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Dolgellau Flood Risk Management Scheme: GCSE Case Study

The Solution



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Thanks

NRW would like to thank staff from Snowdonia National Park Authority and the North Wales branch of the Geography Society for casting an eye over this resource.



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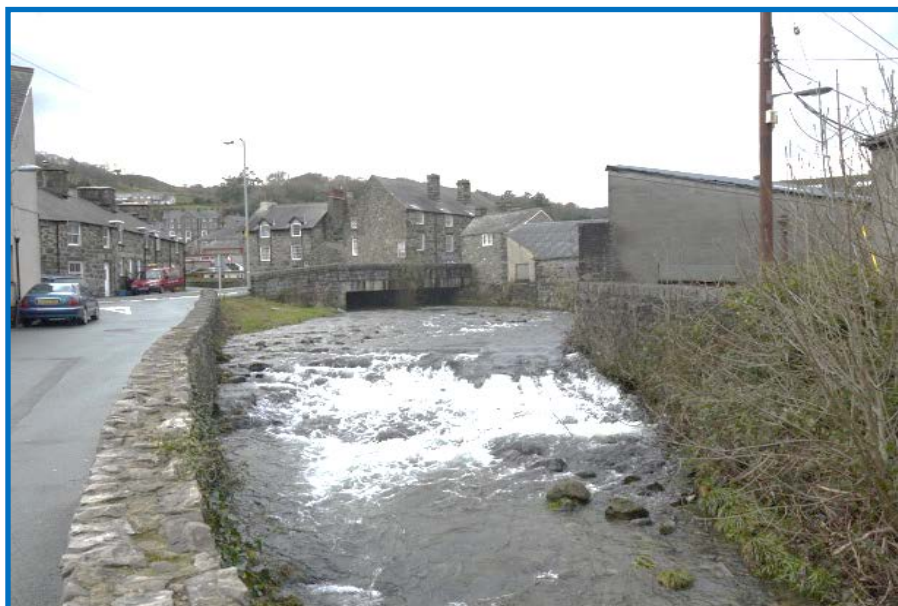
Dolgellau Flood Risk Management Plan - Construct new defences set back from the river

The environmental, technical and economic aspects of each flood risk management option were evaluated. The option that was taken forward for detailed economic consideration was Option 3 “Construct new defences set back from the river”. See [Appendix 1](#) for a detailed outline of the chosen option.



The preferred option included works to defend the town centre comprising of set-back walls, refurbishment of the Arran River left bank wall and works to defend the Arran Road area. This option retains views of the river and provides an opportunity to enhance the riverside area. It increases the floodplain in line with the Government’s ‘Making Space for Water’ report. It also lessens the impact on the right bank, reducing flooding to the A470.

Fig 1, left – School children out on site viewing the construction of the new flood defences first hand



The scheme comprised flood defence walls and embankments extending for approximately 1km from the Marian Mawr Industrial Estate in the west, as far as the Ysgol y Gader sports ground in the east; and extending approximately 330m upstream on the Afon Arran, as far as the Catholic Church. This is to reduce the risk of flooding from the Arran

overtopping its banks in this area.

Fig 2 – the weir on the Afon Arran prior to work commencing



The weir downstream of Pont Arran was removed (see **figures 3-5**) permanently changing the bed level of the river, restoring a more natural channel gradient, and more natural flows and sediment transfer to approximately a 50-70m length of channel. It will also allow passage of smaller fish species up the Afon Arran (larger species such as salmon and sea trout are already able to pass this structure).

Left, **Fig 3** – The dotted red line shows the required height of raised walls, if weir removal had not been undertaken



Below left, **Fig 4** - Work in progress to remove the weir



Bottom left, **Fig 5** – work to remove the weir is complete

The review considered the concerns of the community that gravel accretion and rising river bed levels may increase flood risk. The review examined the issues over a 4km long section of the catchment but concluded to intercept, trap and remove gravel would be both environmentally and economically unsustainable. The report concluded that gravel clearance at Bont Fawr should only be done on a reactive basis after larger floods.

Defences have been constructed with foundations that are suitable to facilitate rising water levels during the next 50 years. This will enable NRW to monitor and react accordingly to actual increases in flows due to climate changes. At 50 years (the end of the design life of the proposed scheme), a major reconstruction would elevate defences to a level that can cope with future climate change flows.



Left, **Fig 6** – gravel accretion at Bont Fawr

An increased Standard of Protection (SoP) for the commercial and residential residents of Dolgellau

Number of properties within the flood outline

The table compares the number of properties at risk for different flood events before and after scheme construction. This shows the benefit of the scheme in protecting property from flooding. In the 1 in 100 (1%) annual probability flood the scheme benefits 237 properties (259 – 22 = 237). There is some detriment caused but this is either not significant or agreement has been sought with the landowner. The number of properties protected increases to 310 when climate change is considered. At the 1 in 1000 (0.1%) annual probability flood there is a small reduction in the number of flooded properties but much of Dolgellau is flooded.

