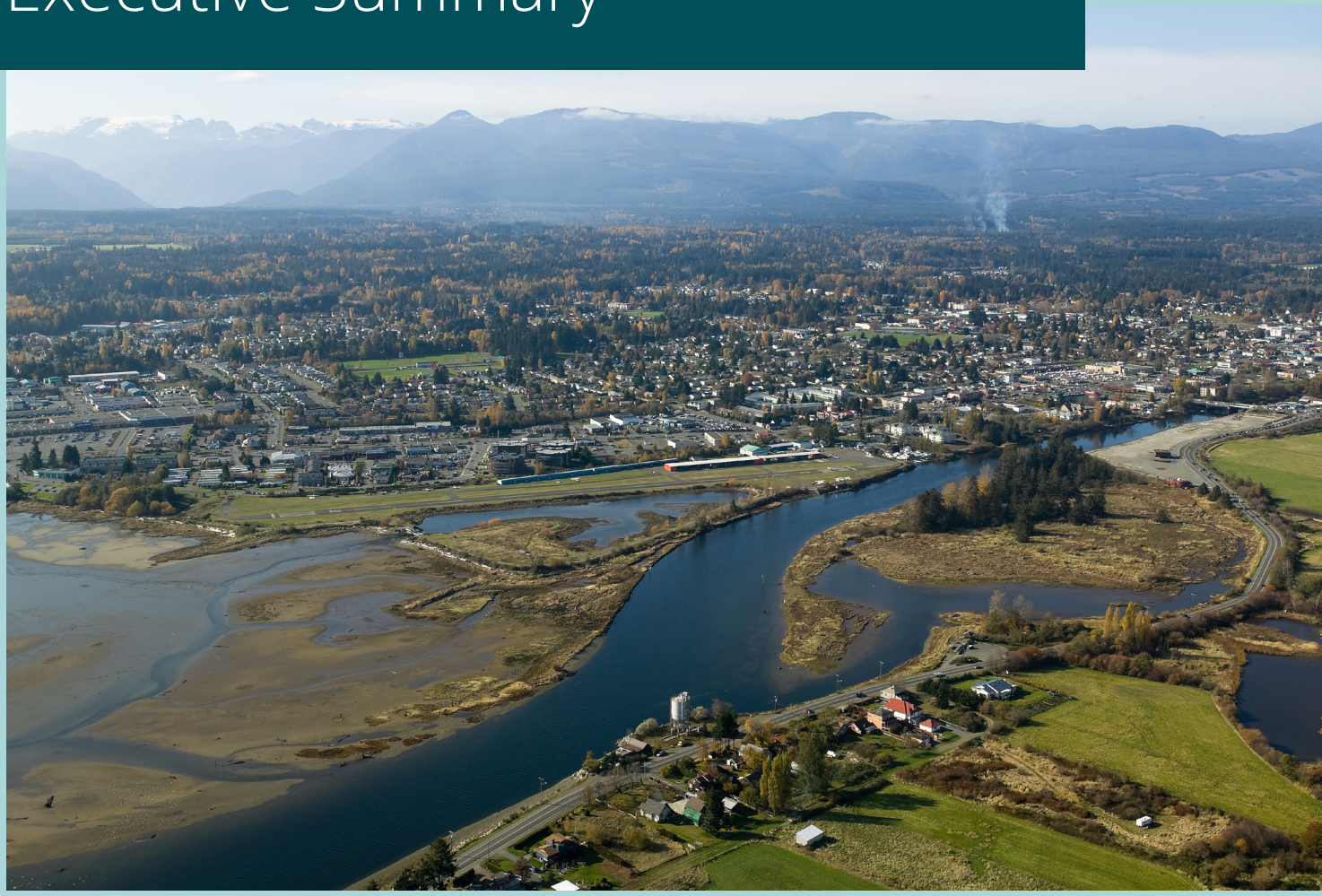
City of Courtenay

City of Courtenay Flood Management Plan

Executive Summary



August 2024

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1. Project Background

In the City of Courtenay, flood risk is present along the coast and the rivers. With expected changes in water levels due to climate change, we are taking proactive steps to reduce impacts from future flood events. The City of Courtenay worked with a team of consultants on the development of a Flood Management Plan. This project aimed to understand the risk of flooding to our community and develop risk reduction and resilience strategies that reflect community priorities.

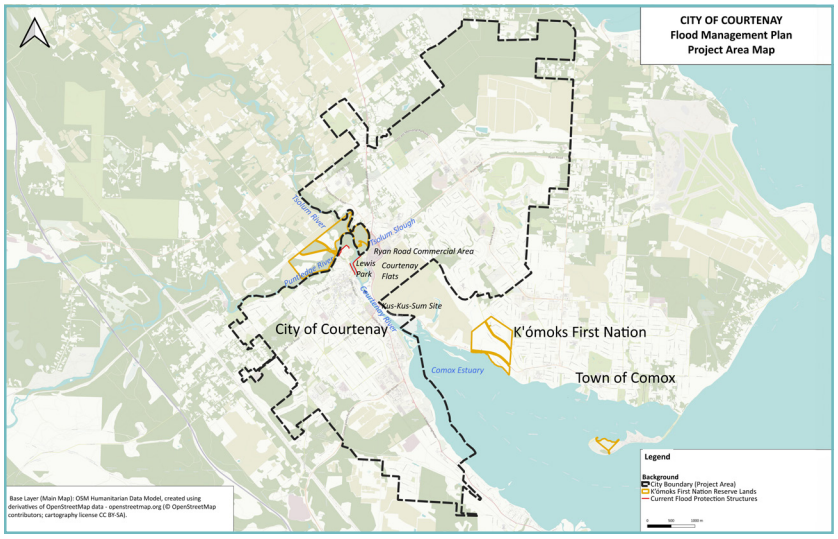
1.1 Project Objectives

1. **To outline a long-term approach for flood management (what needs to be done, by when).**
2. **To recommend specific actions for the next 5 years.**
3. **To align our approach with the BC Flood Strategy, the new Emergency and Disaster Management Act (EDMA), and international best practices, including the United Nations Sendai Framework for Disaster Risk Reduction.**

1.2 Project Area

The project area covers the City of Courtenay (City) on Vancouver Island (see map below). Within the boundaries of the City are a number of rivers and creek systems, the major ones being the Puntledge and Tsolum Rivers, which join together to form the Courtenay River and estuary before flowing out to the Salish Sea. Along the estuary, the City also has a coastal shoreline.

