

Sunnyside Open House Handouts

Different types of flood barriers

To protect against future flooding in Sunnyside, there are five different types of barriers that may be used. The type of flood barrier chosen takes into consideration:

- the height requirements of the barrier,
- available space between the river and Memorial Drive,
- if the barrier needs to tie into existing infrastructure (e.g. crosswalks);
- the impact on the pathway alignment.

Below is a summary of each type.

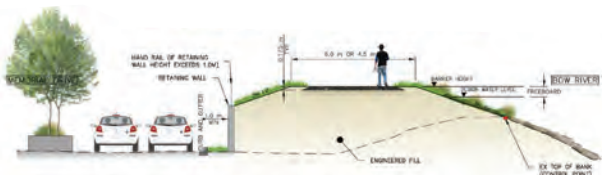
1. Earth berm

An earth berm is an area of land that is raised and built from soil.



2. Earth berm and retaining wall

When space is limited, an earth berm is used for most of the barrier, but a retaining wall is added adjacent to the road to hold back the earth.



3. Flood wall

A flood wall is a vertical barrier that is added to the top of a river bank and is required when space is limited.



4. Flood wall and earth berm

An earth berm with a flood wall is used to increase the overall height of the barrier where space is limited.



5. Flood wall, earth berm and retaining wall

An earth berm with both a flood wall and retaining wall is used to increase the overall height of the barrier where space is significantly limited.



Why isn't the barrier type the same throughout each option?

Where possible, an earth berm is the preferred option because it's an effective form of flood mitigation that blends best into the natural surroundings of the river. An earth berm also takes less time to construct and is a cost-effective type of flood mitigation.

When space is limited and as the height of the barrier increases, we need to consider other barrier options like flood walls and retaining walls that can be accommodated in tighter spaces. However, these options can change the aesthetics of the area, take more time to construct and be more costly.



Benefits and Concerns

In the boxes below, please describe the benefits and concerns you have for each of the options for the flood barrier.

Barrier option - 1 in 20 - year flood level

Benefits	Concerns

Barrier option - 1 in 50 - year flood level

Benefits	Concerns

Barrier option - 1 in 100 - year flood level

Benefits	Concerns

Barrier option - 1 in 200 - year flood level

Benefits	Concerns

Which of the following best describes you?

- a) Hillhurst/Sunnyside resident
- b) Hillhurst/Sunnyside business owner or employee
- c) Pathway/recreation user
- d) Other (please specify):

If you have any other questions for the project team, please write them here. If you would like a response, please add your contact information.



Please provide your input for the Sunnyside Flood Barrier Project and return this form at the end of the Open House.

Alternatively, you can visit engage.calgary.ca/sunnyside-flood-barrier-project to leave additional comments online.

Social Criteria Ranking

Rank each of the social criteria in order of importance by writing a number (1 through 6) in the box provided.

- #1 being the most important criteria
- #6 being the least important criteria

Each box must have a different number. You cannot use the same number more than once.

SOCIAL CRITERIA | **Community well-being**

Definition

Ranking (1 to 6)

Maintains community fabric

Preserves the look and feel of the area.

Provides the same flood protection amongst communities

Balances the community-specific needs with the need for a strong, city-wide flood resilience plan.

Protects vulnerable populations and services

Protects vital community services (i.e. schools, daycares, senior facilities) and Calgarians, who because of age, disability or other circumstances are at greater risk in emergency situations that require evacuation.

Maintains recreation and river access

Maintains or improves access to the pathway system, river and natural areas.

Maintains the aesthetics of the area and pathways

Maintains or improves pathway aesthetics and river views.
Maintains or limits impact to trees.

Improves mental well-being

Reduces flood-related stress and anxiety.



Please let us know your feedback

Alternatively, you can visit engage.calgary.ca/sunnyside-flood-barrier-project to leave additional comments online.

Please check the statement that best describes your opinion and add any additional comments you may have.

This Open House was a good use of my time

Strongly agree Agree Neither agree or disagree Disagree Strongly disagree

Comments

I'm satisfied with the opportunity to participate and receive information.

Strongly agree Agree Neither agree or disagree Disagree Strongly disagree

Comments

The information presented tonight gave me a better understanding of the project

Strongly agree Agree Neither agree or disagree Disagree Strongly disagree

Comments

I understand how my input will be used

Strongly agree Agree Neither agree or disagree Disagree Strongly disagree

Comments

This Open House was an effective way to collect my input

Strongly agree Agree Neither agree or disagree Disagree Strongly disagree

Comments

How did you hear about the Open House?

Any additional information about the Open House you would like to share with The City?

Sunnyside Open House Information Boards

Welcome to the Sunnyside Flood Barrier Open House

At this open house you will be able to:

- Learn more about the flood mitigation plan for Sunnyside.
- View the early designs for the different flood barrier options and begin to understand the impacts as protection increases.
- Provide your feedback on the social impacts of each barrier option.
- Find out what we have learned so far from various studies.
- Learn about the next steps for the project.



