

Wrexham County Borough Council – Western Gateway FCA

Final Report

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GLOSSARY OF TERMS

Term	Meaning / Definition
AEP	Annual Exceedence Probability (of a flood event expressed as a percentage)
CFMP	Catchment Flood Management Plan
CIRIA	Construction Industry Research and Information Association
DAM	Development Advice Map (published by the Welsh Assembly Government)
Development Advice Zone A	Used to indicate that justification test is not applicable and no need to consider flood risk further
Development Advice Zone B	Used as part of a precautionary approach to indicate where the site levels should be checked against the extreme (0.1%) flood level. If site levels are greater than the flood levels used to define adjacent extreme flood outline there is no need to consider flood risk further
Development Advice Zone C	Used to indicate that flooding issues should be considered as an integral part of a decision making by the application of the justification test including the assessment of consequence
Development Advice Zone C1	Used to indicate that development can take place subject to the application of the justification test including acceptability of consequences.
Development Advice Zone C2	Used to indicate that less vulnerable developments should be considered subject to the application of the justification test, including the acceptability of consequences. Emergency services and highly vulnerable developments should not be considered.
EA	Environment Agency
EAW	Environment Agency Wales
EFO	Extreme Flood Outline (Boundary of floodplain associated with a flood event with a probability of occurrence of 0.1%)
FCA	Flood Consequence Assessment
FFL	Finished Floor Level
LPA	Local Planning Authority
m AOD	metres above Ordnance Datum
PPS	Planning Policy Statement
PPW	Planning Policy Wales
S105	Section 105 of the Water Resources Act 1991
SFRA	Strategic Flood Risk Assessment
SMP	Shoreline Management Plan
SuDS	Sustainable Drainage Systems
TAN 15	Technical Advice Note 15: Development and Flood Risk (July 2004)

1 Introduction

1.1 Proposal

Wrexham Council Transport and Asset Management Department seek to develop an area of land (Wrexham Western Gateway) along Ruthin Road, Wrexham. The development proposals are for both residential and non residential use including the provision of a new link road and realignment of the existing Croesnewydd Road.

1.2 National planning policy

The land use planning system regulates development and land use in the public interest, with the aim of ensuring sustainable development which balances environmental, economic and social needs of society both now and in the future. In Wales, a series of planning policy technical advice notes provide advice on a number of subjects. Technical Advice Note 15 (TAN 15) aims to reduce, or at the very least avoid increasing, flood risk by ensuring an integrated approach to land use planning and flood risk management. To achieve this, local authorities are responsible for controlling development, including that in the floodplain which may be affected by flooding, or where changes in runoff may increase flood risk elsewhere.

Developers are required to provide an assessment demonstrating the following (after TAN15):

- ◆ The consequences of flooding on the development
- ◆ The consequences (i.e. the overall impacts) of the development on flood risk elsewhere within the catchment for a range of potential flooding scenarios up to that flood having a probability of 0.1%.
- ◆ That appropriate mitigation measures can be incorporated within the design of the development to ensure that development minimises risk to life, damage to property and disruption to people living and working on the site or elsewhere in the floodplain.

1.3 Environment Agency Wales Requirements

As a statutory consultee, Environment Agency Wales (EAW) has been consulted by the Local Planning Authority (LPA) regarding the proposed development. EAW has advised that the proposed development site is partially within Development Advice Zone C2 of the Development Advice Map (DAM) and that a Flood Consequence Assessment (FCA) is required for this part of the site.

EAW state that the criteria for undertaking the FCA are contained within Section 7 and Appendix 1 of TAN15.

The FCA should be forwarded by the LPA to EAW for further consultation.

Copies of the correspondence with EAW are included in Appendix C.

2 Existing Site

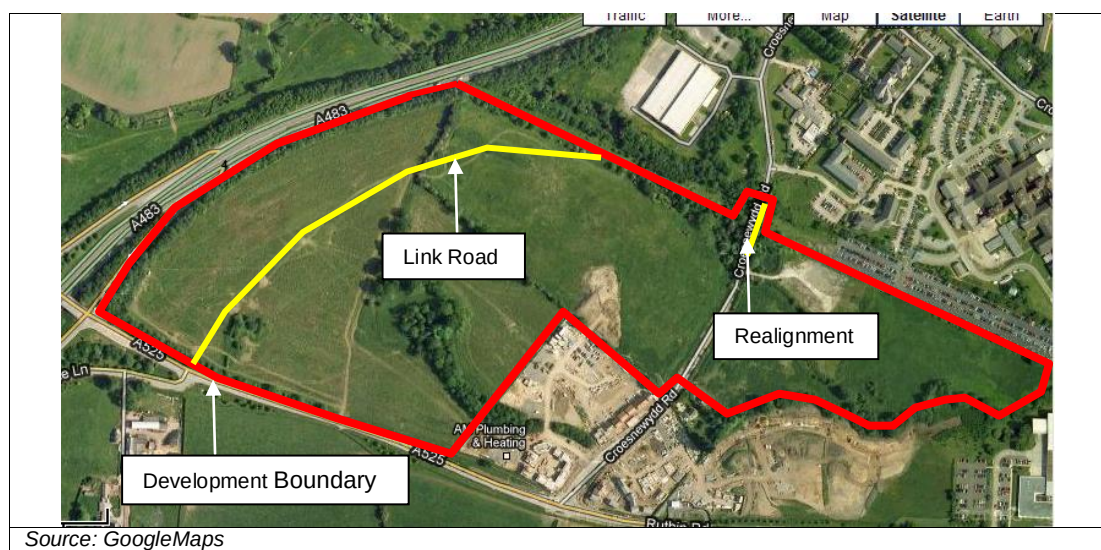
2.1 Introduction

The Wrexham Western Gateway development area lies immediately east the A483 at the junction with the A525. The area lies approximately 0.5km west of Wrexham.

The site is currently open fields but has recently undergone some residential development immediately south east of the development boundary as part of a Redrow Development.

The site location is shown in Figure 2-1.

Figure 2-1 Site Location Plan



2.2 Watercourses

There are 2 watercourses that flow through the proposed development site; the River Gwenfro north of the proposed development site and the small unnamed brook that drains into the Gwenfro in the southern portions of the proposed development site.

The River Gwenfro drains in a south east direction towards Wrexham before confluenting with the River Clywedog. The catchment is considered to be steep and is characterised by grazed pasture land. The catchment is predominately rural.

The small unnamed brook rises within an area bound by Ruthin Road, A483 and the disused railway. Another small tributary joins this unnamed watercourse along the right bank at the junction of Ruthin Road and Crosnewydd Road.

Examination of the published Environment Agency Flood Map (2010) (See Figure 4-1) suggests that the flood risk posed by this unnamed watercourse has been omitted from this map. From previous flood risk studies undertaken for developments within this area it is known that there is a potential risk of flooding. This has been examined as part of this FCA.

2.3 Groundwater

There has been no detailed ground investigation undertaken for this FCA.

2.4 Structures Affecting Local Hydraulics

There are a number of structures along both the River Gwenfro and the unnamed watercourse which have been examined as part of this FCA. These include;

- Structure running under the dismantled railway, River Gwenfro
- Structure underneath Croesnewydd Road, River Gwenfro
- Croesnewydd Road bridge, unnamed watercourse

2.5 Flood Defence Infrastructure

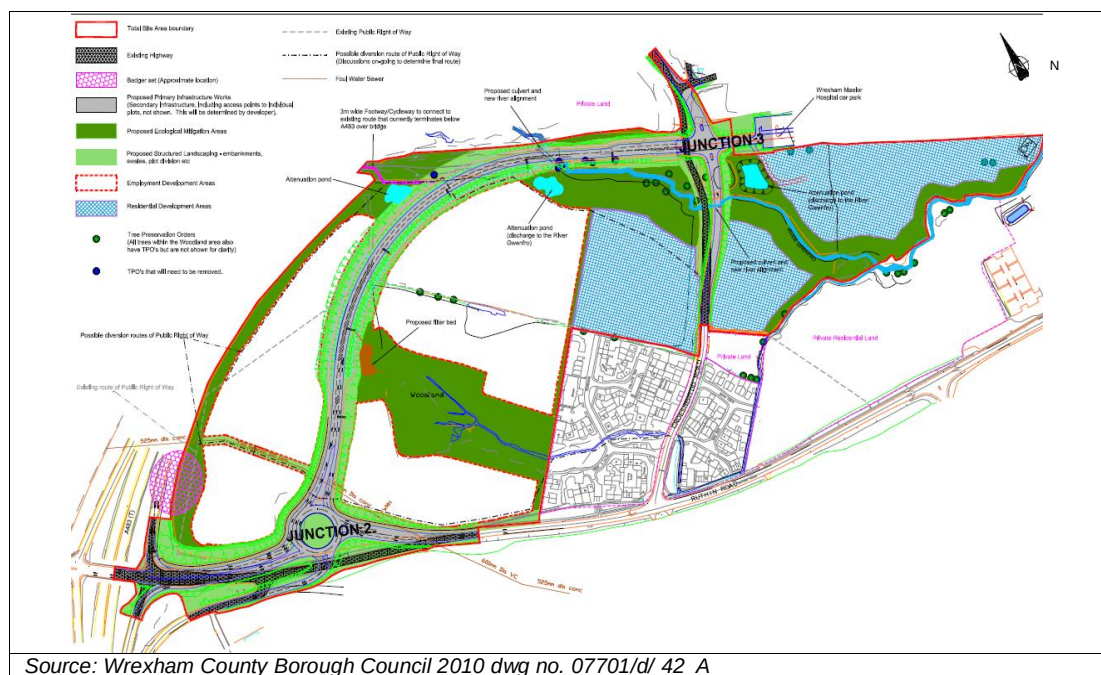
Examination of the Environment Agency Wales flood map suggests that this area is not served by any formal flood defence asset.

3 Proposed Development

3.1 Introduction

Wrexham County Borough Council proposed to develop the Wrexham Western Gateway site for both non residential use and residential use. Included in these proposals is the addition of a new access road running adjacent to the site, along the disused railway embankment across the River Gwenfro and to a new road junction immediately north of the site, including a realignment of Croesnewydd Road. The proposed development conceptual design is illustrated below.

Figure 3-1 Conceptual Design



Planning Policy Wales Technical Advice Note 15 (TAN 15): Development and Flood Risk sets out the policy in relation to development and flooding. This document categorizes land use based on the consequences of flooding to a particular site. TAN 15 classifies industrial, employment and commercial development as less vulnerable and residential use as highly vulnerable.

3.2 Surface water drainage

There are no detailed proposals available for the surface water drainage systems that will service the development. Therefore, unless infiltration systems are proposed, it can be assumed that the proposed development will drain to the adjacent watercourse.

4 Flood Consequence Assessment

4.1 Introduction

A Flood Consequence Assessment, based on the currently available information, has been undertaken in accordance with TAN 15 which specifies a number of criteria that must be met to justify development within the floodplain. It is considered that development of the site can be justified on the basis that the proposed development satisfies the land use planning criteria specified in TAN 15. This section of the FCA aims to confirm that the potential flood risk consequences of pursuing the development are acceptable.

The Flood Consequence Assessment (FCA) will identify:

- ◆ The flooding hazards which may affect the proposed development or where the development may increase flood risk elsewhere;
- ◆ Whether the proposed development could affect the integrity of a flood defence, or obstruct access to watercourses or flood defence assets for operation and maintenance;
- ◆ Whether the development could increase runoff;
- ◆ Suggest appropriate mitigation measures, where appropriate, to manage any flood risk resulting from the development of the site.

4.2 Potential flood hazards

The potential flood hazards identified within this FCA, their impact on flood risk at the site and possible mitigation measures that could be implemented to manage or reduce the flood risk is given in the sections below.

