# Water Services

**Flood Resiliency & Mitigation**
**River Engineering**

**December 2017**

# Building River Flood Resiliency

In 2013, Calgary experienced its largest flood since 1932. Many homes and businesses in historic neighbourhoods and in the downtown core experienced devastating damage from river and stormwater flooding. Traffic was disrupted, businesses were closed, and community services were impacted. The resulting damages within Calgary totaled $1 billion, including over $400 million to infrastructure.

## Investing in resiliency and mitigation

As a result of the many recovery projects following the 2013 flood:

- Riverbanks adjacent to critical infrastructure have been repaired.
- Storm drainage systems are strengthened to mitigate river water backing up into communities during flood events.
- Transportation networks and parks infrastructure have been reconstructed or repaired to be more flood resilient.
- Flood risk is better understood.

In addition, investments in flood mitigation have decreased the flood damage risk by approximately 30 percent, with more measures underway. The projects include:

- Higher gates on the Glenmore dam.
- New barriers (Centre Street bridge, Bonnybrook, Montgomery, Heritage Drive, Calgary Zoo, Stampede, Deane House).

Building flood resiliency is a top priority for the City of Calgary. The City has explored structural and non-structural options for reducing river flood risk. The results of a comprehensive Flood Mitigation Measures Assessment (2017), several technical studies and a social-economic-environmental assessment, identified that a single mitigation measure cannot mitigate against flooding. Rather, a combination of upstream, local and property level mitigation measures is needed, along with planning policy, to reduce flood risk and potential damages.

The high level findings of the assessment were:

- Once completed, the Province of Alberta's Springbank Off-Stream Reservoir and The City's upgraded Glenmore Dam gates will mitigate against an event similar to the 2013 flood on the Elbow River.
- A combination of a new upstream reservoir, continuation of the Province of Alberta and TransAlta's agreement to modify operations at the Ghost Reservoir, and flood barriers in communities at highest risk of flooding are needed to mitigate against flooding on the Bow River.
- Property-level mitigation undertaken by private property owners can significantly reduce the risk of flood damage.

**Community Information Session**
Tuesday, January 16, 2018
6:00 – 9:00 p.m.

Bowness Community Association
7904 - 43 Avenue N.W.

Presentation begins at 6:30 p.m.

Residents of Bowness are invited to attend to learn about The City's plan for flood mitigation and resilience, and actions specific to the community of Bowness.

For information on flooding in Calgary visit calgary.ca/floodinfo

2016-1012

## A proposed solution for Bowness

The Bow River is an integral part of the Bowness community. Residents highly value the river valley, paths and parks for their natural beauty, recreational opportunities, and as a place to connect with nature.

This proximity to the river also means there will always be a risk of flooding. The low topography of the neighbourhood means flooding can occur when the flow rate is approximately 850m$^3$/s, which has a twelve percent chance of occurring each year.

The Flood Mitigation Measures Assessment report, approved by Council in spring of 2017, included technical, cost-benefit, social and environmental analyses for a range of flood mitigation options that would protect public safety, reduce flood risk, and reduce the social, economic and environmental impacts of flooding. Citizen input was carefully considered when assessing flood mitigation solutions for Calgary, including the potential impacts of berms on neighbourhoods.

After exploring various options, the recommended solution for the Bow River is a combination of a new upstream reservoir on the Bow River, continuation of the provincial agreement with TransAlta for modified operations of the Ghost Reservoir during flood season, and barriers in Bowness, Sunnyside, downtown core, and Pearce Estates/Inglewood.

Within Bowness, barriers are proposed above the riverbank roughly extending between the CP Rail tracks and Shouldice Bridge as shown on page 6. The proposed flood barriers would mitigate flooding up to 1,230 m$^3$/s and the barrier heights would be further increased by 0.5 m as an additional safeguard. The barriers will also work with the proposed reservoir upstream of Calgary and modified operations of TransAlta's Ghost Reservoir to protect against larger flood events.

We understand that residents of Bowness are eager to know the finalized flood mitigation plan for their community. The City is still in the planning process for the Bowness barriers. Conceptual work has been done to inform barrier options, and The City has detailed data about river levels and lot elevations at each property. However, technical design has not yet started. Input from citizens is an important piece of the technical design process, and engagement with residents is currently planned to begin in 2018.

Barrier concepts envisioned to-date include earthen barriers where there is sufficient space and structural flood walls where space is limited. Both options will include landscaping that will aim to maintain aesthetics of the barrier footprint area. Much of the riverfront property is privately owned in Bowness and The City will work with individual property owners to gather their input, and discuss their concerns and ideas as the detailed design work gets underway.