Understanding Calgary's flood risk

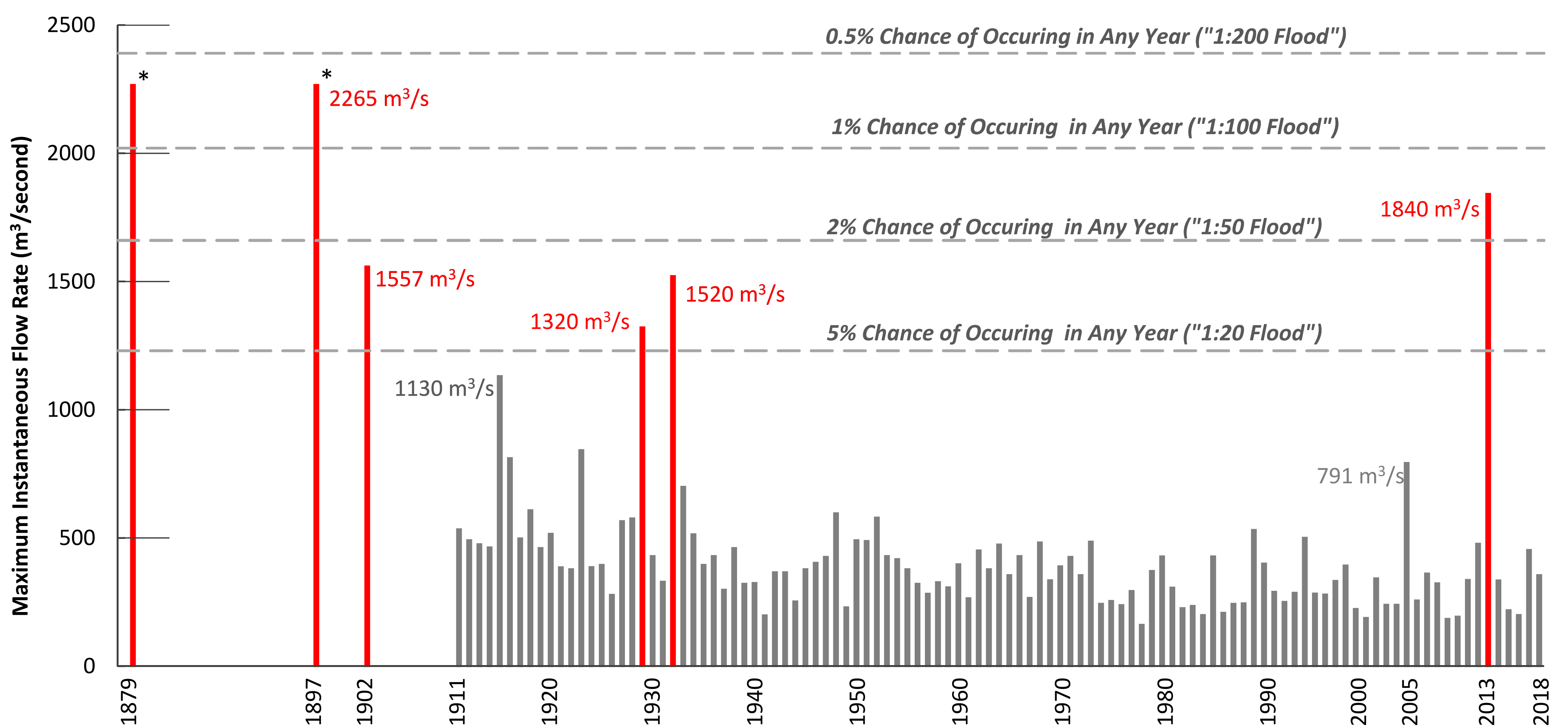
- Communities next to the Bow and Elbow Rivers face the greatest risk of river flooding.
- Flooding can occur at any time with little to no warning.
 - May 15 to July 15 is when we receive our largest rainfalls and are most likely to experience river flooding.
 - While flood risk can be reduced, it cannot be eliminated entirely.
- The City's priority when planning and responding to flooding is to protect its citizens, critical infrastructure, civic property, the environment and the economy.
- It's important to understand the flood risk in your community and your property, so you can be prepared and take action in the event of a flood.
 - Visit calgary.ca/floodinfo to access flood maps and other resources to help you understand your river flood risk.



Flood risk from the Bow River

Since we started recording floods, the Bow River has experienced floods with magnitudes greater than 1,230 m³/s (a 1-in-20 year flood) six times. This is represented by the red bars in the graphs

Annual Flood Peaks on the Bow River at Calgary (above the Elbow River)



* Estimated based on historical high water marks.

** Return period flow estimates are from Bow and Elbow River Basin-Wide Hydrology Assessment and 2013 Flood Documentation Report prepared for The City of Calgary and The Province of Alberta, Sept. 2014.

