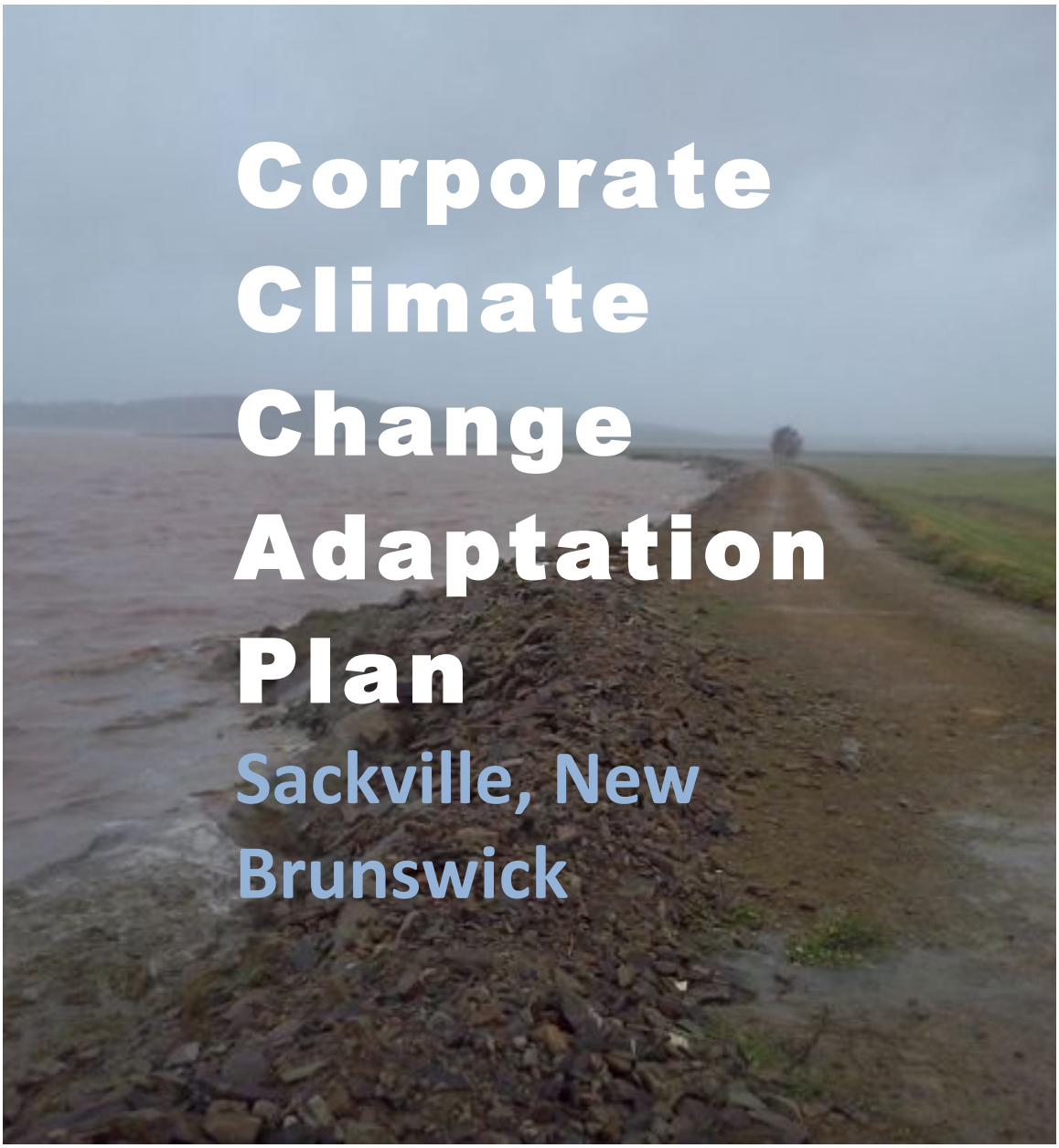

Corporate Climate Change Adaptation Plan

Sackville, New Brunswick

Sackville
NEW BRUNSWICK

Adopted by Sackville Town Council on April 11, 2016.

Cover photo: The Dykes at High Tide by Sackville
Credit: A. Marlin, 2015

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This project was funded by:

New Nouveau Brunswick
Your Environmental Trust Fund at Work
Votre Fonds en fiducie pour l'Environnement au travail

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Climate Change Adaptation Working Group

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Craig Bowser	Fire Chief and EMO	Town of Sackville
Amanda Marlin	Executive Director	EOS Eco-Energy
Lori Bickford	Planner	Southeast Regional Service Commission

Executive Summary

Sackville, New Brunswick, located on the Chignecto Isthmus, is one of the most vulnerable regions to climate change impacts, in particular both freshwater and coastal flooding. Due to these well-known vulnerabilities, the Town of Sackville has taken a series of actions to adapt to climate changes already including adopting an updated flood risk map, the use of Sentinel (a public emergency alert system), an inventory of privately owned flat bottom boats that is regularly updated, and a series of public information sessions on adaptation issues in partnership with local researchers, planners, government and non-profits.

The time has now come to plan for further actions and formalize the municipal government's adaptation actions into a Corporate Climate Change Adaptation Plan. EOS Eco-Energy coordinated the planning process and obtained funding from the New Brunswick Environmental Trust Fund. The working group included representatives from Town of Sackville staff, EOS Eco-Energy and the Southeast Regional Service Commission.

The plan presents an adaptation vision for the Town of Sackville, and details climate change impacts affecting the municipality including changing precipitation patterns, sea level rise, intensifying storms and storm surges, and rising temperatures. A series of flood scenarios are also included. The plan summarizes previous public engagement sessions, including risk and vulnerability assessments. The working group took all of the this information and recommends that the Town of Sackville focus on the following priorities: freshwater flooding; winter storms; sea level rise, storm surges and the dykes; and assisting residents and businesses to adapt. The corporate adaptation plan recommends a series of actions to address each priority area.

To conclude, the working group has not included relocation or retreat in the adaptation plan but recommends a public discussion and that Town Council consider discussing the complex and long-term issue of relocating buildings in areas most vulnerable to flooding. The working group also recommends the formation of an implementation working group to ensure progress on actions and communication to the public.

Contents

Introduction

Sackville, New Brunswick, located on the Chignecto Isthmus, is one of the most vulnerable regions to climate change impacts, in particular both freshwater and coastal flooding. This is due to its low lying coastal location, protected from the Bay of Fundy by a series of dykes, first built by Acadian settlers in the 1600s. The dykes protect the community from the Bay but also limit how quickly freshwater can drain during intense rain events. A number of freshwater flood events in the last few years have cut off major routes in the municipality and flooded numerous homes and businesses resulting in costly damage that insurance does not cover. In addition, sea level rise and intensifying storm surges have caused the Bay to over top the dykes by 1-2cm in places around Sackville.

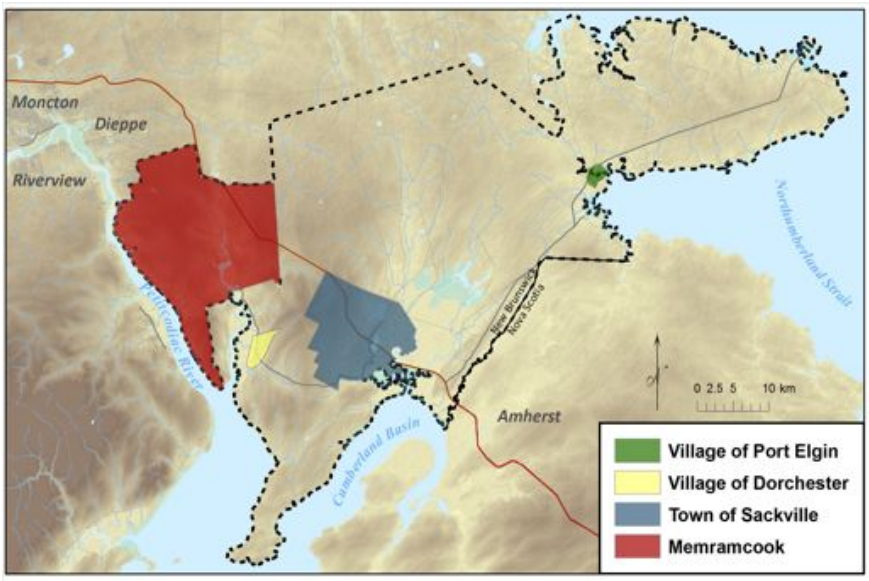
Due to these well-known vulnerabilities, the Town of Sackville has taken a series of actions to adapt to climate changes including adopting an updated flood risk map, and ensuring the new Town Hall, Emergency Measures Organization (EMO) and Fire Department remained outside the identified vulnerable areas. Town of Sackville has an emergency response station and shelter set up at the Tantramar Veterans Memorial Civic Centre, on high ground, with stock piled materials such as water, cots, generators, etc. In addition the Town has implemented the use of Sentinel, a public emergency alert system, and has compiled an inventory of privately owned flat bottom boats. The Town of Sackville and community partners such as the EOS Eco-Energy, Southeast Regional Service Commission, Mount Allison University, the New Brunswick Government, and the Tantramar Climate Change Adaptation Collaborative have conducted a series of public information sessions to provide information on climate change and how to prepare for flooding as well as to obtain public feedback into adaptation options. In addition, the Town of Sackville is taking action to mitigate the effects of climate change by being part of the Partners for Climate Protection (PCP) program, which involves a 5-step process to reduce emissions at the local level.

The time has now come to plan for further actions and formalize the municipal government's adaptation actions into a Corporate Climate Change Adaptation Plan. EOS Eco-Energy coordinated the planning process and obtained funding from the New Brunswick Environmental Trust Fund. The working group included representatives from EOS, Town of Sackville staff and the Southeast Regional Service Commission.

A working group was formed which includes representatives from EOS Eco-Energy, the Southeast Regional Service Commission, EMO, and the Town's manager of corporate projects and Town engineer. The working group met three times to discuss existing and future projects, local climate change impacts, flood scenarios, to review risk and vulnerability assessments, to prioritize vulnerabilities and develop adaptation options

for an action plan. The draft plan was also shared with the public via social media and during a public workshop in February 2016.

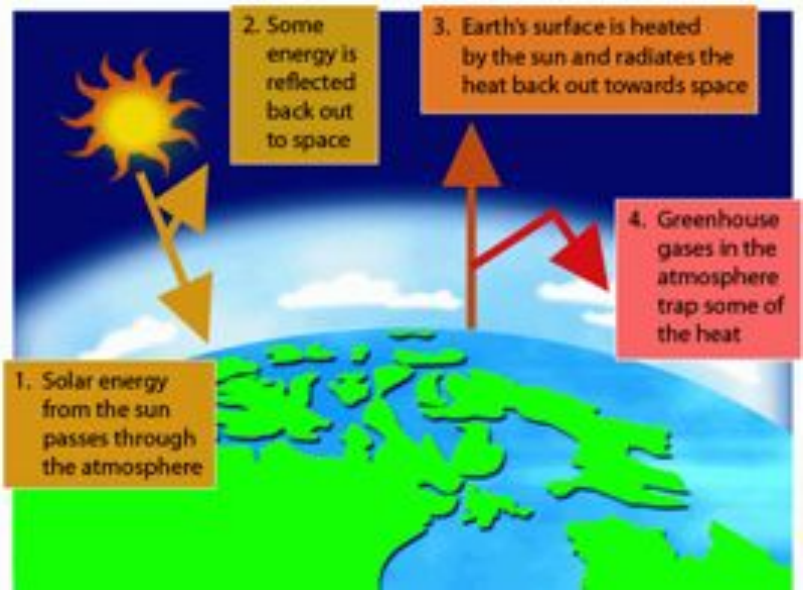
This corporate adaptation plan includes information on climate change adaptation, local impacts, flood scenarios, a summary of previous risk and vulnerability assessments, and the adaptation plan organized by priority area.



Map of the Tantramar Region, including Port Elgin,NB. Source: J. Bornemann

What is Climate Change?

