

Figure 1: Victoria Harbour. Credit: <https://meetingsandconventionspei.com/member/victoria-by-the-sea/>

Tomorrow Ready Victoria:

Community Climate Adaptation Report

Here We Go:

Getting ready for the challenge of climate change

The challenge of climate change can no longer be ignored. Each year the growing impacts of a changing climate become clearer. These felt impacts are a wake-up call to the province of PEI and all municipalities to respond with the action and urgency this issue deserves.

This report was created for the Rural Municipality of Victoria (RMV) in response to these felt impacts and the urgent need for adaptation. By detailing the context of the Municipality and downscaling climate risk, this report outlines the present situation of the RMV and highlights adaptation options to address identified climate risk. The adaptation options presented cover a range of risks and use diverse approaches to address them. It is the hope that this report will allow the Rural Municipality of Victoria to better understand the climate risks they face and steps that can be taken to address them. Adaptation is not an end point, but rather an ongoing process that must change as new information becomes available. In undertaking that process, determining direction is the first step to beginning that journey.

Key Adaptation Recommendations

Big Moves:

- Oyster-tecture, marsh sills and living breakwaters in the harbor
- Land purchase of McDonald's farmland east of causeway and along Dunrovan Estates property in floodplain
- Retrofit Old School House into Emergency Hub and Cooling Hub
- Purchase and reforest community wellfield land
- Move or raise sewage lift station on Water St.

Quick Wins:

- Plant climate resilient species under mature trees throughout municipality
- Eelgrass Meadow restoration projects
- Support low and no mow schedule on municipal lands and private property
- Purchase back-up generator for forced water system
- Purchase temporary flooding protection and develop community plan to protect lift station
- Support residents in accessing energy retrofit grants and programs

How We Got There:

Risk, Vulnerability and Adaptation

Climate risk identification and downscaling



Erosion



Post Tropical Storm



Drought and Heatwaves



Precipitation and Inland Flooding

Climate risks examined were adapted from the 2021 Climate Change Risk Assessment completed by the Provincial government and downscaled to the context of the RMV.

Impacts

The impacts were determined by the probability and consequences of the climate risk on the examined asset



Estuary



Salt Marsh



Forested Lands



Transportation



Waste Water



Buildings



Beaches and Sandflats



Parkland and green spaces



Eel grass meadow



Drinking Water



Wharf

Natural Assets

Physical Assets

Solutions

Big Moves

Long term and strategic actions which high levels of planning and input from the community. Actions of this nature may require significant shifts in values and identity.

Quick Wins

Easy, fast and economical actions to implement and are able to be reversed. These changes are highly visible and have immediate impacts.

Table of Contents

Introduction:1

Goal and Scope:1

Limitations:2

Key Terms and Definitions:2

Signs and Symbols:3

The Rural Municipality of Victoria: In Context4

Cradled in the Shallows: Prince Edward Island4

People in Place4

Watershed Systems: RMV and Ecological Context5

Westmorelands Watershed6

Natural Assets and Service Provision8

The Rural Municipality of Victoria11

Municipal Assets11

Climate Change and Climate Risk in PEI14

Top Climate Risks in PEI and in the Rural Municipality of Victoria15

Downscaling Climate Risk to the Westmoreland and Rural Municipality of Victoria16

Climate Risk Matrix16

Erosion18

Post Tropical Storm20

Heavy Precipitation and Inland Flooding Events21

Heatwaves and Drought26

Human Actions and Compounding Risk28

Adaptive Capacity30

Joining Forces - Supporting South Shore Watershed Association31

Adaptation Recommendations31

Watershed Specific Adaptation Recommendations31

Adaptation Recommendations at the Municipal Level33

Transformational Adaptation:34

Nature-based Solutions:36

Big Moves in Nature-based Solutions:36

Quick Wins in Nature-based Solutions:37

Policy:39

Big Moves in Policy:39

Quick Wins in Policy:41

Infrastructure:42

Big Moves in Infrastructure:42

Quick Wins in Infrastructure:43

Community Capacity:45

Big Moves in Capacity:45

Quick Wins in Capacity:45

A Plethora of Options:48

In Closing - Making Adaptation Happen49

References and Resources:49

Figures

Figure 1: Victoria Harbour. Credit: https://meetingsandconventionspei.com/member/victoria-by-the-sea/	1
Figure 2: Looking up Main St in the RMV. Credit: https://meetingsandconventionspei.com/member/victoria-by-the-sea/	6
Figure 3: Signs and symbols	3
Figure 4: Study location and broader context	5
Figure 5: Watersheds and the RMV	6
Figure 6: Location of natural assets	7
Figure 7: Forested lands	8
Figure 8: Wetland	8
Figure 9: Salt Marsh	9
Figure 10: Beaches	9
Figure 11: Eelgrass Meadow	10
Figure 12: Parkland	10
Figure 13: Victoria lighthouse Credit: https://meetingsandconventionspei.com/member/victoria-by-the-sea/	14
Figure 14: Natural asset risk matrix	16
Figure 15: Municipal asset risk matrix	17
Figure 16: Erosion Impacts and Actions Map	19
Figure 17: Erosion impacts and adaptation actions system map on municipal infrastructure	20
Figure 18: Post tropical storm and inland flooding impacts system map on municipal infrastructure	22
Figure 19: Post tropical storm, inland flooding, heavy participation impacts system map on municipal infrastructure	22
Figure 20: Post tropical storm and inland flooding impacts on municipal assets	23
Figure 21: Post tropical storm and inland flooding impacts on municipal water assets	24
Figure 22: Post tropical storm and inland flooding impacts on municipal transportation, buildings and wharf assets	25
Figure 23: Heatwave and drought impacts on municipal transportation, buildings and water assets.	27
Figure 24: Climate risk impacts and adaptation actions system map on parkland and forested lands	29
Figure 25: Marsh sill Credit: https://coastalreview.org/2016/12/18165/	30
Figure 26: Marsh sill Credit: https://coastalreview.org/2016/12/18165/	36
Figure 27: Beach at Victoria Harbour Credit: https://meetingsandconventionspei.com/member/victoria-by-the-sea/	42
Figure 28: Beach in the Rural Municipality of Victoria Credit: https://meetingsandconventionspei.com/member/victoria-by-the-sea/	47
Figure 29: Beach at Victoria Harbour Credit: https://meetingsandconventionspei.com/member/victoria-by-the-sea/	49
Figure 30: Victoria Harbour and bait shacks Credit: http://escapadeswithemma.com/victoria-by-the-sea/	50

Contributions and Funders:

This report was made possible by the ClimateSense Program, UPEI Climate Lab, BRACE Program and Rural Municipality of Victoria.

Contributions and Funders:

Quinn Howard, Primary Author, ClimateSense Intern

Eric Gilbert, Councilor, Fire Chief, Climate Change Adaptation Committee

Susan Oxley, Councilor, Water and Sewer Committee, Climate Change Adaptation Committee

Juliana Granzoti, South Shores Watershed Alliance, Climate Change Adaptation Committee

Nout Guerts, Climate Change Adaptation Committee



Figure 2: Looking up Main St in the RMV. Credit: <https://meetingsandconventionspei.com/member/victoria-by-the-sea/>

Introduction:

Climate change is contributing to new challenges for municipalities. Rising seas, extreme weather and increased precipitation place community members, infrastructure and sustainable service delivery at risk. In this new normal, municipalities have a critical role to play in addressing both climate mitigation and adaptation.

In August 2021 the Rural Municipality of Victoria (RMV) passed a resolution declaring a Climate Emergency. This report was developed by the RMV Climate Change Adaptation Committee and the UPEI ClimateSense Program in recognition of this declaration and desire to address the impacts of climate change. This report takes an ecosystem based approach, focusing first on the Westmorelands watershed, followed by an assessment of risk to physical infrastructure within the municipal boundaries.

This report focuses primarily on adaptation. While the RMV recognizes the importance of mitigation, community members and council within the RMV feel that the pressing risks of climate change require urgent action to protect infrastructure and minimize vulnerability to residents. Where possible adaptation solutions were developed that were 'win-win' with both adaptation and mitigation impacts.

Goal and Scope:

The goal of this report is first, to identify specific climate risks to the Westmorelands watershed and RMV and second to develop adaptation opportunities which can be undertaken by the municipality in response to identified risks.

This report focuses on the top four climate risks, identified by the 2021 Climate Change Risk Assessment (CCRA) undertaken by the Province of PEI.

These identified risks are:

1. Coastal Erosion
2. Post Tropical Storms
3. Heatwave and Drought
4. Heavy precipitation and inland flooding

Geographically this report encompasses the municipal boundaries of the RMV and the three watersheds: Victoria, Westmorelands, and Macivors Point, which influence its ecology. Climate risks associated with the watershed were determined by ecosystem type (forest, sandflat, eelgrass meadow) and were assessed by the project team and local stakeholders. The identification of climate risks to the municipality was limited to critical physical infrastructure owned by either the municipality or the province on which there was adequate data available.

Limitations:

This report was limited by time, organizational capacity, community buy-in, geographical scope and asset type included. Throughout the project it became apparent that the primary barriers to adaptation within the municipality were financial and administrative in nature. Due to limitations and project team expertise these avenues of adaptation were not investigated. It is recommended that subsequent adaptation plans focus on this area.

Key Terms and Definitions:

Adaptation: Initiatives or actions in response to actual or projected climate change impacts and which reduce the effects of climate change on built, natural and social systems.

Adaptive Capacity: The ability of built, natural and social systems to adjust to climate change (including climate variability and extremes), to moderate potential damages, to take advantage of opportunities, or to cope with the consequences.

Climate Change: Significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer). These changes may be due to natural internal processes or external forces, or to persistent anthropogenic (human caused) changes in the composition of the atmosphere or in land use. It is increasingly recognized that these changes are anthropogenic in nature.

Ecosystem: a geographic area where a community of living organisms (flora, fauna, micro-organisms), the physical environment, climatic conditions and all their interrelationships work together to form a bubble of life.

Ecosystem-based Adaptation: initiatives or actions which include the sustainable management, conservation and restoration of ecosystems to provide services that help people adapt to the adverse effects of climate change.

Ecosystem Services: the basic natural services that make life possible for people. These services include provisioning services such as food and water; regulating services such as flood and disease control; cultural services such as spiritual, recreational, and cultural benefits; and supporting services such as nutrient cycling that maintain the conditions for life on Earth.

Infrastructure: the basic physical and organizational structures and facilities (e.g. buildings, roads, power supplies) needed for the operation of a society or enterprise.

Incremental change: Largely maintains existing activities and building on existing technologies; it is both reactive and proactive.

Mitigation: The promotion of policy, regulatory and project-based measures that contribute to the stabilization or reduction of greenhouse gas concentrations in the atmosphere. Renewable energy programs, energy efficiency frameworks and substitution of fossil fuels are examples of climate change mitigation measures.

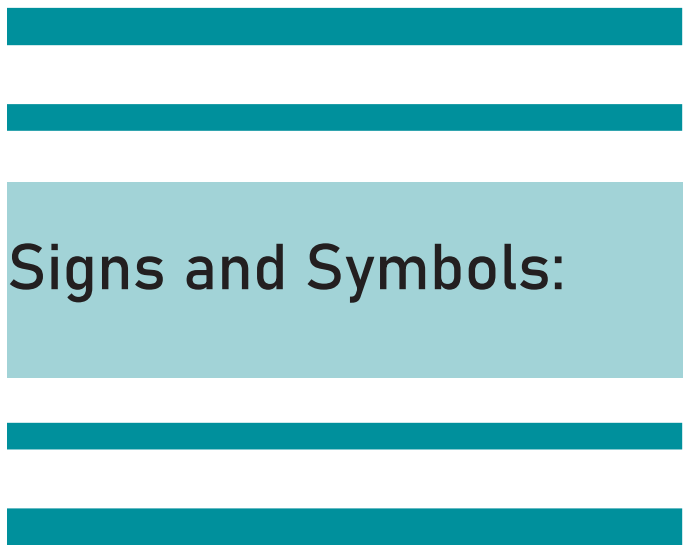
Natural Assets: resources that exist without any actions of humankind. These resources are biological in nature and include soil, air, water, flora and fauna which are sources of valued characteristics such as commercial, industrial, aesthetic value, scientific interest and cultural value.

Resilience: The capacity of a system, community or society exposed to hazards to adapt, by resisting or changing in order to reach and maintain an acceptable level of functioning and structure.

Risk: The degree to which a given system is directly or indirectly affected (either adversely or beneficially) by climatic conditions (i.e. temperature increases) or a specific climate change impact (i.e. increased flooding).

Transformational change; Involves major changes in enterprises, land use and human and social capital; it is largely proactive and strategic.

Systems: The built, natural and human networks that provide services or activities within a municipality.



Signs and Symbols:



Figure 3: Signs and symbols

The Rural Municipality of Victoria: In Context

Cradled in the Shallows: Prince Edward Island

Prince Edward Island (PEI) is located within the Gulf of the St. Lawrence and Northumberland Strait, in the Atlantic Maritime ecozone. The climate of PEI is strongly influenced by the Atlantic Ocean, characterized by mild seasons and high precipitation. The proximity to the Atlantic ocean makes this one of the stormiest areas of Canada.

The province is located within the Magdalen Shallows, a plateau within the Gulf of St. Lawrence. The coastline of PEI is characterized by steep headlands and tidal estuaries. PEI maintains some of the best-developed sand dune and beach systems in the Atlantic Maritime ecozone. These coastal systems, freshwater in-flows from the St. Lawrence river, and shallow nature of the Gulf of St. Lawrence combined to support incredibly diverse marine and estuary ecosystems.

