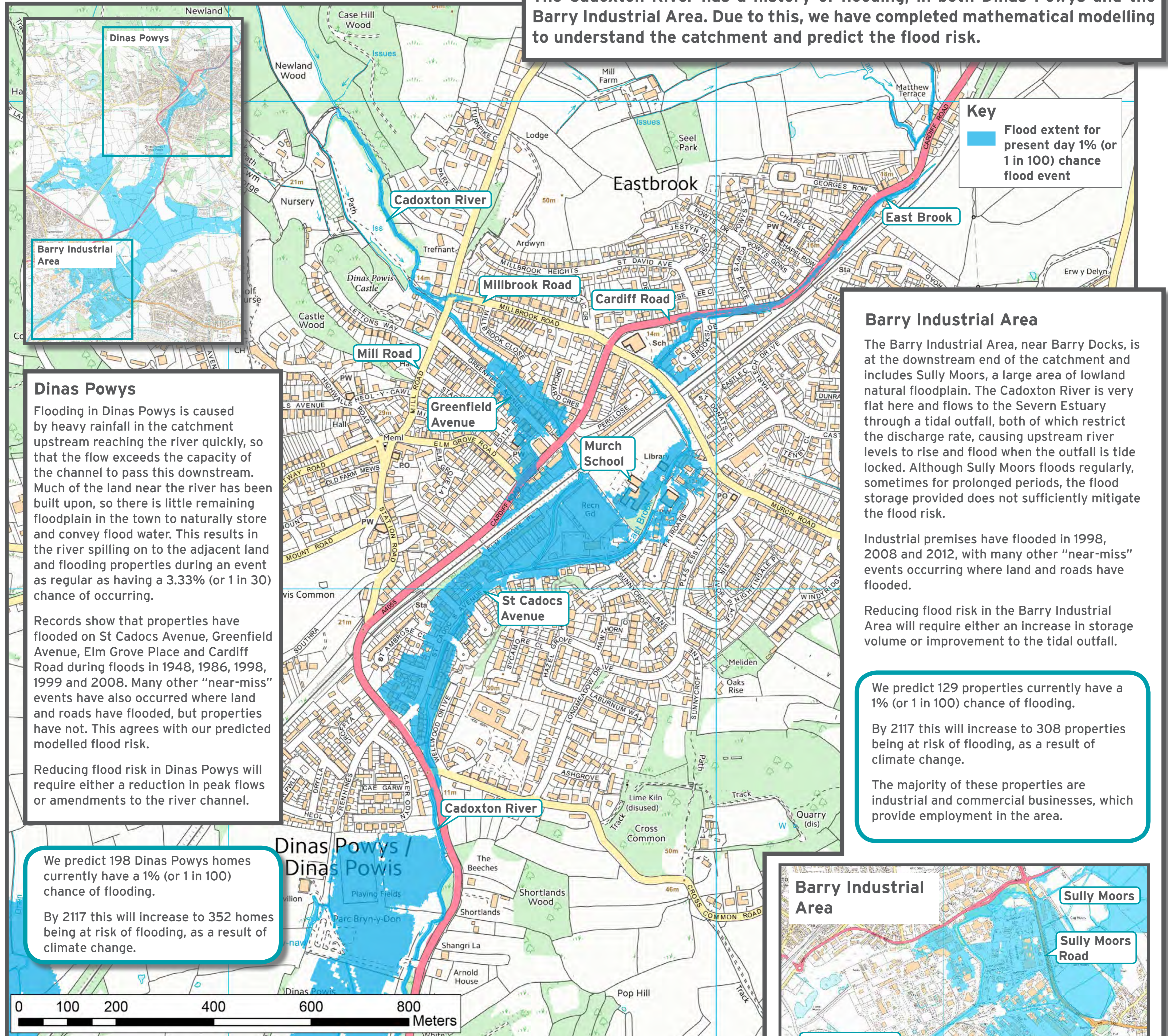


Problem Overview

Flood Risk

The Cadoxton River has a history of flooding, in both Dinas Powys and the Barry Industrial Area. Due to this, we have completed mathematical modelling to understand the catchment and predict the flood risk.



Key
Flood extent for present day 1% (or 1 in 100) chance flood event

Dinas Powys
Flooding in Dinas Powys is caused by heavy rainfall in the catchment upstream reaching the river quickly, so that the flow exceeds the capacity of the channel to pass this downstream. Much of the land near the river has been built upon, so there is little remaining floodplain in the town to naturally store and convey flood water. This results in the river spilling on to the adjacent land and flooding properties during an event as regular as having a 3.33% (or 1 in 30) chance of occurring.

Records show that properties have flooded on St Cadocs Avenue, Greenfield Avenue, Elm Grove Place and Cardiff Road during floods in 1948, 1986, 1998, 1999 and 2008. Many other "near-miss" events have also occurred where land and roads have flooded, but properties have not. This agrees with our predicted modelled flood risk.

Reducing flood risk in Dinas Powys will require either a reduction in peak flows or amendments to the river channel.

Barry Industrial Area
The Barry Industrial Area, near Barry Docks, is at the downstream end of the catchment and includes Sully Moors, a large area of lowland natural floodplain. The Cadoxton River is very flat here and flows to the Severn Estuary through a tidal outfall, both of which restrict the discharge rate, causing upstream river levels to rise and flood when the outfall is tide locked. Although Sully Moors floods regularly, sometimes for prolonged periods, the flood storage provided does not sufficiently mitigate the flood risk.

Industrial premises have flooded in 1998, 2008 and 2012, with many other "near-miss" events occurring where land and roads have flooded.

Reducing flood risk in the Barry Industrial Area will require either an increase in storage volume or improvement to the tidal outfall.

