Understanding the Determinants of Effective Policy Instruments: Lessons Learned from Case studies of Climate Change Adaptation in Québec, Atlantic Canada and Massachusetts

Six case studies identified factors that motivate jurisdictions to develop specific policy instruments and others that facilitate their implementation and promote their positive outcomes. Three studies examined the mechanisms used by provinces or states to support municipalities in their climate change adaptation planning. They looked at the instruments used in Nova Scotia, New Brunswick and Massachusetts. Another study examined the environmental assessment of bank stabilization projects in the North Shore region of Québec. A fifth study examined the consideration of climate change adaptation in the Regional Land Use and Development Plan of the Montreal agglomeration. A sixth study looked at the Climate Ready Boston planning process.

Québec, New Brunswick and Nova Scotia are provinces in eastern Canada. They share borders with each other, and all three have coastlines along the Gulf of St. Lawrence. New Brunswick and Québec share Chaleur Bay (Baie des Chaleurs); New Brunswick and Nova Scotia share the Bay of Fundy. Massachusetts is a state in the northeastern United States, geographically close to Canada but not sharing a border. Massachusetts, Nova Scotia and New Brunswick all have coastlines along the Gulf of Maine.

Like all coastal regions of the world, these regions are being affected by a gradual rise in sea level. However, the vertical movement of the Earth's crust, related to the isostatic rebound that followed the melting of the glaciers of the last ice age, is causing differences in relative sea level rise. Indeed, this rebound causes the crust to rise in the continental areas previously covered by glaciers, but to sink at their edges. In Québec, the isostatic rebound partially offsets sea level rise, while in Nova Scotia, sea level rise is amplified.

Project partners

This brief summarizes key findings from the project "Understanding the Determinants of Effective Policy Instruments: Case Studies of Climate Change Adaptation in Québec, Atlantic Canada and Massachusetts". This project is coordinated by the Observatoire Québécois de l'adaptation aux changements climatiques (OQACC), based at Université Laval, and conducted in collaboration with Ouranos, University of Massachusetts Boston, University of Massachusetts Amherst and CBCL Limited in Halifax. The project is supported by Natural Resources Canada's Climate Change Adaptation Program and the Government of Québec, as part of the Québec Research Funds and the 2030 Plan for a Green Economy. This research contributes to the reflections of the Coastal Management Working Group of Canada's Climate Change Adaptation Platform.

The project's full report acknowledges the many individuals who contributed to the project as researchers or participants.

Our methods

Researchers of the OQACC, CBCL Limited and the Sustainable Solutions Lab at University of Massachusetts Boston collaborated to conduct the case studies. In their respective geographical areas, they examined the policy measures in place, what motivated them, and what factors either enabled or constrained their implementation and outcomes. They identified goals of the policies from review of the associated documentation and conducted discussions as well as semi-structured interviews with key informants. Informants included staff from provincial, state or municipal governments that implement the instruments studied, as well as consultants and staff from non-governmental organizations (NGOs). In some studies, virtual workshops allowed to gather additional perspectives.

This brief summarizes the perceptions expressed in the interviews and goals expressed in the policy documents. It organizes them according to the project's conceptual framework, based on the Theory of Reasoned Goal Pursuit.[1] This framework considers enablers and barriers, as well as factors that motivate the use of policy instruments. Motivating factors include perceived advantages and disadvantages of the policy measures, and perceived social pressures. The project's full report presents details of the project's conceptual framework as well as its application in each case study.

[1] Ajzen, I., & Kruglanski, A. W. (2019). Reasoned action in the service of goal pursuit. *Psychological Review*, *126* (5), 774-786

Common factors

The case study results indicate that many of the motivating and facilitating factors are consistent across all locations and levels of governance. Table 1 presents main factors, organised along the project's conceptual framework. Motivating factors include anticipated benefits in risk reduction as well as improved quality of life. Having had recent catastrophic events in or near their jurisdictions, such as Hurricane Sandy in New York, storm-related flooding in Nova Scotia and New Brunswick, and heat waves in Montreal, reinforces the belief that there is a need to implement adaptation measures. On the other hand, risk reduction goals may fluctuate and be less active between extreme weather events. Setting quality-of-life goals can support governments' motivation to implement public policy instruments and can help obtain public support for them. Specifically, solutions such as greening, parks, and conservation of natural environments can reduce risk while providing opportunities for recreation, access to nature, and socialization.

Perceived social pressures, which may result from government requirements, expectations expressed in public consultations or previous commitments, may also influence governments' motivation. For example, local governments may be reluctant to impose restrictions on development in at-risk areas because of pressure from affected property owners, in addition to possible losses in income from property taxes. Some cities choose to adapt buildings and protect the coast, which in turn raises issues related to the financing of protective structures and their environmental impact.

We note that barriers can result from a lack in some of the enablers, which can in turn result from a lack of motivation of potential collaborators or targeted actors, or from barriers experienced by them. Authorities can develop new policies and instruments to overcome these barriers.

Different policy instruments can influence targeted actors and promote a given adaptation behaviour by:

- motivating the actors, by:
    - informing them of about the advantages of the behaviour;
    - making the behaviour compulsory in order to gain approval (e.g. preparing a municipal adaptation plan to access provincial infrastructure funding; using approved roofing materials to obtain a municipal construction permit), thereby creating a social pressure;
- providing resources (financial, human, organizational and informational) to facilitate it.

Table 1 : Summary of the main determinants of the effectiveness of policy instruments

Motivating factors		**Perceived enablers (☺) or barriers (☹)**
Perceived advantages (☺) and disadvantages (☹)	**Perceived social pressure favourable (☺) and unfavourable (☹)**	
☺ Catastrophic events favour the perception that interventions are needed ☺ Considered options reduce risk ☺ Considered options improve quality of life	☺ Government requirements ☺ Industry standards ☺ Donor requirements ☺ Requests expressed in public consultations ☺ Previous commitments	☺ Motivated and competent human resources within the administration ☺ Availability of experts (academia, consultants, NGOs) ☺ Availability of information, such as climate projections, maps of risk areas ☺ Availability of funds ☺ Involvement of stakeholders/member jurisdictions ☺ Boundary work, at the interface between the different actors/entities and with scientific research. ☺ Developing new policies and instruments to overcome barriers
Considered options: ☹ Can limit what people can do on their property ☹ Can cause a reduction in tax revenue ☹ Some coastal protection measures can reduce access to the coast and have negative environmental impacts	☹ Pressure by members of the constituency or development industry ☹ Elected officials can be reluctant to adopting unpopular measures	☹ Lack in some of the enablers mentioned above ☹ Some considered options may require more resources (financial, human, organizational and informational) than others and are therefore not selected

Factors related to the use of information and knowledge

In each of the case studies, we saw how governments at different levels use research results in a variety of processes, including stakeholder engagement, planning, decision-making, and asset management. These scientific findings, which are often included in information products of all kinds, are enablers for governments to make decisions and know how to proceed. Governments also use them to influence the actors targeted by their public policies, either to motivate them to act or to make it easier for them to do so.

Collaborations between scientists and governments very often shape policy instruments such as adaptation plans, risk maps or regulations. These instruments can therefore be described as "boundary objects". Sometimes consultants use projections to develop information products tailored to the needs of a particular government, for example, flood risk maps that consider both sea level rise and projected precipitation resulting from international modeling efforts. These consultants, often from academia or NGOs, often play an important role in developing adaptation plans or options that are based on scientific research findings. They also play an important boundary role between the scientific community and governments. In addition, Quebec, New Brunswick, Nova Scotia and Massachusetts have funded the development of information portals by universities and research centers for the benefit of municipalities and other stakeholders.

Factors related to stakeholder engagement

All the case studies emphasized the importance of stakeholder engagement, and several highlighted certain challenges.

Several of the public policies studied required, or still require, public consultation, such as Nova Scotia's Integrated Community Sustainability Plans (ICSPs) and Municipal Climate Change Action Plans (MCCAPs); Massachusetts' MVP program; and land use planning and bylaw changes in Nova Scotia, New Brunswick and Quebec, among others. Case study participants expressed concerns about consultation issues. For example, one participant in New Brunswick noted that authorities are sometimes reluctant to present risk maps to residents unless they have strategies to propose. In these cases, they are cutting themselves off from a source of ideas, as residents could also be involved in proposing relevant solutions. On the other hand, the MPV case study highlighted the difficulties of engaging, in consultations, environmental justice populations as well as non-English speaking people and people living with disabilities. The study in the Montréal agglomeration highlighted the fact that tight timelines had reduced the number of consultations possible.

Studies have highlighted some processes in which authorities have gone beyond consultation to facilitate the active participation of many different stakeholders. For example, in New Brunswick, the government supports the New Brunswick Environmental Network in organising the Climate Change Adaptation Collaborative, which holds annual meetings and other activities. NGOs, regional service commissions, universities, consultants and other community partners are very involved in supporting municipalities in their adaptation planning. This has created a momentum that is further influencing government decisions to support various organizations to assist municipalities. There has been a “snowball effect” in which stakeholders have asked for better engagement mechanisms.

Community involvement is also a factor that can contribute to the success of specific adaptation actions. For example, the Montreal agglomeration case study highlighted how volunteers contributed to the maintenance of some parks. Neighbors who get involved in their green alleys maintain green public space and, at the same time, create social networks that increase resilience in various ways.

Private sector engagement is al so very important and has been a key factor in supporting the Climate Ready Boston initiative.

Factors promoting equity and environmental justice

Adequate stakeholder consultation and participation will not be sufficient to promote equity and justice if the most vulnerable are not able to participate. Massachusetts's Municipal Vulnerability Preparedness (MVP) program requires that municipalities receiving grants involve environmental justice populations in significant decisions. In Canada, many public policies require consultation with Indigenous communities, and federal and provincial environmental assessment processes require consideration of the adverse impacts of projects on any group of people. Bill C-230 is currently under consideration by the Canadian Parliament, if passed, would require the Minister of the Environment and Climate Change to develop a national strategy to address environmental racism within two years.

