Non-Structural Flood Mitigation Technical Report

FINAL REPORT

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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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1 Introduction

Floods matter. People whose homes are inundated or damaged will remember for the rest of their lives; landscapes are changed forever; regional and national economies suffer. With climate change driving up the frequency and intensity of flooding and other natural hazards, the risks and impacts to the Okanagan's economic vitality, infrastructure, environment, and citizens will only continue to grow.

The Regional District of the Central Okanagan (RDCO) along with regional First Nation and Local Governments and other regional partners have been working together for many years to increase understanding of the local flood hazards and their trajectory with climate change. This new information, coupled with recent damaging floods has highlighted the need for new approaches in flood management.

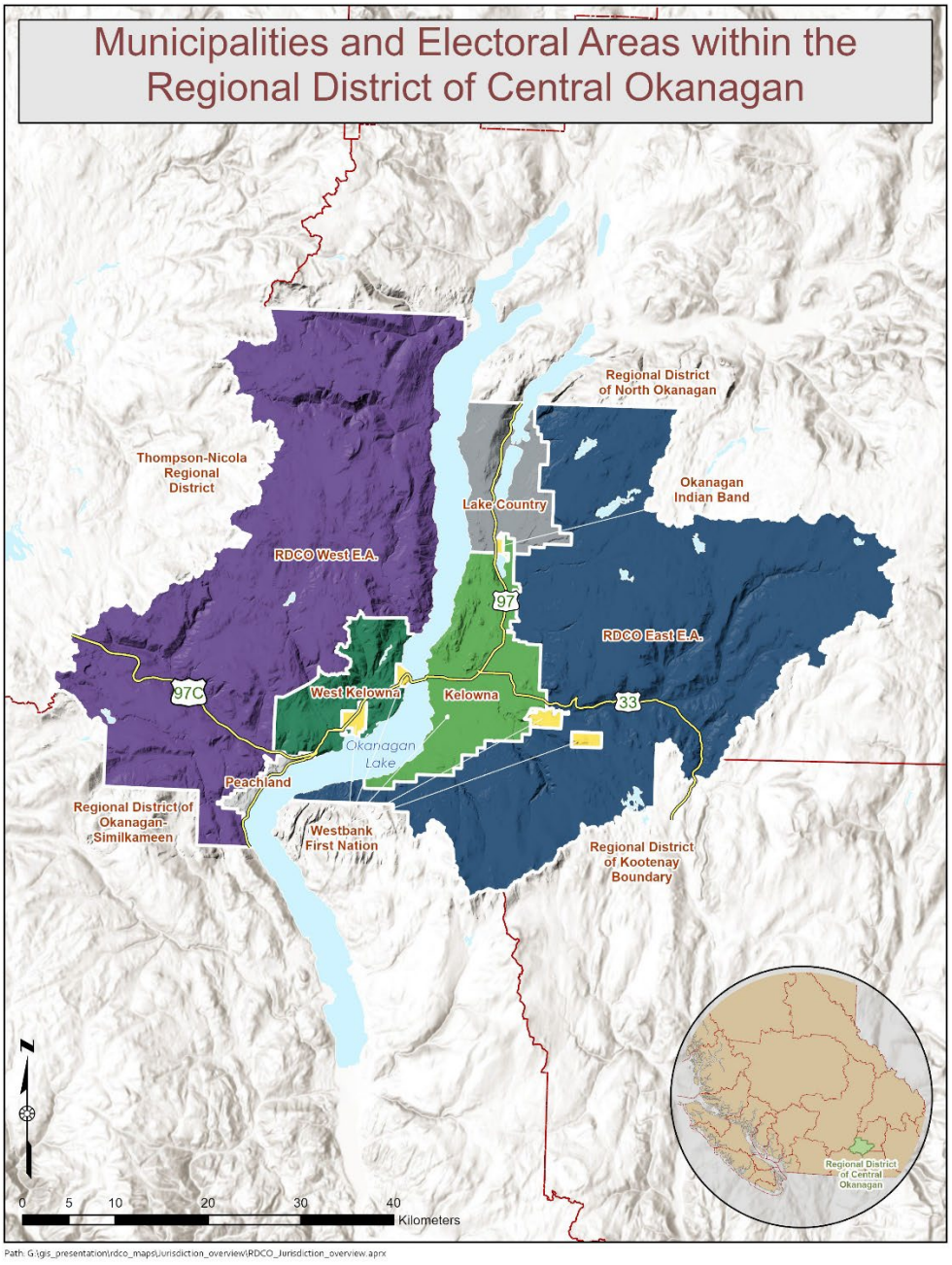
Non-structural flood mitigation actions - the broad group of actions that can be taken to reduce flood risk and increase resilience that are not large engineering works - offer an excellent opportunity to reduce flood risk and gain valuable co-benefits. These actions also align more closely with Traditional Indigenous practices than do large engineering works.

There is much value in non-structural flood mitigation actions. However, they can be challenging to implement because they are less common and governance structures and systems are not in place to support their execution. And so, the RDCO and partners embarked on a project to provide resources to Local and First Nations governments in the Okanagan that would support them in getting non-structural mitigation actions up and running.

In early 2021, the RDCO retained the consultant team of Ebbwater Consulting Inc. (Ebbwater), SHIFT Collaborative (SHIFT), and EcoPlan International (EcoPlan) to work with governments and community members in the Okanagan to build a shared understanding of the wicked nature of flood management and to then provide a strategic resource guide to support governments and others to act both individually and collectively to enable non-structural flood mitigation actions.

1.1 Project Area and Scope

The RDCO, as the central regional government within the Okanagan Valley has taken on a role as a facilitator for Local Governments within the valley. The project is focused on the flood hazard areas and flood hazard types found within the RDCO, inclusive of First Nation reserves and member municipalities (Figure 1). Although this area and these jurisdictions have been the focus of the project, the toolbox of mitigation actions and decision supports are more widely applicable to the Okanagan Valley and the British Columbia (BC) at large.



1.2 Document Purpose and Report Structure

This report is a companion document for the Central Okanagan Non-Structural Flood Mitigation Resource Guide (Resource Guide). The Resource Guide provides concepts and actionable steps that can be taken at a local or First Nation government level to execute non-structural flood mitigation actions. Whereas this document provides background context on flood hazards in the Okanagan Valley, the best practice management context, key international guidance, and the British Columbia governance

context (Section 2). It also provides the methods (Section 3), and the results (Section 4) of a public and stakeholder engagement process that informed the development of values-based criteria to support the selection of most preferred non-structural mitigation activities (as outlined in the Resource Guide). These sections also summarize a policy scan of existing flood management regulations in the RDCO and member communities. This is followed by recommendations, including key concepts that should be tackled at a regional scale (Section 5), and finally some concluding remarks (Section 6).

2 Background and Supporting Information

Flood is a natural and regular phenomenon that has shaped the physical geography of the Okanagan Valley since time immemorial. With more people and development in the region now, these floodwaters 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 creeks spilled their banks onto adjacent floodplains.

Flood is not a straightforward hazard that is either present or absent. There is much nuance in the type, likelihood, and severity of flood, which are further complicated by climate change. Further, there is great diversity in how flood waters interact with the communities and assets that sit in flood hazard areas.

This section first provides some high-level background information on flood hazards in the Okanagan, and then describes the concepts of risk, risk reduction, and resilience, which are used later to organize and score non-structural flood mitigation options. Key international guidance materials are also summarised and placed into the context of the BC regulatory and governance regime.

2.1 Flood Hazards in the Okanagan Valley

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

2.1.1 Flood Types in the Central Okanagan

The Central Okanagan faces four main kinds of flood hazards, summarized here. We encourage readers to look at other resources (Associated Environmental Consultants Inc., 2016; Ebbwater Consulting Inc., 2019; Northwest Hydraulic Consultants Ltd., 2020) for additional and more detailed information.

1. **Lake (coastal) 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 in the watershed being high, or because of storm conditions that push water and waves onshore
2. **Creek and river 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.
3. **Pluvial flooding**. Occurs when heavy precipitation cannot be absorbed into natural or infrastructure systems, creating localized ponding.

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

Each of these flood types has different characteristics. There is also great range within a flood type. These characteristics affect hazard and risk profiles, as well as the effectiveness of flood mitigation actions. A few of the characteristics that are especially relevant to non-structural mitigation actions are outlined below.

2.1.2 Flood Hazard Likelihood and Magnitude

Likelihood (the probability that a flood of a certain size will occur) and magnitude (the size of a flood) are two defining characteristics of flood. These are inversely proportional to each other; large events occur rarely, and small events more frequently (see Figure 2). Frequent but small floods present very different risks than rare and large floods.

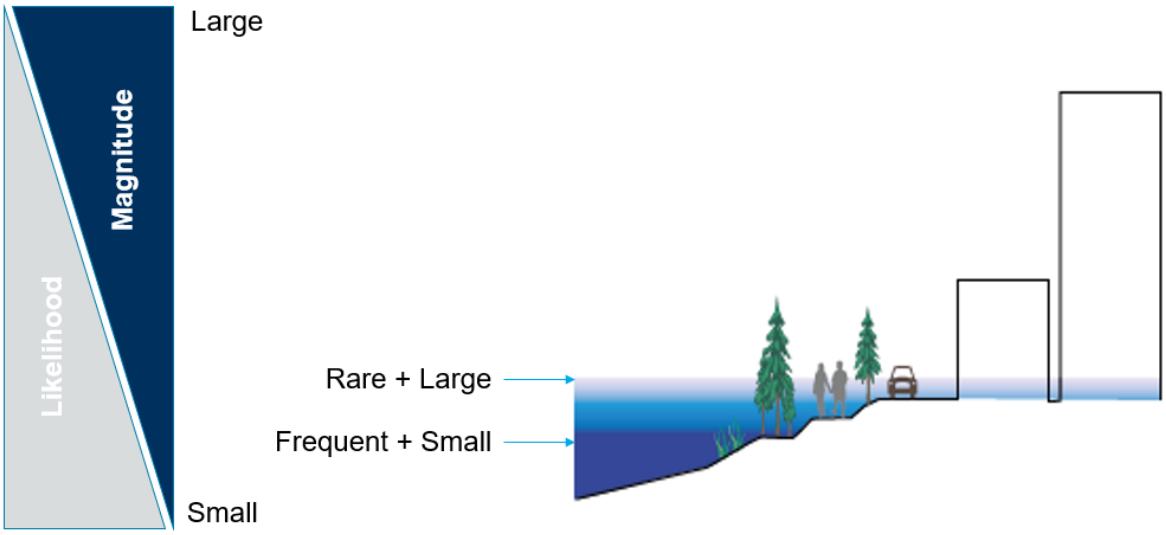


Figure 2: Simplified relationship between flood hazard likelihood and magnitude.

Flood magnitude describes the size of an event. It is measured in cubic metres per second for creek and river flooding and in elevation or volume for lake (coastal) flooding.

Likelihood is generally defined or presented as an Annual Exceedance Probability (AEP), which is the probability of an event of a given size occurring or being exceeded in any year, described as a percentage. For example, a 0.5% AEP event, has a 0.5% chance of occurring or being exceeded in any given year. This is sometimes referred to as a 1/200 or 200-year event. However, this is misleading, as it infers that once an event of this size has occurred, it will not occur again for 200-years, which is not the case.

Another way to think about flood likelihood is through the use of encounter probabilities, where it is possible to calculate the likelihood of encountering an event of a given size over a defined time period—for example, the duration of an average mortgage (25 years) or the lifespan of a human (75 years). For instance, for a 1% AEP event, there is a 22% chance that an event of this size or greater will occur over a 25-year period (Table 1). Understanding the likelihood of an event, as well as the encounter probability of an event, can support decisions related to flood management.

Table 1: Encounter probabilities for various flood likelihoods.

Annual Exceedance Probability (AEP)	Indicative Return Period	Encounter Probability in 25 years	Encounter Probability in 50 years	Encounter Probability in 75 years	Encounter Probability in 100 years
6.67%	Once every 15 years	82%	97%	99%	100%
2%	Once every 50 years	40%	64%	78%	87%
1%	Once every 100 years	22%	39%	53%	63%
0.5%	Once every 200 years	12%	22%	31%	39%
0.2%	Once every 500 years	5%	10%	14%	18%

2.1.3 Flood Hazard Depth and Power

In addition to the total volume or flow associated with a flood event, how the water spreads and moves over the floodplain is an important consideration.

Flood depth is a big determinant of how much damage is caused. Nuisance flooding in a basement, for example, is very different from moderate (>30 cm) or severe (>2m) flooding, which can cause significant to sometimes unrecoverable damage. Depth generally, but not always, decreases with distance from the water source.

Water velocity as it moves down a channel or across a floodplain also affects its damage potential. Faster moving water, especially if it has entrained materials (this could be rocks and logs from natural slopes, or garden furniture or cars that are picked off the urban floodplain) can be more damaging than slow, stagnant water. Higher velocity systems have more power, and can cause erosion or avulsion of natural systems, as well as knocking over people, cars, and even some structures.

Similarly, powerful waves on the shoreline of lakes have additional energy that can cause erosion and other damage to assets within the wave zone.

2.1.4 Flood Hazard Spatial Scale

The spatial scale (how widespread or localized a flood is) will matter for response and recovery. Large regional events that affect many communities at once may stretch

resources, whereas a small, localized event on one creek might be more manageable, if it is a location with good access and response systems.

2.1.5 Flood Onset and Duration

Finally, the characteristic of temporal scale (how quickly it happens, when, and how long it lasts) is an important consideration. The onset time is directly related to the efficacy of many temporary flood mitigation actions, as these are only effective if they are put in place in time. This may be possible for some larger lake flooding events for which there may be a week or even a month of lead time but are not practical for sudden pluvial or some creek flooding events.

Further, it is important to consider how long an event will last, and therefore how long water will be in contact with elements on the flood plain. In general, the damage associated with flood is less for shorter events, whereas if a building is wet for days or weeks the structural damage will be severe and may require that the building be destroyed.

In summary, floods are very nuanced. Therefore, policies and actions need to be equally nuanced, and be selected based on their effectiveness against the type of flood conditions in a given place or neighbourhood.

2.1.6 Historic Events in the Okanagan

The project area has a history of flood events, which were originally documented by Septer (2006). Based on summaries documented by Associated Environmental (2016, 2017a), watercourses and lakes have flooded multiple times (with the specific number for each shown in brackets) during the period 1894 to 2015, as follows by watershed:

- Okanagan Lake (12)
- Mission Creek (8)
- Mill Creek (4)
- Trout Creek (3)
- Kalamalka Lake (3)
- Vaseux (McIntyre) Creek (3)
- Penticton Creek (3)
- Shuttleworth Creek (3)
- Joe Rich Creek (2)
- McDougall Creek (2)
- Single Creek (2)
- Naramata Creek (2)

Widespread floods and debris flows were experienced in the project area in 2017 and 2018. Within the historical context, the events were exceptional. Accordingly, public discourse following the events questioned the role of climate change in their occurrence. The Government of BC's Abbott/Chapman Report (Abbott and Chapman, 2018), commissioned in late 2017, which also included unprecedented wildfires,

suggested that, indeed, disaster management in BC needs to address a “new normal” due to climate change effects.

In the Okanagan watershed in 2017, most areas experienced flows that approximated the 5% AEP (20-year indicative return period), but some areas such as Vernon and Penticton experienced flows that exceeded the 1% AEP (100-year indicative return period). Multiple factors played a role in flooding, with spring precipitation being central. Kelowna experienced the fourth-highest precipitation on record for the period of March to May, inclusive. Vernon experienced the second-highest record for those three months while Penticton experienced the highest precipitation ever in that period.

As a result of the high snowpack and spring precipitation, the inflows to Okanagan Lake during May 2017 were the highest on record, which caused the lake to rise to its highest level since the dam was built. The Water Survey of Canada gauge at Kelowna (08NM083) recorded a water level of 343.472 m CGVD2013. Water levels were approximately 0.20 m above the estimated 0.5% AEP (200-year indicative return period) (Associated Environmental, 2017b). In 2018, the hazard levels were in the range of 2%-5% AEP (50 to 20-year indicative return period), with impacts that included combined flood and debris flow events.

2.1.7 Climate Change and Cumulative Pressures Affecting Flood

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 (Abbott and Chapman, 2018). Increased spring and fall precipitation, which will cause more frequent and intense flooding, is projected for the Okanagan (Pinna Sustainability, 2020) (see also Figure 3, an excerpted map from this same study).