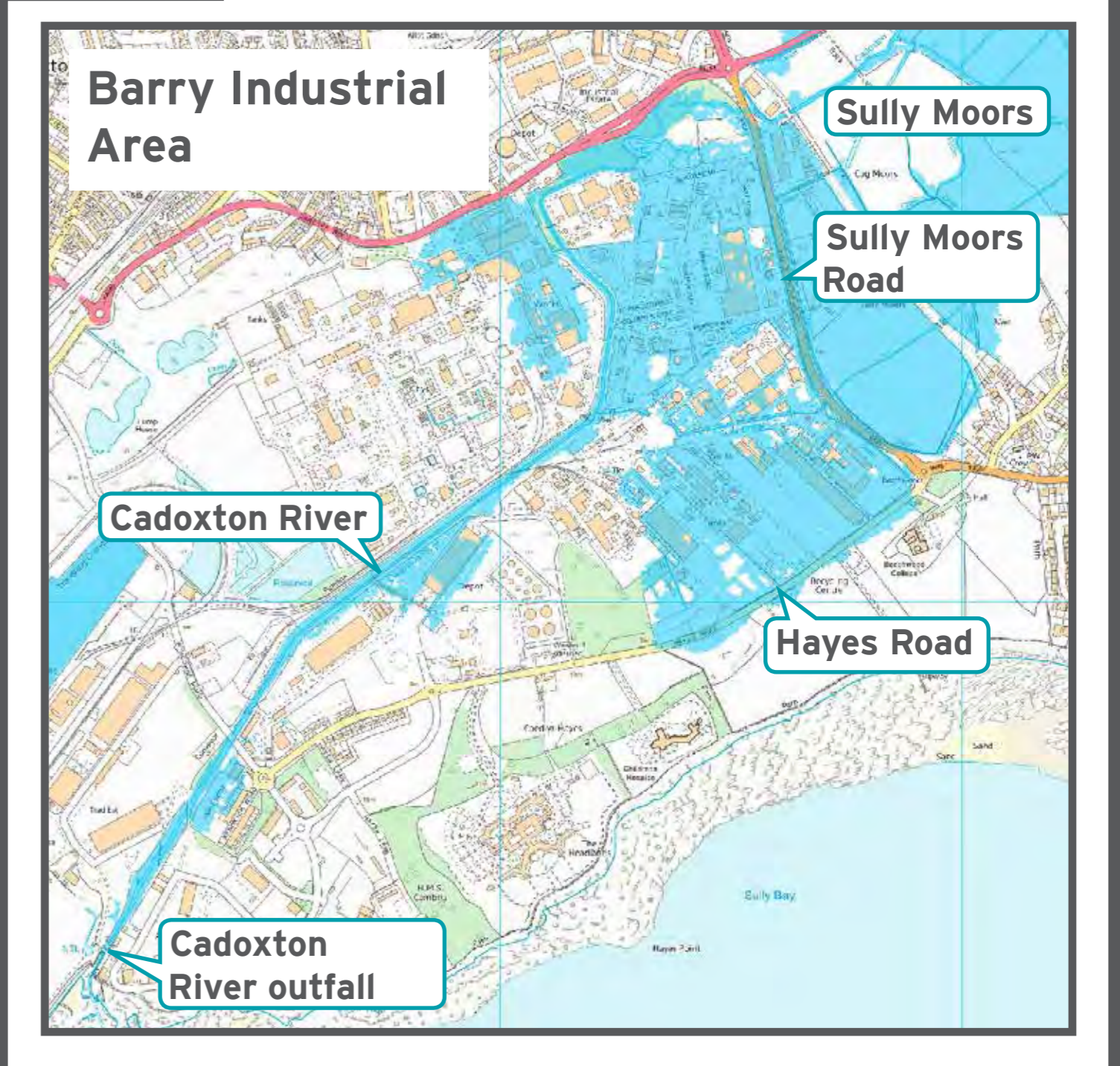
We predict 129 properties currently have a 1% (or 1 in 100) chance of flooding.

By 2117 this will increase to 308 properties being at risk of flooding, as a result of climate change.

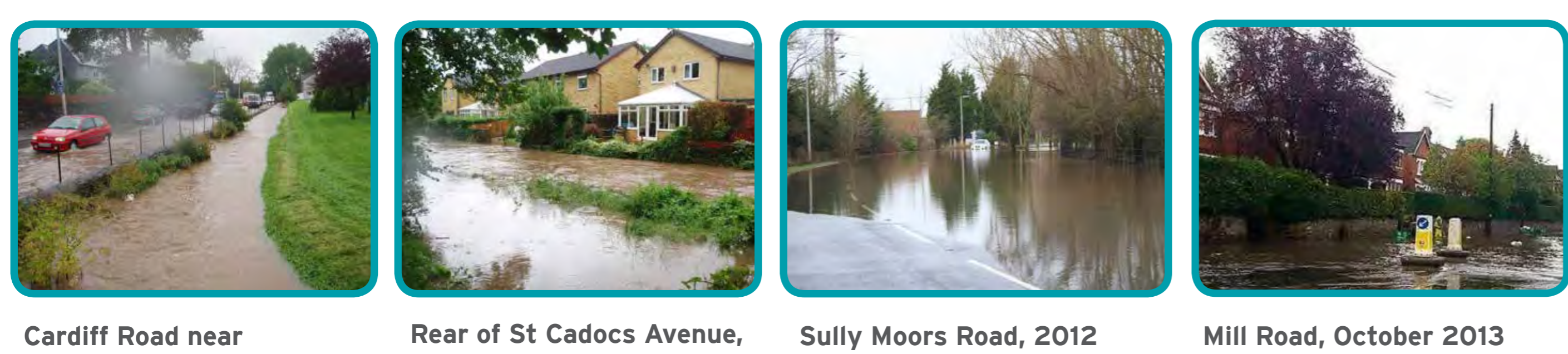
The majority of these properties are industrial and commercial businesses, which provide employment in the area.

We predict 198 Dinas Powys homes currently have a 1% (or 1 in 100) chance of flooding.

By 2117 this will increase to 352 homes being at risk of flooding, as a result of climate change.



Past Flood Events



Cardiff Road near Brookside, July 2007 Rear of St Cadocs Avenue, July 2007 Sully Moors Road, 2012 Mill Road, October 2013

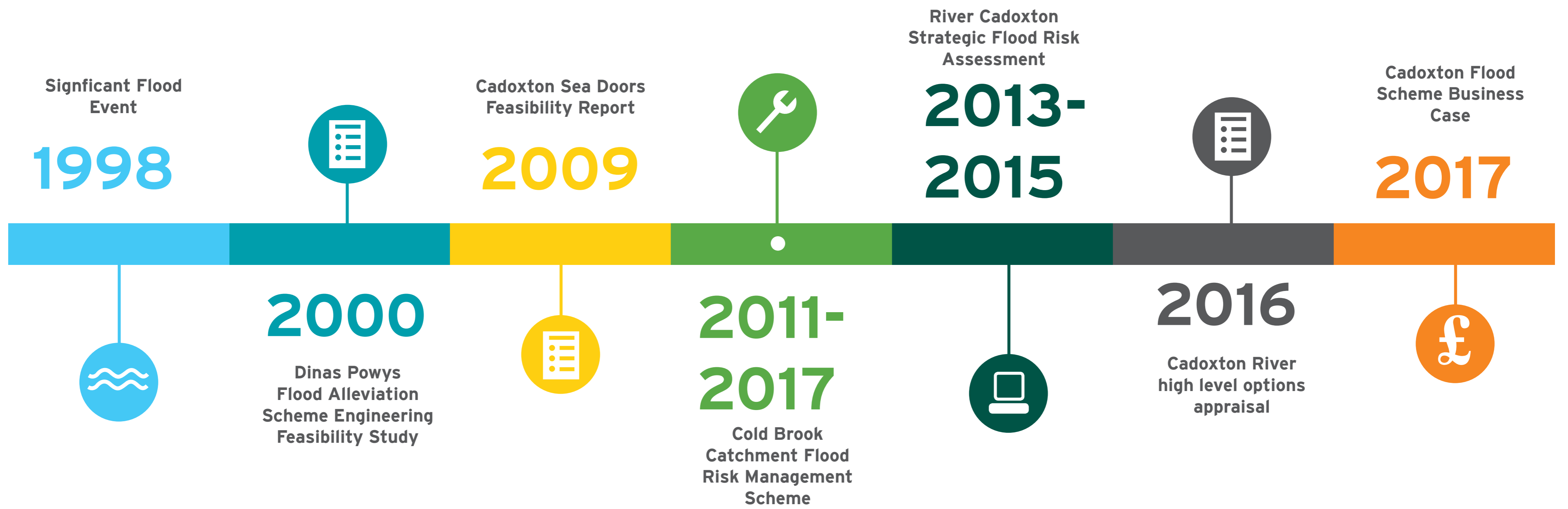


What is NRW doing about flooding?