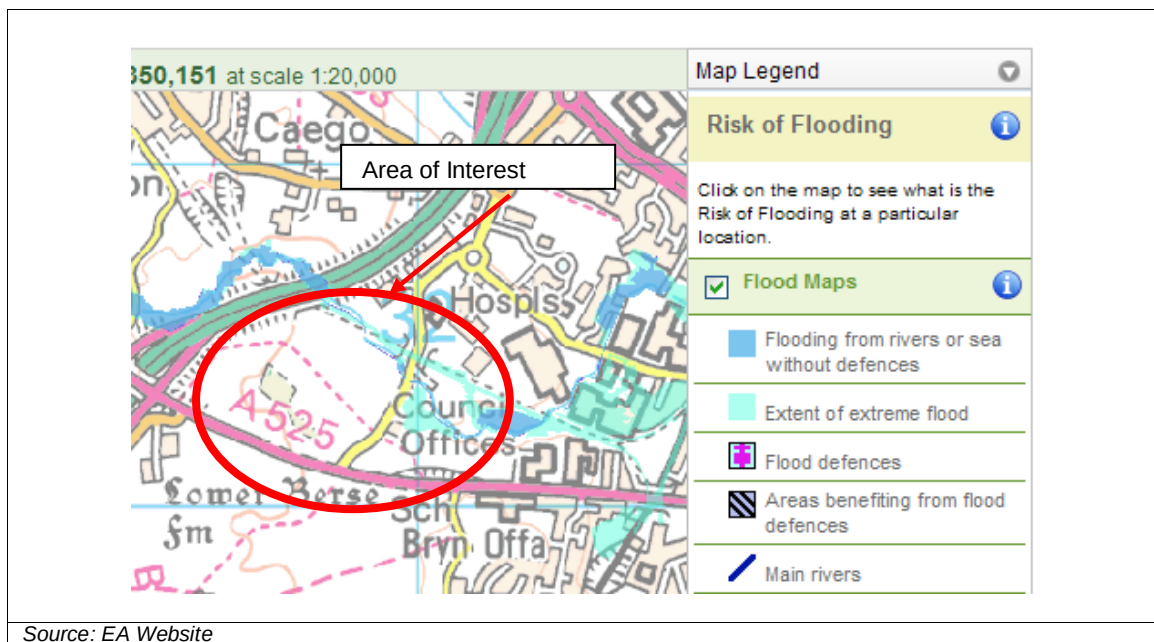
4.2.1 Flood Risk

Flood Risk Mapping

Inspection of the available flood risk mapping published by EAW indicates a portion of the footprint of the proposed development site is within the 1% AEP flood outline. The plot is also within the Extreme Flood Outline (EFO). The extent of the 1% AEP outline (shown in blue) and the EFO (shown in light green), in relation to the site, are shown in Figure 4-1. The EA flood map also indicates that the site is located outside of the area defended from flooding by formal flood defences. This area, under TAN 15, is known as Zone C2 – areas of floodplain without significant flood defence structure.

Only less vulnerable development should be considered in Zone C2 subject to application of the justification test, including acceptability of consequences. Emergency services and highly vulnerable development should not be considered. Industrial, employment or commercial development is classified as less vulnerable development.

Figure 4-1 EA Flood Risk Map



Historic Flood Data

Historical flood risk information has been requested from Environment Agency Wales but no information has been received.

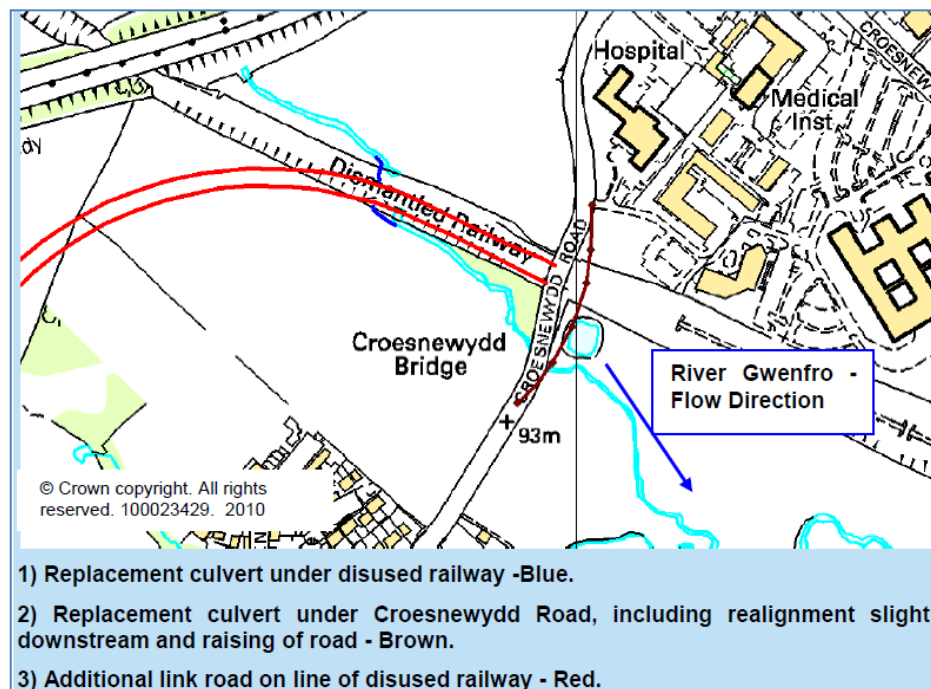
Fluvial Flood Risk (River Gwenfro)

In September 2010 JBA Consulting was commissioned by Wrexham County Borough Council to provide detailed hydrodynamic modelling of the River Gwenfro in the vicinity of the proposed development site, more specifically to assess the impact on flood risk of the proposed changes of the structures under the dismantled railway and the Croesnewydd Road as they traverse the River Gwenfro including the small diversion works as the watercourse approaches these new structures. The output of this work has formed the basis of this FCA assessment.

The modelling work utilised an existing 2d hydrodynamic model undertaking updates to incorporate proposed changes to the 2 structures (Figure 4-2).

Details of the dimension changes can be found in the Afon Gwenfro Western Gateway FCA Modelling Report undertaken by JBA 2010. This report forms part of the Appendix to this FCA report.

Figure 4-2 Proposed Model Changes (JBA 2010)



The JBA modelling exercise set out to establish base line conditions of the existing flood risk to the proposed development and the resultant changes made as a result of the proposed works.

It is clear from the JBA modelling assessment that changes in both flood flow route and flood extent area are apparent, particularly for the 0.1% AEP event.

Figure 4-3 below illustrates the change in flood flow path associated with the proposed changes at Croesnewydd Road. The changes are apparent for the 0.1% AEP along the disused railway downstream of Croesnewydd Road. This includes slight increases in flood extent in the flood plain also downstream of Croesnewydd Road. This change in flood flow route associated with the proposed changes to Croesnewydd Road is only apparent at extreme events and does not result in development of additional flood flow routes. It must also be noted that the JBA modelling suggests that the cutting off of this flood flow route does not have any adverse effects on flood risk off the proposed development site i.e. downstream of the proposed development boundary. Any changes to the flood extent are contained within the development boundary. The JBA modelling report indicates that for the 1% and 1%+CC events there are only very localised changes to the flood extent at the structures.

The modelling of the addition of the link road along the disused railway embankment again shows only small localised changes to the flood extent at the 0.1% AEP and again these changes are concentrated within the development boundary (Figure 4-4). The flood risk envelope at the 0.1% AEP is predominantly confined to the north of the proposed link road.

The JBA modelling report indicates that for the 1% and 1%+CC AEP events there is no difference to the flood extent as a result of the link road.

JBA have also provided indications on proposed levels of the link road. In order to provide dry access and egress from the development area, road levels along the link road should be set at a minimum of 96.05m AOD.

Figure 4-3 Predicted Flood Extents for the 0.1% AEP Event – Existing Case with new Croesnewydd Road Embankment (JBA 2010)

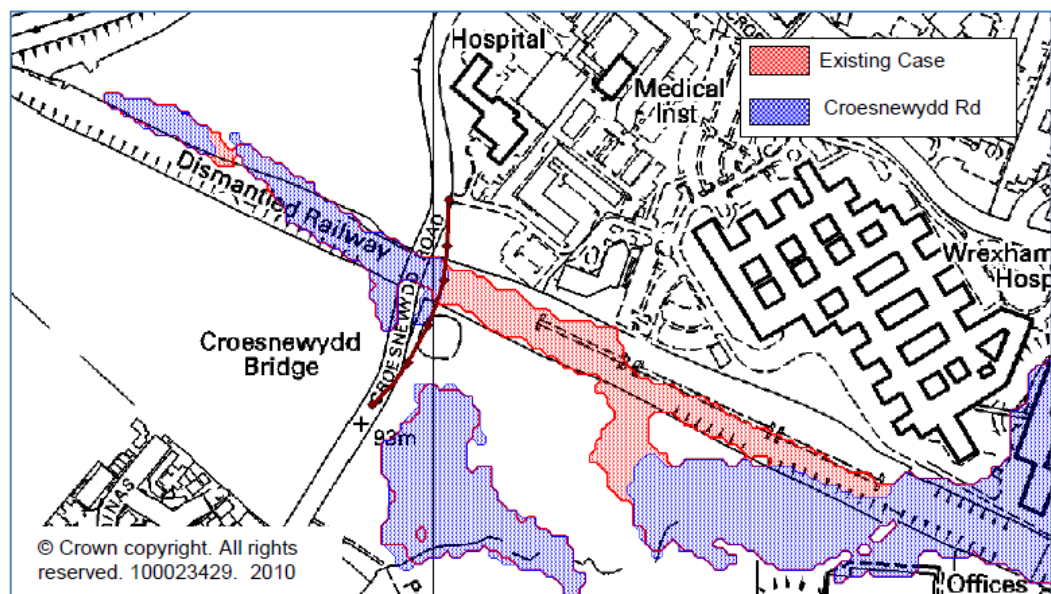
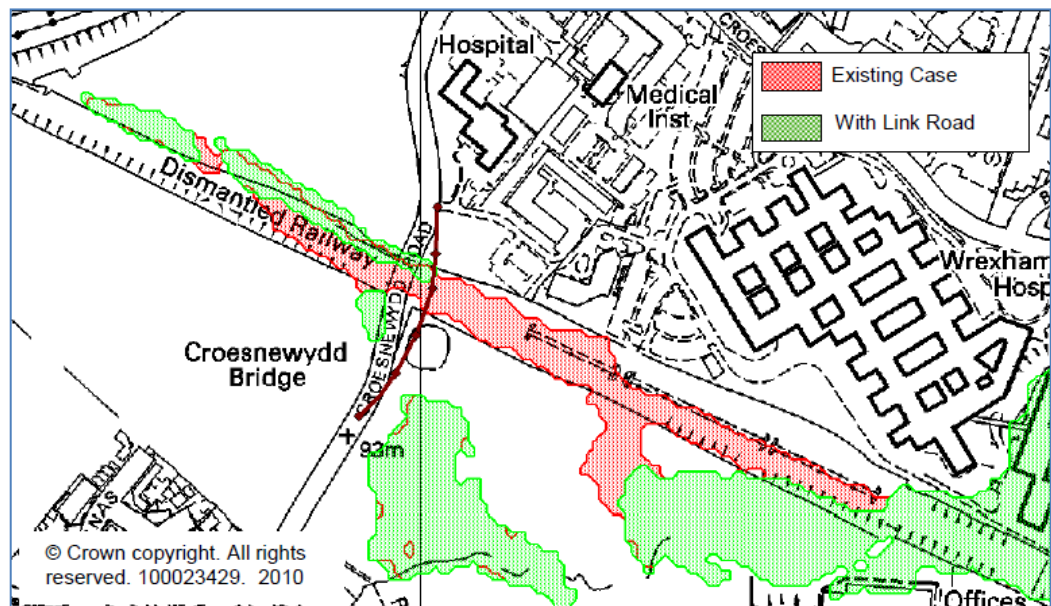


Figure 4-4 Predicted Flood Extents for the 0.1% AEP Event – Existing Case with new Croesnewydd Road Embankment with Link Road (JBA 2010)



The proposed flood extents for the 1%, 1%+CC and 0.1% AEP events are shown in the figures below. The predicted flood extent includes the additions of the link road and Croesnewydd Road proposals.

