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St. Asaph Flood Risk Management Scheme Case Study:

The problem and task

Introduction

This case study can be used in conjunction with the 'St Asaph November 2012 Floods Data Report' which can be found on the Education, Learning and Skills pages of NRW's website. The solution to the problem and task can also be found on these pages.

www.naturalresourceswales.gov.uk

Natural Resources Wales (NRW) has a duty under the Environment Act Wales 2016 to apply the principles of sustainable management of natural resources (SMNR) through it's work.



Figure 1 - The Environment Act 2016 'sustainable management of our natural resources (SMNR) principles

St.Asaph

Awarded city status as part of the Queen's Diamond Jubilee celebrations in 2012, St Asaph is a small city in North Wales, situated in the Vale of Clwyd between Denbigh and the coastal resort of Rhyl. It is home to the smallest Cathedral in Britain and has a population of just under 3,500 according to the 2011 census. It is located on the lower reaches of the River Elwy.

The River Elwy

The River Elwy, a tributary of the River Clwyd comes into existence in the village of Llangernyw (South-west of St.Asaph) as three rivers converge to form the Elwy – Afon Gallen, Afon Collen and the Afon Cleddwen - see **Figure 2**. From Llangernyw the Elwy flows easterly to Llanfair Talhairn where another tributary, Afon Aled joins the Elwy. After passing through Bont-Newydd, the Elwy turns northwards and flows through St.Asaph. Flowing directly through the city, the Elwy is a medium sized river with a catchment area of around 250km² when it reaches St. Asaph. There is also a small tributary of the Elwy known as the Glascoed Stream, which discharges into the Elwy on the left-bank. It runs adjacent to Glascoed Road at the southern end of the city, draining an area of 3km². The Elwy has its confluence with the River Clwyd 1.8km downstream of St Asaph – see **Figure 3**.