Recent Studies

The flood issues in Dinas Powys and the Barry Industrial Area from the Cadoxton River have been well known for some time. Natural Resources Wales has looked carefully at the issues, causes and possible solutions

since significant flooding occurred in 1998. We have undertaken a series of investigations, that utilise the latest methods and technology, to consider options to reduce the flood risk.



Current Project

The Business Case for a flood risk management scheme in the Cadoxton catchment is nearing completion and we want to tell you about it to share our findings and capture your views.

We have undertaken catchment-wide flood modelling to establish the current flood risk and identify and assess options to manage this. We have modelled a number of options to test their viability and prepared outline engineering designs of the preferred options.

A wide range of environmental surveys have been completed to understand the potential impact of options, and how these impacts could be avoided or mitigated.

We have consulted with a range of partners along the way, but appreciate that it is the residents and businesses of Dinas Powys and the Barry Industrial Area that will be most affected by the proposals. We therefore welcome your interest and feedback to help shape the scheme and inform our decisions.

Q & A - What is a Business Case?

A Business Case justifies the investment of public funds in a project, following Treasury and Welsh Government guidance to ensure that money is spent responsibly and where it is most needed.

It explores the options available and considers if they are economically justifiable and deliverable. In short, it demonstrates that the benefits outweigh the costs and risks of a project.

Local Flood Resilience

New or improved flood defences take time to fund, plan and build, and in some cases investment in flood defences is simply not viable. Consequently, Natural Resources Wales works proactively to communicate flood risk and improve community flood resilience. Some of the services and initiatives that Natural Resources Wales leads include:

Floodline

Natural Resources Wales forecasts floods and warns the public. Our staff are on standby 24 hours a day, seven days a week and are ready to warn of and respond to flood events.

We run Floodline, a free service to provide flood warning by phone, email or text message if your home or business is at risk of flooding. The aim of the service is to allow individuals, communities and services time to prepare for flooding.

Flood Warning Codes:



If you would like to register with Floodline please speak to a member of the Natural Resources Wales team or visit our website.

Local Flood Group

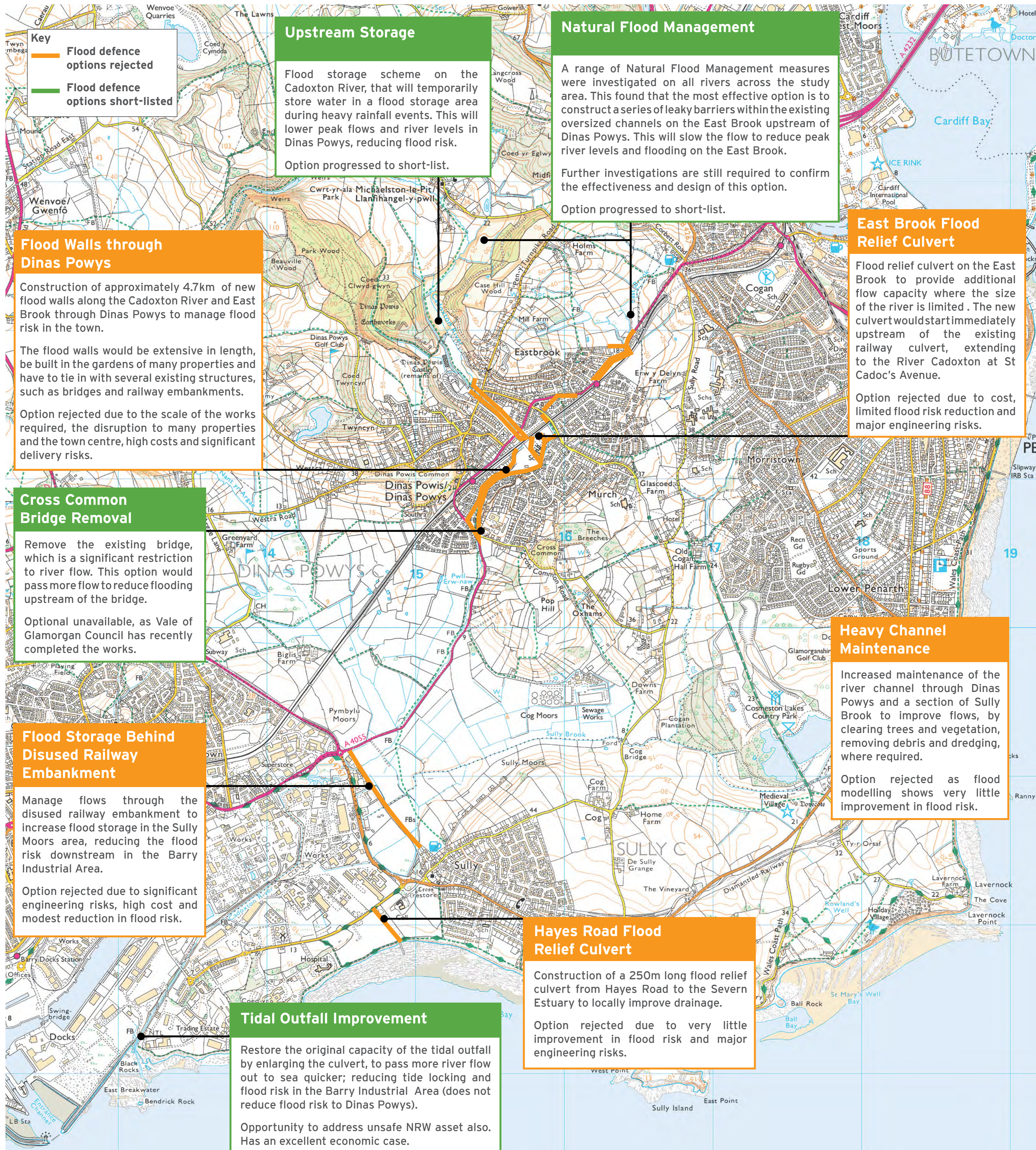
Natural Resources Wales works with local flood groups to better understand and manage flood risks from all sources. Together with Vale of Glamorgan Council, Natural Resources Wales has been an activate participant of the Sully Moors Local Flood Group.

Flood Awareness

We cannot prevent flooding - but we can reduce its likelihood, help people get ready for it and limit its damage. Our flood awareness teams organise events and campaigns to inform communities of their level of flood risk and how to prepare for the possibility of flooding. Our teams visited Dinas Powys in 2013 and 2015.



What options have been considered?



Key
 Flood defence options rejected
 Flood defence options short-listed

Upstream Storage
 Flood storage scheme on the Cadoxton River, that will temporarily store water in a flood storage area during heavy rainfall events. This will lower peak flows and river levels in Dinas Powys, reducing flood risk.
 Option progressed to short-list.

Natural Flood Management
 A range of Natural Flood Management measures were investigated on all rivers across the study area. This found that the most effective option is to construct a series of leaky barriers within the existing oversized channels on the East Brook upstream of Dinas Powys. This will slow the flow to reduce peak river levels and flooding on the East Brook.
 Further investigations are still required to confirm the effectiveness and design of this option.
 Option progressed to short-list.

Flood Walls through Dinas Powys
 Construction of approximately 4.7km of new flood walls along the Cadoxton River and East Brook through Dinas Powys to manage flood risk in the town.
 The flood walls would be extensive in length, be built in the gardens of many properties and have to tie in with several existing structures, such as bridges and railway embankments.
 Option rejected due to the scale of the works required, the disruption to many properties and the town centre, high costs and significant delivery risks.

