qathet Regional District

Tla'amin Nation

Powell River coastal by nature

qathet Regional Coastal Flood Adaptation Strategy

FINAL OVERVIEW REPORT

Ebbwater Consulting Inc.
510 – 119 West Pender St.
Vancouver, BC V6B 1S5
www.ebbwater.ca

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SHIFT shift to a better world

Cover Photo: Aerial view of the qathet Regional District coastline, 22 June 2022.
Image by Ebbwater Consulting Inc.

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Certification

Name, Qualifications, and Project Role	Organization	Signature
Tamsin Lyle, M.Eng., MRM, P.Eng., Project Lead and Senior Reviewer	Ebbwater	(Signature and Stamp provided in original document)

Contributors

Name, Qualifications, and Project Role	Organization	Signature
Erica Crawford, MA, Engagement Lead	SHIFT Collaborative	(Signature provided in original document)
Robert Larson, M.Sc., P.Ag. Project Manager	Ebbwater	(Signature provided in original document)
Tamsin Mills, M.Sc., RPP Planning Lead	Independent	(Signature provided in original document)
Yinlue Wang, M.Sc., Hydrotechnical Specialist	Ebbwater	(Signature provided in original document)

Revision History

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4	25 Nov 2022	Tamsin Lyle, P.Eng.	Final Report	Provided to qathet Regional District

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The analyses were completed, and the report written by a multi-disciplinary team as follows:

- Tamsin Lyle, M.Eng., MRM, P.Eng. (Principal of Ebbwater) was the project technical lead, which included directing hazard mapping enhancements, developing engineering-based components of the adaptation strategy actions, and writing large sections of the strategy documents.
- Erica Crawford, MA (SHIFT Collaborative) led the development, coordination, and delivery of the engagement sessions, as well as managing feedback and writing results. Her support team included Deanna Shrimpton and Devon Francis, and graphic design was done by Mia Hansen.
- Robert Larson, M.Sc., P.Ag. (Ebbwater) managed the project including supporting the development of the engagement activities and materials, and report-writing.
- Tamsin Mills, M.Sc., RPP (Independent Consultant) was the project's planning lead, which included review of policy and regulatory context and development of planning-based adaptation strategy components.
- Yinlue Wang, M.Sc. (Ebbwater) conducted technical analyses and mapping.

EXECUTIVE SUMMARY

Introduction

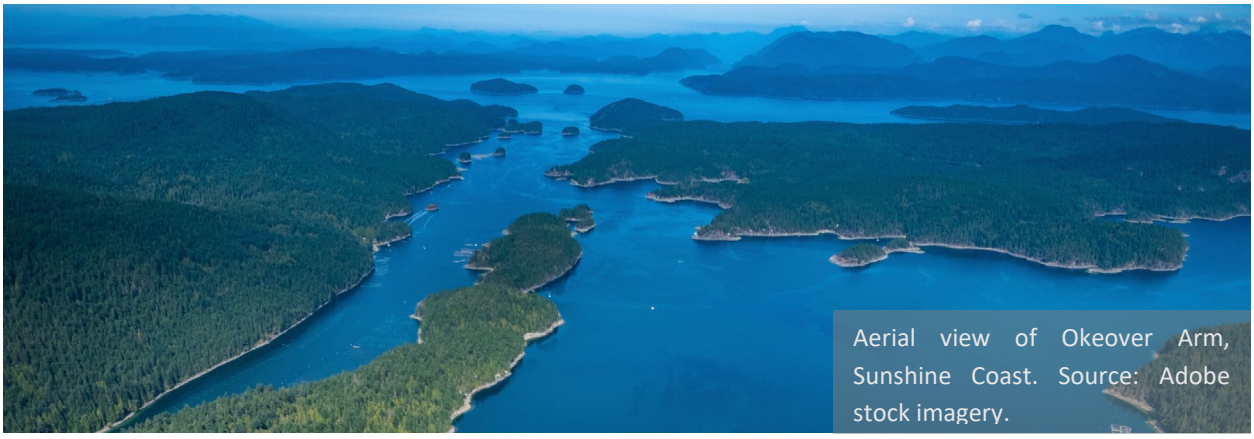
The qathet region has experienced many coastal storms in the last two decades. With climate change, flood and erosion hazards are anticipated to worsen. In coastal areas, sea levels are anticipated to rise, and there is potential for increased frequency and intensity of storms. This will create an escalated toll on coastal areas and ecosystems as impacts become more frequent and damaging. Layered onto these bio-physical changes are the region's own dynamic socio-economic characteristics. The qathet Regional District (qRD) and its project partners the Tla'amin Nation and the City of Powell River (CoPR), have recognised the need to adapt to these changes.

The qRD has previously conducted foundational work, including a coastal risk assessment, coastal flood mapping, and engagement on land use. The goal of this project was **to engage with partners and the public to develop a strategy that explores coastal flood adaptation options and charts a path for next steps in the region.**

This strategy matters because it will support the region by:

- Setting the course to move together by developing clear and consistent guiding principles, educational, guidance, and regulatory tools to reduce coastal flood risk.
- Increasing resilience in communities in the face of potentially rapid bio-physical and socio-economic changes.

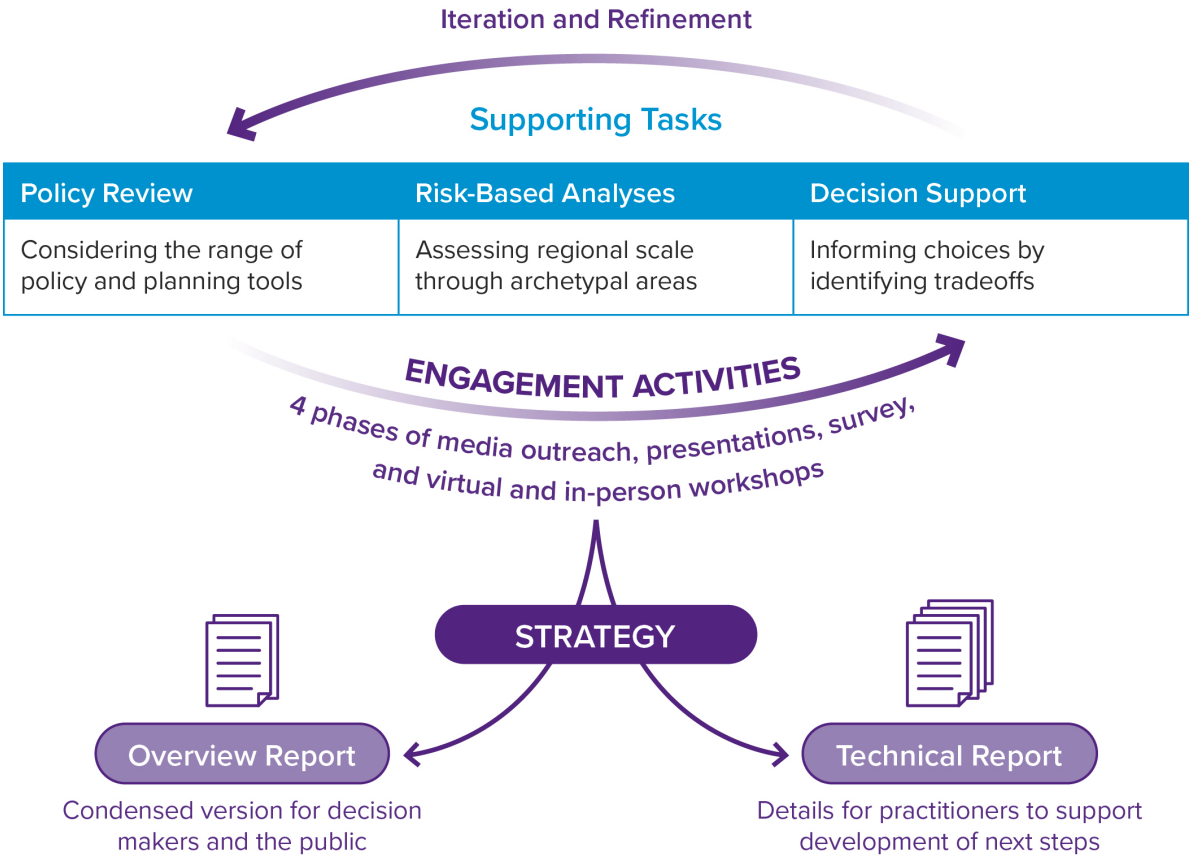
With support from the Community Emergency Preparedness Fund (CEPF), in early 2022 the qRD retained Ebbwater Consulting Inc. (Ebbwater) to conduct this project. Ebbwater partnered with SHIFT Collaborative (Shift) to lead the design and delivery of the communications and engagement process.



Aerial view of Okeover Arm, Sunshine Coast. Source: Adobe stock imagery.

