

Dragon Parc – Flood Consequences Assessment

Version 2

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This report describes work commissioned by Davies Homes. Charlotte Lickman and Arran Bright of JBA Consulting carried out this work.

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Purpose

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1 Introduction

1.1 Terms of Reference

JBA Consulting were commissioned by Davies Homes to prepare a Flood Consequences Assessment (FCA) in support of a planning application for a 200 unit residential development at Dragon Parc, Merthyr Tydfil.

This FCA follows a previously successful planning application and FCA for development enabling flood mitigation works at the site. These engineering works have now been completed. The Merthyr Tydfil County Borough Council (RMTCBC) planning reference for these previous works is P/20/0025.

1.2 FCA Requirements

This FCA follows Welsh Government guidance on development and flood risk set out in Technical Advice Note 15: Development and Flood Risk (TAN15). Where appropriate, the following aspects of flood risk should be addressed in all planning applications over their expected lifetime:

- The likely mechanisms of flooding
- The like source of flooding
- The depths of flooding through the site
- The speed of inundation of the site
- The rate of rise of flood water through the site
- Velocities of floodwater across the site
- The impacts of the proposal on flood risk elsewhere

2 Site Description

2.1 Site location

The land at Dragon Parc was formerly a factory site in Abercanaid, Merthyr Tydfil. The 78ha brownfield site is bound to the south and west by Wildwood Road with residential dwellings beyond. To the north and northwest, the site is bound by commercial and industrial units. To the east the site is bounded by the River Taff. Table 2-1 and Figure 2-1 summarise the key characteristics of the site.

Table 2-1: Site summary

Site Name	Dragon Parc
Site Area	7.8ha
Existing Land-use	Brownfield
Purpose of development	Residential
OS-NGR	SO05400420
Local Planning Authority	Merthyr Tydfil County Borough Council
Lead Local Flood Authority	Merthyr Tydfil County Borough Council

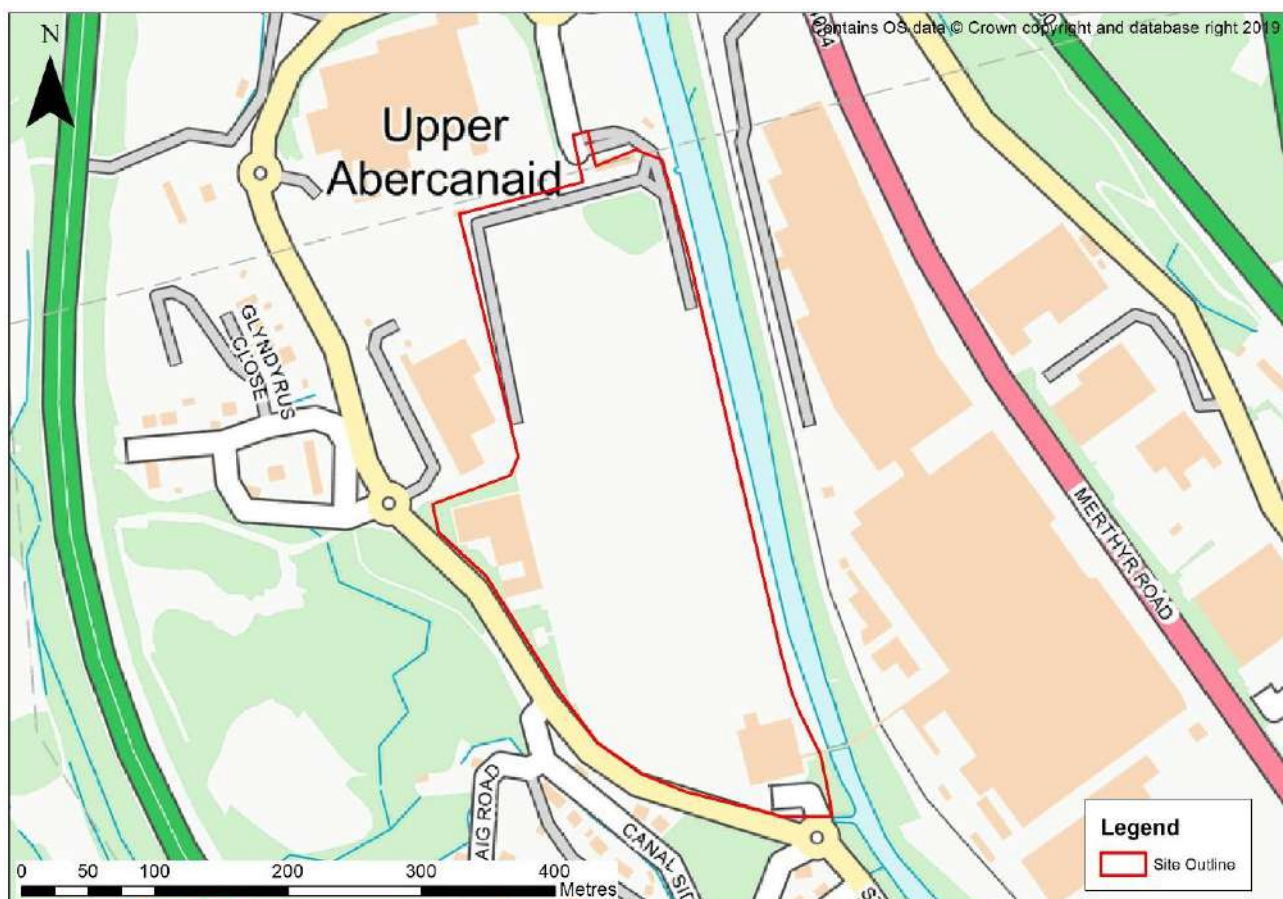


Figure 2-1: Site location

2.2 Site topography and existing land use

The brownfield site is currently vacant, following the demolition of the former factory and completion of the flood mitigation works.

Elevations across the site generally decrease from north (157mAOD) to south (153mAOD) and from west (160mAOD) to east (157mAOD) across the site. A steep bank is present on the southwest boundary, sloping from approximately 160mAOD to 157mAOD into the site. On the eastern site boundary, there is a significant (~6m) drop down to the River Taff.

Two access points currently exist to site, one to the north via the Abercanaid Industrial Estate roundabout and one from the south onto the junction of Wildwood Road and Stanfield Close.

Appendix A contains a topographical survey of the site, completed following construction of the flood alleviation works. Further to this, Figure 2-2 show an illustration of the site topography generated from Natural Resources Wales (NRW) LiDAR data modified onsite with the latest site-specific ground model.

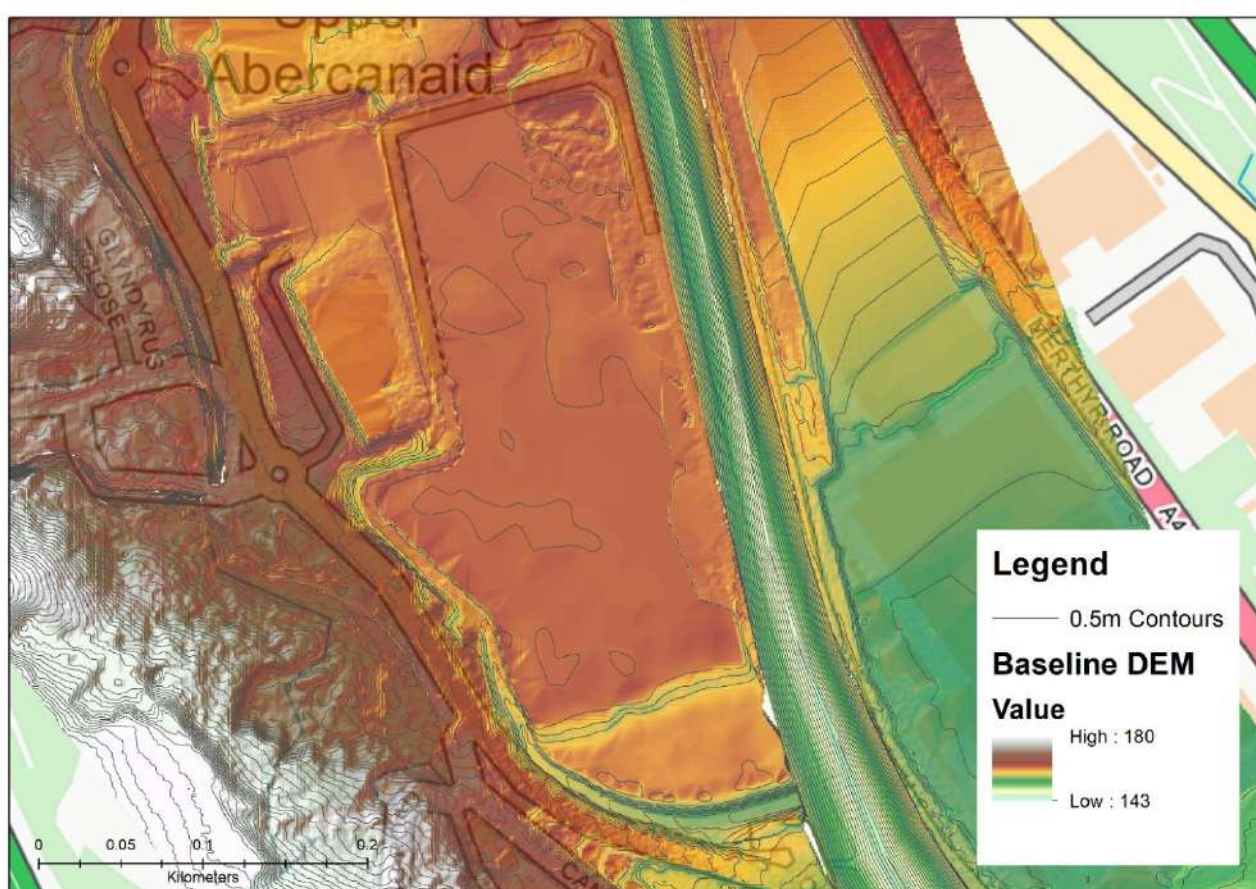


Figure 2-2: Site and local area topography

2.3 Dragon Parc Flood Mitigation Scheme

The Dragon Parc Flood Mitigation Scheme was developed to reduce the risk of flooding on the site, enabling future residential redevelopment of site. The Merthyr Tydfil County Borough Council (RMTCBC) planning reference for the scheme was P/20/0025. Work to construct the scheme was completed in early 2022 and a successful Flood Map Challenge was agreed with NRW in May 2022.

The Dragon Parc Flood Mitigation Scheme consists of the following elements:

- 1 General site re-profiling to 157mAOD, with the southern area being raised to 155mAOD. The re-profiling was designed to raise ground elevations across the site to be above the 0.1% AEP fluvial flood level.
- 2 A proposed 6m wide dry swale along the western boundary of the site with depth ranging between 0.19m in the north to 2m in the south. This feature works to convey floodwater around the site and into the Afon Taff and is also designed to prevent an increase in flood risk to third-party areas caused by site re-profiling.
- 3 A pair pre-cast box culverts at the southern end of the site that will convey water from the swale into a new outfall structure that will discharge into the Afon Taff. *Note: these structures have not been constructed at this time and shall be superseded by a new crossing design that better aligns with the site masterplan.*

Figure 2-3 provides an illustration of the Dragon Parc Flood Mitigation Scheme. Full plans can be found on the MTCBC planning portal.

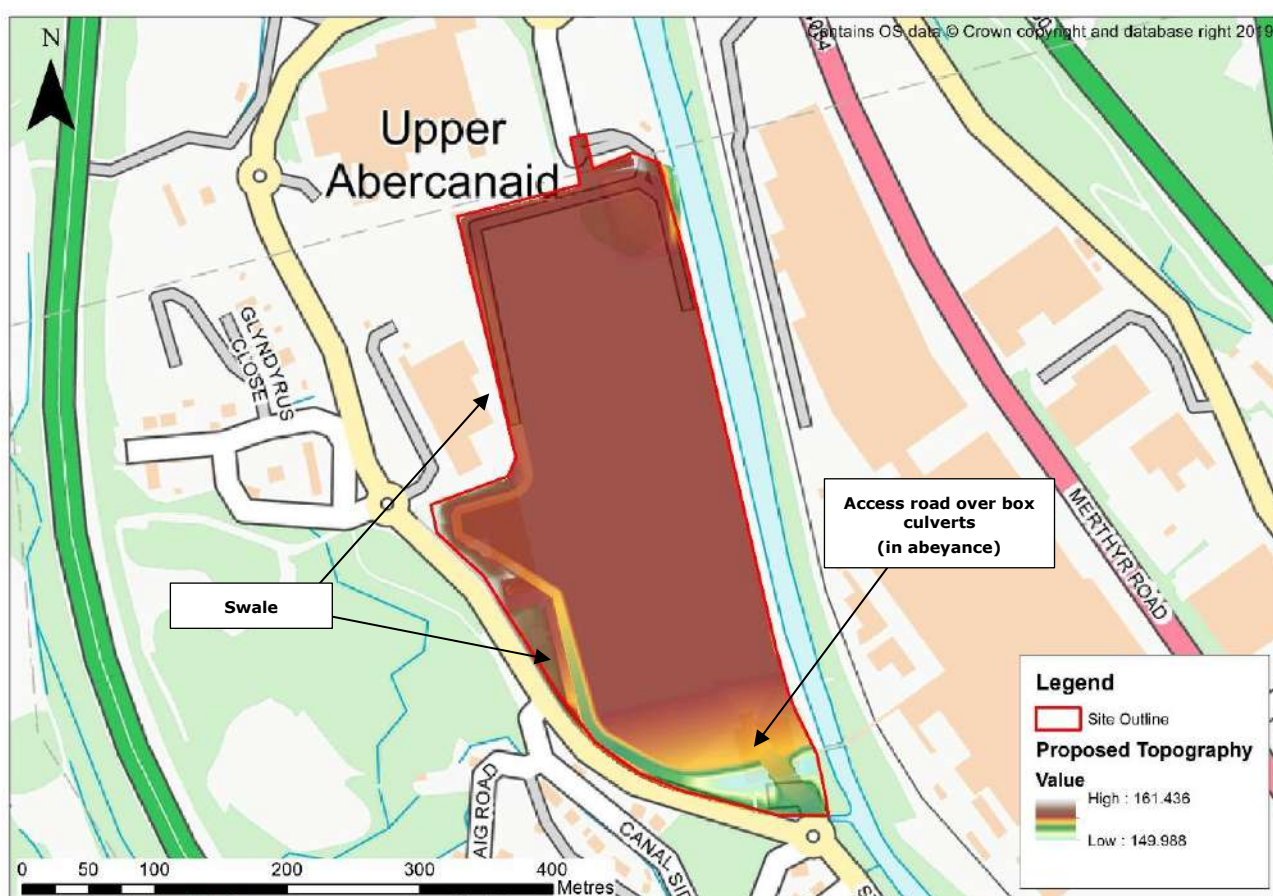


Figure 2-3 Proposed swale and site re-profiling

2.4 Site soils and geology

The existing site is largely surface with rubble and made ground. The British Geological Survey (BGS) Geology of Britain viewer was consulted to identify local underlying geological conditions. The site is part of the South Wales Middle Coal Measures Formation, which consists of mudstone, siltstone, and sandstone. The majority of the site is underlain by superficial deposits of Alluvium, consisting of clay, silt, sand, and gravel – the western part of the site is underlain by Till.

The soils of the site were determined from the Cranfield University Soilscape viewer. The site soils are described as slowly permeable wet very acid upland soils with a wet peaty surface.

2.5 Watercourse and drainage networks

The site is bounded to the east by the Afon Taff which flows in a southerly direction before flowing into the Seven Estuary approximately 60km downstream.

To the west of the site flows a small Ordinary Watercourse, the Nant Canaid. This watercourse enters a culverted system which approximately follows the southwestern site boundary to discharge into the Afon Taff at the site's southern boundary as shown in Figure 2-4. Photos of the culvert inlet and outlet are shown in Figure 2-5.

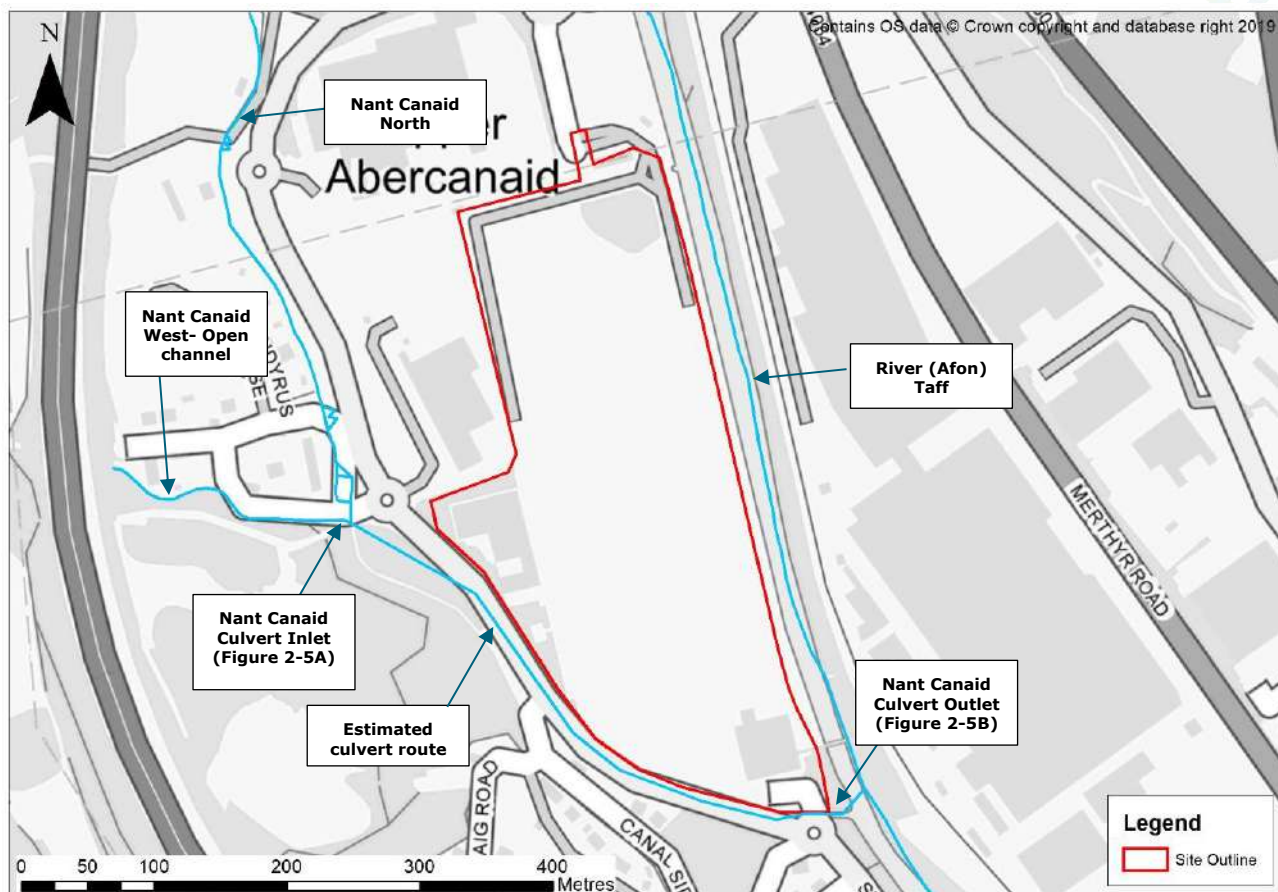


Figure 2-4 Watercourses and site location



A



B

Figure 2-5 Nant Canaid culvert inlet (A) and outlet (B)

2.6 Development Proposal

The proposals are for the development of 200 residential properties across the Dragon Parc site, together with associated infrastructure and public open space. The proposed development site is provided below in Figure 2-6 and contained in full within Appendix B.



Figure 2-6: Proposed site plan

3 Planning Policy and Flood Risk

3.1 Planning Context

Planning Policy Wales (PPW) sets out the land use planning policies of the Welsh Government. It is supplemented by a series of Technical Advice Notes (TANs), Welsh government Circulars, and policy clarification letters, which together with PPW provide the national planning policy framework for Wales. These policies have the aim that all development in Wales is sustainable and improve the social, economic, environmental, and cultural wellbeing of Wales as set out in the Wellbeing of Future Generations Act 2015.

Technical Advice Note (TAN-15) introduced by the Welsh Government in 2014, provides technical guidance relating to development planning and flood risk in Wales. The initial requirements of TAN-15 are to identify the vulnerability classification(s) and flood zones relevant to the proposed development, and to apply this information to the application of the justification tests and acceptability criteria.

An update for TAN-15 was released in October 2021 and was due to come into force on the 1st December 2021. However, Welsh Government have since suspended the implementation of the new TAN-15 until 1st June 2023. Although the new TAN-15 is not a material consideration, Welsh Government and NRW advise that some consideration is given to the draft Flood Map for Planning (FMfP) as best available information.

Therefore, where a site is located either the extant Development Advice Map (DAM) or new FMfP flood risk zone, it is recommended that an FCA is carried out. Although, the policy that should be applied at this time is the current (2004) version of TAN-15.

3.2 Vulnerability Classification

TAN-15 assigns one of three flood risk vulnerability classifications to a development, as shown in Table 3-1.

The proposed development is for residential development. Consequently, the development is classified as Highly Vulnerable.

Table 3-1: TAN15 Development categories

Development category	Types
Emergency services	Hospitals, ambulance stations, fire stations, police stations, coastguard stations, command centres, emergency depots and buildings used to provide emergency shelter in time of flood.
Highly vulnerable development	All residential premises (including hotels and caravan parks), public buildings (e.g. schools, libraries, leisure centres), especially vulnerable industrial development (e.g. power stations, chemical plants, incinerators), and waste disposal sites.
Less vulnerable development	General industrial, employment, commercial and retail development, transport and utilities infrastructure, car parks, mineral extraction sites and associated processing facilities, excluding waste disposal sites.

3.3 Development Advice Map Classification

Figure 3-1 presents the NRW's Development Advice Map (DAM) for the site. The DAM is used to trigger different planning actions based on the precautionary assessment of flood risk. Generally, the northern area of the site mostly falls within Zone B of the DAM, whilst the southern section of the site falls within Zone C2.

TAN-15 designates Zone C2 as “Areas of the floodplain without significant flood defence infrastructure”. The classification is used to “indicate that only less vulnerable development should be considered subject to application of Justification Test, including acceptability of consequences”.

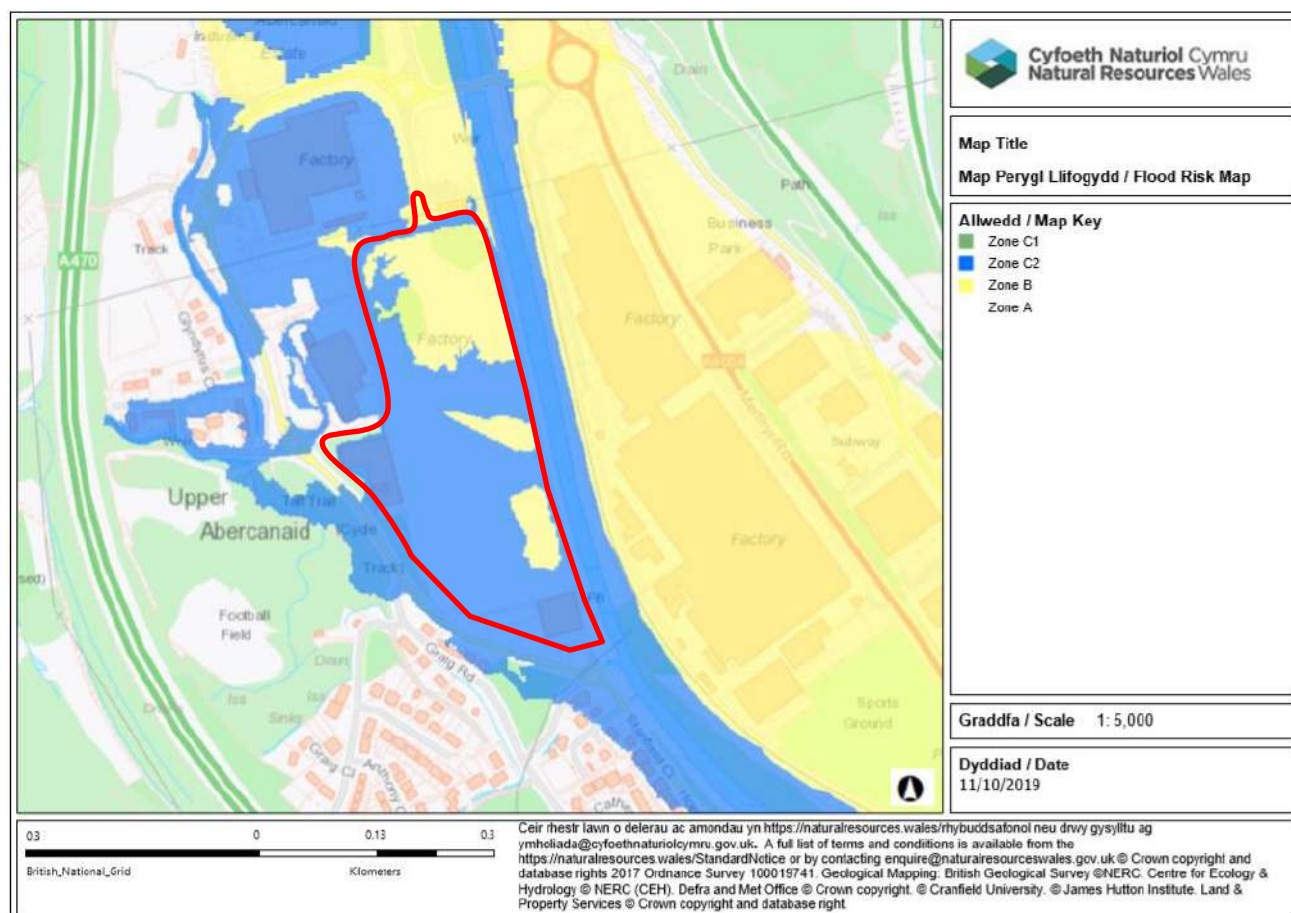


Figure 3-1: Development Advice Map

3.3.1 Flood Map Challenge

In 2019, in anticipation of the new TAN15, NRW suspended their regular updates of the Development Advice Map. Consequently, the DAM has fallen out of date in some locations, no longer presenting the best available information.