Climate is the average weather pattern over many years while weather is short-term. Climate dictates what parts of the planet tend to be warmer, colder, wetter, drier, and how often we see extreme weather events such a hurricanes. Global temperatures are rising which will lead to more severe climate changes in the future.



The greenhouse effect. Source: NB Department of Environment and Local Government

What is Climate Change Adaptation?

Climate change adaptation describes how we adjust to future climate conditions. Adaptation involves making adjustments in our decisions, activities, and thinking, because of projected changes in climate. Making these adjustments will help decrease the negative effects of the changing climate, and allow us to take advantage of any new and favourable opportunities.

Examples of adaptation measures can include:

- Choosing not to build houses in flood plains.
- Having a storm emergency kit and evacuation plan.
- Relocating houses from at-risk areas over time.
- Maintaining natural buffers to floods (wetlands, stream vegetation).
- Adjusting storm water and sewage infrastructure either by moving them, or by increasing their capacity.
- Reducing run-off and the burden on storm water infrastructure by increasing permeable pavements, and increasing tree and vegetation covers.
- Growing new foods better suited to a hotter climate.

In contrast to adaptation there can also be maladaptation. Maladaptation is more harmful than helpful. An example includes sporadic placement of shoreline stabilizers. While these adaptation measures may help protect an individual lot owner, overall maladaptation measures actually increase a community's vulnerability to climate change and often result in increased economic costs.

Our Community

The Town of Sackville is located in South-Eastern New Brunswick, near the Nova Scotia border, 53km from the city of Moncton, NB and is surrounded by the Tantramar Marshes near the Bay of Fundy. Sackville's population of 5,558 is spread across 74.32 $km^{2.}$ The population increases by 2,500 every academic year when students attend classes at Mount Allison University. Mount Allison is also the largest employer in Sackville. This small town has educational opportunities from pre-school to university to seniors' college, weekly farmer's market, a general hospital, banks, seniors housing, RCMP station, fire station, churches, museums, art galleries, parks, as well as a vibrant downtown with restaurants and storefronts. Sackville often has live music shows, and every summer is the host to the annual SappyFest music festival. Sackville is also home to the Sackville Waterfowl Park, a tourist attraction featuring a boardwalk and a wide variety of wildlife, including many types of birds.

Source: https://danks.netfirms.com/Sackville6037.jpg

Adaptation Vision

The Town of Sackville envisions a future where both the town and its residents are resilient to the effects and impacts of climate change.

Climate Change Impacts

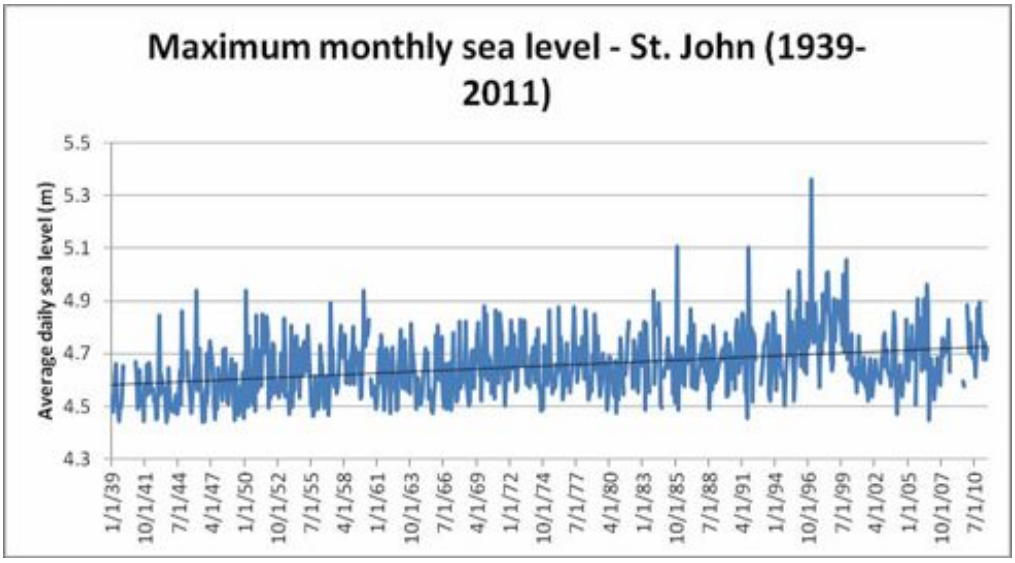
Changing Precipitation Patterns

More rain and snow are falling, but less often and in more severe events. When the town receives approximately100 mm of rain or more over a 24-hour period it has experienced flooding. In recent years, many of these extreme precipitation events have cost millions of dollars in flooding damage to many communities in New Brunswick. Extreme snow storms have closed major highways and left residents without power for a number of days.

Photo: A. Marlin, Freshwater flooding of Lorne St., Dec. 2014

Sea Level Rise

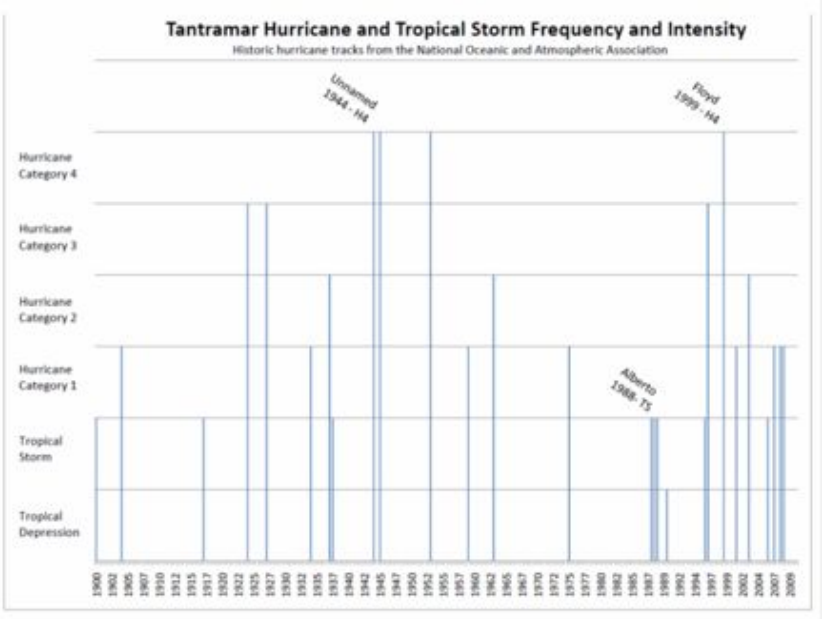
The ocean has been rising over the past 100 years. For example, in Saint John, the sea level has risen by 24 cm since 1920. It is now predicted to rise about 1 metre by 2100 around New Brunswick. Sea level rise is partly due to natural sinking of the land. Melting of the ice caps and glaciers, as well as the expansion of seawater due to heating, adds to a higher and faster rise in sea levels.



The sea is rising around New Brunswick. Source: Lieske and Bornemann, 2012

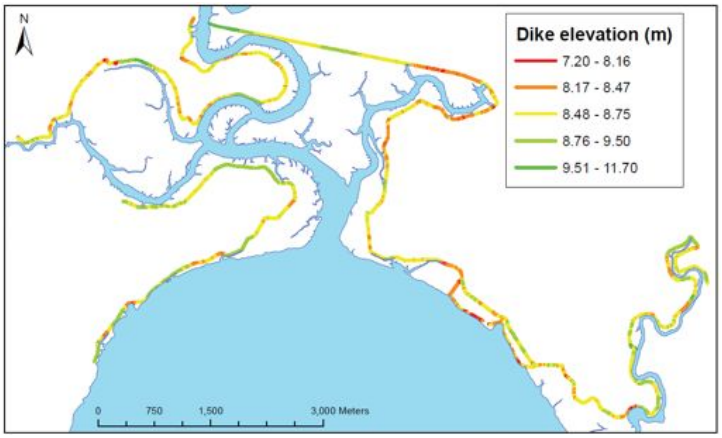
Intensifying Storms and Storm Surges

Storms are becoming more powerful and occurring more often. In the last decade there have been several serious storm events in the region. These are occurring year round, including in the winter. Storm surges often accompany these events and can cause considerable damage to the dykes around Sackville. During the past few years, major storm surges have hit many communities in New Brunswick.



Storms are increasing in frequency and intensity. Source: Lieske and Bornemann, 2012.

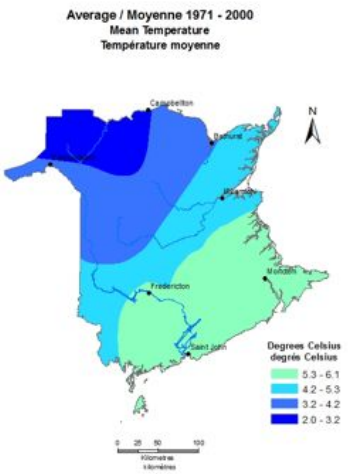
While some sections of the dykes around Sackville have been topped up, other sections remain low and vulnerable to being overtopped by storm surges, such as around the Carter's Brook area.

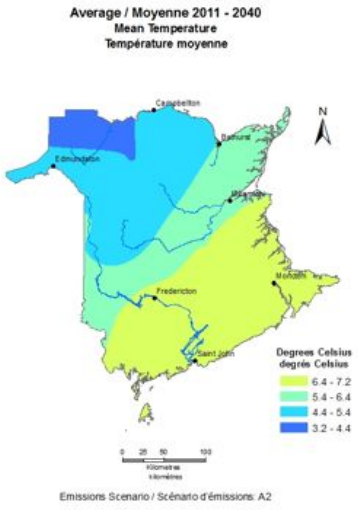


Lieske and Bornemann, 2012

Rising Temperatures

Warmer temperatures may extend the growing season in Sackville, but animals and crops may not respond well. Unfamiliar pests and diseases may spread into the region, such as deer ticks and Lyme disease. The maps below show the average temperatures for New Brunswick in the past and potential increases in the future.





Source: www.acasamaps.com

Flood Scenarios

Flood scenarios are based on projected sea levels and storm events that may impact a given area. They are generally outlined in "likelihood" of the event occurring. For example, a 1 in 10 year storm event is likely to happen once every 10 years, or each year there is a 10% chance of it happening. A 1 in 100 (1:100) year storm event is a major event only projected to happen once in a century, or a 1% chance of happening every year. Flood scenarios are developed through scientific analysis by trained climatologists. Sea level flood scenarios being used for adaptation planning in Sackville are:

Current (year 2010) 1:10 Storm

This flood scenario is currently adopted by Town Council for zoning and municipal planning development purposes. It corresponds to a depth of 8.9m.

Current (year 2010) 1:50 Storm

While this flood scenario has not been adopted by Town Council it is currently used for infrastructure planning and development, recognizing that infrastructure is in place for long periods of time and must be able to withstand more severe flood levels. This scenario has a flood depth of 9.0m.

Current (year 2010) 1:100 Storm

It is also important to think about and plan for the current 1:100 flood scenario. A 1:100 storm will take place more often in the future. It represents a 9.1m flood.

