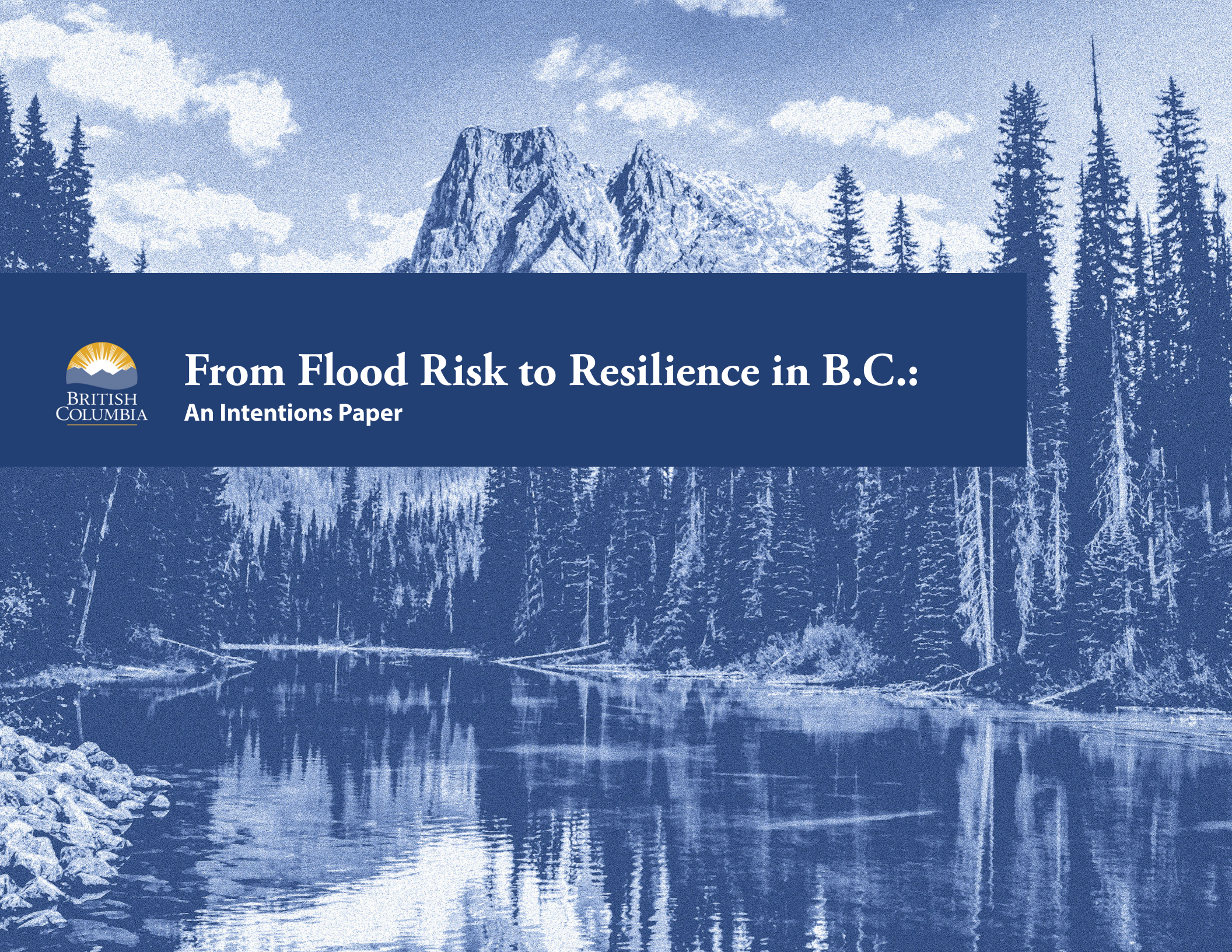


BRITISH COLUMBIA

From Flood Risk to Resilience in B.C.:

An Intentions Paper

Contents

Summary

Flooding is by far the most common, costliest disaster in Canada.[1] In British Columbia, periodic floods have been a fact of life along rivers, lakes, and coasts since time immemorial. Floods are prominent in many First Nations' creation stories and have shaped seasonal migrations and stewardship practices for ages. Major flood events in 1894, 1948, and 1972 in B.C. triggered significant investments and policy and legislative responses. In contrast, long periods with no major flood disasters have tended to be followed by periods of lower investment in flood management policies, programs, and projects.

Due to the placement of many reserves on floodplains, First Nations in B.C. have faced flood concerns for years. The unprecedented atmospheric river events in 2021 led to major flooding and landslides across south central and southern B.C., which impacted many people across British Columbia. Impacts of the Atmospheric River events included, but were not limited to, overflow of the Nooksack River into the Sumas Prairie, extensive damage to critical infrastructure including highways, and devastating impacts to Merritt and Princeton, and First Nations communities along Highway 8. These events, in addition to widespread flooding around the province in 2020, have brought into sharp focus the significant disruption that flooding causes for communities, economies, critical infrastructure, and the environment

Flood risks to British Columbians are substantial and continue to grow due to land use pressures and climate change. Meanwhile, government mandates and priorities such as future-proofing our ability to respond to crises, adapting to climate change, and meaningful Indigenous reconciliation are strong policy drivers, requiring new, modern approaches to flood management that better serve the needs of the people.

Defining a coherent, strategic vision for flood management is needed to turn the corner and increase flood resilience for British Columbians. This strategic vision must clearly define what needs to be achieved, as well as how this could be done over time. It also must build on what the provincial government has already heard at multiple engagement events related to flood management, disaster risk management, climate change, and resource stewardship forums.

The core of this Intentions Paper is a proposed strategic framework, which includes a Vision, Outcomes, and Principles for flood resilience in B.C. It underscores the need for collective leadership in innovative, holistic flood risk management to enhance B.C.'s flood resilience. The framework is complemented by four strategic 'program areas' and associated potential Actions for future implementation. These program areas and Actions are based directly on the United Nations' Sendai Framework for Disaster Risk Reduction, combined with core themes that have been heard through all engagements to date.

Program Area 1: Understanding Flood Risks

Action 1.1: Work with other levels of government to advance flood maps to better inform flood construction levels and development decisions

Action 1.2: Conduct a province-wide flood risk assessment

Action 1.3: Strengthen dike regulatory programs

Action 1.4: Increase public and business awareness of flood risks

Action 1.5: Support applied research and training

Program Area 2: Strengthening Flood Risk Governance

Action 2.1: Improve First Nations' involvement in flood resilience decision-making

Action 2.2: Review and modernize provincial legislation, regulations, and policies to address flood risks

Action 2.3: Review and modernize provincial technical guidance

Program Area 3: Enhancing Flood Preparedness, Response, and Recovery

Action 3.1: Enhance flood forecasting capabilities and early warning systems

Action 3.2: Enhance flood preparedness by developing and exercising flood emergency response plans at multiple scales

Action 3.3: Enhance emergency response activities

Action 3.4: Enhance pre-disaster recovery planning and post-disaster recovery, including "Build Back Better"

Program Area 4: Investing for Flood Resilience

Action 4.1: Enhance investments in flood avoidance

Action 4.2: Enhance investments in flood accommodation

Action 4.3: Enhance investments in flood protection

Action 4.4: Enhance investments in community-led retreat

The new provincial vision and programs must have strong legitimacy and voice, to help align across partner agencies, and reflect the will of the majority of British Columbians. Critically, Indigenous needs, values, and worldviews will be better incorporated in all flood management decisions moving forwards.

Intended Audiences for this Intentions Paper include:

- Partner agencies, including Indigenous, federal, and local government staff working in flood and disaster management, land use planning, climate change adaptation, or related areas.
- Private industry, including insurance, land developers, railways and ports, commercial, industrial small and medium businesses and enterprises in flood risk areas, and the consulting industry.
- Academia, including researchers and subject matter experts in flooding, climate change, recovery, disaster management and resiliency.
- Professionals, including engineers, planners, agrologists, economists, geoscientists involved in flood and disaster management, or related areas.
- Non-government agencies and local community groups interested in watershed management issues
- Engaged members of the public interested in flood management

The feedback received through engagement on this Intentions paper will inform (or provide guidance to) the B.C. Flood Strategy.

Figure 1. Vision Diagram

Indigenous Peoples and Flooding

The B.C. government acknowledges the need for increased rights recognition, self-determination, and partnerships with B.C.'s Indigenous peoples, and is committed to processes to bring all provincial laws into harmony with the UN Declaration on the Rights of Indigenous Peoples Act, particularly Articles 19, 27, and 29.

Many First Nations' worldviews centre around water bodies in their land, and caring for that land, including all people, living things, and other resources in their traditional territories. First Nations peoples have had well structured governance systems before contact. Historical decisions related to flood management and land use have put many First Nations communities at a loss. To move forward with reconciliation, it is essential First Nations' needs, values and worldviews are incorporated in flood management and First Nations must be partners in decision-making going forwards. Accordingly, early and ongoing engagement with Indigenous peoples has informed this Intentions Paper, and First Nations' voices are respected and incorporated throughout this paper.