Water knows no boundaries, and with this in mind, previous flood hazard modelling and mapping was done at the regional scale for the entire Comox Valley Regional District (CVRD). For the Flood Management Plan, the development of risk reduction and resilience strategies was limited to the City of Courtenay's jurisdictional boundary, and opportunities to work with regional partners were identified. These regional partners include the CVRD, the Town of Comox, and importantly the K'ómoks First Nation on whose Territory these modern jurisdictions lie and who has present-day First Nation reserves adjacent to the City of Courtenay.



1.3 What is Risk and Resilience?

Risk is the "potential loss of life, injury, or destroyed or damaged assets and values which could occur to a system, society, or a community, determined as a function of hazard, exposure and vulnerability" (United Nations Office for Disaster Risk Reduction). As shown in the figure to the right, risk is defined by the total area of a triangle, whose sides are hazard (in this case flood), exposure (the things people care about that are located within the floodplain), and the vulnerability or susceptibility of these things to being damaged by floodwaters. When planning for flooding, it is also important to consider where and how communities can build resilience and adapt to flooding. Resilience is 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" (United Nations Office for Disaster Risk Reduction).

1.4 What Types of Flooding Do We Experience in Courtenay?

With climate change, communities are more likely to experience flooding than in the past. This is especially the case when sea level rise combines with high tides and coastal storms (e.g., storm surge, and wind and wave effects) or when extreme rain storms (e.g., atmospheric rivers) and/or snowmelt drive river water levels to rise.

1.4.1 Types of Flooding

Coastal flooding is flooding that occurs along the shoreline and estuaries due to higher than typical water levels in the ocean. There are two main drivers of coastal flooding that this project is studying – **sea level rise** and **storm surge**. While sea level rise is a slower, climate change-driven process, storm surge occurs more suddenly when pressure changes from a storm cause water levels in the ocean to rise.

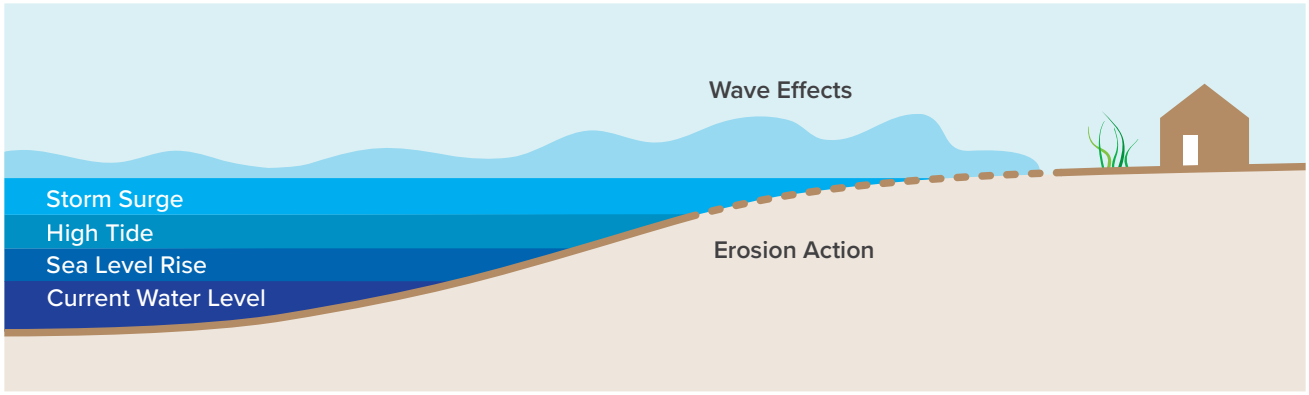
DID YOU KNOW?
As global temperatures increase due to climate change, seawater is expanding as it warms, and polar ice caps and glaciers are melting, resulting in sea level rise around the world.

Riverine flooding occurs when extreme rain or snowmelt causes water levels in a river to overflow its banks onto adjacent land. This type of flooding can also cause damage to dikes increasing the area of flooded land.

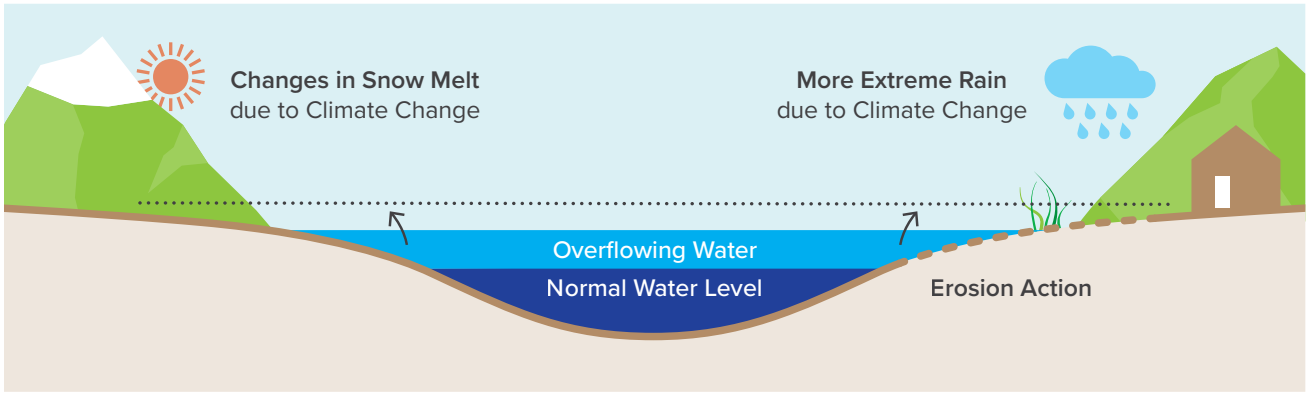
DID YOU KNOW?
Atmospheric rivers (ARs) are like long, narrow rivers in the sky. When they flow over land, strong ARs can bring extreme precipitation in a short amount of time, often resulting in riverine and pluvial flooding.

