

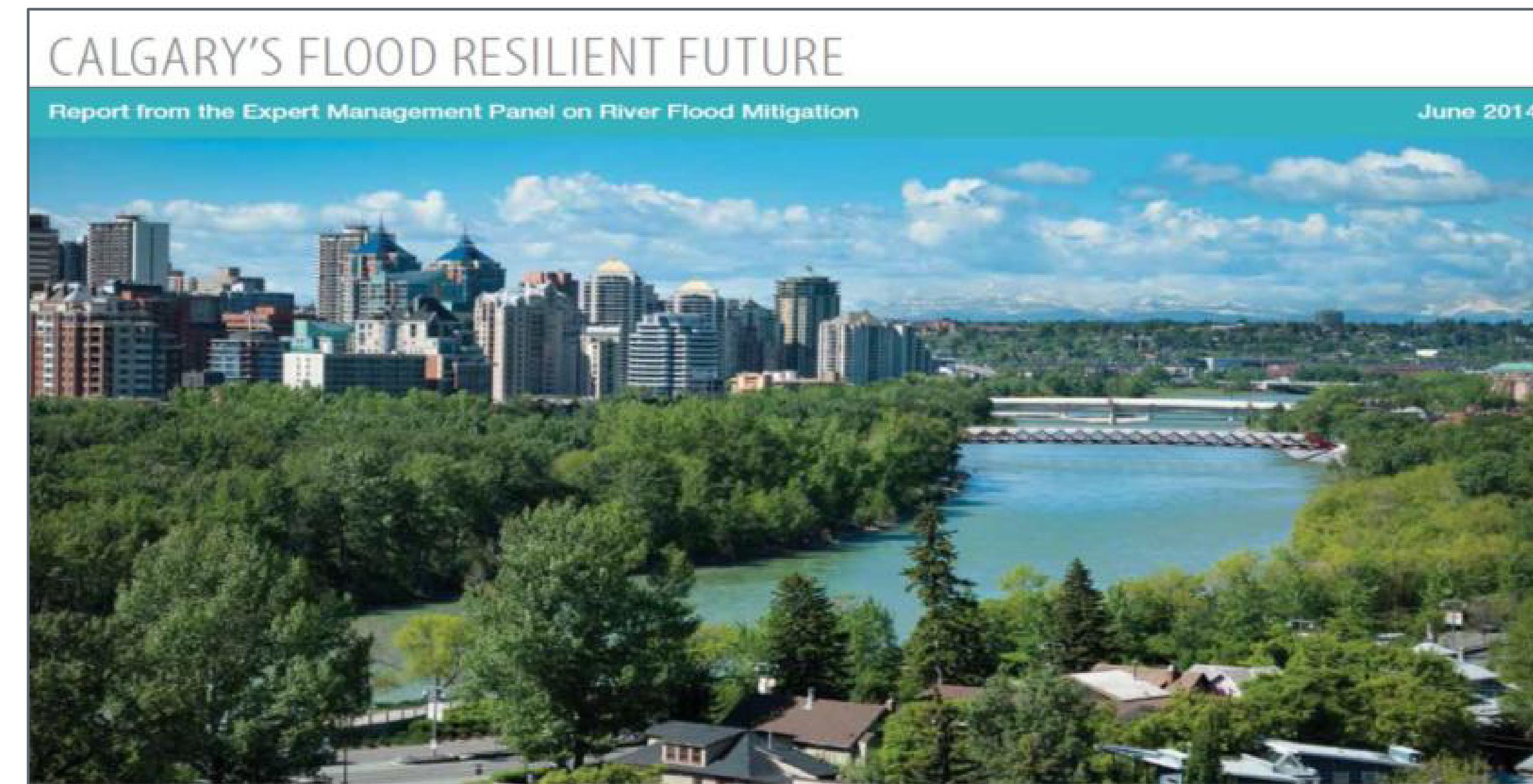
Flood Mitigation Public Engagement Session Materials



At these sessions, the public learned about potential flood mitigation measures for Calgary.

The City held a series of in-person and online engagement events in October and November to gather feedback from citizens on preliminary flood mitigation concepts to assist in making recommendations to Council in early 2017.

Flood Mitigation Measures Engagement Timeline



Report from the Expert Management Panel on River Flood Mitigation

Following the 2013 flood, The City brought together an Expert Management Panel on River Flood Mitigation. The Panel made 27 recommendations to help build flood resiliency throughout the watershed. One of the recommendations was a study that would tell us how much damage floods in Calgary could do, and how mitigation measures could reduce damage from floods. One of the recommendations was to create a Flood Mitigation Measures Assessment which includes public engagement.



Public Telephone Opinion Survey

Calgarians were randomly surveyed by phone to help understand their values, needs and perspectives around River Flood Mitigation.



Community Advisory Group

A group of 19 Calgarians from diverse backgrounds, communities and experiences helped to identify criteria for evaluating mitigation measures.



Public Consultation: Workshops, Open Houses and Online Engagement

A series of in-person and online engagement events will help the project team gather thoughtful and informed feedback on proposed flood mitigation concepts and non-structural measures.



Recommendations to Council

Based on both the technical study and feedback from Calgarians through this public engagement process, the project team will present recommendations to Council around River Flood Mitigation.

April
2016

Feb to
Nov 2016

Oct to
Nov 2016

2017

↑
We are here

Flood Resiliency

- After the 2013 flood, the Expert Management Panel on River Flood Mitigation made 27 recommendations.
- To date, The City has completed or is working on 25 of the recommendations.
- Building flood resiliency is a long-term process, requiring a detailed understanding of our rivers, structural flood protection, strong flood policy and many partnerships.
- Building resiliency takes citizens, communities and The City working together.
- A key recommendation from the Expert Panel was to undertake a study to determine how much damage floods can potentially do in Calgary, and how we can work to reduce that damage.
- Based on the study results and community input, Administration will make recommendations on long-term flood mitigation to Council in early 2017.

River floods:

- Are a natural process that benefits the floodplain environment.
- Bring water and nutrients to regenerate the ecosystem.
- Can carve new channels, change a river's course, or deposit gravels, creating gravel bars.

In urban environments, both the river and a city's development must be wisely managed to reduce conflicts between residents and flooding.



We Are Building Resiliency

Emergency Response Plan

- The City's flood emergency response plan is updated annually.
- Training exercises and practice events are ongoing.
- A Flood Readiness Campaign is delivered every spring to help citizen prepare for flood season.