Introduction + Context

The rainy coasts, mountain valleys, and river deltas in this part of the world have been shaped by floods. Floodplains throughout B.C. have always been viewed as attractive locations for many communities. First Nations have thrived in these landscapes, coexisting with floods and the environment to support their way of life. Since time immemorial, river valleys and floodplains have hosted human settlements, drawn to these areas by an abundance of food, fish, fertile soils, access to water and transportation routes, scenic views, and gentle slopes. Today, over 500,000 people and countless businesses can be found in flood risk areas across B.C. These communities can be exposed to damaging flood events, threatening lives, infrastructure, and the environment. As climate change advances and cities and settlements expand, the risk of damaging floods in B.C. continues to intensify.

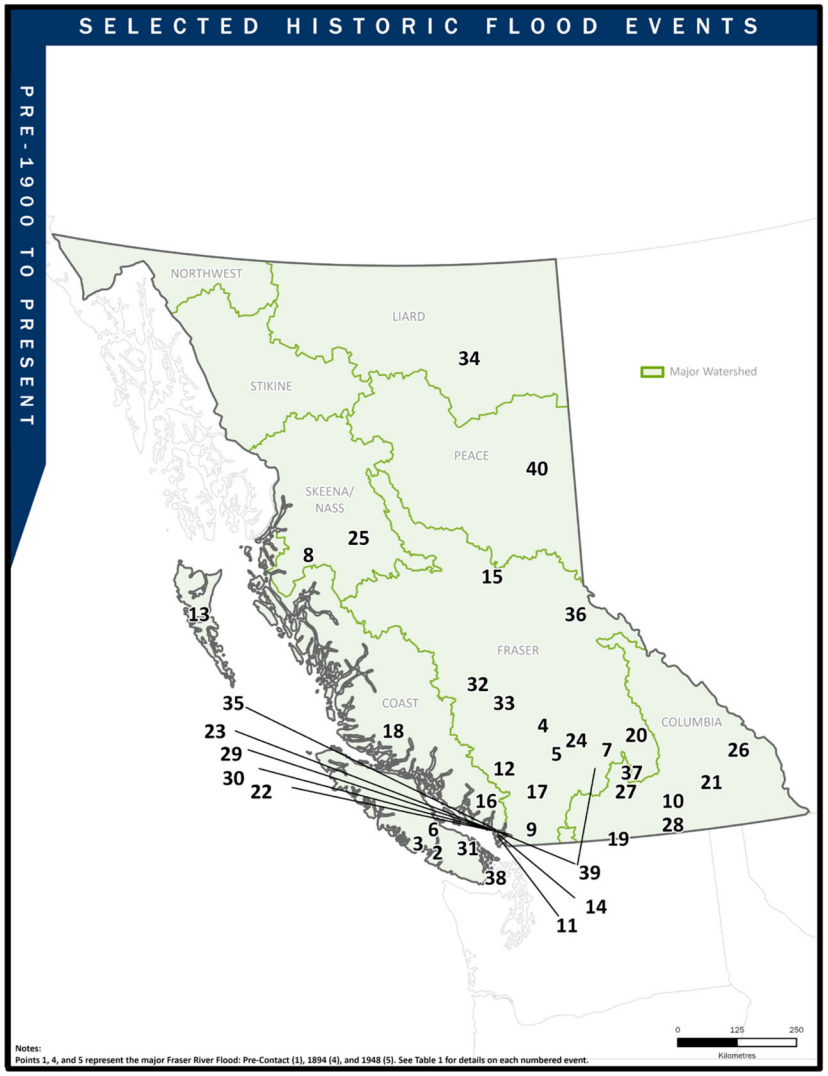
This Intentions Paper is a key step along the path to create a modern B.C. Flood Strategy. Its goal is to create dialogue and enable you and your organization to provide input towards this process. Once complete, a B.C. Flood Strategy will provide a strategic bridge from the present status quo, to a more vibrant future of a holistic, integrated approach to living with floods. The core of the strategy will be unifying provincial vision, outcomes, and guidance on priorities to improve flood resilience, which in turn will inform future implementation (Figure 2).

Figure 2. Flow Chart of Flood Strategy Development and Implementation

Table 1. Major Causes of Floods in B.C. and Examples of Events

Flood Type	Description	Causes
Riverine Floods 	Water levels in a river, lake, or stream overflow onto adjacent lands or infrastructure. Erosion is also typical during these types of floods.	Intense rainfall, atmospheric rivers[8, 10, 18, 31, 39, 40]
		Rapid snowmelt [4, 5, 32, 33]
		Ice jams [15, 25, 34]
		Structural / operational dam failure[10, 19, 35]
		Natural dam failure/glacial outburst [1]
		Debris floods in steep terrain [16, 20, 26, 36]
		Two or more of the above (e.g., rain-on-snow events) [5, 9, 21, 27, 28]
Coastal Floods 	Seawater inundates lands in coastal zones.	Storm surge wind and wave Action [13, 14]
		Tsunamis [2,3, 6]
		High tides [22, 23, 29]
		Sea level rise
Local Pluvial/ Stormwater Floods 	Extreme rainfall creates local flooding away from water bodies.	Heavy rainfall exceeds the capacity of stormwater sewers, culverts, and landscapes to absorb + convey flows [11, 17, 24, 20, 37,40]
		Blocked urban drainage systems [38]
Groundwater Floods 	Rising underground water table floods basements or parkades	Regional flood events Areas with high water tables

Selected Flood Events in B.C. (Pre-1900 to Present)



[1]*Fraser River Coast Salish Communities-Pre Contact,* [2]*Huu-ay-aht – early 1700s,* [3]*Nuu-Chah-Nulth – early 1700s,* [4]*Fraser River-1894,* [5]*Fraser River-1948,* [6]*Port Alberni-1964,* [7]*Kamloops-1972,* [8]*Terrace-1978,* [9]*Sumas/Abbotsford–1990,* [10]*Cannon Creek-1995,* [11]*White Rock-1999,* [12]*Pemberton-2003,* [13]*Haida Gwaii-2003,* [14]*Delta-2006,* [15]*Prince George-2007,* [16]*Cheekye-2009,* [17]*Chilliwack-2009,* [18]*Kingcome-2010,* [19]*Testalinden Creek-2010,* [20]*Sicamous-2012,* [21]*Central Kootenays-2012,* [22]*Metro Vancouver-2012,* [23]*Metro Vancouver 2014,* [24]*Kamloops-2014,* [25]*Smithers-2015,* [26]*Fairmont-2016,* [27]*Okanagan Lake-2017,* [28]*Grand Forks-2018,* [29]*Metro Vancouver-2018,* [30]*Metro Vancover-2018,* [31]*Cowichan-2020,* [32]*Nazko-2020,* [33]*Chilcotin-2020,* [34]*Muskwa-Kechika-2020,* [35]*Cleveland Dam-2020,* [36]*McBride-2020,* [37]*Kelowna + Vernon-2020,* [38]*Oak Bay – 2020,* [39]*Southern (e.g. Nooksack River, Abbotsford) and Southcentral B.C. (e.g. Merritt, Princeton)-2021, Peace flood events -2011, 2016*

Floods in British Columbia

Floods are common events in B.C. and can be categorized into four main types: riverine, coastal, local stormwater, and groundwater (Table 1). Floods can unfold extremely rapidly - such as the Okanagan Lake floods of 2017 and the Grand Forks floods of 2018 - or very gradually - such as sea level rise impacting coastal communities.[2]

Floods carry nutrients to an area and renew plant growth and habitat. Exposing people, roads, or buildings to floods negatively impacts them. Negative impacts from floods include damage to property and infrastructure, economic and social disruption, and loss of life (7 flood-related fatalities recorded in B.C. in 2020).

The Need for a B.C. Flood Strategy

Current provincial government mandates have increased focus on future-proofing our ability to respond to crises, preparing for climate impacts, and reconciliation with Indigenous peoples. As outlined below, all three of these focus areas relate clearly and directly to the need for a modern B.C. Flood Strategy.

Future-Proofing Our Ability to Respond to Crises

Both Canada and B.C. have signed the UN Sendai Framework for Disaster Risk Reduction, which includes four priorities related to knowledge, governance, funding, and disaster preparedness (Figure 2). Sendai sets global targets and pathways for disaster risk reduction and advocates a whole-of-society approach to "empower local authorities, through regulatory and financial means, to work and coordinate with civil society, communities and Indigenous peoples and migrants in disaster risk management at the local level."

Preparing for Climate Change

Climate change is happening, and it is increasing flood risks. A warmer atmosphere leads to heavier rainfall events, earlier and more rapid snowmelt, and rising seas. Severe wildfires also destabilize the landscape's ability to absorb water, leading to more intense peak flows, and flashier rivers and streams that persists years after the flames are put out. Due to climate change, river flooding is expected to be at least 10-20% more frequent, local floods from heavy downpours are expected to be 40% more frequent, and sea level rise of 1m or more is expected by the end of this century.[3,4] The Climate Preparedness and Adaptation Strategy confirmed high public concern on the issue of flooding – with over 80% of those engaged supporting more Provincial Action on flood management, including completion of a Flood Strategy in the short term.

