



# Climate Adaptation Tools for BC Local Governments

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Sea Level Rise & Heat Waves

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# Executive Summary

As climate change induces more severe weather events that wreak havoc on the places we call home in British Columbia, it is essential that local governments effectively plan to adapt to climate change. Our team set out to understand what barriers local governments face in planning for and implementing adaptation actions. Our process includes a comprehensive literature review, one-on-one interviews with 18 local governments and facilitation of a roundtable workshop. What we found are cost related barriers that local governments face in the planning and implementation process when adapting to the impacts of sea level rise and heat waves.

A synthesis of our findings from our literature review and engagement process, identified that there are two types of barriers: cost barriers and adaptation barriers that stem from a scope of limited funding. Cost barriers include characteristics such as a limited funding environment promoting competition, the need to understand co-benefits and return on investment, and the contextual nature of adaptations across various geographies. Adaptation barriers include issues like political and social constraints, capacity challenges, and complexity within the adaptation process itself. The findings were reported back to the local governments in a feedback session during the workshop, in which we identified potential recommendations for all levels of governments to undertake to overcome the barriers to adaptations.

Due to the variability of characteristics within local governments, it is near impossible to have a one-size-fits-all recommendation. Therefore, there is no one perfect case study that can be applied for every local government. As a result, our team identified three high level buckets of recommendations: governance, strategy, and financial accessibility. Governance includes recommendations that every level of government can undertake to ease the challenges local governments face upon adaptation planning and implementation. Strategy recommendations surround concepts of policy, frameworks, and public hearing enhancement. Lastly, financial accessibility introduces a preliminary cost matrix tool that local governments can utilize to assess the best adaptations based on impact and cost for their local government.



# Introduction

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# 1. Introduction

In the Fall of 2018, the IPCC released a critical report urging action to limit global warming to 1.5 degrees Celsius. Within this call to action was the acknowledgement that the Earth's climate is changing (Cities, N.D). Data has shown that from 1900 to 2013 the average annual temperature in British Columbia (B.C.) has already risen 1.4 degrees. Winter night-time temperatures have risen 3.1 degrees (Ministry of Environment, N.D). Alongside these changes in temperature, B.C. has experienced the intensification of weather patterns and rising sea-levels. In the past year, there have been devastating heat waves and atmospheric rivers which have wreaked havoc on the province and tested the capacity of our infrastructure and emergency response systems. These catastrophic climate events have shown the government and residents of B.C. that adaptation strategies in the province are severely underdeveloped. The adaptation responses currently in use are event-driven and their effectiveness highlights the need for the implementation of longer-term adaptation strategies (IPCC, 2022). Thus far, the development and implementation of these strategies have lagged behind climate change mitigation plans that have been developed in the past 5 years. Many local governments are doing their best to respond to the increasingly dangerous climate events we are faced with using adaptation strategies, but are limited by costs, capacity, social, and political constraints. It is imperative that we identify and break down the barriers to implementing these essential strategies. In partnership with West Coast Environmental Law (WCEL), Kerr-Wood Leidal (KWL), and the School of Community and Regional Planning (SCARP) this report focuses on addressing the barriers present in sea level rise (SLR) and heat wave adaptation planning through research and engagement with local governments at risk of these climate events in B.C.

Through this project our team engaged with 18 local governments over 2 months. This process culminated in a workshop in which we asked the government representatives present what project output would be most useful to overcoming the barriers present in the heat wave and SLR adaptation planning process. They voiced a need for a network of adaptation practitioners and local governments, to amplify their voices and get the attention of other levels of government, and to create a policy brief or report. This report addresses the latter two needs with the goal to provide a resource that local governments can use to help overcome monetary and socio-political barriers in the adaptation planning process for heat waves and SLR. The report summarises our desktop research and engagement results and includes recommendations arrived at from the synthesis of both.

# Framing



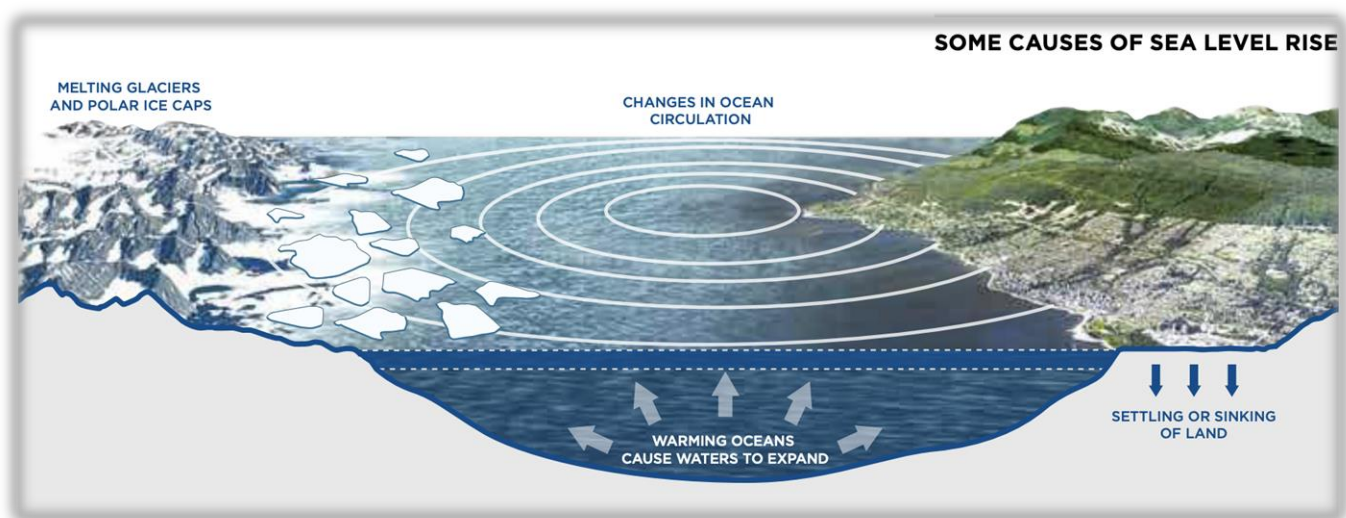
Source: City of Vancouver

## 2. Framing

To properly understand the cost related barriers in the heat wave and SLR adaptation planning process, as well as which communities are at risk and why, it was necessary to contextualise and define each risk.

### 2.1 Sea Level Rise

Sea level rise (SLR) has begun to occur across the Earth due to increasing global temperatures. The increase in temperatures has disrupted planetary paradigms resulting in the expansion of our ocean waters. This occurs through the two main processes of melting and thermal expansion. Warmer air has caused the melting of glaciers and polar ice caps adding water that was previously locked in ice to the world's oceans. The increase in global temperature has also raised the average temperature of the Earth's oceans causing them to physically expand through thermal expansion. The combined effects of these processes are leading directly to SLR (City of Vancouver, 2018). Higher sea levels cause the erosion of beaches, inundation of low-lying areas, and damage to buildings and infrastructure.



Source: City of Vancouver, Vancouver's Changing Shoreline; Preparing for Sea Level Rise (2018)

Globally, sea levels have been projected to rise 1 metre in the next 100 years (Peters, 2011). Coupled with increased storm intensity, this will have dramatic deleterious effects on communities in British Columbia and many are planning for at least 1 metre of SLR. With costs in the billions projected for adaptation responses in British Columbia communities need to be well-equipped to deal with the complexities in planning for this climate change induced risk.