Temporary barrier



Emergency Response Centre

Bank Repair and Protection

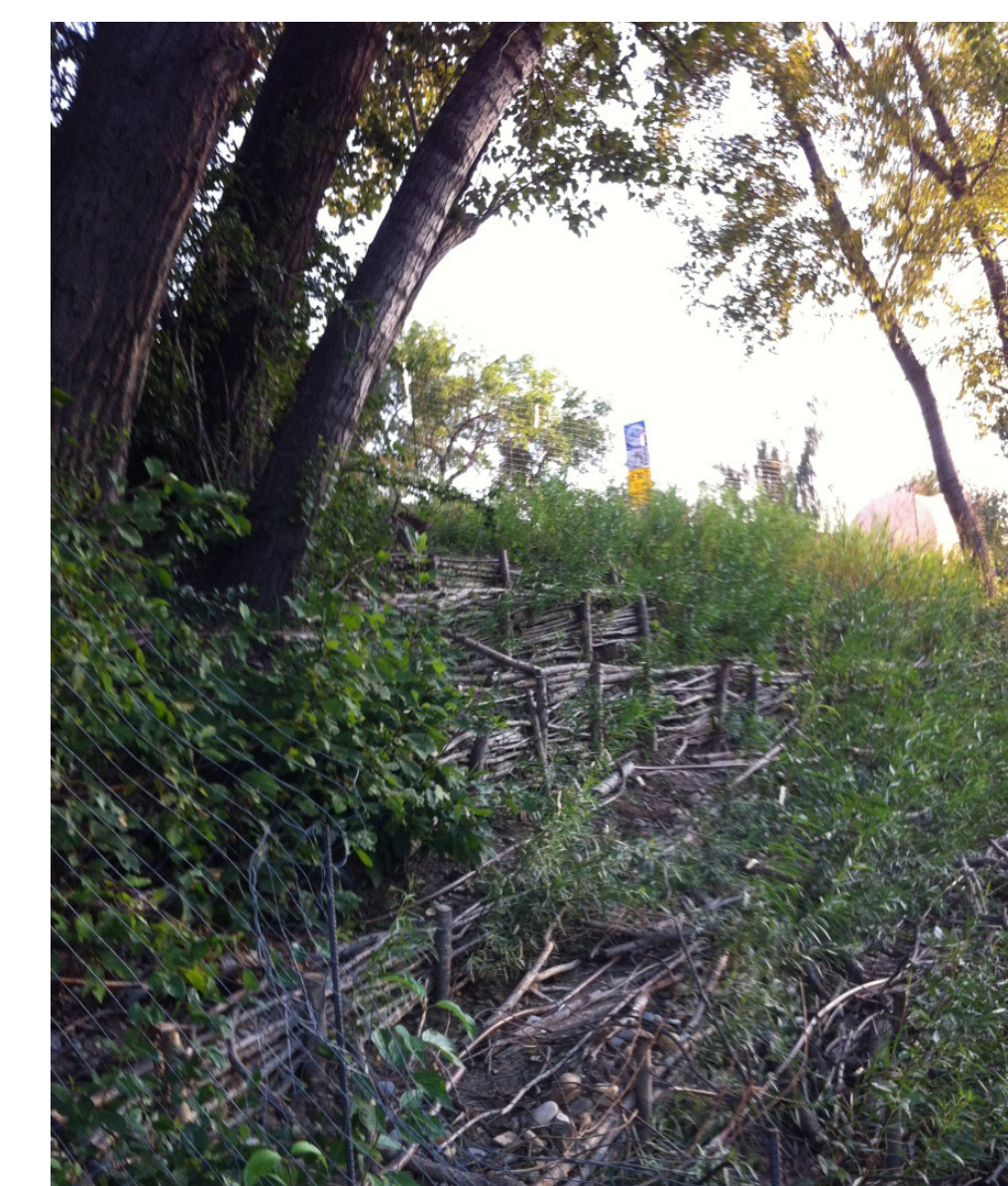
- Strengthened banks are less likely to suffer erosion in the next flood, reducing impacts to property, infrastructure and personal safety.
- Banks are repaired and strengthened using rock or bio-engineering and vegetation.
- 32 critical and high priority sites have been completed.
- Five moderate priority sites are complete, with four more underway.



Discovery Ridge



Elbow River at Ramsay



Riverdale Ave.



Bow River at Glenmore Trail

We Are Building Resiliency

River Flood Mitigation Projects (Since 2013)

- Installing gates on the crest of Glenmore Dam to increase the storage capacity of the reservoir.
- Barriers at Bonnybrook, Centre Street Bridge, Heritage/Deerfoot, West Eau Claire, the Zoo to prevent water from entering communities.
- Removal of river channel constrictions (debris, select gravel bars) to increase the capacity of the river channel.
- Stormwater outfall gates to prevent river backup into communities.
- Improvements to storm and sanitary lift stations to improve their ability to function during river floods.
- Many more mitigation options have been assessed (for example: dredging, diversion tunnel, replacing bridges).



Glenmore Reservoir 2013 Flood

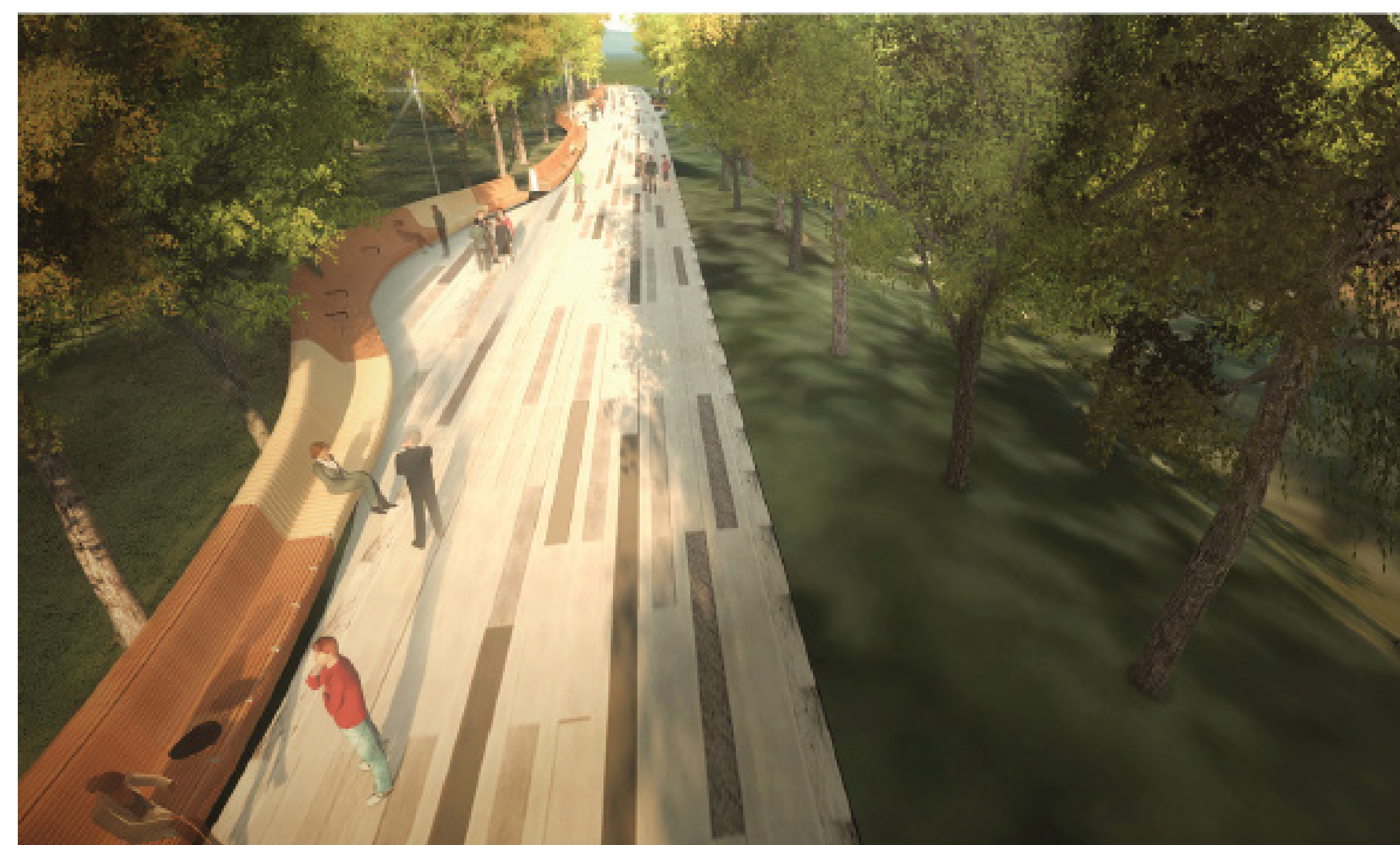
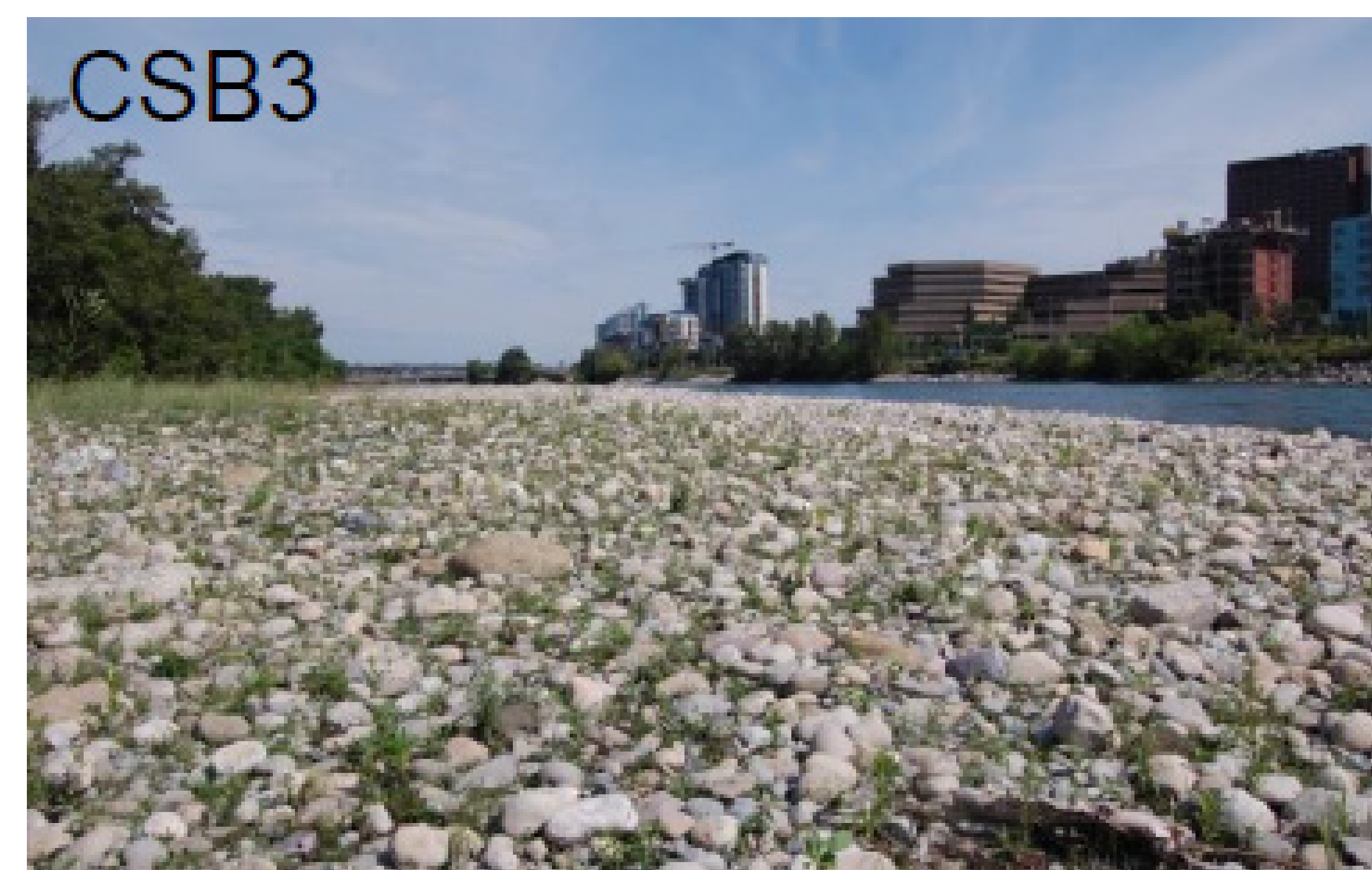