Pluvial flooding (flash floods; surface water flooding) happens when extreme rain cannot be accommodated by drainage systems. This type of flooding can happen anywhere, even in places without a nearby river or estuary.

Coastal Flooding



Riverine Flooding

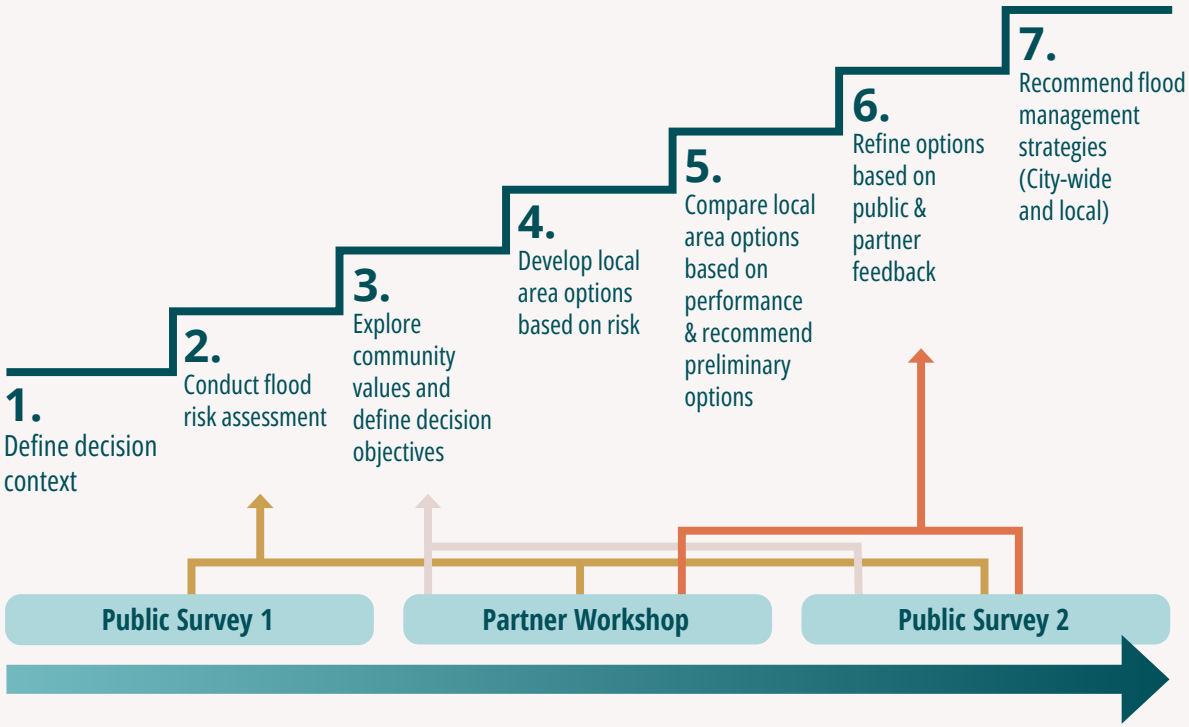


Larger floods occur less frequently and typically have a greater impact. However, the cumulative impacts of small, more frequent floods should not be underestimated. Frequent, smaller floods can damage assets along the shoreline or riverbank over time.

2. How Was the Flood Management Plan for Courtenay Developed?

A Flood Management Plan (FMP) is a tool to support actions to reduce flood risk. It provides a strategic plan that outlines a toolbox of recommendations to reduce flood risk and increase resilience, which will allow adaptation and flexibility into the future, whilst considering environmental, societal, and economic opportunities.

The FMP for the City was developed over a couple of years and included a number of technical and engagement subtasks to further explore and understand the nature of the flood risk in Courtenay, and then to systematically work through risk reduction options and next steps. For this, an adapted structured decision-making approach was used to explore trade-offs between various flood risk reduction and resilience options and recommend a set of preferred strategies (see figure on following page). The steps are explained below the figure.