## 2.2 Heat Waves

As the climate continues to change, local weather patterns are being altered, causing more intense weather events such as heat waves. The severity of heat waves is context dependent and varies based on the vulnerability of the people and places experiencing them. Environment Canada defines a heat wave as “more than three consecutive days with temperatures in excess of 32°C”, however people and infrastructure can be harmed from lower temperatures at shorter durations (Stewart et al, 2017). They cause higher mortality rates than any other climate risk, with cities experiencing up to 14% increases in mortality. British Columbians experienced this in a dangerous and dramatic way with the June 2021 heat dome which is estimated to have killed 595 approximately people (CBC, 2021).

As global temperature levels trend upwards these events will become more common. A warming trend can be seen across Canada, as the frequency of warm summer days that exceed the 90th percentile of daily maximum temperatures has increased in most of the country. The Minister of Health has stated that heat waves are “no longer a one-in-1,000-year event – it's a one-in-one year event, and we need to respond and become more resilient” (CBC, 2021).

## 2.3 Planning Context of Climate Change

Unsustainable land-use and land cover change practices have led to an increase in the vulnerability of humans to the impacts of climate change (IPCC, 2022). Communities who are directly dependent on ecosystems to meet their basic needs, such as Indigenous Peoples, are disproportionately impacted by the adverse effects of such practices as they face increased risks (IPCC, 2022). For that reason, there is a need to increase sustained adaptation actions through strengthened institutional planning cycles, statutory planning, monitory and evaluative frameworks, and recovery efforts from disaster events (IPCC, 2022). **The District of North Vancouver furthers this statement as they state:**

*“with deliberate and decisive planning, proactive action can achieve adaptation goals and simultaneously benefit multiple aspects of the community (District of North Vancouver, 2017).”*

IPCC’s AR5 report Chapter 15, Adaptation Planning and Implementation (2014), profiles the following planning practices in which climate change adaptations employ:

1. Infrastructure and asset development
2. Technological process optimization

3. Institutional and behavioural change or reinforcement
4. Integrated natural resources management (such as for watersheds and coastal zones)
5. Financial services, including risk transfer
6. Information systems to support early warning and proactive planning.

## 2.4 Project Limitations

Due to the limited timeframe of our project, our team was unable to conduct a comprehensive engagement process. Our engagement was limited to the communities who responded to our request within a two-week timeframe. As such, our findings do not represent the whole landscape of adaptation barriers faced by every local government in British Columbia. In particular, we were unable to have meaningful engagement with First Nations in British Columbia - therefore, we are missing a large piece to this scope. Lastly, we have found that due to the recent phenomenon of heat waves in British Columbia, there is still a lack of data on the adaptation process for heat waves.



The sea rising past the shores of Ambleside Beach in 2022.

# Our Process

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## 3. Our Process



The purpose of our engagement plan was to gain information and feedback not commonly available through desktop research. Climate change adaptation strategies are influenced by local context such as local government capacity, political landscape, and costs. The nuance of this information can, in many cases, only be captured through direct engagement with local practitioners and knowledge holders. The value this holds for the project is in accurately portraying the varying contexts, costs, and barriers involved in climate change adaptation across a breadth of communities.

### 3.1 Information Gathering

Our literature review started with a jurisdictional scan within BC to determine what adaptations had already been completed and find any noteworthy examples. This scan included climate change adaptations plans, OCPs, newspaper articles, and public policy documents. We then expanded our search to the rest of Canada to find examples which would be applicable in BC where the political and geographical contexts were similar. To support our initial findings, we examined peer-reviewed articles and looked at the publications of scholars within Canada, the USA, and Europe for evidence which either supported, or improved upon, the work that was already being done on adaptations within the province.



Reports from global institutions like the IPCC, C40, and UNFCCC were used to provide context for climate change scenario planning and reinforce the urgency within this work.

## 3.2 Local Government Interviews

### Engagement Selection Criteria

Local governments were selected through an assessment of existing mapping tools that display the risks of each community to SLR (Climate Central Sea Level Rise Map) and extreme heat waves (Climate Atlas Very Hot Days (+30°C)). The communities selected are those which will see the impacts of SLR and/or heat waves. To ensure comprehensive representation, communities of varying size (based on population) and located within different geographical contexts across B.C. were selected.

### One-on-one Interviews

Engagement was conducted through emails to stakeholders and practitioners identified through the selection criteria and summarized into an Engagement List of practitioners within municipalities. Local governments or practitioners with case studies of interest were prioritized. Upon receiving responses, online meetings were scheduled, and engagement proceeded through a semi-structured interview format conducted over Zoom or Teams. Two sets of questions were created. A general set of questions were asked to each local government regardless of their identified hazard risk. A second set of detailed questions, specific to the adaptation and climate actions of the community, were created to strengthen our understanding of each local government as a case study. Following the interviews, a workshop was scheduled to review and validate the engagement results with the interviewees. Additional objectives of the workshop were to identify information that will be beneficial for local governments planning climate adaptations for sea level rise and heat waves and to help us understand the best output for our findings. Of the 50 local governments identified, we received 20 responses and were able to conduct interviews with municipal staff from 18 different communities. **The map below lists the communities interviewed:**

## Where We Heard: Local Government: Engagement



### Round Table Discussion Workshop

On March 4, 2022, the WCEL team hosted a 'Project Workshop' with staff from multiple local governments across British Columbia and the team's project partners WCEL and KWL. The staff in attendance were those who provided the WCEL team with a one-on-one interview prior to the workshop. The information shared at the one-on-one interviews were collated into nine key takeaways that was presented back to the staff to fact-check the findings.

#### The objective of the workshop was:

1. To review and validate our findings and their relevance to local governments.
2. To identify information that will be beneficial for local governments planning climate adaptations for sea level rise and heat waves.
3. To help us understand the best output for our findings.

# Findings

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## 4. Findings



### 4.1 What We Read: Indirect Barriers to Cost

The IPCC's AR5 report, *Climate Change 2014: Impacts, Adaptation and Vulnerability* (2014) argues that although there is a growing recognition of the drivers and barriers to climate adaptation planning, there is no guarantee that adaptive action ensues (Mimura, et al, 2015). As a result, institutional involvement such as local government adaptation planning will require a series of enabling conditions to create environments for accelerated, sustainable, implementation of adaptations (IPCC, 2022).

The IPCC's succeeding report, the *Sixth Assessment Report: Impacts, Adaptation and Vulnerability* (2022), outlines that the following conditions are needed for adaptation to move forward:

1. Institutional frameworks where policies and instruments have clear goals and priorities
2. Political commitment and follow through
3. Enhanced knowledge on impacts and solutions
4. Mobilizations of and access to adequate financial resources
5. Monitoring and Evaluation
6. Inclusive governance processes

Despite the clear and direct conditions outlined, a multitude of challenges and barriers prevent these conditions from being met. Listed below are six barriers that indirectly and directly reinforce barriers to cost for adaptation action. Furthermore, as adaptation planning for sea level rise and heat waves often require long-term solutions, these barriers are often more arduous.