What We Did

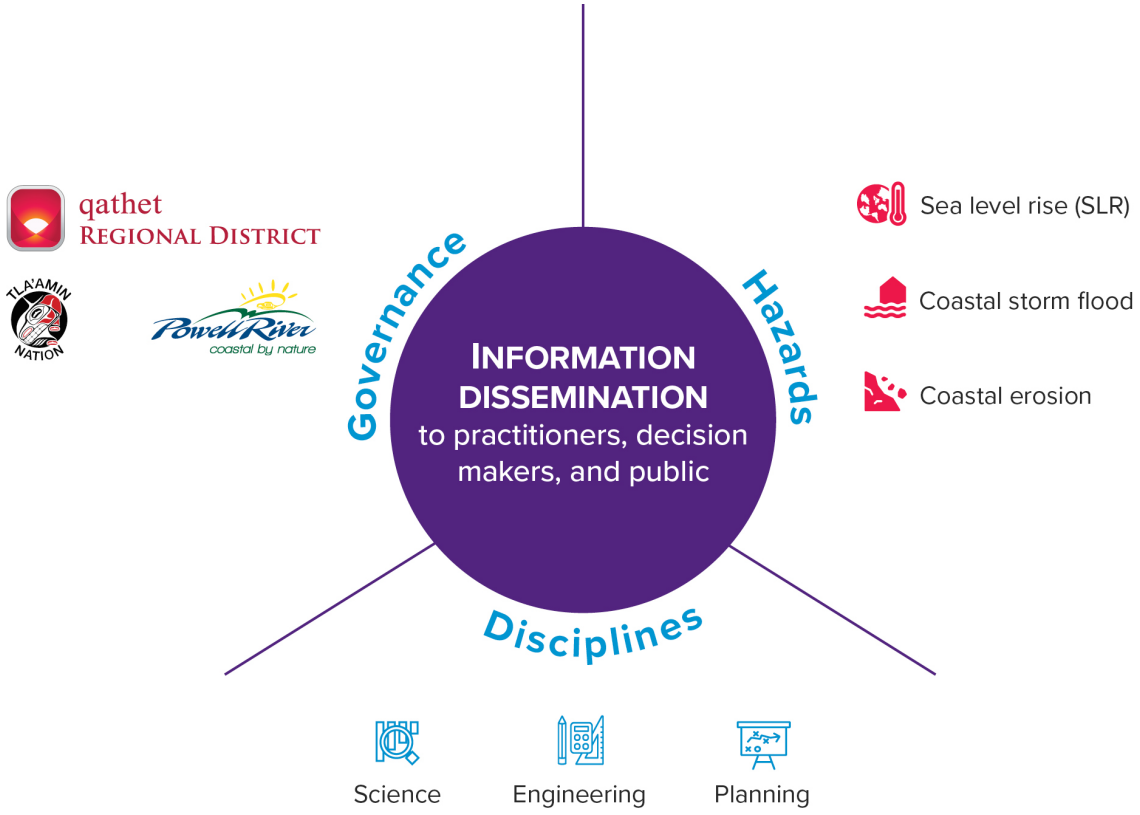
We conducted three bodies of work (supporting tasks) to inform the strategy. The policy review, risk-based analyses, and decision support were iterated and refined through a multi-phase engagement process. This is summarized in the figure below.



This *Overview Report*, which is written for decision makers and the public, provides condensed versions of the work including project background, understanding coastal flood and erosion risk, "what we heard", and the strategy recommendations. The lengthier *Technical Report* is primarily aimed at practitioners who will be working among the three project partners to implement the strategy. It is a companion document that provides more background materials as well as details on the supporting task methods and results including the feedback from engagement.

In recognition of the systemic challenge of climate impacts and climate adaptation, the project explored many dimensions of challenges and opportunities. As shown in the figure below (on the next page) this report explores a variety of coastal hazards. These occur in the context of three separate but ultimately linked jurisdictions and requiring input from a diversity of disciplines

ranging from coastal science, to engineering, to planning. Throughout the project we engaged with and learned from decision-makers, the public, and practitioners.



What Do the Project Partners Do Now?

Climate adaptation and coastal flood adaptation in particular pose a systemic challenge to local governments. This strategy provides a path forward for the qathet region collectively, and for each individual government.

Seven Guiding Principles, listed below (on the next page), lead off the strategy recommendations. These principles are informed by what we heard from partners, stakeholders, rights holders, decision makers, and the public.

Guiding Principles

1. Take a coordinated, consistent approach as a region.
2. Act in the best interests of future generations.
3. Collectively grow our ability to be flexible and adaptive in relation to coastal change.
4. Defend what cannot be replaced (e.g., ecosystems and cultural sites and uses).
5. Prioritize funding to protect things that benefit the most people or greatest good.
6. Enable and incentivize individuals to reduce their risk.
7. Take a phased approach over time.

The Guiding Principles establish common ground among the qRD, Tla'amin Nation, and the CoPR. Next, 15 Regional and Enabling Approaches are provided within the following 6 categories:

Co-ordination and Leadership	Infrastructure	Public Education and Communication
Land Use and Buildings	Resilience and Capacity Building	Monitoring and Updates

We also provide four approaches to reduce risk and build resilience:

- Don't make it worse.
- Limit erosion by restoring and mimicking natural systems.
- Manage for current risk with temporary measures while reducing vulnerability over time.
- Retreat from high-risk areas over the long-term.

More details on the above are included in the *Overview Report*. Place-based adaptation actions and specific approaches by jurisdiction are also provided in the *Technical Report*.

The biggest challenge of coastal adaptation in the region is not the practicalities of implementing individual or suites of adaptation actions; rather, it is the overall approach to the governance (political and public will, diverse regulatory styles, etc.) of coastal areas. Starting simply by **creating opportunities to work collaboratively** will have the biggest long-term impact on the region's risk and resilience.

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Acronyms

BC	British Columbia
C3	Community to Community to Community
CEPF	Community Emergency Preparedness Fund
CFAS	Coastal Flood Adaptation Strategy
CoPR	City of Powell River
DPA	Development Permit Area
EGBC	Engineers and Geoscientists BC
EMBC	Emergency Management BC
LUP	Land Use Plan
MOTI	Ministry of Transportation and Infrastructure
OCP	Official Community Plan
PARAR	Protect, Accommodate, Retreat, Avoid, and Resilience-Building
qRD	qathet Regional District
SLR	Sea Level Rise
UBCM	Union of British Columbia Municipalities
UNDRR	United Nations Office for Disaster Risk Reduction
USA	United States of America

1 Introduction

Coastal floods and erosion matter. People whose homes are inundated or damaged will remember for the rest of their lives; landscapes are changed forever; local, regional, and national economies suffer. Flooding and other natural hazards continue to pose a risk to Canada's economic vitality, infrastructure, environment, and citizens. The qathet region is no stranger to flood and erosion damages having experienced many coastal storms in the last two decades.

The qathet Regional District (qRD), Tla'amin Nation, and the City of Powell River (CoPR), have recognised the need to adapt to these changes and have previously conducted foundational work, including a coastal risk assessment and coastal flood mapping. With support from the Community Emergency Preparedness Fund (CEPF), in early 2022 the qRD retained Ebbwater Consulting Inc. (Ebbwater) to conduct a next phase of work. To complete the Regional Coastal Flood Adaptation Strategy (CFAS), Ebbwater partnered with SHIFT Collaborative (Shift) to lead the design and delivery of the communications and engagement process.

The following sections provide a project overview and outline the project approach.

1.1 Project Overview

1.1.1 Project Setting

The Tla'amin Nation Territories, including the qRD and member municipalities, are located on the edge of the Georgia Strait, and have nearly 800 km of coastline (see blue line in the inset map of Figure 1-2 on the next page). The project area consists of all these coastal areas including Texada and Lasqueti, and many smaller Islands.

The last retreat of the continental glaciers, which ended approximately 7000 years ago, considerably altered the landscape in the project area. Relatively steep, irregular shorelines, and side channels were formed (see Figure 1-1 for an example). These features can act as protection from coastal flooding. However, they are also unstable: a substantial proportion of shorelines are composed of glacial deposits lacking a source of sediment and sedimentary rock cliffs and bluffs subject to wave action (Tetra Tech, 2018).

Figure 1-1: Example shoreline with combination of erodible and rocky material. Source: Tetra Tech 2018.

Although potentially hazardous, the coast is an extraordinary asset and draw. It is not only beautiful, it provides access and transportation

routes, an abundance of food, and endless recreational opportunities among other benefits.

The area's combined population is 21,496 (2021 Census) and includes approximately, 6,197 people from the qRD electoral areas; 13,943 people from the City of Powell River; 797 people from the Tla'amin Nation and 21 people from the shíshálh Nation (Figure 1-2). Hugging the coast, Highway 101 (Sunshine Coast Highway) meanders through the area and is the main transport route that connects the various communities. The area is inaccessible by road to the lower mainland.