Protecting Sunnyside from flooding

A four-part plan



**We can't prevent future floods,
but we have a plan to reduce impacts**

1. Enhanced TransAlta operations of the Ghost Reservoir

Supporting the continuation of the existing Government of Alberta and TransAlta agreement to use the upstream Ghost Reservoir to capture more flood water.

2. New upstream reservoir on the Bow River

Working with the Government of Alberta, a new reservoir on the Bow River would capture more water from large floods, as well as provide an additional source of water supply for drought management.

3. Community Flood Barriers

As the reservoir reaches capacity and is forced to release water, permanent barriers help reduce overland river flooding during these large flood events.

4. Property level mitigation and policies

Policies, bylaws, land use regulations, building codes, possible incentive programs for flood proofing and public education.

Here are the additional projects that will help address localized flooding that happens in the area.

1 **Upper Plateau Separation**

To help prevent flooding of the lower plateau of Sunnyside/Hillhurst, The City is building dedicated stormwater infrastructure for the upper plateau.

2 **Sunnyside Sanitary Lift Station Replacement**

This lift station was upgraded for flood resiliency.

3 **Sunnyside Storm Lift Station 04A Upgrade (Pump Station #2)**

The lift station is being upgraded for flood resiliency and will more than double its pumping capacity.

4 **New Sunnyside Storm Lift Station (Pump Station #1)**

A new lift station will alleviate overland flooding on Memorial Drive, and localized flooding in the southeast area of Sunnyside.

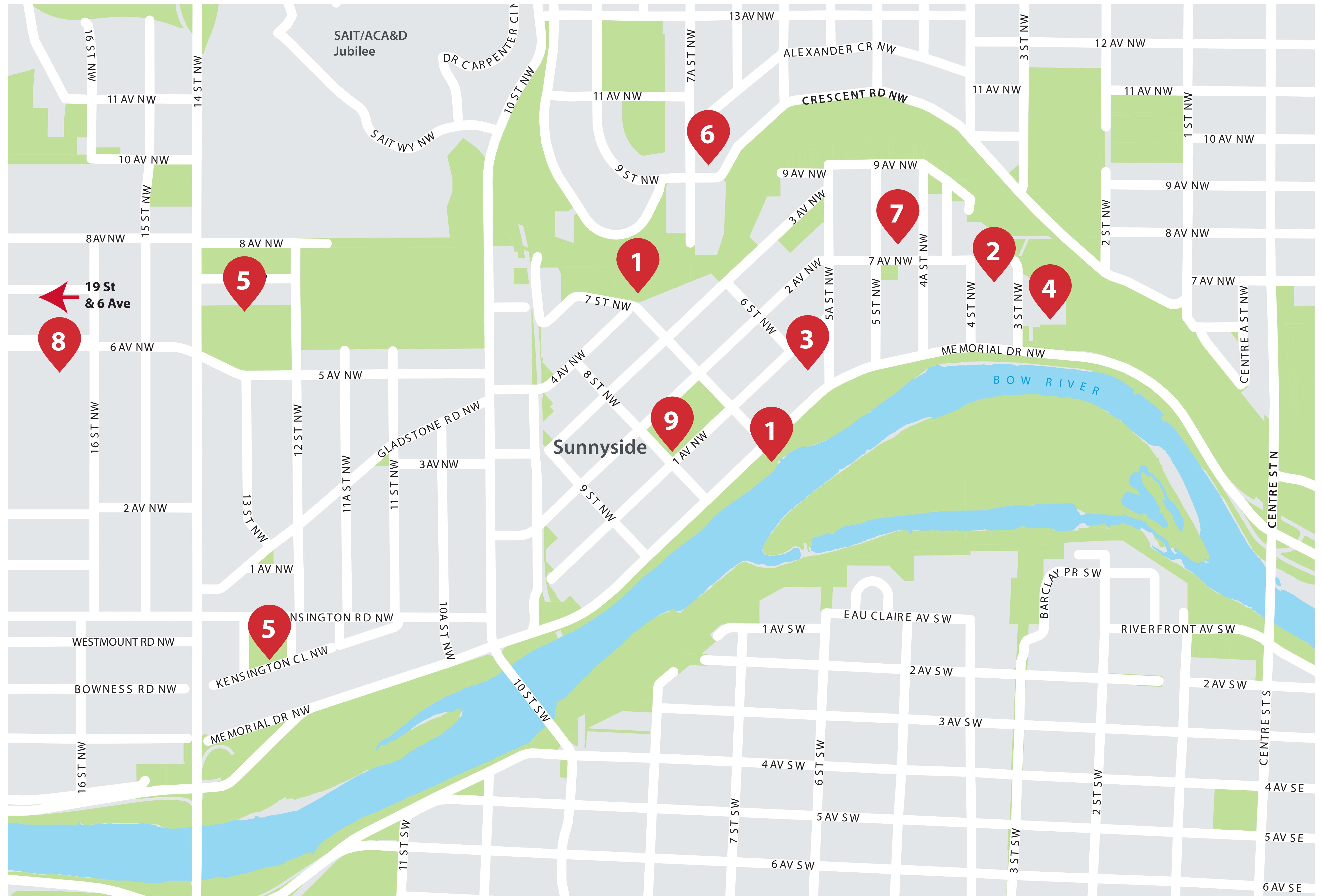
Northwest Inner-City Community Drainage Improvement

Various projects in Sunnyside and Hillhurst will address stormwater capacity issues of the existing system

- 5 Kensington
- 6 10 Street N.W.
- 7 7 Avenue N.W.
- 8 West Hillhurst
- 9 1 Avenue N.W.