Flood Event (annual probability)	Number of properties within Flood Outline	
	Existing	With Scheme
1 in 100 (1%)	259	22
1 in 100 (1%) + climate change	341	31
1 in 1,000 (0.1%)	448	442

Fig. 7 a table to demonstrate the effects of potential flood events in Dolgellau

Modelling suggests that the new defences will delay the onset of flooding by up to one hour in these low probability events, providing more opportunity for residents to prepare and to be evacuated.

The benefit that the defences provide in reducing flood risk and the consequences of flooding to 237 properties in the 1 in 100 (1%) annual probability flood and 310 properties when climate change is considered, is therefore considerable compared to the potential for a greater depth of flooding in parts of the town during an extreme flood.

See [Appendices 2-6](#) for an explanation of the consequences of flooding to different intensities would have on Dolgellau. Hydrographs show different velocities within the river.

Construction began in October 2014 and concluded in June 2015. The £5.6 million Flood Defence Scheme was officially opened on the 25th February 2016 by Carl Sergeant, the then Minister for Natural Resources.



The screenshot shows the Cambrian News website interface. At the top, there is a red navigation bar with the site logo, a search bar, and links for 'View & Buy Photos', 'Public Notices', 'Family Announcements', 'Classifieds', 'Jobs', and 'Competitions'. Below this is a secondary navigation bar with links for 'Home', 'News', 'Sport', 'Letters', 'Blogs', 'What's On', 'Advertise', 'Digital Editions', and 'Our Papers', along with social media icons for Twitter and Facebook.

The main content area features an article titled "Official opening for new flood defences" dated Thursday, 25 February 2016. The article text reads: "DOLGELLAU'S flood defence scheme was officially opened today by a senior Welsh Government minister. Natural Resources minister Carl Sargeant visited Dolgellau today (Thursday) to declare the project, which has already been tested to capacity with horrendous weather this winter, open. Mr Sargeant said: 'I am pleased to officially open the Dolgellau Flood Risk Management Scheme, which is reducing the risk from flooding to over 300 properties in the town. 'We recently witnessed our wettest December on record, yet have not seen widespread flooding in Wales which might have been expected, thanks in large part to flood schemes like this one.'"

The article includes a photograph of four men standing in front of a stone wall. A caption below the photo identifies them as Emyr Roberts, Carl Sargeant, Dyfrig Siencyn, and Helyyn Williams.

On the right side of the article, there is a 'Post a comment' button showing 0 comments. A sidebar on the right contains several utility links: 'Support Local' (Watch our local news video), 'Subscribe' (Digital or printed subscriptions), 'Your Story' (Have a story you want to share?), 'Public Notices' (Development plans in your area), 'Find a Job' (Start your new career here), 'Advertise' (Get noticed online or in print), and 'Buy Photos'.

At the bottom of the browser window, a taskbar is visible with icons for various applications like Internet Explorer, Word, and Excel.

Fig 8, Cambrian News Online, 25th February 2016

Liaising with the local community

NRW worked closely with Snowdonia National Park Authority, Gwynedd Council and Dolgellau Town Council. The local community are proud of their town and challenged NRW throughout the feasibility and design phase. In particular NRW worked with The Trustees of the Marian Mawr, Dolgellau Town Partnership, Dolgellau Anglers, Prince Albert Angling Society and the Rotary Club to identify and address their concerns.

Dolgellau has a strong Heritage Group who were very concerned about the potential impact the proposed works would have on the character of the town which is a Conservation Area, situated in Snowdonia National Park. To satisfy the planning department and concerns raised by the Heritage Group, the new flood defences included a local stone (dolorite) cladding to minimise the impact on the sensitive landscape.



