Bristol Avon Flood Strategy Consultation

Better protecting people and property from flooding

Future-proofing Bristol and neighbouring communities; enabling a greener, more active city; and unlocking our city's potential.

www.bristol.gov.uk/bristolavonflood

Published October 2020

Foreword

Bristol City Council and the Environment Agency are working together to deliver a long-term plan to better protect homes and businesses from flooding and enhance the river for all.

Bristol was built on the River Avon, and as a result became a gateway to the world. Our city grew and prospered because of its riverside location, and the engineering that made it possible is celebrated today.

But having a river at the heart of the city comes with challenges we need to plan for, especially as climate change and rising sea levels increase the risk of flooding.

While we cannot prevent floods from occurring, we have been working on a long-term plan to address what happens when they do. Our ambition is for a strategy that works for Bristol year-round, not just when the river floods. By designing defences that improve public spaces, we will provide new green spaces, better access to the river, enhanced heritage features, and improved transport connections.

By using this approach, we can better protect Bristol and create a more active, sustainable and resilient city.

Marvin Rees,
Mayor of Bristol

We are pleased to be working with Bristol City Council and welcome the consultation on this proposed strategy. It is important that all those who live and work in the city can have a say in how we jointly tackle flooding from the river and the tides.

Climate change brings the risk of more severe flooding, more often, to the residents and businesses of Bristol. It is vital that there is a plan in place across the city to reduce flooding both now and into the future.

The proposals in the emerging strategy represent a sensible and cost effective way of reducing the risk of flooding from the River Avon for both existing and new homes and businesses.

We look forward to continuing to work jointly with the council and others to further develop and help deliver these proposals.

Emma Baker,
Wessex Area Director, Environment Agency

To read the full strategy or to complete the consultation survey online, please visit:
www.bristol.gov.uk/bristolavonflood

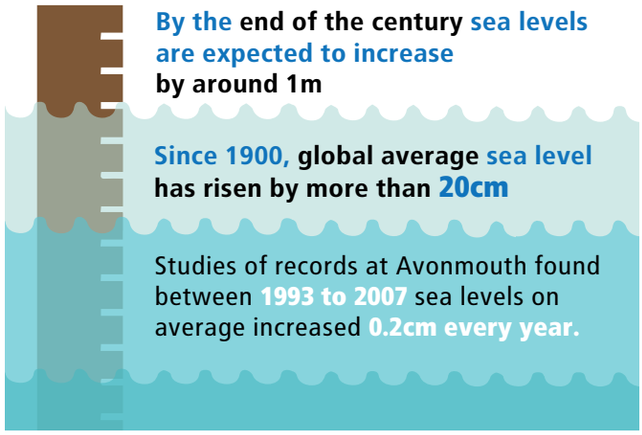
Online you can add comments to an interactive map. You will also find a number of documents providing background information.

The closing date for comments is 20 December 2020.