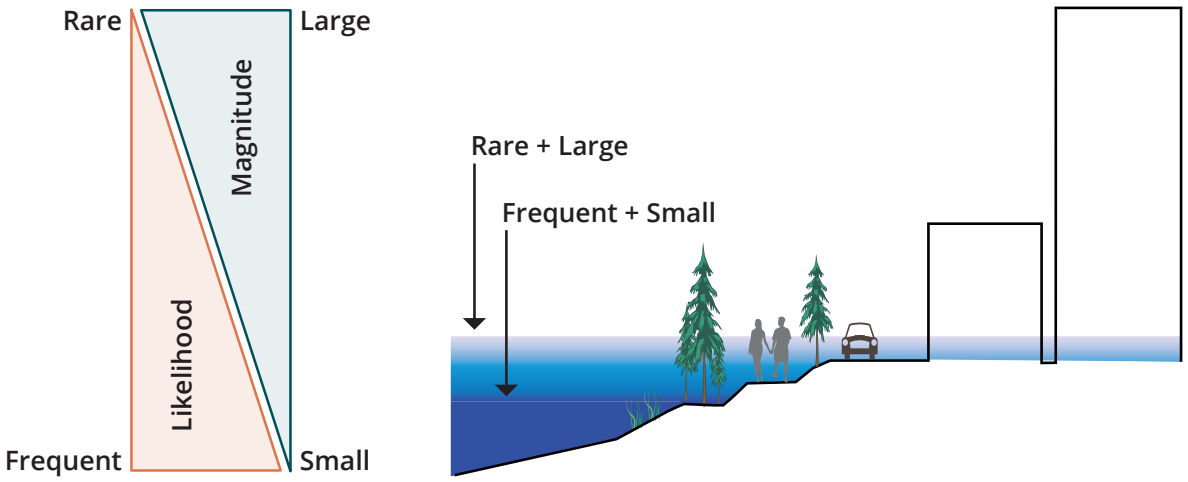


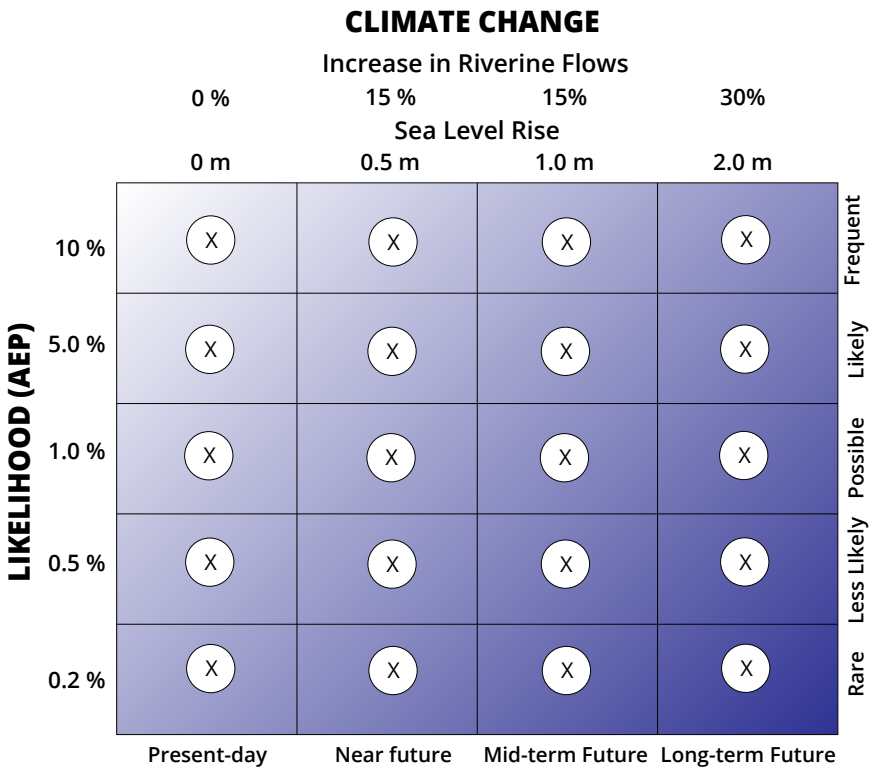
1. Decision Context:

- The project was focused on coastal and riverine flood hazards in the City of Courtenay boundary.
- The project considered present-day risks as well as future risks.

2. Flood Risk Assessment

- A detailed quantitative and holistic flood risk assessment identified assets and areas most at risk.
- **Flood Hazard Input:** A diversity of flood hazards was considered, from small and frequent to large and rare. In total, 20 different scenarios were included, based on the CVRD Flood Hazard Mapping (2021). The annual exceedance probability (AEP) is the probability of an event of a given size occurring or being exceeded in any year, described as a percentage. Five AEPs (or likelihoods) were considered for four different time periods, considering climate change (see figure on following page).



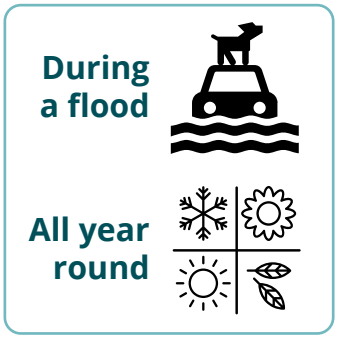


- **Consequence Input:** A range of things that matter to the community were included in the quantitative risk assessment. These were based on national and international best practice, including the Sendai Framework for Disaster Risk Reduction:

People	People are affected in a range of ways by flood. This may include people who are injured or suffer other health effects (e.g., trauma or stress), are evacuated or displaced, or suffer due to compromised livelihoods (e.g., their uninsured house is damaged or they lose their job).
Economy	Flooding can cause potential economic losses through property and equipment damage and other far-reaching consequences. This includes repairs to public and private infrastructure, and losses due to reduced revenues following a flood.
Environment	Flooding is an important component of many ecosystems and is a naturally occurring process. Green spaces can provide positive benefits by absorbing flood waters. On the other hand, floods may lead to the overflow or discharge of contamination sources into the environment, or cause damage to environmentally sensitive areas. Contamination may include sewage and fuel spills from flooded septic systems and storage buildings.
Culture	The cultural life of a community may experience various impacts due to a flood. This includes both Indigenous and non-Indigenous cultural sites, historic uses, beach access points as well as recreational spaces, trails, and sacred areas. It can also include community centres, schools, and other important gathering places.
Critical Infrastructure	Flood can impact many types of infrastructure that are regarded as necessary for communities to function. This can include transportation infrastructure such as docks and highways, as well as health services, emergency response (police, fire, ambulance), and government facilities. Utilities, such as power systems, water and wastewater, and telecommunications, are also critical.