Meaningful Indigenous Reconciliation

It is well documented that First Nations have been disproportionately impacted by flood events in B.C. and have not always received appropriate funding and capacity to reduce flood impacts on their communities. To move forward with reconciliation, it is essential First Nations' needs, values, and worldviews are incorporated in flood management decisions. The B.C government also acknowledges the need for increased rights recognition, self-determination, and partnerships with B.C.'s Indigenous peoples, and is committed to bringing all provincial laws into harmony with the **Declaration on the Rights of Indigenous Peoples Act (Declaration Act)**. Reconciliation also means greater attention paid to environmental sustainability issues, and ecosystem-based approaches that realize the interconnectedness of water and the land. These also relate directly to many Indigenous rights. It is time for conventional planning and design practices for flood control to be better reconciled with Indigenous priorities, knowledge, and wisdom to achieve flood resilience.

The need for a B.C. Flood Strategy has also been previously recognized by:

- B.C. Office of the Auditor General (2018)
- Abbott/Chapman report Addressing the New Normal: 21st Century Disaster Management in B.C. (2018)

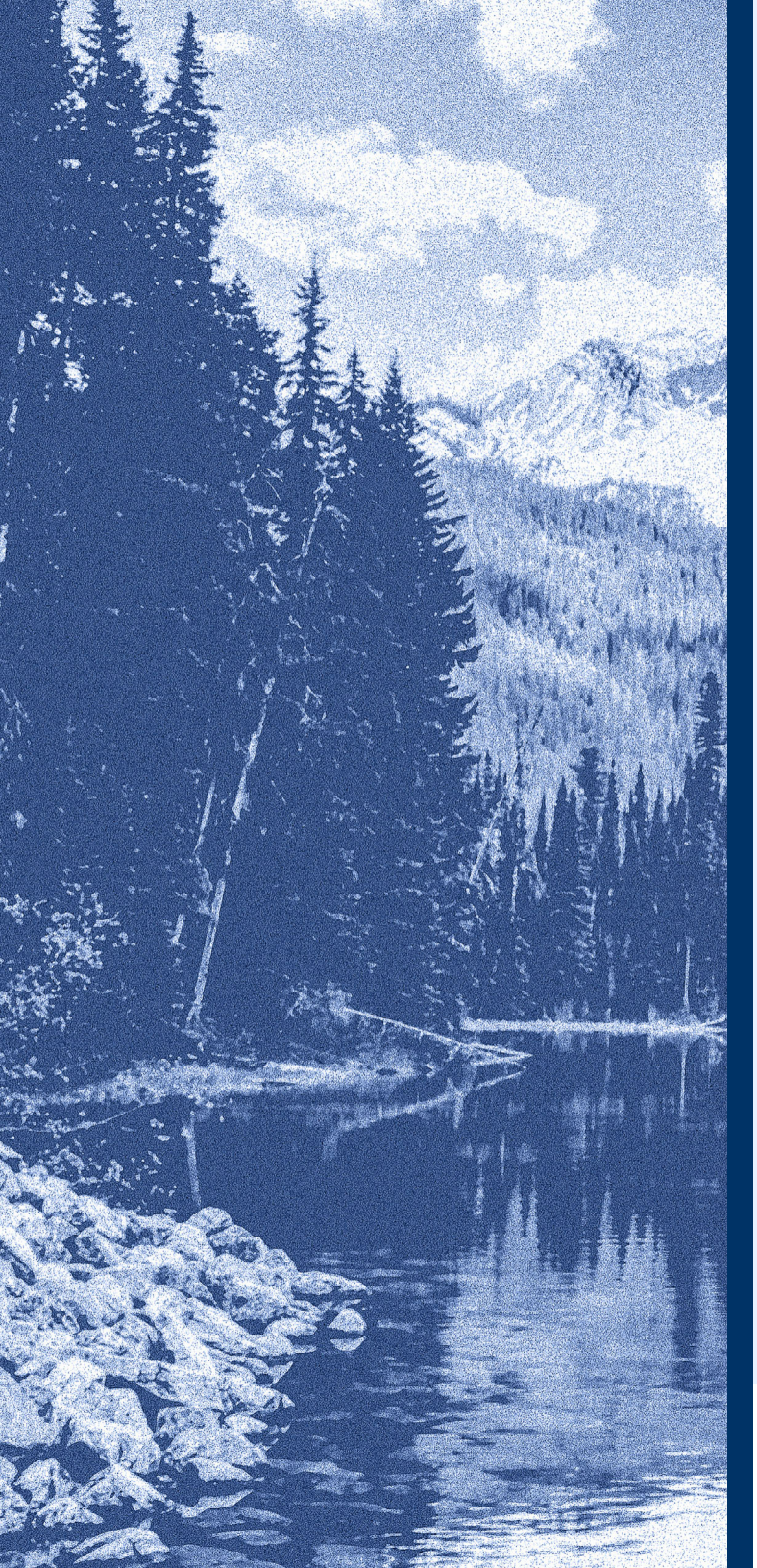
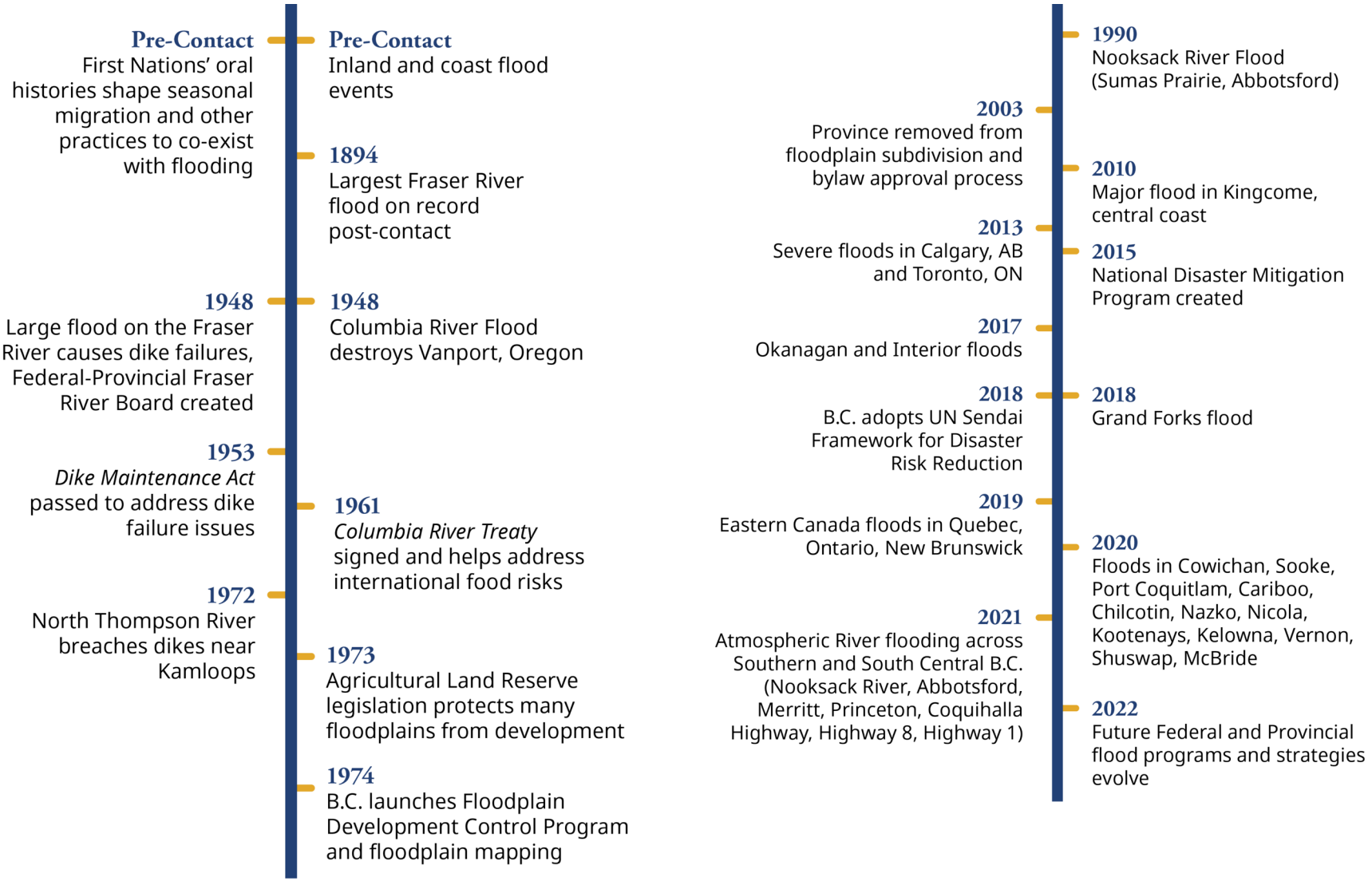


Figure 2. Four Priorities of the Sendai Framework

Building on Our Shared History of Flood Management

Understanding how past events have shaped current policies is important.[5] Throughout history, governments and communities have often reacted to flood events with new policies, programs, and practices (Figure 3). This reactive approach needs to be shifted to a more proactive approach to better prepare for flooding.

Figure 3. Summary of historical flood events and related policy and legislative responses in British Columbia and Canada



A Summary of Engagement to Date

Numerous provincial engagement sessions, workshops, surveys, meetings, and reports addressing flood topics have occurred over the last several years. Under a "whole of government" approach,[6] Provincial staff have compiled a diverse range of perspectives, knowledge and opinions from First Nations, local governments, businesses, the public, non-profit and volunteer organizations, and emergency management practitioners. This feedback has been synthesized into key themes below. Importantly, engagements have shown agreement on two points: that funding and staff capacity at multiple levels in the governance system are frequent barriers to improved flood management in B.C., and that better alignment among Provincial Ministries would provide clearer direction and support.

