Weetwood

Development • Planning • Environment

BRIDGE STREET, WREXHAM

FLOOD CONSEQUENCES ASSESSMENT

Final Report v1.2

August 2018

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Report Title:	**Bridge Street, Wrexham** Flood Consequences Assessment Final Report v1.2
Client:	Lingar Group
Date of Issue:	22 August 2018

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1 INTRODUCTION

1.1 PURPOSE OF REPORT

Weetwood Services Ltd ('Weetwood') has been instructed by Lingar Group to undertake a Flood Consequences Assessment (FCA) in association with the proposed redevelopment of land located off Bridge Street, Wrexham.

A FCA report was produced for the site on 13 August 2018[1]; however, this omitted information relating to the proposed scenario flood risk modelling, which was still in progress at that time. The FCA has subsequently been updated to include this, as detailed in **Section 5.2** and **Section 5.3** of this report, and in turn supersedes the previous version (v1.1).

This FCA has been prepared in accordance with the requirements of Technical Advice Note 15 (TAN15): Development and Flood Risk.

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 and drainage 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

[1] Ref: 4183/FCA/Final/v1.1/2018-08-13

2 PLANNING POLICY AND GUIDANCE

2.1 NATIONAL PLANNING POLICY AND GUIDANCE

2.1.1 Technical Advice Note 15; Development and Flood Risk

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 letter[2] and supporting guidance note[3] 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 consequences to and from the development, taking into account the impacts of climate change'.

[2] Welsh Government consultation letter 23 August, 2016 (Ref: CL-03-16)
[3] https://gov.wales/docs/desh/publications/160831guidance-for-flood-consequence-assessments-climate-change-allowances-en.pdf

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

The Wrexham County Borough Council (WCBC) Unitary Development Plan (UDP) 1996 to 2011 expired at the end of 2015; however, this remains the adopted development plan for the county.

The following policy is relevant in respects of flood risk:

Policy EC12 - Development and Flood Risk

Development (including the raising of land) within the 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 unacceptable risk of flooding on or off-site; and/or
c) Does not adversely affect flood management or maintenance schemes

WCBC is currently preparing a Local Development Plan (LDP) which will replace the current adopted UDP in spring 2019.

2.3 CONSENTS

An Environmental Permit for Flood Risk Activities may be required from 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 by visiting the NRW website[4].

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 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 FCA has been informed by the following documents:

[4] https://naturalresources.wales/apply-for-a-permit/flood-risk-activities/flood-risk-activity-permits-information/?lang=en

- Flood Risk Management Plan (FRMP), WCBC, July 2016
- Local Flood Risk Management Strategy (LFRMS), WCBC, April 2013
- Preliminary Flood Risk Assessment (PFRA), WCBC, November 2017

3 SITE DETAILS AND PROPOSED DEVELOPMENT

3.1 SITE LOCATION

The site is located off Bridge Street, Wrexham, at Ordnance Survey National Grid Reference SJ 333 501 as shown in **Figure 1**. The site is approximately 0.18 hectares (ha) in area.

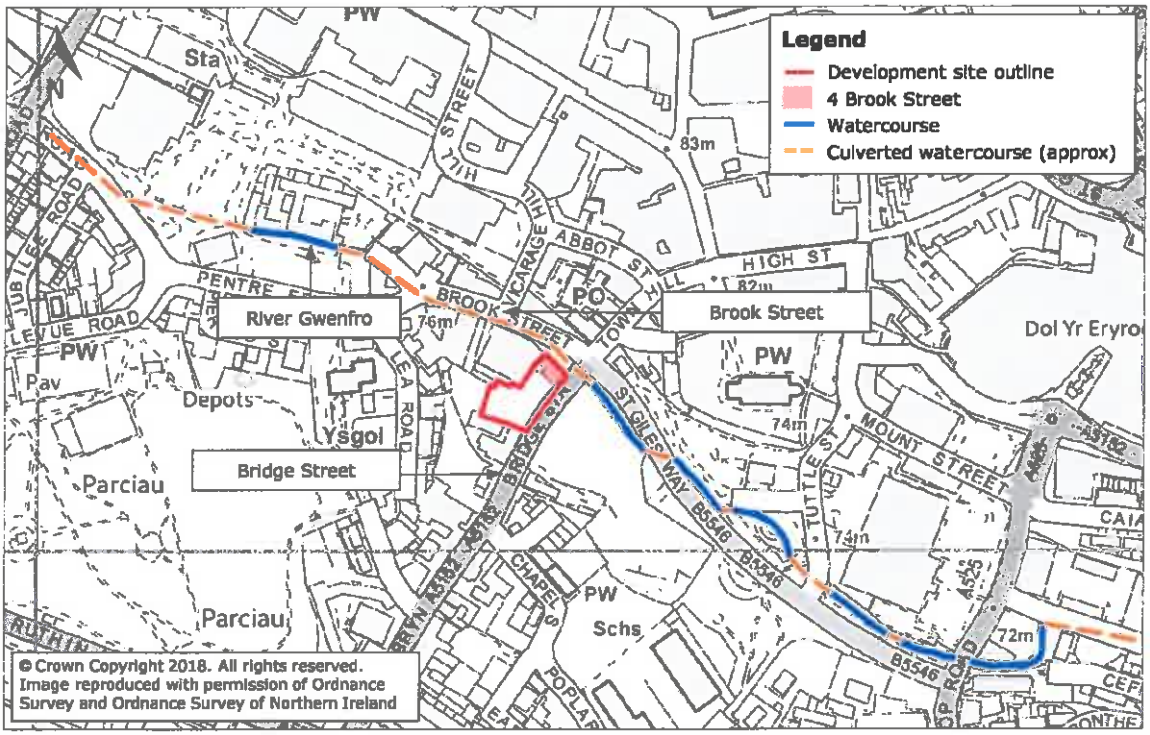


Figure 1: Site Location

3.2 EXISTING AND PROPOSED DEVELOPMENT

The existing site currently comprises an existing building in the north (4 Brook Street), which was previously used a as night club, whilst the southern portion comprises derelict land that was previously subject to a Compulsory Purchase Order by WCBC as this forms part of its regeneration scheme.

Proposals are for the change of use and conversion of the first and second floor of 4 Brook Street into 10 residential apartments, with the existing commercial/retail use retained on the ground floor (it should be noted that the latter does not subsequently form part of the planning application). In addition, it is proposed to construct a new residential block in the southern portion of the site comprising 32 apartments with associated hardstanding and landscaping.

A proposed site layout is provided in **Appendix A.**

TAN15 classifies commercial/retail development as 'less vulnerable' land use and residential development as 'highly vulnerable'[5].

The previous use of the existing building in the north of the site (4 Brook Street) as a night club may be classified as 'highly vulnerable' development, which includes public buildings. As such the conversion of this building to residential use at and above the first floor should not increase the vulnerability classification.

3.3 WATERBODIES IN THE VICINITY OF THE SITE

The River Gwenfro flows in culvert within Brook Street to the north of the site in a predominately south-easterly direction. Throughout the existing built up area of Wrexham the watercourse flows in both open channel and culvert.

The River Gwenfro is classified as a 'main river'.

3.4 GROUND CONDITIONS

According to the Soilscapes maps produced by the National Soils Research Institute[6], soil conditions at the site and within the surrounding area are described as 'freely draining loamy soils'.

British Geological Survey (BGS) borehole records[7] located approximately 20.0 m south and 60.0 m south-east of the site show ground conditions to consist of sandy soils, with groundwater encountered at 0.91 m below ground level (bgl).

BGS Surface Geology mapping[8] indicates the underlying bedrock formation comprises 'Salop Formation – Mudstone, Sandstone and Conglomerate'. This is overlain by 'Glaciofluvial Sheet Deposits, Devensian – Sand and Gravel', with 'Alluvium – Clay, Silt, Sand and Gravel' in the vicinity of the River Gwenfro.

3.5 SITE LEVELS

A topographic survey of the southern portion of the site was undertaken by WCBC in August 2015, with a topographic survey of 4 Brook Street in the north undertaken by Cheshire Surveys Ltd in September 2010. Both surveys are provided in **Appendix B**.

These indicate that site levels in the south of the site are in the region of 76.07 – 77.55 metres Above Ordnance Datum (m AOD) with levels in the north in the region of 75.23 – 75.99 m AOD. The ground floor finished floor level of the existing 4 Brook Street building is shown to be 76.02 m AOD.

3.6 ACCESS AND EGRESS

Vehicular/pedestrian access and egress to the site will be provided via Brook Street to the north and Bridge Street to the east (**Appendix A**).

[5] TAN15, Figure 2
[6] Soilscapes www.landis.org.uk/soilscapes/
[7] www.bgs.ac.uk/data/boreholescans/home.html, Ref: SJ35SW26, SJ35SW25
[8] http://mapapps.bgs.ac.uk/geologyofbritain/home.html

Levels on Brook Street are shown to be in the region of 74.80 – 75.76 m AOD adjacent to the site, whilst levels on Bridge Street are in the region of 76.30 – 75.90 m AOD, rising to the south.

4 REVIEW OF FLOOD RISK

4.1 FLOOD ZONE DESIGNATION

Flood Zones refer to the probability of river and sea flooding, ignoring the presence of defences. TAN15 defines flood zones as follows[9]:

- **Zone A.** Considered to be at little or no risk of fluvial or tidal/coastal flooding.
- **Zone B.** Areas know to have been flooded in the past evidenced by sedimentary deposits.
- **Zone C.** Based on the Natural Resources Wales extreme 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 currently shown on the NRW Flood Risk Map and do not take account of the possible impacts of climate change and consequent changes in the future probability of flooding.

4.1.1 Development Advice Map

The Development Advice Map (**Figure 2**) indicates that the northern portion of the site (i.e. 4 Brook Street) is located in Zone C2 whilst the southern portion is located in Zone B and Zone A.

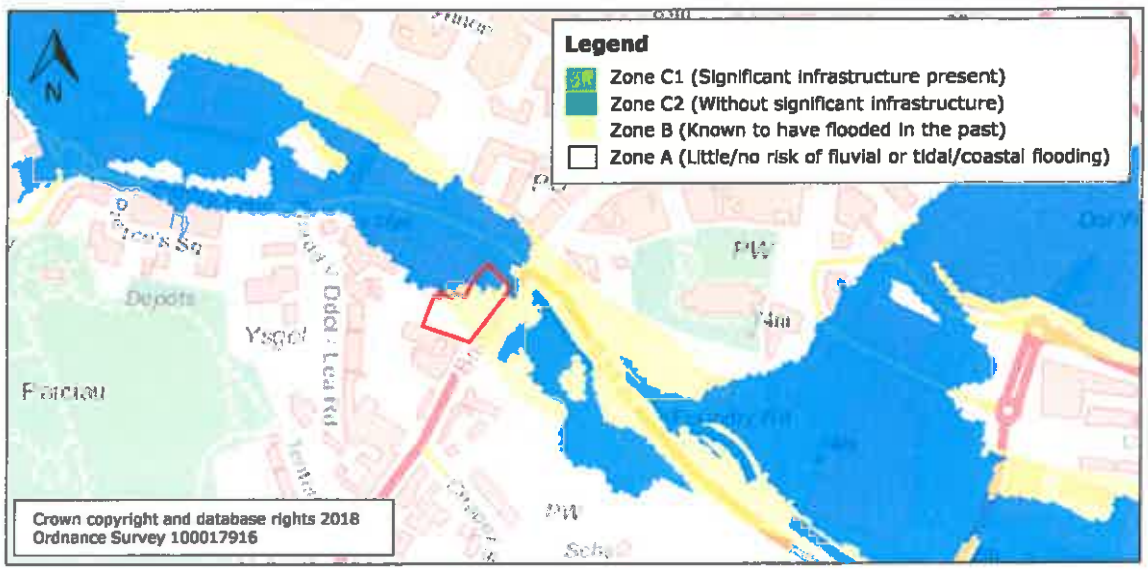


Figure 2: Development Advice Map
(Source: NRW website)

4.1.2 Natural Resources Wales Flood Risk Map

The NRW Flood Risk Map indicates that the northern portion of the site is located in the 1 in 1,000 annual probability flood outline, whilst the southern portion is located outside this flood outline.

