy use at all industrial buildings within the West Hants Regional Municipality was required. This information was not available at the local level, so the Atlantic energy use was scaled down by the employment in the industry sector. The employment in the industry sector was obtained from Statistics Canada's 2016 census data. It was collected for each of the four provinces that make up the Atlantic Region and for West Hants Regional Municipality, as seen in Table 17. The ratio for 'NS/Atlantic' shows that 35.2% of employment in the industry sector in the Atlantic Region comes from Nova Scotia. This was used to calculate the total energy use in the Province. This was further scaled to reflect the energy use in West Hants Regional Municipality using the 'Regional/NS' ratio.

Table 17 - Employment Statistics for the Industry Sector

Local Census Data	Employment in Service Sector	Ratio Regional/NS	Ratio NS/Atlantic
Nova Scotia	87,730	0.0087	0.352
New Brunswick	79,680		
Prince Edward Island	19,220		
Newfoundland and Labrador	62,595		
West Hants Regional Municipality	2,175		

Using this method, the total energy used by the industry sector in the Municipality in 2016 was 337,308 GJ, as seen in Table 18. The energy use from each fuel type was multiplied by the appropriate emission factor in order to quantify the resulting emissions. The total greenhouse gas emissions were determined to be 32,657 tCO_2 eq. Similarly to the residential and commercial sectors, electricity-use contributes the majority of the resulting emissions, at 75.6%. Light fuel and heavy fuel oil make the next largest contributions, at 12.3% and 11.7%, respectively.

Table 18 -Summary of Energy Use and Emissions from the Industry Sector

Fuel Type	Energy Use (GJ) – Atlantic	Energy Use (GJ) – Nova Scotia	Energy Use (GJ) - WHRM	Total GHG (tCO_2 eq) - WHRM	Breakdown
Electricity	39,100,000	13,800,000	120,116	24,690.52	75.6%
Light Fuel Oil	18,100,000	6,400,000	55,604	4,005	12.3%
Heavy Fuel Oil	16,400,000	5,800,000	50,381	3,837	11.7%
Wood Waste/ Pulp Liquor	36,200,000	12,700,000	111,207	124	0.4%
Natural Gas	0	0	0	0	0.0%
District Energy	0	0	0	0	0.0%
Propane	0	0	0	0	0.0%
Total	**110,000,000**	**39,000,000**	**337,308**	**32,657**	**100.0%**

4.5 TRANSPORTATION

The quantification method used to determine the emissions resulting from on-road transportation relied on the total amount of fuel used in West Hants Regional Municipality. This information was not available at the local level. Therefore, the provincial fuel use was scaled down by the number of registered vehicles. The number of registered vehicles by fuel type was obtained from Access Nova Scotia, however, for Hants County. This data was scaled by population to obtain the registered vehicles in Nova Scotia and West Hants Regional Municipality, as seen in Table 19. As a result, it was determined that West Hants Regional Municipality makes up approximately 2.21% of the total registered vehicles in the Province. This information was used to determine the total amount of fuel used. The result was 35,867,450 L, with 76.3% of the fuel used being gasoline. The remainder of fuel used was diesel oil, as petroleum gas/propane was considered negligible. The total emissions resulting from the calculated fuel usage was 87,189 tCO_2 eq.

Table 19 - Summary of Fuel Use and Emissions from On-Road Transportation

Fuel	Registered Vehicles in NS	Registered Vehicles in WHRM	Provincial Total Fuel Used (L)	WHRM Fuel Used (L)	WHRM Energy (GJ)	Total GHG (tCO_2 eq) - WHRM
Gasoline	557,223	12,317	1,237405,000	27,351,917	914,922	63,843
Diesel oil	102,130	2,261	384,649,000	8,515,533	326,571	23,346
Liquefied petroleum gas	Vehicles powered by propane are considered negligible		4,705,000	-	-	-
Total	**659,353**	**14,578**	**1,626,759,000**	**35,867,450**	**1,241,492**	**87,189**

4.6 SOLID WASTE

The emissions resulting from community waste were quantified by direct calculations based on the quantity of waste. The annual tonnage of solid waste sent to the landfill was 2,748. The tonnage of composted materials was 727. These amounts were determined from the Waste Services Coordinator. In order to accurately convert the tonnage of solid waste to emissions, the waste stream composition was determined. While this information was not available for the 2016 waste stream, the compositions were determined from a 2017 Waste Audit by Divert NS. The compositions from the audit can be found in Table 20.P

The total emissions resulting from the solid waste sent to the landfill were 3,787 tCO_2 eq., as seen in Table 21. Because the landfill operates within the Municipality, these emissions represent the complete scope of the community waste emissions. The 125 tCO_2 eq. resulting from composted materials were estimated but not included in the inventory results, as the composting facility lies outside of the Municipality's geographic boundaries.

Table 20 - Summary of Waste Stream Composition

Waste Stream Composition	
Paper, Cardboard	22.0%
Food	16.0%
Textiles	13.8%
Diapers	3.3%
Wood	1.9%
Garden Waste	1.4%
Leather, rubber	0.4%

Table 21 - Summary of Community Waste Tonnage and Emissions

	Tonnage	**Emissions (tCO2 eq)**
Solid Waste	2,748	3,787
Compost	727	125

4.7 AGRICULTURE

The quantification of emissions from the agriculture sector includes only enteric fermentation and manure management. Emissions from agricultural soils, field burning of

agricultural waste, liming, urea application and other carbon containing fertilizers were not included in the calculations as the required information was not available. Enteric fermentation and manure management were both dependent on the headcount of cattle and swine in West Hants Regional Municipality. The headcounts were determined from Statistics Canada. Emission factors were obtained from *IPCC Volume 4 Chapter 10* in order to calculate the resulting emissions. The resulting emissions from enteric fermentation were 12,603 tCO_2 eq. The emissions were composed of only methane. The emissions from manure management, however, were composed of both methane and nitrous oxide. The total resulting emissions were 6,312 tCO_2 eq. These results can be found in Table 22.

Table 22 - Summary of Emissions from Enteric Fermentation and Manure Management

Emissions Source	**WHRM Headcount**	**Total CH4 (t)**	**Total N2O (t)**	**Total GHG (tCO_2 eq) - WHRM**
Enteric Fermentation				
Cattle	3,934	503.6	-	12,589
Swine	343	0.5	-	14
Manure Management				
Cattle	3,934	247.8	0.014	6,200
Swine	343	4.5	0.001	112

5.0 EMISSIONS FORECAST

In addition to the development of a Corporate and Community Inventory, a business-as-usual emissions forecast was developed in order to meet PCP Program requirements. The forecast was required to be 10 years from the baseline year, therefore 2030 was chosen. The forecast was based on the a series of assumptions (of which are the same assumptions proposed in WSP's *2019 Inventory Report* for West Hants). These assumptions were developed based on research conducted by WSP on provincial and national trends in greenhouse gas emissions. Some provincial trends explored include the following:

- Approximately 95% of residents have access to curbside garbage collection.
- With the increased use of heat pumps in homes there has been a 38% reduction of light fuel oil use from 2008-2016.
- The transition to LED street lighting (of which is now mandatory) will reduce energy consumption by 30%.
- With the completion of the Muskrat Falls hydro power project, it is estimated that 40% of electricity will be renewable energy.
- The production of electricity is expected to see a 55% reduction in greenhouse gas emissions.
- The number of registered vehicles in the province increased 15% between 2008 and 2018.

The assumptions developed by WSP are the following:

- An emission factor reduction of 44% for electricity consumption;
- A 10% reduction in energy consumption;
- A 28% reduction in fuel rate;
- An increase of electricity used in the residential sector for charging electric vehicles;
- An increase of registered vehicles by 15%; and
- That 10% of vehicles on the road will be electric vehicles.

The results of the forecast can be seen in Table 23, where corporate emissions can expect to see a reduction of 44%, and community emissions can expect to see a reduction of 41%. An important thing to note is that the reduction of these emissions is not entirely under the direct control of West Hants Regional Municipality. Instead, it largely depends on the ability of Nova Scotia's power grid to become decarbonized.

Table 23 - Summary of the 2030 GHG Emissions Forecast

CORPORATE INVENTORY			***COMMUNITY INVENTORY***		
Sector	**GHG Emissions 2018/2019 (tCO2 eq)**	**GHG Emissions 2030 (tCO2 eq)**	**Sector**	**GHG Emissions 2016 (tCO2 eq)**	**GHG Emissions 2030 (tCO2 eq)**
Buildings	1,386	823	*Residential*	90,502	60,357
Lighting	100	51	*Commercial/ Institutional*	59,562	35,840
Vehicle Fleet	192	139	*Industrial*	32,657	12,701
Water & Wastewater Treatment	1,772	886	*Road Transportation*	87,189	43,700
Solid Waste	53	53	*Solid Waste*	3,787	3,787
Staff Business Travel	26	19	*Agriculture*	12,782	12,782
Total	**3,530**	**1,970**	***Total***	**286,480**	**169,168**
Reduction		*-44%*	*Reduction*		*-41%*

6.0 CONCLUSION

In conclusion, the main requirements of Milestone 1 of the PCP Program were successfully achieved with the development of a baseline Corporate and Community Emissions Inventory for the West Hants Regional Municipality. The baseline Corporate Inventory covered the 2018/2019 fiscal year, whereas the Community Inventory covered the 2016 calendar year. The emissions resulting from municipal operations and services, as highlighted in the Corporate Inventory, were 3,530 tCO_2 eq. Approximately 90% of emissions come from buildings and water and wastewater treatment facilities. The emissions resulting within the Municipality's geographical boundaries, as highlighted in the Community Inventory, were 286, 480 tCO_2 eq. The majority of emissions come from residential energy use and the combustion of fuels used for on-road transportation. By 2030, it is expected that the Corporate and Community emissions will see a reduction of 44% and 41%, respectively. This reduction of emissions is subject to change with the decision of West Hants Regional Municipality to develop and implement action items to help mitigate the effects of climate change.

7.0 REFERENCES

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WSP. (2020). *Corporate and Community GHG Inventory.* West Hants.

APPENDIX A – EMISSION FACTORS AND COEFFICIENTS

CORPORATE EMISSIONS INVENTORY 2018/2019		
Activity Sector	**Energy Source**	**Emission Factor**
Buildings	Electricity	0.760 kg eCO_2/kWh
	Furnace Oil	2,762.90 g eCO_2/L
	Diesel	2,762.90 g eCO_2/L
	Gasoline	2,315.50 g eCO_2/L
Street Lighting	Electricity	0.760 kg eCO_2/kWh
Vehicle Fleet	Diesel	2,334.10 g eCO_2/L
	Gasoline	2,741.6 g eCO_2/L
Water & Wastewater Treatment	Electricity	0.760 kg eCO_2/kWh
	Diesel	2,762.90 g eCO_2/L
	Propane	1,547.80 g eCO_2/L
Staff Business Travel	Gasoline	2,741.6 g eCO_2/L

COMMUNITY EMISSIONS INVENTORY 2016		
Activity Sector	**Energy Source**	**Emission Factor**
Residential	Electricity	0.760 kg eCO_2/kWh
	Light Fuel Oil	2.755 kg eCO_2/L
	Wood	19,903,333 kg eCO_2/PJ
	Propane	1.548 kg eCO_2/L
Commercial/Institutional	Electricity	0.760 kg eCO_2/kWh
	Light Fuel Oil	2.763 kg eCO_2/L
	Heavy Fuel Oil	3.176 kg eCO_2/L
	Propane	1,547.80 g eCO_2/L
Industrial	Electricity	0.760 kg eCO_2/kWh
	Light Fuel Oil	2.762 kg eCO_2/L
	Heavy Fuel Oil	3.178 kg eCO_2/L
	Wood Waste/Pulp Liquor	1,118,333 kg eCO_2/PJ
Road Transportation	Diesel	2,334.10 g eCO_2/L
	Gasoline	2,741.6 g eCO_2/L
Agriculture	Cattle (Enteric Fermentation)	128 kg CH_4/head
	Swine (Enteric Fermentation)	1.6 kg CH_4/head
	Cattle (Manure Management)	63 kg CH_4/head
		0.005 kg N_2O/head
	Swine (Manure Management)	13 kg CH_4/head
		0.005 kg N_2O/head

WINDSOR / WEST HANTS TOGETHER

WEST HANTS REGIONAL MUNICIPALITY REPORT

Information ☐	Recommendation ☐	Decision Request X	Councillor Activity ☐

To: Members of Municipal Climate Change Action Plan Committee

Submitted by: _____
Casey Parker, Sustainability Planner

Date: 2021-02-10

Subject: Setting Corporate and Community Greenhouse Gas Reduction Targets

LEGISLATIVE AUTHORITY

Council Resolution to Join the FCM-ICLEI (Local Governments for Sustainability) Partners for Climate Protection Program. (September 11, 2018)

DECISION REQUEST

Staff request direction from the Municipal Climate Change Action Plan (MCCAP) Committee on setting a corporate and community greenhouse gas emissions reduction target for Milestone 2 of the Partner's for Climate Protection program.

BACKGROUND

Property☐	Public Opinion☐	Environment X	Social☐	Economic☐	Councillor Activity ☐

The Partner's for Climate Protection (PCP) program is a five-milestone program with the purpose of encouraging municipalities across Canada to take action to reduce greenhouse gas (GHG) emissions through the implementation of local action plans and emissions reduction targets. The program is administered and managed by the Federation of Canadian Municipalities (FCM) and International Council for Local Environmental Initiatives (ICLEI) – Local Governments for Sustainability. The milestone framework consists of the following [1]:

Milestone 1: "Create a Baseline Emissions Inventory and Forecast"

Milestone 2: "Set Emissions Reduction Targets"

Milestone 3: "Develop a Local Action Plan"

Milestone 4: "Implement the Local Action Plan"

Milestone 5: "Monitor Progress and Report Results"

The former Municipality of the District of West Hants (West Hants) joined the PCP program in September 2018. The West Hants Regional Municipality (WHRM) continues to be a member of this program. The baseline emissions inventory and business-as-usual forecast for West Hants required for Milestone 1 was completed by WSP and two (2) Dalhousie University co-op students in 2019. This work was not submitted to complete Milestone 1 as the former Town of Windsor (Windsor) data needed to be incorporated to develop a regional inventory. The inventory was updated in October 2020 to incorporate the corporate and community emissions from the former Town of Windsor. The Corporate Inventory highlights the emissions resulting from municipal services. The activity sectors included are buildings, street lighting, water and wastewater treatment, solid waste, and vehicle fleet. Staff business travel was added to the inventory as an optional sector as the data was available. The baseline year chosen for the Corporate Inventory was the 2018/2019 fiscal year. This decision was heavily based on data availability and accuracy. The results of the baseline inventory can be seen in Table 1 below. The total corporate greenhouse gas emissions were 3,530 tonnes of CO_2 equivalent (tCO_2 eq.). Approximately 50% of the total emissions result from the water and wastewater treatment activity sector. The buildings sector makes up the second largest amount of total emissions, representing approximately 39%.

