Cyfoeth Naturiol Cymru
Natural Resources Wales

St. Asaph Flood Risk Management Scheme Case Study

The Solution

Assessing the options for the Flood Risk Management Scheme

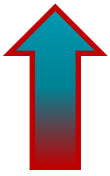
Each of the flood risk management options were assessed against the following criteria:

- **Technical** – does the option deliver an acceptable decrease in flood risk?
- **Environmental** – does the option give rise to any adverse or unacceptable environmental impacts?
- **Economic** – would the option attract sufficient funding so it could be delivered and maintained.

The option that was taken forward was Option 4 – existing defences raised and Spring Gardens Bridge replaced. See **Appendix 1** for a detailed outline of the chosen option. The option chosen was considered the most technically feasible, most economic and provides additional recreation and environmental benefits for the community.

Figure 1 – Table showing the different options that were assessed for the St. Asaph Flood Risk Management Scheme

Option	Description	Appraisal Technical	Environmental	Economic	Taken Forward?
1	Existing defences abandoned leading to failure	xx	√	xx	No
2	Existing defences are maintained to their current condition	x	U	xx	No
3	All in-channel and bankside vegetation is removed along the Elwy from St Asaph to its confluence with the River Clwyd to improve the flow of water within the river channel	x	xx	x	No
4	Existing defences raised, new defences built and Spring Gardens Bridge replaced	√√	U	√	Yes
5	Upstream storage together with improvements to the flood defence through the city where required	√	xx	xx	No

√√		Technically/ Economically/ Environmentally Feasible
√		
U		Neutral / No impact
x		
xx		Not Technically/ Economically/ Environmentally Feasible

The Flood Risk Management Scheme will provide a 1 in 200 (0.5%) annual event probability standard of protection against flooding with the defences being designed so they can be raised again in the future for climate change to maintain a 1 in 100 (1%) annual event probability standard throughout their design life (100 years).

To provide protection against flood detriment, a section of defences on Lower Denbigh Road were built to provide a 1 in 1000 (0.1%) annual event probability standard of protection to minimise the number of new properties at flood risk for the 1 in 1000 (0.1%) flood. Flood defence improvement works were also undertaken at Dol Afon and Rhuddlan to ensure no increase in flood risk downstream of the main scheme works.

Spring Gardens Bridge was recognised in the model as a control in the system during higher flows and therefore is to be replaced. The bridge was viewed locally as a primary cause of the flooding problems experienced in the city. The new level for the bridge is at or above the 1 in 100 (1%) annual event probability allowing for a 30% increase in flows in the future due to climate change.

Figure 2 – work in progress to replace Spring Gardens Bridge

The total Present Value (PV) benefits from the scheme were approximately £35 million.

Options discounted:

Option 1 - existing defences abandoned leading to failure.

Discounted as this would lead to danger to life and property and was deemed un-economic.

Option 2 - existing defences are maintained to their current condition.

Discounted as this would lead to danger to life and property and was deemed un-economic.

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

This option was discounted as it did not provide a sufficient reduction in flood risk and was also economically and environmentally unacceptable.

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

This option was discounted as it would be prohibitively expensive and could give rise to unacceptable environmental impacts.

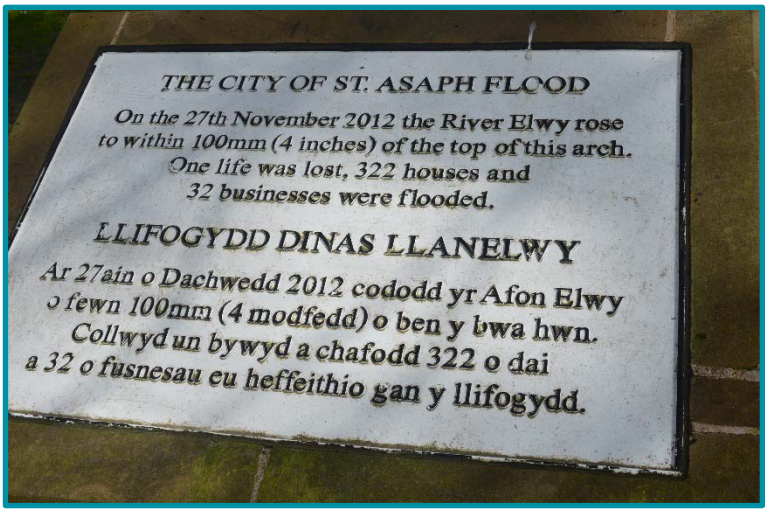


Figure 3 – Above - work in progress by the Old Bridge at St. Asaph

Figure 4 – Left, a plaque to remember the 2012 flood and the damage it caused

An increased Standard or Protection (SoP) for the commercial and residential properties of St. Asaph