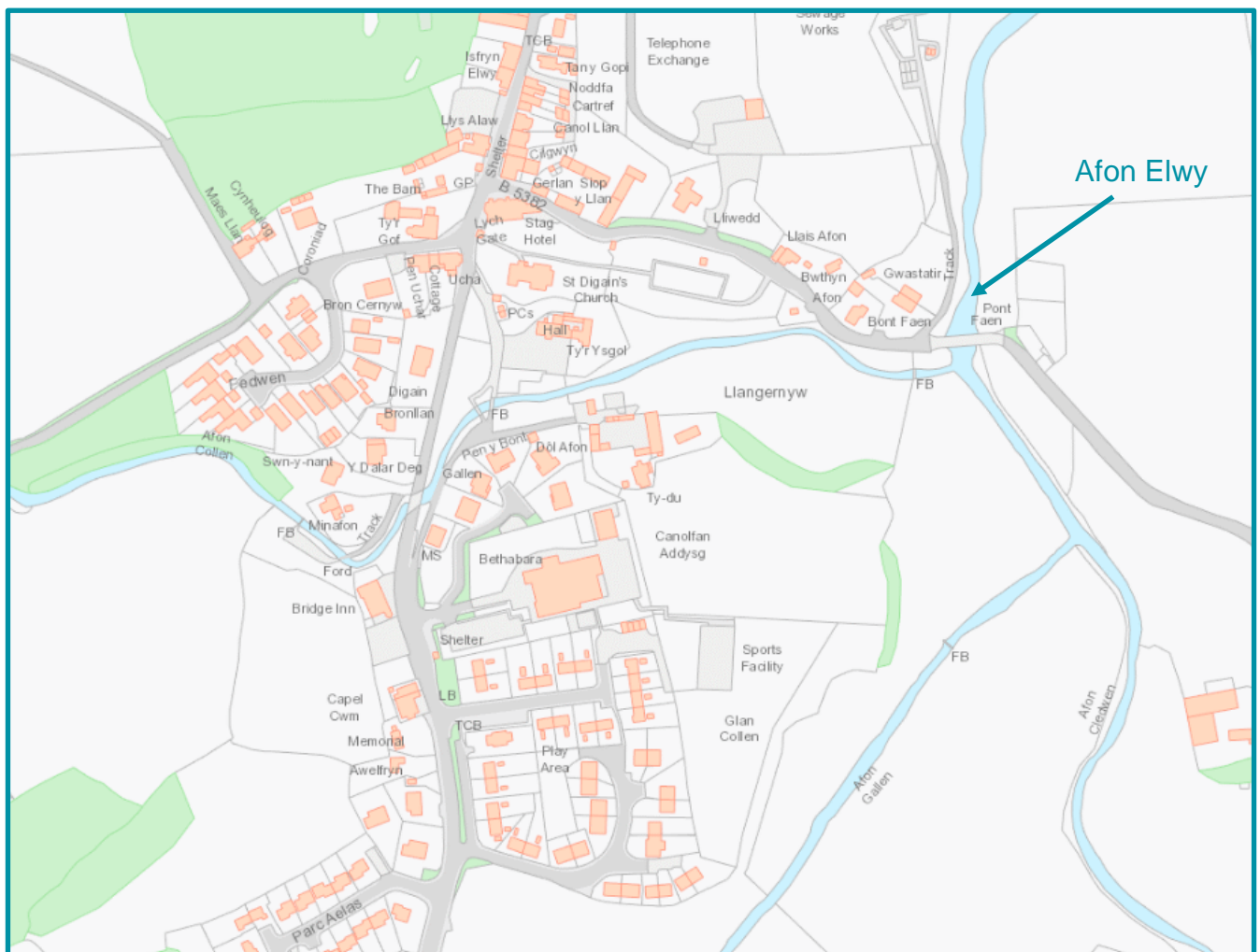


Figure 2 – map showing the Rivers Gallen, Collen and Cleddwen converging at Llangernyw to form the River Elwy