In September 2021, when NRW launched the new FMfP, they also re-established the process of challenging their flood maps with more accurate information. As a result, JBA Consulting prepared and submitted a Flood Map Challenge (FMC) for the Dragon Parc site based upon as-built information on the implementation of the Dragan Parc Flood Mitigation Scheme. This FMC was accepted by NRW in May 2022 and is due to be implemented in the next publication of the FMfP (late November 2022). The NRW accepted FMC report is contained in Appendix C.

The Welsh Government Chief Planner letter (ref. MA-JJ-3967-21) to local planning authorities on the suspension of the new TAN15 advises “*The pause means the existing policy framework remains in place for a further 18 months. Planning authorities should recognise however that it may be appropriate to take best and more recent information into account as a material consideration.*” Consequently, this FCA has been prepared on the basis of detailed and current flood risk information on the Dragon Parc site.

NRW are no longer making updates to the DAM. However, were they to do so the Flood Zones for the site would appear as shown in Figure 3-2. This clearly shows the effectiveness of the

flood mitigation scheme in substantially reducing the extent of flood risk, such that Flood Zone C2 is almost entirely confined to the flood mitigation scheme. All other areas would be classed as Flood Zone A.

Flood Zone A, which covers the vast majority of the site, is used to indicate that justification test is not applicable and there is no need to consider flood risk further. However, give the lengthy and complex history of flood risk assessment at the site, the residual risk of culvert blockage and importance of the flood mitigation scheme, a comprehensive FCA has been prepared and the acceptability criteria of TAN15 rigorously applied.

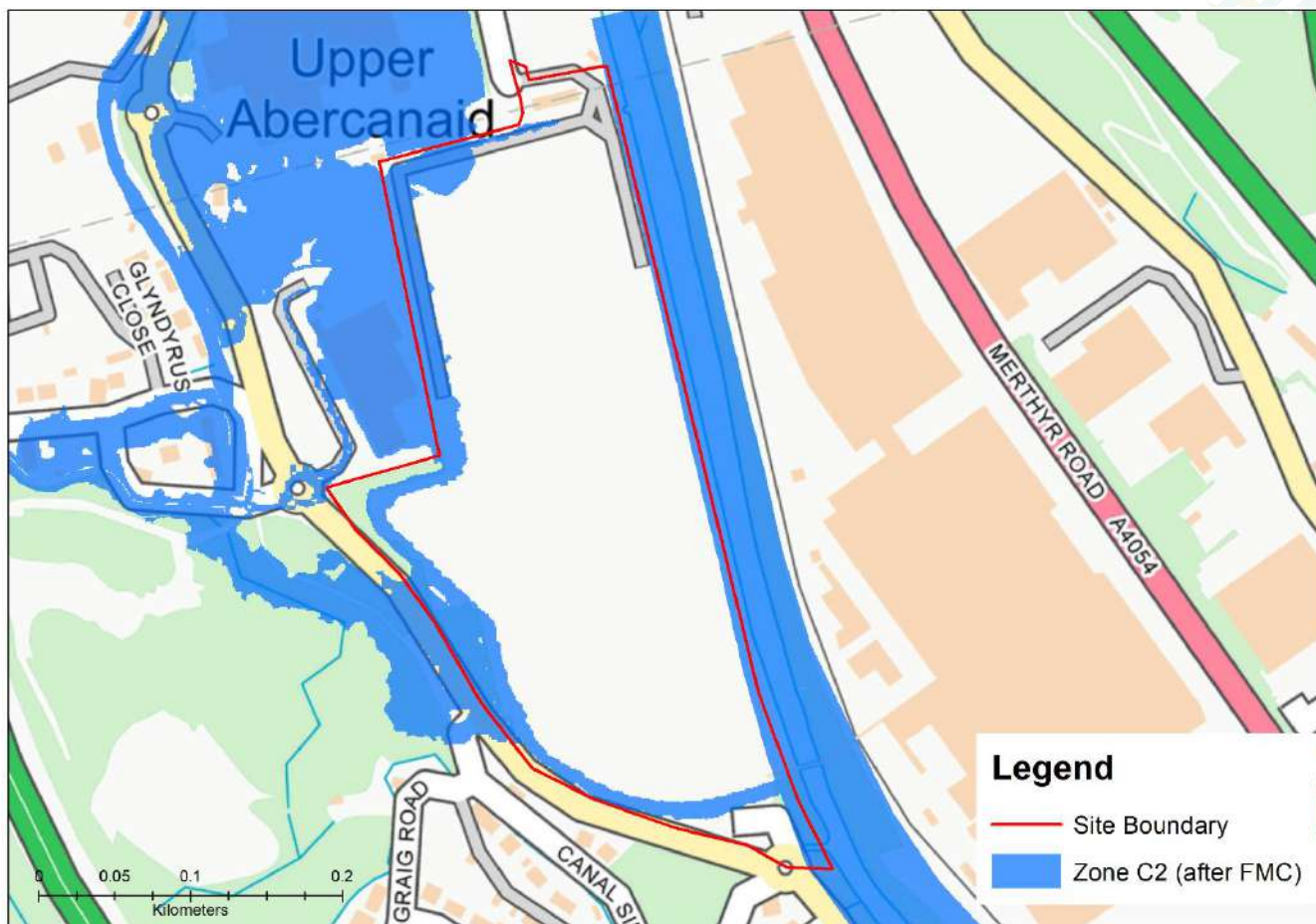


Figure 3-2: DAM Flood Zone C2 based on FMC

3.4 Flood Map for Planning Classification

The new TAN15 will replace the DAM with the Flood Map for Planning (FMfP). Whilst the new TAN15 is not a material consideration until implemented, it does carry weight in providing best available information to inform the assessment of flood risk.

The FMfP is provided for information only in this report, awaiting the full implementation of the new TAN15. Furthermore, the FMfP mapping presented in Figure 3-3 is based upon the FMC discussed above. The NRW online FMfP should match this by December 2022.

The FMfP mapping shows that only those areas of the flood mitigation scheme are located within Flood Zone 3 for the Flood Map for Planning for Rivers. Flood Zone 3 represents areas which have greater than a 1 in 100 (1%) chance of flooding in a given year, including climate change.

Other areas of the site, including some areas proposed for residential housing, are located in Flood Zone 2 for Planning for Rivers. Flood Zone 2 represents areas with 0.1% to 1% (1 in

1000 to 1 in 100) chance of flooding from rivers in a given year, including the effects of climate change.

This mapping clearly shows all residential development to be confined to either Flood Zone 1 or 2, where subject to the justification tests residential development will be allowable under the new TAN15.

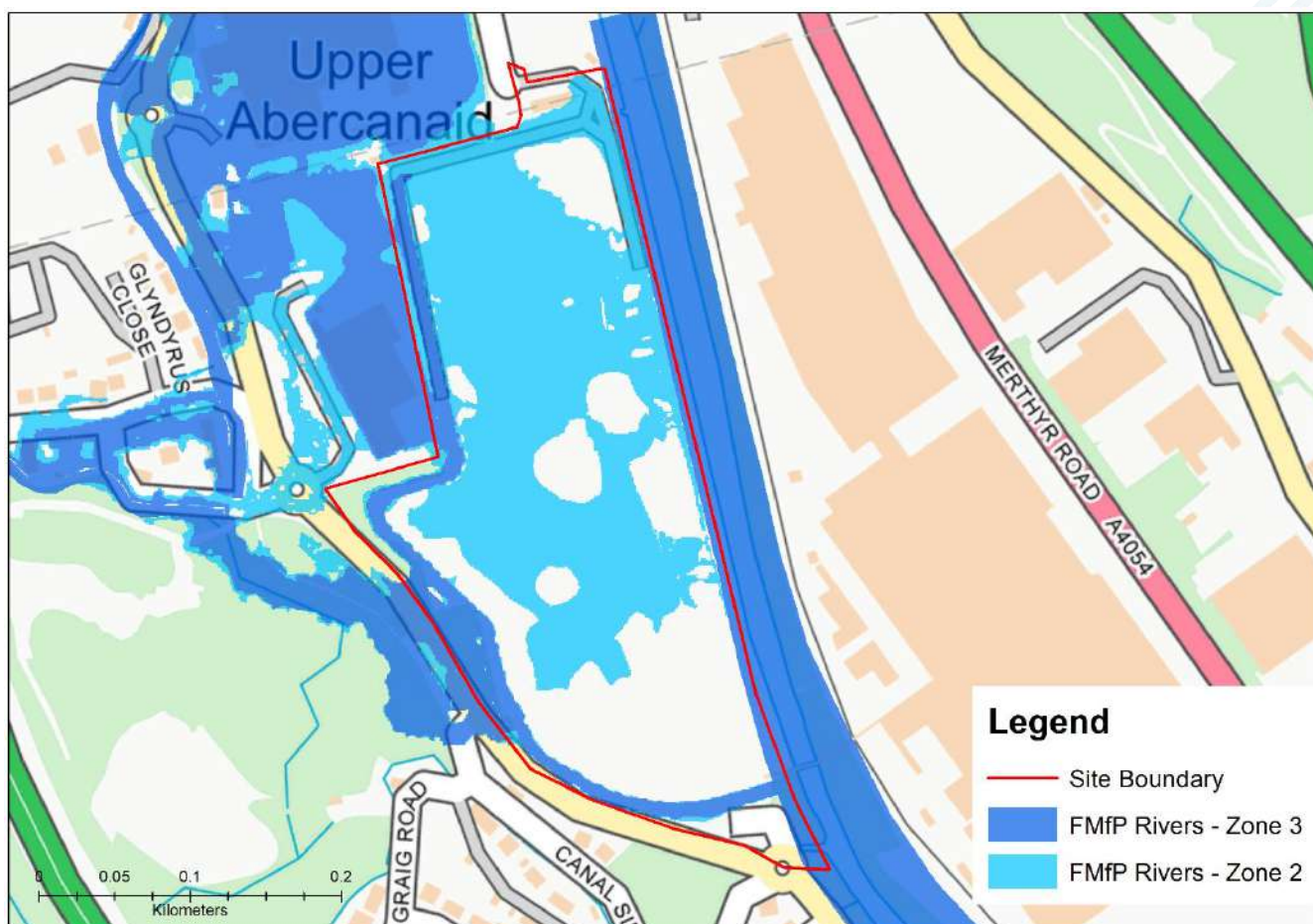


Figure 3-3: Flood Map for Planning

4 Flood Risk Assessment

This section of the FCA assess the risk to the proposed development from all sources of flooding, the risk of increased flooding to others, and how flood risks can be managed. This section of the FCA is based solely on a desk-based analysis of existing flood risk data.

4.1 Review of Existing Flood Risk Data

The latest available information on flood risk at the site, published by Natural Resources Wales (NRW) is summarised in Table 4-1, below.

Table 4-1 Summary of flood risk

Source of Flooding	Onsite Presence	Description
Flood Risk from Rivers	✓	The site is at low to moderate risk of river flooding.
Flood Risk from the Sea	✗	The site is not at risk of tidal flooding.
Flood Risk from Surface Water and Small Watercourses	✓	The site is at low to high risk of surface water flooding.
Flood Risk from Groundwater	✗	The site is at low risk of flooding from groundwater.
Flood Risk from Reservoirs	✓	The site is at risk of flooding from reservoirs.
Flood Risk from Sewers	✗	There is no evidence of historic sewer flooding at the site.

4.2 Historical Flooding

NRW's map of historic flood outlines, shown in Figure 4-1, illustrates that the site has not previously flooded. However, MTCBC's FRMP states that flooding from the Nant Canaid to Lewis Square and Glyndyrus Close has occurred historically, due to the inadequacy of the culvert inlet.

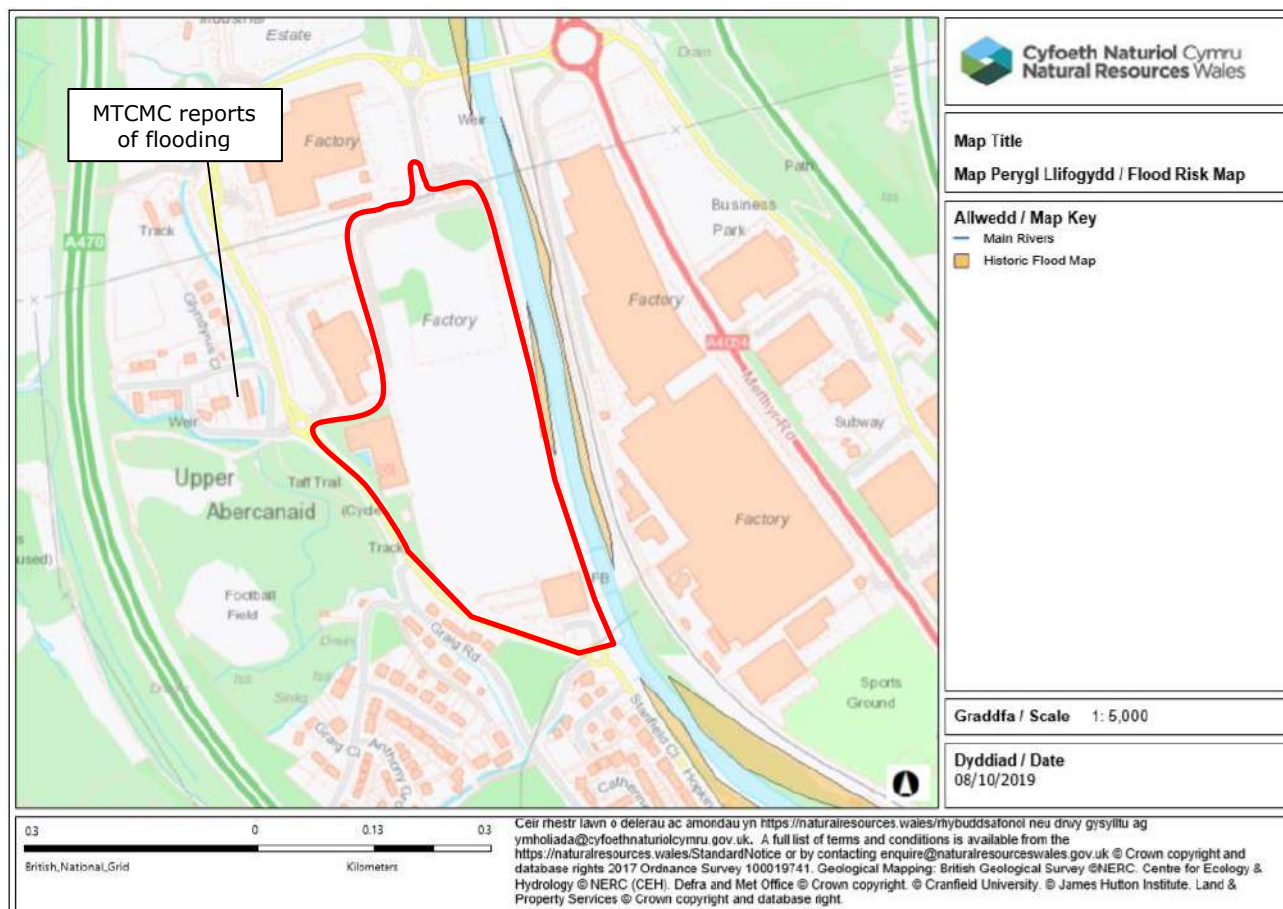


Figure 4-1 NRW Historic Flood Map

4.3 Flood Risk from Rivers

As previously discussed in Section 3.4, the site is at low to moderate risk of flooding from rivers. This flood risk is associated, not with the River Taff, but the Nant Canaid ordinary watercourse to the west of the site. This is the principal source of flood risk to the site and as such is assessed in detailed in Section 5.

4.4 Flood Risk from the Sea

Given the location of the site far above sea level, the site is not at risk of flood from the sea.

4.5 Flood Risk from Surface Water and Small Watercourses

According to NRW's flood map for surface water the site has localised areas at low to high risk of surface water flooding at the boundaries and the north-western area of the site, as shown in Figure 4-2. The source of this flooding is the Nant Canaid and its associated tributaries.

The mapping of Flood Risk from Surface Water and Small Watercourses does not take into account the recently constructed flood mitigation scheme. Furthermore, the generalised flood modelling methods of the NRW mapping are far inferior to the detailed flood modelling used to inform this assessment. As such the risk of small watercourse flooding is accounted for in the fluvial assessment of flood risk and the risk of localised surface water flooding will be addressed through the surface water drainage strategy and SAB consenting process.

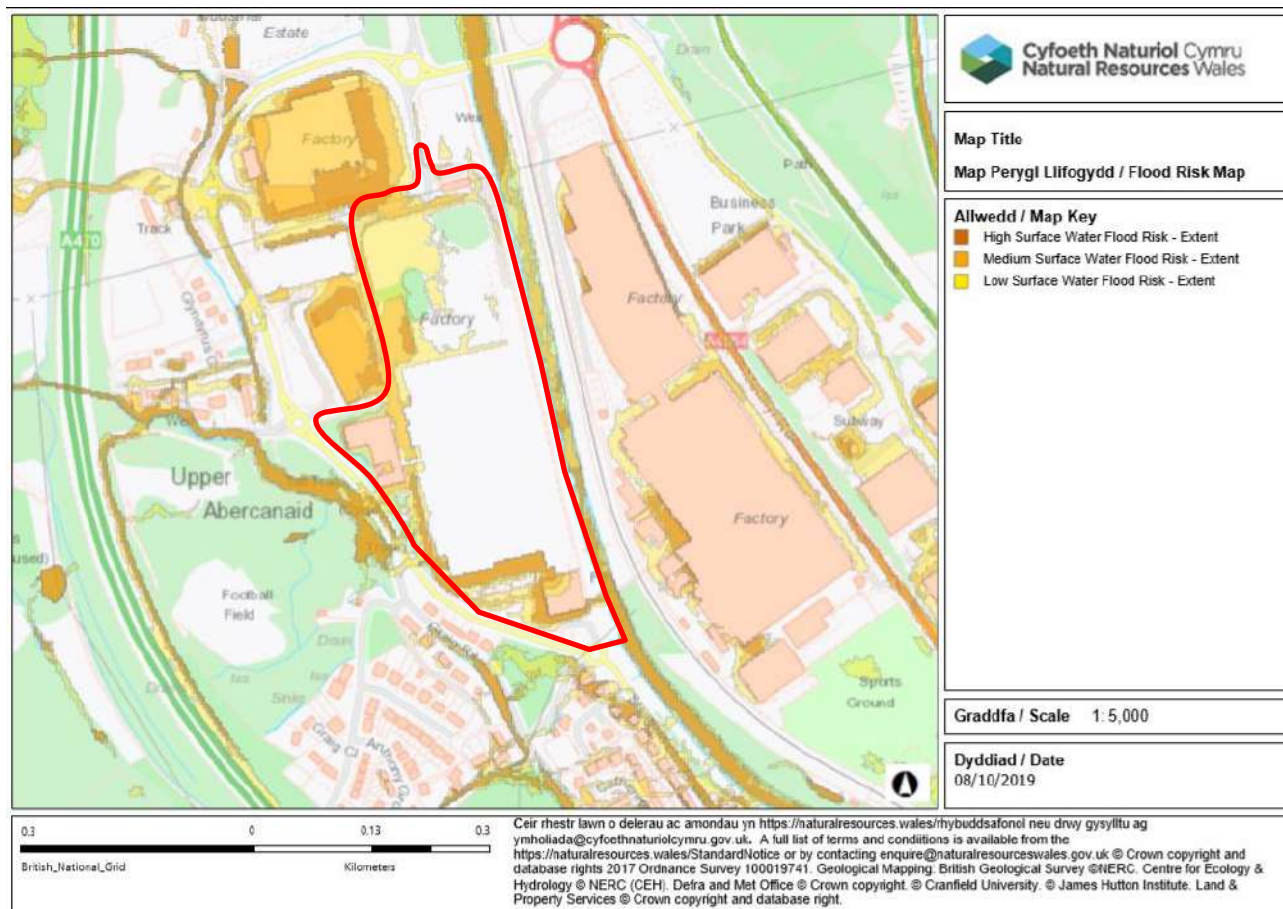


Figure 4-2 NRW Flood Risk Map for Surface Water

4.6 Flood Risk from Reservoirs

NRW flood risk from reservoirs mapping illustrates that the site could experience flooding as a result of reservoir failure as shown in Figure 4-3,. The flood extent is derived from the potential failure of five reservoirs which are located over 7km upstream of the site.

The heavily regulated nature of statutory reservoirs means that the probability of reservoir failure is extremely low. It is therefore reasonable to conclude that the risk of reservoir failure flooding at the site is very low.

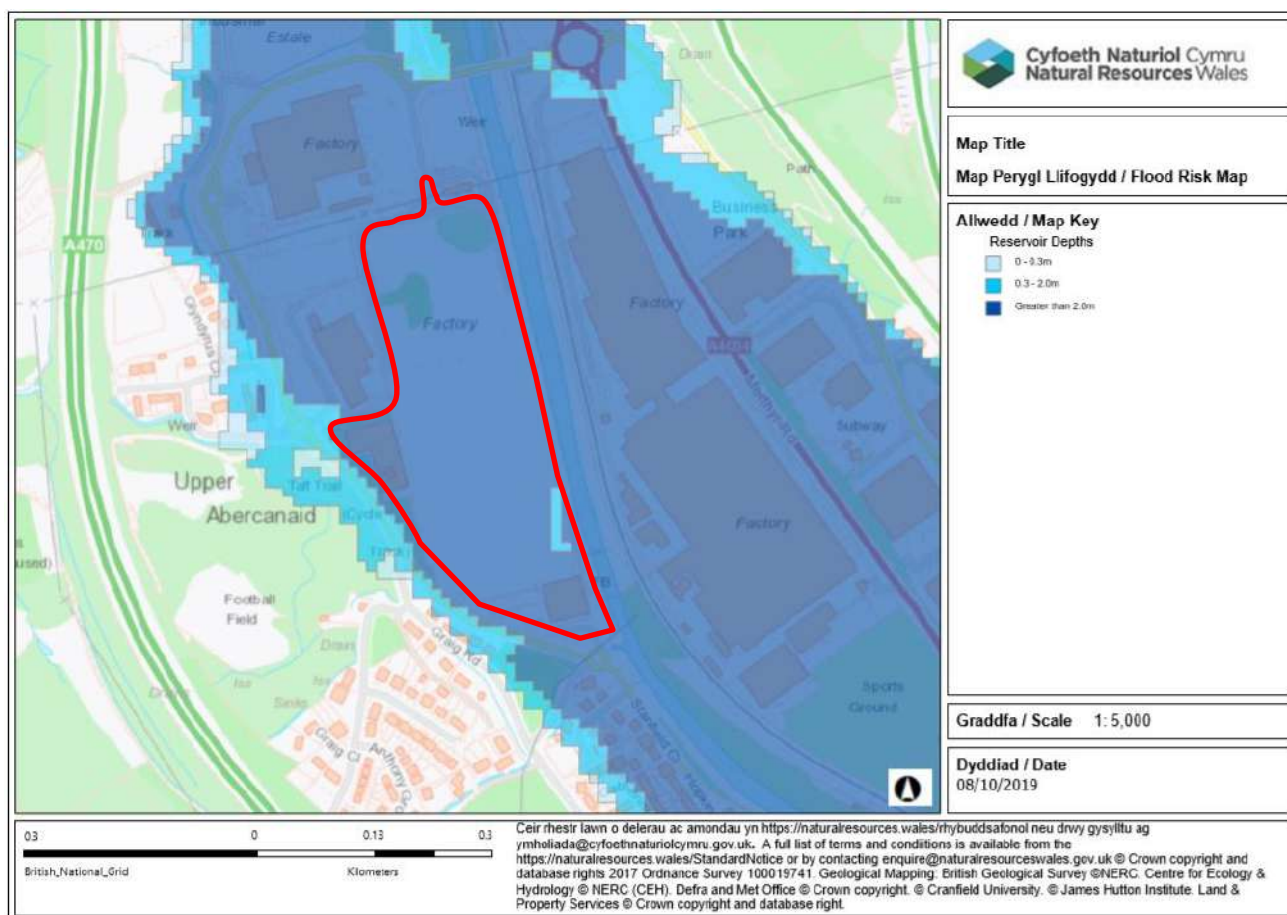


Figure 4-3 NRW Flood Risk Map for Reservoirs

4.7 Risk of flooding from groundwater

Groundwater flooding is caused by unusually high groundwater levels. It occurs as excess water emerging at the ground surface or within manmade structures such as basements. Groundwater flooding tends to be more persistent than surface water flooding, in some cases lasting for weeks or months, and can result in significant damage to property. The risk of groundwater flooding depends on the nature of the geological strata underlying the site, as well as on the local topography. Groundwater flooding is described as “not a major problem” in the MTCBC’s FRMP.