Table 2.1 Summary of key feedback received through Provincial government engagements to date

Indigenous Peoples	Local + Regional Governments	Non-Government Organizations	Business + Industry
Capacity and **funding** shortfalls at the provincial, regional, and local levels are frequent barriers to improved flood management	**Capacity** and **funding** shortfalls at the provincial, regional, and local levels are frequent barriers to improved flood management	**Capacity** and **funding** shortfalls at the provincial, regional, and local levels are frequent barriers to improved flood management	**Capacity** and **funding** shortfalls at the provincial, regional, and local levels are frequent barriers to improved flood management
Alignment among agencies needed	Alignment among agencies needed	Alignment among agencies needed	Alignment among agencies needed
A need for "balance" - when protecting communities from floods, the land, ecology, fish and wildlife must also be respected and protected	Clearer, modern tools, standards, and policy direction from the Province are needed	Reduce barriers to natural approaches to flood risk, and include fish habitat and passage in flood management	Flooding is the single greatest risk to the public due to climate change (insurance industry)
Better alignment and coordination needed between provincial Ministries and the federal government ("engagement fatigue"), and improved capacity to participate and collaborate	Most local authorities want to remain in control of flood planning	Improve existing flood-related funding programs to better target ecological + social objectives	Senior governments should ensure flood maps are current and sufficient capacity and expertise is available (real estate industry)
The need for tangible results that are meaningful at the community level	More provincial support is required on funding; data/mapping/ technical advice; coordination with other provincial and federal agencies	A need to better address increasing uncertainties due to climate change	A need to increase capacity to evacuate livestock from flood risk areas, particularly smaller operators (agriculture industry)

Table 2.2 Summary of key feedback received through Provincial government engagements to date

Indigenous Peoples	Local + Regional Governments	Non-Government Organizations	Business + Industry
A need to reflect all Indigenous values, knowledge, laws, Rights and Title, and the Declaration on the Rights of Indigenous Peoples Act, including the right to self-determination. This includes acknowledging and respecting the unique cultures, customs, law, and aspirations of each individual community, tribe, and Nation.	Extreme weather events causing urban and overland flooding is a top climate-related concern of local governments	Senior government disaster financial assistance is perversely promoting unsustainable floodplain development, by 'bailing out' those who make poor decisions by developing flood risk areas	The provincial government should prioritize data collection and open data sharing
	Local governments have different needs and requirements depending on size and context		Improve communications with the public on flood risks

In June 2021, partner agencies - including Indigenous, federal, and local government staff working in flood and disaster management, land use planning, climate change adaptation, or related areas – provided feedback on an earlier iteration of this paper in the form of a Discussion Paper. The input received from those engagement sessions will inform drafting of the B.C. Flood Strategy.

A Strategic Framework for Discussion

The core of the B.C. Flood Strategy will include a guiding Vision and Outcomes outlining goals for the future (Figure 4). Followed by clear guiding Principles (Figure 5), and coherent Priority Program Areas and actions outlining how the Strategy will be executed. All of these reflect what we heard to date from people across B.C., as well as best practices.

Enhanced Public Safety

In B.C.'s flood resilient future, flood-related public safety risks will improve as communities are built and managed to allow "safe flooding" to help prevent and minimize death, injury, stress, and social disruption from flood events. Over time, negative outcomes on public safety and public health due to floods will be reduced. This includes death from drowning or hypothermia, injuries, disease transmission from compromised sewage systems, or stress and mental health impacts from flood trauma and flood evacuations. In the future, Gender Based Analysis Plus (GBA+) and Intersectional insights (including all identifying factors, such as race, ethnicity, religion, age and mental or physical disability) are applied to meet the needs of specific population segments. For example, reducing the negative experiences many women have after floods such as increased domestic and childcare responsibilities, lost income, and increased anxiety years after flood recovery. For men, this might include efforts to reduce risk-taking behaviour which makes them more prone to death and injury during floods. For low-income residents, this might mean reduced vulnerability through expanded flood insurance programs, and increased access to resources and capacity to repair flood-damaged housing. Greater care will also be taken to meet the needs of the equity-denied populations, such as the unhoused, children, seniors, and Indigenous peoples, who require special considerations during evacuations. Particular attention must increasingly be paid to the needs of Indigenous peoples, who face disproportionate flood risks to their homes and infrastructure, and loss of land and cultural sites to erosion and sea level rise.[7]

Economic Stability

The atmospheric river events of November 2021 demonstrated the significant consequences that flooding can have on communities, economies, critical infrastructure, supply chains, the movement of people and extensive losses to the agricultural sector. It is considered the biggest natural hazard disaster impact in Canadian history, with costs in the billions. Flooding is the most common, costliest disaster in Canada and B.C.[8] In B.C.'s flood resilient future, provincial and local economies and supporting critical infrastructure will absorb flood shocks with less economic disruption and property damage. Every $1M of public investment made towards flood resilience during the 2020s-2030s will save an average of $7-$10M in avoided flood damage and recovery costs in the 2040s-2060s, consistent with recent cost/benefit analyses.[9] Proactive flood resilience investments spread over a number of years will reduce the flood damage costs of a major Lower Fraser River flood - previously estimated at over $30 billion[9]- to a fraction of this amount when it occurs. The trend of ever-increasing government disaster financial assistance payments is reversed, and taxpayers no longer foot the majority of bills for flood damages. As our infrastructure stock becomes more flood resilient, increasing costs to rebuild provincial highways, bridges, public buildings, and other infrastructure damaged by floods stabilizes and reverses over time. Major dam or mine tailings pond failures are averted, through continuous improvement of engineering practices and regulations. Provincial and federal disaster mitigation and green infrastructure funding programs also work together, to help realize multiple benefits.

25% of all Canadians exposed to significant flood hazard threats are in B.C.

Natural Resources Canada

Environmental Sustainability

In B.C.'s flood resilient future, natural floodplains, river corridors, lakes, watersheds, coastal ecosystems, and green infrastructure provide a wide range of valued ecosystem services. These include flood regulation, salmon and wildlife habitat, clean water, open spaces, recreational opportunities, and many cultural and spiritual benefits. Increasingly, flood protection and environmental protection complement one another. Community choices achieve a greater balance between the need to protect people and infrastructure from flooding, with the need to protect our natural watersheds and floodplain ecosystems from people, including engineered alteration of waterfront land. As communities build back better, nature-based solutions are used wherever possible in B.C.'s watersheds. The wisdom of Indigenous peoples - who have always viewed environmental sustainability as inseparable from economic stability and public health issues – is increasingly understood, embraced, and reflected in decision-making. The rights of Indigenous peoples and their traditional ways are protected on our pathway to reconciliation.

"When we take care of the land and water, the land and water take care of us."

-siwɬkʷ (water) Declaration

Principles for Strategic Flood Resilience

Principles are important starting points for any complex, multi-faceted issue such as societal flood resilience. The following principles provide high-level guideposts for flood resilience initiatives across multiple jurisdictions. These principles have been distilled and synthesized from engagement inputs to date, as well as the **UN Sendai Framework for Disaster Risk Reduction**,[10] the B.C. Office of the Auditor General's **Public Sector Governance Guide to the Principles of Good Practice**,[11] the **B.C. Emergency Management System (2016)**,[12] the Climate Change Preparedness and Adaptation Strategy, and the review paper "Strategic Flood Management: 10 'Golden Rules' to Guide a Sound Approach".[13] These principles are considered universal, true, and foundational elements for any flood resilience initiative or program in B.C. - at any scale. Successful strategic flood management in B.C. must be Proactive, Place-Based, Accountable, Collaborative, Transparent, and Fair (Figure 4).

Holistic: A holistic approach to flood management is interdisciplinary, balanced, and Indigenous-centred, and integrates across a network of relations within watersheds, ecosystems, land, and society.

Proactive: Flood resilience must be built before major floods occur - not reactively in response to flood disasters - to proactively protect people and property and enable nature-based solutions.

Place-based: Decisions to reduce flood risks must be based on the best available place-based data and knowledge and reflect regional, watershed-based approaches including upstream and downstream connections. No single solution will work for every flood, requiring flexibility and diversity in solutions.