#### Limited Funding Scope

Financing for climate change adaptation at a local government is often limited to the funding capacity granted by the other levels of government. However, estimates showcase that 'future climate change



finances will be at the same level of current development expenditures (Noble et al, 2014).’ Currently the UN estimates that \$586 million was spent on adaptation projects in 2020 (\$894 million projects if you could those that also focus on mitigation) (UNFCCC, 2021). However, according to the Co-Founder of Climate Funds Update, an independent website that tracks and provides data on global climate finance, the overall gap for climate finance globally is estimated to be near \$100 billion) (UNFCCC, 2021). According to a report on climate change adaptation finance from The Federation of Canadian Municipalities (FCM) and Insurance Bureau of Canada (IBC) (2020) adaptations against all climate disasters in Canada will cost an estimated \$5.3 billion per year, or equivalent to 0.26% of Canada’s GDP.

Limited funding has already been identified as a concern for BC municipalities. A good example is the shift in responsibility regarding the adaptation planning for Integrated Flood Hazard Management. In 2003, implementation of the Changes to the Land Title Act and the Local Government Act, moved the responsibility of managing floodplain risks to local governments (Oulahen et al., 2018). The shift in responsibilities has left the local governments in charge of maintenance, operations, and hazard mapping while the provincial government only provides policies and guidelines through the Ministry of Forests, Lands, Natural Resources Operations, and Rural Development (Oulahen et al., 2018). Without the use of grants, local budgets became the primary source of funding for hazard mapping and climate change adaptation at the local level. Many municipalities have not been able to update their flood hazard management plans since this change in 2003 (Oulahen et al., 2018).

## **Six Barriers to Adaptation Action**

### **1. Dynamism of climate change adaptation planning**

Climate Change is not a static concern rather a dynamic issue (Chambwera et al, 2014). As the climate changes over time, human response to climate change also evolves (Chambwera et al, 2014). Additionally, the dynamic nature of climate change adaptation planning furthers the challenge of ensuring long-term adaptation measures are implemented. Factors such as location, timescale, and cost vary greatly, making it near impossible to have a one-size-fits-all solution that can be easily replicated. The variability of these factors makes it challenging for consistent streams of funding.

**Location:** Detailed geographical knowledge of climate change impacts is crucial in calculating localized impacts (Chambwera et al, 2014). As a result, implementation of physical adaptations will vary by region. Additionally, different locations have different social and cultural values, motivations, social norms, motivations, and trust in science, leading to a need for different adaptation methods (Tuhkanen et al, 2020).

**Timescale:** Climate change is rapidly evolving. Along with climatic conditions shifting, the information and data on climate change adaptation are constantly changing as new adaptation ideas emerge. The United Nations Framework Convention on Climate Change argues in its report *Assessing the Costs and Benefits of Adaptation Options: An Overview of Approaches* (2011), “even under a specific scenario of future emissions, the range of possible impacts is large.” The uncertainty in dealing with climate change adaptation significantly impacts long-term policy making, planning, and program development as political cycles create a pressure to show short-term results (Tuhkanen et al, 2020). As a result, the most attractive adaptation actions within local governments are often those that offer immediate development benefits and the reductions of vulnerabilities in the longer term (Mimura et al, 2014).

**Costs:** When calculating the costs of climate change adaptation, location and time also need to be accounted for. In particular, costs of materials are regionally specific as the cost of goods and labour vary from municipality to municipality (Sun, 2020). Additionally, as adaptation costs and consequences occur over time, costs change due to variable factors of the economy such as inflation. As a result, a low discount rate is needed when estimating for distant future climate change adaptation projects (Chambwera et al, 2014).

## 2. Political and Social Constraints

All levels of government play an important role in advancing climate change adaptation. Funding and regulations from the national government help direct local governments in adaptation planning (Noble et al, 2014). Local governments have the responsibility to translate national and provincial goals into local actions and policies while maintaining the needs of the local communities, non-government organizations (NGOs), and civil society organizations (Noble et al, 2014). However, several political and social factors negatively impact local government’s ability to effectively implement climate change adaptation actions.

## **A lack of coordination between governments**

Globally, it has been found that often there is a confusion in the roles and responsibilities between the different levels of government (Tuhkanen et al, 2020). Local governments often face few national requirements and have little guidance in climate adaptation (Mimura et al, 2014). Additionally, in British Columbia, there is a need to coordinate with the local First Nations and understand their existing projects and plans. Fragmented responsibility for planning adaptation and disaster management hinders the development and implementation of integrated and equitable policies (IPCC, 2022). As a result, misalignment of policies between levels of government can prevent implementation, as a lack of coordination, planning, and intergovernmental support limit sufficient financial resources (IPCC, 2022). The IPCC has argued that in order to see effective climate adaptation, there is a need for an advocate or champion within the different levels of government to initiate, mainstream, and sustain momentum (Mimura et al, 2014).

## **Political Commitment and Follow-Through**

Reiterating the timescale challenge listed above, short-term adaptation solutions are prioritized due to the political cycle. As a result, political commitment, and follow-through across all levels of government is also a challenge for climate adaptation actions. Selwin Hart, Special Adviser to the United Nations Secretary-General on Climate Action argues that the biggest reason financing adaptation solutions has lagged is due to the 'absence of political will' (United Nations, Accessed, 2022).

## **Variability of Interest Groups**

In the realm of socioeconomics, there is an assumption that although the climate will change, society will not. Subsequently, certain interest groups which drive government action, are not always in the public interest (Chambwera et al, 2014). Limited resources and political interests necessitate trade-offs among multiple policy goals and adaptation strategy choices, resulting in climate adaptations not being prioritized (Chambwera et al, 2014). A study in the UK found that from a survey of 300 projects identified as 'adaptive at local government levels', more than half were driven by concerns not directly related to climate change (Noble et al, 2014). Therefore, interest groups fuel the challenges of political will and commitment and can dissuade the acceleration of climate change adaptation action.

## Understanding of Risks

The last two points above demonstrate the need to assess political and societal understanding of the risks faced due to climate change. The UNFCCC (2011) identified that uncertainties on future climate change impact and risk has led to inaction of adaptation options. The IPCC (2014) further argues that adequate information on risks and vulnerability is required in order to identify the appropriate adaptation options to build capacity and build risk. Furthermore, the IPCC adds that local governments influence the distribution of climate risks and are pivotal in positioning the promotion of widespread support for adaptation initiatives, foster intergovernmental coordination, and to facilitate implementation (Noble et al, 2014).

### 3. Capacity Challenges

The ability to adapt to climate change is dependent on numerous capacity challenges: human capital, material resources and infrastructure, socio-political and financial capital, organizational capacity, and information and technology (Denton et al, 2014). Although community adaptation planning has been strengthened in recent years due to an increase in the use of geographic information systems (GIS) modelling, climate change scenarios, increase in scientific research methods, and ecosystem services, local governments still lack a multitude of capacities (Mimura et al, 2014). Local governments often lack in human and technological capacities, funding, and time (Tuhkanen et al, 2020). Limited data quality and quantity on climate change adaptations can further the capacity challenges (Tuhkanen et al, 2020).

The lack of capacity for local governments is exacerbated by the need to attend to a backlog of critical basic services such as housing and water supply (Noble et al, 2014). NGOs and civil society organizations are key actors local governments collaborate with in climate change adaptation actions, however they are also often limited by a lack of capacity and resources (Noble et al, 2014). Additionally, local governments often do not have the mandate to develop and enforce regulations (Noble et al, 2014).



## **Importance of Co-Benefits**

A result of the limited capacities mean that local governments will need to be selective and prioritize adaptation options. Adaptation options are often designed to address different municipal goals such as housing or poverty reduction through climate-related co-benefits (Noble et al, 2014). Co-benefits framing of wider gains in enhanced resilience, greater welfare, and reduced vulnerability has led to more attention being paid to mainstreaming climate change into wider government policy (Noble et al, 2014).