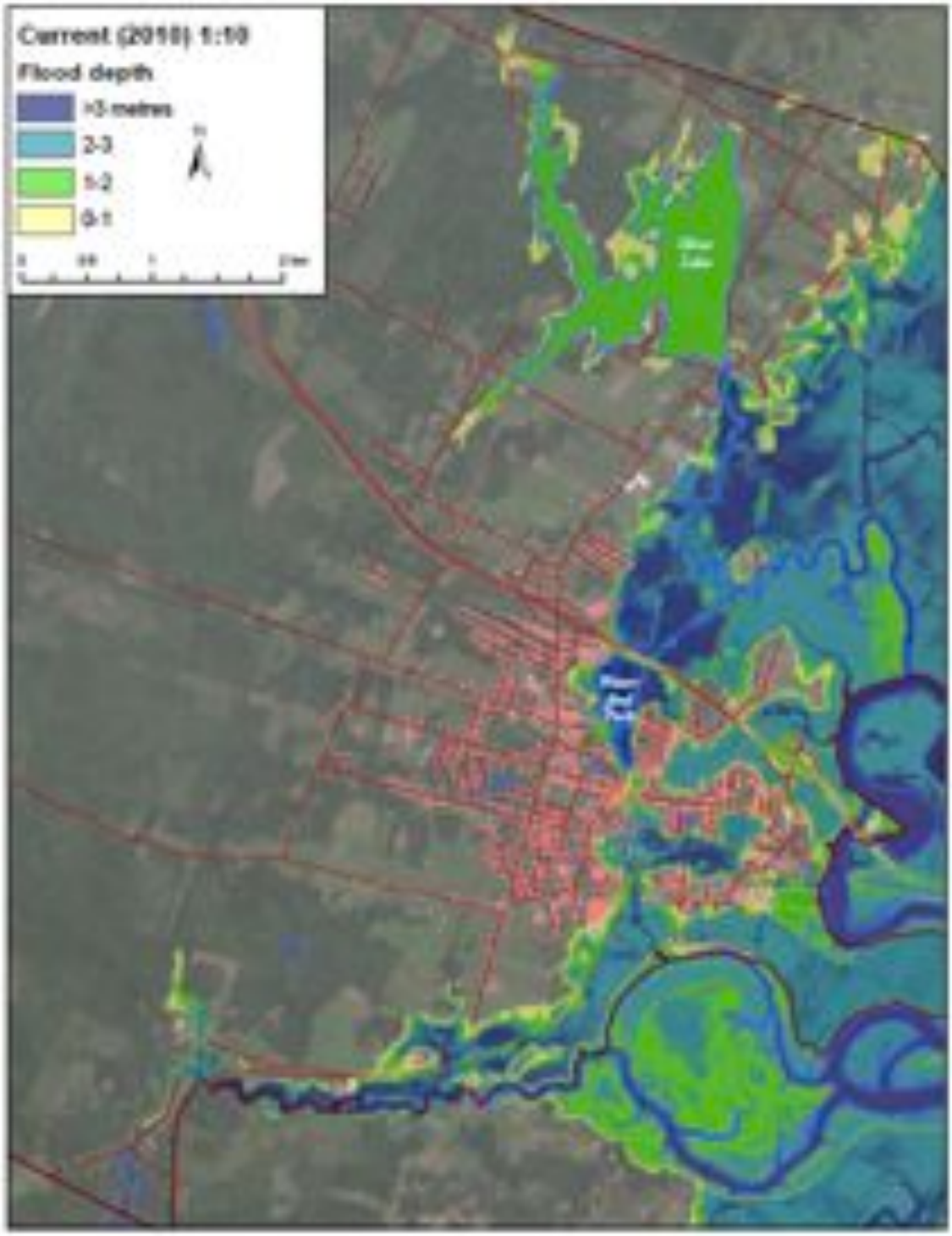
1:100 Storm in the Year 2100

This is the projected "worst-case scenario" storm that could be experienced in that time period, based on scientific projections. It represents a 10.0m flood.

The maps on the next pages show the possible flood extent (how far the water will reach and how deep it will be) during the current 1:10 storm and a 1:100 storm in 2100. The maps depict which properties and buildings are most vulnerable to flood damage.

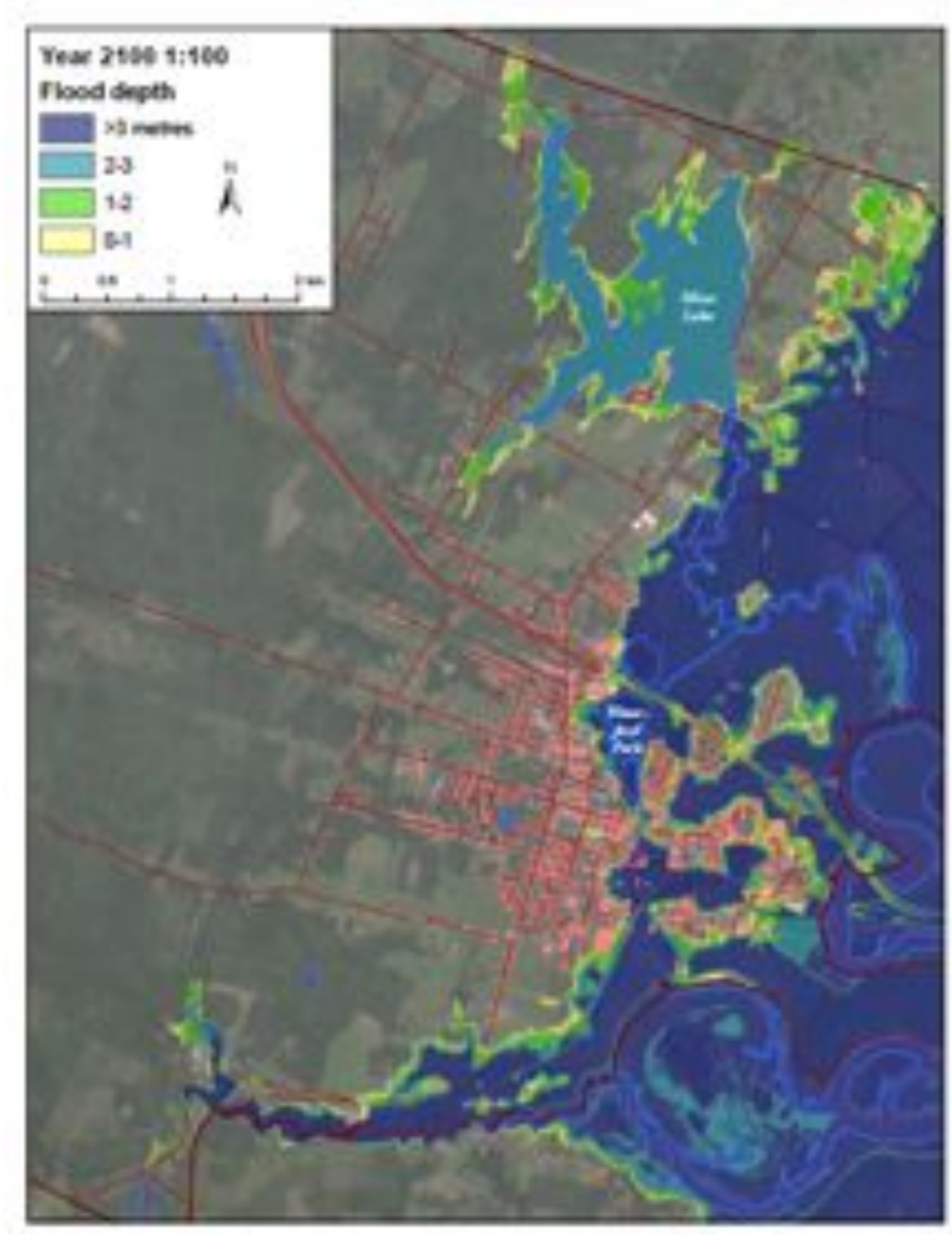
It is strongly recommended that consideration be given during the next municipal plan review process to include these additional storm scenarios.

Current (year 2010) 1:10 Storm



Source: J. Bornemann, 2016

1:100 Storm in the Year 2100



Source: J. Bornemann, 2016

Risk and Vulnerability Assessments

Climate change is and will continue to impact economic, social and environmental assets in Sackville. A number of initiatives, with public input, have taken place over the last few years to assess local risks and vulnerabilities within municipal boundaries.

Photo: A. Marlin, Freshwater flooding of Queens Rd. and Rte 935, Dec. 2014

Tantramar Community Adaptation Viewer Project

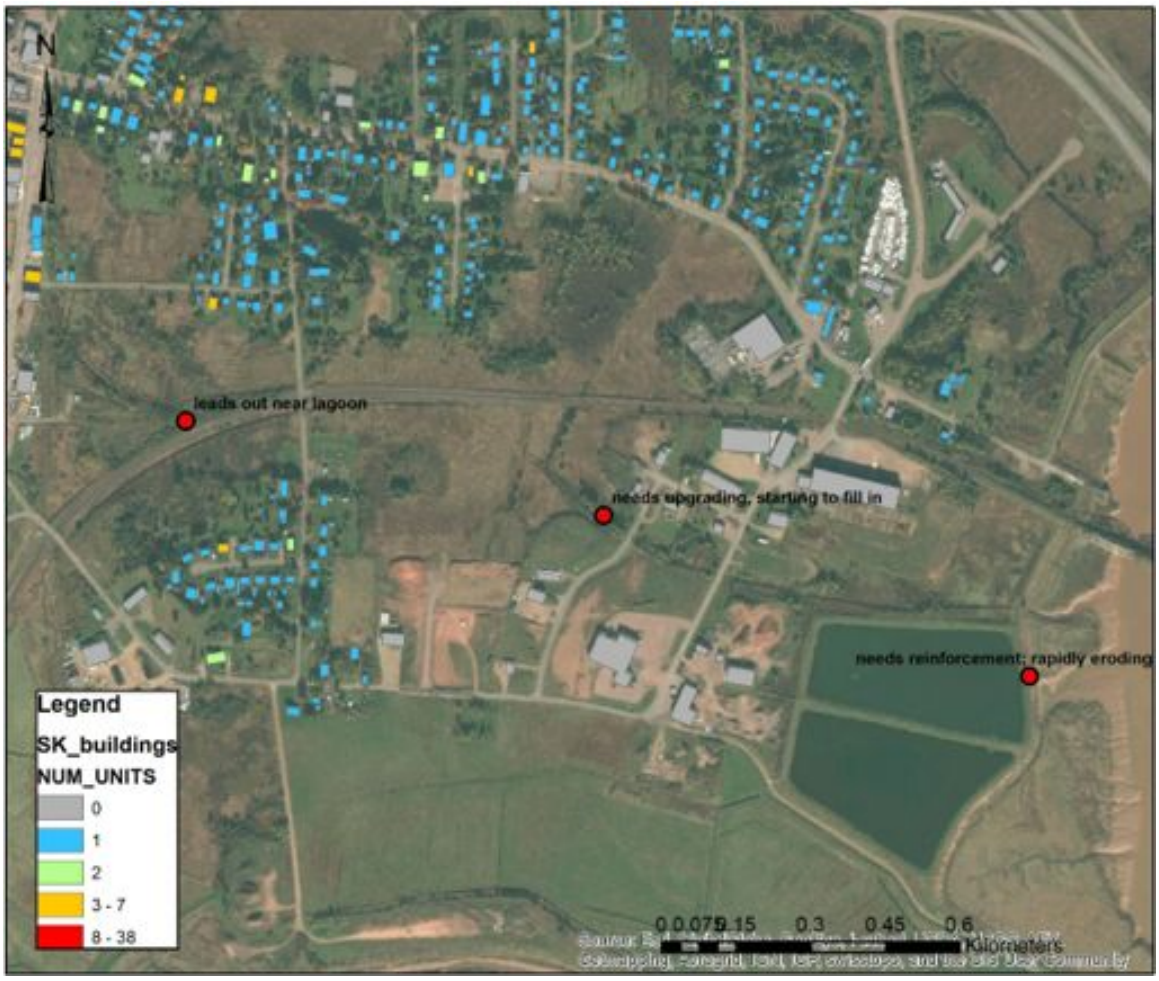
Dr. David Lieske and his research team at Mount Allison University conducted a community vulnerability assessment for Sackville in 2013-2014. They hosted a number of workshops with the public to identify areas of risk and vulnerability to flooding. They used a 1:10 storm scenario (8.9m flood depth) and a 1:25 storm scenario (10.1m flood depth). The study examined impacts to the dykes and aboiteaux, drainage maintenance, agriculture, businesses and industry, community services, emergency measures equipment and service, wetlands and natural areas, isolated neighbourhoods, freshwater flooding, road blockages, historic sites, land uses, lift stations and the sewage lagoon, vulnerable populations. Selected maps are presented below. The full study can be found at:

http://arcgis.mta.ca/toolkit/reports/FinalReport_TCAV_%28Feb2014%29.pdf

Drainage Concerns

The following map depicts various points along the drainage system that are vulnerable. If proper drainage is not maintained, water will be more likely to accumulate. It was noted in the study that drainage vulnerabilities are relatively low cost activities that should be addressed immediately and routinely.