One of the ways to promote equity in adaptation to climate change is to anticipate the undesirable consequences of options considered and to work on solutions to mitigate them. For example, urban greening and parks can contribute to gentrification, making neighborhoods more pleasant and increasing property values and rents. Social housing is one way to curb gentrification and promote a social mix in neighborhoods.

Another equity concern is access to the coast, which is often limited by private property. Risk reduction and access to the coast can be combined by preserving natural environments, establishing parks, and planning pedestrian and bicycle access.

Conclusions

Results show that the effectiveness of public policy instruments depends on the motivation to implement them, as well as on a range of facilitating factors whose absence may constitute barriers. Motivating factors include anticipated benefits in terms of risk reduction and improved quality of life. Solutions that pursue both of these goals, such as greening, parks and conservation of natural environments, can motivate jurisdictions to act and can encourage buy-in from residents. Perceived social pressures, which may result from government requirements, expectations expressed in public consultations or previous commitments, also influence motivation. The effectiveness of a policy can be reduced by a lack of motivation of its targeted actors, or by barriers experienced by them.

Governments use the results of scientific research in planning, stakeholder engagement and decision-making processes. They use them to choose the instruments to implement but also to motivate and facilitate those they seek to influence with their public policies. In the cases we studied, governments were able to advance climate change adaptation by combining different types of instruments, as well as by putting in place new measures to overcome the barriers they faced and to help the targeted actors overcome theirs. The different types of instruments that aim to influence targeted actors can have an effect on the variables in the conceptual framework that serves as the theoretical basis for this project: instruments that seek to inform about the benefits of a promoted behaviour, those that make the behaviour compulsory in order to gain approval, thus creating social pressure, and those that have a facilitating effect (e.g., by providing financial, human, organisational and information resources).

The case studies highlighted challenges related to engaging the most vulnerable populations, coordination between adjacent municipalities, and the need to establish standards on what restrictions to put in place. Our results suggest that strategic planning tools for regional land use planning can foster synergy among different actors around long-term collective goals while taking climate change into account. Equity and environmental justice must also be considered in the objectives and measures put in place.

How Nova Scotia is supporting municipal climate change adaptation planning

Case study findings suggest that a key success factor of Nova Scotia's support for municipal adaptation planning is the responsiveness of the province to the barriers identified by its municipalities. Nova Scotia has responded by providing information, guidance and funds, as well as by imposing new requirements. In the process, the province took advantage of funding opportunities provided by the federal government. In 2010, the province became the first in Canada to require municipalities to develop climate change strategies in order to qualify for federal gas tax funds administered by the province. As a result, by the end of 2013, all fifty municipalities in the province had their own Municipal Climate Change Action Plan (MCCAP).

Nova Scotia has over 7,000 kilometers of coastline. It is a peninsula connected to the west with New Brunswick and the rest of Canada by the Isthmus of Chignecto. It has a population of 923,598 at the 2016 census[2], covering an area of 52,942 km^2. A maritime province, Nova Scotia faces a range of climate change-related risks resulting from increased climate variability, rising sea levels and associated impacts such as erosion, storm surges and flooding.

Our methods

Researchers of the *Observatoire Québécois de l'adaptation aux changements climatiques* (OQACC) and CBCL Limited examined Nova Scotia's policy measures, what motivated them, and what factors either enabled or constrained their implementation and outcomes. They identified provincial goals and planned actions related to supporting municipalities from review of a guidebook prepared by the province to assist the development of MCCAPs. They conducted interviews with officials in Nova Scotia's Department of Municipal Affairs and Housing and the municipalities of Guysborough and Mahone Bay, as well as with a professor at Dalhousie University's School of Planning.

This brief summarizes the perceptions expressed in the interviews and goals expressed in the policy documents. It organizes them according to the project's conceptual framework, based on the Theory of Reasoned Goal Pursuit (TRGP).[3] This framework considers enablers and barriers, as

[2] Statistics Canada. (2017). *Nova Scotia [Province] (table). Census Profile, 2016 Census.* https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/index.cfm?Lang=E

[3] Ajzen, I., & Kruglanski, A. W. (2019). Reasoned action in the service of goal pursuit. *Psychological Review*, *126* (5), 774-786

well as factors that motivate the use of policy instruments. Motivating factors include perceived advantages and disadvantages of the policy measures, and perceived social pressures.

The policy development process

Researchers observed a chain of influence linking federal, provincial and municipal jurisdictions in the development of policies and plans. The Canada-Nova Scotia Agreement on the Transfer of Federal Gas Tax Revenues, in place since 2005, was the initial catalyst. It provided federal funding for the province to invest in eligible municipal infrastructure projects. Nova Scotia administered the Gas Tax Fund and transferred funding to municipalities, conditional on their progress towards an Integrated Community Sustainability Plan (ICSP). In 2009, the group that managed the Fund opted to use the next round of gas tax funding as an incentive to advance key issues expressed in the ICSPs.

The province's examination of the ICSPs revealed that municipalities across Nova Scotia mentioned climate change as an issue of concern, which they often linked to increased costs of repairing infrastructure after storms. Those needs in turn motivated the province's requirement for Municipal Climate Change Action Plans. Analysis of the resulting MCCAPs then showed that a lack of up-to-date flood maps was impeding municipal adaptation. In 2018, federal disaster management funds provided the province with the opportunity to respond to this need by developing a Municipal Floodline Mapping Project. Table 1 presents the policies most relevant to supporting climate change adaptation in Nova Scotia.

Motivating factors for the province

The impetus to introduce the MCCAP requirement stemmed from a desire to encourage municipalities to think about the impacts of climate change and plan accordingly. In addition, the province was responding to a number of pressures, or needs expressed, including:

- the emergence of climate change as an area of concern in municipalities' sustainability plans;
- municipal and provincial emergency management organizations calling for better prevention of flood risks.

Some municipal officials indicated that meeting the Gas Tax Agreement's reporting requirements was challenging. To avoid overburdening municipalities, the province did not require monitoring reports following the MCCAPs.

Table 1: Policies supporting climate change adaptation in Nova Scotia

Policy name	Date	How it supports municipal adaptation
Statement of Provincial Interest Regarding Flood Risk Areas	1998	This statement aims to protect public safety and property and to reduce the need for flood control works and flood damage restoration in the floodplain. It recognizes that floodplains are nature's storage area for floodwaters.
Toward a Green Future: Nova Scotia's Climate Change Action Plan	2009	This plan defines a series of actions for greenhouse gas reduction and adaptation to climate change. Action 48 (p. 28 of document) proposed to *"Amend funding agreements with municipalities by 2010 to require climate change strategies in municipal Integrated Community Sustainability Plans."*
Canada-Nova Scotia Agreement on the Transfer of Federal Gas Tax Revenues	2005-2010	In order to receive funding, municipalities were required to prepare an Integrated Community Sustainability Plan and report their progress.
	2010-2014	In order to receive funding, municipalities were required to prepare an MCCAP by the end of 2013. The province developed a guidebook, published in 2011.
	Since 2015	The federal government requires municipalities in all provinces to conduct asset management efforts and in the future will require asset management plans.
Flood Risk Infrastructure Investment Program	Since 2013	This program aims to encourage municipalities to invest in infrastructure that reduces flood risks and community vulnerability
The Municipal Floodline Mapping Project	2018	This project aims to discourage development in unsafe places and to contribute to climate adaptation planning. It will provide updated flood maps, taking into account sea level rise and storm surges.
New amendments to the *Municipal Government Act*	2018	These amendments make it mandatory for municipalities to have, by 2023, a comprehensive planning strategy and a land use bylaw that covers the entire municipality. The Act also makes it mandatory to incorporate the provisions of Statements of Provincial Interest into these documents.
Coastal Protection Act (regulations in development)	2019	These regulations will set clear rules to prevent activity and development in locations where they would be at risk of sea level rise, coastal flooding, storm surges or coastal erosion.

Factors enabling support for municipalities

Enabling factors for the provincial government to develop this policy included its role in the transfer of funds to municipalities from the federal Gas Tax Fund since 2005 and an opportunity to update the requirements for the 2010-2014 period. It used this funding as an incentive and resource for municipalities to develop climate change action plans. The availability of federal disaster mitigation funding also enabled the development of the Municipal Floodline Mapping Project.

Perhaps the most determining factor in Nova Scotia's relative success in supporting municipal adaptation has been the province's responsiveness to the needs of municipalities and its ability to use federal funding opportunities to motivate and enable adaptation. The development of the Municipal Floodline Mapping Project was one such response to the expressed needs of municipal partners. Based on extensive consultation, the government is developing regulations under the Coastal Protection Act that will set out clear rules to prevent development and activity in locations where they can damage the environment or put residences and buildings at risk. These regulations will further enable municipalities to adapt. New amendments to the Municipal Government Act, meanwhile, encourage comprehensive planning for those municipalities that have not yet developed a municipal planning strategy. The province is also working with municipal engineers to develop a framework for asset management planning that considers the impacts of climate change.

Motivation factors, enablers of and barriers to municipal adaptation

Seven years later, while there have been advances, municipalities still struggle to implement their plans and to control development in areas at risk of coastal flooding and erosion. Some outcomes, such as changes in land use bylaws, can already be seen. But many of the actions included in their plans entail developing other plans, such as for stormwater management, that are yet to materialize.

In addition to pressure resulting from the provincial government's requirement, municipal administrations were motivated to develop their MCCAP and to implement adaptation measures in order to protect their assets and their populations. Having at least one local champion advocating for the necessity and advantages of adaptation was another source of motivation. However, there has been a decline in concern for coastal risks such as storms and floods. Sometimes, it is difficult to perceive the benefits of having avoided disasters.

Pressure from constituency members depends on the options considered. People are very attached to the places where they live and landowners are reluctant to accept limitations to what they can do on their own property. Therefore, restrictive land use bylaws are not popular and relocation is seldom considered. On the other hand, adaptation measures with concrete life quality benefits such as recreation, active transportation, public access to the coast and nature conservation help increase public acceptance.

In addition to the support of the provincial government, enabling factors for municipalities included:

- having supportive council and staff;
- comprehensive strategic planning;
- having additional sources of income, beyond taxation;
- the ability to hire experts to assist with planning;
- collaborations with universities and NGOs; and
- asset management, transportation plans and opportunities to advance adaptation goals.