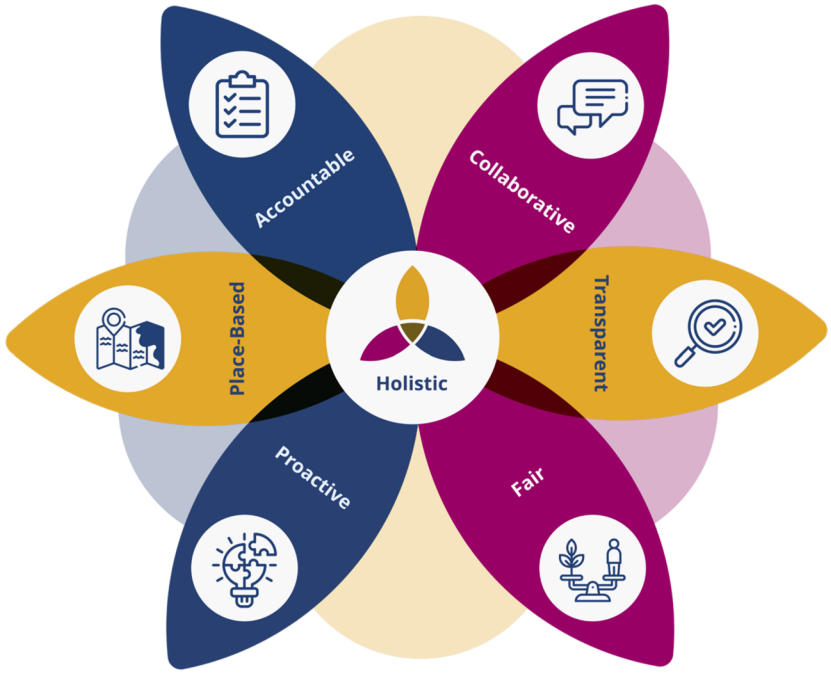
Accountable: Organizations and individuals must take responsibility for their decisions and Actions to build greater flood resilience over time.

Collaborative: Reducing flood risks requires effective collaboration across diverse roles and responsibilities at all levels of governments (including First Nations), and include industries, businesses, communities, landowners, and the public.

Transparent: Flood resilience decisions and flood risk data must be open and accessible to all, enabling full, accurate, clear information on flood risks – including uncertainties.

Fair: Programs to reduce flood risk must be equitable and accessible to all people at risk - including Indigenous peoples - and must apply a GBA+ lens addressing race, culture, gender, sex, age, income, and ability, while respecting human rights and the rule of law.

Figure 4. Draft Provincial Principles for Flood Resilience



Priority Program Areas + Key Actions

Priorities and coherent actions are essential to ensure a tangible Strategy that can guide execution. Accordingly, four priority program areas aligned with the UN Sendai Framework for Disaster Risk Reduction have been identified:[14] (1) Understanding Flood Risks, (2) Strengthening Flood Risk Governance, (3) Enhancing Flood Preparedness, Response and Recovery, and (4) Investing for Flood Resilience. For each program area, a set of key actions are identified. We are seeking feedback from you on possible gaps, changes, or additions you feel are needed. Your ideas are greatly appreciated!

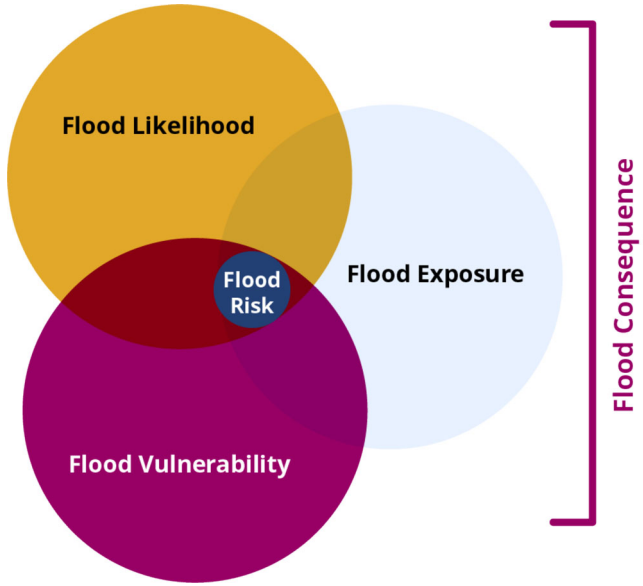
Program Area 1: Understanding Flood Risks

Increasing knowledge and understanding of flood risks in B.C. is critical to effectively build flood resilience over time. Western science, engineering, and risk management disciplines typically define flood risk as the combination of the likelihood and consequence of flooding at a particular location (Figure 5). Flood likelihood represents the chance flooding will occur, often calculated with statistics (Table 3).

Table 3. Understanding Flood Risks: Flood Return Periods and Encounter Probabilities

Likelihood of Flooding	Estimated Flood Return Period	Annual Exceedance Probability (AEP)	Flood Encounter Probability Within 25 Years	Flood Encounter Probability Within 100 Years	Consequence of Flooding
Decreases	10 years	10%	93%	1	Increases
Decreases	50 years	2%	40%	87%	Increases
Decreases	100 years	1%	22%	63%	Increases
Decreases	200 years	0.5%	12%	39%	Increases
Decreases	500 years	0.2%	5%	18%	Increases
Decreases	1000 years	0.1%	2%	10%	Increases

Figure 5. Key Components of Flood Risk



Flood consequence includes the impacts of flooding on people, buildings, infrastructure, ecosystems, and other values. Flood consequence includes the exposure of people or infrastructure to flooding, and vulnerability of people, places, or ecosystems to flood damages (Figure 6). Modern best practices examine a spectrum of flood risk scenarios of differing magnitudes and resilience pathways - rather than focus on a single regulatory flood scenario (e.g., 200-year flood).

There is also a strong need for respectful, reciprocal sharing of information and data to balance Western Science with Indigenous ways of knowing. The knowledge, practices, and values of First Nations - which are complex and deeply contextual – needs to be respected alongside Western science to better understand flood risks. Understanding past decisions that have shaped flood risks - including historical inequities – is also important to understand and address.

Action 1.1: Work with other levels of government to advance flood maps to better inform flood construction levels and development decisions

Clear, consistent, up-to-date flood maps are critical to direct new growth away from flood risk areas and inform decisions on infrastructure investment and emergency management in a changing climate. Yet most flood maps in B.C. remain 20-30 years out of date. Several local flood maps were updated recently, but standards, quality control, and public accessibility has varied considerably.

An improved, provincially coordinated flood mapping program can address this situation. Such a program would include other levels of government, and First Nations, to apply consistent standards and quality control processes, while building on prior work and related initiatives.[15] Innovative modelling and mapping of multiple flood scenarios and channel migration patterns should be integrated, to produce easily accessible flood maps tailored to different learning styles. This information will better enable risk-informed decision-making by communities and individuals.

During implementation of this action the province could guide flood mapping at regional and local scales, maintaining a central, accessible inventory of flood maps. Alternatively, the province could lead a new provincial flood mapping program. In either case, including Indigenous knowledge keepers and building on other flood mapping initiatives and expertise is critical.

Action 1.2: Conduct a province-wide flood risk assessment

A Provincial Flood Risk Assessment based on available province-wide data would provide a more consistent provincial picture of flood risk. This assessment would highlight regions and communities of highest concern including upstream watersheds, integrate Indigenous lenses and GBA+ issues, and inform investment prioritizations at targeted locations. Initial costs to complete a province-wide assessment would be offset in the future through more efficient funding allocations to communities at risk.[16] Implementation must align with ISO 31000 (risk management guidance codified by the International Organization for Standardization) and watershed-based scales. The Provincial Flood Risk Assessment would also build on provincial climate risk assessment and provincial hazard, risk, and vulnerability guidelines. It would also include a cost/benefit assessment, and multi-criteria analysis of economic, social, and environmental values and trade-offs, while addressing future climate conditions (e.g., 2050 and 2100).

Recent flood assessment projects led by the Province over the last few years included:

- A Dike Consequence Study, which classified 35 dikes as “High” consequence dikes
- Orphan Dike study
- Provincial Dike Crest Elevation Survey
- B.C. Extreme Flood Project

A recent study showed that only 6% of Canadian homeowners living in designated flood risk areas are aware of the flood dangers they face.

University of Waterloo Centre on Climate Change, 2020

Action 1.3: Strengthen dike regulatory programs

Over 216 dikes in B.C. are provincially regulated. These protect over 1,600 km2 (160,000 Ha) of land, well over half a million people, and several hundred thousand buildings – including homes, businesses, industries, schools, hospitals, and airports – with a total estimated value of $100 Billion.[17] Over time, our river landscapes have changed, and many of the dikes within B.C. have fallen into disrepair. Today, the vast majority no longer meet provincial standards, with one study estimating only 5% of all dikes in the entire Lower Mainland meet current standards. Many emergency responders continue to rely on information that does not reflect actual conditions. There is a need to complete a publicly accessible, central repository of dike information, capturing the condition, height, and key deficiencies for each dike in B.C. Benefits derived would include:

1. Increased support for effective dike maintenance by Diking Authorities
2. Increased effectiveness of dike safety audits and regulatory compliance
3. Improved information for local governments and other authorities responsible for land use planning and development regulation behind dikes
4. More streamlined emergency planning, response and recovery related to dike failures during flooding
5. Enabling more comprehensive flood risk assessments to prioritize funding for dike upgrades
6. Increased public awareness of flood risks

In addition, increasing the capacity of provincial regulatory staff would support improvements in dike regulatory programs, including approvals, auditing and compliance, guidance documents, and support for implementing innovative solutions.

Action 1.4: Increase public and business awareness of flood risks

Public outreach and increased transparency are critical to achieve public and visitor safety and well-informed decisions before, during, and after floods. All British Columbians living or working in a flood risk area should know the risks they face, the level of protection offered by dikes, what their insurance policies cover, and actions they can take to protect themselves, their families, and their business or property. Flood risk information must be easily accessible and understandable to help inform personal and investment decision-making.