PEI's soils consist largely of Palaeozoic sandstones, siltstone, and conglomerates. These highly porous soils support the functioning of the island's single sandstone aquifer. Soils within the province are generally of the Charlottetown and Alberry series, consisting of sandy loam and fine sandy loam. PEI is located in plant hardiness zone 5 and the New England - Acadian Forest region, with forests are dominated by red oak, sugar maple, yellow birch, and beech in upland regions, black spruce and tamarack through out wetlands and Eastern white pine on coarse-textured soils.

People in Place

Prince Edward Island is part of Mi'kma'ki, the traditional unceded territory of the Mi'kmaq peoples. Known as Abegweit or Epekwitk, in the Mi'kmaq language and roughly translates as "land cradled in the waves" or "lying in the water". Stewards since time immemorial, the Mi'kmaq people currently occupy four reserves; Morrell, Rocky Point and Scotchford held by Abegwiet First Nation and Lennox Island held by Lennox Island First Nation.

First colonial contact occurred in 1534 with Jacques Cartier, with no formal or permanent European settlement established until the 1700's. The arrival and permanent settlement of European people on PEI dramatically shifted land use. The island's rich forests were harvested for timber and converted to agricultural lands; up to 90% of the island's forests were logged at this time. Today, the people of Prince Edward Island remain dependent on the Island's natural resources with agriculture, fishing and tourism as the primary industries on PEI. In 2016, 60.1% of the population of Prince Edward Island was concentrated around the Provinces urban centers, Charlottetown, and Summerside, with the remaining 39.9% living rurally (Statistics Canada).



Figure 4: Study location and broader context

Watershed Systems: RMV and Ecological Context

The Rural Municipality of Victoria (RMV) is known for its picturesque charm and natural beauty. This reputation is linked to the health of natural assets within and beyond the municipal boundaries. The municipal boundaries of the RMV include three watersheds, the Westmoreland to the north, Macivors Point to the south east and the Victoria watershed to the west. The Westmoreland watershed is the largest watershed for the RVM, includes two river branches (east and west), wetland systems and a tidal estuary. The functioning of this watershed system has direct consequences for the health of the estuary and harbour in the RMV boundaries. These natural assets provide valuable services to the municipality, such as flooding mitigation and reduction in dredging costs through siltation management. Other critical services provided to the municipality by the watershed system include the municipal wellfields located at the boundary of the Westmoreland and Victoria watershed on the McDonald farm property. Of the three watershed systems within the RMV the Westmoreland is the largest and most influential in considerations for sustainable development and service delivery.

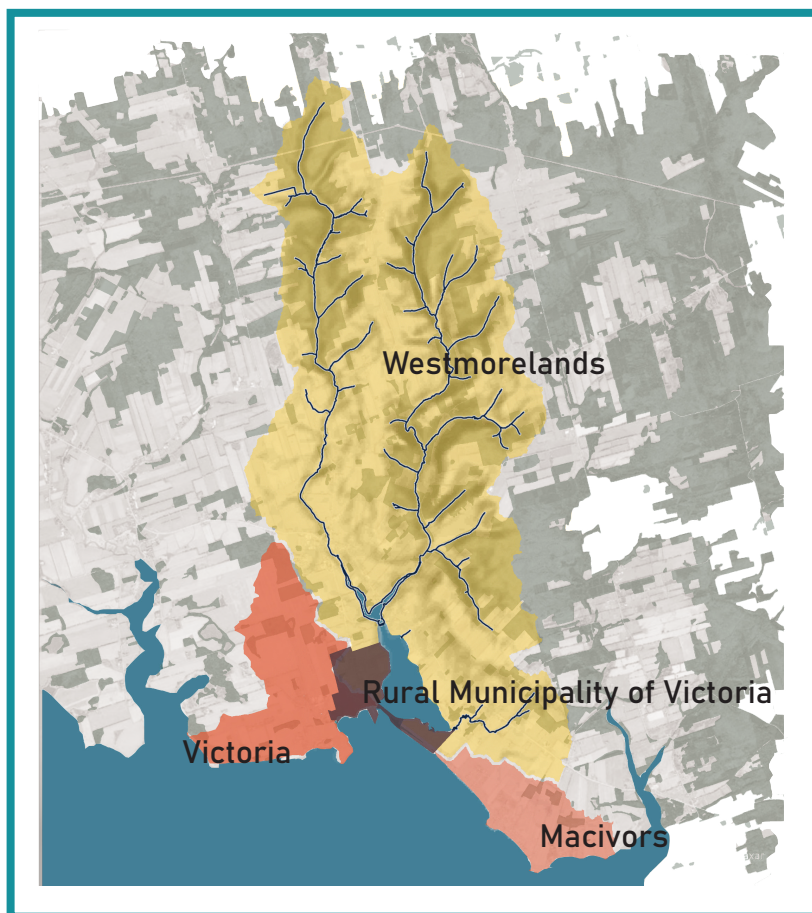


Figure 5: Watersheds and the RMV

Westmorelands Watershed

The Westmoreland watershed is a fast moving cold water system, with headwaters located in PEI's most dramatic topographical region, the Bonshaw Hills. Topographical elevations within the Westmoreland range from approximately 120m at the headwaters to 0m and below at the estuary mouth. Soils within the Westmorelands are predominantly of the Charlottetown series, with a large deposit of Alberry located near the headwaters of the western branch of the Westmorelands. Composed of sandy loam, fine sandy loam and very fine sandy loam these soils are highly erodible, with low moisture holding capacity. The eastern branch of the Westmorelands is characterized by steep slopes (between 16-11%) along the entire river course until it reaches a wetland system located at the top of the Westmoreland River Nature Park, and a single channel between 1-3m wide with fairly regular meanders. The west branch of the Westmoreland is characterized by steep slopes at the headwaters before transitioning to more gently sloping (<10%) topography in its mid to lower reaches and single channel between 1-3m wide. Meanders within the Western branch are fairly regular with two small sections of tortuous meanders located in two reaches in its upper section.

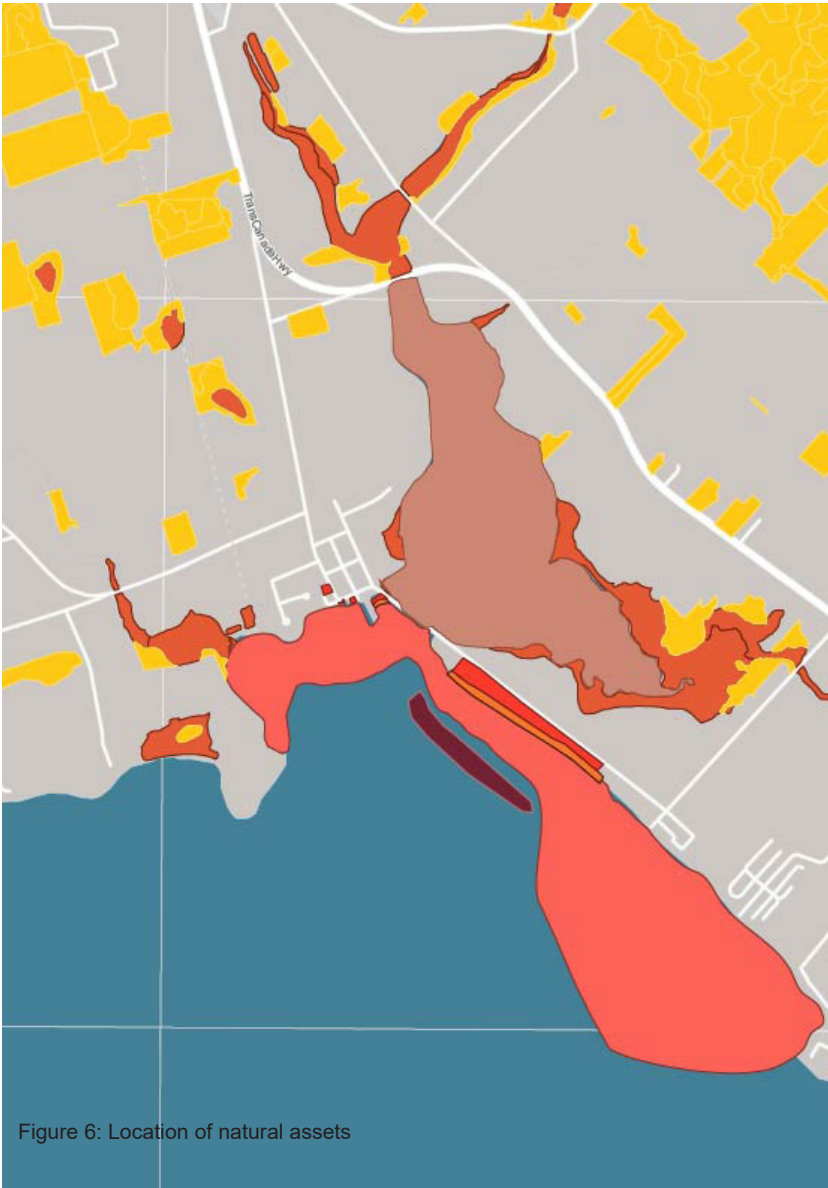
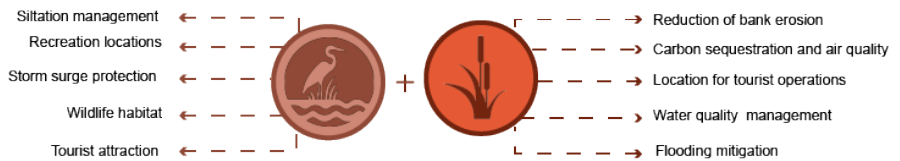
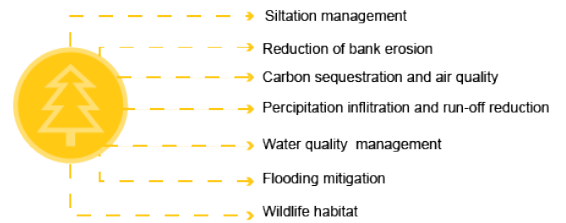


Figure 6: Location of natural assets

RMV Natural Assets

Where to find them
and services provided



Natural Assets: resources that exist without any actions of humankind. These resources are biological in nature and include soil, air, water, flora and fauna which are sources of valued characteristics such as commercial, industrial, aesthetic value, scientific interest and cultural value.

Natural Assets and Service Provision

The natural assets that surround the RMV have both inherent value and provide important services to the municipality. Approaching the protection of these assets as part of the RMV's larger asset management plan and climate adaptation strategy will reduce pressure on other assets owned by the RMV.

Forested Lands:

The headwaters and western branch of the Westmoreland river system has significant areas of forested land. In the western branch of the Westmoreland the proximity to the Brookvale and Bonshaw forested areas function as corridors for species moving from the central region of Queens county to the river and coast line.

Services provided to the RVM by forested lands include:

- Precipitation infiltration and run-off mitigation
- Reduction of bank erosion through control of overland flow
- Siltation management
- Flooding mitigation
- Carbon sequestration and air quality
- Water quality management
- Wildlife habitat



Figure 7: Forested lands

Wetland Systems:

The Westmoreland watershed has one large wetland system located at the Westmoreland River Nature Park (Stewart Pond) and with small wetland habitats occurring at tributary offshoots along the river course. The wetland system occurring at Westmoreland River Nature Park (Stewarts Pond) is constructed, and likely the result of Highway 13 construction which connects Crapaud to central Queens and the North Shore. Siltation build-up at this site may impact downstream ecosystems and accretion patterns within the salt marsh.

Services provided to the RVM by wetland systems include:

- Siltation management
- Flooding mitigation
- Bank protection and erosion mitigation
- Carbon sequestration and air quality
- Water quality management
- Wildlife habitat



Figure 8: Wetland

Salt Marsh and Estuary:

To the north east of RVM the two branches of the Westmoreland River connect to the Northumberland Strait via a estuary and salt marsh system. This system provides a picturesque backdrop to the municipality. The estuary is significantly influenced by surrounding land use and transportation infrastructure including Highway 1 to the north and causeway at the estuary mouth.

Services provided to the RVM by the Salt Marsh and Estuary include:

- Tourist attraction and picturesque setting
- Recreation location for residents and visitors
- Location for tourist operations
- Flooding mitigation
- Storm surge protection
- Bank protection and erosion mitigation
- Siltation management
- Carbon sequestration and air quality
- Water quality management
- Wildlife habitat



Figure 9: Salt Marsh

Beaches, Sand Flats and Harbour:

The beaches, sand flats and harbor are distinct features of Victoria's identity. The tidal range in Victoria is fairly extensive and provides residents access to these features over the course of the day. Within the RMV there is one public beach located between the causeway and wharf.

Services provided to the RMV by Beaches, Sand Flats and Harbour include:

- Tourist attraction and picturesque setting
- Recreation location for residents and visitors
- Location for tourist operations
- Flooding mitigation
- Storm surge protection
- Wave attenuation
- Bank protection and erosion mitigation
- Wildlife habitat



Figure 10: Beaches

Eelgrass Meadow:

This asset was identified by the Department of Fisheries and Oceans the last time the Victoria Harbour was dredged. Eel grass is protected habitat within PEI and the location of the meadow impacts where dredge material can be placed and any interventions to mitigate storm surge that may be installed in future.

Services provided to the RMV by the Eelgrass Meadow include:

- Carbon draw down
- Storm surge mitigation
- Erosion mitigation
- Bait fish and aquatic wildlife habitat
- Beach nourishment



Figure 11: Eelgrass Meadow

Parks and Managed Green Assets:

Managed green assets within the RMV contribute to the charm of the municipality's four core blocks and waterfront as well as provide recreation opportunities for residents. Currently, the provincial park is the largest green asset managed by the RMV. The management of this space occurs through a lease agreement with the provincial government. In addition to the provincial park three small parks, a boardwalk and urban forest that make up the green assets within the RMV.