Fig 9 – construction of new flood defence wall set back from the river



Fig 10 – Completed new flood defence wall along the Marian Mawr carpark

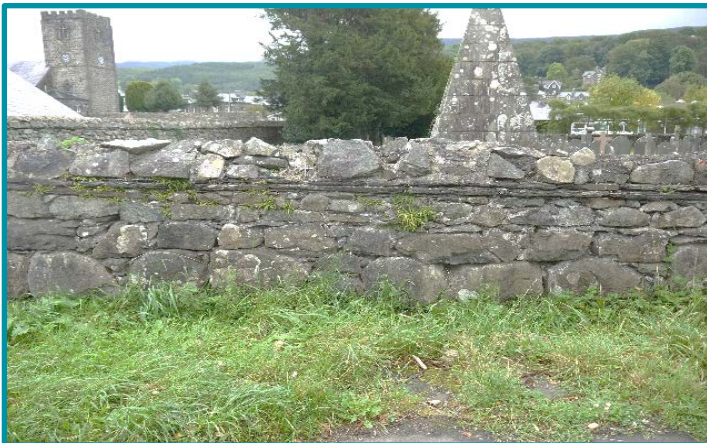


Good for the environment

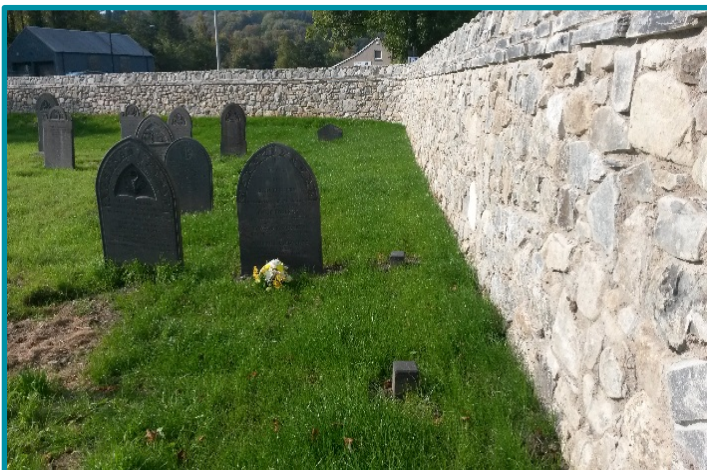
Trees and hedgerows – Early surveys and discussions with Snowdonia National Park guided the scheme design to avoid existing key trees. Unfortunately it was necessary to remove 160 trees as a result of the scheme although some of these were in poor health or growing in a location where they would be unlikely to reach maturity. NRW have re-planted 310 trees within the town and surrounding area.

NRW have contributed £10K to a hedgerow management scheme run by Snowdonia National Park to help mitigate for some of the trees removed as part of the Flood Risk Management Scheme. The hedgerow scheme was aimed at encouraging landowners to either establish new hedgerows, or restore old hedgerows using the traditional craft of hedge laying. Trees and hedges can help to stop bank erosion, reduce overland flow and provide shade to reduce the impact of climate change.

Management of invasive species. The river corridor is heavily infested with Himalayan Balsam and Japanese Knotweed. Measures were undertaken to remove sections of these species within the construction area and implement a five year post construction management plan of spraying and uprooting.



Re-use of waste materials for environmental benefits. Where waste materials from the scheme works were not re-used on site, through ongoing liaison with other developers, they were re-used for environmental benefits elsewhere. Timber was chipped and used as mulch or used to construct log pile otter holts. Stone from the old cemetery wall was reused and included in the new flood defence wall.



Above, **Fig 11** – Old cemetery wall

Left, **Fig 12** – New cemetery wall built as a flood defence

Good for people

New play garden - NRW have built a new play garden for the playgroup users (Ti a Fi) at Dolgellau's Family Centre. This enterprising community project has secured grants from



Welsh Government and the Heritage Lottery Fund to buy and renovate a derelict Drill Hall and turn it into a Family Centre. There is little outdoor space available with this project so NRW has worked with the Dolgellau Partnership to restore a small area of an adjacent park to provide a safe environment for outdoor play for young children. Timber logs left over from the scheme were used to create a story circle seating area in the Drill Hall garden area within the southern portion of the Marian Bach.

Above, **Fig 13**, new play garden constructed at Dolgellau's Family Centre

Improvement of the footpaths and cycleway. NRW have improved the entrance to the Mawddach Trail, a popular cycle route which starts in the car park in Dolgellau and ends in Barmouth and Fairbourne. The newly designed walls make better segregation between pedestrians, cyclists and cars. The formalised planting beds will allow the new trees to grow healthily replacing those that were previously breaking up the footpath and had been damaged by cars.