East Brook Flood Relief Culvert
 Flood relief culvert on the East Brook to provide additional flow capacity where the size of the river is limited. The new culvert would start immediately upstream of the existing railway culvert, extending to the River Cadoxton at St Cadoc's Avenue.
 Option rejected due to cost, limited flood risk reduction and major engineering risks.

Cross Common Bridge Removal
 Remove the existing bridge, which is a significant restriction to river flow. This option would pass more flow to reduce flooding upstream of the bridge.
 Optional unavailable, as Vale of Glamorgan Council has recently completed the works.

Heavy Channel Maintenance
 Increased maintenance of the river channel through Dinas Powys and a section of Sully Brook to improve flows, by clearing trees and vegetation, removing debris and dredging, where required.
 Option rejected as flood modelling shows very little improvement in flood risk.

Flood Storage Behind Disused Railway Embankment
 Manage flows through the disused railway embankment to increase flood storage in the Sully Moors area, reducing the flood risk downstream in the Barry Industrial Area.
 Option rejected due to significant engineering risks, high cost and modest reduction in flood risk.

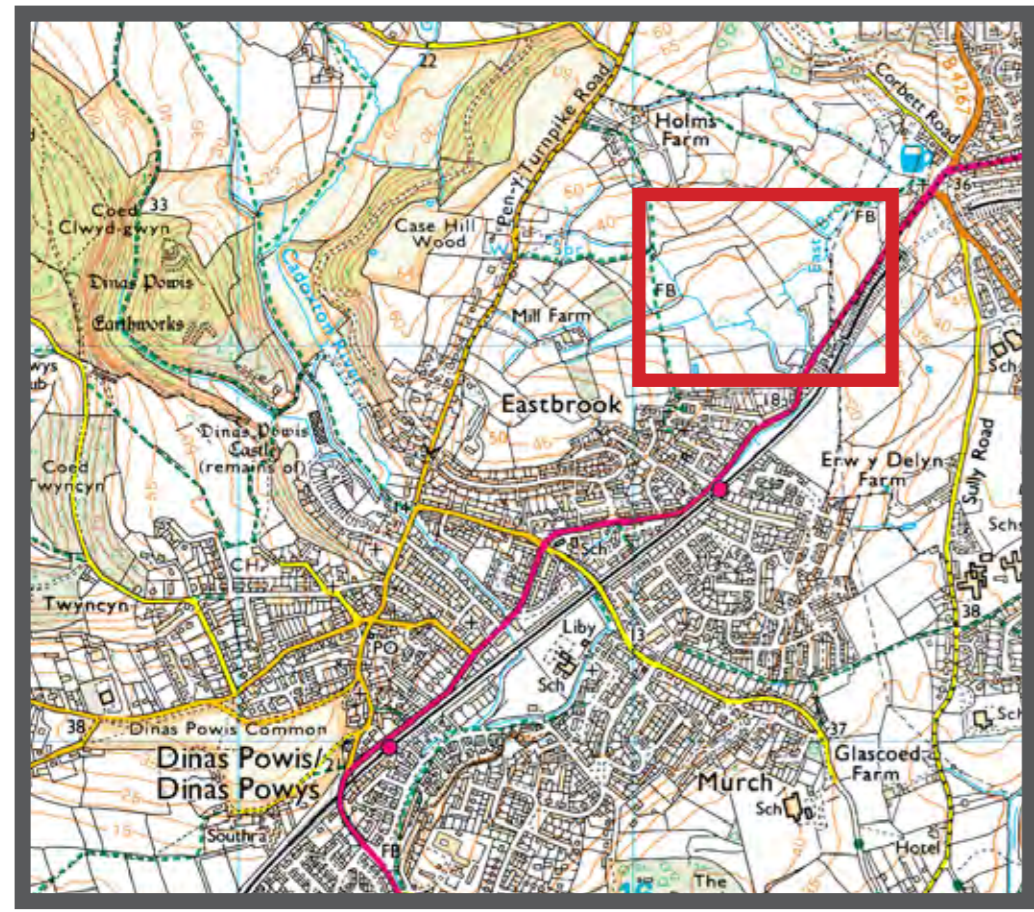
Hayes Road Flood Relief Culvert
 Construction of a 250m long flood relief culvert from Hayes Road to the Severn Estuary to locally improve drainage.
 Option rejected due to very little improvement in flood risk and major engineering risks.

Tidal Outfall Improvement
 Restore the original capacity of the tidal outfall by enlarging the culvert, to pass more river flow out to sea quicker; reducing tide locking and flood risk in the Barry Industrial Area (does not reduce flood risk to Dinas Powys).
 Opportunity to address unsafe NRW asset also. Has an excellent economic case.
 Option progressed to short-list.



What are the preferred options?

East Brook Natural Flood Management



What is NFM?

A Natural Flood Management (NFM) approach to reducing flood risk means protecting, restoring and emulating the natural function of catchments, rivers and floodplains. An NFM approach looks for opportunities to slow flow, temporarily store flood water, increase the river to floodplain connectivity and improve soil infiltration throughout a river catchment. This approach can help to reduce the risk of flooding to people and property and complement more traditional flood risk management measures.

We have looked for potential NFM options across the Cadoxton catchment and have identified a favourable opportunity on the East Brook immediately upstream of Dinas Powys to reduce flood risk to the town. The East Brook and Mill Farm Brook between Llandough and Eastbrook have oversized channels that are well suited to store flood water and reduce peak flows downstream.

Storage would be achieved by constructing leaky barriers in the channels. These barriers would hold back flows during a flood, but would not obstruct normal river flows. There are a range of options for constructing these leaky barriers, two of which are shown adjacent.



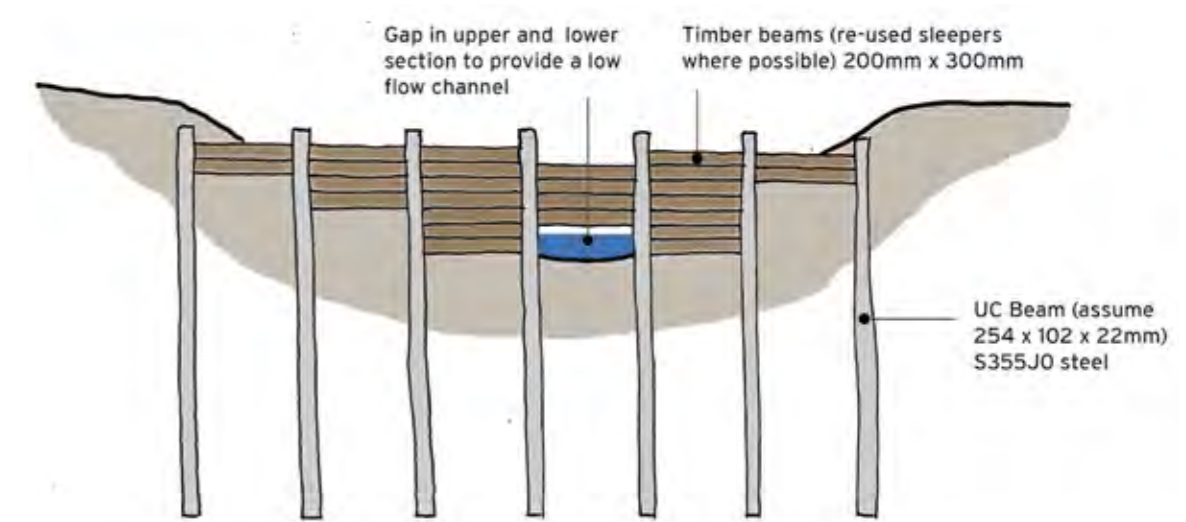
Tree trunks

NFM leaky barriers are most commonly constructed from logs or even fallen tree trunks, laid across the river channel. The timber structure must be tied together and anchored in to the ground so that it is not washed away by flood waters. The more water a leaky barrier is designed to hold back, the stronger and more substantial the structure needs to be.