St. Asaph had a recent history of severe flooding and as a result considerable pressure has been applied by the community and local politicians for works to be undertaken. The preferred option provides protection against the scale of event experienced in 2012 by providing a 1 in 200 (0.5%) standard of protection at present day reducing to a 1 in 100 (1%) Standard of Protection in 2025 due to increased river levels due to climate change.

The defences were designed so that they could be raised again in the future to maintain a 1% (1 in 100) annual event probability standard of flood protection to St Asaph. The scheme not only provided protection to 293 residential properties and 136 commercial properties, it also provided peace of mind to St. Asaph's vulnerable community.

Figure 5 presents projections for changes in river flows West Wales River Basin District over time and are applicable to the River Elwy at St. Asaph.

Forecast	Total Potential Anticipated Change in River Flow		
	Time period 1 - 2020s	Time period 2 - 2050s	Time period 3 - 2080s
Upper end estimate	+25%	+40%	+65%
Change factor	**+15%**	**+20%**	**+30%**
Lower end estimate	+5%	+10%	+10%

Figure 5 – Table demonstrating West Wales River Basin District Climate Change Allowances

Figure 6 lists the flows and adjusted magnitude for floods in St. Asaph for each climate change time period calculated using the change factor given in **Figure 5**, above.

Present Day		Time period 1 – 2020s (Flows + 15 %)		Time Period 2 – 2040's (Flows + 20%)		Time Period 3 – 2060's (Flows + 30%)	
Flow (m^3/s)	Magnitude of flood	Flow (m^3/s)	Magnitude of flood	Flow (m^3/s)	Magnitude of flood	Flow (m^3/s)	Magnitude
85	1 in 2	97	<1 in 2	102	<1 in 2	110	<1 in 2
113	1 in 5	130	1 in 5	135	1 in 5	147	1 in 2
134	1 in 10	154	1 in 5	161	1 in 5	174	1 in 5
165	1 in 25	190	1 in 15	198	1 in 10	215	1 in 10
192	1 in 50	221	1 in 25	230	1 in 25	249	1 in 15
210	1 in 75	241	1 in 40	251	1 in 35	272	1 in 25
223	1 in 100	256	1 in 55	267	1 in 45	290	1 in 30
243	1 in 150	280	1 in 80	292	1 in 65	316	1 in 45
258	1 in 200	297	1 in 105	310	1 in 85	336	1 in 60
323	1 in 500	371	1 in 300	387	1 in 250	420	1 in 170
385	1 in 1000	443	1 in 600	462	1 in 490	500	1 in 380

Figure 6 – Table showing the possible future impacts of climate change on the River Elwy at St. Asaph

Climate change is predicted to increase the frequency of extreme flood events. Taking the present day 1 in 200 (0.5%) annual event probability as an example (highlighted in yellow),

during time period 1 this becomes a 1 in 100 (1%) annual event probability and, by time period 3, is a 1 in 60 (1.66%) annual event probability. This means if a scheme is built for St Asaph providing a present day (2017) 1 in 200 (0.5%) standard of protection, this standard will diminish over the current century, unless there are further interventions, such as raising the defences to track the rate of climate change.

Figure 7 shows that future climate change will both significantly reduce the standard of protection provided by the existing defences and increase the number of properties at risk from flooding.