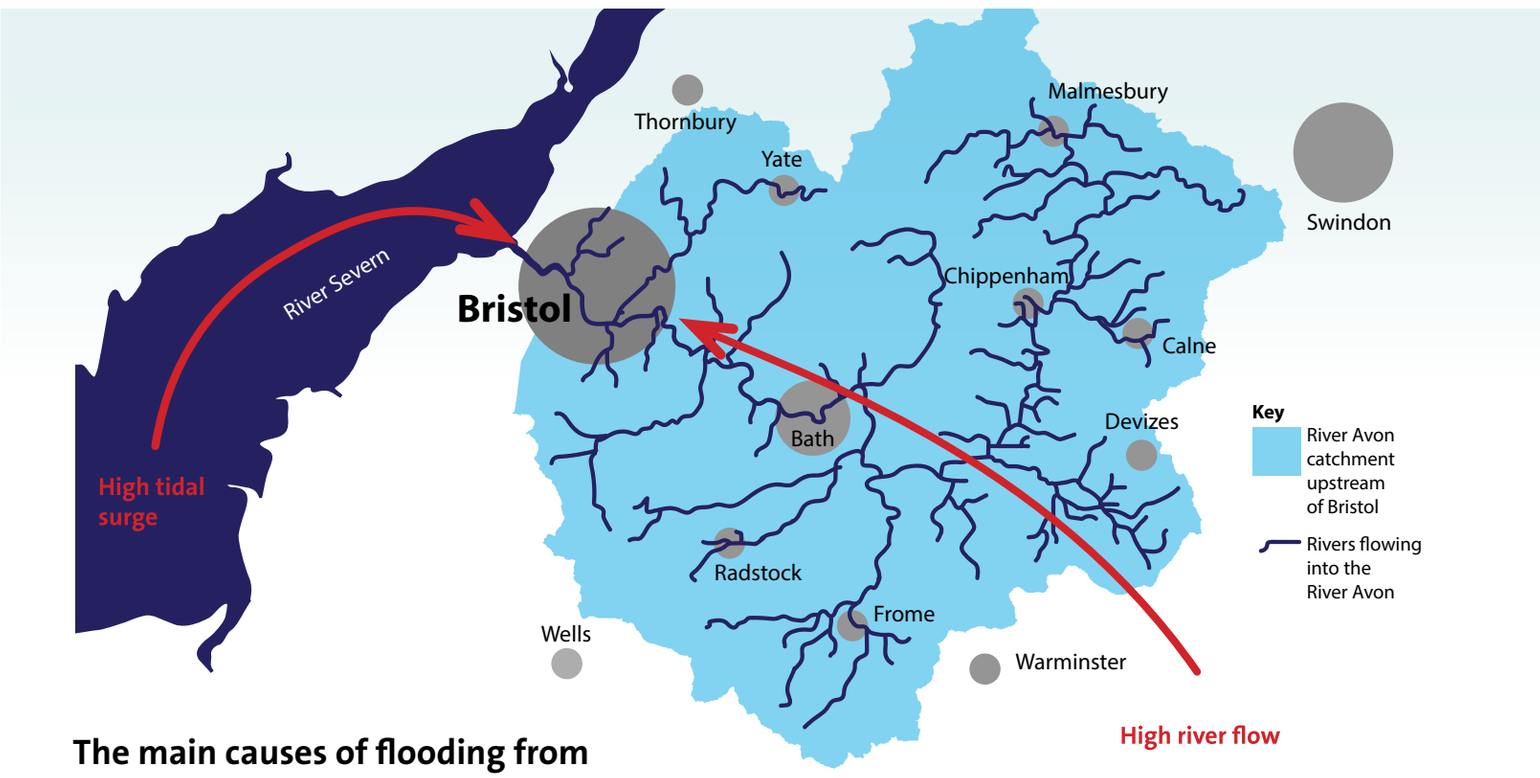
The risk of flooding to Bristol

Because of its location, Bristol is at risk of flooding from both the sea and the River Avon. There have been over 20 minor tidal floods in the last decade alone, the highest in March 2020 when properties and roads around the river were flooded including the A4 Portway.

Around 1,100 homes and businesses near the city centre and 200 properties in neighbouring communities are currently at risk of being flooded in either a severe river or tidal flood from the River Avon. This would have an impact across the west of England because of Bristol's importance for jobs, transport, recreation, tourism and the economy.



Climate change is increasing sea levels and high river-flows, all of which increase the risk of flooding. If we don't take action, by the end of the century almost 4,500 existing properties could be at risk in severe floods.



The main causes of flooding from the River Avon in Bristol are:

High tidal surge Storms can force water to surge in the Severn Estuary, creating a tidal flood up the river. Tidal flooding can be deep, fast flowing and hard to predict. The main risk to the city centre from the River Avon is from high tides combining with storm surges, where water rises over the top of low spots in defences, as well as causing water in the harbour to overflow and flood properties.

High river flows Bristol is located at the bottom of a large 2,200km² river catchment that drains land from the Mendip Hills to the south and the Cotswolds to the north. Heavy rainfall can increase river levels for days and this kind of flooding (fluvial) can be deep. Upstream of the St Philip's area of Bristol, this is the main risk of flooding from the River Avon.

Bristol and the River Avon

Bristol has been shaped by its close proximity to the River Avon and the sea. Its location near the river has enabled the city to thrive and it remains a central part of life in the city for many of Bristol's residents, visitors and businesses.

Bristol's relationship with the river is also an ongoing journey towards managing the ever increasing challenge of being so close to the water. Bristol has been lucky in recent years and has avoided severe flooding. However, there have been more than twenty minor tidal floods in the last decade. Properties and roads around the river have been flooded. Climate change and rising sea levels are increasing the risk of flooding from the river and the city's existing flood defence infrastructure is ageing. The need for a joined-up, long-term flood mitigation strategy has never been greater.

Bristol Harbour Festival

Outflanking of tidal stop gates at Junction Lock, January 2014

Early c19th:
Harbour founded
Bristol's "Floating Harbour" is created, forming a central part of the city's flood defences.

Vauxhall Bridge in 1914

1980s-1990s:
Tidal surges prompt the construction of defences
Tidal flood events, including 1981 and 1990, flood properties and roads from Pill to St Philip's Marsh. Flood defences are constructed at Shirehampton and Pill, as well as a low defence at St Philip's.

2009:
Repairs and refurbishment
Tidal flood gates at Junction Lock and Netham Lock are upgraded.

January 2014:
High tidal floods
close the A4 Portway and riverside roads. Proactive use of a temporary barrier protects properties near Cumberland Road.

What the council and its partners do to reduce flood risk from the River Avon

The Floating Harbour: Tidal flood gates at the entrance to the harbour are operated around 200 times every year. The gates restrict high tides from inundating the harbour. When the River Avon water level is high, the harbour stores water that flows over the top of Bathurst Basin dam, Netham Lock and Junction Lock. When a flood tide is forecast, the harbour water level is lowered so there is more space to store water. However, the harbour's capacity is limited, and the existing defences are vulnerable to rising sea levels and flooding themselves.

Flood Warnings: The Environment Agency and Met Office monitor river levels, sea conditions and rainfall. The council uses these forecasts to prepare when a flood tide is expected, for example by lowering the harbour water level and closing roads. The Environment Agency also issues flood alerts and warnings to areas at risk.

Flood defence operation: There are also flood gates at Pill and Shirehampton, operated by the Environment Agency.

Flood plan and response: The council is part of a local resilience forum, which includes the emergency services, the Environment Agency and others. The forum plans and prepares for emergencies, identifying risks and producing plans to reduce the impact of flooding.

To find out more about what measures you can take to reduce the impact of flooding, visit: **www.bristol.gov.uk/crime-emergencies/flooding**

Pill defences in action

2016:
Enhanced floodwall
between Bristol Harbour Railway and Vauxhall Bridge constructed as part of MetroBus scheme, protecting properties near Cumberland Road.