Old mine workings exist to the west of the site (west of the A470). The MTCBC’s FRMP states that “occasionally water from old mine workings discharges at unexpected locations particularly on hillsides below the workings”. However, it is believed any groundwater discharge would be captured by the network of watercourses which flow eastwards and south-eastwards towards the site and therefore the risk of groundwater flooding from old mine workings is considered to be ‘very low’.

4.8 Risk of flooding from sewers

There are a number of combined sewers along the boundaries of the site as shown in the Welsh Water sewer plan in Figure 4-4. There have been no known incidents of flooding associated with these sewers on or within proximity to the site.

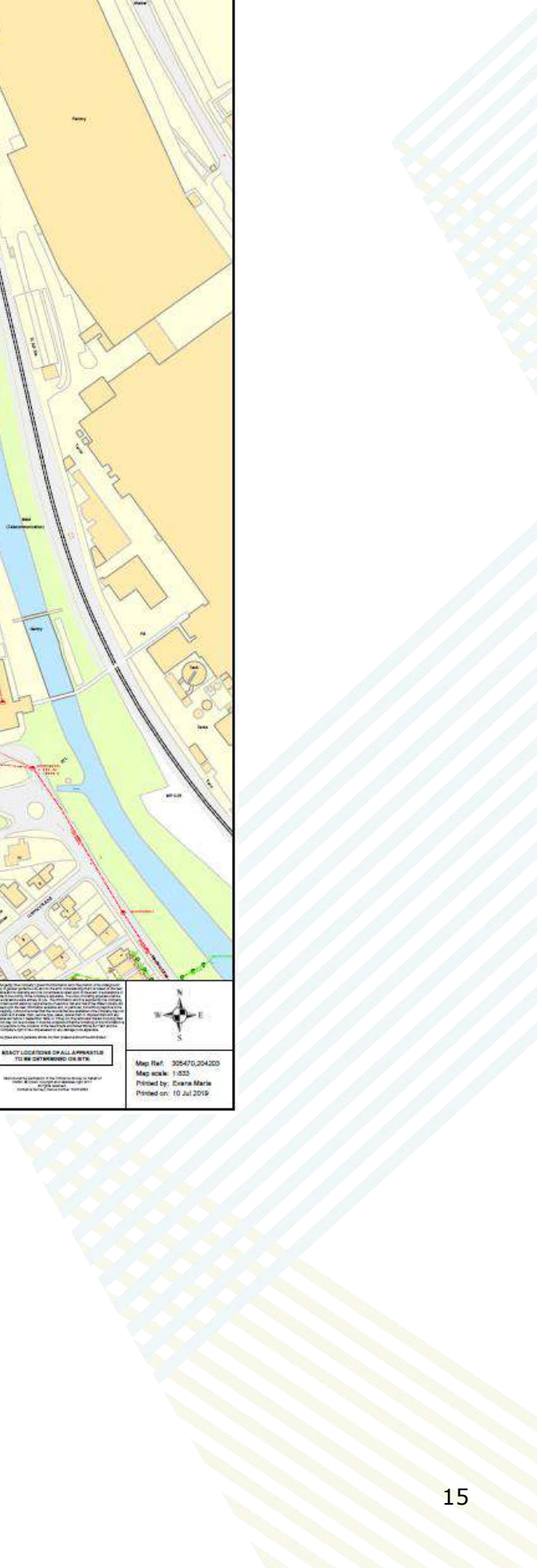


Figure 4-4 Welsh Water sewer plan

5 Detailed Assessment of Fluvial Risk

5.1 Detailed flood modelling

The hydraulic and hydrological model used to inform this assessment was originally developed by Thomas Mackay Ltd. in 2019. This was a 1D-2D ESTRY-TUFLOW model of both the Afon Taff and Nant Canaid developed specifically to assess flood risk at Dragon Parc.

The model was used with minimum updates as the baseline scenario in the FCA prepared for Huntley Wood Investments Ltd. by JBA in 2020 for the flood mitigation scheme planning application.

The flood mitigation scheme engineering works were completed in early 2022. Following this JBA further updated the flood model with as-built information to support a Flood Map Challenge (FMC). The FMC was agreed by NRW in May 2022.

The JBA model used to support the FMC has been used to inform this FCA. The baseline flood model is materially unchanged for the FMC agreed with NRW earlier this year. Full details of the FMC modelling can be found in Appendix D.

The only noteworthy changes made in respect to the FCA baseline flood model relate to the application of culvert blockage. The NRW guidance for a Flood Map Challenge is that allowances for blockage should not be applied when modelling culverts and bridges. However, blockage can be a key consideration in the assessment of flood risk for the purposes of development control, as recognised in TAN15 and NRW FCA guidance.

5.2 Culvert Blockage Modelling

5.2.1 Existing culvert arrangement

As noted in Section 2.5, there are two watercourses in the area. The River Taff and the Nant Canaid. The Nant Canaid is culverted alongside the site and discharges into the River Taff immediately downstream of the site. The Nant Canaid is fed by two smaller watercourses, the Nant Canaid North and Nant Canaid West. The confluence of these two watercourses is culverted west of the proposed site.

Between the Nant Canaid North and Nant Canaid West., there are four culvert entrances. Three of these entrances are located on Nant Canaid North, the fourth is located on Nant Canaid West, as shown in Figure 5-1.

Some of the culvert inlets in the study area have been classified by Merthyr Tydfil County Borough Council (MTCBC) as 'critical'. The northern most culvert entrance is not classified as critical, although all other entrances are. Critical culverts are those which are considered most likely to block during a storm event. MTCBC FRMP states "If intense rainfall has been forecast these intakes are inspected as priority, cleaned where necessary, and inspections continue during and immediately after significant rainfall".

As reported in Section 4.2 there is a history of blockage issues at some of the culvert inlets.

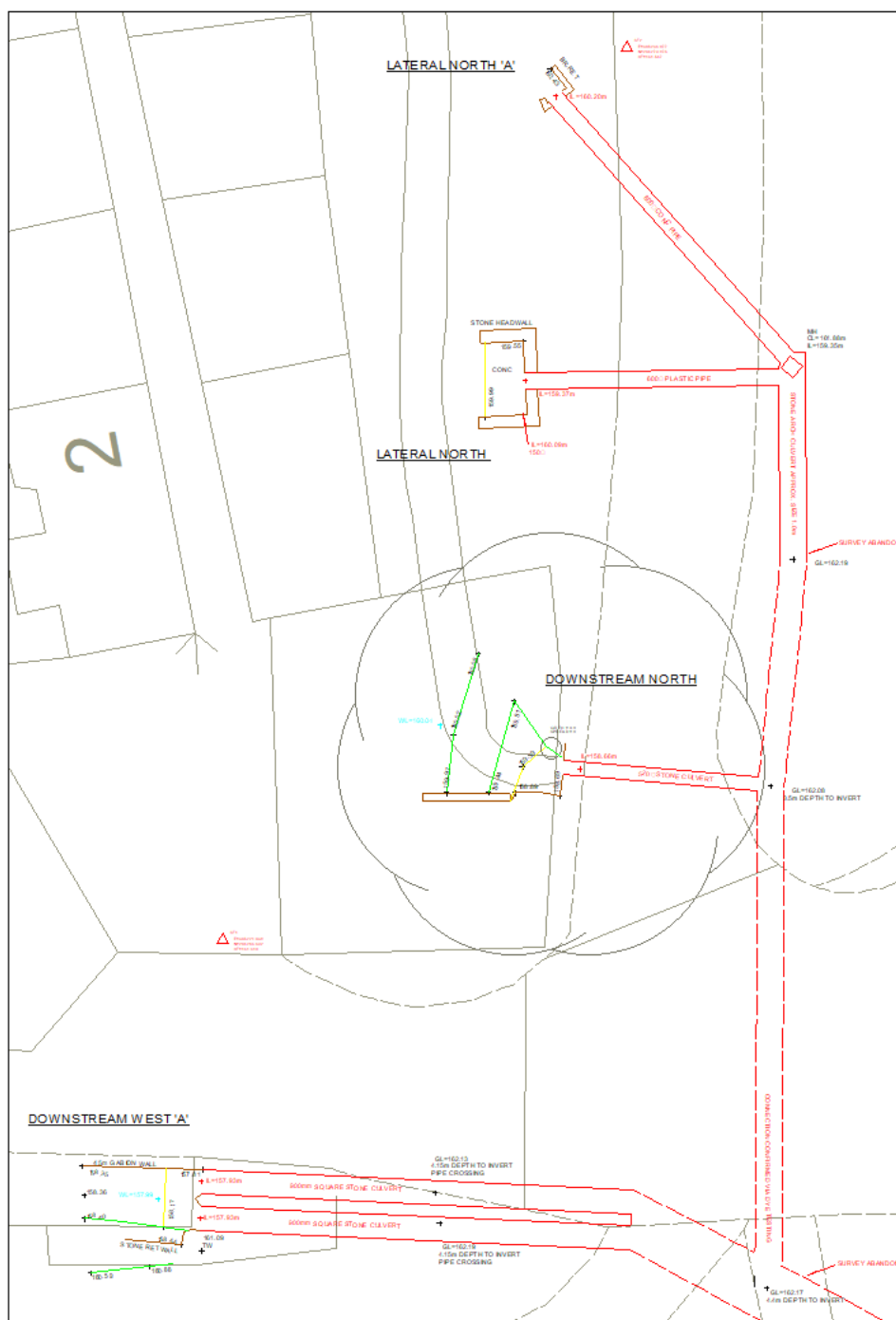


Figure 5-1 Existing culvert inlet arrangement (Strom Geomatics, 2019)

In March 2019, a CCTV survey of the culvert was undertaken by PM Surveys Ltd to inform the modelling process. The aim of the CCTV survey was to survey all culverts between the Nant Canaid and River Taff.

This survey was able to obtain the dimensions and locations of the inlets and key connections. However, access to the full length of the culvert not possible as the equipment used was unable to navigate the uneven terrain of the riverbed (see Figure 5-2). This was further frustrated by a lack of manholes to provide access to the culvert. The images obtained from the CCTV show an effective culvert with no visible defects and little evidence of blockage. That the survey was aborted does not reflect the condition of the channel, but the limitations

of the survey equipment used that are design for pipe systems and not culverted watercourses with uneven riverbeds.

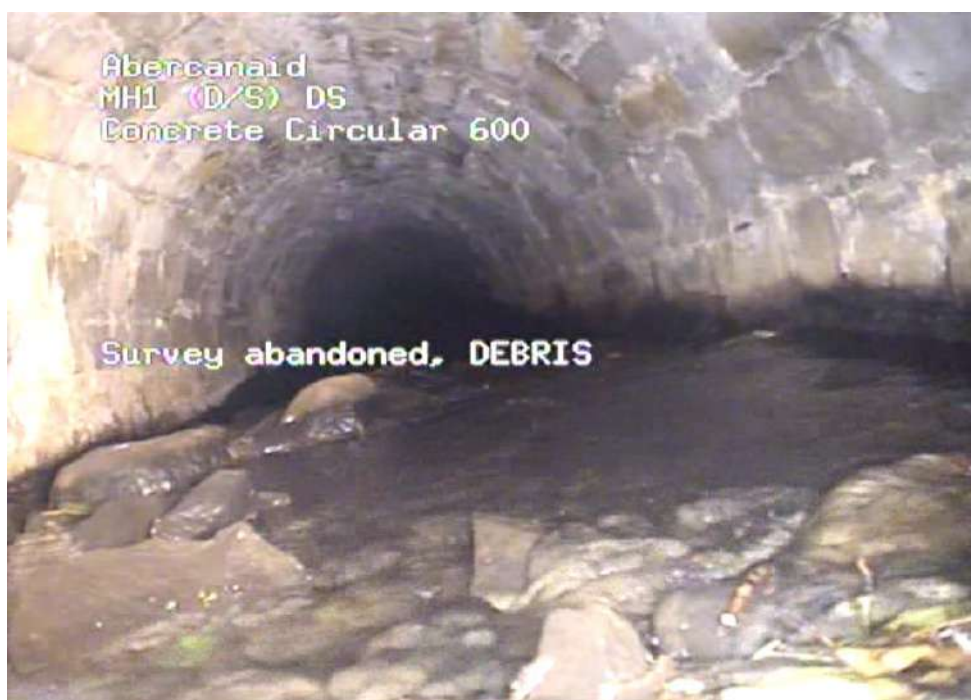


Figure 5-2: CCTV survey abandoned due to uneven terrain

5.2.2 NRW Culvert blockage advice

NRW have previously advised (15th Dec 2020) that as *"the Nant Canaid culvert has not been fully surveyed beneath the site due to obstacles. Therefore, assumptions have been included in the model regarding the capacity of the culvert. Given the presence of broken ground within the culvert and the historical risk of blockage at the inlet, as highlighted within the Section 4.1 of the (Hafren Water) FCA we believe it is appropriate to add a 95% blockage factor when considering the flood events referred to above (i.e. 1% +CCA +blockage and 0.1% +blockage flood events)."*

We disagree with NRW's description of the CCTV survey being abandoned due to 'obstructions' and 'broken ground'. The culvert in this section has a natural bed that is difficult for CCTV cameras systems designed for pipes to navigate. There is no evidence to suggest the culvert is defective.

These most recent comments from NRW also contradict previously received model review comments (Emily Harris, 09/04/2019), that stated *"The culvert route looks reasonable however this is not a confirmed route as there is no survey. The inlet and outlet sizes are modelled appropriately; however, it has been assumed that the culvert maintains its capacity (2.2m rectangular culvert) until it joins with the outfall. This is not the 'worst case scenario' and will need to be reviewed. When looking at the proposed site from an FCA point of view, the blockage scenario should be taken in to account by NRW."*

5.2.3 Culvert blockage modelling approach

It is acknowledged that there is some uncertainty over the condition and dimensions of the culvert over its full course, and that sensitivity analysis is appropriate. However, we see there to be little justification to support an assumed 95% failure of the asset as the 'design event'. Such a scenario would require a total collapse of the culvert or the near total blockage of all

four culvert inlets. We regard this as extremely improbable and have therefore used a 30% blockage scenario as the more probably base case.

However, significant culvert blockage however improbable, cannot be discounted. Therefore a 95% blockage scenario has been assessed as a 'residual risk' to allow consideration of a worst-case scenario and to ensure the safety of the development.

5.3 Pre-development flood model results

5.3.1 1% AEP plus climate change

The pre-development (baseline) modelling of the 1% AEP plus climate change events, shown in Figure 5-3, demonstrates the effectiveness of the Dragon Parc Flood Mitigation Scheme. In this event, flooding is entirely confined to the new flood corridor around the western perimeter of the site, intercepting and conveying exceedance flows from the Nant Canaid safely to the River Taff. No flooding is predicted to the proposed residential development areas.

The flooding mechanism is from channel and culvert capacity exceedance of the Nant Canaid to the west of the site. Water levels in the River Taff remain well below top of bank.

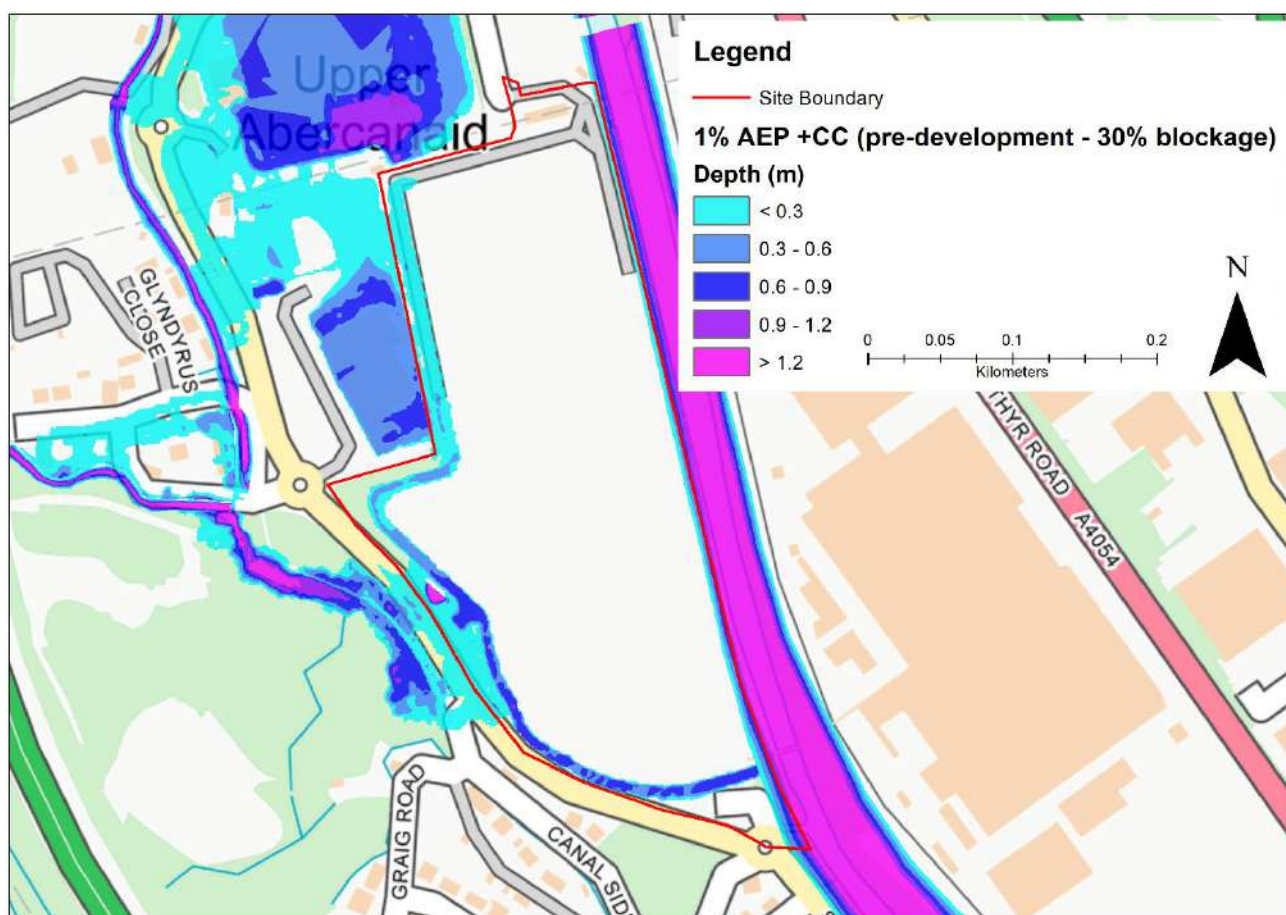


Figure 5-3 Baseline 1% AEP plus climate change Maximum Depths

5.3.2 0.1% AEP

During the 0.1% AEP event flood depths are predicted to be similar to those predicted in the 1% AEP event plus climate change, as shown in Figure 5-4. However, with increasing flood flows and the addition of the 30% blockage allowance, the channel capacity of the flood

mitigation scheme is exceeded resulting in localised areas of very shallow flooding on the site. Maximum flood depths within the proposed residential area typically do not exceed 100mm in this pre-development scenario. The maximum predicted water level within the flood corridor is 157.05mAOD.

In the 0.1% AEP event, water levels in the River Taff remain well below top of bank, with a maximum flood level of 152.40mAOD on the northern boundary of the site.

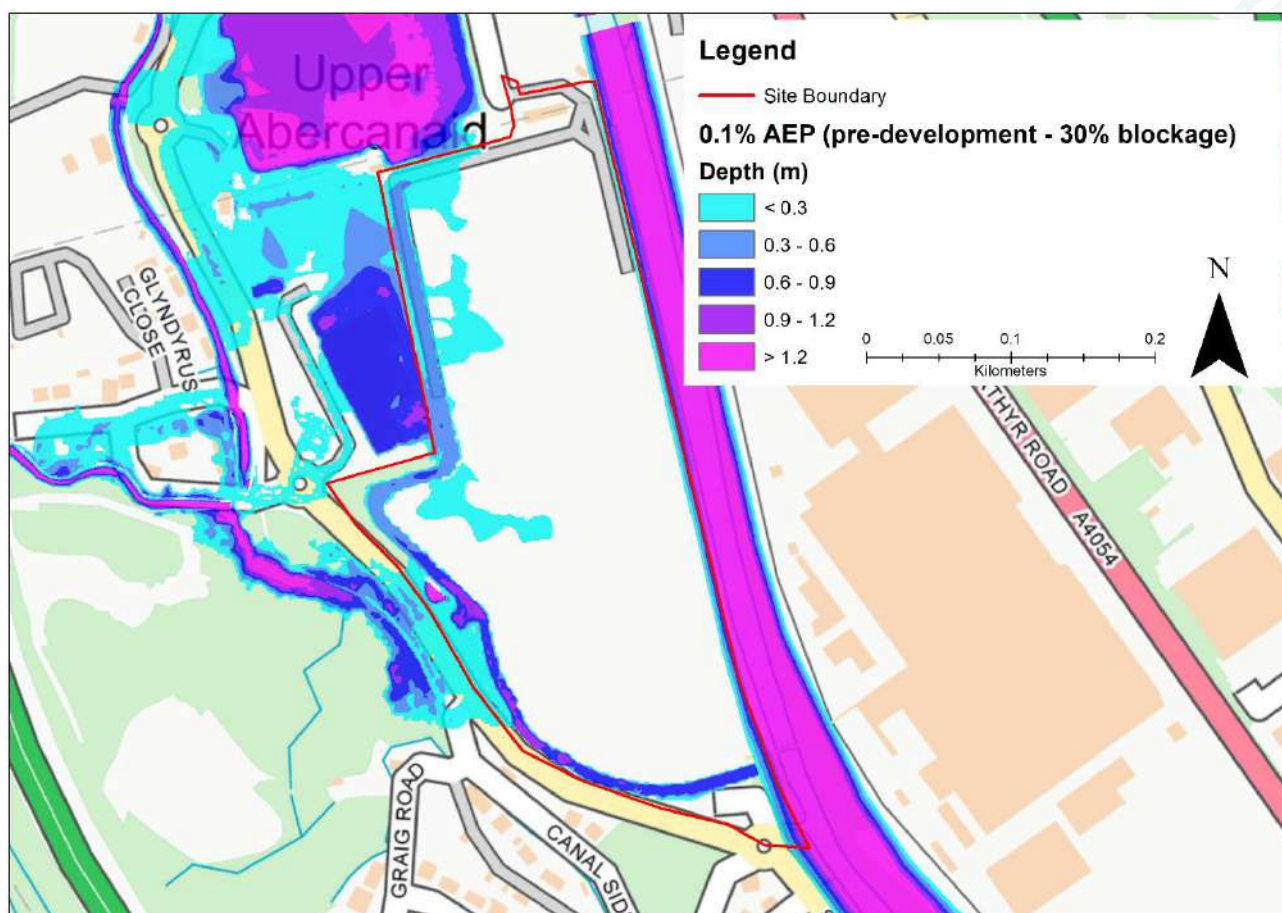


Figure 5-4 Baseline 0.1% AEP Maximum Depths

5.4 Post-development flood modelling

The proposed development is designed to complement and enhance the existing flood mitigation scheme. This is achieved by further raising the development plateau on which all residential development will take place and careful design of the access points to the north and south of the site.

The proposed ground levels of the development plateau shall range from 159.4mAOD at the north of the site to 157mAOD at the south of the site. These levels are significantly higher than all estimates of flooding, as these levels have largely been set by other site considerations.

The post-development flood model incorporates the following changes in addition to the baseline pre-development model:

- 1 **Development plateau.** The 3D ground model (Appendix C) of the proposed development has been used to generate a simplified Digital Elevation Model (DEM) modification to apply the development plateau to the model. This DEM modification is a single (z-shape) polygon with regularly spaced vertex set to match the engineering plans.