Table 1 – Baseline Corporate Inventory Results (2018/2019)

Activity Sector	**GHG Emissions (tCO_2 eq.)**
Water & Wastewater Treatment	1,772
Buildings	1,387
Vehicle Fleet	192
Street Lighting	100
Solid Waste	53

Staff Business Travel	26
Total	3,530

The Community Inventory highlights the emissions within the Municipality. The activity sectors included are residential buildings, commercial buildings, industrial buildings, solid waste, and transportation. Agriculture was added as an optional activity sector as it is a key industry in West Hants. The baseline year chosen for the Community Inventory was 2016. This is because the development of the Community Inventory heavily relied on the use of Statistics Canada's Census data, with the most recent data being from 2016. The results of the baseline inventory are found in Table 2. The total community greenhouse gas emissions were calculated to be 286,480 tCO_2 eq.. The residential and transportation sectors made up the largest majority of emissions, responsible for 31.6% and 30.4%, respectively.

Table 2 - Baseline Community Inventory Results (2016)

Activity Sector	**GHG Emissions (tCO_2 eq.)**
Residential	90,502
Transportation	87,189
Commercial/Institutional	59,562
Industrial	32,657
Agriculture	12,782
Solid Waste	3,787
Total	286,480

Based on the inventory results, a business-as-usual emissions forecast was developed for 2030. The forecast was required to be 10 years from the baseline year, therefore 2030 was chosen for both corporate and community emissions. The forecast was based on a series of assumptions made by WSP based on provincial and national trends. The key assumptions were the following [2]:

- An emission factor reduction of 44% for electricity consumption;
- A 10% reduction in energy consumption;
- A 28% reduction in fuel rate;
- An increase of electricity used in residential sector for charging electric vehicles;
- An increase of registered vehicles by 15%; and
- That 10% of vehicles on the road will be electric vehicles.

This correlates to a reduction of 44% of corporate emissions and 41% of community emissions by 2030. However, it is important to note that these emission reductions are not entirely under the direct control of West Hants Regional Municipality, as they largely depend on the ability of Nova Scotia's power grid to become decarbonized [2].

In addition to completing the emissions inventory and forecast, WSP produced a GHG Emissions Background Study. The purpose of the study was to help inform the WHRM Council after the consolidation of West Hants and Windsor [3]. The Study highlights seven goals for reducing corporate emissions and corresponding actions items. Each action item explored in the Study includes a description, reduction outcome/performance target, anticipated impact, responsibility, contributors/ stakeholder groups, implementation period/priority, monitoring process and cost/level of effort. The full list of action items can be found in the full report in Appendix A. Based on researched action items, WSP developed three GHG reduction scenarios: 'Safe', 'Balanced', and 'Dynamic'. The Safe Scenario is considered the lowest risk, requiring the least amount of effort and cost. It has the lowest potential for GHG reduction. The Balanced Scenario requires moderate effort and cost but has a greater potential for GHG reduction in comparison to the Safe Scenario. Lastly, the Dynamic Scenario is the greatest level of effort and the highest cost. This high risk will result in the greatest GHG reduction of all three (3) scenarios [3]. The emissions reduction was summed for each scenario; however, it is important to note that this is a rough estimation. This is largely due to the fact that many of the actions explored are based on promotion, education, and staff leadership activities with resulting emissions that are not possible to quantify. Three (3) targets were recommended based on each of the scenarios. Target 1 incorporates the GHG reduction from the Safe Scenario. Target 2 incorporates the GHG reduction from the Safe and Balanced Scenarios. Target 3 incorporates the GHG reduction from all scenarios. The three targets are the following:

Target 1: "5% reduction in corporate emissions + incalculable amount of reduction of both corporate and community emissions stemming from staff time" [3]

Target 2: "22% reduction in corporate emissions + incalculable amount of reduction of both corporate and community emissions stemming from staff time" [3]

Target 3: "42% or 46% reduction in corporate emissions + incalculable amount of reduction of both corporate and community emissions stemming from staff time" [3]

These emission reductions are in addition to the business-as-usual forecast for corporate emissions.

DISCUSSION

With the completion of Milestone 1 and the development of the Background Study, the next step of the program is to set emissions reduction targets for Milestone 2. In order to gain recognition for the Milestone, there are three requirements [4]:

1. "The target must clearly state whether it is for corporate or community emissions;
2. The target must be an overall GHG reduction, with the form, *% reduction from base year by target year; and*
3. The targets must be adopted by council resolution."

As a result of these requirements, a series of targets were generated for reducing corporate and community emissions. It is recommended that Council selects one corporate and one community target from below. Staff request the MCCAP Committee provide direction by recommending one (1) corporate and one (1) community target for Council to consider.

<u>Corporate Targets</u>

There are four (4) reduction targets for corporate emissions discussed below. These targets do not consider the reduction from the business-as-usual forecast. All four (4) targets are graphed in Figure 1.

a) **20% below 2018 levels by 2028**
This target is based on the PCP recommendation to achieve a 20 per cent reduction within 10 years. It is considered an appropriate target for many municipalities. This reduction would result in 2,842 tCO_2 eq. by 2028.

b) **5% below 2018 levels by 2030**
This target is based on Target 1 recommended in WSP's Emissions Background Study. This reduction would result in 3,353.5 tCO_2 eq. by 2030. However, it is important to note that this reduction does not include the incalculable amount of reduction stemming from staff time.

This is considered low risk with small effort and cost requirements. Actions that may be implemented to reach a 5% reduction are the same as those recommended by WSP, and as follows [3]:

POTENTIAL ACTION ITEMS
"Perform internal building survey (i.e. ASHRAE Level 1 Energy Audit)"
"Promote and celebrate energy efficient buildings"
"Investigate 'bulk' purchase of electric vehicle and/or EV charging stations"
"Explore options to include anticipated GHG emissions in staff reports for council and committees"
"Explore funding for EV charging stations on municipal property"

c) **22% below 2018 levels by 2030**
This target is based on Target 2 recommended in WSP's Emissions Background Study. This reduction would result in 2,753.40 tCO_2 eq. by 2030. However, it is important to note that this reduction does not include the incalculable amount of reduction stemming from staff time.

This is considered medium risk with greater effort and cost requirements compared to Target 1. Actions that may be implemented to reach a 22% reduction (in addition to those previously mentioned) are as follows [3]:

POTENTIAL ACTION ITEMS
"Behavioral Energy Efficiency Program"
"Consider green power purchasing"
"Fuel switching (heat pumps)"
"Explore a corporate car sharing program"
"Integrate GHG reduction strategies into HR policies"
"Investigate optimizing business/work order travel"

d) **42% below 2018 levels by 2030**
This target is based on Target 3 recommended in WSP's Emissions Background Study. This reduction would result in 2,047.4 tCO_2 eq. by 2030. However, it is important to note that this reduction does not include the incalculable amount of reduction stemming from staff time.

This is considered high risk with the largest effort and cost requirements of the three targets proposed by WSP. Actions that may be implemented to a 42% reduction (in addition to those previously mentioned) are as follows [3]:

POTENTIAL ACTION ITEMS
"Detailed energy audits for the water and wastewater plants"
"Assessment for the Brooklyn Fire Station and Civic Centre"
"Investigate renewable energy opportunities (solar PV for the water and wastewater treatment plants)"
"Create a 'fleet management' program that introduces EVs over a multi-year timeline"
"Consider introducing carpool incentives for work travel"
"Consider hiring a dedicated GHG reduction employee"

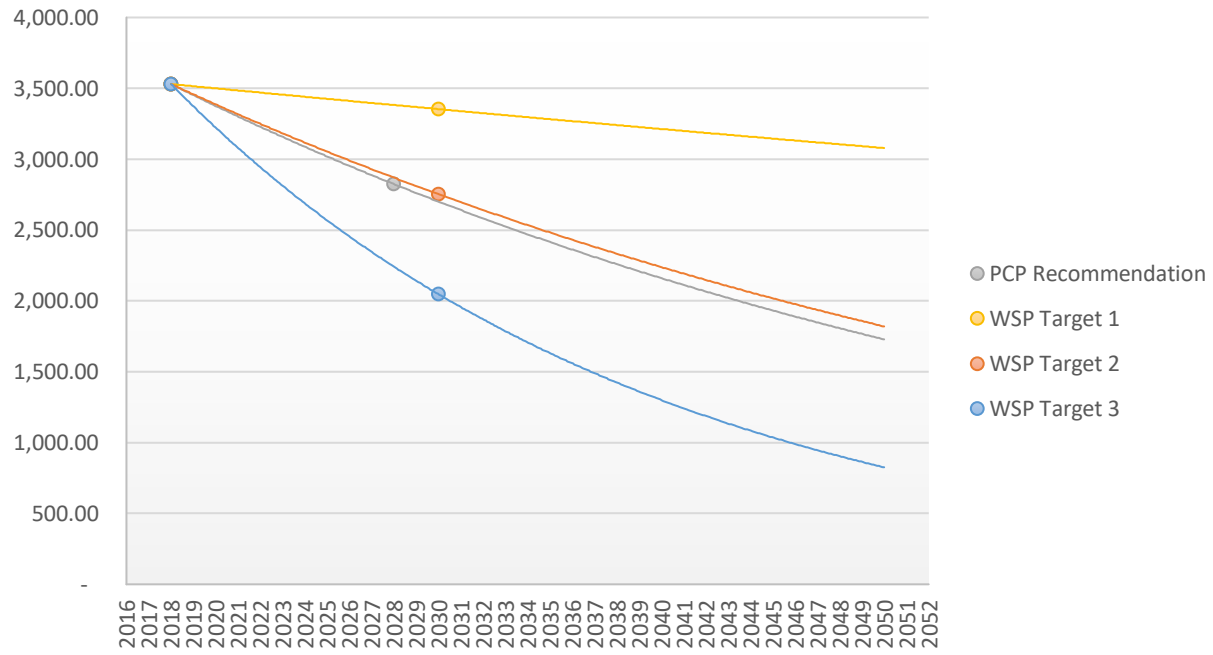

Figure 1 - Corporate Emissions Reduction Targets

<u>Community Targets</u>

There are four (4) reduction targets for community emissions discussed below. These targets do not consider the reduction from the business-as-usual forecast. All four (4) targets are graphed in Figure 2.

a) **6% below 2016 levels by 2026**
This target is based on the recommendation of the PCP Program to achieve a 6% reduction of community GHG emissions within 10 years. This target is much lower than the recommendation for corporate emissions due to that fact that the Community emissions are not entirely under the direct control of the

Municipality. This reduction would lead to total annual emissions of 269,290.26 tCO_2 eq by 2026.

b) **23.2% below 2016 levels by 2030**
This target is based on the Government of Canada's target to achieve a 30% reduction of total emissions from 2005 by 2030. The 2005 community emissions in West Hants were never previously quantified, therefore they were approximated by scaling the Canada-wide emissions by population. Based on the 730 Mt of emissions released in Canada in 2005, the total emissions in West Hants were determined to be 0.314 Mt (314,303.04 tCO_2 eq.). With a 30% reduction, the emissions for 2030 in West Hants were predicted to be 220,012.13 tCO_2 eq.. In order to achieve this, a 23.2% reduction from the 2016 levels must occur.

c) **42.9% below 2016 levels by 2030**
This target is based on the Government of Nova Scotia's target to achieve a 53% reduction of total emissions from 2005 by 2030. As previously mentioned, the 2005 community emissions in West Hants were never previously quantified. For this scenario they were approximated by scaling the Nova Scotia-wide emissions by population. Based on the 23.5 Mt of emissions released in Nova Scotia in 2005, the total emissions in West Hants were determined to be 0.348 Mt (347,792.36 tCO_2 eq.). With a 30% reduction, the emissions for 2030 in West Hants were predicted to be 163,462.41 tCO_2 eq.. In order to achieve this, a 42.9% reduction from the 2016 levels must occur.

d) **65% below 2016 levels by 2030**
This target is based on the reduction required to meet the 1.5°C Global Warming pathway proposed by the Intergovernmental Panel on Climate Change (IPCC). Alternatively, the Paris Agreement suggests a 2°C Global Warming pathway. However, despite the small difference, limiting to 1.5°C greatly reduces the endangering impacts of global warming on the ecosystem and human health [5]. With little to no overshoot of the 1.5°C pathway, global GHG emissions are expected to reduce between 40% and 60% from 2010 levels by 2030 and become net-zero by 2050 [5]. In order to successfully achieve net-zero emissions by 2050, a 65% reduction based on 2016 levels in recommended for 2030. This pathway can be seen in Figure 2, where the 2030 emissions are expected to be 114,591.60 tCO_2 eq..

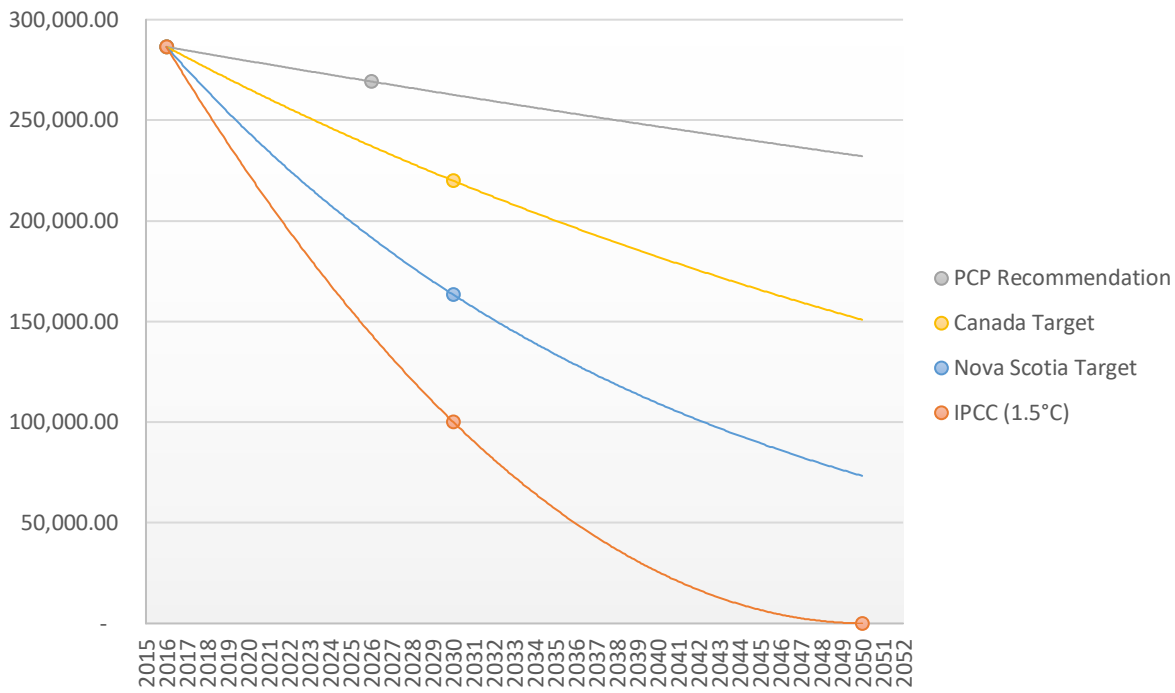

Figure 2 - Community Emissions Reduction Targets

Potential action items for reducing community emissions can be seen below [3]. While they cannot be directly quantified to determine the exact reduction impact, further details can be found in the report in Appendix A.