Services provided to the RMV by the Parks and Managed Green Assets include:

- Tourist attraction and picturesque setting
- Recreation location for residents and visitors
- Carbon draw down
- Precipitation infiltration
- Habitat creation
- Reduction of urban heat island effect



Figure 12: Parkland

The Rural Municipality of Victoria

Situated at the estuary mouth of the Westmoreland River the Rural Municipality of Victoria (RMV) encompasses 1.46 square km of land. The core of the municipality is made up of a historic four block grid defined by three east-west streets and three north south streets. The harbour, causeway, and provincial park bound the municipalities southern shores. The four block grid is characterized by historic architecture and a mix of residential and commercial uses. Outside the four core blocks density is markedly lower and includes residential, seasonal residential, agricultural and some light industrial land use.

The development of physical municipal assets within the RMV reflects the industrial history of the municipality and subsequent shifts in economy. Significant events shaping the development of the RMV include, its early establishment as a port city, the re-routing of the trans-canada highway and transition to tourism as a primary economy. Within the RMV critical physical municipal infrastructure is owned and operated by the municipality, provincial and federal governments raising particular challenges for climate adaptation.

The small size of the RMV and ownership of assets by multiple levels of government creates gaps in sustainable service delivery within the municipality. Within the RMV ambiguity about responsibility and associated priority leads to decreased service quality and longer time periods between maintenance activities. Despite administrative challenges, residents within the RMV are highly committed to their community with high volunteer participation among residents in civic initiatives.

Municipal Assets

Wharf and Harbor Infrastructure:

Built in 1871 the wharves and associated harbor infrastructure were built to accommodate the emerging shipbuilding and lumber industries, with the RVM functioning as the third largest port on the Island until the collapse of the lumber industry in the 1900's. These wharves continue to function today and provide services to both the tourism and fishing industry within Victoria. This asset is federally owned with the RMV responsible for providing both waste and potable water services to private businesses located on the wharf. Space and services are limited on the wharf with minimal room for expansion of either industries currently occupying the wharf. Integrated water services on the wharf are poorly functioning with business owners reporting sewage backup within their establishment.



Road and Associated Vehicle Infrastructure:

The re-routing of the Trans-Canada highway marked a notable shift in the development of the RMV. With traffic redirected through Crapaud, the RMV was isolated from passive visitors. There are three entry points to the RMV from the Trans-Canada, the east and west connections of Highway 116 and Nelson St. The eastern connection of the RVM to the Trans-Canada includes the causeway, critical infrastructure which has been in place since the 1900's. The causeway has undergone many iterations and updates across its life span. The causeway currently connects the municipal core to the provincial park and unincorporated Hampton region. Maintenance and updates of all road networks and the causeway fall under the jurisdiction of the Province, with the RMV providing guidance on expansion and required maintenance. Due to the timing of development within the four-core blocks, there are no sidewalks or on-street parking within the RMV. This places significant pressure on residents and business owners located within the core with road easement and individual front lawns becoming parking locations for visitors. There are four small parking lots located within the RMV. Currently these spaces are inadequate for the number of tourists that visit the RMV during the summer months.



Water Services:

Water services that are currently managed and owned by the RMV include forced water mains, pump house, wastewater mains and treatment facility. Due to size and jurisdictional limitations a number of water services exist outside the municipalities boundaries and direct responsibility.

Potable water infrastructure within the municipality of Victoria includes: the community well field, forced water mains and pumphouse. The community well field is located on private property (Macdonald's farm) and is fed by the Victoria watershed. The pumphouse for the forced water mains is located at the Old School House and runs through the Maritime Electric grid. There is currently no back up power supply for the pumphouse.

Wastewater infrastructure is located both within the municipal boundaries of the RMV and adjacent areas. Pipe and pump infrastructure is located primarily within the municipal boundaries and connected to the below ground treatment tanks and overflow septic field with a line running along HWY 116. In 2011 Federation of Canadian Municipalities (FCM) awarded the RMV the Sustainable Communities Award in the Water Category for piloting an installation of the system. Within the RMV wastewater moves through one of two lift stations located at the Victoria Seaport Lighthouse Museum or Dunrovan Shores. Waste water on the wharf is managed by a series of smaller pumps and lift stations. Residents and business owners have reported sewage backup in wharf facilities and the municipality is currently working with the engineering firm WSP to identify an appropriate solution.



Buildings:

Buildings form a significant portion of the RMV's asset portfolio. These buildings provide administrative, tourism and cultural services to residents and visitors to the RMV. Buildings currently under the management of the RMV include: two washroom facilities, the information center, Playhouse, Fire Hall, Old School House and bait shacks beside the wharf. The washroom facilities located at the provincial park have been closed in recent years due to inability of the RMV to finance maintenance and provision of sundries for the washroom. The washroom and information center located at the corner of Water St and the causeway are seasonal and open from June until September. The Playhouse and Old School House are multipurpose administrative, recreational and cultural facilities. Significant restoration and retrofitting has been completed at the Old School House and includes climate adaptation initiatives such as solar panels.



Significant Assets outside the scope of this report:

The electrical grid and associated infrastructure within the RMV is owned and maintained by Maritime Electric. Limitation of time and information resulted in the exclusion of this infrastructure from being included within this report.

Individuals and the administrative structure are a significant asset within the RMV. In truth, these assets make up the heart of the municipality. Administrative matters within the RMV are handled by the CAO, council and mayor. Within the council sub-committees manage individual aspects of the administration within the RMV, such as, water and sewer, planning, and community events.

Within the last four years there has been a high turnover of CAO's within the RVM. Over the course of this reporting process there were a total of three CAO's. Residents and council members speculate that the high turnover rate is due to a mismatch between pay, hours allotted and hours needed to complete work within the RVM. Scarcity of time by both the CAO and council results in a limited ability to complete work outside the day to day functioning of the RMV. Lack of administrative capacity results in missed opportunities for grant funding to support adaptation activities within the RMV.

Climate Change and Climate Risk in PEI

Climate change is impacting the everyday life of Islanders. In coastal communities like the Rural Municipality of Victoria (RMV) residents and municipal officials are faced with visual and practical reminders of the consequences of climate change. Driven by tourism and home to predominantly older adults the RMV is at significant risk as climate impacts accelerate over the next century.

In 2021 The Government of PEI, in conjunction with various stakeholders and the consulting firm ICF undertook a Climate Change Risk Assessment (CCRA) to better understand how climate risk will impact key social, environmental, health, economic and cultural factors. This assessment and identification of risks provides a jumping off point for the identification of risk and consequence within the RMV.

What is Risk? Quite simply, the likelihood of danger, harm, or loss.

How is climate risk assessed?

Climate risks are assessed through three key components, probability, consequences and vulnerability. Once established risks are then subsequently ranked. Climate risk assessments are both quantitative and qualitative relying on scientific data as well as stakeholder perception of the consequence of each risk. Within this report climate risk was assessed qualitatively through discussion with local stakeholders and assessment of impact to sustainable service delivery.



Figure 13: Victoria lighthouse Credit: <https://meetingsandconventionspei.com/member/victoria-by-the-sea/>

Top Climate Risks in PEI and in the Rural Municipality of Victoria

The CCRA assessed a total of six climate risk scenarios for PEI. These included coastal erosion, post tropical storm, heat wave, heavy precipitation and flood, earlier springs and seasonal drought. These risks were assessed by local stakeholders within the RMV, where residents similarly ranked the identified climate by the CCRA. This report will focus on the top four of these identified risks and their adaptation opportunities. These risk are:



1. Coastal Erosion is the greatest overall risk to PEI. The socioeconomic and socio-cultural reliance on the coast means that all islanders will experience the impacts of coastal erosion. The rate of coastal erosion has been and is likely to accelerate as other climate conditions change. Coastal erosion will have multiple and cascading impacts such as: infrastructure damage, mental health impacts and disruption or damage of environmental and cultural landscapes.



2. Post-Tropical Storms are expected to increase in both frequency and intensity over the next century. While projections indicate that they are unlikely to occur more than once every two years, the consequence of these events has the potential to be quite severe causing: power outages, disruption to critical infrastructure (Charlottetown Harbour, Confederation Bridge), damage to economic sectors and coastline stability. Post-Tropical events were also identified as having compounding impacts determined by factors such as limited access to supplies, difficulties during evacuation and lack of preparedness.



3. Heatwaves, droughts and increasing regular temperatures are expected by 2050. These events pose a risk to vulnerable populations (seniors, infants, low income earners, those with limited access to air conditioning) and heat intolerant species



4. Heavy precipitation and inland flooding are expected to increase in similar frequency to post-tropical storm events. Heavy rainfall has the potential to damage storm water and transportation infrastructure, reduce groundwater recharge, increase sediment and pollutant load in waterways and cause damage to economic activities.

Downscaling Climate Risk to the Westmoreland and Rural Municipality of Victoria

The CCRA assessed risks for the entire province of PEI and provides a starting point for the identification and assessment of risks at the local level. The risks identified by the CCRA were analyzed alongside available local data and stakeholder input to determine specific risks to the watershed system and critical physical infrastructure of the RMV.

Climate Risk Matrix

Climate risks were assessed by stakeholders and the Climate Change Adaptation Committee using an Impact Risk Matrix. The Impact Risk Matrix describes the impacts of climate change variables (y-axis) on elements of the municipality and watershed across a scale of high (red) to low (green).

Westmorelands Climate Risk Matrix

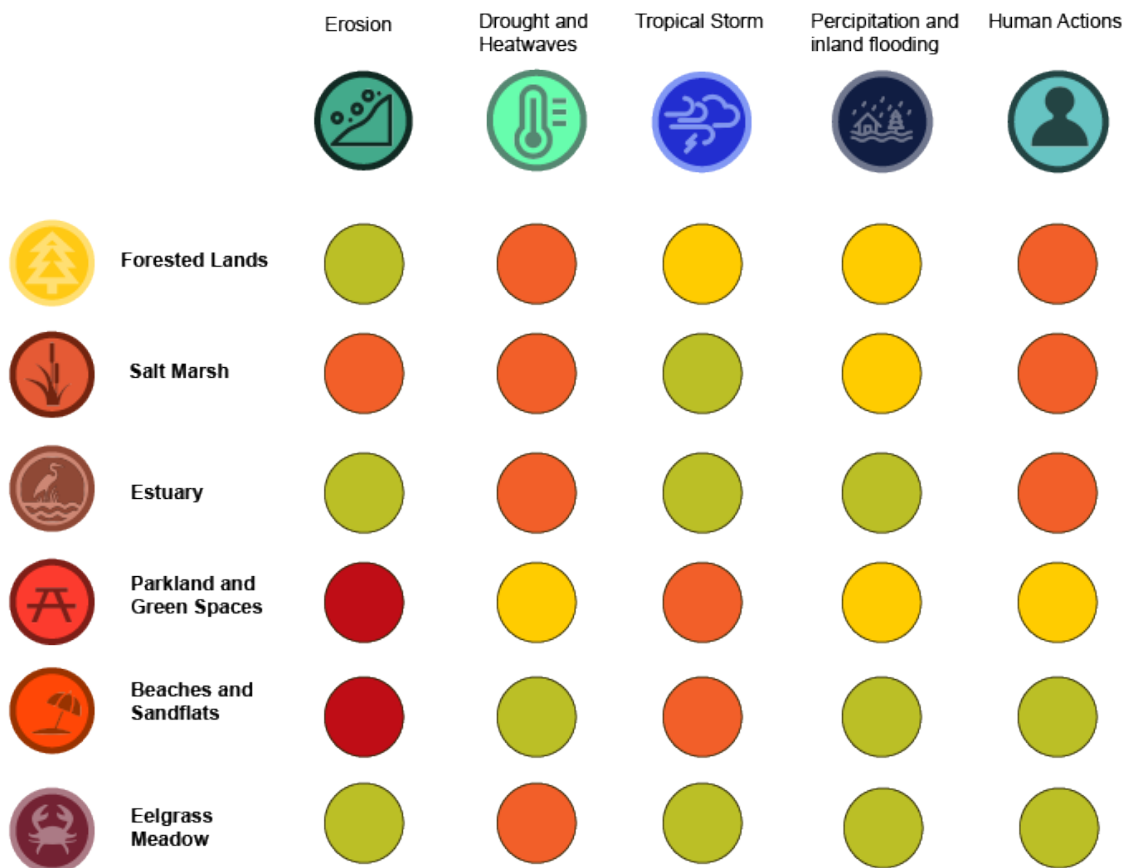


Figure 14: Natural asset risk matrix

In the case of the Westmorelands, conversation with local stakeholders revealed that while the top risks identified by the CCRA remained the same, risk consequence rating shifted, with drought and heatwave identified as the high risk to local watershed systems followed by erosion, anthropogenic or human actions, post-tropical storm and heavy precipitation events.