Reducing stormwater flooding in the area



How a barrier option is chosen

The City uses a **Triple Bottom Line** approach to guide all decision making. This means they consider the social, economic and environmental impacts of a project.



We want your feedback

Help rank the importance of each social criteria. This feedback will be used by the project team during the evaluation process of the barrier options.

SOCIAL CRITERIA Community well-being	Definition
Maintains community fabric	<ul style="list-style-type: none"> Preserves the look and feel of the area.
Provides the same flood protection amongst communities	<ul style="list-style-type: none"> Balances the community-specific needs with the need for a strong, city-wide flood resilience plan.
Protects vulnerable populations and services	<ul style="list-style-type: none"> Protects vital community services (i.e. schools, daycares, senior facilities) and Calgarians, who because of age, disability or other circumstances are at greater risk in emergency situations that require evacuation.
Maintains recreation and river access	<ul style="list-style-type: none"> Maintains or improves access to the pathway system, river and natural areas.
Maintains the aesthetics of the area and pathways	<ul style="list-style-type: none"> Maintains or improves pathway aesthetics and river views. Maintains or limits impact to trees.
Improves mental well-being	<ul style="list-style-type: none"> Reduces flood-related stress and anxiety.

How to rank the social criteria

1. Read each of the social criteria and definitions.
2. On your feedback form, rank each of the social criteria in order of importance by writing a number (1 through 6) in the box provided.
 - #1 being the most important criteria
 - #6 being the least important criteria

Exploring different flood barrier options

On the following tables are early designs for the four barrier options we're exploring:

1. 1 in 20-year flood level
2. 1 in 50-year flood level
3. 1 in 100-year flood level
4. 1 in 200-year flood level

Each option provides its own independent level of flood mitigation. As upstream mitigation (i.e. future reservoir on the Bow River) is built, the level of flood mitigation will also increase in Sunnyside.

Understanding the tradeoffs

As flood mitigation increases and the barrier gets higher and longer, there are also greater impacts to the community. This includes changes to the look and feel of the area, views of the river and removal of trees.

At this stage, we're beginning to uncover the impacts of the different flood mitigation levels. A high-level summary that compares each option is in your handout.

How is the barrier height determined?

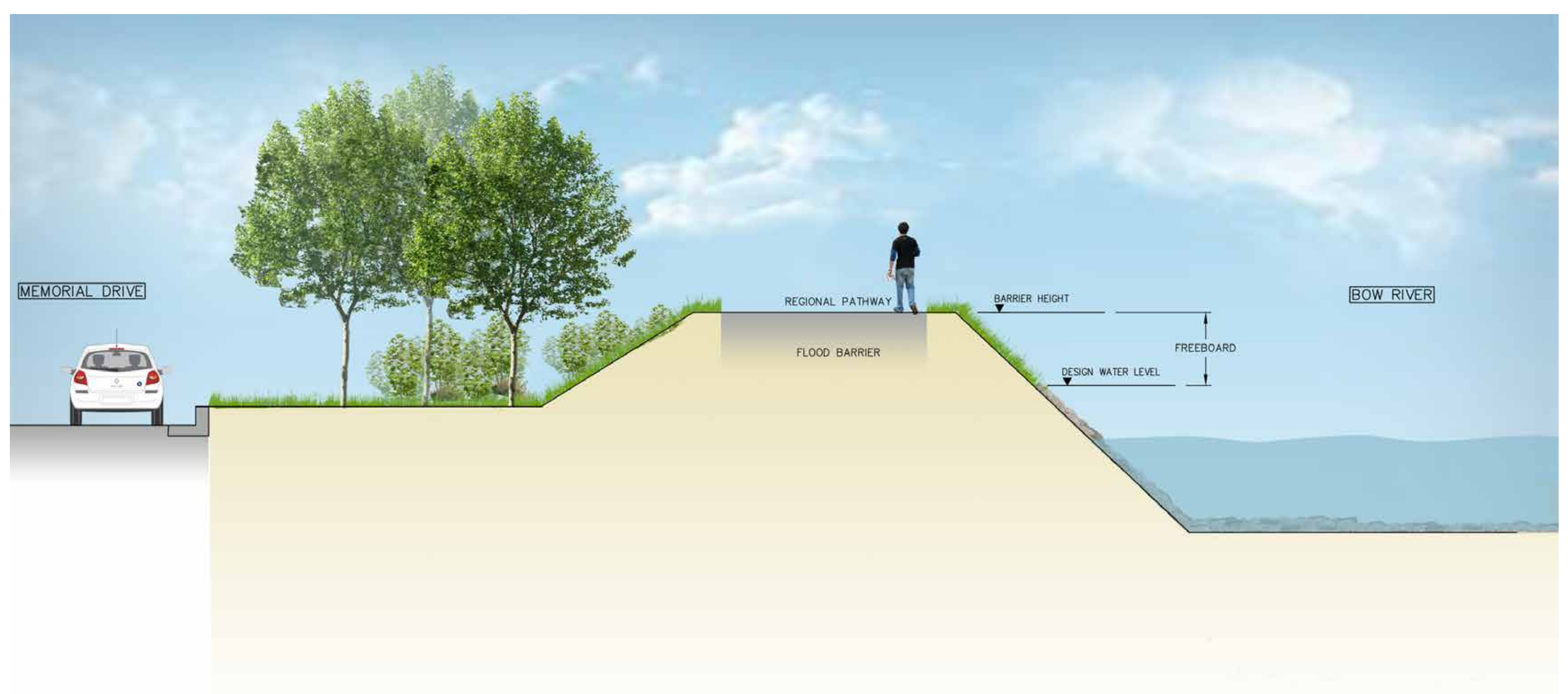
Barrier Height = Design water level + freeboard