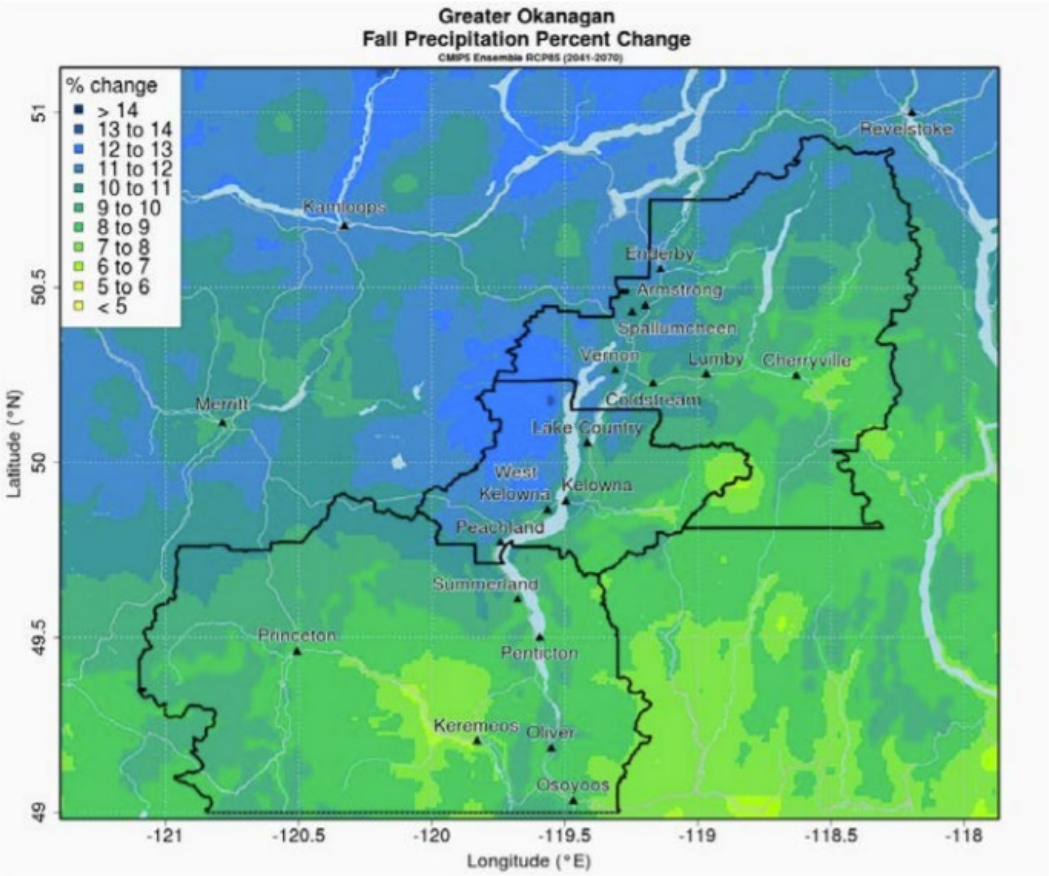


FIGURE 11: AUTUMN PRECIPITATION – PERCENT CHANGE (2050s)

Figure 3: Precipitation trends with climate change in the Region (From Pinna Sustainability, 2020).

On top of climate change, research indicates that other cumulative pressures (such as wildfires, urban development, and industrial activities) are worsening disasters like flooding (Ebbwater Consulting Inc., 2019b).

There will be worsening floods in future, and there is significant uncertainty associated with our understanding of the characteristics of these floods (type, magnitude, likelihood, etc.). Therefore, whatever mitigation actions are used should, as much as possible be effective over a range of potential future conditions.

2.2 Best Management Practice Context

Many jurisdictions around the world are in the process of transitioning toward a risk-based approach to flood management. The following sections summarize some of the key frameworks on disaster risk reduction and flood risk management that have informed our approach and guiding principles for this work.

2.2.1 Reducing Risk and Building Resilience

Rivers and lakes overflowing their banks are not in themselves a problem. It is when flood waters 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 non-structural strategies or actions that can be taken to mitigate its damages.

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 (UNDRR, 2017).

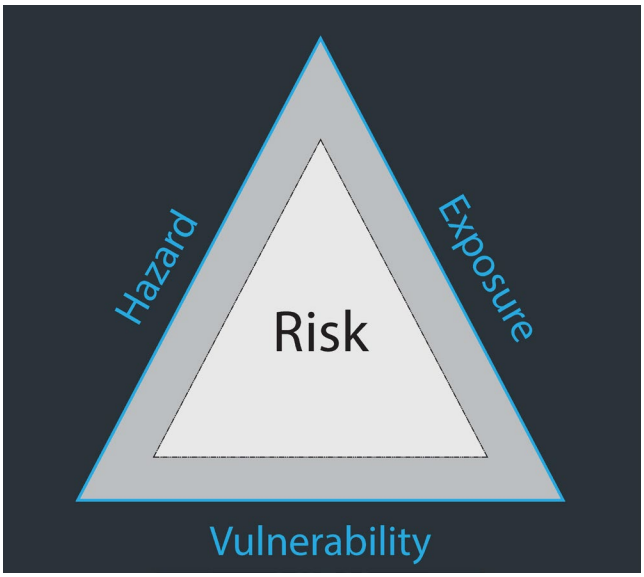


Figure 4: Risk as a function of hazard, exposure and vulnerability. Based on (GFDRR, 2016)

As illustrated in Figure 4, risk is defined by the total area of a triangle, whose vertices are hazard (in this case flood), exposure (the things people, organizations, and stakeholders care about that are exposed to floodwaters) and the vulnerability or susceptibility of these things being damaged by floodwaters.

There are three levers to increase OR reduce risk. Hazard, exposure and/or vulnerability reduction can all play a role in overall risk reduction. This more complex, but important take on flood mitigation, means that there are many more tools available to support risk reduction.

In the last hundred or so years, many western governments have focused on trying to stop water from interacting with assets through the construction of large engineering works. This effectively limits risk reduction options to one of three possible levers (i.e., hazard).

2.2.2 Dynamic Risk

Risk is not static. It can both increase and decrease with time. The challenge is that given present day pressures, two vertices are trending outwards, increasing the overall risk (Figure 5). Climate change is affecting the frequency and severity of flood events, increasing the overall hazard, and development pressures and trends mean that more people and things are being placed in flood hazard areas (i.e., increased exposure).

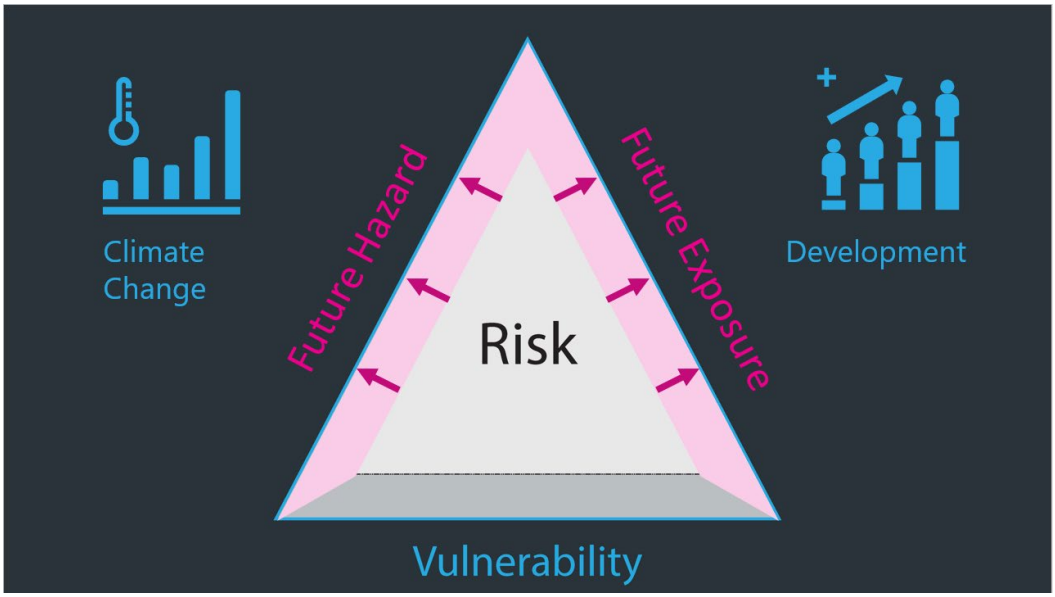


Figure 5: Increasing risk with climate change and increased development.

Although risk is tending to increase, there is still opportunity to arrest the increase, especially as it relates to increased exposure.

And, of course, there is still opportunity to reduce risk through careful considerations of actions that reduce future hazard, exposure, and/or vulnerability.

2.2.3 Systemic and Wide-Ranging Risk

Floods and disasters are extremely complex. Society has become acutely aware of the complexity of disaster throughout the COVID-19 pandemic. Impacts have been felt widely to human health, but also to local and global economies. Impacts have not been felt equally, as some people have faced insurmountable challenges, whereas others have had limited impacts. The following section highlights at a high-level some of the complexities associated with disaster impacts and risks.

2.2.3.1 Holistic Indicators for Risk

Floods and disasters affect many things in different ways (Figure 6). People might be killed or injured, especially during rapid onset and high energy floods. Other people might lose their homes or treasured possessions. Businesses are damaged and may close for short periods of time, or sometimes forever. Economies suffer with disruption of critical services and business closure, and there are generally large financial implications associated with damages to structures and infrastructure. Further, floods

can cause damage to cultural artefacts and cultural spaces, and importantly floods can cause significant environmental damages, especially when contaminants on the floodplain (e.g., pesticides, septic tanks, etc.) seep into waterways and beyond.

Within each of these broadly grouped indicators (see Figure 6), there are additional nuances and complexities. For example, if we consider the potential for an individual to be impacted by a flood, their age, income, education, and even personality will affect their capacity to plan for, respond to, and recover from a flood event. Similar variation in impacts is seen across all the indicator categories.

Figure 6: High-level indicators for holistic flood risk assessment.

Any risk assessment, or risk-based flood mitigation plan, must be mindful of the many and varied tentacles of disaster impacts, and ideally work to ensure that risks are reduced equitably.

2.2.3.2 Indirect and Direct Impacts

Flood hazards may lead to direct and indirect consequences. Direct consequences describe all harm that is caused by the direct physical contact of water with people, infrastructure, or the environment (Figure 7) (AIDR, 2015). This includes, for example, damage to buildings and other assets through floodwaters, damage to the environment through contaminated floodwaters, or loss of human life.

It is important to also think about indirect consequences, which can be somewhat more complex. Indirect consequences will increase the spatial and temporal extent of the consequence, meaning that an area larger than where the hazard occurs can experience disruption in some form. They are typically consequences that are caused by the disruption of the physical and economic links in the region, as well as the costs

associated with the emergency response to a hazard. As shown in Figure 7, when, for example, road access is affected by a natural hazard, schools or other buildings may become inaccessible and emergency services may not be able to reach certain areas or may need to travel longer distances. Another example is business losses because of the interruption of normal activities. Disruption of critical infrastructure, such as electrical power lines, can lead to cascading consequences for many sectors.

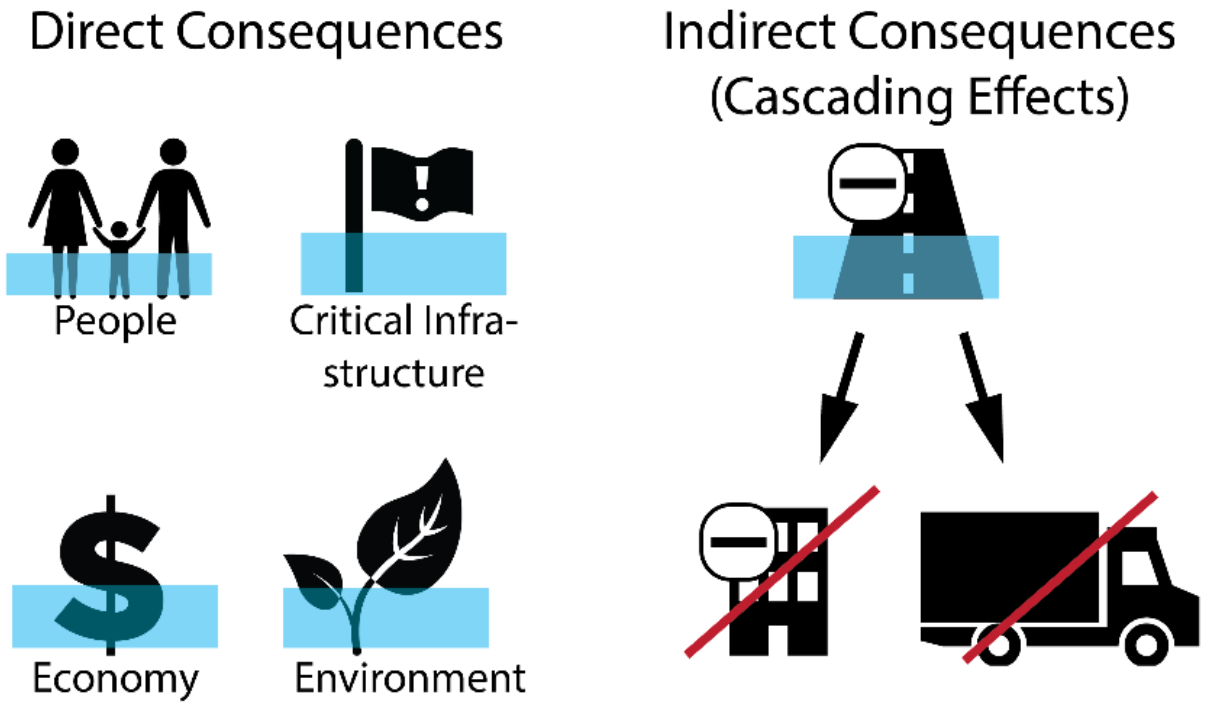


Figure 7: Direct and indirect consequences of flood hazards.

2.2.3.3 Tangible and Intangible Consequences

The effects of a flood hazard event on the environment, human or community health, or loss of life are difficult to quantify in terms of financial values or other quantifiable measures. These impacts are therefore considered to be intangible impacts. On the other hand, the tangible dollar losses from a damaged building or ruined infrastructure are more easily calculated. This does not mean that tangible losses are more important than the intangibles, just that they are easier to quantify and assess. The inclusion of intangible impacts is desirable for the development of a robust risk assessment (Messner and Meyer, 2006). Figure 8 provides examples of direct/indirect and tangible/intangible consequences. While not all these consequence types are easy to estimate, they should still be considered. At a minimum, it is important to recognize what types of consequences have been included in a risk assessment and/or decision tool, and to be explicit about those that have not.

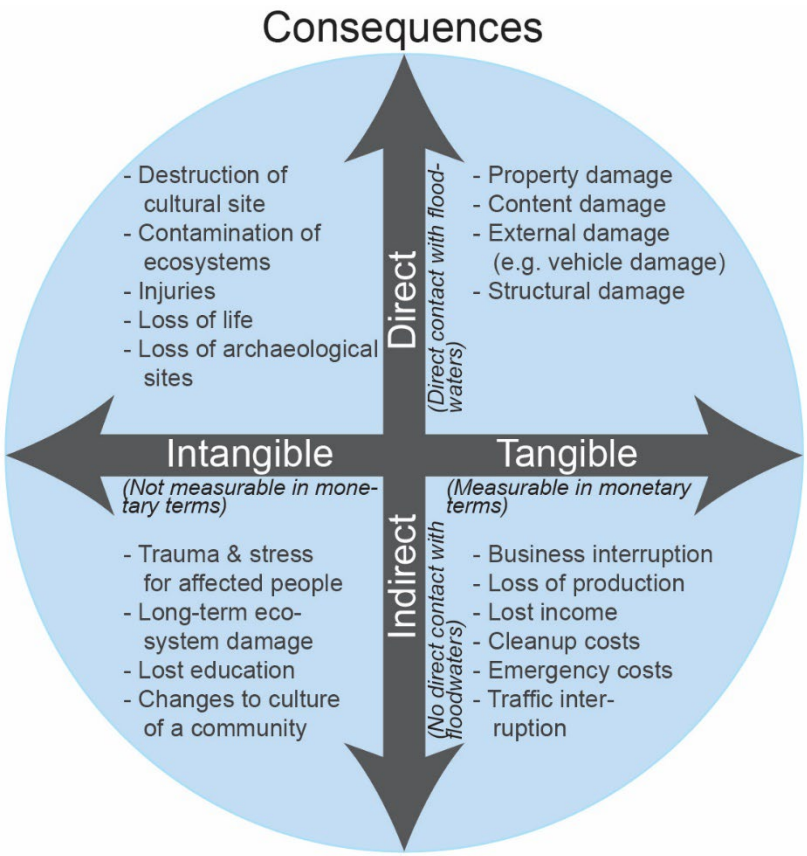


Figure 8: Types of consequences to flooding (Figure from (Murphy *et al.*, 2020)*; used with permission).*

Risk is the basis for good decisions in flood or natural hazard management. It is important to understand the full definition of risk, as a function of hazard, exposure, and vulnerability. Risk is inherently, systemic, and complex.

