NON-STRUCTURAL FLOOD MITIGATION

Resource Guide

Final

FALL 2021

Regional District of Central Okanagan

Central Okanagan FLOOD MITIGATION PLANNING

ACKNOWLEDGEMENTS

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This project has taken place on the unceded traditional territories of the Syilx people.

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Introduction

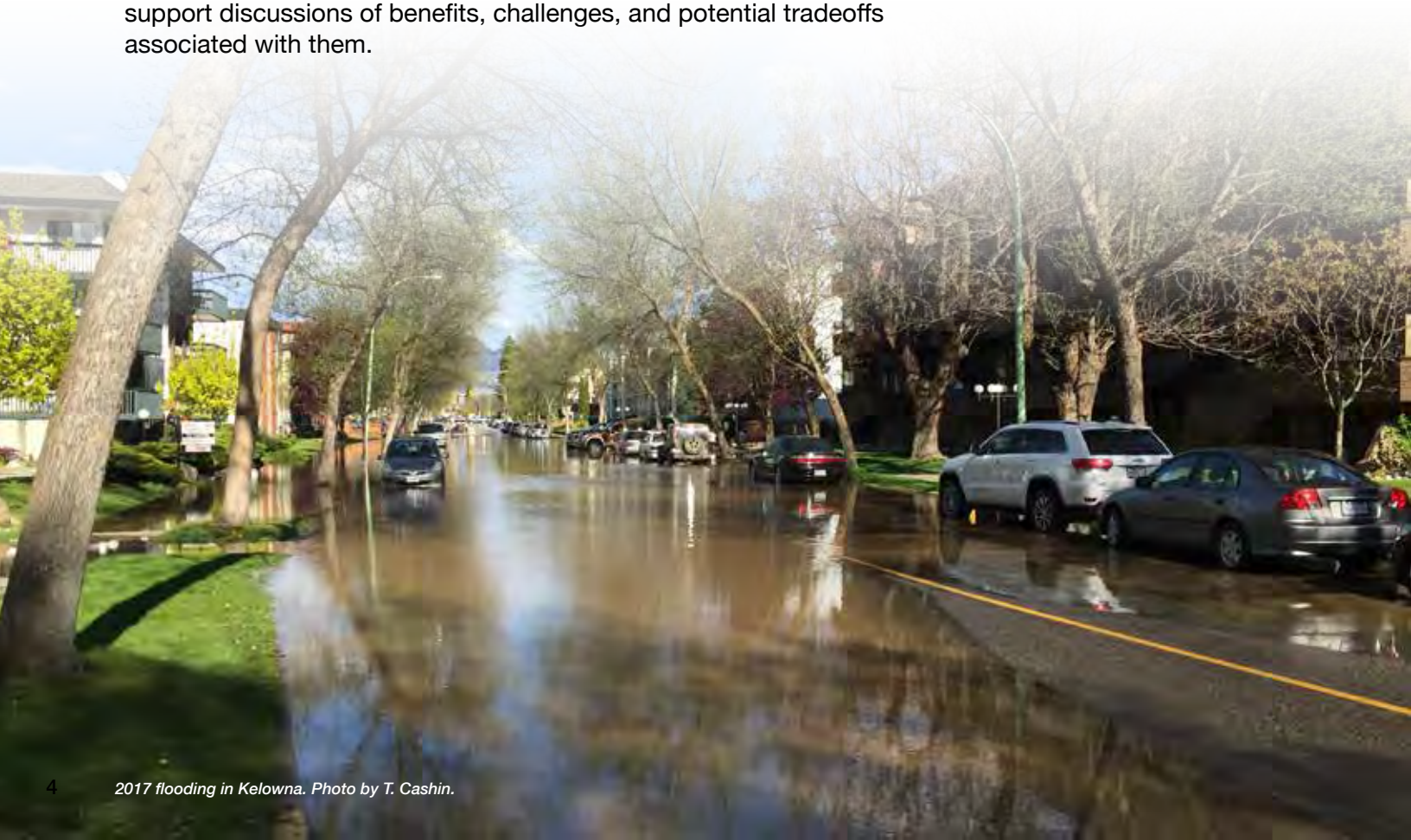
Flood is a natural and regular process that has shaped the physical geography of the Okanagan Valley since time immemorial. With more people and development in the region, these floodwaters now cause more damage and devastation, most recently in 2017 when high lake levels caused widespread flooding along the shorelines in the region, and in 2018 when the lake and creeks spilled their banks onto adjacent floodplains.

For the last century, flood risk has been primarily managed using large structural engineering works such as the Okanagan Lake Dam, and dikes along creeks and rivers. With climate change and increasing development pressures, these hazard reduction measures are being tested to their limits.

With recognition that existing structural mitigation has limits and that alternative measures will be needed to mitigate flood damages in the future, the Regional District of Central Okanagan (RDCO) has worked with partners and stakeholders to better understand the potential to implement non-structural flood mitigation options in the region. This resource guide outlines a 'toolbox' of options that could be applied within the Central Okanagan and is intended to support discussions of benefits, challenges, and potential tradeoffs associated with them.

NON-STRUCTURAL FLOOD MITIGATION

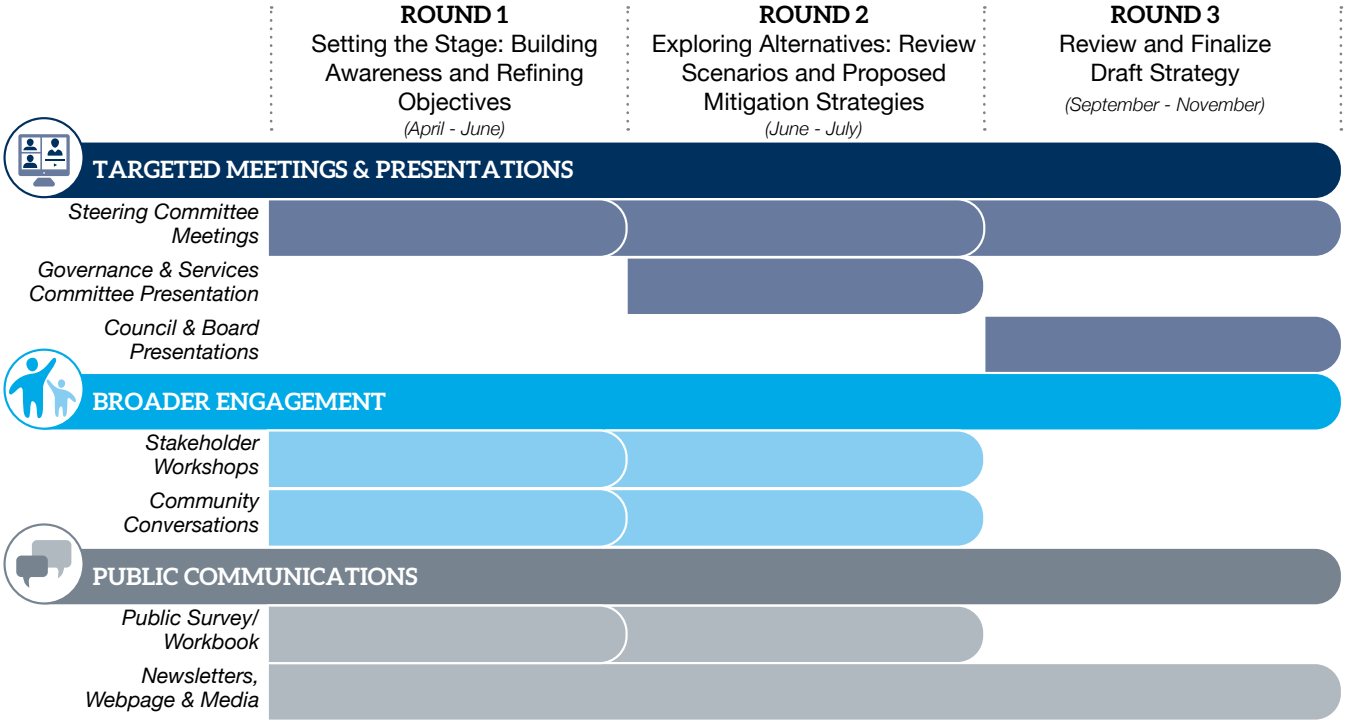
Flood mitigation can be achieved through a wide variety of actions. The broad toolbox of actions that are NOT large, engineered structures (e.g., dikes and dams) are collectively called non-structural flood mitigation options.



2017 flooding in Kelowna. Photo by T. Cashin.

About This Project

This project took place between January and November of 2021 and included three main rounds of engagement. Led by the RDCO and with the support of a Steering Committee, this project included outreach across the Okanagan Valley with local governments, First Nation governments, stakeholders, and the public.



In the first round of engagement, participants were invited to learn about flood risk and resilience, share their insights into the impacts of flooding in the region, and provide input on values and preferred options. Based on these sessions, the project team developed a set of criteria that was used to assess possible flood mitigation options. In the second round, participants considered which suites of options might best address specific place-based examples of flood risk in the Okanagan Valley and what issues might best be addressed at a regional level.

This resource guide informs local and First Nation governments on (1) decision-making about regional flood risks and hazards and (2) the range of non-structural flood mitigation actions available. It is accompanied by a Technical Report that was developed for the RDCO that contains additional information to support implementation of non-structural flood mitigation options.

PRINCIPLES

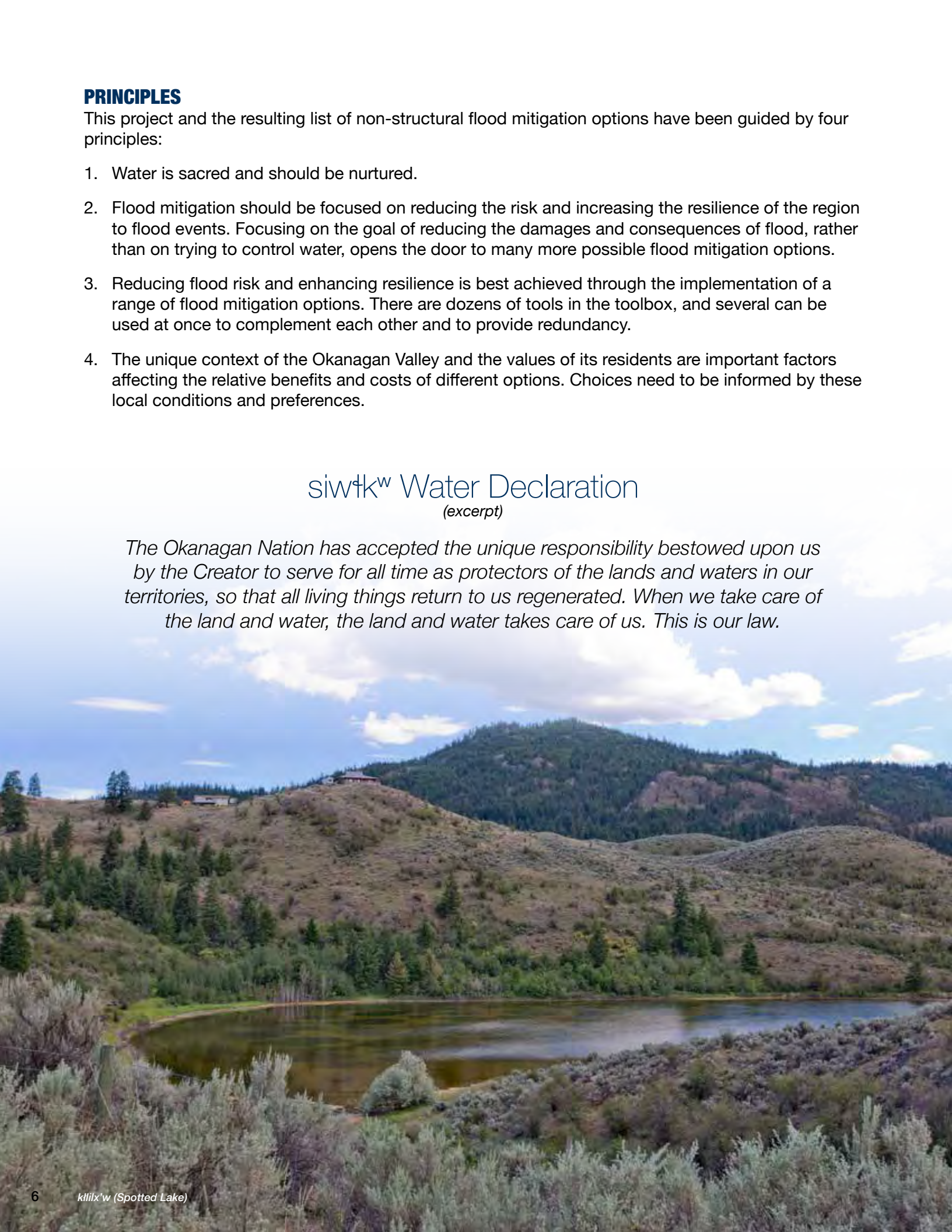
This project and the resulting list of non-structural flood mitigation options have been guided by four principles:

1. Water is sacred and should be nurtured.
2. Flood mitigation should be focused on reducing the risk and increasing the resilience of the region to flood events. Focusing on the goal of reducing the damages and consequences of flood, rather than on trying to control water, opens the door to many more possible flood mitigation options.
3. Reducing flood risk and enhancing resilience is best achieved through the implementation of a range of flood mitigation options. There are dozens of tools in the toolbox, and several can be used at once to complement each other and to provide redundancy.
4. The unique context of the Okanagan Valley and the values of its residents are important factors affecting the relative benefits and costs of different options. Choices need to be informed by these local conditions and preferences.

siwɬkʷ Water Declaration

(excerpt)

The Okanagan Nation has accepted the unique responsibility bestowed upon us by the Creator to serve for all time as protectors of the lands and waters in our territories, so that all living things return to us regenerated. When we take care of the land and water, the land and water takes care of us. This is our law.



kɬilx̓w (Spotted Lake)

How to Use This Guide

This Resource Guide is a go-to reference to support decision-making by local governments and First Nation governments who are considering non-structural flood mitigation in the Central Okanagan region. Given the range of possible locations, priorities, and conditions across this area, this Guide has been developed as a "toolbox", profiling a range of possible non-structural flood mitigation options together with accompanying information that can be used to assess their suitability to a particular context.

Icons and colours are used intentionally throughout the document to help you to navigate more easily through layers of information. For easy reference, you can skip to the following pages to find icons and legends describing:

- Flood types and severity – *page 8*
- Types of Non-Structural Flood Mitigation Approaches – *page 10*
- Criteria for choosing between flood mitigation options – *page 13*

The final section of the Resource Guide provides in-depth information on forty separate non-structural mitigation Options, organized into six Approaches. To help you make the most of these profiles, we have included a "Navigating the Options" section *(page 20)* that provides a quick visual reference guide to the range of information in each profile, and how to interpret it.

Flood in the Central Okanagan

Not all floods are created equal. When planning for flood mitigation, it is important to first understand the different types of floods we are facing today and will continue to face in the decades to come.

The Central Okanagan faces four main kinds of flood and flood-related hazards.

Coastal (lake) flooding. Occurs when lake levels reach higher-than-normal levels and cause flooding along the shoreline. This can be either a result of total water volumes on the watershed being high, or because of storm conditions that push water and waves onshore.

River and creek (riverine) flooding. This type of flooding can include:

a. Clearwater flood, which is when high volumes of water coming from precipitation or snowmelt exceeds the capacity of rivers or creeks and flows onto adjacent lands.

b. Debris floods and flows, which is when debris (soil, rocks, trees, etc.) are entrained in water coming off steep slopes. Like clearwater floods, when normal channel capacity is exceeded, this flows onto adjacent land. Debris floods and flows are particularly damaging because warning times are short, velocities are high, and the entrained materials become powerful projectiles.

Pluvial flooding. Occurs when heavy precipitation cannot be absorbed into natural or infrastructure systems creating localised ponding.

- **Secondary hazards that result from the first two types of floods. These include erosion (the displacement of soil or rock by water) and avulsion (the sudden change of the course of a river).**

Likelihood and magnitude (the size of a flood, measured in cubic metres per second for creek and river flooding, and in elevation or volume for lake flooding) are two defining characteristics of flood. Frequent but small floods present much different risks than rare and large floods.

Flood depth is a big determinant of how much damage is caused. Nuisance flooding in a basement, for example, is much different from moderate (<30 cm) or severe (>1m) flooding, which can respectively cause significant to sometimes unrecoverable damage. Depth generally, but not always, decreases with distance from the water source.

Nuisance flooding (0-10cm)

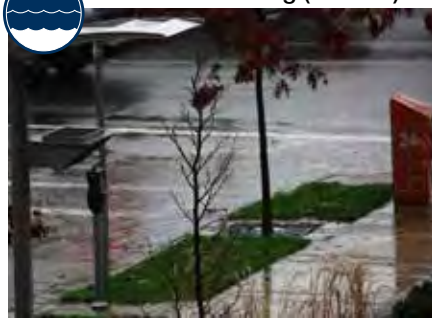


Photo CCby scazon

Moderate flooding (20-40cm)

Photo CCby-sa Indrid Cold

Severe flooding (>100cm)

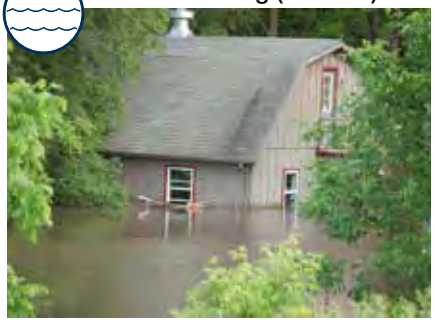


Photo by U.S. Geological Survey

Finally, scale matters for response and recovery. This is based on the spatial scale (how widespread or localized a flood is) and temporal scale (how quickly it happens, when, and how long it lasts).

Beyond understanding the floods we are facing today, it is important to consider how they will change over time and how they interact with other hazards, particularly wildfires. Climate change has been identified as a key force behind recent flooding in BC.[1] Increased fall, winter, and spring precipitation, which will cause more frequent and intense flooding, is projected for the Okanagan.[2] On top of climate change, research indicates that other cumulative pressures (such as wildfires, urban development, and industrial activities) are worsening disasters like flooding.[3]

While it can be daunting to try to plan around so much change and uncertainty, there are some silver linings when it comes to flood. For example, wildlife and waterways can benefit from flooding, and, with creative and thoughtful planning, floodplains can present increased opportunities for parks, natural space, and recreation when not flooding. As such, it is important to consider what is happening in the floodplain outside of flood season, and to focus on options that produce co-benefits.

2017 flooding on Duck (Ellison) Lake. Photo by T. Cashin.

1 Addressing the New Normal: 21st Century Disaster Management in British Columbia. (EMBC 2019). Weblink: https://www.preventionweb.net/publications/view/58245.

2 Climate Projections for the Okanagan Region. February 2020. Weblink: https://regionaldistrict.com/media/279459/OK_Climate_Projections_Report_Final.pdf).

3 Ebbwater Consulting Inc. (2019): Syilx Okanagan Flood and Debris Flow Risk Assessment – Report 1 of 4: Synthesis and Recommendations. Prepared for and with the Okanagan Nation Alliance.

Non-Structural Flood Mitigation Approaches

Rivers and lakes overflowing their banks are not in themselves a problem. It is when floodwaters interact with things we care about on the floodplain and cause damage and negative consequences that we have cause for concern. This project uses the concepts of risk and resilience to support a holistic understanding of flood and the actions that can be taken to mitigate its damages.

As illustrated in the diagram on the right, risk is defined by the total area of a triangle, whose sides are hazard (in this case flood), exposure (the things people, organizations, and stakeholders care about that are exposed to floodwaters), and the vulnerability of these things being damaged by floodwaters.

If we consider risk to be a function of hazard, exposure, and vulnerability, then there are three broad approaches or strategies that can be taken to reduce the risk.

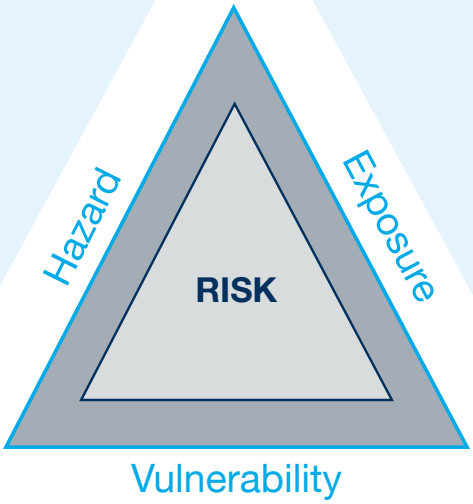
Reducing local flood <u>hazards</u> through land stewardship. This can include maintaining and restoring natural assets and systems (e.g., watersheds, wetlands, riparian areas, natural waterways) to help reduce flooding.

Reducing local <u>exposure</u> to flood hazards through land use management. This can include encouraging or requiring types of land use in flood hazard areas that will prevent or reduce potential damage. For example, a green space would be less affected by flooding than a new subdivision.

Reducing local <u>vulnerability</u> through building management. This can include regulations and strategies that make structures and belongings less susceptible to damage when floods occur. For example, using flood-resistant materials for the ground floor of a building.

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 (United Nations Office for Disaster Risk Reduction).



These approaches can be pursued individually or in combination with one another to minimize damages during a flood.

In addition to risk reduction strategies, activities to increase resilience will benefit communities and reduce the long-term impacts of flood. Resilience strategies are those non-structural flood mitigation options, or groups of options, that can be taken in advance of a flood to ensure a robust and rapid recovery after a flood event. There are three broad strategies that can be applied:

Education and awareness – homeowner guides, flood and climate change education, neighbourhood preparedness programs, and other learning resources.

Emergency response – early warning systems, temporary barriers, and other flood response programs.

Insurance and disaster financial assistance – managing financial risks where no other mitigation strategies are available.

RESILIENCE

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." (United Nations Office for Disaster Risk Reduction).

2017 flooding on Wood Lake. Photo by T. Cashin.