Figure 4-5 Predicted Flood Extent for 1% AEP Event (JBA 2010)

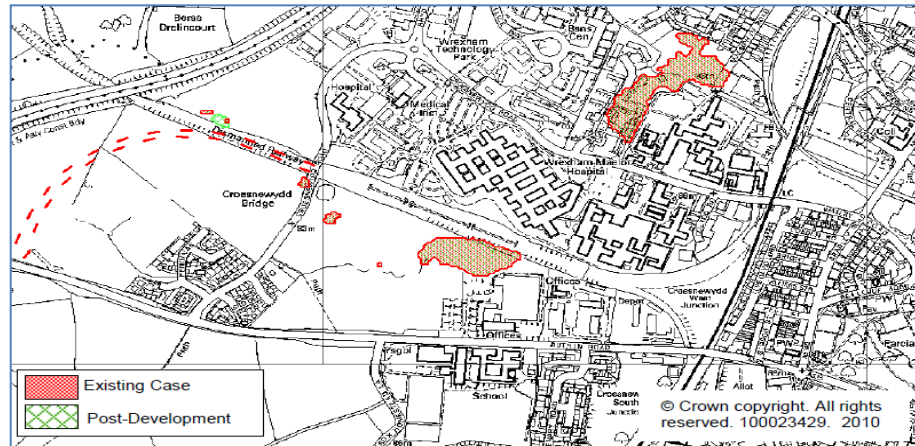


Figure 4-6 Predicted Flood Extent for 1%+CC AEP Event (JBA 2010)

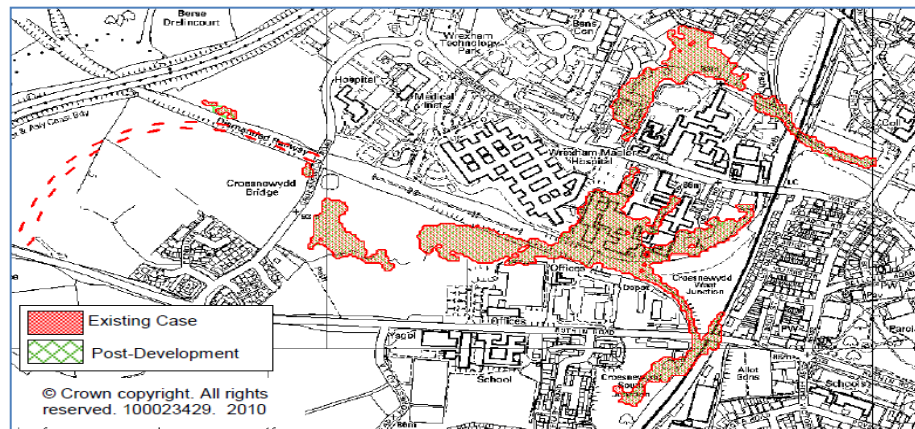
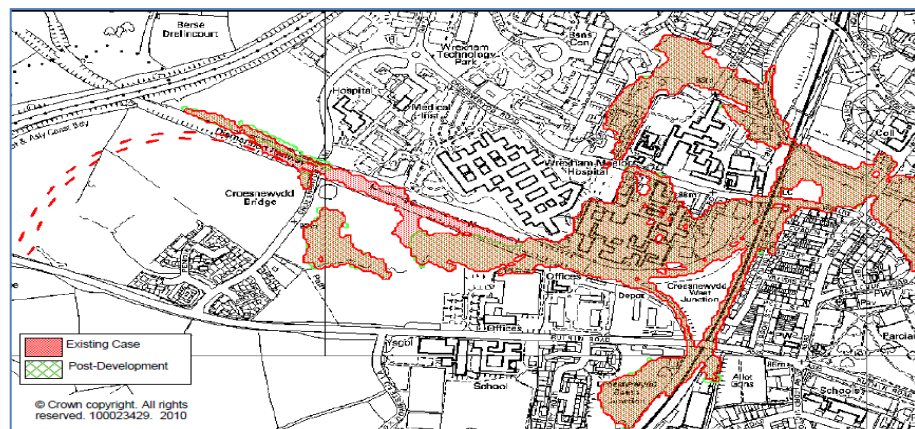


Figure 4-7 Predicted Flood Extent for 0.1% AEP Event (JBA 2010)



The JBA modelling suggests that for the 1% and the 1%+CC AEP events only very localised water levels changes in the vicinity of the proposed structures are predicted.

Details of exact layout of the proposed development and its buildings are not available at this stage. What is apparent is that the proposed foot print of the areas

allocated for residential development fall within Zone C2 (1% AEP) flood risk outline. This highly vulnerable development classification would have to be planned within the land allocated for residential development in such a way that it lies outside such areas or at least any proposed finished floor levels are set above the 1% +CC level. Zone C2 is used to indicate that less vulnerable developments should be considered subject to the application of the justification test, including the acceptability of consequences. Emergency services and highly vulnerable developments should not be considered.

The employment areas of the proposed development site seems to lie within Zone A of the development advice map and as such are not affected by any fluvial flood risk. The conceptual design drawing illustrated in Figure 3-1 provides adequate easement out of the flood risk zones in this area.

Fluvial Flood Risk (Unnamed Watercourse)

In September 2005 Faber Maunsell undertook a FCA for Redrow Homes as part of a proposed residential housing development immediately south of the site. This development has since been constructed.

As part of the Faber Maunsell FCA the report examined the fluvial flood risk to the site posed by the unnamed watercourse. The upstream limits of this watercourse are located within the development boundary of the Western Gateway development boundary from the unnamed watercourse.

In combination with the current masterplan proposals for the Western Gateway development and the conclusions of the 2005 Faber Maunsell FCA it is apparent that there is no direct fluvial flood risk to any proposed development inside the Western Gateway development boundary from the unnamed watercourse.

The Faber Maunsell FCA suggests that any overtopping of this watercourse will occur along its left bank downstream of Croesnewydd Road and not in the upstream portions of the unnamed watercourse which lie within the Western Gateway development boundary.

4.2.2 Increased runoff

There are no detailed proposals available for the surface water drainage systems that will service the proposed development. There are also no details available at this stage on both housing numbers and buildings for employment so detailed calculation of post development runoff cannot be calculated. There will however be an increase in impermeable area and potential surface water runoff. The development must seek to provide storage or flow attenuation for any additional runoff associated with development.

With an increase in impermeable area the runoff rate at the site is likely to increase. SUDS, for example porous car parking, dry swales and attenuation ponds can be incorporated into the surface water drainage system for the development and these will reduce the volume of water discharged to any existing sewer system and reduce the overall flood risk in the area. The selection of appropriate techniques will depend on the soil conditions across the site but are likely to include one or more devices that either store runoff to reduce the rate of discharge to the sewer system or allow infiltration into the ground to replicate the natural drainage of the site. Site investigations and soakaway tests will be carried out at the detailed design stage to identify the ground conditions and the most appropriate sustainable drainage technique. Soakaway tests will be carried out in accordance with BRE 365 and water treatment elements will be included in the detailed design of the site using C697 - The SUDS Manual.

If infiltration is not feasible then attenuation ponds located in public areas can be used to store and attenuate runoff.

Based upon the information available at this time, it is likely that standard SUDs techniques, such as those identified within this section, will be appropriate for the site and can be adopted in full or part to manage surface water runoff from the site. During the detailed design of the site, the type, operation and maintenance of the SUDs should be determined.

While surface water runoff will increase with any proposed development, the mitigation measures proposed for the site will ensure that the discharge from site will not increase, and as such there will be no increased risk elsewhere.

4.3 Compensatory Storage

It is apparent that both the employment zones and the proposed works to the link road and Croesnewydd Road do not fall within the current flood plain and so there are no recommendations to provide compensatory storage for loss of natural flood plain.

The conceptual design suggests that the realignment of Croesnewydd Road will fall within the small attenuation pond immediately downstream of the road. There are proposals to relocate this pond. Any relocation will have to provide like for like attenuation volumes in an effort to prevent a reduction in possible storage of surface water runoff in this area.

Any location of residential housing within the floodplain will require proposals for compensatory storage to be undertaken. This will ultimately depend on development footprint and depth of flooding in these areas. Once more detail is available and masterplanning has been finalised, areas of compensatory storage for these areas can be defined if required.

4.4 Further work

The FCA is based on the information currently available. Further work is required to assess flood risk at the development site when development proposals are confirmed.

5 Conclusions and Recommendations

5.1 Conclusions

A Flood Consequence Assessment has been carried out for the Wrexham Western Gateway site, to determine the potential flood risk associated with proposals. The process has followed TAN 15, 'Development and Flood Risk'.

The following conclusions can be drawn from the work completed:

- ◆ Small portions of the development area are within Zone C2
- ◆ Both Highly Vulnerable development and Less Vulnerable development are proposed for the development site
- ◆ The foot print of the areas allocated for residential development site within Zone C2.
- ◆ Changes in the flood flow path at the 0.1% AEP along the disused railway downstream of Croesnewydd Road and slight increases in flood extent in the flood plain also downstream of Croesnewydd Road are apparent as a result of the proposed changes to Croesnewydd Road.
- ◆ Peak water levels of 93.43m AOD is modelled at the inlet of the new Croesnewydd Road culvert during a 0.1% AEP design event compared with the new soffit level of 93.69m AOD.
- ◆ JBA modelling suggest that the cutting off of this flood flow route does not have any adverse effects on flood risk off the proposed development site i.e. downstream of the proposed development boundary. Any changes to the flood extent are contained within the development boundary.
- ◆ The JBA modelling report indicates that for the 1% and 1%+CC events there are only very localised changes to the flood extent at the structures.
- ◆ The JBA modelling report indicates that for the 1% and 1%+CC events there is no difference to the flood extent as a result of the link road.
- ◆ The JBA modelling suggest that for the 1% and the 1%+CC AEP events only very localised water levels changes in the vicinity of the proposed structures are predicted for both the link road proposals and the re alignment of Croesnewydd Road
- ◆ JBA have also provided indications on proposed levels of the link road. In order to provide dry access and egress from the development area, road levels along the link road should be set at a minimum of 96.05mAOD.
- ◆ In combination with the current masterplan proposals for the Western Gateway development and the conclusions of the 2005 Faber Maunsell FCA of the unnamed watercourse it is apparent that there is no direct fluvial flood risk to any proposed development inside the Western Gateway development boundary.
- ◆ The Faber Mausell FCA suggests that any overtopping of this watercourse will occur along its left bank downstream of Croesnewydd Road and not in the upstream portions of the unnamed watercourse which lie within the Western Gateway development boundary.

5.2 Recommendations

The recommendations of this report are:

- ◆ Residential development would have to be planned within the land allocated for residential development in such a way that it lies outside Zone C2 or at least any proposed finished floor levels are set above the 1% +CC level. Zone C2 is used to indicate that less vulnerable developments should be considered subject to the application of the justification test, including the acceptability of consequences. Emergency services and highly vulnerable developments should not be considered.
- ◆ There will be an increase in impermeable area and potential surface water runoff. The development must seek to provide storage or flow attenuation for any additional runoff associated with development.
- ◆ SUDS in the form of porous car parking, dry swales and attenuation ponds can be incorporated into the surface water drainage system for the development and these will reduce the volume of water discharged to the existing sewer system and reduce the overall flood risk in the area.
- ◆ Any relocation of the attenuation pond will have to provide like for like attenuation volumes in an effort to prevent a reduction in possible storage of surface water runoff in this area
- ◆ The design of the proposed buildings should include, where practicable and applicable, appropriate flood proofing measures.

6 Appendices

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<i>Appendix A:</i>	<i>CONCEPTUAL DESIGN</i>
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<i>Appendix B: JBA MODELLING REPORT</i>
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Afon Gwenfro Western Gateway FCA Modelling

Final Report

September 2010

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Revision History

Revision Ref / Date Issued	Amendments	Issued to
Initial Draft Report (18/12/09)		Paul Sleeman
Draft Report (22/09/10)	Model & report update based upon revised design detail	Robert Browning
Final Report (27/09/10)	Minor Updates.	Robert Browning

Contract

This report describes work commissioned by Paul Sleeman on behalf of Wrexham County Borough Council, by a letter dated 5th November 2009. Krista Davies of JBA Consulting carried out this work.

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Purpose

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Executive Summary

This document describes the modelling work that has been undertaken to identify the change in flood risk from the River Gwenfro that may arise as a result of proposed changes to the existing structures running underneath the dismantled railway and Croesnewydd Road. Two options were also considered regarding changes to ground levels in this area:

1. Croesnewydd Road will be raised on an embankment above the existing levels; this option includes the modifications to the culverts. The new embankment stretches for approximately 100m to the south of the culvert and 150m to the north.
2. As above but also including a new proposed link road running along the course of the disused railway and intersecting with Croesnewydd Road a short distance to the north of the new structure on the Afon Gwenfro.

The key outcomes from the study are:

- The 1% and 1%+CC events show only very localised water level changes in the vicinity of the revised structures between scenarios.
- In the 0.1% AEP event the flow path along the disused railway from Croesnewydd Road to the hospital has been cut off and an additional $1.8\text{m}^3/\text{s}$ passes through the Croesnewydd Road culvert as a result. This has some local implications on flows and levels but the impact does not continue into the hospital site and Wrexham town centre.
- Adding the proposed link road causes some additional local changes in flood extent but again these do not propagate further downstream. No flood water is predicted to flow across the new link road provided that the road level is configured at or above 96.05mAOD.
- A peak water level of 93.43m is modelled at the inlet of the new Croesnewydd Road culvert during a 0.1% AEP design event compared to the proposed new soffit level of 93.69mAOD. No water is predicted to flow over the raised Croesnewydd road.