2.3 Key International Guidance and Syilx Context

Flood and disaster management have evolved significantly over the last couple of decades, moving from an era of "fighting" nature with large engineering works, into an era with a more complex understanding of risk and the many ways that it can be mitigated. The following provides a summary of major international frameworks for flood risk management and closes with a connection between these "new" frameworks and the Traditional *Syilx* ways of knowing and being.

2.3.1 Sendai Framework for Disaster Risk Reduction

The Sendai Framework for Disaster Risk Reduction (Sendai) is the global blueprint for reducing disaster risk and increasing community resilience. The goal of Sendai is to "prevent new and reduce existing disaster risk through the implementation of integrated and inclusive economic, structural, legal, social, health, cultural, educational, environmental, technological, political and institutional measures… to strengthen resilience" (UNDRR, 2015). The framework is thus multi-disciplinary and follows four priorities. This project's activities fit mainly within Priorities 1 and 2 (Figure 9).

Figure 9: Four priorities of the Sendai Framework for Disaster Risk Reduction.

Sendai recognizes that humans are at the centre of disasters. I.e., not only are humans responsible for increasing hazards, hazards themselves are not problematic unless they interact with humans. The framework thus places human decisions at the centre of disaster risk reduction, and advocates for a risk-based approach to managing multiple hazards (i.e., all-hazards approach). Sendai also encourages whole-of-society engagement actions, such as "To empower local authorities, as appropriate, through regulatory and financial means to work and coordinate with civil society, communities and Indigenous peoples and migrants in disaster risk management at the local level."

Both Canada and British Columbia are signatories to the Sendai Framework.

2.3.2 Strategic Flood Risk Management: The Ten Golden Rules

The consensus in global peer-reviewed literature is that implementing a holistic, risk-based approach to flood management reduces negative impacts while promoting other aspects of societal well-being over the long-term. In this section we draw on an internationally recognised paper by Sayers et al. (Sayers *et al.*, 2014), which captures guiding approaches and rules for sound strategic flood management. This paper and framework have been cited more than 50 times in peer-reviewed journals since its publication. Further, this paper and the 'golden rules' also map well with Sendai.

The Sayers et al. (2014) paper was co-authored by representatives of diverse perspectives (academic and government officials, engineers, and planners) as well as recognized leaders in the field of flood risk management. The authors suggest that strategic flood risk management provides a means of working towards sustainable development, and associated social, environmental, and economic goals. However, they also acknowledge that resources to achieve this are limited, and that pragmatic trade-offs must be made between reducing flood risk and investing resources towards achieving other societal goals. In this respect, they emphasise the importance of investing resources effectively and efficiently.

Therefore, the primary goals of strategic flood management are to efficiently use limited resources to:

- Reduce risk to people and communities from flood sources;
- Promote ecosystem goods and services;
- Reduce risk to, and promote, economies; and
- Promote social well-being.

The authors note that these are lofty goals; however, programs aren't expected to reach these goals at the outset. Rather, the goals are intended to guide an iterative, adaptive strategic planning process. The authors go on to outline several common characteristics of successful, strategic plans including:

1. They will be based on understanding of the whole-system behaviour and societal goals (i.e., consideration of cumulative pressures and associated values);
2. Decision-making will be informed by knowledge of risk and uncertainty over time; and
3. A portfolio of measures and instruments will be used to manage risk.

In addition to these characteristics, the authors present ten 'golden rules' for sound strategic flood management. The authors state that these 'golden rules' are necessary, but not sufficient, components of successful flood management.

Table 2: Ten golden rules for flood management.

Rule	Description
1. Accept that absolute protection is not possible and plan for exceedance.	There will always be a bigger flood. Residual risk always exists and resilience to future, inevitable, flood events can be built through the planning process.
2. Promote some flooding as desirable.	The natural connection between land and water is critical. Flood plains provide fertile land and other ecosystem services in addition to accommodating flood waters.
3. Base decisions on understanding risk and uncertainty	Managers should not delay decision-making and action on the basis of uncertainty. Rather, managers should draw on the available knowledge, explicitly account for uncertainty, and then monitor and adapt management plans with time.
4. Recognize that the future will be different from the past	Climate and flood risk are changing. Managers need to move beyond planning processes that focus on historic flood records and information, and account for future changes in flood risk.
5. Do not rely on a single measure; implement a portfolio of responses	Flood risk has multiple components. Management tools can be used to reduce hazard, exposure, and consequence while also working towards other environmental, economic, and social goals.

6. Utilize limited resources efficiently and fairly to reduce risk	A management plan should be tailored to the specific context, with consideration of not only the cost-efficiency of risk reduction outcomes, but also the fairness of these outcomes and the associated ecosystem enhancement opportunities.
7. Be clear on responsibilities for governance and action	Funding and decision-making should reflect shared responsibility. Collaboration on a watershed scale is critical to achieve shared outcomes and to avoid conflicts.
8. Communicate risk and uncertainty effectively and widely	The public does not often understand the degree of flood risk they face. Significant and targeted awareness programs are required to obtain greater public and political support for progressive management initiatives.
9. Promote stakeholder participation in the decision-making process	All interested and affected people play an important role in developing and delivering management activities. This should be done in a way that promotes "living with floods" rather than "fighting against them".
0. Reflect local context and integrate with other planning processes	There is a need for locally relevant and specific management planning, as opposed to focusing on compliance with a one-size-fits-all engineering standard.

The golden rules should be considered throughout the process of adapting to flood risk. Sayers et al. (2014) mentions that plans themselves should be adaptive and underpinned by a continuous process of monitoring and review to be flexible to shifting priorities and governance structures.

2.4 *Syilx* Okanagan Perspective

The following is drawn from *Syilx* Okanagan Flood and Debris Flow Risk Assessment: Basis of Study (Ebbwater Consulting Inc., 2019c). It provides context on the *Syilx* Okanagan worldview as it relates to water and flood. We encourage readers to review the full Flood and Debris Flow project for additional information.

2.4.1 Introduction

"If people can't understand that we *are* water; they have missed the point."
– Arnie Baptiste, *Syilx* Representative

The *Syilx* Okanagan worldview is complex and diverges from the western science worldview. It cannot be fully summarized in this report format; however, in the community discussions and engagement that laid the foundation for the Flood and Debris Flow project, several themes emerged that have been employed as ways of increasing the alignment of this project with *Syilx* Okanagan perspectives. These themes are:

1. Uphold Water Responsibilities
2. Apply *Syilx* Okanagan knowledge
3. Connect to place
4. Value *tmix*^{w} (all living things)
5. Collaborate and develop water partnerships

An overarching understanding that ties all these themes together is: “Water is connection.”

2.4.2 Uphold Water Responsibilities

Syilx Okanagan communities have a deep intrinsic connection to *siwɬk*^{w} (water). Maintaining the integrity of *siwɬk*^{w} and respecting its relationship to all life is essential to *Syilx* Okanagan identity and is entrenched in responsibility to the *tmx*^{w}*ulax*^{w} (land).

Syilx Okanagan community members and ONA staff repeated throughout this project that water is “the most important thing and gives us life”. The *Syilx* Okanagan perspective respects the power of water and recognizes that “water will go where it needs to go”. Within this understanding, there is also a recognition that not all flooding is bad, and that there are positive regenerative aspects of natural phenomena such as flood and debris flows. These phenomena are an intrinsic part of *tmx*^{w}*ulax*^{w} (land) and are connected to *tmix*^{w} (all living things, sacred life forces).

Syilx Okanagan water laws and values related to *siwɬk*^{w} are outlined in the *Syilx* Okanagan Water Declaration (Okanagan Nation Alliance, 2014), which was endorsed by the ONA Chiefs Executive Council in July 2014. The Water Declaration communicates not only water responsibilities that *Syilx* Okanagan people carry, but also water-supporting activities that everyone residing in *Syilx* Okanagan territory can implement in their daily lives.

2.4.3 Apply Syilx Okanagan Knowledge

The *Syilx* Okanagan people have a manifest reverence for Elders and Traditional Ecological Knowledge Keepers who carry a deep responsibility to teach future generations about environmental conditions of the past and present. Elders also offer reminders of historical events that have set the stage for the challenges of today. The history of colonization and settlement patterns of immigrants since 1811 have affected hazards, exposure, and vulnerability in palpable ways for everyone in the region.

Over the generations, the *Syilx* Okanagan have passed down teachings through oral literature such as *captíkʷɬ*. These *captíkʷɬ* contain a collection of laws, customs, values, and principles that reveal truths about the meaning of being *Syilx* Okanagan. Taken together, the *captíkʷɬ* define and inform *Syilx* Okanagan rights and responsibilities to the *siwɬk*^{w}*,* to the land, and to one another. *captíkʷɬ* stories hold teachings on how we all can relate to and live on this land. They serve as reminders of natural laws and protocols that need to be followed for all the future generations to survive in harmony with the *tmix*^{w}.

2.4.4 Connect to Place

From a *Syilx* Okanagan perspective, to effectively engage in watershed planning, it is important for researchers, Elders, community members, and decision makers to venture out into the watershed and observe it from the headwaters to the valley bottoms. This has always been an important part of the sacred responsibilities that *Syilx* communities and families have to their local watersheds. For several years now, the ONA has been implementing watershed tours in support of *Syilx* Okanagan watershed responsibility processes. Watershed tours can range in size from a single creek to the Columbia River. They consist of getting out into a watershed with *Syilx* Okanagan community members or Elders who have intergenerational knowledge of those systems. On the watershed tours, *Syilx* Okanagan community members share not only important knowledge about the water itself but also about the surrounding ecosystem.

2.4.5 Value tmix^{w} (All Living Things)

tmix^{w} is *t*he *nsyilxcən* word that most closely translates as “ecology”. The *Syilx* Okanagan understanding is that *siwɬk*^{w}, *tmx*^{w}*ulax*^{w} (land), and all living things are all part of *tmix*^{w} and are all intricately connected. What we do to one of them, we do to them all. *Syilx* Okanagan responsibilities extend beyond fellow human beings to include everything within the ecosystem: water, plants, animals, land. With the word *tmix*^{w}, the *Syilx* Okanagan responsibility to honour the natural laws of that which gives us life is embedded within the *nsyilxcən* language itself.

As is stated in the *Syilx siwɬk*^{w} (Water) Declaration: “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.”

Throughout the Flood and Debris Flow project, *Syilx* Okanagan knowledge, the *Syilx siwɬk*^{w} (Water) Declaration, *captík*^{w}*ɬ*, and watershed tours were integrated into the risk assessment. The Okanagan Nation is confident that by incorporating *Syilx* Okanagan values, perspectives, and processes into regional planning efforts, a new way of working with nature will emerge that is to the benefit of everyone, inclusive of the *tmix*^{w}.

2.4.6 Collaborate and Develop Water Partnerships

The *Syilx* Okanagan Nation is committed to continued efforts of building relationships and collaborative initiatives towards respecting the shared responsibility for the health of *siwɬk*^{w} and aquatic ecosystems. For example, ONA hosts an annual Water Forum for both *Syilx* and non-*Syilx* participants to build a collective knowledge around *siwɬk*^{w} based on principles from *Syilx* Okanagan natural law. Participants come from a range of backgrounds including all levels of government, academia, industry and non-governmental organizations (NGOs).

At the Environmental Flow Needs Conference held in Kelowna in October 2018, Grand Chief Stewart Phillip spoke of the relationship between the *Syilx* Okanagan people and

the settlers in the region. He explained that the relationship is now entering a phase where climate change is causing widespread havoc on the land. The resulting impacts are creating complexities and interconnections. Responding to these requires non-linear and systems thinking approaches to innovation. This is resulting in non-*Syilx* people, governments, and organizations looking for guidance and insight from *Syilx* Okanagan and other Indigenous Nations whose knowledge systems are holistic, "spiral," and ecosystem-based.

A diversity of perspectives must be coordinated to create more resilient and dynamic planning and responses to care for *siwɬkʷ*. The Grand Chief said that the *Syilx* Okanagan people are up for the challenge and welcome collaboration with others to address these issues.

2.5 Governance Context for First Nation and Local Government Management of Flood in British Columbia

Effective governance of flood risk needs to recognise the wicked[1] and systemic[2] nature of disaster risk. Governance describes the process by which society organizes itself to make decisions and includes consideration of who has power, who makes decisions, how decisions are made, and how the ideas of interested and affected parties and broader society are considered and included in decision processes. Therefore, effective flood risk governance needs to balance the intractable nature of flood with a consistent vision, defined roles and responsibilities, clear planning frameworks, meaningful engagement, and robust decision processes.

Where governance describes the process by which society organises itself to make decisions, flood risk governance describes this process as it relates to flood hazard, flood risk, and flood resilience.

Flood risk governance in BC has shifted over time because of a multitude of intentional and unintentional decisions, political priorities, and directions related to larger shifts in governance approaches, and interjurisdictional relations. The occurrence of actual flood events (in the province or elsewhere in the world) have often been the impetus for (mostly reactive) decisions that shape flood risk governance in BC today.

Presently, the overall approach is polycentric, in that authority and responsibility for flood management activities is spread across different levels of government (e.g., Federal, Provincial, Local and First Nation), and across many sectors within each of these governments (e.g., natural resources, infrastructure, etc.). The private sector also implicitly plays a role. For example, major critical asset holders have responsibility to consider the flood resilience of their infrastructure and have financial self-interest in

[1] A wicked problem in policy, planning, or natural resource management is one that is difficult or impossible to solve. Where competing interests mean that there is no single solution, and because of complex interdependencies, solving one part of the problem will worsen or create other problems.

[2] In this instance the term 'systemic' is used to describe the widespread impacts of flood that can affect all parts of society, are widespread, and can persist for long periods of time.

doing so. The insurance and re-insurance industry, who support the financing of residual risk, are explicitly involved in flood risk governance. Simply, there are a lot of actors who in some cases have overlapping interests, and in other cases have competing interests.

2.5.1 Current Provincial and Federal Direction on Flood and Disaster Risk Reduction

Canada, and more recently BC, are signatories to Sendai (see above). The BC Government is actively taking steps to incorporate Sendai into its activities. For example, the BC Government Action Plan (Emergency Management BC, 2018), developed to answer the Abbott/Chapman Report following the 2017-2018 floods and wildfires in BC, outlines a plan for an Integrated Disaster Recovery Framework. The multi-disciplinary framework is currently under development by various agencies and is focused on activities related to Sendai Priority 4 (see Figure 9).

Further, the Province is currently reviewing the *Emergency Program Act* [1996] and proposing changes to bring it in line with modern best practices. With the modernization of the act, BC becomes the first province in Canada to officially adopt Sendai, which it is using as a cornerstone of the process. This includes the need to:

- Demonstrate stronger connections to climate change and Sendai (see above).
- Recognition that additional resources and capacity will be required.
- Recognition of a broader definition of emergency management to include mitigation and risk reduction.
- Recognition that the *Declaration of the Rights of Indigenous Peoples Act* [2018] (DRIPA, see also below) means that Indigenous Peoples have rights to self-determination over all issues, including emergency management and response.
- Streamline government activities.

The Province has also committed to begin and implement a BC Flood Strategy to "continue to improve flood management and governance for a resilient BC" (Province of British Columbia, 2021).

2.5.2 Indigenous Inclusion

Increasingly, First Nations are being empowered by a changing regulatory landscape. One key driver has been the *United Nations Declaration on the Rights of Indigenous Peoples* (UNDRIP), and its implementation in BC law in 2019. In Canada and BC, other key drivers include the Tsilhqot'in decision [2014], and BC's *Water Sustainability Act* [2016].

UNDRIP is the most comprehensive international instrument pertaining to the rights of Indigenous Peoples. It establishes a framework for minimum standards for the survival, dignity, and well-being of the Indigenous peoples of the world and it elaborates on existing human rights standards and fundamental freedoms as they apply to the specific

situation of Indigenous Peoples. A tenet of UNDRIP is the duty for government to obtain free, prior, and informed consent (FPIC) from Indigenous People on issues that might affect their interest.