Rural Municipality of Victoria Climate Risk Matrix

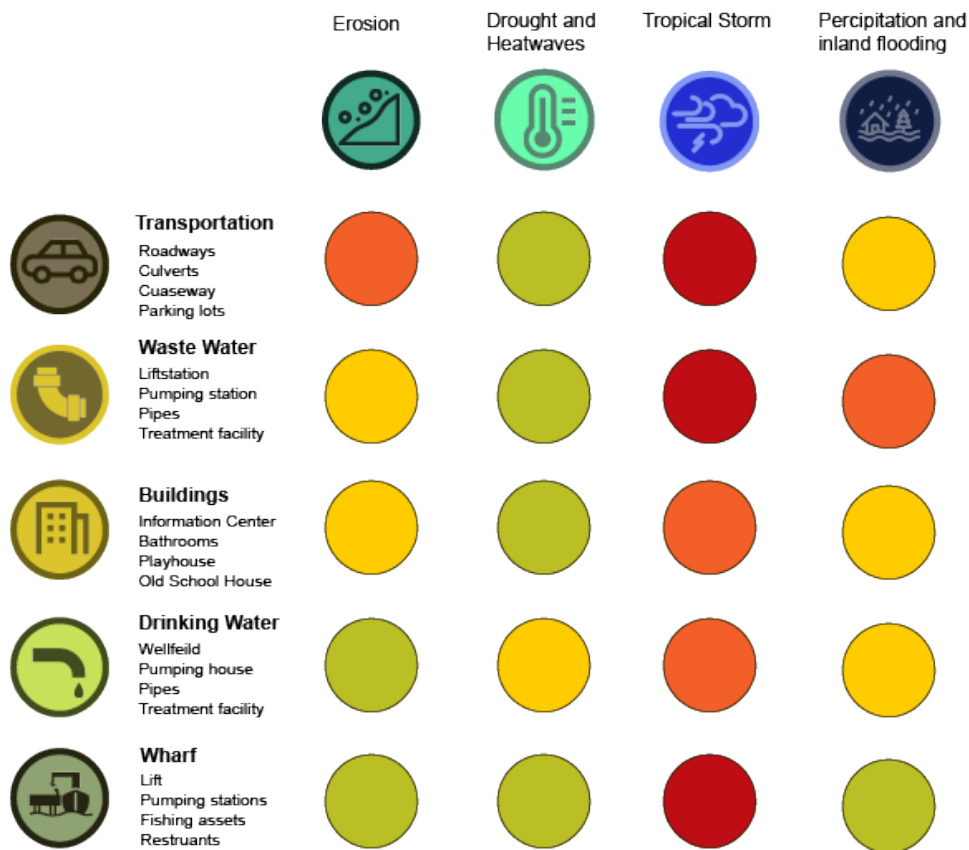


Figure 15: Municipal asset risk matrix

The climate risks to the RMV were ranked similarly to that of the CCRA, with erosion and post-tropical storms identified as the high risk followed by heatwaves and heavy precipitation events. Lack of data resulted in the exclusion of the electrical grid from risk analysis.

Erosion

Erosion in the Westmorelands

Erosion was determined to be the second highest risk to the watershed system by local stakeholders. Within the RVM and Westmoreland concerns about erosion are linked directly to sediment load within the system and its cascading impacts. Identified impacts of increased erosion in the RMV and Westmoreland include:

- Loss of Bank Swallow nesting habitat along the provincial park
- Mismatch between sediment accretion and sea-level rise leading to decay within the salt marsh
- Degradation of banks within the salt marsh decreasing size
- Increased sediment loading resulting in changes to the river width and depth
- Increased sediment loading causing spawning habitat loss for species such as brook trout
- Decreasing riparian buffer



Erosion in the Rural Municipality of Victoria

Erosion is a chronic threat to the RMV. Erosion is currently managed by both hard armoring and 'do-nothing' conditions within the RMV. The hard armoring of the waterfront both along the wharf and harbour boardwalk currently reduces erosion rates for Water St and associated infrastructure. Hard armoring of these areas has changed sediment dynamics within the harbour and has resulted in increased erosion in adjacent natural areas. Residents' most significant concern regarding erosion is related to private property and the shoreline of the provincial park. The identified erosion risks to the RVM include:

- Increased need for repair and replacement of gabion baskets along causeway
- Loss of beach and bank along provincial park
- Threat to washroom facilities located at provincial park
- Perception of erosion by residents of Dunrovan shores and estates resulting in increased shoreline armoring spurring cascading effects up and downstream.

Impacts, Effects and Actions in Response to Erosion in the Westmorelands Watershed

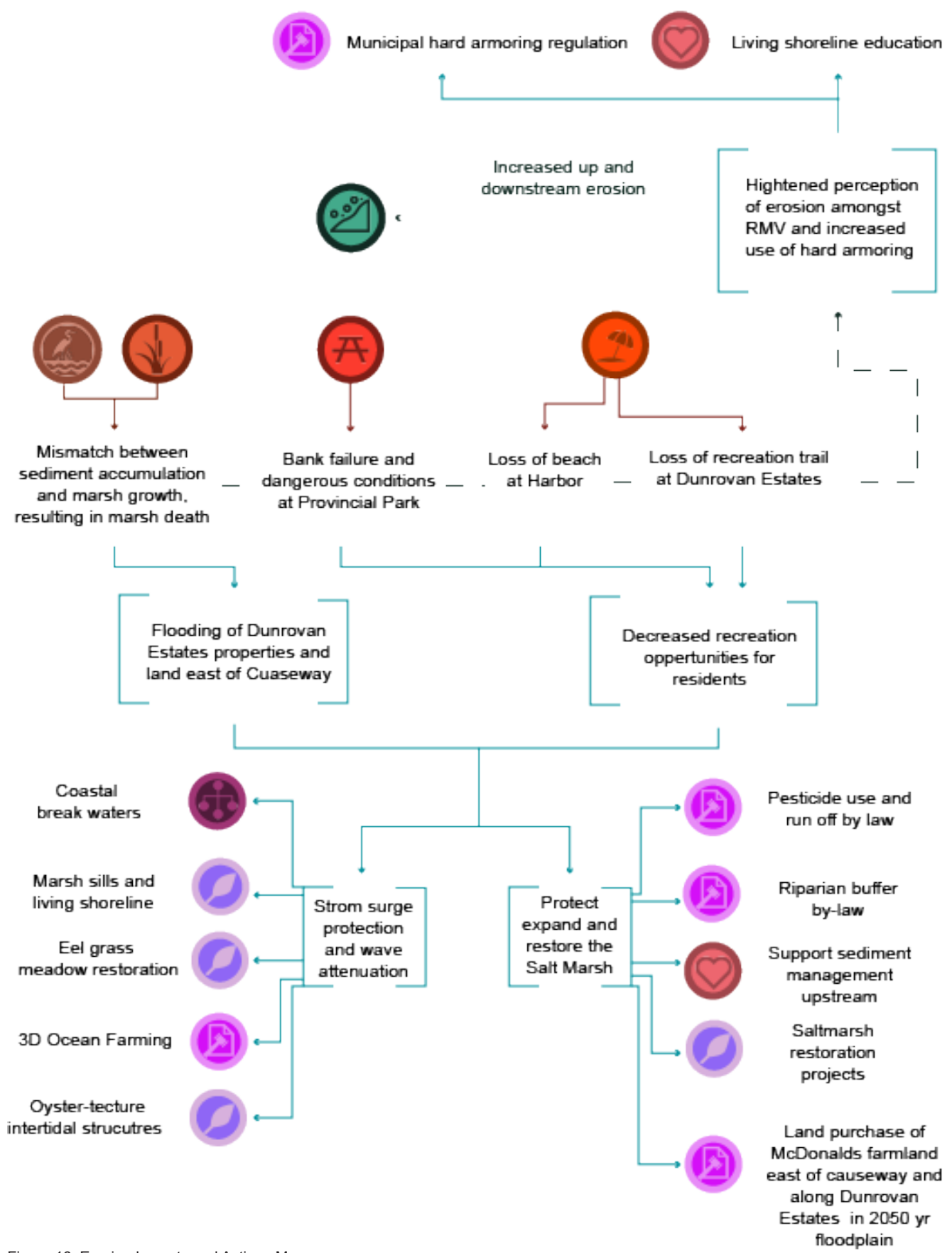


Figure 16: Erosion Impacts and Actions Map

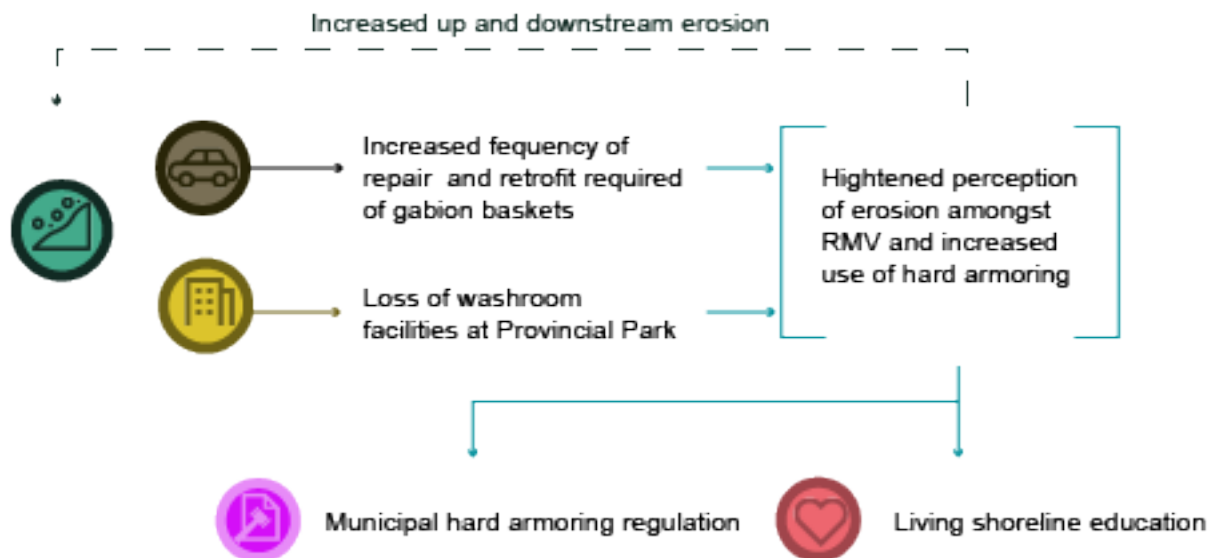


Figure 17: Erosion impacts and adaptation actions system map on municipal infrastructure

Post Tropical Storm

Post Tropical Storm in the Westmorelands

The impacts of more frequent and severe tropical storms was perceived by local stakeholders as the least threatening climate risk to the RMV’s watershed systems. Despite the perception of low risk, stakeholders noted that they are still in the process of cleaning up damages caused by Hurricane Dorrian which occurred in 2019. In addition, risk perception was directly tied to the baseline health of the ecosystem, with a decrease in ecosystem quality leading to a higher perception of risk caused by a tropical storm event. Identified impacts of tropical storm events in Westmoreland include:

- Increased siltation and agricultural runoff
- Increased bank erosion and large bank failure
- Damage to forest canopy and debris entering river system



Post Tropical Storm in the Rural Municipality of Victoria

Post-tropical storm events pose a significant threat to the physical assets and well-being of residents within the RMV. Post-tropical storm events present significant risk to the RMV both in the short-term and the long term. Short-term impacts of a post-tropical storm event are related to issues of access in areas such as food, primary medical care and potable water. Issues of access may be particularly vulnerabl-izing for RMV residents due the advanced median age within the community. Long term impacts of Post-Tropical storm events relate to damage incurred as a result of the storm, and financial capacity of the RMV to implement repairs in a timely fashion. The identified risks from post-tropical storm events include:

- Damage to power grid and loss of power to pump house, resulting in short term disruption of potable water service within the RMV.
- Flooding of the causeway and lower Water St limiting mobility of residents in and out to the RMV
- Damage to causeway resulting in long term limited mobility of residents and disruption of tourism movement through municipality
- Damage to buildings, need for immediate repair and increased frequency of repair
- Damage to road infrastructure along Water St due to long term inundation
- Saltwater intrusion of water mains along Water St due to long term inundation
- Saltwater intrusion of sewer mains along Water St due to long term inundation
- Bacteria death and disruption of functioning of sewage treatment processes as a result of saltwater intrusion
- Damage to waste water pumps on wharf and Water St
- Damage to lift station located beside Victoria Seaport Lighthouse museum and resulting sewage back-up
- Damage to boardwalk and natural setting resulting in decrease in tourist visits
- Flooding and long term inundation of green spaces located along harbour boardwalk and behind Victoria Seaport Lighthouse Museum.
- Large bank failure or slumping along Victoria Provincial park
- Damage to urban canopy and required debris removal

Heavy Precipitation and Inland Flooding Events

Heavy Precipitation and Inland Flooding Events in the Westmorelands

Large precipitation events and inland flooding events were determined by stakeholders to be the third highest risk due to increased siltation and sediment load within the system. Identified impacts of precipitation events and inland flooding in the Westmoreland include:

- Increased siltation and agricultural runoff
- Changes in amount and timing of stream flow
- Small channel creation, and subsequent changes to river pattern
- Increased bank erosion
- Over-saturation recharge areas and resulting lack on infiltration to aquifer
- Long term inundation resulting in vegetation die off



Heavy Precipitation and Inland Flooding Events in the Rural Municipality of Victoria

Heavy precipitation and inland flooding events are expected to increase in frequency and severity in the future century. Storm water is currently managed through a system of culverts which direct water into the harbour. Within the RMV the residents reported no to minimal flooding and no standing water after 24hr after the September 1, 2021 precipitation event where the municipality received between 128-128mm of rain. Risks from increased precipitation events to the RMV include:

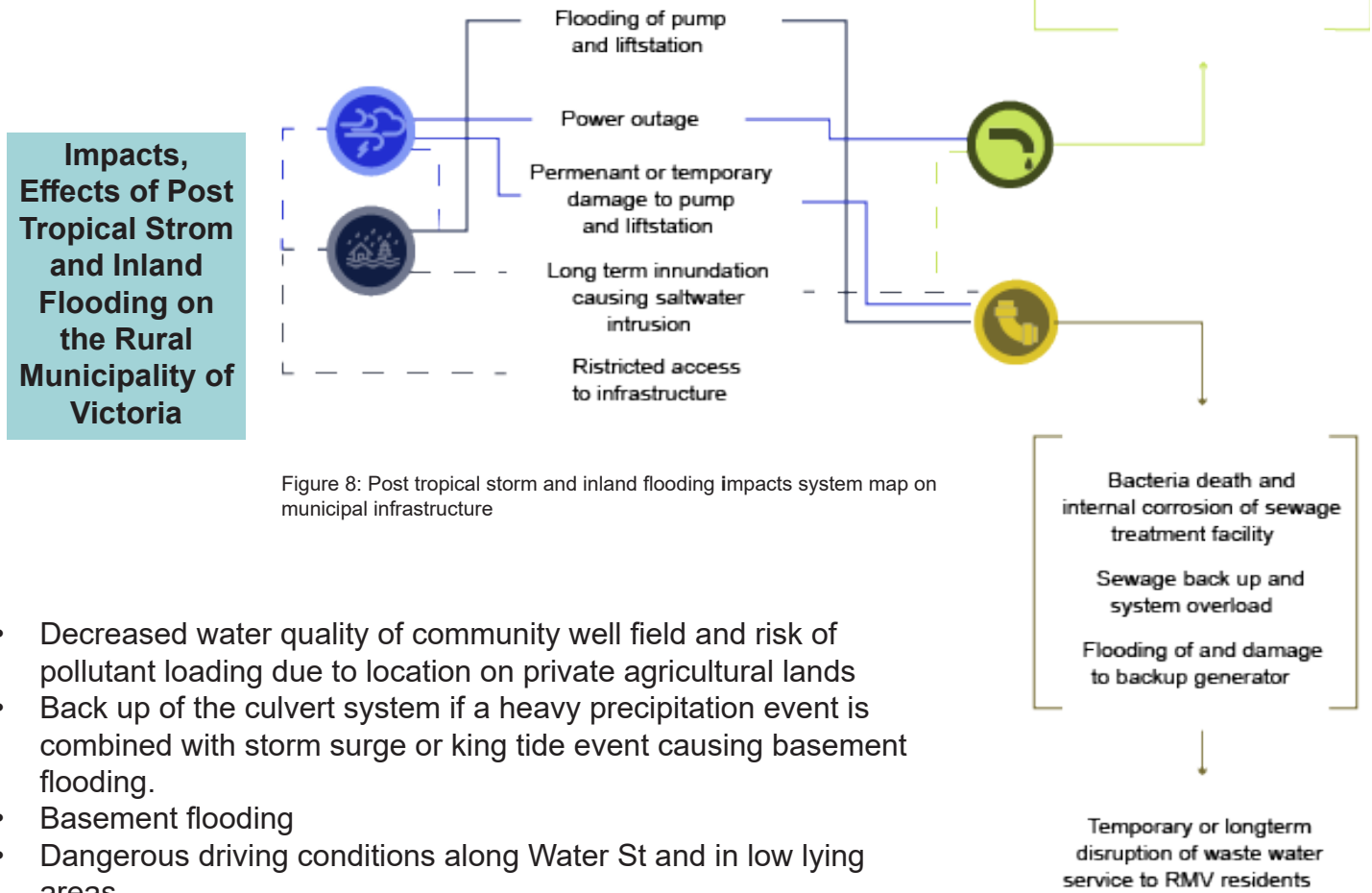


Figure 8: Post tropical storm and inland flooding impacts system map on municipal infrastructure

Figure 18: Post tropical storm, inland flooding, heavy participation impacts system map on municipal infrastructure

- Decreased water quality of community well field and risk of pollutant loading due to location on private agricultural lands
- Back up of the culvert system if a heavy precipitation event is combined with storm surge or king tide event causing basement flooding.
- Basement flooding
- Dangerous driving conditions along Water St and in low lying areas
- Repair and debris removal within culvert system post event
- Basement flooding of Playhouse or Old School House
- Damage to urban canopy and required debris removal



Figure 19: Post tropical storm and inland flooding impacts on municipal assets

A number of community assets could be affected by a post-tropical storm surge and flooding. These assets are mostly located along Water St. and within the Provincial Park. Significant assets include the lift station, information center and bathrooms.



Figure 20: Post tropical storm and inland flooding impacts on municipal water assets

A significant portion of the RMV's water assets could be affected by a post-tropical storm surge and flooding. Risks to this infrastructure include saltwater intrusion, damage and cessation of service delivery.

Impacts, Effects of Post Tropical Storm and Inland Flooding on the Rural Municipality of Victoria

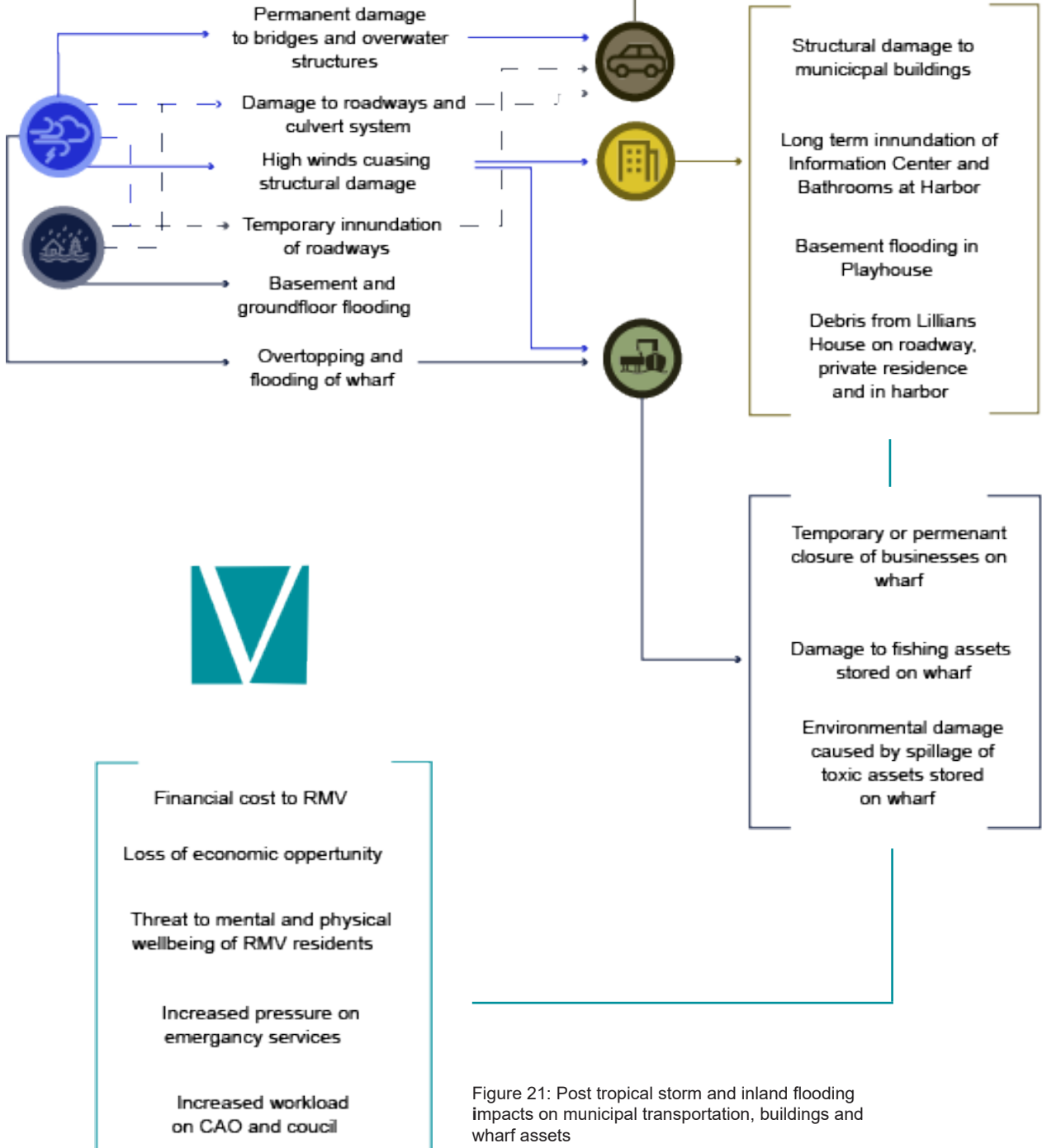


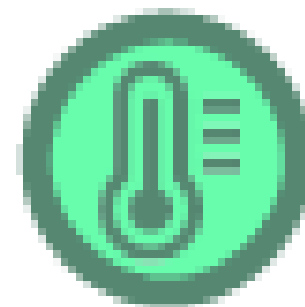
Figure 21: Post tropical storm and inland flooding impacts on municipal transportation, buildings and wharf assets

Heatwaves and Drought

Heatwaves and Drought Conditions in the Westmorelands

Chronic rise in temperature and drought conditions were ranked by local stakeholders as the highest risk to the Westmorelands. Increased temperature impacts the nature of the Westmoreland as a fast moving, cold water system with increased temperature threatening the fundamental characteristics of the ecosystem. Identified impacts of chronic rise in temperature and drought conditions increased Westmoreland include:

- Changing species make up and increased invasive species
- Fish habitat loss (brook trout)
- Increased algae blooms and growth
- Stranded ponds caused by drought conditions
- Increases pollutant concentration within system relative to water levels
- Increased pathogens and diseases
- Loss of springs feeding watershed system



Heatwaves and Drought Conditions in the Rural Municipality of Victoria

Drought and Heatwaves pose a minimal threat to the current functioning of physical assets within the RVM. Risks related to heatwaves arise mainly from increased pressure on services and increased vulnerability of residents due to the absence of services within the RMV. Risks from heat waves include:

- Increased use of beaches
- Increased pressure on water services
- Prolonged drought conditions impacting functioning of community well
- Demand for services such as water fountains and cooling stations
- Increase frequency of repair and maintenance from transportation infrastructure
- Tree death and heat stress resulting in loss of urban canopy and increased stress on green spaces

Impacts, Effects and Actions in Response to Temperature Increase and Drought Conditions in the Rural Municipality of Victoria

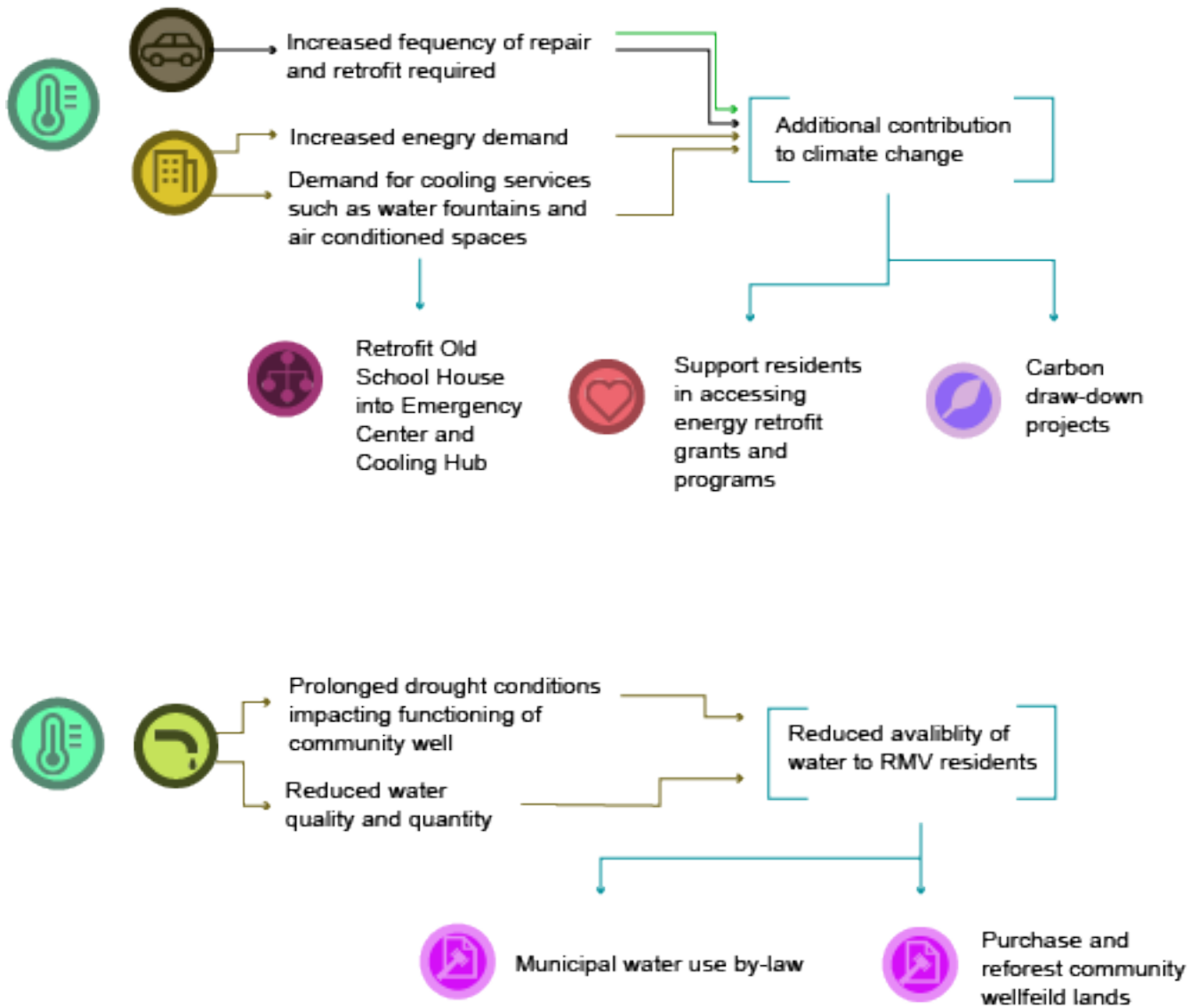


Figure 22: Heatwave and drought impacts on municipal transportation, buildings and water assets.