Barriers faced by municipalities included:

- limited human and financial resources strained by multiple priorities, especially in small towns;
- needing additional funding for their shovel-ready projects;
- limited provincial contributions to infrastructure funding; and
- the unavailability of up-to-date flood maps that take climate change into account.

A toolkit for coastal adaptation

Interviews also highlighted an underused resource—the web-based Coastal Community Adaptation Toolkit (CCAT)— that has tremendous potential for use in municipal adaptation planning. Developed from 2013 to 2015 by members of the Atlantic Climate Adaptation Solutions Association, the Toolkit guides users through a series of questions about coastal risks and capacity for coastal adaptation. It then provides documented examples of the most suitable land use planning and engineering options to manage coastal erosion, flooding or both. This resource may find new users as the province introduces further mandatory planning requirements.

Opportunities for further reflection

Developing a light feedback mechanism about achievements, enablers and barriers, which could apply more generally to issues of comprehensive planning and asset management, could deepen the province's responsiveness to the needs of municipalities.

Other opportunities for further research or reflection include:

- evaluating the costs and benefits of different adaptation options in specific circumstances;
- developing criteria to help municipalities decide when it is better to relocate infrastructure than to continue repairing or adapting it;
- developing a long-term strategy to provide alternatives to coastal roads threatened by flooding; and
- developing a comprehensive provincial strategy for adaptation to climate change.

This brief summarizes key findings from the case study, "How Nova Scotia is Supporting Municipal Climate Change Adaptation Planning". The case study is one of six conducted through the project "Understanding the Determinants of Effective Policy Instruments: Case Studies of Climate Change Adaptation in Québec, Atlantic Canada and Massachusetts" which is coordinated by the Observatoire Québécois de l'adaptation aux changements climatiques (OQACC), based at Université Laval, and conducted in collaboration with Ouranos, University of Massachusetts Boston, University of Massachusetts Amherst and CBCL Limited in Halifax. The project is supported by Natural Resources Canada's Climate Change Adaptation Program and the Government of Québec, as part of the Québec Research Funds and the 2030 Plan for a Green Economy. This research contributes to the reflections of the Coastal Management Working Group of Canada's Climate Change Adaptation Platform.

How New Brunswick is supporting community adaptation planning

New Brunswick developed its 2016 Climate Change Action Plan following extensive public consultation. As specified in the commitments laid out in its plan, the province is supporting community adaptation planning by providing information and guidelines and by encouraging a supportive environment. It has also made the development and implementation of adaptation plans mandatory for cities and coastal municipalities who apply for provincial infrastructure funding. With its Environmental Trust Fund, New Brunswick has also been supporting a highly active network of NGOs and community organizations who, in turn, support communities in their adaptation planning. At the end of 2020, 35 of the province's 104 municipalities had completed adaptation plans and 17 more were in the process of developing one. Some of these municipalities have adopted land use bylaws that impose conditions or restrictions for development in areas that will become at risk of flooding from storm surges because of sea level rise. Some regional service commissions have been developing a regional approach to adaptation planning and/or have been supporting the efforts of their communities. However, the lack of province-wide standards could be slowing down local adaptation processes and hindering a comprehensive response to climate change.

New Brunswick has 5,500 km[4] of coastline along Chaleur Bay, the Gulf of Saint-Lawrence, and the Bay of Fundy. It is otherwise bordered by Québec's Gaspésie region to the northwest, the US state of Maine to the west, and Nova Scotia to the southeast, via the Isthmus of Chignecto. As an Atlantic province, it faces a range of climate change-related risks resulting from increased climate variability, rising sea levels and associated impacts such as erosion, storm surges and flooding. It has also experienced very significant inland flooding in recent years along the Saint John River.

It is also much less densely populated than the other Atlantic provinces, with a population of 747,101 residents as of the 2016 Census[5], on a land area of 71,389 km^2. About half of its population lives outside urban areas. It has a range of local government types, including eight cities, 26 towns, 61 villages, eight rural communities and one regional municipality. A large proportion of its area is unincorporated and governed by the provincial government as Local Service Districts (LSDs). This case study therefore provides insight on the possibilities available to small provinces to foster local adaptation in a range of local communities.

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4 https://www2.gnb.ca/content/gnb/en/departments/erd/energy/content/minerals/content/Coastal_mapping.html#:~:text=New%20Brunswick%20has%205%2C500%20km,dunes%20to%20steep%2C%20rocky%20cliffs.

5 Statistics Canada. (2017). *New Brunswick [Province] (table). Census Profile, 2016 Census.* https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/index.cfm?Lang=E

Our methods

Coordinated by the Observatoire Québécois de l'adaptation aux changements climatiques (OQACC), researchers examined the province's policy measures, what motivated them, and what factors either enabled or constrained their implementation and outcomes. They identified provincial goals and planned actions related to supporting municipalities from review of the province's Climate Change Action Plan. they then conducted discussions with officials in New Brunswick's Department of Environment and Local Government, and semi-structured interviews with a consultant, with staff of the New Brunswick Environmental Network (NBEN) and the Pays de Cocagne Sustainable Development Group, and finally with the Planning Directors of the Chaleur and Acadian Peninsula Regional Service Commissions. A virtual workshop allowed us to gather additional points of view.

This brief summarizes the perceptions expressed in the interviews and goals stated in the policy documents. It organizes them according to the project's conceptual framework, based largely on the Theory of Reasoned Goal Pursuit (TRGP).[6] This framework considers enablers and barriers, as well as motivating factors, including perceived advantages and disadvantages of the policy measures, and perceived social pressures.

The policy development process

New Brunswick developed its first Climate Change Action Plan in 2007. It recognized the importance of adaptation by communities and committed to collaboration with them. The province used its Environmental Trust Fund to support action-oriented research projects led by universities, communities and environmental groups. These created a momentum in the province. New Brunswick was experiencing increasing coastal flooding and erosion, sudden extreme weather events including ice storms and windstorms, heavy precipitation events, early and sudden spring melt causing flooding, and some saltwater intrusion into groundwater.

New Brunswick completely redeveloped its Climate Change Action Plan in 2016 following extensive consultation to include more concrete actions that would allow achievement of its goals. New Brunswick's Climate Change Act was introduced on March 16th, 2018. This act defines the management and uses of the Climate Change Fund.

The Climate Change Action Plan aspired to have climate change vulnerability assessments and adaptation plans completed by 2020 for all cities and for the highest-risk municipalities. The province chose a number of means for this purpose, including a combination of requirements, guidelines, standards and support mechanisms. The identified support mechanisms include direct collaboration with the Department of Environment and Local Government, the support of the Regional Service Commissions, consultants, NGOs and other community partners.

[6] Ajzen, I., & Kruglanski, A. W. (2019). Reasoned action in the service of goal pursuit. *Psychological Review*, *126* (5), 774-786

Several other policies and instruments contribute to supporting community adaptation planning and implementation in the province. Table 1 presents the policies most relevant to supporting climate change adaptation in New Brunswick.

Table 1: Policies supporting climate change adaptation in New Brunswick

Policy name	Date	How it supports municipal adaptation
Environmental Impact Assessment Regulation NB 87-83 under the Clean Environment Act	1987	This regulation requires projects to be designed in such a way as to avoid or reduce environmental impacts that increase the vulnerability of communities to climate change. Can lead to projects deemed harmful being denied an environmental permit.
Watercourse and Wetland Alteration Regulation 90-80 under the Clean Environment Act	1990	Having the provincial government restrict development and other activities on watercourses and wetlands helps protect sensitive areas and reduces risks related to flooding and erosion. In addition, the province can issue Wetlands Designation Orders.
Coastal Areas Protection Policy	2002, updated in 2019	This policy defines a 30m setback along beaches, dunes and marshes where only certain activities are permitted with a WAWA permit and/or an Environmental Impact Assessment Certificate of Determination and/or approval.
Flood Risk Reduction Strategy	2014	This strategy is leading to updated flood risk maps.
Transitioning to a Low-Carbon Economy New Brunswick's Climate Change Action Plan	2016	This action plan includes several commitments related to communities requiring and supporting adaptation planning.
Local Governance Act	2017	This act gives councils the authority to make bylaws and lays out the process for doing so.
Community Planning Act SNB 2017, C19 (Replaces a former version, RSNB 1973, c C-12.)	2017	This act sets out how to enact or change planning documents, including rural plans, municipal plans, regional plans and Statements of Provincial Interest. It defines the role that Regional Service Commissions can play in local planning.
Climate Change Act	2018	This act defines the conditions for using the Climate Change Fund, including support of municipal adaptation activities.

Motivating factors for the province

Increasing climate-related risks motivated the provincial government of New Brunswick to foster the development of adaptation plans by vulnerable municipalities.

The actions chosen to support communities in their adaptation planning were suggested by the Select Committee on Climate Change following public consultations. Citizens, elected officials and staff of local governments, staff of Regional Service Commissions, and staff of community-based and environmental organizations participated in consultations and suggested actions based on their needs and the barriers they had experienced.

We note that there was a "snowball effect" where support from the province strengthened the capacity of individuals and organizations who then exerted social pressure on the provincial government to make commitments that would support communities in their climate change adaptation planning.

Factors enabling support for communities

Enabling factors for the provincial government and community partners included:

- having one provincial department dedicated to managing both the environment and local government;
- the dedication of the Climate Change Secretariat staff;
- the Environmental Trust Fund as a source of funding;
- the existence of numerous environmental and community NGOs;
- the Climate Change Adaptation Collaborative, coordinated by the New Brunswick Environmental Network (NBEN);
- the important role of the Regional Service Commissions in supporting communities;
- collaborations with universities;
- development of local sea level rise projections and storm surge studies by consultants; and
- mapping of flood risks based on sea level rise and storm surge projections developed by experts.