Figure 7 – Table showing the current and future flood risk in St. Asaph during a 1 in 200 annual chance flood

Year	Existing Defence Standard of Protection	Properties at risk during a 1 in 200 Annual Chance Flood	
		Residential*	Commercial*
Present day	1 in 50	293	136
2025	1 in 25	440 (+147)	162 (+26)
2040	1 in 25	454 (+161)	175 (+39)
2070	1 in 25	522 (+229)	185 (+49)
*change from present day indicated in teal text			

If the defences remained at their 2016 height, by 2070 the consequences for St Asaph would be:

- The city's defences would only provide a 6.7% (1 in 15) annual event probability.
- Some 520 residential and 180 commercial properties would be at risk in the 0.5% (1 in 200) annual event probability.

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Good for the environment

Scheme detriments

The key negative impact resulting from the Scheme has been tree loss along the river corridor to enable the construction of the Scheme. The loss of these trees impacted on local amenity value, landscape, fisheries, birds and bats. Whilst tree losses were minimised as far as possible through the design, some tree loss was inevitable due to the proximity of the existing defences to the tree lined river corridor. Approximately 80-90 trees were removed however more new trees were planted to compensate for the loss.

Figure 8 - several trees had to be removed along the river corridor to allow access for machinery to begin work on raising existing defences

Scheme benefits

New or extended defences where practicable were set back. For example to improve the appearance and setting of the St Asaph Old Bridge, a Grade II Listed Building and Schedule Ancient Monument (SAM), walls were set back immediately adjacent to the bridge and an existing high wall which encroached on the western arch of the bridge was removed, opening up this area. An interpretation board for St. Asaph Old Bridge Scheduled Ancient Monument was installed in collaboration with Cadw.

- Bird, bat boxes and otter holts were installed to increase the biodiversity in the project study area and coarse woody debris used to provide fish refuges.

- Landscaping of embankments and sowing of wild flowers seed mix within the recreation ground improved the appearance of the river corridor.

- Access to the river in a less formal manner was encouraged by reducing embankment slope gradient.

- Dual waste and litter bins were installed to help reduce the amount of litter along the riverbank.

- Tree and hedgerow planting were undertaken including the planting of native black poplars and the establishment of a community orchard

Good for people

- Existing foot and cycle paths that linked to the existing flood defences were widened, resurfaced and new lengths of footpath established along the embankment crests. New signage, separate lanes for cyclists and improved access ramp gradients were installed.

- Working in partnership with the Flood Risk Management Scheme contractor, opportunities were sought to work with local schools to raise pupils' awareness of the dangers of flooding and their understanding of the 2012 flood event at St. Asaph. Educational resources which could be used by educators based on the Flood Risk Management Scheme were produced and teacher training sessions on how to run them delivered by NRW Education and Skills staff.

