

TOYOTA GARAGE, WREXHAM

FLOOD CONSEQUENCES ASSESSMENT

Final Report v1.0

December 2019

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Client	Steve Hopewell Holdings Ltd
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1 INTRODUCTION

1.1 PURPOSE OF REPORT

Weetwood Services Ltd ('Weetwood') has been instructed by Lindop Brothers Toyota on behalf of Steve Hopewell Holdings Ltd to prepare a Flood Consequences Assessment (FCA) report to accompany a planning application for the proposed extension of the existing car park at the Toyota Garage, Wrexham.

The assessment has been undertaken in accordance with the requirements of Technical Advice Note 15 (TAN15).

1.2 STRUCTURE OF THE REPORT

The report is structured as follows:

- | | |
|------------------|--|
| Section 1 | Introduction and report structure |
| Section 2 | Presents national and local flood risk planning policy |
| Section 3 | Provides background information relating to the development site, the development proposals, ground conditions and existing site access arrangements |
| Section 4 | Assesses the potential sources of flooding to the development site |
| Section 5 | Presents flood risk mitigation measures based on the findings of the assessment |
| Section 6 | Presents a summary of key findings |
| Section 7 | Presents the recommendations |

2 PLANNING POLICY AND GUIDANCE

2.1 NATIONAL PLANNING POLICY AND GUIDANCE

2.1.1 Technical Advice Note 15

The general approach of TAN15 is to set out a precautionary framework to guide planning decisions in areas at high risk of flooding. The overarching aim of the framework is, in order of preference, to:

- Direct new development away from those areas which are at a high risk of flooding.
- Where development has to be considered in high risk areas (i.e. Zone C) only those development which can be justified should be located in such areas.

2.1.1.1 Justification Test

In accordance with Paragraph 6 of TAN15 for the Justification Test to be passed it must be demonstrated that:

- i. Its location in Zone C is necessary to assist, or be part of, a local authority regeneration initiative or a local authority strategy required to sustain an existing settlement; **or**,
- ii. Its location in Zone C is necessary to contribute to key employment objectives supported by the local authority, and other key partners, to sustain an existing settlement or region;

and,

- iii. It concurs with the aims of Planning Policy Wales (PPW) and meets the definition of previously developed land (PPW Fig 2.1); and,
- iv. The potential consequences of a flooding event for the particular type of development have been considered, and in terms of the criteria contained in sections 5 and 7 and appendix 1 found to be acceptable.

2.1.2 Welsh Government

2.1.2.1 Climate Change Allowances for Planning, August 2016

A consultation letter¹ and supporting guidance note² issued by Welsh Government in August 2016 sets out allowances for climate change for use in FCAs submitted in support of planning applications.

When considering new development proposals, TAN15 states that it is necessary to take account of the potential impact of climate change over the lifetime of development. The Welsh Government guidance note states that *"residential development is assumed to have a lifetime of 100 years while a lifetime of 75 years is assumed for non-residential developments. To ensure future development can provide a safe and secure living and /or working environment throughout its lifetime, national planning policy requires proposals in areas of high flood risk to be accompanied by an assessment of flooding*

¹ Welsh Government consultation letter 23 August, 2016 (Ref: CL-03-16)

² <https://gov.wales/docs/desh/publications/160831guidance-for-flood-consequence-assessments-climate-change-allowances-en.pdf>

consequences to and from the development, taking into account the impacts of climate change”.

The climate change allowances detailed within the Welsh Government guidance note are informed by latest available information on climate change projections and allowances are provided for different epochs (periods) of time over the next century.

The guidance note should be applied to planning applications (full, outline and reserved matters) submitted from 1 December 2016.

2.2 LOCAL PLANNING POLICY AND GUIDANCE

Wrexham County Borough Council (WCBC) is preparing the Local Development Plan 2 (LDP2) 2013 to 2028 which will be a long-term land use and development strategy focused on achieving sustainable development. The LDP2 is still in the process of being prepared and therefore is not yet adopted.

As such, the Unitary Development Plan (UDP) 1996-2011 is the currently adopted plan for WCBC.

2.2.1 Unitary Development Plan 1996-2011, February 2005

The UDP provides a framework for local decision making and seeks to assist land use changes proceeding coherently and with maximum community benefit.

The following policies are relevant in respect of flood risk:

Policy EC12; Development and Flood Risk

Development (including the raising of land) within defined flood plains will only be permitted if it:-

- a. would not be subject to an unacceptable risk of flooding on-site; and/or
- b. does not result in an unacceptable risk of flooding on or off-site; and/or
- c. does not adversely affect flood management or maintenance schemes

2.3 CONSENTS

An Environmental Permit for Flood Risk Activities may be required from the Natural Resources Wales (NRW) for work:

- In, under, over or near a main river (including where the river is in a culvert)
- On or near a flood defence on a main river
- In the flood plain of a main river
- On or near a sea defence

Further information can be found at <https://naturalresources.wales/apply-for-a-permit/flood-risk-activities/flood-risk-activity-permits-information/?lang=en>.

If the location of an activity is on any watercourse that lies within an Internal Drainage District (IDD) an application will need to be made to NRW for a Flood Risk Activity Permit.

Ordinary Watercourse Consent may be required from the lead local flood authority (LLFA) for work to an ordinary watercourse. Undertaking activities controlled by local Byelaws (made under the Water Resources Act 1991) also requires the relevant consent.

2.4 RELEVANT DOCUMENTS

The assessment has been informed by the following documents:

- Flood Risk Management Plan (FRMP), WCBC, July 2016

3 SITE DETAILS AND PROPOSED DEVELOPMENT

3.1 SITE LOCATION

The site is located to the west of the B5425 at NGR SJ 327 536 and is approximately 0.5 ha in area, as illustrated in **Figure 1**.

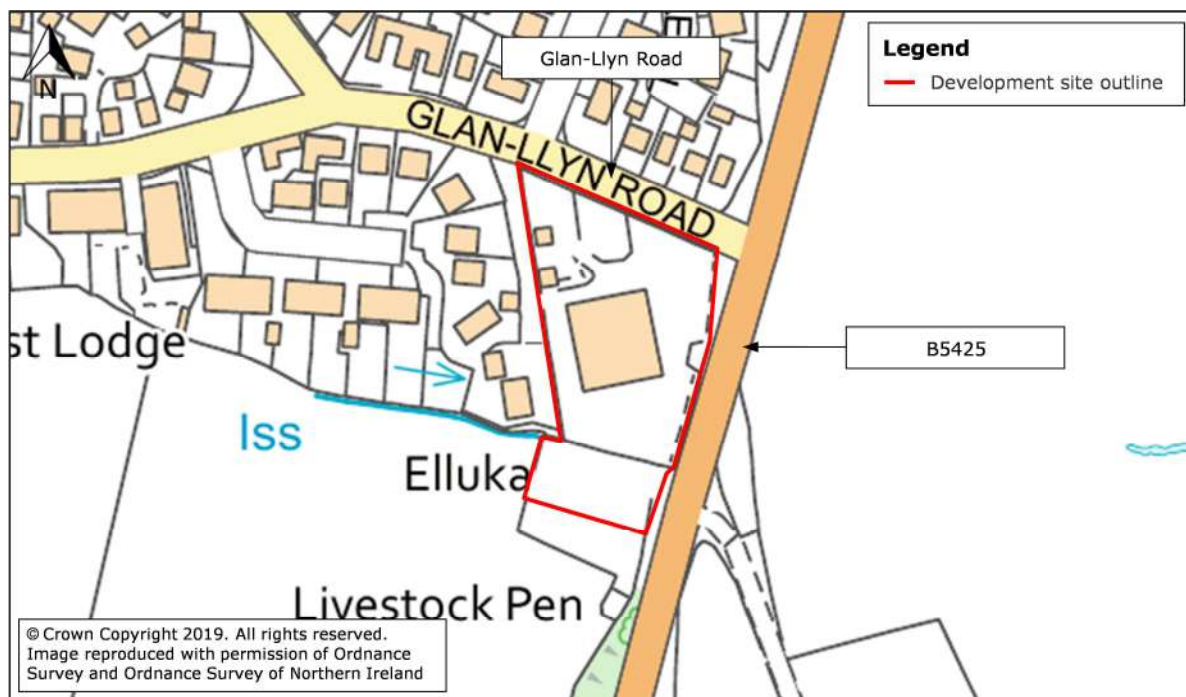


Figure 1: Site Location

3.2 EXISTING AND PROPOSED DEVELOPMENT

The site currently accommodates the existing Toyota Garage and associated car parking and forecourt area. The southern section of the site is currently undeveloped land.

The proposals are for an extension to the existing car parking and forecourt area within the parcel of land in the south of the site (**Appendix A**).

TAN15 classifies commercial development as less vulnerable land use.

3.3 WATERBODIES IN THE VICINITY OF THE SITE

A small unnamed watercourse flows through the southern section of the site in an easterly direction, as illustrated on **Figure 2**.

This watercourse ultimately discharges into the River Alyn to the east of the site.

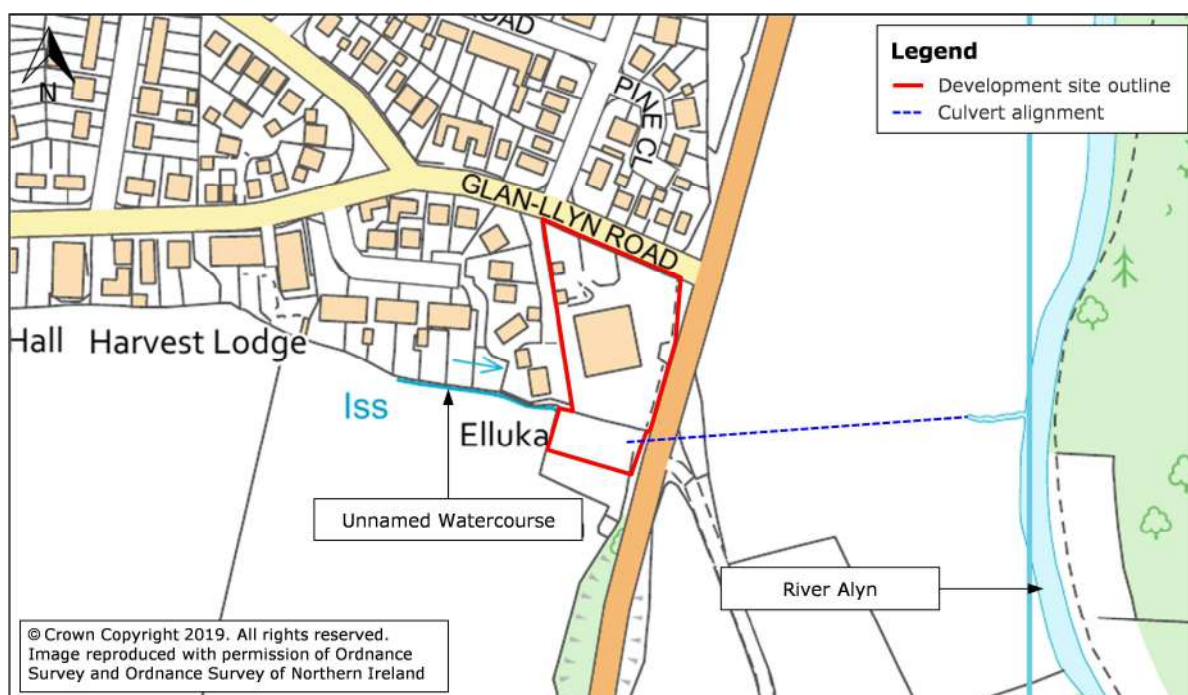


Figure 2: Location of Waterbodies

3.4 GROUND CONDITIONS

National Soils Research Institute mapping³ classifies soil conditions at the site and within the surrounding area as freely drainage slightly acid loamy soils.

British Geological Survey (BGS) Surface Geology mapping⁴ indicates the underlying bedrock formation comprises 'Halesowen Formation – Mudstone, Siltstone and Sandstone', which is overlain by 'Glaciofluvial Sheet Deposits, Devensian – Sand and Gravel' superficial deposits.

3.5 SITE LEVELS

A topographic survey of the site is provided in **Appendix B**.

Existing ground levels in the area of the proposed car park extension are shown to be in the region of 68.3 to 71.7 metres Above Ordnance Datum (m AOD). Levels are lowest surrounding the unnamed watercourse.

3.6 ACCESS AND EGRESS

Access and egress to the site is provided off the B5425.

Levels along the B5425 in the vicinity of the site are in the region of 71.5 to 72.1 m AOD.

³ www.landis.org.uk/soilscapes/

⁴ <http://mapapps.bgs.ac.uk/geologyofbritain/home.html>

4 REVIEW OF FLOOD RISK

4.1 FLOOD ZONE DESIGNATION

Flood zones refer to the probability of river and sea flooding. TAN15 defines flood zones as follows:

- Zone A: Considered to be at little or no risk of fluvial or tidal/coastal flooding.
- Zone B: Areas known to have been flooded in the past evidenced by sedimentary deposits.
- Zone C: Based on [the Natural Resources Wales] flood outline, equal to or greater than 0.1% (river, tidal or coastal). Zone C is subdivided into the following two zones:
 - Zone C1: Areas of the floodplain which are developed and served by significant infrastructure, including flood defences.
 - Zone C2: Areas of the floodplain without significant flood defence infrastructure.

The flood zones are shown on the Development Advice Map. The zones do not account for possible future changes in flooding due to the impact of climate change or the presence of flood defences (although areas benefitting from flood defences may be indicated).

According to the Development Advice Map (**Figure 3**) the site is located in Zone A.

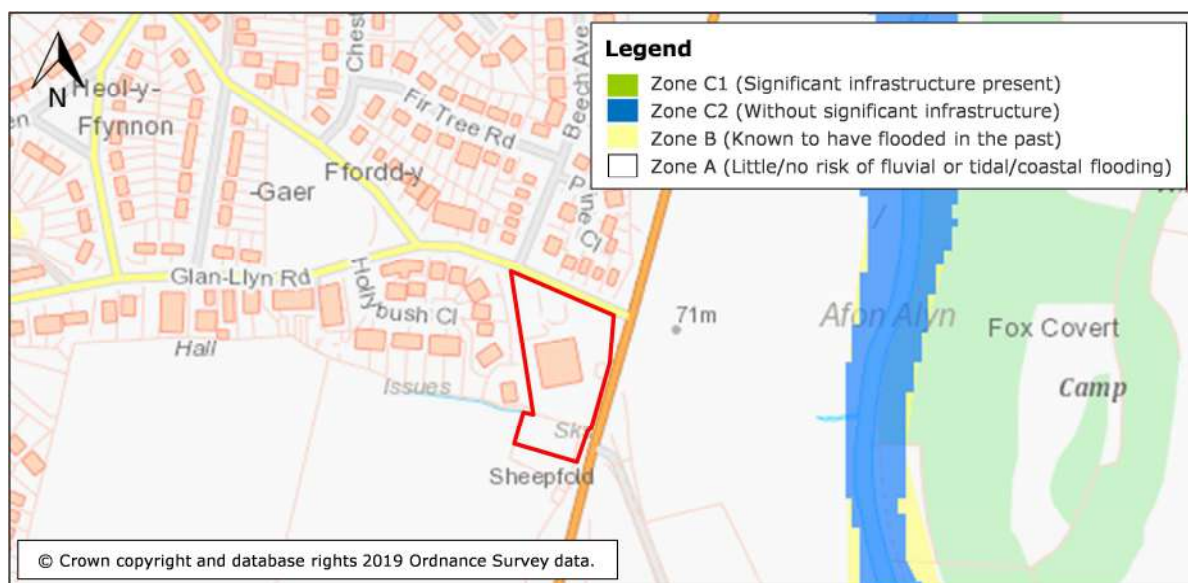


Figure 3: Development Advice Map
(Source: NRW website)

The Flood Risk Map (Rivers and Sea) (**Figure 4**) indicates that the site is located outside the 1:1,000 annual probability flood outline, thereby supporting the sites Zone A designation.

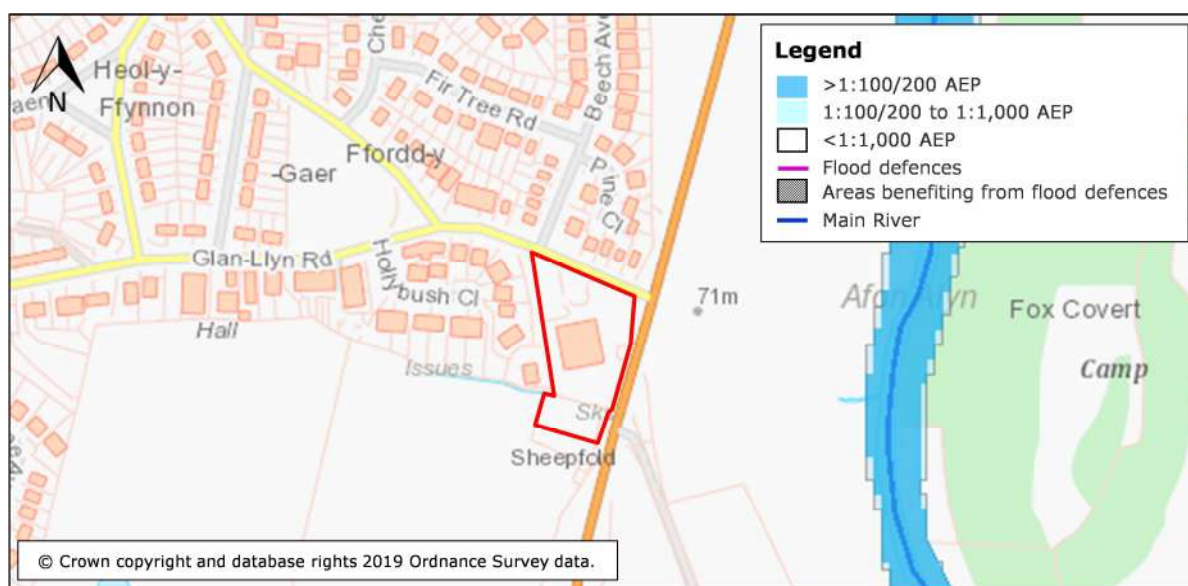


Figure 4: Flood Risk Map (Rivers and Sea)
(Source: NRW website)

However, the flood zone outlines do not generally include flood risk posed from minor watercourses (typically with catchments <3.0 km²). The flood risk from this watercourse may therefore not be accurately represented. This is addressed further in **Section 4.4**.

4.2 JUSTIFICATION TEST

As the site is located in Zone A, application of the Justification Test is not required.

4.3 HISTORICAL RECORDS OF FLOODING

The NRW historic flood outlines database⁵ indicates the site is not known to have previously flooded.

However, information received from the LLFA⁶ indicates that blockage of the culvert inlet adjacent to the B5425 has previously occurred, causing water to weir onto the road.

4.4 FLUVIAL FLOOD RISK – UNNAMED WATERCOURSE

As discussed in **Section 3.3**, a small unnamed watercourse (**Figure 5**) is located at the southern section of the site.

The watercourse is not well defined with little evidence of a channel upstream of the site during a site visit undertaken by Weetwood on 15 April 2019. However, a piped outlet carrying a small amount of flow was present within the site outfalling into a short section of open channel which appears to currently be used as a means of providing water for livestock. The watercourse becomes culverted underneath the B5425 before

⁵ <http://lle.gov.wales/catalogue/item/HistoricFI/?lang=en>

⁶ Email from N. Taunt (WCBC LLFA) to M. Rees (WCBC Planning Officer) on 9 November 2017

outfalling into an open channel to the east of the site, ultimately outfalling into the River Alyn.



(i) Watercourse on-site



(ii) Watercourse downstream of the site

Figure 5: Unnamed Watercourse

4.4.1 Modelled Flood Levels and Extents

In order to more accurately identify and assess the level of flood risk from the unnamed watercourse a 1D-2D ESTRY-TUFLOW hydraulic model has been developed by Weetwood.

Full details of the modelling study are provided in the Hydraulic Modelling Study appended to this report (refer to **Appendix C**).

The model was run for the following baseline free-flowing events:

- 1:100 annual probability
- 1:100 plus 20% climate change (+CC) annual probability
- 1:100+CC (45%) annual probability
- 1:1,000 annual probability

The model output plots for the above events are provided within Annex E of **Appendix C**.

The baseline results indicate that flooding may be expected to occur at the southern part of the site adjacent to the watercourse for all modelled events.

Table 1 summarises the maximum level, depth and velocity of floodwaters expected on site during all modelled events.