Barriers encountered

Barriers for organizations supporting communities in their adaptation efforts included:

- the fact that many residences and infrastructures are located in at-risk areas;
- people's attachment to the place where they live hindering conversations about migration as a possible solution;
- the reluctance of some local governments to consult the public before proposing solutions;
- adaptation plans often highlighting problems without identifying solutions;

- a lack of province-wide standards, due to lack of adoption of Statements of Provincial Interest (SPI);
- local governments being reluctant, in some cases, to enact restrictive bylaws unless other local governments made the same commitment;
- a lack of specific regulations for the Coastal Areas Protection Policy;
- the insufficiency of the Watercourse and Wetland Alteration Regulation for protecting wetlands and coastal areas; and
- small communities' limited resources for implementing adaptation options.

Areas for further reflection

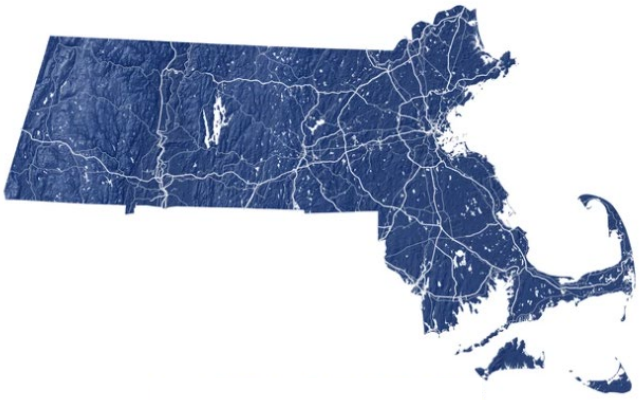
In the future, regional planning could potentially not only be used to set regional standards for land use bylaws but could also tackle problems that require coordination between municipalities, such as ensuring the accessibility of grocery stores during storms, or improving a region's self-reliance during power shortages. Where Statements of Provincial Interest (SPI) have not yet been implemented, it would be useful to understand why, and to find solutions to the obstacles faced.

This brief summarizes key findings from the case study "How New Brunswick is Supporting Community Adaptation Planning". The case study is one of six conducted through the project "Understanding the Determinants of Effective Policy Instruments: Case Studies of Climate Change Adaptation in Québec, Atlantic Canada and Massachusetts" which is coordinated by the Observatoire Québécois de l'adaptation aux changements climatiques (OQACC), based at Université Laval, and conducted in collaboration with Ouranos, University of Massachusetts Boston, University of Massachusetts Amherst and CBCL Limited in Halifax. The project is supported by Natural Resources Canada's Climate Change Adaptation Program and the Government of Québec, as part of the Québec Research Funds and the 2030 Plan for a Green Economy. This research contributes to the reflections of the Coastal Management Working Group of Canada's Climate Change Adaptation Platform.

The Municipal Vulnerability Preparedness Program (MVP)

The findings from this case study suggest that a partnership with environmental groups helped the Commonwealth of Massachusetts develop a municipal assistance program that involves local officials and relevant stakeholders in hazard mitigation and climate adaptation planning. Examples from different cities and towns highlight the important role that vendors play in supporting planning activities and how the use of nature-based solutions for climate adaptation is rewarded by the program. These examples also expose advantages and barriers that arise when using a vendor system, the need for more involvement of vulnerable groups, or how difficult is to address relevant problems within short-term action grants.

Massachusetts is bordered by the Atlantic Ocean to the east, the states of Connecticut and Rhode Island to the south, New Hampshire and Vermont to the north, and New York State to the west. It has a population of 6,892,503 as of the 2019 census, covering an area of 20,202 km[27]. As a coastal State, Massachusetts faces a range of climate change-related risks resulting from increased rainfall, rising sea levels and associated impacts such as storm surges and flooding. Communities in Western Massachusetts are also at risk due to extreme weather events leading to increased frequency and intensity of river floods or heat waves, among others impacts.



Our methods

Researchers from the Sustainable Solutions Lab (SSL) at the University of Massachusetts Boston (UMB) examined the State's Municipal Vulnerability Preparedness (MVP) program, what motivated its development, and what factors either enabled or constrained its implementation and outcomes. The team identified goals and planned actions from the MVP program documentation, existing planning reports and action grant proposals. It conducted interviews and meetings with officials in the Commonwealth of Massachusetts' Executive Office of Energy and Environmental Affairs (EEA), officials of the towns of Wellesley, Watertown, Dartmouth and Somerville, consultants working as vendors of the program and participants who attended planning workshops. The team also conducted observations in municipal planning meetings in Watertown and Dartmouth.

[7] United-States Census Bureau. (2019). *Quick Facts Massachusetts.* United-States Census Bureau. https://www.census.gov/quickfacts/MA

This brief summarizes the main measures adopted by the MVP program to support municipalities. It also summarizes perceptions expressed in the interviews and the main observations of researchers. It organizes them according to the project's conceptual framework, based largely on the Theory of Reasoned Goal Pursuit (TRGP).[8] This framework considers enablers and barriers, as well as factors motivating the use of policy instruments. Motivating factors include perceived advantages and disadvantages of policy measures, and perceived social pressures.

The policy development process

In response to the Global Warming Solutions Act (GWSA) and the Massachusetts Clean Energy and Climate Change Plan for 2020, the Commonwealth developed the Massachusetts Climate Change Adaptation Report, published in 2011. This report recognized the need for the Commonwealth to work with municipalities, and to create incentives for them to integrate climate change into their own planning mechanisms. Although there was not yet a clear mandate, some environmental organizations worked with the administration and legislature to design a program to support municipalities in their plans for climate adaptation.

In September 2016, Executive Order 569 issued by Governor Charlie Baker provided a roadmap of actions by different agencies in the Commonwealth. These included coordination between the Secretary of EEA and the Secretary of Public Safety to develop a Climate Adaptation Plan within two years and to provide a framework and technical assistance to cities and towns to assess their vulnerability to climate change and extreme weather events, as well as to identify and implement adaptation options and strategies.

The Commonwealth created the MVP program as a means to provide both the framework and technical assistance to support cities and towns across the state to identify and address climate change hazards and vulnerabilities, prioritize critical actions, and increase community resiliency. In 2017, the EEA offered the first MVP planning and action grants. Planning grants allow municipalities to complete a vulnerability assessment and develop an action-oriented adaptation plan. Municipalities that complete the planning process receive certification as an "MVP community" and are then eligible for MVP action grant funding to implement their plan, among other benefits of the designation.

Since its launch in 2017, the MVP program has completed four 1-year grant cycles. In 2020, 287 of the 351 municipalities in Massachusetts (82%) had earned MVP certification and 127 (36%) had received subsequent action grants. Overall, the Commonwealth has awarded $33 million USD in planning and action grants through the program. The average amount of an action grant in Fiscal Year 2020 was 195,000 USD.

[8] Ajzen, I., & Kruglanski, A. W. (2019). Reasoned action in the service of goal pursuit. *Psychological Review, 126* (5), 774-786.

In July 2018, the Massachusetts legislature enacted Bill H.4835, known as the "Environmental Bond"[9], for which the full title is "An Act promoting climate change adaptation, environmental and natural resource protection, and investment in recreational assets and opportunity". This new law, based on Executive Order 569, raised 2.4 billion to work on climate change adaptation, including expanded funding for the SHMCAP, the MVP Program, and Resilient MA. Its emergency preamble allowed it to become effective immediately.

Table 1: Main policies framing the MVP program

Title	Date	Description
Global Warming Solutions Act (GWSA)	August 2008	This act is a comprehensive regulatory program to address climate change and mandates EEA to start an adaptation process.
Massachusetts Climate Change Adaptation Report	September 2011	This report covered five different sectors, bringing together over 300 stakeholders for input. Not intended as a comprehensive plan, it defined the issues at hand and made recommendations for next steps.
Community Resilience Building Workshop Guide	February 2016	This guide defines the method used by all MVP vendors in the planning workshops.
Executive Order 569 : Establishing an Integrated Climate Change Strategy for the Commonwealth	September 2016	This executive order concerns greenhouse gas reduction, resilience and adaptation to climate change as well as planning and assessing related risks. It enacts the development of the SHMCAP and MVP Programs.
Resilient MA: Massachusetts Climate Change Clearinghouse, which includes an interactive map	2017	The Clearinghouse shares climate change projections developed by the Northeast Climate Adaptation Science Centre (NE-CASC) at University of Massachusetts Amherst.
Bill H.4835 An Act promoting climate change adaptation, environmental and natural resource protection, and investment in recreational assets and opportunity (Environmental Bond Bill)	July 2018	This bill provided additional financial resources for the MVP program and SHMCAP implementation.
State Hazard Mitigation and Climate Adaptation Plan (SHMCAP) for the Commonwealth	September 2018	This plan integrates climate change impacts and adaptation strategies with hazard mitigation planning.

[9] https://malegislature.gov/Bills/190/H4835

Motivating and enabling factors for the Commonwealth of Massachusetts

Launched in 2017, the MVP program grew out of a strong desire to work with cities and towns to prepare for the impacts of climate change and to improve the resilience of communities. As mentioned earlier, the need to work with municipalities had been identified in the Climate Adaptation report in 2011. The motivation came from within the Commonwealth, as supporting municipalities was not a federal requirement. The commonwealth created the MVP as a means to implement some of the commitments made in its Executive Order 569.

The influence of environmental groups such as the Nature Conservancy (TNC) and Mass Audubon, who have long-time experience working with government officials and constituencies, helped shape requirements for the participation of municipal authorities, relevant stakeholders and local communities in the MVP program. In addition, the MVP Core Principles require the involvement of Environmental Justice populations[10]. in meaningful decision-making,

To overcome challenges related to engaging and receiving input from a broad audience, as well as to integrating climate change in risk assessment, the MVP program used the Community Resilience Building Workshop Guide and trained vendors who could provide facilitation and planning services to municipalities. Vendors represent a large range of agencies with different skills, some in engineering, others in community engagement. Participating municipalities applied for a planning grant and used a certified vendor to conduct the workshops and develop a planning report.

The program also hired six regional coordinators to encourage regional collaboration and facilitate the work between municipalities that may share common climate risks and strategies to increase resilience. To stimulate such collaboration, action grant proposals that include two or more municipalities in their work receive extra points in their score.