**Our current, estimated timelines for this work are:**

- March 2018 to March 2019 – Engagement with community and property owners
- 2018-2019 – Design phase
- 2020-2024 – Construction phase

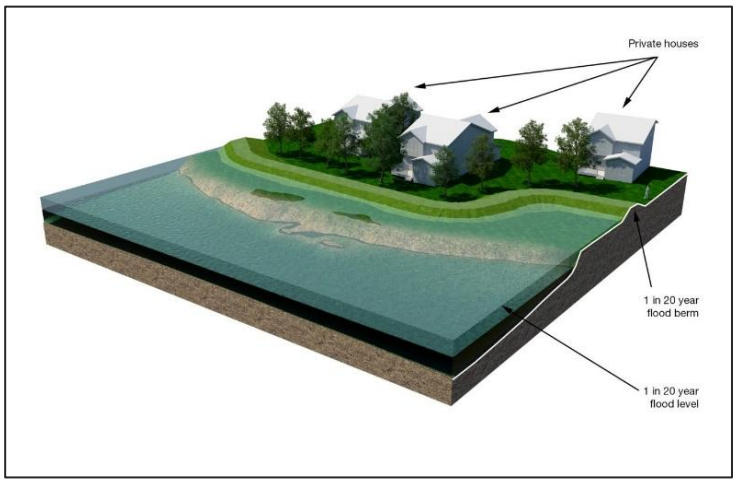


*Illustration of an example barrier in Bowness, showing a barrier that is 1 metre high and 9 metres wide*

## Reducing risk through non-structural mitigation

In addition to building barriers to mitigate against flood water from entering communities, The City has implemented or is exploring a range of policies, land use planning and development regulations, operational and emergency response planning and training activities, and public education to further reduce flood risk.

Key initiatives The City undertakes to protect and wisely manage the river ecosystems include:

- Riparian Action Plan
- Green stormwater infrastructure
- Fish habitat enhancement
- Bioengineering bank restoration projects
- Wetlands Conservation policy
- Environmental Reserve Setback policy

The City's Municipal Development Plan was updated in 2014 with top priorities related to increasing flood resiliency. Amendments to The City's Land Use Bylaw in 2014 included:

- In the floodway, no new development is allowed beyond the existing building footprint. All floodway redevelopment approvals are discretionary.
- In the flood fringe and overland flow areas, main floors and the mechanical/electrical systems must be set above the designated flood elevation. Buildings are required to be setback: 30m/60m depending on which creek/river, or 6m from the floodway, depending on parcel history.
- New and redeveloped properties require back flow prevention valves.
- A “sliding-scale” approach is employed to determine which mitigation measures are required. Small building alterations require minimal mitigation measures and large alterations require more robust flood mitigation measures.
- Restrictions and advisory conditions on what is allowed to be stored on a property, to mitigate against environmental contamination and river debris and damage to private property.

## Frequently Asked Questions

**Is my property at risk of flooding?**
There are a number of maps that are available on The City’s website that can help citizens determine their flood risk. For more information, visit Calgary.ca/floodinfo to see whether your property is at risk.

**What is The City doing to reduce flood risk on the Bow River?**
The results of The City’s technical, economic, social and environmental analyses identified that a **combination** of an upstream reservoir, modified operations of the TransAlta reservoirs during flood season and complementary barriers is required to reduce the flood risk for Bowness. The City is also exploring planning, policy and property level measures to work with these measures to reduce the risk of flooding. The City is working with the Province to move forward a new upstream reservoir on the Bow River.

**How do I find out if a barrier is planned for my property?**
In Bowness, barriers are proposed along the river’s edge roughly between the CP Rail tracks and Shouldice Bridge. This proposed alignment is for planning purposes and will require more technical analysis and property owner input to develop the detailed design.

**What process does The City use to engage with property owners?**
The City is still in the early planning process of developing barrier design concepts for Bowness. As we move forward, The City will seek input from property owners and the community. A plan of how to gather property owner input and address their concerns is currently being developed. The City would like to work with the property owners to create a solution that will be technically sound and effectively protect the community, while maintaining the well-being of property owners.

**What is the proposed height of the barriers, and what level of flood protection will they provide?**
The unique elevation of the riverbank is a key factor in determining the height and location of the barrier for each property. The average height of the barriers is approximately 1 metre (3.6 feet), however for some properties it will be less than 0.5 metres (1.5 feet) or as high as 2.0 metres (6.5 feet).

**Will a barrier on my property reduce my privacy?**
The purpose of the barrier is to provide flood protection. Unlike barriers on public property that might be suitable for recreational access, The City recognizes that privacy is of concern to property owners along the river. The City has no plans to encourage recreation or public access along barrier or riverbank in front of private property.

**How is the project being funded?**
To date, the Province has committed $150 million over ten years through the Alberta Community Resiliency Program (ACRP) for flood mitigation projects within the city.