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Table 3-2: 0.1% Water levels and flows at various locations in Wrexham	

Abbreviations

Abbreviation	Meaning
AEP	Annual Exceedance Probability
ASTSWF	Areas Susceptible to Surface Water Flooding
CEH	Centre for Ecology & Hydrology
DTM	Digital Terrain Model
DEM	Digital Elevation Model
LIDAR	Light Detecting and Ranging
TUFLOW	2 Dimensional Modelling Software

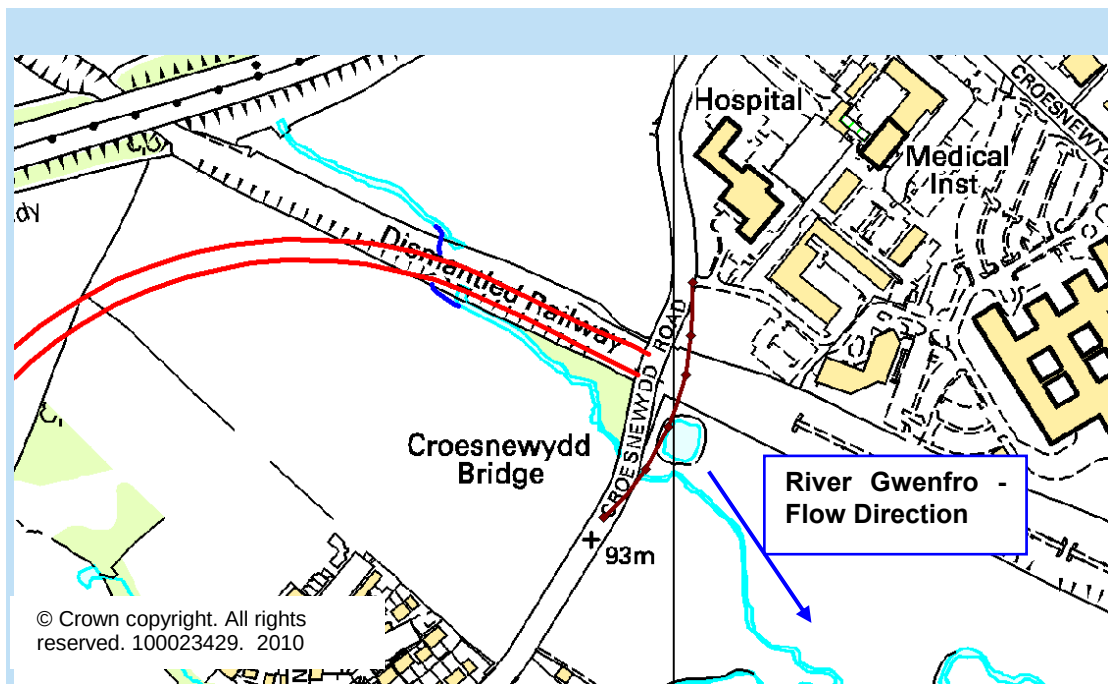
1. Introduction

1.1 Purpose and Scope of Study

This document describes the modelling work that has been undertaken to identify the change in flood risk from the River Gwenfro that may arise as a result of proposed changes to the existing structures running underneath the dismantled railway and Croesnewydd Road (Figure 1-1). This data will be used as part of a Flood Consequence Assessment (FCA) that will be submitted by Wrexham County Borough Council (WCBC) to support their proposal for a new spine road. The study will assess the impact of proposed changes to the structures during the 1%, 1% plus climate change and 0.1% AEP events.

The modelling work undertaken has used the existing ISIS-TUFLOW model of the River Gwenfro developed by JBA Consulting for Environment Agency in 2008 as part of a Floodplain Mapping Study. The study used a 1D ISIS model to represent the Afon Gwenfro river channel and a 2D TUFLOW model to improve the representation of the floodplain. The modelling extends downstream of the A483 road crossing, through Wrexham to the confluence of the Afon Gwenfro with the Afon Clywedog at Kings Mills. Further details about the model can be found within the Afon Gwenfro Modelling Report¹.

Figure 1-1: Proposed Changes to the Croesnewydd Road Area



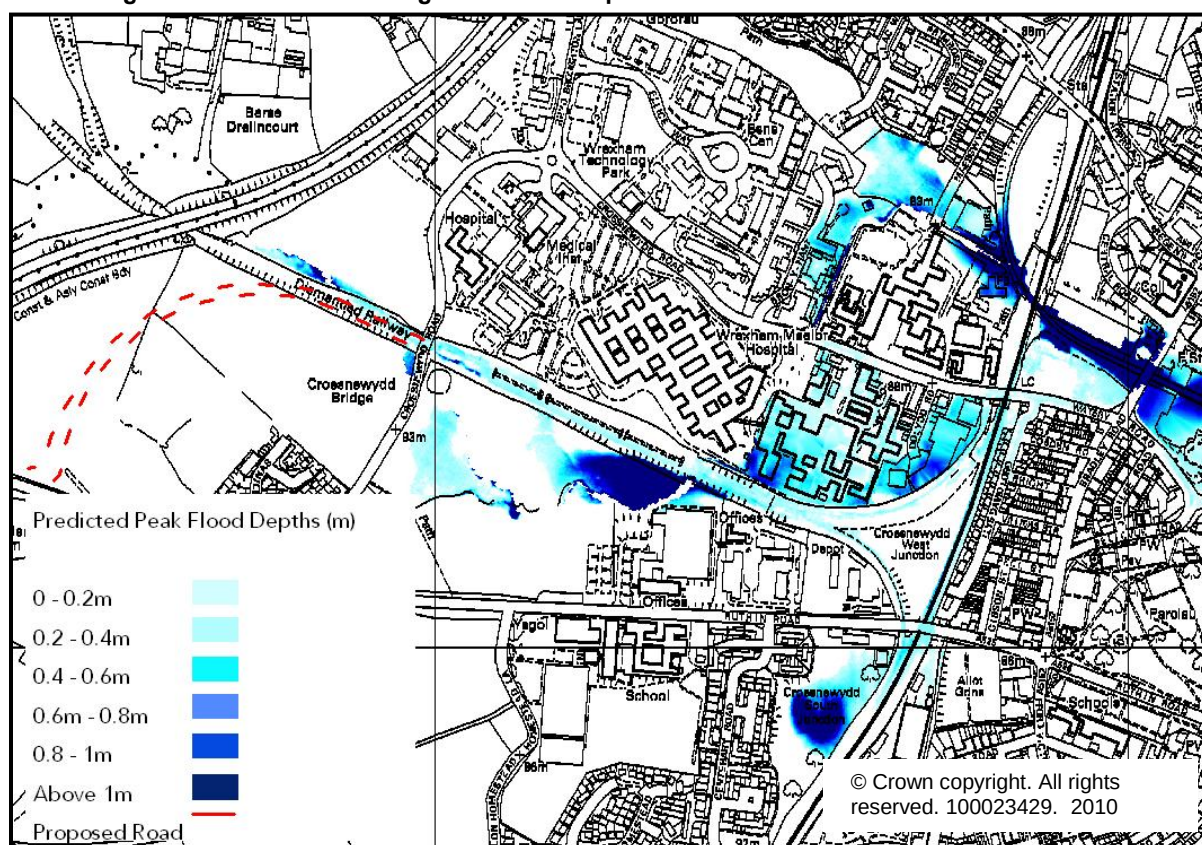
- 1) Replacement culvert under disused railway - Blue.
- 2) Replacement culvert under Croesnewydd Road, including realignment slightly downstream and raising of road - Brown.
- 3) Additional link road on line of disused railway - Red.

¹ Environment Agency Wales. Afon Gwenfro Flood Risk Mapping Study, Final Report (February 2009).

1.2 Existing Flood Risk

The existing flood risk during the 0.1% AEP event in the vicinity of the proposed road crossing is shown in Figure 1-2 below.

Figure 1-2 Predicted Existing Case Flood Depths for the 0.1% AEP Event



This shows that there is only a limited flood risk identified to the area upstream of Croesnewydd Road although the dismantled railway is shown to be an important flow route during the event, conveying floodwater downstream.

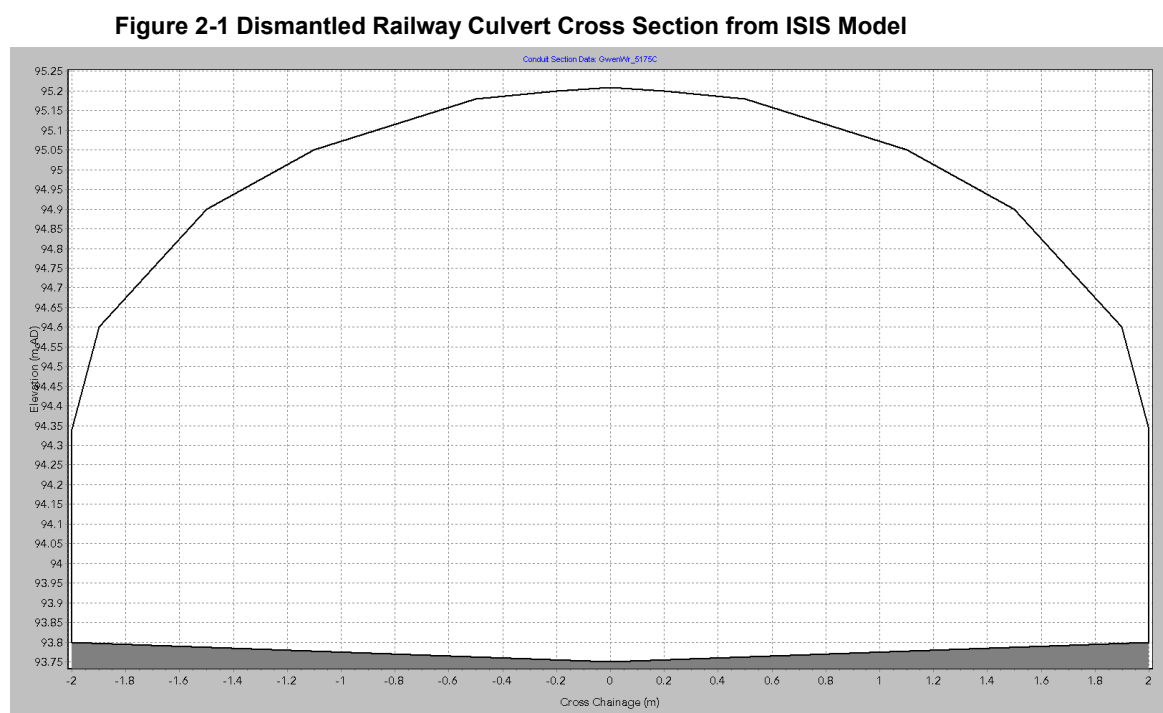
2. Updating the model

The sections below describe the existing representation of both structures within the model and the updates made to represent the proposed culverts.

2.1 Culvert underneath the Dismantled Railway

2.1.1 Existing case representation

Within the model, the culvert running underneath the dismantled railway is modelled as a 27m long culvert using a culvert inlet and outlet unit and symmetrical conduit units to define the barrel of the structure. This is shown in Figure 2-1 below.



The representation of the structure within the model compares favourably to the existing structure information provided on the proposal drawings prepared by WCBC, although the opening area has been calculated as 5.22m² compared to the 3.0m² detailed in the proposal drawings, this is shown in Figure 2-2 overleaf. The modelled area was based on site survey used in the Environment Agency model so has been retained with a 5.22 m² opening for this modelling exercise.

2.1.2 Representation of the Proposed Diversion Channel

The model has been updated to include a short diversion channel that will divert the Gwenfro away from its original course approximately 20m upstream of the existing structure to the new culvert that will be at a different alignment. A short reach of diversion channel is also needed at the downstream face. The geometry of the diversion channel has been defined using cross section drawings provided by WCBC. These are shown in Figure 2-3 to Figure 2-5 below.