## **4. Monitoring and Evaluation (M&E) of Adaptations**

The monitoring and evaluation (M&E) stages of adaptation planning is crucial in understanding the effectiveness of adaptations implemented (IPCC, 2022). M&E allows planners to understand what has been successful and effective. The learnings can be used to guide policymakers and staff as to where further action is needed (IPCC, 2022). However, a challenge local governments face within M&E is the standardization of metrics and evaluation. In comparison to climate change mitigation metrics which can use tonnes of GHGs or radiative forcing values, adaptation has no common reference metrics (Noble et al, 2014). Furthering the challenge, metrics for adaptations are contentious as there are multiple purposes, viewpoints, values that cannot be captured in adaptation metrics (Noble et al, 2014).

## **5. The Adaptation Process Itself**

Often, the biggest barrier to adaptation planning for many local governments is to know how and where to start. The UNFCCC argues that ‘uncertainty surrounding future climate change impacts constrains the identification of optimal adaptation options (UNFCCC, 2011).’ The many limiting factors as stated above, further isolate many local governments from selecting a scope and criteria to start planning and often have a difficult time in identifying long-term and holistic measures to approach adaptation planning. Additionally, adaptation solutions that work for one local government does not ensure ease of replicability within other local governments due to the dynamism of adaptation planning (Tuhkanen et al, 2020).

## 6. Maladaptation

Lastly, maladaptation is a challenge in adaptation planning. Maladaptation, as defined by the IPCC, is the situation in which ‘an adaptation intervention at one location increases the vulnerability of another target group or location (Noble et al, 2014).’ Maladaptation can occur due to not only badly planned adaptation actions, but also the emphasis on short-term outcomes which fail to understand the broader implications of the planned actions (Noble et al, 2014). As a result, the potential for maladaptation further stalls the planning process for adaptation actions.



## 4.2 What We Heard: Sea Level Rise and Heat Wave Adaptation Planning

After completing one-on-one interviews and the feedback workshop, the findings from our literature review began to line up with conversations we were having in our engagement sessions. This includes the importance of how the climate change planning process occurs, the limited availability of consistent funding, and the need to overcome social and political barriers before tackling financial obstacles. Absent from our engagement findings are the responses from local governments who had not begun the adaptation planning process. These communities either did not have the human resource capacity to provide input to our project, or they believed that they would not be able to meaningfully contribute to our study. An assumption can be made that a combination of the barriers listed above and those explored below are preventing these local governments from adapting their communities to climate change. The findings of our engagement are summarised in a high-level description along with local government examples.

### Limited Funding Scope

The limited funding options for local governments are inconsistent, leading to high staff turnover as those contracted to work on adaptation planning face an insecure employment future. When this occurs, there is a loss of institutional memory as projects typically last much longer than a single year. This limits a local government's ability to innovate and 'stand out' on plans. Thus, they are unable to compete for grant funding with other local governments that have high resource capacities. Due to the inconsistent nature of funding, local governments of all sizes are affected.

#### **1. Limited funding for local governments calls for tax reform and creates a dependency on innovative adaptation strategies due to a competitive grant funding environment.**

Local governments are confined to a limited municipal budget with little room for large scale adaptation actions. A main revenue generator for local governments is their municipal tax base. Municipal staff identified this source to be a severely inadequate funding stream for adaptation planning since local

governments are unable to divert enough tax dollars to accomplish the necessary climate work in the community. Calls to reform the tax structure was often voiced in our engagement process to bring consistent funding to adaptation work (personal communication N.D.).

Another potential stream of funding for climate adaptation actions is through grant funding that is often provided by senior levels of government. However, the limited number of grants have created a highly competitive grant application process in which only a few local governments receive funding. Nearly every local government urgently needs adaptations implemented. The competitive grants process also promotes the need to have innovative adaptation solutions rather than proven basic adaptations that will meet the needs for SLR and heat waves (personal communication, N.D.).

### Case Study: Grant Funding Application

#### ***City of Surrey***

*Through funding from the Real Estate Foundation of BC, the City of Surrey was able to undertake an Urban Heat Ready Strategy pilot project. The funding allowed Surrey to co-create solutions to minimise urban heat island impacts in Surrey City Centre through an extensive community engagement process. Additionally, the funding provided an opportunity for Surrey to gather detailed data building on local ambient heat map data collected in collaboration with Washington State University, this project sought to better understand the needs of the community during hot weather events, explore the preferred solutions with the building industry and develop scenarios for different levels of heat interventions in various land-use types in this neighbourhood. - such as driving around the city at 3 different times to heat map ambient air temperature as opposed to the less applicable surface temperature provided by satellite data.*

## **2. Understanding co-benefits and return of investments for adaptations are more important knowledge in comparison to actual costs.**

A limited funding environment prompts local governments to be selective and seek adaptations that can address multiple municipal goals at once. Adaptations that have co-benefits can either directly or indirectly, provide other benefits to the community. For example, building a bike lane can not only reduce greenhouse gas emissions, but also provide mental health and physical health benefits as well. Co-benefits promote local governments to look for adaptation solutions in a more holistic way, providing an opportunity for multiple departments to collaborate and advance their priorities (personal communication, N.D.). Therefore, when approaching adaptations with a co-benefit lens, it is important to understand who

has ownership over the land or assets in question, how can they form partnerships with other interest groups, and who will ultimately take on responsibility for the adaptation?

In addition to seeking adaptation solutions with co-benefits, understanding the return of investments for adaptations also help local governments. Understanding the beneficial return of investing in an adaptation such as long-term flood protection, will help local governments to select adaptation solutions when there is scarce funding.

### Case Study: Application of Co-Benefits

#### **City of Port Moody**

*The City of Port Moody's Climate Action Plan: A path towards a carbon neutral, resilient Port Moody, was created through a collaborative approach by working across multiple departments and organisations. The Staff Climate Action Working Group consisted of representatives from the departments of Building Bylaws & Licensing, Communications and Engagement, Development Planning, Policy Planning, Engineering and Operations, Financial Planning and Reporting, Fire Rescue, Environment and Parks, Facilities, Economic Development and Solid Waste, and Fleet & Shared Services. Having multiple departments involved allows the Climate Action Plan to highlight co-benefits in each aspect of the Plan. For example, in the action regarding emergency response and human health to extreme weather events, it also lists co-benefits of "supports energy use reduction and clean energy transition, improves health, wellbeing and community liveability, and reduces vulnerability to extreme temperatures and weather events." This type of co-benefit identification also helps increase project budgets by collectively sourcing funding from multiple departments, thereby allowing adaptations to be implemented that would otherwise be shelved.*

### **3. Social and political constraints are priority in the planning and engagement stage**

Planning for adaptation actions are constrained by social and political priorities. As politicians' role is to represent the interests of the public, climate adaptation actions are often delayed or pushed aside. For example, when considering sea level rise adaptations, choosing a viable solution can be challenging during engagement. The lived experiences and attachments people have to climate events and how they affect their homes can be difficult to navigate. An equity lens should be applied to the initial stages of the



climate change planning process to help residents and politicians navigate the climate anxiety and trauma associated with hazard events (personal communication, N.D.). The viability of a managed retreat to avoid a hazard's impacts could conflict with the sense of place residents have about their community.