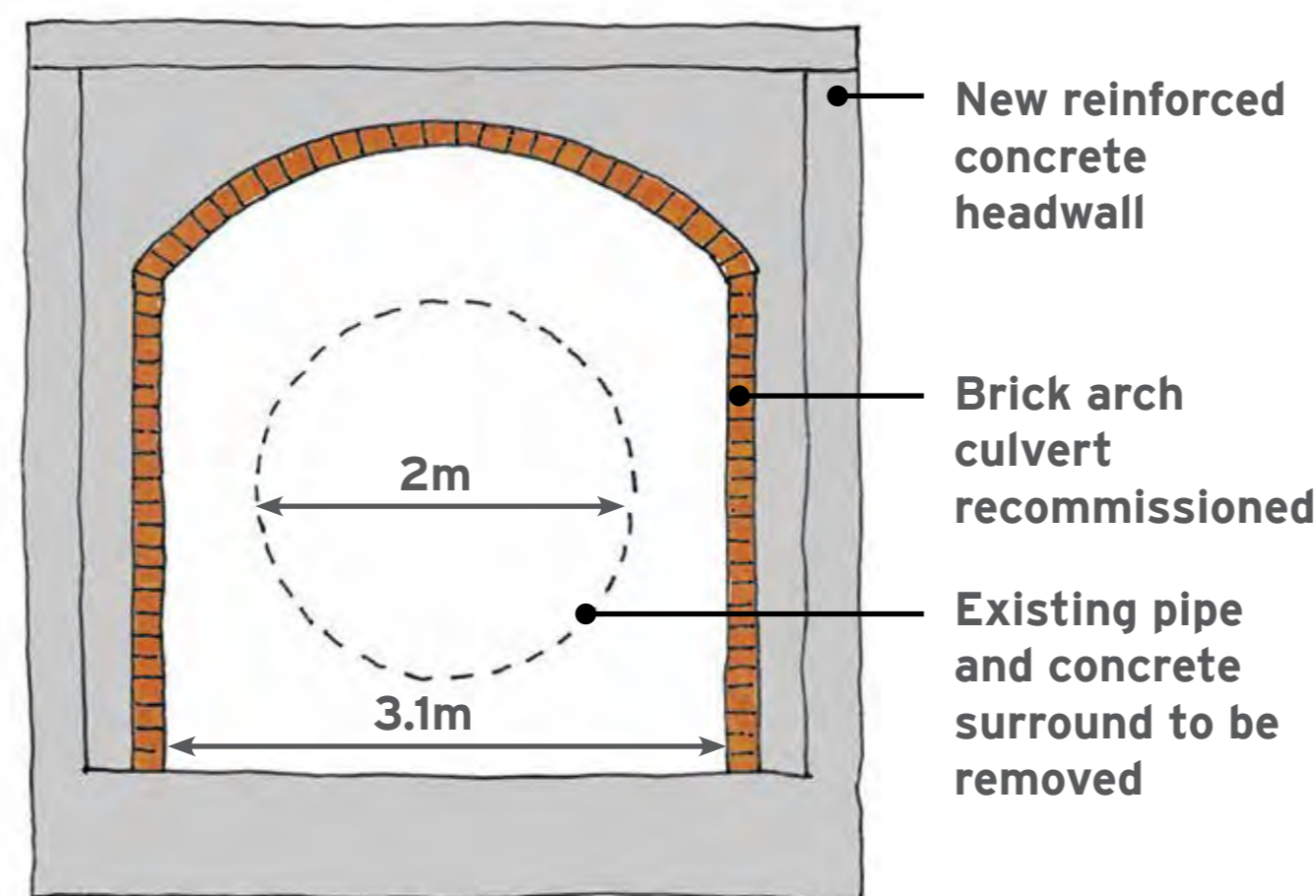
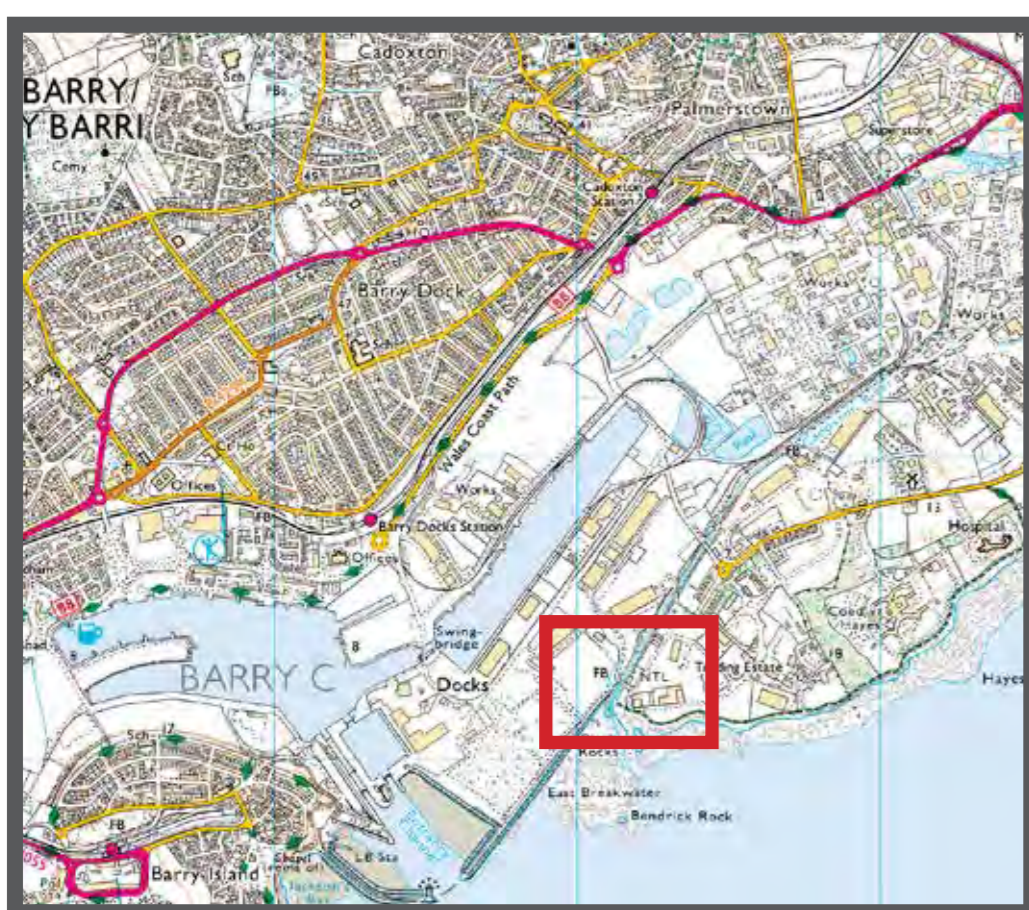
Timber Slats with Column Piles

This is a more 'engineered' option, but provides a longer lasting structure with more confidence in its performance. 'H' section piles are driven into the ground to provide a robust vertical support to the barrier. Timber slats or sleepers are then slotted between the piles to complete the barrier.