Human Actions and Compounding Risk

Climate risks to the watersheds will be influenced by the actions undertaken by the people that reside within them. The effects of climate change will have cascading impacts for the livelihoods of residents within the RMV. Risks such as post-tropical storm events which cause long term damage to assets within the municipality or limit tourism movement to and from Victoria (loss of the causeway) impact the financial well-being of residents. Damage to the wharf infrastructure by a post-tropical storm may impact its current functioning as a working port, thus affecting lobster, crab and fishing activities within the RMV. Industries such as Halibut PEI which are located within the floodplain may be incentivised to leave as a result of risk, which would impact tax revenue to the municipality. Damages to the natural setting and loss of industry could also depress local real estate markets and spurring current residents to move out of the municipality, further impacting the municipal tax base. These associated and cascading risks of climate change such as a shrinking municipal tax revenue alongside increased costs to the municipality caused by climate change are likely the highest threat to sustainable service delivery within the RMV.

Risks associated with land-use planning include:

- Expansion or further development of residential and urban areas, particular in proximity to the water course or near ecologically valuable lands. Within the RMV areas particularly vulnerable areas include development along Dunrovan Estates properties and McDonalds farmland east of the causeway.
- Poor application of and enforcement of riparian buffer setbacks
- Agricultural run-off and increased pollutants within the system

Risks associated with transportation infrastructure include:

- Continued use of undersized culverts disrupting sediment transport and stream flow
- Road salt use and pollutant runoff

Risks associated with lack of riparian buffer enforcement on agriculturally zoned lands include:

- Increased siltation and sediment loading
- Increased pollutant loading
- Bank erosion

Risks associated with increased shoreline armouring include:

- Habitat loss
- Increased erosion up and downstream of intervention
- Changes to sediment transport dynamics within the system

Impacts, Effects and Actions of Climate risk on Parklands and Managed Green Assets

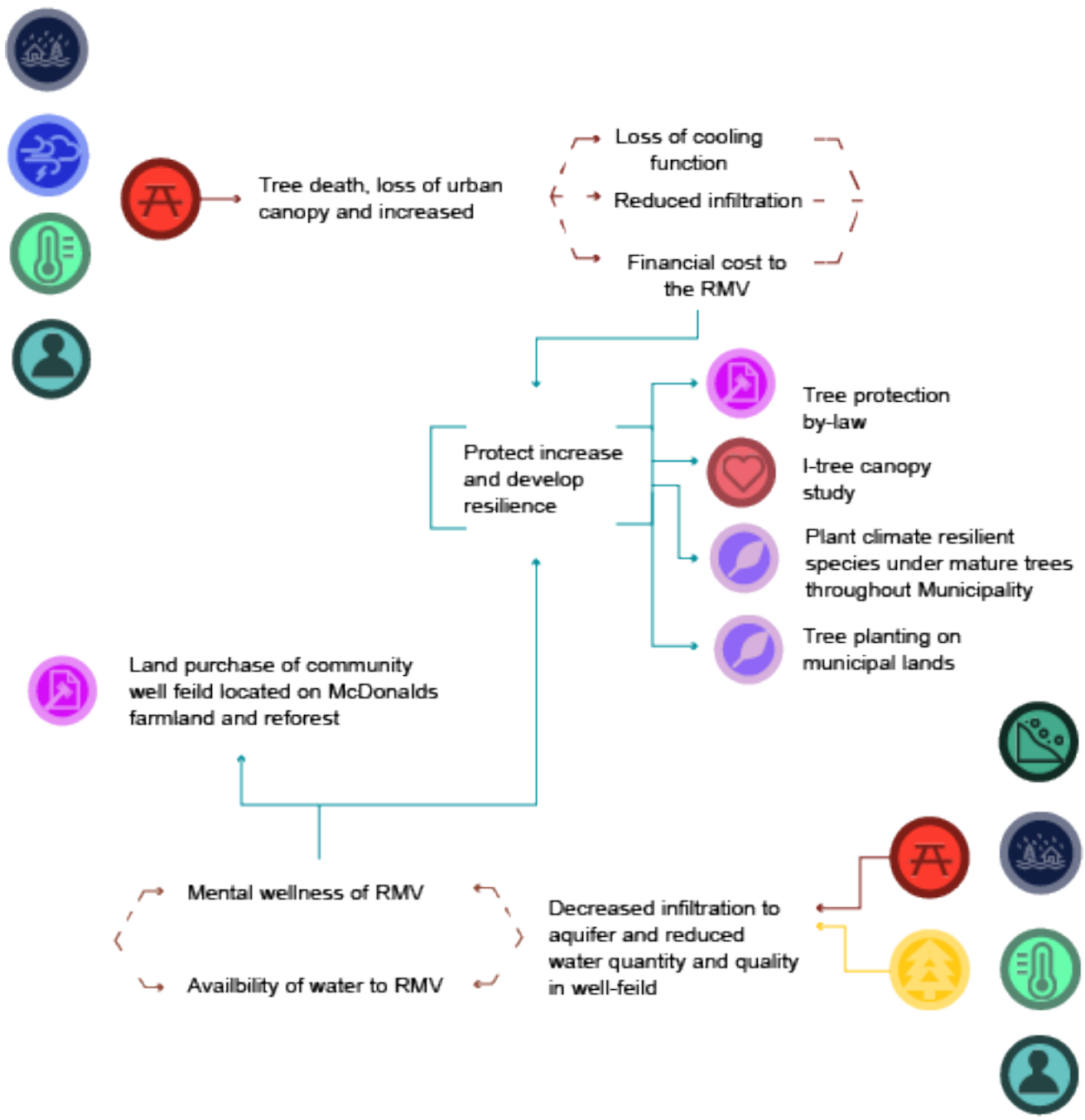


Figure 23: Climate risk impacts and adaptation actions system map on parkland and forested lands

Impacts, Effects and Actions of Climate risk on Salt Marsh and Estuary

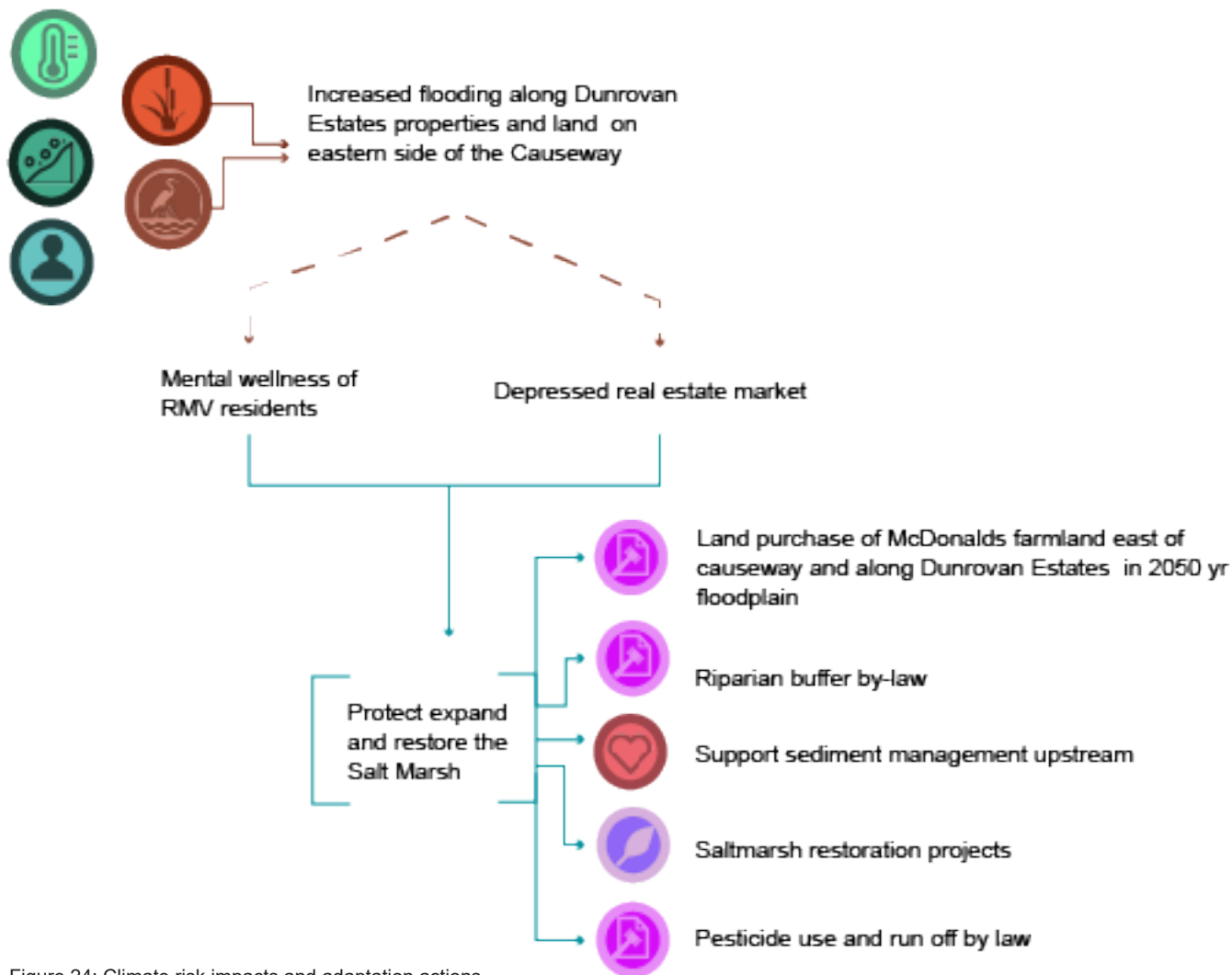


Figure 24: Climate risk impacts and adaptation actions system map on salt marsh and estuary.

Adaptive Capacity

Residents with the RMV are dedicated to their community. Throughout the reporting process individuals within the community consistently demonstrated their love of Victoria and commitment to maintaining a functional municipality. Barriers to adaptation action lie predominantly in the fiscal and administrative capacity of the municipality and entrenched values about the identity of the RMV.

In the case for adaptation, these three issues: values, fiscal and administrative capacity, are deeply linked. Fiscal and administrative capacity of the municipality would be enhanced by strategies which grow the municipal tax base but to grow the municipal tax base the RMV must consider a departure from the status quo - drawing in new industry or encouraging growth within the municipality. The ability of residents and council to imagine and pursue a 'new' Victoria will determine the success of the municipality.

Joining Forces - Supporting South Shore Watershed Association

The South Shores Watershed Association (SSWA) is a tremendous resource located within the RMV. Tasked specifically with care of the local watersheds, activities undertaken by this group will benefit the adaptive capacity of the RMV. The SSWA directly addresses both the fiscal and administrative capacity deficits noted within the RMV with significant time devoted to finding grant funding for ecologically based activities. Recognition of the potential for symbiosis between the municipality and the SSWA was a driving factor in seeking nature-based adaptation options.

Adaptation Recommendations

The Rural Municipality of Victoria has many opportunities to address climate change. The route which the municipality takes toward adaptation will depend on the fiscal and administrative capacity of the municipality and should be guided by the goals of the community.

Watershed Specific Adaptation Recommendations

At the watershed level there are a number of adaptation strategies that could be employed to manage climate risk and prevent further degradation of ecological systems. These include:

Manage Siltation and Sediment Loading

Climate risk and anthropogenic actions compound to make increased sediment load within the Westmoreland system a significant threat to ecosystem health. Climate factors such as increased erosion, extreme weather events and the combination of heavy precipitation with drought conditions all contribute to increased sediment load within the system. The dominance of agricultural land-use within the Westmoreland system further contributes to sediment and harmful pollutants entering the system.

Strategy: Establish, increase and enhance riparian buffers

Prioritize: Gaps in riparian buffers along higher order streams and agricultural lands with steep

Protect Headwaters and Key Infiltration Locations

Headwaters are the starting point for riverine health. Providing adequate forest and riparian protection around these locations contribute to water supply and quality within the watercourse.

Strategy: Establish, increase and enhance riparian and forest buffers around headwaters

Prioritize: Headwaters without buffers in agriculturally zoned lands or in close proximity to roads or urban areas.

Protect, Expand and Restore the Salt Marsh and Estuary

The salt marsh and estuary provide invaluable wildlife habitat and services to the RMV. Intervention in the landscape may have multiple co-benefits for both the RMV and broader watershed system.

Strategy: Land purchase, bylaw development, marsh restoration projects

Prioritize: Marsh restoration around critical municipal infrastructure, purchase of lands with high flood risk and agricultural zoning.

Manage Coastal Erosion along the Provincial Park

There is significant erosion occurring along the provincial park threatening both bank swallow habitat and upland park area. Actions which minimize wave action and reduce overland flow will protect the shoreline from further erosion.

Strategy: Nature-based solutions such as upland planting, living shoreline and living breakwaters, no-mow or low-mow strategies.

Prioritize: Upland planting and no-mow or low-mow strategies

Connect Forest Corridors

The eastern branch of the Westmoreland is connected to significant natural areas in the Brookvale and Bonshaw region. Enhancing forest connections between these regions will provide opportunities for species movement from interior Queens county to the coast. Natural corridors reduce stress on wildlife populations, reduce deaths at road crossings and enhance biodiversity through the system.

Strategy: Land-owner partnership, introduction of agroforestry, riparian buffer enhancement.

Prioritize: Patch areas in close proximity with critical gaps that could be addressed by small interventions.

Clean-up Highly Degraded Areas

Within the western branch of the Westmorelands there are large sections of highly degraded landscape with minimal riparian barriers, garbage and debris. These conditions impair downstream water quality and health across the system.

Strategy: River clean up, garbage and debris removal

Prioritize: Higher order streams, areas with the most damage.

Adaptation Recommendations at the Municipal Level

Adaptation options were presented to the municipality at a public meeting, on-line distribution and through conversation with key stakeholders such as, the mayor, fire chief, and members of the planning and water and sewer committee. Conversations with these stakeholders were used to narrow down the suite of adaptation recommendations provided to the municipality. Feedback on adaptation recommendations was sought, unfortunately none has been received at the time of this report's completion.