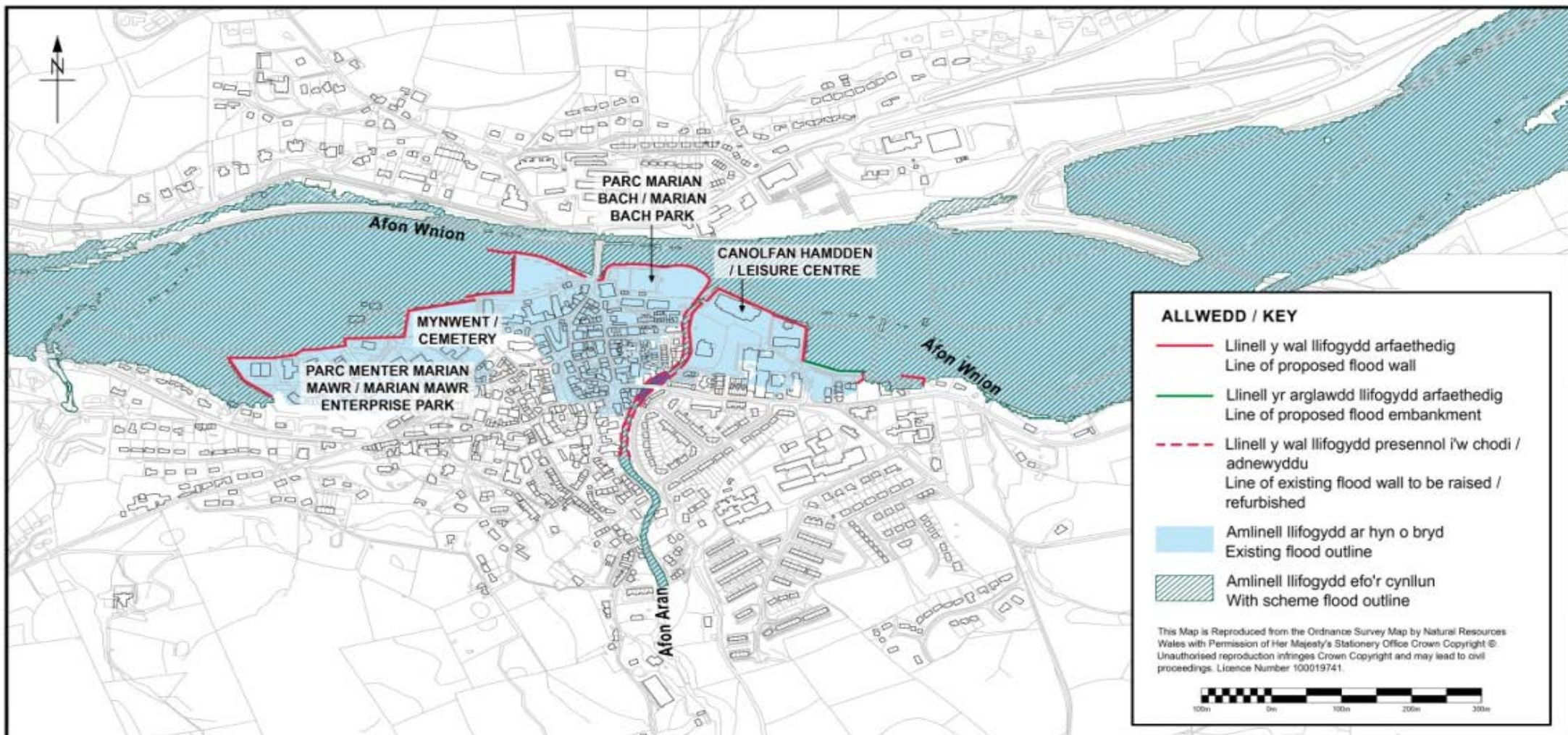
Increased learning and understanding of flooding and it's effects

The local Primary schools, Secondary schools and Coleg Meirion Dwyfor visited the flood defence to see work in progress and have taken part in curriculum linked activities about flooding, the creation of the flood defence and what to do in the event of a flood.

Above, **Fig 14**, schoolchildren get a on-the-job lesson in civil engineering



Appendix 1 – Detailed outline of the chosen flood risk management option



Explanation of Appendices 2-6

Appendix 2 – Flood Consequence assessment, 1 in 100 (1%) annual probability flood outlines

This map shows the flood consequence assessment for a 1 in a 100 (1%) annual probability flood outline. The blue shows the existing flood outline. The red stripes show the possible extent of flooding with the scheme in place. The solid red lines show where the new flood defences were to be built.

Appendix 3 - Flood consequence assessment, 1 in 100 (1%) annual probability flood outlines + climate change flood outlines

The next map shows the flood consequence assessment for a 1 in 100 (1%) annual probability flood outline but includes potential consequences of climate change flood outlines. You will note that the extent of the flood is increased in two small areas. With this scenario there is no flooding in the town, but recreational areas are flooded. These areas include the sports ground on the opposite bank to the Arran Road defences, the recreational land in the Arran Road area and the Marian Mawr. In all these areas, typical flood water velocities exceed 0.3 metres a second and can be as high as 1.0 metre a second under current conditions. The construction of defences can result in some increase in velocity, but generally only in the order of 0.05 – 0.10 metres a second.

Appendix 4 – Flood consequence assessment 1 in 1,000 (0.1%) annual probability

This map demonstrates the extent of flooding as a consequence of a catastrophic flood, a 1 in 1000 (0.1%) annual probability flood. At the 1 in 1000 (0.1%) annual probability flood access to residential and commercial property is flooded in pre and post scheme conditions.

Appendix 5 - Hydrograph Upstream of Bont Fawr on the Afon Wnion

This is a hydrograph to demonstrate Wnion levels pre and post scheme. Time runs along the X axis and the Y axis shows metres above ordnance datum. The blue line indicates water levels occurring before the scheme was built and the red line indicates the impact of the scheme on water levels.

The graph shows the results from the river modelling of the Afon Wnion for the 1 in 100 (1%) annual chance flood with peak flows increased by 20% to account for climate change. By building linear flood defences the flow is constrained to the channel (instead of flooding the town) and the water level increases to compensate.