Motivating and enabling factors for municipal participation in the MVP

Motivating factors for cities and towns to participate in the MVP include the possibility of reducing the risks heightened by climate change. In addition, the possibility of obtaining a certification required to apply for implementation grants is an incentive to complete the MVP planning process. The possibility of pushing forward some initiatives already present in their project portfolios is another motivating factor. Participants also mentioned other factors that improved participation, as follows.

Enablers for the participation of cities and towns in the MVP program included:

- the role vendors play in facilitating the planning process and the expe rtise they bring;

[10] In 2002 the EEA issued an Environmental Justice (EJ) policy that identified Environmental Justice populations defined by socioeconomic, racial, ethnic and/or language factors. See https://www.mass.gov/files/documents/2017/11/29/2017-environmental-justice-policy_0.pdf

- the supporting role of regional coordinators in connecting with vendors and other aspects of proposal development;
- the possibility of teaming up with other municipalities to propose collaborative projects;
- short workshops (one day or two 4-hour sessions), favouring better attendance; and
- the easy-to-understand approach laid out in the *Community Resilience Building Workshop Guide*.

Because it is less technical and expert-driven than a formal vulnerability assessment, the MVP planning workshop has the potential to foster a community-driven process. We note that regional planning agencies sometimes play the role of vendors, like the Metropolitan Area Planning Council (MAPC) serving some towns in the Greater Boston region. Some vendors go further in public consultation, for example administering surveys and conducting focus groups with vulnerable populations. Many municipalities have developed relationships with MVP vendors through previous state programs, such as the Green Communities.

Barriers faced by municipalities included:

- municipal staff having limited time to devote to the planning process;
- difficulty translating a multitude of priorities into adaptation actions;
- the short window of time for workshops and a prescribed approach that may limit in-depth discussions and the possibility of covering all vulnerabilities that require action;
- workshops often lacking representation from certain vulnerable groups including low-income populations, immigrants, non-English speakers and people with disabilities;
- the long process required to make changes to municipal regulations; and
- a lack of regional governance or collaboration mechanisms.

The first series of action grants lasted only one year, which limited the choice of eligible projects. In response to requests from municipalities, the EEA increased the length of the grants, but the projects for a given fiscal year must nonetheless be completed by the middle of the following year. The length of grants remains a constraint for supporting some lengthier processes involved in building community resilience.

Otherwise, the research team found that only a third of municipalities that conducted MVP planning workshops and have Environmental Justice population included specific mention of the term “environmental justice” in their planning reports. After the first cycle of the program, the MVP management liaised with different organizations to reflect about how to improve the participation of Environmental Justice populations in the planning workshops.

Opportunities for Further Reflection

The study noted that further progress is needed to ensure that municipalities work towards reducing inequalities in vulnerability and adaptive capacity. More research should focus on exploring whether outreach efforts result in increased participation of Environmental Justice population, so concerns for and voiced by these communities translate into concrete actions. For those municipalities that were awarded an action grant, research should address whether priorities for these communities resulted in concrete just adaptation efforts and whether unintended consequences were taken into consideration. To date, most adaptation research and practice focuses on the processes that establish conditions for affected communities to participate in planning, but not so much on how affected communities are given power over the decisions that affect them.

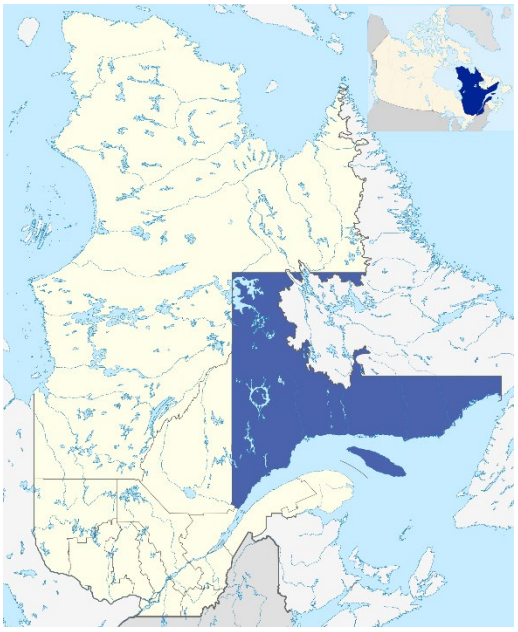
Other opportunities for further research or reflection include examining avenues to increase regional governance of adaptation issues that cross municipal boundaries, such as in watersheds, valleys, and other areas exposed to similar climate impacts.

This brief summarizes key findings from the report "Learning from the Massachusetts Municipal Vulnerability Preparedness (MVP) program in the Greater Boston Region" (Belloy, P.G., Sulewski, D, VanDeveer, S., & Herst, R., 2020). Another brief summarizes key findings related to Climate Ready Boston. The case study is one of six conducted through the project "Understanding the Determinants of Effective Policy Instruments: Case Studies of Climate Change Adaptation in Québec, Atlantic Canada and Massachusetts" which is coordinated by the Observatoire Québécois de l'adaptation aux changements climatiques (OQACC), based at Université Laval, and conducted in collaboration with Ouranos, University of Massachusetts Boston, University of Massachusetts Amherst and CBCL Limited in Halifax. The project is supported by Natural Resources Canada's Climate Change Adaptation Program and the Government of Québec, as part of the Québec Research Funds and the 2030 Plan for a Green Economy. This research contributes to the reflections of the Coastal Management Working Group of Canada's Climate Change Adaptation Platform.

Consideration of Climate Change Impacts in the Environmental Assessment of Bank Stabilization Projects in the North Shore Region, Québec

Bank stabilization projects are considered as climate change adaptations, but they can have significant environmental impacts and even accelerate coastal erosion in some cases. Environmental assessment of such projects is thus important to avoid adaptations that could increase some communities' vulnerability to climate change. This assessment obliges developers to consider removal of infrastructures from the areas that pose risks as well as so-called soft stabilization options, such as beach replenishment and phytotechnology. Furthermore, consideration of climate change effects in environmental impact studies has been mandatory in Québec since March 2018. Moreover, the recent acceleration of coastal erosion and submersion processes during storms is threatening vital roads in some regions. Unfortunately, some bank stabilization projects become urgent and may be exempted from the Environmental Impact Assessment and Review Procedure (PÉEIE) and thus miss out on its benefits

The North Shore is an administrative region of Northeastern Quebec. It is located between Saguenay-Lac-Saint-Jean to the east and Newfoundland and Labrador to the west. It has a population of 92,518 inhabitants at the 2016 census, on an area of 300,282 km2 . The communities and human activities in the North Shore region are mainly established along the estuary and the Gulf of St. Lawrence. Highway 138 is the only land access route and is threatened in many places by coastal erosion.



In Eastern Québec, climate change is causing a decrease in sea ice coverage in winter, thus contributing to an increase in the erosive impacts of waves on the coast, The increase in storm severity and relative rise in sea levels are also heightening the risks of erosion and of coastal flooding.

Québec's Ministry of Transportation (Ministère des transports du Québec [MTQ]) is the most frequent applicant for environmental authorizations concerning bank stabilization projects in this region. This issue of maintaining road infrastructures exists in other Québec regions as well, including Gaspésie, Bas-Saint-Laurent and Îles-de-la-Madeleine.

Our Methods

Researchers of the *Observatoire québécois de l'adaptation aux changements climatiques* (OQACC) examined the factors that motivate governments to create specific instruments and policies and those that facilitate their implementation and promote their positive effects. The study draws on documents related to environmental assessment (laws, regulations and guidelines, environmental impact assessments, communications related to environmental assessments). It also relies on semi-structured interviews with two employees of the *Ministère de l'Environnement et de la Lutte contre les changements climatiques* (MELCC) and one person from the MTQ. A virtual workshop allowed gathering additional perspectives.

This brief summarizes the perceptions expressed in the interviews and goals expressed in the policy documents. It organizes them according to the project's conceptual framework, based on the Theory of Reasoned Goal Pursuit (TRGP).[11] This framework considers enablers and barriers, as well as factors that motivate the use of policy instruments. Motivating factors include perceived advantages and disadvantages of the policy measures, and perceived social pressures.

The process of adapting public policies

The Government of Quebec has integrated climate change adaptation into the environmental authorization regime through a process of modernization of the Environment Quality Act (EQA, chapter Q-2). This Act now requires that climate change risks be considered in government authorizations and gives the Minister the power to consider them in ministerial authorizations. Provisions to this effect have been included in the Regulation respecting the environmental impact assessment and review of certain projects (RIEER). In consultation with experts from the various ministries concerned, the MELCC has prepared new texts and appendices to the Directive for the preparation of an environmental impact study. It also drafted additional information specifically on the consideration of climate change. Appendix 1 of the Directive, on other information required for a shoreline or bank stabilization project or program, now specifies that future climate projections must be taken into account in the description of flow regimes and hydrodynamics of the watercourse or water body. A guide for project proponents entitled "Climate Change and Environmental Assessment" has been developed to assist in this consideration in project design, impact assessments and environmental permit applications.

Even before the modernization of CEQA, the environmental assessment of shoreline stabilization projects was aimed at reducing their impacts by ensuring that all options were seriously considered, starting with the removal of infrastructure from the area of concern. The Directive states that if removal is not feasible, the proponent must prioritize "soft" methods, such as beach nourishment and phytotechnologies. The proponent must demonstrate that they are not suitable to proceed with so-called "hard" methods, such as riprap. Table 1 presents the Quebec government's public policies and instruments for the environmental assessment of bank stabilization projects.