Many existing flood outreach tools and programs are available to draw from, including the federal **Flood Ready** website, the provincial **Flood Preparedness Guide** and **Storm Ready** social media package, the Fraser Basin Council's **Flood Wise** website, and the Intact Centre's **Under One Umbrella** report and **FloodSmart Canada** website.

Action 1.5: Support applied research and training

Post-secondary institutions have a critical role to play in increasing societal understanding, knowledge, awareness, and capacity on what it means to build flood resilience. To the extent possible, research and education should be framed by contemporary needs and priorities, complemented by Indigenous ways of knowing.

UBC's Living With Water project is exploring issues of future coastal flood governance and adaptation along the South Coast.

Program Area 2: Strengthening Flood Risk Governance

Many provincial, federal, Indigenous, regional, and local government agencies have decision-making roles and responsibilities affecting flood risks.[5] Roles are also played by hydropower producers, water boards, insurance providers, businesses, families, private property owners, and individuals. International governance is also drawn where watersheds cross borders - such as the Columbia River and Nooksack River basins. In short, building flood resilience is everyone's business.

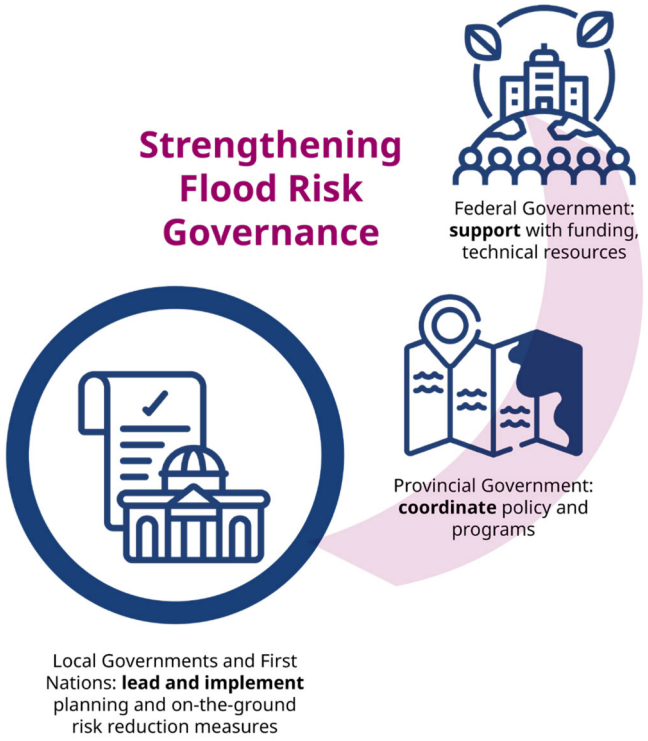
Strengthening flood risk governance requires strong, coordinated roles at all levels of government. This includes support from the Federal government, coordination of policy and programs by the Provincial government, and implementation of specific on-the-ground actions by local authorities and First Nations (Figure 6).

Action 2.1: Improve First Nations involvement in flood resilience decision-making

Strengthening disaster risk governance is a crucial part of reconciliation between Indigenous peoples and other governments and needs to prioritize Indigenous self-determination and the interests of First Nations. Current, evolving flood governance systems must fully incorporate First Nations' inherent and legal rights, set out in Section 35 of the Canadian Constitution, the federal *United Nations Declaration on the Rights of Indigenous Peoples Act*, and the provincial Declaration Act. First Nations' roles in revised governance models must be inclusive, and ideally supported by funding that builds and enhances First Nations' capacity to participate. Many relationships developed by First Nations with neighbours in their watersheds have already established trust and a shared sense of responsibility. Strengthening these relationships across the watershed and beyond are important foundations to co-develop effective future flood resilient governance.

Implementing the Declaration Act within the context of shared decision-making must apply collaborative models allowing First Nations, their priorities and their worldviews to be a part of all plans going forward, while also allowing past plans to be upgraded. The First Nations Emergency Management Services Funding Agreement (2017) requires a review and update, as it provides substantial funding to improve risk assessments, hazard planning, and improvement of emergency response - but currently has limited funding available to increase community level, staffing capacity. Additionally, current funding models for emergency response requires communities to be reimbursed post-event, something that many communities do not have the upfront capital for. Moving forward, a paradigm shift is needed to improve support within and between First Nations communities, allowing individual or groups of communities to build their own emergency coordination centres to better enable participation in regional activities.

Figure 6. Summary of key roles in flood governance



Key Declaration Act Articles

- Article 19: Free, Prior and Informed Consent
- Article 29: Right to the conservation and protection of the environment
- Article 32: Right to determine and develop priorities and strategies

Action 2.2: Review and modernize provincial legislation, regulations, and policies to address flood risks

Provincial legislation, regulations, and policies related to flood management no longer reflect modern public environmental values and growing risks and liabilities. For example, the responsibility to plan and regulate land uses in flood risk areas remains at local and regional levels, whereas many of the liabilities for flood damages continue to accrue to senior levels of government. One significant liability is the existence of over 100 "orphan" dikes and other flood structures in B.C. which are not currently being inspected or maintained by a responsible authority; these protect over $1.9 billion in building values.[17] Where dike owners do exist, there are capacity gaps for enabling more robust compliance, auditing, and enforcement. Clarifying how the province will respond to the Declaration Act will also be needed as well as the province modernizes legislation over time. Addressing these challenges requires careful work across jurisdictions, within regional, watershed-based scales of analysis. Identified key priorities to better address these growing liabilities and changing public values include:

- Complete the Emergency Program Act modernization, with greater focus on mitigation, preparedness, recovery, and disaster risk reduction, and revise the Compensation and Disaster Financial Assistance regulations to better support recovery and resilience
- Create a new Orphan Dike Policy to facilitate the transfer of orphaned dike assets to responsible owners
- Complete the repeal of the Drainage, Ditch, and Dike Act and related processes
- Develop clear regulations under the Dike Maintenance Act to ensure resilient, innovative flood protection infrastructure
- Through the Forest and Range Practices Act Improvement Initiative, modernize forest policy to improve governance of watershed values - including increased risk of peak flows - through forest landscape-level planning and complementary legislation, regulations, and policy
- Review the B.C. Building Code and B.C. Electrical Code to determine if and how codes can further flood resilience
- Consider a climate attestation program for qualified professionals to ensure that the design and construction of flood protection structures incorporates the best available climate, hydrology, and coastal sea level rise modelling

Action 2.3: Review and modernize provincial technical guidance

Much of the provincial technical guidance related to floods and flood hazards are at least 20 years old, and do not fully reflect current practices or innovative design practices. Updates to several guidelines and templates are needed, to improve the accessibility and utility of the information for diking authorities and other interested parties. To help better enable innovative and resilient flood infrastructure planning, design, and construction practices – including seismically resilient dikes, and fish-friendly green flood infrastructure – ongoing improvements to technical guidance and standards are critical. Several professional practice technical guidelines identified as possible priorities for renewal include:

- **Flood Infrastructure Guidelines:** A new, comprehensive set of guidelines for the design, construction, and management of dikes, erosion protection works, and other flood infrastructure is needed, to reflect current science and engineering best practices, and include provisions for emerging bio-engineering and greener technologies. A key goal will be to make these guidelines accessible for multiple users including: diking authorities, design professionals, regulators, and operations and maintenance staff.
- **Flood Hazard Area Land Use Guidelines:** Including updates to better address risks to publicly funded infrastructure and promote green infrastructure.[18]
- **B.C. Dam Emergency Response Plan** to better prevent and mitigate dam breaches.
- **Forestry Watershed Best Practices:** Incorporate and synthesize modern research and knowledge on forestry best practices to reduce peak flow risks.
- **Local Flood Risk Assessment Guidelines** to better standardize professional practices and techniques for conducting flood risk assessments.

"Picking up the phone, checking in, building relationships and taking time to understand the processes is so helpful."

-Indigenous engagement participant

- **Integrated Flood Planning Guidelines** to satisfy the Province's minimum expectations for flood risk management including structural and non-structural approaches, climate change considerations, community planning processes, and First Nations involvement.
- **Local Authority Guidance:** Improved guidance and support to local governments to more explicitly address flood risk and mitigation when developing Official Community Plans, approving new developments or redevelopments in flood risk areas, and informing residents or new homebuyers in flood risk areas of flood risks.
- **Stormwater Guideline Adoption.** Local stormwater flooding issues are the responsibility of local authorities and communities. However, the province is considering the formal adoption of nationally recognized standards and design guidelines for urban flooding, stormwater infrastructure, and development.[19]

Program Area 3: Enhancing Flood Preparedness, Response, and Recovery

The Provincial Flood Emergency Plan describes how flood-related preparedness, response, and recovery is coordinated across the provincial government, local authorities and First Nations. The Plan supports clarifying roles and responsibilities before, during, and after floods. The nature of the flood risks at different locations and watersheds means that regional and local perspectives are critical to shape effective flood preparedness, response, and recovery plans for flood resilience.

Flood preparedness consists of actions taken by individuals, businesses, and governments to ensure they are ready to undertake emergency response and recovery when required. Flood emergency planning and preparedness is generally a local government responsibility, but often requires collaboration and coordination with regional, provincial and federal levels. Flood preparedness helps ensure British Columbians and visitors receive timely flood warning information and develop and exercise comprehensive plans to respond to and recover from flood events.