[9] TAN15, Figure 1

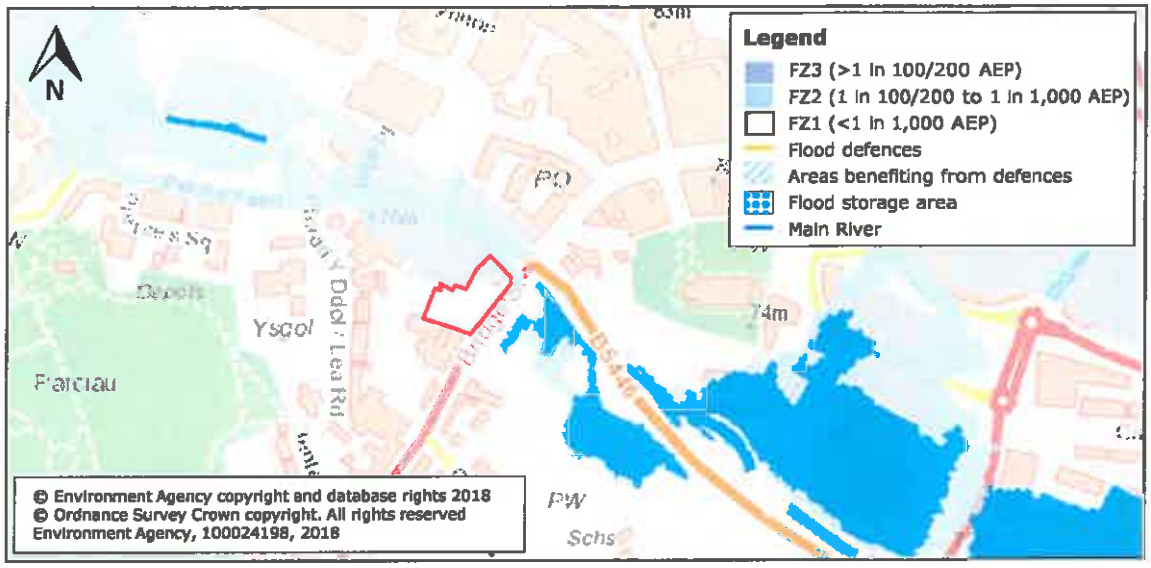


Figure 3: Natural Resources Wales Flood Risk Map
(Source: NRW website)

4.2 JUSTIFICATION TEST

The vast majority of the site (including the area for the proposed new residential apartment block) lies outside Zone C and as such there is no requirement for the Justification Test to be applied.

The land in the north, which is located in Zone C is currently developed. As detailed in **Section 3.2** the proposed conversion of the existing building (4 Brook Street) within this area would not be expected to increase the vulnerability classification. Furthermore, the development of the site is considered to contribute to part of the local authority's regeneration scheme and meets the definition of 'previously developed land'. Part i and iii of the Justification Test are therefore considered to have been addressed.

This report addresses part iv of the Justification Test.

4.3 HISTORICAL RECORDS OF FLOODING

According to NRW historic flood outlines[10], there are no records of the site previously being affected by flooding.

4.4 FLUVIAL FLOOD RISK – RIVER GWENFRO

As outlined in **Section 3.3** the River Gwenfro is located to the north of the site.

The River Gwenfro Model Update was completed by JBA Consulting on behalf of WCBC in December 2016[11]. This included refinements to the previous flood risk mapping study undertaken by JBA Consulting on behalf of Environment Agency Wales (now NRW) in 2008, which included the development of a 1D-2D ISIS-TUFLOW hydraulic model of the River Gwenfro.

[10] http://lle.gov.wales/catalogue/item/HistoricFl/?lang=en
[11] River Gwenfro Model Update, Final Report, JBA Consulting/WCBC, December 2016

The primary purpose of the study was to obtain an up-to-date assessment of the flood risk (extents, depths, velocity and hazard), which could be used to inform future development in Wrexham Town Centre.

The 2016 River Gwenfro Model Update report and accompanying hydraulic model have been obtained from WCBC for the purposes of this assessment.

4.4.1 Flood Defences

The River Gwenfro Model Update indicates that there are no formal flood defences along the watercourse within the vicinity of the site; however, several areas in the vicinity of the site are shown to benefit from 'informal' defences, comprising raised walls, which are included within the hydraulic model. Figure 1-5 of the River Gwenfro Model Update report shows the locations of the informal defences.

4.4.2 Modelled Flood Levels and Extents - Baseline

The site topographic survey has been incorporated within the WCBC River Gwenfro 1D-2D ISIS-TUFLOW hydraulic model in order to more accurately represent ground levels; however, no further amendments or refinements have been made to this.

The following events have subsequently been modelled in order to establish the baseline scenario:

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

Model output plots are provided in **Appendix C**.

These indicate that no flooding of the site would be expected in up to a 1 in 100 +CC (45%) annual probability event. Whilst some flooding of the site may be expected during a 1 in 1,000 annual probability event this is confined to the northern portion of the site.

Table 1 summarises the flood level, depth and velocity expected on site during the aforementioned events.

Table 1: Flood Information – Baseline

Annual Probability Event	Max Level (m AOD)	Depth (m)		Velocity (m/s)	
		Max	Mean	Max	Mean
1 in 100	-	-	-	-	-
1 in 100 +CC (20%)	-	-	-	-	-
1 in 100 +CC (45%)	-	-	-	-	-
1 in 1,000	75.95	0.69	0.27	0.03	0.00

Based upon the maximum flood level provided within **Table 1**, and with an existing surveyed finished floor level of 76.02 m AOD it may be reasonable to assume that no flooding of the existing building in the north of the site (4 Brook Street) would be expected in a 1 in 1,000 annual probability event. As such, the existing building is not considered to be located in Zone C, contrary to the Development Advice Map.

4.4.3 Structure Blockage

A 30%, 67% and 100% blockage of both the Island Green and St Giles Way culverts have also been modelled as a sensitivity assessment for the 1 in 100 +CC (20%), 1 in 100 +CC (45%) and 1 in 1,000 annual probability events.

The model outputs indicate that the site is more sensitive to a blockage of the Island Green culvert which has therefore been considered further below.

Model output plots for the Island Green culvert blockage scenario are provided in **Appendix D**. **Table 2** summarises the maximum flood level, depth and velocity expected on site during the respective blockage scenarios for the Island Green culvert.

The results indicate that the southern portion of the site would be expected to remain dry in up to a 1 in 1,000 annual probability 100% culvert blockage scenario. This accounts for approximately 60% of the site area.

Within the northern portion of the site, flood levels are shown to range between 76.23 and 76.49 m AOD depending on the event, equating to maximum flood depths typically between 0.44 and 0.53 m; however, in some lower parts of the site flood depths could reach 1.21 m in the 1 in 1,000 annual probability 100% culvert blockage scenario. The extents of flooding within the site are not shown to significantly vary for all modelled blockage events.

Given the ground floor finished floor level of 76.02 m AOD within the existing building (4 Brook Street), maximum internal flood depths may be between 0.21 and 0.47 m depending on the event in **Table 2**.

Table 2: Maximum Flood Information – Culvert Blockage (Island Green)

Annual Probability Event	Max Level (m AOD)	Depth (m)		Velocity (m/s)	
		Highest	Mean	Highest	Mean
1 in 100 +CC (20%)					
30% blockage	76.23	0.97	0.44	0.20	0.04
67% blockage	76.38	1.11	0.47	0.44	0.11
100% blockage	76.43	1.16	0.51	0.51	0.13
1 in 100 +CC (45%)					
30% blockage	76.30	1.04	0.44	0.36	0.07
67% blockage	76.43	1.16	0.51	0.51	0.13
100% blockage	76.47	1.20	0.52	0.57	0.15
1 in 1,000					
30% blockage	76.34	1.07	0.46	0.37	0.08
67% blockage	76.45	1.18	0.52	0.55	0.14
100% blockage	76.49	1.21	0.53	0.59	0.16

The flood risk to the site from this source will be mitigated though the implementation of the measures proposed in **Section 5** of this report.

4.5 FLOOD RISK FROM RESERVOIRS, CANALS AND OTHER ARTIFICIAL SOURCES

There are no canals located within the immediate vicinity of the site. The NRW Risk of Flooding from Reservoirs map indicates that the site is not at risk of flooding from such sources. The site is therefore not considered to be at risk of flooding from reservoirs, canals or other artificial sources.

4.6 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 soils. There may therefore be the propensity for some groundwater flooding. However, ground levels are shown to fall to the north towards Brook Street and in turn the River Gwenfro. As such any groundwater emerging at the site would be expected to runoff the site before building to any significant depth.

According to the BGS Groundwater Flooding Hazard map (**Figure 4**) the susceptibility to groundwater flooding is moderate to significant.

The risk of flooding from this source will be mitigated through the implementation of the measures proposed in **Section 5** of this report.

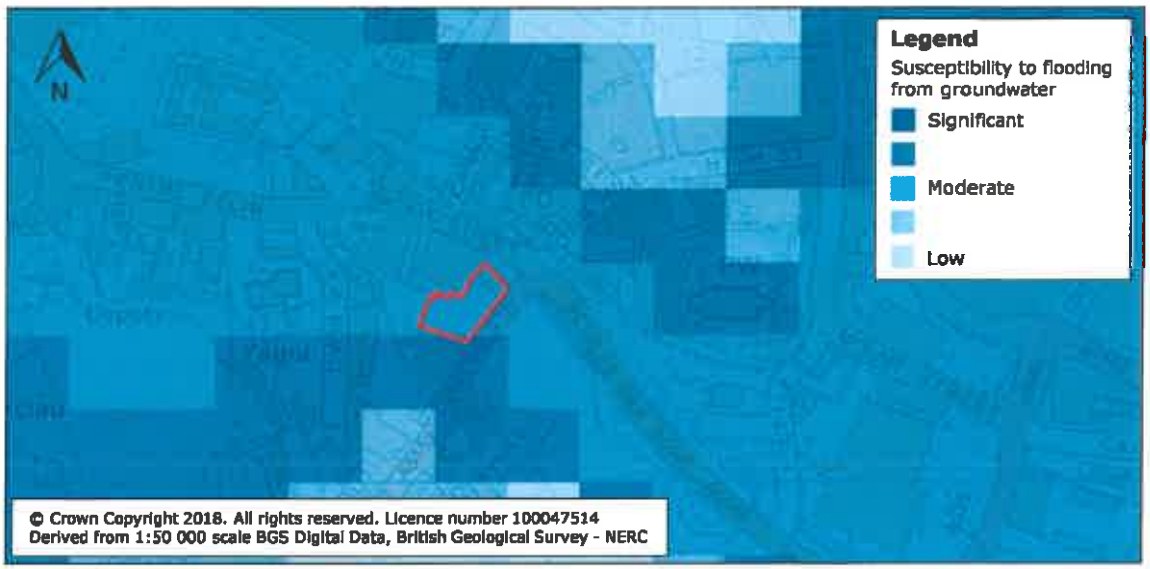


Figure 4: Groundwater Flooding Hazard Map
(Source: Findmaps)

4.7 FLOOD RISK FROM SURFACE WATER

As detailed in **Section 3.4** ground conditions at the site and within the surrounding area are described as freely draining soils. The propensity for surface water flooding may therefore be considered low. Furthermore, ground levels are shown to fall to the north towards Brook Street and in turn the River Gwenfro. As such surface water would not be expected to accumulate to any significant depth at the site itself.