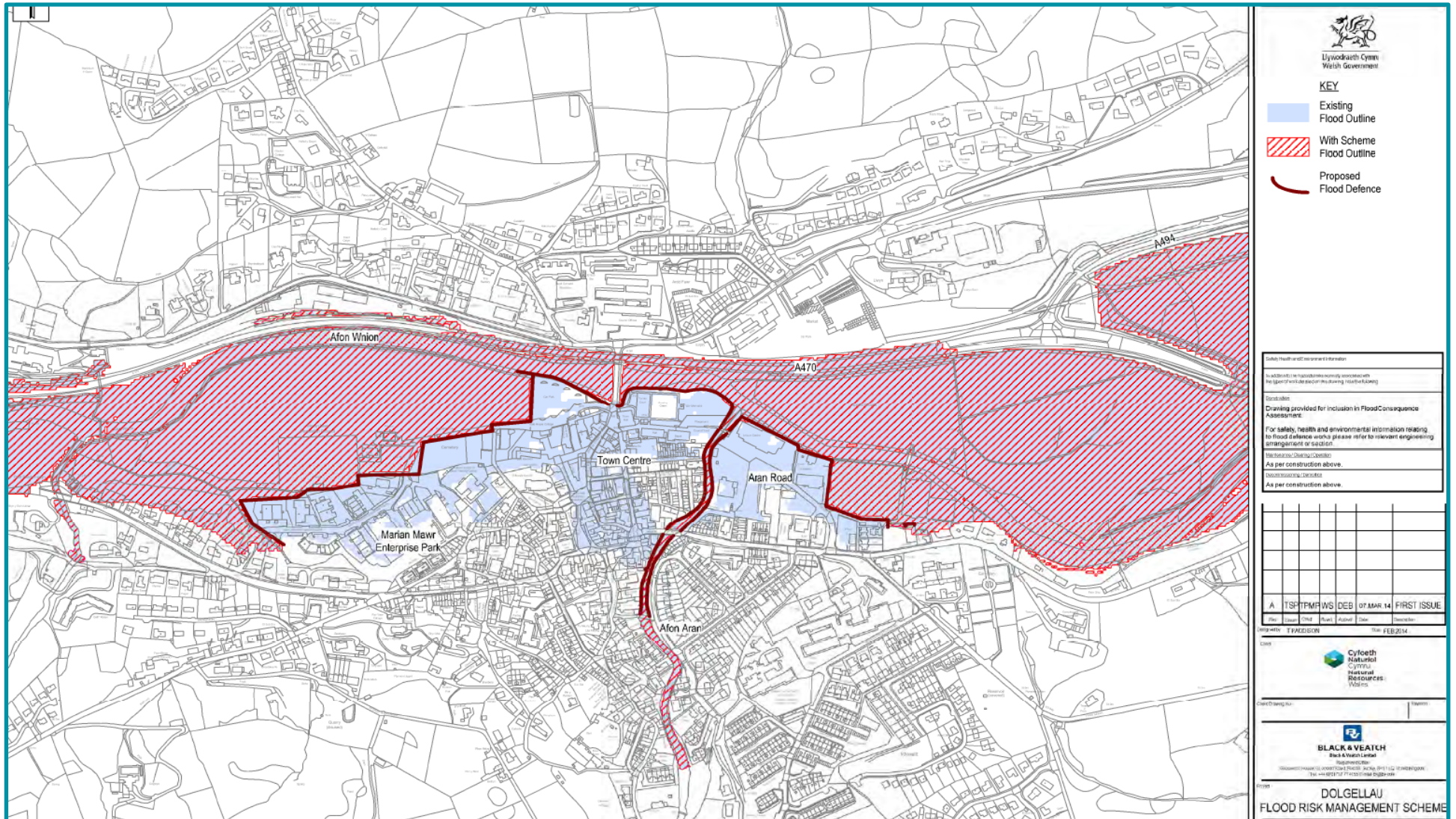
Appendix 6 - Hydrograph Downstream of Bont Fawr

This is a hydrograph to demonstrate Wnion levels pre and post scheme. Time runs along the X axis and the Y axis shows metres above ordnance datum. The blue line indicates water levels occurring before the scheme was built and the red line indicates the impact of the scheme on water levels.