- 2 **Northern flood corridor.** The flood corridor and landscape feature has been extended across the northern boundary of the site to provide greater continuity. This feature is formed by a shallow scrap with a maximum depth of 0.5m. This DEM modification has been applied as a single (z-shape) polygon with levels set at key vertex.
- 3 **Southern crossing.** The proposed main site access is from the south, where it must cross the flood corridor. This crossing has been applied as a single (z-shape) polygon set to a level of 155 mAOD, with a twin box culvert below. The twin box culverts are each 2.4m wide and 1.8m high, with an invert level of 151.8mAOD.
- 4 **Northern crossing.** There shall be a secondary access to the site from north. This crossing has been applied as a single (z-shape) polygon set to a level of 159.4mAOD, with a box culvert below. The box culvert is 2m wide and 1m high, with an invert level of 156.5 mAOD. This is the minimum dimensions of this culvert.

Figure 5-5 below illustrates the model modifications that make up the post-development model setup.

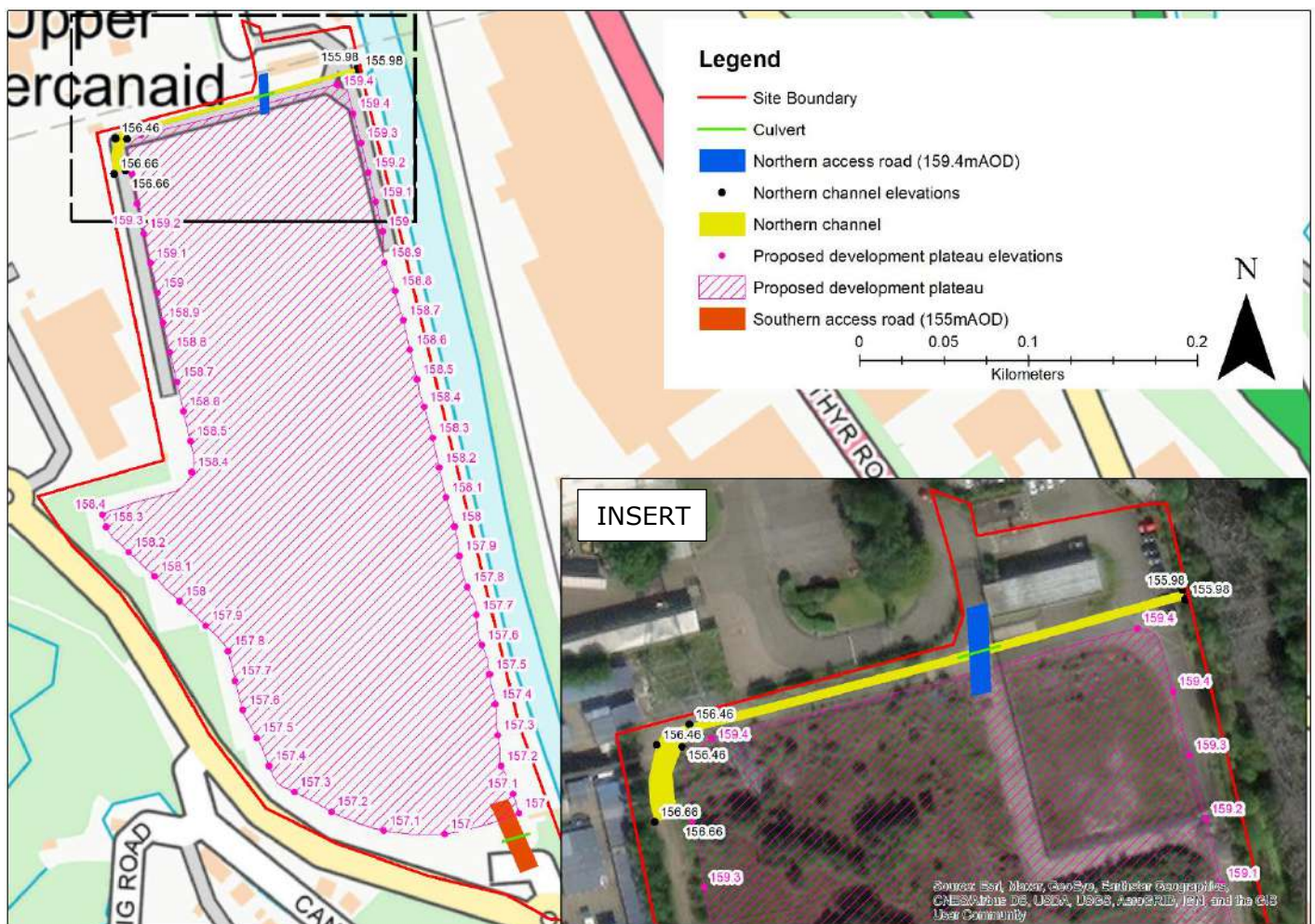


Figure 5-5: Post-development model setup

5.5 Post-development flood model results (30% blockage)

5.5.1 1% AEP plus climate change

Figure 4-4 shows the results of the post-development modelling for the 1% AEP plus climate change event. This includes the 30% blockage of the Nant Canaid culverts.

In this scenario flooding is entirely confined to the flood corridor as intended. The maximum flood level predicted onsite is 156.81mAOD, significantly below the level of the development plateau.

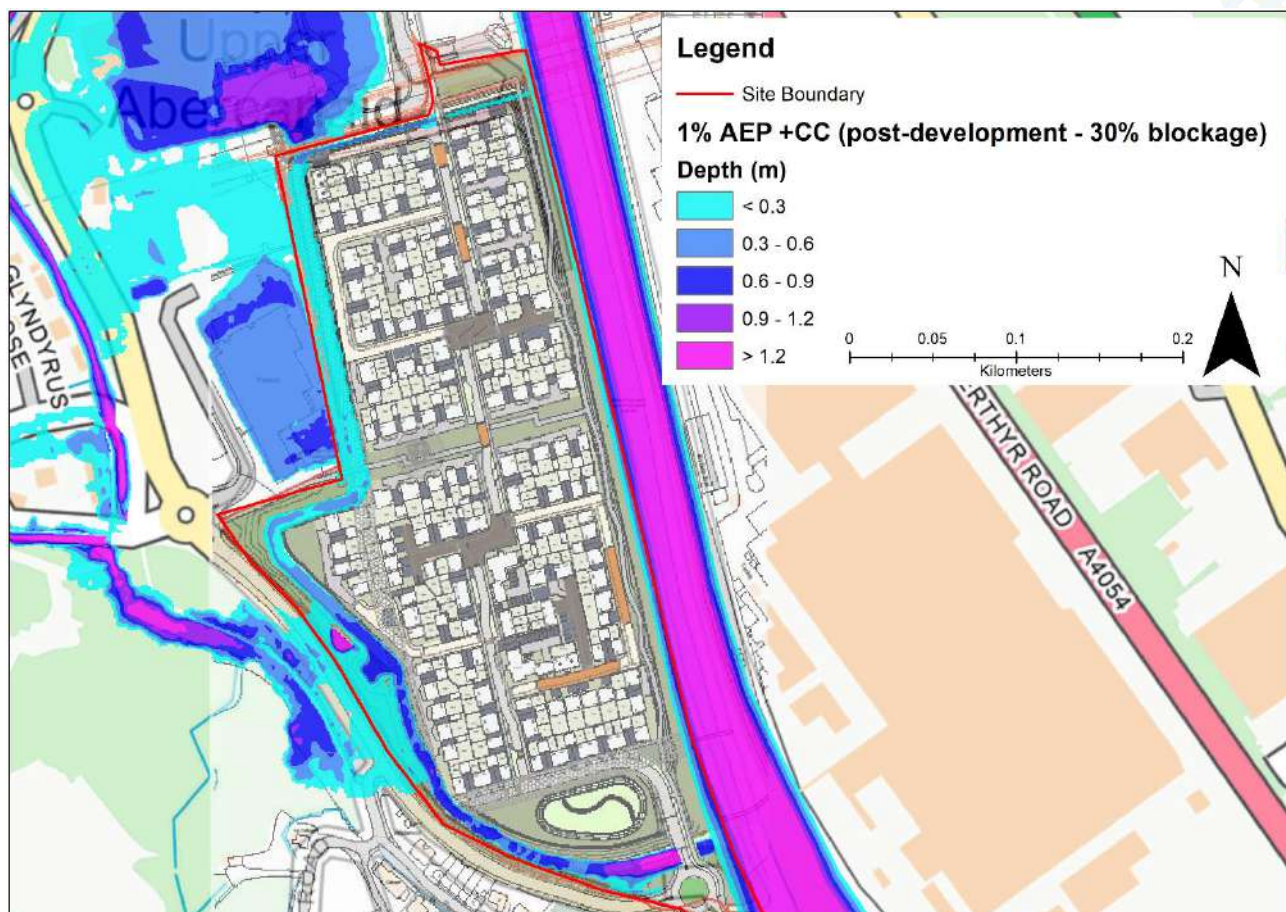


Figure 5-6 Proposed 1% AEP plus climate change maximum depths

TAN-15 Section 7 advises that any new development should not have adverse impacts on third-party flood risk. Therefore, a comparison of the pre- and post-development modelled flood depths for the 1% AEP plus climate change event is provided in Figure 5-7. This demonstrates that there are no adverse off-site impacts on third-parties flood risk as a result of the proposed development. To the immediate west of the site a small (19mm) reduction in flood depths is predicted.

On-site there is a localised increase in water levels resulting from the addition of the southern crossing. This increase is confined to the flood corridor immediately upstream of the culverts. The predicted water level remains below the soffit level of the culverts and approximately 4m below the level of the development plateau.

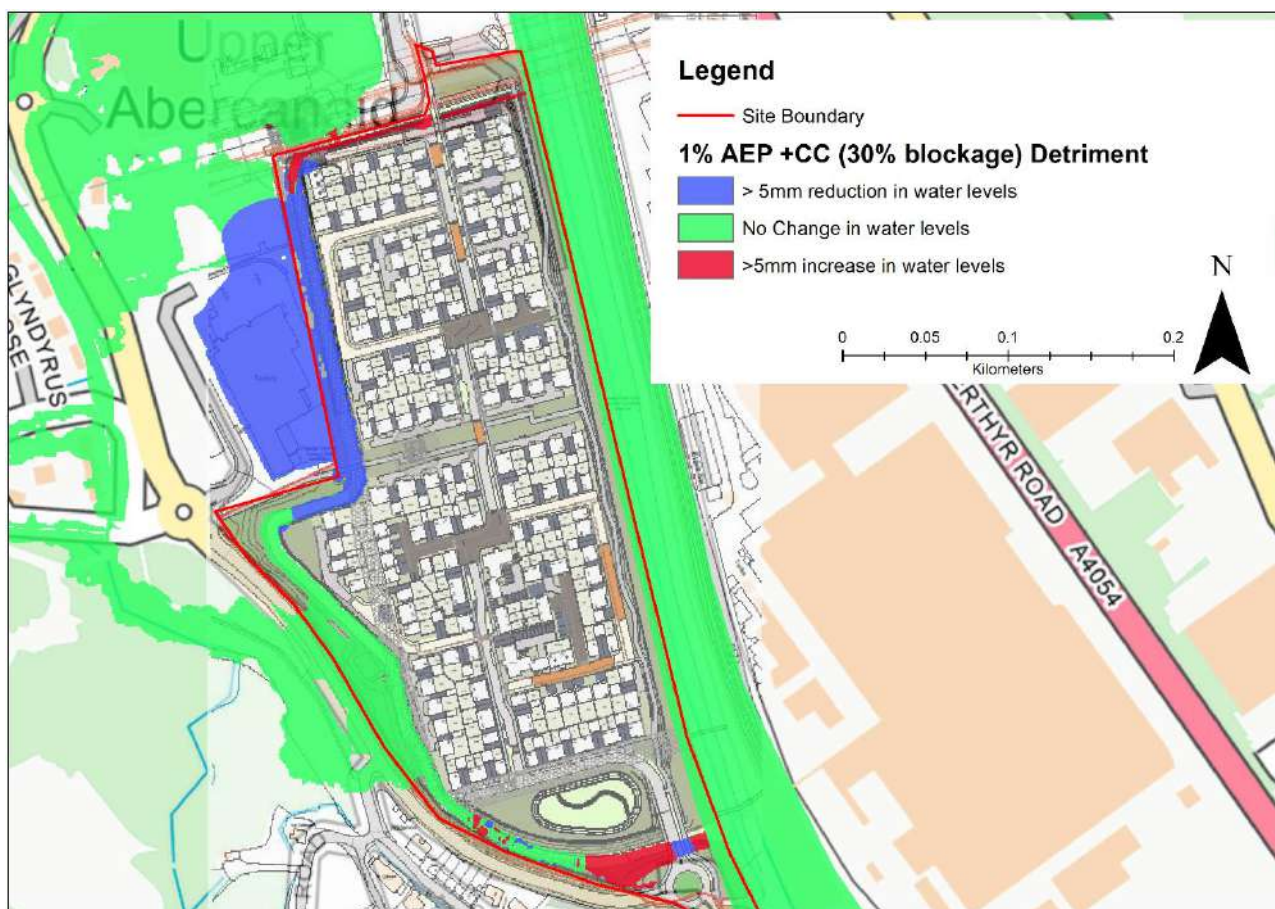


Figure 5-7: pre-development vs post-development 1% AEP plus climate change

5.5.2 0.1% AEP

Figure 4-6 shows the results of the post-development modelling for the 0.1% AEP event. This includes the 30% blockage of the Nant Canaid culverts.

In this scenario flooding is entirely confined to the flood corridor as intended. The maximum flood level predicted onsite is 157.04mAOD, significantly below the level of the development plateau.

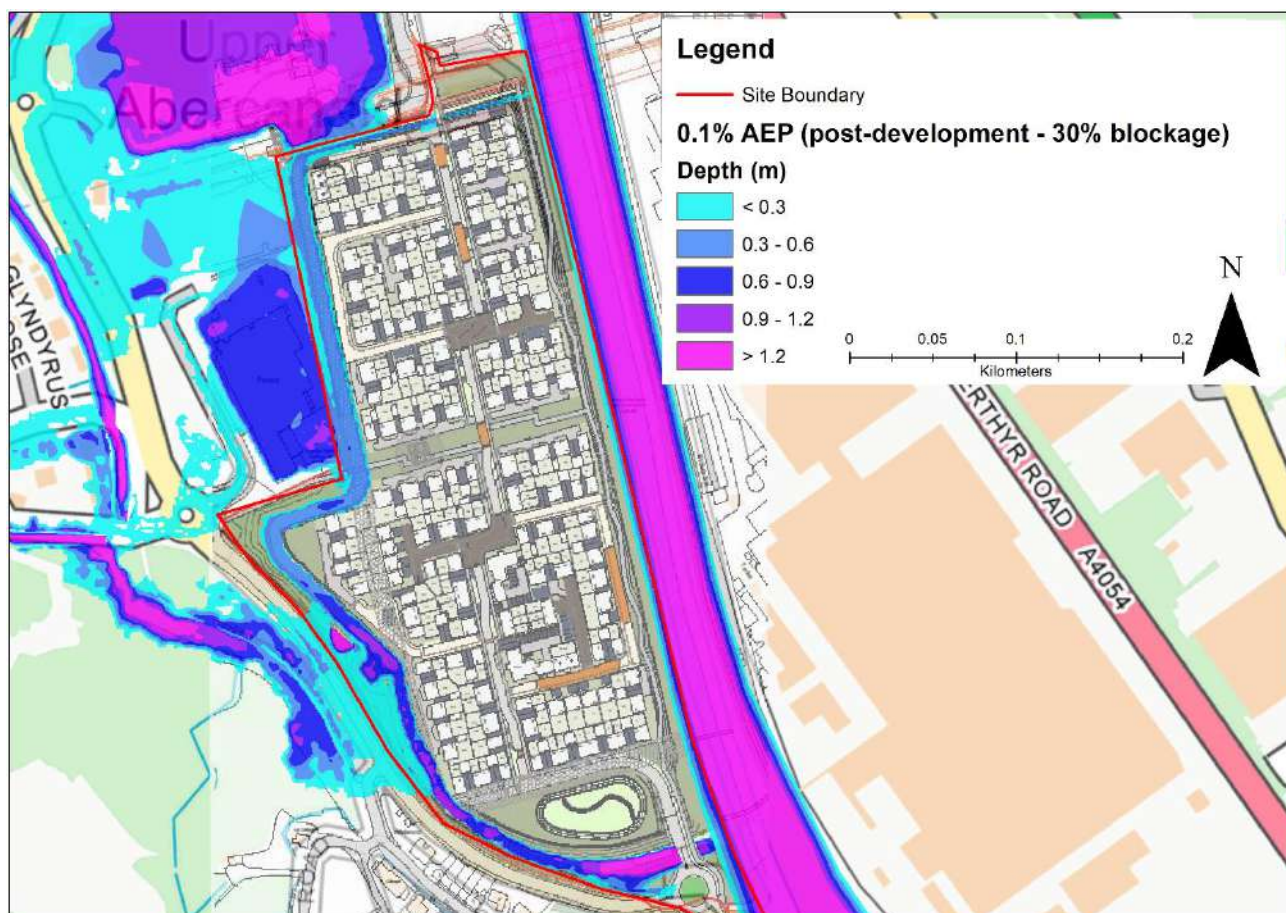


Figure 5-8 Proposed 0.1% AEP Maximum Depths

A comparison of the pre- and post-development modelled flood depth results for the 0.1% AEP event is provided in Figure 5-9. This demonstrates that there are no adverse off-site impacts on third-parties flood risk as a result of the proposed development. To the immediate west and north of the site a small (~30mm) reduction in water levels is predicted.

On-site there is a localised increase in flood depth resulting from the addition of the southern crossing. This increase is confined to the flood corridor immediately upstream of the culverts. The predicted water level remains below the soffit level of the culverts and approximately 3.5m below the level of the development plateau.

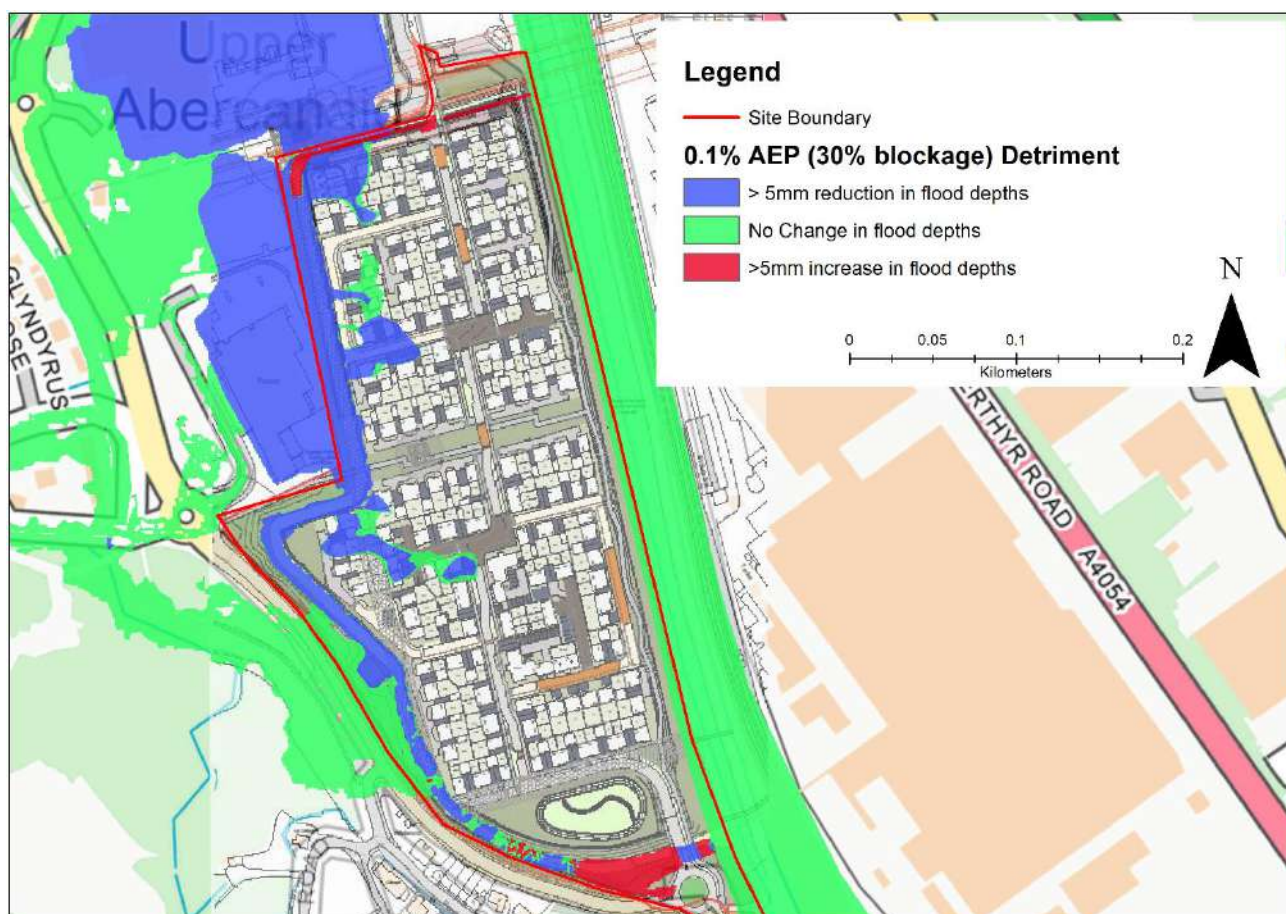


Figure 5-9: pre-development vs post-development 0.1% AEP

5.6 Residual Flood Risk

The culvert on the Nant Canaid is critical in conveying flows to the Taff. To understand the residual flood risks posed by the near total failure of this asset or the blockage of all four inlets, the impact of a 95% blockage of the culvert system has modelled got the 0.1% AEP event to assess the worst-case scenario. The purpose of this modelling is to confirm that the development will remain safe in even the most catastrophic flood event.

Figure 5-10 shows the predicted flood depths in the 0.1% AEP event assuming a 95% blockage of the Nant Canaid culverts for the full duration of the event. These results show that although flood levels in the flood corridor increase somewhat, to a maximum level of 157.15mAOD, flooding remains some distance below the development plateau in all areas.

Therefore, it can be concluded that the residual risk culvert blockage has minimal impact on the development and the assessment of flood risks.

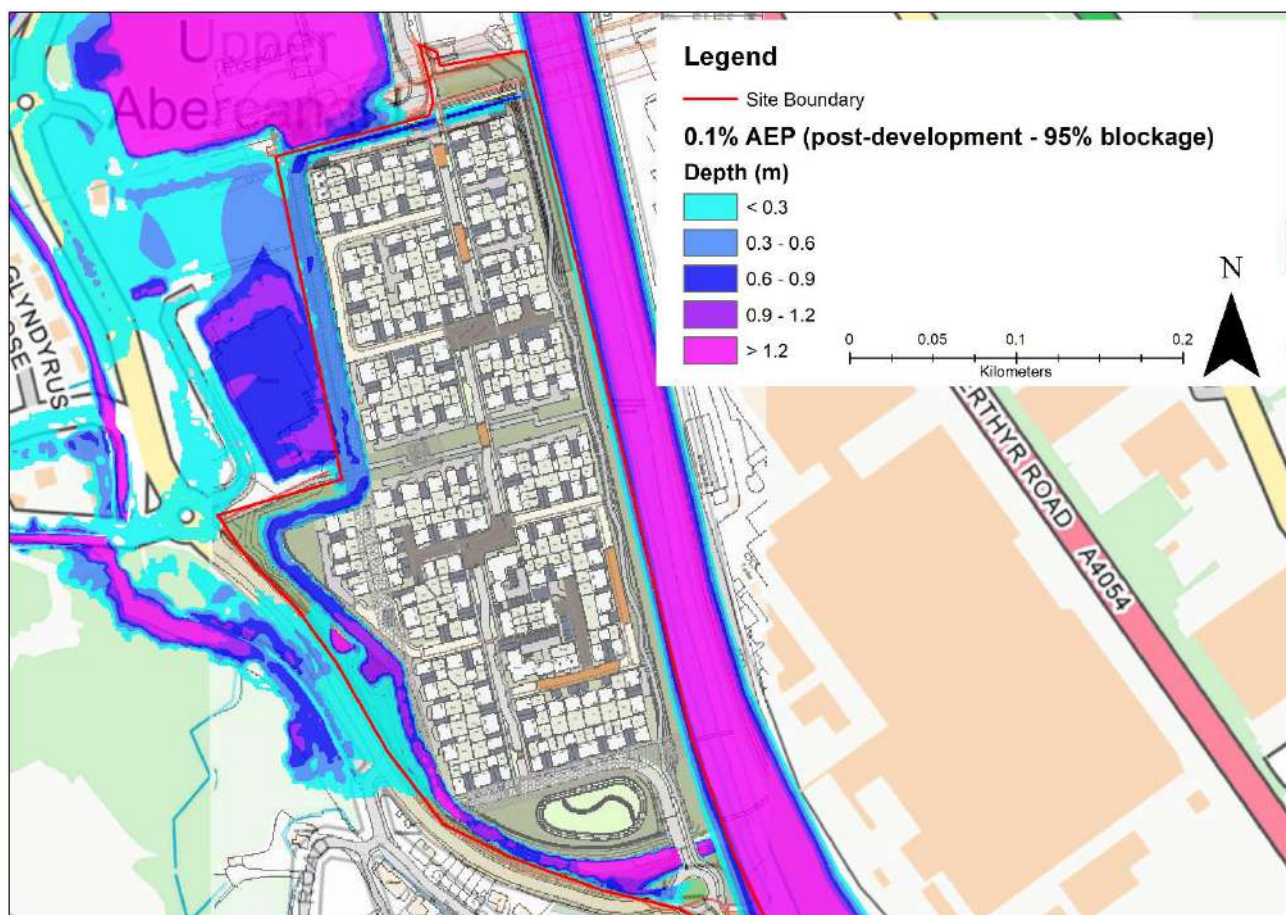


Figure 5-10: 0.1% AEP Maximum Depths – 95% blockage scenario

6 Assessment of Acceptability Criteria

An assessment of the Acceptability Criteria, as set out in TAN15, is summarised in Table 6-1 below. These criteria must be satisfied for the proposed development to comply with all aspects of TAN15.