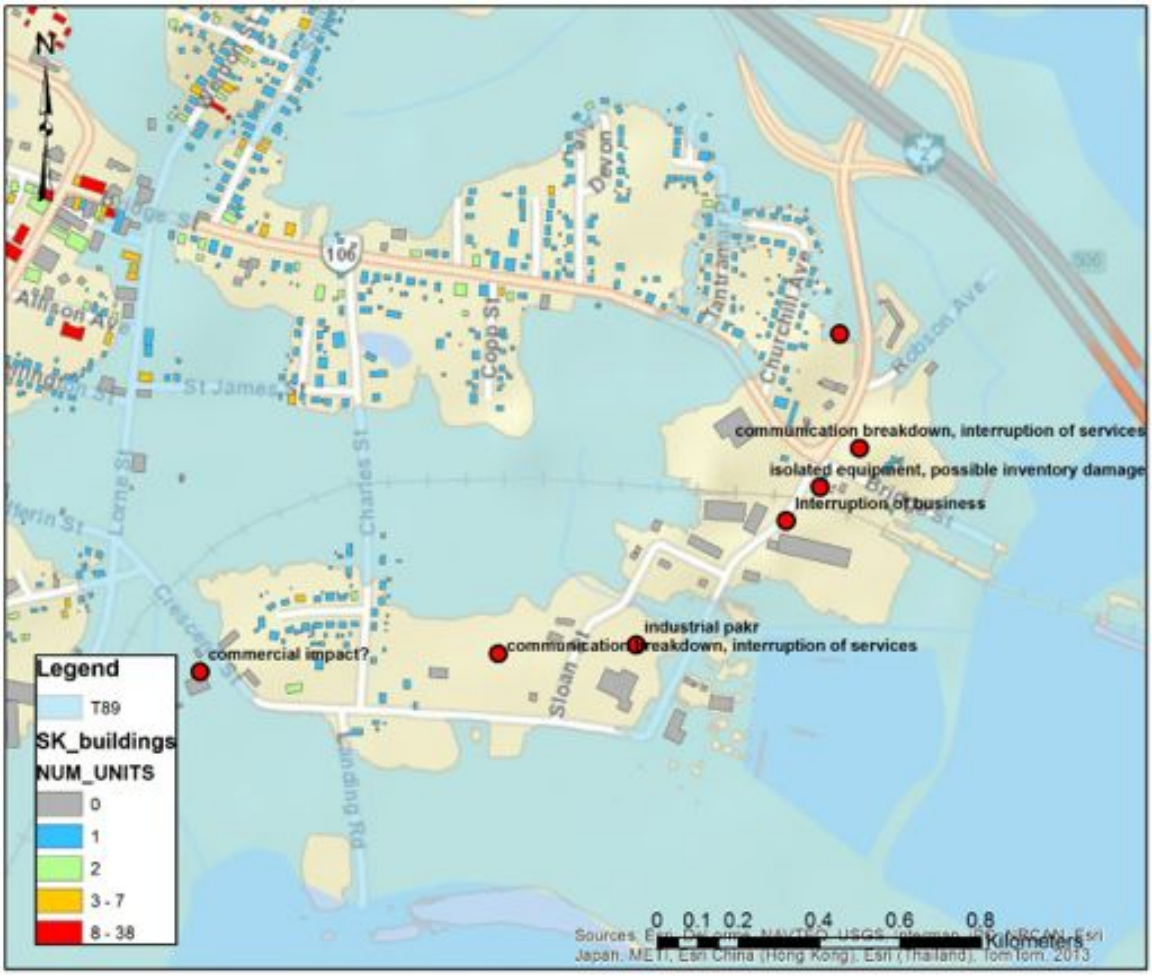
The outlet for the sewage lagoon was also flagged as a location of concern (LOC) on account of its design. Participants reported that water exiting the outlet is causing river bank erosion, and it was suggested that a conduit be installed to convey water further away from the bank.



Lieske, Roness, Phillips, Bornemann, 2014

Commercial and Industrial Impact

Businesses located in the industrial park may not necessarily flood directly but as the map below shows, islands may be formed, temporarily cutting off the industrial area.



Lieske, Roness, Phillips, Bornemann, 2014

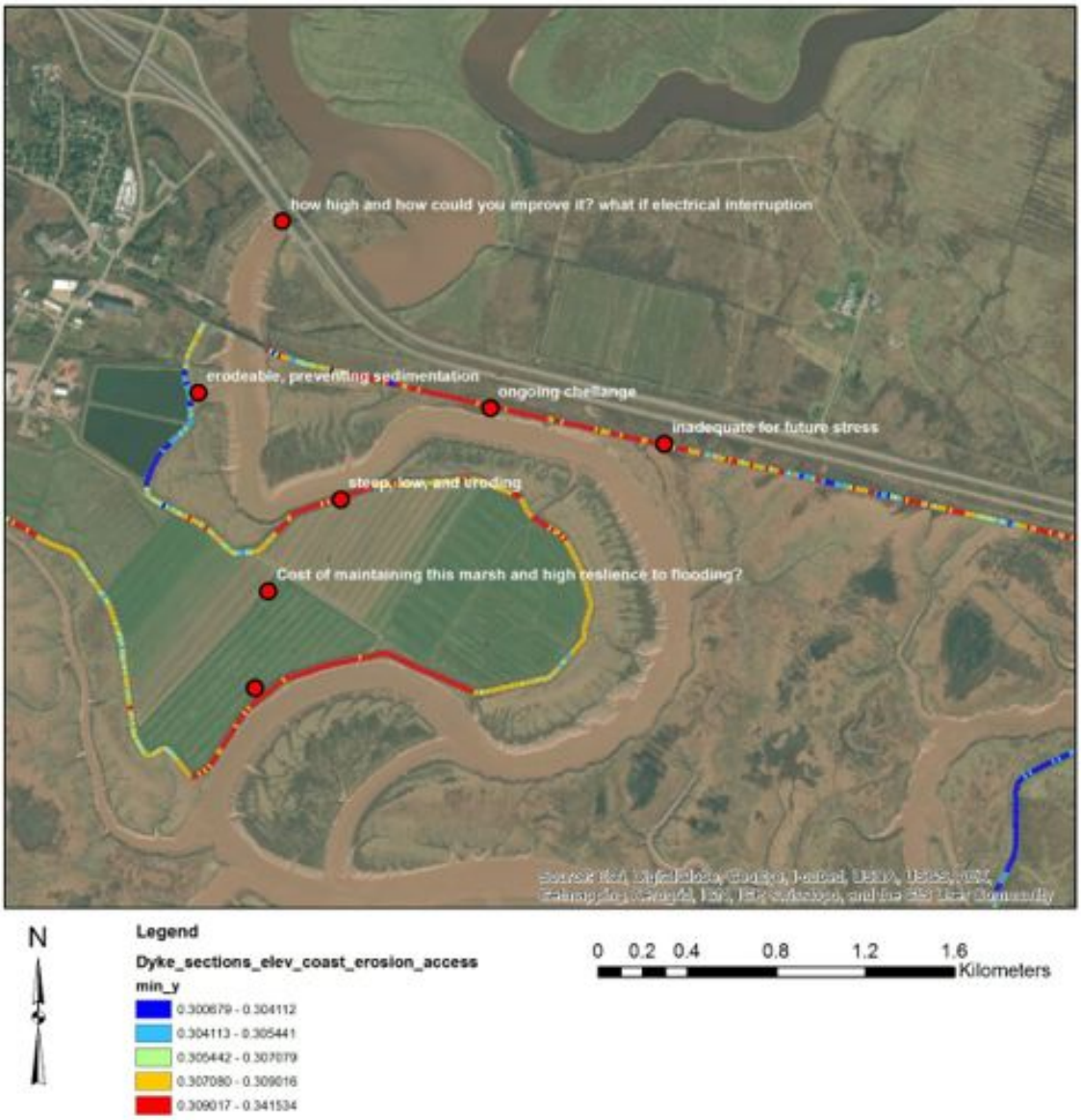
Emergency Services

Emergency measures equipment is currently stored at the civic centre to avoid a flood. Sackville's Public Works building is located in industrial park. At first signs of significant flood risk, equipment from Public Works will be moved to higher ground at the Tantramar Veterans Memorial Civic Centre.

Lieske, Roness, Phillips, Bornemann, 2014

Vulnerable Dykes

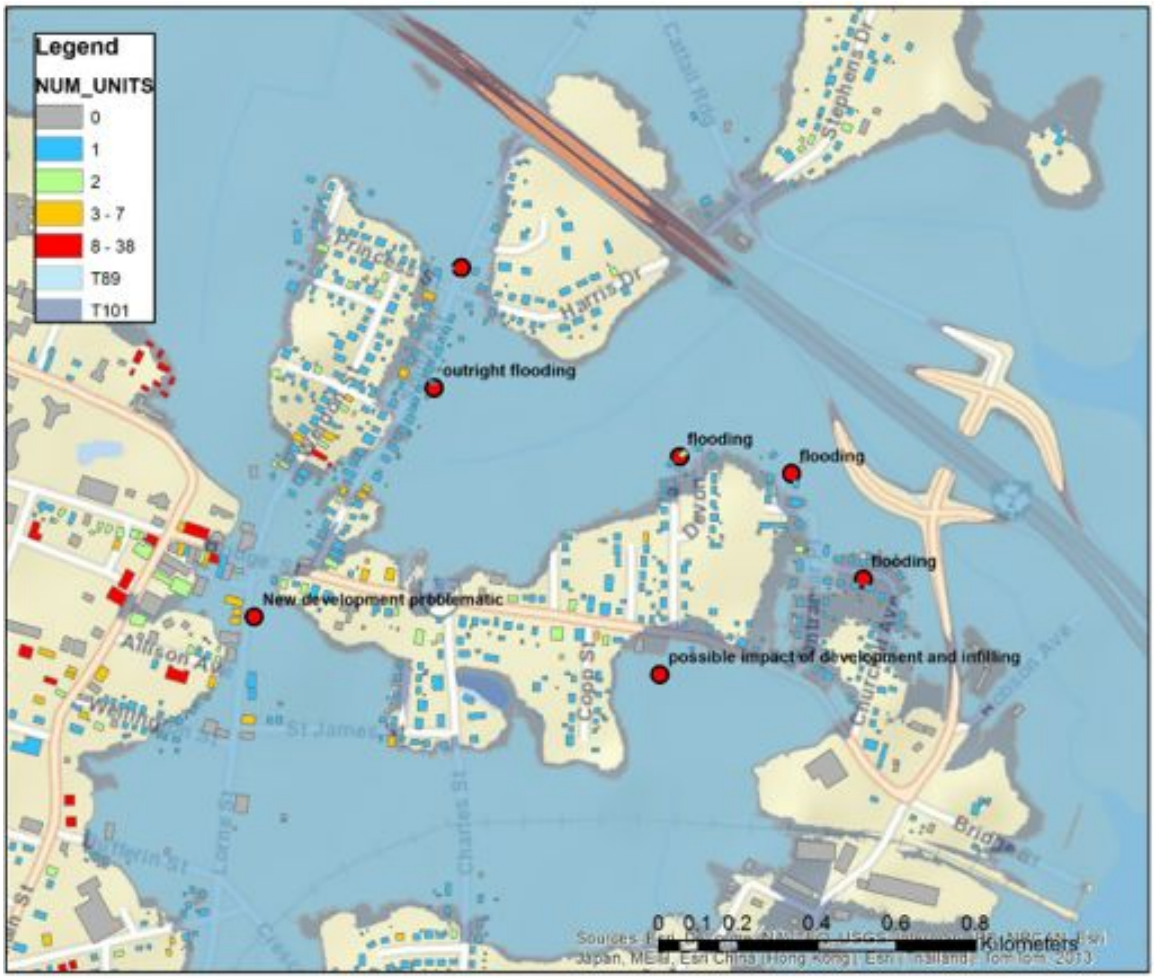
The red areas shown in the map below are the most vulnerable sections of the dykes that are low or considered to be extra vulnerable to erosion.