Metrobus flood wall under construction, Cumberland Road

2016:
Property measures
Flood resilience measures installed for riverside properties between Hanham and Saltford, reducing the risk from high river flows.

2020:
Highest Tidal Event
Highest tidal event since records began closes the Portway and disrupts roads. At Sea Mills, property flood resilience measures protect all but one property.

Our vision

The River Avon is integral to the story of Bristol and remains a central part of daily life for the city and its residents. Our vision is to design measures that work for Bristol year-round. Defences need to better protect homes and businesses on the rare occasions that flooding occurs, but they also need to work on the vast majority of days when river levels are normal.

Future-proofing the city and neighbouring communities

Our preferred approach is to create new flood defences or raise the level of existing flood defences along lower sections of the River Avon.

This would be an adaptive approach. This means we will build in phases over time as we monitor changes to the threat of flooding in Bristol. Defences will be constructed in a way that means they are only as high as needed for the short term, but can be raised in the future to respond to rising sea levels and climate change. We will regularly review our response, including what we build, when and how high.

Flood defences can take many forms and would be designed so that they are in keeping with the local area. In some locations, this could mean upgrades to existing structures; elsewhere, new defences would be needed.

Landscaped flood defences at Porter Brook pocket park, Sheffield

Enabling a greener, more active city

Creating and improving flood defences gives us an opportunity to improve walking and cycling routes along the River Avon. Links could be created with other parts of the city, helping people get to homes, work and recreation more easily, as well as making the riverside more accessible. Improved walking and cycling links could also be incorporated into the defences themselves. For example, in an area where a raised flood embankment is needed, designs could include a traffic free walking and cycleway on top.

In areas where more space is available, defences could take the form of a green space that provides wildlife or recreation value, so that it can be enjoyed on the majority of days when there is no risk of flooding. Historic features and heritage sites, such as the Underfall Yard, could also be protected and improved.

Opportunities to benefit wildlife and habitats include bird, bat and insect boxes; kingfisher perches; wildflower meadows; green walls and the planting of trees.

Unlocking Bristol's potential

Having a long-term plan in place reduces the threat that flooding poses to the future success of Bristol. By defending locations currently at risk of flooding, we can unlock areas for regeneration and new development, creating the jobs, homes and public spaces needed to ensure Bristol is a resilient city where people and business can thrive now and in the future.

Our proposals are ambitious and will rely on funding from a range of sources. With a clear plan, we can ensure that flood defences are integrated with high-quality public spaces in future developments, positively regenerating areas around the River Avon, while giving businesses the confidence to invest in Bristol, unlocking the funding needed to realise these ambitions.

(C) Environment Agency

Flood defence combined with development at Bath Quays

Integrating flood defences into a city

4 Embankments or parks

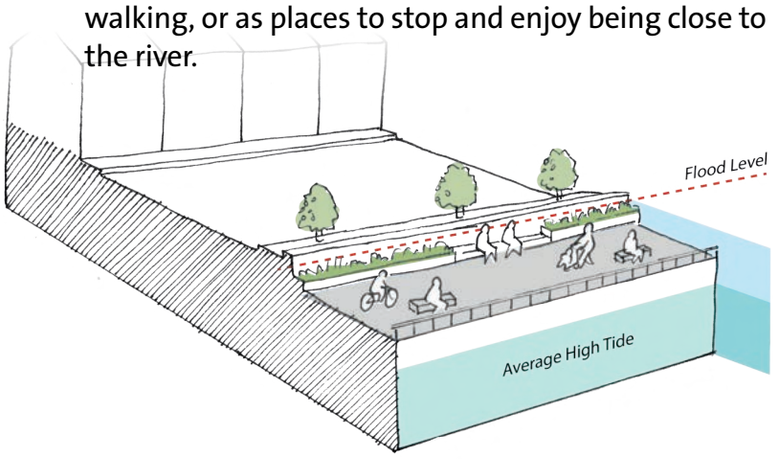
5 Glass Panels

1 Submergible path

2 Defences integrated into buildings

3 Terracing

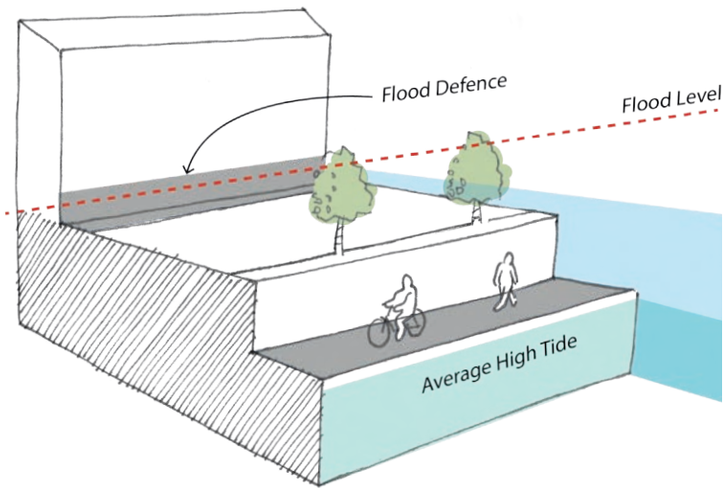
1 Defences can be set back from the river and combined with submergible paths which can be used when there isn't flooding. These paths can be used for cycling and walking, or as places to stop and enjoy being close to the river.