Table 6-1 Assessment of accessibility criteria

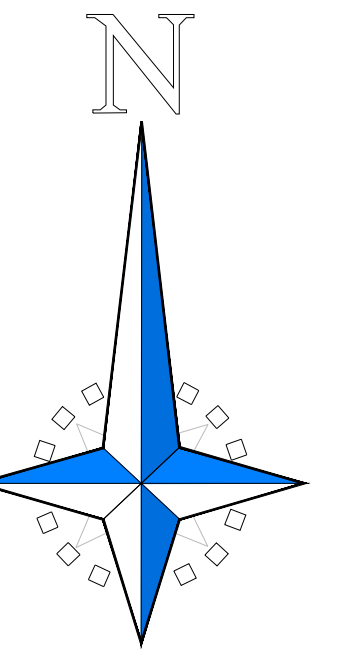
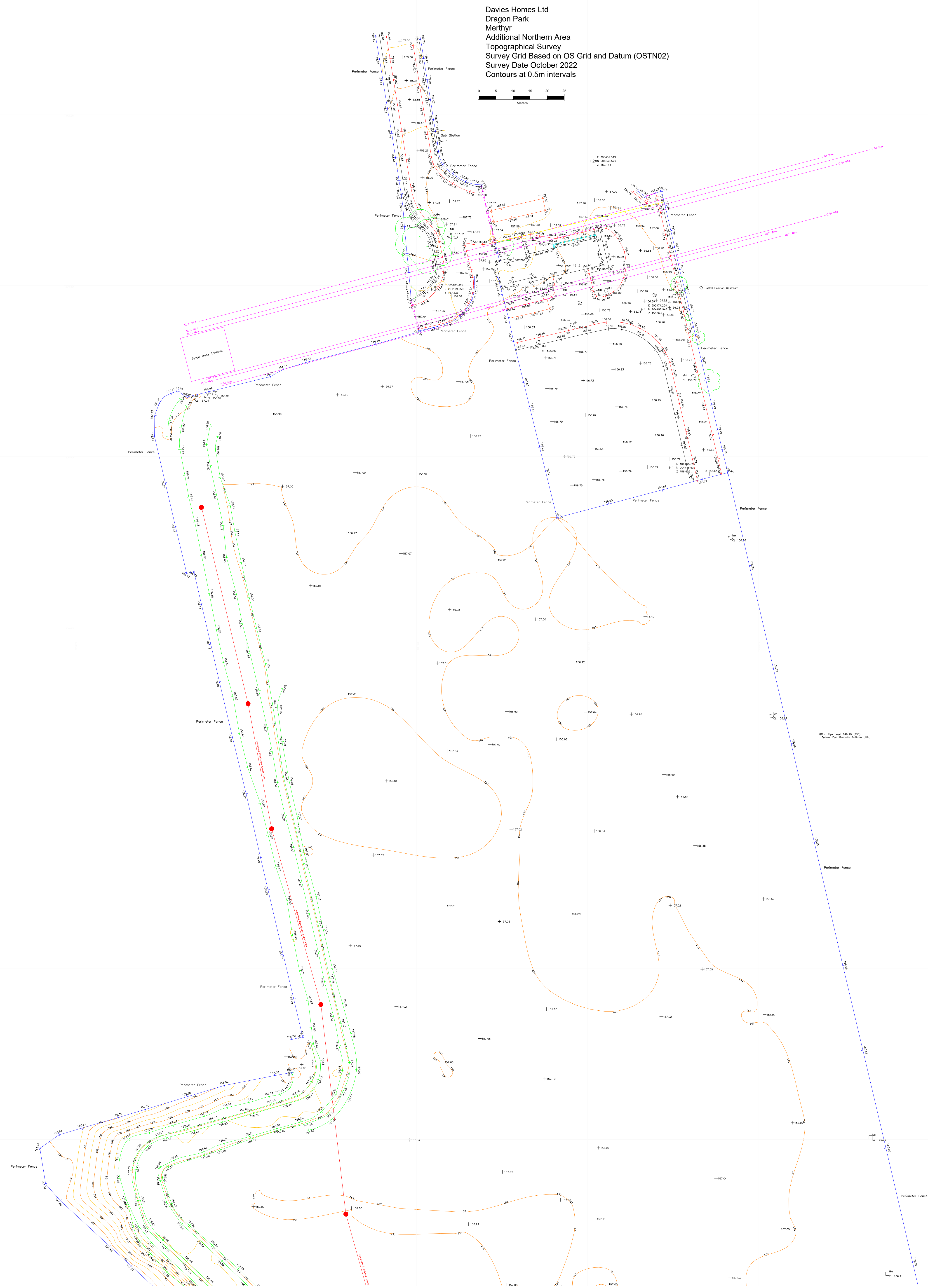
TAN 15 Justification Criteria	Comments	Satisfied
Developer is required to demonstrate that the site is designed to be flood free for the lifetime [Ref: TAN15 A1.5] of development for a 1 in 100 (1%) chance (fluvial) and 1 in 200 (0.5%) chance (tidal) flood event including an allowance for climate change in accordance with TAN15 table A1.14.	The proposed development site is predicted to be flood-free during the 1% AEP plus climate change flood event. The only areas of the site that are predicted to flood are those directly associated with the flood mitigation scheme and are therefore designed to flood (ie. water compatible development).	Yes
The development should be designed so that in an extreme (1 in 1000 chance) event there would be less than 600mm of water on access roads and within the property, in accordance with TAN15 table A1.15	The proposed development site is predicted to be flood-free during the 0.1% AEP flood event. This holds true even with the application of a 95% blockage on the Nant Canaid culverts. The only areas of the site that are predicted to flood are those directly associated with the flood mitigation scheme and are therefore designed to flood (ie. water compatible development).	Yes
No flooding elsewhere.	The proposed development will not increase flooding elsewhere.	Yes
Flood defences must be shown by the developer to be structurally adequate particularly under extreme overtopping conditions (i.e. that flood with a 1 in 1000 chance of occurring in any given year).	The proposed development does not rely upon any formal flood defences. The flood mitigation scheme is passive by design, requiring little or no maintenance. Although it has been incorporated into the proposed landscape strategy as informal public open space.	Yes
The developer must ensure that future occupiers of development are aware of the flooding risks and consequences	The residential development shall be at little or no flood risk. Residents will be informed of the purpose of the flood corridor through appropriate signage.	Yes
Effective flood warnings are provided at the site	The residential development shall be at little or no flood risk. Therefore residents would not directly benefit from a flood	Yes

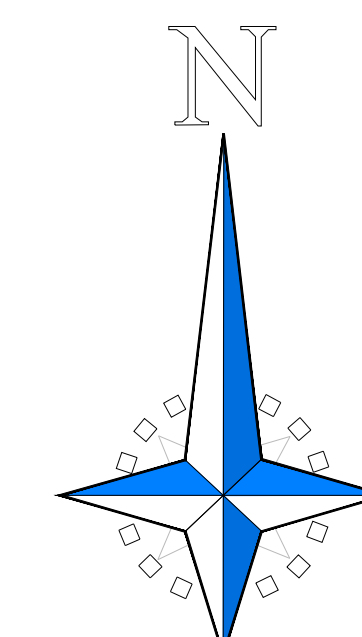
TAN 15 Justification Criteria	Comments	Satisfied
	warning service. The site is located in an NRW Flood Warning Area. However this is associated with the River Taff which does not threaten the site.	
Escape/evacuation routes are shown by the developer to be operational under all conditions.	The residential development, including both accesses, are not predicted to flood in any modelled scenario.	Yes
The development is designed by the developer to allow the occupier of the facility for rapid movement of goods/possessions to areas away from flood waters.	The residential development, including both accesses, are not predicted to flood in any modelled scenario.	Yes
Development is designed to minimise structural damage during a flooding event and is flood proofed to enable it to be returned to its prime use quickly in the aftermath of the flood.	The residential development, including both accesses, are not predicted to flood in any modelled scenario.	Yes

7 Conclusions and Recommendations

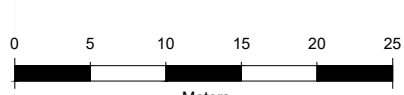
- JBA Consulting were commissioned by Davies Homes to prepare a Flood Consequences Assessment (FCA) in support of a planning application for a 200 unit residential development at Dragon Parc, Merthyr Tydfil.
- This FCA adheres to Welsh Government guidance on development and flood risk set out in the Technical Advice Note 15: Development and Flood Risk (TAN-15).
- The 7.8ha brownfield site is currently vacant, following the demolition of a former factory. Elevations across the site vary from 153m AOD to 160m AOD and generally slope down towards the south-east corner. On the eastern site boundary, there is a significant (~6m) drop down to the River Taff.
- Flood risk from groundwater, surface water, sewers and as a result of reservoir failure are considered to be low.
- Development of the site shall adopt a sustainable drainage strategy to manage surface water originating from the site.
- The principal source of flood risk to the site is the Nant Canaid, an Ordinary Watercourse originating to the west of the site and extensively culverted to the south of the site. The limited capacity of this culvert system is predicted to direct exceedance flood flows overland towards and across the site.
- The FCA follows a previously successful planning application and FCA for development enabling flood mitigation works at the site, which have now been implemented. The Dragon Parc Flood Mitigation Scheme works by channelling floodwater around the perimeter of site and away from areas of proposed residential development.
- The current Development Advice Map predates the flood mitigation scheme. Therefore, a formal flood map challenge was submitted to NRW in early 2022 and subsequently agreed with NRW in May 2022. This new modelling clearly shows the effectiveness of the flood mitigation scheme, placing almost all areas other than the flood mitigation scheme in DAM Zone A. Flood Zone A, is used to indicate that justification test is not applicable and there is no need to consider flood risk further. However, given the lengthy and complex history of flood risk assessment at the site, the residual risk of culvert blockage and importance of the flood mitigation scheme, a comprehensive FCA has been prepared and the acceptability criteria of TAN15 rigorously applied.
- Detailed flood modelling has been undertaken based on the NRW accepted model, incorporating the proposed development, to inform this FCA. This modelling includes appropriate allowances for climate change and the risk of culvert blockages on the Nant Canaid. **Under all scenarios the site is predicted to be flood free, having no negative impact on the flood risk elsewhere.**
- This FCA has demonstrated that all requirements of TAN15, including all acceptability criteria, have been satisfied. Consequently, we conclude that on the grounds of flood risk, the proposed development meets the requirement set out in TAN-15 and the aims of Planning Policy Wales.

Appendix A – Site topographical survey





Davies Homes Ltd
Dragon Park
Merthyr
Flood Diversion Works
Topographical Survey
Survey Grid Based on OS Grid and Datum (OSTN02)
Survey Date January 2021
Contours at 0.5m intervals
Additional Roundabout Survey Added 08/03/2022



Davies Homes Ltd Dragon Park Merthyr Flood Diversion Works Topographical Survey	
Drawing 4 of 4	
Drawing Number	18511/003/DH/DLO
Scale	1/500 @ A0
Date	08/03/2022
Drawn by	DLO

Appendix B – Proposed site layout



Accommodation Schedule					
House Name	Code	Beds	(N/A) ft²	No of Units	Total Area
Open Market Units					
1 Bed Apartment	APT2	1	545	9	4905
Warwick	WAR	2	681	13	8853
Flat Over Garage	FOG	2	774	2	1548
Raglan	RAG	3	818	15	12270
Ascot	ASC	3	1018	18	18324
Hereford	HER	3	1055	4	4220
Chepstow	CHE	3	1057	28	29596
Rockfield	ROC	3	1024	17	17408
Cottage	COT	3	1045	7	7315
Canterbury	CAN	3	1274	14	17836
Harrowgate	HAR	4	1360	4	5440
Radleigh	RAD	4	1534	14	21476
Lynton	LYN	4	1520	15	22800
Windermere	WIN	4	1517	14	21238
Knightsbridge	KNI	5	2043	6	12258
Sub Total				180	205487
Affordable Units					
House/Flat Name	Code	Beds	(N/A) ft²	No of Units	Total Area
Social Rented Units					
1 Bed Apartment	APT2	1	545	9	4905
2.1.1 GF	2.1.1	1	557	2	1114
2.1.1 FF	2.1.1	1	624	2	1248
House					
4.2.1	4.2.1	2	861	7	6027
Sub Total				20	13294
Total				200	218781

Site Key

- Site Boundary
- 1.8m high close board fence
- 1.8m high screen wall (refer to House Finishes Layout)
- 1.8m high personnel gate (Approximate gate location - gates to be located within meter box locations)
- 0.45m timber knee rail
- 0.90m low screen wall
- Parking space
- Primary door to dwelling (unit 10)
- Secondary door(s) to dwelling
- Garage entrance
- Affordable unit - Social Rented
- Easement
- No build zone
- Right of Way for Non-motors
- Bike Store
- Bin Store
- Soft Surface Finishes
 - Front Garden
 - Rear Garden
 - Amenity Space / Open Space
 - Bio-retention System Features / Attenuation System
 - Overflow Channel
 - Swale Features
 - Private Rain Garden
- Indicative Tree Planting Location (refer to landscape architects layout for more details)
- Hard Surface Finishes
 - Adopted highway - Tarmac
 - Adopted footpath/cycleway - Tarmac
 - Adopted shared surface - Coloured Asphalt
 - Adopted highway - Toremere City Pavé V55
 - Adopted highway - Block Paving
 - Ramp & raised table - Tarmac
 - Private drive - Tarmac
 - Private drive - Toremere Tegula 'Heather'
 - Private drive - Toremere Tegula 'Slate'
 - Rumble Strip - Toremere Tegula 'Natural'
 - Private footpath - PCC slabs
 - Patio area - PCC slabs
 - Refuse collection point - PCC Slabs (for public access of private drives only)

DRAFT

REV.	DESCRIPTION	DATE
CLIENT		

Davies Homes
JOB TITLE
Dragon Parc, Merthyr Tydfil.
DRAWING TITLE
Planning Layout

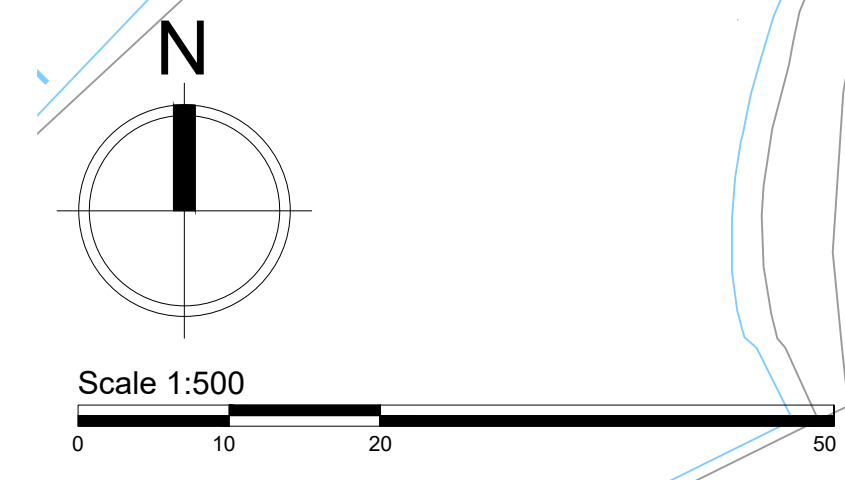
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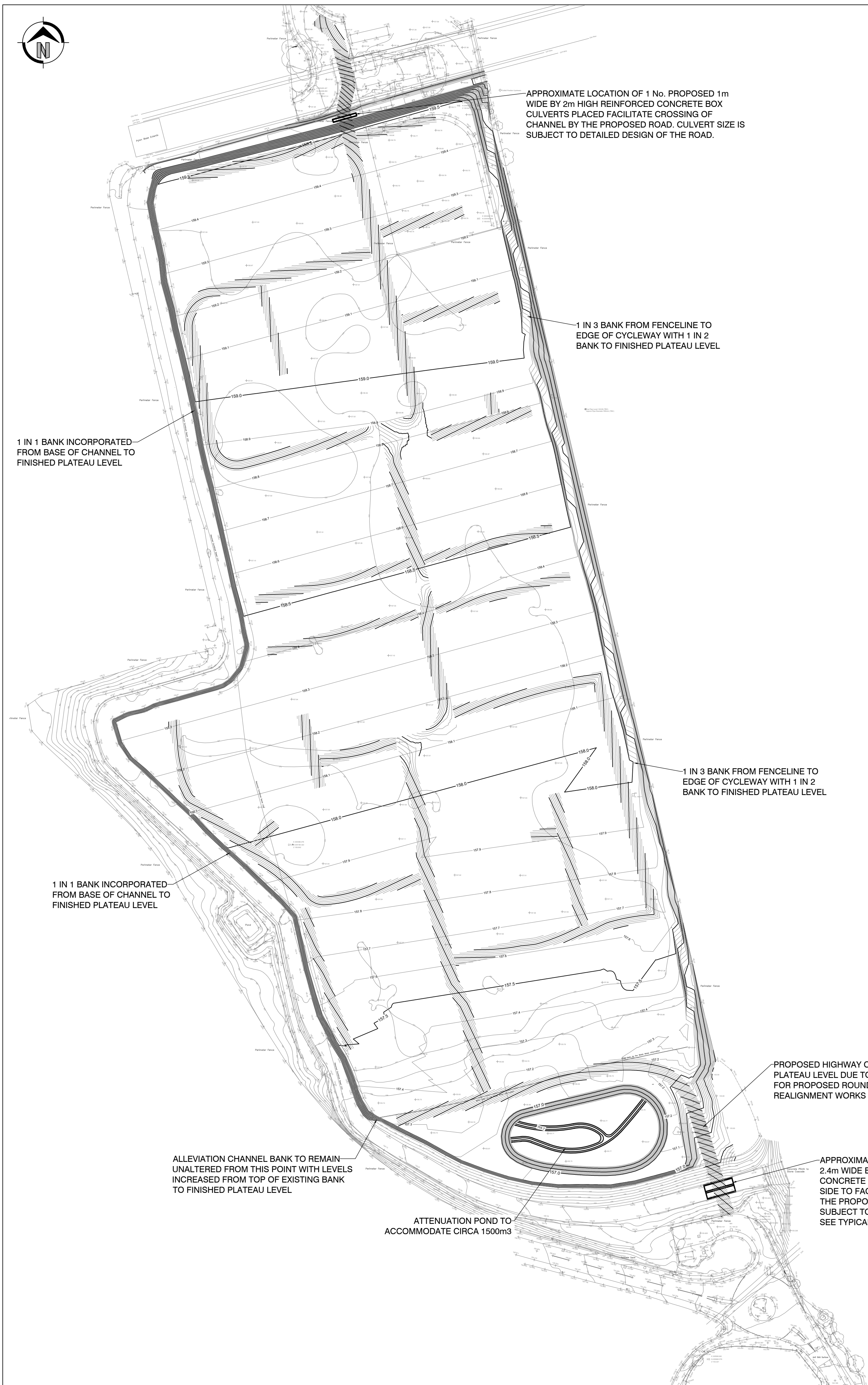
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Figured dimensions must be taken in preference to scaled dimensions and any discrepancies are to be referred to Hammond Architectural Ltd. Contractors, subcontractors and suppliers must verify all dimensions on site before commencing any work or making any workshop drawings



Appendix C – Proposed engineering plans



~1 IN 3 BANK FROM FENCELINE TO
EDGE OF CYCLEWAY WITH 1 IN 2
BANK TO FINISHED PLATEAU LEVEL

1 IN 1 BANK INCORPORATED-
FROM BASE OF CHANNEL TO
FINISHED PLATEAU LEVEL

—1 IN 3 BANK FROM FENCE LINE TO
EDGE OF CYCLEWAY WITH 1 IN 2
BANK TO FINISHED PLATEAU LEVEL

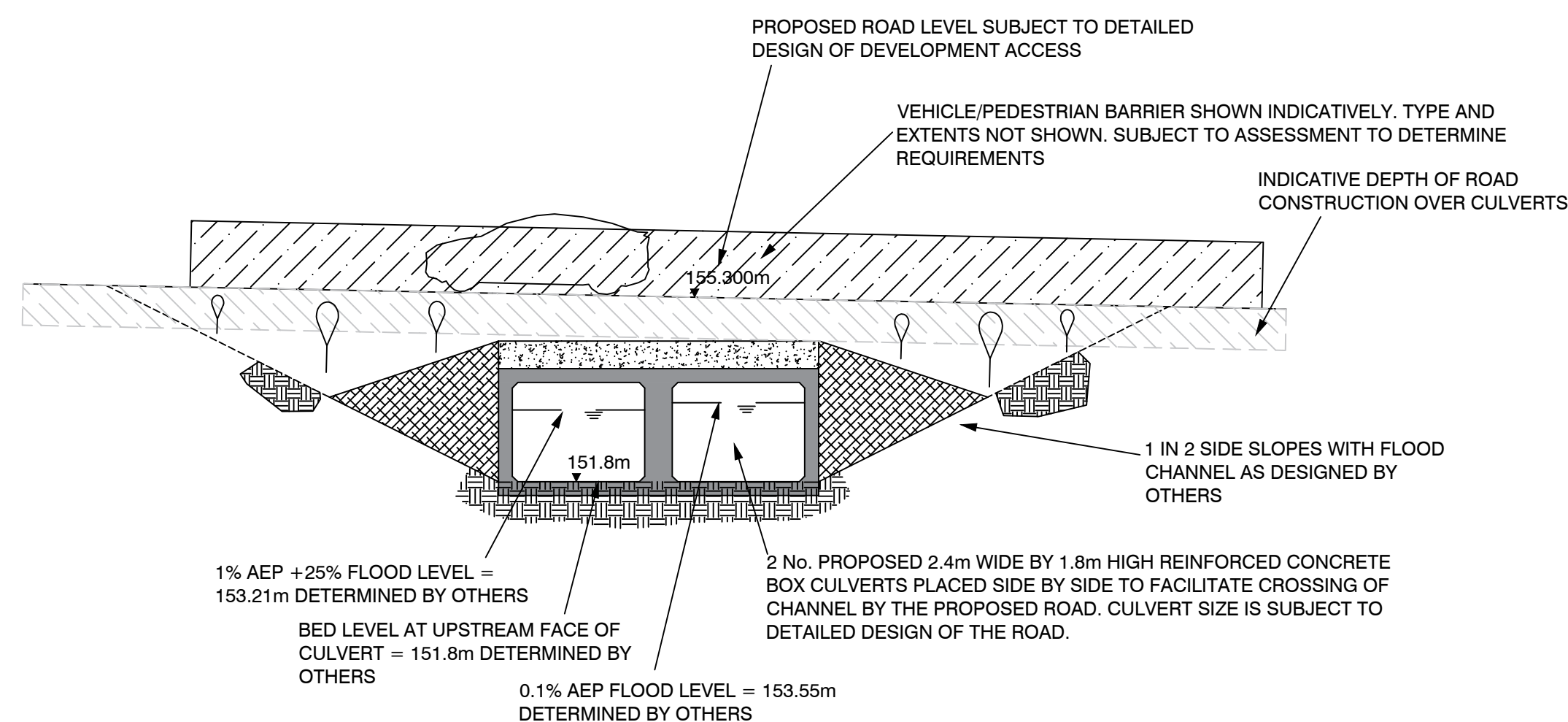
1 IN 1 BANK INCORPORATED
FROM BASE OF CHANNEL TO
FINISHED PLATEAU LEVEL

ALLEVIATION CHANNEL BANK TO REMAIN—
UNALTERED FROM THIS POINT WITH LEVELS
INCREASED FROM TOP OF EXISTING BANK
TO FINISHED PLATEAU LEVEL

ATTENUATION POND TO-
ACCOMMODATE CIRCA 1500m3

✓ PROPOSED HIGHWAY CUTTING INTO FINISHED
PLATEAU LEVEL DUE TO DESIGN CONSTRAINTS
FOR PROPOSED ROUNDABOUT AND HIGHWAY
REALIGNMENT WORKS

-APPROXIMATE LOCATION OF 2 No. PROPOSED
2.4m WIDE BY 1.8m HIGH REINFORCED
CONCRETE BOX CULVERTS PLACED SIDE BY
SIDE TO FACILITATE CROSSING OF CHANNEL BY
THE PROPOSED ROAD. CULVERT SIZE IS
SUBJECT TO DETAILED DESIGN OF THE ROAD.
SEE TYPICAL CROSS SECTION



TYPICAL ELEVATION OF PROPOSED SOUTHERN CULVERTS

1. All dimensions and levels are in metres, U.N.O.
2. Do not scale from this drawing - use figured dimensions only.
3. Formation Levels subject to change following confirmation of development layout and further design at the Planning and Detailed Design stages.