- **Flood Risk:** Flood consequences were calculated for these categories for all 20 hazard scenarios. In addition, a set of consequence maps showing the impact of flood on people, economy, environment, culture, and critical infrastructure were developed for two scenarios - a present-day likely event, and a mid-term future less likely event. Flood risk curves were also developed for each scenario, and the average annual loss (i.e., the long-term expected loss on an annualized basis, averaged overtime) was calculated.
- **Qualitative Information:** In addition to the quantitative analysis, qualitative information gathering during the public and partner engagement as well as provided by City staff informed the risk assessment.

3.-6. Options Analysis



- The development of options was guided by community values, identified within the Official Community Plan (OCP) and project-specific public and partner engagement. Based on these values, decision objectives were defined. Decision objectives are simple values-based statements of the things that matter to people when considering flooding. Importantly, these decision objectives do not only consider the effect of an option during a flood (i.e., the risk reduction), but also the effect this option may have year-round on a community. For instance, a structural option will be in place 365 days of the year, affecting community life and the environment. Based on the decision objectives, quantitative and qualitative performance measures then provide a means of assessing the suitability of different alternative options.
- The City was divided into six local areas based on characteristics of flood water and land use. For each local area, a range of local area options for risk reduction were developed. Each of these local area options was assessed according to performance measures, and preliminary proposed options were identified. Options that are better implemented at a City-wide scale were also identified and evaluated.
- The proposed options were then refined based on feedback from public and partner engagement as well as feedback by various City departments.

7. Recommendations

- The set of refined options forms the recommendations of the Flood Management Plan, and includes both City-wide and local area specific recommendations.

Engage the Public and Partners Throughout

- Public and partner engagement throughout the project was key. Two public surveys were conducted, along with a public information session, and public communications, including: project updates on the City website, backgrounders, social media, and information pamphlets for residents in the floodplain. A workshop with City staff and community partners was held for in depth discussion of the options. Further technical review and discussion was held with City staff, and Provincial regulatory authorities.

3. What Flood Risk Does Courtenay Face?

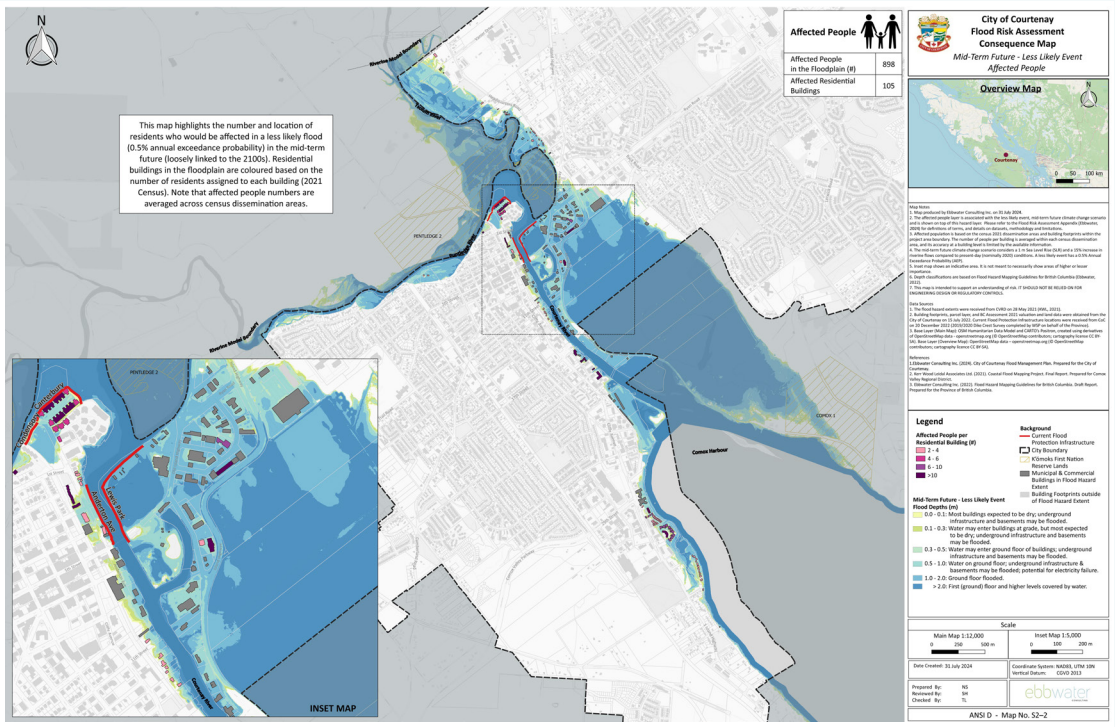
The project highlighted what is likely to be impacted by flooding in the present-day, and what will be impacted in the future, if no risk reduction and resilience actions are taken. It was found that even the less severe but more frequent floods in the future will have more devastating consequences than rare and extreme floods today (see table below). This is particularly concerning when considering the cumulative impacts of multiple flood events over time.