The NRW Risk of Flooding from Surface Water map (**Figure 5**) indicates the majority of the site is at 'very low' risk, with a small area in the north at 'low' risk[12]; however, NRW

[12] Very Low Risk - Chance of flooding of less than 1 in 1000 in each year

data indicates that the flood depths and velocities for the low risk event would less than 0.15 m and 0.25 m/s respectively.

Any residual flood risk from this source **will** be addressed through the mitigation measures as detailed in **Section 5.**

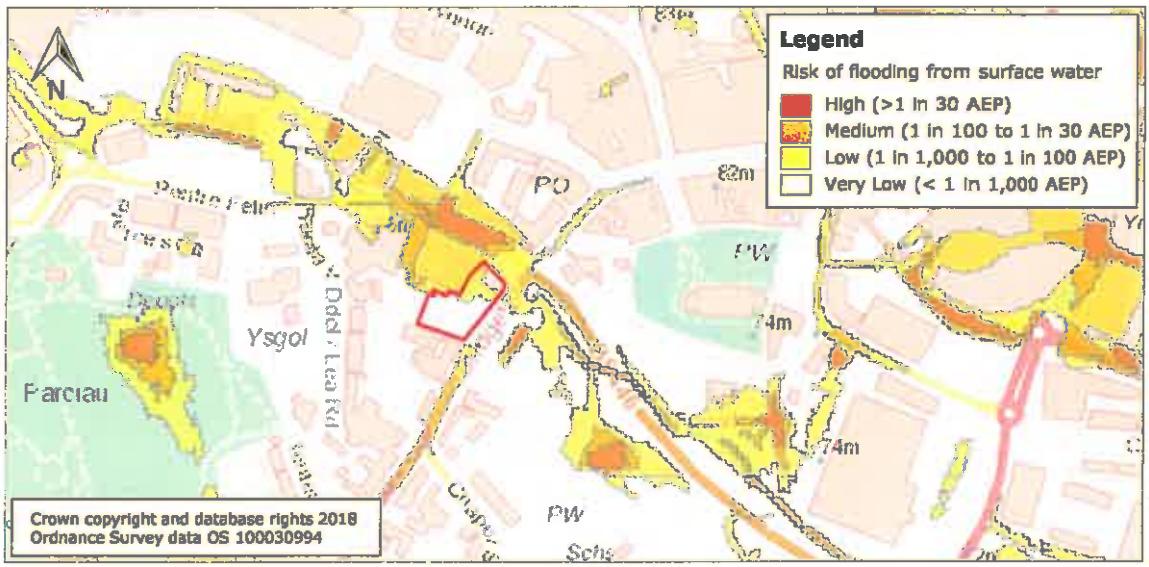


Figure 5: Natural Resources Wales Risk of Flooding from Surface Water
(Source: NRW website)

Low Risk - Chance of flooding of between 1 in 1000 and 1 in 100 in each year
Medium Risk - Chance of flooding of between 1 in 100 and 1 in 30 in each year
High Risk - Chance of flooding is greater than 1 in 30 in each year

5 FLOOD RISK MITIGATION MEASURES

The flood risk to the site from the River Gwenfro and any residual risk of flooding from groundwater and surface will be mitigated though the implementation of the measures proposed within the following section of this report.

5.1 FLOOD MITIGATION

5.1.1 Finished Floor Levels

As detailed in **Section 3.2** the proposals comprise the change of use and conversion of the first and second floor of 4 Brook Street into 10 residential apartments. This will ensure that all 'highly vulnerable' development is located well above the anticipated flood levels expected on site from the River Gwenfro (as indicated in **Table 1** and **Table 2**).

The finished floor level of any new building should be set at a minimum of 76.73 m AOD. This provides a freeboard of 300 mm above the flood level expected at the site during the 1 in 100 +CC (20%) annual probability 100% blockage (Island Green culvert) scenario.

The freeboard allowance is considered appropriate given that this will afford a finished floor level that is also above the 1 in 100 +CC (45%) and 1 in 1,000 annual probability 100% blockage events.

Finished floor levels for new buildings should also be set at a minimum of 0.15 m above adjacent ground levels following reprofiling of the site. This will enable any potential overland flows to be conveyed safely across the site without affecting property in accordance with the approach promoted by government policy[13].

5.1.2 Car Parking

The proposed new car parking area is shown to be located outside of the 1 in 1,000 annual probability flood outline and would therefore be expected to remain dry during 'free-flowing' flood events.

During a 100% Island Green Culvert blockage scenario the proposed new car parking area is also expected to remain dry based on the baseline model outputs; however, car park levels will be profiled in order to provide a consistent gradient across the area, tying in with the access off Bridge Street. This may afford some shallow flooding of the northern extent of the car park with maximum flood depths expected to be less than 300 mm during a 1 in 1,000 annual probability 100% blockage (Island Green culvert) scenario (refer to **Section 5.2**). It has been assumed that the minimum ground levels within the car parking area will be set to at least 76.20 m AOD.

5.2 PROPOSED SCENARIO FLOOD RISK MODELLING

The proposed flood risk mitigation strategy as outlined in **Section 5.1** has been incorporated within the refined Weetwood hydraulic model of the River Gwenfro. The hydraulic model has subsequently been run for the 1 in 100 +CC (20%), 1 in 100 +CC

[13] Making Space for Water, Taking forward a new Government strategy for flood and coastal erosion risk management in England, March 2005, Dept for Environment, Food and Rural Affairs

(45%) and 1 in 1,000 annual probability 100% blockage (Island Green culvert) scenarios. It is not considered to be necessary to include 'free-flowing' proposed scenario model outputs given that all new built development will be located outside of the associated flood extents in up to a 1 in 1,000 annual probability event.

Model output plots for the proposed scenario are provided in **Appendix E.**

These indicate that a peak flood level of 76.48 m AOD would be expected within the existing building (4 Brook Street) in the north of the site in a 1 in 1,000 annual probability 100% blockage (Island Green culvert) event. With a ground floor finished floor level of 76.02 m AOD, a maximum internal flood depth of 0.46 m may subsequently be expected; however, all proposed 'highly vulnerable' development will be located at or above the first floor and as such will be significantly raised above the anticipated flood level.

The new proposed building and the majority of the car parking area in the south of the site are shown to remain dry in up to the 1 in 1,000 annual probability 100% blockage (Island Green culvert) event. However, some shallow flooding may be expected in a small area at the northern extent of the car park with maximum flood depths of 0.28 m (but would typically be less).

5.3 FLOOD RISK ELSEWHERE

Any proposal to modify ground levels should to 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 in 1,000 annual probability event. It is understood that NRW also seek to ensure that blockage scenarios are considered in quantifying flood risk elsewhere.

No inundation of the area of the site to comprise new development is expected in up to the 1 in 1,000 annual probability 'free flowing' event. As such the proposed development would not be expected to increase flood risk elsewhere during this scenario.

Model output plots comparing the baseline and proposed outputs for the 1 in 100 +CC (20%) and 1 in 1,000 annual probability 100% blockage (Island Green culvert) scenarios are provided in **Appendix F.**

This indicates that no significant impact on flood risk elsewhere would be expected as a result of the proposals. Whilst some localised increases in flood risk may be expected to the north-west these are typically in the region of 6 mm during the aforementioned events. This is only slightly greater than the modelling tolerance of +/- 5 mm, which is considered acceptable to NRW.

Furthermore, flood depths within the areas that are shown to be impacted are in the region of 1.09 and 1.14 during the baseline 1 in 100 +CC (20%) and 1 in 1,000 annual probability 100% blockage (Island Green culvert) scenarios respectively. As such an increase of 6 mm is considered to be negligible.

5.4 ACCESS AND EGRESS

The baseline modelled outputs (**Appendix C**) indicate that dry access and egress to the site can be provided via both Brook Street and Bridge Street in up to a 1 in 100 +CC (45%) annual probability event.

In a 1 in 1,000 annual probability event dry access and egress continues to be provided to the site via Bridge Street. Furthermore, the existing external staircase (fire escape) from the first and second floor of 4 Brook Street is to be retained as part of the proposals. This should allow safe access and egress from the building to the southern portion of the site which is shown to be flood free during a 1 in 1,000 annual probability event.

In the event of a blockage of the Island Green culvert dry access and egress to the site is also provided via Bridge Street leading to the south (**Appendix E**). There may be some shallow flooding within a small section of the car parking area in the north with maximum flood depths of 0.27 m (but would typically be less); however, this is shown to remain dry in the south.

6 SUMMARY

This FCA has been prepared on behalf of Lingar Group and relates to the proposed redevelopment of land located off Bridge Street, Wrexham.

According to the NRW Flood Risk Map the northern area of the site is located within the 1 in 1,000 annual probability flood outline. The northern area of the site is subsequently shown to be located within Zone C2, whilst the southern area is classified as Zone B and Zone A.

There is no requirement for the Justification Test to be applied for the area of the site that lies outside Zone C (including the area for the proposed new residential apartment block). The land in the north, which is located in Zone C is currently developed. The proposed conversion of the first and second floor of the existing building (4 Brook Street) within this area would not be expected to increase the vulnerability classification. Furthermore, the development of the site is considered to contribute to part of the local authority's regeneration scheme and meets the definition of 'previously developed land'. Part i and iii of the Justification Test are therefore considered to have been addressed.

The WCBC River Gwenfro 1D-2D ISIS-TUFLOW hydraulic model has been obtained and run for the purposes of this assessment, incorporating the site topographic survey. The model outputs indicate that no flooding of the site would be expected in up to a 1 in 100 +CC (45%) annual probability event. Whilst some flooding of the site may be expected during a 1 in 1,000 annual probability event this is confined to the northern portion of the site.

A 30%, 67% and 100% blockage of the Island Green and St Giles Way culvert has also been modelled as a sensitivity assessment for the 1 in 100 +CC (20%), 1 in 100 +CC (45%) and 1 in 1,000 annual probability events. The model outputs indicate that the site is more sensitive to a blockage of the Island Green culvert. Approximately 60% of the site (within the southern portion of the site) is shown to remain dry in up to a 1 in 1,000 annual probability 100% (Island Green culvert) blockage scenario. Within the northern portion of the site, flood levels are shown to range between 76.23 and 76.49 m AOD depending on the event, equating to maximum flood depths typically between 0.44 and 0.53 m; however, in some lower parts of the site flood depths could reach 1.21 m.

The site is not at risk of flooding from reservoirs, canals or other artificial sources. There may be some susceptibility to groundwater and surface water flooding at the site.