Illustration of West Eau Claire Berm



Gravel Bar



Stormwater Outfall Gate

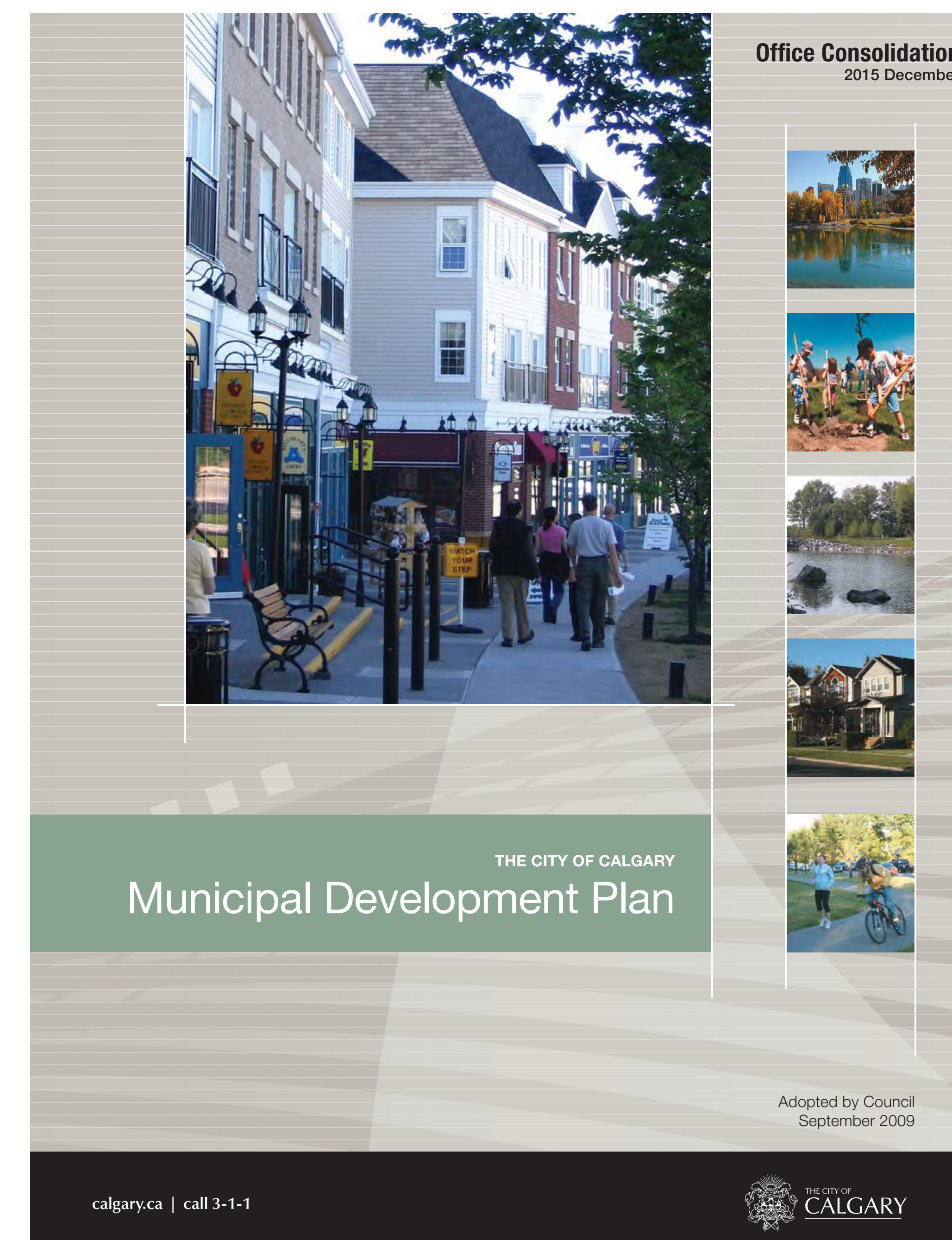
We Are Building Resiliency

Additional Initiatives to Build Resiliency

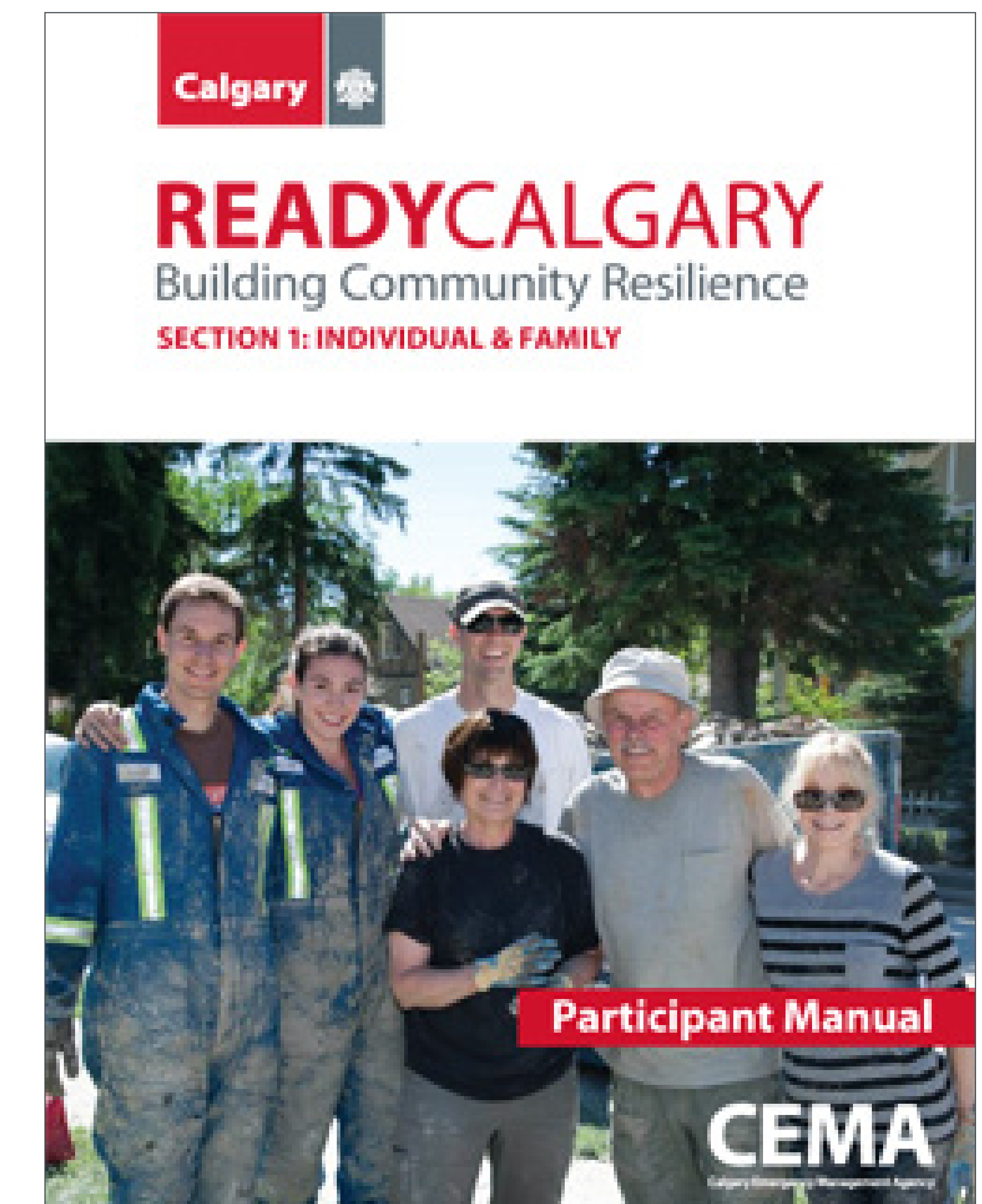
- Studies of the river to understand how it changed in 2013, and how it may change in the future.
- Updated flood policy in the Municipal Development Plan and Land Use Bylaws.
- Working with Province on upstream mitigation.
- Helping businesses, organizations and citizens and communities build resilience.
- Collecting input on how Calgarians view flood resiliency, river health and flood mitigation.