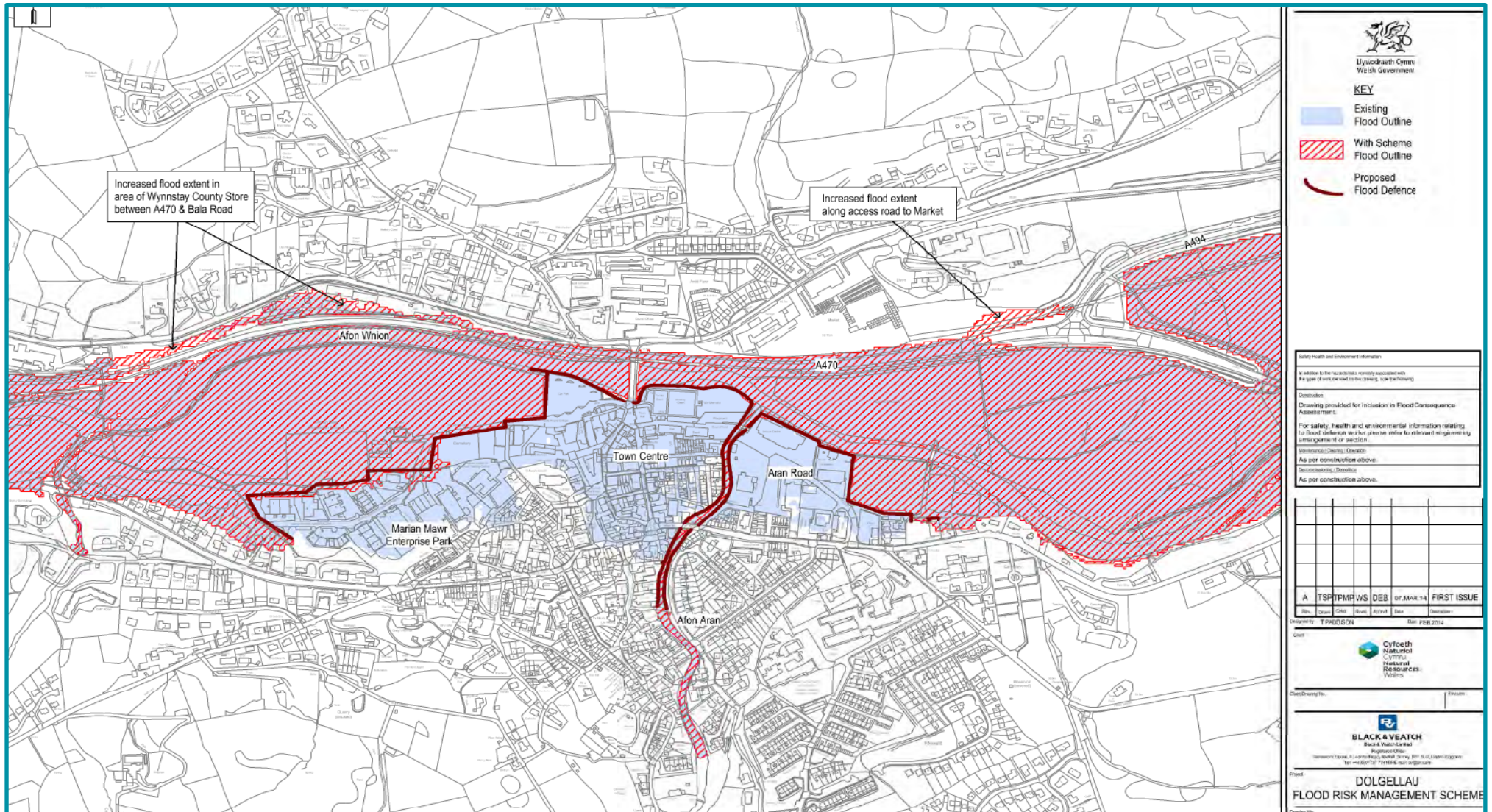
The level increase is more noticeable on the upstream of the Bont Fawr rather than the downstream. The difference in the level increase is down to the double constraint of a narrowed channel (the heightened walls at the Marian Bach park constrain the flow) and the arches of the bridge itself. This means that there is greater impediment to flow at this central part of the town – resulting in a relatively higher increase upstream.



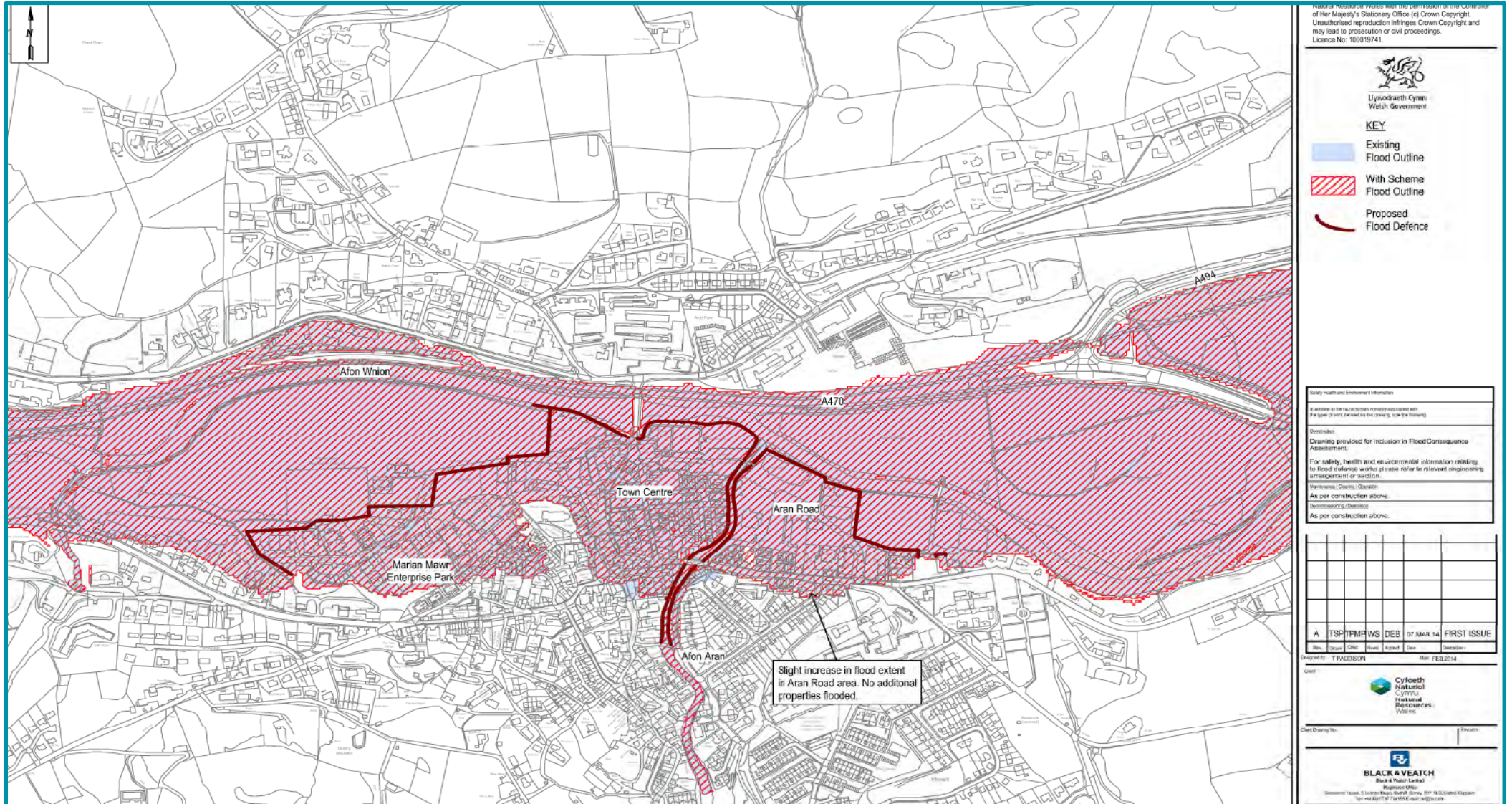
Appendix 2 – Flood consequence assessment, 1 in 100 (1%) annual probability flood outlines