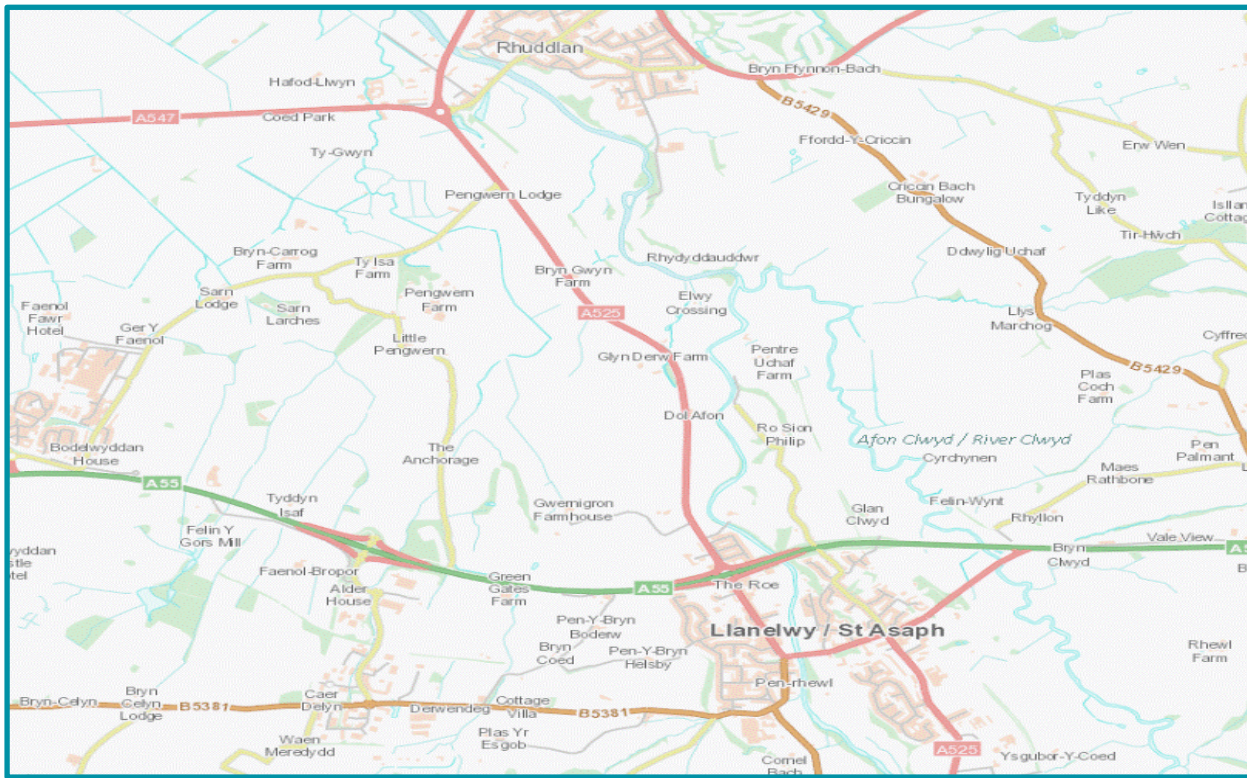


Figure 3 – Map showing the confluence of the River Clwyd and Elwy

The River Clwyd

The River Clwyd has its source in Clocaenog Forest (west of Ruthin). The river flows south until it reaches the village of Melin y Wig where it veers north-eastwards until it reaches the town of Ruthin. Flowing through rich agricultural land known as the Vale of Clwyd, the River Clywedog joins the Clwyd at Rhewl.

The Clwyd meanders gently north to St. Asaph where just north of the city, the two rivers conjoin. The Afon Elwy discharges to the Clwyd 1.8km downstream of St. Asaph and the ground levels fall from around 10m above Ordnance Datum (OD) to between 6-7m Ordnance Datum. At the confluence of the Elwy and Clwyd, the river becomes tidal and enters a narrow estuary. The river channel was straightened at Rhuddlan by King Edward 1st to enable his supply barges to reach his castle at Rhuddlan. The engineered, straightened channel runs for three miles before meeting the Irish Sea at Rhyl.

History of flooding at St. Asaph

Flood risk to the city comes predominantly from raised water levels in the Elwy overtopping the city's flood defences. Historically there are entries in the Chronology of British Hydrological Events that indicate likely flooding in the vicinity of the city in 1871, 1882 and 1896. During the 20th century, flooding was reported during 1913, 1964 and 1965. This prompted construction of the original defences through the city in the 1960's. These defences were raised again during 1975. The defences withstood all flood events until the 27th November 2012.



**Figure 4 -
Images
from the
1964/1965
St.Asaph
floods**



November 2012 Floods

The flooding in November 2012 occurred when prolonged, intense rainfall fell over the catchment. During the early hours of Tuesday the 27th November 2012, the defences were overwhelmed when the Elwy rose 3 metres above its normal level. 322 homes, 32 businesses and 70 caravans within the city were flooded. A flood depth of 0.8 metres was recorded and the floods resulted in one tragic fatality. **Figure 5.** demonstrates the breadth of flooding experienced by St.Asaph.