Local and First Nation Government Authority

The implementation of flood mitigation activities needs to be mindful of the governance context. Governance is the regime that creates the authority to act and provides incentives or disincentives for action. In British Columbia, the authority, and other levers for action (e.g., funding, regulation, etc.), is devolved, which means that all levels of government (Federal, Provincial, Local, First Nation, Crown Corporations) play a variety of sometimes overlapping roles. For the purposes of this document, we have focused on local government responsibility and authority, and related non-structural flood mitigation tools. Local governments in BC get their authority from the Province, and include municipalities and regional districts, who each have slightly different roles, responsibilities, and policy tools. For the most part these are guided by the Community Charter [2003] and the Local Government Act [2004]. The Guide is also applicable to First Nation governments, especially those that act under the authority of a Land Code.

KEY MESSAGE #1:
LOCAL GOVERNMENTS HAVE BOUNDARIES TO THEIR AUTHORITY AND RESPONSIBILITY.

Local governments are extremely diverse, from small rural villages with very limited capacity, to large metropolitan centres with significant populations, tax base, and operations. Municipal governments generally have a larger role, more resources, and greater responsibilities than regional districts, who are obligated to consider emergency management, regional solid waste planning, and broader governance for electoral areas. In general, local governments, especially municipalities, have a lot of authority and responsibility for flood management because they are the lead agencies for land use planning (and therefore exposure to flood hazard), can modify and enhance building regulations (i.e., vulnerability), and are the lead agencies for initial emergency response.

Successful flood mitigation actions require that successive or parallel processes be completed. For example, legislation and regulation that set the legal framework, guidance documents which provide interpretation of the regulations, funding programs that incentivize or disincentivize activities and monitoring and enforcement of activities. Actions that local governments can take for each of these steps are outlined in this document.

KEY MESSAGE #2:
THERE ARE MANY STEPS TO THE IMPLEMENTATION OF FLOOD MITIGATION ACTIVITIES.

In many cases there are dependencies between activities. For example, property level building controls require local government building bylaws, potentially updates to provincial and federal building codes, guidelines, and financing to incentivize the activity, as well as enforcement to ensure success.

Choosing Between Flood Mitigation Options

Flood is a complex problem that creates diverse and cascading impacts. People may be evacuated from their homes and deal with stress and anxiety when they return to damage in their communities. In rare cases, people may lose their lives during large magnitude or sudden flood events. Floods damage the environment when contaminated waters cover valuable habitats or when riparian areas are severely eroded. Floods also cause both short- and long-term financial impacts when structures are damaged, businesses disrupted, and significant emergency and recovery services are deployed. These are just some of the many impacts associated with a flood event.

Fortunately, there are many flood mitigation options available. The challenge is for local governments and stakeholders to choose the best available option or group of options given the unique characteristics of a given area, and the available (and usually limited) resources. To help governments, partners and stakeholders understand the tradeoffs between various flood mitigation options and identify preferred options, a series of criteria were developed with the support of partners and stakeholders in the Okanagan Valley. These were used to assess the options presented later in this document.

The criteria listed in this first table are used to assess the effectiveness of a given flood mitigation option in its ability to reduce risk across a range of values (e.g., people, environment, culture) and to enhance resilience during a flood event.

CRITERIA (OBJECTIVE)		
Risk Reduction Criteria	**People**	Reduce risks to health and safety of people
	Structures	Reduce damage to structures
	Disruption	Minimize disruption of services and mobility (e.g., electricity, gas, communications)
	Economy	Minimize damage to local economy including agriculture and tourism
Resilience Criteria	**Emergency Response**	Increase the effectiveness of response
	Climate	Increase adaptability of option to multiple climate futures

RISK & RESILIENCE SCALE

Ineffective

Moderately effective

Highly effective

CAUTION

The scoring of many criteria is subjective, and would also be dependent on local conditions. The scores used throughout this guide are meant to be indicative, and to the relative differences and tradeoffs between mitigation options.

Given that flooding only occurs rarely, it is also important to consider how an individual mitigation action functions on a day-to-day basis. Some actions can bring positive co-benefits to a community. For example, the restoration of wetlands for flood control also brings with it benefits related to ecological health and recreation. Whereas some options will have a negative impact on some aspects of daily life. For example, building regulations that require first floors to be elevated may cause problems of accessibility for some community members. The criteria in this second table are used to assess the range of impacts an option may have at times when a flood event is not occurring. These impacts can be either negative (the option makes this objective worse) or positive (the option makes this objective better).

CRITERIA (OBJECTIVE)		
Externalities *(negative and/or positive)*	**Community**	Housing
		Social connectedness and supports
	Environment	Habitat health (aquatic, wetland, and riparian) and water quality
	Culture	Recreation and outdoor lifestyle
Implementation Opportunities and Obstacles	**Obstacles**	Regulatory
		Political and public will
	Cost	Implementation cost
		Maintenance cost

EXTERNALITIES SCALE

Very negative
Negative
Neutral
Positive
Very positive

OPPORTUNITIES & OBSTACLES SCALE

Very challenging
Moderately challenging
Relatively easy

COST SCALE

$ - 10,000s
$$ - 100,000s
$$$ - 1,000,000s

The final set of criteria relate to the implementability of an option. For example, *Is this option prohibitively expensive? Are there existing regulations that would impede the implementation of this option?*

Taking Action as a Region

Flood knows no boundaries – it is a shared risk that is best mitigated by working regionally and across jurisdictions to coordinate action and mobilize the necessary resources to effectively address this issue. Stakeholders and partners from across the Central Okanagan took part in shaping this Resource Guide and expressed a strong desire to continue to work together on flood and disaster resilience, for the good of everyone across the region.

While much of the work to plan, make decisions, and implement non-structural flood mitigation will be carried out separately by many actors across the region, there are also a suite of actions needed at a regional level to enable and support those distributed actions and to reduce the potential for working at cross-purposes. The following recommendations – generated through the engagement process and reviewed by the Steering Committee – aim to enhance success through a more consistent and coordinated approach at a regional level.

PROVIDE COORDINATION AND LEADERSHIP FOR A REGION-WIDE APPROACH

RECOMMENDATION 1: FORMALLY ESTABLISH A COLLABORATIVE WORKING GROUP

To ensure this work is coordinated and maintains momentum, it is recommended that a collaborative group be established and supported by a regional coordinator and formal commitment by group members. This could include:

- Establishing a Memorandum of Understanding to work collaboratively as a region.
- Initiate this at the Regional District level and extend to member local governments, other decision-makers, rights and title holders, and stakeholders.
- Developing a Terms of Reference for the resulting collaborative group.

At the outset, this group would work to establish a baseline of shared goals and shared understanding of flood risk & resilience, while advancing some of the “quick start” actions below. Other recommendations for this group would be to:

- Advance this work through the RDCO’s Regional Planning Lab.
- Continue to build capacity for Government-to-Government relationships and decision-making.
- Support ongoing learning within and across the group.
- Build on existing work and capacity in the region, including the work of the OBWB, ongoing flood adaptation work being led by the ONA, and the Okanagan Lake Responsibility Strategy.
- Consider a multi-hazard approach.
- This group could play an important role in relaying local and regional concerns to senior levels of government, as well as providing a coordinated way to access funding and other resources and enable implementation.

QUICK START ACTIONS FOR THE REGION

RECOMMENDATION 2: ADVANCE FLOOD MAPPING AND DISCLOSURE

Most of the risk reduction and resilience actions presented in this guide are dependent on having high quality flood hazard mapping developed and publicly available. In recent years, the region has made a concerted effort to improve mapping coverage, especially on the mainstem lakes. There is however a need to improve coverage on the many creeks and rivers, and to enhance mapping to include pluvial hazards and secondary erosion and avulsion hazards. The public disclosure of this information is imperative to enable flood policies and actions.

- *See Option 6. Land Use Controls to Limit All Development, page 32*
- *See Option 7. Land Use Controls to Limit High Consequence Development, page 34*
- *See Option 27. Covenant on Title, page 74*
- *See Option 28. Public and Accessible Flood Mapping, page 76*

RECOMMENDATION 3: EDUCATE THE PUBLIC, STAKEHOLDERS AND MEDIA.

Floods are complex, and the actions to mitigate flood damages require consideration of tradeoffs. Some actions are financially costly, while others will require significant changes to present-day land uses and neighbourhood structures. To build momentum to make significant shifts in the future, it is important to educate and engage the public, stakeholders, and the media on the complexities of flood and flood mitigation actions.

- *See Option 29. Public Education (Multi-media), page 78*

RECOMMENDATION 4: CREATE POLICY CONSISTENCY AND AVOID INCREASING EXPOSURE

Currently, there is significant flood risk in the Okanagan Valley, which will increase with time as climate change creates greater hazards. However, local and First Nation governments have the authority to avoid and prevent increasing exposure and vulnerability, particularly through land use controls. Establishing policy consistency across the region was one of the strongest recommendations emerging from engagement. The intention is to create clearer expectations and to support more effective implementation of land use and building management strategies, including Retreat, Avoid and Redistribute. This can be advanced through individual leadership by municipalities (establishing a precedent that others can follow) and by enabling individual actions through development of template policies and bylaws. In relation to this, individual local or First Nation governments may also wish to explore ways to establish mechanisms for funding property buy-outs if this is a desired direction.

- *See Option 6. Land Use Controls to Limit All Development, page 32*

IN THE LONGER TERM...

RECOMMENDATION 5: IMPLEMENT A WATERSHED AND NATURAL ASSETS STRATEGY

Through the engagement process, it was well recognized that flood is a regional and landscape level phenomenon that crosses jurisdictional boundaries. Building on existing work and collaboration by various groups in the region, this area of focus could incorporate:

- Protection of upper watersheds
- Restore natural assets (e.g. constructed wetlands)
- Planning and managing at a broader scale
- Restoring an ecosystem approach
- Working in partnership to align with Syilx approaches and priorities

- *See Option 1. Protection of Upper Watersheds, page 22*

Options Overview

While flood risk is complex, the good news is that there is a wide range of possible non-structural flood mitigation options that can be applied to your particular context. The remaining section of the Resource Guide presents detailed information on forty different non-structural flood mitigation options, to help you discern which combination or "suite" of options will allow you to best reduce flood risk, build resilience and meet the particularities of your context. These options can be considered as part of a "toolbox" of possibilities that can be drawn on in different ways over time, to best meet your particular needs, concerns, and opportunities.

We have used the terms "Approach", "Strategy", and "Option" to organize and group ideas to see how they differ one from another, and so that it is easy to consider alternatives. In this Guide, these are defined as:

- **Approach –** an overarching category of non-structural flood mitigation strategies, based on whether it acts to reduce hazard, exposure or vulnerability, or increase resilience. There are six overarching Approaches in this Guide, summarized in the tables directly below. Each Approach is assigned a colour, to help with navigating through the Option profiles that follow.
- **Strategy –** a category of Options with a shared intention or objective. Within each Approach, there are multiple strategies. For example, under the Approach "Emergency Response," there are three strategies: "Monitoring and Warning", "Flood Response Planning", and "Neighbourhood Resilience Building".
- **Option –** specific actions that can be taken to fulfill the intention of a given Strategy. For example, within "Flood Response Planning", specific Options include "Flood Response Plan","Flood Response Plan Maintenance", "Flood Response Training", and "Flood Response Resources".

LAND STEWARDSHIP

Maintaining and restoring natural assets and systems (e.g., watersheds, wetlands, riparian areas, natural waterways) to help reduce flooding.

STRATEGY	RATIONALE	OPTION
Maintain natural assets	It is well documented that natural systems are extremely effective at managing the natural hydrologic cycles. Protecting and maintaining existing natural assets (e.g., natural vegetation and wetlands in upper watersheds, riparian areas, natural coastlines) will maintain the hazard profile going forward. Current practices (e.g., land development, hardening of riverine and coastal edges) generally increase hazard.	1. Protection of Upper Watersheds 2. Protection of Lower Watersheds 3. Protection of Riparian Areas and Lakeshores
Restore natural assets	Recognizing that many natural systems, which would historically have reduced flood hazards, have been damaged by human activity, it is known that in some cases restoring ecological function will reduce risk over time.	4. Constructed Wetlands 5. Dike Setbacks or Removals. Daylighting of Creeks

LAND USE MANAGEMENT

Encouraging or requiring types of land use in flood hazard areas that will prevent or reduce potential damage.

STRATEGY	RATIONALE	OPTION
Avoid	The surest means of limiting risk is to have no exposure to flood hazard. This is ideally managed by avoiding development in hazard areas in the first place.	6. Land Use Controls to Limit All Development
		7. Land Use Controls to Limit High Consequence Development
		8. Acquisition – Undeveloped Land
Retreat	For currently developed areas, managed or strategic retreat is another way to eliminate exposure to flood hazard. This might be total or partial retreat.	9. Acquisition – Post-disaster buyouts
		10. Acquisition – Developed Land (Pre-disaster)
		11. Life-Rights Agreements (Acquisition over time)
		12. Relocation – Property
		13. Relocation – Infrastructure
Redistribute	Another way of approaching exposure reduction is to consider the redistribution of assets across hazard areas. For example, removing highly vulnerable elements from flood hazard areas, or reducing density in highest hazard areas (i.e., floodway), and increasing density in flood fringes or outside the flood hazard area altogether.	14. Transfer of Development Potential
		15. Rolling Easements
		16. Density Redistribution
		17. Right to Flood

BUILDING MANAGEMENT

Regulations and strategies that make structures and belongings less susceptible to flood damage.

STRATEGY	RATIONALE	OPTION
Building Controls for New Builds	With flood hazard areas on the rise, and increasing development pressures, it is not always possible to sterilize land use within flood hazard areas. Changing the built form so that damages to structures are limited, or more easily recoverable is an effective means of reducing risk. This can be relatively easily achieved for new construction.	18. Elevate Structures (New Builds)
		19. Elevate High Consequence Structures (New Builds)
		20. Dry Floodproofing (Permanent)
		21. Dry Floodproofing (Temporary)
		22. Wet Floodproofing (New Builds)
Retrofitting of Existing Buildings	With flood hazard areas on the rise, and increasing development pressures, it is not always possible to sterilize land use with flood hazard areas. Changing the built form so that damages to structures are limited, or more easily recoverable is an effective means of reducing risk. Retrofitting of structures to limit or reduce damage is possible.	23. Elevate structures (Existing Builds)
		24. Dry Floodproofing (Permanent)
		25. Dry Floodproofing (Temporary)
		26. Wet Floodproofing (Existing and New Builds)

EDUCATION AND AWARENESS

Strategies to educate the public, practitioners, and other stakeholders.

STRATEGY	RATIONALE	OPTION
Acknowledge and Disclose	A precursor to developing land use controls in flood hazard areas is the recognition, acknowledgement and public disclosure of the existence, extents, etc. of the hazard. Disclosure can also support uptake of other risk reduction or resilience measures (e.g., floodproofing, insurance).	27. Covenant on Title
		28. Public and Accessible Flood Mapping
Public Education	Programs to educate the public about flood hazard, vulnerability, and risk as well as the provision of resources that can aid the public in making good decisions about flood-risk reduction.	29. Public Education (Multi-media)
		30. Serious Gaming
		31. Public Art
Media Education	Programs to educate the media, in advance of a flood event to support them to provide correct and useful information.	32. Media Education

EMERGENCY RESPONSE

Strategies that are in place to ensure efficient and effective response when floodwaters are on the ground.

STRATEGY	RATIONALE	OPTION
Monitoring and Warning	Timely response requires that monitoring systems and warning systems are in place so that actions within flood response plans can be triggered.	33. Warning System
Flood Response Planning	Effective response requires that plans and resources are in place in advance of an event occurring.	34. Flood Response Plan
		35. Flood Response Plan Maintenance
		36. Flood Response Training
		37. Flood Response Resources
Neighbourhood Resilience Building	During and after disaster, communities will generally recover more quickly if systems are in place to build communities that care about each other.	38. Neighbourhood Resilience Building

INSURANCE AND DISASTER FINANCIAL ASSISTANCE

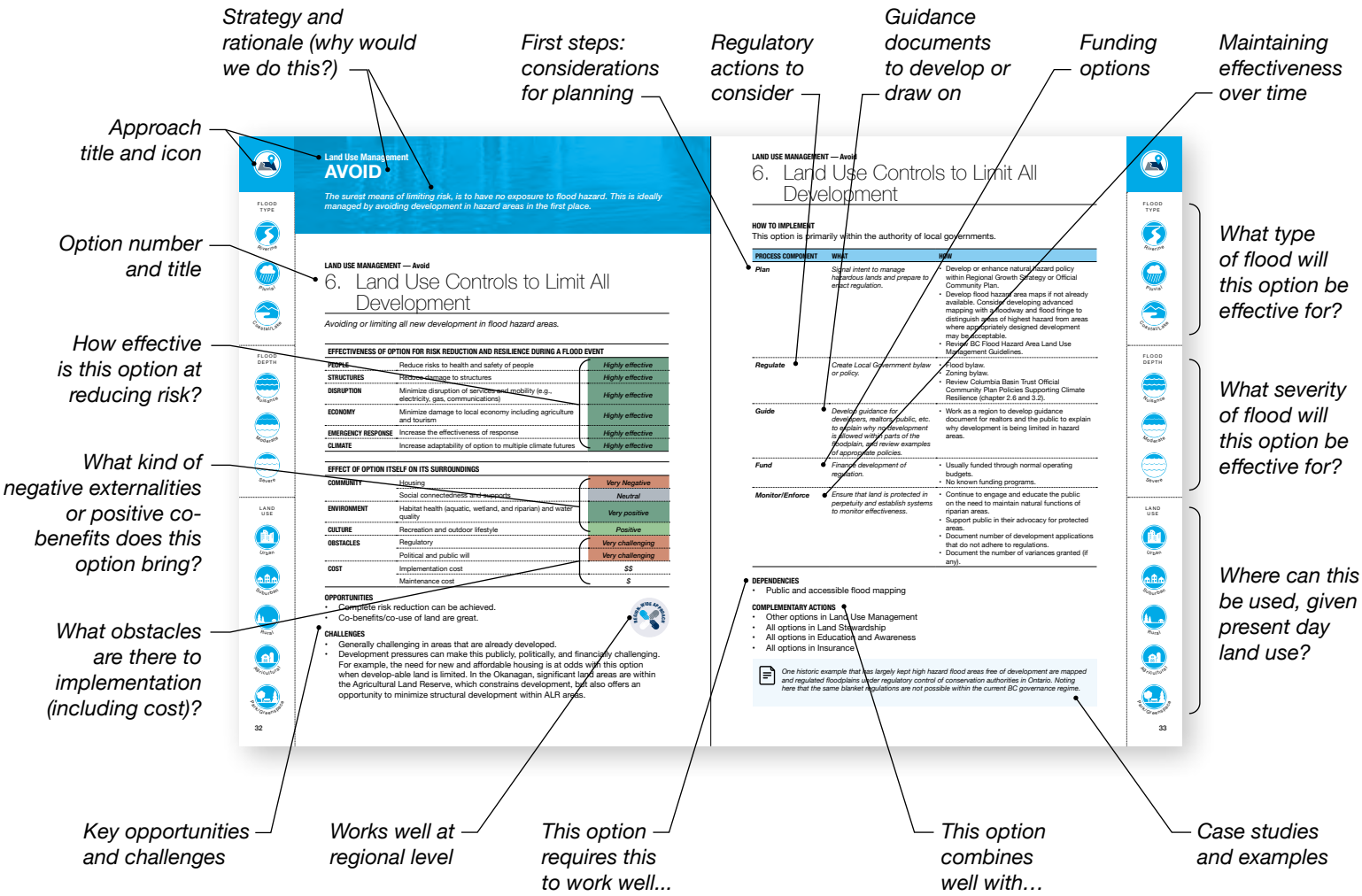
Financial strategies to manage residual risk.

STRATEGY	RATIONALE	OPTION
Insurance	There will always be some residual risk, even when risk reduction measures are in place.	39. Insurance (Private)
		40. Insurance (Public)

NAVIGATING OPTIONS

A navigation guide is provided below so that you can make your way through the many pieces of information contained in each Option profile. The first page of each option provides information to help you in assessing suitability of that option for your context. The second page provides more details to support you in thinking through implementation considerations.

Please note that hyperlinks have intentionally not been included for the additional resources and examples provided, as URLs frequently change. Instead, these resources have been described in ways that should make them easily searchable online.



Non-Structural Flood Mitigation Options

2017 flooding in Kelowna. Photo by T. Cashin.

Land Stewardship

MAINTAIN NATURAL ASSETS

It is well documented that natural systems are extremely effective at managing natural hydrologic cycles. Protecting and maintaining existing natural assets (e.g., natural vegetation and wetlands in upper watersheds, riparian areas, natural coastlines) will maintain the hazard profile going forward. Current practices (e.g., land development, hardening of riverine and coastal edges) generally increase hazard.

FLOOD TYPE

Riverine

Pluvial

Coastal/Lake

FLOOD DEPTH

Nuisance

Moderate

Severe

LAND USE

Urban

Suburban

Rural

Agricultural

Park/Greenspace

LAND STEWARDSHIP — Maintain Natural Assets

1. Protection of Upper Watersheds

Protection of upper watersheds to limit activities that affect the hydrologic regime (e.g., mining, forestry, road construction, etc.).

EFFECTIVENESS OF OPTION FOR RISK REDUCTION AND RESILIENCE DURING A FLOOD EVENT		
PEOPLE	Reduce risks to health and safety of people	*Moderately effective*
STRUCTURES	Reduce damage to structures	*Moderately effective*
DISRUPTION	Minimize disruption of services and mobility (e.g., electricity, gas, communications)	*Moderately effective*
ECONOMY	Minimize damage to local economy including agriculture and tourism	*Moderately effective*
EMERGENCY RESPONSE	Increase the effectiveness of response	*Ineffective*
CLIMATE	Increase adaptability of option to multiple climate futures	*Highly effective*

EFFECT OF OPTION ITSELF ON ITS SURROUNDINGS		
COMMUNITY	Housing	*Neutral*
	Social connectedness and supports	*Neutral*
ENVIRONMENT	Habitat health (aquatic, wetland, and riparian) and water quality	*Very positive*
CULTURE	Recreation and outdoor lifestyle	*Very positive*
OBSTACLES	Regulatory	*Relatively easy*
	Political and public will	*Relatively easy*
COST	Implementation cost	*$$*
	Maintenance cost	*$*

OPPORTUNITIES

- Has many co-benefits related to ecological values, management of other natural hazards (e.g., wildfire).