Figure 2-2 Proposed Culvert at Dismantled Railway

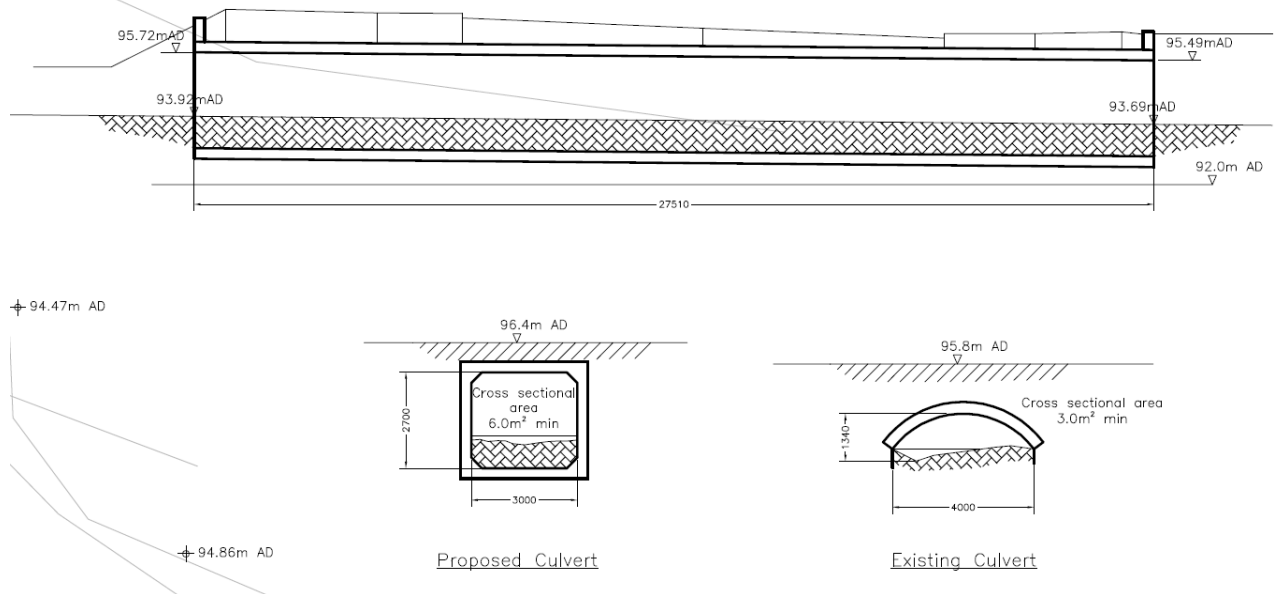


Figure 2-3 Location of Diversion Channel Sections

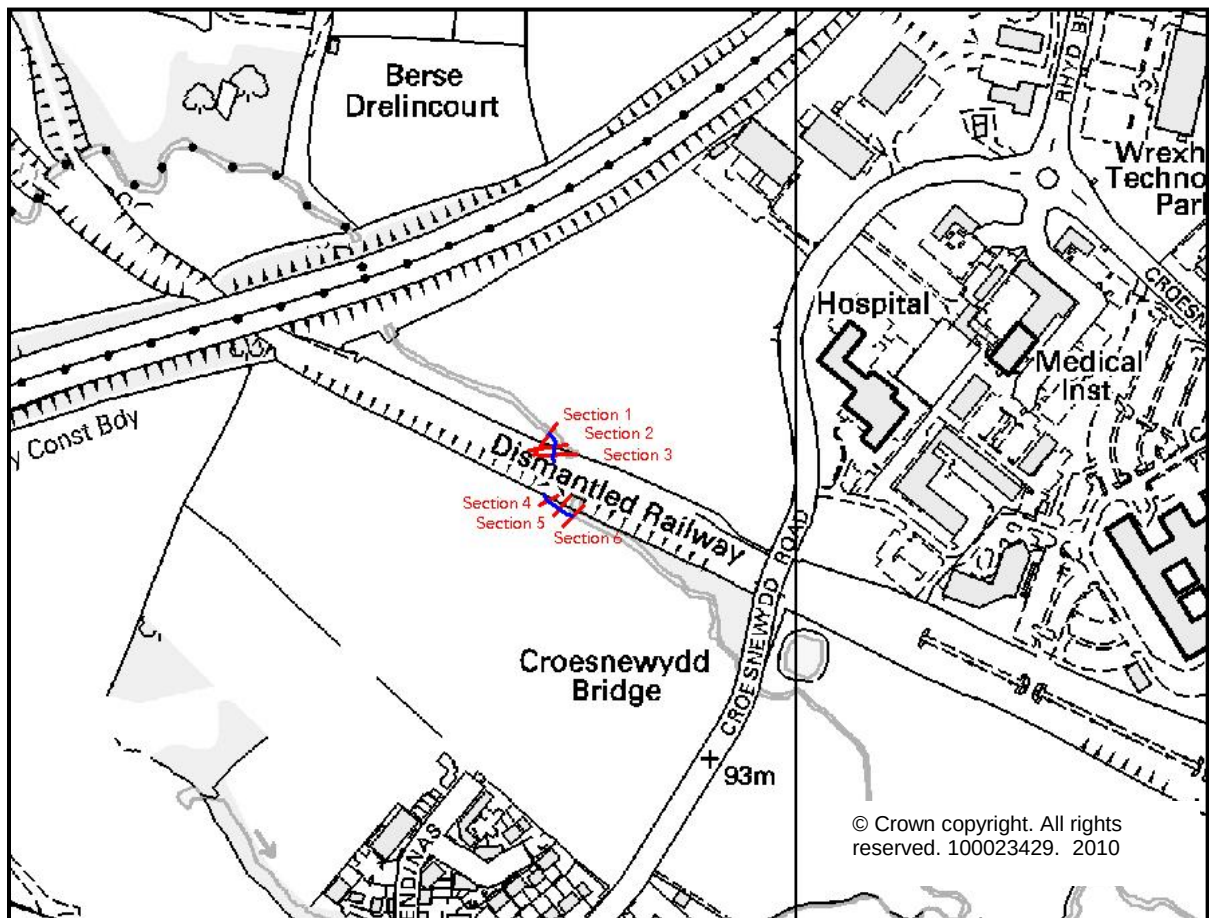


Figure 2-4 Proposed Diversion Channel Sections Upstream of the Dismantled Railway (looking upstream)

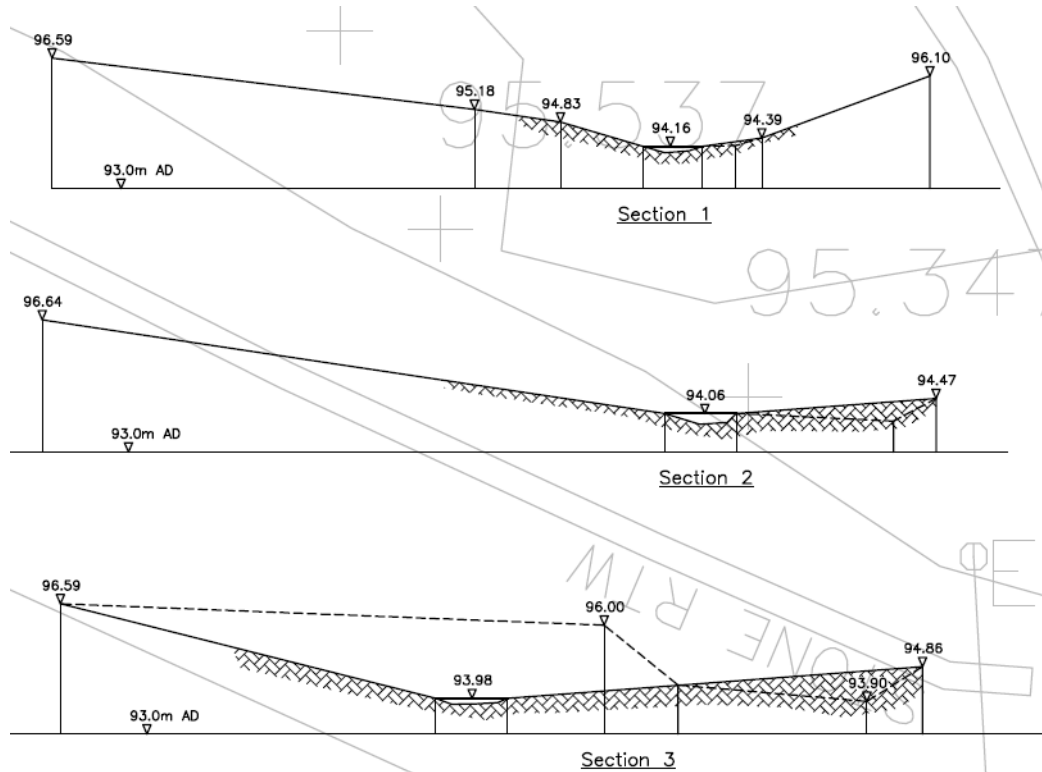
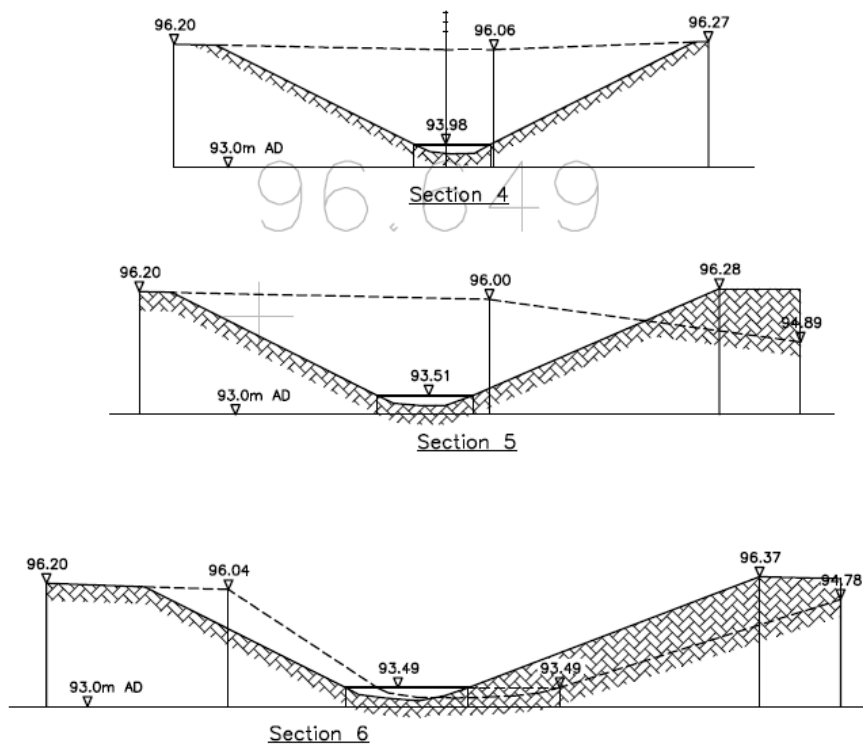


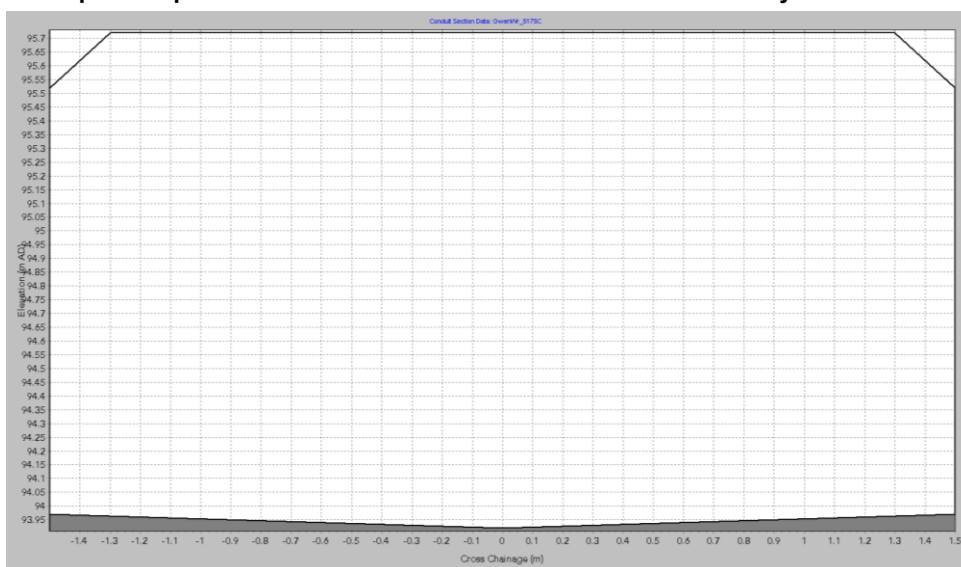
Figure 2-5 Proposed Diversion Channel Sections Downstream of the Dismantled Railway (looking upstream)



2.1.3 Representation of the Proposed Culvert

The proposed culvert underneath the dismantled railway has been included in the model by updating the geometry data within the symmetrical conduit units used to define the barrel of the existing culvert and replacing the culvert inlet unit already included in the model with an orifice unit. The proposed culvert width and the invert and soffit levels marked on the proposed long section (shown in Figure 2-2) have been used to define the 27.5m long culvert. The upstream face of the culvert barrel included in the model is shown in Figure 2-6 below.