Appendix 3 – Flood consequence assessment 1 in 100 (1%) annual probability change in flood

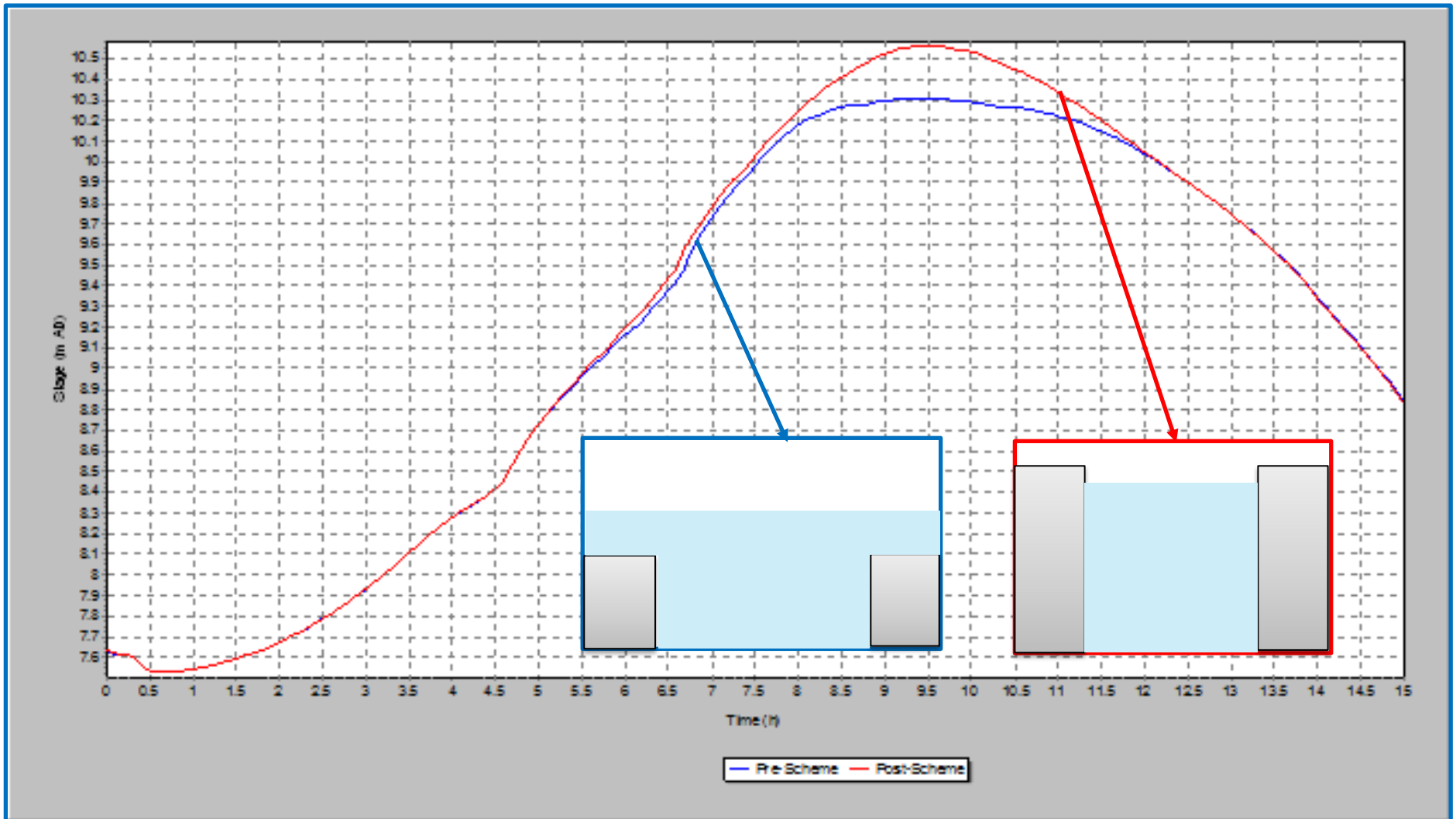


Appendix 4 - Flood consequence assessment, 1 in 1000 (0.1%) annual probability flood outlines