Lieske, Roness, Phillips, Bornemann, 2014

Flooded Neighbourhoods

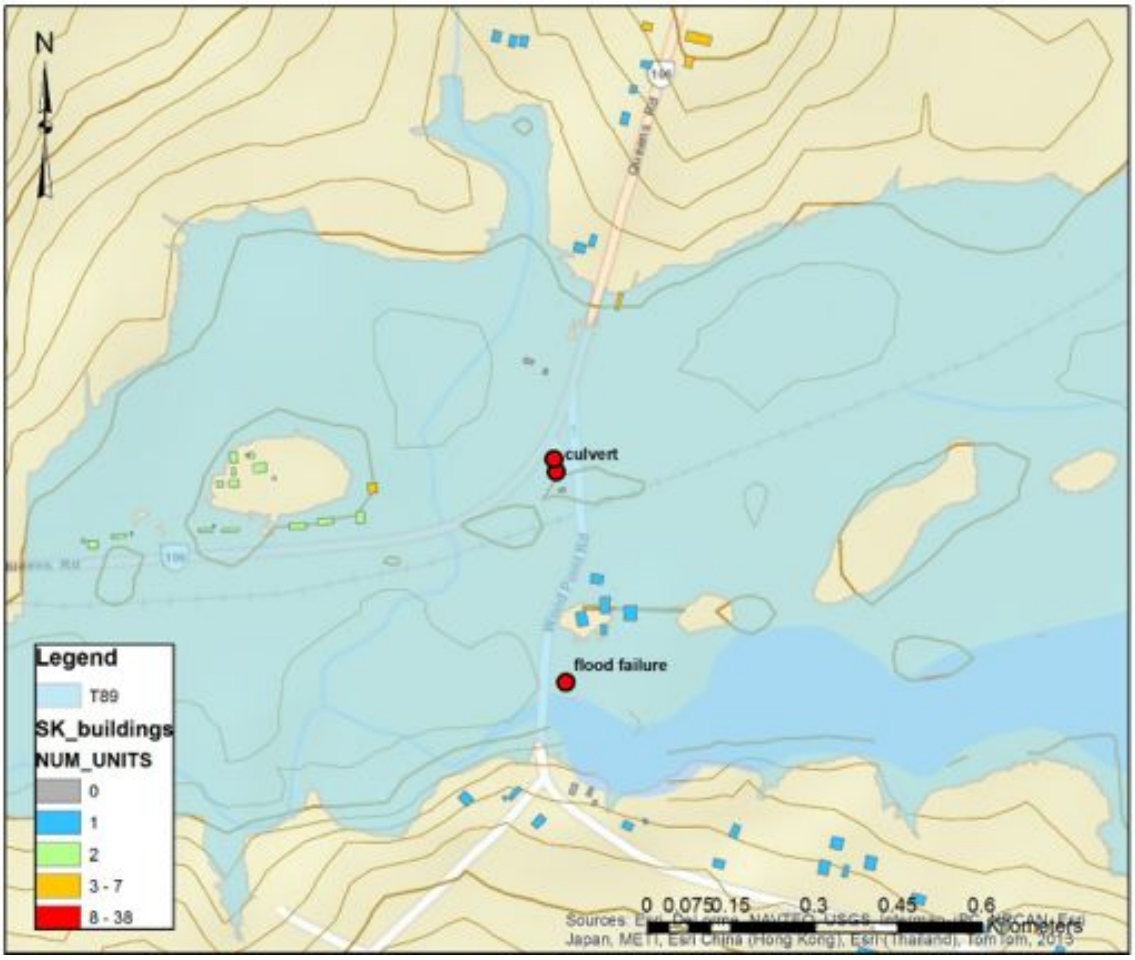
Below is one of the many maps that depict residential areas that are particularly vulnerable to flooding and which may become islands.



Lieske, Roness, Phillips, Bornemann, 2014

Freshwater Flooding

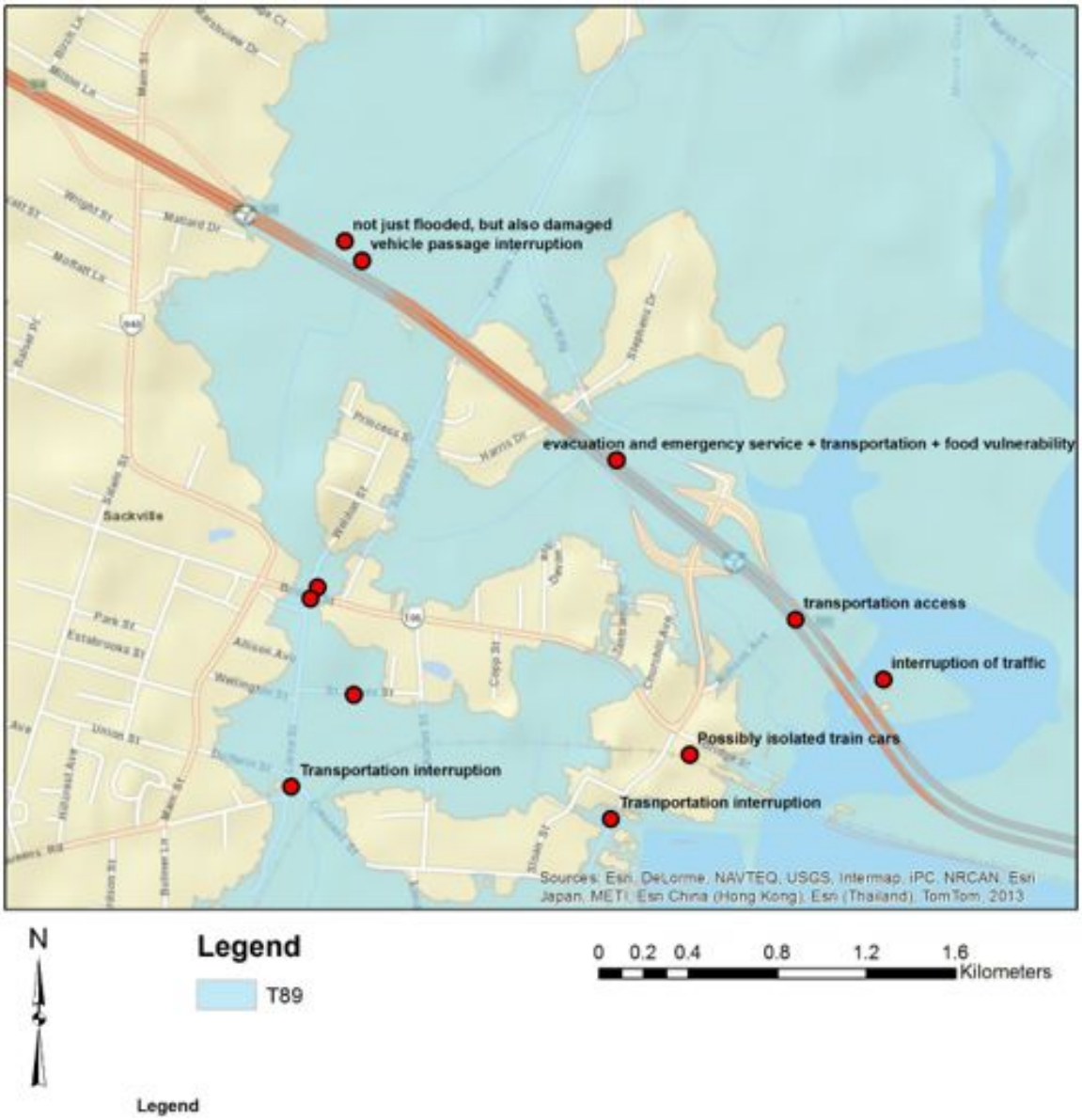
There are multiple sites that experience freshwater flooding within municipal boundaries including the corner of King and Main Streets, around Silver Lake, near Bulmer's Pond, and at the intersection of Queens Rd and Rte 935, depicted below.



Lieske, Roness, Phillips, Bornemann, 2014

Traffic Interruptions

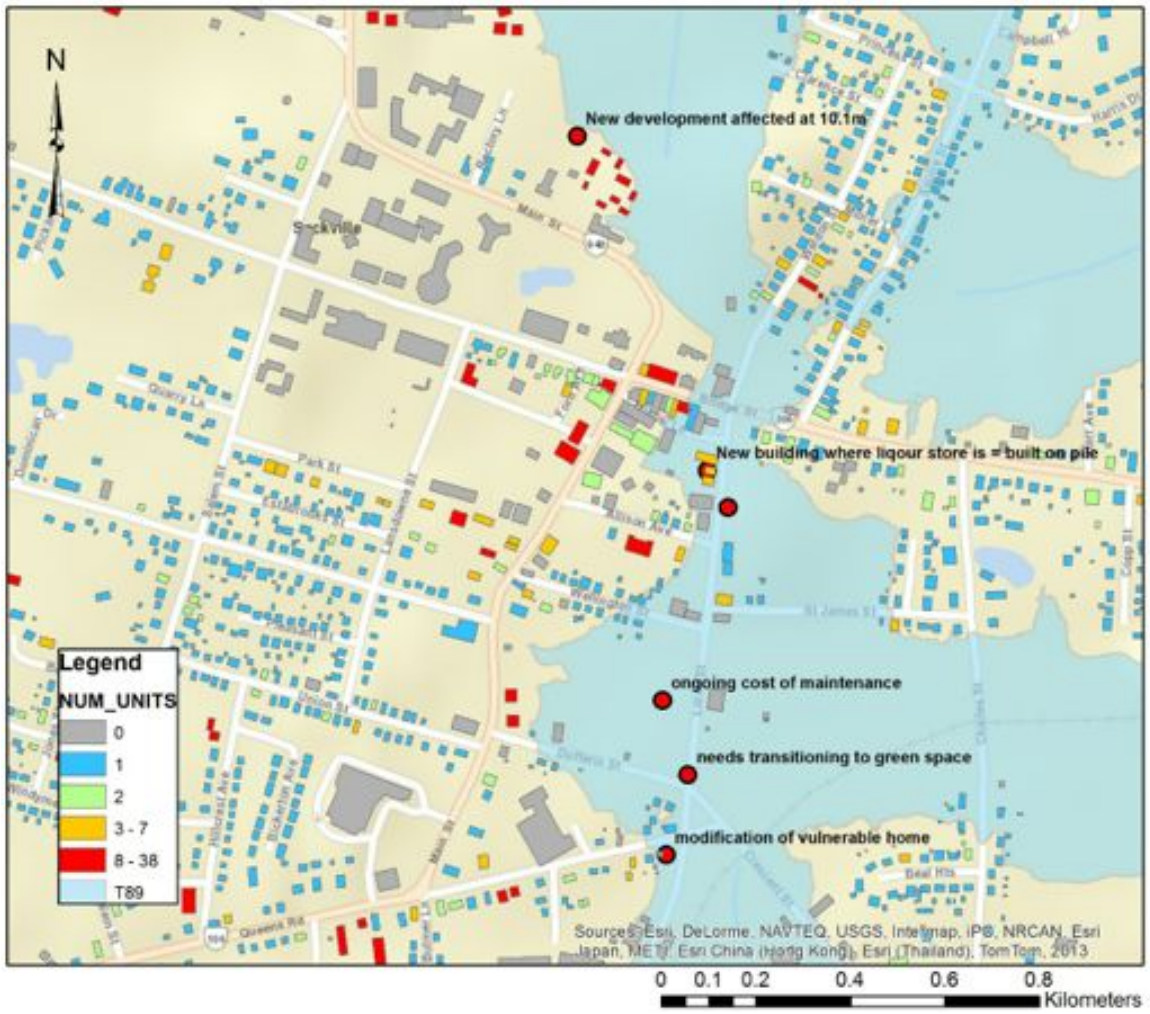
According to study, the areas circled in blue on the map below are sections of highway that will likely be exposed to flood depths < 1 metre under an 8.9 metre (1 in 10 year) flood scenario, but will have more than 1 metre of a water at higher storm scenarios. Areas circled in red are expected to experience flood depths of > 1 metre under all flood scenarios.