Aerial photo of gravel deposits



Municipal Development Plan Updated in 2014



Calgary Emergency Management Agency

Flood Damages in Calgary

Our study calculated that without any mitigation, the average annual cost of all floods over the next 100 years is

\$170 Million
per year in average
annual damages

'Average annual damages' is the total damage that floods of all sizes and frequencies could cause over the next 100 years, calculated as an average yearly "payment."

Existing flood mitigation in Calgary (including projects built since 2013) reduces the potential flood damage to

\$115 Million
per year in average
annual damages

 This is a 30% reduction

The Flood Mitigation Measures Assessment Project looks at what mitigation measures we can put in place to reduce potential damages even further.



Concept 1

Springbank Reservoir (Elbow River)

New Reservoir upstream of Calgary (Bow River)

Already Underway

- Upgraded Glenmore Dam with new gates on crest
- TransAlta operations of Ghost Reservoir for flood mitigation
- Emergency preparedness and response
- Storm water drainage improvements
- River monitoring and flood forecasting

Cost Summary	
Cost of Concept:	\$1.9 Billion
Benefit of Concept:	\$2.6 Billion
Benefit of Concept:	1.4
Remaining Average Annual Damages:	\$34 Million/Year

Springbank Reservoir

- The Government of Alberta has committed to Springbank Reservoir. It is currently in a provincial and federal Environmental Impact Assessment process.
- Springbank Reservoir is intended to be a “dry reservoir” which will only fill during a flood.
- Together with the upgraded Glenmore Reservoir, the two structures are intended to mitigate a 2013-sized event without overbank flooding on the Elbow.

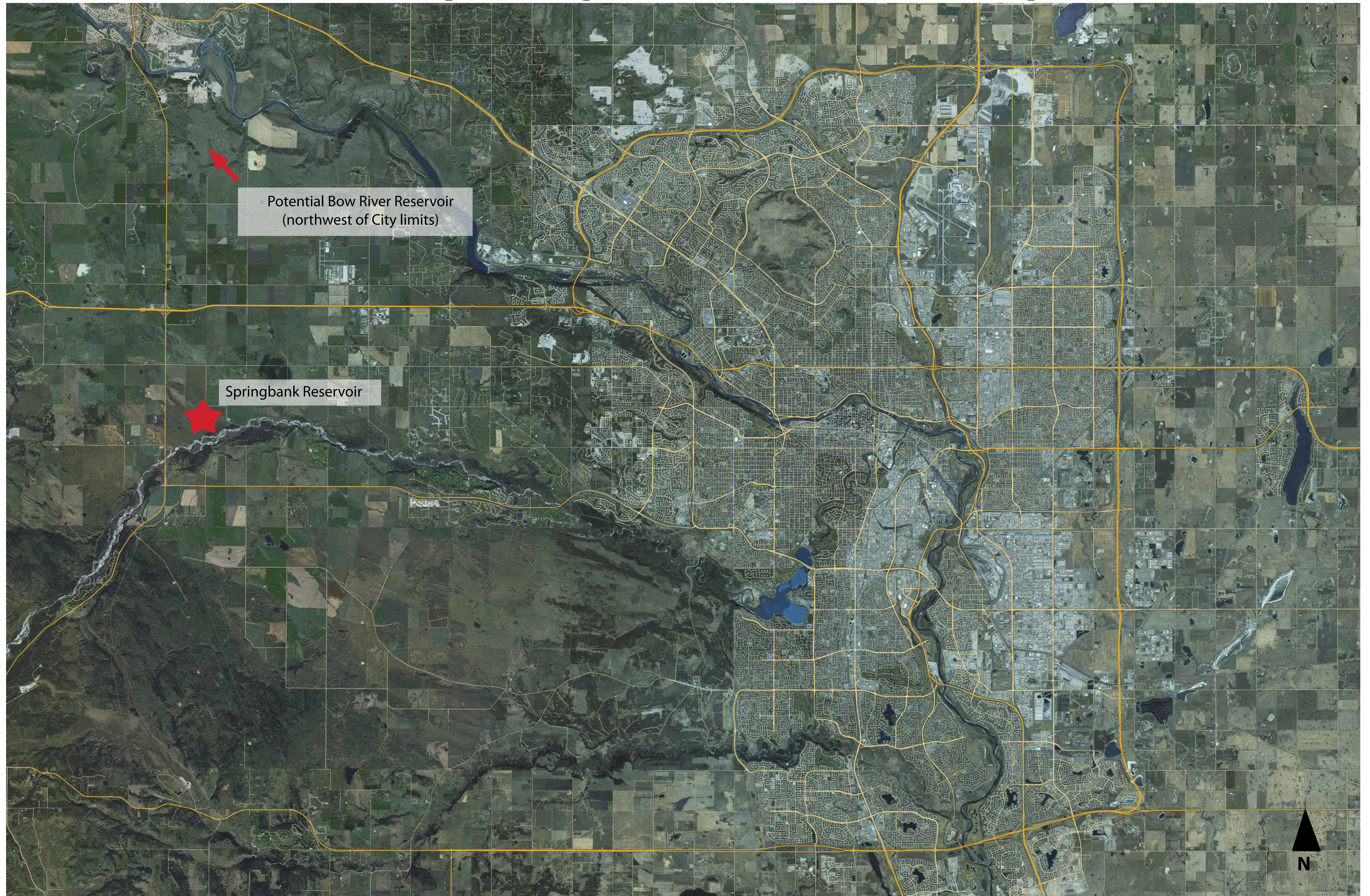
New Bow River Reservoir

- The City is participating in the Bow River Working Group process with the Province and other watershed stakeholders.
- The Working Group is investigating alternatives for flood and drought mitigation structures upstream of Calgary.
- Opportunities for drought mitigation, hydro-electric power and recreation are being considered.
- The total mitigation provided by a new reservoir is uncertain, but one structure alone would not be enough to mitigate a 2013-sized even on the Bow.

Considerations

- Reservoirs can provide some reduction in groundwater flooding during a river flood, by lowering river levels during the flood event.
- For smaller floods, communities downstream would not necessarily need to be evacuated.
- Multiple stakeholders involved.
- Dams and reservoirs can take a long time to approve and build.
- The construction of the dams and reservoirs can have significant environmental impacts.
- While rare, there is the risk that dams can fail, which could cause catastrophic flooding.
- Events larger than the reservoir is designed for may result in flooding downstream – but the dam still provides benefit – the flooding would be less than if the dam was not in place.