In late 2019, BC became one of the first jurisdictions in the world to table and pass legislation, Bill 41, to implement UNDRIP and uphold the rights of Indigenous Peoples. The *Declaration of the Rights of Indigenous People Act* (DRIPA) requires the BC government to bring its laws into alignment with the UNDRIP over time, with mechanisms for transparency, accountability and entering into agreements with a wider range of Indigenous governments.

In Canada, Indigenous People have a constitutional relationship with the Crown based on Section 35 of the *Constitution Act* [1982]. This relationship includes existing Aboriginal and treaty rights. In 2014, the Tsilhqot'in decision by the Supreme Court of Canada clarified that First Nations must be involved in decisions (i.e., at all government levels) that affect their territory; natural hazard adaptation planning falls into this category. The decision also clarified that Aboriginal rights and title exist on a territorial basis, and it recognized ownership rights to Indigenous peoples, including rights related to land use and economic benefits.

Though water management continues to be a provincial responsibility under the *Water Sustainability Act* [2016], the Act envisions delegating aspects of watershed governance to bodies other than the Government of British Columbia. For example, Section 115 of the Act refers to the establishment of Advisory Boards consisting of local groups or entities to provide local expertise and input into statutory decision-making. Local groups could provide recommendations on the appointment of Advisory Board members and developing terms of reference (Polis Project on Ecological Governance, 2019). The Act represents improvements with regard to Indigenous participation in water management compared to its predecessor. However, it has been criticized for the limited consultation process that was used in its development (Joe, Bakker and Harris, 2017), and its disregard for the "unextinguished" water rights of Indigenous People (Gullason, 2018).

An adaptable and sustainable path is forged for all when Indigenous Peoples are recognized as decision makers who have stewarded their territories for millennia and who have inherent jurisdiction with Indigenous natural laws.

2.6 Practical Implementation of Flood Mitigation Activities in British Columbia

Successful flood mitigation actions require that successive or parallel processes be completed. For example, legislation and regulation set the legal framework, guidance documents provide interpretation of the regulations, and funding programs incentivize or disincentivize activities and the monitoring and enforcement of activities. We organize these activities into five components: planning/visioning, regulation, guidance, funding, and monitoring. Each of these is discussed below as a component of the "process context" to flood management. These groupings are also reflected in the Resource

Guide, where they are used on the option implementation pages to describe actions under each process element that can be taken by First Nation or local governments.

2.6.1 Process Context

Implementation of flood management requires consideration of various enabling activities. For the purposes of this project, five distinct process components have been considered. This includes high-level activities such as planning/visioning, as well as the monitoring of activities, successes, and failures, along with both positive and negative levers for action (e.g., regulatory sticks and incentivizing carrots). Each of the process components are described in the next section.

Table 3: Process elements to implement flood management activities.

Process Element	Description
Plan	Good governance of flood risk includes the need for clear direction. The "Plan" component includes the function of providing direction, which in turn can describe a spectrum of activities. At one end, the existence of an authority with a well-developed, transparent, and public strategic vision, and at the other end a simple planning document or an individual person or group with a less well-developed concept for action. The act of developing a strategic direction or vision and articulating steps or components needed to achieve that vision – often developed through engagement and collaboration – is also included in this component.
Regulate	Regulation describes various forms of law and includes legislation and regulations. A mandate to act on issues of flood is necessary, which is generally enabled through legislation, and both creates authorities (the 'who') to carry out flood risk reduction activities, and creates rules for action (the 'what'). Legislation in BC is enacted by the Federal and Provincial governments through parliamentary processes. Regulations refer to rules that are enacted by a legislated authority. With regards to flood management in BC, these generally refer to bylaws or other regulations promulgated by a local or First Nation government. The Province also has regulations related to riparian areas and dam safety for example, which are relevant to flood management.
Guide	As opposed to regulations, which are enforceable and prescriptive, guidelines provide passive regulation. Guidelines are documents that are used to interpret legislation and/or regulation and can provide direction on how to comply with a law. They do not, however, have the force of law behind them.

	In BC, guideline documents are produced by all levels of government, as well as non-governmental bodies. Where applicable, guideline documents – both those that provide guidance to First Nation and local government, and those that are developed by local authorities to guide stakeholders, businesses, residents, etc. are provided in the Resource Guide for each mitigation option.
Fund	An obvious tool for the implementation of most flood management activities is financial investment. Most, if not all, activities require some level of funding, whether it be to resource people, research and development, or physical instruments or structures. A full list of funding programs is presented in Appendix A. And, where applicable is listed under individual mitigation actions in the Resource Guide.
Monitor	An element of any good governance process is a measure of accountability. Ideally, activities should be monitored and reviewed to see if they are successful in achieving the desired outcome. Activities can also have specific targets, which may or may not have penalties for lack of performance. Beyond the function of accountability, monitoring and learning are crucial elements of an adaptive management approach, which is imperative in a changing climate and in the context of continuous change in social, economic, political, and environmental factors.

Given the systemic and broad issue of flood, there are innumerable activities and competencies that are required. In many cases there are dependencies between components and activities (e.g., property level building controls require local government building bylaws, potentially updates to provincial and federal building codes, guidelines, financing to incentivize the activity, as well as enforcement to ensure success).

2.6.2 Authority and Responsibility for Flood Risk Reduction

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 play a variety of sometimes overlapping roles.

This section includes an overview of the legislative, regulatory, and other authorities held by the various levels and types of governments involved. More detailed tables of regulations, funding and authoritative agencies is provided in Appendix A.

2.6.2.1 Federal Government

Canada is a federalist country, where the central government deals with national and international matters. And, although many issues of flood risk governance are devolved to lower levels of government, the systemic nature of flood means that there are some issues that are governed at the federal level. These include issues related to national water resources, fisheries, and natural resource extraction and supporting information. The Federal government also provides some guidance related to the foundational tools (hydrometric data, flood mapping, flood risk assessment, etc.) for flood, to provide some consistency in public safety across the country.

2.6.2.2 Provincial Government

The Provincial Government has several roles and responsibilities related to flood risk governance. The primary role is to set out and enforce legislation related to public safety, water use and land use. The primary agencies with responsibility for flood risk governance are the BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development (MFLNRORD) and Emergency Management BC (EMBC); as well, the BC Ministry of Municipal Affairs (MMA) plays an important role in supporting local governments to manage their responsibilities related to flood risk governance.

The *Local Government Act* (LGA) and *Land Title Act* were amended in 2003 and 2004 to remove the role of the BC Minister of Environment (the predecessor to MFLNRORD) from floodplain designation and approving administration, shifting the authority to local governments. Due to this change, local governments have an increasingly important role to play in the management of flood hazards and gain this authority from the provincial legislation—the *Community Charter* and the *Local Government Act*.

2.6.2.3 Local Government

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.

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 some 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), are able to modify and enhance building controls (i.e., vulnerability), and also typically responsible for initial emergency response. Local governments also have some authority over flood protection infrastructure.

The *Community Charter* [2003] provides the statutory framework for local governments within the province of BC; it sets out areas of authority and procedures. Of relevance to

flood management are the provisions with Division 8 of the Charter that set out the authority of local government to have a Chief Building Inspector permit buildings and occupancy of structures, and to require certification of a qualified professional that "land may be safely used" in areas subject to flood (and other hazards).

The use of the *Community Charter* generally requires base information from flood mapping (either extents or extents and flood depths or Flood Construction Levels, FCLs) to support the Chief Building Inspector and qualified professionals to determine if a site and/or building is safe for intended use. In the absence of an approved flood map, this statute still provides a local government's Chief Building Inspector with the ability to require a geotechnical report to be prepared by a qualified professional for new buildings and for structural alteration or addition to an existing building or structure.

Where flood mapping is available, the LGA provides both policy and regulatory provisions that can be implemented as stand-alone provisions or collectively to form a framework to effectively manage flood hazard areas. Specific tools available under the LGA relevant to natural hazard management are summarised in Table 4.

The LGA provides provisions that enable local governments to manage development in relation to lands prone to flooding. In doing so, the local government must consider the Provincial Flood Hazard Area Land Use Management Guidelines (the Provincial Guidelines). The guidelines are intended to minimize injury and property damage resulting from flooding and are linked to the Provincial Compensation and Disaster Financial Assistance Regulation. Together, the Provincial Regulation and Guidelines are used to determine if property has been adequately protected and whether a local government is eligible for financial assistance following a flood event.

Table 4: Summary of regulatory tools for local government within Local Government Act.

Regulatory Tool	Description
Regional Growth Strategy (RGS) Bylaw	Is a strategic plan that defines a regional vision for sustainable growth. Objectives and policies can be incorporated into an RGS to prepare for flooding and climate change. RGS are developed by regional governments in partnership with membership municipalities (i.e., RDCO)
Official Community Plan (OCP) Bylaw	Is a guiding policy document used to inform land use decisions. OCPs can include policies in support of climate adaptation and risk reduction. OCPs are developed by local governments through a public consultation and visioning process.
Development Permit Areas (DPAs)	Are designated areas requiring special treatment. An OCP may designate DPAs for specified purposes, including the protection of development from hazardous conditions like flooding, wildfire, and slope stability [Section 488]. Hazard DPAs are generally triggered by alterations to the land associated with development activities. DPAs must include contributions or objectives that justify the designation and must also provide guidelines for

	developers and homeowners to meet the requirements of the DPA.
Flood Bylaw	If a local government considers that flooding may occur on land, the local government may adopt a bylaw to designate a floodplain area and specify flood levels for it, establish setbacks and construction elevations for habitable space for new buildings and structures, and for landfill within the flood hazard area [Section 524]. Most often, applications for building and development permits trigger flood bylaw requirements.
Zoning Bylaw	Land use zoning bylaws are used to regulate the use of individual parcels of land, including parcel configuration, the density of the land use, and siting and standards of buildings and structures [Section 479]. These bylaws have been used historically for flood hazard areas to ensure public safety is maintained by limiting the types of uses associated with those lands.
Subdivision Bylaw	Standards for subdivision design that take into consideration sea level rise can be established by local governments (within the Provincial Guidelines). In the case of regional districts, the Approving Authority for subdivision is the Ministry of Transportation and Infrastructure, who is required to consider the Provincial Guidelines to determine the conditions for subdivision approval.
Local Building Bylaw	There is also provision under Section 694 for a local building bylaw or permit process to require floodproofing. Generally, these are no longer used as the updated BC Building Code has some provisions for floodproofing and any additional conditions can also be integrated into a flood bylaw. It should also be noted that the National Research Council of Canada and partners are working to incorporate new floodproofing standards into future iterations of the Canadian Building Code.

2.6.2.4 First Nation Governments

Under Canadian legislation, First Nation Band Councils get some authority from the *Indian Act* [1953], which provides limited powers. This Act is very dated and under review. Under the Indian Act, authority for issues of land management, and therefore flood management, are held by the crown, with Indigenous Services Canada (ISC) providing operational resources.

In 1999, and amended in 2019, the *First Nations Land Management Act* [1999] allows First Nation governments to opt out of approximately 40 sections of the Indian Act. This enables First Nations to develop their own laws related to land use, environment, and natural resources. A First Nation government transitions to this state by first becoming a signatory to the Framework Agreement on First Nation Land Management (the Framework Agreement), which sets out the principal components of governance of

reserve land (Westbank *et al.*, 1999). First Nation governments can ratify the Framework Agreement by enacting a Land Code, which then returns authority for land management from the Crown to the First Nation. In Canada, as of 2019, 165 First Nations have become signatories to the Framework Agreement and 91 have fully enacted Land Codes (First Nations Land Management Reource Centre, 2019), many of which are in BC. Westbank First Nation has a fully enacted Land Code. The Okanagan Indian Band does not (Lands Advisory Board, 2021).

First Nations that have fully enacted Land Codes have authority to:

- Make laws (i.e., regulations as described in Section 2.5.2) with "respect to the development, conservation, protection, management, use and possession of First Nation Land. This includes laws on zoning, land use, interests and licenses, environment and assessment and protection, services…" (First Nations Land Management Reource Centre, 2019).
- Manage land within their jurisdiction related to natural resources, including leasing, managing revenues and expenditures.
- Environmental protection through the authority to require environmental assessments and environmental protection through the implementation of First Nation laws.
- Exchange lands of equal area and quality if advantageous to the First Nation.

There is huge variation in the approaches and tools used by individual First Nations to consider issues of flood risk governance.

For example, the Okanagan Nation Alliance (ONA), has taken a leadership role in flood (ɬ̓ikt) for the Syilx Okanagan Territory, which covers more than 15,000 km^2 of lands in the southern Okanagan and Similkameen watersheds (Ebbwater Consulting Inc., 2019b). They have developed a plan that has the objective to "understand the risk due to ɬ̓ikt and debris flows within the Okanagan and Similkameen Basin in order to support flood risk mitigation planning" and explicitly includes collaboration with local governments within the watersheds. This project is still in its infancy and no on the ground implementation of flood policies has yet occurred, but foundational information that was developed by weaving traditional knowledge and western science has been created and shared.

Other First Nations have policies and tools that are similar or parallel policies to those developed by local governments. For example, the Tsawwassen First Nation (a Treaty Nation), has community area plans, and a Development Permit Area regulation to require that new buildings in the floodplain be built to appropriate standards on reserve lands (Tsawwassen First Nation, 2021).

Some Nations have limited policies, for example, developed during an emergency (e.g. the Declaration of a Local State of Emergency under a Band Council Resolution (BCR) for the Okanagan Indian Band (Louis and Louis, 2017).

Other Nations have partnered with non-Indigenous jurisdictions to develop flood management plans (e.g., Squamish Nation and District of Squamish, and Cowichan Tribes and Cowichan Valley Regional District) for reserve areas.

With regards to Emergency Response, many First Nations have ISC funded Emergency Co-ordinator positions to support the development of emergency plans. ISC has a service agreement with EMBC to provide emergency services; EMBC is the lead in supporting First Nations with response activities (Indigenous Services Canada, 2021).

2.6.3 Summary of Authority for Local Governments

Flood risk governance in BC is very complex and dispersed. There are some activities for which local governments and some First Nation governments have responsibility and strong authority (e.g., land use regulations to reduce flood exposure). However, many actions are outside the authority of local governments currently. In this case, local governments, especially if they work together, can advocate for change to senior governments and others.

3 Project Methods and Evolved Principles and Objectives

This section describes the approaches and methods used to meet the project goals and objectives. It also provides rationale for the evolution of the goals into guiding principles that framed the work. Methods are described for engagement, the development of a decision framework, the population of a toolbox of non-structural flood mitigation options, as well as a baseline policy scan of flood regulations and policies within the RDCO and member communities.

3.1 Project Goals and Objectives

This project is the third phase of work that has been conducted by the RDCO. In earlier phases, an overall planning approach was identified (Phase 1) and flood hazard mapping and some risk assessment was completed (Phase 2). These two projects helped inform the overall goal and objectives for this third phase of work. At the outset of the project, three broad objectives were provided to guide the work (Figure 10).

Figure 10: Project goals as defined by the RDCO.

These objectives are very high-level, but they provide good direction. They also map well to best practice (see previous section). These objectives were reviewed and confirmed by the steering committee (see engagement sections below) at an early stage in the project.

3.2 Guiding Principles

Building on the project objectives, and informed by best management practices, as well as early engagement, four guiding principles were evolved to better frame the needs of the project. These are:

1. Water is sacred and should be nurtured:

   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.---Syilx Water Declaration

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.

3.3 Project Elements

To meet the project objectives and be true to the evolved guiding principles, the project was broken into three elements (Figure 11). Although these are presented as distinct options here, and the report is essentially structured to follow these, the actual project effort involved considerable feedback and iterations between the elements.