Table 1: Modelled Maximum Flood Level, Depth & Velocity - Baseline

Annual Probability Event	Max Level (m AOD)	Depth (m)		Velocity (m/s)	
		Max	Mean	Max	Mean
1:100	70.85	1.20	0.52	1.24	0.15
1:100+CC (20%)	70.86	1.54	0.63	1.33	0.10
1:100+CC (45%)	71.09	1.90	0.73	0.38	0.06
1:1,000	71.31	2.19	0.85	0.41	0.06

4.4.1.1 Culvert Blockage

Sensitivity testing has been carried out for the 1:100+CC (20%) and 1:1,000 annual probability events including a 100% blockage of the B5425 culvert (**Figure 6**).

The model output plots for the blockage scenarios are provided within Annex F of **Appendix C** and expected maximum flood depths, levels and velocities are presented in **Table 2**. These indicate that flood depths are expected to increase by 1.09 m and 0.47 m during the 1:100+20CC and 1:1,000 annual probability events respectively when a blockage is included. The flood level at the site is shown to be controlled by the ground levels along the adjacent B5425 before floodwater can weir over the highway to the east.

Table 2: Modelled Maximum Flood Information – Baseline Blockage

Annual Probability Event	Max Level (m AOD)	Depth (m)		Velocity (m/s)	
		Max	Mean	Max	Mean
1:100+CC (20%)	71.74	2.63	1.08	0.55	0.04
1:1,000	71.77	2.66	1.10	0.65	0.05

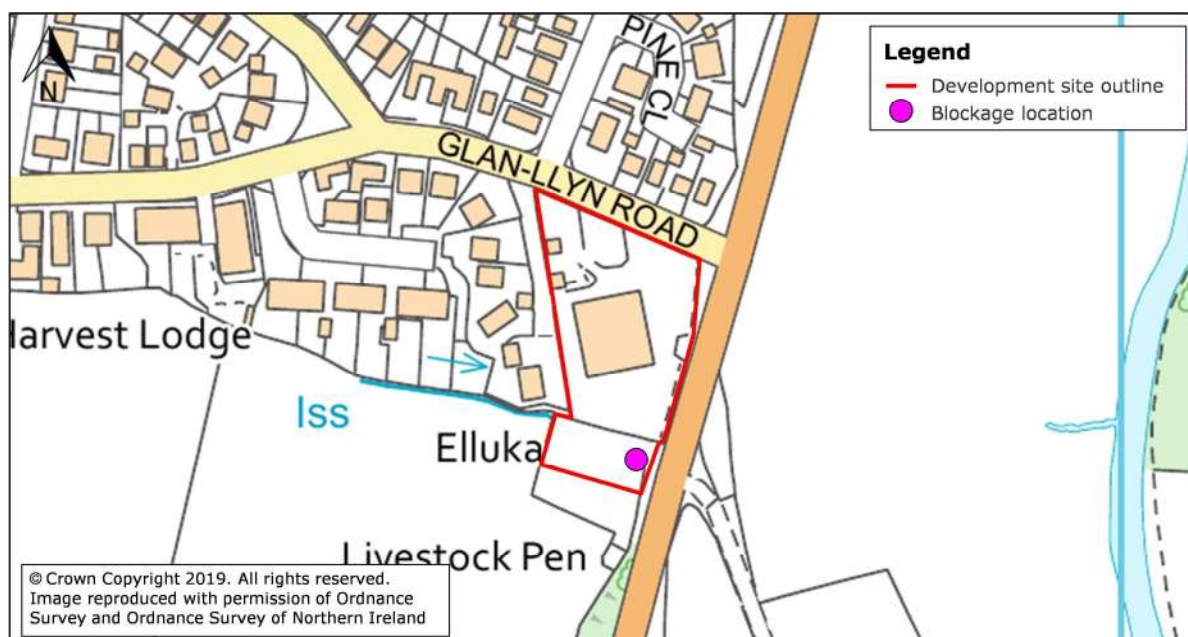


Figure 6: Blockage Location – Baseline Scenario

4.5 FLOOD RISK FROM SURFACE WATER

The Surface Water Flood Risk map (**Figure 7**) indicates there is an area of 'low' to 'high' risk in the location of the proposed car park extension. Whilst surface water flood depths and velocities are available on the NRW website, it is considered that flood risk from surface water is linked with fluvial flood risk from the unnamed watercourse, which has been assessed in more detailed within **Section 4.4**.

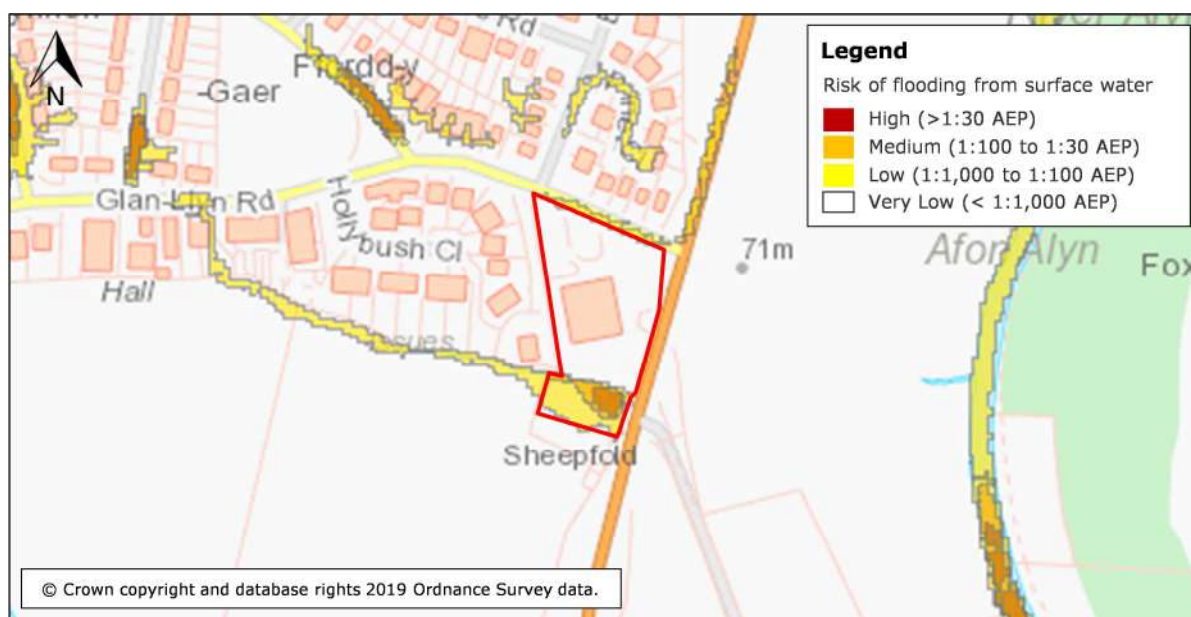


Figure 7: Surface Water Flood Risk
(Source: NRW website)

4.6 FLOOD RISK FROM RESERVOIRS, CANALS AND OTHER ARTIFICIAL SOURCES

There are no canals or other impounded waterbodies located within the immediate vicinity of the site.

The Reservoir Flood Risk map indicates that the site is not at risk of flooding from such sources.

The site is therefore not assessed to be at risk of flooding from reservoirs, canals or other artificial sources.

4.7 FLOOD RISK FROM GROUNDWATER

As detailed in **Section 3.4** ground conditions at the site and within the surrounding area are described as freely draining. There may therefore be the propensity for some groundwater flooding.

According to the BGS Groundwater Flooding Hazard map (**Figure 8**) the susceptibility to groundwater flooding is low to moderate.

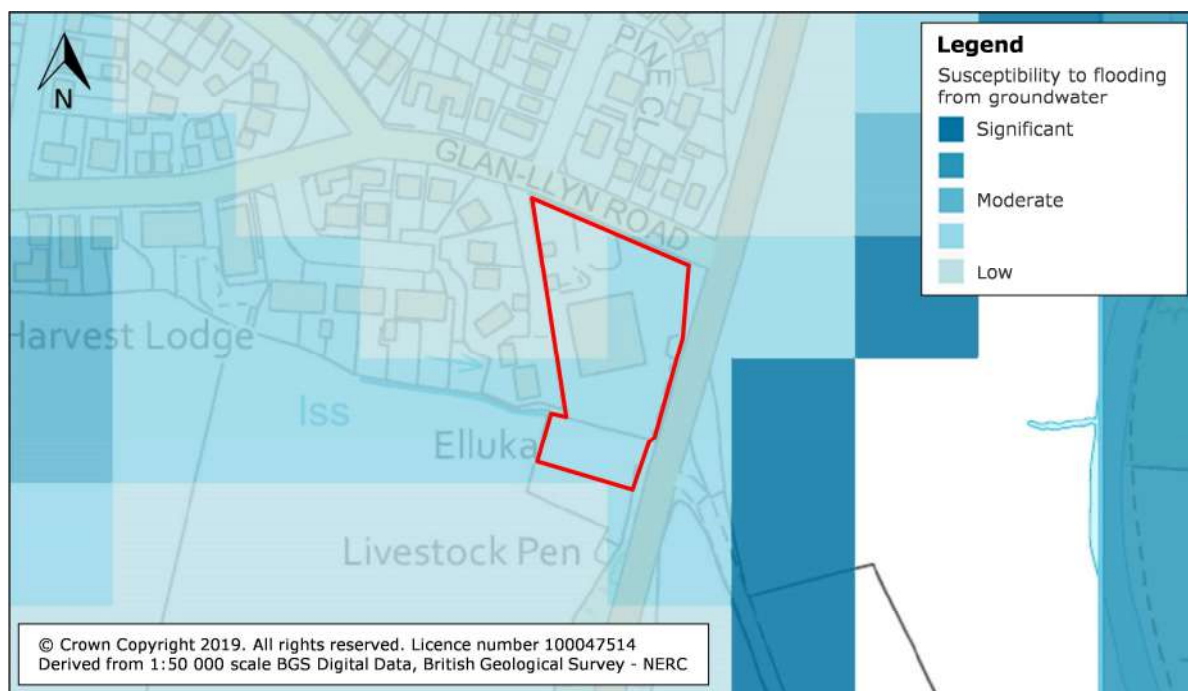


Figure 8: Groundwater Flooding Hazard Map
(Source: Findmaps)

5 FLOOD RISK MITIGATION MEASURES

The flood risk to the site from the unnamed watercourse will be mitigated through the implementation of the measures proposed within the following section of this report.

5.1 PROPOSED SCENARIO FLOOD RISK MODELLING

The proposed works as detailed in **Section 5.2** have been incorporated within the Weetwood model of the unnamed watercourse. Furthermore, a compensatory flood storage area has been incorporated into the model (discussed further in **Section 5.2.2**).

The hydraulic model has been subsequently run for the following 'proposed scenario' events:

- 1:100+CC (20%) annual probability event
- 1:1,000 annual probability event
- 1:100+CC (20%) annual probability event with 100% culvert blockage
- 1:1,000 annual probability event with 100% culvert blockage

The proposed scenario model output plots are provided in **Appendix D**. These show that site is not expected to flood during the free-flowing proposed scenario.

The maximum flood depths, velocities and flood hazard ratings within the proposed car park during the blockage scenario are presented in **Table 3** for the floodplain node points illustrated in **Figure 9**.

The Hazard Rating (HR) has been calculated using the formula $HR = d \times (v + 0.5) + DF$ (where d = depth, v = velocity and DF = debris factor), which has been sourced from the DEFRA FD2320/TR2 Technical Report. The debris factor is considered to be 0 within the developed site given the size of the watercourse and characteristics of the catchment. The highest flood hazard rating shown in **Table 3** for the 1:100+CC (20%) and 1:1,000 annual probability blockage events are 0.08 and 0.11 respectively, which would be regarded as a "very low" according to the aforementioned report.

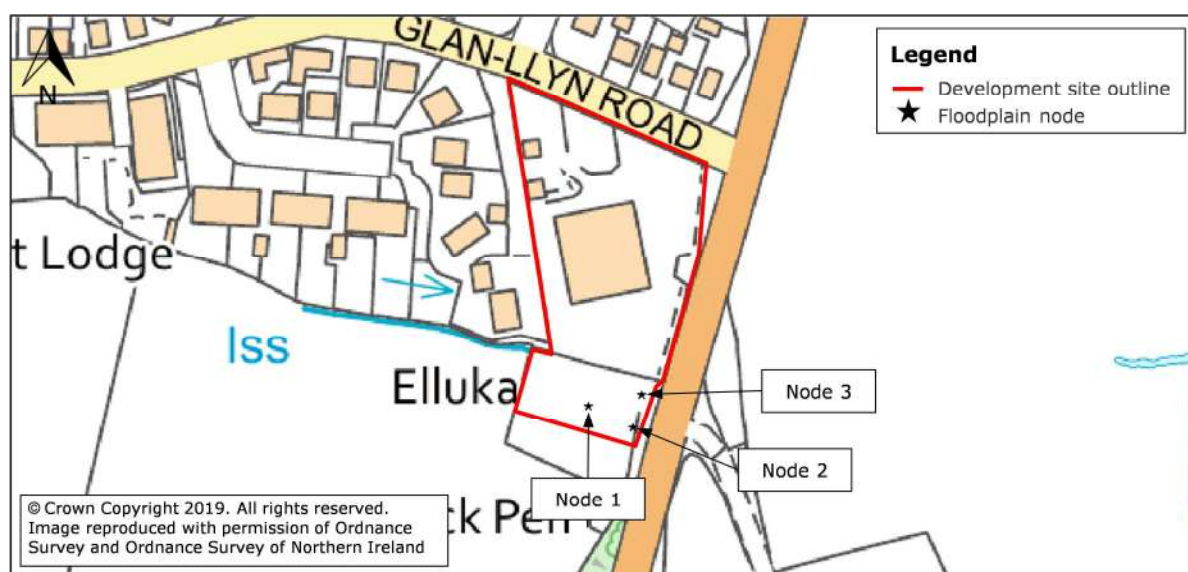


Figure 9: Floodplain Nodes

Table 3: Flood Information (Post-development) – Blockage Scenario

Annual Probability Event	Node	Max Depth (m)	Max Velocity (m/s)	Debris Factor	Flood Hazard Rating
1:100 +CC (20%)	1	0.046	0.003	0	0.02 (very low)
1:100 +CC (20%)	2	0.234	0.060	0	0.13 (very low)
1:100 +CC (20%)	3	0.059	0.021	0	0.03 (very low)
1:1,000	1	0.099	0.018	0	0.05 (very low)
1:1,000	2	0.281	0.282	0	0.22 (very low)
1:1,000	3	0.105	0.085	0	0.06 (very low)

5.2 FLOOD MITIGATION

5.2.1 Car Park Levels

The extent of the car park extension is illustrated in **Appendix A**.

As outlined within the NRW *Operational Guidance Note; Flooding to ancillary areas* dated January 2018, flooding to areas intended for non-residential development should be avoided where possible.

However, where this is not possible to achieve, NRW state that it may not choose to object to a development where the developer has shown within the FCA that the risks are manageable and the anticipated flooding meets the criteria below during the 1:100 +CC annual probability event in order to comply with A1.14 of TAN15.

1. All properties/buildings are designed to be flood free.
2. Flood depths to 'ancillary areas' do not exceed 300 mm.
3. The flood hazard rating is no greater than 'very low' in accordance with the established DEFRA FD2320 hazard guidance. Flood hazard greater than this may result in an unacceptable risk (dependant on the type/location of the development proposal).
4. There is no risk of increased flooding elsewhere.

Given the nature of the proposed development there are no buildings or properties proposed and therefore point 1 of the above is not applicable.

The maximum flood level during the 1:100 +CC (20%) annual probability blockage event is 71.72 m AOD. The car park extension has been designed with the levels illustrated in **Figure 10**. Based on the minimum car park level of 71.46 m AOD, the maximum flood depth during the 1:100 +CC (20%) annual probability blockage event is 260 mm, which meets point 2 above.

The flood hazard rating is assessed to be very low during this scenario as presented in **Section 5.1** which meets point 3 above.

Flood risk elsewhere is discussed in **Section 5.3**, which should meet point 4 above.

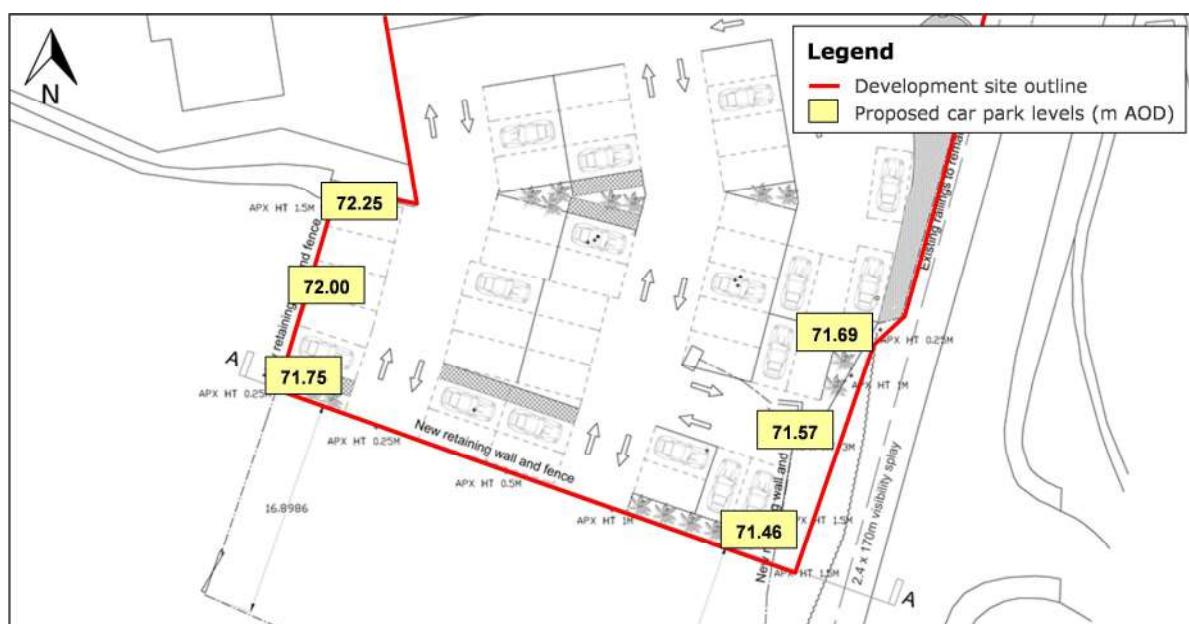


Figure 10: Proposed Car Park Levels

5.2.2 Flood Storage Area and Realigned Watercourse

Compensatory flood storage should be provided in order to mitigate the loss of floodplain associated with the construction of the proposed car park extension.

During the baseline scenario, the volume of floodwater within the vicinity of the site during the 1:1,000 annual probability event including a 100% blockage of the B5425 culvert is approximately 877.9 m³.

The proposed car park extension will require the existing channel to be realigned and a new culvert inlet structure to be constructed for the B4525 culvert. It is proposed to utilise the land to the west and south of the car park extension to realign the existing watercourse and to extend the B5425 culvert.

The illustrative Flood Storage Area (FSA) is shown in **Figure 11**, which has been designed to store 1,224.4 m³ of floodwater by lowering a portion of land, which should increase floodplain storage in the locality compared to the existing situation. An indicative plan showing the realigned watercourse and culvert extension are shown in **Figure 12**.