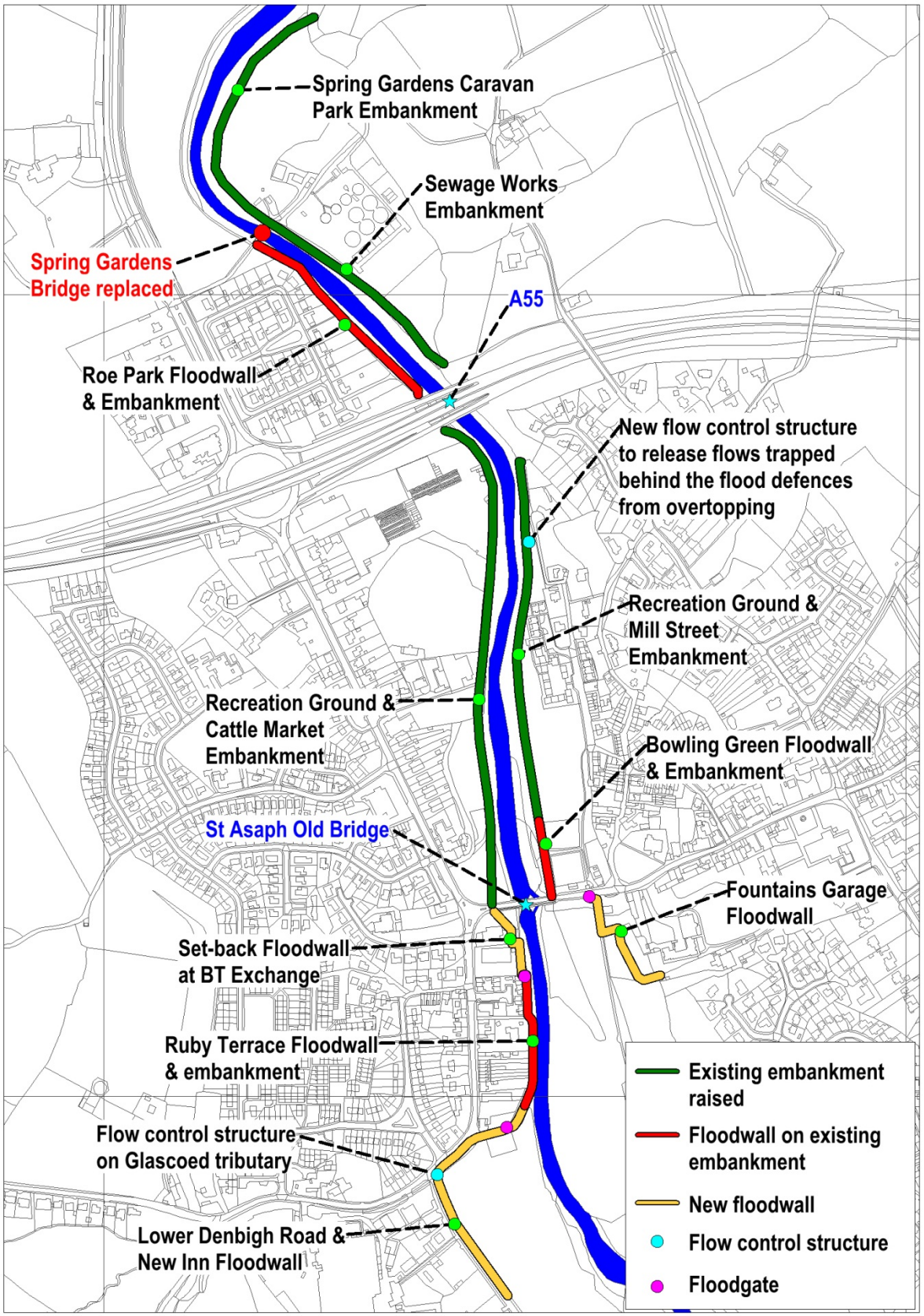
- A contribution was made towards the installation of sculptures along the river embankments to add to the appeal of the riverside walks.

Flood Risk Management Scheme Consultees:

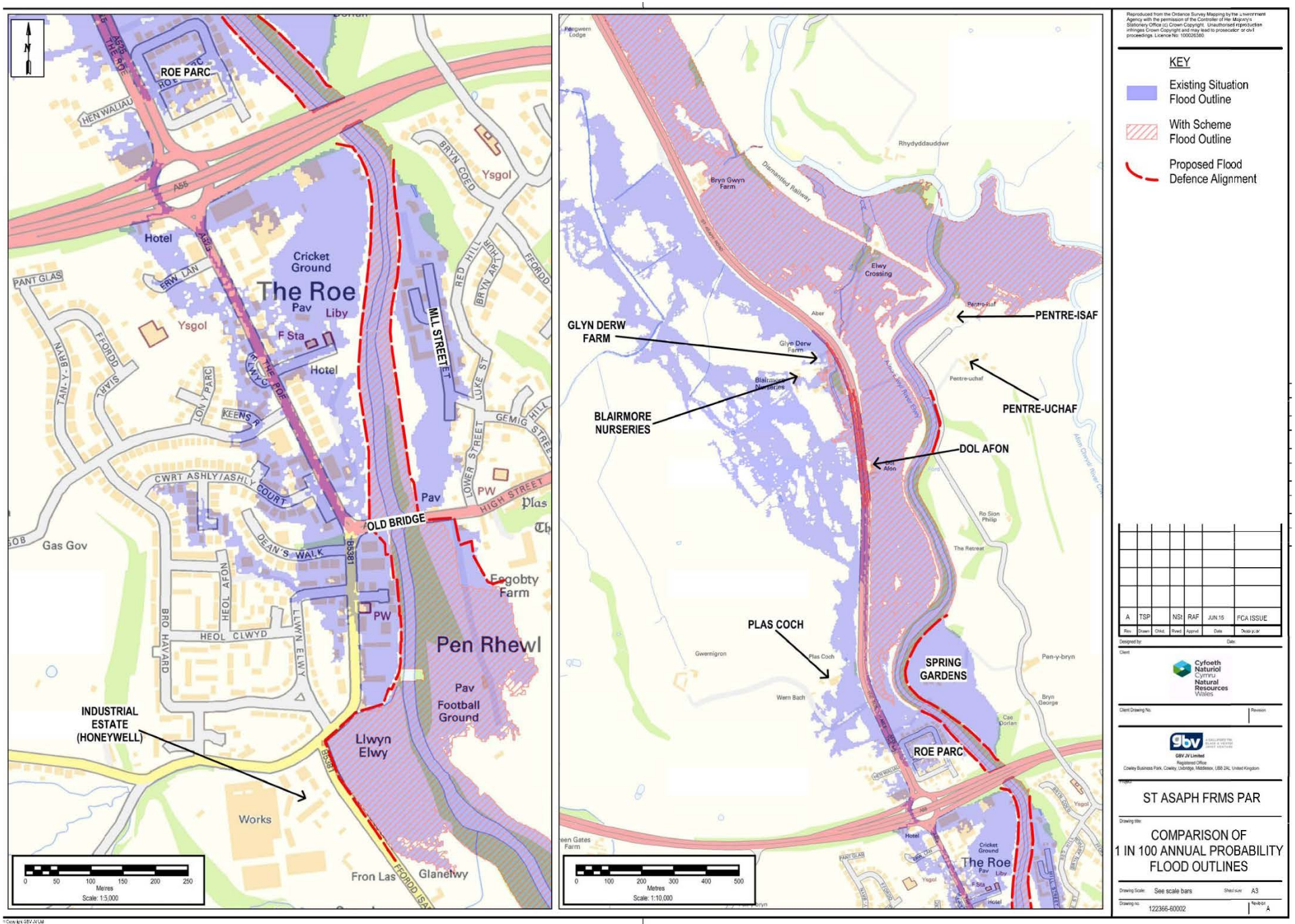
NRW consulted with the following as part of the Flood Risk Management Scheme:

- Affected landowners
- Afon Elwy Environmental group (AEEG)
- St Asaph City Council
- Clwyd and Powys Archaeological Trust (CPAT)
- Cadw
- Denbighshire County Council Archaeology, Conservation and Footpaths officers
- Rhyl and St Asaph anglers
- NRW Fisheries and Geomorphology teams
- NRW Biodiversity and Protected Sites teams
- Sustrans
- Service providers (BT, Dwr Cymru Welsh Water)