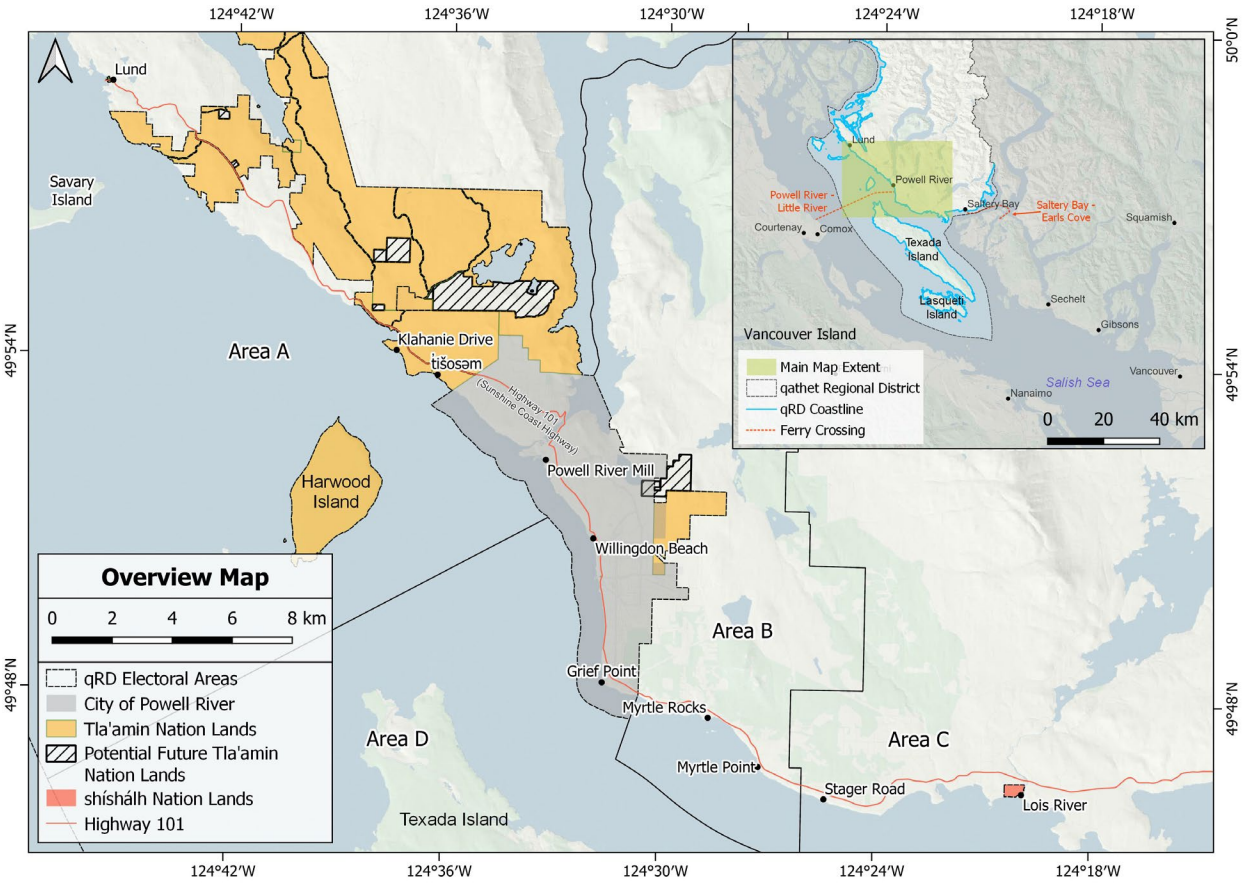

Figure 1-2: Project area, with focus on more inhabited regions.

1.1.2 Problem Statement

All the coastline in the qathet region is subject to flood waters and damaging wave action to varying degrees. Previous studies conducted for the regional district identified preliminary areas of high risk based on an understanding of the people, infrastructure, and mapped cultural assets. This work also highlighted regional challenges specific to a coastal community with no road connections to the rest of the province (Tetra Tech, 2018).

Damages in the qathet region will increase with climate change. Relative sea level rise (SLR) projections for the region are modest with most scenario projections falling in the range of -10

cm to + 55 cm[1]; provincial guidance continues to be 1 m by 2100 (FLNRORD, 2018). Additionally, there is much anecdotal information to support an increase in the frequency and severity of coastal storms. These events are linked to large-scale climate processes, which can bring changes in air pressure and wind, affecting coastal surges and waves. The increase in sea level, as well as increased power in the ocean will most certainly increase the likelihood for secondary erosion impacts.

There is a need to acknowledge and understand these hazards and risks, and more importantly to act through planning and adaptation. In addition to the common-sense imperative to adapt, the 2018 amendment of the Provincial Flood Hazard Area Land Use Management Guidelines (FLNRORD, 2018) encourages local governments to plan for flood hazards with consideration of future climate change.

1.1.3 Project Goal and Objectives

The main goal of this project was to engage with rights holders, stakeholders, decision makers, and the public to build understanding, explore adaptation options, and develop a strategy to increase resilience to coastal hazards in the region.

To meet the project goal, the project objectives were defined as follows:

1. Support collaboration with neighbouring governments and stakeholders to strengthen capacity.
2. Analyse and enhance flood risk mapping and identify possible coastal adaptation options.
3. Engage with the public to raise awareness and define community values to inform decisions.
4. Develop guiding principles to inform the identification of preferred coastal adaptation options.
5. Prepare a strategy with regional and local considerations, and practical timelines for action.

Coastal flood adaptation is a complex, multi-disciplinary issue. The strategy was developed by listening to various people and groups who engaged in the process. The intent with final reporting was to make the strategy accessible to these different groups.

[1] For the qathet region, the median relative SLR projection for the "business as usual scenario" (called "RCP 8.5") is for an increase of approximately 26 cm relative to the 1986 to 2005 period (James, Robin, Henton, and M. Craymer, 2021). The enhanced scenario, which considers melting of large arctic and Antarctic ice sheets, projects a change of 1.0 m. More details are found in the Technical Report.

1.1.4 Previous Work

This project builds on recent technical studies such as the overview coastal flood risk assessment (Tetra Tech, 2018). In addition to identifying high-level flood risk for the qathet region, this report identified priority areas for coastal flood hazard mapping. This was subsequently completed for the mainland areas (Tetra Tech, 2021) and for the islands (Tetra Tech, 2022). Coastal inundation maps were prepared with consideration for 1 m of sea level rise (based on EGBC 2017), storm surge, wind-driven wave action, tidal fluctuations, and coastal erosion. The flood maps identify the spatial boundaries for a large coastal storm flood. The more recent and detailed flood maps allow a more accurate understanding of flood impacts to private property, critical infrastructure, and cultural and archaeological heritage sites within the qRD, Tla'amin Nation, and the CoPR.

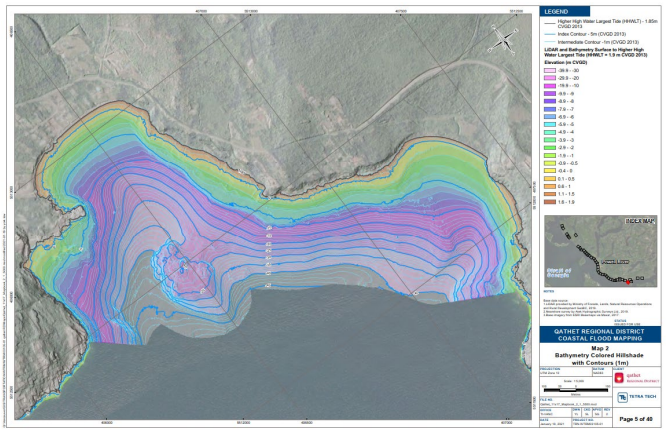

Figure 1-3: Example flood mapping image produced by Tetra Tech (2021).

In 2020 the qRD completed a feasibility study to identify land use and regulatory options available to the regional district. The feasibility study was followed-up by a consultation program that occurred in late 2021. Outputs from the consultation provide a basis to inform the flood adaptation strategy. Concern for coastal areas at risk was listed by 20% of respondents (Arlington Group and EPI, 2022).

1.2 Project Approach

The project was guided by a working group that included representatives from the three project partners: qRD, Tla'amin Nation, and CoPR. We conducted three bodies of work (supporting tasks) to inform the strategy. The policy review, risk-based analyses, and decision support were iterated and refined through a multi-phase engagement process (see blue boxes in Figure 1-4. Details on these tasks are in the *Technical Report*).

Figure 1-4: Method summary.

The engagement activities were advertised in various media, including the project website. There were six online presentations and workshops, one public in-person event hosted at Willingdon Beach Park on 22 June 2022 (Figure 1-5), and a survey. Engagement included working group participants, as well as rights holders, stakeholders, decision makers, and the public. The engagement objectives were to raise public awareness of the project, gather input on community values and preferences, and obtain feedback on a proposed range of coastal adaptation options.

Figure 1-5: A poster board advertising the public in-person event at Willingdon Beach Park Pavilion.

The supporting tasks shown in Figure 1-4 fed into the development of the strategy. Considering the varied

timeframes required for action, the strategy was broadly designed to support the region by:

- Setting the course to move together by developing clear and consistent guiding principles, educational, guidance, and regulatory tools to reduce coastal flood risk.
- Increasing resilience in communities in the face of potentially rapid bio-physical and socio-economic changes.