Flood response helps ensure activities are coordinated across agencies, to effectively support British Columbians and visitors during a crisis. Emergency response can include construction of urgent flood mitigation works, temporary measures like sandbag dikes, and evacuation plans for people and animals. Before and during flood response, effective communication is critical so residents, visitors and businesses can take steps to protect life and property. If required, evacuation needs to be managed and emergency shelter and other services provided.

Flood recovery focuses on reducing risk in communities to prevent or mitigate future flooding. The goal of flood recovery is to increase community resilience to future flood disasters and to "Build Back Better" by:

- Supporting communities to rebuild post-disaster in a resilient, culturally safe and appropriate way, and recover in a timely way from economic, social and cultural disruption.
- Reducing future losses by ensuring reconstructed infrastructure can resist more intense events in a changing climate or relocating exposed assets or people out of floodplains.
- Accelerating reconstruction through measures such as contingent reconstruction plans, pre-approved contracts, and financial assistance.
- Ensuring post-disaster support reaches all affected population groups, community resiliency is leveraged, and community knowledge integrated

"People don't understand how valuable our traditional knowledge keepers are in knowing how to respond."

-Indigenous engagement participant

Action 3.1: Enhance flood forecasting capabilities and early warning systems

Accurate, up to date flood advisories for the public and emergency responders is imperative to enable flood resilience through effective early warnings, which allow people to evacuate out of harm's way or fortify their defences. Flood forecasting is a considerable challenge across B.C.'s diverse geographies, especially as climate change continues to increase severe weather risks. The best available science must be integrated into fast-paced daily operational river forecasts. Notably, the Global Commission on Adaptation found that investments in strengthening early warning systems has a 9:1 cost/benefit return.[20]

Ensuring continuous improvements in flood modelling and forecasting services across B.C. requires investments. A fully staffed, well trained team with sufficient scientific knowledge must be in place, who can provide shift coverage seven days a week to respond to flood events and changing weather forecasts. Cutting edge technologies are also prerequisites for ongoing success, including:

- Robust data management systems and computing resources
- Enhancements to hydrometric and climate monitoring networks
- Ability to rapidly process satellite-based snow data
- Acquisition and integration of a range of numeric weather model outputs
- Continuous improvements in river, lake, and coastal flood forecast models and analysis tools
- Integration of local-scale flood risks into early warning systems; and
- Collaboration across all agencies collecting, producing, and communicating hydrometric and climate monitoring data.

For every dollar of insured losses borne by insurers in Canada, three to four dollars are borne by governments as well as home and business owners.

Source: IBC Facts Book 2017, PCS, CatIQ, Swiss Re, Munich Re and Deloitte

Action 3.2: Enhance flood preparedness by developing and exercising flood response emergency plans at multiple scales

The province develops and exercises a provincial flood response emergency program, encompassing strategic priorities for planning, testing, and validating plans to enhance overall preparedness. Under the Emergency Program Act, local authorities are responsible for developing emergency response plans addressing business continuity and emergency management concerns. Business continuity planning is the process of developing prior arrangements and procedures to enable critical services to remain functional despite a disaster or disruption. Emergency management plans must describe how authorities will prepare, respond, and recover from flood events, while integrating with neighbouring jurisdictions and First Nations.[21] Exercises validate plans, test procedures and provide realistic training for emergency response staff. They are also an effective way to test equipment and facilities. Exercises foster internal and external relationships, confirm expectations, and develop rapport with key partners. Programs such as the Community Emergency Preparedness Fund (CEPF) help communities build capacity for flood emergency response, by funding local Emergency Operations Centres, equipment that supports emergency programs, personnel training, and planning of evacuation routes.

Action 3.3: Enhance emergency response activities

A response to a flood event must be immediate and well-coordinated, to ensure the safety of residents, visitors, and protect property and communities, and meet the needs of residents and businesses. Provincially, this includes training, regional and provincial coordination, cross-cultural competency training, setting priorities for operations and resources, and developing strategies to resolve challenges that arise during multi-agency response situations. The province also must establish logistical supports, such as the provision of sandbags, sandbag filling machines, tiger dams, and gabions. Response activities also include emergency social support services (ESS), including reception centres, and the provision of food, clothing and lodging that can house and feed evacuees, including cultural safety. ESS also provides information about the crisis, coordinates volunteers, and assists in family reunification. Continued enhancement of emergency response by local governments, First Nations, and the Province is critical for future resilience.

Action 3.4: Enhance pre-disaster recovery planning and post-disaster recovery, including "Build Back Better"

In advance of recovery, the modernized B.C. emergency management legislation will place greater emphasis on community planning. Defining community-based flood recovery blueprints before a flood disaster occurs is critical to improve the balance between reactive and proactive approaches. By doing so, opportunities to integrate "Build Back Better" principles into post-disaster recovery can be articulated, while also integrating climate change adaptation opportunities. Creating space for these discussions prior to a crisis allows for more fulsome engagement on options, costs and benefits, and plays a critical role to guide timely, effective recovery decisions in the future. These plans should include considerations of environmental issues, place-making, community values, community-led retreat, and future land use planning and zoning within risk areas during the process of community-based planning and visioning.

Program Area 4: Investing for Flood Resilience

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

Since 2015, most flood resilience investments in B.C. have been tailored to federal funding programs such as the National Disaster Mitigation Program (NDMP). The province must continue working with the federal government to secure additional funding, as every $1 of public investment in flood mitigation tends to avoid $7-$10 in damage and recovery costs. [23] Natural, green infrastructure approaches to combat increasing flood risks in Canada remain underutilized and need to be scaled up [23]. Building a more flood-resilient B.C. will require further investments not only from senior governments, but also by landowners, individuals, and industry.

These investments must be distributed wisely, to achieve "balance" across several dimensions as shown below:

Current funding models must be reimagined – particularly with respect to Indigenous communities. Improvements are needed to better coordinate funding opportunities at regional, watershed-based scales, while integrating local community needs. Funding distributed directly to local communities, and with longer-term planning horizons in mind will help build capacity over time to plan, collect data, establish relationships, and prioritize and lead actions locally.

"Build back better" refers to rebuilding communities and systems stronger, faster, and more inclusively after a disaster, and is a key principle of the UN Sendai Framework.

Action 4.1: Enhance investments in flood avoidance

Flood avoidance refers to approaches to prevent new building in flood hazard areas, often with open spaces and ecological infrastructure approaches (Figure 7). These types of investments allow room for rivers to expand and contract with natural flood cycles and channel migration over time. It also allows for natural water storage in undeveloped floodplains and wetlands, acting as a safety release valve during major flood events to help protect areas downstream. Tools to achieve this include: zoning restrictions on floodplain developments in local government bylaws, acquisition of private lands, or tradeable transfer of development credits. In the past, federal funding programs often excluded land acquisition from eligibility, which has posed barriers to pursue these options more at local levels. Future funding programs should ideally be designed to help support flood avoidance concepts, pilots, and innovative approaches to enhance resilience while promoting environmental stewardship and deterring new flood exposure.

Figure 7. Illustration of Flood Avoidance (natural floodplain)

Action 4.2: Enhance investments in flood accommodation

Flood accommodation allows flooding to occur periodically in developed or agricultural areas, with measures taken to limit, mitigate, or reduce vulnerability to flood damage with appropriate investments made in proportion to the risks (Figure 8). Approaches include grading subdivisions above flood construction levels, elevating living spaces in homes, investing in backwater valves and sump pumps, as well as private flood damage insurance. It also includes having people learn to "live with their feet wet" during floods, by, for example, leaving basements undeveloped or avoiding the storage of valuables in low-lying areas subject to flooding.

Options to enhance flood accommodation investment programs to better reflect modern priorities include:

- Expand existing funding programs to support flood accommodation measures, particularly where communities have no means to relocate. This is an issue in particular for some First Nations communities and mobile home parks. Funding streams should add flexibility to allow support for grant programs to retrofit in order to elevate living spaces above Flood Construction Levels while remaining in the floodplain.
- Upgrade funding programs to include accommodation measures specifically related to tsunamis (e.g., vertical evacuation towers or evacuation routes to higher ground) to save lives.
- Incentivise homeowners and businesses in high-risk areas to floodproof their buildings, potentially through rebate programs.
- Expanded flood insurance coverage.

Figure 8. Illustration of Flood Accommodation (raised grades)

Action 4.3: Enhance investments in flood protection

Flood protection involves building and upgrading structures that hold back flood waters or prevent erosion or flood damage. Dikes, floodwalls, diversion structures, erosion protection structures, debris traps, stormwater ponds, as well as some dams, reservoirs, and spillways all fall into this category. Protection has often been a preferred approach in B.C., particularly where high-value land uses and settlements are vulnerable to flood risks. These approaches can fail, however, under extreme flood scenarios, and can never offer full protection, and are generally not environmentally friendly approaches. It is expected that the use of flood protection as a preferred approach will decrease further during the 21st century, except in circumstances where critical infrastructure, large numbers of people, or vulnerable facilities are present.