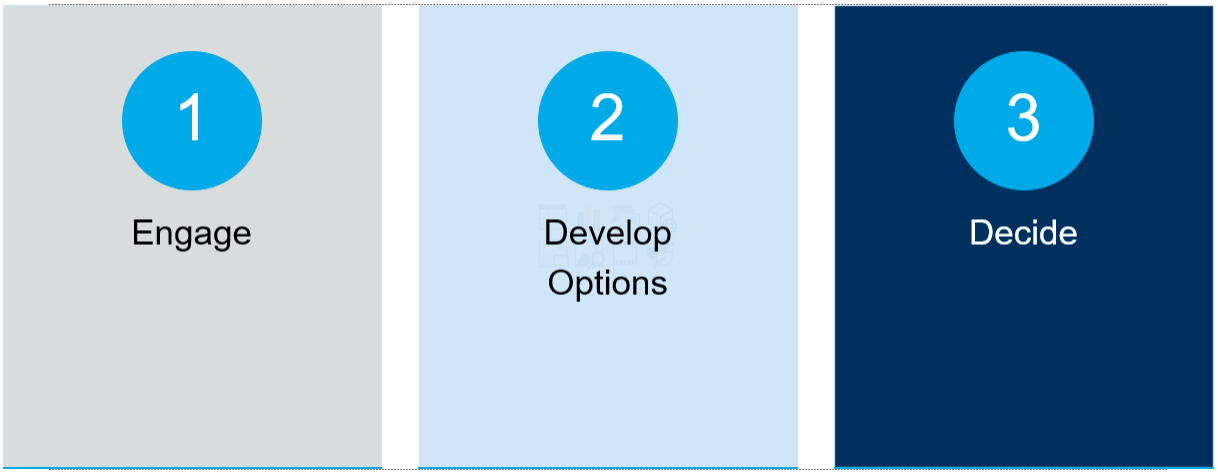


Figure 11: Core elements of project.

1. **Engage**. This element involved engaging with a wide variety of stakeholders, decision-makers and the public to better understand local values related to hazard and water. These values were then used to inform the types of options and the criteria used to understand trade-offs between them.

2. **Develop Options**. This project element consisted of developing and fleshing out the details of a wide array of potential non-structural flood mitigation options suited to the Okanagan.
3. **Decide**. This final element involved conducting research into the suitability of various options to different circumstances, as well as developing a values-based decision tool to inform on trade-offs between different types of options, and finally placing these into the context of existing local government authority and responsibility, and the baseline policy initiatives that exist in the Okanagan today.

3.4 Engagement methods

Engagement was a core component of this process and was key to ensuring that the mitigation options presented are acceptable and supported by member local governments, *Syilx* communities, stakeholders, and the public.

One of the first project tasks was the development of an Engagement and Communications Framework, which was reviewed and contributed to by the Project Steering Committee (see below, Appendices B and C). The Framework guided engagement and communications throughout the project, although the Project Team adapted some steps along the way in response to what worked well, what didn't, and other external factors (e.g., summer events and wildfires that redirected community members' focus).

The Engagement Approach was founded on six principles:

- Equitable and Inclusive
- Two-Way Communication
- Respectful Partnerships
- Transparency
- Knowledge and Education
- Structured

All engagement followed the provincial guidelines around COVID-19, respecting social distancing and limitations on gatherings. This presented an opportunity to utilize the many online and remote engagement platforms and techniques; at the same time, the Project Team continued to utilize some traditional media (e.g., local news outlet) and paper communications (e.g., posters) to include those who aren't online.

General project communications took place across social media (Facebook, Instagram), e-Newsletters, an RDCO webpage set up for this project, a two-page project overview distributed online and on paper, local advertising, phone calls and emails with individuals and specific groups, and posted print materials.

As described below, engagement employed a variety of tools and techniques with three key groups: the General Public, a Project Steering Committee, and Stakeholders. For additional detail, please see the Full Engagement Summary Report (Appendix E).

3.4.1 General Public

Public engagement sought to engage community members and residents from RDCO member municipalities, electoral areas, and Syilx First Nations including Westbank First Nation and Okanagan Indian Band. Efforts were made to focus on residents living in floodplain areas (such as by posting notice of engagement opportunities in neighbourhoods that were particularly affected by past floods) and Syilx community members (such as by working directly with Syilx First Nation representatives on the Steering Committee to understand the best way to engage community members).

The focus of public engagement was to build broad public support for and understanding around flood mitigation planning in the Central Okanagan, promote education around flood and climate change, and to elicit community values that help inform decision making around options.

3.4.1.1 Tools and Methods

Two primary engagement formats were used in engaging the public, along with various communication tools and approaches.

First, a series of Community Conversations were organized as 1-hour Zoom sessions. These included a short PowerPoint Presentation from the Project Team, followed by interactive activities and discussion with participants, utilizing Mentimeter for online instant polling. The series was broken out into two rounds, which were organized as follows:

- Round 1 focused on the question “what do you care about with flooding and your home and community?” This helped shape values which later fed into decision criteria used to evaluate non-structural options.
- Round 2 focused on the question “which flood mitigation options do you want to see in your community?” which introduced residents to non-structural options and sought their high-level feedback.

The first Round included two Zoom sessions with a total of seven participants; due to low registration, the second Round included just one Zoom session which was also attended by seven participants.

Second, an online survey offered similar content and questions as the Community Conversations for those who preferred to participate on their own time. The survey was active for close to a month and received 39 responses.

The Community Conversations and survey were advertised through various communication platforms including a dedicated RDCO webpage, RDCO and City of Kelowna social media pages, RDCO and City of Kelowna e-Newsletters, a series of ads run on Castanet, as well as a digital signboard, paper posters, and sandwich boards strategically placed in neighbourhoods that have experienced significant flooding in the past.

3.4.2 Project Steering Committee

Key decision-makers and governing bodies within the project area were convened to form a Steering Committee for this project. This group of approximately 25 included RDCO project staff and relevant departments, City of Kelowna, City of West Kelowna, District of Peachland, District of Lake Country, Westbank First Nation, Okanagan Indian Band, Okanagan Nation Alliance, Okanagan Collaborative Conservation Program, the Okanagan Basin Water Board, and UBC Okanagan (Watershed Management Research Extension Facilitator).

Guided by a Terms of Reference (see Appendix C), the Steering Committee provided key feedback and high-level direction on the project. They reviewed and provided feedback on deliverables such as the Engagement Framework and draft Flood Mitigation Resource Guide; helped spread information and project awareness (e.g., sharing social media posts about public engagement opportunities); attended and supported other project engagement sessions; and helped integrate and coordinate this project with other Okanagan projects and initiatives.

3.4.2.1 Tools and Methods

The Steering Committee was primarily engaged through three 1.5-hour Zoom meetings that focused on the following:

1. Project introduction, discussion of project objectives, and engagement framework review.
2. Presentation of the structured decision-making process, review of values-based criteria used in evaluating mitigation options, and identification of case studies for discussing mitigation options with stakeholders.
3. Discussion and feedback on the draft Flood Mitigation Resource Guide, which was shared prior to the meeting.

3.4.3 Stakeholders

Stakeholders included a broader representation of local governments (beyond those included in the Steering Committee) such as the North Okanagan and Okanagan-Similkameen Regional Districts, as well as other relevant groups such as non-government organizations doing flood-related work, the School District, Interior Health, relevant provincial ministries, local business representatives (e.g., Chamber of Commerce), neighbourhood / residents associations, and land and asset owners (e.g., Fortis BC, City of Kelowna International Airport, BC Hydro). Over 120 workshop invitations were sent to stakeholders; for a full list of those invited to participate, please see Appendix D.

Stakeholders were engaged to: provide input on values that, together with feedback from the general public, helped inform decision making criteria; and help identify challenges and opportunities with non-structural flood mitigation options and how they can be implemented both locally and regionally.

3.4.3.1 Tools and Methods

Stakeholders were primarily engaged through two 2-hour workshops held over Zoom that also used Mentimeter and Mural online engagement platforms. Content for the two sessions were as follows:

1. Project introduction, flood background, values and impacts, and discussion of opportunities and challenges with the six non-structural options.
2. Group exploration of how to apply non-structural options to two case study locations in the Central Okanagan, and how to address flood risk as a region.

These two sessions included a combination of presentations from the Project Team, interactive small group activities (using facilitated Zoom break out rooms), and plenary discussions.

3.5 Development of Criteria, Objectives and Measures

Most flood-management options involve the *definite* expenditure of resources and alteration of current land uses or environments to create new situations that, except during future *potential* flood events themselves, are otherwise less-desirable than they were before: a scenic beach becomes spoiled by a berm; a café near the shoreline has its view of the water obscured by a raised seawall. It is certainly not inevitable that all changes are negative; with creativity and skill, such physical features can become seamlessly integrated into the landscape to the point that their function is not obvious to the casual observer, and form and functionality may even be increased. Nevertheless, where there is a need to take an existing location and intervene to incorporate design features that are only necessary in rare flood events, controversy is to be expected, no matter which mitigation approach is selected.

The selection of preferred options will often be reduced to questions of values-based trade-offs. Is it better to accept the loss of tax revenues from increased development in the floodplain by holding the land and developing park spaces, or to accept the occasional costs associated with response and recovery to the increased development areas? Should government help a location become more resilient to occasional floods rather than trying to prevent it from ever getting wet? These questions have no technically optimal answers. An informed consultation of this kind requires communication about what the choices might entail and analysis on how these choices might affect the things people value the most.

For this project, a values-based approach to decision making was used. This involved first identifying locally relevant values through engagement (see above), then developing decision objectives and measures. A basket of options was then developed (see next section), and these were compared against the objectives and measures (see Figure 12)

A note on terminology

Objectives are simple values-based statements of the things that matter to people when considering flooding.

Performance measures provide a means of assessing the performance of different flood mitigation options across objectives. Various methods may be used to estimate the value of the performance measures under each of the flood management alternatives.

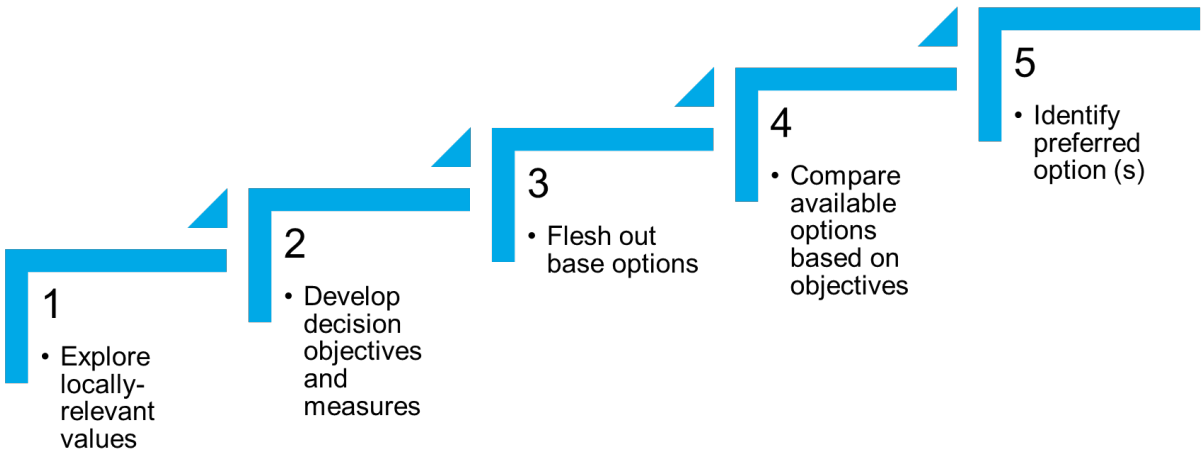


Figure 12: Decision-making process.

A simplified set of criteria were developed from the more detailed objectives and measures to support the development of the Resource Guide for a lay audience. Some important criteria were collapsed or eliminated during this process. The simplified criteria provide an excellent base for initial screening of options. However, if and when more detailed work is completed, the full list of objectives and measures should be considered.

3.5.1 Strengths and Limitations of this Approach

This structured approach to looking at options allows for easy identification of preferred options (or low-hanging fruit) as well as least preferred options. This approach also provides additional information on the weak points of an option that might be improved by augmenting the concept, or alternately might be complemented with a second or third option to better score across all criteria.

This approach does not however provide 'an answer'. The provision of a single solution does not in itself make a lot of sense, as it is important to consider the very local context where an option might be implemented.

3.6 Development of Options

One of the guiding principles for this work was to develop a full toolbox of options to provide a range of tools that can complement each other and provide redundancy. This was accomplished by first developing a structure to understand the full toolbox of options, and then through the authors' knowledge and research tools were established and fleshed out.

3.6.1 Grouping of Non-Structural Mitigation Approaches

To provide some structure to the numerous options, some overarching strategy groups were developed. If risk is a function of hazard, exposure, and vulnerability, then there are three broad non-structural approaches or strategies that can be taken to reduce the risk.

1. **Reducing local flood hazards 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.
2. **Reducing local exposure 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.
3. **Reducing local vulnerability through building management**. This can include regulations and strategies that make structures and belongings less susceptible to flood damage. For example, using flood-resistant materials for the ground floor of a building.

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 is defined as the "ability of a system, community or society exposed to hazards to resist, absorb, accommodate, adapt to, transform and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of the essential basic structures and functions through risk management." (UNDRR, 2015).

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:

1. **Education and awareness.** Homeowner guides, flood and climate change education, neighbourhood preparedness programs, and other learning resources.
2. **Emergency response**. Early warning systems, temporary barriers, and other flood response programs.
3. **Insurance and disaster financial assistance**. Managing financial risks where no other mitigation strategies are available.

3.6.2 Materials Reviewed to Develop Toolbox

The authors approached the task of filling the toolbox with tools using “blue-sky” thinking; we assumed that there were no bounds to the possible options. For example, we did not limit the options to those that would function under current governance systems, rather we included options that would require significant shifts in senior government policy alongside those that would be easily achieved today.

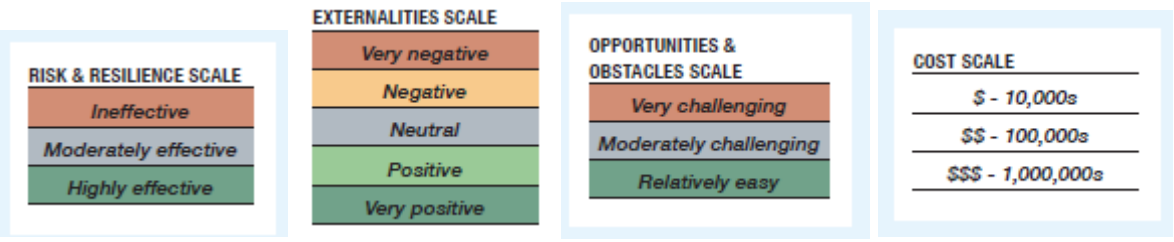
An initial list of options was developed by considering previous lists of non-structural mitigation activities, for example within the core competencies list of the BC Flood Governance Review reporting (Ebbwater Consulting Inc. and Pinna Sustainability, 2021), the Federal Land Use Guide for Flood Risk Areas (Ebbwater Consulting Inc., 2019a) and the relevant approaches with the Sea Level Rise Adaptation Primer (Arlington Group; EBA Engineering Consultants; DE Jardine Consulting; Sustainability Solutions Group, 2013) and the Flood Protection Strategies for BC (The Arlington Group, 2010). We then built on this list through internet searches and author knowledge. We researched many reports related to sea level rise adaptation, as the trend in expanding flood areas for coastal areas is more recognised at this time than changing flood inland flood hazard, and many resources and toolkits have been developed in the last few years to address this.

The full list of options was then simplified and reduced through amalgamation (when two options were deemed similar enough to combine) and some separation (when for example the option would be different based on the existing condition (e.g., retrofitting a building is very different than requiring floodproofing in a new build).

3.7 Scoring of Criteria

Each of the options was scored against the simplified criteria developed from the more detailed objectives and measures. This process was conducted by the project team, based on their understanding of the criteria and the options, these are therefore subjective scores. The scores are meant to be indicative to highlight relative differences and trade-offs between flood mitigation options.

The following scales were used:



Further, the scoring was conducted in the absence of “place”. Whereas the effectiveness of an option is in large part determined based on the local circumstances for which it is being considered. For example, the risk reduction efficiency of an option is dependent on the existing exposure and vulnerability of a neighbourhood or place.

We encourage users of the Resource Guide and this report to score their own projects, using local, and quantifiable (where available) information.

3.8 Policy Scan

In addition to understanding what non-structural flood mitigation options are possible, and the trade-offs associated with each of them, it is important to understand the baseline of existing policies in the region. This is especially important given the dependencies in policy (e.g., having a floodplain map that is then designated within a flood bylaw or DPA prior to being able to enact many building controls or land use controls; see also Background and Supporting Information).

A high-level policy scan was conducted for the RDCO and First Nation and local governments within the RDCO boundaries. For each jurisdiction a number of policy and/or regulatory tools were reviewed to establish how flood is currently managed, which tools are currently in place to support non-structural mitigation, and finally where the gaps lie.