1.2.1 Assessment Scales

Due to the vast project area, two spatial scales were used in the following ways:

- **Local Scale:** We focused on a limited number of local areas that together illustrate the range of land use as well as bio-physical and socio-economic conditions we need to consider across the region. These areas were identified in discussion with the project partners and leveraged earlier work that had previously identified areas of high risk along the coast.
- **Regional Scale:** All the engagement activities were conducted based on participant representation for the project area. The broad concepts presented, and the adaptation actions explored, are intended to be considered for local areas across the project area.

1.2.2 Deliverables

The project resulted in three key outputs:

- Enhancement of coastal flood maps, identifying areas of higher flood and erosion risk.
- An engagement process to explore values and options related to coastal adaptation.
- Development of a region-wide strategy to guide and align future adaptation efforts.

Reporting consists of this O*verview Report* (see Figure 1-4), which provides a summary understanding of coastal flood and erosion risk (Section 2), "what we heard" from the engagement process (Section 3), and the strategy recommendations (Section 4). This is followed by a summary (Section 5) and references. This report is aimed at decision makers and the public.

The lengthier *Technical Report*, including its appendices, is primarily aimed at practitioners who will be working among the three project partners to implement the strategy. It is a companion document and provides more background materials as well as details on the supporting task methods and results including the feedback from engagement. The recommendations section includes additional practical considerations, recognizing that the project partners have different regulatory styles.

2 Understanding Coastal Flood and Erosion Risk

This section describes key risk concepts starting with coastal flood and erosion hazards. We then provide an overview of the potential impacts from those hazards. These ideas are used as a basis to present a risk-based approach, which can be applied to explore adaptation actions.

2.1 Coastal Hazards (Flood and Erosion)

A hazard is a process or phenomenon that may cause damage; the British Columbia (BC) coastline is exposed to a number of coastal flood hazards. Coastal storm-driven flood hazards in the qRD arise when water levels are higher than normal in the Strait of Georgia (Figure 2-1).

Figure 2-1: Storm waves collide with a breakwater in Powell River. Source: Derek Poole.

During these events, water levels are a function of many components, as shown in Figure 2-2. Sea level rise (SLR) is caused by climate change (i.e., warmer oceans make water expand and ice sheets melt). Though scientists know that sea level is rising, the uncertainty in sea level rise projections is large (i.e., they are somewhat predictable).

Compared to SLR, storm surges are more variable in space and time. A storm surge is a localized increase in water levels due to low-pressure systems in the atmosphere. Wave effects, which result from wind and wave set-up, also become important during storm surges (see Figure 2-2). Compared to SLR and storm surges, tides are more predictable as they follow regular and known cycles.

Through higher water levels and other storm-related coastal processes, coastal storms can result in erosion action (Figure 2-2), creating a significant secondary hazard affecting the shoreline and assets on it. Under climate change, sea levels and coastal storms are likely to worsen flood and erosion conditions (Eyquem, 2021).

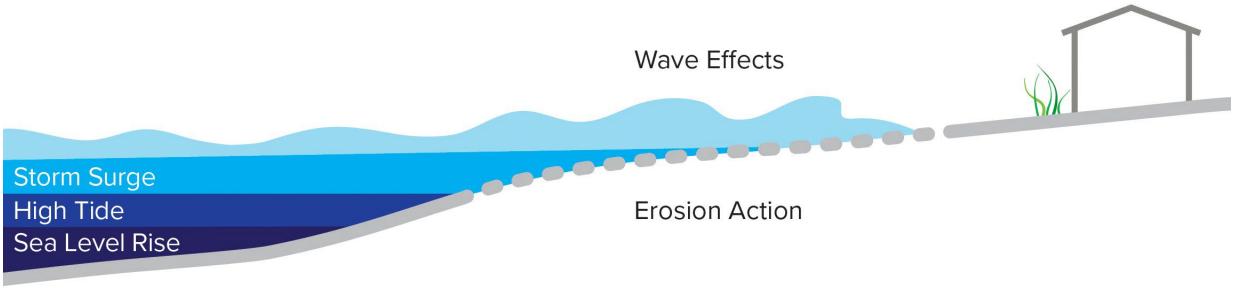

Figure 2-2: Coastal storm flood components.

2.1.1 Flood Likelihood and Magnitude

Likelihood (the probability that a flood of a certain size will occur) and magnitude (the size of a flood) are two defining characteristics of flood. These are inversely proportional to each other; large events occur rarely, and small events occur more frequently (see Figure 2-3). Frequent but small floods present very different risks than rare and large floods. Coastlines of the qathet region, for example, contain many archaeological sites that are located in areas affected by small floods. These sites are at risk of being eroded by an increase in the frequency of small storms and floods.

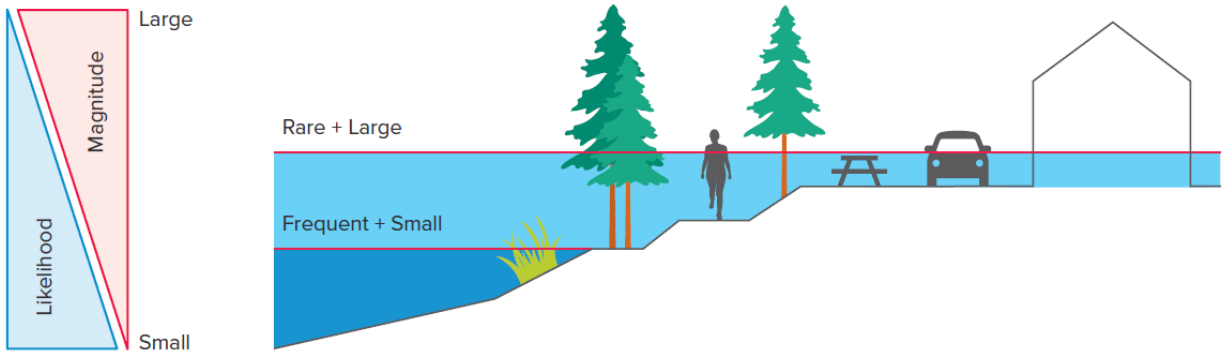

Figure 2-3: Simplified relationship between flood hazard likelihood and magnitude.

The *Technical Report* provides more information on other key flood hazard components to consider including depth and power, spatial scale, as well as and onset and duration.

2.1.2 Erosion Susceptibility

Erosion occurs due to the pressure generated by repeated wave action compounded with saturated soils. This causes shoreline substrate materials to breakdown. A shoreline's susceptibility to erosion is dependent on the frequency and size of coastal storms, as well as the shoreline materials. For example, rocky shorelines are more resistant to erosion than soil shorelines. Figure 2-4 shows erosion occurring in a sandy environment. In the qathet region, approximately 7% of the areas assessed on the mainland have high erosion potential. These shorelines are located in qRD Electoral Area A, as well as south of Grief Point (CoPR and qRD Electoral Area B), and Stager Road (qRD Electoral Area C) (Tetra Tech, 2021). Approximately 12% of the areas on the islands have

Figure 2-4: Erosion eats away at waterfront property on Savary Island. Source: Bud Graham.

high erosion potential (the majority are located on Savary Island, in qRD Electoral Area A) (Tetra Tech, 2022).

Human activities such as building coastal structures and clearing coastal ecosystems is a significant driver of coastal erosion. Over time and over large areas erosion protection measures such as stacked rock walls and concrete seawalls can lead to increased beach erosion and bank destabilization (Kerr Wood Leidal Associates Ltd., 2021).

2.2 Impacts of Coastal Flood and Erosion

Inundated and eroding coastal shorelines are not in themselves a problem. It is when these hazards interact with things we care about (exposed elements) with negative consequences that we have cause for concern. Flooding and erosion impacts are wide-ranging. In this project we considered six exposure indicators: people, economy, environment, culture, and critical infrastructure. Figure 2-5 contains example prompting questions for each indicator to provide a sense of the impacts considered within each of them.

INDICATOR	IMPACTS DESCRIPTION
People	How many **people** may be affected and who is most vulnerable?
Critical Infrastructure	What **services** (e.g., water and wastewater, emergency services and health care, electricity, and roads) could be affected?
Culture	Are there **cultural heritage** (e.g. archaeological) sites or gathering places that could be affected?
Economy	What are the potential direct and indirect **financial losses** resulting from damage, reduced tourism, etc.?
Environment	Are sensitive **ecosystems** at risk? What opportunities are there for nature-based solutions?

Figure 2-5: Summary of exposure indicators.

Many impacts can have "cascading" consequences – impacts that are felt far beyond what is touched by the actual floodwaters. For example, damage to a ferry dock affects the communities and supply chains that are dependent on service from that station. Similarly, one localized disruption from a flooded road or power transmission pole affects a whole network. Remote areas have few alternative systems, meaning that these disruptions can severely reduce access to services and goods such as medical care, schools, and food.

2.3 A Risk-Based Approach

In keeping with international best practice and recent direction from the Province [2] this project used the concepts of risk and resilience to support a holistic understanding of flood and erosion and the actions that can be taken to mitigate them.