(C) Environment Agency

Submergible path and park, Bath Quays

2 Sometimes flood defences can be integrated into buildings, particularly in areas where new development is proposed. This can reduce the need for additional riverfront defences. Such techniques can also be combined with other approaches, such as submergible paths and new green spaces.



© Environment Agency

New development with integrated flood defences, Bath Quays

Terracing up to higher riverside walk. Southbank, London.

© Davis Landscape Architecture, London, UK

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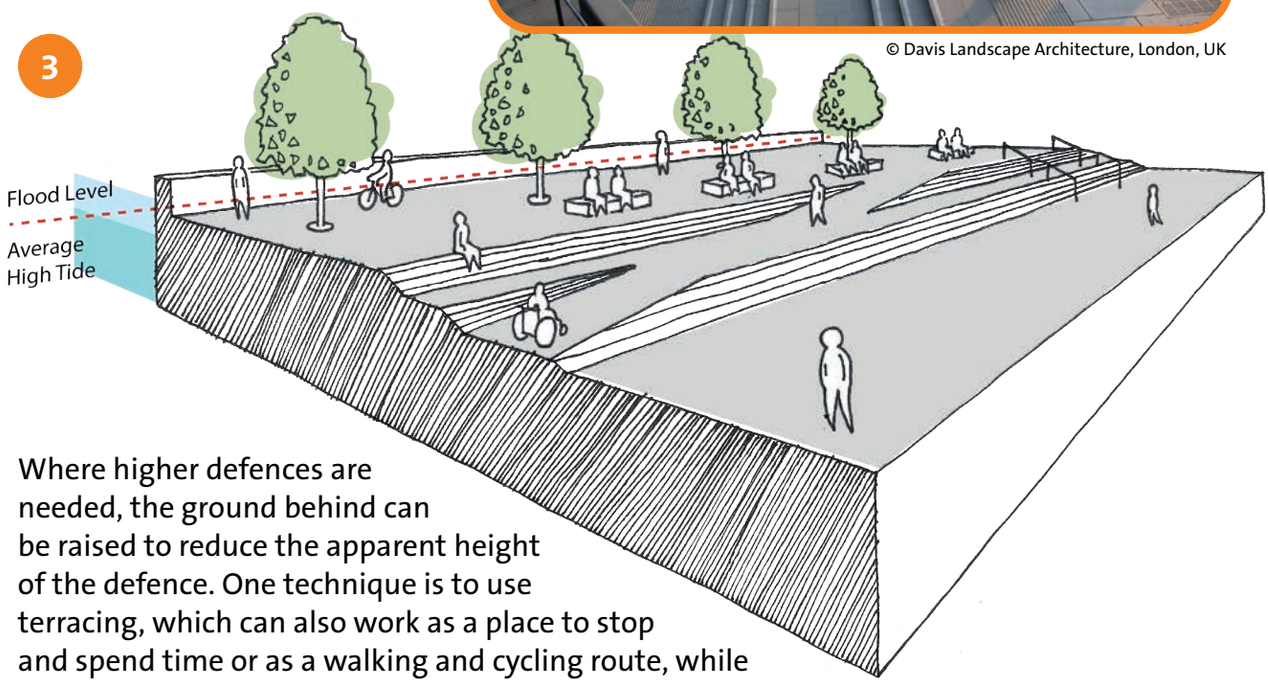
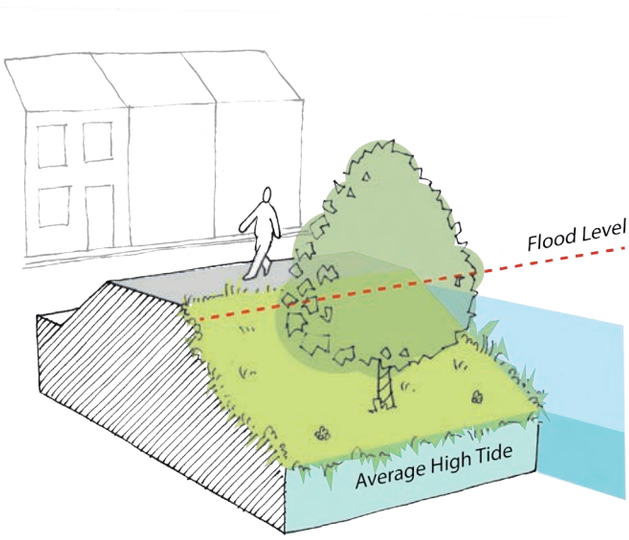


Where higher defences are needed, the ground behind can be raised to reduce the apparent height of the defence. One technique is to use terracing, which can also work as a place to stop and spend time or as a walking and cycling route, while still giving views over the river.

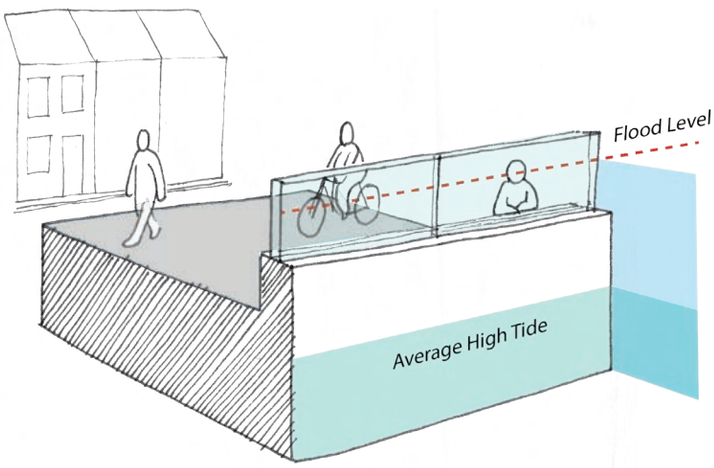
4 Where there is space, measures such as embankments or linear parks can be used to combine flood defence with opportunities for leisure, improved green spaces, active travel and increased biodiversity.