Figure 5 – photo demonstrating the breadth of flooding at St.Asaph

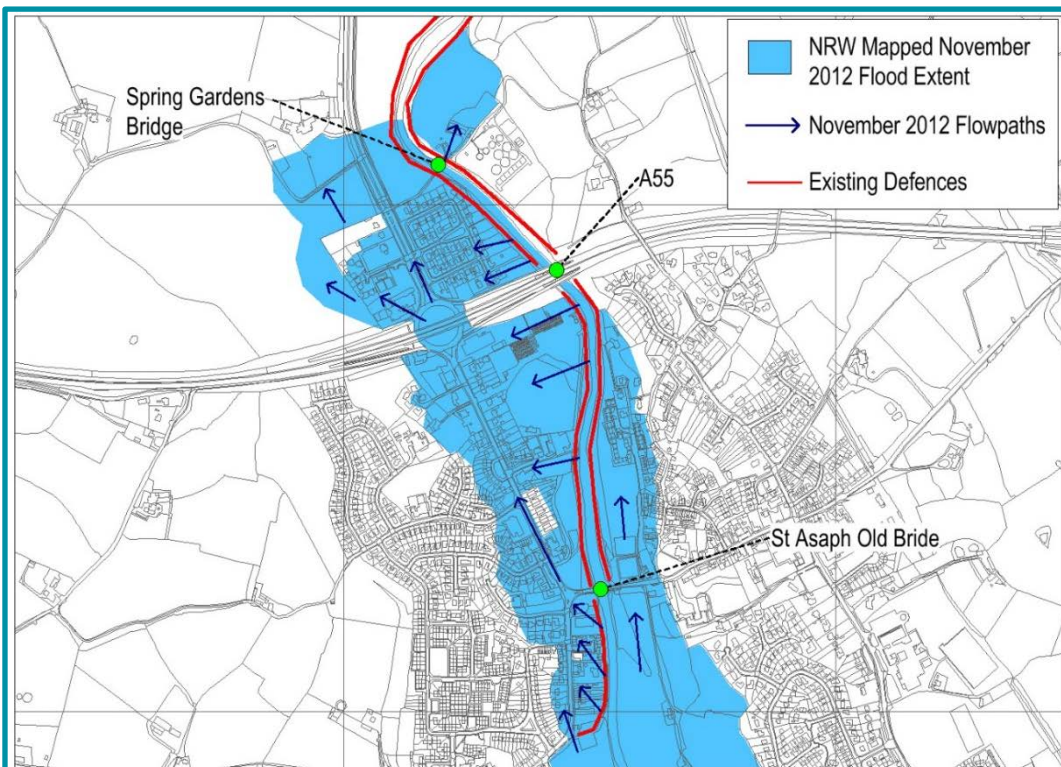


Figure 6 – map showing the November 2012 flood extent

Initial reports from site stated that flooding began to occur downstream of the A55 with water spilling into the Spring Gardens area - see **Figure 6**. This area was then cut off as upstream sections flooded. Out of bank water was fast flowing and all areas affected were quickly inundated.

Standard of Protection (SoP)

A flood defence standard of protection provides an indicative level of risk to a specific area from flooding from the sea or a river.

Flood defences are built to reduce the risk of flooding from the sea or a river. The standard of protection they offer is usually described in terms of the likelihood of a flood event happening from overtopping of those defences.

For example, a flood defence could be described as providing a 1 in 100 year standard of protection. This means that the defence could overtop if subjected to an event which has a probability of less than 1% in any given year. It is however worth noting that defences can fail by other means (eg breach) which is why it is so important to have appropriate inspection and maintenance regimes in place. **Figure 7** explains different the 'Standard of Protection' concept further.

Standard of Protection (SoP)	% Likelihood of flooding happening
1 in 1,000 annual event probability	0.1% chance of flooding in any given year, very low probability
1 in 200 annual event probability	0.5% chance of flooding in any given year, low probability
1 in 100 annual event probability	1% chance of flooding in any given year, medium probability
1 in 50 annual event probability	2% chance of flooding in any given year, medium probability
1 in 20 annual event probability	5% chance of flooding in any given year, high probability

Figure 7 – The 'Standard of Protection' model explained

These figures do not take account of the possible impacts of climate change and consequent changes in the future probability of flooding. Neither do they consider the impact of flooding.

*Flood risk assessment combines 'the **probability** and the **potential** consequences of flooding from all sources – including from rivers and the sea, directly from rainfall on the ground surface and rising groundwater, overwhelmed sewers and drainage systems, and from reservoirs, canals and lakes and other artificial sources.'* UK Government Planning Practice Guidance²

For example, a defence might have a 1 in 20 annual event probability (high probability) of flooding at a given location but the impact will be negligible as only fields with livestock will be affected. Or a defence may have a 1 in 1,000 annual event probability (low probability) of flooding at a given location but if a flood was to happen the impact would be high as hundreds of homes and commercial properties would be damaged. Therefore when assessing flood risk, both the probability and the potential impact of a flood need to be taken into consideration.

St. Asaph's Standard of Protection (SoP)

The November 2012 flood was estimated to have been between a 1 in 100 (1%) and 1 in 200 (0.5%) annual probability event.

Flood damage

Overtopping of the defences during November 2012 caused severe flood damage throughout the city.