REGION-WIDE APPROACH

CHALLENGES

- Competing priorities for land use and especially natural resource extraction.

1. Protection of Upper Watersheds

HOW TO IMPLEMENT

This option is within the authority of rural regional districts to support but will require cooperation with senior level government agencies.

PROCESS COMPONENT	WHAT	HOW
Plan	*Signal intent to advocate for protected areas in upper watershed.*	• Develop or enhance conservation policies within Regional Growth Strategy or Official Community Plan. • Conduct a scoping level review to see if there are other regional initiatives to leverage (e.g., ecological conservation initiatives). • Build partnerships with other government authorities and Non-Government Organisations to enable conservation activities.
Regulate	*Limited activities for local governments.*	• Advocate to senior governments on the potential for enhanced watershed protections within provincial regulations.
Guide	*Limited activities for local governments.*	
Fund	*Limited activities for local governments.*	
Monitor/Enforce	*Limited activities for local governments.*	

COMPLEMENTARY ACTIONS

- Other options in Land Stewardship
- All options in Land Use Management
- All options in Education and Awareness
- All options in Insurance

2. Protection of Lower Watersheds

Protection of greenspaces within the lower (often urban) watershed to support infiltration and natural ecological function to "slow the flow" and decrease the damage potential of floodwaters.

FLOOD TYPE

FLOOD DEPTH

LAND USE

EFFECTIVENESS OF OPTION FOR RISK REDUCTION AND RESILIENCE DURING A FLOOD EVENT		
PEOPLE	Reduce risks to health and safety of people	*Moderately effective*
STRUCTURES	Reduce damage to structures	*Moderately effective*
DISRUPTION	Minimize disruption of services and mobility (e.g., electricity, gas, communications)	*Moderately effective*
ECONOMY	Minimize damage to local economy including agriculture and tourism	*Moderately effective*
EMERGENCY RESPONSE	Increase the effectiveness of response	*Ineffective*
CLIMATE	Increase adaptability of option to multiple climate futures	*Highly effective*

EFFECT OF OPTION ITSELF ON ITS SURROUNDINGS		
COMMUNITY	Housing	*Negative*
	Social connectedness and supports	*Positive*
ENVIRONMENT	Habitat health (aquatic, wetland, and riparian) and water quality	*Very positive*
CULTURE	Recreation and outdoor lifestyle	*Very positive*
OBSTACLES	Regulatory	*Moderately challenging*
	Political and public will	*Relatively easy*
COST	Implementation cost	*$$*
	Maintenance cost	*$*

OPPORTUNITIES

- This is a well-known well researched option with existing enabling regulations (e.g., Integrated Storm Water Management Plans), many of which include natural assets as well as infrastructure assets.

CHALLENGES

- Can be challenging when areas are urbanised and face development pressures.

2. Protection of Lower Watersheds

HOW TO IMPLEMENT

This option is primarily within the authority of local governments.

PROCESS COMPONENT	WHAT	HOW
Plan	*Signal intent to advocate for natural function policies.*	• Develop or enhance policies within Regional Growth Strategy or Official Community Plan. For example, by requiring that "all new subdivision developments shall require a stormwater management plan and that all stormwater is to be contained on site". • Develop or enhance policies within Liquid Waste Management Plans.
Regulate	*Create regulations to improve stormwater management.*	• Develop Stormwater Bylaws under Section 8 of the Community Charter.
Guide	*There are well established guiding documents that can be used.*	• Review Stormwater Planning Guidebook for BC. • Review International Guidelines on Natural and Nature-Based Features for Flood Risk Management.
Fund	*Local governments can fund activities through internal revenues and look to senior government granting programs.*	• Infrastructure Planning Grant Program.
Monitor/Enforce	*Local governments should consider how to enforce and monitor the effectiveness of any protected greenspace.*	

COMPLEMENTARY ACTIONS

- Other options in Land Stewardship
- All options in Land Use Management
- All options in Education and Awareness
- All options in Insurance

West Kelowna Stormwater Best Management Practices

FLOOD TYPE

Riverine

Pluvial

Coastal/Lake

FLOOD DEPTH

Nuisance

Moderate

Severe

LAND USE

Urban

Suburban

Rural

Agricultural

Park/Greenspace

3. Protection of Riparian Areas and Lakeshores

Protection of areas immediately adjacent to waterbodies (rivers, creeks, and lakes) through the creation of parkland or otherwise protected public areas, or through setbacks on private lands. Parks and protected areas provide the most robust long-term mechanism to maintain riparian areas and lakeshores.

FLOOD TYPE

FLOOD DEPTH

LAND USE

EFFECTIVENESS OF OPTION FOR RISK REDUCTION AND RESILIENCE DURING A FLOOD EVENT		
PEOPLE	Reduce risks to health and safety of people	*Moderately effective*
STRUCTURES	Reduce damage to structures	*Moderately effective*
DISRUPTION	Minimize disruption of services and mobility (e.g., electricity, gas, communications)	*Moderately effective*
ECONOMY	Minimize damage to local economy including agriculture and tourism	*Moderately effective*
EMERGENCY RESPONSE	Increase the effectiveness of response	*Ineffective*
CLIMATE	Increase adaptability of option to multiple climate futures	*Highly effective*

EFFECT OF OPTION ITSELF ON ITS SURROUNDINGS		
COMMUNITY	Housing	*Negative*
	Social connectedness and supports	*Positive*
ENVIRONMENT	Habitat health (aquatic, wetland, and riparian) and water quality	*Very positive*
CULTURE	Recreation and outdoor lifestyle	*Very positive*
OBSTACLES	Regulatory	*Relatively easy*
	Political and public will	*Relatively easy*
COST	Implementation cost	*$-$$*
	Maintenance cost	*$*

OPPORTUNITIES

- Limited protection through setbacks is already in place and well understood.
- Many co-benefits (ecological function, water quality, recreational values, etc.).
- Can be relatively economical.

CHALLENGES

- Can be challenging when areas are urbanised and face development pressures.

3. Protection of Riparian Areas and Lakeshores

HOW TO IMPLEMENT

This option is within the authority of local governments but will generally require co-operation with senior government and other organizations.

PROCESS COMPONENT	WHAT	HOW
Plan	*Signal intent to advocate for and enable protected areas in lower watershed.*	• Develop or enhance conservation policies within Regional Growth Strategy or Official Community Plan. • Conduct a scoping level review to see if there are other regional initiatives to leverage (e.g., ecological conservation initiatives). • Build partnerships with other government authorities and Non-Government Organisations to enable conservation activities.
Regulate	*Create protected park space in coastal and riparian areas.*	• There are provisions under the Local Government Act and Community Charter that give authority and incentive to local governments to create park spaces. • The Riparian Areas Protection Regulation provides some minimal regulation. • Local government regulations can provide additional, enhanced regulations and enforcement opportunities (e.g., the RDCO Aquatic Ecosystem Development Permit Areas).
Guide	*Review available guidance documents on land use.*	• Review Modernized Land Use Planning: A Guide to Giving Legal Effect to Land Use Plan Content, which provides examples of legislated protected areas in BC. • Review the Stewardship Centre for BC's Green Bylaws Toolkit, which provides practical guidance on ecologically sustainable land-use practices. • Review City of Kelowna's Mission Creek Habitat Compensation Strategy.
Fund	*Local government funds and taxation to support park land.*	• Park lands procurement funds for areas designated as a park can be created. • Residents can be taxed to support the fund (e.g., the Cowichan Valley Regional District Parkland Acquisition Fund, Bylaw 3163).
Monitor/Enforce	*Ensure that park areas remain protected in perpetuity.* *Ensure bylaws are adhered to.*	• Create strong policy language and regulatory components to ensure land is protected in perpetuity. For example, require a no-build/no-disturb convenant on the riparian area. • Require a no-build / no-disturb covenant of the riparian area at time of development. • Support public in their advocacy for protected areas.

COMPLEMENTARY ACTIONS

- Other options in Land Stewardship
- All options in Land Use Management
- All options in Education and Awareness
- All options in Insurance

RESTORE NATURAL ASSETS

Recognizing that many natural systems, that would historically have reduced flood hazards, have been damaged by human activity, it is known that restoring ecological function will reduce hazard and risk over time.

FLOOD TYPE

FLOOD DEPTH

LAND USE

LAND STEWARDSHIP — Restore Natural Assets

4. Constructed Wetlands

Wetlands can be constructed upstream or within the hazard area with the goal of absorbing water during peak flow events.

EFFECTIVENESS OF OPTION FOR RISK REDUCTION AND RESILIENCE DURING A FLOOD EVENT		
PEOPLE	Reduce risks to health and safety of people	*Moderately effective*
STRUCTURES	Reduce damage to structures	*Moderately effective*
DISRUPTION	Minimize disruption of services and mobility (e.g., electricity, gas, communications)	*Moderately effective*
ECONOMY	Minimize damage to local economy including agriculture and tourism	*Moderately effective*
EMERGENCY RESPONSE	Increase the effectiveness of response	*Ineffective*
CLIMATE	Increase adaptability of option to multiple climate futures	*Highly effective*

EFFECT OF OPTION ITSELF ON ITS SURROUNDINGS		
COMMUNITY	Housing	*Negative*
	Social connectedness and supports	*Positive*
ENVIRONMENT	Habitat health (aquatic, wetland, and riparian) and water quality	*Very positive*
CULTURE	Recreation and outdoor lifestyle	*Very positive*
OBSTACLES	Regulatory	*Relatively easy*
	Political and public will	*Relatively easy*
COST	Implementation cost	*$$*
	Maintenance cost	*$*

OPPORTUNITIES

- Can be effective for hazard reduction.
- Many co-benefits (ecological function, water quality, recreational values, etc.).

CHALLENGES

- Land acquisition and construction costs can be prohibitive.
- Performance and effect on flow reduction is very site-dependent (e.g., location within the catchment, vegetation type, slope, soils).

4. Constructed Wetlands

HOW TO IMPLEMENT

This option is within the authority of local governments but will generally require co-operation with senior government and other organizations.

PROCESS COMPONENT	WHAT	HOW
Plan	*Signal intent to advocate for restoration / construction of wetland areas.*	• Develop or enhance conservation policies within Regional Growth Strategy or Official Community Plan. • Conduct a scoping level review to see if there are other regional initiatives to leverage (e.g., ecological conservation initiatives, Okanagan Wetland Committee). • Build partnerships with other government authorities and Non-Government Organisations to enable conservation activities. Consider developing Memorandum's of Understanding to cement these relationships.
Regulate	*Ensure project meets existing Federal, Provincial, and local regulations.*	• Review Federal Fisheries Act, Species at Risk Act, Migratory Birds Convention Act. • Review Provincial Water Sustainability Act, Environmental Management Act (Waste Discharge Regulation), Fish Protection Act (Riparian Areas Regulation), Water Sustainability Act.
Guide	*Use existing guidance to support design of constructed wetlands.*	• Review OBWB Guidebook for local context and implementation information. • Review International Guidelines on Natural and Nature-Based Features for Flood Risk Management.
Fund	*Local governments can fund activities through internal revenues and look to senior government granting programs.*	• Review BC Infrastructure Planning Grant Program for eligibility and intake timelines. • Review BC Adaptation, Resilience and Disaster Mitigation Program for eligibility and intake timelines.
Monitor/Enforce	*Ensure that wetlands are protected in perpetuity and continue to be effective at absorbing flow over time.*	• Create strong policy language and regulatory components to ensure land is protected in perpetuity. • Support public in their advocacy for protected areas. • Develop a monitoring protocol and maintenance plan to ensure effectiveness over time (see guidance material above for examples).

COMPLEMENTARY ACTIONS

- Other options in Land Stewardship
- All options in Land Use Management
- All options in Education and Awareness
- All options in Insurance

Guidebook for Constructed Wetlands in the Okanagan, Okanagan Basin Water Board

FLOOD TYPE

Riverine

Pluvial

Coastal/Lake

FLOOD DEPTH

Nuisance

Moderate

Severe

LAND USE

Urban

Suburban

Rural

Agricultural

Park/Greenspace

5. Dike Setbacks or Removal. Daylighting of Creeks.

The restoration of riparian and coastal areas through the removal of structural works.

FLOOD TYPE

Riverine

Pluvial

Coastal/Lake

FLOOD DEPTH

Nuisance

Moderate

Severe

LAND USE

Urban

Suburban

Rural

Agricultural

Park/Greenspace

EFFECTIVENESS OF OPTION FOR RISK REDUCTION AND RESILIENCE DURING A FLOOD EVENT		
PEOPLE	Reduce risks to health and safety of people	*Moderately effective*
STRUCTURES	Reduce damage to structures	*Moderately effective*
DISRUPTION	Minimize disruption of services and mobility (e.g., electricity, gas, communications)	*Moderately effective*
ECONOMY	Minimize damage to local economy including agriculture and tourism	*Moderately effective*
EMERGENCY RESPONSE	Increase the effectiveness of response	*Ineffective*
CLIMATE	Increase adaptability of option to multiple climate futures	*Highly effective*

EFFECT OF OPTION ITSELF ON ITS SURROUNDINGS		
COMMUNITY	Housing	*Negative*
	Social connectedness and supports	*Positive*
ENVIRONMENT	Habitat health (aquatic, wetland, and riparian) and water quality	*Very positive*
CULTURE	Recreation and outdoor lifestyle	*Very positive*
OBSTACLES	Regulatory	*Moderately challenging*
	Political and public will	*Moderately challenging*
COST	Implementation cost	*$$$*
	Maintenance cost	*$*

OPPORTUNITIES

- Can be extremely effective for hazard reduction.
- Many co-benefits (ecological function, recreational values, etc.).

CHALLENGES

- Land acquisition costs can be prohibitive.
- Public perception of removal of structural works can be negative.

5. Dike Setbacks or Removal. Daylighting of Creeks.

HOW TO IMPLEMENT

This option is within the authority of local governments but will generally require co-operation with senior government and other organizations.

PROCESS COMPONENT	WHAT	HOW
Plan	*Signal intent to advocate for dike setback or creek daylighting and prepare technical materials to support future implementation.*	• Develop or enhance conservation policies within Regional Growth Strategy or Official Community Plan. • Conduct technical studies (hydrologic and hydraulic) to establish the effectiveness of option. • Build partnerships with other government authorities and Non-Government Organisations to enable conservation activities. • Build public enthusiasm for the project through educational materials.
Regulate	*Ensure project meets existing Federal, Provincial, and local regulations.*	• Review BC Dike Design and Construction Guide. • Adhere to Provincial Dike Maintenance Act.
Guide	*Review existing guidance from outside BC as no known guidance specific the province is available.*	• Review Alberta based Green Communities Guide for Stream Daylighting.
Fund	*Local governments can fund activities through internal revenues and look to senior government granting programs.*	• Review BC Infrastructure Planning Grant Program for eligibility and intake timelines. • Review BC Adaptation, Resilience, and Disaster Mitigation Program for eligibility and intake timelines.
Monitor/Enforce	*Ensure that newly restored riparian areas are protected in perpetuity.*	• Create complementary land use regulation to protect riparian areas. • Develop a monitoring and maintenance protocol to ensure continued effectiveness over time.

DEPENDENCIES

- Public and accessible flood mapping
- Public education materials

COMPLEMENTARY ACTIONS

- Other options in Land Stewardship
- All options in Land Use Management
- All options in Education and Awareness
- All options in Insurance

Mission Creek Dike Setback and Restoration

FLOOD TYPE

Riverine

Pluvial

Coastal/Lake

FLOOD DEPTH

Nuisance

Moderate

Severe

LAND USE

Urban

Suburban

Rural

Agricultural

Park/Greenspace

The surest means of limiting risk, is to have no exposure to flood hazard. This is ideally managed by avoiding development in hazard areas in the first place.

FLOOD TYPE

FLOOD DEPTH

LAND USE

LAND USE MANAGEMENT — Avoid

6. Land Use Controls to Limit All Development

Avoiding or limiting all new development in flood hazard areas.

EFFECTIVENESS OF OPTION FOR RISK REDUCTION AND RESILIENCE DURING A FLOOD EVENT		
PEOPLE	Reduce risks to health and safety of people	*Highly effective*
STRUCTURES	Reduce damage to structures	*Highly effective*
DISRUPTION	Minimize disruption of services and mobility (e.g., electricity, gas, communications)	*Highly effective*
ECONOMY	Minimize damage to local economy including agriculture and tourism	*Highly effective*
EMERGENCY RESPONSE	Increase the effectiveness of response	*Highly effective*
CLIMATE	Increase adaptability of option to multiple climate futures	*Highly effective*

EFFECT OF OPTION ITSELF ON ITS SURROUNDINGS		
COMMUNITY	Housing	*Very Negative*
	Social connectedness and supports	*Neutral*
ENVIRONMENT	Habitat health (aquatic, wetland, and riparian) and water quality	*Very positive*
CULTURE	Recreation and outdoor lifestyle	*Positive*
OBSTACLES	Regulatory	*Very challenging*
	Political and public will	*Very challenging*
COST	Implementation cost	*$$*
	Maintenance cost	*$*

OPPORTUNITIES

- Complete risk reduction can be achieved.
- Co-benefits/co-use of land are great.

CHALLENGES

- Generally challenging in areas that are already developed.
- Development pressures can make this publicly, politically, and financially challenging. For example, the need for new and affordable housing is at odds with this option when developable land is limited. In the Okanagan, significant land areas are within the Agricultural Land Reserve, which constrains development, but also offers an opportunity to minimize structural development within ALR areas.

6. Land Use Controls to Limit All Development

HOW TO IMPLEMENT

This option is primarily within the authority of local governments.

PROCESS COMPONENT	WHAT	HOW
Plan	*Signal intent to manage hazardous lands and prepare to enact regulation.*	• Develop or enhance natural hazard policy within Regional Growth Strategy or Official Community Plan. • Develop flood hazard area maps if not already available. Consider developing advanced mapping with a floodway and flood fringe to distinguish areas of highest hazard from areas where appropriately designed development may be acceptable. • Review BC Flood Hazard Area Land Use Management Guidelines.
Regulate	*Create Local Government bylaw or policy.*	• Flood bylaw. • Zoning bylaw. • Review Columbia Basin Trust Official Community Plan Policies Supporting Climate Resilience (chapter 2.6 and 3.2).
Guide	*Develop guidance for developers, realtors, public, etc. to explain why no development is allowed within parts of the floodplain, and review examples of appropriate policies.*	• Work as a region to develop guidance document for realtors and the public to explain why development is being limited in hazard areas. • Leverage existing materials such as “A Resource for Okanagan Lakeshore Living”.
Fund	*Finance development of regulation.*	• Usually funded through normal operating budgets. • No known funding programs.
Monitor/Enforce	*Ensure that land is protected in perpetuity and establish systems to monitor effectiveness.*	• Continue to engage and educate the public on the need to maintain natural functions of riparian areas. • Support public in their advocacy for protected areas. • Document number of development applications that do not adhere to regulations. • Document the number of variances granted (if any).

DEPENDENCIES

- Public and accessible flood mapping

COMPLEMENTARY ACTIONS

- Other options in Land Use Management
- All options in Land Stewardship
- All options in Education and Awareness
- All options in Insurance

One historic example that has largely kept high hazard flood areas free of development are mapped and regulated floodplains under regulatory control of conservation authorities in Ontario. Noting here that the same blanket regulations are not possible within the current BC governance regime.

7. Land Use Controls to Limit High Consequence Development

Avoiding the development of new high consequence structures (e.g., critical infrastructure) or land uses within the floodplain.

FLOOD TYPE

Riverine

Pluvial

Coastal/Lake

FLOOD DEPTH

Nuisance

Moderate

Severe

LAND USE

Urban

Suburban

Rural

Agricultural

Park/Greenspace

EFFECTIVENESS OF OPTION FOR RISK REDUCTION AND RESILIENCE DURING A FLOOD EVENT		
PEOPLE	Reduce risks to health and safety of people	*Moderately effective*
STRUCTURES	Reduce damage to structures	*Moderately effective*
DISRUPTION	Minimize disruption of services and mobility (e.g., electricity, gas, communications)	*Highly effective*
ECONOMY	Minimize damage to local economy including agriculture and tourism	*Moderately effective*
EMERGENCY RESPONSE	Increase the effectiveness of response	*Moderately effective*
CLIMATE	Increase adaptability of option to multiple climate futures	*Highly effective*

EFFECT OF OPTION ITSELF ON ITS SURROUNDINGS		
COMMUNITY	Housing	*Neutral*
	Social connectedness and supports	*Neutral*
ENVIRONMENT	Habitat health (aquatic, wetland, and riparian) and water quality	*Neutral*
CULTURE	Recreation and outdoor lifestyle	*Neutral*
OBSTACLES	Regulatory	*Moderately challenging*
	Political and public will	*Relatively easy*
COST	Implementation cost	*$$*
	Maintenance cost	

OPPORTUNITIES

- Complete risk reduction can be achieved.
- Co-benefits/co-use of land are great.

CHALLENGES

- Generally challenging in areas that are already developed and that require services.
- Development pressures can make this publicly, politically, and financially challenging, although generally less challenging than general land use controls.

7. Land Use Controls to Limit High Consequence Development

HOW TO IMPLEMENT

This option is primarily within the authority of local governments.