Figure 2-6 Proposed Upstream Face of the Culvert at the Dismantled Railway included in the ISIS Model

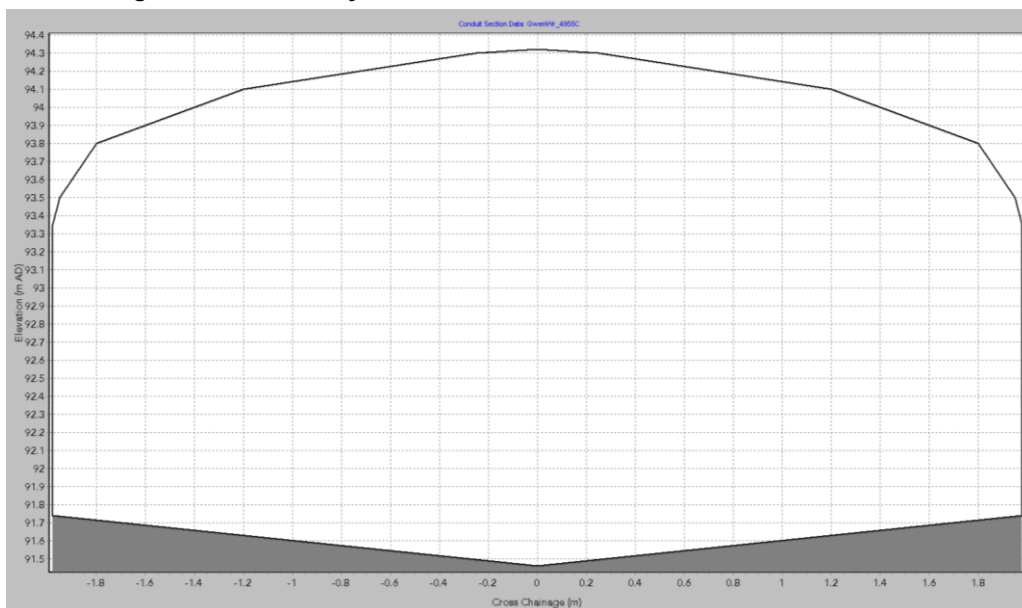


2.2 Croesnewydd Road Culvert

2.2.1 Existing case representation

Within the existing ISIS model, the Croesnewydd Road crossing is modelled as a culvert using culvert inlet and outlet units and symmetrical conduit sections. The geometry of the structure included in the model is shown in Figure 2-7 below. It is 8m long. The cross sectional area of the structure has been calculated as 9.62m².

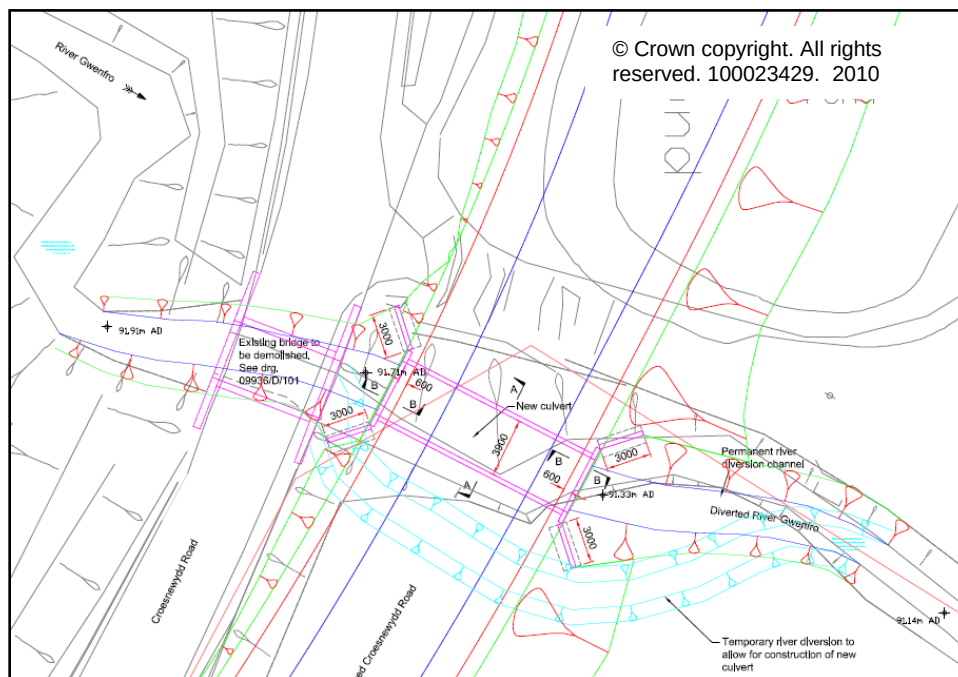
Figure 2-7 Croesnewydd Road Culvert Cross Section from ISIS Model

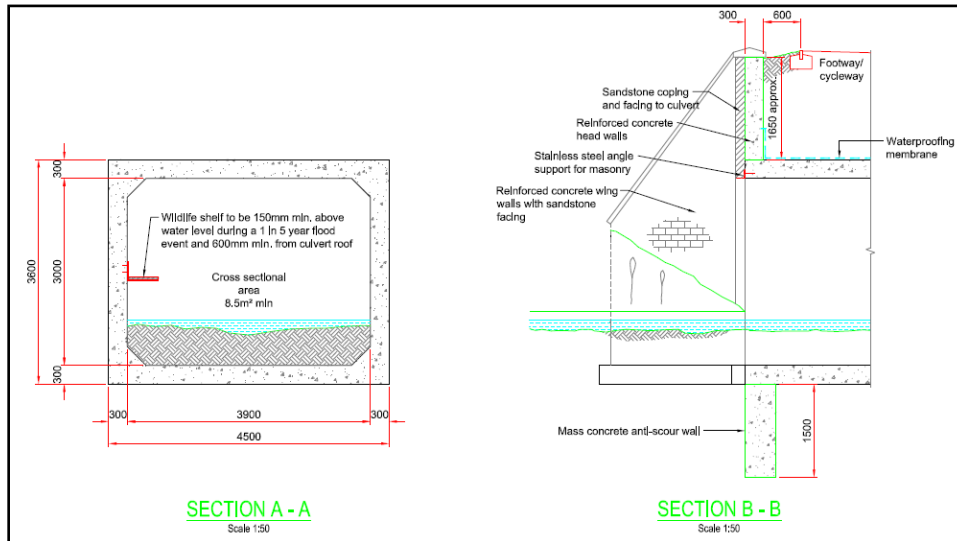


2.2.2 Proposed Culvert and Embankments

A new culvert and embankment is proposed to replace the existing Croesnewydd culvert. The new structure would be immediately downstream of the existing culvert and Croesnewydd Road would be on an embankment, eventually tying into a new link road along the route of the disused railway. The planned new culvert is shown in Figure 2-8.

Figure 2-8 Croesnewydd Road Culvert Cross Section taken from WCBC Proposal Drawings

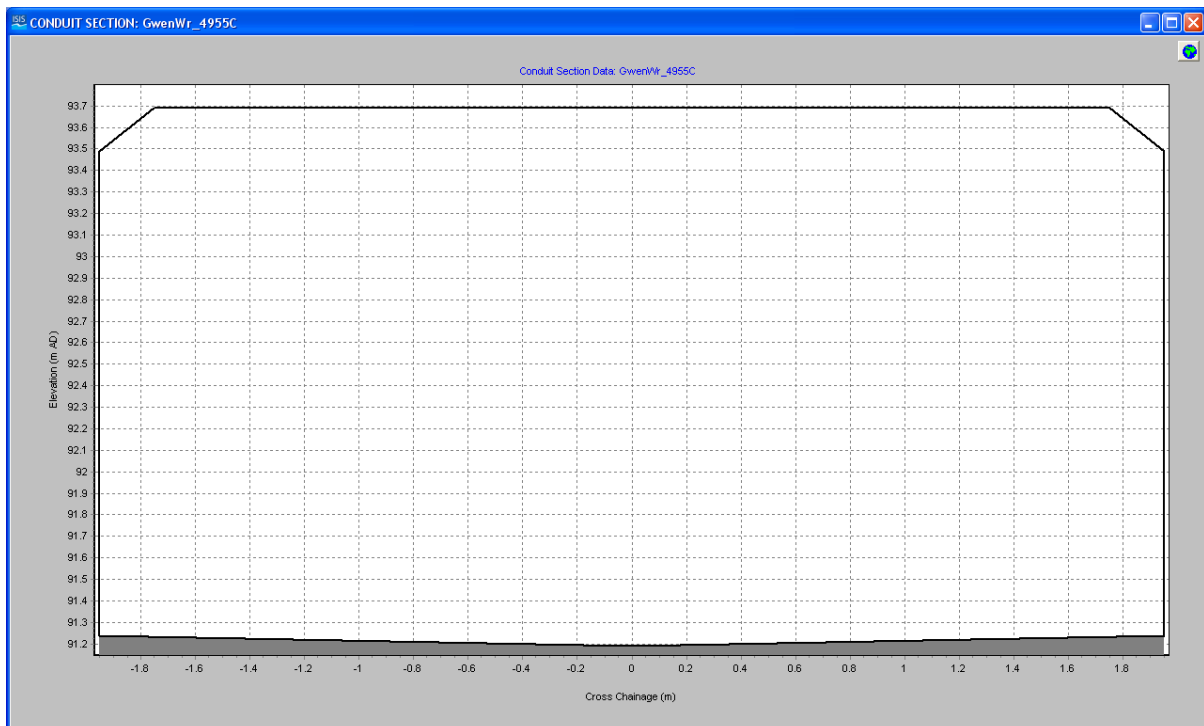




2.2.3 Representation of the Proposed Culvert and Embankments

To reflect the proposed culvert at Croesnewydd Road, the geometry of the existing culvert has been updated using the information provided by WCBC in Figure 2-9. The ISIS model has been updated to represent the new position and dimensions of the Croesnewydd Road culvert. The new culvert in the ISIS model has a height of 2.5m, width of 3.9m and a length of 14m. The culvert cross section is shown in Figure 2-9.

Figure 2-9 Proposed Upstream Face of the Culvert at Croesnewydd Road included in the ISIS Model



The TUFLOW model of the floodplain has been amended to link to the updated ISIS model and to consider two scenarios to represent the proposed embankments:

1. Croesnewydd Road has been raised on an embankment above the existing levels; this option represents the modifications to the culverts discussed above. The new embankment stretches for approximately 100m to the south of the culvert and 150m to the north.
2. As above but also including a new proposed link road running along the course of the disused railway and intersecting with Croesnewydd Road a short distance to the north of the new structure over the Afon Gwenfro.

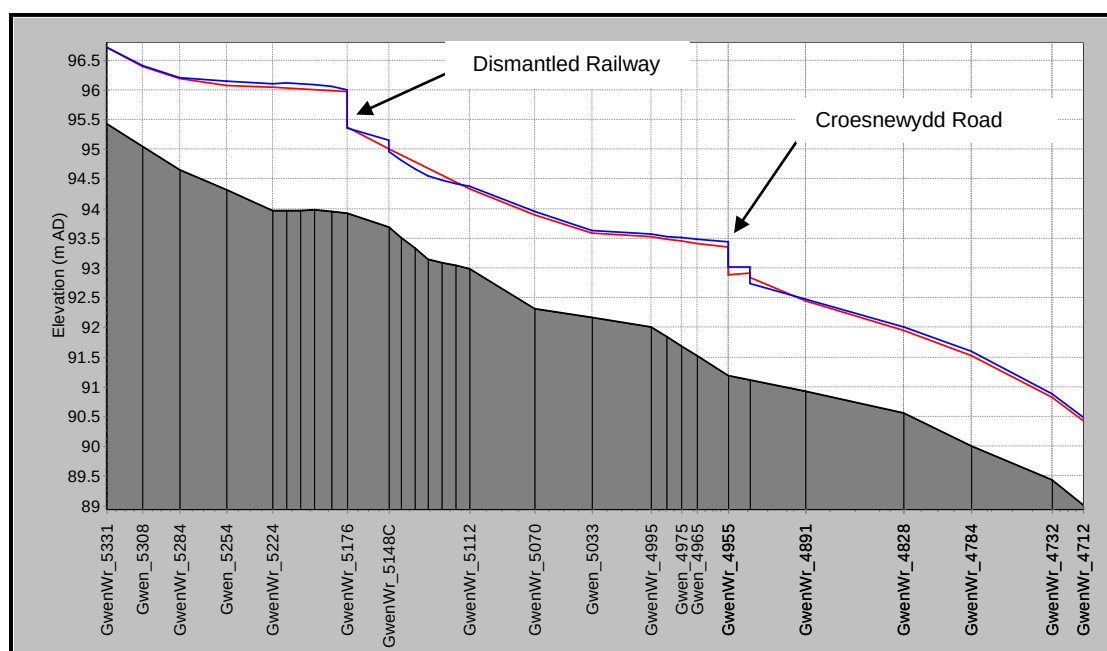
3. Model Results

The models containing the proposed culverts at the dismantled railway and Croesnewydd Road have been linked to the 2D TUFLOW model of the floodplain that includes the new height and alignment of Croesnewydd Road and have run for the 1%, 1% plus climate change and 0.1% AEP events. These events have also been run with the additional link road in place. The model results have then been compared to the model with the existing structures in place. The results are discussed below.