RaceStreetPier_R. Kennedy for Visit Philadelphia™

Linear green space along the Delaware River, Philadelphia

5 Glass panels can be used to minimise the impact on people's views. This is particularly useful when defences need to be raised over time, incorporating a low traditional defence in the short term but future-proofing it to allow for the addition of glass panels as sea levels rise.



(C) EA, Jackie Surtees

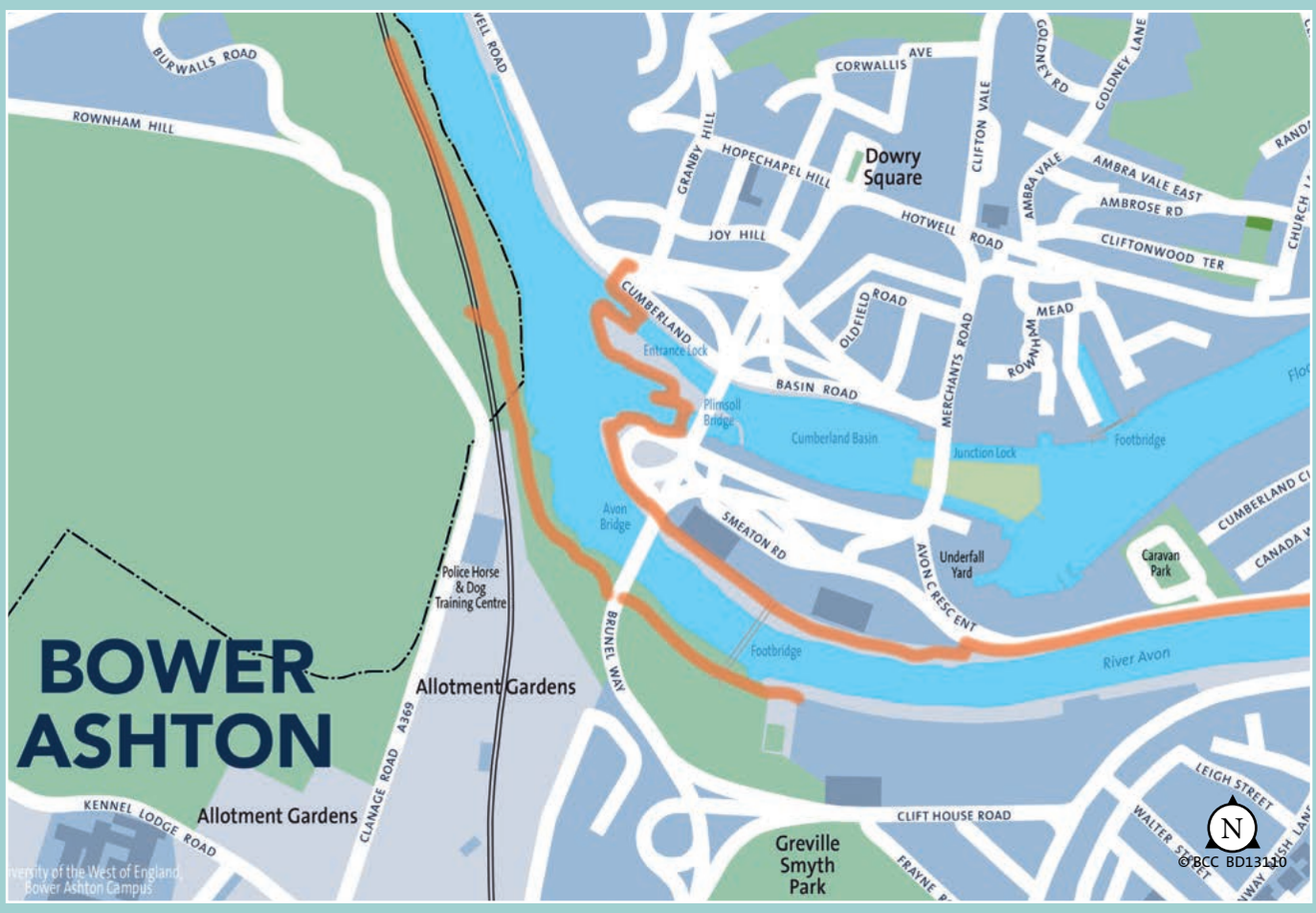
Glass panels as part of flood defences, Upton-upon-Severn, Warwickshire

Where defences are needed

We have identified six main areas where flood defences will be needed, with different factors affecting the type of defences that each area will need.

During the consultation there will be a focus on ensuring we have conversations with residents and businesses in these areas, so that those most affected have the chance to have their say. As we develop our proposals further, we will continue to work with these communities to shape the defences needed to better protect them from flooding.