Damage	Applicable to St. Asaph	Notes
Property damage – residential	✓	
Evacuation costs	✓	
Indirect costs (health)	✓	
Vehicle damage	✓	
Non-residential	✓	
Electricity and gas	x	No critical infrastructure in St. Asaph
Water and waste water	x	Existing sewage works too small to be included in the assessment
Roads	✓	Flood damages from connection between A525 and A55
Railways	x	No railways at risk in St. Asaph
Telecommunications	x	No critical infrastructure at risk in St. Asaph
Schools	✓	4 schools in St. Asaph
Hospitals	X	No hospitals at risk in St. Asaph
Emergency services	✓	
Recreation	X	Risk to recreation deemed negligible
Agriculture	x	No agricultural land at risk in St. Asaph although there are fields at risk both upstream and downstream of the city.
Environment	x	
Risk to life	✓	

Figure 8 – List of the potential sources of flood damages¹ together with whether they were applicable for St. Asaph

It was concluded in the St Asaph Flood Risk Management Scheme Project Appraisal Report that a scheme was required to reduce both the present day risk of flooding in St Asaph and to allow for it to be managed for the effects of future climate change.

Flood Risk Modelling

Flood risk modelling showed:

- The existing defences would be overtopped by a 1 in 50 (2%) annual event probability flood.
- Flood risk modelling highlighted that there were around 430 properties in St Asaph at risk from a flood with a 1 in 200 (0.5%) annual event probability. This includes 293 homes and 136 businesses, together with locally important highway infrastructure.
- Sections of the existing defence were identified as being in poor condition and require strengthening. Private gardens had encroached over parts of the defence, limiting access to maintain it.
- Large flows in the River Elwy could cause flooding in the River Clwyd at Rhuddlan
- The Clwyd is tidally influenced and can give rise to tidal flooding at the confluence with the River Elwy. St Asaph is too far upstream for there to be a tidal influence on flood levels in the city.
- Reservoir and canals can present a flood risk as a result of dam or embankment failure. These risks are very low as a result of regular maintenance and inspection. All large reservoirs must be inspected regularly and supervised by the Reservoir Panel Engineers under the 1975 Reservoirs Act. Reservoir flood maps on the NRW website show a worst case scenario and indicate that St Asaph is at risk of flooding resulting from a failure of either Llyn Aled or Llyn Aled Isaf. These two reservoirs lie some 30km upstream of St Asaph. There are no canals in this area and therefore no risk of flooding from a canal embankment failure.

Climate change is predicted to increase the frequency with which severe floods occur in St Asaph. Future climate change would both significantly reduce the standard of protection provided by the existing defences and increase the number of properties at risk from flooding.



Figure 9 – An otter sculpture in the park during the 2012 floods.



Figure 10 – view along the A525 during the 2012 floods

Photos taken by Alun Williams

Current approach to flood risk management

Measures to manage the probability of flood risk

The existing defences were operated and maintained by Natural Resources Wales and provided protection against flooding with a 1 in 50 (2%) annual event probability. NRW did not own any of the land on which the defences were built; existing landowners include private residential, commercial and public holdings.

Work undertaken by NRW includes:

- Operation of temporary defences by Spring Gardens Bridge and removal of mesh fence panels from the bridge during a flood warning.
- Mowing and repairs to the existing defences.
- Routine vegetation clearance and blockage removal from the channel.

Were this work to be discontinued:

- The condition of the existing defences would deteriorate, leading to eventual breach and failure over a period of around 15 years.
- Blockages of Spring Gardens and St. Asaph Old Bridge would occur which would hamper the flow of water within the river channel.

Measures to manage the consequences of flood risk

In the event of a flood warning, NRW would deploy temporary defences in the vicinity of Spring Gardens and remove mesh panels from Spring Gardens Bridge to reduce the risk of overtopping and blockage respectively. This raises the standard of flood protection to a 1 in 75 annual event probability in this location.

- NRW provides a flood warning service for the city - residents and businesses have to register for this service.
- A Community Flood Plan exists, which is implemented by the St Asaph Flood Action Group to manage the consequences of flooding.
- The St Asaph Flood Partnership Group was established in the aftermath of the November 2012 event and consists of representatives from NRW, Denbighshire County Council, St Asaph City Council, Welsh Water, other professional partners and members of the local community. The network includes local flood wardens to promote flood awareness and manage the consequences of flooding through the city. The network is maintained by the North Wales Flood Incident Management team to aid information passage during a flood event.

Considerations for the new flood risk management scheme

A study area for the Flood Risk Management Scheme was identified to ensure that all properties and land which could be affected by the scheme to reduce the flood risk could be considered. The full study area for the St Asaph Flood Risk Management Scheme spread along the River Elwy from properties at Wigfair Isaf in the south to Rhuddlan in the north - see **Figure 11**.