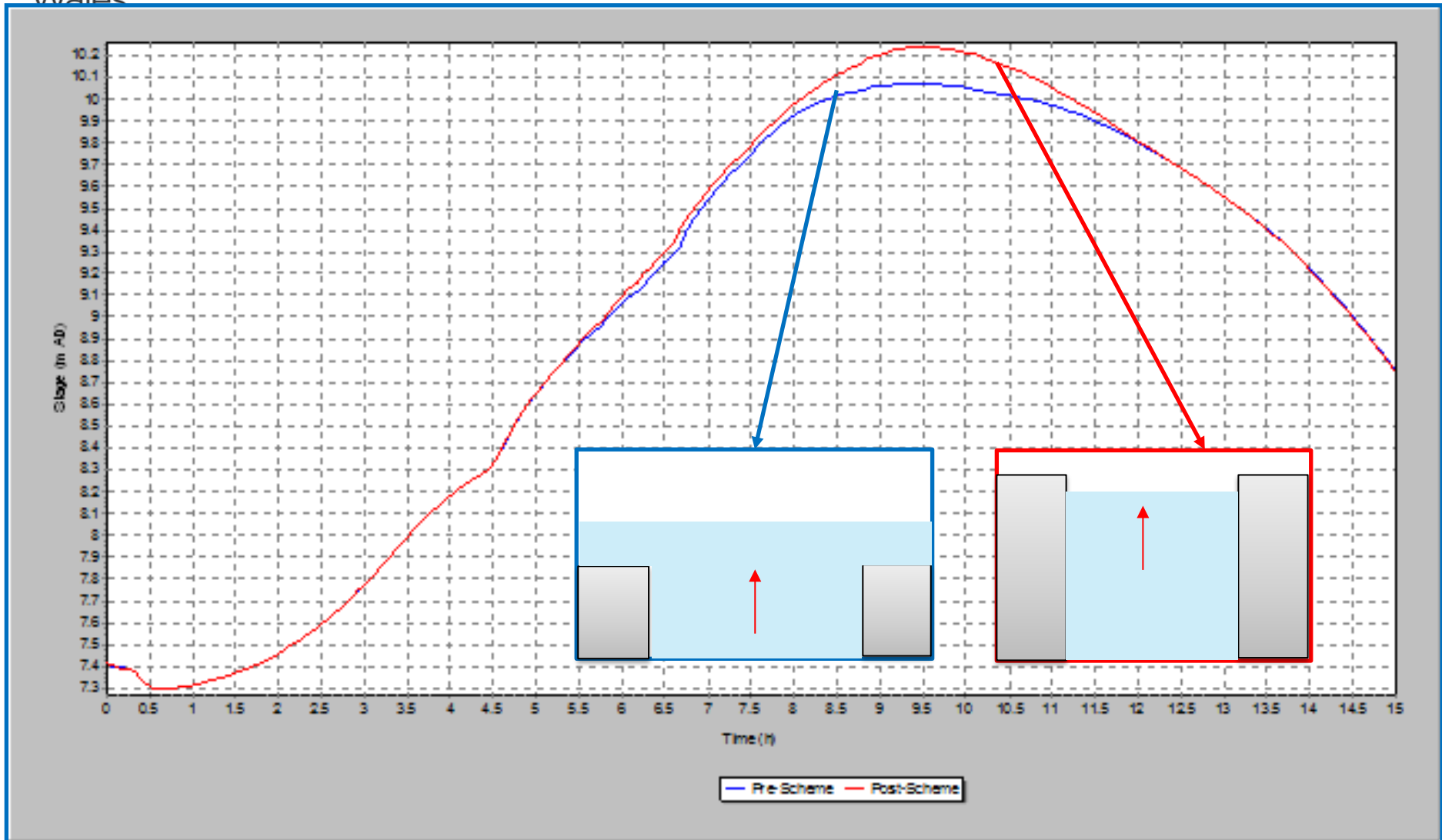




Appendix 5 - Hydrograph Upstream of Bont Fawr on the Afon Wnion



Appendix 6 - Hydrograph Downstream of Bont Fawr



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Natural Resources Wales
Cambria House
29 Newport Road
Cardiff
CF24 0TP

0300 065 3000 (Mon-Fri, 8am - 6pm)

enquiries@naturalresourceswales.gov.uk
www.naturalresourceswales.gov.uk

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