Cumberland Basin and Ashton

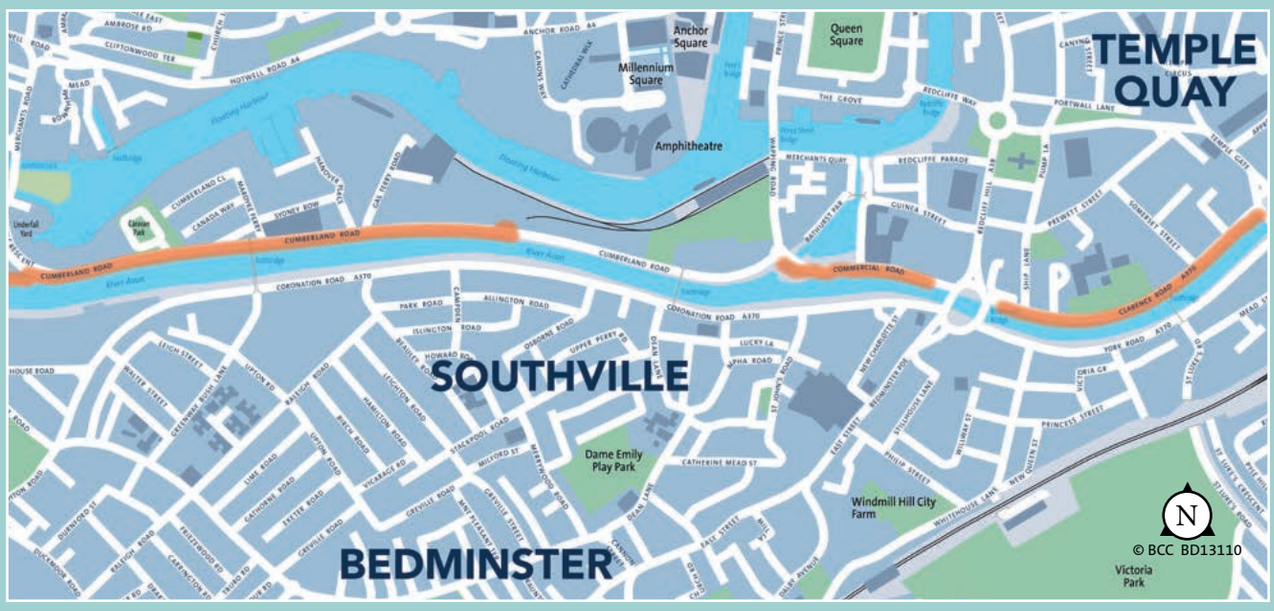


We need to upgrade the existing gates at Entrance Lock, at the western end of the Harbour, and create a new defence around "the knuckle". There are no existing defences near the Create Centre so a new defence is needed here too.

The height of defences required varies depending on the ground levels and at this stage no defence level is set.

Any future development proposals in this area could sympathetically integrate flood defences into their design, or we could use terracing, as shown on page 8, so that the finished flood defences could be enjoyed as public open spaces.

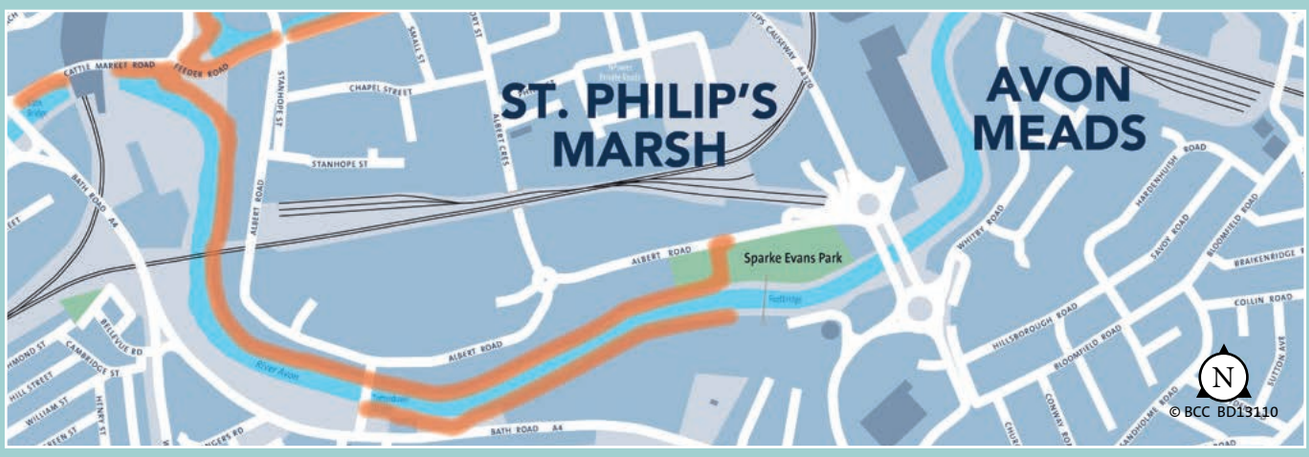
Cumberland Road, Commercial Road and Clarence Road



In this area, we need to raise the height of existing defences to ensure that the risk of flooding remains low as sea levels rise. The existing Chocolate Path could be enhanced so that it is more resilient to flooding.

The ongoing repairs to the Cumberland Road wall have already been designed to accommodate future flood defences.

St Philip's and Bath Road



St Philip's Marsh is a particularly low-lying area of Bristol. The existing riverside greenway is very narrow and needs improvement. One option here could be to introduce a new defence on the side of the path furthest from the river, on the Albert Road side, and to use that to provide a widened path.