3.1 Local Impacts on Water Levels and Flows

Predicted peak water levels in the River Gwenfro during the 0.1% AEP event for the existing and proposed cases are shown in Figure 3-1. This long section shows that there are some localised changes in peak water levels as a result of the proposed new road structure. There are small (up to 80mm) local increases in water levels upstream of both Croesnewydd Road and, when the link road is raised, the dismantled railway, which result from the obstruction of the existing flow routes by the new embankments. The new culvert inlet at Croesnewydd Road is predicted to have a peak water level of 93.43mAOD compared to the culvert soffit level of 93.69mAOD.

Figure 3-1 Predicted Peak Water Levels in the River Gwenfro for the 0.1% AEP Event
(Red - existing risk; Blue - Croesnewydd and Link Road option)



There is no impact on flows through the Croesnewydd Culvert during the 1% AEP and 1% plus climate change events (Table 3-1). In these cases there are small localised changes in water level close to the structures resulting from the changes to the structures but no changes further upstream or downstream.

For the 0.1% AEP event there is a 1.6-1.8m³/s increase in flow through the Croesnewydd Road culvert as the flow route along the railway is cut off in the option models. The impacts of this further downstream are discussed in Section 3.3.

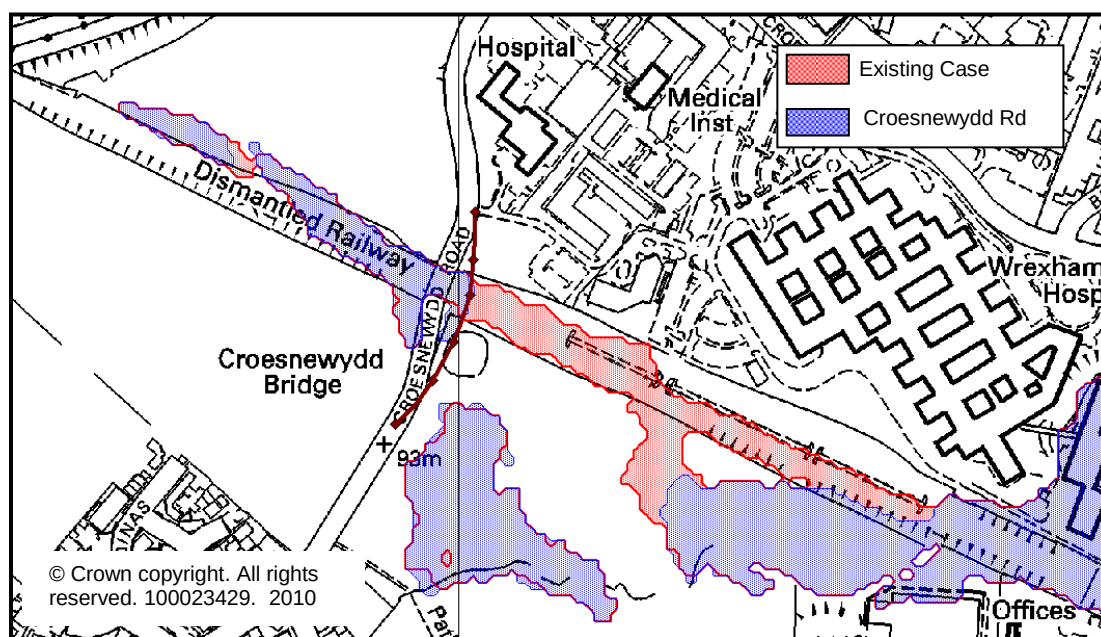
Table 3-1: Flows through Croesnewydd Road Culvert (m3/s)

	1% AEP Event	1% AEP+CC Event	0.1% AEP Event
Existing Case	9.9	11.9	15.4
Croesnewydd Road Only	9.9	11.9	17.2
Croesnewydd Road and Link Road	9.9	11.9	17.0

3.2 Local Impacts on Flood Extents

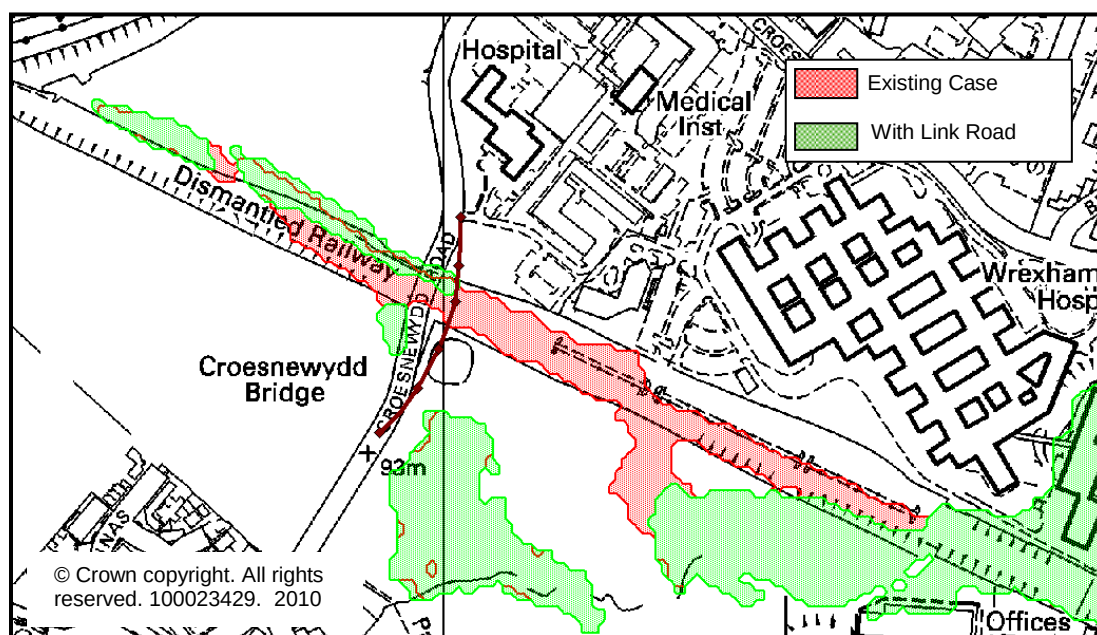
The new alignment and increased elevation of Croesnewydd Road stops the flow of water along the disused railway towards the hospital in the 0.1% AEP event (Figure 3-2). This leads to a slight increase in the flood extent both upstream and downstream of the Croesnewydd Road crossing, the latter being due to the additional flow that passes through the new proposed culvert. For the 1% and 1%+CC events there are only very localised changes in flood extent close to the structures.

Figure 3-2 Predicted Flood Extents for the 0.1% AEP Event - Existing case and with new Croesnewydd Road embankment and culvert



When the new link road is added to the model this produces only minor additional changes to the local flood outline in the vicinity of the roads (Figure 3-3). In addition, it should be noted that, provided that the link road is constructed to have a minimum elevation of 96.05m AOD between the railway culvert and Croesnewydd Road, then no overtopping of the proposed link road should occur as floodwater will remain ponded on the northern side of the link road. For the 1% and 1%+CC events there is essentially no difference in the flood extents as a result of the link road.

Figure 3-3 Predicted Flood Extents for the 0.1% AEP Event - With new Croesnewydd Road culvert and link road added



3.3 Downstream impacts on water levels

For the 0.1% AEP event the flows under Croesnewydd Road increase in the proposed scenarios by up to $1.8 \text{ m}^3/\text{s}$ (i.e. from $15.4 \text{ m}^3/\text{s}$ to up to $17.2 \text{ m}^3/\text{s}$) leading to some additional flooding in the vicinity of the road crossing. However, as the floodwater that would travel along the disused railway under existing conditions would rejoin the Gwenfro upstream of the hospital site, the water levels and flows are almost identical to the existing case in the vicinity of the hospital site (Figure 3-4 & Table 3-2). During the 0.1% AEP event, the impact of the proposed road arrangement downstream within Wrexham town centre is shown to be negligible. As such the changes to the flow regime following development remain fairly localised with more water being retained in the river channel rather than flowing along the disused railway as in the existing case.

Figure 3-4 Predicted Peak Water Levels in the River Gwenfro for the 0.1% AEP Event
(Red - existing risk; Blue - Croesnewydd and Link Road option)

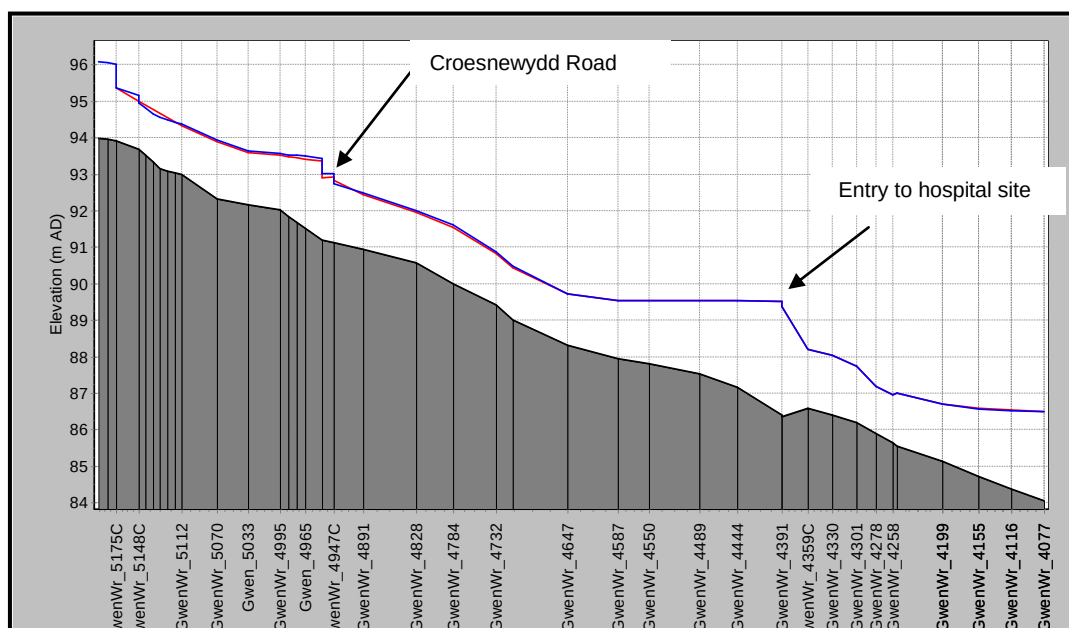


Table 3-2: 0.1% AEP Event Water levels and flows at various locations in Wrexham

		Maesgwyn Road Bridge (3771)	Inlet to Brook Street Culvert (3033)	Rivulet Road Culvert (2358)
Existing Case	Flow (m ³ /s)	11.0	17.1	11.6
	Level (mAOD)	83.14	76.81	72.59
Croesnewydd Road Only	Flow (m ³ /s)	11.0	17.1	11.6
	Level (mAOD)	83.14	76.81	72.59
Croesnewydd Road and Link Road	Flow (m ³ /s)	11.0	17.0	11.6
	Level (mAOD)	83.14	76.80	72.59

3.4 Downstream impacts to flood extents

Predicted flood extents from the 2D TUFLOW model for the 1%, 1% plus climate change and 0.1% AEP events are shown in Figures 3-5 to Figure 3-7 for both the existing case and the developed case in which both the link road and Croesnewydd Road have been raised. These show that downstream there are only localised and very minor variations to the flood extents as a result of the proposed development.