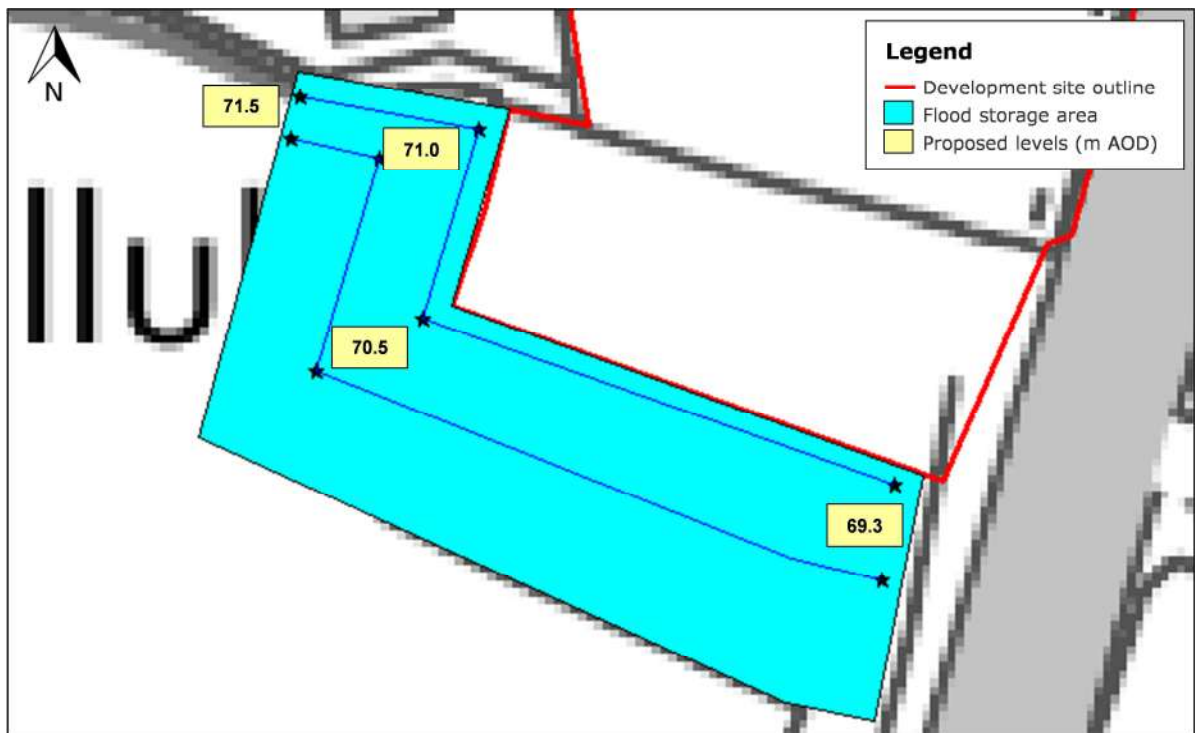


Figure 11: Proposed Flood Storage Area

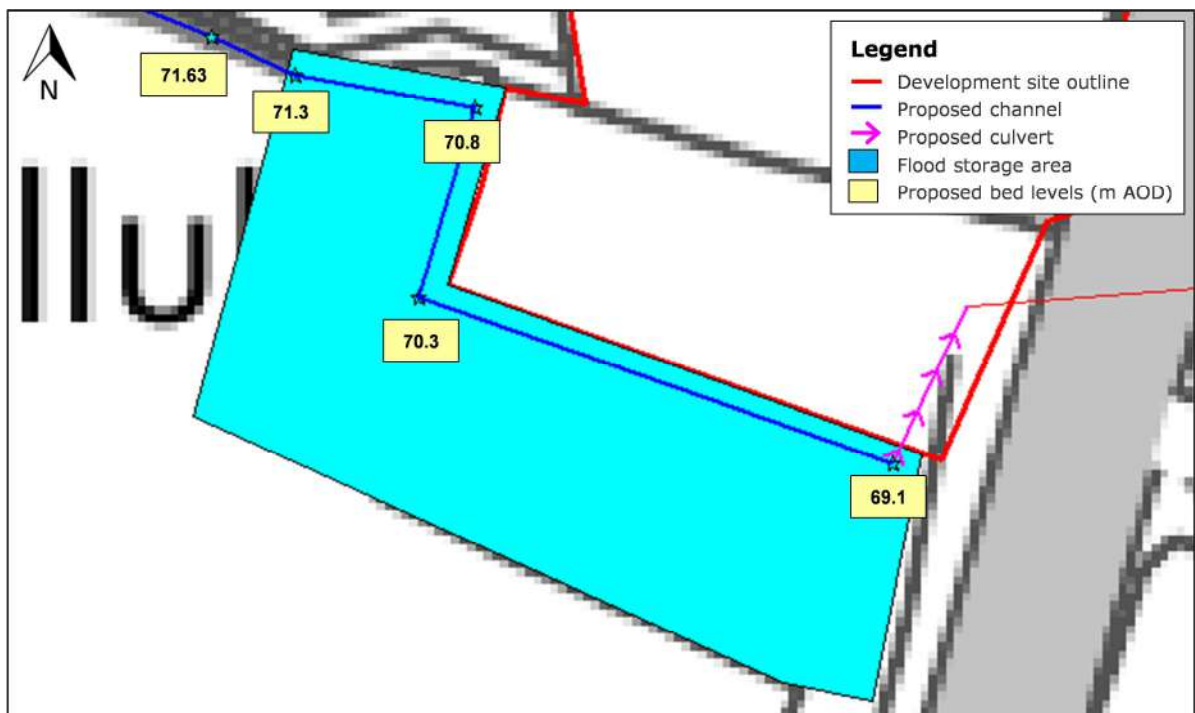


Figure 12: Proposed Channel within Flood Storage Area

5.2.3 Fencing

Suitable fencing should be incorporated around the proposed development in order to contain vehicles within the site during flood events. The fencing should be permeable to floodwater to allow the free passage of floodplain flows.

5.3 FLOOD RISK ELSEWHERE

Any proposal to modify ground levels should demonstrate that there is no increase in flood risk to the development itself, or to any existing buildings which are known to, or are likely to flood.

In accordance with A1.2 of TAN15 the consequences of the development on flood risk elsewhere should be assessed for up to the 1:1,000 annual probability event. It is understood that NRW seek to ensure that, where necessary, climate change and breach and blockage scenarios are considered for assessing the impact on flood risk elsewhere.

As discussed above, in order to minimise the impact of the development on the floodplain, it is proposed to incorporate a FSA within the land to the south of the car park extension. In order to determine the impact that the proposed FSA, the modelled outputs from the baseline and proposed scenarios have been compared.

Comparison plots showing the difference in flood depths between the baseline and proposed scenarios are provided in **Appendix E**.

These illustrate that with the incorporation of the FSA, the development is not expected to significantly impact flood risk elsewhere.

5.4 WATERCOURSE MAINTENANCE

Consent for the new culvert will be sought from the LLFA in accordance with the requirements of the Land Drainage Act.

5.5 ACCESS AND EGRESS

No flooding of the B5425 is expected during the free flowing scenario.

Some shallow flooding of the B5425 may be expected during the blockage scenarios, due to water weiring over the road. Flood depths are shown to remain below 0.1 m. This is in accordance with the baseline flood risk to the road. Given the nature of the proposals, the development is not expected to significantly impact the number of people accessing the site.

Irrespective, no flooding of the site entrance would be expected and therefore safe access and egress would remain available to the north.

6 SUMMARY

This report has been prepared by Lindop Brothers Toyota on behalf of Steve Hopewell Holdings Ltd and relates to the proposed car park extension at Toyota Garage, Wrexham.

According to the Flood Risk Map (Rivers and Sea) the proposed development is located outside the 1:1,000 annual probability flood outline and is therefore defined by TAN15 as being situated within Zone A.

As the site is located in Zone A, application of the Justification Test is not required.

In order to more accurately define the level of fluvial flood risk to the site posed by the unnamed watercourse, 1D-2D ESTRY-TUFLOW hydraulic model has been developed by Weetwood. This indicates that flooding may be expected to occur at the southern part of the site adjacent to the watercourse for all modelled events.

The Surface Water Flood Risk map indicates the extension area is at low to high risk of surface water flooding.

The site is not at risk of flooding from reservoirs, canals or other artificial sources.

The site is shown to be at low to moderate susceptibility to groundwater flooding.

Proposed car park levels have been set at a minimum of 71.46 m AOD.

Suitable fencing should be incorporated around the proposed development that is permeable to floodwater.

A FSA has been designed by lowering land within the wider ownership boundary to the south of the car park extension.

Proposed scenario modelling including the aforementioned mitigation measures has been completed for the 1:100 +CC (20%) and 1:1,000 annual probability events for the free flowing and blockage scenarios. The site is not expected to flood during the free flowing scenarios but would be expected to convey shallow floodwater during blockage scenarios.

Due to the incorporation of the FSA to the south of the car park extension, the development is not expected to impact flood risk elsewhere.

Consent for the new culvert will be sought from the LLFA in accordance with the requirements of the Land Drainage Act.

Some shallow flooding of the B5425 may be expected during the blockage scenarios, due to water weiring over the road. Flood depths are shown to remain below 0.1 m. Irrespective, no flooding of the site entrance would be expected and therefore safe access and egress would be available to the north.

7 RECOMMENDATIONS

This report has demonstrated that the proposed development may be completed in accordance with the requirements of planning policy subject to the following:

- Car park levels to be set at a minimum of 71.46 m AOD
- A compensatory flood storage scheme to be developed in accordance with the principles set down in this FCA should be submitted to and approved by the local planning authority prior to the commencement of development.
- Suitable permeable fencing should be incorporated around the proposed development.

APPENDIX A:

Development Proposals



BLOCK PLAN
SCALE - 1:200

HDS ARCHITECTURAL SERVICES
Fennell Villa, 25 Marley Road,
Wrexham, LL13 8HD
Tel: (01978) 303445
www.hdsarchitectural.co.uk

Project: Proposed Car Park Extension to Toyota Garage, Llay New Road, Bradney, Wrexham	
Title: Site Plan as Proposed	Scale (A1): 1:200
Dwg No: JC/PD/01	Date: June 2017
Revision: Rev A: Revised parking layout as per clients requirements - 16-05-17 Rev B: Move new wall as per clients requirements - 16-07-17 Rev C: Add dwarf wall and piers to entrance - 04-08-17 Rev D: Clarified extent of retaining wall - 12-10-17 Rev E: Amend layout of parking spaces - 24-10-18	

APPENDIX B:

Topographic Survey



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APPENDIX C:

Hydraulic Modelling Study

TOYOTA GARAGE, WREXHAM

HYDRAULIC MODELLING STUDY

Final Report v1.0

December 2019

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Report Title: **Toyota Garage, Wrexham**
Hydraulic Modelling Study
Final Report v1.0

Client: Steve Hopewell Holdings Ltd

Date of Issue: 10 December 2019

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1 INTRODUCTION

1.1 PURPOSE OF REPORT

Weetwood Services Ltd ('Weetwood') has been instructed by Lindop Brothers Toyota on behalf of Steve Hopewell Holdings Ltd to undertake a modelling study of an unnamed watercourse in order to identify and assess the level of flood risk from this source in association with the proposed extension at the existing Toyota Garage, Wrexham.

1.2 STRUCTURE OF THE REPORT

The report is structured as follows:

- Section 1** Introduction and report structure
- Section 2** Provides background information relating to the development site and the watercourse
- Section 3** Describes the derivation of flows for the watercourse
- Section 4** Describes the hydraulic model development process
- Section 5** Describes the hydraulic modelling runs and results
- Section 6** Describes the hydraulic model calibration and sensitivity assessment that has been undertaken
- Section 7** Presents a summary of key findings

2 SITE LOCATION AND WATERCOURSE DETAILS

2.1 SITE LOCATION AND DESCRIPTION

The site is located to the west of the B5425 and south of Glan-Llyn Road at NGR SJ 327 536 and is approximately 0.5 ha in area, as illustrated in **Figure 1**.

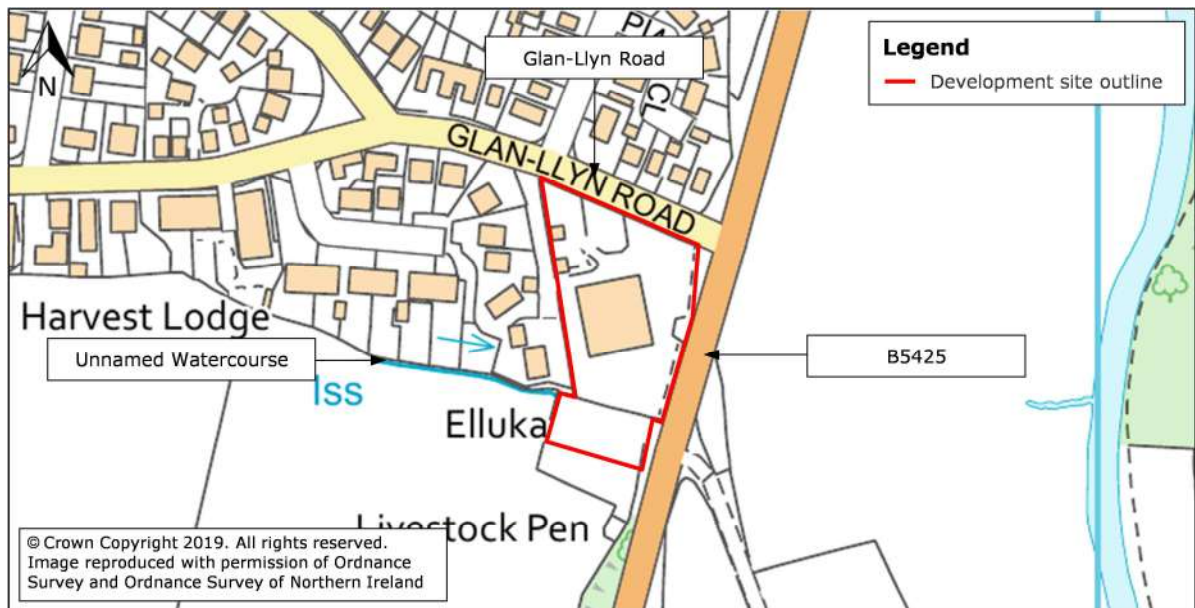


Figure 1: Site Location

A topographic survey of the site is provided in **Annex A**, which indicates that existing ground levels in the area of the proposed car park extension are shown to be in the region of 68.3 to 71.7 metres Above Ordnance Datum (m AOD). Levels are lowest surrounding the unnamed watercourse.

2.2 WATERBODIES IN THE VICINITY OF THE SITE

A small unnamed watercourse is located at the southern section of the site as illustrated in **Figure 1**. The watercourse is not well defined with little evidence of a channel upstream of the site during a site visit undertaken by Weetwood on 15 April 2019. However, a piped outlet carrying a small amount of flow was present within the site outfalling into a short section of open channel, identified as a 'ditch' in **Annex A**, which appears to currently be used as a means of providing water for livestock. The watercourse becomes culverted underneath the B5425 before outfalling into an open channel to the east of the site. The unnamed watercourse subsequently discharges into the River Allyn.

A channel survey of the unnamed watercourse in the vicinity of the site has been undertaken by Survey Operations and is provided in **Annex B**.

Photographs of the waterbodies are presented in **Figure 2**.



(a) Unnamed Watercourse (adjacent to River Alyn)



(b) River Alyn

Figure 2: Photographs of Waterbodies

2.3 FLOOD ZONE DESIGNATION

Flood zones refer to the probability of river and sea flooding. TAN15 defines flood zones as follows:

- Zone A: Considered to be at little or no risk of fluvial or tidal/coastal flooding.
- Zone B: Areas known to have been flooded in the past evidenced by sedimentary deposits.
- Zone C: Based on [the Natural Resources Wales] flood outline, equal to or greater than 0.1% (river, tidal or coastal). Zone C is subdivided into the following two zones:
 - Zone C1: Areas of the floodplain which are developed and served by significant infrastructure, including flood defences.
 - Zone C2: Areas of the floodplain without significant flood defence infrastructure.

The flood zones are shown on the Development Advice Map. The zones do not account for possible future changes in flooding due to the impact of climate change or the presence of flood defences (although areas benefitting from flood defences may be indicated).

2.3.1 Development Advice Map

According to the Development Advice Map (**Figure 3**) the site is located in Zone A.

The Flood Risk Map (Rivers and Sea) (**Figure 4**) indicates that the site is located outside the 1:1,000 annual probability flood outline, thereby supporting the site's Zone A designation.

However, the flood zone outlines do not generally include flood risk posed from minor watercourses (typically with catchments <3.0 km²). The flood risk from this watercourse may therefore not be accurately represented.

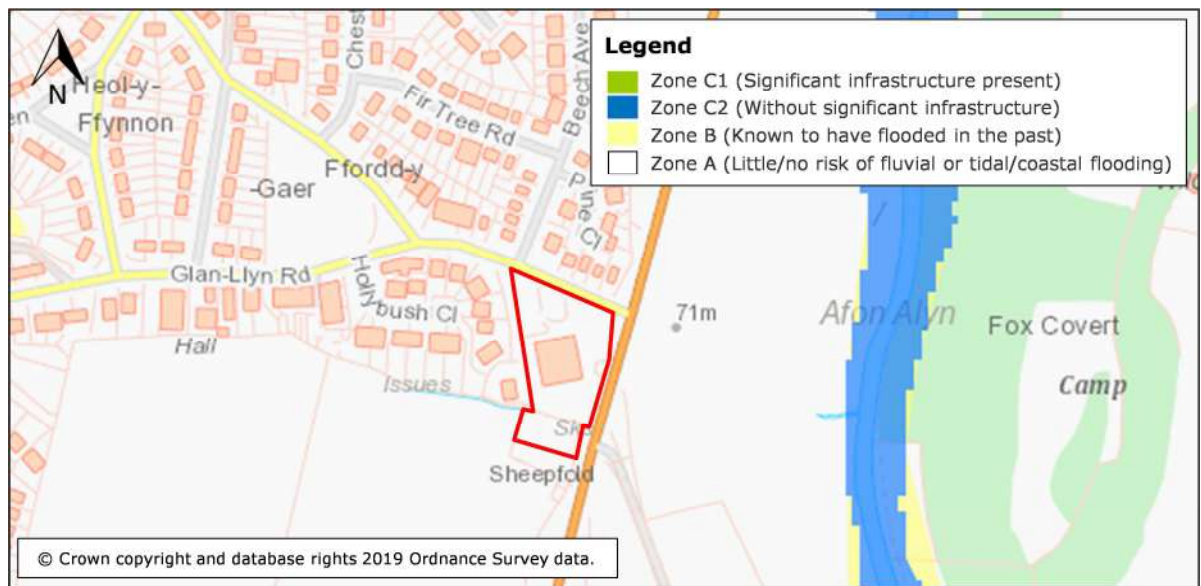


Figure 3: Development Advice Map
(Source: NRW website)

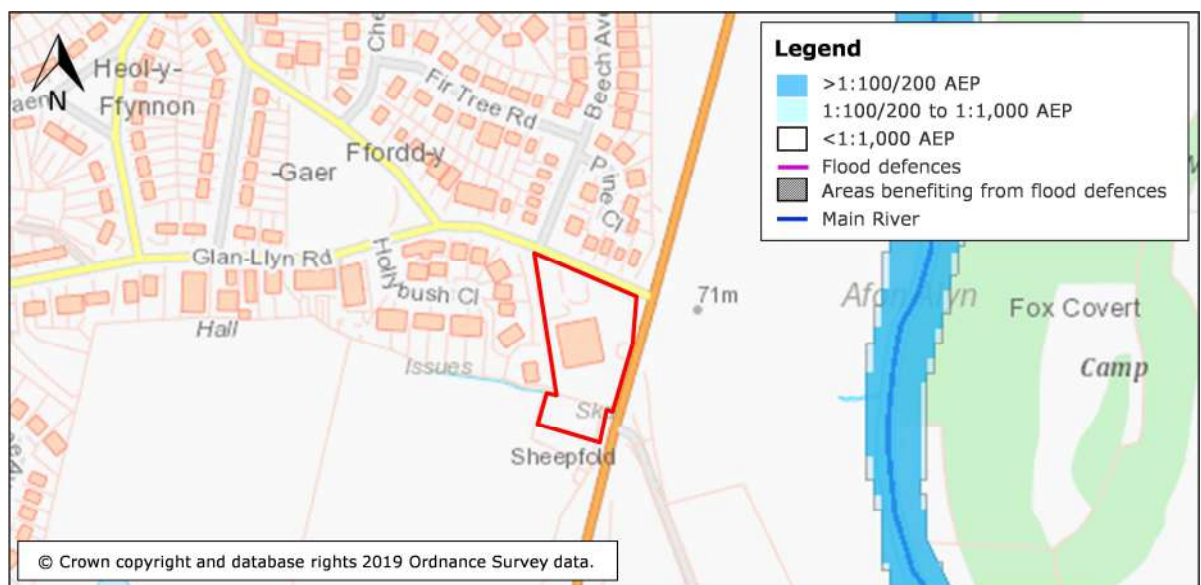


Figure 4: Flood Risk Map (Rivers and Sea)
(Source: NRW website)

2.4 FLUVIAL FLOOD RISK – UNNAMED WATERCOURSE

In order to more accurately identify and assess the level of flood risk from unnamed watercourse a 1D-2D ESTRY-TUFLOW hydraulic model has been developed by Weetwood and is discussed in the following sections of this report.

3 HYDROLOGY

3.1 CATCHMENT EXTENTS

The extent of the unnamed watercourse catchment has been derived using the Flood Estimation Handbook (FEH) Web Service (**Figure 5**) and was refined using Ordnance Survey (OS) mapping and LiDAR data. The catchment descriptors presented by **Table 1** represent the refined catchment values.