Concept 1 - Upstream Reservoirs Map



Concept 2

Barriers along the Elbow River

Barriers along the Bow River

Already Underway

- Upgraded Glenmore Dam with new gates on crest
- TransAlta operations of Ghost Reservoir for flood mitigation
- Emergency preparedness and response
- Storm water drainage improvements
- River monitoring and flood forecasting

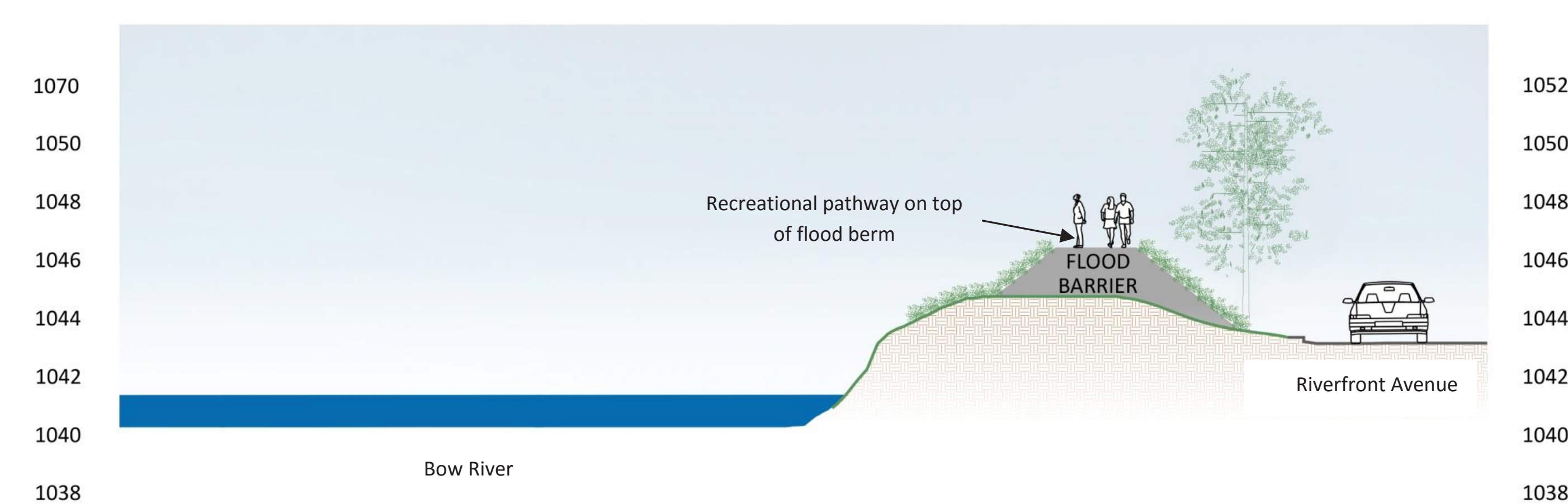
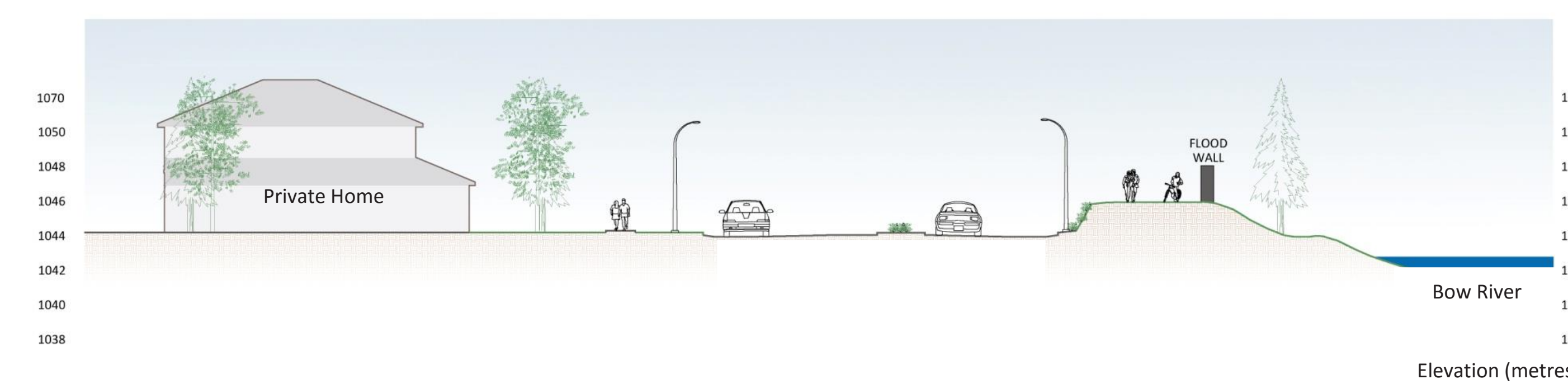
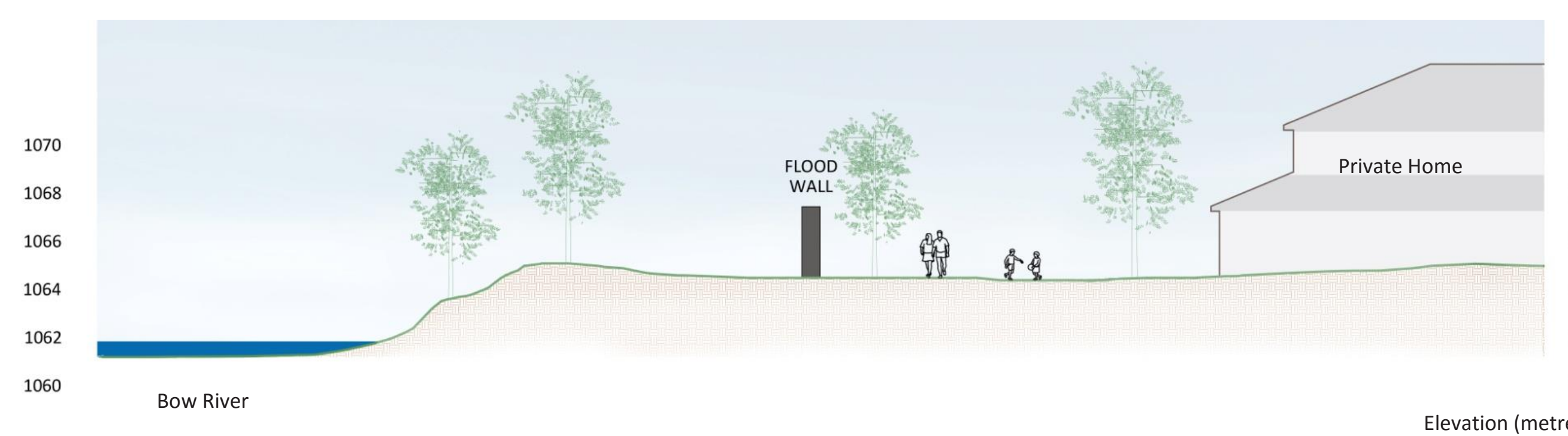
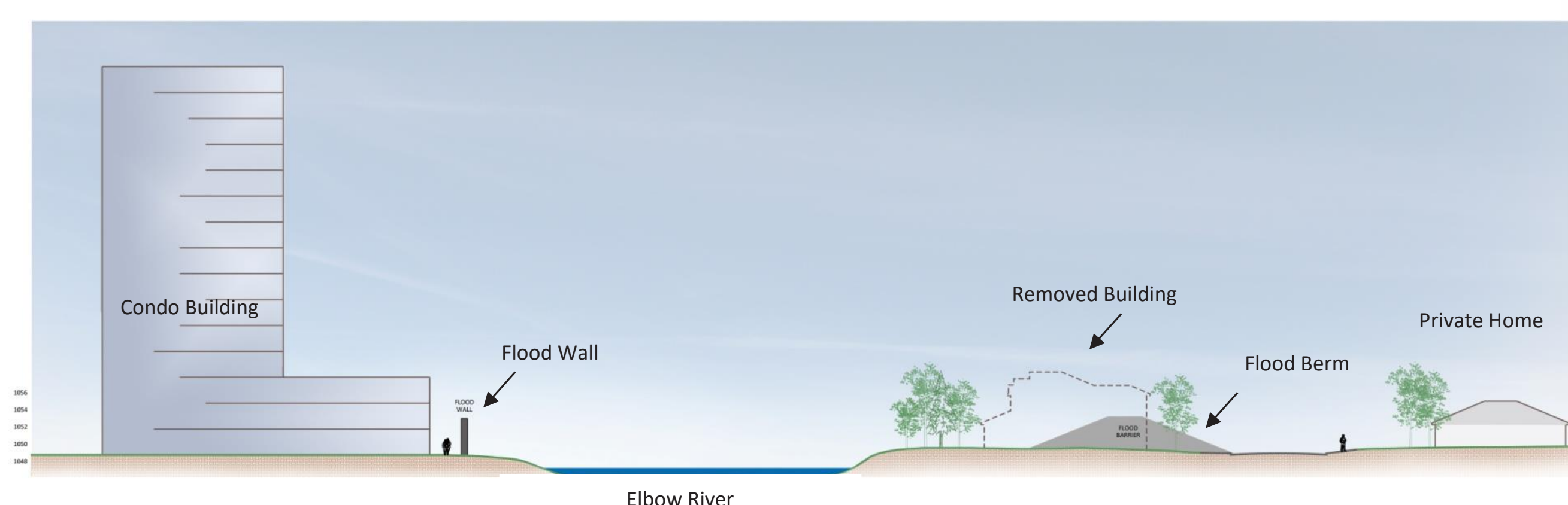
Cost Summary