[11] Ajzen, I., & Kruglanski, A. W. (2019). Reasoned action in the service of goal pursuit. *Psychological Review*, *126* (5), 774-786

Table 1: The Government of Québec's Public Policies and Instruments for the Environmental Assessment of Bank Stabilization Projects

Name of the public policy	Dates or periods	Connection with the environmental assessment of bank stabilization projects and the adaptations made to consider climate change
Environment Quality Act (EQA)	Adopted in 1972, amended in 2017	The EQA governs the entire environmental authorization scheme. The amendments, in 2017, provide for consideration of the expected impacts and risks of climate change for the project and the environment where it will be carried out
Protection Policy for Lakeshores, Riverbanks, Littoral Zones and Floodplains	Adopted in 1998, last amended in 2014	The policy aims at protecting lakes and waterways as well as "water" itself as a resource. It led to the amendment of the EQA and of several other laws. Clarifies the definition of the target zones and defines the applicable restrictions.
Green Book on modernizing the environmental authorization scheme in the EQA, entitled, *Moderniser le régime d'autorisation environnementale de la Loi sur la qualité de l'environnement*, having led to the filing and adoption of Bill 102.	Green Book submitted in 2015, Bill 102 adopted March 23, 2017	Reflection tool for specific consultations before a bill is tabled at the National Assembly. Intended to provide Québec with a clearer, more predictable and more efficient scheme, while maintaining the most stringent environmental protection requirements and incorporating the issue of fighting climate change.
Act Respecting the Conservation of Wetlands and Bodies of Water and Regulation Respecting Compensation for Adverse Effects on Wetlands and Bodies of Water	Law sanctioned June 16, 2017, regulation in force March 23, 2018	Aims at curbing the loss of wetlands and bodies of water in Québec This law also led to the amendment of the EQA. The environmental authorization scheme must now ensure that the developer commits to compensating for damage to wetlands and bodies of water, through conservation, restoration or creation projects or through financial contributions
Environmental Impact Assessment and Review Procedure (PÉEIE; Chapter Q-2, r. 23.1)	The new regulation came into effect March 23, 2018	Defines the work requiring government authorization Section IV, Paragraph 5, an environmental impact study must contain, notably, in Paragraph 6 "an analysis of the expected climate change impacts on and risks to the project and on the environment in which it will be carried out"
Directive for the design of an environmental impact assessment (Directive pour l'élaboration d'une étude d'impacts sur l'environnement)	Amended in 2018	Specifies the content of the impact study for projects subject to the PÉEIE Appendix I, Autres renseignements requis pour un projet ou un programme de stabilisation des rives et des berges, provides other information required for a bank and shore stabilization project or program.
A guide for developers to climate change and environmental assessment entitled Les changements climatiques et l'évaluation environnementale	March 2021	Provides developers with clear indications and guidelines for climate change consideration in the design of projects, impact studies and authorization applications

Motivating factors for the province

The consideration of climate change in environmental assessment is the result of a political will of the Quebec government, which was expressed in 2012 in the Climate Change Action Plan (PACC) 2013-2020. Furthermore, the person responsible for ensuring that climate change is considered in the environmental authorization scheme is motivated by the benefits of such an approach. This consideration would make projects more sustainable, less costly in the long run, and would allow for the anticipation of costs that might arise over the duration of the project.

It is in view to prevent or reduce the environmental impacts of shoreline protection structures that the government is subjecting them to environmental approval. In particular, rigid structures such as low walls or riprap often accelerate erosion in adjacent zones (the so-called "end effect"). Where there is a beach, these measures result in its narrowing or even disappearance. Rigid structures, and even beach nourishment with non-compatible materials, encroach on fish habitat.

Facilitating Factors

Factors that facilitated the modification of regulatory tools and support for the actors involved include the collaboration of experts from the MELCC and other ministries, private firms and Ouranos. Funds provided by the PACC 2013-2020 have made it possible to mobilize experts to support the MELCC in its efforts. The MELCC favors adaptations modulated over time to avoid unnecessary environmental impacts from structures that are oversized to withstand future climate conditions.

The availability of climate and sea level change projections, university teams and consultants who monitor the coastline and use hydrodynamic models and cost-benefit analyses allows proponents to take climate change into account in their project design, environmental impact assessments and decision-making. The MTQ works closely with the Laboratory of Dynamics and Integrated Coastal Zone Management[12] at the UQÀR and participates in its Coastal Resilience project. It has also set up a monitoring system for problematic areas to help it anticipate the work to be done.

Barriers

The barriers encountered by the MELCC and the developers include the following:

- A transition period during which the tools were not all available and climate change had to be considered retroactively for projects where the impact study was already developed.
- Because of the delays, projects often become urgent and must be exempted from the procedure.
- The difficulty in carrying out fish habitat compensation projects in the same watershed (requirement of the DFO) prolongs the time frames.

[12] https://ldgizc.uqar.ca/Web/about

- One barrier to the adoption of beach replenishment is the fact that Québec engineers have less experience with these approaches.

Furthermore, there are several challenges involved in relocating sections of roads, including:

- Significant costs;
- Reluctance on the part of residents who would be obliged to move;
- Sometimes requires zoning changes, expropriations or new environmental authorizations;
- Takes longer to implement and is thus not favoured in an emergency.

Opportunities for reflection

Several replenishment projects will be carried out soon by the MTQ and municipalities on the North Shore. It is hoped that they will contribute to the expertise in the area and may have a ripple effect.

As part of its action plan for infrastructure management in a context of climate change, the MTQ is contemplating an integrated and concerted procedure to make its approaches more preventive. Significant progress should be seen over the next few years.

The investment in pilot projects and in the entire life cycle of the projects (including monitoring, maintenance and potential adjustments) by the MTQ and the disaster prevention programs would help promote soft approaches as well as an adaptation modulated over time (or adaptive management).

Consideration of the risks of erosion and of submersion by the Regional County Municipalities (RCM)s in their land use and development plans helps to develop a long-term vision, to open discussions with the local actors and various ministries concerned to be able to consider, more globally, the relocation of some sections of Route 138.

This brief summarizes key findings from the case study "Consideration of Climate Change Impacts in the Environmental Assessment of Bank Stabilization Projects in the North Shore Region, Québec". The case study is one of six conducted through the project "Understanding the Determinants of Effective Policy Instruments: Case Studies of Climate Change Adaptation in Québec, Atlantic Canada and Massachusetts" which is coordinated by the Observatoire Québécois de l'adaptation aux changements climatiques (OQACC), based at Université Laval, and conducted in collaboration with Ouranos, University of Massachusetts Boston, University of Massachusetts Amherst and CBCL Limited in Halifax. The project is supported by Natural Resources Canada's Climate Change Adaptation Program and the Government of Québec, as part of the Québec Research Funds and the 2030 Plan for a Green Economy. This research contributes to the reflections of the Coastal Management Working Group of Canada's Climate Change Adaptation Platform.

Consideration of Climate Change Adaptation in the Regional Land Use and Development Plan of the Montréal Agglomeration

In the latest revision of its regional plan[13], which has been in effect since April 2015, the Montreal agglomeration has included a theme dealing with adaptation to climate change. It mainly addresses the risks related to heat and rainfall, which are becoming increasingly abundant and pose problems in managing runoff. In addition, the plan also addresses the protection and enhancement of natural environments as well as constraints related to riverbanks and floodplains. The results of this case study suggest that the regional land use and development plan is a valid tool for encouraging climate change adaptation at regional and local levels. This plan helps to establish a strategic vision of development and objectives related to climate change adaptation and to identify means to attain them. Its mechanism for influencing local-level adaptation rests mainly on the conformity obligations introduced in the Act Respecting Land Use Planning and Development*. Local planning programs and bylaws must be made to comply with the objectives and provisions contained in the regional plan. Nonetheless, urban planning bylaws allow control only over new developments, constructions and transformations. To intervene in what is already developed or built, complementary measures are needed and they may be proposed in the regional plan.*

Montréal is an island situated at the confluence of the St. Lawrence and Outaouais Rivers. The agglomeration includes the City of Montréal (the "centre city") as well as the 15 other cities on the Island of Montréal (i.e., the "linked cities"). At the time of the 2016 census, the agglomeration counted 1,942,044 inhabitants[14] across a surface of 499 km^2. It has been dealing with river floods, which have become more common in recent years, but without a connection to climate change being demonstrated. Montréal is in the St. Lawrence fluvial zone, of which the level is not affected by the rise in sea level.

[13] Agglomération de Montréal. (2015). Schéma d'aménagement et de développement de l'agglomération de Montréal. Janvier 2015. http://ville.montreal.qc.ca/pls/portal/docs/PAGE/PROJ_URBAINS_FR/MEDIA/DOCUMENTS/Schema20170301.pdf

[14] Ville de Montréal. (2018). *Profil sociodémographique Recensement 2016 pour l'agglomération de Montréal*. Mai 2018. Montréal en statistiques, Service du développement économique, Ville de Montréal. 42 p. http://ville.montreal.qc.ca/pls/portal/docs/PAGE/MTL_STATS_FR/MEDIA/DOCUMENTS/PROFIL_SOCIOD%C9MO_VILLE%20DE%20MONTR%C9AL%202016.PDF

Regional land use and development plans (hereafter regional plans) are planning and intention documents provided for in Québec's *Act Respecting Land Use Planning and Development* (ALUPD[15]) for the regional level. The regional plans must enable regional county municipalities (RCMs), as well as some cities and agglomerations with certain RCM jurisdictions, to coordinate choices and decisions regarding land use on their territory around a regional vision of sustainable development. In respecting the conformity obligations defined by the ALUPD, the plans must be coordinated with the Government of Québec's strategic directions, the metropolitan land use and development plans (PMAD) and the local urban planning bylaws.

Our approach

Researchers of the *Observatoire québécois de l'adaptation aux changements climatiques* (OQACC) examined the actions planned for climate change adaptation, what motivated them and the factors that that facilitate or impeded their implementation. The study draws on the documentation of Montreal's regional plan. It also draws on semi-structured interviews conducted with three staff members of the City of Montreal, two of them having participated in the elaboration of the regional plan. A discussion held with members of the City of Montreal's Office of Ecological Transition and Resilience allowed to gather other points of view. During the development of this case study, we obtained additional documents to corroborate or complement the participants' accounts. For example, we consulted media articles to find out the point of view of elected representatives or citizens affected by weather hazards or who had criticized some of the proposed measures.

This brief summarizes the perceptions expressed in the interviews and goals expressed in the policy documents. It organizes them according to the project's conceptual framework, based largely on the Theory of Reasoned Goal Pursuit (TRGP).[16] This framework considers enablers and barriers, as well as motivating factors, including perceived advantages and disadvantages of the policy measures, and perceived social pressures.

[15] The ALUPD refers to these plans as "RCM plans".