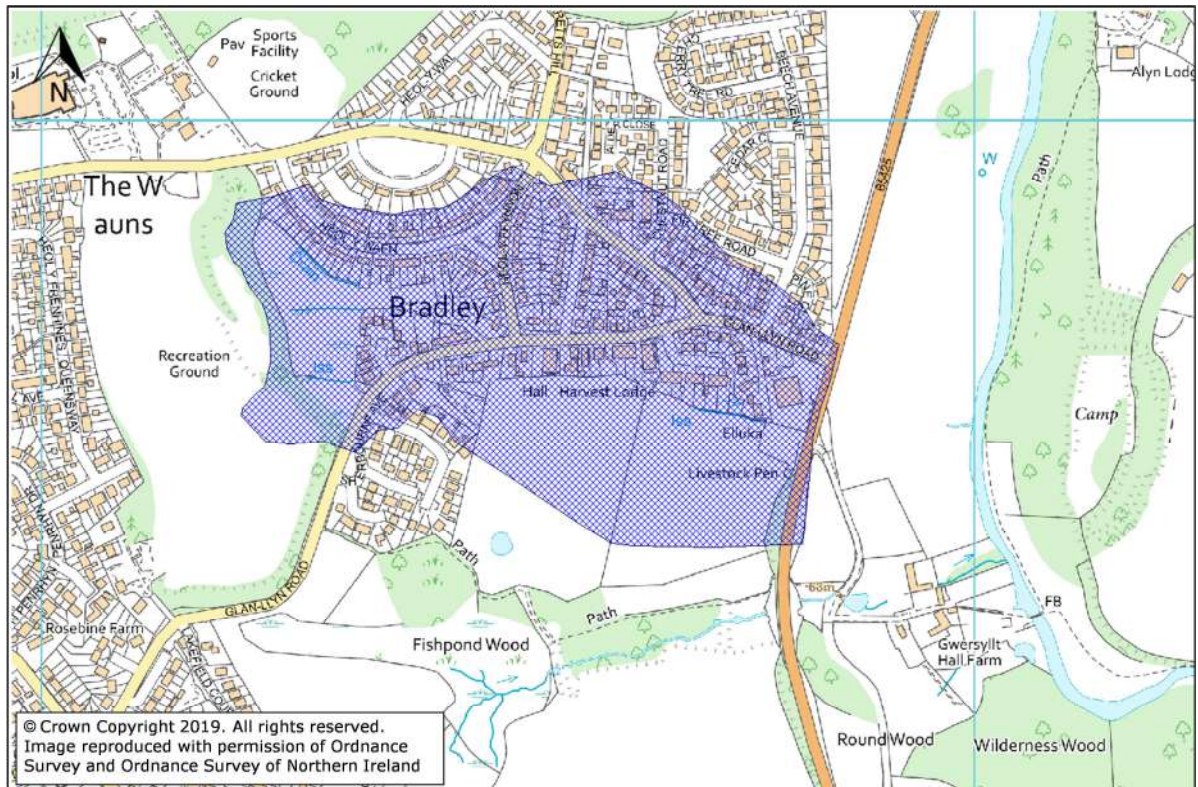


Figure 5: FEH Catchment Extents

Table 1: FEH Catchment Descriptors

Descriptor	Value	Descriptor	Value
OS NGR	332750 353500	LDP	2.81
AREA	0.18	RMED-1H	10
FARL	0.94	RMED-1D	33.2
PROPWET	0.51	RMED-2D	40.6
ALTBAR	97	SAAR	802
ASPBAR	67	SAAR4170	800
ASPVAR	0.53	SPRHOST	21.94
BFIHOST	0.87	URBCONC	0.84
DPLBAR	0.39	URBEXT	0.39
DPSBAR	44.1	URBLOC	0.94

3.2 APPROACH TO HYDROLOGICAL ANALYSIS

The FEH Statistical Method and Revitalised Flood Hydrograph Model v2.2 (ReFH2)¹ have been used to derive peak flows for the catchment.

3.2.1 FEH Statistical Method

The FEH Statistical Method for calculating peak flows uses gauged flow data from hydrologically similar catchments in the UK gauging station network. Flows calculated by the FEH Statistical Method may be considered more robust where a suitably homogeneous 'pooling group' of gauging stations similar to the study site can be identified.

The approach to calculating peak flows for given return periods using the FEH Statistical Method can be divided into two components:

- Estimating the index flood (QMED²)
- Estimating the flood growth curve (pooled analysis)

QMED is the median sized flood for a given catchment. The FEH recommends that data transfer from nearby gauged donor catchments should be used to calculate QMED wherever possible. QMED can be derived for ungauged catchments from catchment descriptors alone, or by adjusting the QMED value using a gauged 'donor' catchment to take into account differences between the donor catchment and the study catchment.

Most gauging stations record lengths are too short to allow for reliable estimation of long return-period floods. WINFAP-FEH allows for a pooled analysis, which draws together records from a group of hydrologically similar catchments into a pooling group.

The FEH Handbook recommends that 500 station years should be used, if possible, as this gives the best balance between a robust pooling group and enough data years to allow the determination of peak flows for extreme events.

The pooling group was generated in WINFAP-FEH v7.0, and catchment descriptors were used to assess whether the pooling group was acceptably homogenous and representative of the subject site.

A sufficiently representative pooling group could not be found due to the relatively high SAAR values (refer to **Annex C** for pooling group information). Nevertheless, peak flows estimated using the Generalised Logistic growth curve fitting are presented in **Table 2**.

3.2.2 ReFH2 Method

The ReFH2 method provides good definition of runoff contributions from small catchments and involves using 'catchment descriptors' to define:

- a) The duration of the critical rain storm for the catchment³.
- b) The rainfall for the critical storm duration with the required return period.
- c) The profile of the critical storm to apportion storm rainfall total.
- d) The shape of the unit hydrograph.

¹ Revitalised Flood Hydrograph Model ReFH2: Technical Guidance, Wallingford HydroSolutions Ltd, 2015

² To derive Qmed, a list of the maximum flow recorded in each year is drawn up. This is referred to as the Annual Maxima, or AMAX, series. Qmed is the median value in the AMAX series. As there is a 50% chance each year of the maximum flood being greater than Qmed, then Qmed is also analogous to the 1:2 annual probability flood.

³ In small, steep and urbanised catchments the duration will be shorter than in large, flat and undeveloped catchments

From these, the unit hydrograph and the profile storm are combined to produce the time against flow storm hydrograph from which a peak runoff rate can be determined.

The duration of the critical storm for the catchment was calculated using the catchment descriptors as approximately 1.54 hours. This duration was used with the catchment descriptors to calculate the design flood flows along the channel which are provided in **Table 2**.

Table 2: Peak Flow Estimates – Whole Catchment

Annual Probability	Peak Flow (m^3s^{-1})	
	FEH Statistical	ReFH2
QMED	0.031	0.07
1:100	0.080	0.25
1:1,000	-	0.43

The ReFH2 Method is shown to provide a more conservative estimate of peak flow rates and it was not possible to derive a suitably representative pooling group using the FEH Statistical Method. As such, the ReFH2 Method flows will be used for the purpose of the hydraulic modelling study.

4 HYDRAULIC MODEL DEVELOPMENT

4.1 MODELLING APPROACH

In order to more accurately define the level of fluvial flood risk to the site posed by unnamed Watercourse, 1D-2D ESTRY-TUFLOW hydraulic model has been developed by Weetwood.

The downstream channel section (adjacent to the River Alyn) and the long culverted section of watercourse downstream of the site have been represented in 1D using ESTRY with the upstream areas including the poorly defined channel and floodplain being modelled in 2D using TUFLOW. The 1D and 2D model domains have been dynamically linked.

4.2 MODEL EXTENT

The upstream extent of the 1D domain is located within the southern area of the development site at the B5425 culvert inlet. The downstream extent of the 1D domain is located approximately 184 m east of the development site at model node WREX01_00007.

The 2D domain extends across both the left and right floodplain between the entire modelled reach. The lateral extents of the 2D domain have been derived with reference to local topography and site location. The upstream and downstream extent of the 2D domain has been based on topography in order to have minimal influence on the assessed flood risk at the site. **Figure 6** illustrates the model extent.

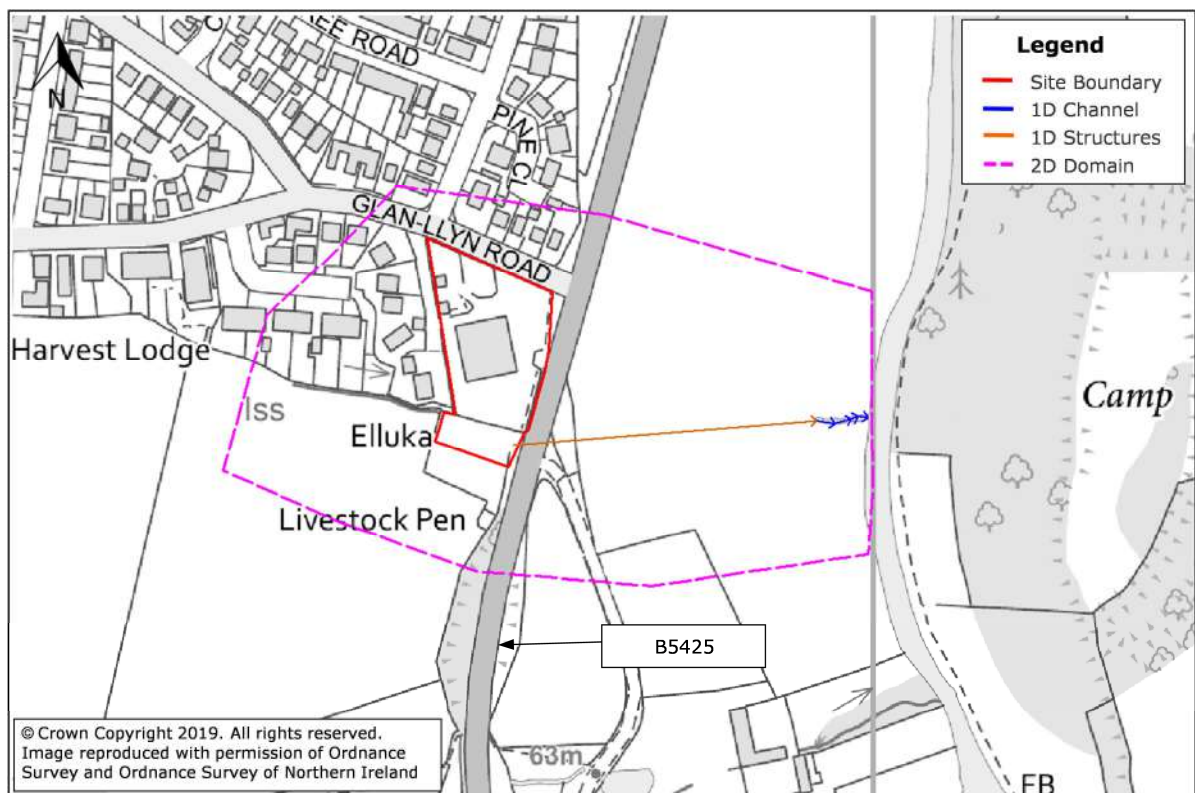


Figure 6: Model Extent

4.3 TOPOGRAPHIC DEVELOPMENT

In the 1D domain the channel topography is defined by cross-sections. The data collected during the channel survey (**Annex B**) has been used to define these channel cross-sections. The cross-sections are spaced at regular intervals with more detailed information collected around the structures.

The 2D domain topography is based upon filtered LiDAR data as shown in **Figure 7**. Channel bed levels have been reinforced into the 2D domain upstream of the site using a "z-line" file.

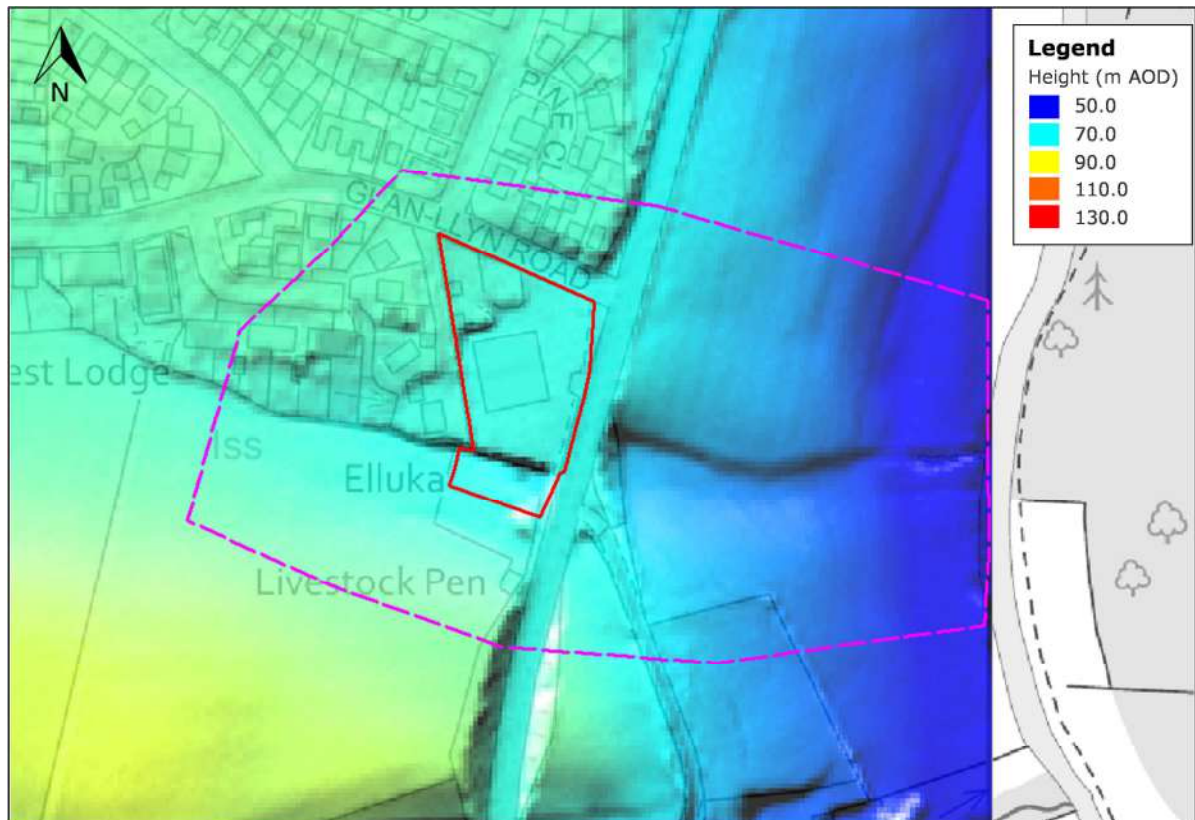


Figure 7: LIDAR

The LiDAR data that has been utilised in the model is the latest available composite digital terrain model (DTM) on the Lle Welsh Government website. It has a grid resolution of 2 m and is considered fit for purpose as it has been validated against the survey data.

The grid size used for the 2D domain was chosen as 2 m thus enabling any flow paths between buildings/along roads to be modelled whilst still permitting reasonable model run times.

4.3.1 Structures - Floodplain

The structures along the watercourse are represented within the 1D domain. The location of these structures is shown in **Figure 8** with photographs of each structure and the ETRY unit type provided in **Figure 9**.

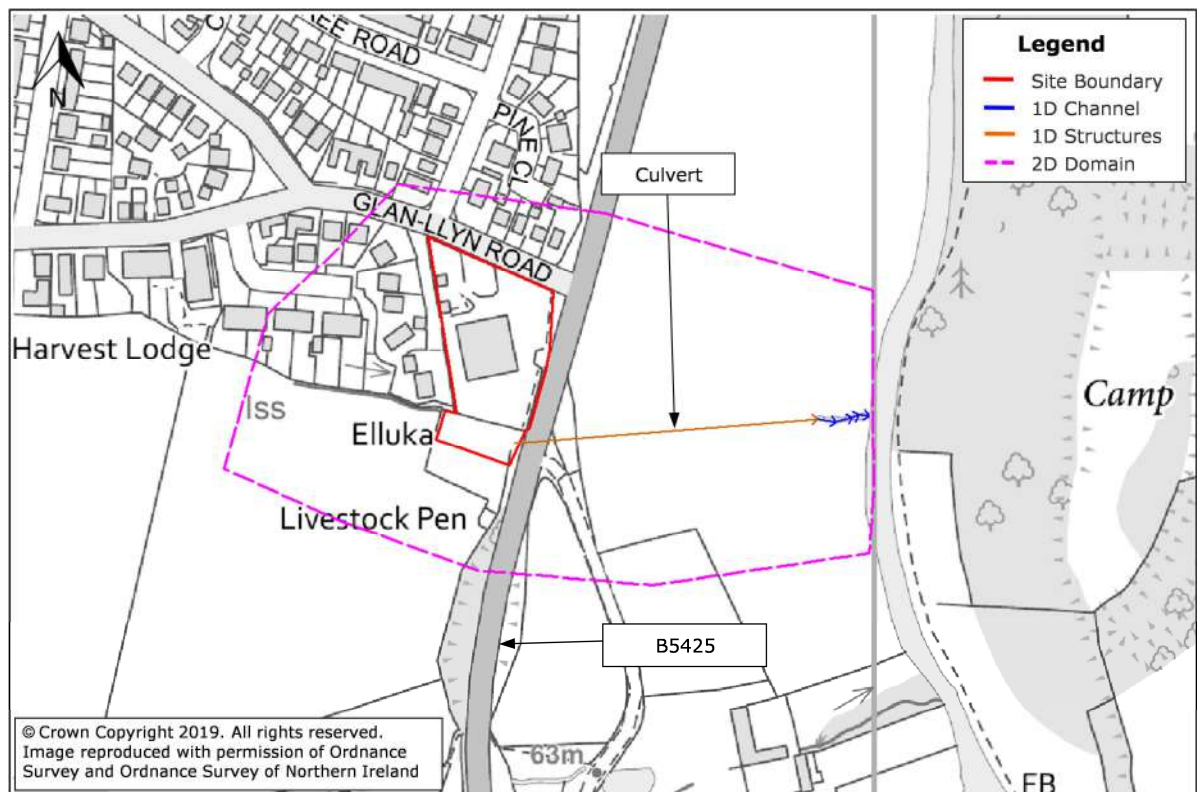


Figure 8: Location of Channel Structure in Modelled Reach



B5425 Culvert Inlet
ESTRY Unit: Circular Culvert

Figure 9: Photographs of Floodplain Structures in Study Area

4.4 1D/2D LINKING

The 1D channel has been dynamically linked to the 2D domain. This has been carried out using 'HX' lines and 'CN' connectors within the '2d_bc_hxe' layer in TUFLOW. In addition, 'SX' links have been provided at the culvert inlet.

Linking the two domains allows water to pass from the 1D domain to the 2D domain if water levels in the channel are higher than the floodplain. Conversely it allows water to pass into the 1D domain when water levels in the channel drop below floodplain levels.

4.5 MODEL COEFFICIENTS

4.5.1 Mannings n

The Mannings n values represent the 'roughness', or resistance to water flow due to friction, in both the river channel and the floodplain. Mapping data, aerial photography and several site visits were used to define the channel and land use types, which were then assigned Mannings n values.

The Mannings n values used in the model are shown in **Table 3**.

Table 3: Mannings n Values

Land Use		Mannings n Value
Channel	Clean, straight channel with stones and weeds	0.035
	Clean windy channel with shoals and pools	0.045
Structures	Brick with Cement Mortar	0.013
Floodplain	Rough Grass	0.035
	Dense Trees and Shrubs	0.075
	Roads	0.020
	Footpaths/Paved Areas/Car Parks/Work Yards	0.020
	Buildings	0.500

4.6 BOUNDARY CONDITIONS

4.6.1 Input Boundaries

The input flow hydrographs are those outlined within **Section 3**. These have been input into the upstream extent of the 2D model using a 'QT' boundary.

4.6.2 Downstream Boundaries

At the downstream extent of the 1D model, a 'HT' link is applied to node 'WREX01_00007' (refer to **Figure 6**).

At the downstream extent of the model, 'HQ' lines have been included and are read into TUFLOW using the '2d_bc_HQ' file. These lines allow water to move out of the model and to continue to flow down the floodplain, without being restricted by the model extent.

4.7 MODEL VERSION AND SIMULATION INFORMATION

The model was developed using TUFLOW build 2018-03-AB-iSP-w64.

Simulations for all design events were run with a 0.5 second timestep. Information on timestep and other variables can be seen in the '*.ief' files for each run, and is recorded in the modelling logbook spreadsheet ('4411 Modelling Logbook.xls') accompanying this report (see **Annex D**).

5 MODEL RUNS AND RESULTS

5.1 MODEL RUNS

Table 4 details the model runs that have been undertaken in order to assess the flood risk at the existing site under the baseline scenario. The blockage location is illustrated in **Figure 10**.

Full details are provided in the '4411 Modelling Logbook.xls' included within **Annex D** of this report.