POTENTIAL ACTION ITEMS
"Train WH staff about efficiency N.S. programs to integrate into their day-to-day work and interaction with citizens"
"Investigate partnerships for renewable energy provision"
"Partner with efficiency N.S. to educate public on home renovation programs/incentives, overall reduced cost of living, etc."
"Consider adopting land use policies that mandate or encourage efficient/sustainable growth models"
"Explore potential partnerships for EV charging stations"
"Explore opportunities to create a 'transportation hub'"
"Integrate active transportation considerations into land use planning decisions"
"Explore options on P.A.C.E Programming"
"Promote desired actions, policies, and incentives to the provincial government"

"Make renewable energy investments and sustainability practices (current and future) visible and known to the community"

"Create food education programs in partnership with community and schools, including waste reduction"

"Local Procurement Policies"

NEXT STEPS

The MCCAP Committee may select one of the suggested corporate and community targets. In order to complete Milestone 2 of the PCP Program, Council would need to adopt corporate and community emissions target and provide a Council resolution of the targets chosen to the PCP program [1]. Once this is complete, a local action plan will be developed for Milestone 3. The local action plan will entail a description of the following [1]:

- The actions proposed in order to meet the chosen targets;
- The participation of the public and internal stakeholders in developing the plan;
- The potential cost and funding sources; and
- Responsibilities for the plan and proposed actions.

FINANCIAL IMPLICATIONS

There are no financial implications associated with this report.

Estimations for the cost of potential action items can be found in WSP's Emissions Background Study in Appendix A. These estimations are not guaranteed and will require more further information when being implemented. Therefore, a more accurate estimation will be developed during the completion of Milestone 3 and 4.

ALTERNATIVES

In response to this report the MCCAP Committee can decide to delay recommending emissions targets until the local action plan has been developed for Milestone 3. This is an acceptable practice for the PCP program.

ATTACHMENTS

Appendix A Background Study on Actions to Reduce Greenhouse Gas Emissions in West Hants

REFERENCES

[1] Federation of Canadian Municipalities, "Milestone Framework," [Online]. Available: https://fcm.ca/en/programs/partners-climate-protection/milestone-framework.

[2] WSP, "Corporate and Community GHG Inventory," West Hants, 2020.

[3] WSP, "Background Study on Actions to Reduce GHG Emissions in West Hants," 2020.

[4] Federation of Canadian Municipalities, "Reaching Milestone 2: How to set emission reduction targets," 2016.

[5] Interngovernmental Panel on Climate Change, "Summary for Policymakers," 2018.

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APPENDIX A

(see next page)

THE MUNICIPALITY OF WEST HANTS

BACKGROUND STUDY

ON ACTIONS TO REDUCE GHG EMMISSIONS IN WEST HANTS

FEBRUARY 24, 2020

FINAL REPORT

TABLE OF CONTENTS

1 INTRODUCTION

The Partners for Climate Protection (PCP) program is a network of Canadian municipal governments that have committed to reducing greenhouse gases (GHGs) and to act on fighting climate change. PCP is administered by the Federation of Canadian Municipalities (FCM) in partnership with the International Council for Local Environmental Initiatives (ICLEI). Since its inception, over 250 municipalities have joined PCP, making a public commitment to reduce emissions. The program consists of a framework to guide municipalities in reducing GHG emissions at both the corporate and community levels. This framework is comprised of five-milestones which include:

- Milestone 1: Creating a greenhouse gas emissions inventory and forecast
- Milestone 2: Setting an emissions reduction target
- Milestone 3: Developing a local action plan
- Milestone 4: Implementing the local action plan or a set of activities
- Milestone 5: Monitoring progress and reporting results

The GHG Inventory Report and Forecast, completed in 2019, meets Milestone 1 of the PCP program. The outcome of this Background Study was originally intended to deliver on Milestone 2 and 3 – to set a reduction target and developing a Local Action Plan for West Hants. Given the imminent consolidation with the neighbouring Town of Windsor, West Hants has decided to use this report as a Background Study to help inform the future Local Action Plan and emission reduction targets for the new municipal Council and staff of the Municipality of The Region of Windsor and West Hants Municipality.

This report outlines a series of actions from which the newly amalgamated Municipality can choose from to meet the goal for GHG reduction (to be set by the Regional Council). A description of each available action is also provided along with three GHG reduction scenarios that have also been provided to help to inform decision-making by the future Council.

This report is presented in the following five sections:

1 Introduction
2 Background Study Development
3 Recommended Goals and Actions
4 GHG Reduction Scenarios
5 Future Funding Options

It should be noted that the intent of Section 5 is not to create an exhaustive list of all funding streams, but to assist the future Municipality in implementing some of the actions suggested under this plan as well as build external partnerships that may help the Regional Municipality implement many of the longer-term actions presented in this report.

2 BACKGROUND STUDY DEVELOPMENT PROCESS

2.1 MUNICIPAL STAFF ENGAGEMENT

On the morning of November 12, 2019, Senior Municipal Staff were gathered for a workshop in West Hants Council Chambers to talk about opportunities and challenges in developing and implementing a Local Action Plan in Green House Gas reduction for the Municipality of West Hants. Participants included directors and managers from the Municipality of West Hants. An important consideration for the Municipality at this time is the upcoming consolidation with the Town of Windsor, slated to take place in April 2020. As such, some directors from the Town of Windsor and the future municipality were also invited to this workshop. A complete list of those invited and in attendance is included in Appendix A.

Participants were presented with the results of the Green House Gas (GHG) Inventory results produced by WSP previous to this Background Study and reviewed the current status of emissions at the corporate and community level. Staff then participated in a facilitated discussion on actions that could be taken to help reduce emissions at the corporate level.

Several themes emerged from this workshop, including:

- Decreasing the use of electricity in municipally-owned buildings by taking actions such as educating staff on how to reduce energy consumption and retrofitting old lightbulbs and appliances with energy efficient versions.
- Performing detailed energy audits of all municipal buildings and major equipment to prioritize the retrofitting or replacement of buildings or systems.
- Exploring the electrification of the corporate vehicle fleet and creating more efficient systems to deal with work orders, which could reduce duplication of GHG emissions.
- Exploring renewable energy sources that may help to reduce the municipal GHG emissions.
- Taking initiative, as the local government, to set an example of efforts to reduce GHG emissions and fight climate change within the Municipality.

The opportunities and actions which emerged through this workshop were used to inform the actions and goals found in this Background Study.

2.2 COMMUNITY STAKEHOLDER ENGAGEMENT

2.2.1 WORKSHOP FOR STAKEHOLDERS

Community stakeholders were invited on November 12, 2019 to participate in a workshop to speak to their experiences and goals for the Municipality in reducing GHG emissions. A complete list of those who attended this workshop is included in Appendix A. These stakeholders represent groups that work in the Climate Change, Energy, Local Food, Environmental, and other relevant sectors on either a local level or a provincial level.

Participants were also introduced to the results of the Community GHG Inventory and Forecast Report. This inventory showed that the greatest level of GHG emissions were related to residential activities (largely electricity use in homes) and road transportation. Following this presentation, participants were welcomed to highlight and have a discussion on opportunities that the Municipality could pursue which, based on their experience and/or their knowledge of West Hants, they felt would be positive steps in reducing community GHG emissions. Themes from this discussion included:

- Building partnerships with Efficiency Nova Scotia (and others who sponsor home energy retrofits) to better educate homeowners on available funding options for home energy upgrades.

- Investing in infrastructure for electric vehicles that could help both the corporate fleet and the community (i.e. charging stations, community car share, etc.).
- Encouraging land-use planning that fosters 'complete communities' and more walkable/bikeable communities that are close to amenities and schools.
- Advocating to the Province to reduce the percentage of energy that comes from fossil fuels and work towards further greening the power grid.
- Explore funding assistance programs and/or incentives for people in the municipality to reduce their GHG emissions.
- Making it easier for food and goods producers in the Municipality to sell their products and encouraging people in the Municipality to shop and eat local more often.

The opportunities and actions which emerged through this workshop were also used to inform the actions and goals found in this Background Study.

2.2.2 PRESENTATION OF DRAFT TO STAKEHOLDERS

Following the development of the first draft of this Background Study, stakeholders were invited to attend a presentation and discussion on January 29, 2020. A complete list of stakeholders in attendance has been included in Appendix A of this report.

The purpose of this meeting was to review the proposed Goals and Actions for GHG emission reduction and to collect stakeholder feedback on each of the specific actions. This feedback has been accounted for in this version of the Background Study. Broadly, feedback received from stakeholders included:

- The various organizations represented at the stakeholder table had information on partnerships and data access that the Municipality would have access to once the Goals and Actions are determined by the Regional Council.
- The report emphasized sustainable travel but more reference to Active Transportation (AT) was needed, especially if the Municipality hopes to access some of the sustainable transportation funding available from Provincial and Federal government levels.
- The idea of combining sustainable transportation actions (i.e. actions associated with car share, electric vehicles, active transportation, etc.) at a spatial location (i.e. a "Transportation Hub") was favoured amongst the group of stakeholders, due to its visibility and convenience.
- Some stakeholders suggested solutions to energy efficiency issues that are being experienced in some of the Municipality's buildings. These suggestions included 'quick fixes' that may be inexpensive but could have a larger impact.
- Marketing, outreach, and communication will be important to successfully implement the proposed Actions.

In addition to the general comments expressed above, stakeholders recommended further specific changes and adjustments to the proposed Actions to improve their effectiveness or to provide additional clarity.

2.3 MUNICIPAL CLIMATE CHANGE ACTION PLAN (MCCAP) COMMITTEE MEETING

Following the development of the first draft of this Background Study, the Municipal Climate Change Action Plan (MCCAP) Committee, along with some additional staff directors, were invited to a meeting to discuss the proposed actions.

Feedback collected from the MCCAP Committee spoke specifically to the suggested actions based on the experience of members of the Committee and staff. Information collected included:

- More information may be required on the Brooklyn Fire Centre, and it is recommended that an energy assessment be conducted to understand what further actions may help reduce the energy consumption of the building.
- It was noted that Solar P.V. payback period for the Water and Wastewater treatment plants is a long period.

- There are still some questions about the Corporate Car Sharing program and specifically, how that might work based on the Municipality's insurance for the corporate fleet. It was noted that this model has been successfully implemented in Quebec, but that Nova Scotia does not yet have any examples. Determining the insurance model would likely be up to the first Municipality who chooses to implement Corporate Car Sharing.
- It was noted that EfficiencyOne may have programs that could help fund the salary of a Climate Change-focused employee.
- There is some concern about the procedure for including estimated GHG emission impacts in Municipal Staff Reports to Council, specifically regarding how estimates might be made for multi-faceted projects, such as Land Use regulation amendments.
- It was recommended that Goal 7, which refers to Local Procurement, should be expanded beyond 'local food' to also include language referencing local goods and services as well.
- There was concern about whether the Municipality should be operating farmers markets, which was one interpretation of Action 7.4. It was noted that this is not something the Municipality is interested in becoming involved in, and therefore that language should be clarified in this Action to express that the Municipality would be supportive of their facilities being used by private entities for farmers markets and other local goods vending.
- There were questions surrounding the inclusion of transitioning to Electric Vehicles (EVs) in the Actions, specifically on whether the emissions savings of operating the EVs are significant given that there are emissions associated with production of the vehicles.
- It was noted that transitioning to an electric fleet might be more favourable if it was done in partnership with another municipality, or if another Nova Scotia municipality was to make the switch first.

3 RECOMMENDED GOALS AND ACTIONS

3.1 INTRODUCTION

The following sections highlight the recommended goals and actions that the Municipality of West Hants should consider to reduce corporate GHG emissions as well as to encourage practices amongst residents to help lower emissions produced by residents in the broader community.

A total of seven goals have been presented as part of this Background Study. Under each of the seven goals, a list of recommended actions has been provided. The Municipal Council, once amalgamated and elected, will have the opportunity to review the recommended goals and actions and define their Local Action Plan to reduce GHG Emissions.

GOAL 1 – REDUCE ENERGY CONSUMPTION FOR MUNICIPAL BUILDINGS
1.1 Perform internal building condition survey (i.e. ASHRAE Level 1 Energy Audit)
1.2 Consider performing detailed energy audits for the water and waste water treatment plants
1.3 Assessment of the Brooklyn Fire Station and Civic Center
1.4 Promote and celebrate Energy Efficient Buildings
1.5 Introduce a Behavioral Energy Efficiency Program (i.e. educate staff about how to reduce personal energy consumption)
1.6: Office Building location review

GOAL 2 – INTRODUCE RENEWABLE ENERGY TO MUNICIPAL BUILDINGS
2.1 Investigate fuel switching - heat pumps
2.2 Investigate renewable energy opportunities - solar PV for the water and waste water treatment plants
2.3 Consider Green Energy Purchasing (e.g., Bullfrog Power) OR investing in own renewables
2.4 Investigate partnerships for renewable energy provision

GOAL 3 – DEFINE A GREEN FLEET PROGRAM
3.1 Create a ‘fleet management program’ that introduces EVs over a multi-year timeline
3.2 Consider introducing carpool and bicycle incentives for work travel
3.3 Investigate ‘bulk’ purchase of electric vehicles and/or EV charging stations
3.4 Explore a corporate Car Sharing program

GOAL 4 – INVEST IN EDUCATION FOR THE COMMUNITY AND STAFF
4.1 Partner with Efficiency N.S. to educate public on home renovation programs/incentives, overall reduced cost of living, etc.
4.2 Train WH staff about Efficiency N.S. programs to integrate into their day-to-day work and interaction with citizens.
4.3 Consider hiring a dedicated Climate Change/Energy Efficiency employee

GOAL 5 – CREATE OPPORTUNITIES FOR WH TO SUPPORT THE COMMUNITY AND LEAD BY EXAMPLE
5.1 Integrate GHG reduction strategies to HR policies (i.e. introduce home-working and flex days)
5.2 Investigate optimizing business/work-order travel
5.3 Explore options on P.A.C.E. Programming
5.4 Promote desired actions, policies and incentives to the Provincial government (i.e. greening of grid would help municipalities achieve emission targets)
5.5 Consider adopting land-use policies that mandate or encourage efficient/sustainable growth models (i.e. creating walkable neighbourhoods or smaller lots, etc.)
5.6 Make renewable energy investments and sustainability practices (current and future) 'visible' and known to the community
5.7 Explore options to include anticipated GHG Emissions in staff reports for Council and committees

GOAL 6 – MAKE WEST HANTS MORE ELECTRIC VEHICLE AND ACTIVE TRANSPORTATION FRIENDLY
6.1 Explore potential partnerships for EV charging stations
6.2 Explore funding for EV charging stations on municipal property
6.3 Explore opportunities to create a 'transportation hub'
6.4 Integrate active transportation considerations into Land Use Planning decisions

GOAL 7 – MAKE IT EASIER TO BUY FROM LOCAL VENDORS AND EAT LOCAL FOOD
7.1 Create food education programs in partnership with community and schools, including waste reduction
7.2 Review and amend policies to promote small-scale local agriculture
7.3 Local procurement policies
7.4 Make Municipal facilities available to local food and goods vendors

3.2 GOALS AND ACTIONS

The following section reviews each of the seven goals provided to the Municipality as well as the related actions that could be taken to achieve each goal. The following information has been provided for each action:

1. Action Description
2. Outcome/ Performance Target
3. Anticipated Impact (low, medium, high)
4. Authority Responsible for Action
5. Contributors / Stakeholder Groups
6. Implementation Period or Priority
7. Monitoring Process
8. Cost/ Level of Effort*

*Please note that Cost/Level of Effort are high-level estimates which have been determined by WSP professionals with experience in the field and based on 2019 cost models. The cost estimates account for capital costs and exclude internal Municipal staff time. Costs listed are not guaranteed and further investigation will be required by the Municipality when Actions are being pursued.