Lieske, Roness, Phillips, Bornemann, 2014

Land Use Concerns

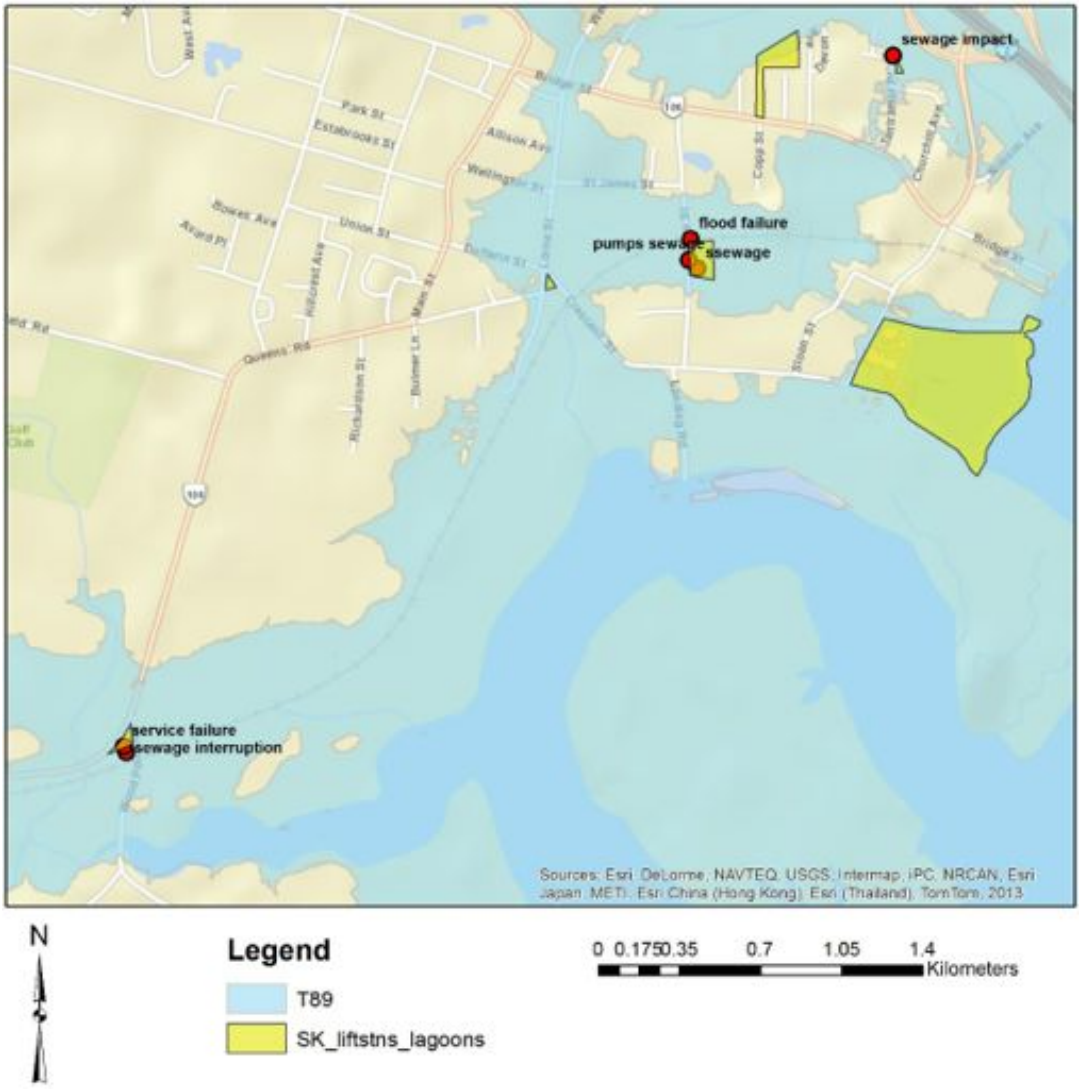
Participants in the study commented that land use concerns include the cost of maintaining baseball fields along Lorne Street and the extent to which homeowners invest in, repair or renovate homes that are in or on the edge of the flood prone areas.



Lieske, Roness, Phillips, Bornemann, 2014

Lift Stations and the Sewage Lagoon

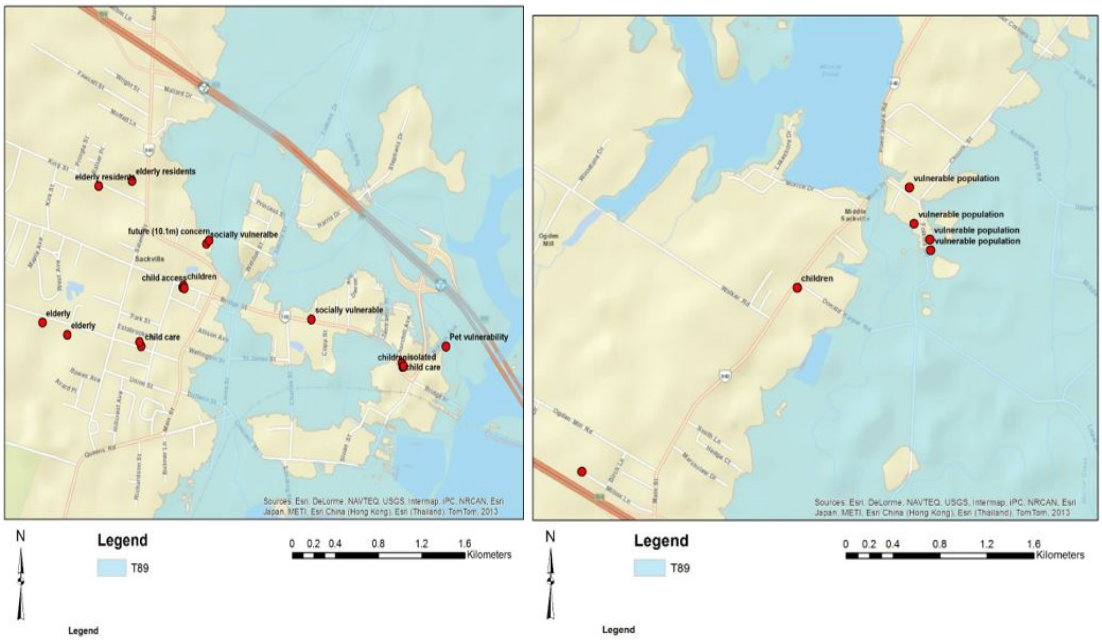
The main lift station along Charles Street is vulnerable to water infiltration. There are questions about how much water the facility can withstand before it ceases to function. In the event of water infiltration, sewage transport will be affected. Sewage lagoon upgrades mandated by 2040 will protect sewage lagoons from future flood scenarios.



Lieske, Roness, Phillips, Bornemann, 2014

Vulnerable Populations

The maps below depict the location of various programs that serve vulnerable populations, such as childcare centres, programs for people with cognitive delays, and residences for the elderly. These locations are mostly situated outside of the flood plain. However, it is necessary to consider that an interruption to highway traffic flow will prevent the arrival of services from Nova Scotia. Likewise, it will likely not be possible to travel to Nova Scotia (Amherst) for medical services. Though children may be physically safe, parents may not be able to pick up their children because they themselves are stranded on temporary islands or are behind flood impassable sections of road.



Lieske, Roness, Phillips, Bornemann, 2014

Lieske and his team also examined the economic vulnerability due to climate change. Under a 9.1 metre flood scenario, the estimated damage is over $5 million. This shifts to $10 million under a 10.1 metre flood by the end of the century. If the damage over the century is averaged out annually, it is estimated that there will be approximately $1.4 million/year in damages that will accumulate to $3 million as the frequency of storms increase and the community contends with more stress.

The project concludes that a number of things are needed for communities to be resilient to climate change:

- New planning and government by-laws
- Management realignments
- Strong and proactive leadership
- Proactive action planning
- Emergency response measures
- Financial and human resources
- Community cohesion and support
- A sustainable community with access to local food. local power generation; community-based services
- Water management
- Understanding the locations of risk
- Good communications and information management creating a broad understanding of the issues and risks
- Identifying community assets and formulating a plan to protect them
- Improving housing and infrastructure
- Creating regulations and bylaws to lead the development and utilization of new tools and planning policies.

The following recommendations came as a result of Tantramar Community Adaptation Viewer project:

- The Member of the Legislative Assembly for Tantramar-Memramcook should be engaged in flood discussions.
- The provincial and federal governments are exposed to a minimum of $6-13 million dollars worth of residential disaster relief in the wake of a Tantramar flood, and need to weigh the relative costs of proactive relocation versus post-flood disaster relief.
- Dyke maintenance should continue, and requires renewed investment.
- The municipal government (Town of Sackville) should issue a policy statement regarding flood adaptation and develop a long-term flood mitigation plan.
- The reality of Sackville's flood risk should be integrated into municipal planning and activities.
- Municipal by-laws and land use zoning should restrict development in areas known to be especially vulnerable to flooding.
- A dedicated manager at the municipal level should be designated to spearhead flood mitigation and adaptation.

- The 8.9 metre flood map should be amended to better reflect the community's true flood risk aversion.
- Flood mitigation plans should be developed or continue to be developed.
- Consideration should be given to converting areas in the flood zone to less vulnerable recreational or agricultural uses.
- Surveys are a useful way to assess the willingness of the public to tolerate periodic flooding, or to pay for particular flood risk reduction strategies.
- An education and awareness campaign and communications strategy should be developed to inform residents and business owners about flood risk and the actions they can take to reduce their risk.
- Public communication should be ongoing.
- Risk-reduction activities currently underway should be regularly promoted.
- Communication should be enhanced among the municipal, provincial, and federal governments and others like CN rail that have joint responsibility for the maintenance of transportation systems.
- Dialogue should begin with service providers who serve vulnerable populations.
- Children and youth should be engaged.
- Information should be available in multiple formats, including on paper and via the Internet.
- Freshwater flooding scenarios should be incorporated into general flood risk communication.
- The drainage/sewage/lift station/lagoon system should be reassessed.
- The municipal government should bulk purchase items, such as emergency preparedness kits, backflow valves, or crank radios and sell them to the public at cost.
- The municipality should actively promote lower-cost risk-reduction strategies, such as rain barrels or maintenance of green space to reduce overland water flow and help alleviate the strain on municipal storm water systems.

Preparing for Flooding in Tantramar

A public workshop was organized by EOS Eco-Energy and the Tantramar Climate Change Adaptation Collaborative (Town of Sackville are members of the Collaborative) in November 2014 at the Marshlands Inn with funding from the New Brunswick Environmental Trust Fund. Eighty people were in attendance. The workshop provided the public with information on the current state of the dykes, flood scenarios, and how to prepare for emergencies at home. The session concluded with a tour of the dykes. Some ideas suggested by participants at the session included:

- Have more events like this one and that more of the public need to hear the messages provided.
- Participants wanted to hear more details, more information about how to prepare, more on rescue methods, more on what EMO is planning.

- Some participants wanted to see sessions designed specifically for their neighborhoods and streets.
- Others wanted to see more federal government involvement and key decision makers such as CN.
- And others wanted to know why construction of new buildings is still allowed in flood plains.
- It was suggested to organize a meeting with the federal government, CN and other key decision makers.
- Have a bulk purchase of sump pumps and backflow valves.
- Weekly preparedness tips in the local paper.
- Participants also wanted to see an EMO flood simulation exercise for Sackville.