PROCESS COMPONENT	WHAT	HOW
Plan	*Signal intent to manage hazardous lands and prepare to enact regulation.*	• Develop or enhance natural hazard policy and commit to risk-based planning within Regional Growth Strategy or Official Community Plan. • Develop flood hazard area maps if not already available. • Review BC Flood Hazard Area Land Use Management Guidelines. • Review BC Emergency Program Act modernisation information. Specifically, the elements related to the inclusion of critical infrastructure operators in large regional planning processes. • Check for updates to Federal guidance (Public Safety Canada) on the siting of critical infrastructure, funded through Federal programs, in hazard areas.
Regulate	*Create Local Government bylaw or policy.*	• Flood bylaw. • Zoning bylaw.
Guide	*Develop guidance for developers, realtors, public, etc. to explain why some types of flood vulnerable development is allowed within parts of the floodplain, and review examples of appropriate policies.*	• No known examples of regulations or guidance.
Fund	*Finance development of regulation.*	• Usually funded through normal operating budgets. • No known funding programs.
Monitor/Enforce	*Ensure that land is protected in perpetuity and establish systems to monitor effectiveness.*	• Continue to engage and educate the public on the need to maintain natural functions of riparian areas. • Support public in their advocacy for protected areas. • Document number of development applications that do not adhere to regulations. • Document the number of variances granted (if any).

DEPENDENCIES

- Public and accessible flood mapping

COMPLEMENTARY ACTIONS

- Other options in Land Use Management
- All options in Land Stewardship
- All options in Education and Awareness
- All options in Insurance

US Executive Order 13690. Establishing a Federal Flood Risk Management Standard: This is a recent regulatory initiative in the US that puts restrictions on the use of federal investments to build infrastructure in flood hazard areas.

8. Acquisition – Undeveloped Land

Also referred to as open space acquisition. Buyout of property using public funds to sterilize area, thereby decreasing future assets at risk.

FLOOD TYPE

FLOOD DEPTH

LAND USE

EFFECTIVENESS OF OPTION FOR RISK REDUCTION AND RESILIENCE DURING A FLOOD EVENT		
PEOPLE	Reduce risks to health and safety of people	*Moderately effective*
STRUCTURES	Reduce damage to structures	*Ineffective*
DISRUPTION	Minimize disruption of services and mobility (e.g., electricity, gas, communications)	*Ineffective*
ECONOMY	Minimize damage to local economy including agriculture and tourism	*Ineffective*
EMERGENCY RESPONSE	Increase the effectiveness of response	*Ineffective*
CLIMATE	Increase adaptability of option to multiple climate futures	*Highly effective*

EFFECT OF OPTION ITSELF ON ITS SURROUNDINGS		
COMMUNITY	Housing	*Neutral*
	Social connectedness and supports	*Neutral*
ENVIRONMENT	Habitat health (aquatic, wetland, and riparian) and water quality	*Very positive*
CULTURE	Recreation and outdoor lifestyle	*Positive*
OBSTACLES	Regulatory	*Relatively easy*
	Political and public will	*Moderately challenging*
COST	Implementation cost	*$$$*
	Maintenance cost	*$*

OPPORTUNITIES

- Risk is eliminated in the long-term because no assets will be developed on land within a hazard area. However, limited risk reduction benefits are realized because exposed elements are not being removed from a hazard area.
- Co-benefits/co-use of land are great.

CHALLENGES

- Cost can be prohibitive.
- Public perception may be negative.
- Quick action required in areas of rapid development.

8. Acquisition – Undeveloped Land

HOW TO IMPLEMENT

This option is primarily within the authority of local governments but will generally require financial support from senior government.

PROCESS COMPONENT	WHAT	HOW
Plan	*Signal intent to acquire land for the purposes of hazard mitigation and monitor real estate market.*	• Develop or enhance natural hazard policy in Regional Growth Strategy and/or Official Community Plan. • Provide information and rationale to decision-makers. • Build partnership with local realtors to enable opportunistic acquisitions. • Prioritize parcels for acquisition using available flood mapping to identify targeted and prioritized parcels. Also consider how these parcels fit within broader long-term land use planning (e.g., future parks).
Regulate	*Limited activities for local governments.*	• Advocate to senior governments on the need for targeted legislation to enable buyouts of hazardous lands.
Guide	*No known BC specific guidance is available.*	
Fund	*Local government funds and taxation to support park land.*	• Park lands procurement funds for areas designated as a park can be created. • Residents can be taxed to support the fund (e.g., the Cowichan Valley Regional District Parkland Acquisition Fund, Bylaw 3163). • Monitor senior government funds for shift in eligibility for buyouts. • Review Federal Disaster Mitigation and Adaption Fund eligibility. • Work with environmental NGOs to build funds to support buyouts and restoration of ecological function.
Monitor/Enforce	*Ensure that acquisitions remain protected in perpetuity.*	• Create strong policy language and regulatory components to ensure land is protected in perpetuity. • Support public in their advocacy for protected areas. • Monitor amount of land acquired over time against total land identified for acquisition.

DEPENDENCIES

- Public and accessible flood mapping

COMPLEMENTARY ACTIONS

- Other options in Land Use Management
- All options in Land Stewardship
- All options in Education and Awareness
- All options in Insurance

Greenseams program in Wisconsin is a collaborative initiative between a conservation organization and the Milwaukee Metropolitan Sewerage District to acquire land and conservation easements from willing landowners within the floodplain.

For currently developed areas, managed or strategic retreat is another way to eliminate exposure to flood hazard. This might be total or partial retreat.

FLOOD TYPE

FLOOD DEPTH

LAND USE

LAND USE MANAGEMENT — Retreat

9. Acquisition – Post-disaster Buyouts

Buyout of damaged property or buildings using public funds to sterilize area, thereby decreasing future assets at risk. This is best enabled by having systems, authority, and expectations in place prior to disaster.

EFFECTIVENESS OF OPTION FOR RISK REDUCTION AND RESILIENCE DURING A FLOOD EVENT		
PEOPLE	Reduce risks to health and safety of people	*Moderately effective*
STRUCTURES	Reduce damage to structures	*Moderately effective*
DISRUPTION	Minimize disruption of services and mobility (e.g., electricity, gas, communications)	*Moderately effective*
ECONOMY	Minimize damage to local economy including agriculture and tourism	*Moderately effective*
EMERGENCY RESPONSE	Increase the effectiveness of response	*Ineffective*
CLIMATE	Increase adaptability of option to multiple climate futures	*Moderately effective*

EFFECT OF OPTION ITSELF ON ITS SURROUNDINGS		
COMMUNITY	Housing	*Negative*
	Social connectedness and supports	*Negative*
ENVIRONMENT	Habitat health (aquatic, wetland, and riparian) and water quality	*Positive*
CULTURE	Recreation and outdoor lifestyle	*Positive*
OBSTACLES	Regulatory	*Moderately challenging*
	Political and public will	*Very challenging*
COST	Implementation cost	*$$$*
	Maintenance cost	*$*

OPPORTUNITIES

- Post-disaster can be a good time to acquire properties.
- Risk reduction is achieved when an exposed element (the damaged structure) is removed from the floodplain.
- Co-benefits/co-use of land are great.

CHALLENGES

- Public and political will can be challenging in the face of “return-to-normal” sentiment.
- Cost may be prohibitive in the short-term, although long-term return-on-investment will be high.

9. Acquisition – Post-disaster Buyouts

HOW TO IMPLEMENT

This option is primarily within the authority of local governments but will generally require financial support from senior government.

PROCESS COMPONENT	WHAT	HOW
Plan	*Signal intent and build momentum with public and decision-makers to discuss post-disaster planning during a non-disaster period.*	• Prepare briefings for decision-makers on the rationale for post-disaster buyouts over rebuilding communities. • Be opportunistic, and leverage media coverage of disasters outside the Okanagan to communicate the importance of reducing exposure over time. • Review Grand Forks Buyout program. • Leverage pre-disaster conversations to implement post-disaster buyouts.
Regulate	*Limited activities for local governments.*	• Advocate to senior governments on the need for targeted legislation to require buyouts of hazardous lands post-disaster. • Advocate to senior government for changes to disaster financial assistance program requirements to increase incentives for buyouts over rebuilding. • Consider developing policy to require post-disaster buyouts (as opposed to rebuilding).
Guide	*No known BC specific guidance is available.*	
Fund	*Acquire senior government financial support.*	• Use funding opportunities within Disaster Financial Assistance programs to support buyouts. • Advocate for use of 15% of Federal Disaster Financial Assistance Arrangements Mitigation Enhancement funds to support buyouts.
Monitor/Enforce	*Ensure that acquisitions remain protected in perpetuity.*	• Create strong policy language and regulatory components to ensure land is protected in perpetuity. • Support public in their advocacy for protected areas.

DEPENDENCIES

- Public and accessible flood mapping

COMPLEMENTARY ACTIONS

- Other options in Land Use Management
- All options in Land Stewardship
- All options in Education and Awareness
- All options in Insurance

Willing seller program in New Jersey (Blue Acres Buyout Program). This is one of the oldest comprehensive post-disaster buyout programs in the US. One of its key tenets is the pre-disaster planning to ensure that buyouts can happen efficiently after disaster. This reduces financial and mental stress for flooded homeowners, and increases the success of the overall buyout program.

Within Canada, the Province of Québec, has recently offered property buyouts to repetitive loss property owners to relocate. The land is then sold to the local government for $1.

10. Acquisition – Developed Land (Pre-disaster)

Buyout of property or buildings using public funds to sterilize (prevent development of) an area, thereby decreasing future assets at risk.

FLOOD TYPE

FLOOD DEPTH

LAND USE

EFFECTIVENESS OF OPTION FOR RISK REDUCTION AND RESILIENCE DURING A FLOOD EVENT		
PEOPLE	Reduce risks to health and safety of people	*Highly effective*
STRUCTURES	Reduce damage to structures	*Highly effective*
DISRUPTION	Minimize disruption of services and mobility (e.g., electricity, gas, communications)	*Highly effective*
ECONOMY	Minimize damage to local economy including agriculture and tourism	*Highly effective*
EMERGENCY RESPONSE	Increase the effectiveness of response	*Moderately effective*
CLIMATE	Increase adaptability of option to multiple climate futures	*Highly effective*

EFFECT OF OPTION ITSELF ON ITS SURROUNDINGS		
COMMUNITY	Housing	*Very negative*
	Social connectedness and supports	*Very negative*
ENVIRONMENT	Habitat health (aquatic, wetland, and riparian) and water quality	*Very positive*
CULTURE	Recreation and outdoor lifestyle	*Positive*
OBSTACLES	Regulatory	*Very challenging*
	Political and public will	*Very challenging*
COST	Implementation cost	*$$$*
	Maintenance cost	*$*

OPPORTUNITIES

- Complete risk reduction can be achieved.
- Co-benefits/co-use of land are great.

CHALLENGES

- Cost can be prohibitive, but long-term return-on-investment is great.

10. Acquisition – Developed Land (Pre-disaster)

HOW TO IMPLEMENT

This option is primarily within the authority of local governments but will generally require financial support from senior government.

PROCESS COMPONENT	WHAT	HOW
Plan	*Signal intent and build momentum to acquire exposed land parcels and buildings in a pre-disaster period.*	• Be opportunistic, and leverage media coverage of disasters outside the Okanagan to communicate the importance of reducing exposure over time. • Prioritize parcels for acquisition using available flood mapping to identify targeted and prioritized parcels.
Regulate	*Limited activities for local governments.*	• Advocate to senior governments on need for regulations to support acquisition of hazardous lands.
Guide	*No known BC specific guidance is available.*	
Fund	*Local government funds and taxation to support park land.*	• Park lands procurement funds for areas designated as a park can be created. • Residents can be taxed to support the fund (e.g., the Cowichan Valley Regional District Parkland Acquisition Fund, Bylaw 3163). • Review Federal Disaster Mitigation and Adaption Fund or any similar funds for shifts in eligibility for buyouts. • Work with environmental non-governmental organizations to build funds to support buyouts and restoration of ecological function.
Monitor/Enforce	*Ensure that acquisitions remain protected in perpetuity.*	• Create strong policy language and regulatory components to ensure land is protected in perpetuity. • Support public in their advocacy for protected areas.

DEPENDENCIES

- Public and accessible flood mapping

COMPLEMENTARY ACTIONS

- Other options in Land Use Management
- All options in Land Stewardship
- All options in Education and Awareness
- All options in Insurance

New Jersey Blue Acres Buyout Program. City of Portland Willing Seller Program. This program, which has been in place for more than 20 years, is a land acquisition program for floodplain areas with the City. This program was one of the first acquisition/buyout programs to reframe the language of the initiative to encourage landowners to sell, at a fair market value, at a time of their choosing.

11. Life-Rights Agreements (Acquisition over time)

A life rights agreement involves granting a property owner the right to live in their home for the duration of their life or tenure. Some restrictions may be placed in the agreements to adjust the rights should a flood damage the building. At the time the agreement is established, the property owner is paid the market value amount for their property. At the end of life or tenure, the land is fully owned by the agency (non-profit or government) that acquired the rights.

FLOOD TYPE

FLOOD DEPTH

LAND USE

EFFECTIVENESS OF OPTION FOR RISK REDUCTION AND RESILIENCE DURING A FLOOD EVENT		
PEOPLE	Reduce risks to health and safety of people	*Moderately effective*
STRUCTURES	Reduce damage to structures	*Moderately effective*
DISRUPTION	Minimize disruption of services and mobility (e.g., electricity, gas, communications)	*Moderately effective*
ECONOMY	Minimize damage to local economy including agriculture and tourism	*Moderately effective*
EMERGENCY RESPONSE	Increase the effectiveness of response	*Moderately effective*
CLIMATE	Increase adaptability of option to multiple climate futures	*Moderately effective*

EFFECT OF OPTION ITSELF ON ITS SURROUNDINGS		
COMMUNITY	Housing	*Neutral*
	Social connectedness and supports	*Neutral*
ENVIRONMENT	Habitat health (aquatic, wetland, and riparian) and water quality	*Positive*
CULTURE	Recreation and outdoor lifestyle	*Neutral*
OBSTACLES	Regulatory	*Very challenging*
	Political and public will	*Moderately challenging*
COST	Implementation cost	*$$$*
	Maintenance cost	*$*

OPPORTUNITIES

- A measured approach to strategically acquire land.
- Complete risk reduction can be achieved, although over a long period of time.

CHALLENGES

- This tool is not commonly used in BC, and implementation may be challenging.

11. Life-Rights Agreements (Acquisition over time)

HOW TO IMPLEMENT

This option is primarily within the authority of local governments but will generally require financial support from senior government or other interested parties.

PROCESS COMPONENT	WHAT	HOW
Plan	*Build partnerships with local organizations that could support a transfer of title.*	• Work with local environmental non-governmental organisations to identify long-term stewards of the acquired land. • Work with local realtors and umbrella agencies to educate potential landowners of opportunities. • Using available flood mapping to prioritize parcels to target for acquisition.
Regulate	*No known BC or Canadian specific regulation.*	
Guide	*No known BC or Canadian specific guidance is available.*	
Fund	*Local government funds and taxation to support park land.*	• Park lands procurement funds for areas designated as a park can be created. • Work with environmental non-governmental organizations to build funds to support buyouts and restoration of ecological function.
Monitor/Enforce	*Ensure that acquisitions remain protected in perpetuity.*	• Create strong policy language and regulatory components to ensure land is protected in perpetuity. • Support public in their advocacy for protected areas.

DEPENDENCIES

- Public and accessible flood mapping

COMPLEMENTARY ACTIONS

- Other options in Land Use Management
- All options in Land Stewardship
- All options in Education and Awareness
- All options in Insurance

This technique has been applied by the Monmouth County Conservation Foundation as part of a program to establish and preserve open space and natural habitat.

FLOOD TYPE

Riverine

Pluvial

Coastal/Lake

FLOOD DEPTH

Nuisance

Moderate

Severe

LAND USE

Urban

Suburban

Rural

Agricultural

Park/Greenspace

12. Relocation – Property

Moving of assets (buildings, businesses, people) out of floodplain. This includes the physical movement, especially of historic structures, out of the floodplain, to a new site.

FLOOD TYPE

Riverine

Pluvial

Coastal/Lake

FLOOD DEPTH

Nuisance

Moderate

Severe

LAND USE

Urban

Suburban

Rural

Agricultural

Park/Greenspace

EFFECTIVENESS OF OPTION FOR RISK REDUCTION AND RESILIENCE DURING A FLOOD EVENT		
PEOPLE	Reduce risks to health and safety of people	*Highly effective*
STRUCTURES	Reduce damage to structures	*Highly effective*
DISRUPTION	Minimize disruption of services and mobility (e.g., electricity, gas, communications)	*Moderately effective*
ECONOMY	Minimize damage to local economy including agriculture and tourism	*Moderately effective*
EMERGENCY RESPONSE	Increase the effectiveness of response	*Moderately effective*
CLIMATE	Increase adaptability of option to multiple climate futures	*Highly effective*

EFFECT OF OPTION ITSELF ON ITS SURROUNDINGS		
COMMUNITY	Housing	*Negative*
	Social connectedness and supports	*Negative*
ENVIRONMENT	Habitat health (aquatic, wetland, and riparian) and water quality	*Positive*
CULTURE	Recreation and outdoor lifestyle	*Neutral*
OBSTACLES	Regulatory	*Very challenging*
	Political and public will	*Very challenging*
COST	Implementation cost	*$$$*
	Maintenance cost	*$*

OPPORTUNITIES

- Risk reduction is achieved when an exposed element (the damaged structure) is removed from the floodplain.

CHALLENGES

- Need to find alternative locations for properties and people, which can be challenging given development pressures.

12. Relocation – Property

HOW TO IMPLEMENT

This option is primarily within the authority of local governments but will generally require financial support from senior government.

PROCESS COMPONENT	WHAT	HOW
Plan	*Signal intent to acquire and move assets for the purposes of hazard mitigation.*	• Develop or enhance natural hazard policy in Regional Growth Strategy or Official Community Plan.
Regulate	*No known BC or Canadian specific regulation.*	
Guide	*No known BC or Canadian specific guidance is available.*	
Fund	*No known senior government funds.*	
Monitor/Enforce	*Ensure that relocated assets remain outside hazard areas in perpetuity.*	• Create strong policy language and regulatory components to ensure land is protected in perpetuity. • Support public in their advocacy for protected areas.

DEPENDENCIES

- Land use acquisition strategies

COMPLEMENTARY ACTIONS

- Other options in Land Use Management
- All options in Land Stewardship
- All options in Education and Awareness
- All options in Insurance

Relocation of a museum away from the Cedar River in Iowa.

13. Relocation – Infrastructure

Moving of public infrastructure (roads, services, etc.) out of the floodplain.

FLOOD TYPE

FLOOD DEPTH

LAND USE

EFFECTIVENESS OF OPTION FOR RISK REDUCTION AND RESILIENCE DURING A FLOOD EVENT		
PEOPLE	Reduce risks to health and safety of people	*Moderately effective*
STRUCTURES	Reduce damage to structures	*Highly effective*
DISRUPTION	Minimize disruption of services and mobility (e.g., electricity, gas, communications)	*Highly effective*
ECONOMY	Minimize damage to local economy including agriculture and tourism	*Moderately effective*
EMERGENCY RESPONSE	Increase the effectiveness of response	*Moderately effective*
CLIMATE	Increase adaptability of option to multiple climate futures	*Highly effective*

EFFECT OF OPTION ITSELF ON ITS SURROUNDINGS		
COMMUNITY	Housing	*Neutral*
	Social connectedness and supports	*Neutral*
ENVIRONMENT	Habitat health (aquatic, wetland, and riparian) and water quality	*Positive*
CULTURE	Recreation and outdoor lifestyle	*Neutral*
OBSTACLES	Regulatory	*Relatively easy*
	Political and public will	*Very challenging*
COST	Implementation cost	*$$$*
	Maintenance cost	*$*

OPPORTUNITIES

- Can be done over time as assets are renewed or retired.
- Risk reduction is achieved when an exposed element (the infrastructure asset) is removed from the floodplain.

CHALLENGES

- Need to find alternative locations/solutions.

13. Relocation – Infrastructure

HOW TO IMPLEMENT

This option is primarily within the authority of local governments but will generally require financial support from senior government.

PROCESS COMPONENT	WHAT	HOW
Plan	*Signal intent to acquire and move assets for the purposes of hazard mitigation.*	• Develop or enhance natural hazard policy in Regional Growth Strategy or Official Community Plan. • Add relocation strategies to Asset Management Plans and Capital Plans. • Include financing for relocation in engineering capital and operational budgeting. • Complete a technical study to identify which infrastructure assets should be targeted for relocation.
Regulate	*No known BC or Canadian specific regulation.*	
Guide	*No known BC or Canadian specific guidance is available.*	
Fund	*Fund relocation opportunistically and strategically through normal asset management and engineering budgets.*	• Ensure that asset management and capital planning consider expected annual damage costs from flooding. This will highlight return-on-investment benefit of relocation.
Monitor/Enforce	*Ensure that relocated assets remain outside hazard areas in perpetuity.*	• Create strong policy language and regulatory components to ensure land is protected in perpetuity. See *Option 3: Protection of Riparian Areas and Lakeshores* for additional information on the protection of land in legislation and regulation. • Create strong documentation on rationale for relocation so that decision is not reversed in future.

DEPENDENCIES

- Public and accessible flood mapping

COMPLEMENTARY ACTIONS

- Other options in Land Use Management
- All options in Land Stewardship
- All options in Education and Awareness
- All options in Insurance

FLOOD TYPE

Riverine

Pluvial

Coastal/Lake

FLOOD DEPTH

Nuisance

Moderate

Severe

LAND USE

Urban

Suburban

Rural

Agricultural

Park/Greenspace

Another way of approaching exposure reduction is to consider the redistribution of assets across hazard areas. For example, removing highly vulnerable elements from flood hazard areas, or reducing density in highest hazard areas (i.e., floodway), and increasing density in flood fringes or outside the flood hazard area altogether.