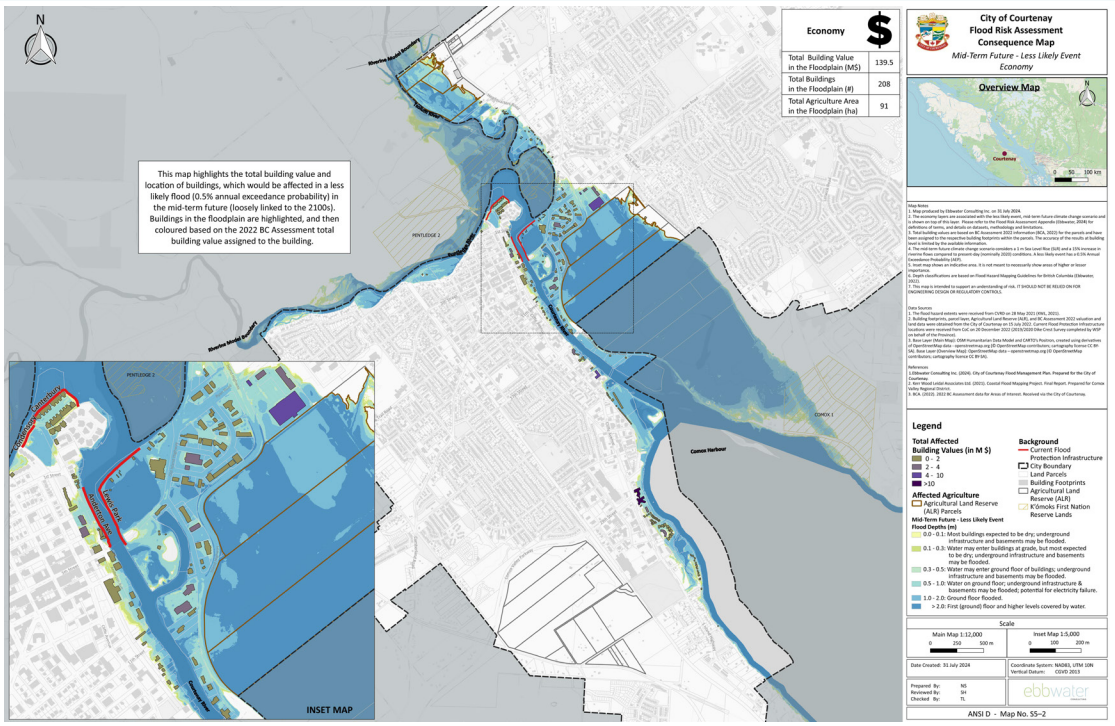
Impacts of floods on people, the economy, the environment, culture and critical infrastructure (CI) are summarized for two present-day flood scenarios, and two future flood scenarios (assuming no action is taken) in the table below.

It was noted that many residents live in the floodplain, and would be directly affected by flooding. Similarly, many buildings and much agricultural land are in the floodplain. Critical infrastructure impacts and disruption will have cascading consequences on the wider society. Many potential contamination sources are also within the floodplain, which may cause detrimental consequences for downstream sensitive ecosystems. Cultural sites, including Indigenous archaeological sites, are also located within the floodplain.

	PEOPLE	ECONOMY			ENVIRONMENT			CULTURE		CI & DISRUPTION	
Scenario description/details	**Affected People (#)**	**Buildings (#)**	**Total Building Value (M$)**	**Total Agricultural Land (ha)**	**Contamination Sources (#)**	**Species/ Ecosystems at Risk & Conservation Lands (ha)**	**Greenspace, Parks (ha)**	**Total Cultural Sites (#)**	**Community Buildings (#)**	**CI Facilities (#)**	**Total Road lengths (km)**
Present-day Likely (No SLR/increase in riverine flows; 5% AEP)	290	96	42	57	26	9	41	30	14	3	3.1
Present-day Less Likely (No SLR/increase in riverine flows; 0.5% AEP)	320	128	69	58	31	10	45	33	15	5	5.5
Mid-term Future Likely (1 m SLR; 15% increase in riverine flows; 5% AEP)	660	166	116	58	30	11	47	33	15	6	5.7
Mid-term Future Less Likely (1 m SLR; 15% increase in riverine flows; 0.5% AEP)	900	208	140	59	32	12	48	37	19	6	6.5

A set of maps, showing the consequences associated with each flood scenario were developed. For example, maps showing the affected people and economic consequences for a future flood scenario are provided below. The full map book can be found on the City of Courtenay website.





Risk curves were developed to analyse how the impacts from a flood event will change, as the pressures of climate change intensify. It was found that frequent events of the future will have a greater impact than rare events that occur today.

4. Flood Management Recommendations for the City

4.1 Overarching Framing

Flood management actions may be grouped into general strategies, such as: *Protect*, *Accommodate*, *Retreat*, *Avoid* and *Resilience-building*. To reduce flood risk and increase resilience in the City, a combination of flood management actions from different strategies should be selected to work together. A brief overview of these general strategies is provided below; they are not listed in order of importance.

PROTECT

Reduce the hazard by reducing its presence or power. Building "green" or artificial barriers or land forms to reduce water hazard of existing developed areas. Protect options are best applied to medium risk areas. Protect options are vulnerable to catastrophic failure as these options generally will not protect against very high hazard events.

ACCOMMODATE

Reduce the vulnerability of the built environment and society to flooding by accommodating the presence and movement of water ('living with the water'). Adapt buildings, infrastructure and land uses to allow areas in the floodplain or along the estuary to flood over time without causing negative impacts. It is best applied for low to medium risk scenarios but it may not be sufficient for extreme events.

RETREAT (also called managed retreat or relocation)