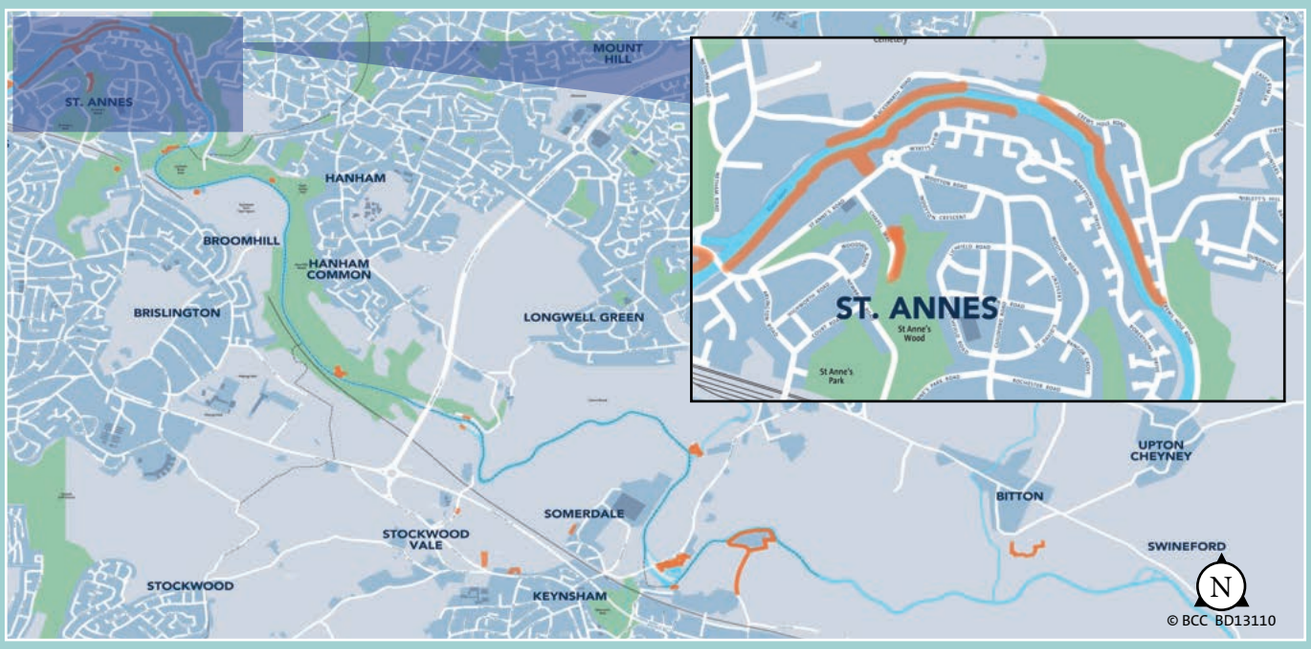
The area is also identified for significant regeneration, including homes and businesses. This brings opportunities to combine new flood defences with much-improved green spaces that could be used as picnic areas and outdoor gyms, as well as boosting biodiversity and walking and cycling access.

Because St Philip's is so low-lying, the height of defences needed along the north side of the river are higher than in other areas. Defences along the low-lying section of existing path would need to be raised to a level that would support new development to be made safe into the future. Extra work would be done to integrate them sensitively into the landscape.

Netham and Feeder Road

The lock gates at Netham will require upgrading and increasing in height to cope with rising sea levels. New gates would likely need to be located further west inside the Feeder Canal, meaning a raised wall along the Feeder Road would also be needed to better protect the Avonside Industrial Park.

St Anne's, Crews Hole, Hanham, Keynsham and Swineford



Upstream of the city centre, some riverside properties and communities are at risk of flooding from the River Avon. Further measures are likely to be needed in these areas. The timing and scale of improvements are influenced by how work progresses in Bristol city centre.

In St Anne's, some raising of defences on the south bank of the river is required along with a new defence on Chapel Way to reduce the risk from the Brislington Brook overflowing.

On the north side of the River Avon, some improvements to existing defences may be required along the bank parallel to Crew's Hole Road, though it is anticipated much of this work will not be required until the year 2065. Further upstream in Hanham, Keynsham and Swineford, localised measures are needed to better protect smaller communities and individual properties.

Pill, Shirehampton and Sea Mills

There is a risk of flooding downstream of the city centre. Defences are needed at Sea Mills, whilst existing defences at Pill and Shirehampton may also need to be upgraded. Much of this improvement work will not be required until 2065, but some work will be needed earlier.

The timing and scale of improvements is largely dependent on sea level rise, but is also influenced by how work progresses in Bristol's city centre. The Environment Agency is planning maintenance of the Pill defences over the coming years.

What happens next

Proposals are at a very early stage. This is the first step. At the moment we are not finalising any plans for flood defences at any particular location and there will be many opportunities to have a say.

The first phase would be delivered over several years, it is anticipated works could start from 2025 onwards. Engineering surveys, public engagement and design work would be needed before the details of the flood defences could be finalised.

Bristol City Council will work collaboratively with many different organisations such as the Environment Agency, Local Enterprise Partnership and private companies to fund the proposed flood defences in the coming years. This will involve making applications to central government, as well as working with other partners, to secure the funds needed to deliver the long term flood defences that Bristol and neighbouring communities need.