FLOOD TYPE

FLOOD DEPTH

LAND USE

LAND USE MANAGEMENT — Redistribute

14. Transfer of Development Potential

Transfer of allowable development potential to an alternate location out of the floodplain. This is generally an action taken by local government through zoning bylaws, decisions and variances, to grant landowners within the floodplain the right to increase density on properties that they own outside the floodplain if they reduce (or sterilize) the density of development within the floodplain. The option is however targeted at private landowners and developers.

EFFECTIVENESS OF OPTION FOR RISK REDUCTION AND RESILIENCE DURING A FLOOD EVENT		
PEOPLE	Reduce risks to health and safety of people	*Moderately effective*
STRUCTURES	Reduce damage to structures	*Moderately effective*
DISRUPTION	Minimize disruption of services and mobility (e.g., electricity, gas, communications)	*Moderately effective*
ECONOMY	Minimize damage to local economy including agriculture and tourism	*Moderately effective*
EMERGENCY RESPONSE	Increase the effectiveness of response	*Moderately effective*
CLIMATE	Increase adaptability of option to multiple climate futures	*Moderately effective*

EFFECT OF OPTION ITSELF ON ITS SURROUNDINGS		
COMMUNITY	Housing	*Neutral*
	Social connectedness and supports	*Negative*
ENVIRONMENT	Habitat health (aquatic, wetland, and riparian) and water quality	*Positive*
CULTURE	Recreation and outdoor lifestyle	*Neutral*
OBSTACLES	Regulatory	*Relatively easy*
	Political and public will	*Very challenging*
COST	Implementation cost	*$*
	Maintenance cost	*$*

OPPORTUNITIES

- May be a less cost prohibitive option than land acquisition.

CHALLENGES

- Challenge associated with finding alternate locations where it would be acceptable to increase density.
- Voluntary, market-based tool for areas with existing zoning/density agreements and thus difficult to enforce.

14. Transfer of Development Potential

HOW TO IMPLEMENT

This option is primarily within the authority of local governments.

PROCESS COMPONENT	WHAT	HOW
Plan	*Build partnerships with developers to support density redistribution*	• Develop or enhance natural hazard policy within Regional Growth Strategy or Official Community Plan. • Work with Urban Development Institute and others to reach local developers. • Develop flood hazard area maps if not already available. Consider developing advanced mapping with a floodway and flood fringe to distinguish areas of highest hazard from areas where appropriately designed development may be acceptable. • BC Flood Hazard Area Land Use Management Guidelines. • Research the creation of a density bank to facilitate density transfers between landowners.
Regulate	*Create Local Government bylaw or policy.*	• Update zoning bylaws with new density requirements.
Guide	*Develop guidance.*	• Develop materials for developers, realtors, public, etc. to explain concept, rationale and eligibility requirements. • Develop guidance to support local government staff.
Fund	*Finance development of regulation.*	• Funding of staff time to identify opportunities for density transfer usually funded through normal operating budgets.
Monitor/Enforce	*Ensure that land is protected and establish systems to monitor effectiveness.*	• Create strong policy language and regulatory components to ensure land is protected in perpetuity. • Continue to engage and educate the public on the need to maintain natural functions of riparian areas. • Document and map density within flood hazard areas over time.

DEPENDENCIES

- Public and accessible flood mapping

COMPLEMENTARY ACTIONS

- Other options in Land Use Management
- All options in Land Stewardship
- All options in Education and Awareness
- All options in Insurance

15. Rolling Easements

Rolling easements describe a group of policies and actions that are designed to gradually remove people, structures, and infrastructure as floodplains expand with climate change. For example, new developments within high hazard zones are subject to various requirements, such as being modular and relocatable by 4-wheel-drive vehicle. Or, for example applying set increases in existing setback requirements on a pre-determined schedule.

FLOOD TYPE

FLOOD DEPTH

LAND USE

EFFECTIVENESS OF OPTION FOR RISK REDUCTION AND RESILIENCE DURING A FLOOD EVENT		
PEOPLE	Reduce risks to health and safety of people	*Moderately effective*
STRUCTURES	Reduce damage to structures	*Moderately effective*
DISRUPTION	Minimize disruption of services and mobility (e.g., electricity, gas, communications)	*Moderately effective*
ECONOMY	Minimize damage to local economy including agriculture and tourism	*Moderately effective*
EMERGENCY RESPONSE	Increase the effectiveness of response	*Moderately effective*
CLIMATE	Increase adaptability of option to multiple climate futures	*Moderately effective*

EFFECT OF OPTION ITSELF ON ITS SURROUNDINGS		
COMMUNITY	Housing	*Negative*
	Social connectedness and supports	*Negative*
ENVIRONMENT	Habitat health (aquatic, wetland, and riparian) and water quality	*Positive*
CULTURE	Recreation and outdoor lifestyle	*Neutral*
OBSTACLES	Regulatory	*Very challenging*
	Political and public will	*Moderately challenging*
COST	Implementation cost	*$-$$$*
	Maintenance cost	*$*

OPPORTUNITIES

- A measured approach to strategically acquire land.
- Complete risk reduction can be achieved, but over a longer time.
- Rolling easements are becoming more common as a tool, especially in coastal areas in the US and Australia. As such, there is practical guidance and educational materials to draw from.

CHALLENGES

- Challenge associated with property owners' reluctance to lose land.
- This is not a commonly applied tool in BC, and as such there are obstacles to implementation.

15. Rolling Easements

HOW TO IMPLEMENT

This option, depending on the approach, is primarily within the authority of local government.

PROCESS COMPONENT	WHAT	HOW
Plan	*Build partnerships with local organizations that could support a transfer of title.*	• Work with local environmental non-governmental organisations to identify long-term stewards of the acquired land. • Work with local realtors and umbrella agencies to educate potential landowners of opportunities. • Complete technical studies, especially related to expanding floodplains with climate change, and timelines for erosion and/or avulsion, to identify appropriate timelines for future easements.
Regulate	*No known BC or Canadian specific regulation.*	• Advocate to Province for simpler use of rolling easements in future updates to legislation.
Guide	*No known BC or Canadian specific guidance is available.*	• Review international guidance such as the US EPA Rolling Easements Primer.
Fund	*No known funding mechanisms at this time given current regulatory impediments.*	
Monitor/Enforce	*N/A*	

DEPENDENCIES

- Publicly available floodplain mapping

COMPLEMENTARY ACTIONS

- Other options in Land Use Management
- All options in Land Stewardship
- All options in Education and Awareness
- All options in Insurance

Within the Shire of Byron Bay, Eastern Australia, Coastal Hazard Planning Provisions are in place to manage ongoing erosion by limiting the types of development to structures that will be move-able when a predetermined level of erosion has occurred.

The U.S. Environmental Protection Agency (EPA) Rolling Easements Primer.

FLOOD TYPE

Riverine

Pluvial

Coastal/Lake

FLOOD DEPTH

Nuisance

Moderate

Severe

LAND USE

Urban

Suburban

Rural

Agricultural

Park/Greenspace

16. Density Redistribution

Graduated use of flood hazard areas, where the least vulnerable land uses are closest to the river or coast, and critical services are placed well out of harm's way, is a simple conceptual approach to land use and flood hazard. This option is applied through local government planning processes, especially for large parcels of land.

FLOOD TYPE

FLOOD DEPTH

LAND USE

EFFECTIVENESS OF OPTION FOR RISK REDUCTION AND RESILIENCE DURING A FLOOD EVENT		
PEOPLE	Reduce risks to health and safety of people	*Moderately effective*
STRUCTURES	Reduce damage to structures	*Moderately effective*
DISRUPTION	Minimize disruption of services and mobility (e.g., electricity, gas, communications)	*Moderately effective*
ECONOMY	Minimize damage to local economy including agriculture and tourism	*Moderately effective*
EMERGENCY RESPONSE	Increase the effectiveness of response	*Moderately effective*
CLIMATE	Increase adaptability of option to multiple climate futures	*Moderately effective*

EFFECT OF OPTION ITSELF ON ITS SURROUNDINGS		
COMMUNITY	Housing	*Negative*
	Social connectedness and supports	*Negative*
ENVIRONMENT	Habitat health (aquatic, wetland, and riparian) and water quality	*Positive*
CULTURE	Recreation and outdoor lifestyle	*Positive*
OBSTACLES	Regulatory	*Moderately challenging*
	Political and public will	*Very challenging*
COST	Implementation cost	*$*
	Maintenance cost	*$*

CHALLENGES

- Generally challenging in areas that are already developed.

16. Density Redistribution

HOW TO IMPLEMENT

This option is primarily within the authority of local governments.

PROCESS COMPONENT	WHAT	HOW
Plan	*Signal intent to manage hazardous lands and prepare to enact regulation.*	• Develop internal understanding and capacity to site any growth or settlement nodes outside hazard areas. • Build a business case and identify co-benefits for density redistribution. • Work with staff and stakeholders to identify externalities and benefits of densification. • Incorporate ideas of density redistribution within Official Community Plans or Regional Growth Strategies.
Regulate	*Regulate within Regional Growth Strategy or Official Community Plan.*	• Update zoning bylaws to reflect changes in allowable density.
Guide	*No known resources.*	
Fund	*Finance development of regulation.*	• Usually funded through normal operating budgets. • No known funding programs.
Monitor/Enforce	*Ensure that land is protected and establish systems to monitor effectiveness.*	• Create strong policy language and regulatory components to ensure land is protected in perpetuity. • Continue to engage and educate the public on the need to maintain natural functions of riparian areas. • Document and map density within flood hazard areas over time.

DEPENDENCIES

- Public and accessible flood mapping

COMPLEMENTARY ACTIONS

- Other options in Land Use Management
- All options in Land Stewardship
- All options in Education and Awareness
- All options in Insurance

Manitoba provides robust guidance on how to redistribute and move high value infrastructure in its Planning Resource Guide: Subdivision in Manitoba.

City of Brampton, working with Toronto Regional Conservation Authority have recently proposed a plan to redistribute density floodplain, which runs through the downtown.

17. Right to Flood

Provision in law that land be allowed to flood during high-water conditions. (Temporal redistribution). For example, asserting the right to have a controlled dike or levee breach and allowing water to temporarily be stored or diverted onto land that would otherwise be dry. This type of right or law is not in common practice in Canada, but has de facto been applied on the Assiniboine River in Manitoba in 2011.

FLOOD TYPE

FLOOD DEPTH

LAND USE

EFFECTIVENESS OF OPTION FOR RISK REDUCTION AND RESILIENCE DURING A FLOOD EVENT		
PEOPLE	Reduce risks to health and safety of people	*Ineffective*
STRUCTURES	Reduce damage to structures	*Ineffective*
DISRUPTION	Minimize disruption of services and mobility (e.g., electricity, gas, communications)	*Ineffective*
ECONOMY	Minimize damage to local economy including agriculture and tourism	*Ineffective*
EMERGENCY RESPONSE	Increase the effectiveness of response	*Ineffective*
CLIMATE	Increase adaptability of option to multiple climate futures	*Moderately effective*

EFFECT OF OPTION ITSELF ON ITS SURROUNDINGS		
COMMUNITY	Housing	*Neutral*
	Social connectedness and supports	*Neutral*
ENVIRONMENT	Habitat health (aquatic, wetland, and riparian) and water quality	*Neutral*
CULTURE	Recreation and outdoor lifestyle	*Neutral*
OBSTACLES	Regulatory	*Very challenging*
	Political and public will	*Very challenging*
COST	Implementation cost	*$*
	Maintenance cost	*$*

OPPORTUNITIES

- Can be an effective tool to co-use land for multiple purposes, as for the majority of time, the land can be used for park or agricultural or other purposes.

CHALLENGES

- Challenging to convince current landowners/users, especially without financial incentivization.
- This is not commonly applied in Canada. No legal or regulatory examples were found, and so there would likely be legal and/or regulatory obstacles to implement this option.

17. Right to Flood

HOW TO IMPLEMENT

This is a grey area in current legislation. Local governments may be able to authorize covenants on title under certain conditions.

PROCESS COMPONENT	WHAT	HOW
Plan	*Conduct technical studies to establish most effective land parcels for temporary flood storage.*	• Use hydrologic and hydraulic modelling to understand the effectiveness of temporary storage. • Determine the need for additional infrastructure (e.g., agricultural berms to contain and store floodwaters) to support the initiative. • Develop policy to re-purpose public infrastructure (e.g., roads, parks, trails) during seasonal flood events to minimize flood impacts that may disrupt services (e.g., City of Kelowna's Draft 2040 OCP Policy 15.4.5). • Build partnerships with larger landowners (especially agricultural landowners). • Identify potential parcels where temporary flood storage would benefit the large community. • Build partnership with suitable landowners. • Work regionally to establish consistent approaches. • Develop guidance materials on how to approach landowners and set up legal mechanism to support this option.
Regulate	*No known mechanism for regulation.*	
Guide	*No known guidance materials available.*	
Fund	*No known funding mechanisms are available to support development of policy.* *No known funding mechanisms are available to compensate landowners during flood event.*	
Monitor/Enforce	*N/A*	

DEPENDENCIES

- Public and accessible flood mapping

COMPLEMENTARY ACTIONS

- Other options in Land Use Management
- All options in Land Stewardship
- All options in Education and Awareness
- All options in Insurance

North Dakota Waffle Program has been in place for more than 20 years on the Red River in the US. The concept is to contain floodwaters temporarily on agricultural lands by using agricultural berms with strategically located culverts, weirs, and gates. The fields are filled with floodwaters, much like a waffle is filled with syrup.

BUILDING CONTROLS FOR NEW BUILDS

With flood hazard areas increasing in size, and increasing development pressures, it is not always possible to sterilize land use within flood hazard areas. Changing the built form so that damages to structures are limited, or more easily recoverable is an effective means of reducing risk. This can be relatively easily achieved for new construction.

FLOOD TYPE

FLOOD DEPTH

LAND USE

BUILDING MANAGEMENT — Building Controls for New Builds

18. Elevate Structures (New Builds)

The elevation of an individual building above the expected flood level using fill, stilts, or other structural means.

EFFECTIVENESS OF OPTION FOR RISK REDUCTION AND RESILIENCE DURING A FLOOD EVENT		
PEOPLE	Reduce risks to health and safety of people	*Ineffective*
STRUCTURES	Reduce damage to structures	*Highly effective*
DISRUPTION	Minimize disruption of services and mobility (e.g., electricity, gas, communications)	*Highly effective*
ECONOMY	Minimize damage to local economy including agriculture and tourism	*Highly effective*
EMERGENCY RESPONSE	Increase the effectiveness of response	*Highly effective*
CLIMATE	Increase adaptability of option to multiple climate futures	*Ineffective*

EFFECT OF OPTION ITSELF ON ITS SURROUNDINGS		
COMMUNITY	Housing	*Negative*
	Social connectedness and supports	*Neutral*
ENVIRONMENT	Habitat health (aquatic, wetland, and riparian) and water quality	*Neutral*
CULTURE	Recreation and outdoor lifestyle	*Neutral*
OBSTACLES	Regulatory	*Relatively easy*
	Political and public will	*Relatively easy*
COST	Implementation cost	*$*
	Maintenance cost	*$*

OPPORTUNITIES

- Standard approach currently applied in BC. Well understood and relatively easy to implement.

CHALLENGES

- Creates challenges for accessibility and servicing.
- Potential for reduced aesthetics when neighbouring sites are at different elevations.

18. Elevate Structures (New Builds)

HOW TO IMPLEMENT

Local governments have the authority to enact regulations to require elevation of structures within the floodplain.

PROCESS COMPONENT	WHAT	HOW
Plan	*Prepare technical and background materials to support enactment of flood construction level regulations.*	• Find or develop engineering quality flood mapping to establish flood construction elevations across the floodplain. • Consider developing modified flood construction level mapping that incorporates existing built environment and any future growth (i.e., maps that balance the protection from hazard with servicing and accessibility of raised structures). • Work with local building inspectors to understand any local challenges to implementation.
Regulate	*Regulate buildings in the floodplain.*	• Use existing floodproofing provisions within the BC Building Code. • Use a Building Bylaw (no longer common). • Include building requirements within a flood bylaw (e.g., City of Kelowna Mill Creek Flood Plain Bylaw). • Ensure covenant on title for all buildings requiring a permit (new and renovations).
Guide	*Develop guidance for landowners.*	• Provide materials to support applicants through building permitting process (e.g., District of Tofino Flood Plain Bylaw Development). • Develop guidance for staff and qualified professionals. • Provide checklists and example quality assurance statements for qualified professionals.
Fund	*No known funding mechanisms. Bylaw development usually funded within local government operational budgets.*	
Monitor/Enforce	*Ensure that non-habitable areas of buildings remain uninhabited.*	• Conduct inspections opportunistically with support of local building inspectors. • Ensure covenant is on title so that any new owners understand the regulations.

DEPENDENCIES

- Public and accessible flood mapping
- Flood Bylaw (see Land Use Management options)

COMPLEMENTARY ACTIONS

- Other options in Building Management
- All options in Education and Awareness
- All options in Insurance

FCLs (Flood Construction Level) in BC (within Flood Hazard Area Land Use Management Guidelines).

FLOOD TYPE

Riverine

Pluvial

Coastal/Lake

FLOOD DEPTH

Nuisance

Moderate

Severe

LAND USE

Urban

Suburban

Rural

Agricultural

Park/Greenspace

19. Elevate High Consequence Structures (New Builds)

Specific building design controls or regulations for critical facilities in flood hazard areas.

FLOOD TYPE

FLOOD DEPTH

LAND USE

EFFECTIVENESS OF OPTION FOR RISK REDUCTION AND RESILIENCE DURING A FLOOD EVENT		
PEOPLE	Reduce risks to health and safety of people	*Highly effective*
STRUCTURES	Reduce damage to structures	*Moderately effective*
DISRUPTION	Minimize disruption of services and mobility (e.g., electricity, gas, communications)	*Moderately effective*
ECONOMY	Minimize damage to local economy including agriculture and tourism	*Moderately effective*
EMERGENCY RESPONSE	Increase the effectiveness of response	*Highly effective*
CLIMATE	Increase adaptability of option to multiple climate futures	*Moderately effective*

EFFECT OF OPTION ITSELF ON ITS SURROUNDINGS		
COMMUNITY	Housing	*Neutral*
	Social connectedness and supports	*Neutral*
ENVIRONMENT	Habitat health (aquatic, wetland, and riparian) and water quality	*Neutral*
CULTURE	Recreation and outdoor lifestyle	*Neutral*
OBSTACLES	Regulatory	*Relatively easy*
	Political and public will	*Relatively easy*
COST	Implementation cost	*$*
	Maintenance cost	*$*

OPPORTUNITIES

- Relatively cheap, especially for new builds.

CHALLENGES

- Relatively novel approach for Canada which creates challenges for implementation (regulations, building codes, materials, etc.).
- Especially challenging for some critical infrastructure that are gravity dependant (e.g., wastewater treatment plants).

19. Elevate High Consequence Structures (New Builds)

HOW TO IMPLEMENT

Local governments have the authority to enact regulations to require elevation of structures within the floodplain.

PROCESS COMPONENT	WHAT	HOW
Plan	*Prepare technical and background materials to support enactment of flood construction level regulations.*	• Find or develop engineering quality flood mapping to establish flood construction elevations across the floodplain. • Find or develop mapping for less likely and/or future climate flood scenarios.
Regulate	*Regulate buildings in the floodplain.*	• Include building requirements for critical facilities within a flood bylaw.
Guide	*Develop guidance for staff and qualified professionals.*	• Provide guidance for staff and qualified professionals on the rationale for higher design standards (see National Research Council Flood Risk Assessment Guidelines on Criticality of Infrastructure and Design Controls).
Fund	*No known funding mechanisms.*	• Bylaw development usually funded within local government operational budgets. • No known funding mechanisms for the marginal costs associated with higher standards for critical infrastructure design and construction.
Monitor/Enforce	*Ensure that rationale for additional safety factor is well documented.*	• Develop clear documentation within design and as-built packages to support understanding of rationale for higher design standard so that it is not eroded over time.

DEPENDENCIES

- Public and accessible flood mapping
- Flood Bylaw (see Land Use Management options)

COMPLEMENTARY ACTIONS

- Other options in Building Management
- All options in Education and Awareness
- All options in Insurance

The City of Baltimore combined all hazards mitigation and climate adaptation plan. This plan includes explicit consideration of the need for higher standards for critical infrastructure (i.e., the lower risk tolerance for failure of these systems).

20. Dry Floodproofing (Permanent)

Products or actions, permanently in place, designed to stop water from entering buildings through existing openings or by penetrating walls.

FLOOD TYPE

FLOOD DEPTH

LAND USE

EFFECTIVENESS OF OPTION FOR RISK REDUCTION AND RESILIENCE DURING A FLOOD EVENT		
PEOPLE	Reduce risks to health and safety of people	*Ineffective*
STRUCTURES	Reduce damage to structures	*Highly effective*
DISRUPTION	Minimize disruption of services and mobility (e.g., electricity, gas, communications)	*Ineffective*
ECONOMY	Minimize damage to local economy including agriculture and tourism	*Moderately effective*
EMERGENCY RESPONSE	Increase the effectiveness of response	*Moderately effective*
CLIMATE	Increase adaptability of option to multiple climate futures	*Moderately effective*

EFFECT OF OPTION ITSELF ON ITS SURROUNDINGS		
COMMUNITY	Housing	*Neutral*
	Social connectedness and supports	*Neutral*
ENVIRONMENT	Habitat health (aquatic, wetland, and riparian) and water quality	*Neutral*
CULTURE	Recreation and outdoor lifestyle	*Neutral*
OBSTACLES	Regulatory	*Very challenging*
	Political and public will	*Relatively easy*
COST	Implementation cost	*$*
	Maintenance cost	*$*

OPPORTUNITIES

- Relatively cheap, especially for new builds.
- Potential for significant vulnerability and risk reduction.
- Potential to target protection to areas that need it (e.g., mechanical room).