If local governments do not fund the staff or studies needed to begin the climate change planning process, then the relative costs of different adaptations are not significant. However, recent natural disaster events in British Columbia such as the heat dome, extreme wildfires, and flooding, have heightened the public's understanding of risk and have prompted Councillors and local governments to prioritize climate change adaptation solutions (personal communication, N.D.).

## Case Studies: Political and Social Needs Influencing Planning Direction

### ***The District of Port Hardy***

*In the 1980s, the District of Port Hardy completed a Stormwater Management Study, estimating the cost of improvements to be \$1 million. However, for a small local government with a population of only 4,000, residents expressed their interest in allocating accessible capital into improving recreational amenities such as a pool as opposed to implementing stormwater adaptations. As the immediate impacts of sea level rise are not evident within the community, priorities to improve the current quality of life is preferred by the residents.*

### ***The District of Tofino***

*The District of Tofino is a coastal community with many valuable waterfront private properties that exceed millions of dollars. Due to the high property values and a limited municipal budget, managed retreat solutions for sea level rise adaptation such as land buy back are not financially and politically feasible. For example, an increase of 1% property tax on a \$3.5 million dollar home in Tofino's waterfront will provide the local government with only \$35,000 in tax funding. The discrepancy in funding means that for the local government to buy that 1 waterfront property, residents who are not as at risk of sea level rise will also be charged with increased taxes. Therefore, the political feasibility of this option removes managed retreat from the conversation.*

#### 4. Costs become the most significant barrier during the implementation and maintenance stages of adaptations.

Implementation of sea level rise and heat wave adaptations often require a larger investment of funding in comparison to the planning and engagement stage. Separate grants are required from the planning to implementation stage and may include additional costs in developing architectural and engineering plans. Additionally, maintenance and upgrades for adaptations require continuous funding throughout the year. For example, a stormwater master plan may identify the need to update existing infrastructure against SLR, however those upgrade costs could total 1 million dollars. This type of spending may not be the priority of a smaller municipality with a constrained budget. Further, the lifetime costs of an adaptation may lock in expenses for decades, limiting future allocation of funds for residential needs such as recreational facilities. For example, after spending millions to build a sea dike, annual maintenance costs could be nearly \$200,000 per year (personal communication, N.D.). These considerations are important for local governments because decisions on the implementation and maintenance of large-scale adaptations allocate public funds for generations.

#### Case Study: Costing information for implementation of adaptation

##### ***District of Squamish: Xwu'nekw Park Sea Dike***

*As a result of a \$500k Integrated Flood Hazard Management Plan that identified the need to build and improve upon the existing dike system, the District of Squamish is currently planning a \$10 million project to construct a sea dike built to 4.7m above sea level that is projected to protect the community from coastal flooding hazards until 2100. The total cost of the sea dike is estimated to be around \$27.5 million. Implementation of this project has been made possible due to a \$4,049,878 grant from Investing in Canada Infrastructure Program. Ongoing maintenance and costs to remove vegetation from the district's dike system are estimated to be \$200,000 per year. Over the coming decades, improvements to reduce seismic impacts on the structure could increase the costs of maintaining the dike system by tens of millions of dollars.*

## Case Study: Maintenance costs of existing adaptations

### ***District of West Vancouver: Centennial Sea Walk***

*The District of West Vancouver has a sea walk along its shorelines that is well liked and admired by both residents and tourists. The promenade is valued by residents for its urban design features including the paved surfaces, granite features, and its overall aesthetic beauty. However, in terms of maintenance, structures like the sea walk are costly to maintain and susceptible to extreme weather events in comparison to dynamic nature-based solutions such as rip rap and naturally fortified vertical slopes.*

### **5. The costs of adaptations are relative to various aspects such as geography. Costs for future expenses are hard to estimate - as inflation and future costs of material are not consistent.**

The cost of an adaptation varies contextually over time and by location, making it difficult to replicate adaptations in different communities. For example, two neighbouring regions looking to build a sea dike may not be able to use the cost information from one local government as an accurate predictor for the other. Despite their geographic proximity, steep changes in elevation could dictate whether your region is in a high-risk tsunami zone. This will inevitably change the cost per kilometre of sea dike construction (personal communication, N.D.).

Scope creep is also a concern that public works and engineering departments may encounter when constructing and maintaining climate adaptations. Cost overruns are common for any adaptation that is designed for a lifecycle of multiple decades (personal communication, N.D.). Rising material costs may impact the implementation stage, but economies of scale could also make widespread adoption of climate solutions more feasible. Forecasting how adaptation expenses vary across geography requires an understanding of supply chains, macroeconomics, and engineering innovation that may not be accessible to all local governments.

## Case Study: Adaptation planning with specific geography

### ***District of North Vancouver (DNV)***

*The District of North Vancouver, in partnership with the City of North Vancouver, District of West Vancouver, Vancouver Fraser Port Authority, Squamish Nation, and North Shore Emergency Management, created a \$320,000 Sea Level Rise Strategy to protect the North Shore from rising sea levels with \$175,000 funding from the Federation of Canadian Municipalities (FCM) and funding from other partners. Costing information from existing adaptation approaches are not readily transferable for each community as different topographies result in different needs for each community. For example, the topography of the DNV is generally on the mountain side in comparison to the District of West Vancouver (DWV) which is located along the Burrard Inlet. As a result, the DNV are in a favourable position for sea level rise as they do not have the same flooding damages as the DWV. The different topographical and geographical context, therefore, will make costs vary for adaptation approaches.*