Design water level

- The elevation of the water during different flood events. This is estimated using computer models.
- The water levels define a barrier's height (e.g. 1 in 50-year flood level).
- Models include post-2013 flood conditions, including the Prince's Island causeway, impacts from other barriers (e.g. Downtown barrier).

Freeboard

- Additional barrier height that accounts for uncertainties, including:
 - standing wave effects
 - sediment deposition
 - debris jam at Prince's Island lagoon
 - climate change effects
- Analysis showed that a 0.5 metre freeboard is suitable for Sunnyside.



We want your feedback

Look at the different barrier design options and share your initial feedback by telling us what you like and what your concerns are about each of the options on your feedback form.

The input you provide will help the project team as they evaluate the social impacts of each barrier option.



Barrier option – 1 in 20-year flood level

Key Takeaways

Flood mitigation	<p>Barrier only Mitigates up to a 1 in 20-year flood.</p> <p>With full upstream mitigation * Mitigates up to a 1 in 200-year flood.</p> <p>In context, the 2013 flood was a 1 in 70-year flood event.</p>
Total barrier length	1,066 metres
Average barrier height increase above existing ground level	0.3 metres (up to 0.5 metres maximum)
River views	Street level river views along Memorial Drive remain largely unchanged. Pathway river views are maintained.
Area of trees and shrubs removed	Fewest trees are removed (4,100 m ²)
Pathway access	All pathways will be maintained or improved.
Relative cost compared to other options	\$

* These numbers are approximate. They are based on information currently available to The City of Calgary and are subject to change.

Barrier option – 1 in 50-year flood level

Key Takeaways

Flood mitigation	<p>Barrier only Mitigates up to a 1 in 50-year flood.</p> <p>With full upstream mitigation * Mitigates up to a 1 in 400-year flood.</p> <p>In context, the 2013 flood was a 1 in 70-year flood event.</p>
Total barrier length	2,260 metres
Average barrier height increase above existing ground level	0.8 metres (up to 1.3 metres maximum)
River views	Street level river views along Memorial Drive remain largely unchanged. Pathway river views are maintained.
Area of trees and shrubs removed	Moderate amount of trees are removed (5,100 m ²)
Pathway access	All pathways will be maintained or improved.
Relative cost compared to other options	\$\$\$

* These numbers are approximate. They are based on information currently available to The City of Calgary and are subject to change.

Barrier option – 1 in 100-year flood level

Key Takeaways

Flood mitigation	<p>Barrier only Mitigates up to a 1 in 100-year flood.</p> <p>With full upstream mitigation • Mitigates up to a 1 in 900-year flood.</p> <p>In context, the 2013 flood was a 1 in 70-year flood event.</p>
Total barrier length	2,525 metres
Average barrier height increase above existing ground level	1.1 metres (up to 1.7 metres maximum)
River views	<p>Street-level river views along Memorial Drive are blocked by retaining wall for most of length.</p> <p>Pathway river views are maintained</p>
Area of trees and shrubs removed	Moderate amount of trees are removed (5,500 m ²)
Pathway access	All pathways will be maintained or improved.
Relative cost compared to other options	\$\$\$\$

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Barrier option – 1 in 200-year flood level