GOAL 1: REDUCE ENERGY CONSUMPTION FOR MUNICIPAL BUILDINGS

Energy use in Municipally-owned buildings accounted for 36% of the total GHG emissions produced in the corporate emissions report. Taking actions to reduce this energy consumption would be a significant step in reducing overall corporate GHG emissions. Some of the actions related to this goal are to establish baselines for how different buildings are performing or what 'quick fixes' might exist to improve energy consumption. Other actions are associated with anticipated replacements of systems as well as focusing efforts or staff building occupant education and outreach. Some actions can be quantified with estimated GHG reductions and/or targets, while others are associated with outcomes and performance targets that are not possible to measure numerically, but have other performance targets.

ACTION 1.1: PERFORM INTERNAL BUILDING CONDITION SURVEY	
Description/ Detail of Actions	A condition survey, or ASHRAE Level 1 energy audit, is a walking tour conducted by internal staff to identify obvious opportunities for energy savings that can be implemented with minimal capital investment (repair or maintenance work) or even replacement of equipment that does not require in-depth technical analysis (e.g. inefficient lighting or windows, air leakage, smart metres etc.). It also makes it possible to identify areas that warrant further examination for potential energy savings opportunities or GHG reduction opportunities, such as fuel switching for heating systems. Natural Resources Canada has developed an Energy Savings Toolbox where checklists are provided to help in-house building condition auditing[1]. Condition surveys, if completed on buildings with electric heating and cooling systems, may be eligible for support from Efficiency Nova Scotia. Condition surveys could be conducted for all buildings, but based on the GHG inventory, the following buildings should be prioritized: - Brooklyn Fire Station and Civic Center

[1] NRCan (2018). Conducting an energy audit. https://www.nrcan.gc.ca/energy/efficiency/energy-efficiency-industry/energy-management-industry/conducting-energy-audit/20401

ACTION 1.1: PERFORM INTERNAL BUILDING CONDITION SURVEY	
	- Municipal Building – 76 Morrison Dr. - Hants County Courthouse – 240 King St. - Town Hall – 20 Main St. - Hantsport Fire Department – 5 Oak St. - Public Works Shed – 19 Chittick Ave - Police Station – 3 Oak St.
Outcome / Performance Target	Typical savings associated with energy audits range from 5% to 20%. For a simple condition survey (ASHRAE Level 1 energy audit), the suggested reduction target is 5%, or 27.5 tCO2e.
Anticipated Impact (low, medium, high)	Medium
Responsible Authority	Municipality of West Hants, Department of Public Works
Contributors / Stakeholders	Efficiency Nova Scotia, QUEST Canada (funding or partnership), Nova Scotia Power (for Smart Metres)
Priority	Short-term
Monitoring Process and Period	Energy consumption should be tracked for each building that was audited and maintained or upgraded. Consumption should be compiled on a quarterly basis and compared (seasonally) to historical data to demonstrate energy savings.
Cost / Effort	Cost is equivalent to the time for internal staff to perform the audits. Alternatively, an outside consultant could be retained to audit the buildings. Cost for maintenance and upgrades to be identified based on audit findings.

ACTION 1.2: DETAILED ENERGY AUDITS FOR THE WATER AND WASTE WATER PLANTS	
Description/ Detail of Actions	Detailed (ASHRAE Level 2) energy audits are used to investigate capital-intensive energy conservation measures and energy saving opportunities. This type of analysis requires technical skills and is typically conducted by experts. For West Hants, detailed energy audits should be conducted for the drinking water and wastewater treatment plants, as well as the water distribution system, which have some of the highest rates of electricity consumption amongst municipal assets. Condition surveys could be conducted for all buildings, but based on the GHG inventory, the following locations should be prioritized: - Falmouth Sewer Plant - 48 Falmouth Connector Road - Falmouth Water Plant - 242 Eldridge Street - Water Treatment Plant - 2160 Bishopville Road

ACTION 1.2: DETAILED ENERGY AUDITS FOR THE WATER AND WASTE WATER PLANTS	
Outcome / Performance Target	Typical savings associated with energy audits range from 5% to 20%. For a detailed energy audit (ASHRAE Level 2 energy audit), the suggested reduction target is 15%, or 109.62 tCO2e.
Anticipated Impact (low, medium, high)	High
Responsible Authority	Municipality of West Hants, Department of Public Works
Contributors / Stakeholders	Engineering consultant
Priority	Long-term
Monitoring Process and Period	Electricity consumption should be tracked for each building that was audited and maintained or upgraded. Consumption should be compiled on a quarterly basis and compared (season) to historical data to demonstrate energy savings.
Cost / Effort	Budget cost of approximately $12,000 / audit, however costs vary depending on requirements of audit and service provider. Cost for maintenance and upgrades to be identified based on audit findings.

ACTION 1.3: ASSESSMENT OF BROOKLYN FIRE STATION AND CIVIC CENTER	
Description/ Detail of Actions	The Brooklyn Fire Station and Civic Centre was noted as the most energy intensive asset of the Municipality's portfolio. This was surprising to many, since it is a LEED Certified building which was commissioned in 2012. However, even buildings with energy efficient systems fall out-of-tune as buildings age and adjustments are made without fully considering energy impact. It is recommended that an assessment be completed to understand whether the building performance is meeting its original LEED standard and evaluating the building against other, similarly-sized buildings in Nova Scotia. Optimizing the performance and operation of a building's system is known as re-commissioning. NRCan is a leading advocate of recommissioning in Canada, as CanmetENERGY developed a guide to successfully use recommissioning (RCx) as a cost-effective method of improving performance and saving energy through a more rational operation of institutional and commercial buildings[2]. Recommissioning begins with an in-depth investigation of existing system design, controls and as-operated performance. The resulting optimization recommendations (typically related to control adjustments, maintenance, and minor equipment retrofits) are then implemented. It was also suggested at the stakeholder meeting that small adjustments, such as automatic doors for the fire department

[2] Natural Resources Canada, 2012, ecoENERGY Efficiency for Buildings, https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/oee/pdf/Publications/commercial/pdf/CxRCx_eng.pdf

ACTION 1.3: ASSESSMENT OF BROOKLYN FIRE STATION AND CIVIC CENTER	
	(through which heat is often lost) could be 'quick fixes' that may have a big impact.
Outcome / Performance Target	A Lawrence Berkeley National Laboratory survey reported median energy savings of 15% for an existing building sample with a median construction date of 1978.[3] For the Brooklyn Fire Station and Civic Center, this translates into a reduction of 23 tCO_{2eq}.
Anticipated Impact (low, medium, high)	High
Responsible Authority	Department of Public Works
Contributors / Stakeholders	Engineering consultant
Priority	Long-term
Monitoring Process and Period	Electricity consumption should be tracked for this specific building. Consumption should be compiled on a quarterly basis and compared (season) to historical data to demonstrate energy savings.
Cost / Effort	Budget cost estimate of $25,000 / audit, however costs vary depending on requirements of audit and service provider. Cost for maintenance to be identified based on audit findings.

ACTION 1.4: PROMOTE AND CELEBRATE ENERGY EFFICIENT BUILDINGS	
Description/ Detail of Actions	The corporate GHG inventory showed that some of the Municipality's buildings are performing with high energy efficiency. This efficiency should improve and extend to other buildings as some of the actions associated with the Local Action Plan (GHG reductions) are implemented. West Hants should work to promote and celebrate energy efficient buildings in an effort to normalize energy efficiency as a positive action and to make energy efficiency more visible in the Municipality. This could be accomplished by including updated information about building efficiency within the buildings, using pamphlets or posters. Information should be clear and simple, for example, the lights in this building are LEED, which use 75% less energy than a regular, incandescent lighting. Another tactic, as noted at the stakeholder meeting, is to show 'How easy it is' to transition a building and make it more energy efficient. The Municipality could take other actions, such as hosting tours of energy efficient buildings or promoting energy efficient actions by those using the buildings (i.e. encouraging people to take shorter showers at the gym, etc.). It was noted at the stakeholder meeting that promoting energy efficiency in Municipal buildings may also give the Municipality the opportunity to

[3] Evan Mills et al. 2005, The Cost-Effectiveness of Commissioning New and Existing Commercial Buildings: Lessons from 224 Buildings, https://www.bcxa.org/ncbc/2005/proceedings/19_Piette_NCBC2005.pdf

ACTION 1.4: PROMOTE AND CELEBRATE ENERGY EFFICIENT BUILDINGS	
	highlight local builders/tradespeople who can perform renovations and upgrades to make homes more efficient. Such lists already exist province-wide, as provided by Efficiency Nova Scotia and Nova Scotia Power. The Municipality could make this list readily available to people in West Hants.
Outcome / Performance Target	Increased awareness/literacy on the actions West Hants is taking to reduce GHG emissions, and increased literacy on energy efficiency that individuals can apply at home.
Anticipated Impact (low, medium, high)	Medium
Responsible Authority	Planning & Development
Contributors / Stakeholders	Opportunity for a Planning intern to begin and/or operate this project
Priority	Short-term
Monitoring Process and Periodicity	Questions on building efficiency can be included in Community GHG reduction surveys – using baseline data from survey completed in 2019 about energy efficiency literacy. Survey should be updated to meet current needs and circulated annually.
Cost / Effort	The cost for printing promotional/celebratory materials upfront. Recurring every two-years as materials become outdated.

ACTION 1.5: BEHAVIORAL ENERGY EFFICIENCY PROGRAM	
Description/ Detail of Actions	Energy consumption in office buildings is often as important when the building is not in use, as lighting, temperature control, and equipment are still in use. An awareness program can help boost employees' contributions to energy savings by doing simple zero-cost measures, such as ensuring that equipment is turned off when not in use. Another opportunity to influence employee behaviour is to encourage people to choose active modes of transportation where possible, when making trips for work. Ways to do this may include providing employees with an internal bike share program, providing bicycle parking at office locations, and allowing employees to take extra time out of their day to arrive at meeting locations. As with any other management system, tracking and reporting of results is important to sustain the motivation of employees. The awareness program can be developed and tailored to West Hants' needs by a summer student. There is plenty of material online to get inspiration: - BC Hydro - Employee awareness (2019) - Carbon Trust - Employee awareness and office energy efficiency (2019) - NRCan - Implementing an energy efficiency awareness program (2012).

ACTION 1.5: BEHAVIORAL ENERGY EFFICIENCY PROGRAM	
Outcome / Performance Target	Offer a first-time awareness session to 100% of the municipal employees. Offer a yearly refresher when presenting the yearly energy consumption.
Anticipated Impact (low, medium, high)	Low
Responsible Authority	Department of Planning; MCCAP Committee
Contributors / Stakeholders	University Student Interns
Priority	Medium-term
Monitoring Process and Periodicity	Electricity consumption should be tracked for this specific building. Consumption should be compiled on a quarterly basis and compared (season) to historical data to demonstrate energy savings.
Cost / Effort	No capital cost; staff time required.

ACTION 1.6: OFFICE BUILDING LOCATION REVIEW	
Description/ Detail of Actions	The location of an office building can help to influence an employee's decision on what mode of transportation they might choose. For instance, if an office is located in a 'walkable' neighbourhood, which is within walking distance of residential areas and other commercial destinations, and has access to active transportation facilities like sidewalks, then employees are more likely to choose active transportation to get to work. It was noted by stakeholders that there is an opportunity during the consolidation process to consider transportation choices and walkability when determining the siting of the new Region of Windsor and West Hants Municipality Municipal office.
Outcome / Performance Target	New Municipal office located within a walkable area, close to other amenities and residential neighbourhoods.
Anticipated Impact (low, medium, high)	Medium
Responsible Authority	Municipal Council (Staff TBD)
Contributors / Stakeholders	n/a
Priority	Short-term
Monitoring Process and Periodicity	One-time decision. However, walkability and proximity to other destinations could be a consideration of all Municipal buildings, when recapitalization or the need for a new building is being considered.
Cost / Effort	No capital cost; staff time required.

GOAL 2: INTRODUCE RENEWABLE ENERGY TO MUNICIPAL BUILDINGS

While Goal 1 aims to achieve efficiencies and reduce the amount of energy consumed by municipal buildings, Goal 2 is focused on the energy profile of the remaining energy needs for municipal buildings. Goal 2 focuses on switching to renewable energy sources. The following actions present options for switching to renewables and switching away from back-up energy that comes from non-renewable energy sources.

ACTION 2.1: FUEL SWITCHING - HEAT PUMPS	
Description/ Detail of Actions	Facilities consume energy in many forms. In West Hants some facilities consume multiple fuels such as electricity, light fuel oil or propane. Fossil fuels such as light fuel oil emit GHGs as they are consumed. Converting heating equipment to use renewable fuels can be an attractive option for reducing GHG emissions. The greater the carbon load of the current fuel used, the more beneficial it is to switch to renewable energy. Fuel switching can also involve the replacement of oil-fired heating furnaces, boilers, and distributed equipment with high-efficiency electric heat pump alternatives, predominantly ground-sourced heat pumps, air-sourced heat pumps, variable refrigerant flow (VRF) heat pumps, etc. As Nova Scotia's electricity grid gets cleaner, electric heat pumps will offer significant carbon reduction potential. Highly-efficient electric heat pump operation is effective at most times of year but must be supplemented either with conventional electric resistance or combustion-based heating during times of extreme cold weather. Such hybrid systems are becoming relatively common. For West Hants, a technical and economic analysis for heat pumps should be completed for the following buildings: - Hants County Courthouse – 240 King St. - Hantsport Fire Dept – 5 Oak St. - Public Works Shed – 19 Chittick Ave - Police Station – 3 Oak St.
Outcome / Performance Target	Thermal exchange is considered to eliminate fossil fuel consumption, replaced instead by electric-powered air, ground or water-sourced heat pumps at each building. The conversion for the four buildings noted, would result in an immediate reduction of approximately 16 tCO2e per year.
Anticipated Impact (low, medium, high)	Medium
Responsible Authority	Department of Public Works
Contributors / Stakeholders	Engineering consultant
Priority	Medium-term
Monitoring Process and Periodicity	Electricity consumption should be tracked for this specific building. Consumption should be compiled on a quarterly basis and compared (seasonally) to historical data to demonstrate energy savings.

ACTION 2.1: FUEL SWITCHING - HEAT PUMPS	
Cost / Effort	For air-source heat pumps, average costs are $2,400/ton or $65/m2. This is WSP's estimate based on RSMeans Cost Books. This gives rise to a capital cost estimate of approximately $310,000. This system is not expected to result in any change in maintenance costs relative to the hot-water systems.