The proposed flood risk mitigation strategy for the site is detailed in **Section 5.1**.

The proposals have been incorporated within the refined Weetwood hydraulic model of the River Gwenfro, which in turn has been run for the 1 in 100 +CC (20%), 1 in 100 +CC (45%) and 1 in 1,000 annual probability 100% blockage (Island Green culvert) scenarios. The model outputs indicate that all proposed 'highly vulnerable' development would remain dry during the modelled events.

The proposals are expected to have a negligible impact on food risk elsewhere.

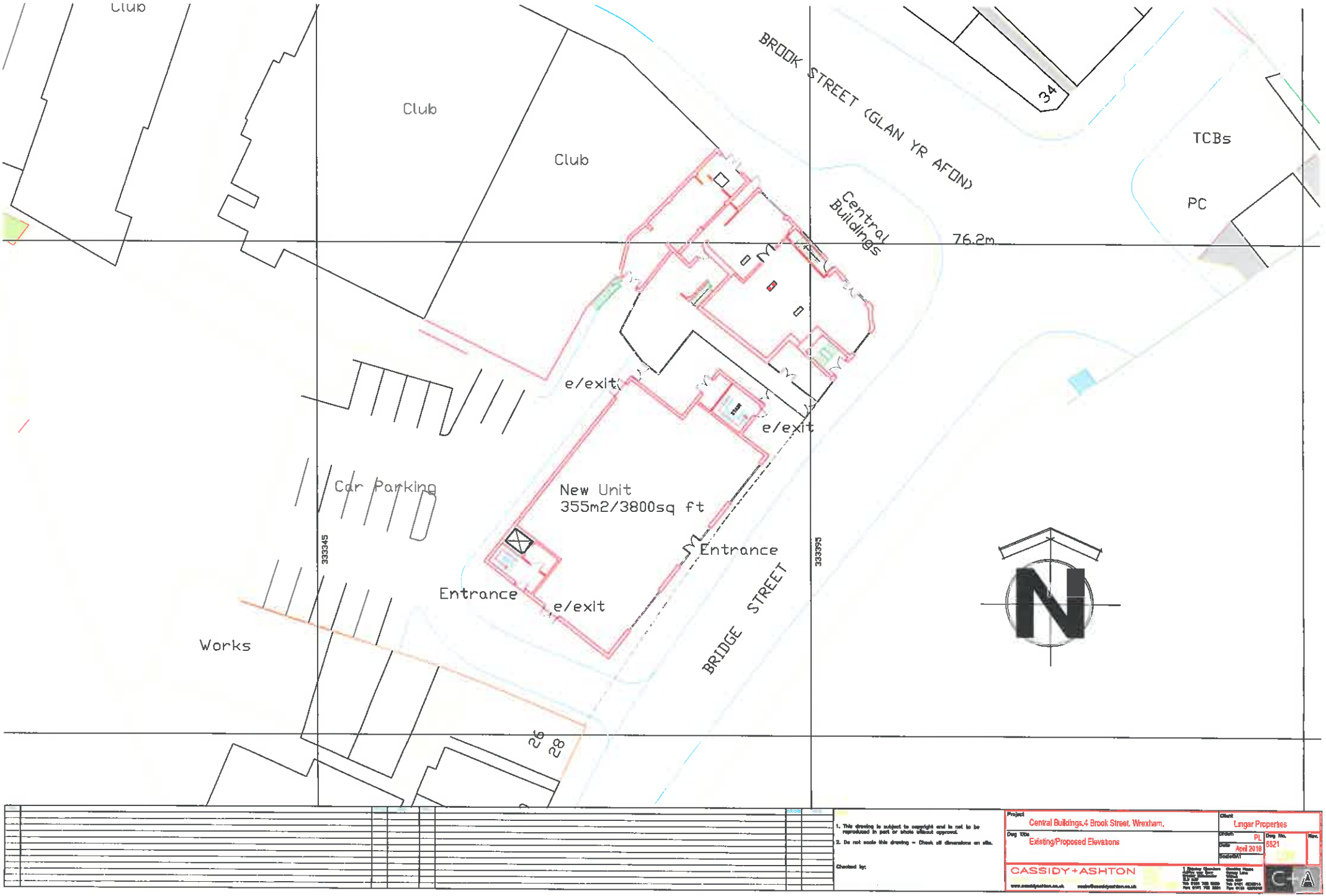
Dry access and egress to the site can be provided via both Brook Street and Bridge Street in up to a 1 in 100 +CC (45%) annual probability event, and via Bridge Street in a 1 in 1,000 annual probability event and Island Green culvert blockage scenario.

7 RECOMMENDATIONS

This FCA has demonstrated that the proposed development may be completed without conflicting with the requirements of TAN15 subject to the following:

- All 'highly vulnerable' development within the existing building (4 Brook Street) to be provided at or above the first floor
- Finished floor level of the new apartment block to be set at a minimum of 76.73 m AOD
- Finished floor levels to be set 0.15 m above adjacent ground levels
- Minimum ground levels within the car parking area will be set to at least 76.2 m AOD

APPENDIX A:	Development Proposals



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2. Do not scale this drawing – Check all dimensions on site.

Checked by:

Project: Central Buildings,4 Brook Street, Wrexham.

Client: Lingar Properties

Dwg Title: Existing/Proposed Elevations

Drawn: PL

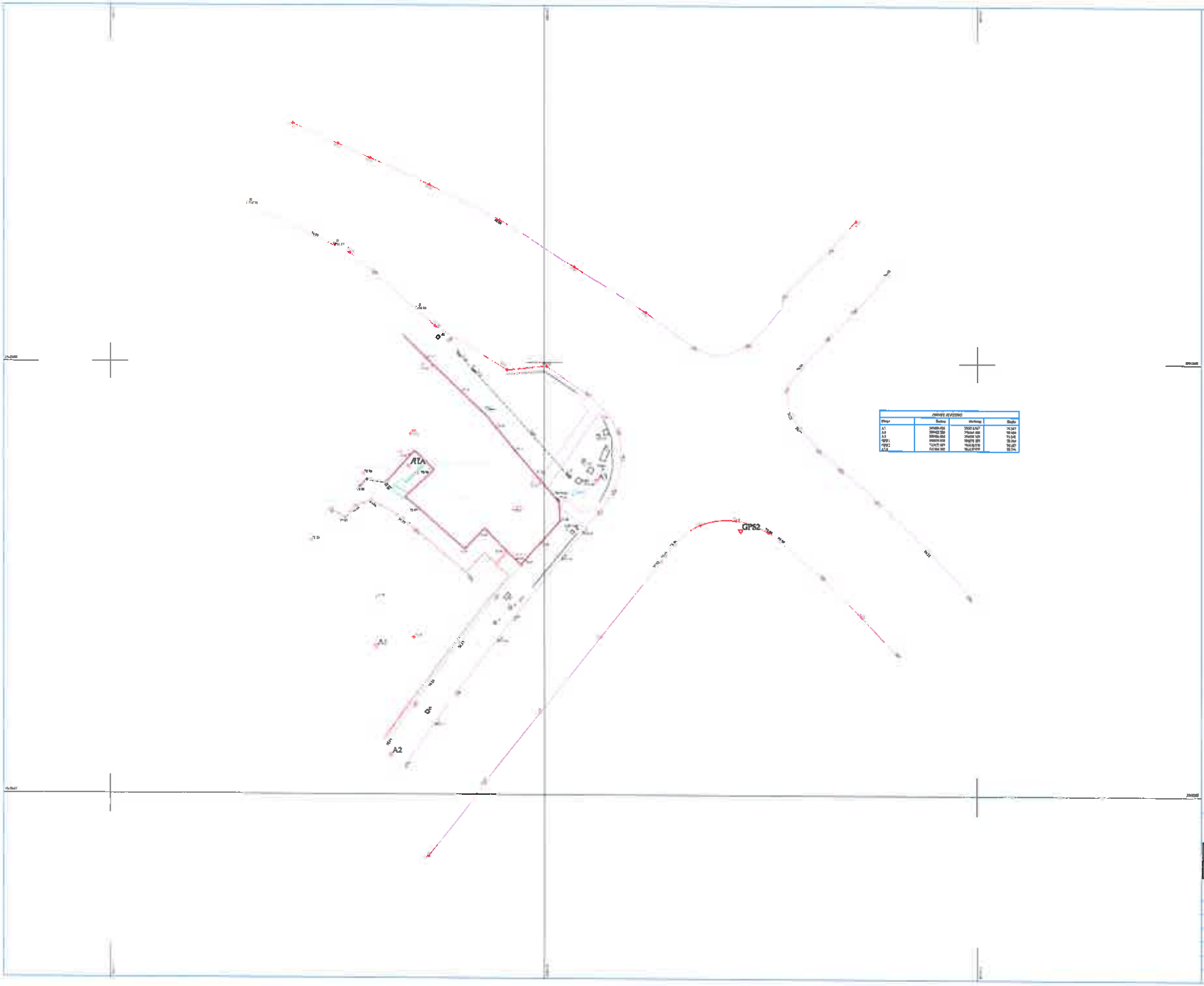
Date: April 2018

Dwg No.: 6521

Rev.:

CASSIDY+ASHTON

APPENDIX B:	Topographic Survey



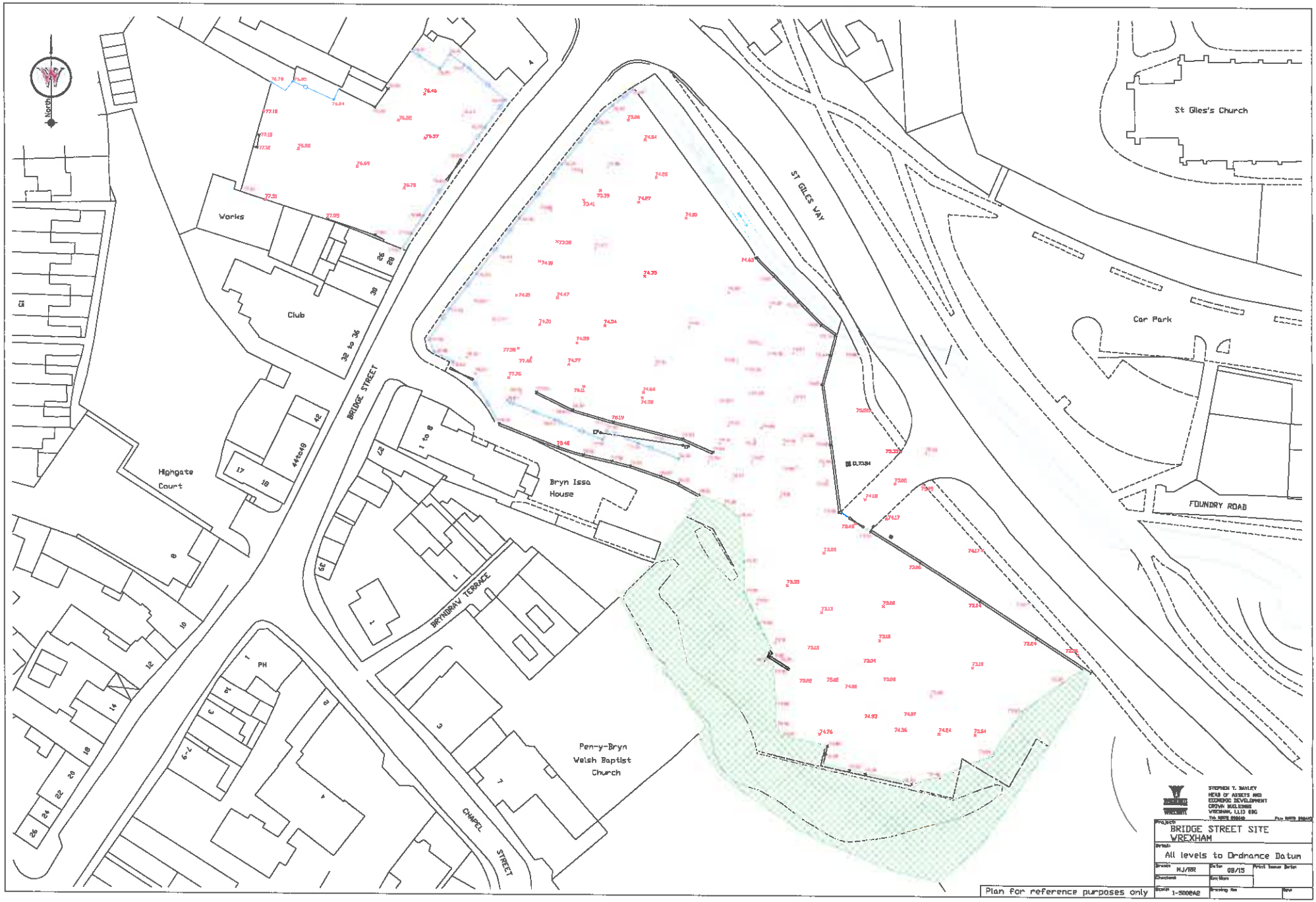
Disclaimer:
All effort has been made to survey all utility services within the boundary of the survey
We can not guarantee that we have been able to locate everything and further investigation will be required to establish full extents of services