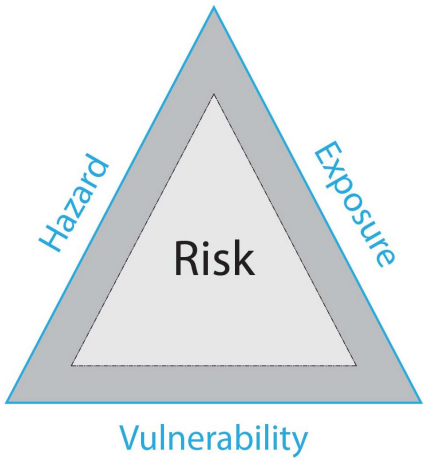

Figure 2-6: The main components of risk.

Risk is the "potential loss of life, injury, or destroyed or damaged assets which could occur to a system, society, or a community, determined probabilistically as a function of hazard, exposure, and vulnerability and capacity" (UNDRR[3]).

Resilience is defined as the "ability of a system, community or society exposed to hazards to resist, absorb, accommodate, adapt to, transform and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of the essential basic structures and functions through risk management" (UNDRR).

2.4 Adaptation Approaches

With a risk and resilience-based framing, and thinking more specifically about coastal flood adaptation, we considered five commonly used conceptual options outlined below: Protect, Accommodate, Retreat, Avoid, and Resilience-Building (i.e., PARAR). Within each option there are a range of actions that could be implemented. An overall coastal flood adaptation strategy would typically include a combination of actions from many, or all, of these options.

PROTECT

This option reduces the hazard by restoring previous, enhancing existing, or constructing new nature-based features to reduce the power of the hazard and guard areas and community assets. These are green measures that are considered "soft" and low impact. In addition to these natured-based measures that utilize sediment- or vegetation, protection also includes grey, or "hard" engineered,

[2] From Flood Risk to Resilience in BC: An Intentions Paper. British Columbia 2022. https://engage.gov.bc.ca/app/uploads/sites/797/2022/10/From-Flood-Risk-to-Resilience-in-B.C.pdf

[3] United Nations Office for Disaster Risk Reduction. Weblink: https://www.undrr.org/terminology/disaster-risk. Accessed 25 November 2022.

structures. The soft and hard approaches can occur in combination. Typical actions focus on technical disciplines and include:

- Enhancement of natural offshore features (e.g., island restoration), and construction of offshore features (e.g., sea barrier) to help reduce wind and wave action.
- Placement of stacked rock walls (otherwise known as rip-rap).
- Planting shoreline or submerged vegetation such as salt marshes and sea grasses to absorb wind and wave energy.

ACCOMMODATE

This option uses a range of actions to allow flooding to occur with minimal damage or consequence. It is sometimes described as a "living with water" strategy, in the sense that humans adjust their behaviours and built environment to accommodate the presence and movement of water. Typical actions range through educational, planning, and building options, and they include:

- Establishing development permit areas (DPAs) and setbacks to make space for water.
- Using Flood Construction Levels to raise the height of the damageable components of structures.
- Retrofitting infrastructure, buildings, and communities over the natural building cycle.

RETREAT

Also called Managed Retreat, this option reduces exposure by moving existing structures out of flood risk areas. It is increasingly considered as governments spend taxpayer funds on costly rebuilding efforts. Typical actions are policy-based and include:

- Opportunistic buyouts as homes and businesses come up for sale over time, with more aggressive buyouts as hazards become greater with climate change.
- Opportunistic removal of roads, other infrastructure, and contaminants as land is vacated.

AVOID

This option prevents or limits development within the floodplain. These actions reduce risk by not putting things we care about in the way of flood. Natural shorelines also act as erosion protection. Typical actions are based on planning and regulation and include:

- Developing tools such as flood bylaws so that rules and practices are consistent across the region.
- Establishing sea level rise planning areas to avoid building critical infrastructure in flood-prone areas.

- Integrating future flood hazard area considerations within guidance documents such as regional growth strategies and official community plans.

RESILIENCE-BUILDING

In contrast to the previous four conceptual adaptation options, resilience-building is less about reducing risk and more about helping communities bounce back from flood events. It covers all aspects of work with the community to enhance its ability to cope with and recover from flood events, and the cumulative effects of change. Typical actions range from education to policy-based approaches and include:

- Engaging broadly in city and community planning to build understanding and capacity of the community to address risk and build resilience (individual and collective).
- Grow social connectedness (with emphasis on care for vulnerable populations).
- Developing robust emergency preparedness and response plans (e.g., flood monitoring and warning systems) to limit damages during a flood event.

2.4.1 Values and Tradeoffs

While technical information is needed to inform decisions, choosing between adaptation options often comes down to tradeoffs based on particular values. For example, is it better to accept the loss of tax revenues from increased development in the floodplain and instead develop park spaces that can absorb flood waters, or to accept the occasional costs associated with response and recovery if these areas are developed? Should government help a location become more resilient to occasional floods, or try to prevent it from ever getting wet? These questions have no technically optimal answers. An informed deliberation of this kind requires discussion, understanding and analysis of tradeoffs and how various choices could affect the things people value the most. The participatory approach taken in this project helps to build a basis for future decisions that are more likely to be relevant, understood and supported by stakeholders, partner organizations and the public.

3 What We Heard

Through a combination of media, information sessions, a survey, workshops, and an open house, the Regional CFAS process aimed to engage broadly across the community. The goal was to build understanding and capacity to address coastal risk, and to inform development of adaptation approaches that reflect the values and realities of the community. The sections below provide a snapshot of priorities and perspectives from participants that have informed the Regional CFAS guiding principles and approaches that are presented in Section 4.

Figure 3-1: A project team staff member discusses with a member of the public.

Through the iteration of the multiple engagement activities, we refined our materials (e.g., moving from introductory and background presentations to preliminary adaptation options). Figure 3-1 provides an example image from this process.

As participants considered impacts in different contexts, emphasis was placed on those things that are hard (or impossible) to replace and that provide value to many or across a large area (Figure 3-2). These collective values are illustrated through the words of participants in response to the community survey, in Figure 3-3.

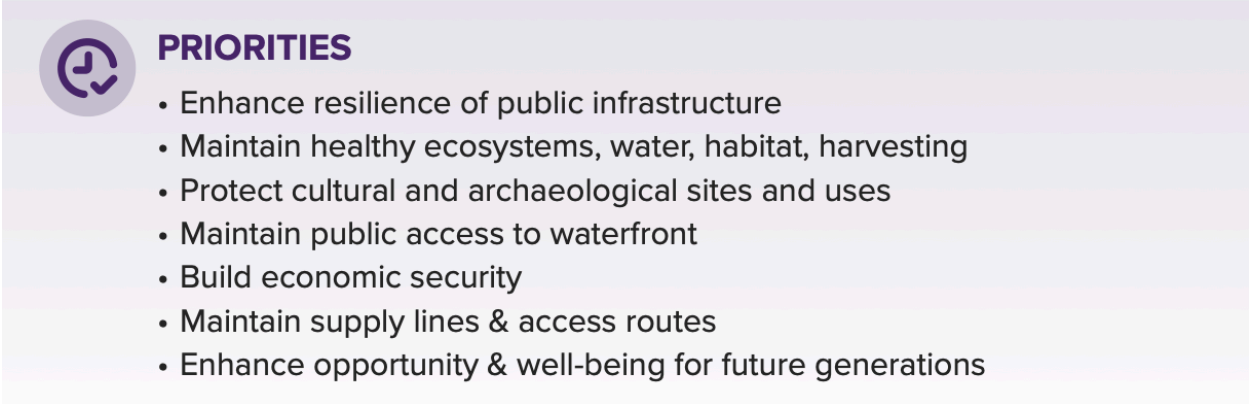

Figure 3-2: Priority objectives for adaptation strategies.