The City has included the design and building of barriers in Bowness, downtown core, Sunnyside and Pearce Estates as part of its 2018 funding application through this program. The City is required to match a portion of the funding that is acquired through the program.

**Is there upstream mitigation planned for the Bow River? Where can I learn more?**
The Province led the Bow River Working Group to explore a long term water management plan that considers both flood and drought for the Bow River Basin. Included in the recommendations from the Bow River Working Group was the need for a new reservoir on the Bow River upstream of Calgary, which is a critical piece of Calgary’s flood mitigation plan. Mitigation projects outside of city limits fall under the jurisdiction of The Province of Alberta. For a copy of the Bow River Working Group’s report, visit aep.alberta.ca.

**What can citizens do to protect their property?**
Flooding can happen at any time in Calgary. The period between May 15 and July 15 is when we are most likely to experience flooding since historically this is when we receive the most rainfall.

To make sure you and your family are as prepared as possible in the event a flood occurs, follow the steps below:

- Read The City's Flood Readiness Guide
- Create a 72 hour kit
- Get the latest alerts and notices from Alberta Emergency Alert and Alberta Rivers apps
- Create an evacuation plan
- Visit Calgary.ca/floodinfo for more information.

The City is also able to provide recommended flood elevations for your property if you are constructing flood proofing measures or rebuilding.

**Why is The City not buying out the properties at risk of flooding?**
Based on property values alone, it is cost prohibitive to purchase all properties in the current flood hazard area. The buy-out costs have been estimated to be up to be several times greater than the cost of upstream mitigation. In addition, there would be costs associated with building demolition, conversion of the properties to parkland, and incentives to assist homeowners to relocate. Property buy-outs are also very disruptive to communities and have significant impacts on property owners.

**What other measures is The City taking to protect citizens?**
A variety of additional non-structural flood mitigation measures are currently being reviewed to evaluate which are the most effective and feasible for implementation in our city. Options being investigated include policy, land use, building regulations for undeveloped, developed or re-development areas. Property-level incentive and education programs are being considered.

**What measures are not being pursued?**
The following measures have previously been researched and set aside as they were not technically, economically, environmentally, or socially practical:

- Dredging of the Glenmore Reservoir, Elbow River or Bow River.
- Elbow River tunnel from Glenmore Reservoir to Bow River.
- Full barrier fortification of the Elbow and Bow Rivers.

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# Glossary

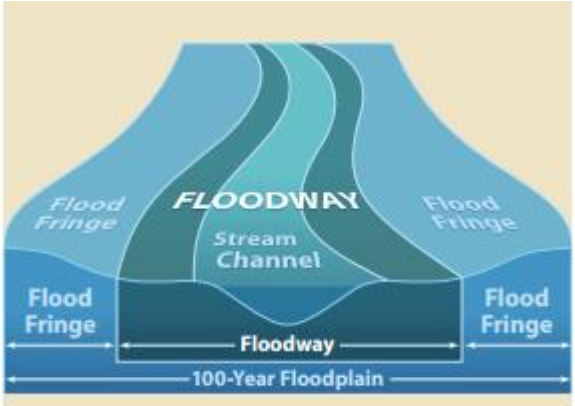
**Design Flood** – The size of flood that flood-related policies and structures are designed to protect against. In Alberta, flood-related policies, such as Calgary bylaws, are based on a 1:100 year flood. The design flood for structural design depends on the structure, but it is often the 1:100 year flood.

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

**Flood barrier** – An earthen embankment (known as a berm or a dyke), flood wall, or a temporary wall constructed of sand bags or other materials built to provide protection from floods.

**Flood hazard mapping** – Mapping that shows flood hazard areas along streams and rivers.

**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.




**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. The floodway and flood fringe are within the floodplain.

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

**Flow Rate –** Flow is a measure of the amount of water traveling past a point in a given amount of time. In rivers, the flow of water is typically reported in cubic metres per second ($m^3/s$). A cubic meter is the volume of water contained in a cube of one metre high, one metre wide, and one metre deep. It is equivalent to 1000 litres of water and weighs a metric tonne. Typical flow rates on the Bow River upstream of where it meets the Elbow River is ranges between 70 to $400m^3/s$.

**Non-structural mitigation measures –** Knowledge, practice, or agreements to reduce risk and improve resiliency. These measures include policies, land use planning, development regulations, emergency response and public training and awareness.

**Recovery --** The process of returning a community, organization, businesses, institutions back to normality after a disaster.