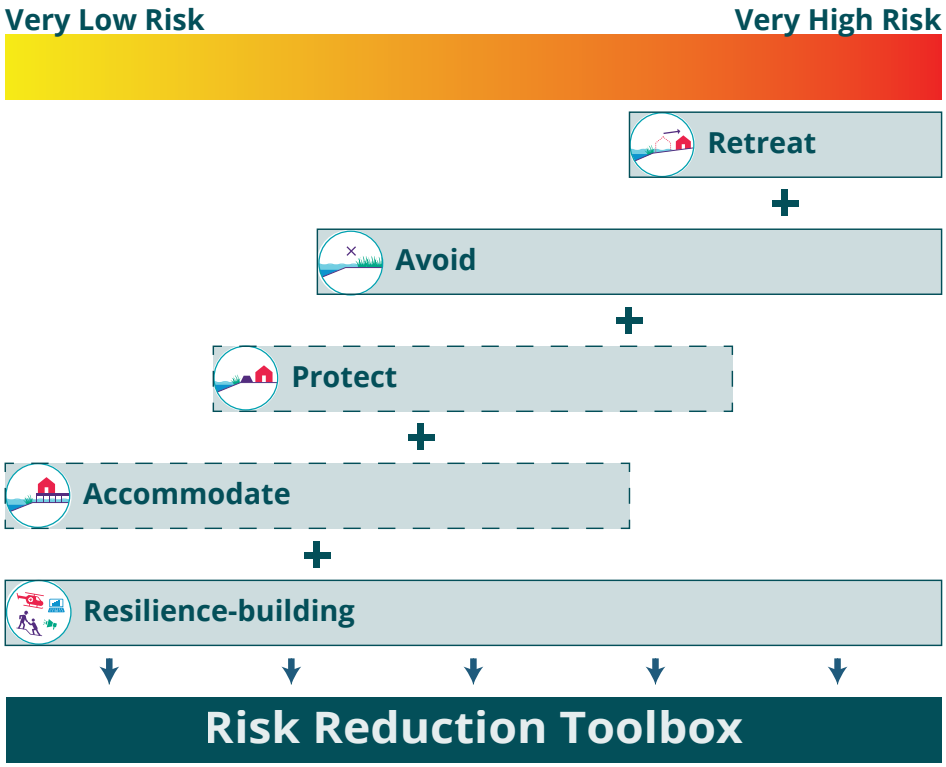
Reduce exposure by moving existing structures out of floodplain. Explore alternative locations to relocate homes and infrastructure back from affected areas and restore natural ecosystems. It is recommended for areas with existing high risk (e.g., residential housing in high hazard areas).

AVOID

Prevent new building, infrastructure or some land uses from happening in areas at risk of future flooding and related impacts, by limiting development within the floodplain. This strategy is particularly important for medium to high risk, whereas in lower risk, *Accommodate* and *Resilience-building* strategies may be sufficient.

RESILIENCE-BUILDING

Invest in awareness, preparedness and emergency response as a community, so that we can work together well to respond to challenges and bounce back from negative impacts. This strategy focuses on setting communities up to prepare, cope with, and bounce back from flood events. It can address low to high risk, and should always complement other strategies.



The strategy of *Retreat* is most effective for all levels of hazards but is best reserved for high to very high risk hazards due to its high economic and social costs. Similarly, *Avoid* strategies can be applied across the board, and should be considered for areas of risk. *Protect* strategies often address moderate to high risk areas, however they also have a high economic, social, and environmental cost, and are vulnerable to catastrophic failure, so they may not be necessary if the risk can be addressed by other means. *Accommodate* strategies are suitable for low to moderate risk areas. *Resilience-building* is effective for all levels of flood risk, helping communities prepare for the next flood event. The five strategies are meant to work together as a combined 'toolbox' to jointly reduce risk.

4.2 Recommendations Overview

A set of flood management recommendations was developed for the City. The recommendations were based on community values, as identified in the OCP and in public engagement for this project (see box to the right), as well as the risk profile of the City. Overall, the recommendations align with the direction provided in the OCP. These include directing growth away from the floodplain while developing a long-term strategy for managed retreat from vulnerable areas. OCP policies also promote a priority on environmental protection, soft edges and restoration along shorelines and riverbanks.

The figure below provides an overview of the recommendations, which are grouped by strategy. Out of the 86 recommendations that were identified in the Flood Management Plan, 81 apply to the short-term (5-Year Capital Plan), and the remaining five apply to the medium- to very long-term.

Community Values That Guided Recommendations

- Biodiversity
- Recreation and Natural Assets
- Community & Culture
- Social Equity
- Economic Success
- Low carbon
- Public Safety

City of Courtenay - Flood Management Plan Recommendations Overview

City-wide Recommendations

Avoid

- Develop flood risk-based zoning bylaw.
- Avoid new residential development in the floodway.
- Recommended floodway land uses include: agricultural, recreational, and parks.
- New development in the flood fringe must accommodate flood waters.
- Over the long term, opportunistically acquire land in the floodway .

Retreat

- Develop a managed retreat strategy to convert residential land uses in the floodway to land uses that are compatible with the flood risk.

Protect

- Clarify Provincial expectations for vegetation management on dikes that only offer erosion protection.
- Manage vegetation along all dikes in accordance with Provincial expectations.
- Complete annual inspections for all dikes, as required by the Dike Maintenance Act.

Resilience-Building

- Develop a comprehensive Communications Campaign to educate the public, residents of the floodplain, and property owners in high risk areas about flood risk, and actions to reduce the risk.
- Update monitoring and warning procedures.
- Update emergency response plan.
- Develop flood recovery and post-disaster plans.
- Work with insurance companies to address residual risk.
- Collaborate regionally on emergency preparedness and response.

Accommodate

- Update floodplain bylaw (new flood construction levels & erosion setbacks).
- Consider Development Area Permit for flood and erosion hazards.
- Encourage property-level flood barriers to reduce damages to properties in the floodplain.
- Use temporary flood barriers as an emergency response measure.
- Floodproof City-owned facilities and infrastructure (including lift stations).
- Develop tools to track all flood related covenants registered on property titles. Inform property owners of the covenant requirements and seek enforcement.
- Work with residents, business owners, the Airpark, agricultural producers, and City Operations to minimize contamination sources (septic systems, hazardous material storage).
- Consider regulation of hazardous material storage in floodplain.
- Improve the resiliency of park infrastructure to flooding (through Park Master Plans).
- Work together with K'ómoks First Nation to identify solutions for Indigenous sites at risk that are supported by their community.