Options to enhance flood protection investments to better reflect modern priorities include:

- Seek co-benefits for flood protection investments with fish habitat restoration, agricultural land protection, reconciliation with Indigenous peoples, and rural economic development.
- Emphasize green infrastructure as a preferred option in structural mitigation funding guides, to incentivize the design and construction of environmentally friendly flood protection works where suitable, such as bioengineered erosion control structures (e.g., timber crib walls, live stakes), and other green flood protection structures such as green shores, foreshore nourishment, engineered wetlands, living dikes, or fish-friendly pumps.
- Ensure archaeological resources and sites of Indigenous cultural significance are identified and protected, in partnership with First Nations and Métis, early on in the planning and design process for any flood protection infrastructure.
- Incentivize enhanced pumping capacity and back-up power generation at pump stations behind dikes, particularly where critical infrastructure is present.
- Consider new funding programs for more regular, proactive maintenance and inspection of dikes by local authorities and/or regional task forces.
- Conduct more post-flood infrastructure and riverbank inspections, to address deficiencies while leveraging local knowledge and science.

Figure 9. Flood Protection

B.C. Provincial staff are participating in Public Safety Canada's Task Force on Flood Insurance and Relocation examining options to protect homeowners with inadequate flood insurance.

Action 4.4: Enhance investments in community-led retreat

This involves the purposeful movement of people and infrastructure out of known high-risk floodplains. Often called "Managed Retreat"[24] or "buyouts", this can be achieved through fee simple purchase, land swaps, or expropriation. In some cases, redistribution of people or infrastructure can occur out of flood hazards altogether, while in some cases it may entail the redistribution of assets out of the highest risk areas (e.g., floodway) into lower risk areas (e.g., flood fringe). Some obstacles typically faced by local governments with these types of initiatives include community opposition, and the lack of cohesive financial and administrative resources or supporting policy, legislation and regulations. Effectively executing such programs over time to maximize success requires close collaboration between all levels of government. Critically, affected communities must support such measures and be involved in leading change to enable success.[25]

Importantly, many First Nations in both coastal and inland areas commented during engagements on ongoing and projected losses of their reserve lands due to coastal sea level rise or river erosion as a major issue. Many First Nations strongly expressed expectations that sooner rather than later, the federal and provincial governments must proactively plan and implement measures to address this loss of land in collaboration with them.

Figure 10. Flood Retreat

"The Sto:Lo worldview is similar to other First Nations – a worldview centred on water bodies – that's what needs to be incorporated into a B.C. Flood Strategy – A First Nations way of thinking for the future."

-Tyrone McNeil, Sto:Lo Tribal Chief

Next Steps + Conclusions

At its' core, governing for flood resilience implies significant shifts in philosophy. Rather than a primary focus on costly yet fallible engineering defences to resist flooding, more balanced approaches to avoid, cope with, prepare, and adapt to flooding will increasingly complement structural approaches. Rather than relying on senior government disaster financial assistance during flood recovery, more balanced approaches will include a greater role for risk transfer, flood insurance, and private investments in flood resilience initiatives. Rather than seeking to predict and control changes, we will enhance community capacity to anticipate uncertainties and adapt to change. Rather than focus on static norms and rigid, hazard-based standards, increasingly, strategic alternatives and pathways to adapt to flooding within our watersheds will be explored. Rather than a focus on Western science, increasingly, Indigenous ways of knowing and seeing will complement and strengthen our governance systems.

All levels of government have critical and distinct roles to play in strengthening B.C.'s flood resilience over time. Critical provincial coordination roles to strengthen over time include: setting clear high-level strategy and policy direction, linking higher and local scales of governance at a watershed-based scale, adopting technical standards as well as enabling legislation and regulations.

Once robust engagement on this Intentions Paper is complete, all feedback will be considered carefully prior to creating and releasing a B.C. Flood Strategy.

The Flood Strategy aims to clearly articulate why new directions for the province are needed and how that can be achieved over time. Subsequent program planning will need to better answer questions such as when (phasing/timing of specific commitments), who (clarifications to roles and responsibilities), where (locations for pilots and investments), and how much (funding amounts government is willing to dedicate to building flood resilience). Importantly, implementation planning must also commit to what performance indicators, metrics, and targets will be monitored, measured, and tracked at the provincial scale to ensure accountability. These are likely to include flood-related fatalities, flood-related economic losses in relation to GDP, and floodplain and river ecosystem indicators such as salmon habitat. It is envisioned that implementation planning will continue to be based on the 'golden threads' of the four program priorities of the UN Sendai Framework for Disaster Risk Reduction, complemented by a watershed ecosystem-based lens.

Full implementation of all actions will be phased over time. Implementation will need the appropriate balance between regulation, guidance, and funding, and include performance monitoring. Once final and approved, the B.C. Flood Strategy is intended to be reviewed every 10 years, as part of an adaptive management cycle and continuous improvement.

By shifting to more proactive measures in collaboration with partners, we will be better prepared to reduce the number of people impacted by flooding, while securing future growth and prosperity, avoiding cultural asset destruction, and improving our shared environments for the benefit of all. This Strategy will be future-focused and will meet current government mandates to: support communities to prepare for climate impacts; future-proof our province-wide ability to respond to flood crises; protect land and water; and invest in the infrastructure of tomorrow.

Call to Action

It is important that we hear from you:
BCFloodStrategy@gov.bc.ca

Together, we will define B.C.'s flood resilient future, then act accordingly to make that vision a reality. Thank you in advance for your feedback–it is highly valued and appreciated.

Endnotes

1 Insurance Bureau of Canada. 2019. Combatting Canada's Rising Flood Costs: Natural infrastructure is an underutilized option

2 City of North Vancouver. Draft North Shore Sea Level Rise Risk Assessment and Adaptive Management Strategy.

3 Canadian Standards Association (draft 2020). CSA W210, Prioritizing Flood Resilience Work in Existing Communities. Khaliq, M.N. 2019. An Inventory of methods for estimating climate change-informed design water levels for floodplain mapping. National Research Council of Canada. Ocean, Coastal, and River Engineering. Report no: NRC-OCRE-2019-Tr-011, 2019t

4 EGBC. 2018. Legislated Flood Assessments in a Changing Climate in BC.

5 Appendix B provides additional events, details, and descriptions

6 Engagement inputs related to flood risks to date have been received from the former Ministry of Forests, Lands, Natural Resource Operations and Rural Development, Ministry of Environment and Climate Change, Emergency Management B.C., and Ministry of Municipal Affairs and Housing

7 Public Safety Canada. 2019. Evaluation of the National Disaster Mitigation Program. Also see: US National Institute of Building Sciences. 2019. Natural Hazard Mitigation Saves.

8 Insurance Bureau of Canada. 2019. Also see: Insurance Bureau of Canada et al. 2018. Combatting Canada's Rising Flood Costs: Natural infrastructure is an underutilized option.

10 UNDRR. 2021. What is the Sendai Framework?. [online]. https://www.undrr.

org/implementing-sendai-framework/what-sendai-framework

11 Office of the Auditor General of British Columbia, (n.d.). Public Sector

Governance - A Guide to the Principles of Good Practice.

12 The Government of British Columbia, 2016. British Columbia Emergency

Management System.

13 Sayers et al. (2014). Strategic flood management: ten 'golden rules' to guide a sound approach. International Journal of River Basin Management. 13(2): 137-151.

14 The draft priority program areas and key actions are based on the engagement and research results to date, and international and national best practices, including the UN Sendai Framework for Disaster Risk Reduction, as well as consulting reports received in 2020 under the ongoing FBC-managed "Investigations in Support of Flood Strategies in British Columbia" projects.

15 Including LiDAR elevation data acquisition and hydrometric monitoring data

16 Ebbwater Consulting Inc. 2020. DRAFT Fraser Basin Council Investigations in Support of Flood Strategies in British Columbia: Issue B-3: Flood Risk Assessment.

17 Kerr Wood Leidal Consulting Inc. and Ebbwater Consulting Inc. 2020. B.C.'s Orphaned Flood Protection Structures.

18 Alberta's Flood Risk Management Guidelines (2017) indicate different risk thresholds for various public facilities e.g., 0.1% AEP flood level for hospitals + extended care facilities.

19 Examples include: CSA W204 (Flood resilient design of new residential communities), CSA W210 (Prioritizing flood resilience work in existing residential communities), CSA W211 (Management Standard for Stormwater Systems), and CSA Z800 (Guideline on basement flood protection and risk reduction).

20 Global Commission on Adaptation. 2019. Adapt now: a global call for leadership on climate resilience - Global Center on Adaptation (gca.org)

21 A local Integrated Flood Management Plan addressing all components of flood risk reduction should be nested above local emergency response plans

22 Public Safety Canada. 2019. Evaluation of the National Disaster Mitigation Program. Also see: US National Institute of Building Sciences. 2019. Natural Hazard Mitigation Saves.

23 Insurance Bureau of Canada. 2018. Combatting Canada's Rising Flood Costs: Natural infrastructure is an underutilized option.

24 Freudenberg, R., Calvin, E., Tolkoff, L. Brawley, D. 2016. Buy-in for Buyouts: The Case for Managed Retreat from Flood Zones. Lincoln Institute of Land Policy.

25 Thistlethwaite, Jason, Daniel Henstra, and Anna Ziolecki. 2020. Managed Retreat from High-Risk Flood Areas: Design Considerations for Effective Property Buyout Programs. Centre for International Governance Innovation Policy Brief No. 158. April 28, 2020.