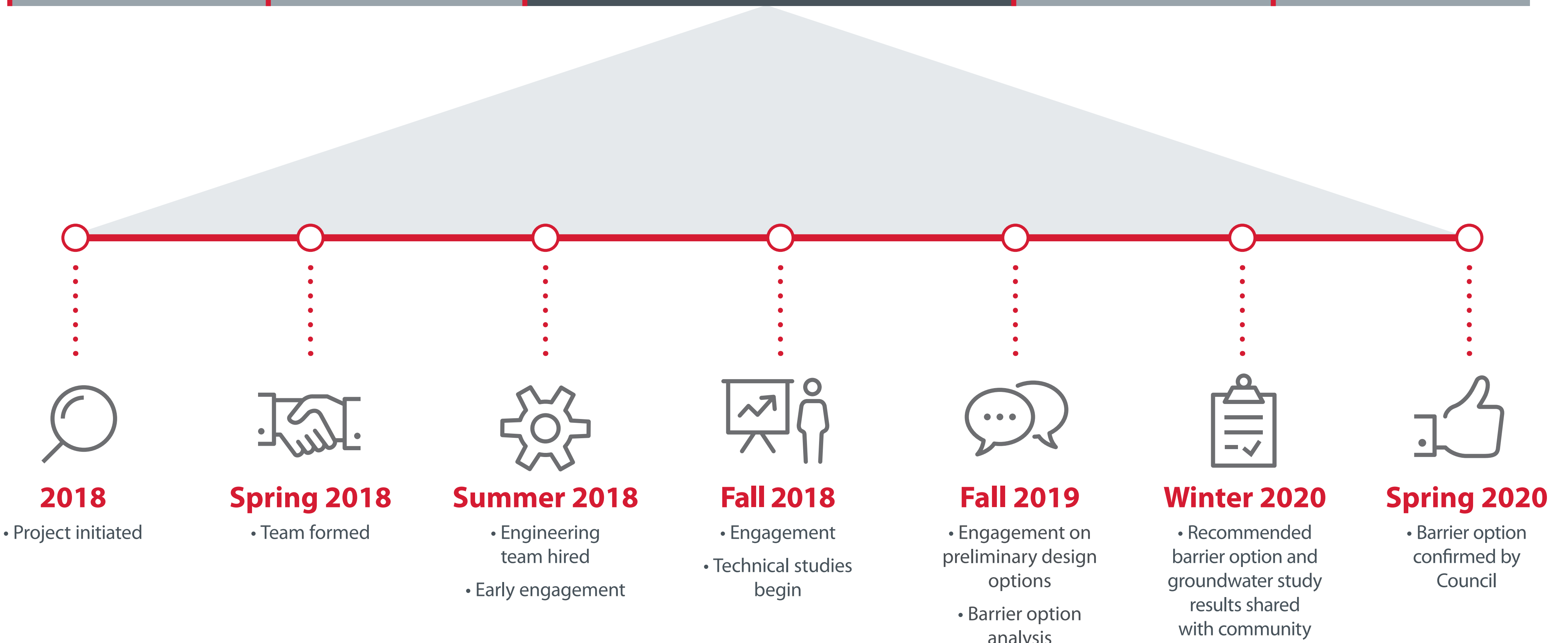
Key Takeaways

Flood mitigation	<p>Barrier only Mitigates up to a 1 in 200-year flood.</p> <p>With full upstream mitigation * Mitigates up to a 1 in 1000-year flood.</p> <p>In context, the 2013 flood was a 1 in 70-year flood event.</p>
Total barrier length	2,662 metres
Average barrier height increase above existing ground level	1.6 metres (up to 2.2 metres maximum)
River views	<p>Street-level river views along Memorial Drive are blocked by retaining wall for most of length.</p> <p>Pathway river views are maintained</p>
Area of trees and shrubs removed	Largest amount of trees are removed (10,100 m ²)
Pathway access	All pathways will be maintained or improved.
Relative cost compared to other options	\$\$\$\$\$

* These numbers are approximate. They are based on information currently available to The City of Calgary and are subject to change.

Sunnyside Flood Barrier - Next steps

- This fall, we will integrate your feedback on the social impacts and continue to evaluate the barrier options according to the Triple Bottom Line approach.
- A barrier option recommendation will be shared with the community in early 2020 and presented to the Standing Policy Committee for Utilities and Corporate Services in spring 2020.



Thank you for attending our open house

Online engagement is open until October 9

If you have additional comments, or have neighbours who were unable to attend, please visit engage.calgary.ca/sunnyside-flood-barrier-project to share your feedback.

A summary of your feedback and an overview of the different flood barrier design options will be available at calgary.ca/sunnysidebarrier



Sunnyside Open House Technical Boards

Understanding ground conditions and groundwater in Sunnyside

- We need to understand the ground conditions and soil in Sunnyside to determine how stable the ground is to resist flood forces.
- Studies are still underway to determine if the flood barrier will have an impact on groundwater in Sunnyside.
- The results of these studies will inform future decisions on the need for mitigation to reduce water seepage under the barrier.
- Today, we're sharing some of these early findings with the community. In early 2020, we will return to the community to share the full groundwater results and if mitigation is needed.