F	17.11.22	PLATEAU & FLOOD LEVELS UPDATED	IMH
E	09.11.22	PLATEAU UPDATED & PROPOSED DEVELOPMENT ROAD ADDED	IMH
D	29.09.22	PLATEAU UPDATED TO SUIT COMMENTS AND POND REVISED	AV
C	21.07.22	LAND BOUNDARY EXTENDED. LEVELS ADDED TO SUIT.	TH
B	13.07.22	CULVERT LOCATION, NOTE AND INDICATIVE CROSS SECTION ADDED.	TH
A	05.07.22	LEVELS RAISED FOLLOWING DISCUSSION WITH CLIENT	TH
Rev	Date	Description	By

Dimensions to be verified on site.
This drawing should not be scaled. Use figured dimensions only
Any discrepancies should be referred to the Engineer prior to work being put in hand.
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**DAVIES
HOMES** 

Probi

DRAGON PARC

Title

PROPOSED PLATEAU LEVELS

Drawing Status

INFORMATION

Designed by	Drawn by	Checked by	Date	Scales @ A1 size
TJH	ACV	ACV	23/06/22	1:1000 UNO

Drawing No.

21566-SK-901-F

Appendix D – Flood Map Challenge report

Dragon Parc – Flood Modelling Report

May 2022

www.jbaconsulting.com

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Revision history

Revision Ref/Date	Amendments	Issued to
Rev 1 / February 2022	First Issue	NRW
Rev 1.1 / May 2022	Minor correction of typo in Table 3-1. Model updated with lower grid resolution.	NRW

Contract

This report describes work commissioned by Matthew Worton, on behalf of Davies Homes.

Prepared by Arran Bright BSc MSc
Assistant Analyst

Reviewed by George Baker BEng AIEMA CEnv IEng MCIWEM
C.WEM
Associate Director

Purpose

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1 Introduction

1.1 Terms of reference

JBA Consulting have been commissioned by Davis Homes to prepare a Flood Map Challenge (FMC) for the Dragon Parc site, Abercanaid, Merthyr Tydfil. This report has been prepared to document the technical work undertaken in support of the FMC to allow NRW to review the FMC application.

1.2 Overview of FMC development

In 2017, Thomas Mackay Ltd. developed a 1D-2D ESTRY-TUFLOW hydraulic model of the Afon Taff and Nant Canaid at the study area. The baseline (existing) scenario was reviewed and accepted by NRW in May 2019. Appendix A contains the final modelling report prepared by Thomas Mackay Ltd. This flood modelling work established an accepted baseline understanding of flood risk and a proposed strategy for managing this flood risk.

At the time, NRW advised that due to the Development Advice Map (DAM) Zone C2 classification a flood mitigation strategy would need to be implemented and the flood map subsequently challenged, before plans for residential development of the site could be brought forward. This is because TAN15 does not allow Highly Vulnerable Development in DAM Zone C2. Therefore, this was the approach that has been followed from this point forward.

JBA Consulting were commissioned in 2019 by Huntley Wood Investments Ltd to progress with the refinement and design of the Dragon Parc model mitigation strategy to support a planning application for the engineering works to deliver the strategy. This work ultimately resulted in comprehensive scheme details, a Flood Consequence Assessment (FCA), granting of planning permission (Ref. P/20/0025) and a Flood Risk Activity Permit (FRAP) (Ref. DFR/S/2021/0134). A copy of the final FCA for the flood mitigation works is contained in Appendix B. NRW reviewed and accepted the final flood modelling contained in the FCA with the understanding that a FMC would follow on completion of the works.

Since the granting of the planning permission and FRAP, the engineering works to deliver the flood mitigation strategy have been completed, with the exception of the site access bridge which is currently in abeyance. On completion of these works the site has been resurveyed to capture the as-built topography, the flood model updated accordingly, and this FMC prepared.

Since the 2020 FCA, planning policy in Wales has been transitioning to a major update of Technical Advice Note 15 (TAN15). The proposed update to TAN15 will see the current Development Advice Map replaced with the Flood Map for Planning (FMfP). Consequently, NRW have updated their requirements for the submission of a Flood Map Challenge to capture the new requirements of the FMfP and Flood Risk Assessment Wales (FRAW). Therefore, this FMC proposes changes to both the FMfP and FRAW.

Details of the DAM and how it would change, if updates were being made by NRW, are provided for information only.

1.3 Flood Map Challenge requirements

The Flood Map for Planning (FMfP) along with the Flood Risk Assessment Wales (FRAW) together make up the flood maps for Wales. The Flood Map for Planning is considered the starting point for consideration of flood risk in the planning system.

When the new TAN15 comes into effect from the 1st June 2023, the FMfP will be used for the control of development on the floodplain as set out in Technical Advice Note 15: Development, flooding, and coastal erosion¹. The FMfP zones take into the consideration climate change in the 1% and 0.1% AEP events.

1.4 Current flood maps

1.4.1 Flood Map for Planning

Figure 1-1 below shows the current Flood Map for Planning in the vicinity of the Dragon Parc site. The mapping shows that a majority of the Dragon Parc site is located in Zone 3, with comparatively small areas of Zones 1 and 2. Zone 3 is defined as areas with more than 1% (1 in 100) chance of flooding from rivers in a given year, including the effects of climate change.

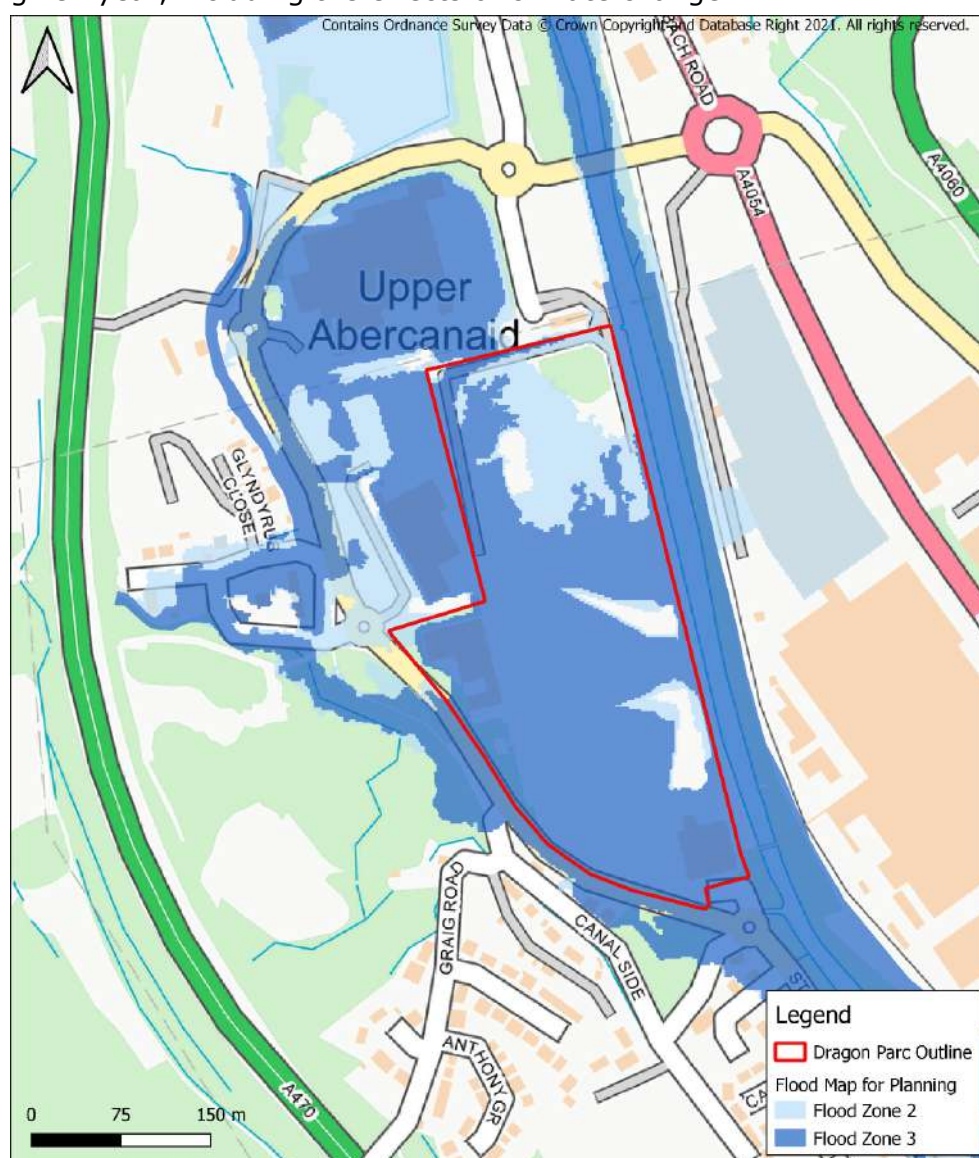


Figure 1-1: Flood Map for Planning²

¹ Welsh Government (2021): Technical Advice Note 15: Development, flooding, and coastal erosion

² Natural Resources Wales (2022) Flood Map for Planning - Flood Zones:

1.4.2 Flood Risk Assessment Wales - Rivers

According to the current Flood Risk Assessment Wales (FRAW) mapping, as reproduced in Figure 1-3, the Dragon Parc site is situated within the low, medium and high-risk zones. The risk levels are defined below:

- Low Risk – Floods during a 0.1% AEP (1 in 1000 year) event
- Medium Risk – Floods during a 1% AEP (1 in 100 year) event
- High Risk – Floods during a 3.3% AEP (1 in 30 year) event

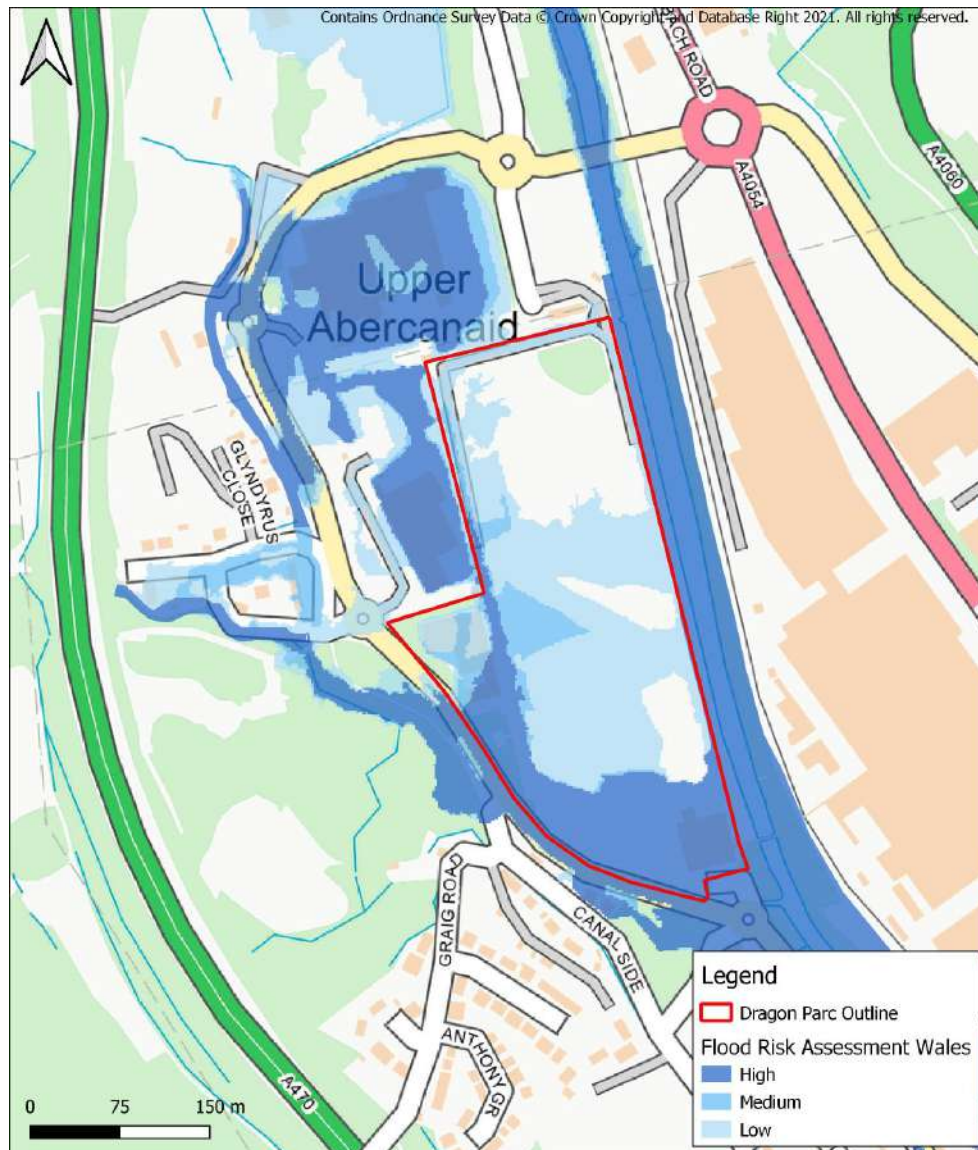


Figure 1-2: Flood Risk Assessment Wales³

1.4.3 Development Advice Map

The Dragon Parc site is currently extensively located within Zone C2, with remaining areas within Zone B. Zone C2 is based on the 0.1% AEP flood outline in

³ Natural Resources Wales (2022) – Flood Risk Assessment Wales

areas of the floodplain without significant flood defence infrastructure. Zone B is defined as Areas known to have been flooded in the past evidenced by sedimentary deposits.

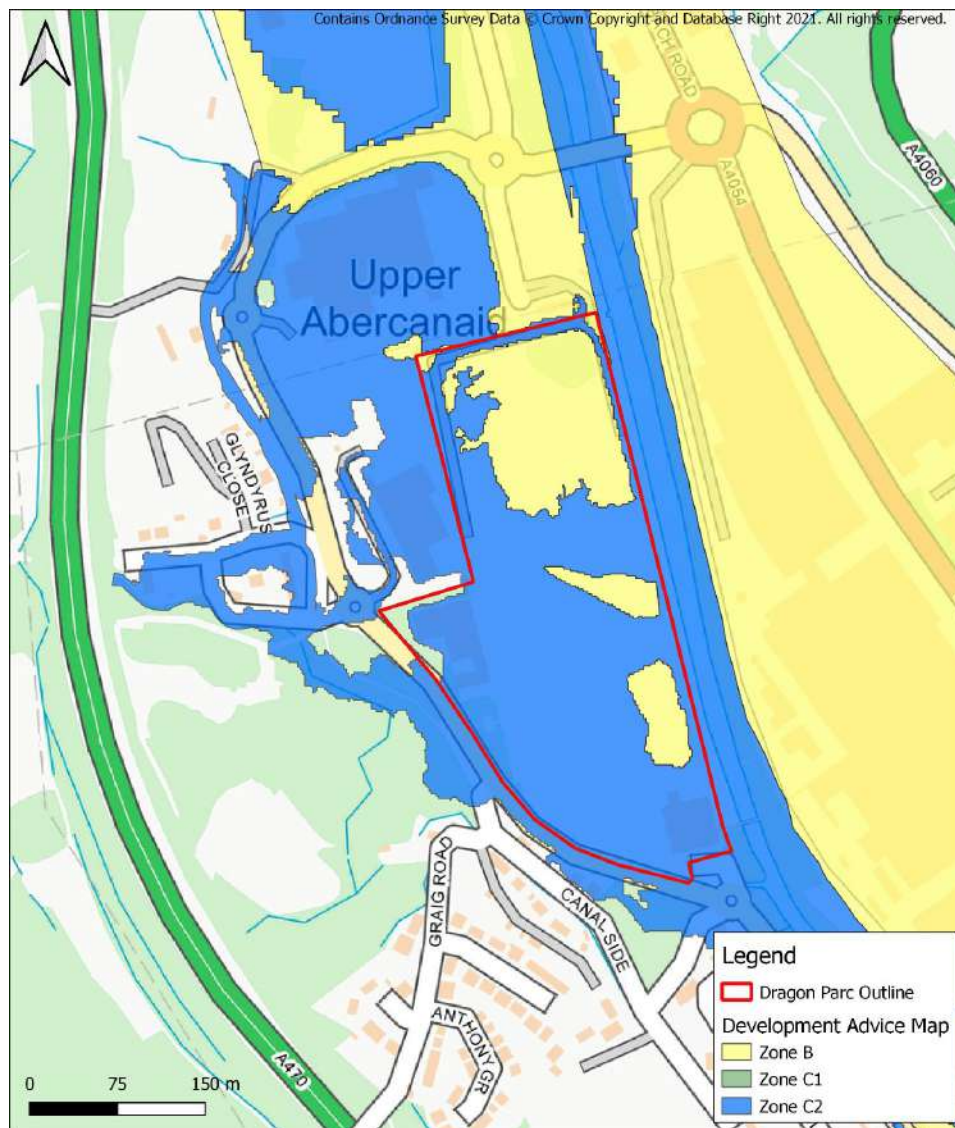


Figure 1-3: Development Advice Map⁴

1.5 Proposed extent of FMC

Whilst the objective of this FMC is to change the NRW flood maps at Dragon Parc, flooding does not follow site boundaries. Consequently, flood modelling and flood map challenges must extend to the nature limits of a 'flood cell'. Figure 1-4 highlights the proposed extent of the Flood Map Challenge in relation to the Dragon Parc site. The proposed FMC extent reflects the limits of the hydraulic model, the extent of modelled flooding and the natural extent divisions of flood risk from the Nant Canaid and other watercourses in the area.

All of the flooding that occurs this region during the events highlighted in Section

⁴ Natural Resources Wales (2022) – Development Advice Map

1.5.1 and 1.5.2, will be reviewed against the flooding shown in the current Flood Map for Planning and Flood Risk Assessment Wales.

1.5.1 Flood Map for Planning design events

- 0.1% AEP plus Climate Change (Flood Zone 2)
- 1% AEP plus Climate Change (Flood Zone 3)

1.5.2 Flood Risk Assessment Wales design events

- 0.1% AEP (Low Risk)
- 1% AEP (Medium Risk)
- 3.3% AEP (High Risk)

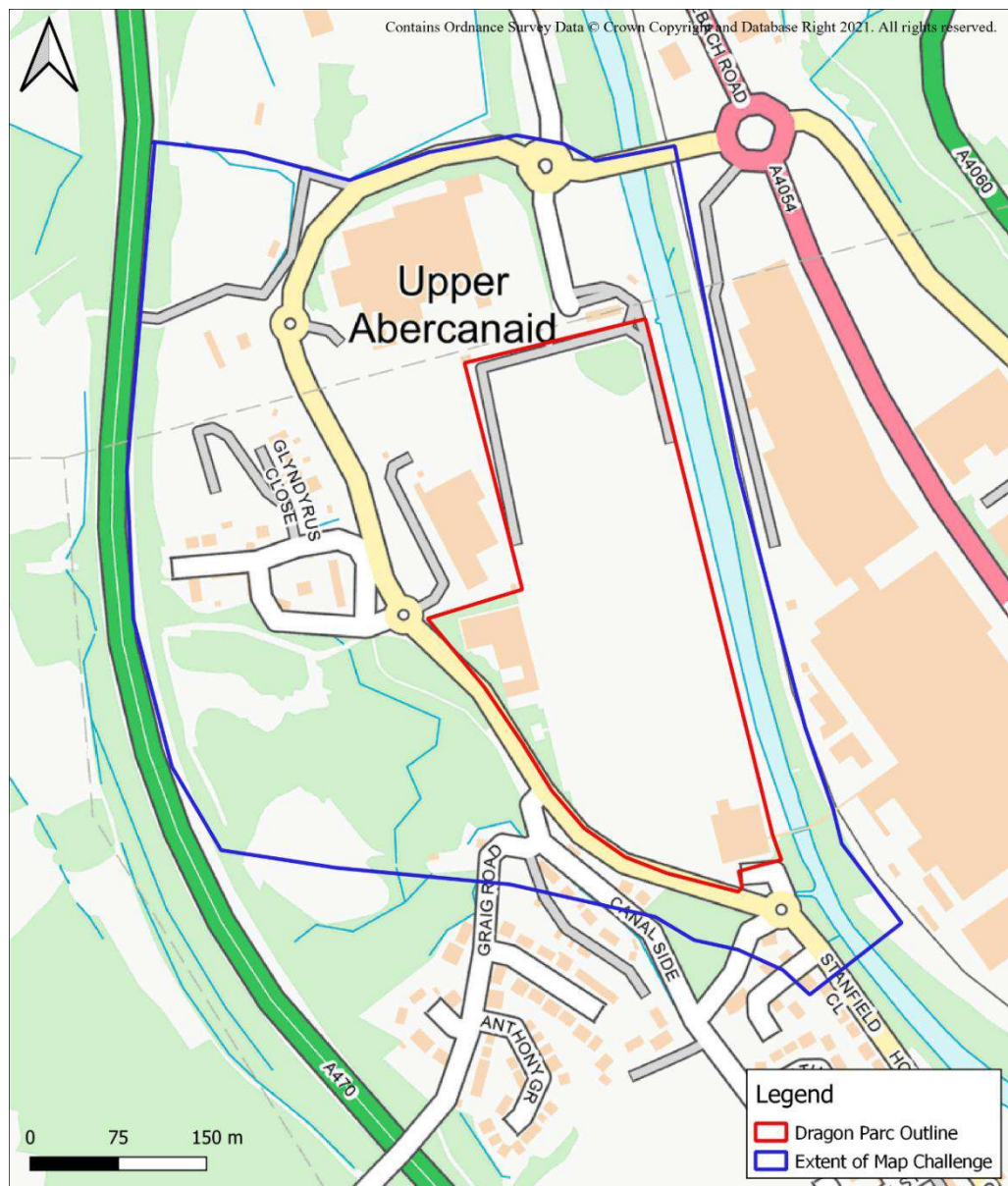


Figure 1-4: Proposed extent of Flood Map Challenge

2 Site description

The Dragon Parc site is brownfield in nature and located on within the town of Abercanaid in Methyr Tydfi, South Wales. The Ordnance Survey (OS) National Grid Reference (NGR) for the site is SO 05437 04319.

The former industrial site has remained disused since the demolition of a former factory. Most of the site is surfaced with rubble and man-made ground, with some previous relic buildings from its previous use.