Tidal Outfall Improvements

The existing tidal outfall has a varied history. The original structure consisted of a large brick arch culvert and timber tidal doors. Unfortunately, a storm in 1986 destroyed the tidal doors and emergency works were required to prevent tidal flooding to the Barry Industrial Area. The emergency works consisted of installing a 2m diameter steel pipe within the existing culvert and filling the space between the arch and pipe with concrete. The tidal doors were also replaced with a smaller tidal flap. This work reduced the capacity of the outfall to discharge flow to approximately one-third of its original capacity.



Cross section to show existing and proposed changes to the tidal outfall

NRW subsequently took on responsibility for this asset and installed a debris screen in the river channel on the upstream face of the culvert. However, this is difficult to maintain and has done little to improve the situation.

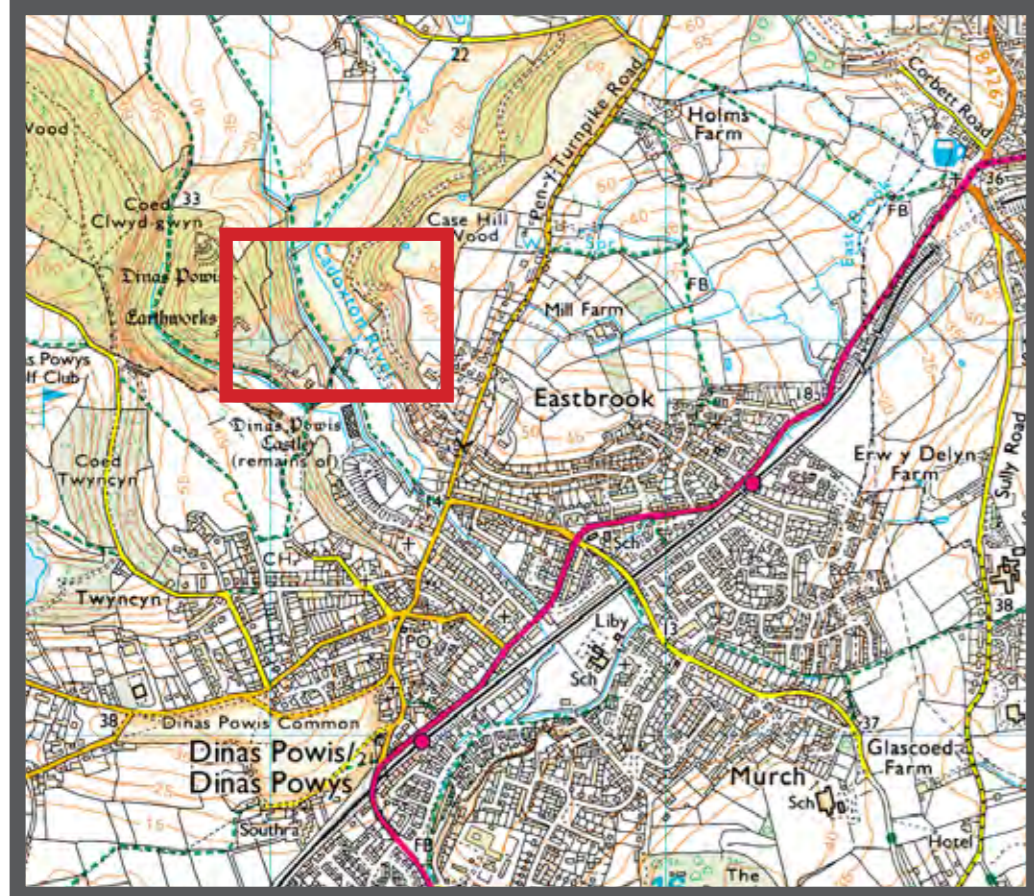
The proposal is to demolish the emergency works by removing the narrower 2m diameter pipe and restore the outfall structure to its original size. The tidal flap will also be replaced with larger tidal doors. This will revert the outfall to its original arrangement and capacity, and reduce flood risk to the Barry Industrial Area by passing more river flow quicker in to the Severn Estuary after tide locking of the outfall.

We shall also undertake work to improve access for operational staff and provide long term resilience.



What are the preferred options?