Table 4: Model Runs

Scenario	Run Name	Flood Event (AEP)
Baseline	4411_009_Q100	1:100
	4411_009_Q1000	1:1,000
	4411_009_Q100cc20	1:100 + 20% climate change (20CC)
	4411_009_Q100cc45	1:100 + 45% climate change (45CC)
Blockage	4411_010_Q100cc20_BLK100	1:100+20CC with 100% blockage
	4411_010_Q1000_BLK100	1:1,000 with 100% blockage

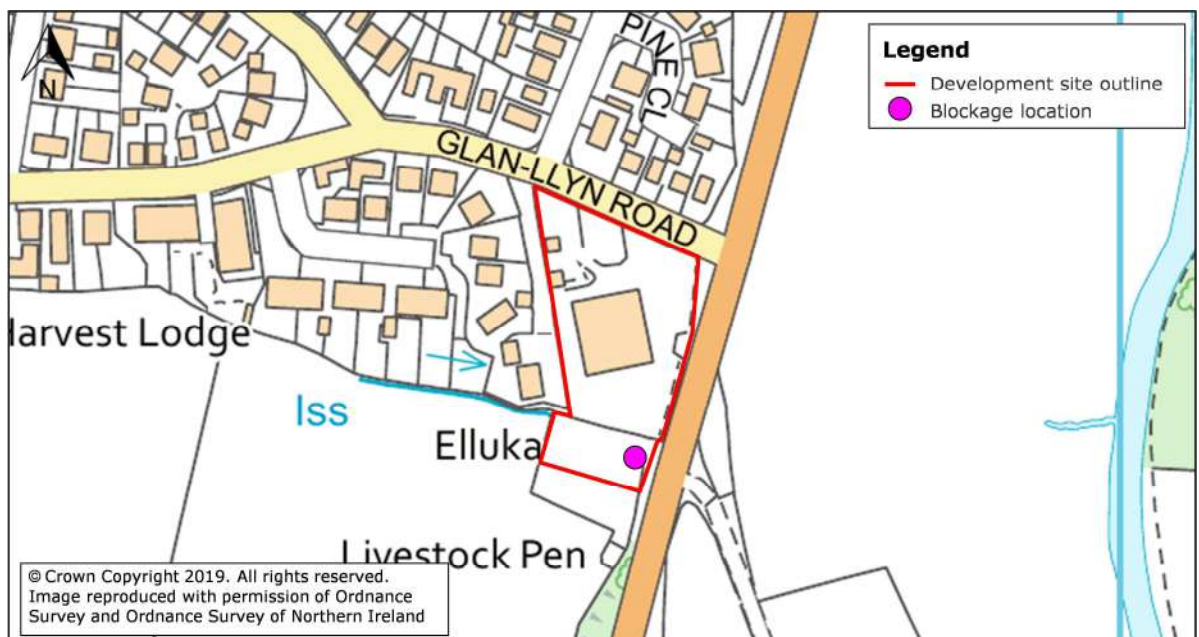


Figure 10: Blockage Location – Baseline Scenario

5.2 MODEL RESULTS

Model output plots illustrating the maximum flood extents for all modelled events are provided in **Annex E**.

The baseline results indicate that flooding may be expected to occur at the southern part of the site adjacent to the watercourse for all modelled events.

Table 5 summarises the maximum level, depth and velocity of floodwaters expected on site during all modelled events.

Table 5: Modelled Maximum Flood Level, Depth & Velocity - Baseline

Annual Probability Event	Max Level (m AOD)	Depth (m)		Velocity (m/s)	
		Max	Mean	Max	Mean
1:100	70.85	1.20	0.52	1.24	0.15
1:100+CC (20%)	70.86	1.54	0.63	1.33	0.10
1:100+CC (45%)	71.09	1.90	0.73	0.38	0.06
1:1,000	71.31	2.19	0.85	0.41	0.06

6 MODEL CALIBRATION AND SENSITIVITY

6.1 MODEL CALIBRATION

6.1.1 Known Historical Flood Events

The catchment is ungauged and there are no known historic flood events that have impacted the site. Therefore it is not possible to calibrate the hydraulic model using historic data.

6.2 MODEL SENSITIVITY

6.2.1 Manning's n

Sensitivity testing has been carried out for the 1:100+20CC annual probability event on the Manning's n coefficients by varying them by +/- 20%.

The results indicate that despite expected changes in velocity as a result of increasing and decreasing Manning's n , peak water levels were generally not altered beyond +20 mm and -10 mm respectively.

The model is therefore not considered to be sensitive to changes in roughness coefficients.

6.2.2 Downstream Boundary

Given that the downstream boundary of the model is located in an area where the channel invert is more than 20 m below the lowest channel invert level within the site, sensitivity testing on the downstream boundary should not be required as this is not likely to have any impact on flood risk at the site.

6.2.3 Structure Blockage

Sensitivity testing has been carried out for the 1:100+20CC and 1:1,000 annual probability event for a 100% blockage of the B5425 culvert.

The model output plots for the blockage scenarios are provided within **Annex F** and expected maximum flood depths, levels and velocities are presented in **Table 6**. These indicate that flood depths are expected to increase by 1.09 m and 0.47 m during the 1:100+20CC and 1:1,000 annual probability events respectively when a blockage is included.

Table 6: Modelled Maximum Flood Information – Baseline Blockage

Annual Probability Event	Max Level (m AOD)	Depth (m)		Velocity (m/s)	
		Max	Mean	Max	Mean
1:100+20CC	71.74	2.63	1.08	0.55	0.04
1:1,000	71.77	2.66	1.10	0.65	0.05

7 SUMMARY

Weetwood has been instructed to assess the flood risk in association with the proposed extension of car park at the existing Toyota Garage, Wrexham.

According to the Development Advice Map, the proposed development site is located in Zone A. However, the risk of flooding from the unnamed watercourse is not expected to have been assessed owing to the small size of the catchment.

In order to more accurately define the level of fluvial flood risk to the site posed by unnamed Watercourse, 1D-2D ESTRY-TUFLOW hydraulic model has been developed by Weetwood. This indicates that flooding may be expected to occur at the southern part of the site adjacent to the watercourse for all modelled events.

There are no recorded flood incidents at or within the vicinity of the site, the catchment is also ungauged. As such, it is not possible to calibrate the model in this instance.

The model is not considered to be sensitive to variations in Manning's n roughness coefficients nor by modifying the downstream boundary condition of the model.

However, the model is sensitive to blockages of the B5425 culvert adjacent to the site as flood depths are expected to increase by 1.09 m and 0.47 m during the 1:100+20CC and 1:1,000 annual probability events respectively.

Annex A:

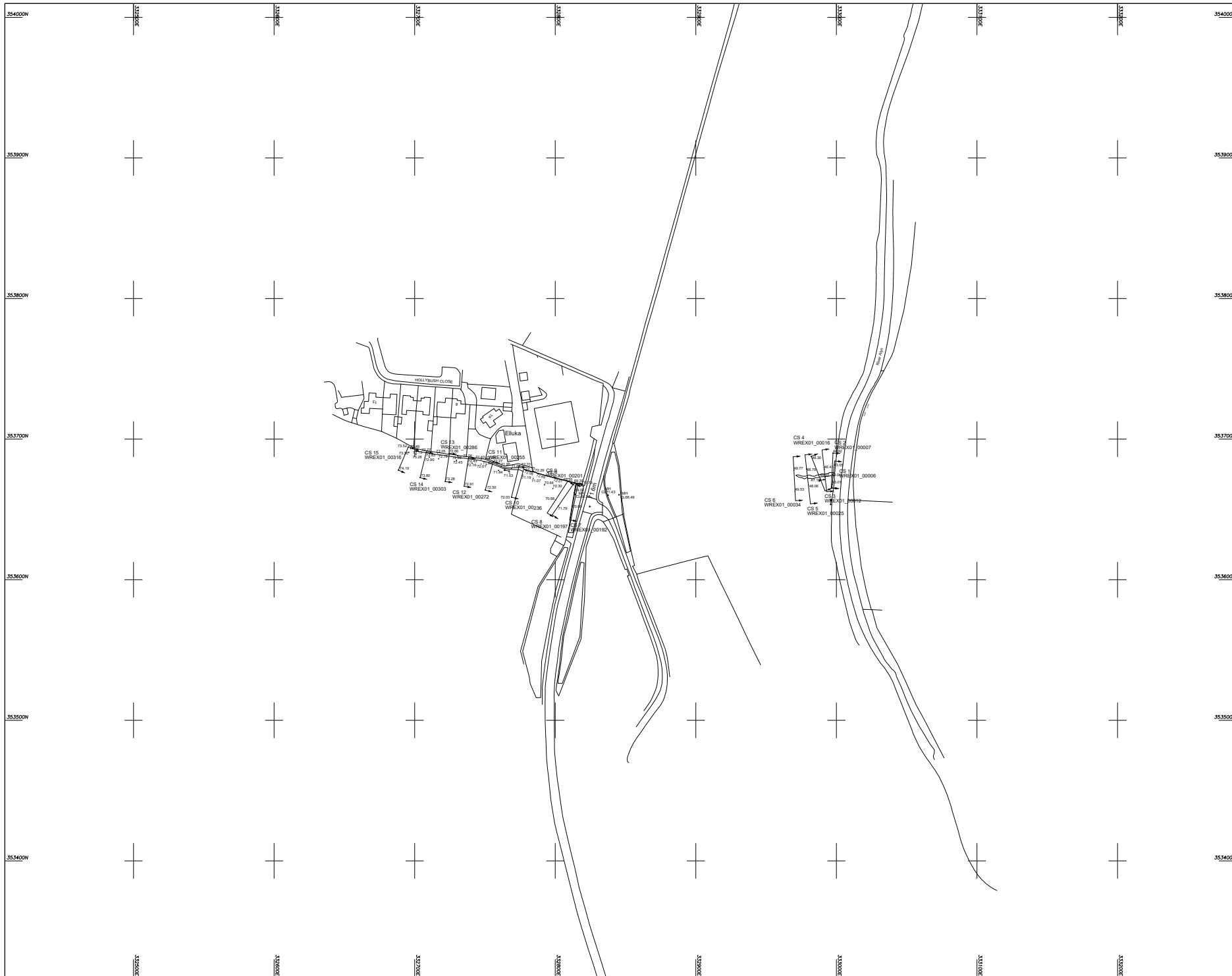
Topographic Survey



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Annex B:

Channel Survey



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Note:
The survey is plotted on a plane local
Grid. Orientation to National Grid.
All levels relate to Ordnance Datum,
achieved using the
OS National GPS Network.

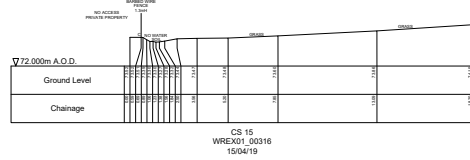
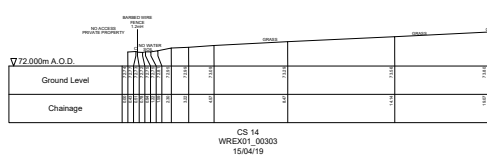
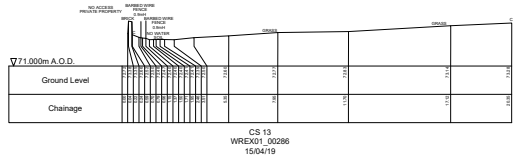
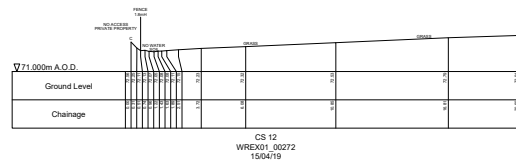
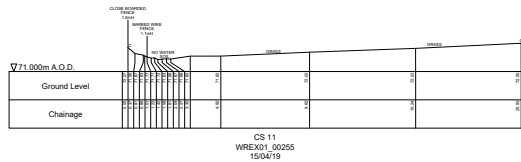
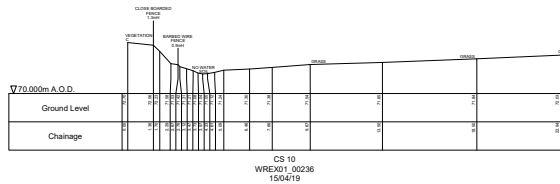
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Client	
Weetwood Environmental Engineering	
Drawing Title	
Cross Section Location Plan at:	
Toyota Garage	
Wrexham	
Sheet 1 of 3	

Scale(s)	1:1250	Surveyor	JD/MF
Date	APR 19	Drawn	JR
Job Number	19C025	Checked	SO

Sheet Size & Drg Number & Revision	
A1 19C025/001	



NOTE: ALL CROSS SECTIONS VIEWED LOOKING DOWNSTREAM.
NOTE: CROSS SECTION DATUM VALUES VARY.

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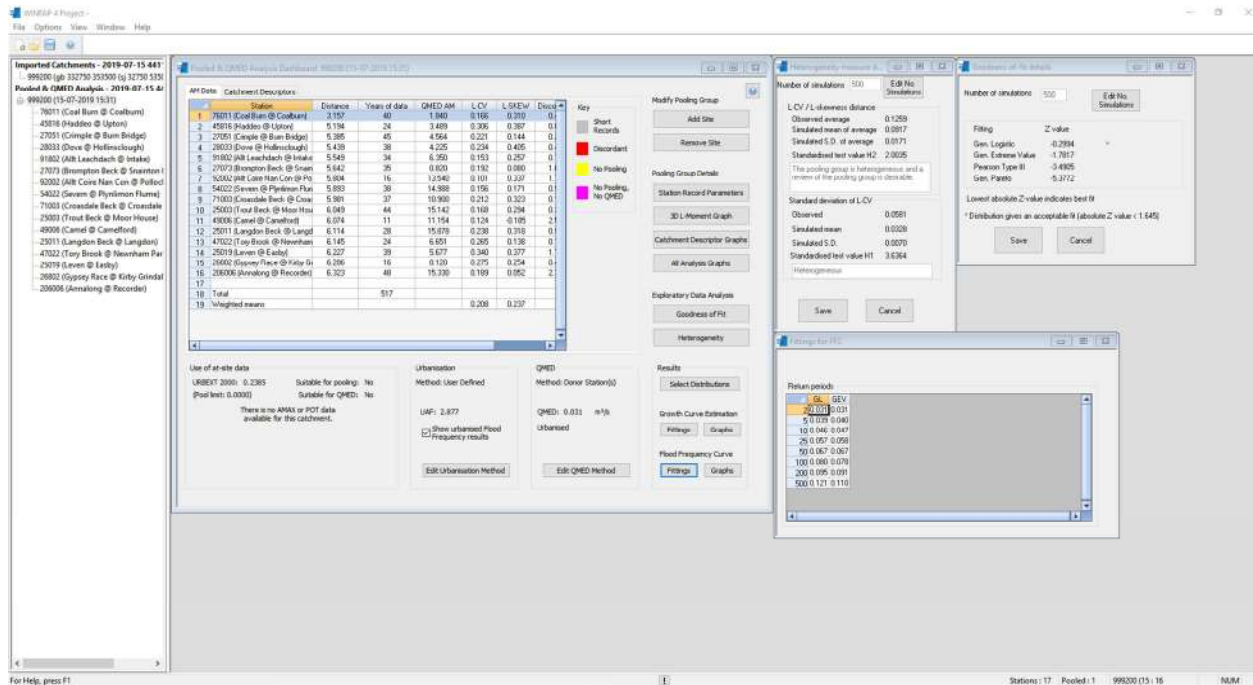
Smith Street, Stammerside, Leam. WMS 8LN
Tel: 01895 725462 Fax: 01895 51816
Email: mail@surveys.co.uk - www.surveys.co.uk

Client Westwood Environmental Engineering	
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Scale(s) 1:100	Survey JD/MF
Date APR 19	Drawn JR
Job Number 19C025	Checked SO

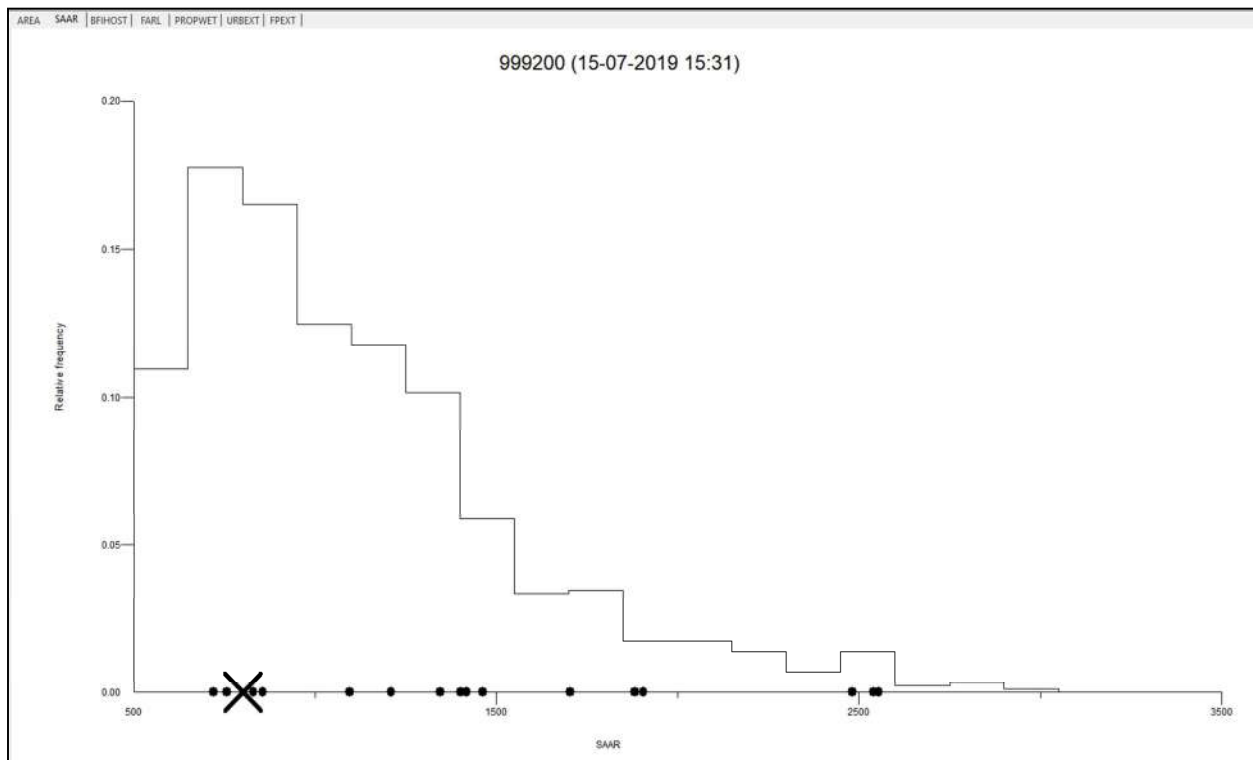
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Annex C:

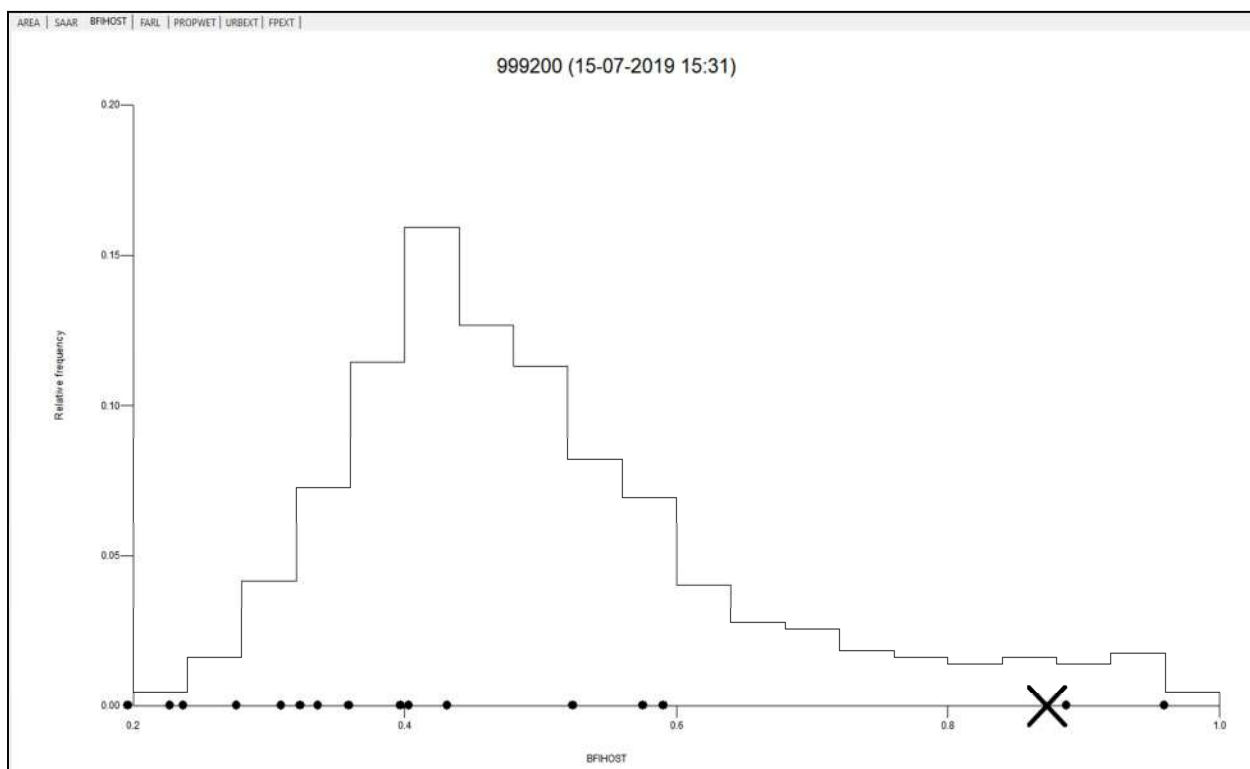
FEH Statistical Method - Pooling Group Details