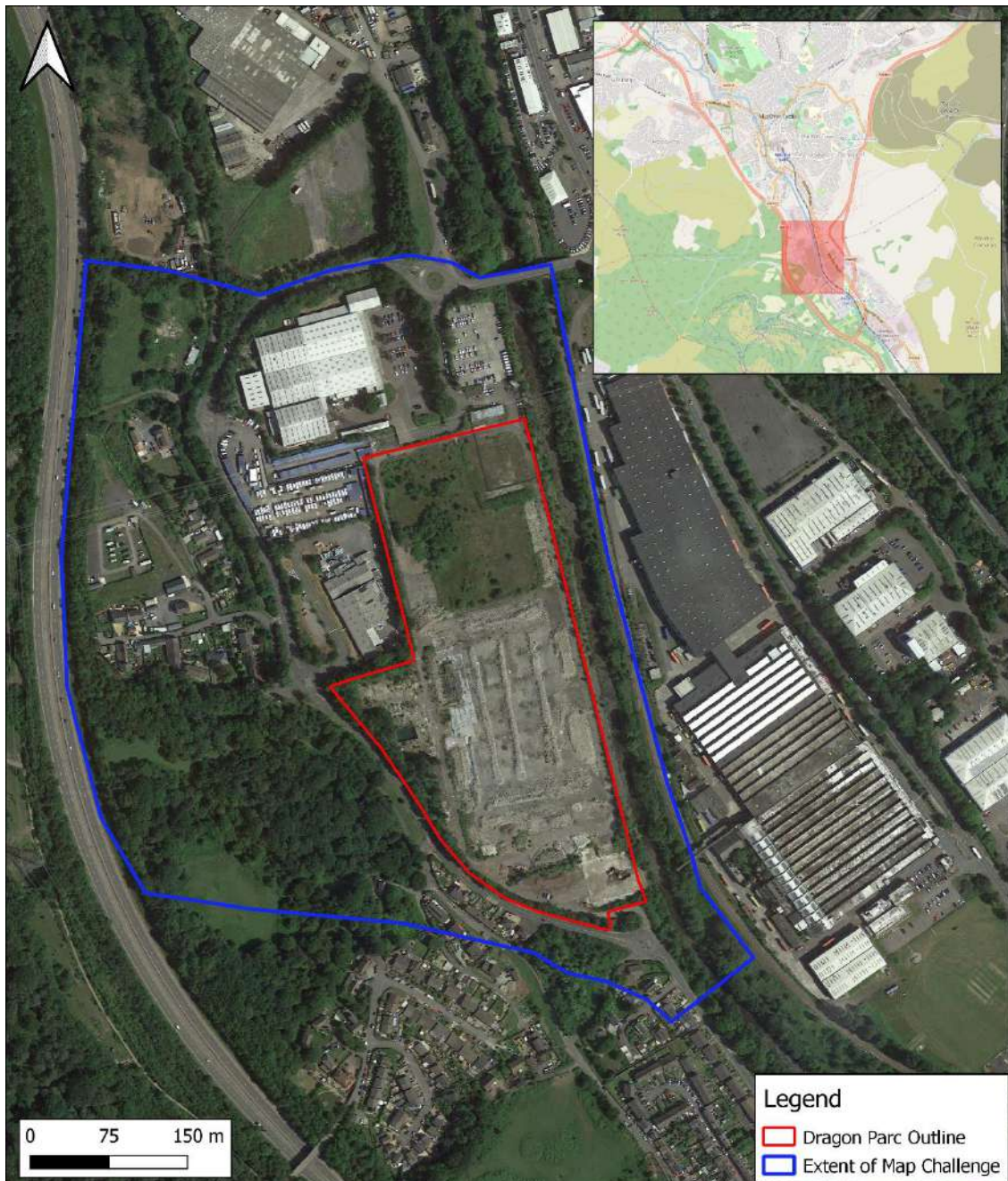


Figure 2-1: Site location

2.1 Watercourses

As illustrated in Figure 2-2, there are several watercourses in the vicinity of Dragon Parc. The Afon Taff flows in a southerly direction along the eastern edge of the site before spilling into the Severn Estuary 60km downstream. To the west of the site a small 'ordinary watercourse', the Nant Canaid, enters a culvert system which spills into the Afon Taff at the southern boundary of the site.

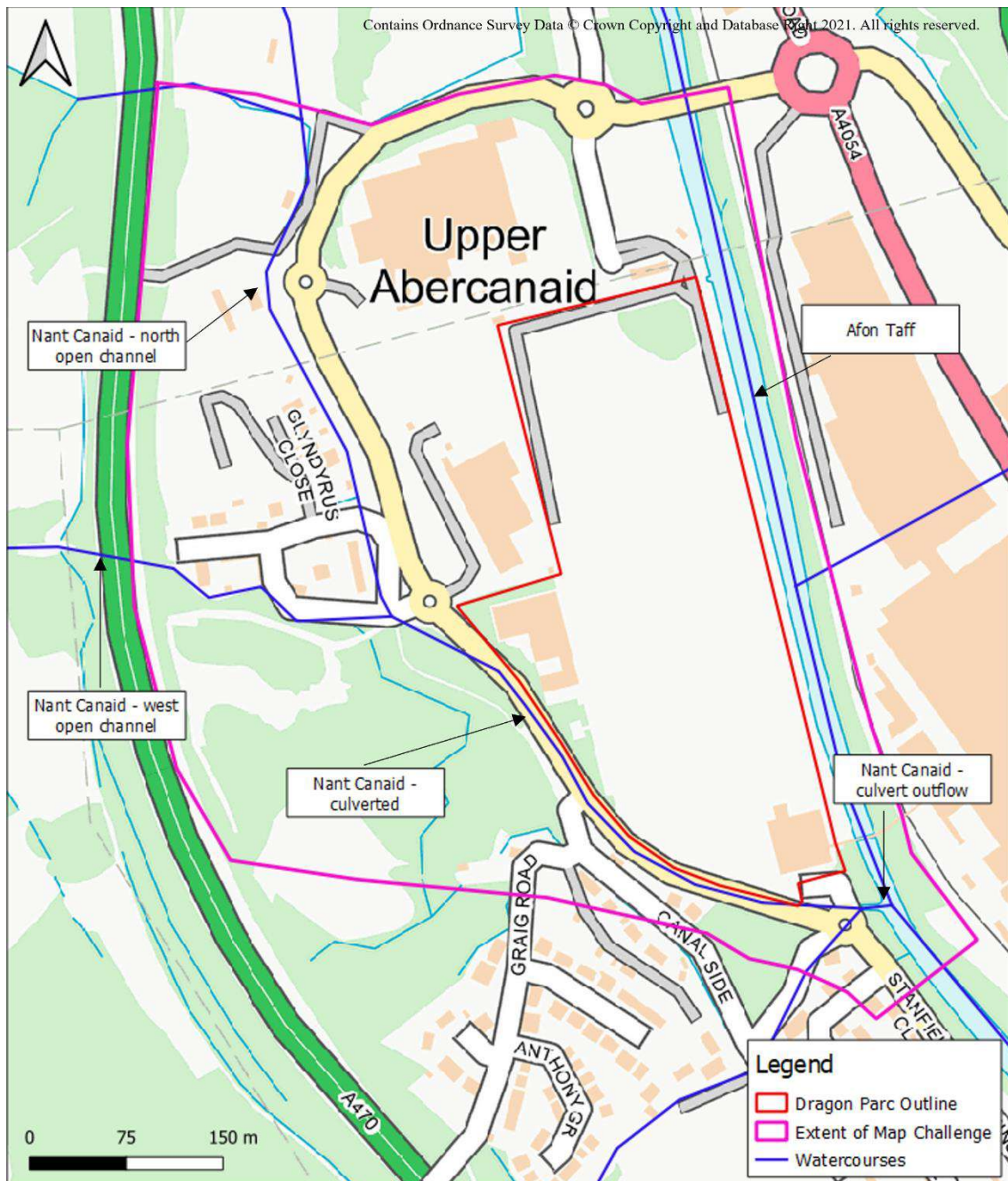


Figure 2-2: Watercourses present around Dragon Parc.

2.2 Site Topography

In accordance with the planning permission and FRAP, in early 2022 the consented engineering works to deliver the flood mitigation strategy were completed.

On completion of the work the site has been surveyed in January 2022 by Daren Oliver Civil Eng Services Ltd to capture the as-built site topography. A copy of the topographical survey is contained in Appendix C, and an extract shown below in Figure 2-3.

The topography across the site remains relatively flat, with elevations ranging from 157mAOD to 156.1mAOD north to south across the site, and 157.1mAOD to 157mAOD from the site's western extent to its eastern extent. The most significant change made to the site was the placement of a 6m wide dry swale along the western boundary of the site, which works to transport floodwater around the site.

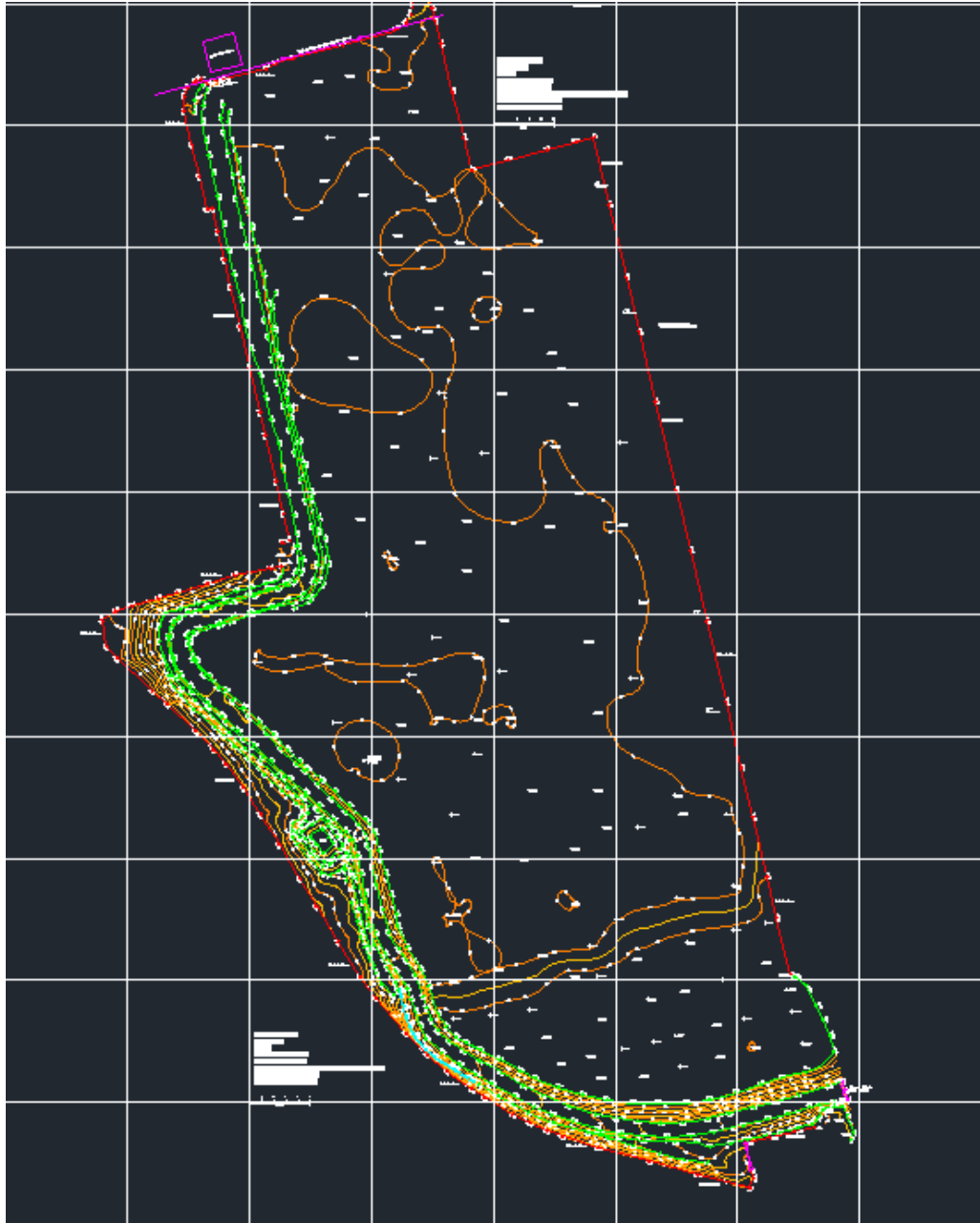


Figure 2-3: Topographic survey used in model.

3 Hydrological Assessment

The fluvial flood flow estimates used in this study originated from the flood model

of Dragon Parc carried out by Thomas Mackay Ltd. in 2019. These were also used in the Huntley Wood Investments Ltd. FCA carried out by JBA. Full documentation of the hydrological assessment can be found in the Thomas Mackay report, Appendix A. Provided below is a short summary of the assessment.

The fluvial flow estimates were derived using the Flood Estimation Handbook (FEH) statistical method for events up to the 1 in 100 year (1% AEP). All larger return periods required the use of a growth curve derived from the ReFH2 ratio method. Both statistical and rainfall runoff methods (ReFH2) were used to determine peak flows for the full range of return periods to aid comparison. All flow estimates have been derived in accordance with NRW flood estimation technical guidance.

Peak flows derived as part of this study are provided in Table 3-1.

NRW reviewed and approved the hydrology estimates in 2019, and the input hydrology has not been revisited for the 2021/22 flood modelling work. However, to comply with current requirements of TAN-15, a climate change increase of 25% has been applied to both the 1% and 0.1% AEP events.

Table 3-1: Updated peak flows

Inflows	Peak Flow (m/s)				
	Q0030	Q0100	Q0100 + CC	Q1000	Q1000 + CC
1.021	145.1	183.5	263.6	302.6	378.3
2.012	2.14	2.8	3.5	4.6	5.8
3.008	10.77	13.9	17.4	23.3	29.1

4 Hydraulic modelling

4.1 Existing hydraulic modelling

The hydraulic model used in this flood Map Challenge was originally developed by Thomas Mackay Ltd. in 2019, which encompassed a 1D-2D ESTRY-TUFLOW model of both the Afon Taff and Nant Canaid.

Following its review in October 2019, the model was used with minimum updates as the baseline scenario in the FCA prepared for Huntley Wood Investments Ltd. by JBA in 2020. This FCA included modelling of the proposed flood mitigation strategy for the Dragon Parc site. These engineering works were completed in early 2022, and included:

- Creation of a 6m wide swale around the western boundary of the site to carry flood waters originating from the north and west of the site.
- Site reprofiled adjustment to the swale to 157mAOD, with reprofiling of the southern area.

4.2 2022 FMC hydraulic model updates

The FMC modelling has adopted the following modelling approach:

- The flood model is based on the 2020 JBA FCA 1D-2D flood model.
- New topographic survey of the Dragon Parc site has been applied to the model.
- Flow estimates have been uplifted by 25% in all climate change scenarios.
- Model grid size reduced from 2m to 1m resolution

4.2.1 Site Topography

A topographic survey of the Dragon Parc site, obtained from Darren Oliver Civil Eng Services Ltd., was included in the model as a Triangular Irregular Network (TIN). This captures the most recent topographic changes made to the site following the consented engineering works detailed in the JBA FCA.

Figure 4-1 shows the extent of the TIN and the resulting Digital Terrain Model (DTM) patch that was applied to the model. This patch replaces/overwrites the previous modelled topography in this area.

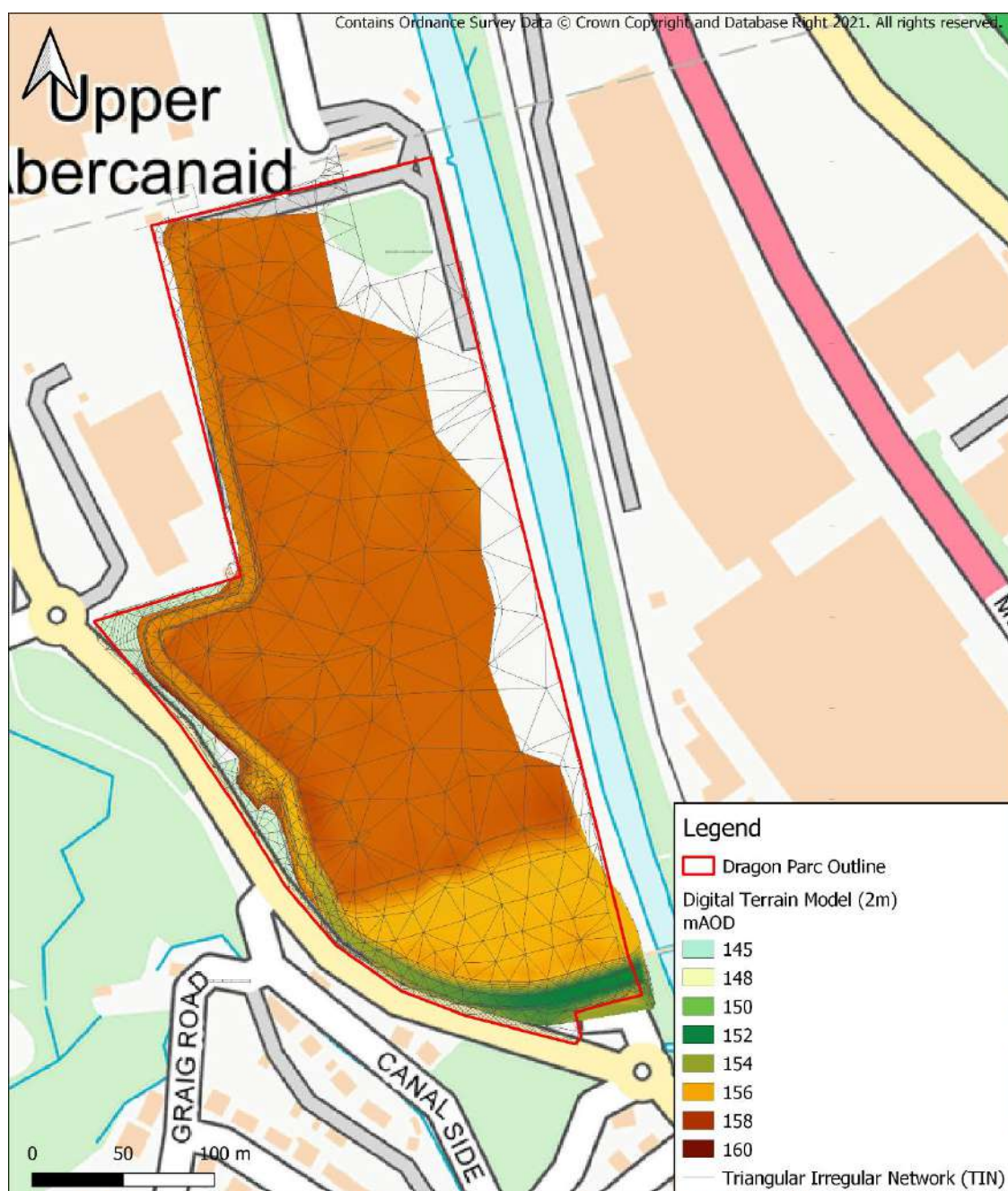


Figure 4-1: Digital Terrain Model overlain by the Triangular Irregular Network (TIN) extent

4.2.2 Boundary conditions

No changes made to boundary conditions since previous FCA.

4.2.3 Hydraulic structures

No changes made to hydraulic structures since previous FCA.

4.2.4 Model Configuration

A summary of all the hydraulic modelling files used is detailed below in Table 4-1.

Table 4-1: Summary of all hydraulic modelling files used for latest results

Run Reference:	UpperAbercanaid_PR_164_Q30_ScA_v2_2022_baseline UpperAbercanaid_PR_164_Q100_ScA_v2_2022_baseline UpperAbercanaid_PR_164_Q1000_ScA_v2_2022_baseline UpperAbercanaid_PR_164_Q30cc25_ScA_v2_2022_baseline UpperAbercanaid_PR_164_Q100cc25_ScA_v2_2022_baseline UpperAbercanaid_PR_164_Q1000cc25_ScA_v2_2022_baseline	
Purpose of Runs:	The purpose of this model scenario was to understand the fluvial flood risk to the Dragon Parc site from the Afon Taff and Nant Canaid.	
ISIS/TUFLOW file and Version:	File names:	
	UpperAbercanaid_PR_164.tcf	UpperAbercanaid_PR_143.tbc
	UpperAbercanaid_PR_154.tmf	
	UpperAbercanaid_PR_162.tgc	
Model Timesteps:	1D model timestep: 0.25s 2D model timestep: 0.5s	
Run Time:	Model run time: 6 hours Maximum simulation time: 4 hours	
Return period(s):	For the Flood Map challenge, the following events have been simulated using the updated hydraulic model: • Fluvial 3.3% AEP event • Fluvial 1% AEP event • Fluvial 0.1% AEP event • Fluvial 3.3% AEP event plus climate change • Fluvial 1% AEP event plus climate change • Fluvial 0.1% AEP event plus climate change	
Run Settings:	Negative depth warnings: 0 during model simulations Maximum cumulative ME: -0.04%	
Comments on results:	See Section 5.	

5 Model results

The model has been simulated for both the present day and with the application of climate change.

Section 6.1 details the flood risk for those design events that inform Flood Map for Planning (FMfP).

Section 6.20 details the flood risk for those design events that inform the Flood Risk Assessment Wales (FRAW).

5.1 Flood Risk Assessment Wales events

5.1.1 3.3% AEP fluvial event

Results from the 3.3% AEP fluvial present-day event shows that all flood water appears to be kept within the flood mitigation swale at the western edge of the Dragon Parc site, keeping the rest of the site flood free. Some areas of Upper Abercanaid to the north experience shallow flooding.

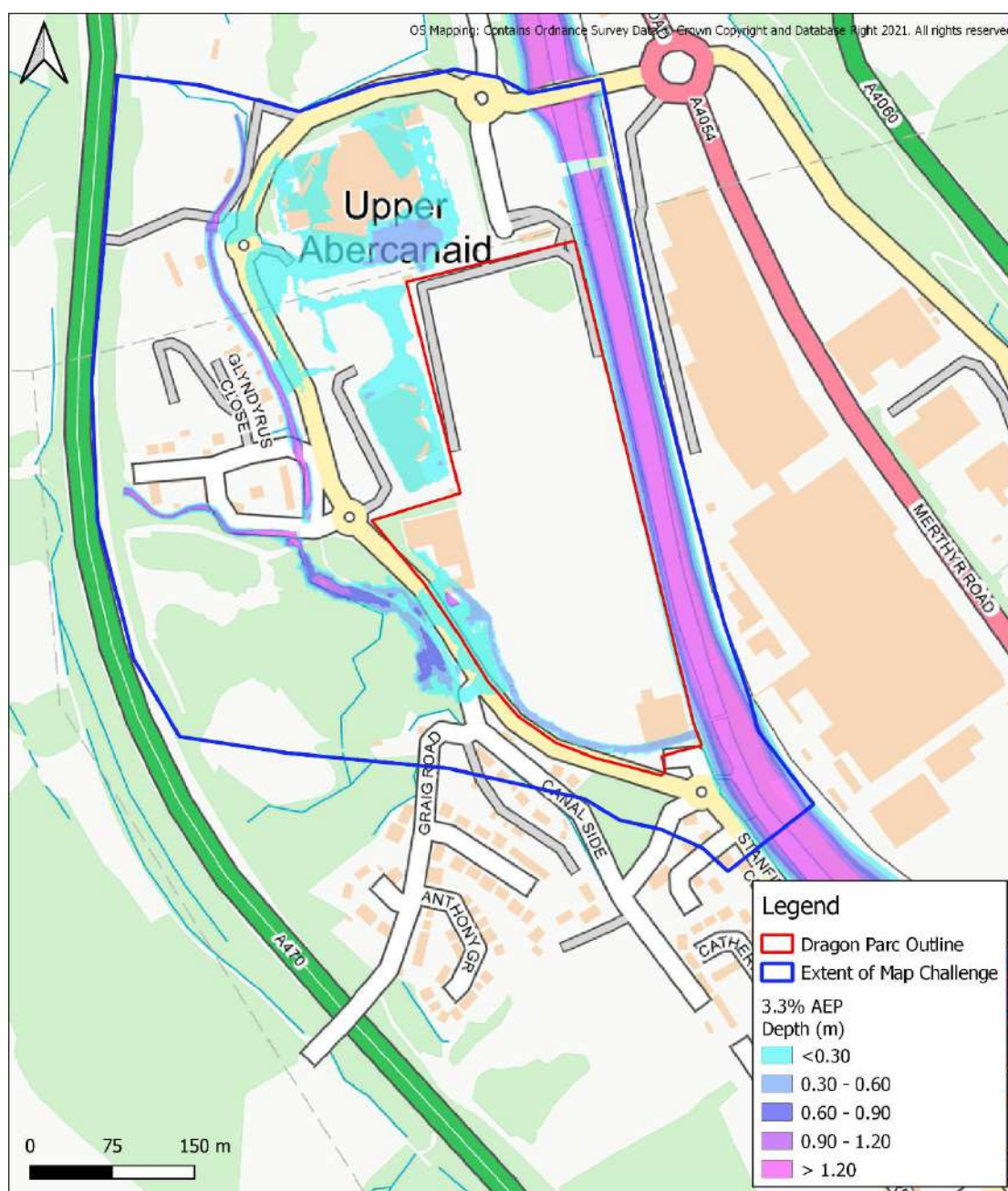


Figure 5-1: 3.3% AEP present-day event flood depths

5.1.2 1% AEP fluvial event

The results from the 1% AEP fluvial present-day event shows that the Dragon Parc site remains flood free, due to all flood water continuing to be kept within the food mitigation swale at the western boundary of the site.