Adaptation options provided to the community are sorted into three overarching categories that differentiate the scale of the actions:

Transformational Adaptation: options offered in this section are visionary in nature. Options offered in this category depart incremental forms of adaptation, and reflect a change in the underlying system within the municipality. Changes of this nature would require fundamental shifts in thinking among community members and significant capacity inputs from all levels of government.

Big Moves: These are long term and strategic solutions. Adaptation options under this category require high financial and administrative capacity to undertake.

Quick Wins: Adaptation options under this category are intended to be easily implemented and highly visible. Options of this nature provide the community with tangible examples of addressing climate change which may help to encourage more radical climate adaptation options in the future.

Within these overarching categories adaptation options were further subdivided to identify how and who these actions would involve.



Nature-based Solutions: Adaptation options in the category use nature as the first line of defense. These options preserve, restore or enhance functions of existing ecological assets to address climate risk. Options in this category may also be constructed or engineered to mimic or adapt principles and functions found in the natural world.



Policy: Options within the category are an administrative action such as a regulation, procedure, incentive or law. These actions set up the rules for future actions within the community and provide a framework for climate smart decision making by both council and residents.



Infrastructure: Actions within this category relate specifically to physical infrastructure or material assets located within the RMV. Adaptation options within this category are tied directly to the physical assets that were examined within the risk identification process and contribute to sustainable service delivery within the RMV.



Community Capacity: Adaptation options within this category are intended to build capacity within members of the community through both material interventions and investment in training activities. Adaptation options provided in this category reduce the overall vulnerability of RMV residents to climate change.

Transformational Adaptation:

Explore models of mixed use development or specialty development types and advocate as a place to grow

The population of PEI is growing. Situated between PEI's two main industrial and urban centers (Summerside and Charlottetown) the RMV has an opportunity to capitalize on this growth and become a location for provincial investment. Self-advocating as a 'place to grow' for housing development at the provincial level may spur increased investment in housing development in Victoria, expanding the municipal tax base and further increasing financial investment within the RMV. Seeking out specific development types such as mixed income housing, housing for seniors or newcomers could further spur provincial investment.

Strategy: Advocating as a place to grow and location for specialized housing typologies.

Prioritize: Mixed-income low density and multi family units, seniors specific living communities.

Advocate for rapid transit links between Charlottetown and Summerside with connections to Victoria

The provincial government has shown a vested interest in mitigating contributions to climate change and investment in GHG reduction strategies. Public transit has been proven as a meaningful method for achieving this goal. Public transit options running along HWY 1 have the potential to reduce emissions generated by commuters and provide islands without access to personal vehicles access to rural areas. To directly benefit the RMV the development of public transit options along HWY 1 would need to be paired with a community rideshare program for commuters and community bus or bike program operated during the summer for visitors. The development of a public transit option for the summer months would significantly reduce pressure on parking infrastructure currently occurring within the municipality, limiting the need for expansion of impervious surfaces within the RMV.

Strategy: Advocate for public transit connections along HWY 1.

Prioritize: Summer bus and bike program to demonstrate value to the provincial government.

Expansion of current aquaculture practices and 3D long-line aquaculture

Within the RMV existing infrastructure offers the opportunity to grow the aquaculture industry. Expansion of the aquaculture industry could be explored through on-land aquaculture facilities and changes to current in-water aquaculture practices. Currently there are two pre-existing aquaculture facilities located in proximity to the RMV (Center for Aquaculture Technologies - Victoria/Biontech and Halibut PEI INC.). In addition to these physical resources, the operations at wharf and at Halibut PEI mean that there are shipping and receiving systems which are already linked to the community that could be expanded to support new industry.

Expansion of on-land aquaculture practices could be achieved by partnership with Halibut PEI and economic grants provided by the provincial government. In addition to onland operations methods of 3D ocean farming could be explored at currently existing aquaculture leases along the western shore of harbor. 3D Ocean Farms are a form of aquaculture that consist of shellfish and high value, fast growing seaweeds grown at varying levels of the water column. These models offer opportunities for increased food production and additional services such as carbon draw down and wave attenuation.

Strategy: Develop relationships with Halibut PEI, investigate provincial, academic and technical partnerships, explore changes to aquaculture zoning, begin awareness campaigns with local aquaculture farmers.

Prioritize: Advocacy and education of 3D ocean farming, explore partnership with Halibut PEI.

Nature-based Solutions:



Big Moves in Nature-based Solutions:

Oyster-texture and Coastal breakwaters

Post-tropical storm wave action and regular tidal forces contribute to erosion and flooding risk in the RMV. Methods such as oyster-texture structures and living coastal breakwaters disrupt wave energy reducing its impacts on the shoreline. These structures may be employed in the harbor of the RMV to reduce erosion occurring along the provincial park and potential protection of the causeway from damage.

Strategy: Develop relationships with technical partners and seek grant funding opportunities

Prioritize: Disaster Mitigation and Adaptation Fund (DMAF), partnership with Transcoastal Adaptation

Marsh-sills and Living Shoreline

Post-tropical storm wave action and regular tidal forces contribute to erosion and flooding risk in the RMV. Nature-based solutions such as installation of a living shoreline along the provincial park and integrated into the existing causeway may protect these areas from erosion. Due to the long fetch in both areas inter-tidal structures may need to be installed to disrupt wave action enough to ensure the success of the shoreline.

Strategy: Develop relationships with technical partners and seek grant funding opportunities

Prioritize: Small scale projects in partnership with SSWA as capacity building and proving ground opportunities.



Figure 25: Marsh sill Credit: <https://coastalreview.org/2016/12/18165/>

Large Scale Salt Marsh Restoration Projects

The salt marsh provides valuable habitat, flooding mitigation and recreational opportunities to the RMV. Currently there is erosion occurring along the Dunrovan Estates properties and agricultural pollutants leaking into the marsh from the McDonalds farm. Both of these factors along with climate change threaten the health of the marsh. Investment in marsh health holds significant benefit for the RMV, providing flooding attenuation, protection for Dunrovan Estates properties, the causeway and potentially the sewage lift station located along Water St. Salt marsh restoration projects would also have multiple co-benefits such as climate change mitigation through carbon sequestration.

Strategy: Develop relationships with technical partners and seek grant funding opportunities.

Prioritize: Small scale projects in partnership with SSWA as capacity building and proving ground opportunities. Seek opportunities for the installation of monitoring equipment (Marker horizons or SET monitor) and assessment of sediment dynamics by technical experts such as TransCoastal Adaptation, St. Mary's University or CBWES.

Quick Wins in Nature-based Solutions:

Eelgrass Meadow Restoration Project

An eelgrass meadow was located during the dredging of the harbour. Restoration and expansion of the eelgrass meadow has multiple climate mitigation and adaptation benefits. Eelgrass has been shown to provide wave attenuation which would reduce the rate of erosion along the provincial park. In addition to wave attenuation eelgrass creates valuable bait fish habitat strengthening local fisheries and surrounding ecosystems. In 2021, the Souris Watershed began an eelgrass meadow restoration project, partnership with this group and the SSWA would significantly increase the capacity of the municipality to undertake this project.

Strategy: Reach out the Souris Watershed and Partner with SSWA to explore the potential for a salt marsh restoration project.

Prioritize: Finding the boundaries of the existing meadow and performing an initial health assessment.

Plant Climate Resilient Species under Mature Trees throughout the Municipality.

Throughout the RMV there are large mature trees. The age and species of these trees places them at risk from post-tropical storm damage and heat stress due to changing temperature profiles caused by climate change. These trees provide valuable habitat and urban heat island cooling effect. To ensure a continuous canopy the municipality can under plant climate resilient trees alongside mature trees.

Strategy: Partner with SSWA and explore grants which support municipal tree planting.

Prioritize: Mature trees in the four core blocks.

Tree Planting on Municipal Lands

Increasing tree canopy within the municipality will increase stormwater infiltration, reduce urban heat island effect and provide valuable habitat within the RMV. Increasing tree and natural cover on municipal lands will have both adaptation and mitigation effects. Increased tree and natural cover may have additional benefits for the RMV such as reduced maintenance costs (mowing).

Strategy: Partner with SSWA and explore grants which support municipal tree planting.

Prioritize: Municipal lands.

Rain Gardens and Storm water Infiltration Methods

Rain gardens are a beautiful and functional way to manage storm water runoff on municipal and private lands. Rain gardens are easy to construct and require relatively low financial input.

Strategy: Partner with SSWA and explore grants which support municipal greening projects.

Prioritize: Demonstration rain gardens at the Old School House and Play House

Seeding and Planting Projects along the Causeway to Mitigate Overland Erosion

Along the causeway there is currently erosion occurring between the barrier fence and gabion baskets. There are both deep rills emerging along the dirt fill and soil loss occurring behind the baskets. If left bare these areas will continue to erode and contribute to the failure of the gabion baskets. Simple strategies such as increasing vegetation cover with low growing salt tolerant pioneer species and infilling deeply eroded areas will root stabilizing properties (willow, rose, dogwood) will reduce erosion and stabilize soil on the causeway.

Strategy: Partner with SSWA and explore grants which support municipal greening projects.

Prioritize: Deeply eroded areas behind gabion baskets.

Seeding and Planting Projects along the Causeway to Mitigate Overland Erosion

Along the causeway there is currently erosion occurring between the barrier fence and gabion baskets. There are both deep rills emerging along the dirt fill and soil loss occurring behind the baskets. If left bare these areas will continue to erode and contribute to the failure of the gabion baskets. Simple strategies such as increasing vegetation cover with low growing salt tolerant pioneer species and infilling deeply eroded areas will root stabilizing properties (willow, rose, dogwood) will reduce erosion and stabilize soil on the causeway.

Strategy: Partner with SSWA and explore grants which support municipal greening projects.

Prioritize: Deeply eroded areas behind gabion baskets.

Policy:



Big Moves in Policy:

Land purchase of community well-field located on McDonald farmland and re-forest lands.

The location of the community well-field on private lands stands out as a particularly high risk situation for the RMV. Gaining control over this resource would allow for better regulation and management of the communities water resources. Once land has come under control of the municipality a re-forestry program should be employed to increase infiltration, filter overland flow from adjacent farm fields and provide carbon sequestration.

Strategy: Explore provincial programs for land purchase, agricultural land retirement and develop relationships with McDonalds family to explore strategies such as easements, land gift or trust.

Prioritize: Develop relationship with the McDonalds family.

Land purchase of McDonalds farmland east of causeway and along Dunrovan Estates property within the 2050yr floodplain

The residential and agricultural properties located at the eastern end of the causeway along the inside of the estuary are located within the 2020 and 2050 yr flood plain as identified by the Coastal Hazards Information Platform (CHIP). Purchase of these lands would reduce flood risk to adjacent areas, expand current recreational opportunities for residents and visitors, restore valuable habitat and protect the salt marsh from leaching of agricultural chemicals. Areas of this land could be used as a location for additional infrastructure for the municipality (parking) or revenue generating opportunities such as a small campground.

Strategy: Explore provincial programs for land purchase, agricultural land retirement and develop relationships with McDonalds family to explore strategies such as easements, land gift or trust.

Prioritize: Develop relationship with the McDonalds family

Riparian Buffer By-Law

Currently no municipal regulations or by-laws exist protecting the riparian area of the Westmorelands. While provincial set-backs do exist, they are largely un-monitored and under enforced. Municipal by-laws which provide protection to the riparian area would strengthen current regulations and prevent encroachment into the riparian. It is recommended that the municipal by-law be calculated utilizing the river belt-width and average rate of erosion rather than the provincial standard of 15m for increased accuracy and enhanced protection.

Strategy: Develop a riparian buffer by-law

Prioritize: Partnership with SWWA to calculate river belt-width via student work program, and establish committee or hold community meetings.

Tree Protection By-Law

Protecting the existing urban canopy is valuable for both climate mitigation and adaptation. Currently no tree protection bylaws exist within the RMV. The establishment of a tree protection bylaw would create a process for both residents and future developers that would require the assessment of tree health, value and need for removal before approval of tree removal. In addition the by-law should employ a compensation planting ratio to be used if and when a tree is removed.

Strategy: Develop a riparian buffer by-law.

Prioritize: Establish a committee or hold community meetings.

Stormwater By-Law or Fees

Residential stormwater management and increased infiltration may reduce pressure on municipal infrastructure and decrease inland flooding risk. The development of this by-law should apply to the control, management, treatment and disposal of all stormwater runoff from all lands located within the RMV with language that enforces the infiltration of stormwater on-site whenever possible. Fee schemes, which are calculated using the proportion of impervious surface and infiltration opportunities on-site, may be most useful in the case of new development. These schemes are currently being developed in Ontario and are linked with increased municipal funds which could be used to upgrade municipal infrastructure. It is recommended that these by-laws be created before additional development takes place rather than during or after processes have begun.

Strategy: Develop a stormwater by-law or fee scheme

Prioritize: Raise the issue within the water and sewer committee and hold community meetings.

Municipal Hard Armouring By-Law

Hard armour of shorelines has occurred up and downstream within the watershed. Increased rates of erosion alongside the highly visible locations such as the provincial park may lead to the perception among residents that hard armouring of shoreline properties is necessary. A municipal by-law which limits hard armouring to all but the most necessary, such as critical infrastructure protection, would limit hard armouring on residential properties. The process of creating such a by-law should be paired with community education sessions about living shoreline methods and the training of municipal staff in the Green Shores for Homes program.

Strategy: Develop a stormwater by-law or fee scheme

Prioritize: Research by-law and fee schemes currently in place within Ontario, establish a committee or hold community meetings

Pesticide Use By-Law

Runoff from residential and agricultural lands contribute to polluted waterways and degraded habitat quality. Reduction of pesticide use and regulation of pesticide type offers one way to limit these negative impacts. In 2017 the City of Charlottetown developed the Cosmetic Pesticide Bylaw. The bylaw restricts the application of non-domestic pesticides for the control of pests within the municipality. This by-law may be used as a model for the development of pesticide use by-law within the RMV.