A relatively simple scan approach was taken. For each jurisdiction:

1. The presence or absence of local government regulatory tools (see Table 4 and First Nation Governments section) was determined.
2. When a local government regulatory tool was present, it was reviewed for elements related to flood, natural hazards, climate adaptation.
3. A broader search of all public materials on the jurisdiction's website was also conducted for any other policy direction (e.g., board or council resolutions, etc.)
4. Where relevant, this was compared to materials in recently completed *Analysis of Flood Resilience Policy and Planning Tools in the Okanagan Valley* (Nahiduzzaman *et al.*, 2021).

For each jurisdiction a summary of relevant policies were summarised in text and tables, and a brief analysis of opportunities and gaps to the implementation of non-structural flood mitigation was developed.

4 Results

The following section provides a summary of results from the various tasks described in the previous section. First a summary of the engagement is provided. This is followed by a full list of project-specific objectives and measures and the summarised criteria used to score the options. The options themselves are presented within the Resource Guide, although a full scoring table is presented in Appendix F. This section also provides the results of the policy scan and presents next step policy actions for each jurisdiction within the RDCO.

4.1 Engagement Summary

On top of supporting education and awareness building, engagement with the public, Stakeholders, and the Steering Committee the engagement process helped elicit values – i.e., what people care about when it comes to flooding and its impacts, and approaches to building resilience and reducing risk. This feedback informed the Project Team's development of values-based criteria to evaluate non-structural mitigation options.

Engagement activities were also designed to gauge perceptions and preferences around the various flood mitigation options. The public was introduced to and engaged on these options at a high-level. Further detail was sought from the Steering Committee and Stakeholders which helped to characterize the challenges and opportunities in implementing suites of mitigation options and coordinating at a regional scale.

Altogether, **engagement findings helped to identify a suite of non-structural mitigation options that are broadly accepted and supported**, and to understand which options are appropriate when and where.

4.1.1 Values and Principles

Both Stakeholders and the public were asked what they value about living among rivers and lakes in the Okanagan. Their responses touched on key themes such as:

- Recreation and outdoor, healthy lifestyle
- Water quality and access (e.g., for drinking water, cultural uses, etc.)
- Nature and biodiversity, with frequent mention of aquatic habitat
- Aesthetics (beauty, sounds, scenery, etc.)
- Weather and climate

When asked to prioritize a list of pre-determined flood impacts, the top three* were as follows:

Table 5: Stakeholder and public ranking of flood impacts.

Ranking	Stakeholders	General Public
1	Environment	Affected People
2	Affected People	Environment
3	Economics	Infrastructure Disruption

*Other impacts included mortality and cultural impacts.

4.1.2 Options

The general public and Stakeholders were both asked which of the six non-structural mitigation strategies they are most drawn to. Based on their input, the options were ranked as follows:

Table 6: Stakeholder and public ranking of non-structural mitigation strategies.

Ranking	Stakeholders	General Public
1	Land Use Management	Land Stewardship
2	Land Stewardship	Land Use Management
3	Education and Awareness(tie)	Education and Awareness
4	Building Management (tie)	Building Management
5	Emergency Response	Emergency Response
6	Insurance and DFA	Insurance and DFA

For additional detail on the challenges and opportunities that stakeholders and the public identified with each of these options, please see the Full Engagement Summary Report (Appendix E).

4.1.3 Implementation through Regional Coordination

During the two workshops, stakeholders were asked to consider how some of the non-structural options could be implemented regionally and where coordination is needed. There was widespread agreement that there needs to be a consistent and coordinated approach across the region, with more detail in the following themes:

- **Take a watershed and natural assets approach**. Centring discussion and policy on watershed protection helps underscore the importance of working collaboratively across the region, rather than following jurisdictional boundaries. It is also important to see natural assets as infrastructure that offer opportunities and positive values.
- **Manage "transfer of risk" across properties or jurisdictions**. Actions taken on one property can inadvertently transfer flood risk to other sites up or downstream. This needs to be managed regionally (e.g., through monitoring and response of even small-scale property-level changes that affect hydrology) as changing lake levels and stream flooding take place across property lines and jurisdictional boundaries.
- **Consistent policies across the region could enable bolder action**. For example, buy-out and retreat options would require a regional approach. Having consistent policy and messaging across the region strengthens the abilities of each jurisdiction within to implement some of the more 'controversial' options.
- **Approach regional coordination with everyone at the table, including upper levels of government**. A regional approach needs to be developed collaboratively to ensure everyone in the region (e.g., member municipalities and

First Nations) is on board. It will also be important to work with the provincial and federal governments to clarify roles and responsibilities, align approaches, and seek to create policy at the provincial and federal level policy that enables, rather than limits, local governments to adequately implement flood mitigation options.

- **Align and adapt funding priorities**. Local governments need to have a mechanism to buy land (rather than obtaining funding for infrastructure projects, which is a more common funding priority) to support managed retreat.

4.2 Objectives, Measures, and Criteria for Decision-Making

The following briefly summarises how the criteria, presented in the Resource Guide, were developed.

4.2.1 Locally Relevant Values

First, locally relevant values were determined through the stakeholder engagement process (specifically Round 1). Through a series of workshops and surveys a list of important values were developed (see Figure 13 and Engagement Summary).

Figure 13: Locally relevant values used in decision tool.

4.2.2 Objectives and Measures

Using the previously identified values, along with standard indicators used in Disaster Risk Reduction literature (see Best Management Practice Context, Section 2.2), an initial list of objectives and measures were developed.

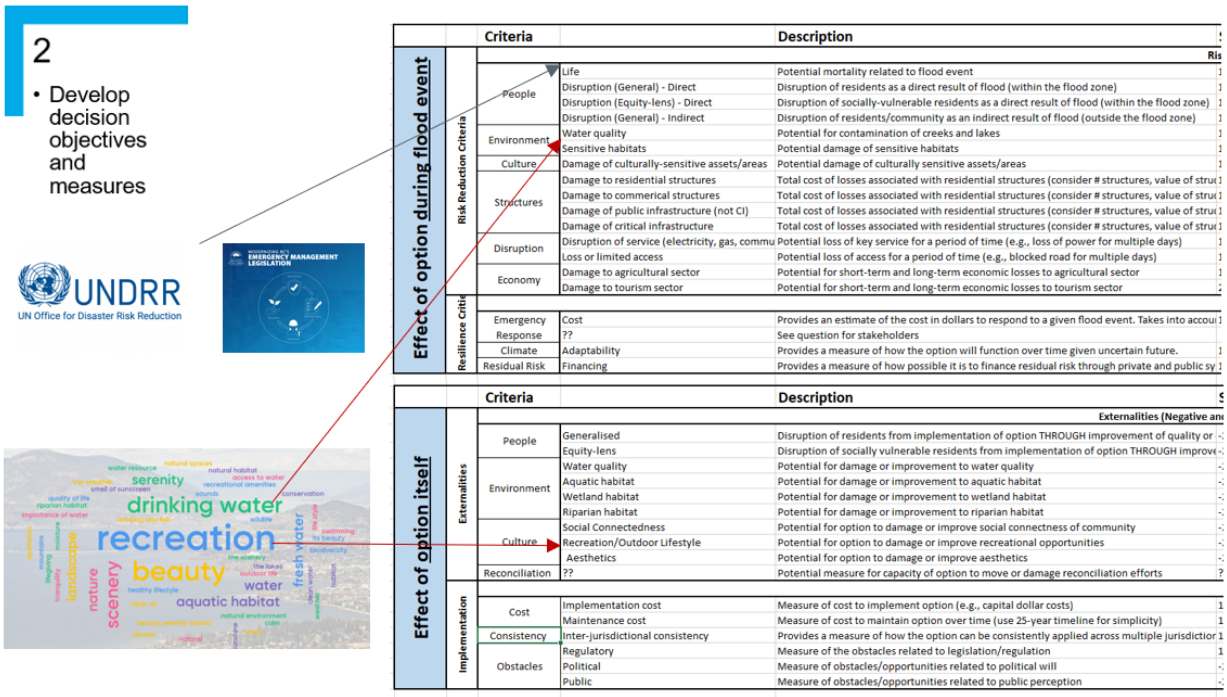


Figure 14: Example process to develop objectives and measures from values.

These objectives and measures were then workshopped with the Steering Committee and refined (see Figure 15 and Figure 16). Importantly, the decision objectives were grouped into two distinct categories. The first category includes objectives to determine the effectiveness of the option for flood risk reduction or increasing resilience (i.e., the effect of the option during a flood event). The second category of objectives relates to the potential co-benefits or negative externalities that will result from the implementation of the option; these are the impacts that will be felt 'year-round', as opposed to the benefits that are brought during a flood event.

Effect of option during flood event		Criteria (Objective)	Measure
Risk Reduction Criteria			Risk Reduction Criteria
	People	Health & safety	Potential mortality related to flood event
		Disruption (General) - Direct	Disruption of residents as a direct result of flood (within the flood zone)
		Disruption (Equity-lens) - Direct	Disruption of socially-vulnerable residents as a direct result of flood (within the flood zone)
		Disruption (General) - Indirect	Disruption of residents/community as an indirect result of flood (outside the flood zone)
	Environment	Water quality	Potential for contamination of creeks and lakes
		Fish population health	Potential damage or improvement of fish population health
		Change to sensitive habitats	Potential damage or improvement of sensitive habitats
	Culture	Damage of culturally-sensitive assets/area	Potential damage of culturally sensitive assets/areas
	Structures	Damage to residential structures	Total cost of losses associated with residential structures (consider # structures, value of structure, and susceptibility of structure to
		Damage to commercial structures	Total cost of losses associated with commercial structures (consider # structures, value of structure, and susceptibility of structure t
		Damage of public infrastructure (not CI)	Total cost of losses associated with public infrastructure (consider # structures, value of structure, and susceptibility of structure to
		Damage of critical infrastructure	Total cost of losses associated with critical infrastructure (consider # structures, value of structure, and susceptibility of structure to
	Disruption	Disruption of service (electricity, gas, comm	Potential loss of key service for a period of time (e.g., loss of power for multiple days)
		Disruption of transportation and mobility	Potential loss of access for a period of time (e.g., blocked road for multiple days)
	Economy	Damage to local economy	Potential for short-term and long-term economic losses to broader local economy
		Damage to agricultural sector	Potential for short-term and long-term economic losses to agricultural sector
		Damage to tourism sector	Potential for short-term and long-term economic losses to tourism sector
Resilience Criteria			Resilience Criteria
	Emergency Response	Cost of response	Provides an estimate of the cost in dollars to respond to a given flood event. Takes into account costs associated with deployment o
		Retention of human resources and capacity	Potential for burnout and turnover of emergency response staff
	Climate	Adaptability of option to multiple climate	Provides a measure of how the option will function over time given uncertain future
	Residual Risk	Access to financing	Provides a measure of how possible it is to finance residual risk through private and public systems

Figure 15: Objectives and measures related to the effectiveness of an option during a flood event.

Effect of option itself		Criteria (Objective)	Measure
Externalities			**Externalities (Negative and/or Positive) (a.k.a. co-benefits for positive)**
	Community	Location/character of housing and neighbo	Disruption of residents from implementation of option THROUGH improvement of quality or quantity of housing and community
		Equity-lens (relative impacts for population	Disruption of socially vulnerable residents from implementation of option THROUGH improvement of quality or quantity of housing
	Environment	Social Connectedness & Support	Potential for option to damage or improve social connectness of community
		Water quality	Potential for damage or improvement to water quality
		Aquatic habitat health	Potential for damage or improvement to aquatic habitat
		Wetland habitat	Potential for damage or improvement to wetland habitat
		Riparian habitat	Potential for damage or improvement to riparian habitat
		Aesthetics	Potential for option to damage or improve aesthetics
	Culture	Recreation/Outdoor Lifestyle	Potential for option to damage or improve recreational opportunities
		Indigenous Culture	Potential for damage or improvement to Indigenous cultural sites
		Non-Indigenous Culture	Potential for damage or improvement to non-Indigenous cultural sites
	Reconciliation	(Pending discussion with Syilx Okanagan Peoples)	
Implementation			**Implementation Criteria**
	Cost	Implementation cost	Measure of cost to implement option (e.g., capital dollar costs)
		Maintenance cost	Measure of cost to maintain option over time (use 25-year timeline for simplicity)
	Consistency	Inter-jurisdictional consistency	Provides a measure of how the option can be consistently applied across multiple jurisdictions
	Obstacles	Regulatory	Measure of the obstacles related to legislation/regulation
		Political	Measure of obstacles/opportunities related to political will
		Public	Measure of obstacles/opportunities related to public perception

Figure 16: Objectives and measures related of the effect of the option itself.

The final list of detailed objectives and measures are presented in the figures above. A digital version of this list that includes potential scales of measurement (either quantifiable from risk analyses, or simple expert judgement likert scales) was provided alongside this report.

4.2.3 Simplified Criteria

Given the complexity of the full list of objectives and measures, and the need for place-based analysis to score many of the objectives, a simplified list of criteria and targets were evolved.

Table 7: Simplified criteria applied to non-structural flood mitigation options.

Criteria			Target
Effect of option during flood event	**Risk Reduction Criteria**	**People**	Reduce risks to health and safety of people
		Structures	Reduce damage to structures
		Disruption	Minimize disruption of services and mobility (electricity, gas, communications, etc.)
		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
Effect of option itself	**Externalities**	**Community**	Housing
			Social connectedness and supports
		Environment	Habitat health (aquatic, wetland, riparian, and water quality)
		Culture	Recreation and outdoor lifestyle
	Implementation Criteria	**Obstacles**	Regulatory
			Political and public will
		Cost	Implementation cost
			Maintenance cost

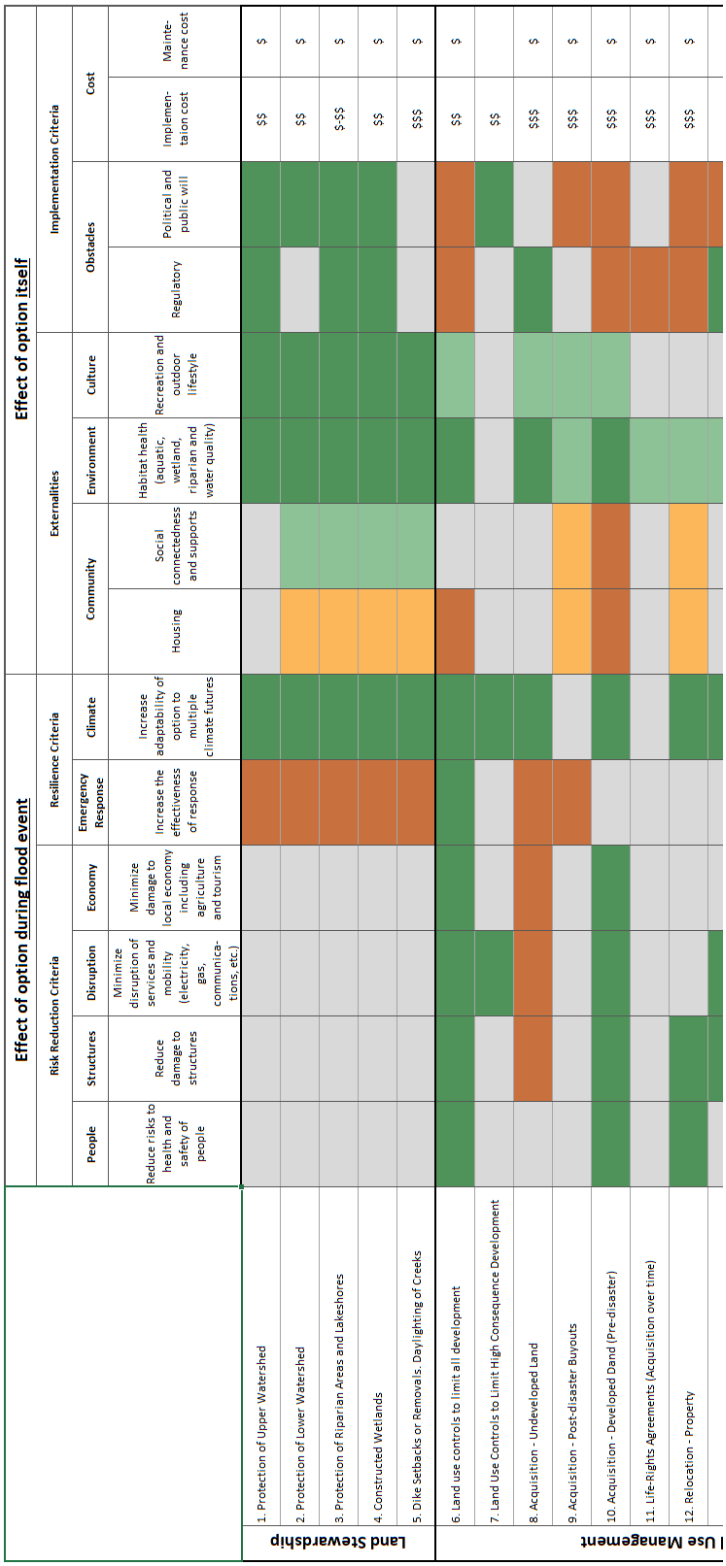
4.2.4 Options Development

The Resource Guide showcases 40 non-structural flood mitigation options that may be applied within the Okanagan. For each option, a description is given. This is followed by a table and narrative description of trade-offs associated with the option. Implementation steps are also provided along with example applications if known. Please refer to the Resource Guide for the results of the options development.