[16] Ajzen, I., & Kruglanski, A. W. (2019). Reasoned action in the service of goal pursuit. *Psychological Review*, *126* (5), 774-786

The process of developing adaptation measures

The regional plan review team included a staff member from the City Montréal's Department of Urban Planning and Mobility, who coordinated the theme on climate change adaptation. She formed a multidisciplinary working group to address these issues, which included advisors from different departments. She also formed a group of external experts whose role was to make recommendations and propose provisions for inclusion in the plan.

The theme pertaining to climate change adaptation falls under the broad theme related to favouring a quality living environment. It aims at decreasing the risks associated with the impacts of climate change. Its objectives are to:

- Adopt the appropriate measures to fight heat islands;
- Increase the canopy index to 25% by 2025 as well as general greening of the territory;
- Reduce the quantity of runoff water and improve its quality.

Moreover, other aspects of the regional plan are relevant for climate change adaptation because they contribute to the above-mentioned objectives. Under the theme related to enhancing the territories of interest, the regional plan contains conservation objectives and aims at increasing the areas of protected land from 5.8% to 10%.

The regional plan that was previously in force had been written by the Montréal Urban Community (MUC) in 1987. Its revision was catalyzed by the implementation, on March 12, 2012, of the MMC's metropolitan plan. According to the ALUPD, the regional plan had to comply with the metropolitan plan within two years after its implementation. The revised regional plan thus reflects the directives, objectives and criteria of the metropolitan plan as well as the agglomeration's aspirations and specificities. A completely new document was written, even if it is officially considered to be a revision of the previous plan.

Factors motivating the consideration of climate change in the agglomeration's regional plan

Included in the factors that motivated the Montréal Agglomeration to include climate change in its regional plan are public health issues related to episodes of extreme heat and to sewer backup and overflow, exacerbated by increasingly abundant rains. Requirements from various levels of government, as well as demands or pressure from citizens and elected representatives also contributed to this motivation.

Projections produced by the Ouranos consortium suggested that climate change would exacerbate these issues. Montréal's public health directorate had produced a study showing the effects of the 2010 heatwave on the excess mortality recorded in the health system. Other City of Montreal documents, including its 2004 urban plan and its emergency plan for extreme heat, considered the fight against heat islands.

In addition, the policy on protection and enhancement of natural environments, advanced objectives in terms of increasing areas of protected natural environments. The Montréal community's 2010-2015 sustainable development plan already contained objectives related to the quality of runoff water and the improvement of green infrastructures. The 2012-2021 canopy action plan aimed at increasing the canopy by 20% to 25% across the agglomeration's entire territory.

When the regional plan was under revision, the agglomeration had the benefit of consultations on Montréal's development plan, held in Montréal in June 2013. The permanent commission on Montréal's land use and development regional plan organized a 12-session public consultation in autumn 2014 around the proposed regional plan.

The ALUPD specifies mandatory content and accompanying documents, to which optional content may be added. There is no legal obligation to incorporate climate change consideration in municipal planning or bylaws. For its part, the metropolitan plan suggested examining adaptation but did not include obligations in that respect. Nonetheless, the regional plan must respect the constraint zones mapped by the MMC.

Greening and natural environments help combat the heat island effect and reduce runoff, while helping to improve the living environment and providing opportunities for recreation and access to nature and shorelines. When located in flood-prone areas, protected areas and green spaces also help prevent disasters by storing water and avoiding residential development.

Through conformity obligations, the provisions of the plan will influence the granting of permits by the boroughs and linked cities, which in turn will influence property owners, builders and developers. However, under the ALUPD, planning by-laws cannot be applied retroactively. They apply only to new construction and changes to the existing built environment. They do not provide any control over what is already developed or built.

Factors that facilitated considering climate change adaptation

Factors that facilitated consideration of climate change adaptation in the Montréal Agglomeration's regional plan include the following:

- The presence of a person who has experience with adaptation on the regional plan-revision team;
- The creation of a multidisciplinary working group consisting of advisers from various departments and of an external group of experts;
- A prior adaptive process having led to the identification of some measures;
- The fact that the adaptation options considered help to meet some of the agglomeration's other objectives;
- The fact that some boroughs and linked cities had made regulatory innovations that could serve as examples during the compliance-achievement period.

Barriers faced in considering climate change adaptation

Factors that impede greening and the conservation of natural environments include

- significant maintenance costs;
- reluctance on the part of some property owners to be constrained in the way they develop their land;

These barriers are overcome in some places by using a combination of regulatory, education and consultation approaches to develop greening and conservation projects.

Social housing policies are important to ensure neighbourhood diversity and to prevent greening from causing rent increases for low-income residents.

The use of green infrastructure for stormwater retention and infiltration is increasing in Montreal. There was insufficient knowledge about this in 2015 to make provisions, but that knowledge has evolved significantly since then.

The two-year time frame that the team was allowed after the metropolitan plan came into effect, in 2012, was very short, and two extensions[17] had to be requested from the MAMH[18] so the revision work could be completed. Because approval of the regional plan was urgent, only one public consultation was possible.

[17] See page 9 of the http://ville.montreal.qc.ca/pls/portal/docs/PAGE/COMMISSIONS_PERM_V2_FR/MEDIA/DOCUMENTS/RAPPORT_FINAL_20150129.PDF

[18] MAMOT, now the ministère des Affaires municipales et de l'Habitation (MAMH)

Opportunities for reflection

During the next update of the regional plan, the revision team could consider the inclusion of the following elements:

- A constraint map related to the topography and natural drainage, and provisions related to these zones, for example, limiting the construction of below-ground driveways;
- Provisions to help preserve and even enhance the role of streets in surface drainage during heavy rains, to prevent flooding of homes and other buildings;
- Provisions to set up floodable parks;
- Provisions for the use of green infrastructures, notably paired with road repair projects (bioretention systems, drainage curb bulbs, etc.);
- Provisions that would act in complement with the City of Montréal's Bylaw 20-030 to reduce runoff from roofs (e.g., require outside drains for buildings of less than 1,000 m^2 and permeability of at least 20% of the surface of a property, to enable runoff water to flow onto permeable surfaces);
- Provisions concerning the installation of parking lots, not only in heat islands.
- A more constraining provision for the conservation of mosaics of natural environments

The regional plan must be combined with other steps to enable the agglomeration to meet its climate change adaptation and environmental objectives. Among these, we suggest:

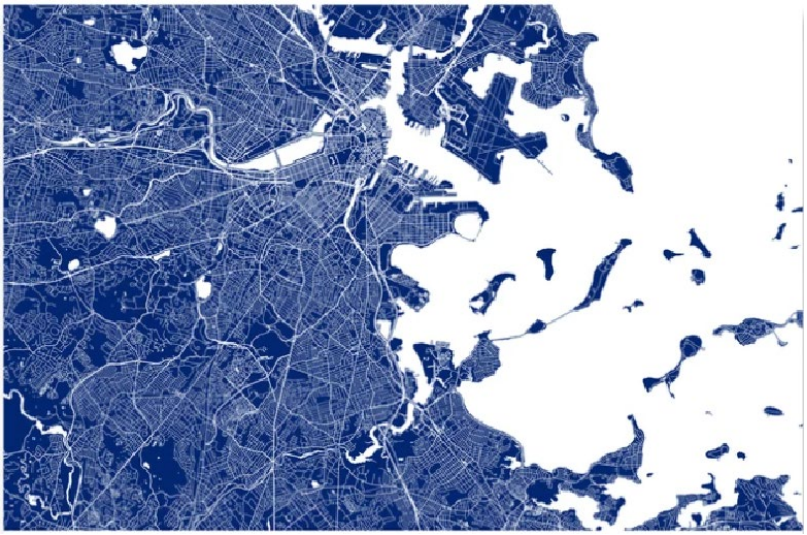
- Awareness-raising activities to enable better adherence to the principles stated in the regional plan and to encourage their voluntary application by owners, in already developed and built environments;
- Support for owners affected by recurrent flooding to help them make adaptations to their buildings;
- The search for solutions to dispose of groundwater currently being sent to the sewer system;
- Developing a strategy for realty development on brownfields in the agglomeration, which entails decontamination of the properties, in many cases.

This brief summarizes key findings from the case study "Consideration of Climate Change Adaptation in the Regional Land Use and Development Plan of the Montréal Agglomeration". The case study is one of six conducted through the project "Understanding the Determinants of Effective Policy Instruments: Case Studies of Climate Change Adaptation in Québec, Atlantic Canada and Massachusetts" which is coordinated by the Observatoire Québécois de l'adaptation aux changements climatiques (OQACC), based at Université Laval, and conducted in collaboration with Ouranos, University of Massachusetts Boston, University of Massachusetts Amherst and CBCL Limited in Halifax. The project is supported by Natural Resources Canada's Climate Change Adaptation Program and the Government of Québec, as part of the Québec Research Funds and the 2030 Plan for a Green Economy. This research contributes to the reflections of the Coastal Management Working Group of Canada's Climate Change Adaptation Platform.

Climate Ready Boston

Case study findings suggest that a catalyzer was Hurricane Sandy in 2012 and the damages it caused in the American Northeast, particularly in New York City. Key success factors have been the Mayor's vision to face climate change as well as the ongoing involvement of the private sector in an organization called the Green Ribbon Commission. Challenges remain to ensure that adaptation will benefit all Bostonians.

Boston is a coastal city located in the state of Massachusetts. It has a population of 692,600 as of the 2019 census[19], with an area of 124.04 km^2. It faces a range of climate change-related risks resulting from increased climate variability, rising sea levels and associated impacts, such as storm surges and flooding. The natural geometry of Boston Harbor protects Boston and neighbouring cities relatively well, but sea level rise and stronger storms are compromising safety and development on the waterfront.



Our methods

Researchers from the Sustainable Solutions Lab (SSL) at University of Massachusetts Boston examined the City's policy measures, what motivated them, and what factors either enabled or constrained their implementation and outcomes. The team first identified goals and planned actions from a review of the Climate Ready Boston Adaptation Plan prepared by the City and studies developed to support it. The team conducted interviews and meetings with officials in the Boston Planning & Development Agency (BPDA), directors of the Green Ribbon Commission and faculty who managed some of the studies.