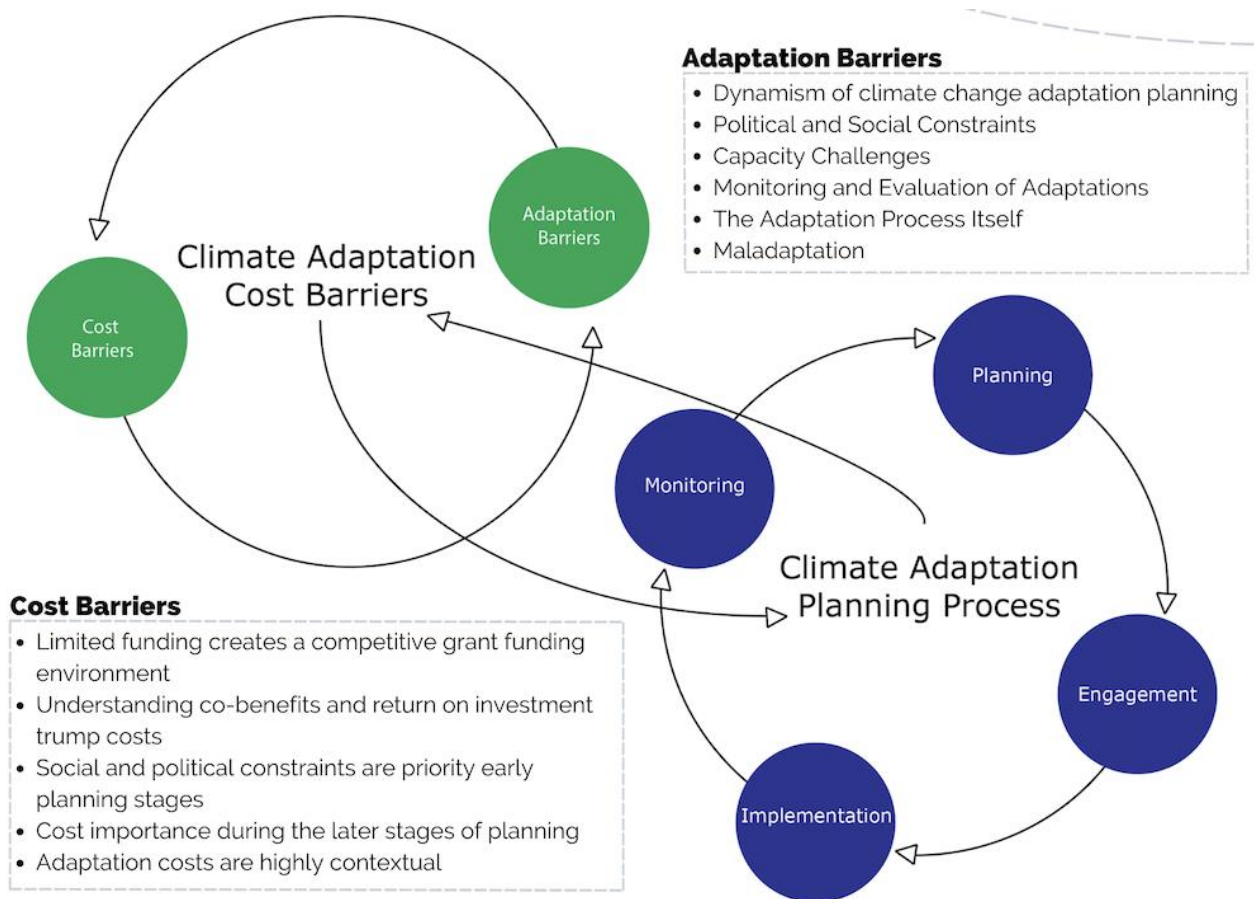
# Discussion

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## 5. Discussion

### What the barriers mean in terms of adaptation planning for SLR and Heat Waves:



The corollaries between our local British Columbian examples and the findings globally from the IPCC and beyond, show that there is a need to provide guidance on how to address these crippling barriers. Our literature review and engagement results show that there are systemic issues in adaptation planning that must be addressed to allow communities to effectively respond to heat waves and SLR. As we have found through our research, many organisations have effectively identified why adaptation planning and implementation is slow or non-existent. However, very few outline the interrelation between cost and adaptation barriers to arrive at a way forward. This is likely due to the hyper-local context of adaptation



work. We found that the adaptation planning process, cost barriers, and adaptation barriers interact in a mutually reinforcing cycle that makes action on climate adaptation very difficult.

The identified barriers to successfully plan for and implement climate adaptation are both directly related to cost, and the adaptation process as a system. They intermingle to create the endlessly complex web of barriers and constraints that have stopped many local governments from planning for and implementing measures to adapt to heat waves and SLR.

The web of interacting barriers and processes shown in the diagram above highlight the complexities within the adaptation planning process and the need for holistic solutions that consider enhancement of public knowledge, funding, policies, and frameworks. If the barriers present in adaptation planning are not addressed as systemic, adaptation strategies will continue to stall.

Foundational to climate adaptation cost barriers is limited funding. Though limited funding is not explicitly written into the diagram, it impacts both cost and adaptation barriers. By following the diagram of interactions above, it is possible to see how compounding barriers affect the adaptation process. Much of the cost barriers identified are barriers and challenges we heard from our engagement process and the adaptation barriers are those we identified in our literature review. **As such cost barriers are seen through challenges such as:**

- **Limited funding creates a competitive grant funding environment,**
- **Understanding co-benefits and return of investment is more important than understanding costs,**
- **Social and political constraints are a priority early in the planning stages,**
- **Costs become more of a priority during the later stages (implementation and monitoring stages) of planning,**
- **Adaptation costs are highly contextual.**

#### **Cost Barriers to Climate Change Adaptation**

**As a result of the cost barriers, the adaptation barriers such as:**

- **Dynamism of climate change adaptation planning,**
- **Political and social constraints,**
- **Capacity challenges,**
- **Monitoring and evaluation of adaptations,**
- **The adaptation process itself,**
- **Maladaptation magnification.**

#### **General Barriers to Climate Change Adaptation**

The intensified adaptation barriers then further compound the cost barriers creating a mutually reinforcing cycle. The cycle of climate adaptation barriers inadvertently impacts the planning process as the inability to address the barriers create challenges with furthering adaptation planning at all levels of the planning process.

An example of this cycle in practice could follow this path: a lack of funding can lead to poor understanding of adaptation options within a local government and the public they serve impeding engagement processes. When these foundational barriers are present in the planning process they develop as social and political constraints that can halt planning. Public knowledge on the effects of a climate risk such as SLR is essential to effective engagement and selection of an appropriate adaptation measure. Within an organisation having funding to hire and retain staff knowledgeable on these topics is just as important for planning and implementation phases. Further, a lack of organisational capacity can affect political support for adaptation work in the pre-planning and planning stages. The systems that create and perpetuate barriers to this work are complex but must be acknowledged to work through them.

# Recommendations

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## 6. Recommendations

The IPCC argues that accelerated political commitment and follow-through can be achieved through building a business case for adaptation, raising public awareness, increasing accountability and transparency mechanisms, monitoring evaluation of adaptation progress, and social movements (IPCC, 2022). However, when creating recommendations to address the barriers, attempting to find a one-size fits all solution is difficult as each community has a unique local context, problem to address, set of needs, and public they are accountable to. This makes prescribing recommendations based on successful case studies of climate change adaptation action difficult to do.

To synthesize what we read and what we heard, listed below are recommendations for future actions to assist local governments in overcoming cost barriers to climate change adaptations. Our recommendations are broken down into three themes: governance, strategy, and data transparency.



### 6.1 Governance

Throughout our literature review and engagement process, limited capacity consistently was mentioned as a barrier that needs to be addressed. Limited funding affects every part of the adaptation process and informs how well a local government can respond to climate risks such as sea level rise and heat waves. The main issues with the current funding system are the amount, accessibility, and continuity of funding streams. All three must be addressed to effectively support local governments undertaking adaptation work. As the IPCC's most recent report argues, there is a "need for integrated discussions and finance actions across governance levels that prioritise risk reduction as well as equity and justice can ensure climate resilient development (IPCC, 2022)."

Accelerating political commitment also calls for strong leadership, either from political figures or from a member in the community or government staff. Additionally, it is important to consider that with the

increasing complexity of adaptation practices, continual learning at all levels of government is important to achieve effective adaptation (Noble et al, 2014).

The current state of grant funding in British Columbia has local governments competing for limited resources through innovative and award-winning adaptation strategies. Cross governmental collaboration and public-private partnerships will be needed to capacity build and remove barriers in accessing financing that is crucial in accelerating adaptation, specifically for communities and regions most vulnerable to the immediate impacts of climate change.

### **Local Governments**

- Future climate adaptation planning should incorporate the concept of co-benefits of adaptations to secure more funding from different levels of government and for further political buy-in.

### **First Nation Governments**

- There is a need to further engage with First Nations to understand their current barriers to adaptations and to learn from their existing practices. A good example is the Tsleil-Waututh Nation Community Climate Resilience Plan which aims to build the Nation's resilience to climate change. The project features strong in-house collaboration with a team that includes planners, biologists, water resources engineers, coastal engineers, community engagement specialists, and geoscientists (Lilley, n.d.).