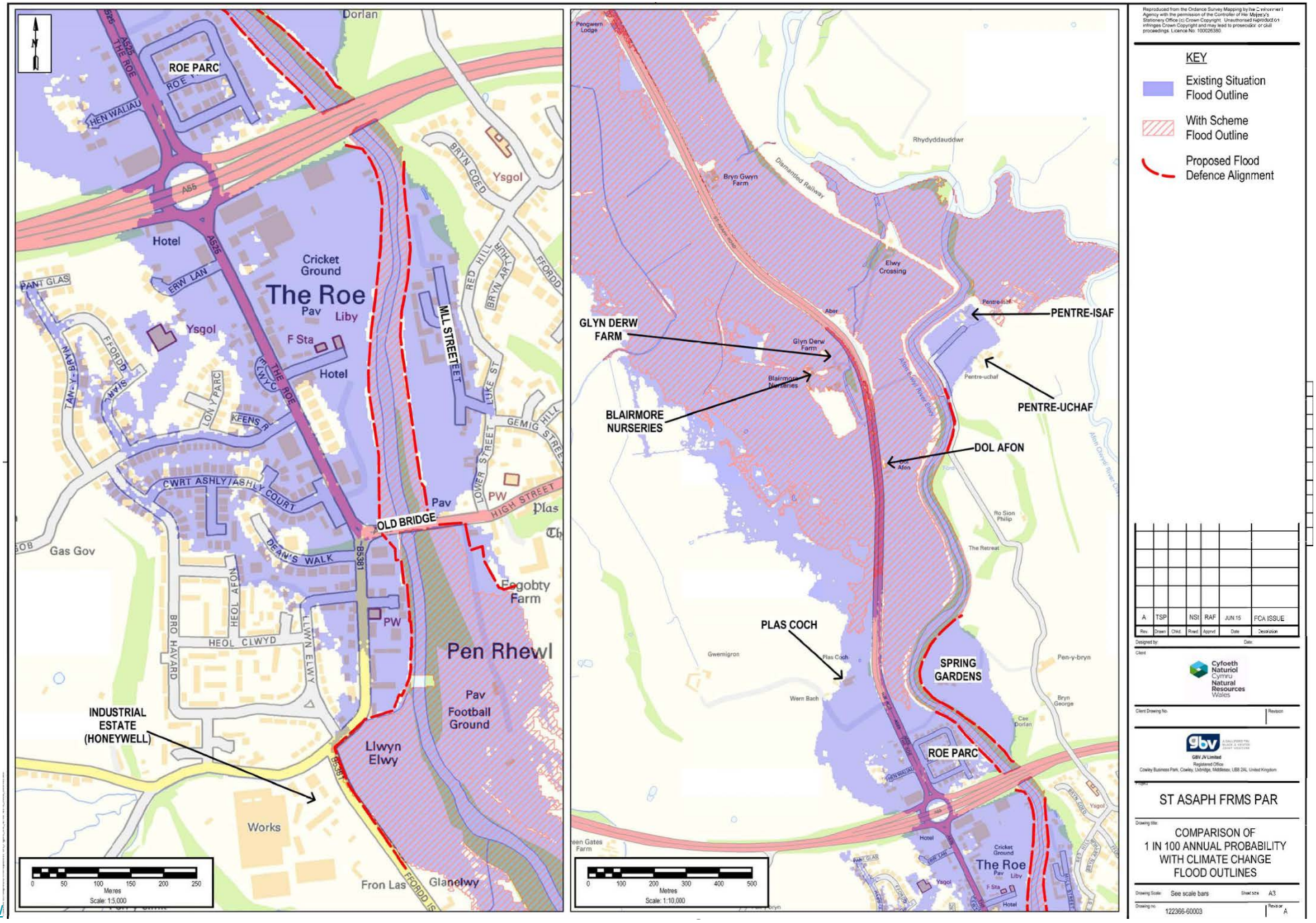
Appendix 1 - Detailed outline of the chosen option for the St. Asaph Flood Risk Management Scheme