ACTION 2.2: INVESTIGATE RENEWABLE ENERGY OPPORTUNITIES - SOLAR PV FOR THE WATER AND WASTE WATER TREATMENT PLANTS	
Description/ Detail of Actions	Solar PV generation refers to the installation of solar PV panels and ancillary equipment (inverters, racking, etc.) on site to produce renewable alternating current (AC) electricity for use at the facility. Small-scale systems are typically grid-connected without battery storage, with net metering available to "balance" hourly differences between facility electricity demand and system generation. For West Hants, there are a couple of options that could be considered. 1) a ground mounted solar PV system on the waste water treatment plant site (48 Falmouth Connector Road); or 2) "Floatovoltaic" systems, solar PV panels mounted on a floating rack system, for the Falmouth Water Treatment reservoirs at French Mill Lake and Davidson Lake. The ground mount and floatovoltaic systems are both scalable, meaning that they can start small and be expanded upon.
Outcome / Performance Target	From one site to another, variables like solar availability, utility rates, shading, and access to NSP distribution will all play a role in determining the capital cost and lifetime performance of a system. The site-specific viability of the property must be further assessed as a next step towards implementing this to the action plan. The potential GHG reductions are 244 tCO2e for the ground mount PV system (13 ground mounted two-axis trackers, each supporting 50 PV panels) at the waste water treatment plant, and 300 tCO2e for a floatovoltaic system, consisting of 1000 PV panels mounted on a floating racking system, installed on either French Mill Lake or Davidson Lake (note, this could scale up to 11,700 tCO2e if both lakes were practically covered with solar PV panels).
Anticipated Impact (low, medium, high)	High
Responsible Authority	Department of Public Works
Contributors / Stakeholders	Engineering consultant
Priority	Medium-term
Monitoring Process and Periodicity	Feasibility study
Cost / Effort	1) $557,700 for 650 panels, and 13 two-axis trackers ($2,285/tCO2e) 2) $858,000 for 1000 panels on floating racking system ($2,860/tCO2e)

ACTION 2.2: INVESTIGATE RENEWABLE ENERGY OPPORTUNITIES - SOLAR PV FOR THE WATER AND WASTE WATER TREATMENT PLANTS	
	*Please note that the average cost per solar panel is between $900-$1,100 based on 2019 estimates. However, the cost per solar panel is reduces when 'buying in bulk'. Likewise, the cost of installation for the system remains relatively equivalent whether purchasing 10 or 1000 solar panels.

ACTION 2.3: CONSIDER GREEN POWER PURCHASING	
Description/ Detail of Actions	Some Municipalities in Nova Scotia, in an effort to reduce their GHG emissions, have chosen to invest in renewable energy. This can be done in one of two ways: the first is to build and/or buy a portion of a renewable energy production facility like a solar field or a wind farm, as addressed above. The second option is green energy purchasing. In the latter scenario, providers own renewable energy production facilities and will put a customer's desired amount of renewable energy onto the electrical grid to offset the non-renewable sources. This allows the Municipality to offset their use to the extent that they desire. It was suggested that, instead of waiting for Nova Scotia Power to 'Green the grid', taking initiative would both help to reduce the Municipality's GHG emissions more quickly, could give the Municipality more energy-independence, and could help to set a strong example and create momentum for green initiatives within the community. Nova Scotia Power, when consulted as stakeholders, did note that in terms of reducing GHG emissions through green power, the preferable method is a 'community solar garden'. This entails a centrally-located Solar Photovoltaic (PV) system that provides electricity to participating subscribers and can sell 'extra' energy to the public energy grid.
Outcome / Performance Target	Transition the Municipality to a 50% renewable energy by 2022.
Anticipated Impact (low, medium, high)	High
Responsible Authority	All departments; CAO's office
Contributors / Stakeholders	Green Energy Purchasing provider
Priority	Long term
Monitoring Process and Period	Aim to achieve goal within 1.5 years
Cost / Effort	The incremental cost is $0.0015 to $0.025 per kWh, depending upon where the renewable energy certificate is purchased from. The corporate electricity consumption for buildings, street lights and water and waste water infrastructure is 1,979,427 kWh (2018-2019). If green power was purchased to offset 100% of the emissions corresponding to all electricity consumed by the corporate Municipality, the additional annual cost be $3,000 to $49,500, depending upon where the renewable energy certificate is purchased. If goal is to achieve an offset of 50% by 2022, the anticipated maximum cost annually would be approximately $25,000.

ACTION 2.4: INVESTIGATE PARTNERSHIPS FOR RENEWABLE ENERGY PROVISION	
Description/ Detail of Actions	Some Municipalities and organizations in Nova Scotia have already invested in renewable energy. There may be an opportunity to connect with these entities to either build a stronger understanding of investing in renewables for Municipal energy, or even partnering with these entities to purchase, build, or invest in renewables. Key organizations that provide programming for GHG reduction strategies include the Clean Foundation of Nova Scotia, Nova Scotia Power and EfficiencyOne, and the Nova Scotia Department of Energy and Mines.
Outcome / Performance Target	Build connections with others that may lead to partnerships for renewable energy production.
Anticipated Impact (low, medium, high)	Low
Responsible Authority	Planning & Development Department
Contributors / Stakeholders	n/a
Priority	Short-term
Monitoring Process and Period	Revisit option for partnerships every 3-5 years
Cost / Effort	No capital cost

GOAL 3: DEFINE A GREEN FLEET PROGRAM

A Green Fleet Program is comprised of several options and are based on the purchase of electric vehicles by the Municipality. Switching away from gas vehicles to electric vehicles can help a municipality to reduce the GHG emissions caused by their municipal vehicle fleet. However, it has been accurately pointed out that unless the Municipality invests in renewable energy production, or the Provincial energy grid is more quickly transitioned away from GHGs, electrifying the fleet likely will not have as significant of an impact in lowering GHG emissions.

ACTION 3.1: CREATE A 'FLEET MANAGEMENT PROGRAM' THAT INTRODUCES EVS OVER A MULTI-YEAR TIMELINE	
Description/ Detail of Actions	It was suggested that a longer-term Fleet Management Program could help the Municipality to plan for the future, which would see traditional gasoline vehicles being phased out and electric vehicles being phased in. This Management program would track the maintenance and operational costs and determine yearly capital funding needed to transition to EVs. In addition to the reduction of GHGs, one of the biggest benefits to introducing EVs is the reduced refueling costs, electricity being far cheaper than fuel at the pump. Fleet managers will identify and select the lowest carbon options which will continue to meet their operation needs. Once done, it will be possible to establish a vehicle replacement schedule. When fleet managers have an accurate understanding of the type and quantity of zero-emission vehicles they intend to purchase over the long

term, they can model the infrastructure needed to support the operation of these vehicles.

The Clean Foundation has a program called 'Next Ride' that the Municipality may want to participate in prior to undertaking their fleet management program. Next Ride team members will visit the Municipality and bring electric vehicles with them to allow individuals to test drive and learn more about EV ownership and maintenance. This could help increase literacy about EVs amongst staff and could also help those managing the fleet to have an opportunity to ask questions and review concerns with knowledgeable individuals.

It was noted by stakeholders that in some instances, having a private car share company located in the Municipality can be a good, lower-cost opportunity for the Municipality to use these cars for non-work-order related business travel. An agreement with a Municipality for a certain level of service can encourage a car share company to locate in the Municipality, and this also helps to provide an additional transportation option to residents in West Hants.

Outcome / Performance Target	Replace municipal vehicles with electric vehicles that meet operational needs, when available. Anticipated reduction in energy consumption between a conventional vehicle and an electric vehicle has been estimated based on the 2020 Grid Intensity of the Nova Scotia Power energy profile, and the 2030 estimated Grid Intensity used in the West Hants GHG Emissions Inventory. The following table compares Gas and Diesel vehicles of different sizes to their electric counterparts and represents the anticipated reduction in GHG emissions per vehicle. These numbers can be used to estimate the anticipated reductions of a Fleet Management Program, based on the targets and goals set in the Program for replacement of conventional vehicles to electric vehicles.

Nova Scotia	2020	2030
Gas --> Electric	**kg CO_{2e}/km**	**kg CO_{2e}/km**
Passenger Car	-0.071	-0.073
Passenger Truck	-0.090	-0.092
Light Commercial Truck	-0.074	-0.080
Diesel --> Electric	**kg CO_{2e}/km**	**kg CO_{2e}/km**
Passenger Car	-0.073	-0.060
Passenger Truck	-0.215	-0.237
Light Commercial Truck	-0.186	-0.199

Please note that this reduction has not been accounted for in the Scenario calculations under Section 4 of this Plan, due to the variability of targets and goals in the Fleet Management Program.

Anticipated Impact (low, medium, high)	Medium

ACTION 3.1: CREATE A 'FLEET MANAGEMENT PROGRAM' THAT INTRODUCES EVS OVER A MULTI-YEAR TIMELINE	
Responsible Authority	Procurement
Contributors / Stakeholders	Electric Vehicle Dealer
Priority	Long-term
Monitoring Process and Period	Yearly with the municipal budget.
Cost / Effort	Capital cost of acquiring an EV when the fleet needs a replacement. Basic electric vehicles for non-work-order staff travel cost approximately $30,000, based on 2019 numbers.

ACTION 3.2: CONSIDER INTRODUCING CARPOOL AND BICYCLE INCENTIVES FOR WORK TRAVEL	
Description/ Detail of Actions	Transportation is on average the second largest expense for Nova Scotia households. In West Hants, there are few incentives to carpool although a high portion of the population work daily in HRM. The Municipality could play a leading role to promote carpooling. Additionally, many lots around the Municipality have the potential to function as carpool lots. While influencing residents in the Municipality to carpool may be a longer-term goal complete with providing more carpooling lots and investigating rapid bus transit to HRM, there is an opportunity to influence Municipal Staff behaviour in the meantime. Municipal Staff themselves could receive incentives to carpool to work or for work trips. Such incentives to carpool – like more flexible arrival times to work or increased re-imbursement rates for carpooling for a work trip instead of taking individual – would encourage more frequent carpooling. Additionally, it was noted that while employees get reimbursed for work travel in their personal vehicles, the same is not true for personal bicycles. The Municipality could introduce a ratio like that for car travel, so as to encourage employees to choose an active mode of transportation and pay them a small stipend for making this choice. In addition to carpooling and AT incentives, it was mentioned by stakeholders that programs like 'guaranteed ride home' have helped to shift employee travel choices in other Municipalities. These programs guarantee employees who carpool an allotted number of taxi chits, which, in case of emergency or change in circumstance, they won't be 'stranded' without a car. It was noted that these programs can help alleviate the anxiety of not having a personal vehicle at work.
Outcome / Performance Target	Increase of carpooling among the community and Municipal Staff – eliminating redundant trips by two people traveling to and from the same location.
Anticipated Impact (low, medium, high)	Medium
Responsible Authority	CAO

ACTION 3.2: CONSIDER INTRODUCING CARPOOL AND BICYCLE INCENTIVES FOR WORK TRAVEL	
Contributors / Stakeholders	Public Works, Finance
Priority	Long-term
Monitoring Process and Period	Changes made during HR policies review. Twice-yearly review of program uptake to help estimate GHG reductions.
Cost / Effort	Capital costs associated with increasing staff reimbursement rate for work travel.

ACTION 3.3: INVESTIGATE 'BULK' PURCHASE OF ELECTRIC VEHICLES AND/OR EV CHARGING STATIONS	
Description/ Detail of Actions	As demand grows for electric vehicles, maintaining supply has been difficult for producers and the vehicles remain expensive in upfront cost in comparison to their gasoline counterparts. Most EV charging currently takes place in the home. In order for EVs to gain widespread consumer adoption, it is critical for an infrastructure of electric vehicle supply equipment (EVSEs) to exist outside the home; at work as well as at population destination points. The cost of installing a charger varies with its power capacity. Although higher power chargers can provide a quicker charge, they are also more expensive. Costs may sometimes fall if chargers are installed in bulk (such as for apartment complexes), although this depends on available power capacity on the site. It is possible that West Hants could take part in a bulk purchase of EVs and EV charging stations, in partnership with interested individuals from the Municipality. This could help to 'kick-off' the presence of EVs in West Hants and make them more affordable. Municipal Staff would have to investigate that avenue. It was noted that currently, there are no EV charging stations located in West Hants. For a full list of publicly-available charging stations in Nova Scotia, visit the Nova Scotia Power website.
Outcome / Performance Target	Staff Report on the financial implications of purchasing in bulk EV and/or EV charging stations to inform Council.
Anticipated Impact (low, medium, high)	Low
Responsible Authority	Procurement
Contributors / Stakeholders	Finance, CAO
Priority	Short-term
Monitoring Process and Period	Annual reporting
Cost / Effort	No capital cost for the investigation. Exact cost to be determined by staff report.

ACTION 3.4: EXPLORE A CORPORATE CAR SHARING PROGRAM	
Description/ Detail of Actions	The SAUVéR program allows municipalities to share with their partners and citizens the use of vehicles. It is a tool that combines cost-cutting targets and provides alternative mode of public transportation for communities using greener vehicles (all-electric vehicles, plug-in hybrid vehicles, hybrid vehicles). During business hours, the vehicles are used as the municipal fleet. Outside business hours, the cars are made available to a public car-sharing program. While optimizing the use of fleet vehicles among employees and other potential users, provide a public transit service tailored to specific needs. Staff need to explore the feasibility of this project in terms of liability and insurance. It was noted by stakeholders that the Clean Foundation's 'Next Ride' program may offer a model for insurance, since that program allows multiple drivers to test ride vehicles owned by the Clean Foundation.
Outcome / Performance Target	Staff Report on the implications of implementing a corporate car sharing program to inform Council. Performance target is to normalize and popularize car-sharing and electric vehicles, while providing sustainable transportation options to people of all income levels.
Anticipated Impact (low, medium, high)	Low
Responsible Authority	Public Works, Procurement
Contributors / Stakeholders	Finance, YHC Environment
Priority	Medium term
Monitoring Process and Period	Annual Reporting
Cost / Effort	Based on preliminary research based on 2019 numbers, the costs for electric vehicles range from around $30,000 at the lower end for smaller models like the Nissan Leaf or the Chevrolet Bolt, to $70,000 at the higher end for larger models like the Tesla Model X. A corporate car-sharing program itself is not anticipated to add costs to having an electric Municipal Fleet. FCM offers funding through its Municipalities for Climate Innovation Program.

GOAL 4: INVEST IN EDUCATION FOR THE COMMUNITY AND STAFF

An important element of making investments that will reduce GHG emissions is coupling these efforts with education that will make the actions more sustainable and better supported on a long-term basis. This goal aims to facilitate actions that will empower municipal staff and the community in the Municipality to make decisions or take actions that collectively can help to reduce GHG emissions. Such suggested activities under this Goal included the public 'open streets' days where education can take place, in addition to the suggested Actions under this Goal. The following actions do not have numeric values of the GHG reduction associated with them, however as the programing grows out of these actions, numeric values will likely be appropriate and can contribute to the GHG reduction in the Municipality.