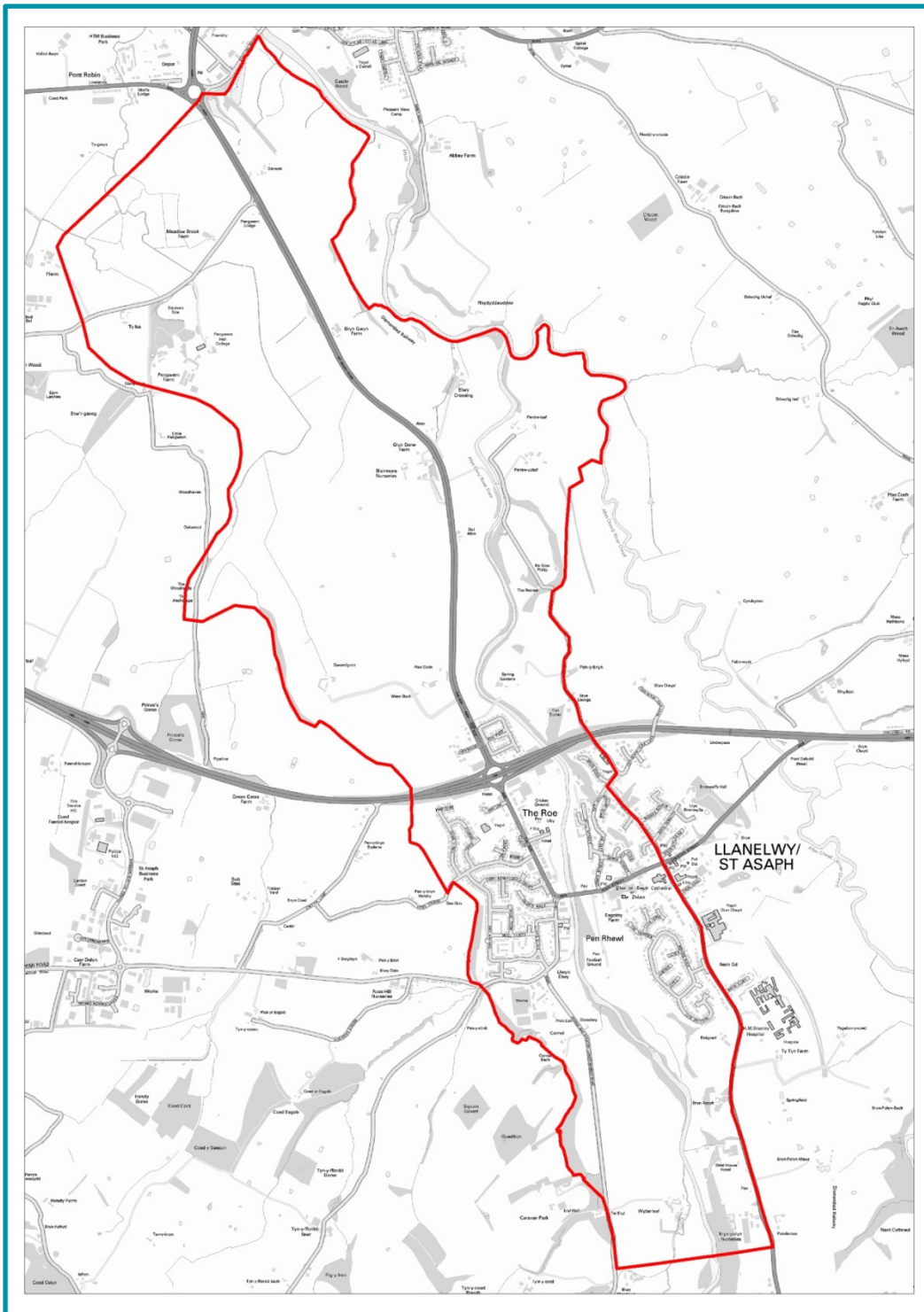


Figure 11 – St Asaph Flood Risk Management Scheme Study Area

Biodiversity

A total of 21 habitats were found to be present within the Study Area. Of note for their biodiversity value were:

- 6 ponds within 250 metres of the scheme which all appear to be potentially suitable for Great Crested Newts.
- All trees with ivy were considered to offer roosting habitat for individual bats as day roosts. A number of trees were identified as having high bat roost potential.
- The habitats within the study area were considered to be of high value to breeding birds and likely to support a diverse range of birds.
- A number of otter spraints were found throughout the survey area confirming that otters pass through the area.
- The River Elwy itself is likely to support an array of fish species including salmon, sea trout, eel and lamprey.