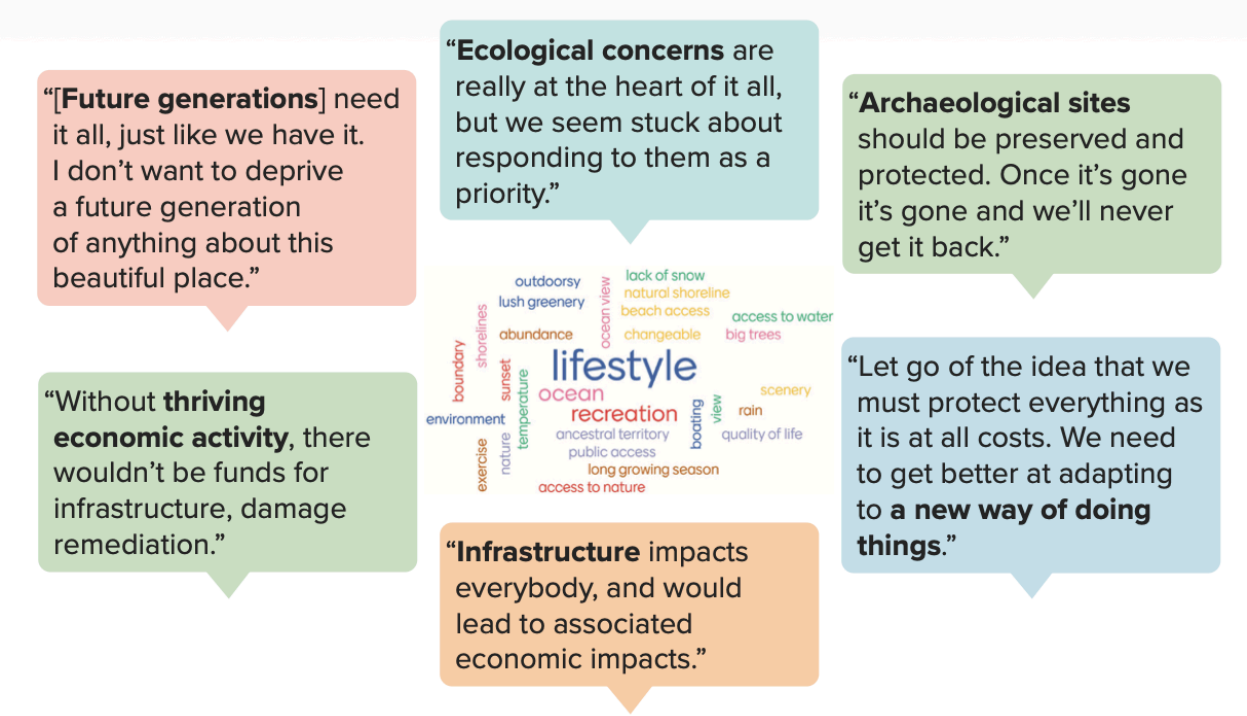

Figure 3-3: Illustrating the collective values voiced by participants in the community survey.

Participants were asked to identify what was most important to them when making choices between different adaptation options – for example when choosing between Protect, Accommodate or Retreat. Ecological and cultural values were key considerations, along with consistency and fairness, as reflected in Figure 3-4.

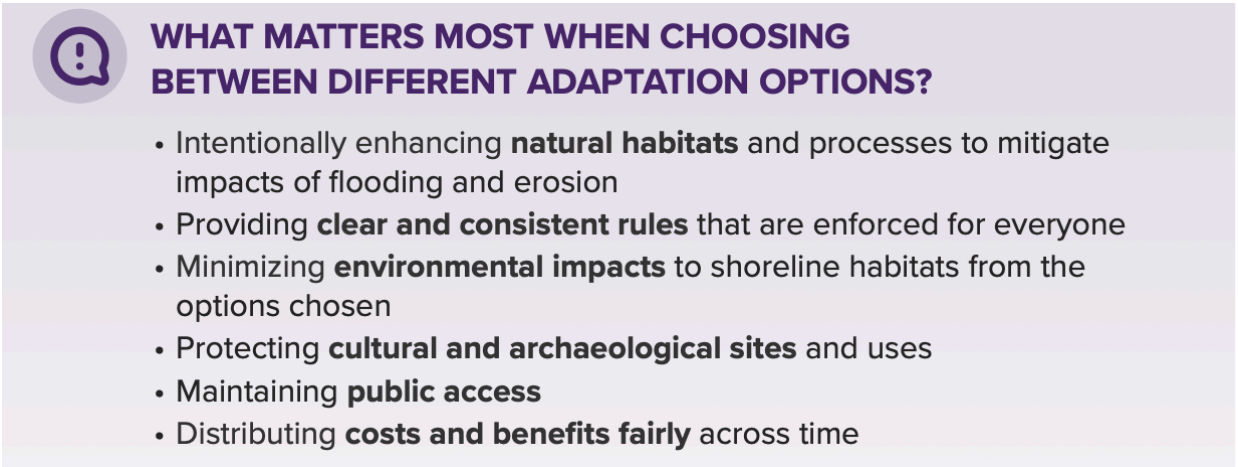

Figure 3-4: Participant priorities when choosing between different adaptation options.

The preferences of waterfront residents were different from other residents in the region in predictable ways, as illustrated in Figure 3-5. Participants recognized that coastal flood and erosion have significant impacts for homes and property along the shoreline and expressed

concern for their fellow residents. At the same time, many participants felt that public resources should be focused on upholding collective and public values more so than individual or private assets. Participants preferred that governments put in place supportive strategies to enable waterfront residents to reduce their risk (such as information, coordination, and incentives), while also promoting personal responsibility for private assets.

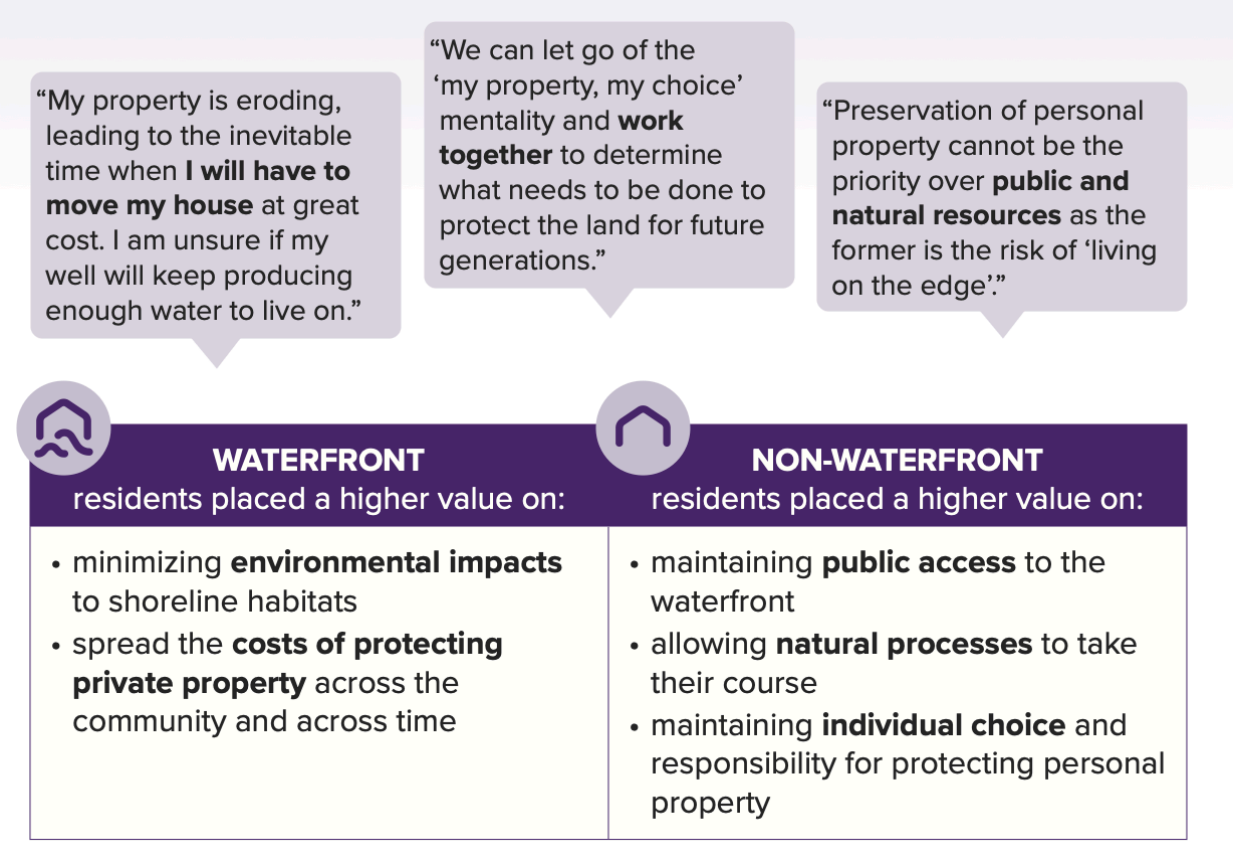

Figure 3-5: Priorities of waterfront and non-waterfront residents.

Through the first round of engagement some key tensions surfaced. One strong theme had to do with whether it was best to emphasize individual actions or collective actions. Another had to do with whether regulation was a desirable tool for reaching the intended outcomes. We explored these tensions further by developing a set of four planning scenarios. They represented a combination of less government regulation (i.e., the "carrot" approach) versus more government regulation (i.e., the "stick" approach), as well as collective versus individual action (see Figure 3-6). Through exploring these different scenarios with participants, we gained insight into potential tradeoffs and preferred approaches and potential tradeoffs here in the region (Figure 3-7).