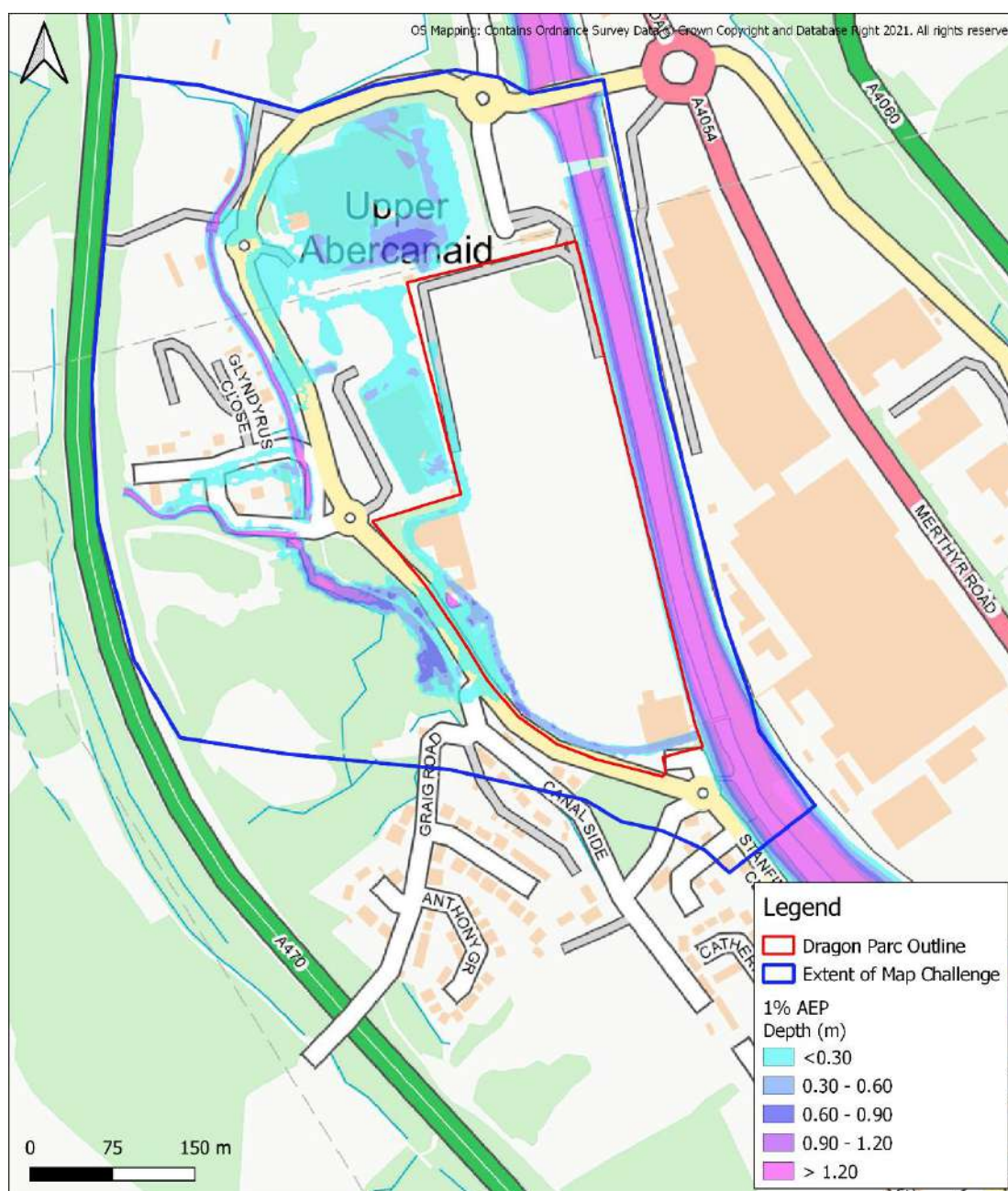


Figure 5-2: 1% AEP present-day event flood depths

5.1.3 0.1% AEP fluvial event

The results from the 0.1% AEP fluvial present-day event shows that the Dragon Parc site remains flood free, aside from a small encroachment of flood water at the northern boundary of the site reaching a maximum depth of 300mm.

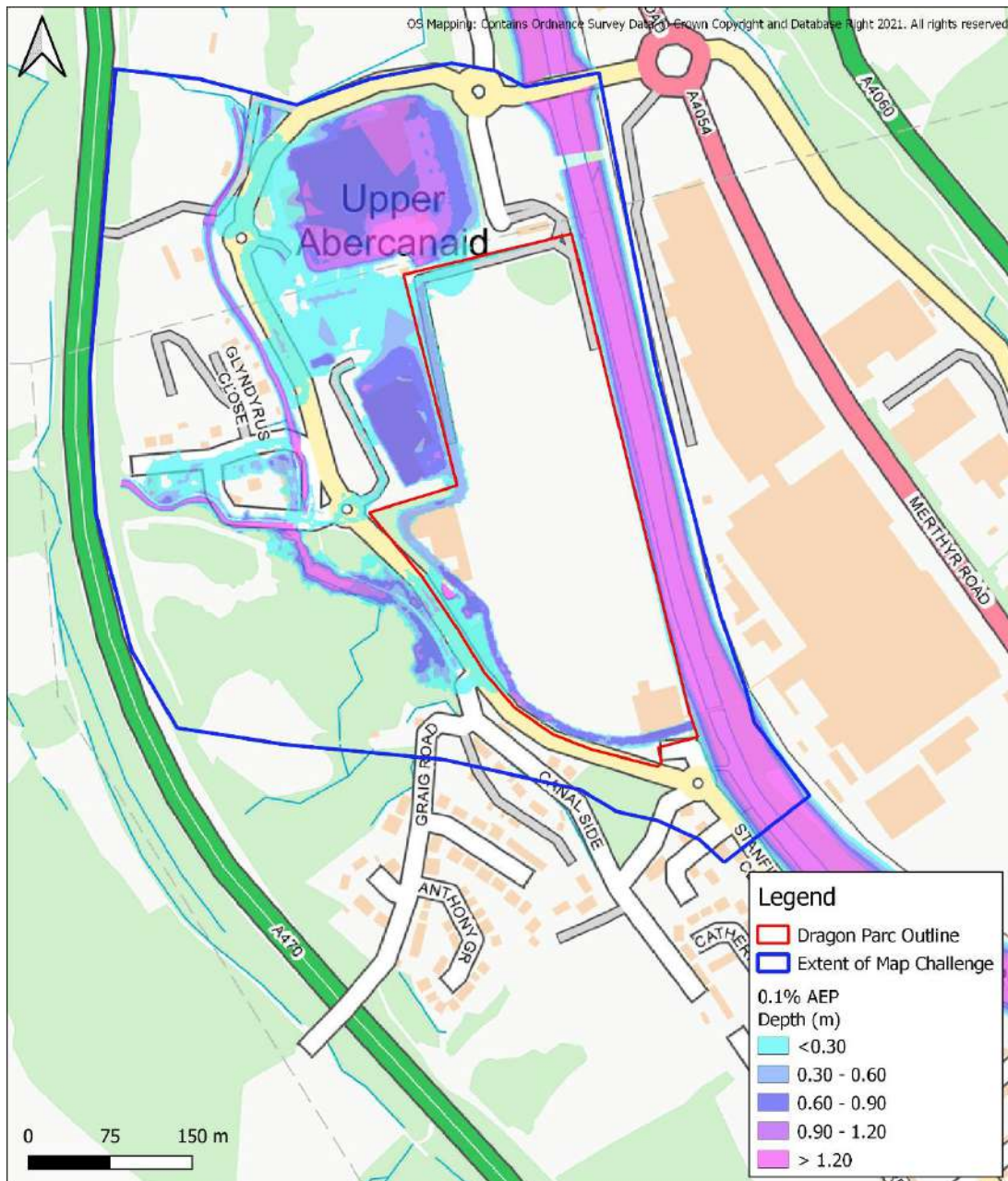


Figure 5-3: 0.1% AEP present-day event flood depths

5.2 Flood Map for Planning events

5.2.1 1% AEP plus climate change

Results for the 1% AEP plus climate change fluvial event (equivalent to fluvial Flood Zone 3) shows that the Dragon Parc site remains flood free.

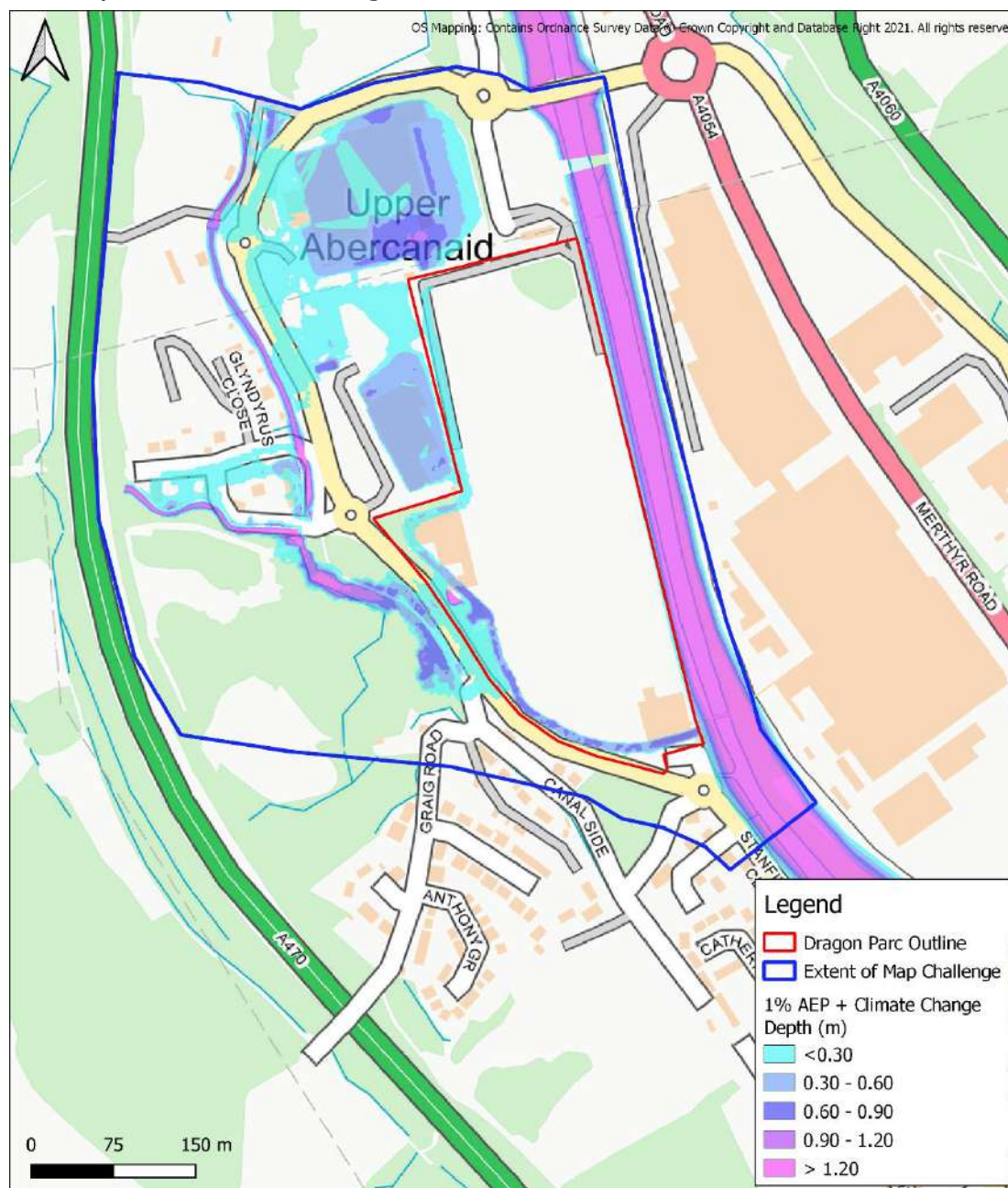


Figure 5-4: 1% AEP plus Climate Change event flood depths

5.2.2 0.1% AEP plus climate change event

For the 0.1% AEP plus climate change fluvial event (equivalent to fluvial Flood Zone 2), results from the hydraulic modelling show that very shallow flooding may affect much of the Dragon Parc site.

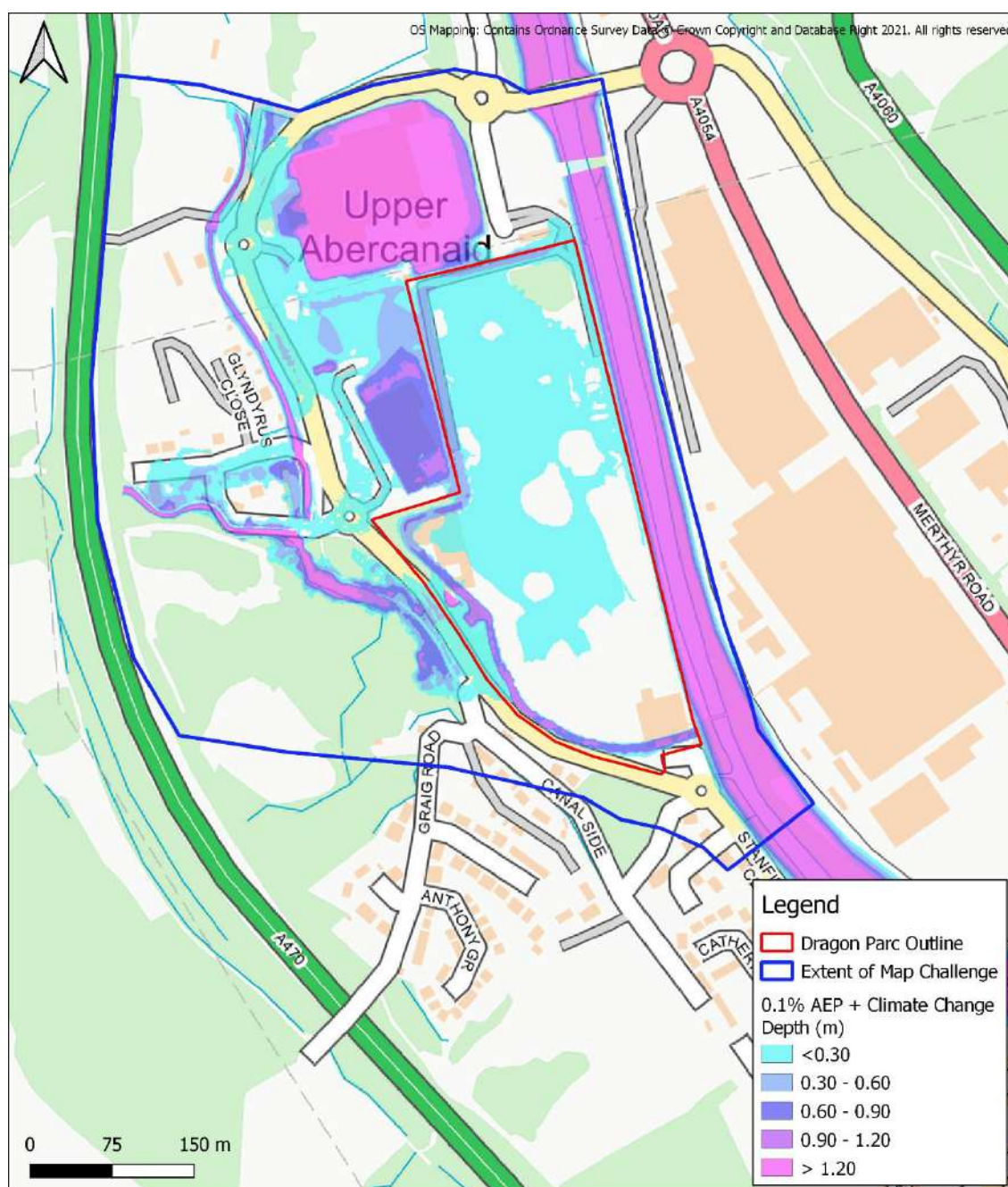


Figure 5-5: 0.1% AEP plus Climate Change event flood depths

6 Proposed flood map changes

6.1 Flood Map for Planning - Rivers

As a result of the updated hydraulic modelling detailed in this report, the proposed changes to the FMfP are illustrated in Figure 6-1 below.

The new modelling for Flood Zone 2 shows an increased flood extent within the site compared to that from the current FMfP, showing that there is a more extensive risk of flooding to the Dragon Parc site during 0.1% event plus climate change than previously predicted. This is largely caused by the site being very level, causing floodwater to spread across large areas but to very shallow depths.

There is a significant reduction in the extent of Flood Zone 3 within the Dragon Parc site, with all but the flood mitigation works remaining flood free during the 1% AEP event, plus climate change.

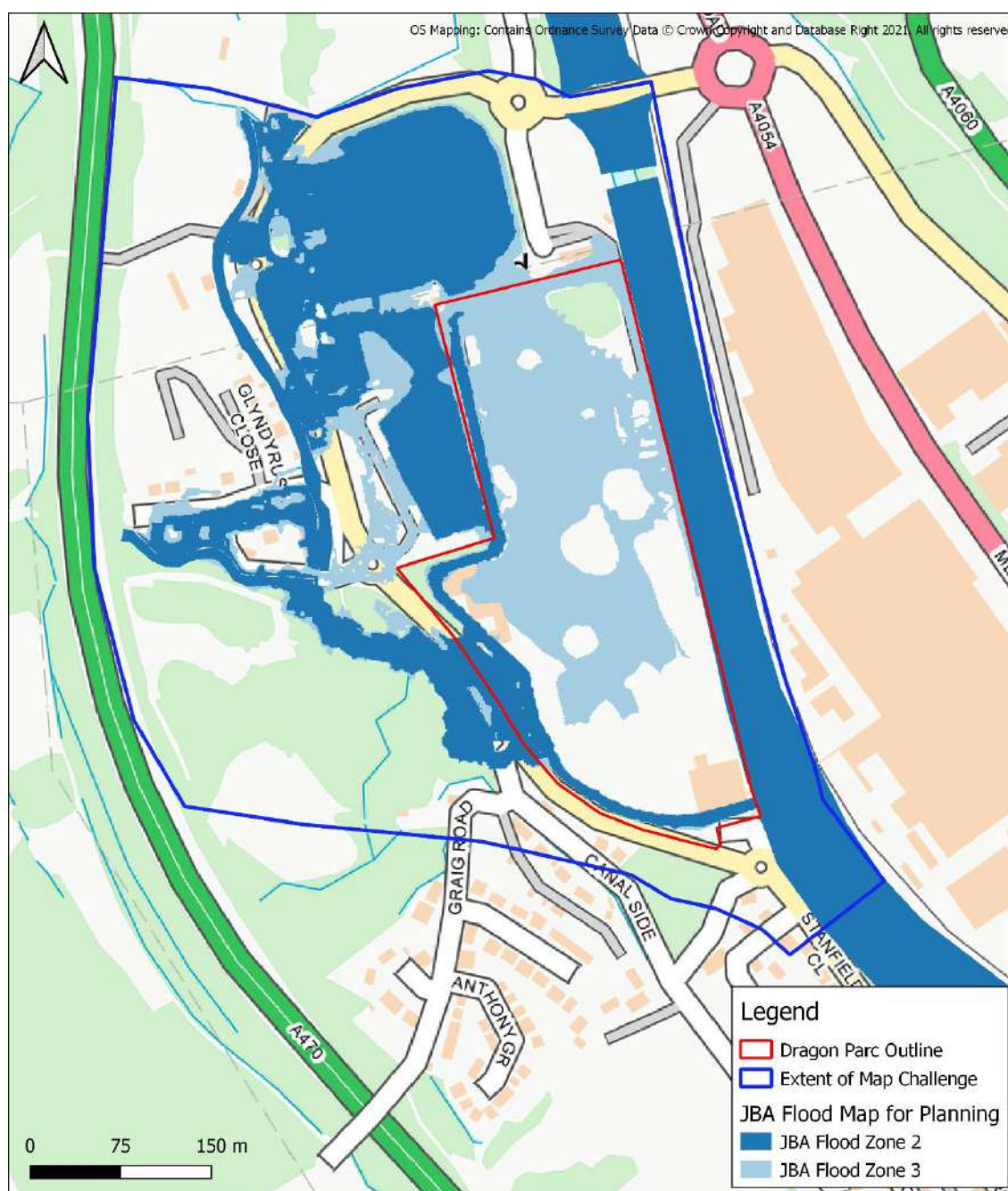


Figure 6-1: Proposed Flood Map for Planning following JBA modelling

6.2 Flood Risk Assessment Wales – flood risk from rivers

The new modelling for the Flood Risk Assessment Wales design events shows a significant decrease in flood risk across the Dragon Parc site. Figure 6-2 shows that there is now only a low risk of flooding at the northern boundary of the Dragon Parc site. Areas of High and Medium risk are confined to the flood mitigation works. The Low Risk flood extent is equivalent to Zone C of the Development Advice Map.

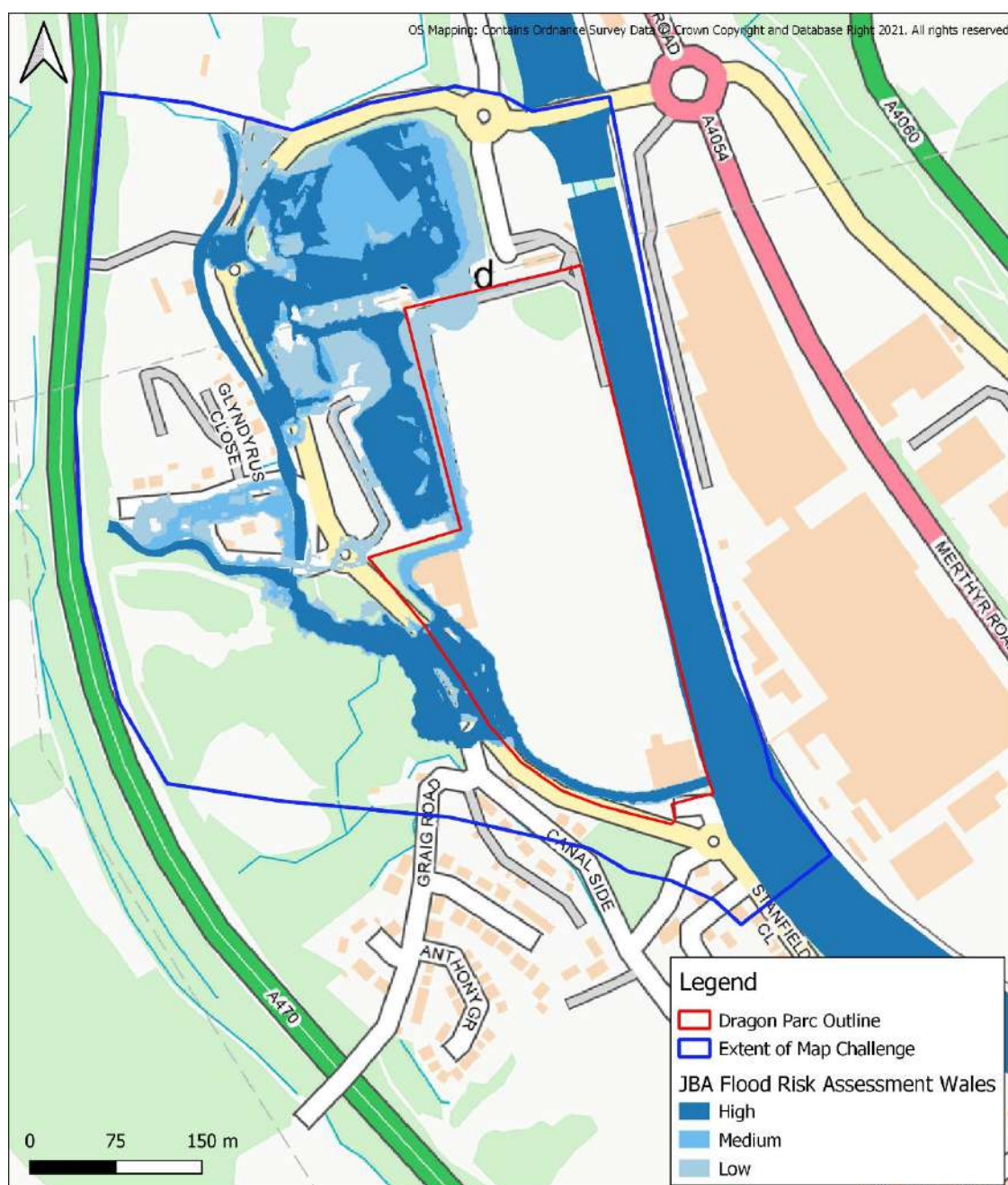


Figure 6-2: Proposed Flood Risk Assessment Wales following JBA modelling

7 Assumptions and Limitations

The following assumptions and limitations apply to this study.

- Other than the changes detailed in Section 4, no other alternations have been made to the model.
- It is assumed that the use of the ReFH2 ratio method for return periods greater than the 1 in 100 year improves the accuracy compared to the statistical method.
- It is assumed that topographic survey data provided by the client is correct.
- All hydraulic structures, including culverts, have been assumed to perform at their optimal capacity (ie. no blockage).

8 Conclusions

Hydrological and hydraulic modelling of the Afon Taff and Nant Canaid has been undertaken to inform a Flood Map Challenge (FMC) for the Flood Map for Planning and Flood Risk Assessment Wales at Dragon Parc. This modelling follows recently completed works to implement a consented flood mitigation strategy for the site.

Detailed hydraulic modelling of both watercourses shows a significant reduction in flood risk across the study area when compared to NRW's Flood Map for Planning and Flood Risk Assessment Wales. The site should now largely be classified as Flood Zone 2 of the Flood Map for Planning, with the residual flooding being of very shallow flood depths. With regards to the Flood Risk Assessment Wales mapping, JBA's modelling shows a significant decrease in flood risk across all of the site.

If the Development Advice Map were still subject to updates, the site would be substantially outside of Zone C2.

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