4.2.5 Scoring and Trade-offs

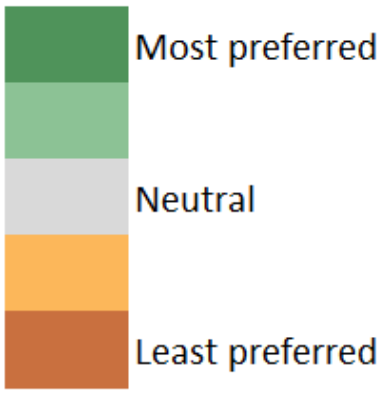
Each of the 40 non-structural mitigation options developed and fleshed out earlier were then scored against the simplified criteria, using the subjective judgement of the consultant team. The scores are presented in the option summary sheets within the

Resource Guide, as well as a group below (illustrative only) and in a large format within Appendix F.



		Effect of option during flood event							Effect of option itself									
		Risk Reduction Criteria				Resilience Criteria		Externalities					Implementation Criteria			Cost		
		People	Structures	Disruption	Economy	Emergency Response	Climate	Community		Environment	Culture	Obstacles						
		Reduce risks to health and safety of people	Reduce damage to structures	Minimize disruption of services and mobility (electricity, gas, communications, etc.)	Minimize damage to local economy including agriculture and tourism	Increase the effectiveness of response	Increase adaptability of option to multiple climate futures	Housing	Social connectedness and supports	Habitat health (aquatic, wetland, riparian and water quality)	Recreation and outdoor lifestyle	Regulatory	Political and public will	Implementation cost	Maintenance cost		
Land Stewardship	1. Protection of Upper Watershed													$$	$		
	2. Protection of Lower Watershed													$$	$		
	3. Protection of Riparian Areas and Lakeshores													$-$$	$		
	4. Constructed Wetlands													$$	$		
	5. Dike Setbacks or Removals. Daylighting of Creeks													$$$	$		
Land Use Management	6. Land use controls to limit all development													$$	$		
	7. Land Use Controls to Limit High Consequence Development													$$			
	8. Acquisition - Undeveloped Land													$$$	$		
	9. Acquisition - Post-disaster Buyouts													$$$	$		
	10. Acquisition - Developed Dand (Pre-disaster)													$$$	$		
	11. Life-Rights Agreements (Acquisition over time)													$$$	$		
	12. Relocation - Property													$$$	$		

Table 8: Illustrative partial consequence table for non-structural flood mitigation options (refer to Appendix F for full table).



The table (illustrative above, and complete in Appendix F) shows at a glance how each option has different trade-offs. Some options are reasonably effective at reducing risk, and offer many positive co-benefits, but have significant implementation challenges (e.g., land stewardship options; top few rows of the table). Whereas, other options have excellent co-benefits, are relatively easy to implement, but are only moderately effective or barely effective at actual risk reduction (e.g., emergency response options).

The key to meeting the project objectives of reducing risk and increasing resilience is to develop a suite of options that can be applied together.

The scoring results can and should be used by local governments to support initial screening and prioritisation of a tool or suite of tools for a specific area. Given the unique hazard and risk profiles of any given area, and of any potential co-benefits or externalities, the scoring and objectives should be revisited and updated as appropriate prior to being used to determine final plans.

4.3 Policy Scan

The following provides an overview of existing policies and regulations that are in place within the RDCO and member communities.

4.3.1 Regional District of Central Okanagan

The RDCO has a number of regulations and policies related to flood management along Okanagan Lake and other watercourses. This includes broad policy statements within the RGS, more detailed policy statements within four OCPs, a Zoning Bylaw, and one Rural Land Use Bylaw. The OCPs and Rural Land Use Bylaw also include an Aquatic Ecosystems DPA, which covers the creek systems. The RDCO Zoning and Rural Land Use Bylaws have a full section on floodplain regulations, that for the most part follow the Provincial guidelines.

Table 9: Regulations related to flood management within the Regional District of Central Okanagan

Regulation	Section	Details/Description
Regional Board Strategic Priorities (2020 Update)	Environment	This section includes several relevant priorities: 1. A commitment to “a reduction in new construction in higher risk floodplain areas” 2. A commitment to collaborate with other regional partners to “address dangers from flooding and enhance the region’s ecosystems”
	Sustainable Communities	A commitment to “advocate to the Province to review Okanagan Lake levels to reduce the risk of flooding”
Regional Growth Strategy	Section 3.2.3	This includes a policy to “work with local governments, provincial agencies to assess and mitigate risks in floodplains”

(RDCO, 2013)	Section 3.2.7	This includes a policy to "encourage land use and transportation infrastructure that improves the ability to withstand climate change impacts and natural hazard risks"
RGS Monitoring Program (2019)	Section C.7	Includes a proposed indicator for Natural Disaster Resilience of "# of dwellings in flood risk (hazard) zone"
OCPs (Electoral Areas) Bylaws Nos. 1124,1274, 1303 and 1304 (Sections and Policies noted for Brent Road-Trepanier OCP, similar policies and statements are within all 4 OCPs, exceptions are noted as separate rows below)	Section 5.1.1	P3 "Work with provincial and federal water and resource managers to protect and enhance water quality, base flows, natural drainage patterns, and continuous riparian corridors of sufficient width to accommodate the dynamic nature of the hydrologic system, to avoid and reduce flood damage…" P7 "Support efforts that maintain appropriate riparian buffers, determined by qualified professionals that take account processes of natural erosion, deposition and movement of natural stream boundaries, floodplain provisions and sensitive terrestrial habitats" P12 "Local low intensity land uses and manage forms of development on floodplains and aquifers in accordance with provincial regulations"
	Section 5.2	P9 "Discourage development that may be damaged by flooding from being located on land that might be flooded as identified by setbacks and elevation provisions recommended by Water Management officials of the Province of BC and outlined in Zoning Bylaw No 871. This includes flood construction levels 1.5 m above the natural boundary of certain watercourses. Where construction may occur on existing parcels that might be flooded, buildings should meet those construction and location requirements. Development of property should be consistent with the provincial Flood Hazard Land Use Management Guidelines"
	Section 7.3 (Agriculture)	P10 "Investigate methods to jointly administer storm water drainage systems with the Ministry of Transportation and Infrastructure and provide sustainable funding for stormwater management and flood protection works"

		P11 “Support development designs involving major flood control works when sustainable funding to maintain these works is secured”
	Aquatic Ecosystems DPA	Describes active floodplains as areas that are flooded more frequently than 1 in 5 years (20% AEP). Mapping includes creeks but does not include Okanagan Lake; although a 15 m riparian buffer is applied to all watercourses. Guidelines generally promote natural processes and limit the use of engineered solutions (e.g., riprap to manage bank erosion).
Rural Westside OCP	Section 3	This OCP includes a description of normal and flood lake levels; a 200-year (0.5% AEP) design level of 343 m (no datum) is given.
Zoning Bylaw 871	Section 3.28 Floodplain Regulations	This defines FCLs for Okanagan Lake (343.66 m, no datum is given), 3 m above Mission Creek natural boundary, and 1.5 m above natural boundary of any other watercourse. It also defines horizontal setbacks from Okanagan Lake (15 m) and from other water sources (7.5 m to 30 m) The remaining text is generally pulled from the Provincial guidelines. It has a provision to require a covenant on title related to any exemption under Section 219 of the Land Title Act.
Joe Rich Rural Land Use Bylaw 1195 [2007]	Section 3.1	This, like the Zoning Bylaw, provides specific regulations for floodplains within the Joe Rich area. The regulations mimic those in the Zoning Bylaw with the exception of an additional statement to limit liability to the RDCO: Damage by Flooding By the enactment, administration or enforcement of this bylaw the Regional District of Central Okanagan does not represent to any person that any building or structure, including a manufactured home, located, constructed, sited or used in accordance with the provisions of this bylaw, or in accordance with any advice, information, direction or guidance provided by the Regional District of

		Central Okanagan in the course of the administration of this bylaw will not be damaged by flooding.
Development Application Procedure Bylaw 944	Section 6.2 (f)	Provides potential to require reporting prepared by a qualified professional related to flooding.

In addition to the regulations above, the RDCO has relevant guidelines. This includes the 2007 Central Okanagan Foreshore Plan, which maps out a Foreshore Area, and provides guidance on the management, development and use of lands within the foreshore area. This document provides useful guidance as it relates to issues of land stewardship, as it has a focus on the protection and naturalisation of foreshore (i.e., flood hazard) areas. The document also has specific policies for *designated* flood plains within the RDCO. However, as noted elsewhere, this terminology is outdated and is likely in reference to the pre-2004 era when floodplains were provincially designated. Regardless, there are some strong tools within this guidance document to support non-structural flood mitigation actions.

As companions to the above document, the RDCO has worked to update the foreshore mapping in the plan in the Okanagan Lake foreshore inventory and mapping project, and has complemented this with their Sensitive Habitat Inventory Mapping.

4.3.1.1 Opportunities for non-structural mitigation

The RDCO regulations and policies set an excellent foundation for non-structural mitigation actions. The RGS strategies reflect many of the best practices highlighted earlier in this document, and the recommendation for leadership and regional collaboration reflected in the recommendations (later in this document).

4.3.1.2 Challenges for non-structural mitigation

The current regulations reflect older information related to flood hazard from the lakes. The newly reported FCL (Northwest Hydraulic Consultants Ltd., 2020) for Okanagan Lake is 344.6 m (CGVD2013)/ 344.3 m (CGVD1928) which is significantly higher than the FCL within the current policy.

The current zoning bylaws reflect provincial guidance, and therefore limit vulnerability reduction approaches to raising structures above the FCL, whereas, best practice (as described in this report and elsewhere) highlights the possibility of using a broader definition of flood proofing, to include all the measures within the building management section of the Resource Guide.

4.3.1.3 Next steps for non-structural mitigation

As an immediate next step, the RDCO should consider updating the zoning bylaw to reflect the new FCLs for Okanagan Lake (and potentially including an easy mechanism to continue to update these levels as they are reviewed in future).

The RDCO could also consider developing a hazard area DPA (to include Okanagan Lake) within the OCPs to better reflect and manage flood hazards, as opposed to relying on related measures within the Aquatic Ecosystems DPA.

4.3.2 Westbank First Nation

As noted earlier, the Westbank First Nation has a Land Code, and as such has authority to manage land use decisions on their reserves. They also have greater rights and title that are in flux (see earlier sections on Governance Context for First Nation and local governments). In this section, we review the Comprehensive Community Plan, as the existing *de jure* regulatory tool for the Nation. An updated version of the plan is being developed at this time.

Table 10: Regulations related to flood management within Westbank First Nation.

Regulation	Section	Details/Description
Community Plan (Westbank First Nation, 2015)	Section 3.3	The plan defines an Environmentally Sensitive Area that considers the foreshore and floodways for watercourses.
	Principle 3.3.1 (c)	This principle aims to "minimize the hazard of floodplains on development by locating lower intensity land uses in these areas and regulating development within the floodplains"

4.3.2.1 Opportunities for non-structural mitigation

The overarching principle within the Plan to locate lower intensity land uses in flood hazard areas is very much in line with best practice for flood risk reduction. As long as this principle is followed through in land use planning then there is a good opportunity to reduce risk in the community.

4.3.2.2 Challenges for non-structural mitigation

A primary challenge to implement non-structural mitigation is the lack of specificity in the regulations. For example, flood hazard areas are not defined, nor are "lower intensity land uses" described.

4.3.2.3 Next steps for non-structural mitigation

As an immediate next step, WFN could consider adopting the 2020 Flood Maps (Northwest Hydraulic Consultants Ltd., 2020) and explicitly including them in the community plan within the Environmentally Sensitive Area or as a new Hazard Area. In the medium term, more detail on land and building controls could be developed with the community.

4.3.3 Okanagan Indian Band

As noted earlier, the Okanagan Indian Band (OKIB) does not have a Land Code, and as such has limited authority to manage land use/hazard decisions on their reserves. They also have greater rights and title that are in flux (see earlier sections on Governance Context for First Nation and local governments).

In this section, we review the 2020 Strategic Plan, as an existing public document. The OKIB has draft land use plans for areas outside the RDCO jurisdictional boundary, but these are for OKIB members only.

The 2020 Plan and accompanying 2020 annual report lays out high level priorities for the OIB. As a high-level document, this makes no reference to flood or hazard. However, a key theme relates to lands and territory: "We exercise our inherent rights over OKIB lands, water and territory through culture, technical expertise, strategic partnerships, and Syilx laws." Under this strategic goal are objectives related to land use planning and the development of environmental management protocols. Within the long-term objectives are a desire to build relationships and protocols with Local and Regional governments, as well as an objective to build a Land Governance Model (i.e., adopt a Land Code).

4.3.3.1 Opportunities for non-structural mitigation

As the OKIB works towards a Land Governance Model, there is excellent opportunity for the nation to work collaboratively with regional governments to implement non-structural mitigation options, especially those related to land stewardship.

4.3.3.2 Challenges for non-structural mitigation

While the OKIB works towards a Land Governance Model, there are considerable challenges to applying non-structural flood mitigation options as outlined in the resource guide, which was developed on the precept that land use regulations are an option.

4.3.3.3 Next steps for non-structural mitigation

The OKIB may wish to consider the inclusion of land stewardship concepts that mitigate flood risk as they work on next steps in their land use planning.

4.3.4 City of Kelowna

The City of Kelowna has very recently (January 2022) finalised its OCP, which contains some excellent and progressive objectives and policies related to flood. Given the timing of the project, the majority of insights were gleaned from a version of the Draft OCP.

We note that the Okanagan Lake floodplain that is included in OCP 2030 has been removed from OCP 2040, which only includes the Mill Creek floodplain within the hazardous area DPA.

The City also has a bylaw for the Mill Creek floodplain, which has language is pulled from provincial guidance. The City Building Bylaw does not reference flood or flood mitigation. The draft City Zoning Bylaw includes a Riparian Management Area setback, but does not directly reference flood hazard areas.

The City also has a dated policy that has applicability for non-structural mitigation, specifically a 1971 Land Acquisition/Long Range Development Plan.

Table 11: Regulations related to flood management within the City of Kelowna.

Regulation	Section	Details/Description
OCP Bylaw No. 12300 (City of Kelowna, 2022)	Objective 13.3	Design stormwater infrastructure to mitigate flooding and pollution to our neighbourhoods, streams, and Okanagan Lake. This includes policy direction to manage stormwater infrastructure to mimic natural conditions.
	Objective 14.3	Preserve Okanagan Lake for its environmental, traditional, cultural, spiritual, and recreational values. This includes policy direction to use avoid hard armouring (structural controls) and where possible use green infrastructure.
	Object 15.4	Reduce flood risk to health and safety, infrastructure, property, and natural assets. Policy 15.4.1. **Developing in Floodplains**. Where development is already located in a floodplain, or zoning permits new development in these areas, as identified in Map 16.5: Hazardous Condition Development Permit Area or along any watercourse, the future construction of, addition to, or alteration of a building or structure should be constructed to minimize impacts of future flooding as well as meet Natural Environment Development Permit Guidelines. Development where threat to life and property is low, such as agriculture, parks or greenspace is preferred. Policy 15.4.2. **Maintain Flood Data**. Maintain up to date flood data to understand the risk to the community and where necessary consult local Indigenous organizations for expertise and oral historical data. Policy 15.4.3. **Retrofit Critical Infrastructure**. Continue to retrofit critical infrastructure (airport, roads, bridges, sewer) within the floodplain to withstand increased frequency and intensity of flood events. Policy 15.4.4. **Repurpose public infrastructure during disruptions**. Repurpose public

		infrastructure (e.g. roads, parks, trails) during seasonal flood events to minimize flood impacts that may disrupt city services.
	Implementation Action 59	Develop a plan to "identify floodplain areas and develop policies to minimize flood risk" in the short-term.
	Proposed Hazardous Condition DP/DPA	Includes Mill Creek Floodplain and proposes updates to include new flood hazard areas as mapping becomes available. Provides basic guidance on how to achieve permit through elevation to FCL or through sign off by a qualified professional.
Mill Creek Flood Plain Bylaw 10248 [2010]	Section 2	Designates the flood plain area for Mill Creek based on engineering studies.
	Section 3	Sets the FCL for the floodplain and describes the requirements to build the base floor above the FCL.
	Section 5	Includes provisions for exemptions, primarily for secondary buildings, storage, etc. This also provides a potential for an exemption if a report/design from a Professional Engineer or Geoscientist that declares that "the land may be safely used for the use intended".
DRAFT Building Bylaw [2021]	Section 6.6	This section sets out the requirements for a setback of between 15 m and 30 m from naturalised streams.
Land Acquisition Policy 75 [1971]		This policy provides guidance to City staff and council on the potential acquisition of properties that could be applied to long range development planning.