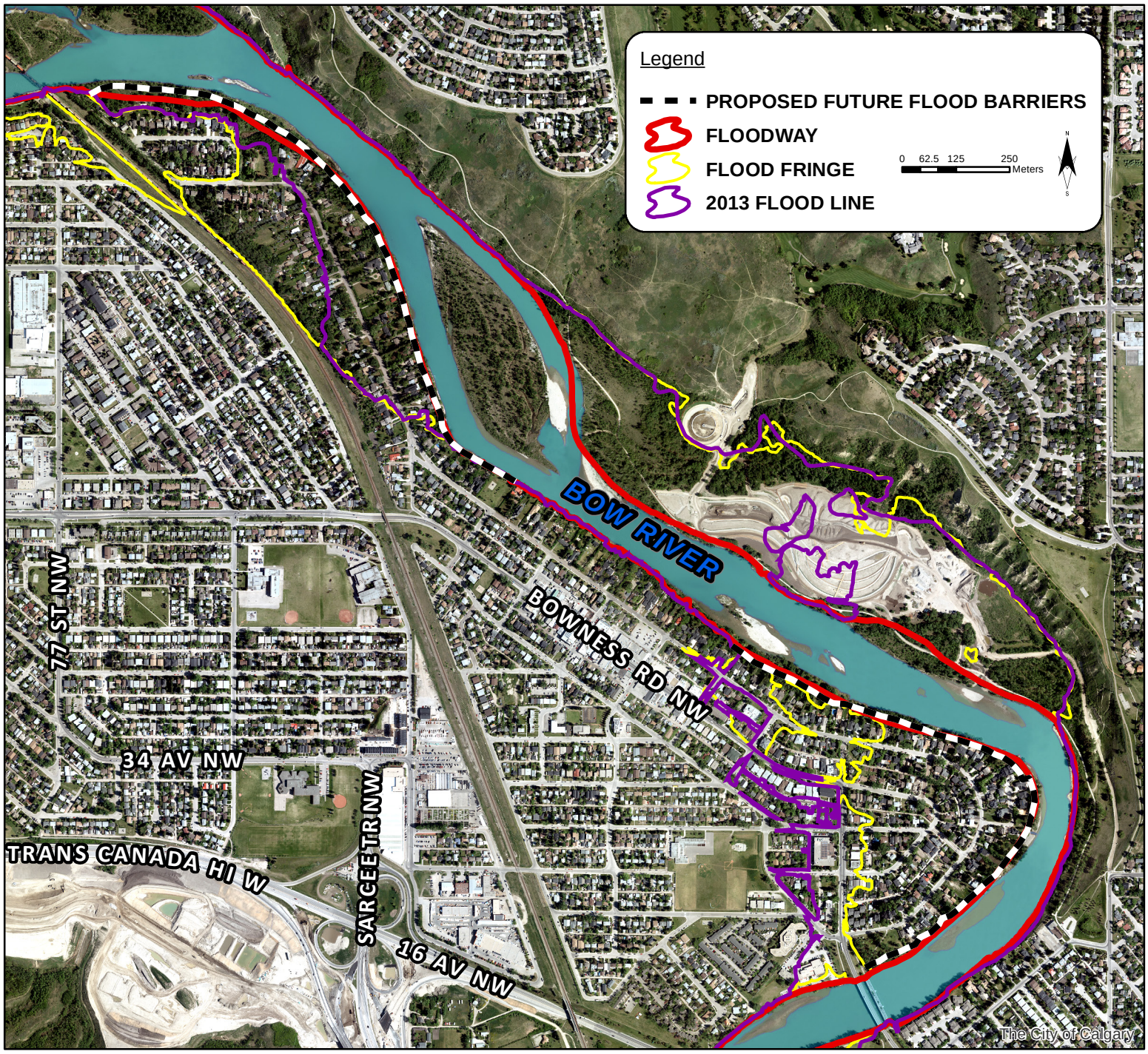
**Resilience –** The capacity of individuals, communities, institutions, businesses and systems to absorb stresses and maintain function during external stresses.

**Structural mitigation measures** – Keep river flood water out of communities to a specified water level, reduce property damage and increase public safety. Examples of physical structures are dams and reservoirs, as well as barriers.

- **Upstream physical measures** such as dams and reservoirs are built 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 berms, dykes and flood walls are placed where the river banks need to be raised to mitigate flooding at specific locations and providing protection to specific communities/areas.

**Watershed** – The entire land area that drains to a river. The Elbow River watershed extends up into the Rocky Mountains beyond Bragg Creek. Calgary gets its water from both the Elbow River and Bow River watersheds.

**1 in 100 year return period flood** – A large flood that has a one per cent chance of occurring in any given year. It can also be called a 1 per cent flood or 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. On the Bow River, the estimated flow rate for a 1:100 year return period is about 2020 $m^3/s$.


Legend
PROPOSED FUTURE FLOOD BARRIERS
FLOODWAY
FLOOD FRINGE
2013 FLOOD LINE
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Meters
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S
BOW RIVER
BOWNESS RD NW
77 ST NW
34 AV NW
TRANS CANADA HI W
SARCEE TR NW
16 AV NW
The City of Calgary