Cost of Concept:	\$1.8 Billion
Benefit of Concept:	\$1.9 Billion
Benefit of Concept:	1.1
Remaining Average Annual Damages:	\$57 Million/Year

Considerations

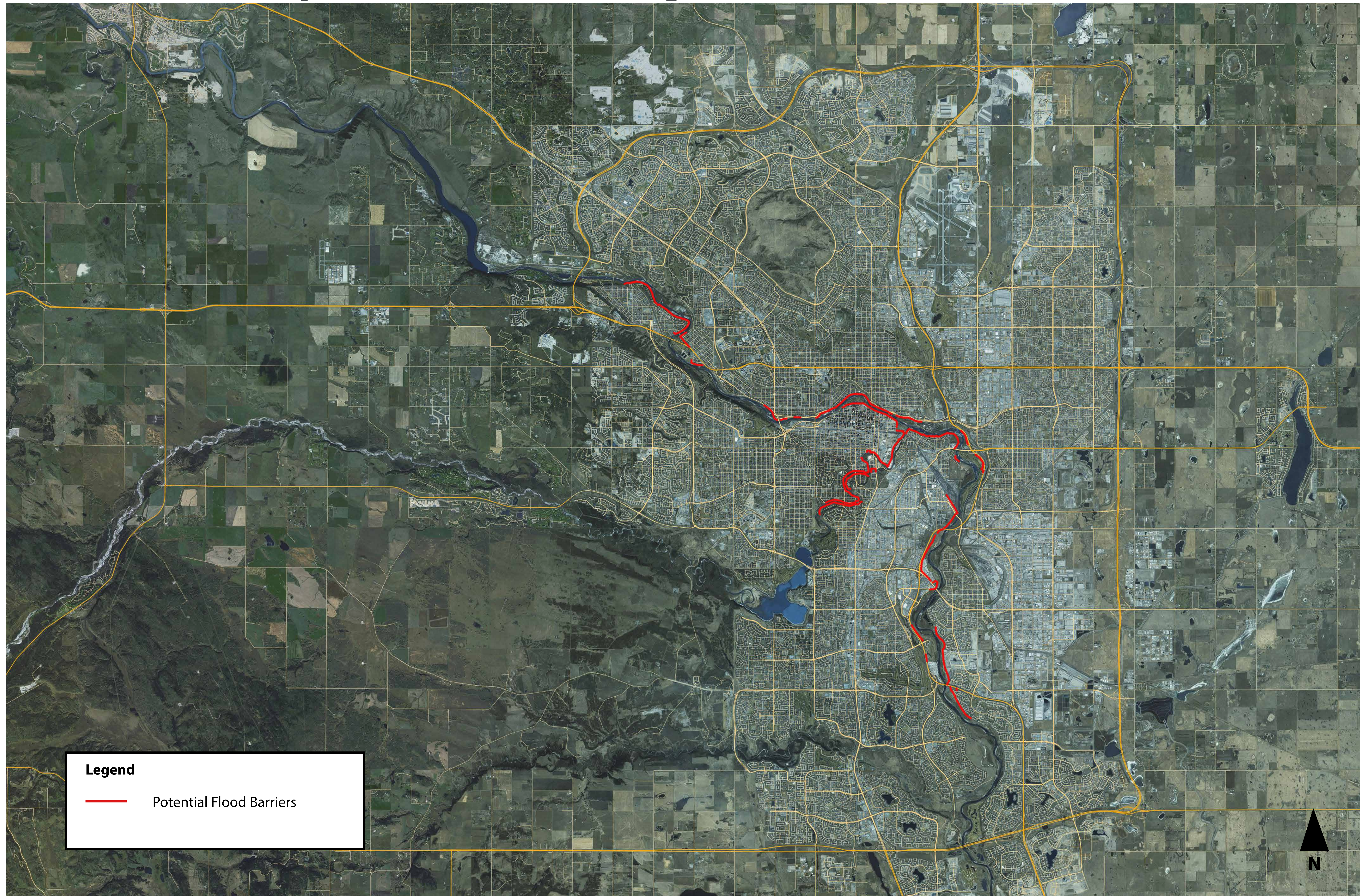
- Building barriers within the city limits can be done by The City in stages.
- Extending the barriers underground to protect against groundwater flooding from the river is possible, but costly. It could double the cost of the barrier.
- It will take time to approve and build all the barriers.
- The length and height of barriers required to protect all at-risk communities are significant.
- Many barriers will require purchase of land along the river where space is needed to build the barrier.
- Barriers will change the visual aesthetics of the river and nearby communities, and may affect the location and number of access points for recreational actives.
- There is significant impact to the natural riverbank environment, including drainage and interactions between the river and floodplain areas.
- Barriers do not provide any additional benefits to the watershed, such as drought management, energy generation or recreation.
- If a larger event occurs, water will flow over the barrier. These situations would cause water to flow into communities that were considered protected.
- Depending on the size of the a flood event, communities protected by barriers may still need to be evacuated for safety.

Conceptual Illustration of Flood Barriers



Need more info? Please refer to the participant package or ask us!

Concept 2 - Barriers Along the Bow and Elbow Rivers



Concept 3

Springbank Reservoir (Elbow River)