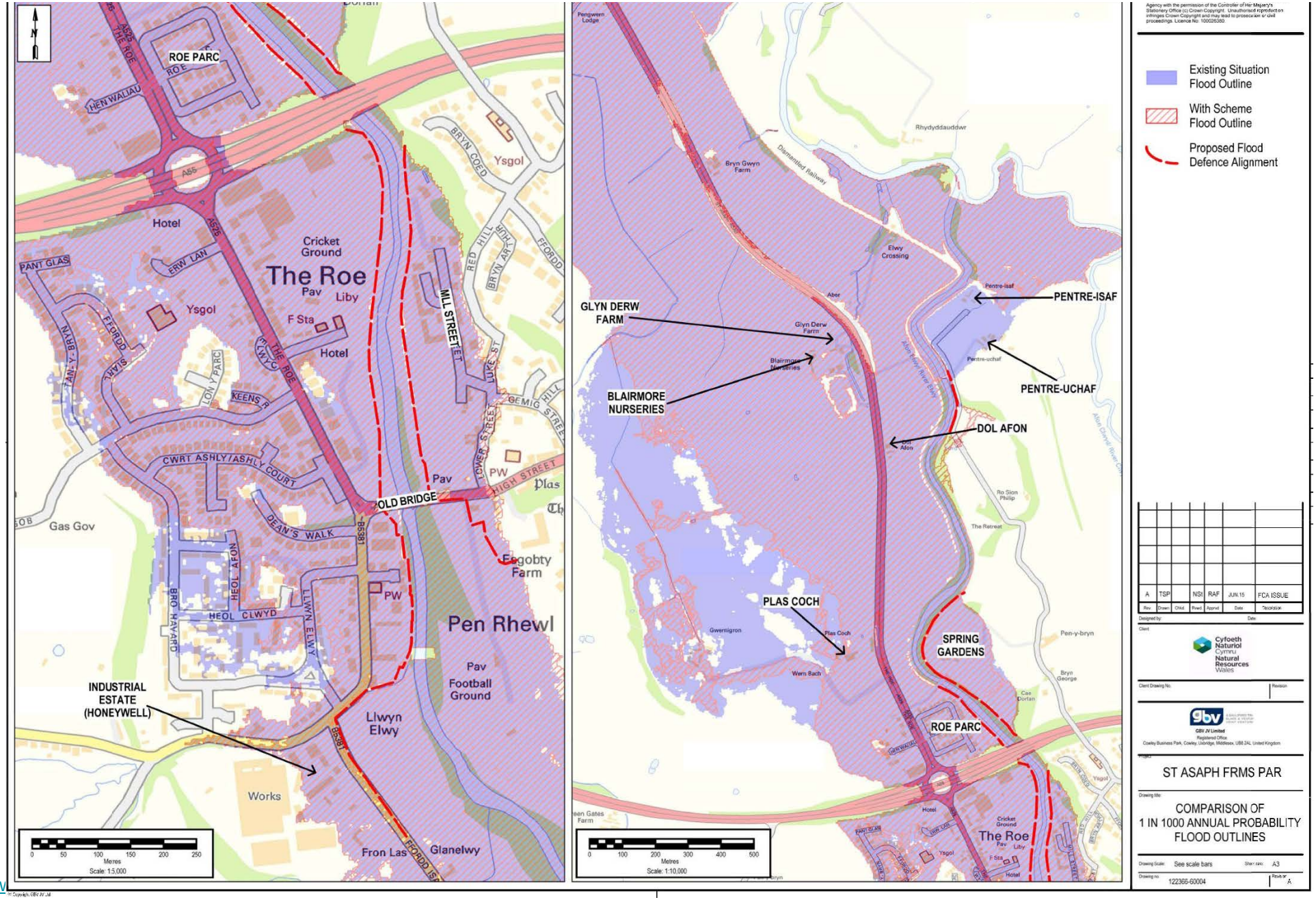
Appendix 2 - Comparison of 1 in 100 annual probability flood outlines



Appendix 3 - Comparison of 1 in 100 annual probability with climate change flood outlines



Appendix 4 - Comparison of 1 in 1000 annual probability flood outlines



Explanation of Appendices 2 – 4

Appendices 2 and 3 compare the flood outlines from the existing situation with the flood defence scheme for the 1 in 100 annual probability flood and climate change scenario (flows increased by 20%) respectively.

By containing larger floods in-bank than is currently the case however, it is inevitable that more flood water will be conveyed downstream at a faster rate and this could have an impact on thirds parties. Mitigation works were undertaken to ensure no increase in flood risk to properties downstream of St Asaph.

Downstream of St Asaph flooding continues to occur, but to a lesser extent than pre-Flood Risk Management Scheme. This is because flows overtopped the defences in the city and would continue on the floodplain to affect properties downstream. Raising the defences in the city therefore provided a slight reduction in flood risk to some areas located downstream of the city.

Appendix 4 demonstrates the extent of flooding as a consequence of a catastrophic flood, a 1 in 1000 (0.1%) annual probability flood. The flood defences are now overtopped and as a consequence much of St Asaph is shown to be flooded. The flood outline is generally slightly reduced on the left-bank side through St Asaph with a significant reduction in the flooding of farmland downstream of the A55. There is an almost slight increase in the flood outline through the industrial estate at the upstream end of the proposed defences on the left-bank side and a very slight increase in the flood outline along the right-bank side principally along Lower Street, Luke Street and Mill Street.

Mitigation work to ensure no flood risk detriment through St Asaph for the 1 in 1000 annual chance flood was not practicable. This would require construction of defences to provide a 1 in 1000 annual chance standard of flood protection throughout the city. A scheme of this type would be too expensive to construct and generate significant local environment, landscape and heritage impacts.

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The accompanying ‘Task and Problem’ 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.

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