Notes

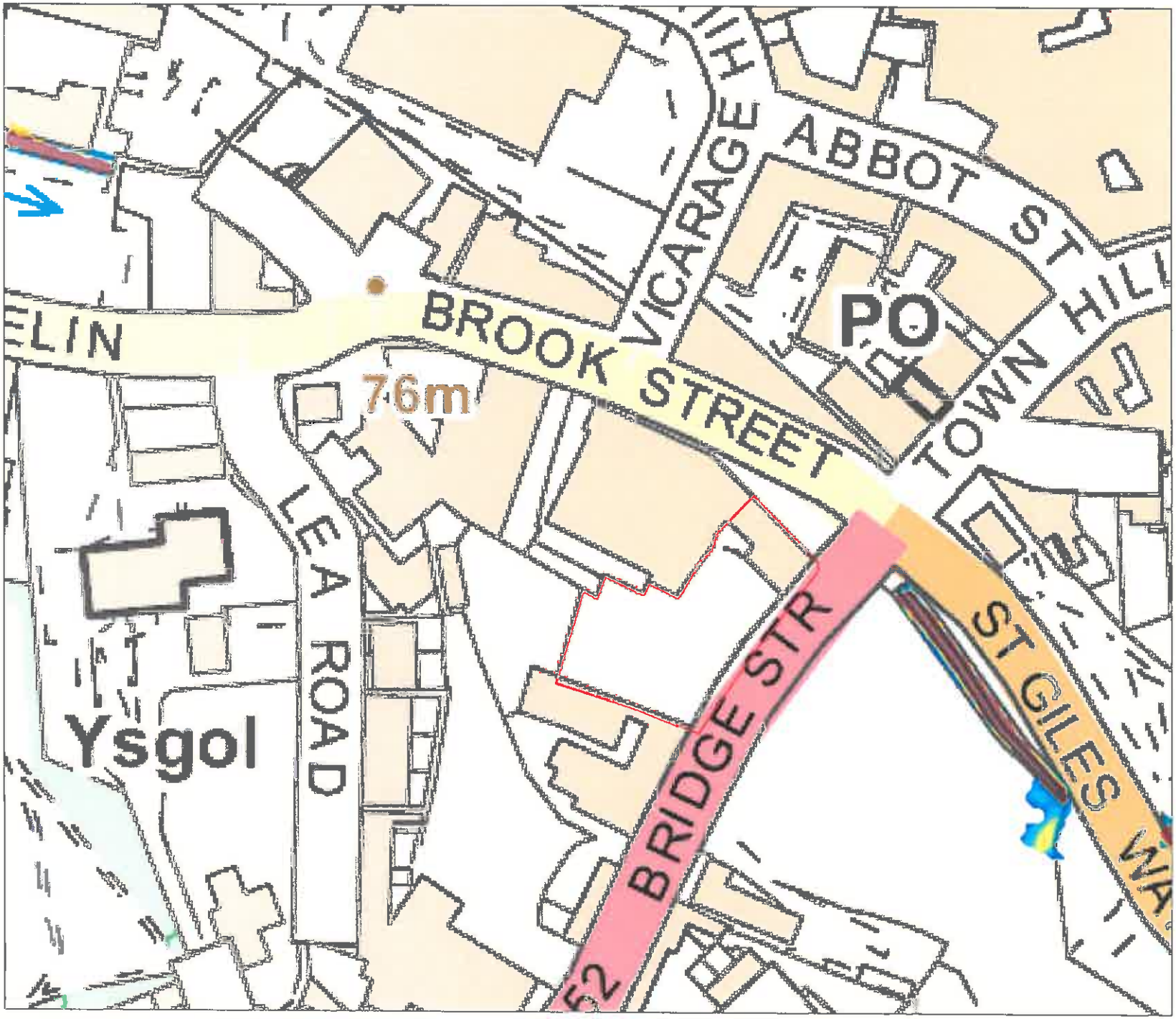
CHESHIRE SURVEYS LTD
Setting out and Survey Engineers

Client	Westwood		
Location	4 Brook St, Wrexham		
Description	Level Survey		
Drg. No.:	2140/1	Surveyed By:	GF
Scale: 1:	200/A1	Drawn By:	GF
Date:	20/09/10	Amend:	*

PDF created with pdfFactory trial version www.softwarelabs.com


North
St Giles's Church
ST GILES WAY
Car Park
FOUNDRY ROAD
Works
Club
BRIDGE STREET
Highgate
Court
Bryn Issa
House
BRYNDRAW TERRACE
PH
Pen-y-Bryn
Welsh Baptist
Church
CHAPEL
STREET
STEPHEN T. BAILEY
HEAD OF ASSETS AND
ECONOMIC DEVELOPMENT
CROWN BUILDINGS
WREXHAM, LL13 8BG
BRIDGE STREET SITE
WREXHAM
All levels to Ordnance Datum
MJ/RR
08/15
1-500@A2
Plan for reference purposes only

APPENDIX C:	Model Output Plots – Baseline Scenario



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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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W: www.weetwood.net

Client: Lingar Group

Project Title: Bridge Street, Wrexham

Drawing Title: Max Flood Depths: 1 in 100 Annual Probability Event - Baseline Scenario

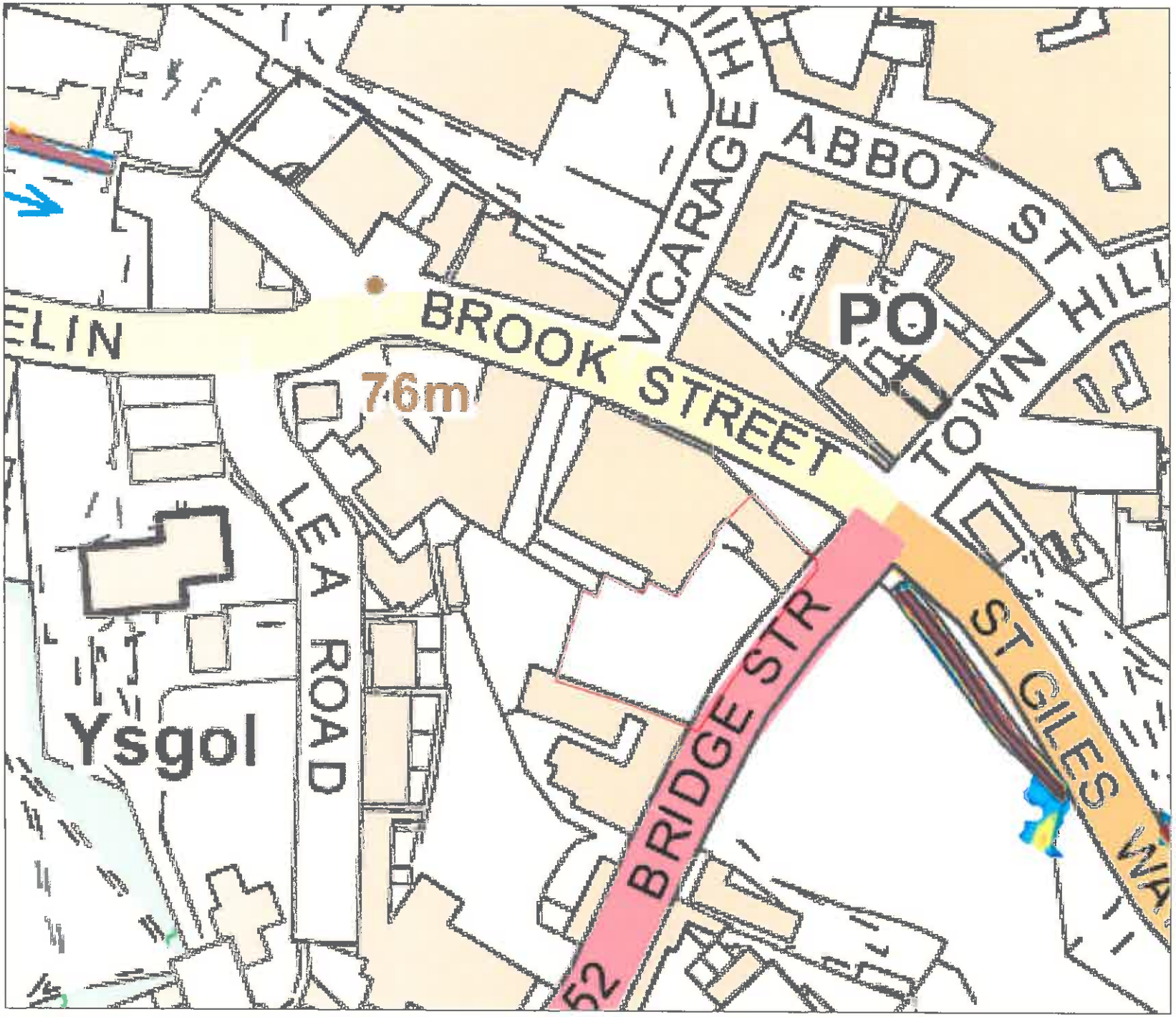
Map Orientation: N

Scale:

Drawn:	Checked:	Date:
AE	RMu	10 August 2018

Drawing No: Gwen_Design_WS_4183_005_AE_3M_Q100_d

Rev: A



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KEY:

Site Location

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- 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: Bridge Street, Wrexham

Drawing Title: Max Flood Depths: 1 in 100 +CC (20%) Annual Probability Event - Baseline Scenario