November 2014 workshop. Photo: Amanda Marlin

Sackville's Flood Risk Public Workshop

As part of the Municipal Plan review process a public session was held at the Vogue Theatre on May 7, 2015 to discuss the issue of flooding in the Town. The session was developed with the intent of sharing important flood related information with residents as well as obtaining feedback from the public on their views of the issue within the Town. A number of presentations were given on fresh water flooding, emergency preparedness, current state of the dykes, EOS Eco-Energy's variety of climate related projects, sea level rise, and an overview of the municipal plan process.

Sixty-seven people were in attendance. Some of the general feedback from participants included:

- Dykes are important to the protection of developed areas of Sackville's downtown and municipal infrastructure and therefore should not be a burden on the Department of Agriculture (more developed areas in the Town boundary than agricultural lands)
- Support for the continued work towards Provincial and Municipal collaboration on maintaining dyke system for its importance to Sackville and surrounding agricultural lands

- Landowners impacted by changes that affect the development of their land should be contacted by letter when new regulations are proposed
- It is Important to control up stream waters in efforts to slow water before it reaches the bottle neck points of the aboiteau(x).

Participants were also asked to fill survey questions during the workshop. Some of the results included:

- Participants would like to see more natural infiltration to address flooding, as well as the clearing of ditches.
- Participants plan to prepare for emergencies by assembling 72 hour emergency kits and development evacuation plans.
- The majority of respondents to the survey feel that climate change is a serious issue in Sackville.
- Damage to buildings, flooding of town streets and being cut off because of flooding were seen as the key risks.
- Respondents felt that the town is at risk from flooding by both fresh water and storm surges.
- Majority of respondents (24 people) supported the ability to permit some level of development/redevelopment within the flood risk area – under certain conditions. Eleven said that new construction and/or expansion should be prohibited.
- Most respondents supported further interactions with other government levels and CNR as a means of protecting residents from flood impacts.

ACASA Workshop with Town of Sackville Staff and Council

During July 2015 Town of Sackville staff and council met with researchers from an ACASA (Atlantic Climate Adaptation Solutions) project focused on developing an on-line decision tree for small rural coastal communities in Atlantic Canada. The tool is designed to help communities identify different land use and engineering options to address coastal sea level rise and erosion issues. Participants in the session used the tool to explore options for the flooding of the Lorne Street area. The tool recommended the following adaptations:

Land Use Planning

- Stormwater management plan (Sackville has a plan)
- Emergency preparedness (Sackville has an EMO plan)
- Statutory community plan, zoning and other applicable land use bylaws (Sackville has a municipal plan and flood risk zone)
- Integrated community sustainability plan (Sustainable Sackville Plan)

- Green shoreline rating system
- Conservation subdivision design
- Land use conversion and re-development
- Development agreements
- Land swap
- Urban design standards
- Strategic land acquisition
- Development standards
- Subdivision by laws or regulations

Engineering

- Stormwater management
- Rain garden/Constructed wetland
- Relocate infrastructure
- Dykes

Priority Areas for Corporate Adaptation

Taking into consideration all of the previous research, public input, workshops, and risk and vulnerability research, the working group selected the following priority areas for the municipality:

- Fresh water flooding of Lorne St, Rte 935, Queens Rd, and Silver Lake areas
- Winter storms and highway closures
- Sea level rise, storm surges and the dykes
- Assisting residents and businesses to adapt

Each of these priority areas are addressed further below with a series of action plans to address their vulnerabilities and reduce the associated risks.

Corporate Adaptation Plan

Freshwater Flooding

Activity: Hydro-Technical Study of Carter's Brook

Goal: To assess adaptation options to limit flooding in the Carter's Brook watershed.

Description	During Phase 1 the study will identify the Carters Brook basin and measure culvert sizing, elevation, etc. The study will look at both the water cycle and overland flooding. The study will address flooding in the Rte 935, Queens Rd, and Lorne Street areas. The study will indicate where the flooding is coming from and how different options will affect water flow and accumulation. Variables the study will look at include the addition of retention ponds within the watershed, forest cover, land uses, climate change and rain storms. The study will also assess the economic value of different adaptation options.
Lead and Partners	Town of Sackville, Province of New Brunswick (DTI), Hilcon Consultants
Resources Required	NB Department of Transportation and Infrastructure is covering the cost of this study
Timeline	Scheduled to be completed winter 2016
Indicators of Success	Completion of study, presented in a report to council

Activity: Emergency Measures Plan Review and Update
Goal: To ensure the plan is up to date and reflects changing impacts and resources. To simplify wording and make the plan more accessible.

Description	The EMO plan for Sackville was last updated in 2010. It is currently undergoing a revision.
Lead and Partners	Sackville EMO, Sackville CAO, Regional EMO
Resources Required	Town of Sackville staff time
Timeline	2016
Indicators of Success	An updated EMO plan, approved by Sackville Town Council

Activity: Flat Bottom Boat Inventory
Goal: To improve public safety.

Description	Sackville EMO will continue to update its registry of privately owned flat bottom boats. This inventory can be used in the event of a flood and residents in certain parts of town are stranded.
Lead and Partners	Sackville EMO
Resources Required	Town of Sackville staff time
Timeline	Ongoing
Indicators of Success	Updated inventory is accessible and used by Town staff during flood emergencies

Activity: Municipal Plan and Land Use Bylaws Review and Update 2016
Goal: To include flood adaptation options into the municipal plan.

Description	The updated/revised Municipal Plan for the Town of Sackville contains an updated flood plain policy as well as education and collaboration between the Town and Government regarding flood events. All new medium and high-density residential developments are now required to have 50% impervious cover. All new residential dwellings, commercial, institutional and industrial development required to have a storm management plan that indicates how runoff will be contained or routed. No new residential units are allowed below the flood plain. Erosion and sediment control plan is now in effect. Through the development of the current adaptation plan as well as others such as the municipal plan, discussions have taken place regarding limiting development in vulnerable areas. Current zoning regulations are very restrictive for development and redevelopment in these areas and to date have worked very well in deterring development. As various plans are monitored, continued discussion on this topic is highly recommended.
Lead and Partners	Southeast Regional Service Commission (SERSC) and Manager of Corporate Projects
Resources Required	SERSC and Town of Sackville staff time
Timeline	The Municipal Plan review was completed winter 2016 and will be updated again in 2021

Indicators of Success	Updated Municipal Plan

Activity: Municipal Plan and Land use Bylaws Review and Update 2021
Goal: To include the latest scientific data into long-term planning for the municipality.

Description	The municipal plan and land use bylaws for the Town of Sackville will be reviewed and updated again in 2021 to ensure the latest scientific data and best practices are incorporated into long-term planning for the community including flood prone areas as well as other adaptation issues.
Lead and Partners	Southeast Regional Service Commission (SERSC) and Manager of Corporate Projects
Resources Required	SERSC and Town of Sackville staff time
Timeline	2021
Indicators of Success	Updated Municipal Plan

Activity: Lorne Street Infrastructure Upgrade with Storm Sewer Mitigation
Goal: To address flooding and make the Lorne Street area more adaptable to flood events.

Description	Lorne Street is in the Flood Plains in the Town of Sackville, N.B., therefore, this project consists of total reconstruction and replacement of all utilities on Lorne Street. This includes the replacement of an aging/failing sanitary sewer line and the main collection sewer that carries the sanitary from Lorne Street to the Town of Sackville's main sewage lift station on Charles Street. It will also serve to replace the aging twelve inch (12") water main on Lorne Street that is in constant need of repair. The largest part of this project will be to design and install a much needed storm sewer and collection/storage system that will discharge at the Aboiteau that is being controlled and maintained by the NB Department of Agriculture.
Lead and Partners	Town engineer
Resources Required	Funding has been requested from the Canada Build Fund
Timeline	2017
Indicators of Success	Lorne Street has adapted to flooding

Activity: Integrated Stormwater Management Plan for the Town of Sackville
Goal: To create an integrated, community-wide approach to stormwater management, thereby decreasing freshwater flood risk.

Description	Integrate existing plans for stormwater collection and management in locations such as Lorne St and the Waterfowl Park, etc. Add additional details for other parts of town. Conduct analysis and assessments as needed. Include management approaches such as drainage areas, sediment control structures, culvert replacement program, wetlands, wet and dry storm water retention ponds, rain gardens, and other green infrastructure, etc.. Additional public engagement may be part of the planning process.
Lead and Partners	Town engineer
Resources Required	Staff time, funding
Timeline	2018-2021
Indicators of Success	Development and adoption of the integrated stormwater management plan

Activity: Stormwater Retention Ponds
Goal: To ensure adequate size to deal with increased precipitation.

Description	Construct a stormwater retention wet pond between Lorne Street, the CN tracks and St. James Street as a catchment for freshwater precipitation in that area. Construct an additional one in the abandoned quarry near Quarry Lane, and other suitable locations in the municipality. The wet ponds will bring aesthetic value and increase the ecological function of the landscape.
Lead and Partners	Town engineer and Ducks Unlimited
Resources Required	Funding
Timeline	Begin in 2018-2021 and ongoing
Indicators of Success	Stormwater effectively managed in the ponds, decreased flooding of streets and properties within municipal boundaries

Activity: Culvert Replacement Program
Goal: To ensure adequate size to deal with increased precipitation.

Description	The size and conditions ore culverts in Sackville is known and thus replacements are taking place on an ongoing and increasing basis. For example, when re-paving of streets takes place, culverts are replaced if needed. The culvert replacement program will form part of the

	Integrated Stormwater Management Plan.
Lead and Partners	Town engineer and Public Works
Resources Required	Materials, budget
Timeline	Ongoing
Indicators of Success	Culverts in proper operation

Activity: Raising Roads
Goal: To ensure access and connectivity during flood events.

Description	Raise roads to allow connectivity during flood events. A portion of route 935 requires raising by 3-4ft.
Lead and Partners	Town engineer in partnership with DTI
Resources Required	Funding
Timeline	Long-term
Indicators of Success	Roads have been raised and are passable during flood events

Activity: Climate Change-Resistant Tree Planting Program
Goal: To plant trees that will adapt to a warmer, wetter climate.

Description	Climate change will guide the selection of tree species planted in an ongoing program to maintain and increase green/low impact development in Sackville. Natural areas absorb more rainwater and slow the flow of rainwater. Trees offer natural shade and wind barriers.
Lead and Partners	Manager of Parks and Facilities in partnership with Fundy Biosphere Reserve (and their climate change resistant tree database)
Resources Required	Staff time, funding
Timeline	Ongoing
Indicators of Success	Trees are planted annually leading to a more resilient, and adaptable community

Winter Storms

Activity: Install Highway Closure Gates and Variable Message Boards at Both On-Ramps to TransCanada Highway

Goal: To improve public safety.

Description	Gates at both on-ramps to the TransCanada Highway in

	Sackville have been installed in order to keep people safely off the highway when it is closed during winter storms (and for any other emergency situations). This will eliminate the need for police to man the on-ramps. In addition, variable message boards have been placed on the TransCanada Highway to alert drivers of closures or other hazards ahead.
Lead and Partners	Provincial Departments of Transportation, RCMP, EMO NB, Town of Sackville
Resources Required	In kind
Timeline	December 2015 with continued monitoring
Indicators of Success	The gate is installed and functioning

Activity: Highway Closure Communication Procedure

Goal: Better communication and preparation for highway closures. To ensure the comfort of those being directed into Sackville during highway closures.