Flood Storage

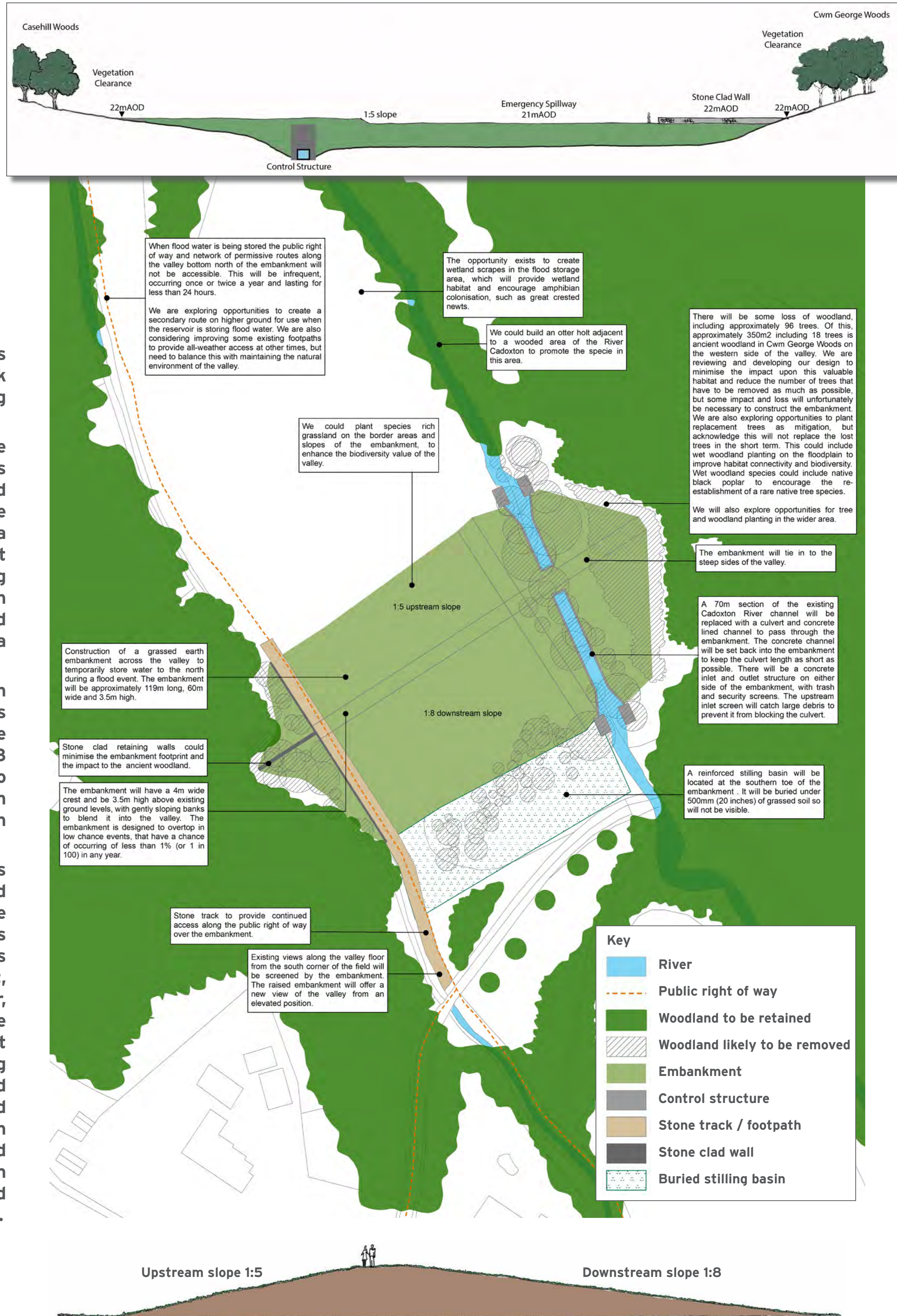


A flood storage area upstream of Dinas Powys will significantly reduce the peak flood flows through the town, reducing water levels and flooding.

The concept is to temporarily store flood water upstream of Dinas Powys and then release this at a controlled rate that will not cause flooding. The flood water would be stored behind a large earth embankment, with a culvert through it that restricts the flow being passed downstream. The floodplain area behind the embankment would only hold water infrequently and for a short duration.

We have identified the area between Cwm George Woods and Casehill Woods as a potential flood storage site. The area could store up to 180,000m³ of flood water, which is sufficient to reduce flood risk in Dinas Powys from a 3.33% (1 in 30) chance to a 1% (1 in 100) chance

The potential Cwm George site has been identified due to its location and the naturally suitable topography. We believe this option and location reduces the scheme's impact on the Dinas Powys community and the environment, compared to other options. However, as with any new flood defence there will be impacts on the area, both short term and long term. We are working hard to explore options to reduce and mitigate these negative impacts and welcome the community's feedback on this option, to inform our choice and shape the scheme. The adjacent plan shows the key aspects being considered during the development of this option.

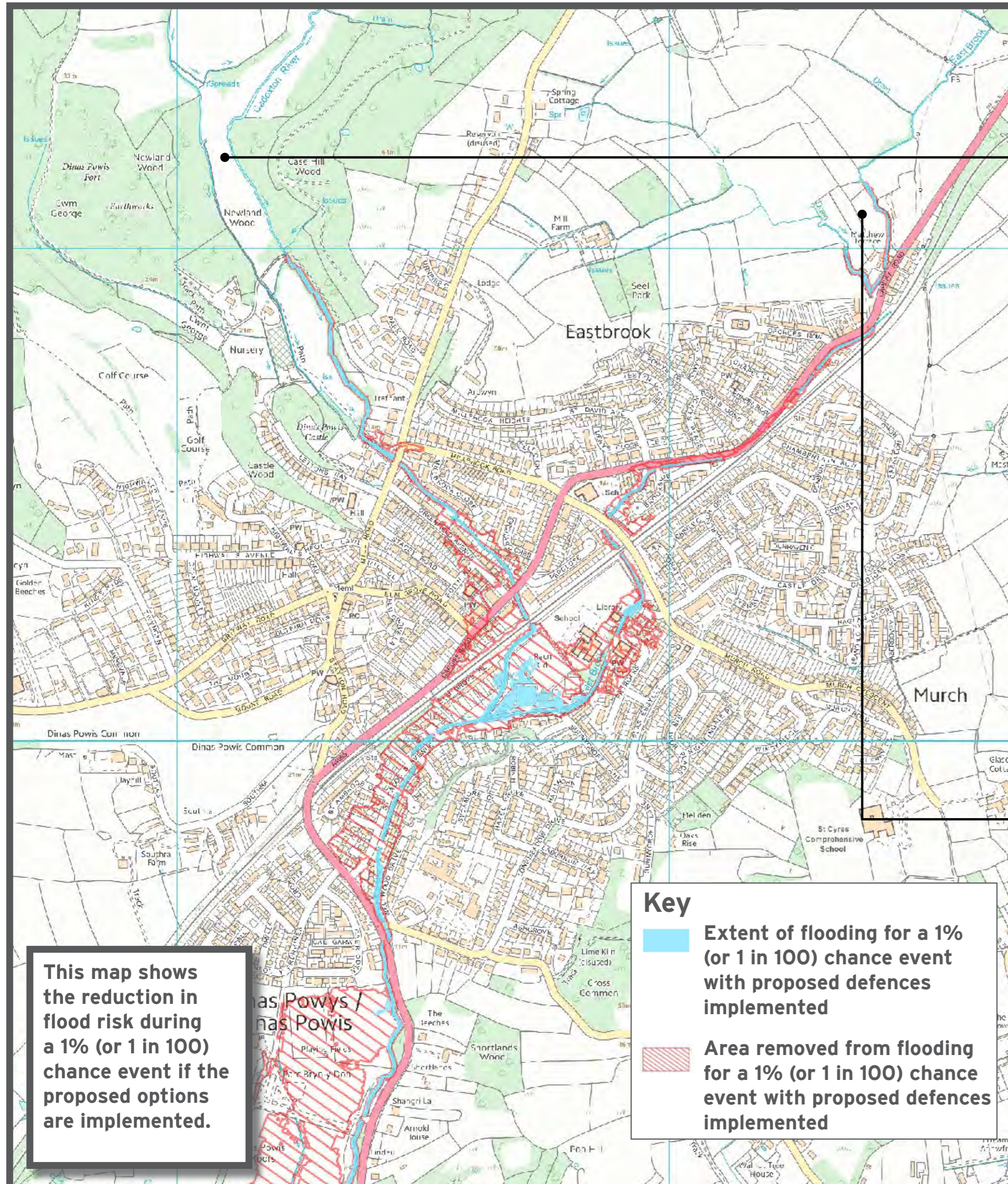


Cross section through embankment



What are the benefits and risks?

Overall reduction in flood risk



Flood Storage Area

+	-
<ul style="list-style-type: none"> • Improve public access to outdoor space and nature. • River restoration measures to improve connectivity of the river with the floodplain. • Wetland scrapes to provide wetland habitat and encourage amphibian colonisation, such as great crested newt. • Wet woodland planting on the floodplain to improve habitat connectivity and biodiversity. • Educational boards adjacent to the scheme to encourage appreciation of the environment and flood risk. • Material to form the embankment could be sourced from within the flood storage area, reducing traffic movements during construction and reducing the carbon footprint. 	<ul style="list-style-type: none"> • Some loss of ancient woodland. • Potential for the scheme to impact on protected species, such as bats, breeding birds, badger, fish and invertebrates. • Potential impact to the Cwm George valley landscape setting from the presence of the embankment. • Footpaths will be temporarily closed/diverted during flood events. • Local disruption during construction.

East Brook NFM

+	-
<ul style="list-style-type: none"> • Utilise nature features to manage flood risk. • River restoration measures may be possible downstream in Dinas Powys. • Habitat improvements and biodiversity enhancements. • Potential to involve local landowners in the management of flood risk. 	<ul style="list-style-type: none"> • Further investigations are required to confirm effectiveness and construction requirements. • Potential for the scheme to impact on protected species, such as bats, breeding birds, badger, fish and invertebrates. • Multiple landowners will be affected and disrupted during construction.