Invasive Species

Himalayan Balsam was present within the study area and had to be removed before work on the Flood Risk Management Scheme could commence.

Designations

There were no designated sites of international or national conservation importance in the study area.

There were three Local Wildlife Sites (LWS) located between 200-700m from the study area however these had no effect on the options considered.

There was a Site of Special Scientific Interest (Coedydd ac Ogofau Elwy a Meirchion SSSI) located 3km upstream from the study area.

Liverpool Bay Special Protection Area (SPA) is located 7km downstream from the study area. Special Protection Areas are special sites designated under the EU Birds Directive to protect rare, vulnerable and migratory birds.

Constraints

The study area contained the St Asaph Conservation Area and over 50 listed buildings in and around the city, notably, St Asaph Old Bridge – see **Figure 12**. The bridge crosses the Elwy within the scheme area and is an important landmark within the city being Grade 2 Listed and a Scheduled Ancient Monument. Existing flood defences are connected to the bridge. Works connecting to or affecting the setting of the bridge required Listed Building Consent to proceed.

All trees within the Conservation Area were protected and required permission from the Local Planning Authority for their removal.

Consultees:



Figure 12 - St. Asaph Old Bridge – A Grade 2 listed building and Scheduled Ancient Monument

Public consultation events have been held in St Asaph in February 2013, July 2013, December 2014, February 2016 and October 2016 in order to update the community on the developments of both short and longer term improvements. These events have been attended by people from across the Elwy catchment.

Further updates have been provided through newsletters, articles in the local journal and a dedicated page on the NRW website.

Options considered for the St. Asaph Flood Risk Management Scheme

The following options were considered as part of the St Asaph Flood Risk Management Scheme.

Option 1 - existing defences abandoned leading to failure

Option 2 - existing defences to be maintained to their current condition

Option 3 - all in-channel and bankside vegetation to be removed along the Elwy from St Asaph to its confluence with the River Clwyd to improve the flow of water within the river channel

Option 4 - existing defences raised, new defences built and Spring Gardens Bridge replaced

Option 5 - upstream storage together with improvements to the flood defence through the city where required

Task

A scheme is required to reduce both the present risk of flooding in St Asaph and allow for it to be managed for the effects of future climate change.

What would you do if you worked for NRW? Study the facts and the options and decide on the benefits and the constraints of each option.

Place them in order of merit and explain why you chose your first option over the other options.

Consider who you would need to consult and involve?

References

1 - UK Government Planning Practice Guidance

<http://planningguidance.communities.gov.uk/blog/guidance/flood-risk-and-coastal-change/planning-and-flood-risk/what-is-flood-risk/>

2 - Flood and Coastal Erosion Risk Management Handbook and Data for Economic Appraisal 2016

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1. Natural Resources Wales, Project Appraisal Report, St. Asaph Flood Risk Management Scheme, August 2015
2. A Galliford Try, Black & Veatch Joint Venture, St. Asaph Flood Risk Management Scheme Preliminary Ecological Appraisal Report
3. Natural Resources Wales, St. Asaph Flood Risk Management Scheme, Environmental Assessment Summary
4. Black & Veatch, St. Asaph Flood Risk Management Scheme Flood Consequence Assessment Report, August 2016

This document will be reviewed on an annual basis.

Acknowledgements

NRW would like to thank the following:

- Charlotte Lang
- Carwyn Hughes
- Tim Owen
- Marianne Jones
- Rob Green
- Eirian Gilford
- Staff yr adran cyfieithu
- Angharad Harris – Snowdonia National Park / Geography Association

The accompanying 'Solution' document for this case study can be found on the Education, Learning and Skills pages of NRW's website. You may also wish to refer to the 'St. Asaph November 2012 Floods Data Report' which can also be found on these pages.

Published in April 2017

Review due in April 2018

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