Description	An internal communication procedure and policy are needed regarding highway closures. Traffic needs to be directed to parking areas and the logistics of opening the welcome/warming centre at the Tantramar Memorial Civic Centre must be evaluated.
Lead and Partners	Sackville EMO with Manager of Corporate Projects and Town Engineer, EMO NB, EMO Cumberland
Resources Required	Staff time
Timeline	A trial period will take place during winter 2016
Indicators of Success	Development of procedure documents; documents shared with key partners

Sea Level Rise, Storm Surges and the Dykes

Activity: Find more resources for dyke maintenance

Goal: To ensure safety of the community from rising sea level and storm surges

Description	Continue to regularly meet with CN, NB Dept of Agriculture, DTI
Lead and Partners	Town of Sackville engineer, manager of corporate projects, EMO
Resources Required	Meeting time

Timeline	Ongoing
Indicators of Success	Additional funds acquired

Activity: EMO Flood Simulation with Dyke Breach

Goal: To ensure safety of the community from rising sea level, storm surges, potential dyke breaches

Description	Simulate 1962 dyke breach and emergency response. Done through a tabletop exercise.
Lead and Partners	Town of Sackville EMO
Resources Required	Meeting time, borrow sand tables from DNR, use EMO budget
Timeline	Long-term
Indicators of Success	Completed tabletop exercise and better preparation for future responses

Assisting Residents and Businesses to Adapt

Activity: Sentinel Emergency Alert System

Goal: Better prepared community when floods or other emergencies strike. Increased self-reliance during emergencies. Decreased reliance on the Town and its resources during flood and winter storm emergencies.

Description	Sentinel is an emergency alert system used by the Town of Sackville to alert residents about road closures due to flooding and other emergencies. The service is tested annually. Training also takes place annually. Additional notices may be sent to the public to sign up for the service.
Lead and Partners	Sackville EMO
Resources Required	Funding to pay for the service, annual operating cost
Timeline	Ongoing
Indicators of Success	Continued active registrations and the town's continued promotion of the system.

Activity: Education and awareness regarding climate change and adaptation
Goal: Increased public awareness and preparation for flooding

Description	On going education and awareness regarding climate change and adaptation will keep the issues top of mind

	for residents and businesses. Education may include workshops, presentations, information brochures, etc.
Lead and Partners	Manager of Corporate Projects, EMO, Town Engineer, EOS Eco-Energy
Resources Required	Staff time
Timeline	Ongoing
Indicators of Success	A more resilient, safe and adaptable community

Activity: Continual testing of EMO response plan
Goal: Increased preparedness by the town to provide emergency response

Description	Continual testing of EMO response plan, which may include flood related simulation exercises.
Lead and Partners	Sackville EMO
Resources Required	Staff time
Timeline	Ongoing
Indicators of Success	A more resilient, safe and adaptable community

Summary of Recommended Actions

Timeline	Actions
Ongoing	• Flat bottom boat inventory • Find more resources for dyke maintenance • Sentinel Emergency Alert System • Continual testing of EMO response plan • Education and awareness regarding climate change and adaptation • Culvert replacement program • Climate change-resistant tree planting program
Short (2016-2017)	• Emergency Measures Plan review and update • Hydro-Technical Study of Carter's Brook • Municipal plan and land use bylaws review and update 2016 (completed) • Install highway closure gates and variable message boards at both on-ramps to TransCanada Highway • Highway closure communication procedure
Medium (2018-2021)	• Lorne St. and area stormwater infrastructure and utility upgrade • Integrated stormwater management plan • Stormwater retention pond (eg. Lorne St.)
Long (beyond	• Municipal plan and land use bylaws review and update 2021

2021)	• EMO flood exercise with a dyke breach • Additional stormwater retention ponds • Raising roads (eg. a portion of Rte 935)

Implementation and Monitoring

The Town of Sackville council and staff will be responsible for implementing the municipal adaptation plan and meeting their goals according to the timelines in the plan. Progress will be monitored regularly and communicated to the public through a variety of means, such as the local paper, community meetings, and social media. Progress will be ensured through the workings of council and staff. Members of an implementation working group may include:

- Senior Manager of Corporate Projects
- Fire Chief and Emergency Measures Coordinator
- Town Engineer
- Representative from SERSC
- Community representative/EOS Eco-Energy

The working group recommends that the Town of Sackville continue to support and encourage public engagement in implementing climate change adaptation strategies.

Additional Adaptation Activities By Other Groups

In addition to the Town of Sackville's priority areas, there are related activities and research studies taking place or being planned in the Sackville area by other groups including provincial governments, universities and non-profit organizations. The Town of Sackville is appreciative of these initiatives and may draw on the results of these projects in the future.

Disaster Mitigation Study for the Dykes

This study, by the New Brunswick and Nova Scotia Departments of Agriculture, aims to understand how the dykes will need to be constructed in the future. The Town of Sackville supports this project and submitted a letter of support in 2015.

Chignecto Isthmus Cost-benefit Analysis of Adaptation Options for the Transportation Corridor

The study will assess cost of climate change impacts to transportation infrastructure, evaluate adaptation options, and assess costs and benefits of various options. The lead

contact for this study is Jeff Hoyt, with the Climate Change Secretariat, NB Department of Environment and Local Government. The report will be released during winter 2016.

Ecosystem Services Project

The goal of this project is to develop a methodology that incorporates ecosystem services as adaptation solutions to address climate change, specifically flood risk. The study is being lead by the Southeast Regional Service Commission in partnership with a variety of non-governmental organizations, including Nature NB. The project will be completed in 2018.

Flood Modeling in New Brunswick Watersheds

This study, lead by researchers at the Université de Moncton, seeks to develop a methodology for planners and decision-makers to include flood modeling in land use planning. The project will be completed in 2018.

Tantramar Climate Change Adaptation Collaborative

The Tantramar Climate Change Adaptation Collaborative was formed in 2012 and is coordinated by EOS Eco-Energy, a Sackville-based environmental non-profit. The Collaborative includes representatives from all levels of government, EMOs, planners, university-based researchers and local environmental non-profits. A smaller working group consisting of representatives from the Town of Sackville, Town of Amherst, Cumberland County, Ducks Unlimited, EOS Eco-Energy, NS and NB Departments of Agriculture, Transport Canada, Southeast Regional Service Commission, NS and NB Departments of Environment, and Tantramar area Emergency Measures Organizations meet regularly throughout the year to update and advance a regional adaptation action plan. The working group hosts an annual workshop for Collaborative members focused on current research activities in the region. The Collaborative was formed as a result of extensive local research on climate issues (funded through NRCan's RAC program) and the recognition that climate change adaptation is too big a challenge for one organization or municipality to tackle alone.

Bulk Purchases of Adaptation and Flood Preparation Items

EOS Eco-Energy organizes bulk purchases of items to help local residents prepare and adapt to climate change and flooding. Bulk purchase programs include Red Cross 72 Hour Emergency Kits, backwater valves, sump pumps, etc. EOS assists with raising awareness about the importance of these items while also helping local residents reduce costs. EOS's mandate is to help the Tantramar-Memramcook area be more aware, resilient and better prepared for climate change impacts, including flooding.

Public Climate Change Education Campaigns

EOS Eco-Energy conducts a variety of ongoing public education activities including workshops on how to make rain barrels, how to plan rain gardens (natural storm water

management systems), how to prepare for emergencies, etc. The organization also coordinated community-based climate change adaptation plans, visits local schools, and organizes the annual Tantramar Climate Change Week to raise awareness and take action.

Conclusion and Summary

In conclusion, Sackville is one of the most vulnerable regions to climate change impacts, including both freshwater and coastal flooding. Due to these vulnerabilities, the Town of Sackville has taken a series of actions to adapt to climate changes over recent years and the time came to formalize the municipal government's adaptation actions into a Corporate Climate Change Adaptation Plan. A working group formed to guide the plan's development including representatives from the Town's corporate projects, pubic works and emergency measures departments along with EOS Eco-Energy and the Southeast Regional Service Commission.

This plan envisions a future where both the town and its residents are resilient to the effects and impacts of climate change. In particular, the plan incorporates changing precipitation patterns, sea level rise, increasing intensity and frequency of storms and storm surges, and rising temperatures. Furthermore, the plan considers a variety of storm scenarios (current 1:10, 1:50, 1:100, and 1:100 in 2100) ranging in flood depth from 8.9m to 10.0m.

The working group also reviewed and incorporated results from a number of past public workshops on the community's risk and vulnerability including those conducted by Dr. David Lieske and his team in 2013-2014, a session on preparing for flooding in Tantramar in November 2014 hosted by EOS Eco-Energy and the Tantramar Climate Change Adaptation Collaborative, and a flood risk workshop organized by the Town in May 2015. The plan also incorporates adaptation decisions as a result of a workshop with ACASA researchers in July 2015.

As a result of the known climate change impacts, storm scenarios, and input from the public, researchers and experts, the following priority areas were selected: fresh water flooding; winter storms and highway closures; sea level rise, storm surges and the dykes; and assisting residents and businesses to adapt. The adaptation activities presented in this plan include ongoing projects as well as a range of recommendations including building stormwater retention ponds, conducting an emergency flood simulation, creating an integrated stormwater management, and many others.

The working group did not included relocation or retreat in the adaptation plan but recommends a public discussion and that Town Council consider discussing the complex and long-term issue of relocating buildings in areas most vulnerable to flooding. The working group also recommends that the Town of Sackville continue to work toward including adaptation considerations in all municipal operations and decisions in the future.

Glossary

Abandonment refers to leaving an area that has become too vulnerable to flood and/or erosion risks.

Adaptation describes how we adjust to future climate conditions. Adaptation involves making adjustments in our decisions, activities, and thinking, because of projected changes in climate. Making these adjustments will help decrease the negative effects of the changing climate, and allow us to take advantage of any new and favourable opportunities.

Climate change adaptation plan is a community plan that examines local climate change impacts, flood risk scenarios, risks and vulnerabilities to climate-related impacts, and outlines an action plan with adaptation options including lead, partners, resources needed, timelines and goals.

Constructed wetlands are manmade wetlands or restored wetlands.

Development agreements are contracts between two parties establishing an agreement concerning development of a parcel of land.

Emergency preparedness is the creation of plans through which communities reduce vulnerability to hazards and cope with disasters.

Dry flood proofing buildings involves making the structure watertight by sealing the walls with waterproof coatings, impermeable membranes, or a supplemental layer of masonry or concrete

Dyke is a long wall or embankment built to prevent flooding from the sea.

Flood scenarios are based on projected sea levels and storm events that may impact a given area. They are generally outlined in "likelihood" of the event occurring. For example, a 1 in 10 year storm event is likely to happen once every 10 years, or each year there is a 10% chance of it happening.

Green/living shorelines use vegetation and natural materials to reduce negative impacts on near shore habitat for plants, fish, and wildlife while protecting property.

Integrated community sustainability plan is a long-term plan, developed in consultation with community members, to help the community realize sustainability objectives within environmental, cultural, social and economic dimensions.

Land use bylaws regulate and control the use and development of all land and buildings within the municipal boundaries.

Maladaptation is a course of action that is more harmful than helpful as it results in more problems it was intended to prevent.

Managed retreat allows an area that was not previously exposed to flooding by the sea to become flooded by removing coastal protection.

Rain gardens are planted with native plants and grasses and allow runoff to be absorbed into the ground slowly and naturally; they limit flooding and are a natural storm water management option.

Raised infrastructure refers to increasing the height the buildings and other infrastructure to decrease impacts from flooding.

Setbacks are rules to ensure buildings are set back from roads, property lines, rivers, wetlands, coastal areas, etc. for safety and environmental reasons.

Statutory community plan in New Brunswick is a Municipal or Rural Plan developed under the Community Planning Act.

Stormwater management involves techniques used to reduce pollutants from, detain, retain, or provide a discharge point for storm water to best preserve or mimic the natural hydrologic cycle, to accomplish goals of reducing combined sewer overflows or basement sewer backups, or to fit within the capacity of existing infrastructure.

Wet flood proofing buildings involves making a series of modifications to a structure to allow an enclosed area to flood. Allowing the building to flood reduces the risk of damage to the structure. It can also involve placing electrical utilities above the flood level as well as appliances, important documents, etc. so that what remains can withstand a flood.

Appendix – Public Engagement

A public engagement session was held on February 24th, 2016 to share the draft adaptation plan with the public. The draft plan was also placed on the Town of Sackville's website at www.sackville.com. EOS Eco-Energy received comments, feedback and questions from the public regarding stormwater management, the sewage lagoon and pumping stations, limiting/banning development in flood prone areas, relocation/retreat, additional vulnerability assessments, and further public engagement and discussions. These were then discussed with the working group.