ACTION 4.1: PARTNER WITH EFFICIENCY N.S. TO EDUCATE PUBLIC ON HOME RENOVATION PROGRAMS/INCENTIVES, OVERALL REDUCED COST OF LIVING, ETC.	
Description/ Detail of Actions	It was suggested that while programs exist from Efficiency NS, Nova Scotia Power, and the Clean Foundation that might help residents of West Hants retrofit their homes for energy efficiency, many members of the community are unaware of them. The Municipality could work together with these service/program providers to expand the information available to the West Hants community on these programs and how home renovations that promote efficiency can save them significant amounts of money, long-term. This promotion could be through existing avenues that Efficiency NS, Nova Scotia Power, and Clean Foundation already use, like brochures and posters, in key locations around the Municipality.
Outcome / Performance Target	More uptake on Efficiency NS programs in West Hants
Anticipated Impact (low, medium, high)	High
Responsible Authority	Planning & Development Department
Contributors / Stakeholders	Efficiency Nova Scotia (EfficiencyOne), Nova Scotia Power, Clean Foundation of Nova Scotia
Priority	Short-term
Monitoring Process and Period	Tracking the number of homeowners in WH who have used the program annually
Cost / Effort	Estimated capital costs include cost of printing and other promotional activities. Staff time should also be accounted for.

ACTION 4.2: TRAIN WH STAFF ABOUT EFFICIENCY N.S. PROGRAMS TO INTEGRATE INTO THEIR DAY-TO-DAY WORK AND INTERACTION WITH CITIZENS.	
Description/ Detail of Actions	Complimentary to educating the public on programs that are available for home efficiency improvements is educating Municipal staff, during their interactions with the community, to be able to speak helpfully about various programs that may be available. West Hants staff, especially Planning & Development staff, speak to individuals and developers who are developing or renovating houses frequently and as such, there is an opportunity for them to make suggestions about how greater energy efficiency may be achieved through participation in one of the Efficiency NS, Nova Scotia Power, or Clean Foundation programs. This action would have WH staff trained on these programs with the help of program administrators from the respective organization, and then encouraging staff when interacting with the public and developers on projects, permitting, and things pertaining to home and business ownership, to share the potential to take advantage of these programs.
Outcome / Performance Target	More uptake on Efficiency NS, Nova Scotia Power, and Clean Foundation programs in West Hants. More citizen support for the Municipality to take action on efficiency and GHG emissions reductions.
Anticipated Impact (low, medium, high)	Low
Responsible Authority	Planning & Development Department
Contributors / Stakeholders	Efficiency Nova Scotia (EfficiencyOne), Nova Scotia Power, Clean Foundation of Nova Scotia
Priority	Short-term
Monitoring Process and Period	Tracking the number of homeowners in WH who have used the program annually.
Cost / Effort	No capital cost anticipated, however staff time and training would be required.

ACTION 4.3: CONSIDER HIRING A DEDICATED GHG REDUCTION EMPLOYEE	
Description/ Detail of Actions	During the staff stakeholder workshops, it was noted that many of the actions in this Background Study rely on projects that will be ongoing for many years and will require a 'point person' to manage them. It was suggested that the responsibility for this could be given to a dedicated GHG reduction program employee. This employee would be responsible for liaising with all departments involved, with community groups, with provincial partners, and monitoring the status of projects. Stakeholders noted that partial funding for this employee may be available through a grant from Efficiency Nova Scotia. Additionally, it was noted by staff stakeholders that a budget to implement projects would be required for this employee. It was suggested that to offset the cost, local university students could be hired to do supporting research and help the employee run programs to carry out these actions.

ACTION 4.3: CONSIDER HIRING A DEDICATED GHG REDUCTION EMPLOYEE	
Outcome / Performance Target	Streamlined tracking of GHG reduction projects under one manager to keep Municipality on-track with goals and keep projects running over longer periods of time.
Anticipated Impact (low, medium, high)	Medium
Responsible Authority	CAO's Office
Contributors / Stakeholders	n/a
Priority	Long-term
Monitoring Process and Period	n/a
Cost / Effort	Exact cost to be determined by CAO's office for salaried employee.

GOAL 5: CREATE OPPORTUNITIES FOR WEST HANTS TO SUPPORT THE COMMUNITY AND LEAD BY EXAMPLE

The GHG Emissions Inventory shows that the Municipality itself contributes only a small fraction of the overall GHG Emissions in West Hants. Most emissions are associated with the community – specifically, in the residential and transportation sectors. As such, the Municipality's capacity to effect change is much greater if members of the community are encouraged to and see a strong example of reducing their GHG emissions. Likewise, the Municipality, as an employer, has an opportunity to set an example for other businesses in West Hants.

ACTION 5.1: INTEGRATE GHG REDUCTION STRATEGIES INTO HR POLICIES	
Description/ Detail of Actions	It was indicated that a review of HR policies is ongoing (winter 2019-2020). This was highlighted as an opportunity to build increased flexibility into work hours and/or working location to help employees take individual actions to reduce the GHG emissions associated specifically with traveling to and from work. Initiatives suggested include: - 'Home-working' days – a pre-fixed day per week or bi-weekly that individual employees can work from home - 'Flex' Days – employees can choose to work extra hours to achieve their bi-weekly salaried hours (i.e. taking a shorter lunch; staying later in the afternoon; etc. to achieve e.g. 70 hour work week) and then take a day off at the end of the bi-weekly period. - More flexible arrival/departure times: it was noted that being able to arrive later and leave later, within reason, would help employees to carpool with friends or spouses, thereby reducing their emissions getting to/from work.
Outcome / Performance Target	Employees using their personal vehicles for commute to work 1 or more fewer day(s) per month.
Anticipated Impact (low, medium, high)	Low
Responsible Authority	All non-essential WH staff members and their managers (managers tracking employee activities)
Contributors / Stakeholders	n/a

ACTION 5.1: INTEGRATE GHG REDUCTION STRATEGIES INTO HR POLICIES	
Priority	Medium-term
Monitoring Process and Periodicity	Ask employees to self-monitor and managers to report to CAO on reductions in employee commutes.
Cost / Effort	No capital cost.

ACTION 5.2: INVESTIGATE OPTIMIZING BUSINESS/WORK-ORDER TRAVEL	
Description/ Detail of Actions	Work travel for the Public Works and Parks departments in West Hants is necessary to complete work orders. It was noted that 'optimizing' work orders to optimize work travel is a method that may help to reduce the GHG emissions associated with individual work orders. The intention of this would be to better plan work-order travel to take place on a locational basis. For example, if there are two jobs required in Brooklyn in one week, those jobs would be scheduled for the same day. The first option is to optimize work orders 'in house'. There are many Municipalities who optimize their scheduling internally – with one manager directing and organizing the work orders like this. The second option is to purchase and utilize available Software which can then be programmed to optimize work-order travel. Some such Softwares include: - Hippo CMMS Software: incorporates work order management, preventive maintenance, and inventory management to create an optimized maintenance management plan - City Works Software: uses GIS to group assets by location, type, age, etc. to create work orders-work flow for both scheduled and reactive work. - Accela Work Crew: uses company smart phones to schedule and track work-orders as they are completed.
Outcome / Performance Target	Reduction in work-order redundancies. More information needed on work-orders to determine exact calculation.
Anticipated Impact (low, medium, high)	Low
Responsible Authority	Public Works Department / Parks Department (each authority responsible for department work orders)
Contributors / Stakeholders	n/a
Priority	Medium-term

ACTION 5.2: INVESTIGATE OPTIMIZING BUSINESS/WORK-ORDER TRAVEL	
Monitoring Process and Periodicity	Annual monitoring of number of work-order trips.
Cost / Effort	Option 1 – no capital cost. Option 2 – price of Software varies.

ACTION 5.3: EXPLORE OPTIONS ON P.A.C.E. PROGRAMMING	
Description/ Detail of Actions	Explore building a partnership with Clean Foundation of Nova Scotia to introduce a Property Assessed Clean Energy (P.A.C.E.) financing model. The financing is structured around a Municipal funding model wherein a pre-determined amount is allocated each year and financing is available on a first come-first served basis. The Province will provide the Municipality with start-up funding for this program, and then the Municipality commits to funding the program during following years. P.A.C.E. programming helps individuals to do energy retrofits to their homes with financing from the Municipality. The first step is a Home Energy Assessment, which helps to determine whether a home is eligible for financing and what upgrades a home may be eligible for. These could include energy efficient windows and doors, insulation, heat pumps, solar panels, etc. The homeowner pays back the loan over the course of a 10-year (or as desired) payment period. It has been suggested that West Hants could form a partnership to deliver this program, and that funding sources for the financing could come from the Gas Tax revenue and/or existing Municipal capital funds that have been allocated for 'future' expenditures.
Outcome / Performance Target	Intended outcome of a P.A.C.E. program is that the yearly financing is 100% allocated and, as such, a pre-determined number of homes in the Municipality are becoming more energy efficient each year. Energy consumption reductions vary depending on house age, condition, and improvements made. However, estimates from Nova Scotia have shown that investments under $5,000 can result in a reduction of 4 tCO_2e per year.
Anticipated Impact (low, medium, high)	High
Responsible Authority	Planning & Development
Contributors / Stakeholders	Clean Foundation of Nova Scotia / Province of Nova Scotia
Priority	Long-term
Monitoring Process and Periodicity	Annual reporting.
Cost / Effort	Determined in partnership with Clean Foundation – dependent on how many homeowners Municipality wants to finance at once.

ACTION 5.4: PROMOTE DESIRED ACTIONS, POLICIES AND INCENTIVES TO THE PROVINCIAL GOVERNMENT	
Description/ Detail of Actions	The Municipality recognizes, through the GHG Inventory, that energy consumption is one of the major contributors to overall GHG emissions in the Municipality. This is due to the Municipality's use of the Provincial energy grid, which still uses a greater percentage of coal-powered energy than the other Provincial energy providers in Canada. Knowing this, Municipalities in Nova Scotia who have GHG reduction targets often utilize existing chances for collaboration and support to advocate for a faster transition away from fossil fuels and towards renewable energy. This action can be accomplished through channels and avenues that already exist. For instance, inviting representatives from Nova Scotia Power to attend the GHG Emissions Inventory presentation and workshop was a good opportunity to provide feedback to the service provider that West Hants will need a Provincial commitment to 'greening the grid' to help meet the GHG reduction targets.
Outcome / Performance Target	More frequent communication with Provincial decision-makers and Nova Scotia Power regarding West Hants GHG reduction targets and the provincial energy grid.
Anticipated Impact (low, medium, high)	High (potential)
Responsible Authority	All Departments – Managers & CAO
Contributors / Stakeholders	n/a
Priority	Long-term
Monitoring Process and Periodicity	n/a
Cost / Effort	No capital cost

ACTION 5.5: CONSIDER ADOPTING LAND USE POLICIES THAT MANDATE OR ENCOURAGE EFFICIENT/SUSTAINABLE GROWTH MODELS	
Description/ Detail of Actions	The link between GHG emissions and land use planning is well-established in scholarship (for a summary, see CIP Briefing[4]). As such, a recommended action is for the Municipality to emphasize policies that drive efficient growth and development when reviewing their Municipal Planning Strategy and Land Use By-law. Such policies should seek to permit growth and development in such a way that does not necessitate the use of a car. Examples of this include: - Policies regarding the citing of community centres and facilities close to existing residential or commercial areas;

[4] Climate Brief: Climate Change and Land Use Planning. CIP, 2018. URL: https://www.cip-icu.ca/getattachment/ca4806bb-0c53-4ad6-a4c6-47fe0c9e0d51/Climate-Brief_Land-Use-Planning-bm.pdf.aspx

ACTION 5.5: CONSIDER ADOPTING LAND USE POLICIES THAT MANDATE OR ENCOURAGE EFFICIENT/SUSTAINABLE GROWTH MODELS	
	- Policies to reduce lot sizing and citing requirements, including greater lot coverages permitted and less lot frontage and area required; - Policies to permit a variety of housing forms, including medium-to-high density forms like townhomes and small multi-unit buildings - Policies to encourage or incentivize 'infill' development in/around existing residential and commercial areas, as opposed to large-scale green field development (i.e. greater permissions for density in these areas) - Policies to support the existing Active Transportation Plan in implementation. - Policies to introduce mixed use zoning in more residential areas, which results in the development of amenities like a corner store, pharmacy, daycare, etc. to be located closer to or within existing residential neighbourhoods. Another important initiative will be to review the policies of the Active Transportation Plan to focus on reducing GHG emissions through providing better active transportation opportunities and to update these policies, where necessary, to match initiatives under the Municipality's future Local Action Plan. Keeping these Plans up-to-date with new information can help to ensure that the Municipality is taking all available actions to encourage the use of active transportation, so as to result in reduced GHG emissions from transportation.
Outcome / Performance Target	Results in a reduction of GHG emissions from the transportation/housing sector over a long period of time. Reduction in percentage of car ownership/number of cars per household would be a good starting place (with data available from the census).
Anticipated Impact (low, medium, high)	High
Responsible Authority	Planning & Development
Contributors / Stakeholders	Council – requires political will
Priority	Medium-term
Monitoring Process and Periodicity	Census-year monitoring – every 5 years for 25 years.
Cost / Effort	No capital investment.

ACTION 5.6: MAKE RENEWABLE ENERGY INVESTMENTS AND SUSTAINABILITY PRACTICES (CURRENT AND FUTURE) 'VISIBLE' AND KNOWN TO THE COMMUNITY	
Description/ Detail of Actions	Celebrating the efforts associated with the Local Action Plan (once determined by Council and staff) are important for introducing the goals to the community and garnering and maintaining buy-in. This is especially important if/when the Municipality makes a monetary investment, the success of which depends on positive public perception. The Municipality should aim to include promoting sustainable practices and renewable energy projects, when being pursued or completed, in all correspondence to residents of the Municipality. This includes using newsletters and social media, but also making an effort to do wayfinding and signage in and around buildings where renewable energy and sustainability practices are featured. For example, the tendency when introducing solar panels is to install them with little visibility. This action would encourage making solar panels more visible or, at the very least, putting up wayfinding signage close to the pedestrian paths around the building.
Outcome / Performance Target	More overall awareness as measured in annual GHG literacy community survey.
Anticipated Impact (low, medium, high)	Low
Responsible Authority	Parks / Planning & Development Departments
Contributors / Stakeholders	Marketing Consultant – for a communications/marketing program like this, it may be pertinent to hire a marketing consulting firm.
Priority	Long-term
Monitoring Process and Periodicity	n/a
Cost / Effort	Costs associated with hiring a marketing consultant through an RFP process; capital costs associated with promotion materials.