4.3.4.1 Opportunities for non-structural mitigation

The City of Kelowna has some excellent provisions within OCP 2040, which if passed provide a solid, but adaptive basis to reduce risk from flooding. The connection to natural areas protection and the recognition of these as assets to reduce flooding is particularly novel and interesting. Further, the consideration for temporal redistribution of flood risk, and the co-benefits of using public amenities to mitigate flood impacts is an excellent consideration.

The 1971 land acquisition policy may support many of the non-structural mitigation actions that require acquisition of hazardous lands.

4.3.4.2 Challenges for non-structural mitigation

The obvious challenge in the City of Kelowna regulations and OCP2040 is the lack of explicit consideration of flooding along Okanagan Lake. The 2020 floodplain mapping (Northwest Hydraulic Consultants Ltd., 2020) shows extensive flood hazard along the lake, outside the Mill Creek floodplain (see Figure 10).

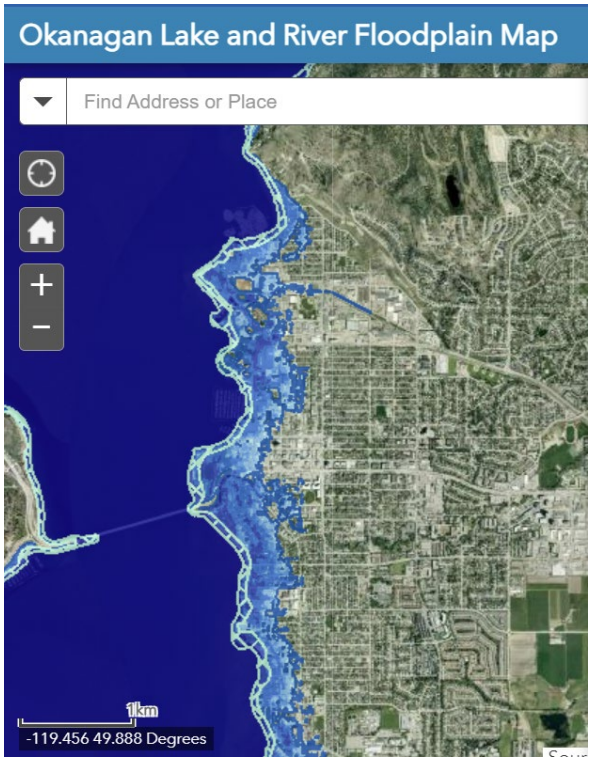


Figure 17: Screenshot of flood hazard area along Okanagan Lake in the City of Kelowna.

A second identified challenge, is that within the Mill Creek Flood Plain bylaw, although a "restrictive covenant" is defined, it is not used in the bylaw itself. There is no explicit mention of requiring a covenant if an exemption is granted.

4.3.4.3 Next steps for non-structural mitigation

As an immediate next step, the City should consider adding the Okanagan Lake floodplain, as identified in the 2020 flood mapping into the hazardous areas development permit area.

The City should also consider updating the Mill Creek Flood Plain bylaw to include a requirement that covenants be on title at a minimum when an exemption is granted, and ideally, over time for all parcels within the flood plain.

As a next step, a more progressive policy could be developed through a Flood Bylaw, which creates targeted opportunity for risk reduction policies that focus on exposure

reduction (land use) and vulnerability reduction (building controls), and/or through the use of a flood hazard DPA, which will support vulnerability reduction over time.

4.3.5 City of West Kelowna

The City of West Kelowna was only incorporated in 2007, until when it was under the jurisdictional authority of the RDCO, and as such has some remnant policies and systems from this era.

The City of West Kelowna is in the early stages of updating its OCP, which is planned for completion in 2022. The existing, in force, OCP (2011) was reviewed for this report. The City also has a zoning bylaw with a section on floodplain regulations. The building bylaw does not consider flooding. The City also has a Waterfront Plan (HB Lanarc and Ecoscape Environmental Consultants, 2011), which does not mention flood (or any natural) hazards specifically, but does include a modicum of concepts to enhance an 'natural lakeshore environment', including an approach to preserve and restore natural areas.

Table 12: Regulations related to flood management within the City of West Kelowna

Regulation	Section	Details/Description
OCP, Bylaw 0100 (City of West Kelowna, 2010)	3.2.12	Requires consideration of natural hazards, including flood, in the development of Comprehensive Development or Area Plans.
	3.6.3	Highlights the importance of balancing flood protection against ecosystem and aquatic habitat values. And has a Servicing Objective to "manage stormwater to mitigate risks and damages associated with flooding"
	3.7.1	The OCP includes a section on natural hazards with the objectives of: 1. Identify potential and existing natural hazards and avoid or mitigate the impacts on people, property, and the environment. 2. Raise awareness of wildfire and other natural hazards through public education.
	4.3.6 (Aquatic Ecosystem DPA)	This DPA includes the objective of "discourage(ing) development in areas that are susceptible to flooding as a result of proximity to a watercourse that could flood, as identified by the Province" (noting here that the Province never had any mapping within the City of West Kelowna, nor do they currently have the authority to designate flood hazard areas).

		The DPA guidelines cite the Provincial guidelines and use the standard setbacks of 1.5 m vertically above a natural boundary of a watercourse to identify areas that may be impacted by flood. The DPA also includes mention of an 343.66 m FCL (no datum) for Okanagan Lake
Zoning Bylaw 154 [2014]	Section 3.24 Floodplain Regulations	This defines FCLs for Okanagan Lake (343.66 m, no datum detail), 3 m above Mission Creek natural boundary, and 1.5 m above natural boundary of any other watercourse. It also defines horizontal setbacks from Okanagan Lake (15 m) and from other water sources (7.5 m to 30 m)

4.3.5.1 Opportunities for non-structural mitigation

The City of West Kelowna uniquely identifies the need to communicate about natural hazards to the public within its OCP, this is focused on wildfire, but could easily be stretched to include flood.

4.3.5.2 Challenges for non-structural mitigation

The current regulations reflect older information related to flood hazard from the Okanagan. The newly reported FCL (Northwest Hydraulic Consultants Ltd., 2020) Okanagan Lake is 344.6 m (CGVD2013)/ 344.3 m (CGVD1928) which is higher than the FCL within the current policy.

The current building and zoning bylaws reflect provincial guidance, and therefore limit vulnerability reduction approaches to raising structures above the FCL, whereas, best practice (as described in this report and elsewhere) highlights the possibility of using a broader definition of flood proofing, to include all the measures within the building management section of the Resource Guide.

There is no explicit mention of requiring a restrictive covenant if an exemption is granted.

4.3.5.3 Next steps for non-structural mitigation

The clear next step for the City is to update FCL regulations within the zoning bylaw and new OCP to reflect new information.

As a next step, a more progressive policy could be developed through a Flood Bylaw, which creates targeted opportunity for risk reduction policies that focus on exposure reduction (land use) and vulnerability reduction (building controls), and/or through the use of a flood hazard DPA, which will support vulnerability reduction over time. Given that the City is in the midst of renewing its OCP, there is a strategic opportunity to develop a hazard DPA at this time.

4.3.6 District of Lake Country

The District of Lake Country has existing policies in place that support flood risk reduction. These include policies within the OCP that outline future direction on hazard management, as well as series of land use and building control bylaws that provide basic regulations.

Table 13: Regulations related to flood management within the District of Lake Country.

Regulation	Section	Details/Description
OCP, Bylaw 1065 **(District of Lake Country, 2018)**	Objective 3.1.16	Minimize risk to citizens and development from natural hazards: b. Provide clear development guidelines for safe and environmentally sensitive development c. Seek to identify potential floodplain areas within the District.
	Objective 3.14.1	Reduce potential to development of damage from flooding: a. Conduct floodplain mapping. b. Prepare floodplain management plan. c. Avoid new development in areas within and close to the floodplain.
	Section 9.2	"stormwater management plans must accommodate the 10-year flood event onsite and provide positive relief for a 100-year flood event."
	Natural Environment DPA and Guidelines	This DPA is intended to support ecological function and values of natural areas. An explicitly noted co-benefit is a reduction in flood hazard.
Stormwater management Bylaw		Bylaw to support servicing of new developments to ensure that stormwater is managed appropriately, and largely onsite.
Building Regulation Bylaw 1070	Section 10.3	"for a parcel of land on which a building or structure is proposed if the building official believes the parcel is or is likely to be subject to flooding, mud flows, debris flows, debris torrents, erosion, land slip, rock falls, subsidence, or avalanche, and the requirements for a professional design is in addition to a requirement under Part 3, Division 8 of the Community Charter (i) for a report certified by a professional engineer with experience in geotechnical engineering that the parcel may be used safely for the use intended, and (ii) that the plans submitted with the application comply with the relevant provisions of the Building Code and applicable bylaws of the District.

	Section 11.4	Requires that for complex buildings that the underslab of the structure meet provincial flood mapping requirements (noting that there are none within Lake Country) or District land use regulations (see Zoning Bylaw).
Zoning Bylaw 561 [2007, amendments to 2021]	Section 7.16.1	Limits development within a buffer zone from a still water body (7.5m) or a moving watercourse (15 m). It also provides elevations below which construction should not occur in relation to Okanagan (343.66 m, no datum detail) and Kalamalka and Wood Lakes (393.2 m, no datum detail).
Development Applications Bylaw 1133	Section 6.2 (o)	Opens the door to requiring reporting prepared by a qualified professional related to flooding.

4.3.6.1 Opportunities for non-structural mitigation

The District of Lake Country has in place many of the policy tools that are precursors to non-structural mitigation. The OCP policies set an excellent foundation for future risk reduction and resilience building, and the existing Building Regulation and Zoning Bylaw lay the groundwork for future enhancements once more information is available (i.e. a engineering quality flood map with elevations for multiple climate futures).

4.3.6.2 Challenges for non-structural mitigation

The current regulations reflect older information related to flood hazard from the lakes. The newly reported FCL (Northwest Hydraulic Consultants Ltd., 2020) for in the vicinity of Lake Country for Okanagan Lake is 344.6 m (CGVD2013)/ 344.3 m (CGVD1928), and for Wood and Kalamalka Lakes is 393.7 m (CGVD2013)/ 393.4 m (CGVD1928) which is higher than the FCL within the current policy.

The current building and zoning bylaws reflect provincial guidance, and therefore limit vulnerability reduction approaches to raising structures above the FCL, whereas, best practice (as described in this report and elsewhere) highlights the possibility of using a broader definition of flood proofing, to include all the measures within the building management section of the Resource Guide.

4.3.6.3 Next steps for non-structural mitigation

The clear next step for the District of Lake Country is to update FCL regulations within the zoning bylaw to reflect new information.

As a next step, a more progressive policy could be developed through a Flood Bylaw, which creates targeted opportunity for risk reduction policies that focus on exposure reduction (land use) and vulnerability reduction (building controls), and/or through the use of a flood hazard DPA, which will support vulnerability reduction over time.

4.3.7 District of Peachland

The District of Peachland has some good direction in flood policy within their OCP, although details are limited. Basic conditions (boiler plate text from provincial guidance) for non-structural flood mitigation is included within zoning and building bylaws (see Table 14).

Table 14: Regulations related to flood management within the District of Peachland

Regulation	Section	Details/Description
OCP, Bylaw 2220 (District of Peachland, 2018)	5.4.4	The stormwater management section of the OCP notes the need to develop Integrated Stormwater Management Plans to incorporate and consider both climate change and flood protection.
	5.6	The natural environment section of the OCP notes the importance of collaboration with "senior levels of government to mitigate the risks of development in the floodplain"
	5.6.1	Notes the potential to update the Shoreland Plan to incorporate new floodplain mapping (now complete).
	6.3.1	The Aquatic DPA for Peachland includes a provision to include areas within a 1:5 year (20% AEP) flood level, as determined by the Province (no such determination exists) or lower than 343 m (no datum provided).
	6.4	A natural hazard area inclusive of floodplains is described, but no details on flood specific information is provided. No map showing DPA is included.
Zoning Bylaw 2100 [2014]	5.16	Creates a 15 m horizontal and 1.5 m vertical buffer from natural watercourses, and a 7.5 m horizontal boundary from Okanagan Lake. An FCL of 343.75 m (no datum) is also given.
Building Bylaw 2273 [2020]	9.3	Allows for a building official (inspector) to require for a report and/or design from a qualified professional if a property is considered likely subject to flooding.
	10.2	Requires that for complex buildings that the underslab of the structure meet provincial flood mapping requirements (noting that there are none within Lake Country) or District land use regulations (see Zoning Bylaw).
	10.4	Much like for complex buildings, simple buildings are required to have the underslab of the structure meet provincial flood mapping requirements (noting that there are none within Lake Country) or District land use regulations (see Zoning Bylaw).

Development & License Approval Procedures Bylaw 2278 [2020]	5.7	Provides detail on requiring reporting prepared by a qualified professional related to flooding.
	5.23 (f)	References Natural Hazard Area DPA with regards to permitting fees.

In addition to the policies above, the District has recently completed a flood risk assessment and mitigation plan for its shoreline. This has a focus on understanding local-level hazards (including the important secondary hazard associated with erosion). Several structural engineering projects are proposed within this project.

4.3.7.1 Opportunities for non-structural mitigation

The current regulations include the basic information to support flood mitigation; policy objectives within the OCP, plus basic minimum standards within zoning and building bylaws.

4.3.7.2 Challenges for non-structural mitigation

The current regulations reflect older information related to flood hazard from Okanagan Lake. The newly reported FCL (Northwest Hydraulic Consultants Ltd., 2020) for in the vicinity of Peachland is 344.6 m (CGVD2013)/ 344.3 m (CGVD1928), which is significantly higher than the FCL within the current policy.

The OCP includes reference to flood hazard, but not substantive policies or guidance. For example, although the Natural Hazard DPA references floods, there is no accompanying map to describe the DPA.

The current building and zoning bylaws reflect provincial guidance, and therefore limit vulnerability reduction approaches to raising structures above the FCL, whereas, best practice (as described in this report and elsewhere) highlights the possibility of using a broader definition of flood proofing, to include all the measures within the building management section of the Resource Guide.

4.3.7.3 Next steps for non-structural mitigation

Next short-term steps for the District of Peachland, include reviewing the 2020 and 2021 mapping updates for the Okanagan (Northwest Hydraulic Consultants Ltd., 2020) and the adoption of the these new FCLs into current policy (i.e. by updating zoning bylaw). This mapping could also be used to refine the OCP to include a mapped DPA for flood.

In the longer-term the District could consider developing a flood bylaw (to subsume information in existing zoning and building bylaws) that would allow for more flexibility in mitigation actions, as well as being flexible to updates in hazard information or provincial direction.

5 Recommendations – Taking Action as a Region

Flood knows no boundaries – it is a shared risk that is best mitigated by working regionally and across scales 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 rationale for a regional approach, an indication of which non-structural mitigation options are best implemented at a regional level, as well as specific next steps are presented in the accompanying Resource Guide.

6 Conclusions

The Regional District of the Central Okanagan (RDCO) along with regional First Nation and Local Governments and other regional partners have been working together for many years to increase understanding of the local flood hazards and their trajectory with climate change. This new information, coupled with recent damaging floods have highlighted the need for new approaches in flood management.

This project, report and accompanying resource guide form a strategic next step, to help local governments implement flood risk reduction and resiliency strategies. The strategies developed as part of this project have been grounded in the Okanagan context through engagement and research. So, that despite the many implementation challenges associated with more novel non-structural management approaches, the region now has actionable concepts to move forward with both as individual local and First Nation governments, and collectively as a region.

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