What we did

- Drilled 26 boreholes.
- Dug 3 test pits.
- Installed 11 data loggers (3 in the Bow River and 8 in monitoring wells).
- Conducted geotechnical laboratory testing of borehole materials.
- Conducted pumping tests and single well response testing of the gravel layers.



Study locations in Sunnyside.

What are the ground conditions in Sunnyside?

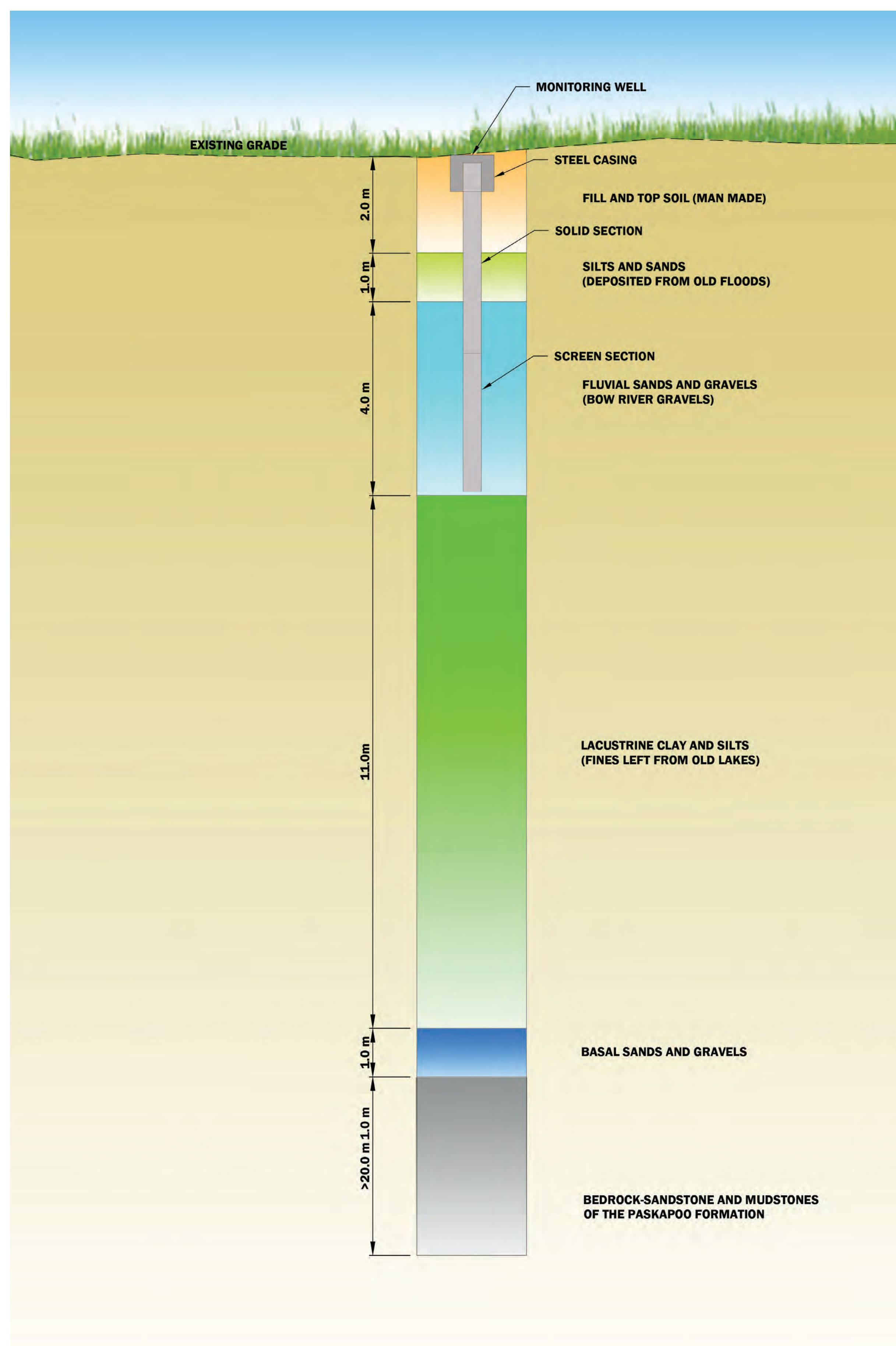
By characterizing the soil makeup under the barrier, we can understand:

- its stability to resist flood forces; and
- the potential for water seeping under the barrier.

Key takeaways

Materials are generally consistent throughout Sunnyside, but some differences exist. The image below shows the soil layers found in a typical borehole along the existing barrier alignment in Sunnyside:

- Blue layers are more likely to have groundwater moving through them faster.
- Green layers are more likely to have groundwater moving through them slowly.



How might water flow under the barrier?