Figure 3-5 Predicted Flood Extents for the 1% AEP Event Downstream of the Proposed Development

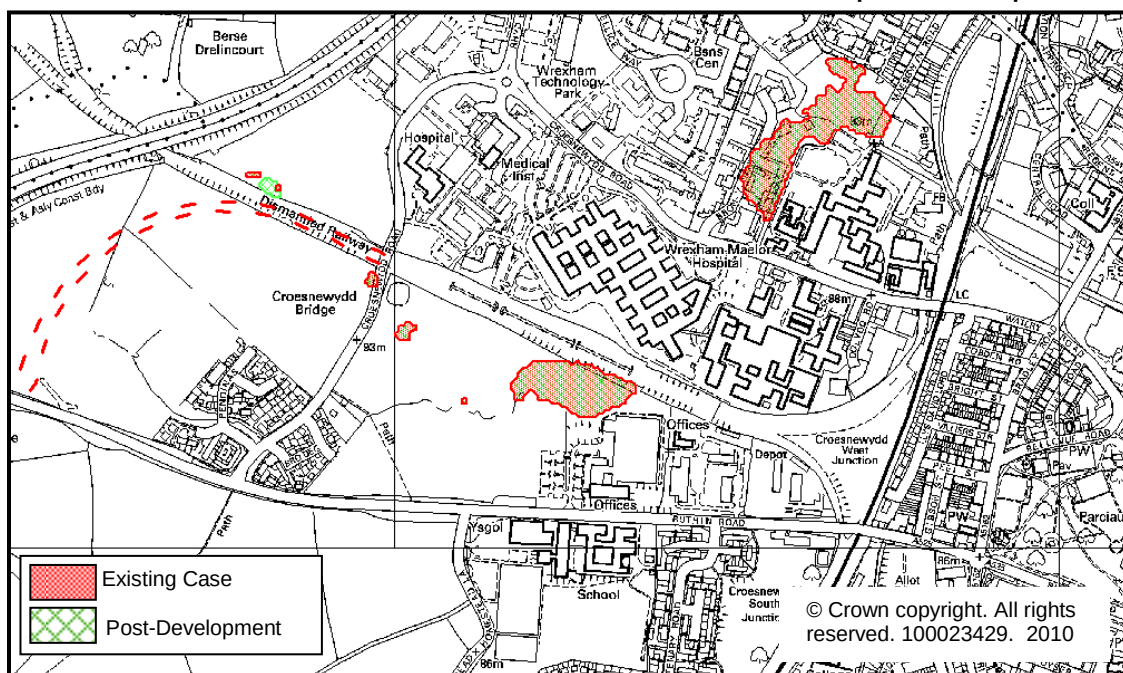


Figure 3-6 Predicted Flood Extents for the 1% Plus Climate Change AEP Event Downstream of the Proposed Development

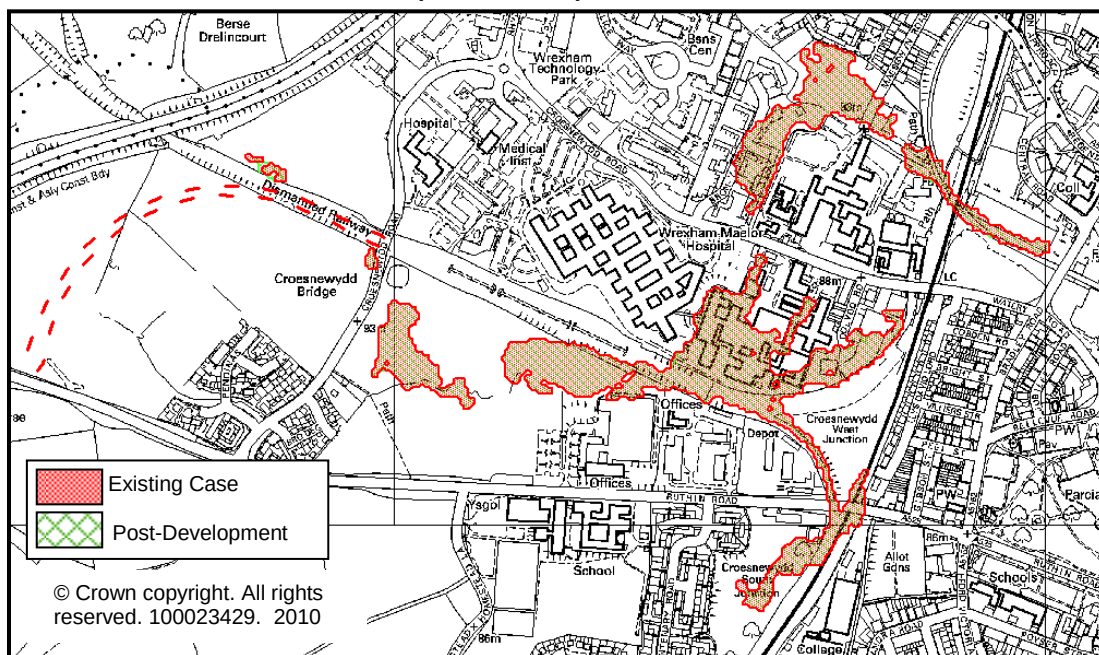
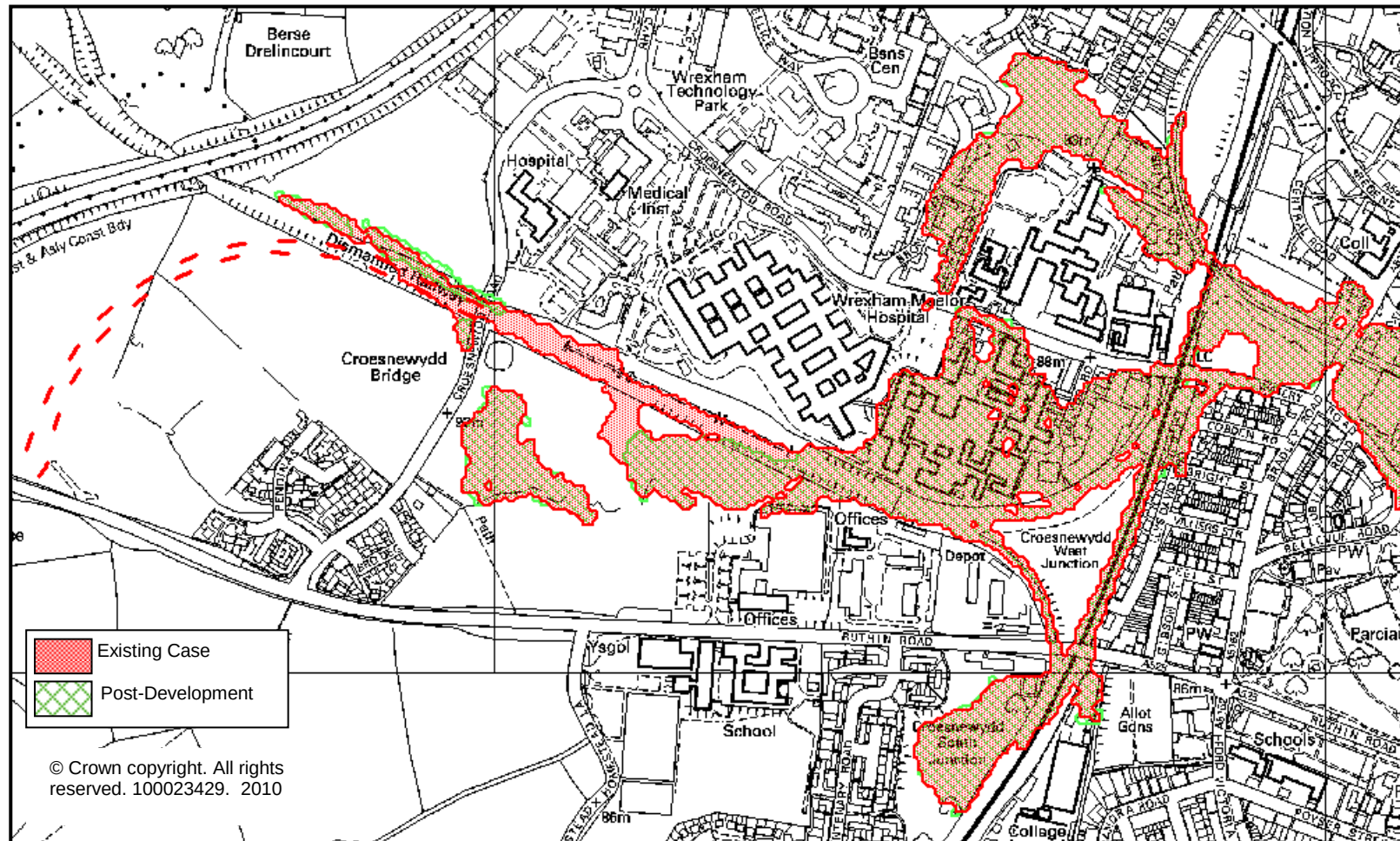


Figure 3-7 Predicted Flood Extents for the 0.1% AEP Event Downstream of the Proposed Development



4. Conclusions

Modelling work has been undertaken to identify the change in flood risk from the River Gwenfro that may arise as a result of proposed changes to the existing structures running underneath the dismantled railway and Croesnewydd Road. Two options were considered regarding changes to ground levels in this area:

1. Croesnewydd Road will be raised on an embankment above the existing levels; this option will also require a new culvert to replace the one at the existing location. The new embankment would stretch for approximately 100m to the south of the culvert and 150m to the north.
2. As above but including a raised new link road running along the course of the disused railway and intersecting with Croesnewydd Road a short distance to the north of the new structure on the Afon Gwenfro.

The key outcomes from the study are:

- For the 1% and 1%+CC events only very localised water level changes in the vicinity of the proposed structures are predicted.
- In the 0.1% AEP event the flow path along the disused railway from Croesnewydd Road to the hospital is cut off and this results in an additional flow of up to 1.8m³/s through the culvert underneath Croesnewydd Road. This has some local implications on flows and levels downstream but the impacts do not continue into the hospital site and Wrexham town centre.
- Adding the proposed link road causes some additional localised changes in flood extent between the disused railway culvert and Croesnewydd Road but once again this scenario does not propagate any changes further downstream into Wrexham. No flood water is predicted to flow across the new link road provided that the road level is configured at or above 96.05mAOD.
- A peak water level of 93.43mAOD is modelled at the inlet of the new Croesnewydd Road culvert during a 0.1% AEP design event compared to the proposed new soffit level of 93.69m. No water is predicted to flow over the raised Croesnewydd road.



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<i>Appendix C: CORRESPONDENCE EAW</i>

Johnson, Tony

From: Johnson, Tony
Sent: 14 October 2009 13:31
To: 'Ruairi.Barry@Environment-Agency.gov.uk'
Subject: Wrexham Western Gateway Flood Consequence Assessment.

FTAO Mr Ruairi Barry

Dear Sir

We have been speaking with Paul Sleeman in Transport and Asset Management Department at Wrexham Council with regards to the Wrexham Western Gateway development proposals (Ruthin Road). Paul suggested you maybe the appointed EAW Development Control Officer who will be overseeing the flood risk element of this proposal and I should contact you in the first instance.

Atkins have been appointed the flood risk consultants on this planning proposal and we will be undertaking the FCA on behalf of Wrexham Council.

In an effort to be proactive and to engage EAW Development Control at every stage of this application, we have taken the opportunity to outline our initial thoughts of flood risk on the current site and possible flood consequence issues associated with post development. We hope to get an agreement with you in principle at this initial stage on the way forward with the FCA and what EAW would like to see addressed as part of the FCA.

We have attached a plan and conceptual design of the development proposals for your attention.



Development
Area.zip

The Development Advice Map suggest portions of the Western Gateway development area are within Zone C2 and that only less vulnerable development should be considered subject to the application of the justification test, including acceptability of consequences. The Western Gateway proposals are for the development of non residential use.

Here are our thoughts on what we feel should be addressed as part of the FCA.

-Could you please confirm our initial thoughts that portions of the site fall within Zone C2.

-We are not sure of any history of the site flooding. Could you please provide any evidence of flood history on the site which you may hold.

-The emphasis of the assessment will concentrate on the risk of fluvial flooding to the site from the 2 watercourse and the setting of finished floor levels.

- Post development runoff rates should not exceed current greenfield runoff. **Could you please provide guidance on whether you would like us to calculate current greenfield rates or should we use EAW default greenfield runoff ?**

-Our initial assessment suggest that with the used of SUDS the development is unlikely to increase flood risk to the proposed site and to others.

We understand that a previous FCA (Ruthin Road Development, Wrexham. Faber Maunsell, 2005) has been undertaken for a Redrow housing development adjacent to the site which has been approved and is now under construction and near completion. As part of the Redrow FCA a hydraulic model was constructed and flood levels developed for the River Gwenfro and an unnamed watercourse running through the centre on the site. We do have a few questions associated with the modelling and conclusions and recommendations of the Redrow FCA which you may be able to help with, although we do appreciate that this work was undertaken some 4 years ago.

Has this model been approved by EAW ?

Are you happy for the Atkins to use the results of the hydraulic modelling work undertaken in the Redrow FCA for the Western Gateway FCA ?

Has the recommended works on the Croesnewydd Road culvert and downstream culvert been authorised by EAW ?

It is our intention to progress the FCA on the basis of the above initial assessment. I should be grateful if you would confirm your 'in principle' agreement to the basis of the assessment.

The FCA will contain the necessary information which forms the basis of the above statements.

Please do not hesitate to contact me if you require any further information or clarification.

Thanks
TJ

Tony Johnson BSc (Hons) MCIWEM
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