### **Provincial Government**

- The provincial government should conduct an assessment on existing long-term climate adaptation needs and understand where local governments do not have capacity to undertake due to their constrained municipal budgets. For example, sea level rise adaptation infrastructure, flood risk mapping.
- The Provincial Government should either hire a permanent staff person at the provincial level or fund permanent staff members at the local government level who can convene and coordinate climate change adaptation planning and implementation across local governments in BC.
  - a. Multiple local governments identified the need to have a dedicated staff member who can coordinate climate adaptation efforts within the organization and across departments. This

- could address some of the discontinuity and loss of institutional knowledge that results from current funding structures.
- b. The permanent staff member(s) should convene working groups that promote collaboration across different local governments and levels of government, staff departments, and non-profit experts, to integrate a comprehensive approach to climate change planning and establish metrics and approaches to data collection and sharing of information. This is also particularly relevant for heat waves as local health authorities often manage emergency services during these events, such as cooling centres.
  - c. A good example is the Fraser Basin Council's Regional Adaptation Collaborative Program which aims to strengthen regional capacity and increase action to advance adaptation planning and implementation in local governments, First Nations governments, and the natural resource sector. The program brings together the different levels of government, the non-profit and private sector, and academic community (Fraser Basin Council, n.d.).
- Depending on the implementation of the new CARIP, there is a need to provide a continuous stream of funding for local governments for climate change planning.
    - a. Climate Action Revenue Incentive Program (CARIP) is a new conditional grant program launched by the provincial government that provides local governments who are signed on to the B.C. Action Charter, funding that is equal to 100 percent of the carbon taxes they paid, to encourage investment in climate action (Government of British Columbia, 2022).

## **Federal Government**

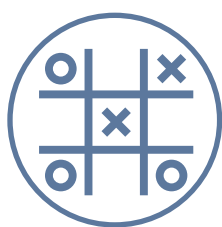
- There is a need for more equitable funding from the federal government on climate change adaptation planning that should be based on the risks local governments face from disaster and damages from climate change impacts. A shift to need-based funding would be a more equitable process.



## Private Sector Partnerships

The challenges with limited funding allocated to climate change is not from a lack of capital. Rather, it is due to the market behaviour of businesses. Provincial and Federal governments are often looked to as a funding source, however they also must balance the needs of other priorities such as affordable housing, advancing equity work, providing infrastructure upgrades, etc. Therefore, there is a need to identify institutions in the private sector who have the capacity to support local governments financially, and foster their engagement and participation in adaptation decisions and actions (Noble et al, 2014). The private sector includes institutions that range from banks, pension funds, insurance companies, charities, and larger enterprises such as multinational corporations (Mimura et al, 2014).

The private sector can help address risk management options such as through financing larger projects or insurance provision (Mimura et al, 2014). Additionally, private sectors, similar to the local governments, are looking for predictable ROIs that are comparable to the returns on investments for non-adaptation measures, leading to their interest in providing private financing (IPCC, Chapter 15, 2014). Municipalities should consider seeking out ways to improve their creditworthiness and utilise private lending to fund climate adaptation projects when possible (100R, 2019). As a result, the private sector can provide bottom-up efforts of planning and implementation while the public sector provides the top-down flow of risk information and financing (Noble et al, 2014). The private sector will benefit from a collaborative approach, as climate change has and will continue to impact their production systems, supply chains, and markets (Deloitte, n.d.).



## 6.2 Strategy

### Policies and Frameworks

The current policies and frameworks that guide climate change adaptation work in British Columbia are decentralised and difficult to navigate. Many local governments voiced that it is often difficult to sift through the available information from various organisations with limited or non-existent staff capacity. There are several organisations spanning many jurisdictions that local governments must find their way through to do adaptation work. This could even cause delays in meaningful climate actions as years can

be added on to an adaptation effort when the implementation stage of an adaptation triggers the need to meet engineering guidelines or environmental standards from organisations like the Department of Fisheries are met (Personal Communication, 2022). This can make starting an adaptation plan or moving to implementation unfeasible for smaller local governments.

Therefore, there is a need to integrate adaptation measures into policy and frameworks to clarify roles of each municipal department involved, ensure successful collaboration, and as a result, reduce the possibility of maladaptive actions (Noble et al, 2014). Additionally, through strong policy and institutional instruments, it will strengthen and sustain adaptation actions (IPCC, 2022). Stronger collaborative efforts can ensure that co-benefits to adaptations will be addressed, furthering the possibility for more funding for adaptation plans. For example, Port Moody's Climate Action Plan stated above, demonstrates how collaboration can incorporate co-benefits throughout a climate action plan.

Policy and legal frameworks can also strengthen the participation of the private sector. This can be seen through policies around behavioural incentives, climate risk disclosure, economic instruments that address market failures, and inclusive and deliberative processes that strengthen adaptation actions (IPCC, 2022). A good example is the incorporation of the Task Force on Climate-Related Financial Disclosures (TCFD), which is a globally accepted framework that helps public companies and other organisations to effectively disclose climate-related risks and opportunities through their existing reporting process. At present, the British Columbia Securities Commission (BCSC), as directed from the Canadian Securities Administrators (CSA), to implement this framework into BC legislation (BC Securities Commission, 2019).

## **Ensure Flexibility in Adaptation Planning**

An important consideration when planning for policies and frameworks for adaptation actions is to ensure space for flexibility. With an increased awareness and focus on adaptation planning, new adaptation discourse and hard adaptations are constantly changing. Therefore, there is a need to ensure that adaptation measures are designed in a flexible manner so that when new adaptation options are produced it can be incorporated.

## Enhancement of Public Knowledge

International organisations have underlined the importance of climate change education for responding to climate change. Organisations ranging from the United Nations, UNESCO, and the World Meteorological Organization advocate for and support public education campaigns in pursuit of a more well-informed public that can understand and internalise the devastating impacts of climate change. There are several frameworks, policies, and initiatives that attempt to motivate the international community to develop public education campaigns such as the Sustainable Development Goals (SDGs) formed by the United Nations and the Climate Without Borders network developed by the World Meteorological Organization (UN, 2013). Section 4.7 of the SDG, which Canada accepted in 2015, specifically outlines climate literacy in the education goals. The education goals, which are ranked 3rd out of 17 goals, are set to be met by 2030 (Goal 4, n.d.).

At the beginning of the adaptation planning process political and social constraints are the largest barriers to moving forward to effective implementation. These barriers can often stem from a lack of understanding of or an aversion to discussing the risks of sea level rise and heat waves. It is always important to approach public engagement with an equity lens and consider people's varying comfort levels and lived experiences (Personal Communication, 2022). Moving forward there is a need to enhance the knowledge on impacts, risks, and consequences as well as adaptation options to promote societal and policy response. Local governments have already begun this work, but more wide-reaching programs will be needed to continue the enhancement of public knowledge and to foster support for adaptation initiatives. Through a collaborative and wide range of top-down and bottom-up approaches, a co-produced process in which the public communicate their needs and local governments offer support should be developed.