Strategy: Develop a Pesticide use by-law

Prioritize: Research the by-law currently in place in the Charlottetown, seek input and advice (The Department of Environment, Energy and Climate Action), establish a committee or hold community meetings

Quick Wins in Policy:

Support Low and No Mow Maintenance Schedule on Municipal and Private Lands

Turf grass is a high maintenance plant which provides little to no habitat value. Re-seeding municipal lands with a low-mow native mix will reduce pressures on maintenance and increase habitat quality throughout the RMV. In addition to a low-mow seeding strategy, areas of municipal lands could go un-mowed and restricted from public use for portions of the season, providing soil and root structures with 'rest time' and further reducing maintenance costs to the RMV.

Strategy: Seed municipal lands with low-mow native mix and create rest areas

Prioritize: The provincial park

Support Low Water Use on Municipal and Private Lands during Heatwaves and Drought

Excess water use during times of drought places unnecessary strain on water resources. Limiting water use on non-essentials will reduce strain on the community well field preserving water for essential activities.

Strategy: Develop drought awareness through the community and create municipal policy regarding water use

Prioritize: low or no water use on municipal lands during times of drought

Infrastructure:



Big Moves in Infrastructure:

Retrofit Information Center and Bathrooms at the Harbor to allow for Rapid Drainage in Flooding Events.

The information center and bathrooms at the harbor are located within the 2020 and 2050 yr flood plain as identified by the Coastal Hazards Information Platform (CHIP). This is valuable infrastructure for tourist activities within the RMV. Assessment. Retrofitting of both buildings to allow for rapid drainage and return to working order would allow for the re-establishment of regular tourist activity post storm. Additionally, flood proofing these buildings prior to an event may reduce repair costs post-event reducing financial strain on the municipality over the long term.

Strategy: Explore flood proofing methods and financing opportunities specific to protection of municipal infrastructure from flooding (Intact Adaptation Action Grant, PEI Climate Challenge grant).

Prioritize: Bathrooms



Figure 26. Beach at Victoria Harbour Credit: <https://meetingsandconventionspei.com/member/victoria-by-the-sea/>

Move Central Lift Station and Retrofit Existing

The central lift station located on Water St is in close proximity to the 2020 and 2050 flood plains as identified by the Coastal Hazards Information Platform (CHIP). In the calculation of risk it is important to remember that these flood plains are model calculations only, do not account for overland precipitation and reflect only one possibility of flooding. The proximity of the lift station to the floodplains place this infrastructure at risk of damage and short term inundation. In either of these instances this may cause temporary loss of wastewater service to RMV residents and damage to the treatment facility. Relocation of the lift station and retrofitting of the existing lift station would likely need to be considered to protect wastewater infrastructure within the RMV.

Strategy: Employ outside technical experts to assess the risk to the lift station and identify opportunities for new lift station location.

Prioritize: Feasibility study.

Quick Wins in Infrastructure:

Assess the Condition of the Central Lift Station

The central lift station within the RMV is in close proximity to the 2020 and 2050 floodplains. The condition and current state of the lift station will be a contributing factor in future plans to retrofit or move the lift station. A preliminary assessment would provide the community with valuable information regarding the current state of the asset and lend itself to future decision making.

Strategy: Engage a technical professional to complete an asset assessment, detailing current state, expected timeline for asset retirement and flooding risk

Prioritize: Complete as part of current community sustainability study

Assess Conditions of Forced Water Main Pipes along Water St

Currently there is limited to no knowledge of the condition of the forced water mains located along Water St. The condition of these mains is a concern due to the risk of salt water seepage which could occur in a post-tropical storm event. Salt water seepage has the potential to place all water sources downpipe at risk for contamination. If possible a conditions assessment for the entire forced water system should be completed.

Strategy: Engage a technical professional to complete an asset assessment, detailing current state, expected timeline for asset retirement and flooding risk.

Prioritize: Water infrastructure located on Water St. Complete as part of current community sustainability study.

Retrofit Old School House in the Emergency Center and Community Cooling Hub

During an emergency a central location stocked with adequate resources will be a determining factor in response, experience of and return to normal for RMV residents. The basement of the Old School house is currently used for general storage with adequate room for the storage of emergency provisions. In addition to an emergency center, the existing air conditioning system and communal space could be used to create a community cooling hub for residents without air conditioning during times of prolonged heat waves.

Strategy: Create a community Emergency Center in the Old School House.

Prioritize: a list of basic supplies and equipment, with associated cost required for retrofitting of Old School House into an Emergency Center. Pilot Community Cooling Center.

Purchase Back-up Generator for Pump House and Forced Water Main System

Currently the forced water system in Victoria is powered by the Maritime Electric grid with no back up power source. With this configuration a storm event where power is disconnected will leave residents without access to potable water until electricity services are restored. The duration of the water shortage will be determined by the impact of the storm across the island and response time of Maritime Electric.

Strategy: Assess municipal finances and grants available for adaptation

Prioritize: All funding streams and potential loan options to finance.

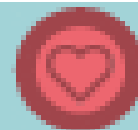
Retrofit Playhouse with Backup Sump-pump, Battery and Flood Warning System

During Hurricane Dorrian the Playhouse basement was flooded. As heavy precipitation events increase in frequency it is likely that such a flooding event may occur again. Simple retrofits such as ensuring the existing sump-pump has a backup battery and installing a flood warning system would protect existing assets stored within the basement and reduce repair cost incurred by the municipality. Internal flooding mitigation tactics could be paired with external retrofits (rain garden, rain garden, grading modification, window wells) to strengthen resilience.

Strategy: Install a suit of flood mitigation and warning systems within the Play House

Prioritize: Back-up battery

Community Capacity:



Big Moves in Capacity:

Support Sediment Management and River Restoration Activities Upstream

Overall river health and sediment dynamics play an important role in the quality of ecosystem services provided by the estuary, salt marsh and sand flats. Located at the end point of the river the RMV essentially receives the magnified effects of all problems which occur upstream. Partnership with the SSWA and support of activities which educate individuals about good sediment management actions upstream would benefit ecosystem health downstream and within the RMV.

Strategy: Partner with SSWA in grant applications, events and awareness campaigns which occur both within municipal boundaries and beyond.

Prioritize: Sediment management awareness campaigns.

Quick Wins in Capacity:

Pre-storm Community Culvert Clean Out

Debris or overgrowth within the culvert system in the four core blocks may contribute to instances of in-land flooding on near-by properties. Seasonal clean out of culvert systems or maintenance checks prior to a known storm event would decrease this risk and may contribute to increase social capital and feelings of resilience among RMV residents.

Strategy: Create a seasonal community event dedicated to culvert clean out

Prioritize: Four core blocks

Develop Saltwater Intrusion and Flooding Plan for Septic Treatment Facility

Long term inundation of Water St or flooding of the pump station in a Post-tropical storm event may result in saltwater intrusion to the wastewater system and septic treatment facility. The RMV septic system is fairly unique and relies on a delicate balance of bacteria to process waste. This bacteria is not salt tolerant and it is likely that the function of the wastewater system would be disrupted by salt water entering the system. Determining the likelihood of this event, steps to remedy and associated costs should be a consideration for the municipality and may inform decision making around the managed retreat of the sewage lift station.

Strategy: Include as area of consideration during larger asset assessment of sewage lift station

Prioritize: Feasibility study and associated costs.

Purchase Flooding Protection Infrastructure and Develop Community Plans to Protect Lift Station in Post-Tropical Storm Events.

Until the time where the lift station can be moved temporary flood protection may serve as the most prudent way to reduce risk. To further reduce risk, having the appropriate flood protections on hand and a plan with which to employ them will increase the adaptive capacity of the RMV to flood events.

Strategy: Research and determine the most appropriate and reusable methods of flood protection that could be employed around the lift station.

Prioritize: lowest cost readily available solutions that can be used while longer term flooding protection is researched and financed.

I-tree Canopy Study

Having a solid understanding of assets is the first step to protecting and improving them. An I-tree canopy study would provide the RMV with a baseline understanding of the urban canopy and natural cover that exists within the RMV. This information could then be used to inform future planting strategies and bolster grant applications.

Strategy: Partner with SSWA and develop a baseline understanding of urban canopy within the RMV

Prioritize: Summer student work programs and grants which support municipal greening initiatives.

Support Residents in Accessing Energy Retrofit Grants and Programs

Numerous provincial grants exist which support residential energy retrofits. Unfortunately, the structure of these grants can be challenging for residents to negotiate on their own. Access to these grants may be further limited by the older age and internet literacy of RMV residents. The age of the housing stock within the RMV's four core blocks is likely contributing to high energy use and continued use of other unsustainable methods (oil or wood) in heating homes. Developing programs or a community resource person which can aid residents in navigating these programs would likely increase their successful completion and contribute to both mitigation and adaptation efforts within the RMV.

Strategy: Increase ability of residents to access and successfully complete energy retrofits available through the province.

Prioritize: Training and capacity development of 1 community resource person. Leverage existing knowledge from the retrofit of Old School House.

Living Shoreline Education Program

Living shorelines offer a nature based solution to erosion control in addition to offering benefits such as habitat creation, overland flow control and storm surge protection. These methods are a departure from traditional armoring methods and are likely unfamiliar to most Victoria residents. Education programs which increase awareness of living shoreline methods will increase the likely-hood that residents will select them over traditional hard armoring methods.

Strategy: increase awareness of alternative methods of shoreline protection

Prioritize: residents with waterfront property.



Figure 27. Beach in the Rural Municipality of Victoria Credit: <https://meetingsandconventionspei.com/member/victoria->

A Plethora of Options:

When undertaking adaptation in the RMV and Westmorelands there are many paths to consider. Each option must be weighed against the risk it addresses and benefits offered. The provided adaptation actions are wide ranging and provide an opportunity for the RMV to address the climate risks that are most important to the municipality. Decision making about which risk to address should be chosen collectively by both the community and council ensuring a sense of ownership and agency.

However, within the provided adaptation solutions there are actions which may be either easier to implement, provide a high return on investment in adaptation to climate change or lay the groundwork for larger transformational forms of adaptation. Through discussion with the Climate Change Adaptation Committee and assessment of relative risk key actions for the RMV to consider were identified. Those options are:

Big Moves:

- Oyster-tecture, marsh sills and living breakwaters in the harbor
- Land purchase of McDonalds farmland east of causeway and along Dunrovan Estates property in floodplain
- Purchase and reforest community well field land
- Retrofit Old School House into Emergency Hub and Cooling Hub
- Move or raise sewage lift station on Water St

Quick Wins:

- Plant climate resilient species under mature trees throughout municipality
- Eelgrass Meadow restoration projects
- Support low and no mow schedule on municipal lands and private property
- Purchase back-up generator for forced water system
- Purchase temporary flooding protection and develop community plan to protect lift station
- Support residents in accessing energy retrofit grants and programs

In Closing - Making Adaptation Happen

Adaptation can occur in two ways, it can be pre-emptive and planned for or a forced response created by an experienced event. While both move the needle toward climate resilience, pre-emptive adaptation is lower cost, can find win-win opportunities and increases adaptive capacity to future climate risks. Within the RMV adaptation to climate change will be synonymous with finding models of growth or diversification that support sustainable service delivery to residents. Limits to adaptation within the RMV are largely a question of fiscal and administrative capacity. Strain on the COA and council leaves little resources to undertake projects beyond the day to day functioning of the municipality. Unfortunately, the cost of not undertaking adaptation will be more costly in the long term and further restrict the ability of the RMV to adapt to climate change. Currently most adaptation action is incremental in nature, with municipalities taking small steps toward adaptation. While this is effective it does not result in the deep and systemic changes required to meaningfully adapt to climate change and new socio-economic paradigms. Within the RMV pairing 'Quick Wins' with conversations about transformational models of adaptation may be the most appropriate strategy and the only way to finance adaptation options offered in the 'Big Moves' category. Adaptation to climate change is a long term commitment with no silver bullet to climate resilience. Within the RMV the ability to capitalize on opportunities, be it grant funding or provincial partnership will determine timelines to be successful in adaptation.



Figure 28. Beach at Victoria Harbour Credit: <https://meetingsandconventionspei.com/member/victoria-by-the-sea/>

References and Resources:

1. CHANGING CLIMATE, CHANGING COMMUNITIES: GUIDE AND WORKBOOK FOR MUNICIPAL CLIMATE ADAPTATION

<https://icleicanada.org/project/changing-climate-changing-communities-guide-and-workbook-for-municipal-climate-adaptation/>

2. Climate Change Adaptation Planning: A Handbook for Small Canadian Communities

<https://cip-icu.ca/Files/Resources/RURAL-HANDBOOK-FINAL-COPY>

3. Building Resilience With Nature: Ecosystem-based Adaptation in National Adaptation Plan Processes

<https://napglobalnetwork.org/resource/building-resilience-with-nature-eba-in-nap-processes/>

4. C40 CITIES CLIMATE CHANGE RISK ASSESSMENT GUIDANCE

https://cdn.locomotive.works/sites/5ab410c8a2f42204838f797e/content_entry5ab410fb74c4833febe6c81a/5b17dd2614ad660612c5dc54/files/C40_Cities_Climate_Change_Risk_Assessment_Guidance.pdf?1541689629

5. PEI province-wide Climate Change Risk Assessment (CCRA)

https://www.princeedwardisland.ca/sites/default/files/publications/pei_ccra_2021.pdf



Figure 29. Victoria Harbour and bait shacks Credit: <http://escapadeswithemma.com/victoria-by-the-sea/>