This brief summarizes the main studies, plan and tools as well as perceptions expressed in the interviews. It organizes them according to the project's conceptual framework, based on the Theory of Reasoned Goal Pursuit (TRGP).[20] This framework considers enablers and barriers, as well as factors that motivate the use of policy instruments. Motivating factors include perceived advantages and disadvantages of the policy measures, and perceived social pressures.

The policy development process

[19] United-States Census Bureau. (2019). *Quick Facts Boston city, Massachusetts.* United-States Census Bureau. https://www.census.gov/quickfacts/bostoncitymassachusetts).

[20] Ajzen, I., & Kruglanski, A. W. (2019). Reasoned action in the service of goal pursuit. *Psychological Review, 126* (5), 774-786.

In 2007, the City of Boston developed a Climate Action Plan aimed at reducing greenhouse gas emissions to contribute to international efforts to mitigate climate change. In 2010, Mayor Menino convened the business community and leaders from Boston's key sectors and launched the Boston Green Ribbon Commission (GRC) to support the outcomes of the Climate Action Plan. The Barr Foundation decided to dedicate funding to address climate change issues and became the GRC's main financial supporter. The GRC rallies members from the real estate, health, educational, and cultural sectors. It devised a plan to implement change in the numerous facilities owned by its members, with co-benefits in energy efficiency, reduced energy costs and increased air quality.

When Hurricane Sandy hit the Northeastern region of the United States in October 2012, it spurred interest in preparedness and adaptation. If the hurricane had hit Boston at high tide, damages would have been significant. One of the participants in the GRC had assets in New York City, and advocated for creation of a Climate Preparedness Working Group. This group then coordinated the Climate Ready Boston (CRB) process, which included two phases, each involving carrying out studies and developing plans. The working group also commissioned studies about potential climate impacts affecting the Greater Boston area and in support of the implementation of the plan. In order to develop projections of climate and sea level rise, the academic partners of GRC formed the Boston Regional Advisory Group (BRAG). It included experts from different universities and research centres, coordinated by UMB faculty. Table 1 summarizes the main studies, plans and tools for adaptation.

The first of these efforts was a study of the city's vulnerability to climate change impacts. A second important study was commissioned by the Massachusetts Department of Transportation (MassDOT) to evaluate the impact of sea level rise and extreme weather on the Central Artery, the 2.4 km tunnel that runs through Boston. For this study, the "bathtub" modelling approach used in the vulnerability study was not precise enough, so MassDOT worked with the Woods Hole Group, which provided hydrodynamic modelling expertise. Meanwhile, BRAG continued its projections of climate change and sea level rise, culminating in the publication of a report in June 2016.

Following these three studies, the City of Boston issued the Climate Ready Boston report, its adaptation plan. A few months later, the Resilient Boston plan—as part of the city's participation in the Rockefeller Foundation's 100 Resilient Cities initiative—outlined visions, goals and actions to support climate change adaptation measures and solutions targeting the most vulnerable residents in the city.

Table 1: Main studies, plans and tools for adaptation in Boston

Title	Date	Description
City of Boston Climate Action Plan	2007	Focused on reduction of greenhouse gases and co-benefits
Creation of the Green Ribbon Commission (GRC)	2010	Rallies together CEOs from the business community and leaders from Boston's key sectors
Creation of GRC's Climate Preparedness Working Group	2013	This working group coordinates the Climate Ready Boston (CRB) process
Climate Ready Boston: Municipal Vulnerability to Climate Change	October 2013	Used a "bathtub" approach to flood mapping
MassDOT-FHWA Pilot Project Report: Climate Change and Extreme Weather Vulnerability Assessments and Adaptation Options for the Central Artery	June 2015	Included the development of the Boston Harbor Flood Risk Model (BH-FRM) , a hydrodynamic model prepared by Woods Hole Group
Climate Change and Sea Level Rise Projections for Boston. BRAG Report	June 2016	Like a mini-IPCC report for the Greater Boston area
Climate Ready Boston report Executive Summary	December 2016	Boston's adaptation plan
Resilient Boston Report: An Equitable and Connected City	July 2017	Report developed in the context of the 100 Resilient Cities program.
BPDA's climate resiliency guidance, including flood overlay and checklist	December 2017	The flood overlay map was developed using the hydrodynamic model developed for the flooding of the Central Artery
Financing Climate Resilience report by SSL commissioned by GRC	April 2018	This report assessed the projected costs of climate resilience in Boston and evaluated various options to finance these needs.
Feasibility of Harbor-wide Barrier Systems. Preliminary Analysis for Boston Harbor by SSL	May 2018	This report was focused on the costs, technical functionality and environmental impacts of a harbor-wide flood barrier. It advised against pursuing such a strategy in the coming decades and recommended shore-based solutions
Governance for a Changing Climate: Adapting Boston's Built Environment for Increased Flooding report by SSL, commissioned by GRC	September 2018	This report focuses on how the structure and tools of the local, regional, and state government can be modified and enhanced to minimize the impacts of climate changed-induced flooding on Boston's built environment.
Expanding Boston's Capacity to Build Coastal Resilience Infrastructure. Lessons from the Seaport District, Report by Arcadis, commissioned by GRC	April 2020	The report makes recommendations along two parallel tracks of action, the first focused on leveraging existing frameworks to complete initial urgent actions and the second to identify opportunities for transformative measures needed to support citywide implementation
Neighborhood CRB studies: East Boston and Charlestown; South Boston; Downtown and North End; Dorchester; Moakley Park vision plan	2017 to present	These studies develop neighborhood visions and propose catalyst projects for the short term as well as long term strategies to achieve the vision

Factors that motivated Climate Ready Boston

Even before Hurricane Sandy, Boston was facing challenges related to the impacts of climate change, such as coastal flooding at king tides, extreme heat episodes compounded by the heat island effect, and stormwater management issues caused by more intense rains. The damages in New York City following Hurricane Sandy revealed challenges that Boston might face in the near future, highlighting the advantages of adaptation. The City of Boston received pressure from the private sector to act and to adapt. The private sector was already involved in the GRC and committed to reducing greenhouse gas emissions.

Enablers of Climate Ready Boston

The formation of the GRC's Climate Preparedness Working Group, alongside the funding provided by the Barr Foundation, were strong enablers of the Climate Ready Boston process and the development of studies and plans. Other enablers were the presence of numerous research universities in the Boston area who coordinated and contributed to the studies.

A tangible outcome of the studies conducted has been BPDA's guidance and checklist for climate preparedness (see box on next page), developed with funds from the State's Municipal Vulnerability Preparedness (MVP) program. The approach in Boston is to allow construction in areas at risk of flooding but to ensure that these constructions are resilient. Adaptation interventions include having a floodable first floor that does not house residents or essential electric or mechanical equipment for the operation of the buildings. Additional enabling factors include:

- developing an overall Resilient Boston Harbor vision, and neighborhood visions, that focus on values such as preparedness, accessibility and connectedness;
- co-benefits of the proposed coastal infrastructure (recreation, public access to the coast) and the fact that plans envisage access to them through pedestrian and bicycle paths;
- the quality of the climate projections and flooding studies, which provided credible representations of future impacts of climate change and facilitated public buy-in;
- Mayor Walsh participating in the C-40 association of cities taking bold climate action;
- increased public participation in Climate Ready Boston phase II (neighborhood studies).

An inspiring tool for municipal planning

BPDA's Climate Resiliency guidance and checklists provides developers with information on how to adapt their buildings to climate change impacts, including storms, extreme heat and flooding. The BPDA also uses the flood overlay map based on the hydrodynamic model prepared by the Woods Hole Group to examine the effect of flooding on the underground infrastructure of the Central Artery.

Barriers to implementing Climate Ready Boston

The Resilient Boston Harbor's vision proposes the implementation of elevated green shore protection infrastructure, but some aspects remain unclear, including how to integrate this infrastructure in areas with strict zoning regulations such as Designated Port Areas (DPA); what the arrangements will be with private landowners; and how to fund these interventions. In addition, some interventions could involve filling the shoreline, causing environmental impacts and sometimes conflicting with existing local coastal wetland regulations and State laws like Chapter 91, which guarantees public access to the waterfront. The elevated shoreline can also interfere with the flow of inland stormwater. If not taken into consideration, unintended consequences of the plan and the proposed infrastructure could disproportionately benefit private owners and residents of the luxury housing on or near the waterfront.

The 2013 vulnerability study and 2016 Climate Ready Boston final report focused on coastal flooding, extreme heat and stormwater management. Until now, coastal flooding has received the most attention due to the visible flooding that followed strong nor'easter storms in recent years, and perhaps because of the implication of the real estate sector. On the other hand, extreme heat is affecting health and quality of life, especially in marginalized neighborhoods with poor air quality, such as East Boston. Increased public participation in studies of each neighborhood could eventually lead to better social distribution of the benefits of adaptation.

Areas for further reflection

Increasing public participation and responding to the needs of different stakeholders appear to be key elements toward just adaptation in Boston. Other opportunities for further research or reflection include:

- how to deal with complicated regulation issues;
- how to approach and negotiate with private coastal landowners to implement resilient infrastructure; and
- institutional arrangements to govern and fund research and the implementation of proposed adaptation strategies.

This brief is a complement to the report "Learning from the Massachusetts Municipal Vulnerability Preparedness (MVP) Program in the Greater Boston Region" (Belloy, P., Sulewski, D, & VanDeveer, S., 2021). Another brief summarizes key findings related to the MVP program. This case study is one of six conducted through the project "Understanding the Determinants of Effective Policy Instruments: Case Studies of Climate Change Adaptation in Québec, Atlantic Canada and Massachusetts" which is *coordinated by the Observatoire Québécois de l'adaptation aux changements climatiques (OQACC), based at Université Laval, and conducted in collaboration with Ouranos, University of Massachusetts Boston, University of Massachusetts Amherst and CBCL Limited in Halifax. The project is supported by Natural Resources Canada's Climate Change Adaptation Program and the Government of Québec, as part of the Québec Research Funds and the 2030 Plan for a Green Economy. This research contributes to the reflections of the Coastal Management Working Group of Canada's Climate Change Adaptation Platform.*