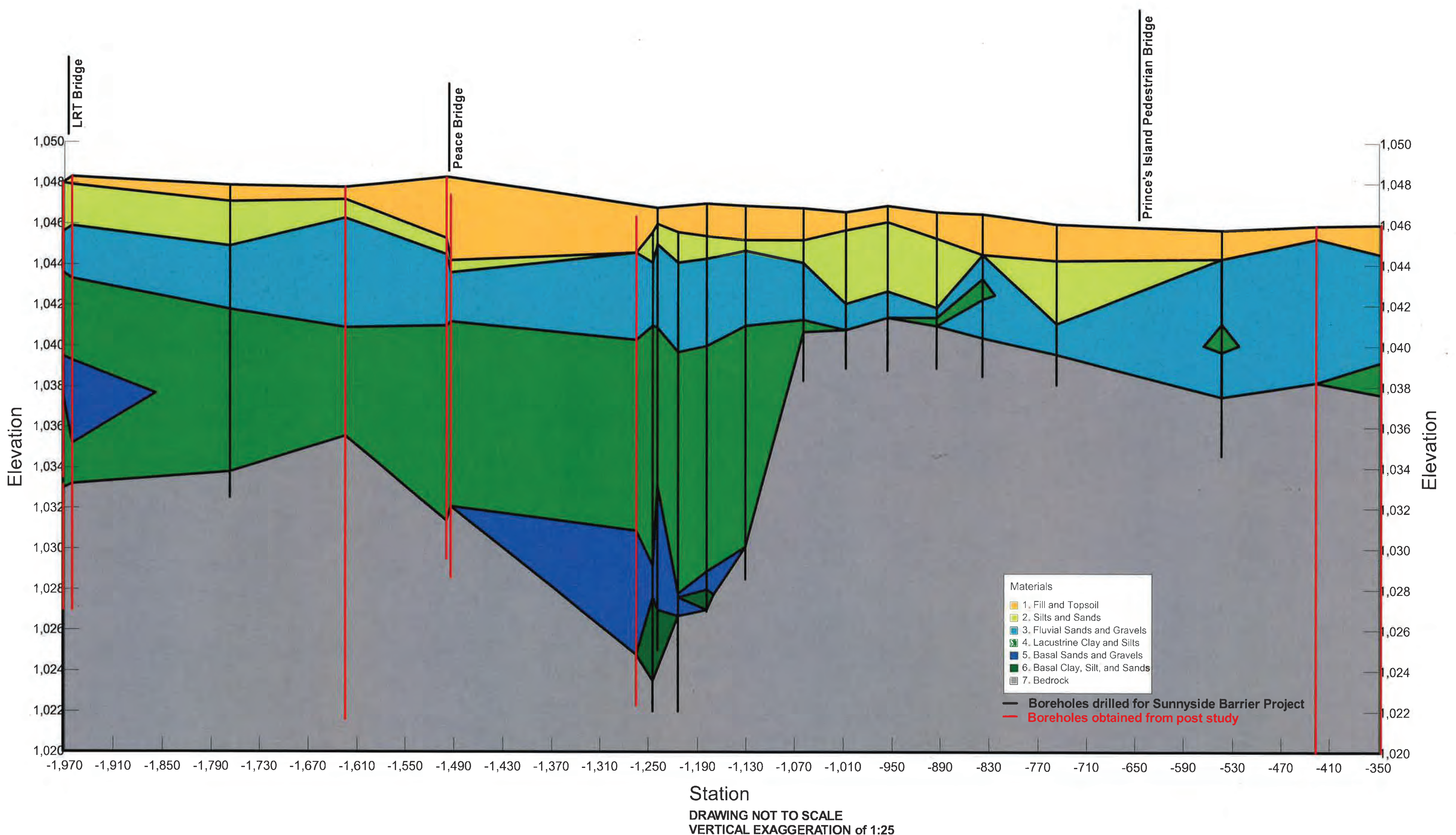
How water flows under the barrier depends on the properties of the soil and the differences between the river level and the groundwater level.

Below is a profile of the soil layers based on boreholes drilled along the Sunnyside barrier alignment.

- Blue layers are more likely to have groundwater moving through them faster.
- Green layers more likely to have groundwater moving through them slowly.

Next steps

We are currently modelling how water might flow through these soil layers during different flood sizes and durations.



Where does groundwater move in Sunnyside?

By determining how groundwater moves through the community, this will help inform future decisions on the need for mitigations to reduce seepage under the barrier.

Key takeaways

- Groundwater may move from three directions through Sunnyside:
 - 1. From the floodplain:** Groundwater is continuously moving from upstream through the fluvial sand and gravel layers.
 - 2. From the Valley:** Groundwater may be entering Sunnyside from under McHugh Bluff (from the basal sand and gravel layers).
 - 3. From the River:** When the river floods, the high-water levels may change groundwater flow direction and seep under the barrier into Sunnyside.
- Any mitigation for seepage coming from the river needs to consider groundwater moving from the floodplain and the valley to make sure we don't block its path out to the river.
- Any mitigation must not negatively impact groundwater movement, or it could make subsurface flooding problems worse.



Groundwater flow directions in Sunnyside