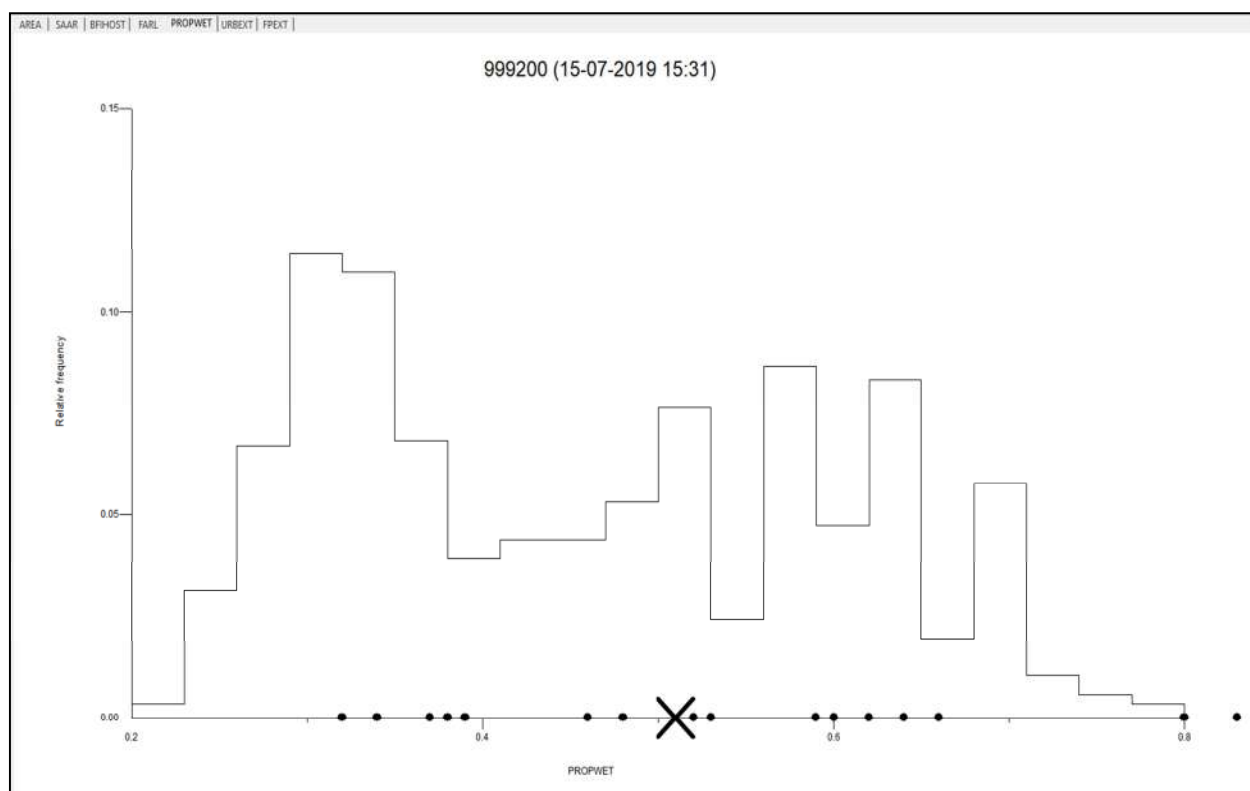
Pooling Group with Heterogeneity measures, Goodness of fit details and Fittings for Flood Frequency Curve



Catchment Descriptor Graph - SAAR



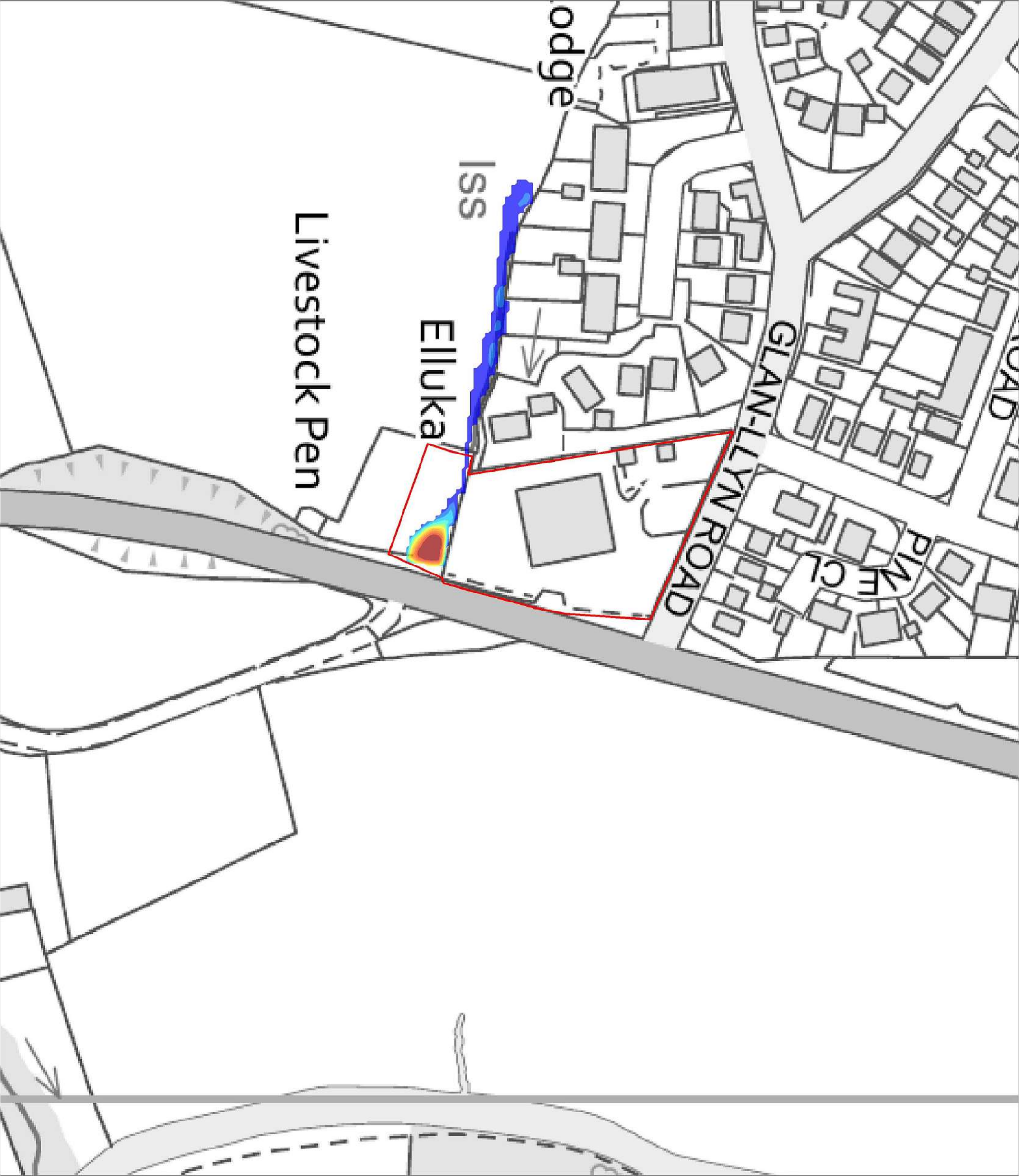
Catchment Descriptor Graph - BFIHOST



Catchment Descriptor Graph - PROPWET

Annex E:

Model Results - Baseline



- Notes:
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KEY:

— Site Location

Depth (metres)

0.0 to 0.1
0.1 to 0.2
0.2 to 0.3
0.3 to 0.4
0.4 to 0.5
0.5 to 0.6
0.6 to 0.7
0.7 to 0.8
0.8 to 0.9
0.9 to 1.0
> 1.0

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Tel: 0203 757 5444
Email: info@weetwood.net

Client:
Steve Hopewell Holdings Ltd

Project Title:
Toyota Wrexham

Drawing Title:
**Baseline Scenario
1:100 AEP**

Map Orientation:

Scale: 0 15 30 metres

Map Orientation: N E S W

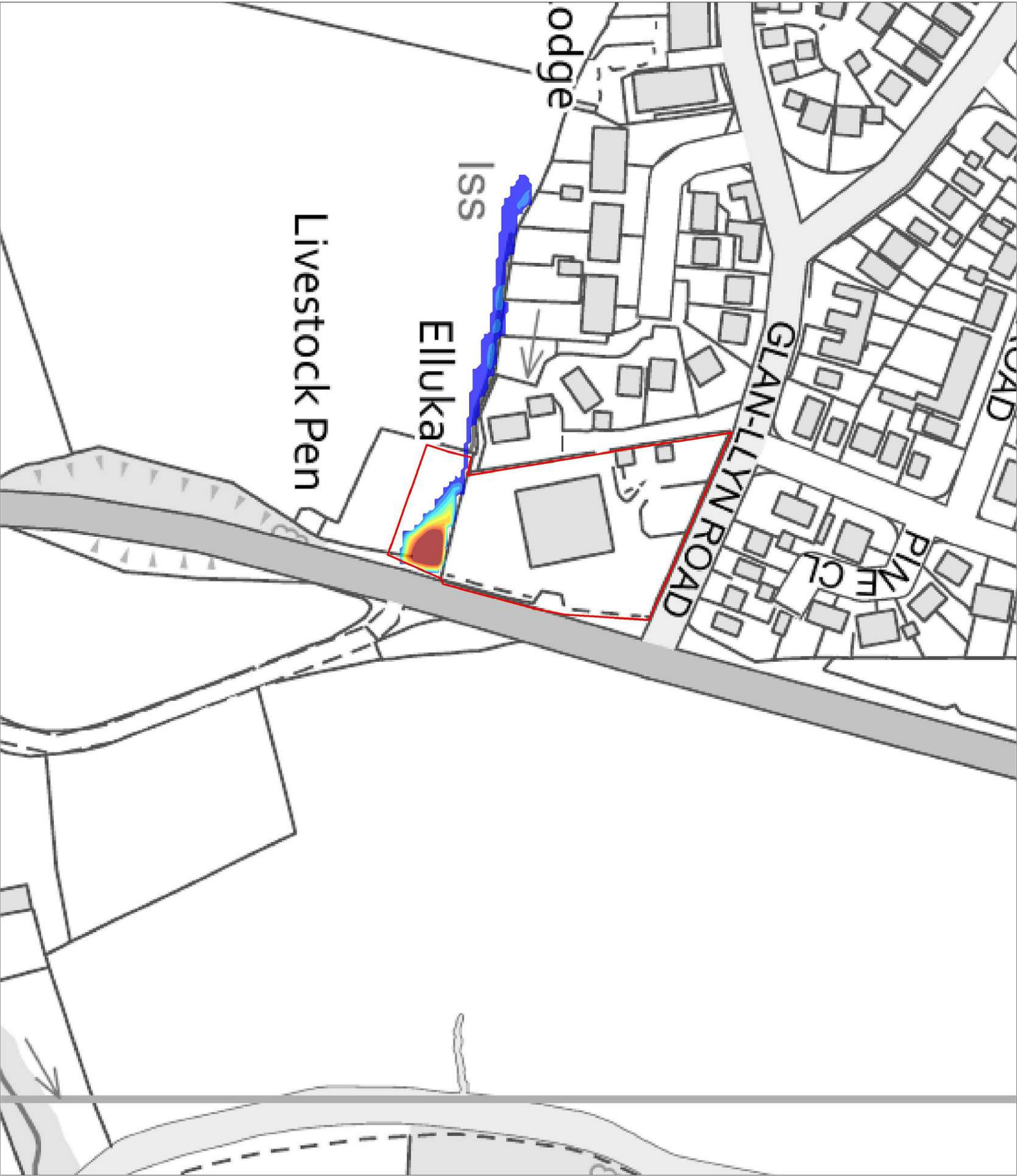
Drawn: DJ

Checked: JA

Date: 18 July 2019

Drawing No: 4411_009_Q100_d

Rev: B



Notes:

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KEY:

— Site Location

Depth (metres)

0.0 to 0.1
0.1 to 0.2
0.2 to 0.3
0.3 to 0.4
0.4 to 0.5
0.5 to 0.6
0.6 to 0.7
0.7 to 0.8
0.8 to 0.9
0.9 to 1.0
> 1.0

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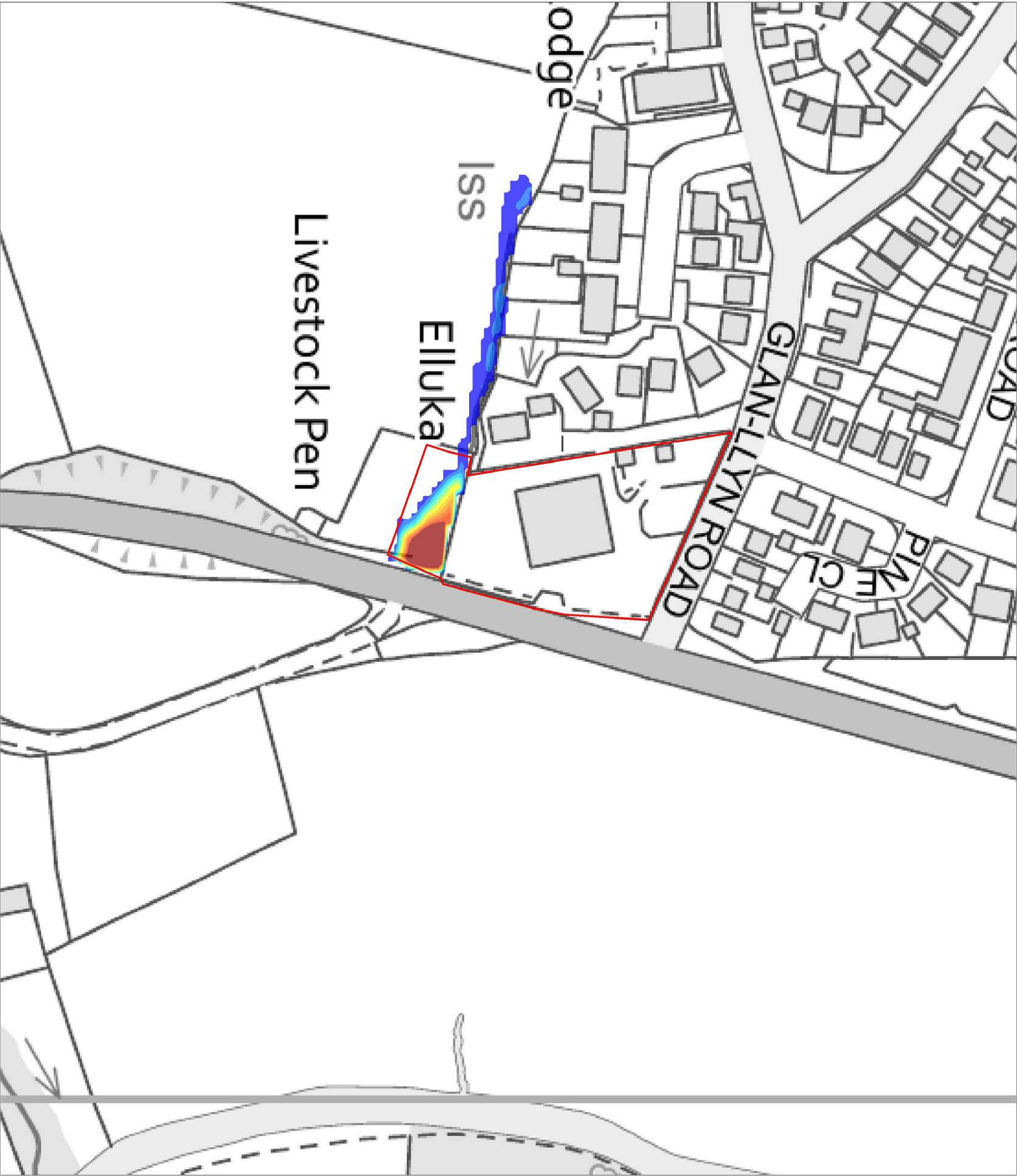
Project Title:
Toyota Wrexham

Drawing Title:
**Baseline Scenario
1:100+CC (20%) AEP**

Map Orientation: Scale: 0 15 30 metres

Drawn: DJ Checked: JA Date: 18 July 2019

Drawing No: 4411_009_Q100cc20_d Rev: B



Notes:

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KEY:

Site Location

Depth (metres)

0.0 to 0.1
0.1 to 0.2
0.2 to 0.3
0.3 to 0.4
0.4 to 0.5
0.5 to 0.6
0.6 to 0.7
0.7 to 0.8
0.8 to 0.9
0.9 to 1.0
> 1.0

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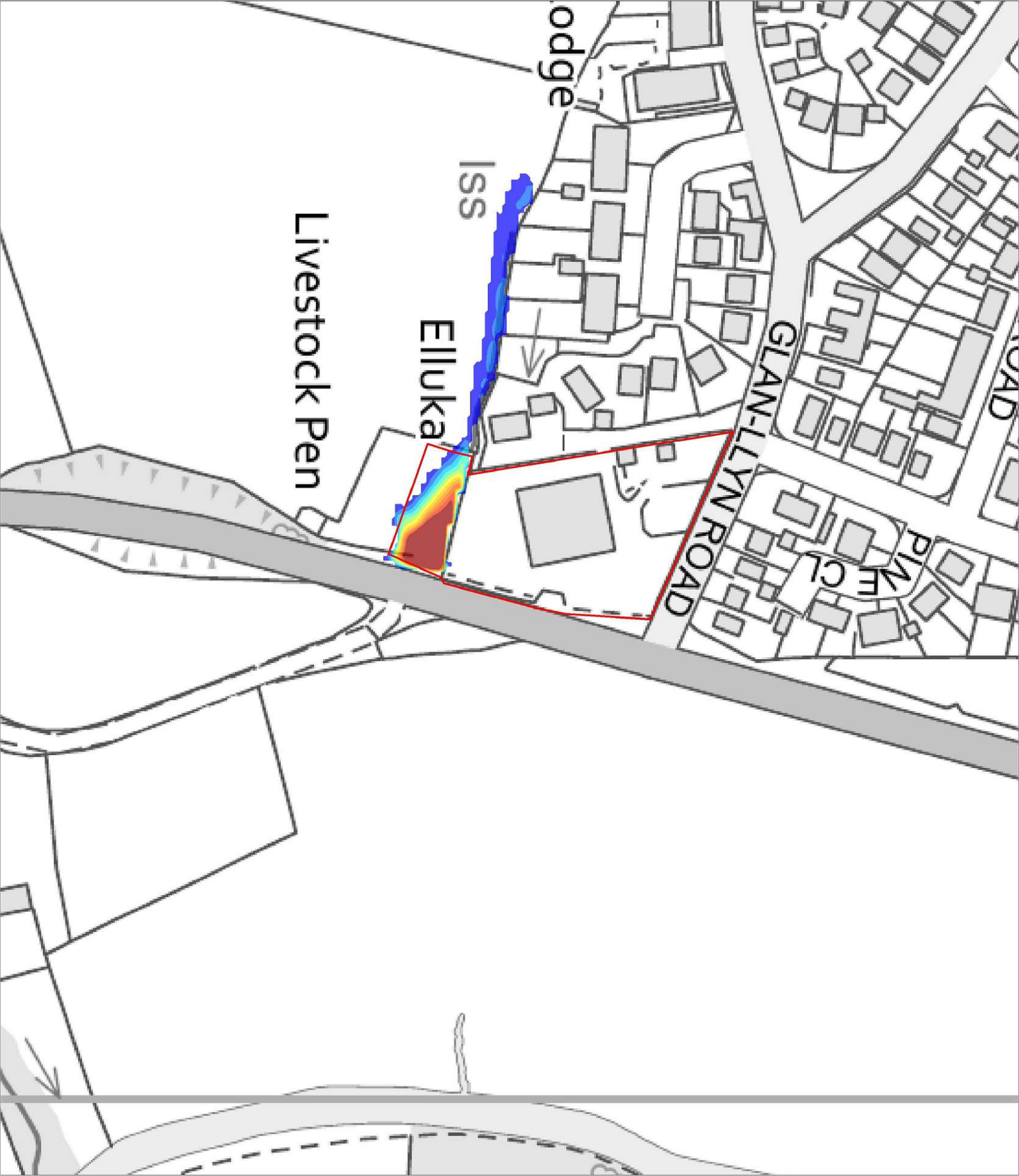
Project Title:
Toyota Wrexham