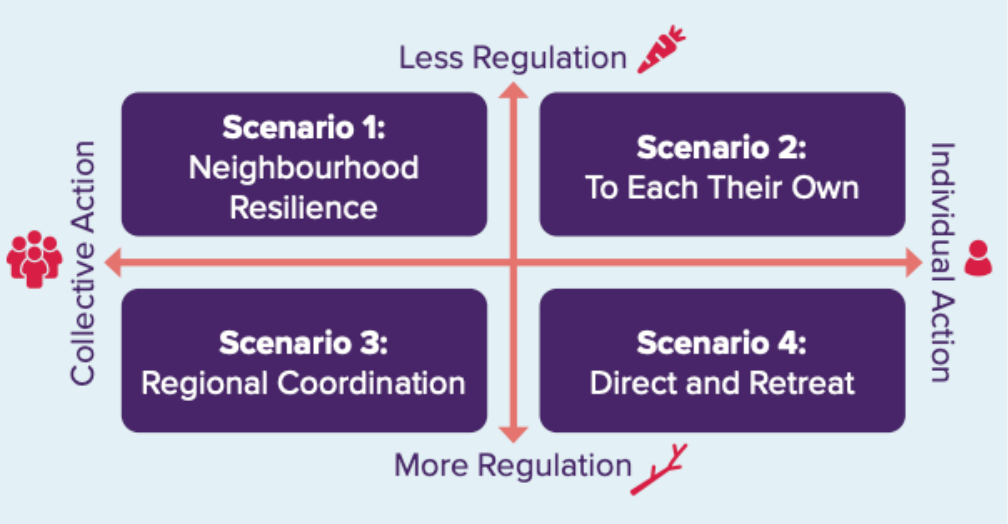

Figure 3-6: Participants discussed planning scenarios that described a range of approaches combining more and less regulation, and individual to collective action.

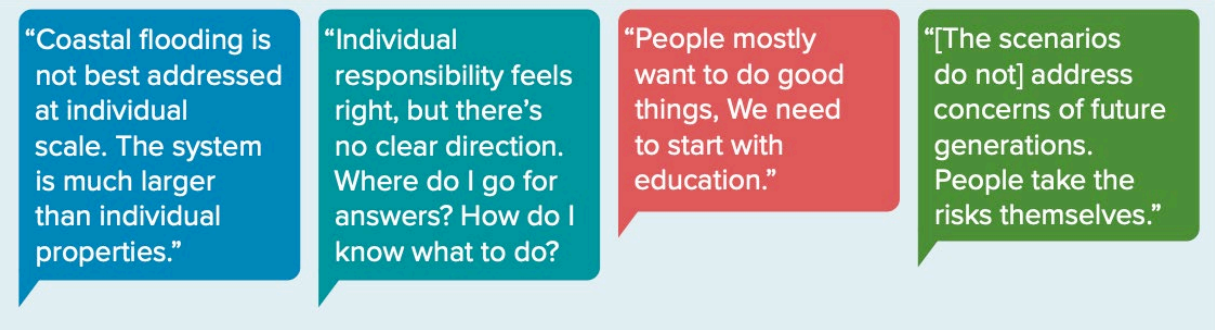

Figure 3-7: Preferred approaches and potential tradeoffs identified through engagement and explored using planning scenarios.

4 Strategy Recommendations

The region has begun to address coastal flooding and erosion issues. And through this current project the partners have worked to increase understanding about the present-day and future risks. They have considered the many challenges and tradeoffs associated with addressing coastal hazards in a changing climate. This section outlines a mix of high-level, tangible, and practical next steps that can be taken by the project partners and others to address immediate challenges, as well as prepare to make challenging decisions in future.

The recommended actions are wide-ranging and are based on best practices and guiding principles discussed in Section 4.1. This is followed by some actions and approaches that should be taken as a region, ideally with alignment and engagement between each jurisdiction. The project aims to align the three governments in their general adaptation approaches but notes that each government will likely apply different tools at different times. In Section 4.3, we provide actions and approaches, based on the guiding principles, that could be taken at a local site scale,.

The recommendations are described at a high level in this *Overview Report*, to illustrate the set of recommended approaches for managing and reducing coastal flood and erosion risk over time. The *Technical Report* provides greater detail on specific actions.

4.1 Guiding Principles

The engagement process provided a rich set of ideas and feedback to shape the strategies being proposed for the region. Key themes from the engagement were distilled into a set of seven Guiding Principles that have been used to inform the recommended strategy and are intended to be a helpful decision-making guide as this strategy develops and changes over time.

The Guiding Principles provide overarching direction to the regional approach; they are also meant to be considered and balanced when deciding on specific actions to be taken in the future. Some of the principles may seem to contradict one another, such as taking a consistent, coordinated approach and maintaining flexibility and choice. This is not in error, but a reflection of the different values that exist simultaneously, and not always harmoniously. These are places where tradeoffs must be made when making specific decisions, to best balance the set of values that the community holds.

The seven Guiding Principles are as follows:

1. Take a coordinated, consistent approach as a region.
2. Act in the best interests of future generations.
3. Collectively grow our ability to be flexible and adaptive in relation to coastal change.
4. Defend what cannot be replaced (e.g., ecosystems and cultural sites and uses).
5. Prioritize funding to protect things that benefit the most people or greatest good.
6. Enable and incentivize individuals to reduce their risk:

- Prioritize education and incentives.
- Use regulation where that is the best tool.
- Maintain a certain level of flexibility and choice at a site level.

7. Take a phased approach over time:
   - Emphasize Accommodate, Avoid, and Resilience-Building in early phases.
   - Use Protect only where necessary, and with an emphasis on soft, low impact, green options.
   - Work towards Retreat later in time, where and as needed.
   - Maintain options and flexibility over time, and proactively create the conditions to take bigger steps later.

4.2 Regional and Enabling Approaches

The region has great diversity in terms of the level of risk from flood and erosion hazards, and also in the tools available to manage these risks in the different jurisdictions. The following six regional and enabling actions are provided to align approaches, guide the project partners on issues that are best managed at a regional scale, and enable individual and collective action across the area. We also provide relative indications of the priority, timing, and effort needed for each action.

4.2.1 Co-ordination and Leadership

Priority	High
Timing	1-2 Years
Effort	Low

Given much of the work to plan for and implement adaptation actions will be carried out by individual local governments, other levels of government, or even individual property owners it is important to have governance mechanisms in place to support moving together as a region. This includes leveraging existing political and public will to advocate with senior governments for actions that will support improved coastal resilience in the region (e.g., changes to legislation and regulation, funding, etc.). To build on the momentum of the current project and ensure that long-term goals are met, we recommend the following:

1. Create the opportunity for collaboration to move towards consistency, while recognising the unique cultures, governance models, and regulatory styles within each jurisdiction. Some approaches to this might include:
   a. Addition of a standing or occasional item related to climate adaptation and coastal resiliency, within Community to Community to Community (C3) Forums. This would create an opportunity for senior staff to provide updates to elected officials on progress made and challenges encountered with regards to the implementation of the Regional CFAS.
   b. Respect existing protocol agreements and land use harmonization policies (through government-to-government meetings) prior to the implementation of

any major decisions related to coastal erosion and flood management, especially for any structural works near jurisdictional boundaries.

c. In the longer-term, on the assumption that capacity increases, consider the development of a staff-level working-group (like the working group that guided this project) to support alignment on land use and land regulation approaches to flood and erosion risk mitigation.

4.2.2 Land Use and Buildings

Priority	Medium
Timing	5-10 Years
Effort	Medium

Overall, the project partners should aim for policy consistency in the region. Currently the three governments have different setbacks and shore zone regulations and policies. Moving toward a more consistent alignment of approaches will ease collaboration between residents, contractors, and government staff. The following recommendations are made:

1. Work towards consistent approaches for land use along the shore (e.g., setbacks) through amendments to Official Community Plan (OCP), Land Use Plan (LUP) and other land use policies.
2. Work towards consistent permitting and enforcement of building controls (e.g., flood proofing and flood construction levels) through amendments to OCP, LUP and other land use policies.
3. Work with the Province (the approving authority) to support consistent permitting for parcel level protective measures in the foreshore.
4. Work with the Province to educate residents and support permits for parcel level protective measures that prioritize soft/naturalized approaches over hard engineering (e.g., stacked rock walls, seawalls) approaches.
5. Work with the Province to educate residents and support consistent and comprehensive permitting for archaeological site assessments to minimize potential impacts from flood mitigation works. The Tla'amin Nation is prepared to send cultural monitors to observe and advise on any land alteration near the shoreline. The qRD and the CoPR should collaborate with First Nations to create a clear and consistent process to follow within their respective jurisdictions.
6. Consider land stewardship as a flood management approach in concert with structural measures. Governments should identify and protect or restore natural systems that help buffer the magnitude and impact of coastal flooding. A future step for the region may be to build on existing species at risk mapping to understand where these areas overlap with high hazard areas and where there would be mutual benefit in protecting areas.

4.2.3 Infrastructure

Priority	Medium
Timing	1-10 Years
Effort	Low

As a region, all residents and jurisdictions rely on some common infrastructure such as roads, docks, water supply, etc. The reliability of this infrastructure in the face of climate change will be tested. To minimise future damage and disruption of this infrastructure the following recommendations are made:

1. Hold a cross-partner workshop that includes Provincial partners and utilities (e.g., BC Ferries, Ministry of Transportation and Infrastructure (MOTI), BC Hydro, telecommunications companies) to discuss risk and support future proofing of regional infrastructure and potential cascading impacts and interdependencies. Share the flood mapping and this report with these service providers.
2. To improve asset management, project partners and other critical infrastructure service providers (e.g., BC Ferries, MOTI, BC Hydro, etc.) should align policies and procedures to explicitly account for a review of hazard and risk over the lifecycle of the asset. Condition assessments or new siting of facilities and infrastructure should consider the flood and erosion hazard mapping.