2021 – 2022: further technical assessments, engagement, outline design and business cases

2022 – 2024+: detailed design work, public engagement, planning and other consents

2025 – 2030: first phase construction works

2030 onwards: regular review and updates to strategy based on climate change and flood risk, future construction phases

Other flood defence options we considered

Multiple studies for Bristol City Council and the Environment Agency have allowed us to better understand the nature and cause of flood risk from the River Avon.

We identified different flood defence techniques that might be effective. Combinations of these techniques were used to create a long list of approaches.

This was reduced to a shortlist from which our preferred approach was selected as the most feasible option for reducing the flood risk to Bristol and its neighbouring communities.

You can read about some of the flood defence techniques that were discounted below. To read the technical studies, visit:

Bristol.gov.uk/bristolavonflood

Slowing the flow upstream

Using techniques such as flood storage areas, working with nature or land management to capture and store water, reducing and slowing the peak flow within rivers.

The upstream River Avon catchment is large with peak flood flows today more than 330 cubic metres every second. These techniques were discounted on technical grounds due to the impractically large scale of required upstream works and the fact that this approach would not reduce tidal flooding from the estuary.

Storing the flood water

Safely storing flood water in the harbour as it overtops low spots along the River Avon, with levels lowered at times when flooding is forecast.

There is not enough storage space in the harbour and it would be overwhelmed during a severe flood.

Conveying the flow

Techniques to increase the amount of water that a river corridor can convey such as dredging or constructing a flood relief channel or tunnel.

Widening the river could potentially reduce river (fluvial) flooding however this technique has been discounted as it would increase tidal flood risk by allowing more water to flow up the river from the estuary.

Keeping out the tide

Techniques which prevent tidal surges from causing flooding including tidal barrages (permanently damming the river and controlling water levels upstream, such as the Cardiff Bay barrage) and tidal barriers (closes at times when flood tides are forecast, such as the Thames Barrier in London).

A tidal barrier would be significantly more expensive than the proposed approach. A barrage would be even more costly than a tidal barrier and would have significant negative impacts on habitats, landscape, fish passage and navigation of the river.

Both a barrage and barrier were found to increase upstream flood risk as the River Avon does not have sufficient space to store river flows trapped when the barrier is closed.

Resilience

Working with local communities and businesses to deliver measures that increase the capacity of people, property and the environment to withstand the impacts of flooding and to rapidly recover after a flood such as flood plans, flood doors and flood resilient buildings.

We currently use these measures when minor flooding is forecast, and will continue to do so, but the future scale, depth and speed of predicted flooding is too great to rely on these on their own.

Glossary

Climate change
Large-scale long-term changes in weather patterns. As land ice melts and the warming oceans expand sea levels rise. Since 1900, global average sea level has risen by more than 20cm. Studies of records at Avonmouth found between 1993 to 2007 sea levels on average increased 0.2cm every year.

Flood defences
Structures that are built to reduce flood risk.

Flood embankment
A raised soil structure designed to reduce the chance of flood water flowing over low spots along the banks of a river.

Flood risk
A combination of the chance and the impact of flooding in an area. The flood risk from the River Avon is caused largely by high tides and storm surges, high river levels and heavy rainfall.

Floodwall
A raised wall structure designed to reduce the chance of flood water flowing over low spots along the banks of a river.

Fluvial flood
Fluvial, or riverine flooding, occurs when excessive rainfall over an extended period of time causes a river to exceed its capacity.

Greenway
A path set aside for recreational use or environmental enhancement.

Storm surge
When stormy weather out at sea, creates a 'surge' of higher water levels that can travel inland, increasing the water level in the River Avon.

Tidal flood
A flood tide caused by a high tide and a storm surge forcing water up the River Avon and into the city centre.

FAQ

Why are you consulting now?
The risk of flooding to Bristol is increasing and we need a long-term plan to manage this risk. Without a strategy to identify ways to reduce the risk of flooding, homes and businesses remain at risk of widespread flooding from the River Avon. In addition emerging proposals for growth and regeneration throughout the city centre that can unlock the housing and jobs the city needs risk being unable to progress.

Will the preferred option increase flood risk elsewhere?
Flood defence proposals must include careful consideration to upstream and downstream effects. We have assessed the impact of the proposals to ensure that flood risks are not increased elsewhere, and this work will continue as we progress our technical assessments.

How long is all this going to take?
The proposals are at an early stage. We will conduct further technical assessments, public engagement and design development. This will be followed by business cases, further design work and engagement, as well as applying for planning and other consents. The first phase could start around 2025, while enabling works could start sooner.

What will the flood defences look like?
At this stage, all images are simply indications of what flood defences could look like. If the decision is made to take the proposals forward, further engagement would take place during the design stage of the project, which is when detailed plans and images of what the defences would look like and their locations would be developed and shared.

To read the full strategy or to complete the consultation survey online, please visit **www.bristol.gov.uk/bristolavonflood**

Online you can add comments to an interactive map. You will also find a number of documents providing background information.

We chose to subject the plans to a Strategic Environmental Assessment so that we could better understand any environmental impacts of the proposed strategy. You can view and comment on the SEA at the website above.

If you would like to request a paper copy of the consultation survey, please call **07775 115 909** or email **bristolavonflood@bristol.gov.uk**

If you would like to speak to someone we can arrange a phone conversation or online meeting. Please contact us on the details above and we will book an appointment with you.

The closing date for comments is **20 December 2020**.

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