ACTION 5.7: EXPLORE OPTIONS TO INCLUDE ANTICIPATED GHG EMISSIONS IN STAFF REPORTS FOR COUNCIL AND COMMITTEES	
Description/ Detail of Actions	In West Hants' pre-formatted 'Staff Report', which goes either directly to Council or to a review Committee and then to Council, there is a subheading that asks the author of the report to consider Financial Implications in the proposed project. This action suggests including 'Greenhouse Gas Emissions Implications' as a subheading in the pre-formatted staff report. This would compel the Municipal staff authoring the staff report to consider the emissions associated with the proposed project and, therefore, help Council and other committees to make decisions and recommendations based on a consideration of whether the actions taken would negatively or positively impact the Municipality's GHG reduction goal. To integrate this subheading and streamline the consideration process for staff, it may be necessary to hire a climate change consultant on retainer

ACTION 5.7: EXPLORE OPTIONS TO INCLUDE ANTICIPATED GHG EMISSIONS IN STAFF REPORTS FOR COUNCIL AND COMMITTEES	
	who can assist staff in making estimated calculations when drafting this section of the report. The alternative would be to hire a climate change consultant to develop a 'checklist' system that helps employees arrive at a 'low', 'medium', or 'high' impact on GHG emissions for potential projects. It was noted during the stakeholder engagement meeting that this may be difficult for certain types of staff reports, and further categorization of reports may be necessary in order for a climate change consultant to provide assistance developing a program.
Outcome / Performance Target	Avoiding unintentional negative impacts on the Municipality's GHG emissions target
Anticipated Impact (low, medium, high)	Medium
Responsible Authority	All staff departments
Contributors / Stakeholders	Climate change consultant
Priority	Short term
Monitoring Process and Periodicity	n/a
Cost / Effort	Estimated cost for a consultant depends on requirements of projects and staff reports. If hired on retainer, a climate change consulting engineer would likely cost $130-160/hour. Associated staff costs.

GOAL 6: MAKE WEST HANTS MORE ELECTRIC VEHICLE FRIENDLY

Once again referring to the corporate and community GHG inventories, it is clear that transportation for members of the community is much more of a significant GHG contributor than for the Municipality itself. However, the Municipality still has a role to play in increasing the use of and ease of transitioning to electric vehicles for the public.

ACTION 6.1: EXPLORE POTENTIAL PARTNERSHIPS FOR EV CHARGING STATIONS	
Description/ Detail of Actions	In light of the ongoing electrification of the Trans-Canada Highway, it was suggested that employers and commercial vendors in West Hants may be interested in partnering with the Municipality to host electric vehicle charging stations on their properties for the use of employees or customers. Likewise, it was suggested that there may be other partnership opportunities to provide EV charging stations, through provincial or federal funding. Partnerships for the Municipality to explore include: - Hants Community Hospital (Capital Health) - McDonalds - Atlantic Superstore (Loblaws) - Sobeys - Tim Horton's
Outcome / Performance Target	Increasing the number of EV charging stations from 0 to 2 in West Hants over the next 5 years. Estimated emissions reductions between conventional and electric vehicles can be found in the table under Action 3.1. Rapid charging stations can provide an electric vehicle with full charge within 1-1.5 hours.
Anticipated Impact (low, medium, high)	Medium
Responsible Authority	Planning & Development
Contributors / Stakeholders	University Summer Student
Priority	Medium-term
Monitoring Process and Periodicity	Monitoring to count EV charging stations every 5 years
Cost / Effort	Approx. $2,500-3,500 per charging station in total (less if cost-shared with partner) based on cost estimates in 2019.

ACTION 6.2: EXPLORE FUNDING FOR EV CHARGING STATIONS ON MUNICIPAL PROPERTY	
Description/ Detail of Actions	There are funding sources for electric vehicle and zero-emission vehicle infrastructure through both the Federal Government and the Canadian Federation of Municipalities. There may be additional funding sources that become available over the next several years, as well and the number of electric vehicles owned by residents is likely to increase. As such, the Municipality has an opportunity to take a leadership role in providing EV charging stations for the public on Municipally-owned properties in central locations such as the West Hants Municipal Building and the Arena. Continuing to investigate funding and the applicable requirements will allow West Hants, if desired by Council, to allocate a portion of capital funding towards pursuing funding for and cost-sharing EV charging stations. Given that West Hants is a location in Central Nova Scotia that does not yet have an EV charging station (while many other locations along the Trans-Canada Highway do, this may position West Hants well to be eligible for funding.
Outcome / Performance Target	Acquire sufficient funding to introduce two (2) EV charging stations in West Hants, thereby increasing the number of electric vehicles and reducing emissions from transportation. Estimated emissions reductions between conventional and electric vehicles can be found in the table under Action 3.1. Rapid charging stations can provide an electric vehicle with full charge within 1-1.5 hours.
Anticipated Impact (low, medium, high)	Medium
Responsible Authority	Planning & Development
Contributors / Stakeholders	Public Works Department / Funding sources to be ascertained
Priority	Short-term
Monitoring Process and Periodicity	2 EV charging stations every 5 years
Cost / Effort	No capital cost if funding acquired covers 100% of cost. Staff time required for research.

ACTION 6.3: EXPLORE OPPRTUNITIES TO CREATE A 'TRANSPORTATION HUB'	
Description/ Detail of Actions	Transitioning people in West Hants to modes of transportation other than their personal vehicles will be challenging, due to the predominantly rural nature of the Municipality. However, it was suggested that having a 'transportation hub' – a place where different modes converge, and people can switch from one mode to another seamlessly – may help to encourage this transition. The overall goal of this would be to make it easy, intuitive, and enjoyable for people to choose a more sustainable mode of transportation. Creating a transportation hub would entail identifying a central location which is available to the public for parking (i.e. a 'park and ride' type lot), and then accommodating other modes at this same lot, including infrastructure such as a bicycle parking and quick-repair station, transit pick-up/drop-off point (should transit eventually be available in the Municipality), an identified area for parking for carpooling, electric vehicle charging stations, and others. This may necessitate the Municipality purchasing land for this hub, or otherwise making currently-owned land available for such use. It is important that this hub is located in a walkable area (i.e. a place that has sidewalks and is close to neighbourhoods and commercial areas) to make it possible for people to walk to and from the hub, or to other nearby destinations.
Outcome / Performance Target	Identify step-by-step process of introducing a 'transportation hub' and begin incorporating steps into yearly capital spending. Suggested steps would be 1) identify existing area/parking lot owned by Municipality (or acquired by Municipality) to locate the hub; 2) identify modes of transportation to be made available (to be done in tandem with other 'actions' from this background report, like investing in EV charging stations); 3) install infrastructure at hub location; 4) promote and advertise hub for public use.
Anticipated Impact (low, medium, high)	High
Responsible Authority	Planning & Development / Active Living Coordinator
Contributors / Stakeholders	Department of Energy and Mines (potential funding source)
Priority	Medium-Term
Monitoring Process and Periodicity	Overall plan incorporate different elements of transportation hub to be completed within 1-3 years (short-term), allowing for further monitoring of implementation.
Cost / Effort	Staff time required for coordinating and planning. Associated costs of infrastructure (i.e. bike corrals, EV charging stations, etc.). Cost of land acquisition, if not already Municipally-owned.

ACTION 6.4: INTEGRATE ACTIVE TRANSPORTATION CONSIDERATIONS INTO LAND USE PLANNING DECISIONS	
Description/ Detail of Actions	Land use planning decisions often determine whether or not people will choose active transportation (AT) or passive (vehicular) transportation. Increasing the use of active transportation offers opportunities to increase overall public health, decrease the GHG emissions from transportation, and boost the local economy. Shifting the mode share (i.e. the number of people using any given mode of transportation) in West Hants to encourage people to use active transportation instead of passive transportation has been made a priority of Council through the Active Transportation Plan. As such, considering the priorities and actions of the Active Transportation Plan is critical when making land use planning decisions. This action entails collaboration and coordination between the Planning Department and the Active Living Coordinator when master planning, strategic planning, and application processing and other significant land use planning decisions are being made. Note that for some applications, like industrial applications, this will be less relevant. On the other hand, applications for residential buildings or communities may present many opportunities to encourage future inhabitants to choose AT.
Outcome / Performance Target	Planning Staff, when completing a land use planning exercise such as strategic planning or processing a planning application, consult and discuss opportunities to consider and promote active transportation in the planned community/building, where possible and relevant.
Anticipated Impact (low, medium, high)	Medium
Responsible Authority	Planning & Development / Active Living Coordinator
Contributors / Stakeholders	Land use planning applicants
Priority	Short-term
Monitoring Process and Periodicity	Evaluate success of coordination every 1-2 years
Cost / Effort	Staff time required for coordination and collaboration.

GOAL 7: MAKE IT EASIER TO BUY FROM LOCAL VENDORS AND EAT LOCAL FOOD

Local production and purchasing has the potential not only to boost the local economy, keeping money earned in the municipality circulating in the municipality, but also to reduce the GHG emissions associated with food and good production and purchasing from elsewhere. The associated emissions include transportation emissions to deliver food and goods from point of production to point of sale (often necessitates air travel) and emissions associated with large scale agricultural or warehousing facilities consumption of energy and production of waste, among other, smaller contributors. Encouraging growing and making, selling, and buying local food and goods can help the Municipality to reduce its overall GHG emissions and promote placemaking, sense of community, increased security of livelihood for local producers, and better nutrition and physical health for members of the community.

ACTION 7.1: CREATE FOOD EDUCATION PROGRAMS IN PARTNERSHIP WITH COMMUNITY AND SCHOOLS, INCLUDING WASTE REDUCTION	
Description/ Detail of Actions	Research from Ontario has shown the strong link between food education programs in school and long-term benefits in food literacy and overall health and wellbeing. [5] This program can and should be developed in partnership with community organizations and individuals who are able to provide resources on the topic and/or direct knowledge of food systems in the West Hants context. For instance, this could be the local representative of the Nova Scotia Federation of Agriculture, or a non-local charity with food education and provision programs, like the Ecology Action Centre. There is also provincial-wide programming to provide food education and, in partnership with knowledgeable people from the Municipality, this could be specialized to West Hants.[6] A key feature of this program should be to educate school-aged children on the importance of eating local foods and how to prepare these foods. It was noted during stakeholder engagement that a good example of such a program is that at the Dr. Arthur Hines District School.
Outcome / Performance Target	Offer an in-school program for elementary, middle, and high schools twice yearly.
Anticipated Impact (low, medium, high)	Low
Responsible Authority	TBD by West Hants
Contributors / Stakeholders	Community Partners; Department of Education
Priority	Long-term
Monitoring Process and Periodicity	Review program success annually
Cost / Effort	Possible capital cost upfront to run program, including travel costs for staff and print and promotional materials. Additionally, staff time can be expected.

[5] Sustain Ontario, Collected Research on Food Education, 2018. URL : https://sustainontario.com/work/edible-education/impacts-of-good-food-education/

[6] References or Provincial programming include:
Food and Nutrition Policy for Nova Scotia Public Schools, Nova Scotia Department of Education: https://novascotia.ca/dhw/healthy-communities/healthy-eating-schools.asp
Nourish Nova Scotia: https://www.nourishns.ca/

ACTION 7.2: REVIEW AND AMEND POLICIES TO PROMOTE SMALL-SCALE LOCAL AGRICULTURE	
Description/ Detail of Actions	It was noted during the community group workshop that certain policies are either advertently or inadvertently working to make small-scale local agriculture more difficult. The upcoming Municipal Planning Strategy and Land Use By-law review is an opportunity to review the policy documents to take opportunities, where possible, to promote small-scale agriculture. During the review, the documents should be examined for policies that prohibit small-scale agriculture. Likewise, a literature review of local agriculture policies for urban/suburban/small-scale agriculture should be undertaken. This was seen as a strong opportunity for West Hants to harness its largely rural nature to reduce the GHG emissions associated with food production and freight.
Outcome / Performance Target	Reduce 'red tape' around small-scale local agriculture policies. Increase the number of local, small-scale producers in West Hants.
Anticipated Impact (low, medium, high)	Medium
Responsible Authority	Planning & Development
Contributors / Stakeholders	n/a
Priority	Short-term
Monitoring Process and Periodicity	One occurrence; monitored through ongoing engagement with local producers.
Cost / Effort	Built into cost of performing MPS and LUB review.

ACTION 7.3: LOCAL PROCUREMENT POLICIES	
Description/ Detail of Actions	The Municipality has existing local procurement policies for projects and items that go to tender. However, these are limited since many times, when food for meetings, workshops, or events is sourced, tendering is not required. The objective of this action would be to create a Policy of Council that would mandate staff to consider and prioritize local food or vendors who work with local food above those who are not producers from West Hants, or Nova Scotia more broadly.
Outcome / Performance Target	Increase the incidence of 'local' food being served by the Municipality
Anticipated Impact (low, medium, high)	Low
Responsible Authority	All departments
Contributors / Stakeholders	Municipal Council
Priority	Long-term
Monitoring Process and Periodicity	More local procurement over a multi-annual basis
Cost / Effort	No capital cost associated. Staff time required for policy review.

ACTION 7.4: MAKE MUNICIPAL FACILITIES AVAILABLE TO LOCAL FOOD AND GOODS VENDORS	
Description/ Detail of Actions	It was noted in engagement with local producers that having more locations, like gyms, recreation rooms, etc. across the Municipality where there were consistent and predictable times and vendors for local food and goods might help encourage more residents to shop locally. It was noted by stakeholders that oftentimes, Municipal facilities across the Municipality are not utilized during all available timeslots, and that making these timeslots known to and available to private individuals or groups who may wish to rent them for a low fee on a consistent weekly or monthly basis would be one avenue for the Municipality to support local makers and growers without any significant monetary investment. This action entails the Municipality offering existing Municipal buildings to groups or collectives and providing rental of these buildings at a low or no cost for the purpose of farmers or makers markets.
Outcome / Performance Target	More consistent programming space for local food producers.
Anticipated Impact (low, medium, high)	Medium
Responsible Authority	TBD by West Hants
Contributors / Stakeholders	Community partners in local food production
Priority	Long-term
Monitoring Process and Period	Addition of at least one consistent space for local producers and makers.

ACTION 7.4: MAKE MUNICIPAL FACILITIES AVAILABLE TO LOCAL FOOD AND GOODS VENDORS	
Cost / Effort	No capital cost.

4 GHG REDUCTION SCENARIOS

Using data from the seven Goals and the Actions which fall under each goal, three scenarios were developed: 'Safe', 'Balanced', and 'Dynamic'. The Safe Scenario introduces the lowest effort and cost but results in the lowest level of GHG reduction. The Balanced Scenario requires moderate effort and cost but has a greater potential for GHG reduction than the Safe Scenario. Finally, the Dynamic Scenario is the greatest level of effort and the highest cost but will yield the greatest GHG reductions.

While none of these scenarios have been selected by the Municipality, they can help to inform the future Municipal Council (of The Region of Windsor and West Hants Municipality) on the different approaches that could be taken, and what actions might fall under each. The format of the scenarios allows Municipal staff to make adjustments to meet the needs and will of Council, once a GHG emission reduction target is set.

The Scenarios have been created by grouping together the short-, medium-, and long-term actions. Short-term actions are characterized as actions that could feasibly take place in 1-3 years; medium-term in 3-5 years; long-term in 5-10 years. It is important to note that the outcomes and costs of the scenarios are only rough estimates – they do not represent all of the possible GHG reduction outcomes, and they do not represent the total cost. This is due to the fact that many of the 'Actions' are premised on promotion, education, staff leadership, and other such activities. It is not possible to calculate direct emissions reductions from these activities. However, cumulatively, it is anticipated that these activities will make an impact on West Hants' GHG emissions target.