Tidal Outfall Improvements

+
<ul style="list-style-type: none"> • Improve the passage of fish and eels upstream. • Improve operational safety for NRW staff. • Increase the asset resilience against failure of the tidal flap, by installing a secondary penstock.
-
<ul style="list-style-type: none"> • Fish and eel passage will be disrupted during construction. • Potential to impact on existing boundary wall.



Economic Benefits:

Catchment wide

- Reducing flood risk to existing properties that have a 3.33% (or 1 in 30) chance of flooding each year
- 311 properties protected from flooding up to a 1% (or 1 in 100) chance event, increasing to 449 properties protected by 2117
- Estimated flood damages reduced from £28.7m to £6.0m in a 1% (or 1 in 100) chance event over a 100 year period
- Estimated economic benefits of £22.7m over a 100 year period

Dinas Powys Benefits

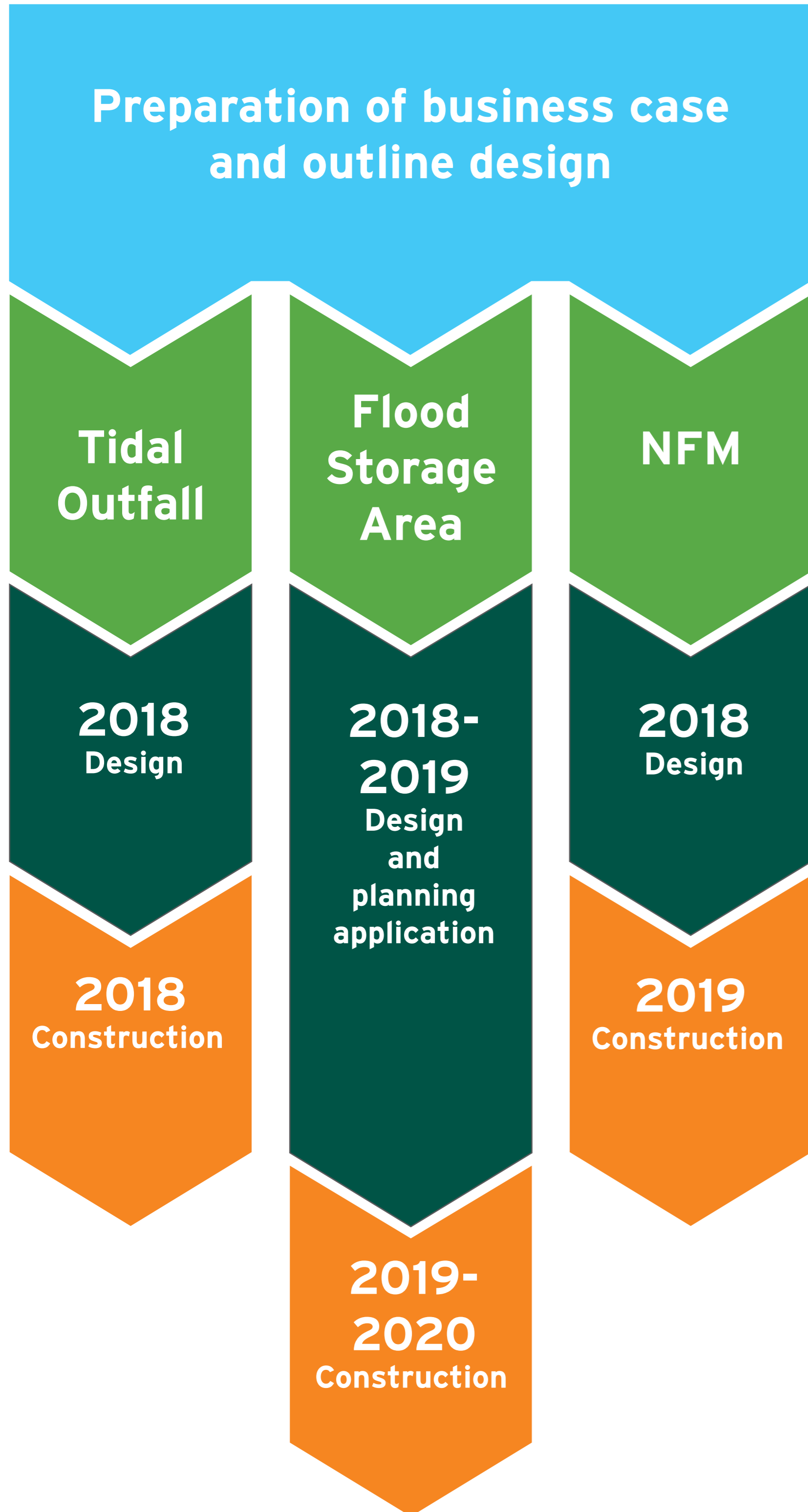
- 207 properties protected from flooding up to a 1% (or 1 in 100) chance event, and 237 by 2117
- Properties protected are mostly residential, but schools and a library benefit also
- May facilitate future re-naturalisation of the East Brook concrete channel section

Barry Industrial Area Benefits

- 104 properties protected from flooding up to a 1% (or 1 in 100) chance event, increasing to 212 by 2117
- Properties protected are mostly industrial, including employment and critical infrastructure sites



What happens next?



Natural Resources Wales expects to conclude the options appraisal, outline design and business case in early 2018. This will be informed by the consultation feedback we receive from the community and stakeholders.

The business case will be presented to Natural Resources Wales' Flood Risk Board and Welsh Government for funding approval. We believe there is a strong social and economic case for undertaking a scheme in Dinas Powys and the Barry Industrial Area, and that our preferred options are the most balanced solutions to reduce flood risk. However, all options have a range of delivery risks and it is important to us to understand the community's support for and concerns with the proposals.

If funding is secured, Natural Resources Wales will produce detailed designs and obtain the necessary permissions, consents and agreements required to deliver the schemes in advance of construction. Natural Resources Wales will work closely with the community, the Council and affected landowners when developing the detailed design to produce a scheme that addresses concerns raised as much as possible and is feasible. The flood storage area will require planning permission also. We will undertake further community and stakeholder consultation on the scheme during this design development stage.

Once the designs have been completed and all permissions have been obtained, construction work on the schemes can begin. We currently anticipate that the tidal outfall in the Barry Industrial Area will be constructed in 2018, whilst the flood storage embankment and natural flood management works in Dinas Powys and Eastbrook will be constructed in 2019 - 2020.

Please tell us what you think...

It is very important to us that we receive your views. The project team is on hand to discuss flood risk, the options considered and answer your questions. Feedback forms are available to record all comments and suggestions that you may have, and we will use these to inform our proposals.

We would be particularly interested on hearing your thoughts on the following:

Did you know Dinas Powys and the Barry Industrial Area are at risk of flooding?

Have you flooded before?

Do you support the scheme options and designs we have presented here?

Do you have any concerns with the scheme options and designs?

Do you think the scheme will enhance or threaten the character of Dinas Powys?

How can we improve on the options and designs presented?

FOR MORE INFORMATION PLEASE EMAIL CADOXTON@NATURALRESOURCESWALES.GOV.UK
OR WRITE TO TY CAMBRIA, 29 NEWPORT ROAD, CARDIFF, CF24 0TP