**In B.C. there have been effective examples of public education done by local governments:**

*The City of West Vancouver and The City of Kamloops have both run effective public knowledge campaigns aimed at increasing understanding on SLR and heat waves, respectively. The City of West Vancouver worked with waterfront residents to understand how coastal management can be coordinated and utilised in a way that maximises adaptation to SLR and minimises downstream effects. The City of Kamloops ran a communications campaign to alert residents to the effects of heat waves and prepare them for the extreme temperatures. The goal was to communicate the severity of the coming climate event and let residents know where they could seek shelter and look for support. Initiatives like these are essential to successfully implementing adaptation strategies and minimising risk.*



## 6.3 Financial Data Accessibility

### Open Data Availability and Access

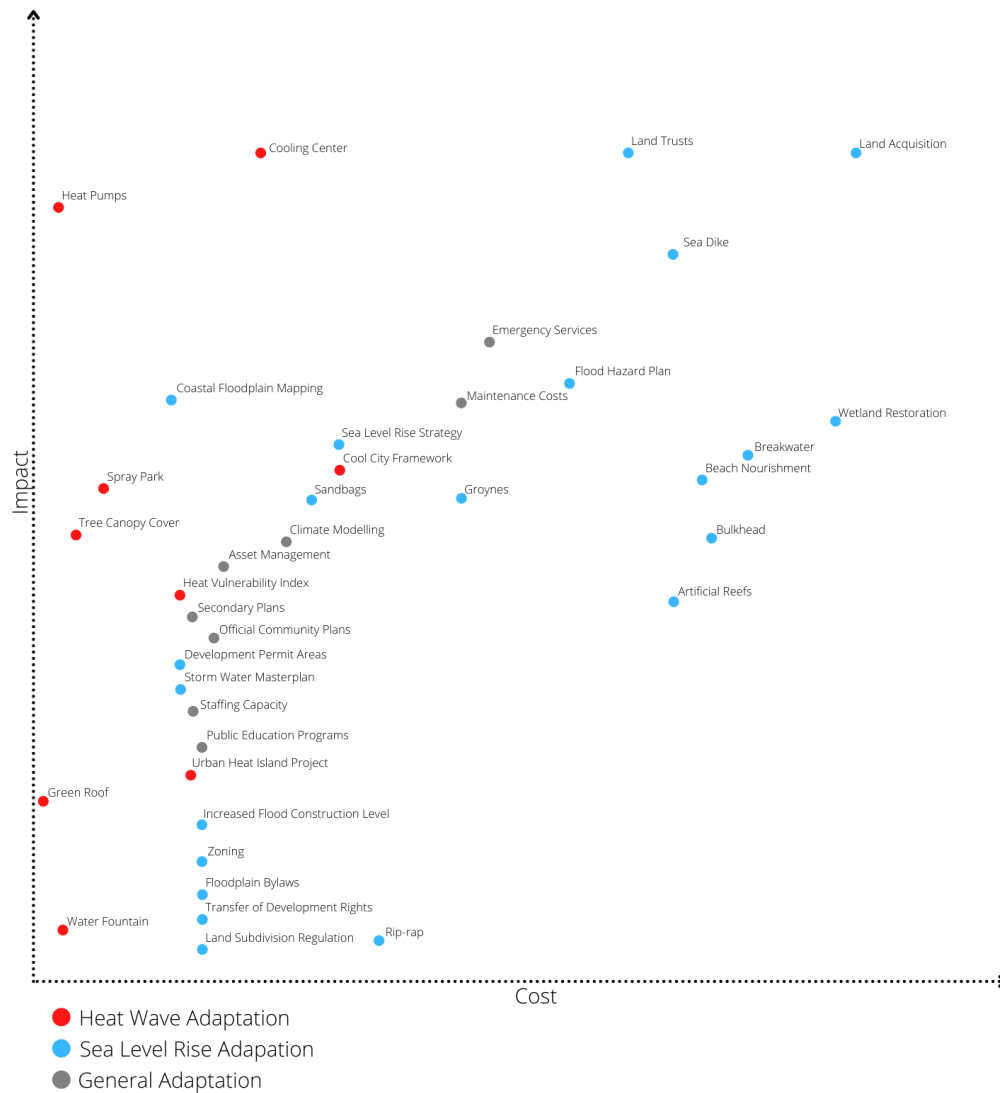
We recognize that both the Federal and Provincial governments have open data policies and portals in place to allow for government transparency (Government of Canada, 2016; Government of British Columbia, 2011). Public budgets are easily accessible at all three levels of government, but financial information on specific projects was incredibly difficult to source. The OECD highlights the benefit of open data and transparent government activity stating that “by making their datasets available, public institutions become more transparent and accountable to citizens” (OECD, n.d.). All levels of government should be encouraging the use, reuse, and free distribution of public datasets (OECD, n.d.). This is especially significant when financial data can be used as tools to fight against our current climate crisis.

### Cost Matrix Tool

The matrix below portrays the relative impact and cost of different sea level rise and heat wave adaptations. It has cost on the x-axis and impact on the y-axis. Cost information was collected primarily through literature review and supported by our one-on-one interviews. However, the costs associated with many of the adaptations were often unclear, unavailable, or too high level. Therefore, we were unable to assign hard costs to the adaptations within the matrix. Impacts are measured qualitatively from low to high impact based on the scale of the adaptation, its effective time horizon, and its overall effectiveness as an adaptation response. Each adaptation is placed in the matrix relative to other adaptations. It is important to note that contextual variations can occur within each adaptation. As an example, land acquisition may be used to purchase only one dwelling or parcel of land, as opposed to an entire floodplain. Thereby, greatly impacting both cost and impact.

The creation of this graphic shows the need for data transparency on the localized costs of adaptation strategies. The dearth of local knowledge on these costs can impede the planning process and complicate selecting the best adaptation.

## Cost Matrix of Climate Change Adaptations



The release of project specific information could be facilitated under the Access to Information Act and Privacy Act, with responses by local governments expected within 30 days (Government of Canada, 2016). We recognize that ethical considerations must be made prior to publishing all public data, including the anonymization of data which can leave individual residents or staff exposed (Janessen et. al. 2012). However, we feel that the financial data required to improve our cost matrix would help generate better climate solutions at the local government level in future research.

## Asset Management Studies

Another data tool for local governments to utilise would be asset management strategy (Asset Management BC, n.d.). Quantifying natural assets, along with both public and private infrastructure at risk to climate disasters, informs both the public and council on the potential negative impacts of climate change (Asset Management BC, n.d.). Additionally, this type of research supports information behind return on investments on climate change adaptation which has already been identified by FCM (2020) as providing a return on investment of \$6 in future averted losses for every \$1 spent proactively. We believe this tool would greatly improve the identification of co-benefit opportunities within local governments. Thus, it has the potential to overcome social or political barriers which currently exist within the climate change adaptation process. Asset Management BC has created a framework for improving climate resilience through Asset management which should be including local climate action plans.



# Conclusion

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## 7. Conclusion

As climate change continues to alter weather patterns and incite more severe climate events it is essential that local governments can effectively plan to adapt. This report summarizes barriers that local governments face in the planning process for adapting to sea level rise and heat waves. These barriers were uncovered through a thorough literature and an engagement process in which local governments were identified as at risk to sea level rise or heat waves and contacted for an interview. 50 local governments were contacted and 18 were engaged with on cost related barriers to the sea level rise and heat wave adaptation planning process. The findings were then synthesized and reported back to the local governments in a feedback session workshop.

Through this process we found that barriers fall into the two broad categories of adaptation barriers and cost barriers. The barriers interact in a mutually reinforcing cycle that causes friction in the adaptation planning process and can stall adaptation work. Three categories of recommendations were arrived at to address these barriers. Governance, strategy, and financial accessibility related solutions were recommended based on both literature review and feedback from local governments. It is our hope that this report lays the foundation for future work and new directions towards breaking down barriers in the adaptation planning process.

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