The Total Cumulative calculation at the bottom of the 'Balanced' and 'Dynamic' tables represents the total cost and total amount of reduction for each scenario. The anticipated reductions are in addition to the business-as-usual forecast (found in the West Hants Greenhouse Gas Inventory Report) of 44% at the corporate level.

4.1 SAFE

The 'Safe' scenario represents the lowest level of effort, which is anticipated to result in the lowest level of GHG reductions. The following table summarizes the action number, action item, anticipated outcome of the action (if available) and the anticipated cost. In this table, staff time is assumed as time not included in capital budgeting, however due to increased workloads it is possible that the Municipality will require additional staff. The 'low' costs indicated under the anticipated costs column are costs that are predicted to be equal to or less than $10,000 one-time expenditure. The actions included in this scenario are:

Action Number	Action Item	Anticipated Outcome	Anticipated Cost
Action 1.1	Perform internal building survey (i.e. ASHRAE Level 1 Energy Audit)	Suggested reduction target is 27.5 tCO2e	Staff time + cost of upgrades (low)
Action 1.4	Promote and celebrate energy efficient buildings	Increased awareness and support	Staff time + cost of materials (low)
Action 2.4	Investigate partnerships for renewable energy provision	Improved partnerships and potential pathway for renewable energy provision	Staff time
Action 3.3	Investigate 'bulk' purchase of electric vehicles and/or EV charging stations	Staff Report	Staff time
Action 4.1	Partner with Efficiency N.S. to educate public on home renovation	Increased uptake on Efficiency N.S. programs	Staff time + cost of materials and travel (low)

	programs/incentives, overall reduced cost of living, etc.		
Action 4.2	Train WH staff about Efficiency N.S. programs to integrate into their day-to-day work and interaction with citizens.	Increased uptake on Efficiency N.S. programs	Staff time
Action 5.7	Explore options to include anticipated GHG Emissions in staff reports for Council and committees	Avoiding GHG emission increases	Staff time
Action 6.2	Explore funding for EV charging stations on municipal property	Funding options for EV charging stations	Staff time
Action 6.4	Integrate Active Transportation considerations into Land Use Planning Decisions	Increase uptake of Active Transportation	Staff time
Action 7.2	Review and amend policies to promote small-scale local agriculture	Increased number of local providers	Staff time
Total		**27.5 tCO2e** (5% of existing corporate emissions**)** + incalculable amount of reduction of both corporate and community emissions stemming from staff time	**Low costs** (anticipated $15,000 total) + staff time

The anticipated total GHG reductions for this scenario are relatively low, but have potential to result in greater overall GHG reductions than the anticipated total because several actions mandate research or promotion. It is not possible to calculate what research and promotion actions might lead to, but they are anticipated to have a low-to-moderate impact on the overall GHG emissions in West Hants if completed successfully.

4.2 BALANCED

The 'Balanced' scenario represents a moderate investment and level of effort, and a moderate reduction which is greater than the 'safe' scenario. In this table, it is assumed that staff time is not included in capital budgeting, however due to increased workloads it is possible that the Municipality will require additional staff. The 'medium' costs indicated under the anticipated costs column are costs that are predicted to be equal to or less than $10,000 one-time expenditure.

The Balanced scenario includes **all the actions from the 'Safe' Scenario**, in addition to the following:

Action Number	Action Item	Anticipated Outcome	Anticipated Cost
Action 1.5	Behavioral Energy Efficiency Program	Increased awareness and decreased Municipal staff energy consumption	Staff time

Action 2.3	Consider Green Power Purchasing	50% of power offset by green energy (approx. 315 tCO_2eq based on total electricity emissions of 631 tCO_2eq for Municipal buildings).	Anticipated maximum annual capital cost of $25,000
Action 2.1	Fuel Switching – Heat Pumps	Approximately 16 tCO2e	Approximately $310,000 capital cost.
Action 3.4	Explore a Corporate Car Sharing Program	Normalization of EVs and provision of sustainable transportation options.	Staff time
Action 5.1	Integrate GHG reduction strategies into HR Policies	Reduction associated with 1 day of work per month, per employee.	Staff time
Action 5.2	Investigate optimizing business/work order travel	Reduction in work-order redundancies.	Staff time + Software cost (medium annual)
Action 5.5	Consider adopting land use policies that mandate or encourage efficient/ sustainable growth models	Long-term reduction in car usership and ownership.	Staff time
Action 6.1	Explore potential partnerships for EV charging stations	Increase in EV charging stations for municipal and public use.	Staff time + potential cost-sharing of EV charging stations (medium cost)
Action 6.3	Explore Opportunities to Create a 'Transportation Hub'	Increase the use of sustainable transportation modes	Staff time + infrastructure purchases (some included in other actions and approx. $3,000 per bike corral x 3) + possible land cost (unknown)
Total		**331 tCO2e** (19% of existing corporate emissions) + incalculable amount of reduction of both corporate and community emissions stemming from staff time and mode shift initiatives	**$319,000 one-time cost** + **35,000 per annum cost** + unknown capital costs, depending on decisions made by WH + staff time

Total Cumulative ('Safe' and 'Balanced' Scenario)		**358.5 tCO_2eq** (20.5% of existing corporate emissions) + incalculable amount of reduction of both corporate and community emissions stemming from staff time	**$334,000** one-time cost + **$35,000** per annum cost + unknown capital costs, depending on decisions made by WH + staff time

4.3 DYNAMIC

The 'Dynamic' scenario features all proposed actions, and is anticipated to be a high-cost, high-return solution for GHG reductions in West Hants. In this table, it is assumed that staff time is not included in capital budgeting, however due to increased workloads it is possible that the Municipality will require additional staff. The 'medium-to-high' costs indicated under the anticipated costs column are costs that are predicted to be equal to or less than $10,000 – $30,000 for one-time expenditure.

The Dynamic scenario includes **all the actions from the 'Safe' and 'Balanced' Scenarios**, in addition to the following:

Action Number	Action Item	Anticipated Outcome	Anticipated Cost
Action 1.2	Detailed energy audits for the water and wastewater plants	Suggested reduction target of 109,62 tCO2e	Anticipated capital cost of $36,000 + staff time
Action 1.3	Assessment of the Brooklyn Fire Station and Civic Centre	Anticipated reduction of 23 tCO2e	Anticipated cost of $25,000 + staff time
Action 2.2	Investigate Renewable Energy opportunities – solar PV for the water and wastewater treatment plants	Two Options Available: Approximately 244 tCO2e for option 1 **OR** 300 tCO2e for option 2	Approximately $557,700 (panels and axis trackers) **OR** $858,000 (panels on racking system)
Action 3.1	Create a 'fleet management' program that introduces EVs over a Multi-Year Timeline	Anticipated energy consumption/GHG reduction per vehicle is shown in table under action 3.1	$30,000 per annum (approximate replacement rate)
Action 3.2	Consider introducing carpool incentives for work travel	Increased carpooling and decreased redundancy	Suggested increase of $0.10 for reimbursement for those traveling. Overall increase

			unknown, but anticipated low.
Action 4.3	Consider hiring a dedicated GHG reduction employee	Streamlined projects and tracking	Staff cost (for new salaried employee)
Action 5.3	Explore options on P.A.C.E. programming	Reduction of GHG emissions from homes in East Hants.	Dependent on # of homes supported by program.
Action 5.4	Promote desired actions, policies, and incentives to the Provincial Government	Streamlined communication with NS gov.	Staff time
Action 5.6	Make renewable energy investments and sustainability practices (current and future) visible and known to the community	More awareness of and support for renewable energy	Capital costs estimated to be low
Action 7.1	Create food education programs in partnership with community and schools, including waste reduction	Increased literacy in Municipality about healthy and local food procurement	Staff time
Action 7.3	Local Procurement Policies	Increasing Municipality's investment in local food	Staff time
Total		**376.62 tCO_2eq** (22% of existing corporate emissions) **OR** **432.62 tCO_2eq** (46% of existing corporate emissions) + incalculable amount of reduction of both corporate and community emissions stemming from staff time	**$625,700** one-time cost + **$55,000** per annum cost + unknown capital costs, depending on decisions made by WH + staff time
Total Cumulative ('Safe', 'Balanced', and 'Dynamic' Scenario)		**735.12 tCO_2eq** (42% of existing corporate emissions) **OR** **791.12 tCO_2eq** (46% of existing corporate emissions) + incalculable amount of reduction of both corporate	**$673,700** one-time cost **OR** **$965,000** one-time cost + **$80,000** per annum cost +

		and community emissions stemming from staff time	unknown capital costs, depending on decisions made by WH + staff time

4.4 RECOMMENDED SCENARIO

The recommended scenario is based upon decisions made by the Municipality of West Hants' municipal Council, and that of the amalgamated Councils of West Hants and Windsor. The Municipality needs to set a target and can most appropriately match the scenario to this target. The options for the targets under this scenario are:

Target 1: 5% reduction in emissions + incalculable amount of reduction of both corporate and community emissions stemming from staff time

Target 2: 22% reduction in emissions + incalculable amount of reduction of both corporate and community emissions stemming from staff time

Target 3: 42% or 46% reduction in emissions + incalculable amount of reduction of both corporate and community emissions stemming from staff time

The scenarios, represented as targets above, can be adjusted by adding or removing different actions to achieve the Municipality's desired reduction. It was suggested by stakeholders that the Municipality should consider aligning its target with the Province's target under the *Sustainable Development Goals Act.*

5 FUNDING OPTIONS

5.1 EFFICIENCY NOVA SCOTIA

Efficiency Nova Scotia is Nova Scotia's energy efficiency utility, which operates funding for efficiency and conservation activities of Nova Scotia Power. Efficiency Nova Scotia works with local partners to assist Nova Scotians in retrofitting their homes and businesses to increase energy efficiency and reduce costs. As such, Efficiency Nova Scotia offers a variety of funding programs to help reduce energy consumption in homes and businesses, saving participants money in heating, cooling, and energy costs in the long-run. These programs are directed at home and business owners, and do not provide funding to Municipalities. However, Efficiency Nova Scotia does rely on Municipalities to help them advertise these programs in different parts of the Province. These programs include:

Program	Funding Available	Eligibility
Home Energy Assessment	$99 cost to participant; up to $5,000 in rebates for $25,000 low interest financing for upgrades	Homes heated primarily with electricity
New Home Construction	$99 cost to participant; up to $2,000 in rebates available for upgrades	Building a new home primarily heated with electricity; register before or within 30 days of receiving building permit
Home Warming	Free upgrades like draft-proofing and insulation	Income-qualified participants (see Efficiency NS website)
Appliance Retirement	$30 rebate for fridge or freezer; $10 rebate for window air conditioner or mini-fridge	Appliance at least 10 years old and in working order
Green Heat	Rebate up to $2,500	Installing efficient heating system (i.e. heat pump, solar air, etc.)
Instant Savings	Discounts up to $75	Available at checkouts where appliances are bought each Fall and Spring; year-round for fridges and washing machines
Product Installation	Free products and installation (for products like LED lights, water saving devices, smart power strips)	Available to all homes, apartments, and condos in NS

5.2 NOVA SCOTIA FEDERATION OF MUNICIPALITIES

The Nova Scotia Federation of Municipalities (NSFM) is the collective voice for Nova Scotia municipalities and offers policy and programmatic assistance to their Municipal members. Funding programs include:

Program	Funding Available	Eligibility
Carbon Surcharge Fund Awards	Various amounts	Dispersed at Fall Conference for small-scale initiatives that help Municipality reduce energy consumption and GHG emissions

5.3 FCM

The Federation of Canadian Municipalities has a 'catch-all' funding program for environmental and GHG reduction projects in Municipalities, called the **Green Municipal Fund**. Funding is offered in various amounts as percentages of eligible proposed projects based on a $1 Million annual allotment federally across all Municipalities.

Eligible projects include a wide range of municipal environmental initiatives, including buildings, wastewater, green infrastructure, etc. Specifically, eligible projects are **studies**, **pilot projects**, OR **capital projects**, including:

- Innovative 'signature' projects to reduce GHG emissions;
- Reduce fossil fuel use in Municipal Fleet;
- Stormwater quality improvement;
- Septic wastewater systems;
- Brownfield site redevelopment;
- Retrofitting energy efficiency programs for homes or commercial buildings;
- Energy recovery or district energy;
- Retrofit municipal facilities;
- Wastewater systems;
- Community water conservation;
- Transportation networks and commuting options;
- Waste diversion;
- Renewable energy production on a brownfield site;
- Site remediation or risk management;
- Waste stream management; and
- New construction of energy-efficient municipal facilities.

5.4 PROVINCIAL PROGRAMS

The Province of Nova Scotia and the federal government, in most cases, utilize secondary or arms-length organizations to provide grants and funding – for instance, the Federation of Canadian Municipalities or Clean Nova Scotia. However, the Province does have some funding streams that Municipalities can choose to access or automatically have access to. These include:

Program	Funding Available	Eligibility
Federal Gas Tax Fund	Based on formula (WH receives consistent amount each year)	Gas Tax fund can be used for projects that aim to reduce GHG emissions. Specifically, projects that are eligible that can help reduce GHG emissions include: wastewater, solid waste, community energy systems, and public transit.
Provincial Capital Assistance Program	Up to 50% of eligible project costs	Eligible projects include: — Construction or expansion of facilities for the treatment and disposal of sanitary sewage. — Construction of sanitary sewage collection systems. — Construction of storm water collection systems — Installation of individual and communal in-ground sewage disposal facilities within a Wastewater Management District. — Construction of water intake, treatment, pumping, and storage facilities. — Well field exploration and development. — Installation of water transmission and distribution systems. — Construction, acquisition, upgrading or expansion of solid waste management facilities and equipment. — Municipal infrastructure engineering and research studies related to eligible project categories.
Low Carbon Communities Program	Various amounts of funding available between $50,000 to $75,000 per project.	Grants are done through Connect2 program and Low Carbon Communities grants.

		Funding stream options available include: — Active Transportation Infrastructure and Design — Clean Fleets and Shared Mobility — Community Building and Engagement — Advanced Buildings — Electricity

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APPENDIX

A LIST OF STAKEHOLDERS

APPENDIX

Staff Representatives at the November 12 Meeting

1. West Hants Finance Director
2. West Hants Parks and Recreation Director
3. West Hants/ Windsor Planning Department (2)
4. West Hants Public Works Director
5. Current CAO West Hants
6. Current CAO Windsor
7. CAO for Region of West Hants and Windsor (April 2020)

Community Stakeholder Groups at the November 12 Meeting

1. Citizen Action to Protect the Environment (2)
2. Hantsport Area Advisory Committee member
3. Nova Scotia Power Representatives (2)
4. Nova Scotia Federation of Agriculture
5. QUEST
6. Alternative Resource Authority

Community Stakeholder Groups at the January 29 Meeting

1. Nova Scotia Power
2. Clean Foundation of Nova Scotia
3. West Hants Active Communities Programmer (West Hants Staff)
4. Nova Scotia Health Authority
5. Nova Scotia Department of Energy and Mines