Barriers on the Bow River

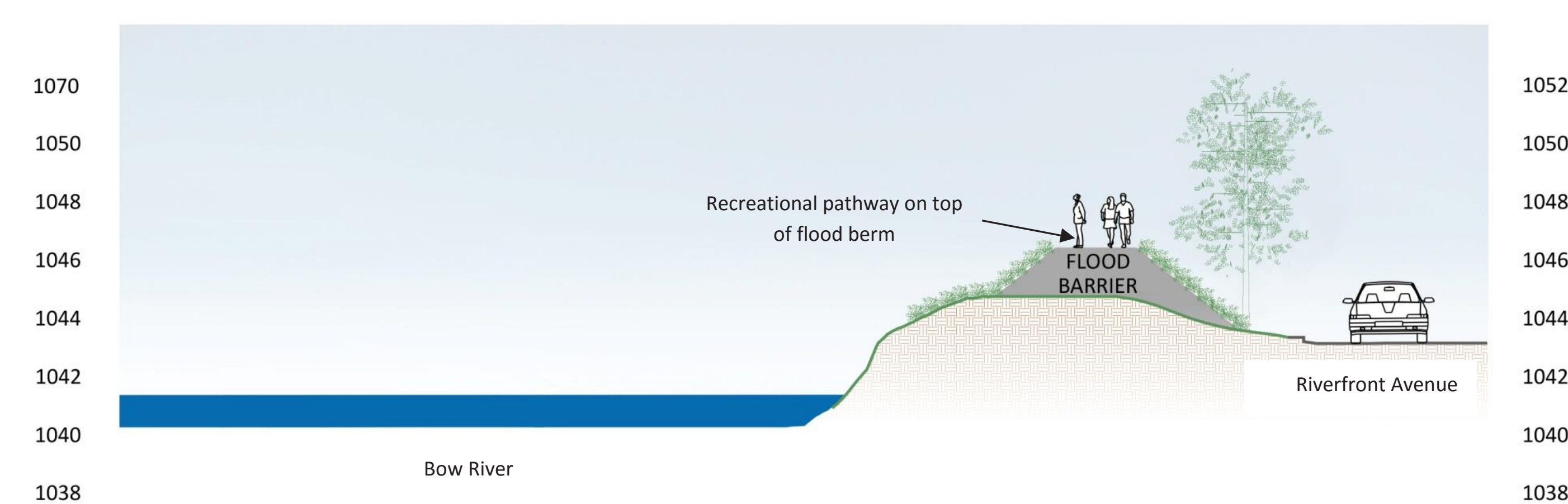
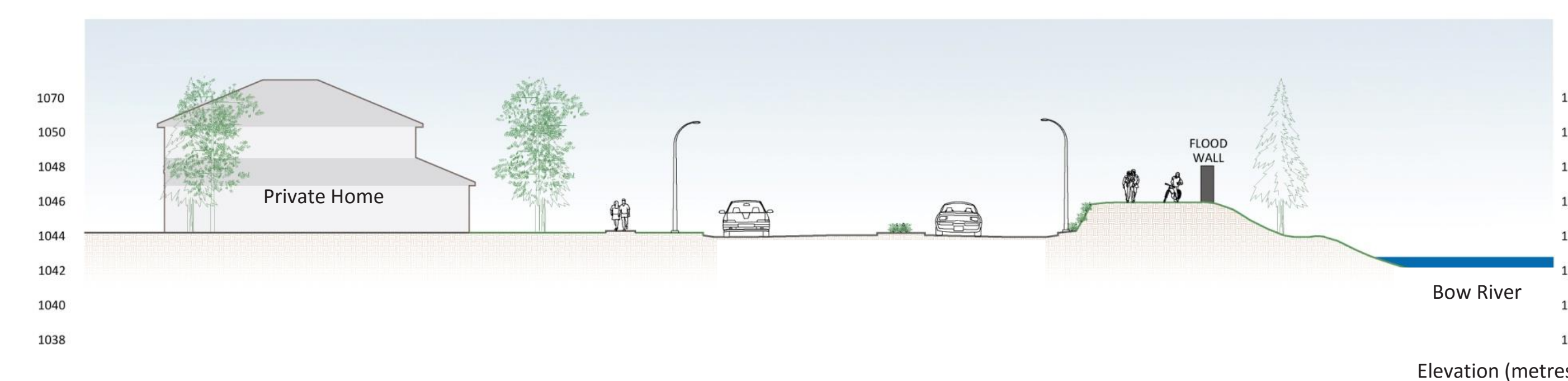
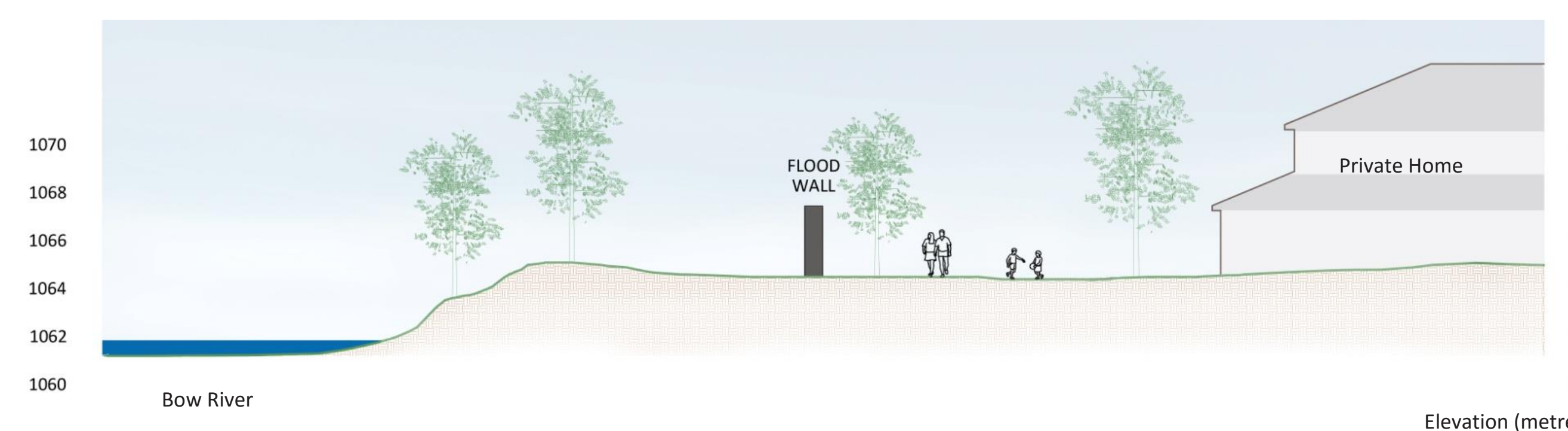
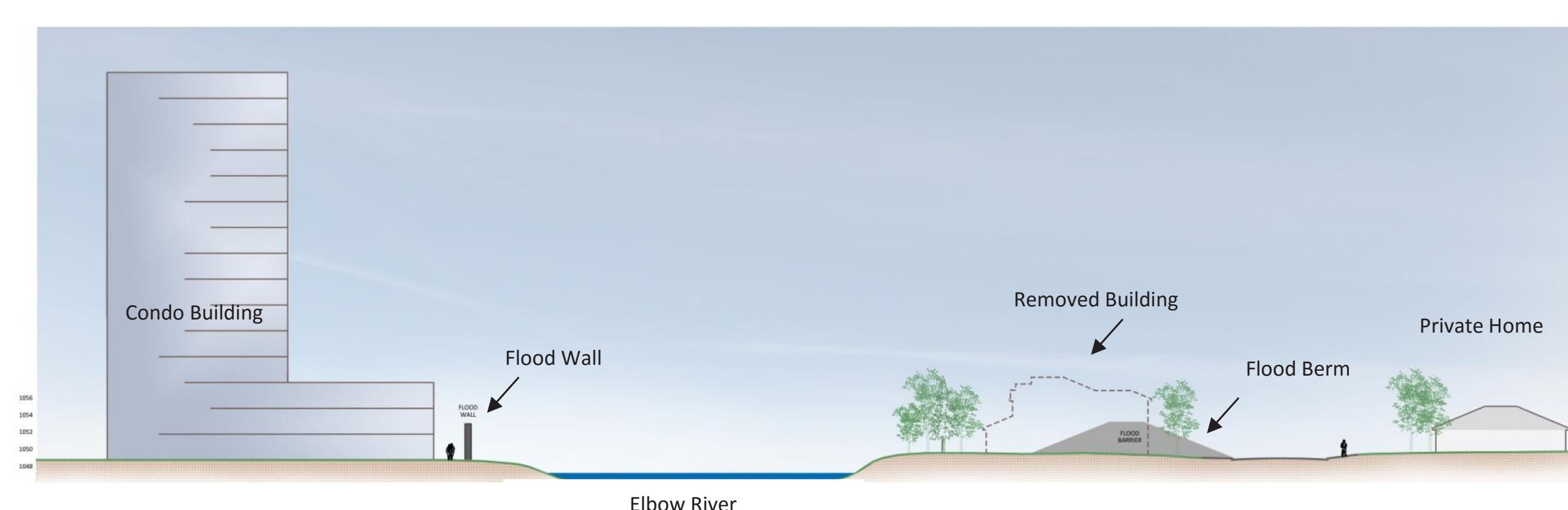
Already Underway

- Upgraded Glenmore Dam with new gates on crest
- TransAlta operations of Ghost Reservoir for flood mitigation
- Emergency preparedness and response
- Storm water drainage improvements
- River monitoring and flood forecasting

Cost Summary

Cost of Concept:	\$1.01 Billion
Benefit of Concept:	\$2.5 Billion
Benefit of Concept:	2.4
Remaining Average Annual Damages:	\$37 Million/Year