CHALLENGES

- Relatively novel approach for Canada which creates challenges for implementation (regulations, building codes, materials, etc.).
- Requires geotechnical/hydrogeological considerations to ensure buildings do not ‘pop’ as groundwater rises.

20. Dry Floodproofing (Permanent)

HOW TO IMPLEMENT

Local governments have limited authority to enact regulations or enable novel and/or progressive flood proofing methods. The building code remains under the authority of Federal and Provincial governments.

PROCESS COMPONENT	WHAT	HOW
Plan	*Signal intent to advocate for broader definitions of flood resilient structures.*	• Use existing advocacy mechanisms, such as UBCM resolution, to advocate, with other partners for changes to BC Building Code, and broader definitions for funding programs to explicitly include permanent floodproofing options.
Regulate	*Advocate to senior governments for changes to Canada and BC Building Codes.* *Advocate to BC for changes to the Flood Hazard Area Land Use Management Guidelines.*	
Guide	*N/A*	
Fund	*No known funding mechanisms.*	
Monitor/Enforce	*N/A*	

DEPENDENCIES

- Public and accessible flood mapping
- Flood Bylaw (see Land Use Management options)

COMPLEMENTARY ACTIONS

- Other options in Building Management
- All options in Education and Awareness
- All options in Insurance

ASCE 24-05 Flood Resistant Design and Construction Standard. This US guideline provides practical advice and design standards for property-level flood protection.

BSI 851188 The British Standard for Flood Resistant Products provides a minimum standard for building materials used for floodproofing. No similar standards exist in Canada.

21. Dry Floodproofing (Temporary)

Products or actions, deployed temporarily with appropriate warning times, designed to stop water from entering buildings through existing openings or by penetrating walls.

FLOOD TYPE

FLOOD DEPTH

LAND USE

EFFECTIVENESS OF OPTION FOR RISK REDUCTION AND RESILIENCE DURING A FLOOD EVENT		
PEOPLE	Reduce risks to health and safety of people	*Ineffective*
STRUCTURES	Reduce damage to structures	*Highly effective*
DISRUPTION	Minimize disruption of services and mobility (e.g., electricity, gas, communications)	*Moderately effective*
ECONOMY	Minimize damage to local economy including agriculture and tourism	*Moderately effective*
EMERGENCY RESPONSE	Increase the effectiveness of response	*Moderately effective*
CLIMATE	Increase adaptability of option to multiple climate futures	*Highly effective*

EFFECT OF OPTION ITSELF ON ITS SURROUNDINGS		
COMMUNITY	Housing	*Neutral*
	Social connectedness and supports	*Neutral*
ENVIRONMENT	Habitat health (aquatic, wetland, and riparian) and water quality	*Neutral*
CULTURE	Recreation and outdoor lifestyle	*Neutral*
OBSTACLES	Regulatory	*Moderately challenging*
	Political and public will	*Relatively easy*
COST	Implementation cost	*$*
	Maintenance cost	*$*

OPPORTUNITIES

- Potential for significant vulnerability and risk reduction.

CHALLENGES

- Relatively novel approach for Canada which creates challenges for implementation (regulations, building codes, materials, etc.).
- As this is still relatively uncommon in Canada, suppliers for temporary floodproofing materials and barriers are limited.
- Requires adequate warning time, and resources to deploy measures in a timely fashion.

21. Dry Floodproofing (Temporary)

HOW TO IMPLEMENT

Local governments have limited authority to enact regulations or enable novel and/or progressive flood proofing methods. However, temporary flood protection, is generally allowable during periods of disruption such as a flood.

PROCESS COMPONENT	WHAT	HOW
Plan	*Signal intent to advocate for broader definitions of flood resilient structures.*	• Use existing advocacy mechanisms, such as UBCM resolution, to advocate, with other partners for changes to BC Building Code, and broader definitions for funding programs to explicitly include permanent floodproofing options.
Regulate	*Advocate to senior governments for changes to Canada and BC Building Codes.*	• Advocate to BC for changes to the Flood Hazard Area Land Use Management Guidelines to include a broader definition of floodproofing.
Guide	*N/A*	
Fund	*No known funding mechanisms.*	
Monitor/Enforce	*N/A*	

DEPENDENCIES

- Public and accessible flood mapping
- Flood warning systems

COMPLEMENTARY ACTIONS

- Other options in Building Management
- All options in Education and Awareness
- All options in Insurance

See Flood Resilient Homes Program from Brisbane, Australia. This program provides inspections and advice to homeowners on how to permanently or temporarily protect their homes from floodwaters.

See BRE Flood House, from UK. This is a joint industry and academic project to build and flood model homes to better understand the susceptibility of various materials to flood damage.

FLOOD TYPE

FLOOD DEPTH

LAND USE

22. Wet Floodproofing (New Builds)

Building design and construction aimed at allowing floodwaters but minimizing damage. The use of flood-tolerant building materials (e.g., waterproof replacements for drywall) are an example of this option.

FLOOD TYPE

FLOOD DEPTH

LAND USE

EFFECTIVENESS OF OPTION FOR RISK REDUCTION AND RESILIENCE DURING A FLOOD EVENT		
PEOPLE	Reduce risks to health and safety of people	*Ineffective*
STRUCTURES	Reduce damage to structures	*Highly effective*
DISRUPTION	Minimize disruption of services and mobility (e.g., electricity, gas, communications)	*Ineffective*
ECONOMY	Minimize damage to local economy including agriculture and tourism	*Moderately effective*
EMERGENCY RESPONSE	Increase the effectiveness of response	*Moderately effective*
CLIMATE	Increase adaptability of option to multiple climate futures	*Highly effective*

EFFECT OF OPTION ITSELF ON ITS SURROUNDINGS		
COMMUNITY	Housing	*Positive*
	Social connectedness and supports	*Neutral*
ENVIRONMENT	Habitat health (aquatic, wetland, and riparian) and water quality	*Neutral*
CULTURE	Recreation and outdoor lifestyle	*Neutral*
OBSTACLES	Regulatory	*Very challenging*
	Political and public will	*Relatively easy*
COST	Implementation cost	*$*
	Maintenance cost	*$*

OPPORTUNITIES

- Relatively cheap, especially for new builds.
- Potential for significant vulnerability and risk reduction.
- Can create additional co-benefits especially for accessibility and usability of homes. For example, raising electrical sockets for flood resilience can improve accessibility and usability of the home.

CHALLENGES

- Relatively novel approach for Canada which creates challenges for implementation (regulations, building codes, materials, etc.).
- Potential public perception challenge that ‘no water is acceptable’.
- Building is unusable during flooding and alternate accommodation needs to be provided for people and goods.

22. Wet Floodproofing (New Builds)

HOW TO IMPLEMENT

Local governments have limited authority to enact regulations or enable novel and/or progressive flood proofing methods.

PROCESS COMPONENT	WHAT	HOW
Plan	*Signal intent to advocate for broader definitions of flood resilient structures.*	• Use existing advocacy mechanisms, such as UBCM resolution, to advocate, with other partners for changes to BC Building Code, and broader definitions for funding programs to explicitly include permanent floodproofing options.
Regulate	*Advocate to senior governments for changes to Canada and BC Building Codes.*	• Advocate to BC for changes to the Flood Hazard Area Land Use Management Guidelines to include a broader definition of floodproofing.
Guide	*N/A*	
Fund	*No known funding mechanisms.*	
Monitor/Enforce	*N/A*	

DEPENDENCIES

- Public and accessible flood mapping
- Flood Bylaw or Development Permit Area (see Land Use Management options)

COMPLEMENTARY ACTIONS

- Other options in Building Management
- All options in Education and Awareness
- All options in Insurance

See Flood Resilient Homes Program from Brisbane, Australia. This program provides inspections and advice to homeowners on how to permanently or temporarily protect their homes from floodwaters.

See BRE Flood House, from UK. This is a joint industry and academic project to build and flood model homes to better understand the susceptibility of various materials to flood damage.

ASCE 24-05 Flood Resistant Design and Construction Standard. This US guideline provides practical advice and design standards for property-level flood protection.

RETROFITTING OF EXISTING BUILDINGS

With flood hazard areas increasing in size, and increasing development pressures, it is not always possible to sterilize land use with flood hazard areas. Changing the built form so that damages to structures are limited, or more easily recoverable is an effective means of reducing risk. Retrofitting of existing structures to limit or reduce damage is possible.

FLOOD TYPE

FLOOD DEPTH

LAND USE

BUILDING MANAGEMENT — Retrofitting of Existing Buildings

23. Elevate Structures (Existing Builds)

The elevation of an existing individual building above the expected flood level using fill, stilts, or other structural means.

EFFECTIVENESS OF OPTION FOR RISK REDUCTION AND RESILIENCE DURING A FLOOD EVENT		
PEOPLE	Reduce risks to health and safety of people	*Ineffective*
STRUCTURES	Reduce damage to structures	*Highly effective*
DISRUPTION	Minimize disruption of services and mobility (e.g., electricity, gas, communications)	*Ineffective*
ECONOMY	Minimize damage to local economy including agriculture and tourism	*Moderately effective*
EMERGENCY RESPONSE	Increase the effectiveness of response	*Highly effective*
CLIMATE	Increase adaptability of option to multiple climate futures	*Highly effective*

EFFECT OF OPTION ITSELF ON ITS SURROUNDINGS		
COMMUNITY	Housing	*Negative*
	Social connectedness and supports	*Neutral*
ENVIRONMENT	Habitat health (aquatic, wetland, and riparian) and water quality	*Neutral*
CULTURE	Recreation and outdoor lifestyle	*Neutral*
OBSTACLES	Regulatory	*Relatively easy*
	Political and public will	*Moderately challenging*
COST	Implementation cost	*$$*
	Maintenance cost	*$*

OPPORTUNITIES

- Raising of existing structures can readily occur during major renovations.

CHALLENGES

- Creates challenges for accessibility and servicing.
- Potential for reduced aesthetics when neighbouring sites are at different elevations. Additional architectural and engineering challenge of raising structures.
- For retrofit, can also create challenge of having inconsistent building heights in an existing neighbourhood.

23. Elevate Structures (Existing Builds)

HOW TO IMPLEMENT

Local governments have the authority to enact regulations to require elevation of structures within the floodplain. However, the requirement to retrofit buildings will generally only be triggered during major renovations or redevelopment, and therefore is subject to market forces and property turnover.

PROCESS COMPONENT	WHAT	HOW
Plan	*Prepare technical and background materials to support enactment of flood construction level regulations.*	• Find or develop engineering quality flood mapping to establish flood construction elevations across the floodplain. • Consider developing modified flood construction level mapping that incorporate existing built environment and any future growth (i.e., maps that balance the protection from hazard with servicing and accessibility of raised structures). • Work with local building inspectors to understand any local challenges to implementation.
Regulate	*Regulate buildings in the floodplain using existing permitting thresholds to trigger updated requirements.*	• Use existing floodproofing provisions within the BC Building Code. • Use a Building Bylaw (no longer common). • Include building requirements for within a flood bylaw. • Ensure covenant on title for all buildings requiring a permit (new and renovations). • Use a Hazardous Area Development Permit Area to regulate triggering requirements and standard of retrofit for existing builds.
Guide	*Develop guidance for landowners.*	• Provide materials to support applicants through building permitting process (e.g., District of North Vancouver Creek Hazard Permit Area). • Provide resources to support applicants on how to elevate susceptible areas of existing structures. • Develop guidance for staff and qualified professionals. • Provide checklists and example quality assurance statements for qualified professionals.
Fund	*No known funding mechanisms to develop regulation. Usually funded within local government operational budgets.*	
Monitor/Enforce	*Ensure that non-habitable areas of buildings remain uninhabited.*	• Conduct inspections opportunistically with support of local building inspectors.

DEPENDENCIES

- Public and accessible flood mapping
- Flood Bylaw (see Land Use Management options)

COMPLEMENTARY ACTIONS

- Other options in Building Management
- All options in Education and Awareness
- All options in Insurance

FLOOD TYPE

Riverine

Pluvial

Coastal/Lake

FLOOD DEPTH

Nuisance

Moderate

Severe

LAND USE

Urban

Suburban

Rural

Agricultural

Park/Greenspace

24. Dry Floodproofing (Permanent)

Products or actions, permanently in place, designed to stop water from entering buildings through existing openings or by penetrating walls.

FLOOD TYPE

FLOOD DEPTH

LAND USE

EFFECTIVENESS OF OPTION FOR RISK REDUCTION AND RESILIENCE DURING A FLOOD EVENT		
PEOPLE	Reduce risks to health and safety of people	*Ineffective*
STRUCTURES	Reduce damage to structures	*Highly effective*
DISRUPTION	Minimize disruption of services and mobility (e.g., electricity, gas, communications)	*Ineffective*
ECONOMY	Minimize damage to local economy including agriculture and tourism	*Moderately effective*
EMERGENCY RESPONSE	Increase the effectiveness of response	*Moderately effective*
CLIMATE	Increase adaptability of option to multiple climate futures	*Moderately effective*

EFFECT OF OPTION ITSELF ON ITS SURROUNDINGS		
COMMUNITY	Housing	*Negative*
	Social connectedness and supports	*Neutral*
ENVIRONMENT	Habitat health (aquatic, wetland, and riparian) and water quality	*Neutral*
CULTURE	Recreation and outdoor lifestyle	*Neutral*
OBSTACLES	Regulatory	*Very challenging*
	Political and public will	*Moderately challenging*
COST	Implementation cost	*$$*
	Maintenance cost	*$*

OPPORTUNITIES

- Potential for significant vulnerability and risk reduction.

CHALLENGES

- Relatively novel approach for Canada which creates challenges for implementation (regulations, building codes, materials, etc.).
- Requires geotechnical/hydrogeological considerations to ensure buildings do not ‘pop’ as groundwater rises.

24. Dry Floodproofing (Permanent)

HOW TO IMPLEMENT

Local governments have limited authority to enact regulations or enable novel and/or progressive flood proofing methods.

PROCESS COMPONENT	WHAT	HOW
Plan	*Signal intent to advocate for broader definitions of flood resilient structures.*	
Regulate	*Advocate to senior governments for changes to Canada and BC Building Codes.*	• Advocate to BC for changes to the Flood Hazard Area Land Use Management Guidelines to include a broader definition of floodproofing. • Advocate to senior government and industry groups (e.g, BC Construction Association) to update Building Codes to include modern floodproofing methods.
Guide	*N/A*	
Fund	*No known funding mechanisms.*	
Monitor/Enforce	*N/A*	

DEPENDENCIES

- Public and accessible flood mapping
- Flood Bylaw or Development Permit Area (see Land Use Management options)

COMPLEMENTARY ACTIONS

- Other options in Building Management
- All options in Education and Awareness
- All options in Insurance

Flood Resilient Homes Program from Brisbane, Australia. This program provides inspections and advice to homeowners on how to permanently or temporarily protect their homes from floodwaters.

BRE Flood House, from UK. This is a joint industry and academic project to build and flood model homes to better understand the susceptibility of various materials to flood damage.

ASCE 24-05 Flood Resistant Design and Construction Standard. This US guideline provides practical advice and design standards for property-level flood protection.

Hazard and Hope YouTube channel for retrofitting guidance. This provides tips, aimed at homeowners, on why they should retrofit their homes and what they can easily do themselves.

UK Homeowners Guide to Property Flood Resilience. This UK publication provides simple guidance, aimed at homeowners, on why they should retrofit their homes and what they can easily do themselves.

City of New York Retrofitting Buildings for Flood Risk Design Manual

Farm Flood Readiness Toolkit from the BC Agriculture & Food Climate Action Initiative. This document provides background information and a series of worksheets for farm operators to better prepare their homes and operations to flood.

FLOOD TYPE

FLOOD DEPTH

LAND USE

25. Dry Floodproofing (Temporary)

Products or actions, deployed temporarily with appropriate warning times, designed to stop water from entering buildings through existing openings or by penetrating walls.

FLOOD TYPE

Riverine

Pluvial

Coastal/Lake

FLOOD DEPTH

Nuisance

Moderate

Severe

LAND USE

Urban

Suburban

Rural

Agricultural

Park/Greenspace

EFFECTIVENESS OF OPTION FOR RISK REDUCTION AND RESILIENCE DURING A FLOOD EVENT		
PEOPLE	Reduce risks to health and safety of people	*Ineffective*
STRUCTURES	Reduce damage to structures	*Highly effective*
DISRUPTION	Minimize disruption of services and mobility (e.g., electricity, gas, communications)	*Ineffective*
ECONOMY	Minimize damage to local economy including agriculture and tourism	*Moderately effective*
EMERGENCY RESPONSE	Increase the effectiveness of response	*Moderately effective*
CLIMATE	Increase adaptability of option to multiple climate futures	*Highly effective*

EFFECT OF OPTION ITSELF ON ITS SURROUNDINGS		
COMMUNITY	Housing	*Neutral*
	Social connectedness and supports	*Neutral*
ENVIRONMENT	Habitat health (aquatic, wetland, and riparian) and water quality	*Neutral*
CULTURE	Recreation and outdoor lifestyle	*Neutral*
OBSTACLES	Regulatory	*Very challenging*
	Political and public will	*Relatively easy*
COST	Implementation cost	*$*
	Maintenance cost	*$*

OPPORTUNITIES

- Potential for significant vulnerability and risk reduction.

CHALLENGES

- Relatively novel approach for Canada which creates challenges for implementation (regulations, building codes, materials, etc.).
- Requires geotechnical/hydrogeological considerations to ensure buildings do not ‘pop’ as groundwater rises.
- Requires adequate warning time, and resources to deploy measures in a timely fashion.
- As this is still relatively uncommon in Canada, suppliers for temporary floodproofing materials and barriers are limited.

25. Dry Floodproofing (Temporary)

HOW TO IMPLEMENT

Local governments have limited authority to enact regulations or enable novel and/or progressive flood proofing methods.

PROCESS COMPONENT	WHAT	HOW
Plan	*Signal intent to advocate for broader definitions of flood resilient structures.*	
Regulate	*Advocate to senior governments for changes to Canada and BC Building Codes.*	• Advocate to senior government and industry groups (e.g, BC Construction Association) to update Building Codes to include modern floodproofing methods. • Advocate to BC for changes to the Flood Hazard Area Land Use Management Guidelines to include a broader definition of floodproofing.
Guide	*N/A*	
Fund	*No known funding mechanisms.*	
Monitor/Enforce	*N/A*	

DEPENDENCIES

- Public and accessible flood mapping
- Flood warning systems

COMPLEMENTARY ACTIONS

- Other options in Building Management
- All options in Education and Awareness
- All options in Insurance

Flood Resilient Homes Program from Brisbane, Australia. This program provides inspections and advice to homeowners on how to permanently or temporarily protect their homes from floodwaters.

BRE Flood House, from UK. This is a joint industry and academic project to build and flood model homes to better understand the susceptibility of various materials to flood damage.

ASCE 24-05 Flood Resistant Design and Construction Standard. This US guideline provides practical advice and design standards for property-level flood protection.

Hazard and Hope YouTube channel for retrofitting guidance. This provides tips, aimed at homeowners, on why they should retrofit their homes and what they can easily do themselves.

UK Homeowners Guide to Property Flood Resilience. This UK publication provides simple guidance, aimed at homeowners, on why they should retrofit their homes and what they can easily do themselves.

City of New York Retrofitting Buildings for Flood Risk Design Manual

Farm Flood Readiness Toolkit from the BC Agriculture & Food Climate Action Initiative. This document provides background information and a series of worksheets for farm operators to better prepare their homes and operations to flood.

26. Wet Floodproofing (Existing and New Builds)

Building design and construction aimed at allowing floodwaters but minimizing damage. The use of flood-tolerant building materials (e.g., waterproof replacements for drywall) are an example of this option.

FLOOD TYPE

Riverine

Pluvial

Coastal/Lake

FLOOD DEPTH

Nuisance

Moderate

Severe

LAND USE

Urban

Suburban

Rural

Agricultural

Park/Greenspace

EFFECTIVENESS OF OPTION FOR RISK REDUCTION AND RESILIENCE DURING A FLOOD EVENT		
PEOPLE	Reduce risks to health and safety of people	*Ineffective*
STRUCTURES	Reduce damage to structures	*Highly effective*
DISRUPTION	Minimize disruption of services and mobility (e.g., electricity, gas, communications)	*Ineffective*
ECONOMY	Minimize damage to local economy including agriculture and tourism	*Moderately effective*
EMERGENCY RESPONSE	Increase the effectiveness of response	*Moderately effective*
CLIMATE	Increase adaptability of option to multiple climate futures	*Highly effective*

EFFECT OF OPTION ITSELF ON ITS SURROUNDINGS		
COMMUNITY	Housing	*Positive*
	Social connectedness and supports	*Neutral*
ENVIRONMENT	Habitat health (aquatic, wetland, and riparian) and water quality	*Neutral*
CULTURE	Recreation and outdoor lifestyle	*Neutral*
OBSTACLES	Regulatory	*Very challenging*
	Political and public will	*Moderately challenging*
COST	Implementation cost	*$$*
	Maintenance cost	*$*

OPPORTUNITIES

REGION-WIDE APPROACH

- Relatively cheap, especially for new builds.
- Potential for significant vulnerability and risk reduction.
- Can create additional co-benefits especially for accessibility and usability of homes. For example, raising electrical sockets for flood resilience can be easier for some owners for all activities.

CHALLENGES

- Relatively novel approach for Canada which creates challenges for implementation (regulations, building codes, materials, etc.).

26. Wet Floodproofing (Existing and New Builds)

HOW TO IMPLEMENT

Local governments have limited authority to enact regulations or enable novel and/or progressive flood proofing methods.