Drawing Title:
**Baseline Scenario
1:100+CC (45%) AEP**

Map Orientation: Scale: 0 15 30 metres

Drawn: DJ
Checked: JA
Date: 18 July 2019

Drawing No: 4411_009_Q100cc45_d
Rev: B



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KEY:

— Site Location

Depth (metres)

0.0 to 0.1
0.1 to 0.2
0.2 to 0.3
0.3 to 0.4
0.4 to 0.5
0.5 to 0.6
0.6 to 0.7
0.7 to 0.8
0.8 to 0.9
0.9 to 1.0
> 1.0

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Project Title:
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Drawing Title:
**Baseline Scenario
1:1,000 AEP**

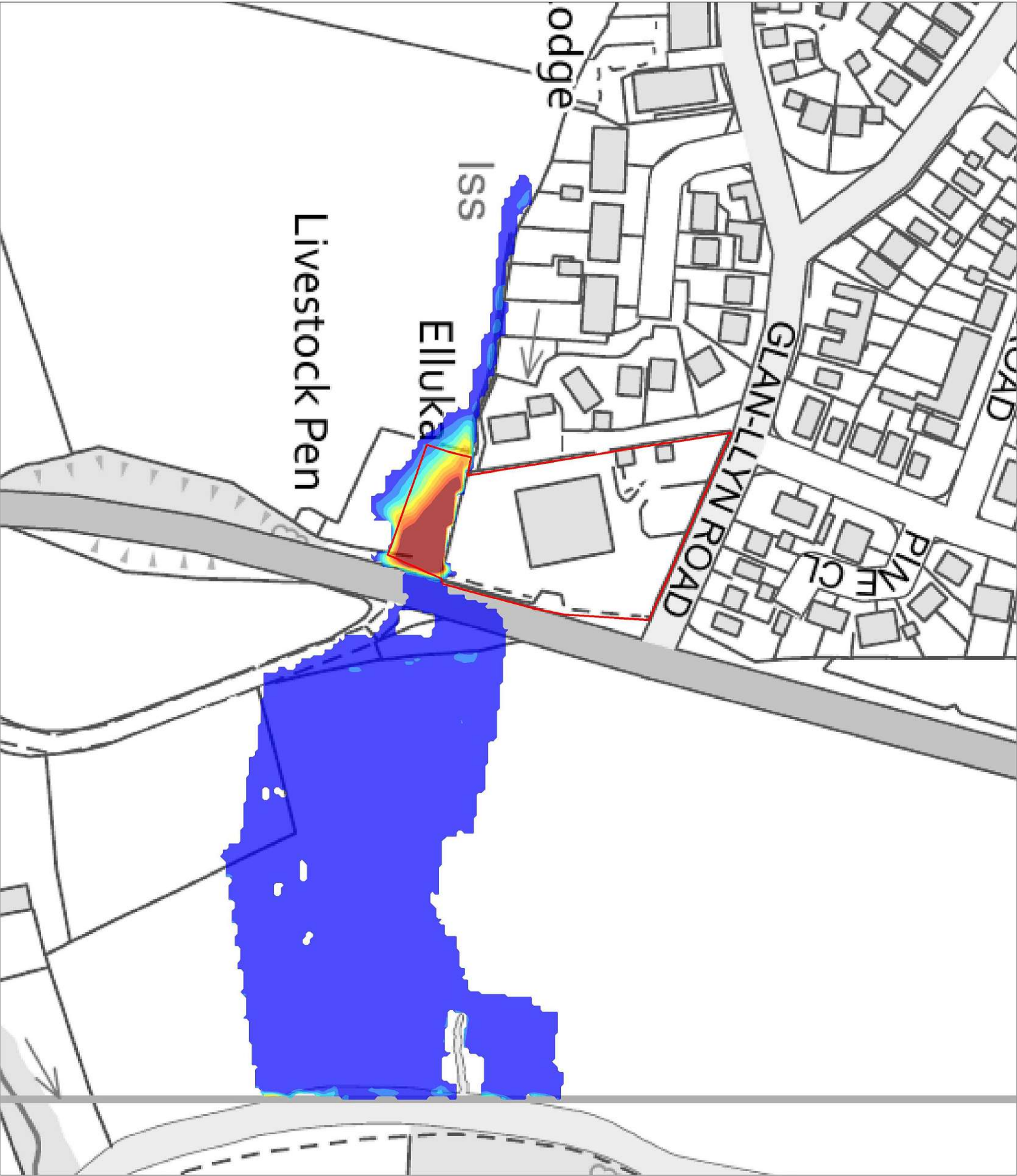
Map Orientation: Scale: 0 15 30 metres

Drawn: DJ Checked: JA Date: 18 July 2019

Drawing No: 4411_009_Q1000_d Rev: B

Annex F:

Model Results - Sensitivity



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KEY:

— Site Location

Depth (metres)

0.0 to 0.1
0.1 to 0.2
0.2 to 0.3
0.3 to 0.4
0.4 to 0.5
0.5 to 0.6
0.6 to 0.7
0.7 to 0.8
0.8 to 0.9
0.9 to 1.0
> 1.0

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Client:
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Project Title:
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Drawing Title:
**Baseline Scenario-Blockage 100%
1:100+CC (20%) AEP**

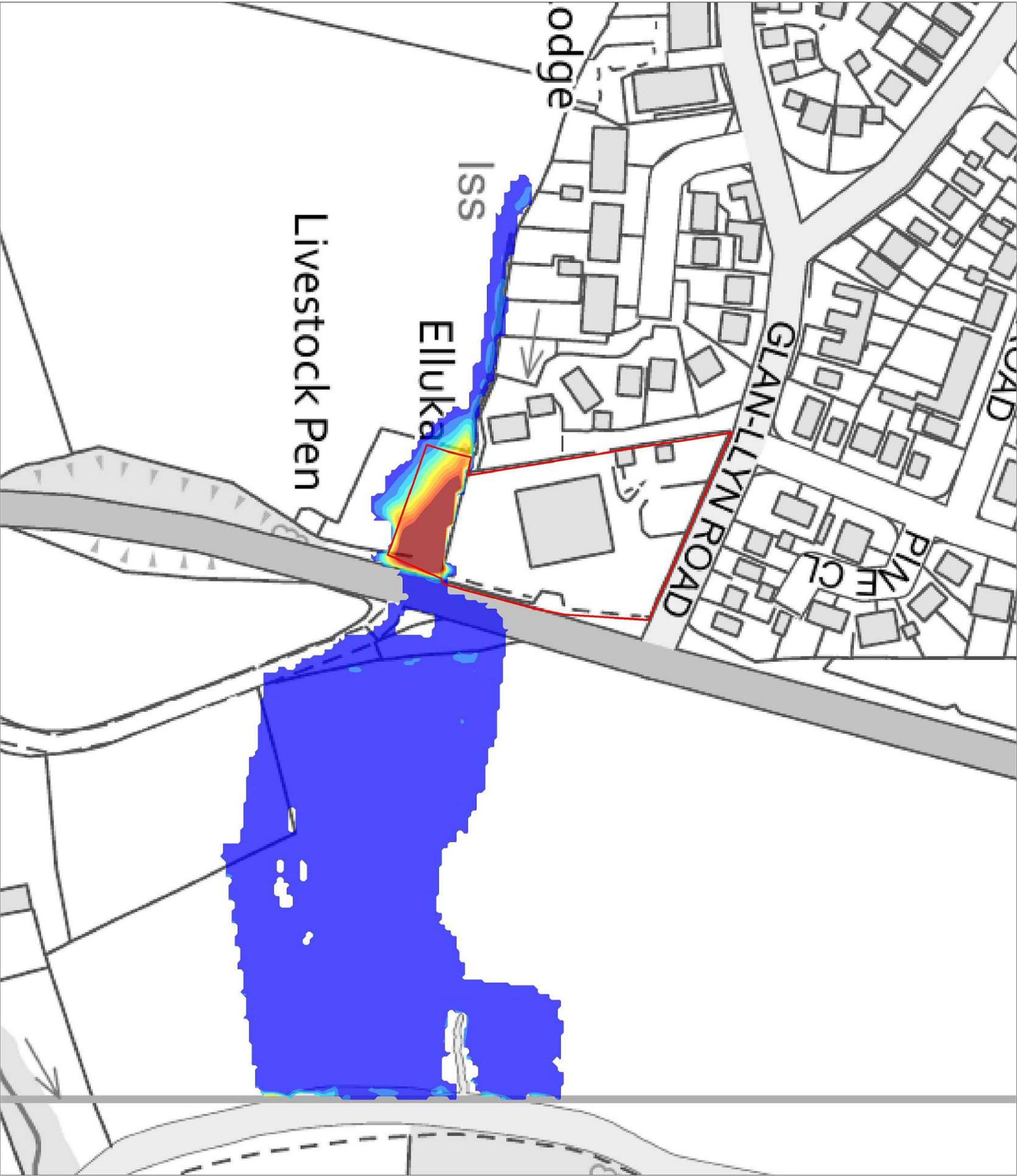
Map Orientation:

Scale: 0 15 30 metres

Map Orientation: N S E W

Drawn: DJ
Checked: JA
Date: 18 July 2019

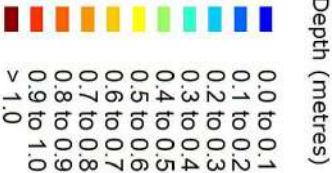
Drawing No: 4411_010_Q100cc20_BLK100_d
Rev: B



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KEY:

— Site Location



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Project Title:
Toyota Wrexham

Drawing Title:
Baseline Scenario-Blockage 1000% 1:1,000 AEP

Map Orientation:

Scale: 0 15 30 metres

W E S N

Drawn: DJ

Checked: JA

Date: 18 July 2019

Drawing No: 4411_010_Q1000_BLK100_d

Rev: B



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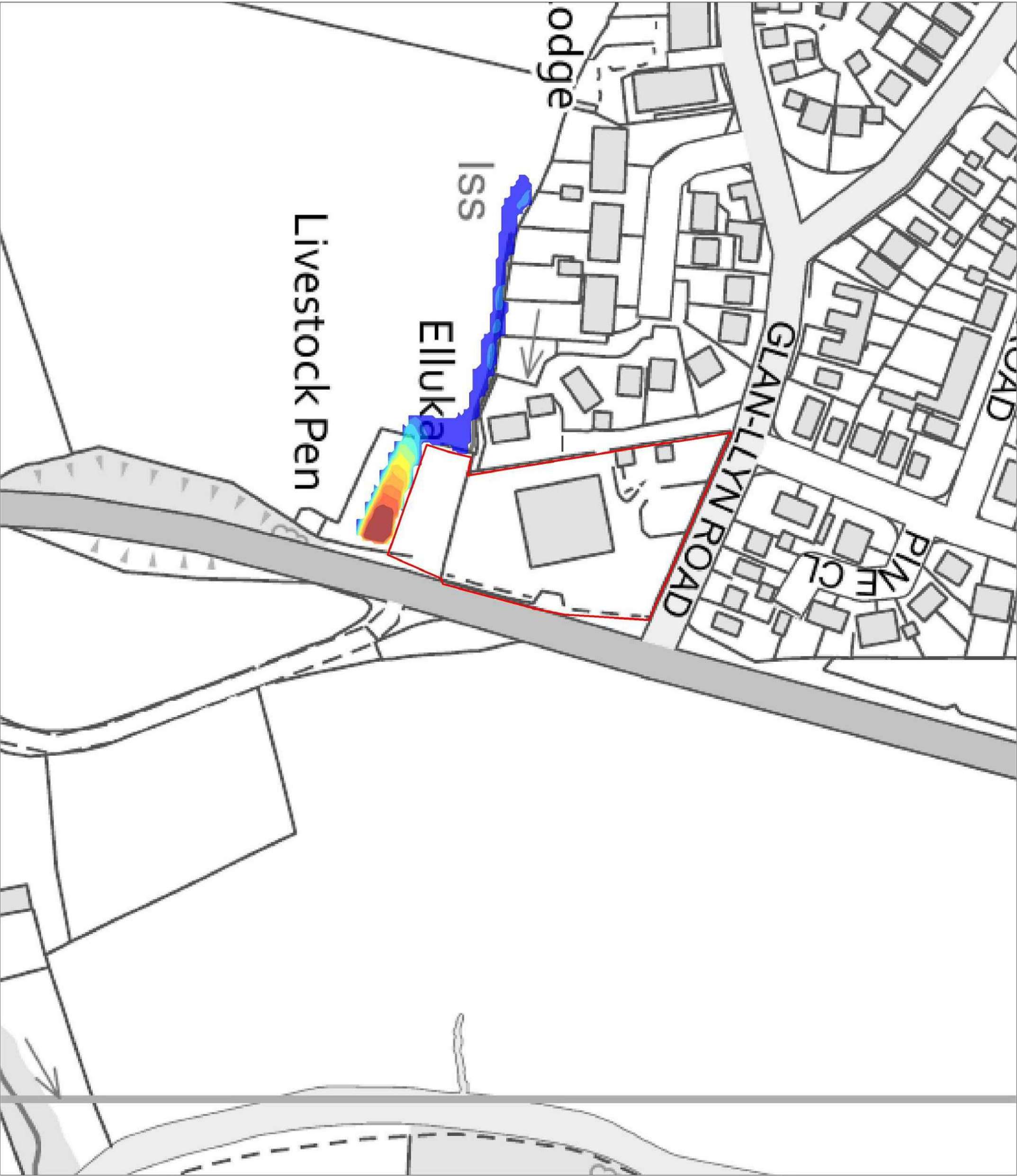
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Flood Risk Assessments
Flood Consequences Assessments
Surface Water Drainage
Foul Water Drainage
Environmental Impact Assessments
River Realignment and Restoration
Water Framework Directive Assessments
Flood Defence Consent Applications
Sequential, Justification and Exception Tests
Utility Assessments
Expert Witness and Planning Appeals
Discharge of Planning Conditions

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APPENDIX D:

Model Output Plots – Proposed



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KEY:

— Site Location

Depth (metres)

0.0 to 0.1
0.1 to 0.2
0.2 to 0.3
0.3 to 0.4
0.4 to 0.5
0.5 to 0.6
0.6 to 0.7
0.7 to 0.8
0.8 to 0.9
0.9 to 1.0
> 1.0

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Project Title:

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Drawing Title:

**Proposed Scenario
1:100+CC (20%) AEP**

Map Orientation:



Drawn:

DJ

Checked:

JA

Date:

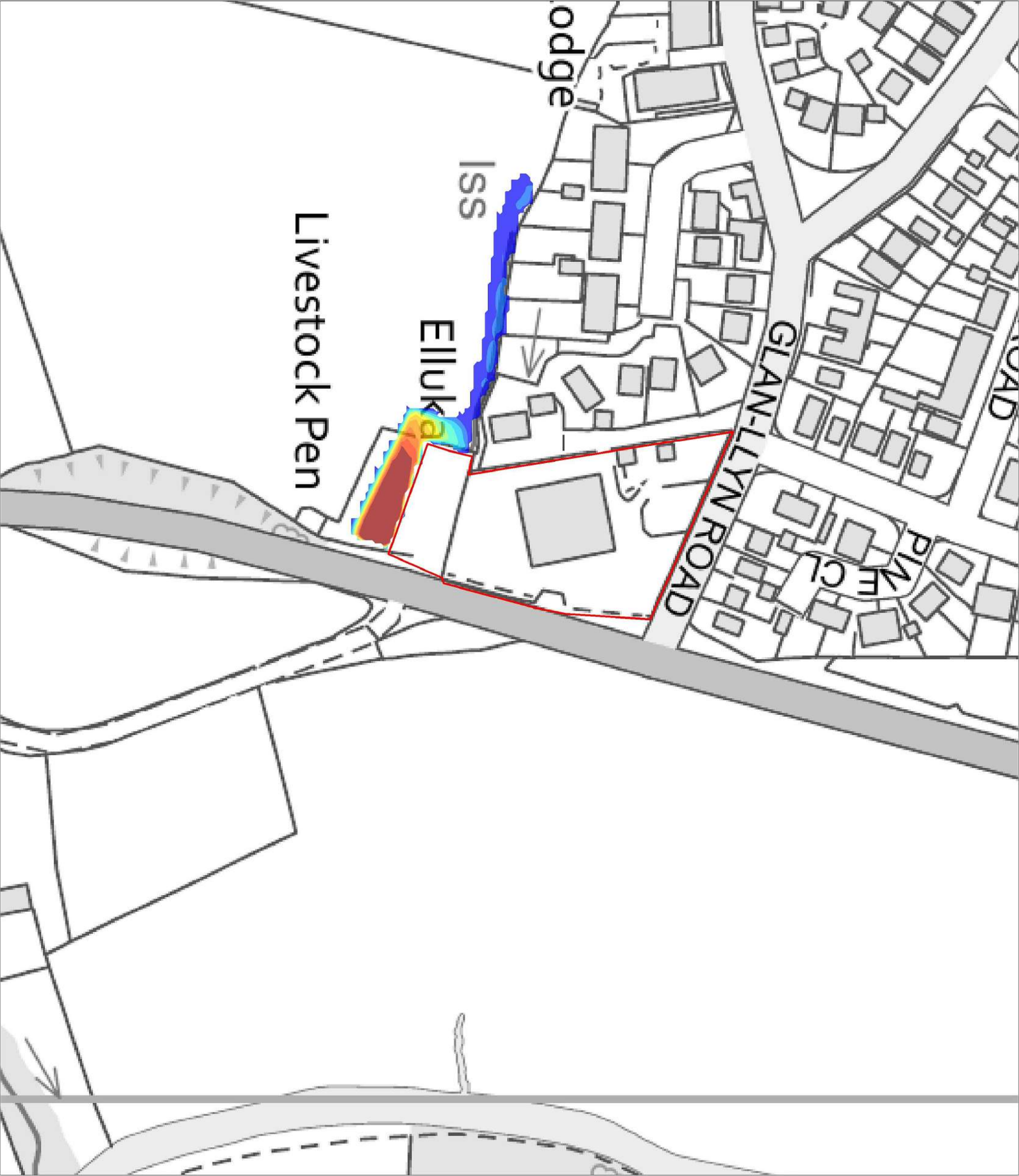
26 November 2019

Drawing No:

4411_015_Q100cc20_Prop_Mit_d

Rev:

A



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KEY:

— Site Location

Depth (metres)

0.0 to 0.1
0.1 to 0.2
0.2 to 0.3
0.3 to 0.4
0.4 to 0.5
0.5 to 0.6
0.6 to 0.7
0.7 to 0.8
0.8 to 0.9
0.9 to 1.0
> 1.0

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Client:

Steve Hopewell Holdings Ltd

Project Title:

Toyota Wrexham

Drawing Title:

**Proposed Scenario
1:1,000 AEP**

Map Orientation:

Scale: 0 15 30 metres

N
W E
S

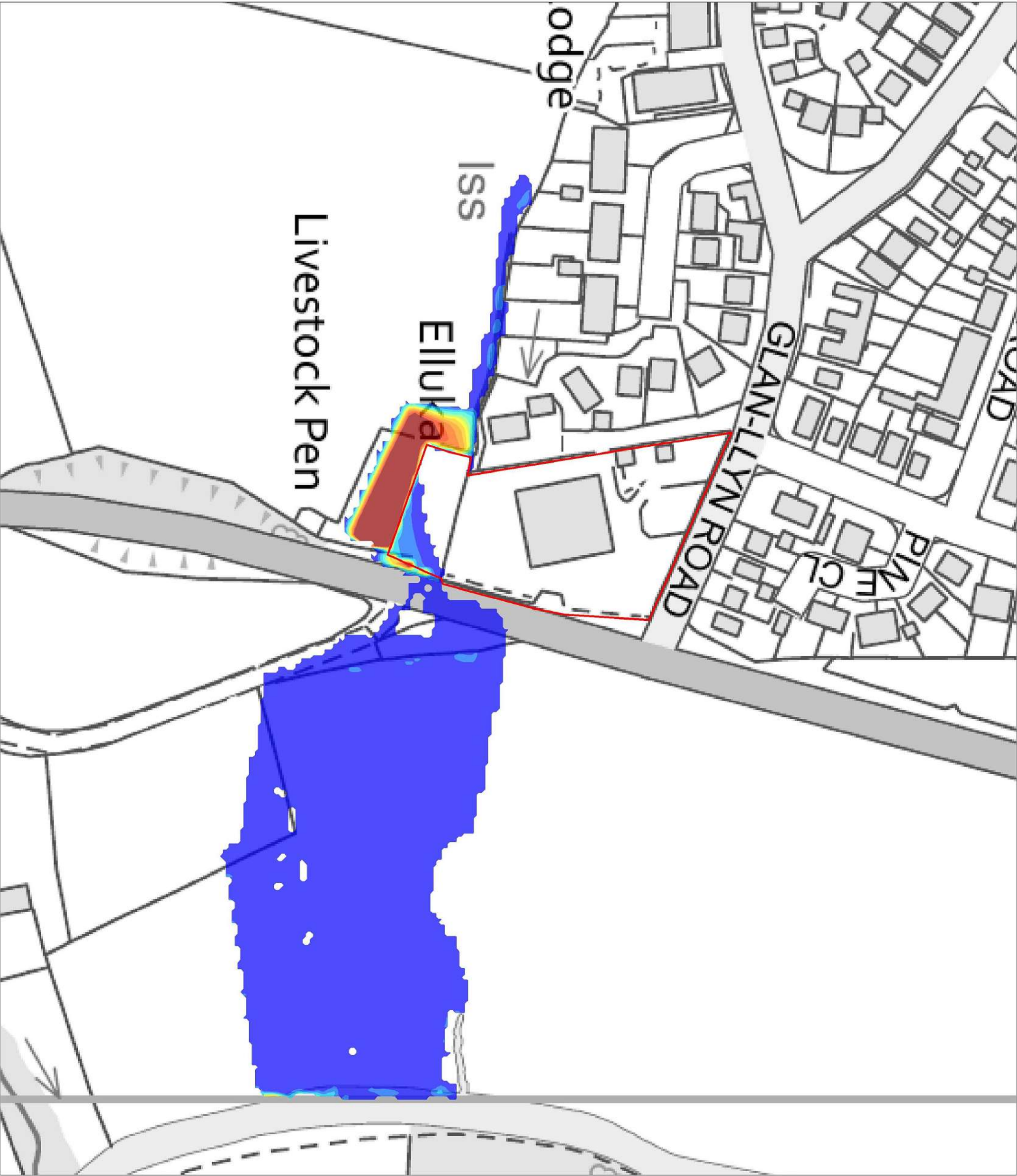
Drawn: DJ

Checked: JA

Date: 26 November 2019

Drawing No: 4411_015_Q1000_Prop_Mit_d

Rev: A



Notes:

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KEY:

Site Location

Depth (metres)

- 0.0 to 0.1
- 0.1 to 0.2
- 0.2 to 0.3
- 0.3 to 0.4
- 0.4 to 0.5
- 0.5 to 0.6
- 0.6 to 0.7
- 0.7 to 0.8
- 0.8 to 0.9
- 0.9 to 1.0
- > 1.0

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Client:

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Project Title:

Toyota Wrexham

Drawing Title:

Proposed Scenario-Blocakage 1000%
1:100+CC (20%) AEP

Map Orientation:



Drawn:

DJ

Checked:

JA

Date:

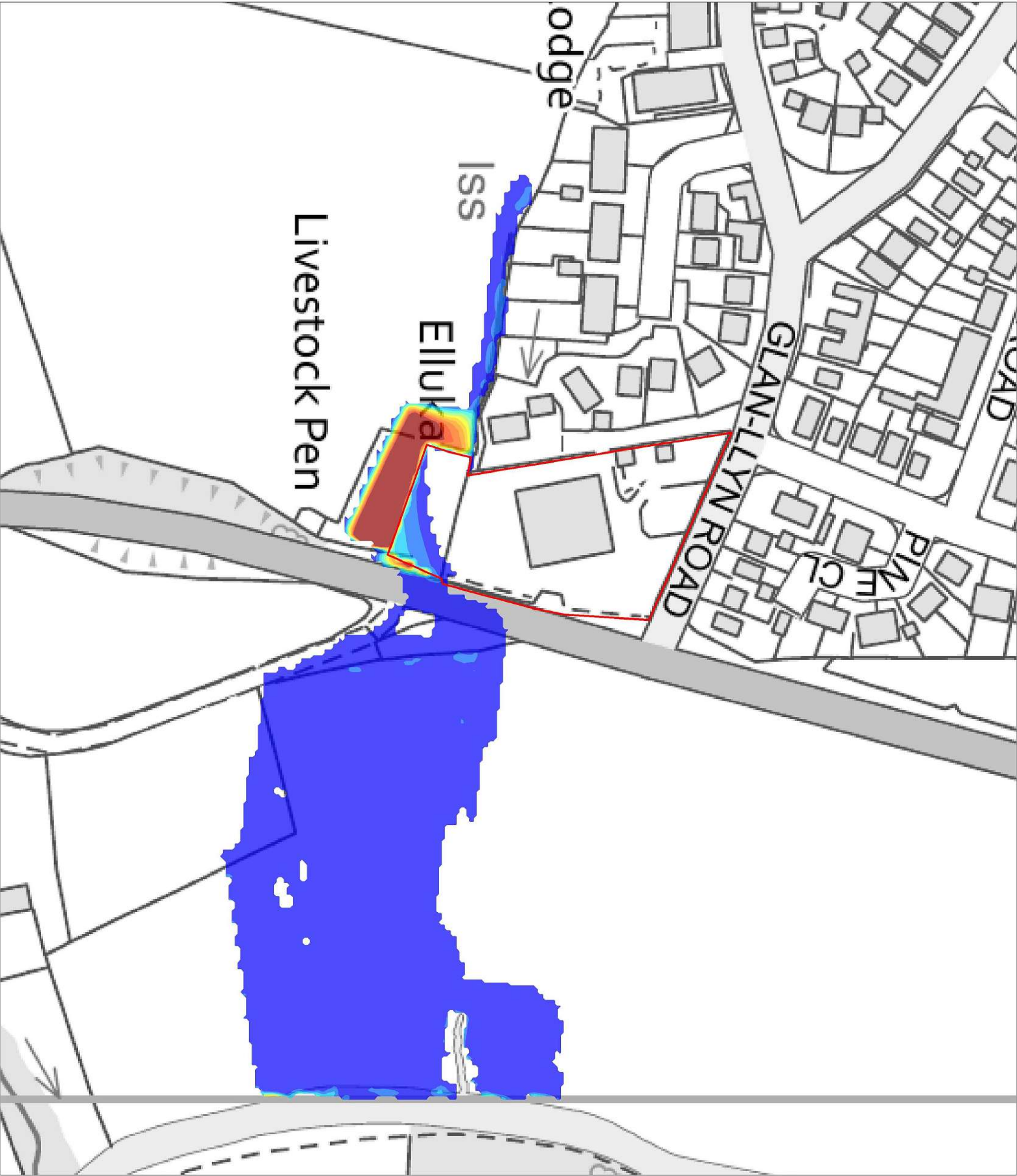
26 November 2019

Drawing No:

4411_016_Q100cc20_
Prop_Mit_BLK100_d

Rev:

A



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KEY:

— Site Location

Depth (metres)

0.0 to 0.1
0.1 to 0.2
0.2 to 0.3
0.3 to 0.4
0.4 to 0.5
0.5 to 0.6
0.6 to 0.7
0.7 to 0.8
0.8 to 0.9
0.9 to 1.0
> 1.0

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Project Title:
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Drawing Title:
**Proposed Scenario-Blocakage 1000%
1:1,000 AEP**

Map Orientation:

Scale: 0 15 30 metres

Drawn: DJ
Checked: JA
Date: 26 November 2019

Drawing No: 4411_016_Q1000_
Prop_Mit_BLK100_d
Rev: A

APPENDIX E:

Model Output Plots – Flood Risk Elsewhere

Notes:

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KEY:

Site Location

Change in flood depths

Decrease

No change (± 5 mm)

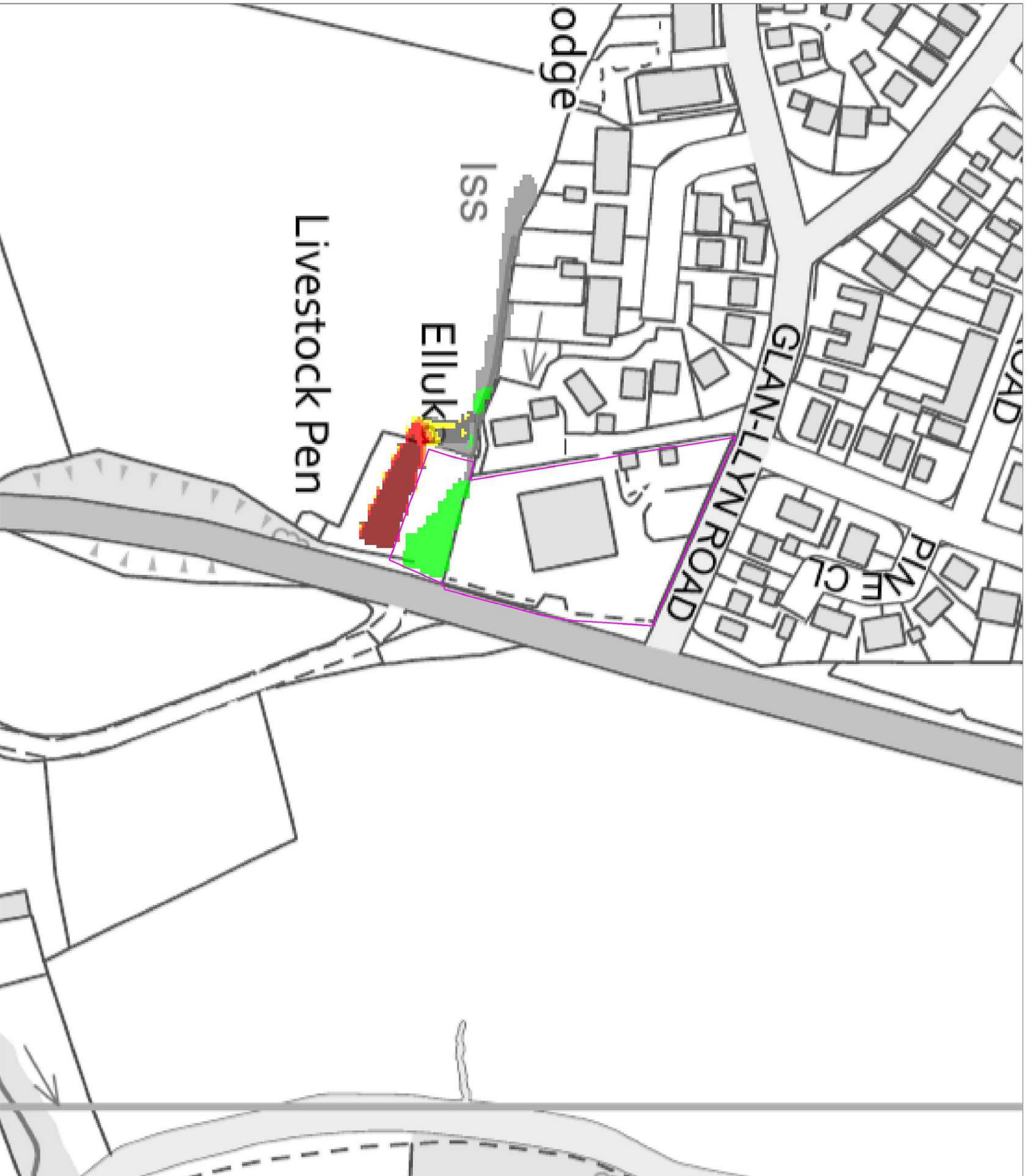
Increase (5 to 30 mm)


 Increase (30 to 75 mm)

Increase (75 to 150 mm)

Increase (150 to 300 mm)

Increase (>300 mm)



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Email: info@weetwood.net

Client:

Steve Hopewell Holdings Ltd

Project Title:

Toyota Wrexham

Drawing Title:

Flood Risk Elsewhere:

1:100+CC(20%) AEP

Map Orientation:



Drawn:

Checked:	Date:
----------	-------

ד

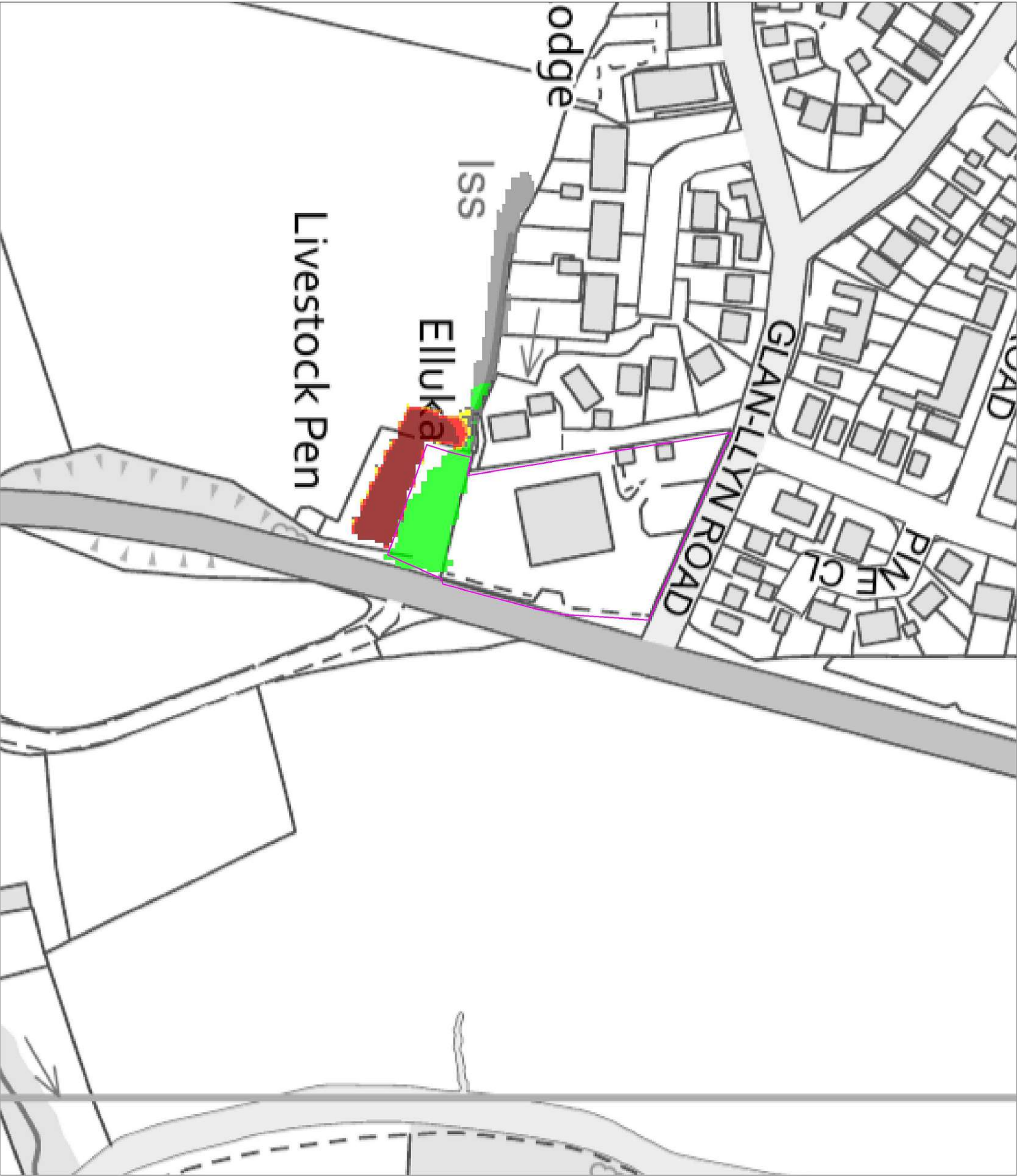
JA 26 November 2019

Drawing No:

4411_015-009_Q100cc20_d

Rev:

A



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KEY:

- Site Location
- Change in flood depths
- Decrease
- No change (+/- 5 mm)
- Increase (5 to 30 mm)
- Increase (30 to 75 mm)
- Increase (75 to 150 mm)
- Increase (150 to 300 mm)
- Increase (>300 mm)

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Tel: 0203 757 5444
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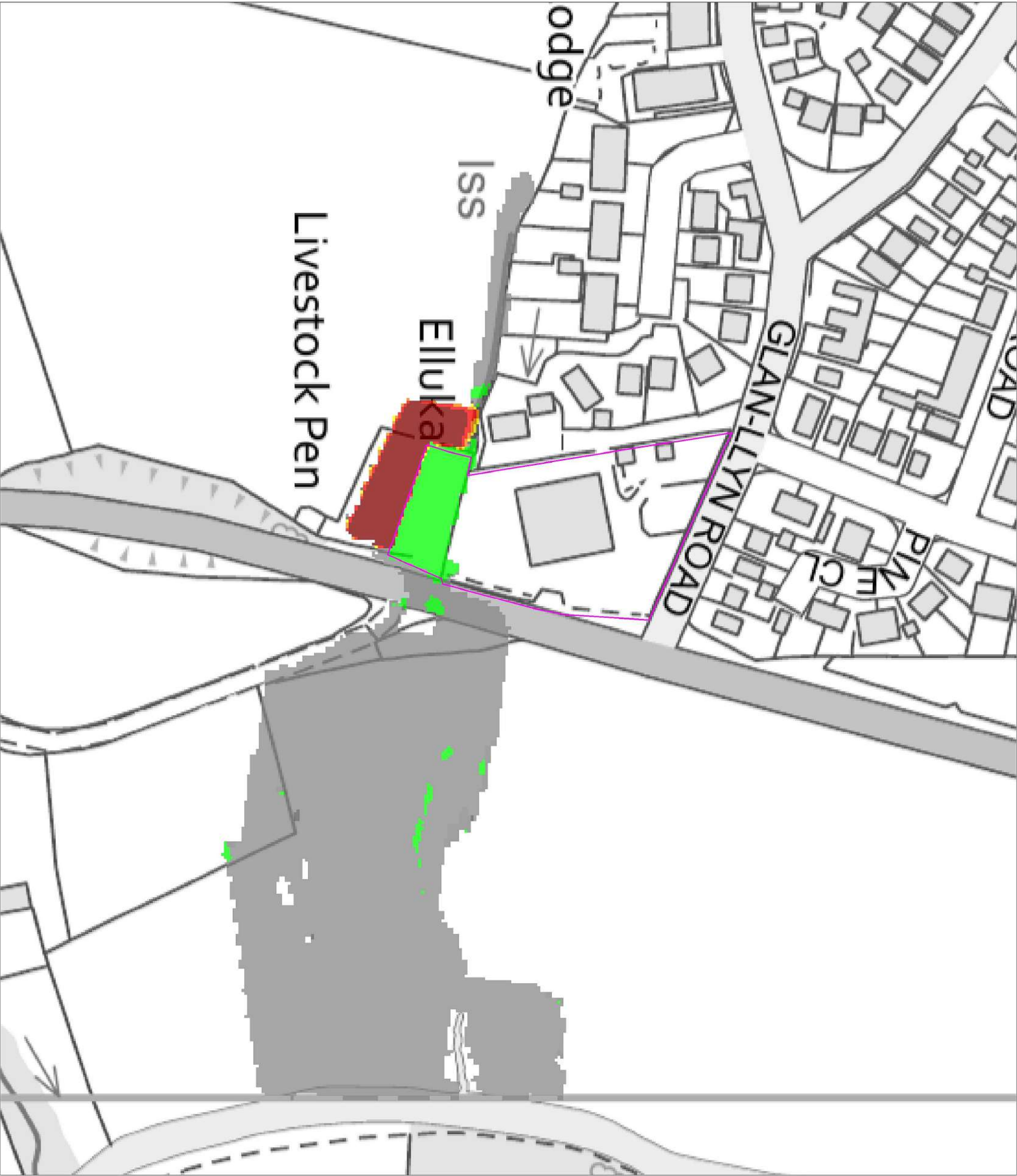
Client:
Steve Hopewell Holdings Ltd

Project Title:
Toyota Wrexham

Drawing Title:
**Flood Risk Elsewhere:
1:1,000 AEP**

Map Orientation: Scale: 0 15 30 metres

Drawn:	Checked:	Date:	Rev:
DJ	JA	26 November 2019	A
Drawing No: 4411_015-009_Q1000_d			



- Notes:
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KEY:

Site Location

Change in flood depths

Decrease

No change (+/- 5 mm)

Increase (5 to 30 mm)

Increase (30 to 75 mm)

Increase (75 to 150 mm)

Increase (150 to 300 mm)

Increase (>300 mm)

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Client:

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Project Title:

Toyota Wrexham

Drawing Title:

Flood Risk Elsewhere:Blockage 100% 1:1,000 AEP

Map Orientation:

Scale: 0 15 30 metres

Drawn: DJ

Checked: JA

Date: 26 November 2019

Drawing No: 4411_016-010_Q1000_BLK100_d

Rev: A

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Water Framework Directive Assessments
Flood Defence Consent Applications
Sequential, Justification and Exception Tests
Utility Assessments
Expert Witness and Planning Appeals
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