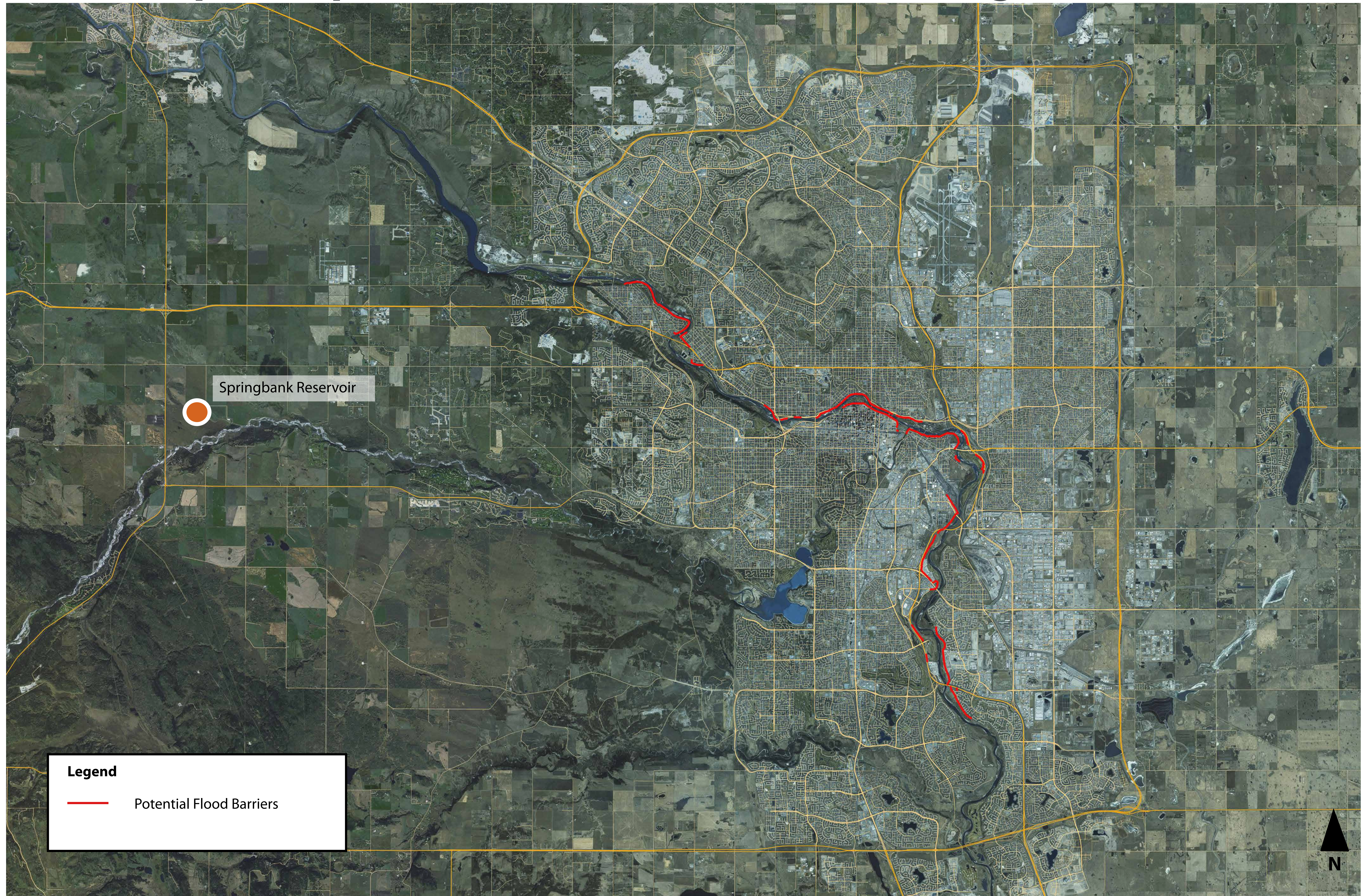
Conceptual Illustration of Flood Barriers



Considerations

- Mitigation measures can be combined in various ways to provide optimal long-term protection for Calgary.
- A combination of different measures could allow for equal service levels for protection on the Elbow and Bow Rivers.
- The considerations for reservoirs and barriers listed under Concepts 1 and 2 would apply.

Concept 3 - Upstream Reservoir & Barriers Along the Bow River



Non-Structural Measures

Overview

What is a non-structural measure?

- Non-structural measures are policies, bylaws, operating procedures, emergency response plans, and river forecasting models that are designed to reduce potential severity of damage to property and increase public safety.
- Non-structural measures do not prevent flooding. They reduce the risk of damages and protect public safety.
- Non-structural measures and community-scale structural flood protection can be combined in many ways to build a community's resilience to flooding.

Examples of potential non-structural measures:

- Removing some or all buildings from the floodway.
- Increasing regulations on how buildings are redeveloped in the flood hazard area.
- Not allowing basement secondary suites within the flood hazard area.
- Not allowing basements in new developments within the flood fringe.
- Prohibiting or restricting land uses within the flood hazard area that pose an increased safety risk during flood emergencies (e.g. hospitals, assisted living, protective and emergency services).
- Stricter flood proofing regulations in the flood hazard areas.
- Note: Due to the amount of development within Calgary's floodplain, including much of the downtown core, removing *all* development from the floodplain is not a feasible option in Calgary.

Benefits and Impacts

What would these measures strive to achieve?

- Recognize that even if flood protection is in place, a larger flood can happen and there is always flood risk.
- Reduce damages to buildings and contents during a flood.
- Create more room for flood water to flow through.
- Protect human life and safety.
- Encourage wise development and activity within the flood hazard areas.

How might these possible measures impact communities and property owners?

- They could restrict the way properties are redeveloped and used in some communities to a greater extent than in other communities.
- The cost of flood proofing measures and development requirements may be the responsibility of the property owner.
- May lead to a change of existing community architecture, building form, and design.
- May reduce rental housing availability.
- May include moving buildings out of the floodway.
- May restrict the development of new hospitals, assisted living facilities, and protective & emergency services in some communities.

Note: These measures are preliminary for discussion. Implementation has not been designed. There would be more community engagement around any policy or by-law changes pursued.

Glossary of Terms

Design Flood - The size of flood that flood-related policies and structures are designed to protect against. In Alberta, flood-related policies, such as Calgary bylaws, are based on a 1:100 year flood.

Flood mitigation - Includes policies or structures that reduce the risk of floods to a community, either by preventing floodwater from inundating the community, or by reducing the potential damages or threats to public safety when flooding does occur.

Flood wall (or floodwall) - Is a primarily vertical artificial barrier designed to temporarily contain the waters of a river or other waterway which may rise to unusual levels during seasonal or extreme weather events.

Floodway - The floodway includes the channel of a river and, in some places, the land next to the river. The floodway carries the bulk of the floodwater downstream. Flow is usually fastest and deepest in the floodway.

Floodplain - The area next to a river which can flood when river flows are high.

Flood fringe - The area outside of the floodway that is flooded in a 1:100 year event, but where flows are not as deep or fast as in the floodway.

Flood Hazard Area - In Alberta, the flood hazard area is the area that would be flooded in a 1:100 year flood. It is typically divided into two zones: floodway and flood fringe. In some areas, such as Calgary, there may also be a third zone, called the overland flow zone, which is considered a special part of the flood fringe.

1 in 100 year flood - A flood that has a one per cent chance of occurring (or being exceeded) in any given year. It can also be called a 1%-flood, a 100-year flood, and is often written as "1:100 year flood". Although called a "1 in 100 year flood" there will not necessarily be one every 100 years. It is even possible to have more than one 1 in 100 year flood in the same year. Similarly, a 1:50 year flood has a 2% chance of occurring in any year, and a 1:200 year flood has a 0.5% chance of occurring in any year. These terms are associated with specific flow rates, and the 1:100 year flood flow rate on the Elbow River is different than the 1:100 year flood flow rate on the Bow River.

Mitigation measures - Structural measures keep river flood water out of communities to a specified water level, reducing property damage and increasing public safety. Examples of physical structures are dams and reservoirs, as well as barriers (dykes or berms).

- Upstream physical measures such as dams and reservoirs are built higher in the watershed to control or slow the flow of the river to reduce the risk of flooding to a community as a whole.
- Local physical barriers, such as dykes and barriers are placed where the river banks need to be raised to prevent flooding at specific locations and providing protection to specific communities/areas.

Non-structural measures - Are measures based in knowledge, practice or agreement to reduce risk and improve resiliency. These measures include policies, land use planning, development regulations, emergency response and public training and awareness.

Residual risk - The risk that remains after efforts have been made to reduce or eliminate the hazard.

Triple Bottom Line - Is an approach that considers economic, social, environmental, and smart growth and mobility implications in the decision-making process. Triple Bottom Line has been adopted by many organizations in both the public and private sector. It is a departure from making decisions based solely on the financial bottom line. It also reflects a greater awareness of the impacts of our decisions on the environment, society and the external economy - and how those impacts are related. This policy was adopted by Calgary City Council on September 12, 2005. Triple Bottom Line thinking means that Council and staff consider and address social, economic, environmental, smart growth and mobility impacts in all City business. This includes City decisions and actions, planning, policies, strategies, services, operations and approvals.