PROCESS COMPONENT	WHAT	HOW
Plan	*Signal intent to advocate for broader definitions of flood resilient structures.*	
Regulate	*Advocate to senior governments for changes to Canada and BC Building Codes.*	• Advocate to senior government and industry groups (e.g, BC Construction Association) to update Building Codes to include modern floodproofing methods. • Advocate to BC for changes to the Flood Hazard Area Land Use Management Guidelines to include broader definition of floodproofing.
Guide	*N/A*	
Fund	*No known funding mechanisms.*	
Monitor/Enforce	*N/A*	

DEPENDENCIES

- Public and accessible flood mapping
- Flood Bylaw or Development Permit Area (see Land Use Management options)

COMPLEMENTARY ACTIONS

- Other options in Building Management
- All options in Education and Awareness
- All options in Insurance

Flood Resilient Homes Program from Brisbane, Australia. This program provides inspections and advice to homeowners on how to permanently or temporarily protect their homes from floodwaters.

BRE Flood House, from UK. This is a joint industry and academic project to build and flood model homes to better understand the susceptibility of various materials to flood damage.

ASCE 24-05 Flood Resistant Design and Construction Standard. This US guideline provides practical advice and design standards for property-level flood protection.

Hazard and Hope YouTube channel for retrofitting guidance. This provides tips, aimed at homeowners, on why they should retrofit their homes and what they can easily do themselves.

UK Homeowners Guide to Property Flood Resilience. This UK publication provides simple guidance, aimed at homeowners, on why they should retrofit their homes and what they can easily do themselves.

City of New York Retrofitting Buildings for Flood Risk Design Manual

Farm Flood Readiness Toolkit from the BC Agriculture & Food Climate Action Initiative. This document provides background information and a series of worksheets for farm operators to better prepare their homes and operations to flood.

ACKNOWLEDGE AND DISCLOSE

A precursor to developing land use controls in flood hazard areas, is the recognition, acknowledgement and public disclosure of the existence, extents, etc. of the hazard. Disclosure can also support uptake of other risk reduction or resilience measures (e.g., floodproofing, insurance).

FLOOD TYPE

FLOOD DEPTH

LAND USE

EDUCATION AND AWARENESS — Acknowledge and Disclose

27. Covenant on Title

Requirement that flood hazard be disclosed on property title. The intent is to require that all parcels within a hazard area have disclosure on title, and not only those with exemptions or variances. This option does not have significant immediate benefits to risk reduction. However, this option can greatly support the implementation of other options by increasing awareness and understanding of existing hazards.

EFFECTIVENESS OF OPTION FOR RISK REDUCTION AND RESILIENCE DURING A FLOOD EVENT		
PEOPLE	Reduce risks to health and safety of people	*Ineffective*
STRUCTURES	Reduce damage to structures	*Ineffective*
DISRUPTION	Minimize disruption of services and mobility (e.g., electricity, gas, communications)	*Ineffective*
ECONOMY	Minimize damage to local economy including agriculture and tourism	*Ineffective*
EMERGENCY RESPONSE	Increase the effectiveness of response	*Ineffective*
CLIMATE	Increase adaptability of option to multiple climate futures	*Highly effective*

EFFECT OF OPTION ITSELF ON ITS SURROUNDINGS		
COMMUNITY	Housing	*Neutral*
	Social connectedness and supports	*Neutral*
ENVIRONMENT	Habitat health (aquatic, wetland, and riparian) and water quality	*Neutral*
CULTURE	Recreation and outdoor lifestyle	*Neutral*
OBSTACLES	Regulatory	*Relatively easy*
	Political and public will	*Moderately challenging*
COST	Implementation cost	*$$*
	Maintenance cost	*$*

OPPORTUNITIES

- Increased transparency of flood risk to homebuyers can stimulate risk reducing actions (e.g., floodproofing, insurance uptake).

CHALLENGES

- Requires support of other agencies (e.g., BC Land Title and Survey).
- Perception that this will affect property values (and or taxation revenues).

27. Covenant on Title

HOW TO IMPLEMENT

Local governments have the authority to require covenants on title when local government regulations are triggered.

PROCESS COMPONENT	WHAT	HOW
Plan	*Ensure consistency in approach.*	• Work with staff across multiple departments on flood and land use regulations. • Conduct studies to explore legal implications of registering a covenant on title for hazardous lands. • Work within the region to collaborate on this to ensure consistency. • Collaborate with local realtors to ensure they understand the need for covenants.
Regulate	*Include provision for covenants within Flood Bylaw.*	• Include requirement that any technical reports or any granted exemptions are registered on title under a Section 219 Covenant.
Guide	*No known senior government guidance.*	• Work with other regional governments to develop guidance materials for realtors and developers to provide information on where hazard areas are, and the importance of disclosure.
Fund	*No known funding mechanisms to develop regulation. Usually funded within local government operational budgets.*	
Monitor/Enforce	*Monitor the proportion of properties within flood hazard areas with covenants.*	• Ensure that local government property databases include an attribute related to covenants related to flood hazard.

DEPENDENCIES

- Public and accessible flood mapping.
- Land Use Management and Building Management

COMPLEMENTARY ACTIONS

- Other options in Education and Awareness
- All options in Insurance

State of California Disclosure Law

FLOOD TYPE

Riverine

Pluvial

Coastal/Lake

FLOOD DEPTH

Nuisance

Moderate

Severe

LAND USE

Urban

Suburban

Rural

Agricultural

Park/Greenspace

FLOOD TYPE

Riverine

Pluvial

Coastal/Lake

FLOOD DEPTH

Nuisance

Moderate

Severe

LAND USE

Urban

Suburban

Rural

Agricultural

Park/Greenspace

EDUCATION AND AWARENESS — Acknowledge and Disclose

28. Public and Accessible Flood Mapping

The delivery of high-quality flood mapping in multiple formats (simple through detailed, and viewable through downloadable) to support understanding or hazard and risk.

EFFECTIVENESS OF OPTION FOR RISK REDUCTION AND RESILIENCE DURING A FLOOD EVENT		
PEOPLE	Reduce risks to health and safety of people	*Moderately effective*
STRUCTURES	Reduce damage to structures	*Ineffective*
DISRUPTION	Minimize disruption of services and mobility (e.g., electricity, gas, communications)	*Ineffective*
ECONOMY	Minimize damage to local economy including agriculture and tourism	*Ineffective*
EMERGENCY RESPONSE	Increase the effectiveness of response	*Moderately effective*
CLIMATE	Increase adaptability of option to multiple climate futures	*Highly effective*

EFFECT OF OPTION ITSELF ON ITS SURROUNDINGS		
COMMUNITY	Housing	*Neutral*
	Social connectedness and supports	*Neutral*
ENVIRONMENT	Habitat health (aquatic, wetland, and riparian) and water quality	*Neutral*
CULTURE	Recreation and outdoor lifestyle	*Neutral*
OBSTACLES	Regulatory	*Relatively easy*
	Political and public will	*Relatively easy*
COST	Implementation cost	*$-$$*
	Maintenance cost	*$*

OPPORTUNITIES

- Support public education and increase flood risk awareness using authoritative maps.

REGION-WIDE APPROACH

CHALLENGES

- Requires resources to create and maintain accessible spatial data sets.
- Perception that this will affect property values (and or taxation revenues).

28. Public and Accessible Flood Mapping

HOW TO IMPLEMENT

Local governments have the authority and responsibility to develop and make accessible flood mapping. They can, however, be supported by senior governments.

PROCESS COMPONENT	WHAT	HOW
Plan	*Produce and make available suitably targeted mapping.*	• When scoping developing any new flood mapping project discuss the end users and mapping needs prior to commissioning mapping. • Work with local government GIS staff to understand potential options to make data publicly available.
Regulate	*Include flood and other hazard mapping in any open-data initiatives.*	• Work internally within local government to understand current commitments to open-data initiatives.
Guide	*Limited senior government guidance on disclosure and accessibility.*	• Review data schema and other background information within National Flood Hazard Data Layer reporting (available by request from Natural Resources Canada).
Fund	*No known targeted funding for mapping disclosure and accessibility.*	• Disclosure and accessibility can be included in grant asks for larger mapping projects. • Community Emergency Preparedness Fund. • National Disaster Mitigation Program. • UBCM Gas Tax Fund (Strategic Priorities).
Monitor/Enforce	*Ensure information remains publicly accessible.*	• Develop regulations to support open-data initiatives.

DEPENDENCIES

- Public Education Options

COMPLEMENTARY ACTIONS

- Other options in Education and Awareness
- All options in Emergency response
- All options in Insurance

Okanagan Flood Story

FLOOD TYPE

Riverine

Pluvial

Coastal/Lake

FLOOD DEPTH

Nuisance

Moderate

Severe

LAND USE

Urban

Suburban

Rural

Agricultural

Park/Greenspace

PUBLIC EDUCATION

Programs to educate the public about flood hazard, vulnerability, and risk as well as the provision of resources that can aid the public in making good decisions about flood-risk reduction.

FLOOD TYPE

Riverine

Pluvial

Coastal/Lake

FLOOD DEPTH

Nuisance

Moderate

Severe

LAND USE

Urban

Suburban

Rural

Agricultural

Park/Greenspace

EDUCATION AND AWARENESS — Public Education

29. Public Education (Multi-media)

EFFECTIVENESS OF OPTION FOR RISK REDUCTION AND RESILIENCE DURING A FLOOD EVENT		
PEOPLE	Reduce risks to health and safety of people	*Moderately effective*
STRUCTURES	Reduce damage to structures	*Ineffective*
DISRUPTION	Minimize disruption of services and mobility (e.g., electricity, gas, communications)	*Ineffective*
ECONOMY	Minimize damage to local economy including agriculture and tourism	*Ineffective*
EMERGENCY RESPONSE	Increase the effectiveness of response	*Moderately effective*
CLIMATE	Increase adaptability of option to multiple climate futures	*Highly effective*

EFFECT OF OPTION ITSELF ON ITS SURROUNDINGS		
COMMUNITY	Housing	*Neutral*
	Social connectedness and supports	*Positive*
ENVIRONMENT	Habitat health (aquatic, wetland, and riparian) and water quality	*Neutral*
CULTURE	Recreation and outdoor lifestyle	*Neutral*
OBSTACLES	Regulatory	*Relatively easy*
	Political and public will	*Relatively easy*
COST	Implementation cost	*$*
	Maintenance cost	*$*

OPPORTUNITIES

- Empowers residents and business owners to act.
- Media outlets can target difficult-to-reach communities (e.g., minority language media outlets).

REGION-WIDE APPROACH

CHALLENGES

- Can seem costly with limited information on return on investment.
- Reaching socially vulnerable communities require more thought and a tailored approach as a one-size-fits-all approach will be ineffective.

29. Public Education (Multi-media)

HOW TO IMPLEMENT

Local governments have the authority and responsibility to educate the public. They can work with senior governments to develop consistent messaging.

PROCESS COMPONENT	WHAT	HOW
Plan	*Conduct a scan of existing public education materials.*	• Develop a gap analysis for public education at a regional scale. • Collaborate with regional local governments to develop consistent, high-quality materials to fill any gaps.
Regulate	*N/A*	
Guide	*No know senior government guidance on how to educate the public.*	
Fund	*No known targeted funding for public education.*	• Public education can be included in grant asks for larger mapping projects. • Community Emergency Preparedness Fund. • National Disaster Mitigation Program.
Monitor/Enforce	*Monitor the reach and effectiveness of all materials supported by local governments.*	• Monitor hits to websites, etc. • Monitor the number of interactions with the public on issues of flood at local government front counters.

DEPENDENCIES

- Public and accessible flood mapping

COMPLEMENTARY ACTIONS

- Other options in Education and Awareness
- All options in Emergency response
- All options in Insurance

BC FloodWise Website. This website, originally conceived for the Lower Mainland Flood Management Strategy, but with broad application, provides basic background information targeted at a lay audience.

Alberta YouTube Channel. This channel includes a series of videos that describe flood mapping and mitigation basics for a lay audience. They were developed by the Watershed Resilience and Mitigation Branch of Alberta Environment and Parks.

30. Serious Gaming

Board or computer games that encourage learning about floods and tradeoffs of different strategies.

FLOOD TYPE

FLOOD DEPTH

LAND USE

EFFECTIVENESS OF OPTION FOR RISK REDUCTION AND RESILIENCE DURING A FLOOD EVENT		
PEOPLE	Reduce risks to health and safety of people	*Moderately effective*
STRUCTURES	Reduce damage to structures	*Ineffective*
DISRUPTION	Minimize disruption of services and mobility (e.g., electricity, gas, communications)	*Ineffective*
ECONOMY	Minimize damage to local economy including agriculture and tourism	*Ineffective*
EMERGENCY RESPONSE	Increase the effectiveness of response	*Moderately effective*
CLIMATE	Increase adaptability of option to multiple climate futures	*Highly effective*

EFFECT OF OPTION ITSELF ON ITS SURROUNDINGS		
COMMUNITY	Housing	*Neutral*
	Social connectedness and supports	*Positive*
ENVIRONMENT	Habitat health (aquatic, wetland, and riparian) and water quality	*Neutral*
CULTURE	Recreation and outdoor lifestyle	*Neutral*
OBSTACLES	Regulatory	*Relatively easy*
	Political and public will	*Relatively easy*
COST	Implementation cost	*$*
	Maintenance cost	*$*

OPPORTUNITIES

- Low cost. Excellent learning immersive opportunities.

CHALLENGES

- Obstacle to get public to engage in these types of activities.

30. Serious Gaming

HOW TO IMPLEMENT

Local governments can support serious gaming initiatives within other flood management activities.

PROCESS COMPONENT	WHAT	HOW
Plan	*Consider working together as a region to develop and online serious gaming tool for flood in the Okanagan.*	• Build relationships with potential partners. • Consider working with higher educational institutions, especially those with video game programs (e.g., Okanagan College).
Regulate	*N/A*	
Guide	*No know senior government guidance on how to educate the public.*	
Fund	*No known targeted funding for public education.*	• Public education can be included in grant asks for larger mapping projects. • Community Emergency Preparedness Fund. • National Disaster Mitigation Program.
Monitor/Enforce	*Develop project specific indicators.*	

DEPENDENCIES

- Public and accessible flood mapping

COMPLEMENTARY ACTIONS

- Other options in Education and Awareness
- All options in Emergency response
- All options in Insurance

Game of Floods is one readily available serious game. It was originally produced by Marin County in California to explore tradeoffs related to sea level rise, but is now a fully imagined board game.

FLOOD TYPE

Riverine

Pluvial

Coastal/Lake

FLOOD DEPTH

Nuisance

Moderate

Severe

LAND USE

Urban

Suburban

Rural

Agricultural

Park/Greenspace

31. Public Art

Use of art and public spaces to educate and remind residents and others that floods can and do occur.

FLOOD TYPE

FLOOD DEPTH

LAND USE

EFFECTIVENESS OF OPTION FOR RISK REDUCTION AND RESILIENCE DURING A FLOOD EVENT		
PEOPLE	Reduce risks to health and safety of people	*Moderately effective*
STRUCTURES	Reduce damage to structures	*Ineffective*
DISRUPTION	Minimize disruption of services and mobility (e.g., electricity, gas, communications)	*Ineffective*
ECONOMY	Minimize damage to local economy including agriculture and tourism	*Ineffective*
EMERGENCY RESPONSE	Increase the effectiveness of response	*Moderately effective*
CLIMATE	Increase adaptability of option to multiple climate futures	*Highly effective*

EFFECT OF OPTION ITSELF ON ITS SURROUNDINGS		
COMMUNITY	Housing	*Neutral*
	Social connectedness and supports	*Positive*
ENVIRONMENT	Habitat health (aquatic, wetland, and riparian) and water quality	*Neutral*
CULTURE	Recreation and outdoor lifestyle	*Neutral*
OBSTACLES	Regulatory	*Relatively easy*
	Political and public will	*Relatively easy*
COST	Implementation cost	*$*
	Maintenance cost	*$*

OPPORTUNITIES

- Creates interesting conversations.
- Co-benefits related to aesthetics and community building can also be achieved.

CHALLENGES

- Can seem costly or be perceived as a low priority.

31. Public Art

HOW TO IMPLEMENT

Local governments have the authority to support and promote public art.

PROCESS COMPONENT	WHAT	HOW
Plan	*Conduct a 'needs assessment' to establish potential for public art with a focus on flood and/or climate change.*	• Develop relationships to support future initiatives. • Collaborate internally with planners and others who are charged with public art. • Build relationships with stakeholders and outside agencies who might support or host public art.
Regulate	*N/A*	
Guide	*No know senior government guidance on how to educate the public.*	• Review existing resource materials from other BC local governments.
Fund	*No known targeted funding for public art (for flood/climate awareness).*	
Monitor/Enforce	*Develop project specific indicators.*	

DEPENDENCIES

- Public and accessible flood mapping

COMPLEMENTARY ACTIONS

- Other options in Education and Awareness
- All options in Emergency response
- All options in Insurance

A Public Engagement Toolkit for Sea Level Rise. This City of Vancouver Greenest City Scholar document provides a comprehensive list of public education tools for coastal flooding. Many, if not most, concepts are equally applicable to flooding types in the Okanagan.

FLOOD TYPE

Riverine

Pluvial

Coastal/Lake

FLOOD DEPTH

Nuisance

Moderate

Severe

LAND USE

Urban

Suburban

Rural

Agricultural

Park/Greenspace

MEDIA EDUCATION

Programs to educate the media, in advance of a flood event, to support them to provide correct and useful information when flood warnings are issued or during a flood event.

FLOOD TYPE

Riverine

Pluvial

Coastal/Lake

FLOOD DEPTH

Nuisance

Moderate

Severe

LAND USE

Urban

Suburban

Rural

Agricultural

Park/Greenspace

EDUCATION AND AWARENESS — Media Education

32. Media Education

EFFECTIVENESS OF OPTION FOR RISK REDUCTION AND RESILIENCE DURING A FLOOD EVENT		
PEOPLE	Reduce risks to health and safety of people	*Moderately effective*
STRUCTURES	Reduce damage to structures	*Ineffective*
DISRUPTION	Minimize disruption of services and mobility (e.g., electricity, gas, communications)	*Ineffective*
ECONOMY	Minimize damage to local economy including agriculture and tourism	*Ineffective*
EMERGENCY RESPONSE	Increase the effectiveness of response	*Moderately effective*
CLIMATE	Increase adaptability of option to multiple climate futures	*Highly effective*

EFFECT OF OPTION ITSELF ON ITS SURROUNDINGS		
COMMUNITY	Housing	*Neutral*
	Social connectedness and supports	*Neutral*
ENVIRONMENT	Habitat health (aquatic, wetland, and riparian) and water quality	*Neutral*
CULTURE	Recreation and outdoor lifestyle	*Neutral*
OBSTACLES	Regulatory	*Relatively easy*
	Political and public will	*Relatively easy*
COST	Implementation cost	*$*
	Maintenance cost	*$*

OPPORTUNITIES

- Can ensure that good messaging is delivered when it matters.

CHALLENGES

- Can seem like a low priority, especially when it is not flooding.

REGION-WIDE APPROACH

32. Media Education

HOW TO IMPLEMENT

Local governments have the authority to develop materials to support media.

PROCESS COMPONENT	WHAT	HOW
Plan	*Build internal capacity.*	• Work with local government communications staff to develop flood specific resources to be deployed before, during and after a flood. • Review existing communication strategies. • Build relationships with media. • Share information with media proactively. • Build relationships with higher education institutions, especially those with journalism programs (e.g., UBCO and Okanagan College). • Work with students to develop materials for publication before, during and after a flood.
Regulate	*N/A*	
Guide	*No known government guidance materials.*	• Review available resources. • None known, except for issue specific (e.g., No Natural Disasters).
Fund	*No known targeted funding to support media education.*	
Monitor/Enforce	*Develop project specific indicators.*	

DEPENDENCIES

- Public and accessible flood mapping

COMPLEMENTARY ACTIONS

- Other options in Education and Awareness
- All options in Emergency response
- All options in Insurance

No Natural Disasters is a non-profit organisation that provides media toolkits to support journalists to use correct terminology during disaster events. Namely, that disasters are generally human-caused and not "natural".

FLOOD TYPE

Riverine

Pluvial

Coastal/Lake

FLOOD DEPTH

Nuisance

Moderate

Severe

LAND USE

Urban

Suburban

Rural

Agricultural

Park/Greenspace

MONITORING AND WARNING

Timely response requires that monitoring systems and warning systems are in place so that actions within flood response plans can be triggered.

FLOOD TYPE

FLOOD DEPTH

LAND USE

EMERGENCY RESPONSE — Monitoring and Warning

33. Warning System

A program or automated system that provides a warning of impending flooding (hours to days to onset). More sophisticated systems use text messaging, but can also include media coverage, sirens, etc. A warning system on its own does not reduce risk to all elements in the floodplain, but when paired with flood response plans and temporary building controls can be very effective at mitigating risks.

EFFECTIVENESS OF OPTION FOR RISK REDUCTION AND RESILIENCE DURING A FLOOD EVENT		
PEOPLE	Reduce risks to health and safety of people	*Highly effective*
STRUCTURES	Reduce damage to structures	*Ineffective*
DISRUPTION	Minimize disruption of services and mobility (e.g., electricity, gas, communications)	*Ineffective*
ECONOMY	Minimize damage to local economy including agriculture and tourism	*Ineffective*
EMERGENCY RESPONSE	Increase the effectiveness of response	*Highly effective*
CLIMATE	Increase adaptability of option to multiple climate futures	*Highly effective*

EFFECT OF OPTION ITSELF ON ITS SURROUNDINGS		
COMMUNITY	Housing	*Neutral*
	Social connectedness and supports	*Neutral*
ENVIRONMENT	Habitat health (aquatic, wetland, and riparian) and water quality	*Neutral*
CULTURE	Recreation and outdoor lifestyle	*Neutral*
OBSTACLES	Regulatory	*Relatively easy*
	Political and public will	*Relatively easy*
COST	Implementation cost	*$-$$*
	Maintenance cost	*$*

OPPORTUNITIES

- Relatively low-cost item, although requires ongoing maintenance.

CHALLENGES

- May seem like a low priority when it is not flooding.
- Requires testing and training prior to use and ongoing maintenance.

33. Warning System

HOW TO IMPLEMENT

Local governments have the authority and responsibility to develop warning systems with the support of senior governments.