4.2.4 Resilience and Capacity Building

Priority	Medium
Timing	1-10 Years
Effort	Medium

In addition to approaches that support active change to mitigation approaches, it is equally important to consider enabling approaches (e.g., capacity building) as well as longer-term approaches that will support improved recovery after climate events. The following recommendations related to resilience and capacity building are made:

1. Work with the construction, earthworks, and environmental assessment industries in the region to understand best practices and existing or new guidelines or regulations. Provide experts and resources related to archaeological and cultural sites, siting of buildings and septic fields, and design of parcel level protective measures.
2. Include a standing agenda item on natural hazard risk in set meetings with regional partners or consider an annual review with all partners.
3. Include a regional coastal flood response plan as part of regional emergency response planning and encourage homeowners to work with neighbours to develop emergency supply kits and enable neighbourhood-level resilience networks.

4.2.5 Public Education and Communication

Priority	Medium
Timing	1-10 Years
Effort	Medium

Flood risk reduction and climate resilience are "whole-of-society" challenges. Approaches to mitigate risk must bring in broad sectors, including the public, to both support the implementation of approaches and to spread the responsibility for action. A few recommendations to increase public education in this field include:

1. Currently there are a few guidebooks for residents regarding coastal development that are on the qRD website. These resources include the Canadian Edition of the Washington State "Your Marine Waterfront", the "Adapting to Climate Change on the BC Coast" videos, and the "Green Shores for Homes" website). Consistency of communication and recommended approaches across the region could be improved. Some considerations include:
    a. Cite guidebooks for coastal development on websites and in OCPs.
    b. Identify best management practices for coastal parcel-specific protective measures.
    c. Assess and disseminate archaeological and cultural site density along the waterfront and measures to protect them.
    d. Prepare and disseminate flood preparedness guidance.
    e. Prepare and disseminate guidance on siting septic fields in floodplains.
2. Make flood and erosion maps available to the public. Many local governments have now disclosed new flood hazard mapping publicly without significant issue (e.g., Squamish, Saanich, Victoria, Dawson Creek, etc.). Consider the following lessons learned:
    a. Clearly articulate in simple terms the scenario that is being depicted (what year, how much sea level rise, etc.).
    b. Provide illustrative information on what the water level includes (high tide, storm surge, sea level rise, etc.).
    c. Include limitations on the mapping (e.g., modelling and SLR projections uncertainty, suitability for regional planning or detailed design, and what additional knowledge or investigations are required to achieve a desired suitability).
    d. Explain how mapping is being used by local governments to address any current and future flood risk.

4.2.6 Monitoring and Updates

Priority	Medium
Timing	1-10 Years
Effort	Low

The above recommendations are premised on the work completed for this report, and are based on current climate and SLR projections, as well as the senior government policies and guidelines (e.g., direction from the Province to plan for 1 m of SLR). As highlighted through this project,

there is considerable uncertainty in many driving issues around climate risk and adaptation. As such it is important to keep abreast of any changes:

1. Monitor climate projections periodically (e.g., once per year through climatedata.ca and consult with the Pacific Climate Impacts Consortium) to understand how the science and modelling is evolving.
2. Monitor any changes to the B.C. Flood Hazard Management Land Use Guidelines. Consider a review cycle for flood hazard mapping and associated regulations of every 5 years.

4.3 Approaches to Reduce Risk and Build Resilience to Coastal Hazards

The four approaches described below illustrate how coastal flood and erosion risk can be managed over time.

4.3.1 Don't make it worse

The OCP and LUP processes should be used to identify areas to limit growth and infill or identify areas to remain in lower risk land use designations. Flood prone areas and environmentally sensitive areas such as the foreshore are typical places to limit growth. New infrastructure, especially critical public infrastructure, should be sited outside of hazardous areas as much as possible.

Currently in the region, individual site protective measures are constructed at the shoreward property line or in the foreshore area. Excavation and construction activities can result in several consequences including transfer of risk to neighbouring properties; impacts to the intertidal zone from scour and erosion; loss of habitat; pollution from runoff; and loss of sites of cultural significance.

Project partners should work with the Province (the approving authority) to include environmental guidelines for work within a certain distance from the natural boundary. To capture new and renovated site level protective measures on existing sites, building bylaws or land use plan specifications could stipulate a lower threshold for requiring a permit when building or moving soil in the waterfront area. These actions should be combined with workshops conducted with experts in erosion management to earth works contractors and residents in specific areas.

Development permit areas are often used for steep slopes to avoid landslides and erosion. Consider implementing a steep shoreline development permit area that introduces appropriate setbacks, water management, and monitoring and maintenance. Include guidelines on water management to ensure stormwater is not directed off steep slopes and vegetation management to reduce removal of anchor vegetation and plant with native species. The DPA should prohibit removal of trees near or on the steep slope.

4.3.2 Limit erosion by restoring and mimicking natural systems

Recognize that erosion is effectively irreversible and can be catastrophic. Natural shorelines are effective at limiting this erosion at large scales and should be maintained. The natural shoreline approach contrasts with engineered slopes that can exacerbate larger scale erosion whilst trying to protect individual sites.

To move forward the idea that soft shoreline approaches are effective, acquire funding to support implementing a demonstration project for soft shoreline erosion and flood management practices along a public shoreline. This might be the restoration of native plant species or the placement of natural offshore barriers for highly erosive locations.

4.3.3 Manage for current risk with temporary measures while reducing vulnerability over time

Retrofitting existing buildings/structures to address flood hazard is challenging. The greatest opportunities lie in evolving the building stock by incorporating updated flood standards during redevelopment. In the interim, temporary flood barriers could be deployed to protect buildings that are flood prone, based on forecasts for high tides and/or large storms. More permanent flood defense measures such as breakwaters are an option. However, these are only recommended in high-risk situations where there is a rationale for the high expense.

As an immediate action across the region, the flood hazard mapping and related information should be shared among staff and with consultants working on capital projects. Asset managers can work together to identify priority infrastructure and buildings in the flood prone areas, starting with critical infrastructure, that may require resilience upgrades either at renewal or renovation.

Over the longer term, repair costs of infrastructure that is regularly flooded will need to be weighed against retiring the assets in favour of more flood-adapted systems (e.g., by developing flood damage thresholds).

4.3.4 Retreat from high-risk areas over the long-term

Over the longer term those engaged in the project strongly supported including Retreat among alternative approaches as opposed to continued efforts to keep the water out. As sea level rises and protective measures are built to stop the water, intertidal areas, habitat, beaches, and important ecosystems are squeezed out.

The Retreat approach can be accomplished through several potential pathways. In the USA following super storm Sandy, government buy-out programs were introduced through voluntary and regulated mechanisms. Buy-out programs can occur following several flood events or proactively over years. Another pathway, which is also practiced in the USA, is a rolling easement. Over time, site level protected measures would be regulated and removed allowing the water to

move in. Structures could be removed at the owner or government expense with potential for compensation.

In B.C., riparian rights currently run with upland properties along the foreshore and include the right to protect the property from erosion. Any protection that extends beyond the natural boundary requires Crown approval. As land erodes, and the natural boundary[4] moves inland, it becomes Crown land. Sea level rise has yet to challenge the extent of riparian rights associated with erosion protection. Another Retreat pathway is relocation of properties in the flood hazard area to upland areas. This could include physical relocation or some transfer of property rights.

[4] See the *Technical Report* for more information on the natural boundary concept.

5 Summary

The qathet region has experienced flood and erosion damages in recent decades. Climate change processes, which are increasing both sea levels and the potential for more intense and frequent storms, are likely to worsen damages in future. Managing for these hazards is incredibly challenging, especially in a region with such diversity in relative risk as well as regulatory styles.

View south along Highway 101 (Sunshine Coast Highway) near Myrtle Rocks. Source: Tetra Tech 2018.

Despite the challenges, the region has strong advantages. First, the natural topography of the region means that there are fewer immediate challenges associated with sea level rise, although erosion does continue to be an issue. This gives the region time to act and adapt; it is not too late. Second, there is a large toolbox of adaptation actions that can be taken to mitigate risks down the road. It is however important to determine the right suite of tools for the risk and jurisdictional context. Each tool will come with tradeoffs. It is important to be aware of these, and work with interested and affected parties to determine which tools should be pursued.

This brings us to the biggest challenge of coastal adaptation in the region. It is not the practicalities of implementing individual or suites of adaptation actions; rather, it is the overall approach to the governance (political and public will, varied regulations, etc.) of coastal areas. Starting simply by creating opportunities to work collaboratively will have the biggest long-term impact on the region's risk and resilience.

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