Local Area Recommendations

Condensory & Canterbury:

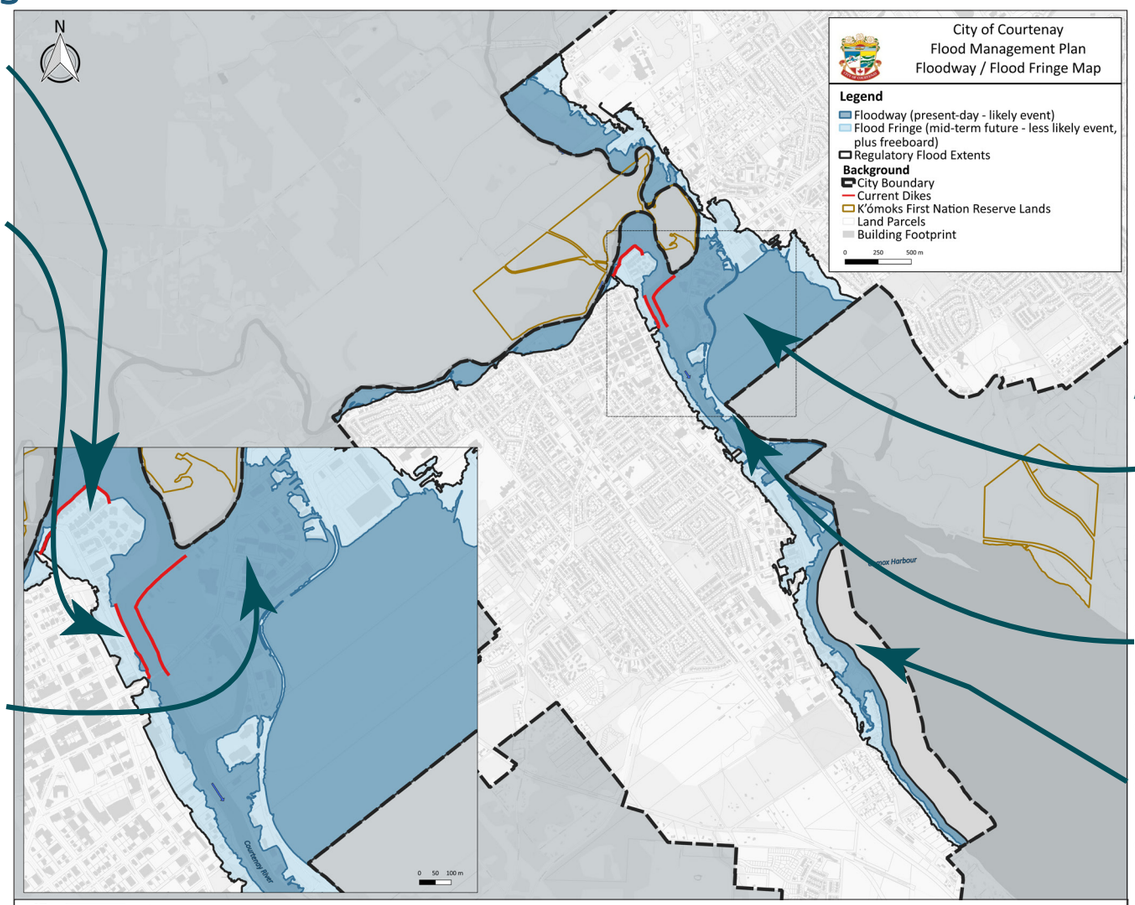
- Resolve the ownership dispute associated with Canterbury Dike by working with the Province and the strata.
- Ensure inspections of Canterbury Dike are conducted, and any required repairs are made.

Anderton Avenue:

- Conduct additional inspections and monitoring needed to ensure public safety.
- Develop plans to remediate Anderton Dike, including removal of the wall and naturalization of the shore.

Puntledge Road Commercial Area:

- Ensure City-owned buildings and infrastructure, including the Lewis Recreation Centre, LINC Youth Centre, Memorial Outdoor Pool, and outbuildings are floodproof and resilient to flood damages.
- Complete repairs of Lewis Park Dike, and consider naturalizing the shore over the long-term.
- Floodproof Puntledge Road lift station.
- Develop a detailed evacuation plan for the area, with a focus on traffic management, signage, and public education.
- Maintain TideFlex valves in the area, and consider the installation of additional TideFlex valves.
- Update, repair, and maintain culverts along the Rye Road Flood corridor, and in Lewis Park.
- Remove tall wall, and replace with a traffic barrier, if required.
- Change Tiger Dam from seasonal deployment in current location to targeted critical infrastructure protection on an event-basis.
- Work with the Ministry of Transportation and Infrastructure on Highway 19A upgrades.



Floodway: The river channel and shoreline and adjacent areas, where water depths, veolocities and wave action are greatest and most hazardous.

Flood Fringe: The remaining areas of the floodplain that are outside the floodway. Floods less likely with less depth and velocity/wave action.

Agricultural Area:

- Communicate flood risk and resources to reduce risk to local agricultural producers as part of communications campaign. Align with the CVRD Comox Valley Agricultural Plan information.
- Encourage minimizing agricultural contamination sources.

Kus-kus-sum Site:

- Continue restoration and naturalization at Kus-kus-sum site.

Coastal Area:

- Restrict new development in coastal erosion setback.
- Continue working with Airpark to avoid potential contamination sources.
- Over the long-term, consider increasing erosion protection given sea level rise and associated coastal erosion, with a Green Shores approach.

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The City will implement recommendations within municipal boundaries and will collaborate with individuals and partners in the region wherever needed.

The table below summarizes the total number of actionable recommendations associated with each strategy.

STRATEGY	NUMBER OF RECOMMENDATIONS
Protect	**26**
Accommodate	**39**
Retreat	**3**
Avoid	**3**
Resilience-building	**15**
Total Flood Management Plan	**86**

5. Next Steps Forward

This Flood Management Plan outlines the steps required to reduce flood risk in the City of Courtenay and build resilience. Implementation of this plan over the short and long term will limit impacts of future flood events, and ensure Courtenay is equipped for the climate of the future.

City of Courtenay, August 2024. The Flood Management Plan was developed with support from Ebbwater Consulting Inc. and its team (SHIFT Collaborative, Water Street Engineering, and Adapt Collaborative).