PROCESS COMPONENT	WHAT	HOW
Plan	*Build connections and capacity within local government to deploy warning and monitoring systems.*	• Work with local emergency response officials to conduct a needs assessment to determine if improved monitoring and warning systems are warranted. • Build relationships with agencies that have technical capacity to provide information to warning systems. - Water Survey of Canada - BC River Forecast Centre
Regulate	*N/A*	
Guide	*No known senior government guidance is available on the development of warning systems.*	
Fund	*Provincial funding is available to support monitoring and warning programs.*	• Community Emergency Preparedness Fund.
Monitor/Enforce	*Monitoring programs to ensure systems continue to be effective must be developed and funding.*	

DEPENDENCIES

- Public and accessible flood mapping

COMPLEMENTARY ACTIONS

- All options in Education and Awareness
- Neighbourhood resilience building

City of Fort Collins Flood Warning System (Colorado, USA) have an innovative warning system that includes a real-time flood warning mapping that is available online.

Alberta Rivers App. The Government of Alberta has an app (available in "iOS" for iPhone Operating System and android) that links to its normal warning system. The App will alert users to flood warnings, evacuations, etc., and provides real-time streamflow information.

FLOOD TYPE

Riverine

Pluvial

Coastal/Lake

FLOOD DEPTH

Nuisance

Moderate

Severe

LAND USE

Urban

Suburban

Rural

Agricultural

Park/Greenspace

FLOOD RESPONSE PLANNING

Timely response requires that monitoring systems and warning systems are in place so that actions within flood response plans can be triggered.

FLOOD TYPE

FLOOD DEPTH

LAND USE

EMERGENCY RESPONSE — Flood Response Planning

34. Flood Response Plan

A flood response plan enables a community to efficiently respond during a flood emergency and limit loss and damages. A plan should include consideration of aims and objectives, triggers and activation, known hazards and risks, etc.

EFFECTIVENESS OF OPTION FOR RISK REDUCTION AND RESILIENCE DURING A FLOOD EVENT		
PEOPLE	Reduce risks to health and safety of people	*Highly effective*
STRUCTURES	Reduce damage to structures	*Ineffective*
DISRUPTION	Minimize disruption of services and mobility (e.g., electricity, gas, communications)	*Ineffective*
ECONOMY	Minimize damage to local economy including agriculture and tourism	*Ineffective*
EMERGENCY RESPONSE	Increase the effectiveness of response	*Highly effective*
CLIMATE	Increase adaptability of option to multiple climate futures	*Highly effective*

EFFECT OF OPTION ITSELF ON ITS SURROUNDINGS		
COMMUNITY	Housing	*Neutral*
	Social connectedness and supports	*Neutral*
ENVIRONMENT	Habitat health (aquatic, wetland, and riparian) and water quality	*Neutral*
CULTURE	Recreation and outdoor lifestyle	*Neutral*
OBSTACLES	Regulatory	*Relatively easy*
	Political and public will	*Relatively easy*
COST	Implementation cost	*$-$$*
	Maintenance cost	

OPPORTUNITIES

- Common tool that is for the most part already in place.
- Allows for community involvement to incorporate local knowledge and build trust.

CHALLENGES

- Plan users do not always have the right resources and tools to build appropriate systems.

34. Flood Response Plan

HOW TO IMPLEMENT

Local governments have the authority and responsibility to develop flood response plans.

PROCESS COMPONENT	WHAT	HOW
Plan	*Conduct a review of existing flood response plans.*	• Work with emergency response teams to review effectiveness of flood response plans in light of any new information. • Conduct a review of proposed new requirements for flood response and evacuation planning. • Work with emergency response teams to review BC Emergency Program Act modernisation. • Build on regional relationships to create consistency in approaches and support effective sharing of resources during emergencies. • Review existing Hazards, Risks, and Vulnerability Assessment (HRVA).
Regulate	*Develop and/or review/update an Emergency Program Bylaw.*	
Guide	*Review available guidance material.*	• Flood Planning and Response Guide for British Columbia. • Prepare guidance materials for staff on how to implement plan.
Fund	*Provincial funding is available to support the development and updating of flood response plans.*	• Community Emergency Preparedness Fund.
Monitor/Enforce	*Develop project specific indicators.*	

DEPENDENCIES

- Public and accessible flood mapping

COMPLEMENTARY ACTIONS

- All options in Education and Awareness
- Neighbourhood resilience building

FLOOD TYPE

FLOOD DEPTH

LAND USE

35. Flood Response Plan Maintenance

Flood response plans must be updated frequently so that they incorporate new information, and so responders are familiar with materials.

FLOOD TYPE

Riverine

Pluvial

Coastal/Lake

FLOOD DEPTH

Nuisance

Moderate

Severe

LAND USE

Urban

Suburban

Rural

Agricultural

Park/Greenspace

EFFECTIVENESS OF OPTION FOR RISK REDUCTION AND RESILIENCE DURING A FLOOD EVENT		
PEOPLE	Reduce risks to health and safety of people	*Highly effective*
STRUCTURES	Reduce damage to structures	*Ineffective*
DISRUPTION	Minimize disruption of services and mobility (e.g., electricity, gas, communications)	*Ineffective*
ECONOMY	Minimize damage to local economy including agriculture and tourism	*Ineffective*
EMERGENCY RESPONSE	Increase the effectiveness of response	*Highly effective*
CLIMATE	Increase adaptability of option to multiple climate futures	*Highly effective*

EFFECT OF OPTION ITSELF ON ITS SURROUNDINGS		
COMMUNITY	Housing	*Neutral*
	Social connectedness and supports	*Neutral*
ENVIRONMENT	Habitat health (aquatic, wetland, and riparian) and water quality	*Neutral*
CULTURE	Recreation and outdoor lifestyle	*Neutral*
OBSTACLES	Regulatory	*Relatively easy*
	Political and public will	*Relatively easy*
COST	Implementation cost	
	Maintenance cost	*$*

OPPORTUNITIES

- Provides ongoing opportunities for community involvement and incorporating new knowledge.

REGION-WIDE APPROACH

CHALLENGES

- Flood response plans are often not updated except in times of crisis.

35. Flood Response Plan Maintenance

HOW TO IMPLEMENT

Local governments have the authority and responsibility to keep flood response plans up-to date.

PROCESS COMPONENT	WHAT	HOW
Plan	*Create local policies and plans to require a review of flood response plan annually.*	
Regulate	*N/A*	
Guide	*Review available guidance material*	• Flood Planning and Response Guide for British Columbia. • Prepare agricultural producers for flood. • Share Farm Flood Readiness Toolkit. • Prepare guidance materials for staff on how to implement plan.
Fund	*Provincial funding is available to support the development and updating of flood response plans.*	• Community Emergency Preparedness Fund.
Monitor/Enforce	*Develop project specific indicators.*	

DEPENDENCIES

- Flood response plan development

COMPLEMENTARY ACTIONS

- All options in Education and Awareness
- Neighbourhood resilience building

FLOOD TYPE

Riverine

Pluvial

Coastal/Lake

FLOOD DEPTH

Nuisance

Moderate

Severe

LAND USE

Urban

Suburban

Rural

Agricultural

Park/Greenspace

36. Flood Response Training

Trained and up-to-date personnel are necessary for successful flood response. To ensure that personnel are flood ready, regular training and exercises are required.

FLOOD TYPE

Riverine

Pluvial

Coastal/Lake

FLOOD DEPTH

Nuisance

Moderate

Severe

LAND USE

Urban

Suburban

Rural

Agricultural

Park/Greenspace

EFFECTIVENESS OF OPTION FOR RISK REDUCTION AND RESILIENCE DURING A FLOOD EVENT		
PEOPLE	Reduce risks to health and safety of people	*Highly effective*
STRUCTURES	Reduce damage to structures	*Ineffective*
DISRUPTION	Minimize disruption of services and mobility (e.g., electricity, gas, communications)	*Ineffective*
ECONOMY	Minimize damage to local economy including agriculture and tourism	*Ineffective*
EMERGENCY RESPONSE	Increase the effectiveness of response	*Highly effective*
CLIMATE	Increase adaptability of option to multiple climate futures	*Highly effective*

EFFECT OF OPTION ITSELF ON ITS SURROUNDINGS		
COMMUNITY	Housing	*Neutral*
	Social connectedness and supports	*Neutral*
ENVIRONMENT	Habitat health (aquatic, wetland, and riparian) and water quality	*Neutral*
CULTURE	Recreation and outdoor lifestyle	*Neutral*
OBSTACLES	Regulatory	*Relatively easy*
	Political and public will	*Relatively easy*
COST	Implementation cost	*$*
	Maintenance cost	*$*

OPPORTUNITIES

- Training of new responders can be costly.

CHALLENGES

- Turnover (and burnout) in flood response roles can be challenging.

REGION-WIDE APPROACH

36. Flood Response Training

HOW TO IMPLEMENT

Local governments have the authority and responsibility to ensure readiness for flood response.

PROCESS COMPONENT	WHAT	HOW
Plan	*Identify needs for training.*	• Work with emergency response officials to identify gaps in training. • Build on regional relationships to create consistency in approaches and support effective sharing of resources during emergencies.
Regulate	*N/A*	
Guide	*No known recent materials to guide training.*	
Fund	*Provincial funding is available to support training of emergency personnel and volunteers*	• Community Emergency Preparedness Fund.
Monitor/Enforce	*Develop project specific indicators.*	

DEPENDENCIES

- Flood response plan development
- Flood response plan maintenance

COMPLEMENTARY ACTIONS

- All options in Education and Awareness
- Neighbourhood resilience building

37. Flood Response Resources

Flood response requires physical resources for deployment. This includes space to manage operations (e.g., EOCs), transportation to deploy people and other tools, as well as temporary flood defence barriers, etc. It also includes personnel with appropriate training.

FLOOD TYPE

Riverine

Pluvial

Coastal/Lake

FLOOD DEPTH

Nuisance

Moderate

Severe

LAND USE

Urban

Suburban

Rural

Agricultural

Park/Greenspace

EFFECTIVENESS OF OPTION FOR RISK REDUCTION AND RESILIENCE DURING A FLOOD EVENT		
PEOPLE	Reduce risks to health and safety of people	*Highly effective*
STRUCTURES	Reduce damage to structures	*Ineffective*
DISRUPTION	Minimize disruption of services and mobility (e.g., electricity, gas, communications)	*Ineffective*
ECONOMY	Minimize damage to local economy including agriculture and tourism	*Ineffective*
EMERGENCY RESPONSE	Increase the effectiveness of response	*Highly effective*
CLIMATE	Increase adaptability of option to multiple climate futures	*Highly effective*

EFFECT OF OPTION ITSELF ON ITS SURROUNDINGS		
COMMUNITY	Housing	*Neutral*
	Social connectedness and supports	*Neutral*
ENVIRONMENT	Habitat health (aquatic, wetland, and riparian) and water quality	*Neutral*
CULTURE	Recreation and outdoor lifestyle	*Neutral*
OBSTACLES	Regulatory	*Relatively easy*
	Political and public will	*Relatively easy*
COST	Implementation cost	*$*
	Maintenance cost	*$*

OPPORTUNITIES

- Is a very effective tool to minimise damages if other options have failed.

REGION-WIDE APPROACH

CHALLENGES

- Physical resources can be challenging to sell to public and decision-makers during non-flood periods.
- Some temporary barriers, etc. require that personnel be trained to deploy them.
- Can be challenging to advocate to spend money on flood barriers and other physical resources during non-flood periods.

37. Flood Response Resources

HOW TO IMPLEMENT

Local governments have the authority and responsibility to ensure readiness for flood response. They can also support individual residents and business owners to prepare themselves for flooding.

PROCESS COMPONENT	WHAT	HOW
Plan	*Identify needs for flood resources.*	• Work with emergency response officials to identify gaps in training. • Build on regional relationships to create consistency in approaches and support effective sharing of resources during emergencies.
Regulate	*N/A*	
Guide	*Limited resources to guide policy and decisions.*	• Prepare agricultural producers for flood. • Farm Flood Readiness Toolkit includes links to protective measures (e.g., flood barriers, enhanced drainage systems, etc.) suitable for agricultural operations.
Fund	*No known funding to support the acquisition of flood response resources.*	
Monitor/Enforce	*Monitor the number of deployments of any flood response resources.*	• Develop systems and databases in advance of a flood. • Monitor the effectiveness of any flood response resources. • Complete after action/after deployment reviews.

DEPENDENCIES

- Flood response plan development
- Flood response plan maintenance
- Flood response training

COMPLEMENTARY ACTIONS

- All options in Education and Awareness
- Neighbourhood resilience building

Farm Flood Readiness Toolkit from the BC Agriculture & Food Climate Action Initiative. This document provides background information and a series of worksheets for farm operators to better prepare their homes and operations to flood. This document also lists flood barriers, etc. available for purchase in Canada.

FLOOD TYPE

Riverine

Pluvial

Coastal/Lake

FLOOD DEPTH

Nuisance

Moderate

Severe

LAND USE

Urban

Suburban

Rural

Agricultural

Park/Greenspace

NEIGHBOURHOOD RESILIENCE BUILDING

During and after disaster, communities will generally recover more quickly if systems are in place to build communities that care about each other.

FLOOD TYPE

Riverine

Pluvial

Coastal/Lake

FLOOD DEPTH

Nuisance

Moderate

Severe

LAND USE

Urban

Suburban

Rural

Agricultural

Park/Greenspace

EMERGENCY RESPONSE — Neighbourhood Resilience Building

38. Neighbourhood Resilience Building

EFFECTIVENESS OF OPTION FOR RISK REDUCTION AND RESILIENCE DURING A FLOOD EVENT		
PEOPLE	Reduce risks to health and safety of people	*Highly effective*
STRUCTURES	Reduce damage to structures	*Ineffective*
DISRUPTION	Minimize disruption of services and mobility (e.g., electricity, gas, communications)	*Ineffective*
ECONOMY	Minimize damage to local economy including agriculture and tourism	*Ineffective*
EMERGENCY RESPONSE	Increase the effectiveness of response	*Moderately effective*
CLIMATE	Increase adaptability of option to multiple climate futures	*Highly effective*

EFFECT OF OPTION ITSELF ON ITS SURROUNDINGS		
COMMUNITY	Housing	*Positive*
	Social connectedness and supports	*Very Positive*
ENVIRONMENT	Habitat health (aquatic, wetland, and riparian) and water quality	*Neutral*
CULTURE	Recreation and outdoor lifestyle	*Neutral*
OBSTACLES	Regulatory	*Relatively easy*
	Political and public will	*Relatively easy*
COST	Implementation cost	*$*
	Maintenance cost	*$*

OPPORTUNITIES

- Has immense co-benefits associated with general population health and well-being.
- Can support resilience for all-hazards (e.g., wildfire, pandemic).

REGION-WIDE APPROACH

CHALLENGES

- Can be seen as a low priority during non-disaster periods.

38. Neighbourhood Resilience Building

HOW TO IMPLEMENT

Local governments have the authority to develop resilience strategies and plans.

PROCESS COMPONENT	WHAT	HOW
Plan	*Conduct a baseline assessment of existing risk and resilience strategies.*	• Build on and leverage regional relationships for long-term resilience building.
Regulate	*N/A*	
Guide	*Review available international guidance*	• 10 Essentials for Making Cities Resilient. • Words into Action Guidelines: Implementation Guide for Local Disaster Risk Reduction and Resilience Strategies.
Fund	*Review potential funding programs.*	• Focus and leverage on climate adaptation and resilience funds and programs.
Monitor/Enforce	*Repeat any assessment on a 5-year basis to monitor gains or losses to resilience in the region.*	

DEPENDENCIES

- Public and accessible flood mapping

COMPLEMENTARY ACTIONS

- All options in Education and Awareness
- Other options in Emergency Response

City of Vancouver Resilient Neighbourhoods Program

Social Planning Council for the North Okanagan

FLOOD TYPE

Riverine

Pluvial

Coastal/Lake

FLOOD DEPTH

Nuisance

Moderate

Severe

LAND USE

Urban

Suburban

Rural

Agricultural

Park/Greenspace

There will always be some residual risk, even when risk reduction measures are in place.

FLOOD TYPE

FLOOD DEPTH

LAND USE

INSURANCE AND DISASTER FINANCIAL ASSISTANCE — Insurance

39. Insurance (Private)

The management of residual risk for financial losses can be achieved through private insurance. Insurance and re-insurance companies, with premiums paid by both the public and private sector, cover some financial losses after a flood event. This generally requires that potential policy holders are aware of the need for flood insurance, and then opt-in to the coverage.

EFFECTIVENESS OF OPTION FOR RISK REDUCTION AND RESILIENCE DURING A FLOOD EVENT		
PEOPLE	Reduce risks to health and safety of people	*Ineffective*
STRUCTURES	Reduce damage to structures	*Highly effective*
DISRUPTION	Minimize disruption of services and mobility (e.g., electricity, gas, communications)	*Ineffective*
ECONOMY	Minimize damage to local economy including agriculture and tourism	*Highly effective*
EMERGENCY RESPONSE	Increase the effectiveness of response	*Ineffective*
CLIMATE	Increase adaptability of option to multiple climate futures	*Moderately effective*

EFFECT OF OPTION ITSELF ON ITS SURROUNDINGS		
COMMUNITY	Housing	*Neutral*
	Social connectedness and supports	*Neutral*
ENVIRONMENT	Habitat health (aquatic, wetland, and riparian) and water quality	*Neutral*
CULTURE	Recreation and outdoor lifestyle	*Neutral*
OBSTACLES	Regulatory	*Moderately challenging*
	Political and public will	*Moderately challenging*
COST	Implementation cost	*$*
	Maintenance cost	*$*

OPPORTUNITIES

- Is an effective tool to manage financial element of residual risk.

CHALLENGES

- Premiums in high-hazard areas of the Okanagan can be high and deemed unachievable (e.g., residents of strata complexes in Mill Creek floodplain).
- Hard to convince residents and owners to purchase insurance when there is a perception that government will manage the risk and residual risk (through disaster financial assistance).
- Overland flood insurance is a relatively new product in Canada (2014 start) and is generally an ‘opt-in’ coverage on most policies.
- Some insurance coverages limit re-building to the original condition (i.e., do not allow for additional building controls for flood mitigation).

39. Insurance (Private)

HOW TO IMPLEMENT

Local governments have no authority or responsibility to enable or implement insurance.

PROCESS COMPONENT	WHAT	HOW
Plan	*Work with regional partners to monitor the state of private flood insurance programs in Canada and BC in particular.*	• Follow communications from the Insurance Bureau of Canada. • Work with realtors and developers to understand market penetration and barriers to purchasing insurance. • Advocate to senior government for better coverage and affordability particularly for high-risk properties.
Regulate	*N/A*	
Guide	*N/A*	
Fund	*N/A*	
Monitor/Enforce	*N/A*	

DEPENDENCIES

- Public and accessible flood mapping
- Public Education and Awareness

COMPLEMENTARY ACTIONS

- All the options in Land Stewardship
- All the options in Land Use Management
- All the options in Building Management

FLOOD TYPE

Riverine

Pluvial

Coastal/Lake

FLOOD DEPTH

Nuisance

Moderate

Severe

LAND USE

Urban

Suburban

Rural

Agricultural

Park/Greenspace

40. Insurance (Publicly Funded)

The management of residual risk for financial losses can be achieved through public insurance. In BC and Canada this is called the Disaster Financial Assistance Act/Program.

FLOOD TYPE

Riverine

Pluvial

Coastal/Lake

FLOOD DEPTH

Nuisance

Moderate

Severe

LAND USE

Urban

Suburban

Rural

Agricultural

Park/Greenspace

EFFECTIVENESS OF OPTION FOR RISK REDUCTION AND RESILIENCE DURING A FLOOD EVENT		
PEOPLE	Reduce risks to health and safety of people	*Ineffective*
STRUCTURES	Reduce damage to structures	*Highly effective*
DISRUPTION	Minimize disruption of services and mobility (e.g., electricity, gas, communications)	*Ineffective*
ECONOMY	Minimize damage to local economy including agriculture and tourism	*Highly effective*
EMERGENCY RESPONSE	Increase the effectiveness of response	*Ineffective*
CLIMATE	Increase adaptability of option to multiple climate futures	*Moderately effective*

EFFECT OF OPTION ITSELF ON ITS SURROUNDINGS		
COMMUNITY	Housing	*Neutral*
	Social connectedness and supports	*Neutral*
ENVIRONMENT	Habitat health (aquatic, wetland, and riparian) and water quality	*Neutral*
CULTURE	Recreation and outdoor lifestyle	*Neutral*
OBSTACLES	Regulatory	*Moderately challenging*
	Political and public will	*Relatively easy*
COST	Implementation cost	*$*
	Maintenance cost	*$*

OPPORTUNITIES

- Greater accessibility to insurance as public funding is used to subsidize costs.

REGION-WIDE APPROACH

CHALLENGES

- This program is in flux.
- There are limits to financial payouts.
- This is a costly program for the public purse (estimated $1Bn/annually for the Federal Government).

40. Insurance (Publicly Funded)

HOW TO IMPLEMENT

Local governments have no authority or responsibility to develop of fund disaster financial assistance programs.

PROCESS COMPONENT	WHAT	HOW
Plan	*Work with regional partners to advocate for improvements to the Disaster Financial Assistance Program.*	• Leverage experience with recent flood and wildfire events to support streamlining of systems. • Advocate for changes to the program to support buyouts and "build back better" initiatives.
Regulate	*N/A*	
Guide	*N/A*	
Fund	*N/A*	
Monitor/Enforce	*N/A*	

DEPENDENCIES

- Public and accessible flood mapping
- Public Education and Awareness

COMPLEMENTARY ACTIONS

- All the options in Land Stewardship
- All the options in Land Use Management
- All the options in Building Management
- Other options in Insurance

BC Disaster Financial Assistance

Regional District of Central Okanagan

Central Okanagan
FLOOD MITIGATION PLANNING

Document prepared with the assistance of:

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