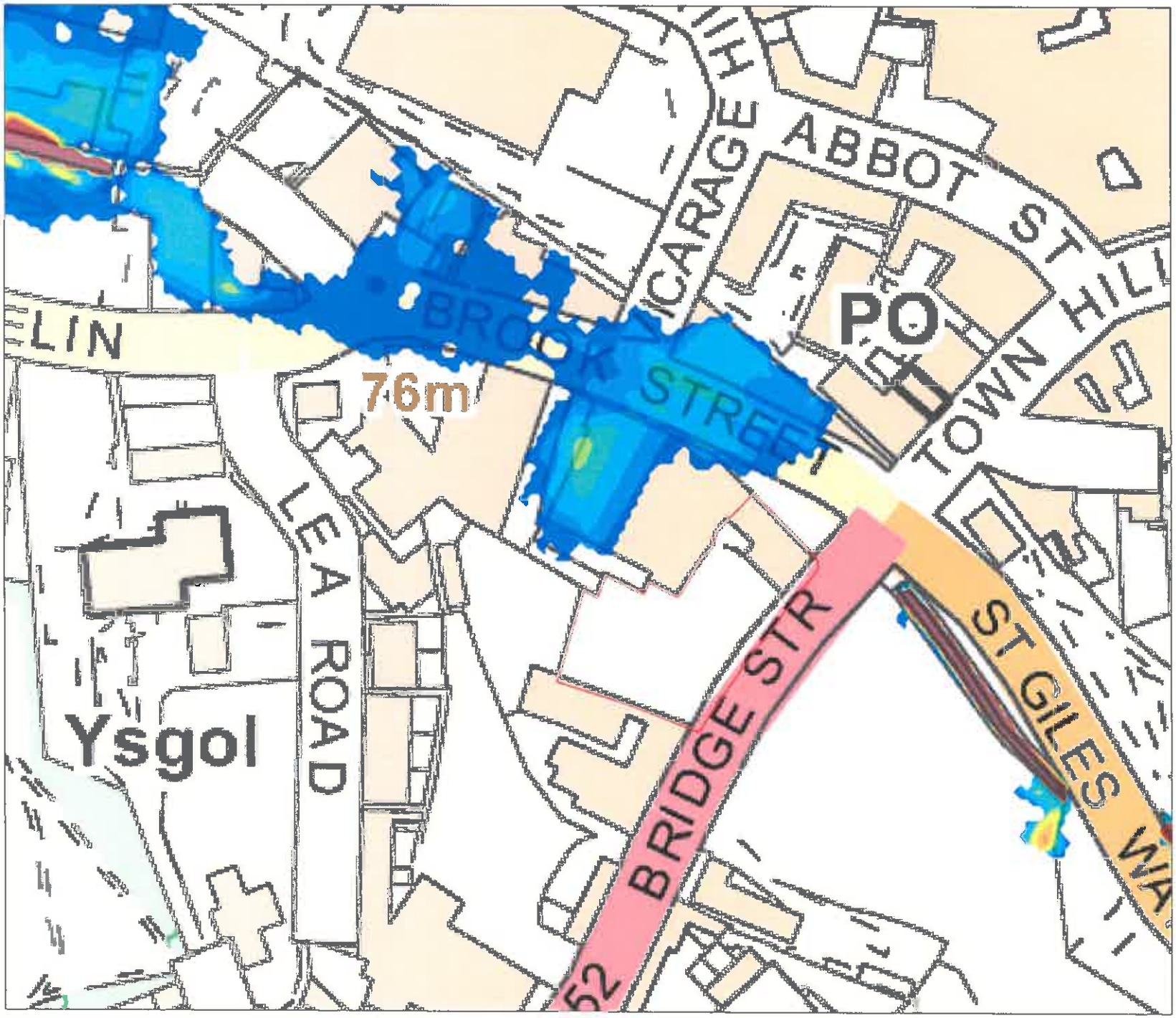
Map Orientation: N W E S

Scale:

Drawn:	Checked:	Date:
AE	RMu	10 August 2018

Drawing No: Gwen_Design_WS_4163_005_AE_3M_Q100CC20_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: Bridge Street, Wrexham

Drawing Title: Max Flood Depths: 1 in 100 +CC (45%) Annual Probability Event - Baseline Scenario

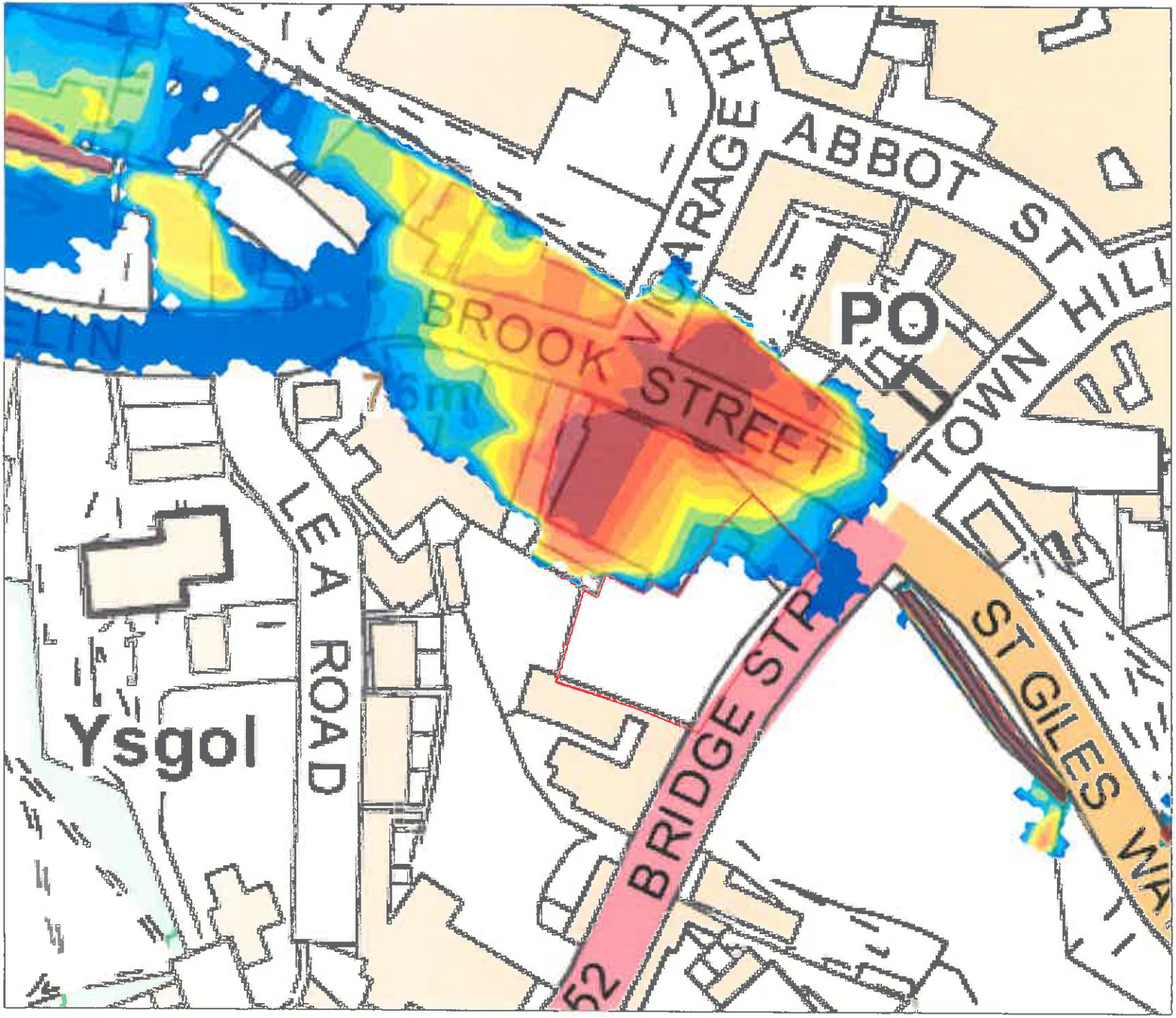
Map Orientation: N

Scale:

Drawn:	Checked:	Date:
AE	RMu	10 August 2018

Drawing No: Gwen_Design_WS_41E3_0ES_AE_3M_Q100CC45_6

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: Lingar Group

Project Title: Bridge Street, Wrexham

Drawing Title: Max Flood Depths: 1 in 1,000 Annual Probability Event - Baseline Scenario

Map Orientation:: N

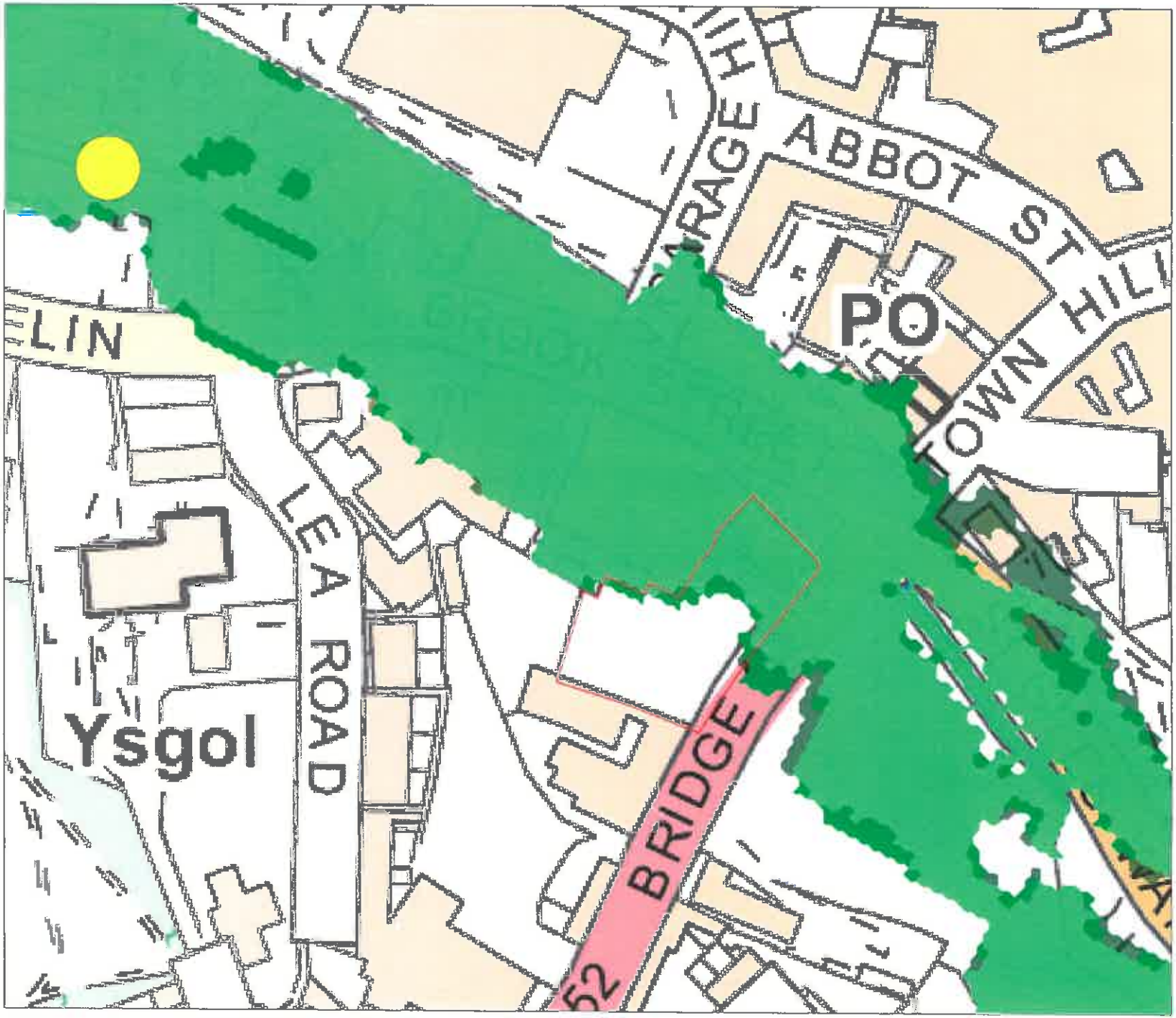
Scale:

Drawn:	Checked:	Date:
AE	RMu	10 August 2018

Drawing No: Gwen_Design_WS_41E3_005_AE_3M_Q1000_d

Rev: A

APPENDIX D:	Model Outputs Plots – Baseline Blockage Scenario



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KEY:

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- Blockage Location

Blockage Percentage

- 30%
- 67%
- 100%

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Client: **Linger Group**

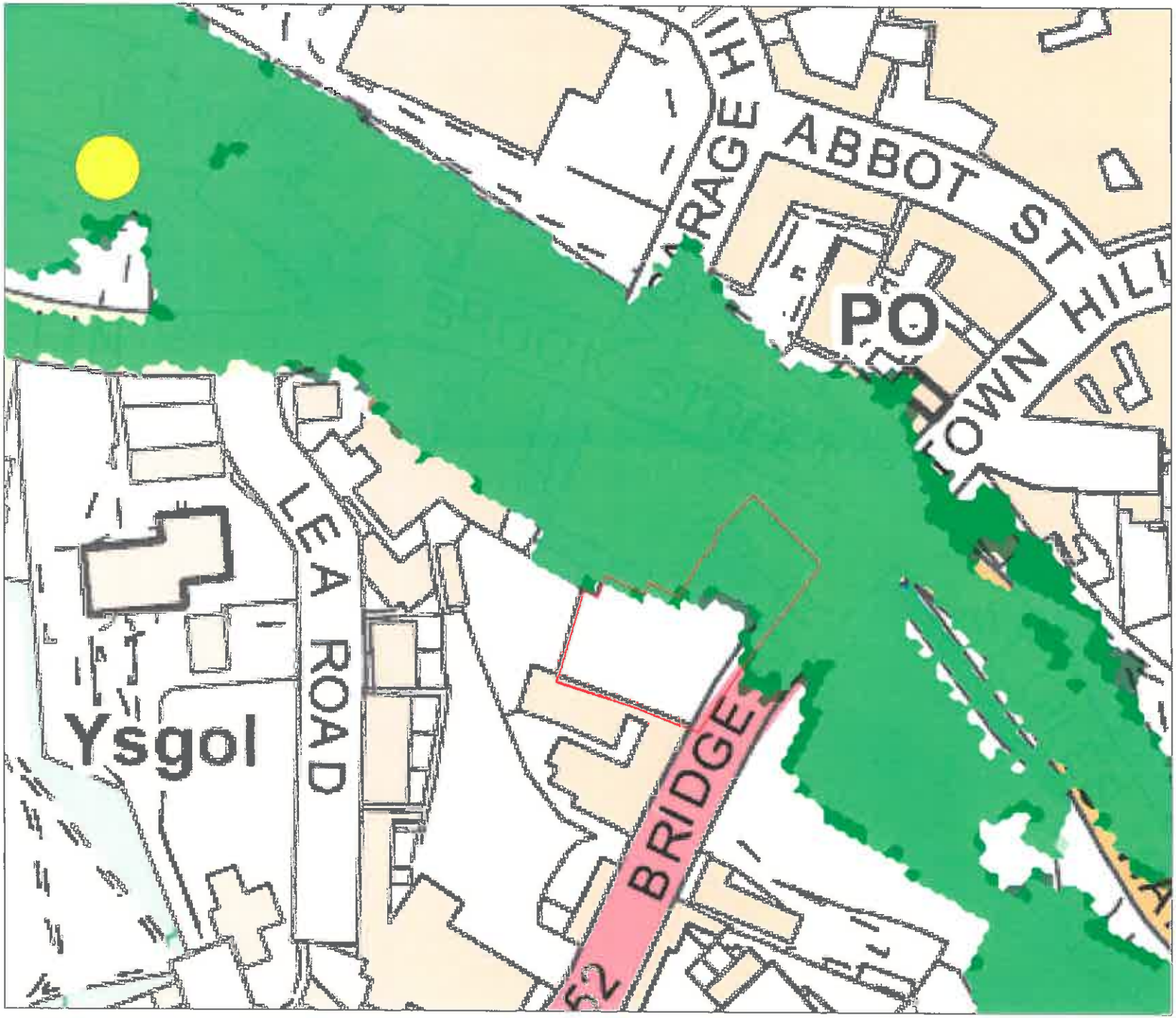
Project Title: **Bridge Street, Wrexham**

Drawing Title: **Structure Blockage: 1 in 100 +CC (20%) Annual Probability Event - Baseline Scenario**

Map Orientation:	Scale:	
Drawn: AE	Checked: RMu	Date: 10 August 2018

Drawing No: GwenBLK_WS_4183_006_BLKS_Q100CC20

Rev: A



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KEY:

- Site Location
- Blockage Location

Blockage Percentage

- 30%
- 67%
- 100%

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Client: Lingar Group

Project Title: Bridge Street, Wrexham

Drawing Title: Structure Blockage: 1 in 100 +CC (45%) Annual Probability Event - Baseline Scenario

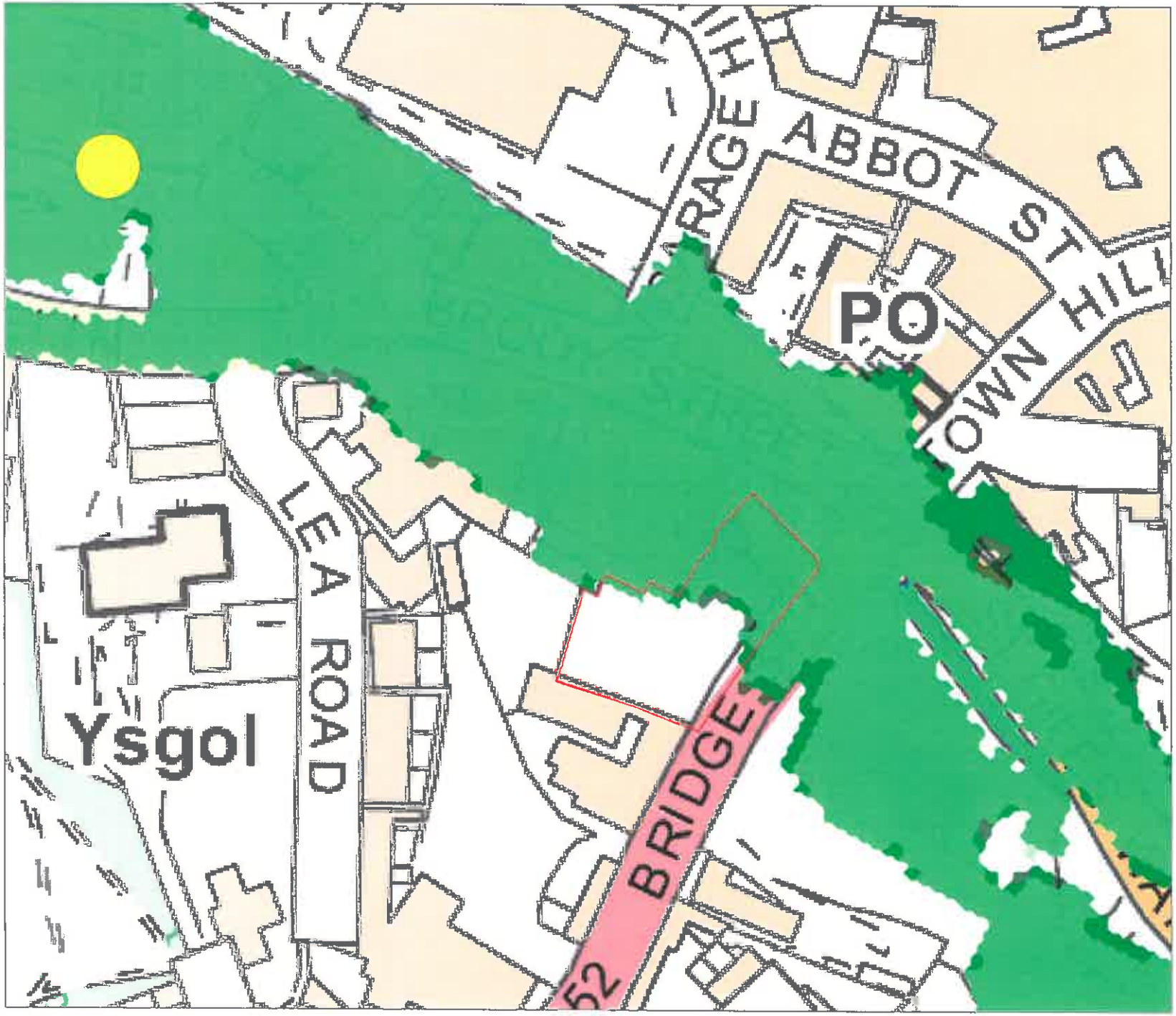
Map Orientation:: N

Scale:

Drawn:	Checked:	Date:
AE	RMu	10 August 2018

Drawing No: GwenBLK_WS_4183_006_BLKS_Q100CC45

Rev: A



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KEY:

- Site Location
- Blockage Location

Blockage Percentage

- 30%
- 67%
- 100%

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Client: Lingar Group

Project Title: Bridge Street, Wrexham

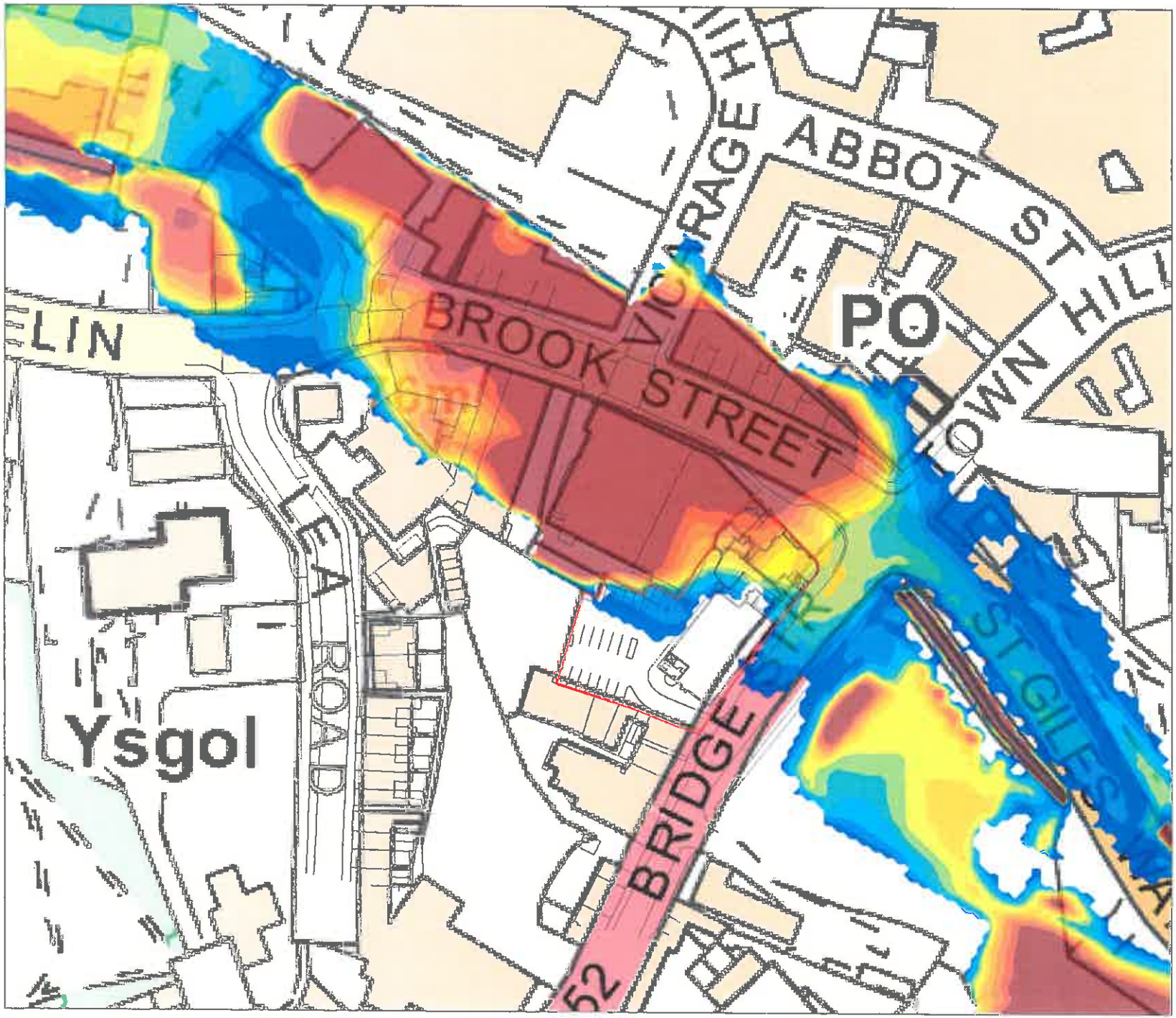
Drawing Title: Structure Blockage: 1 in 1,000 Annual Probability Event - Baseline Scenario

Map Orientation:	Scale:
N W E	

Drawn:	Checked:	Date:
AE	RMu	10 August 2018

Drawing No:	Rev:
GwenBLK_WS_4183_006_BLK5_Q1000	A

APPENDIX E:	Model Outputs Plots – Proposed Scenario



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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: Lingar Group

Project Title: Bridge Street, Wrexham

Drawing Title: Max Flood Depths (Island Green culvert 100% blockage): 1 in 100 +CC (20%) Annual Probability Event - Proposed Scenario

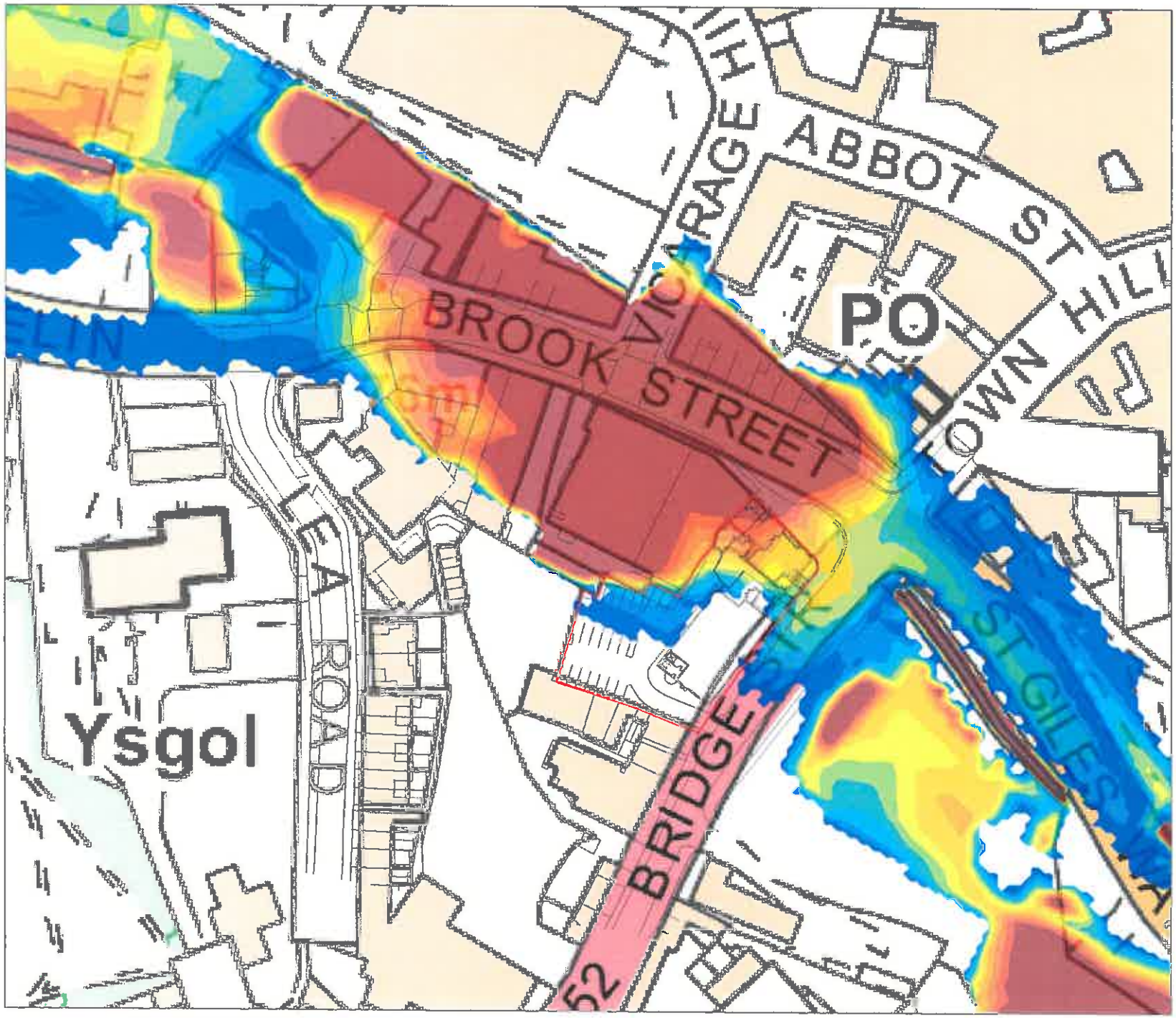
Map Orientation: N

Scale:

Drawn:	Checked:	Date:
AE	RMu	22 August 2018

Drawing No: GreenBLK_WS_4183_009 BLK5_100%_Q100CC20_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: Lingar Group

Project Title: Bridge Street, Wrexham

Drawing Title: Max Flood Depths (Island Green culvert 100% blockage): 1 In 100 +CC (45%) Annual Probability Event - Proposed Scenario

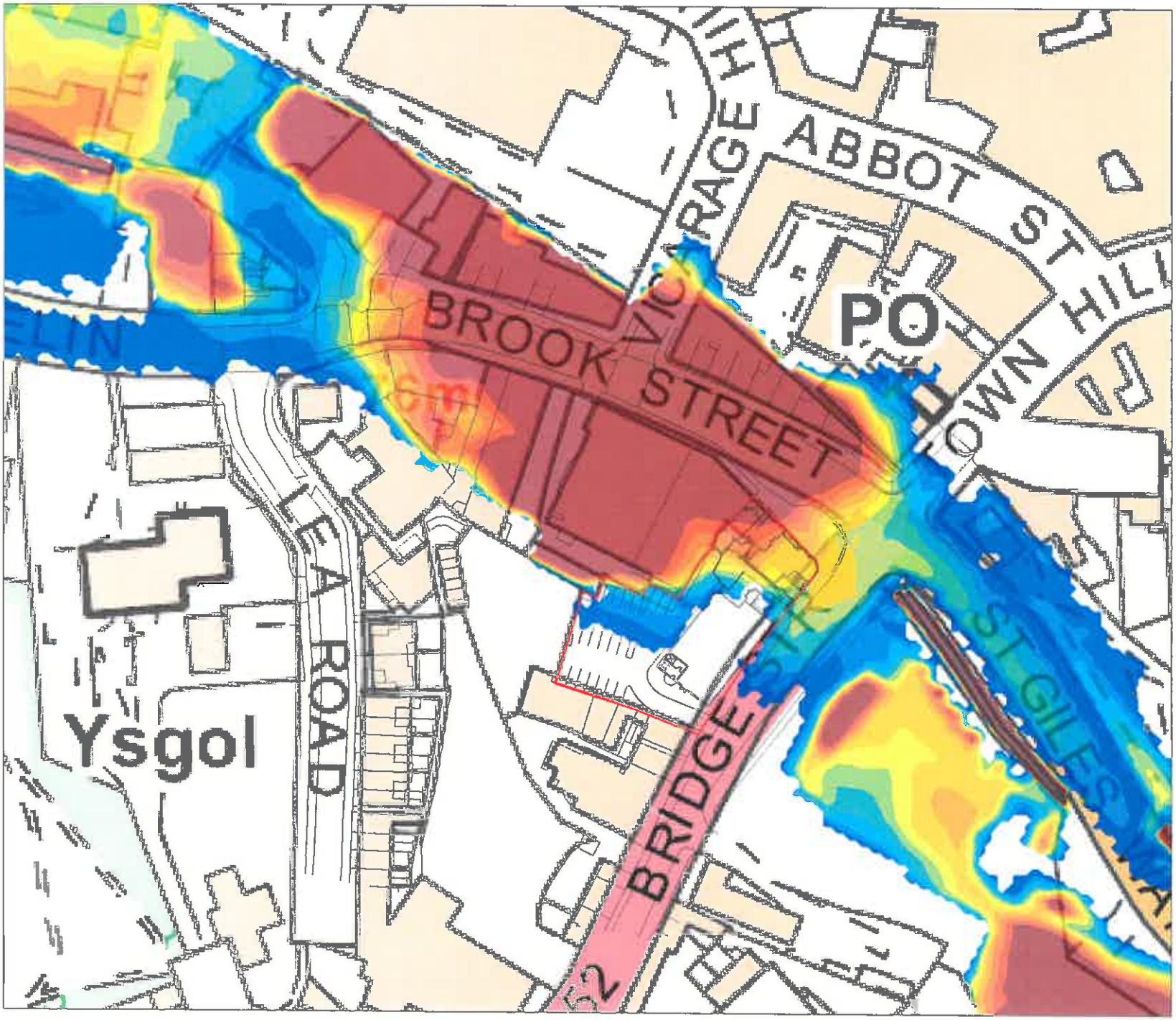
Map Orientation:

Scale:

Drawn:	Checked:	Date:
AE	RMu	22 August 2018

Drawing No: GwenBLK_WS_4183_005 BLK5_100%_Q100CC45_d

Rev: A



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KEY:

Site Location

Depth (metres)

- 0.0 to 0.1
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- 0.8 to 0.9
- 0.9 to 1.0
- > 1.0

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Client: Linger Group

Project Title: Bridge Street, Wrexham

Drawing Title: Max Flood Depths (Island Green culvert 100% blockage): 1 in 1,000 Annual Probability Event - Proposed Scenario

Map Orientation:

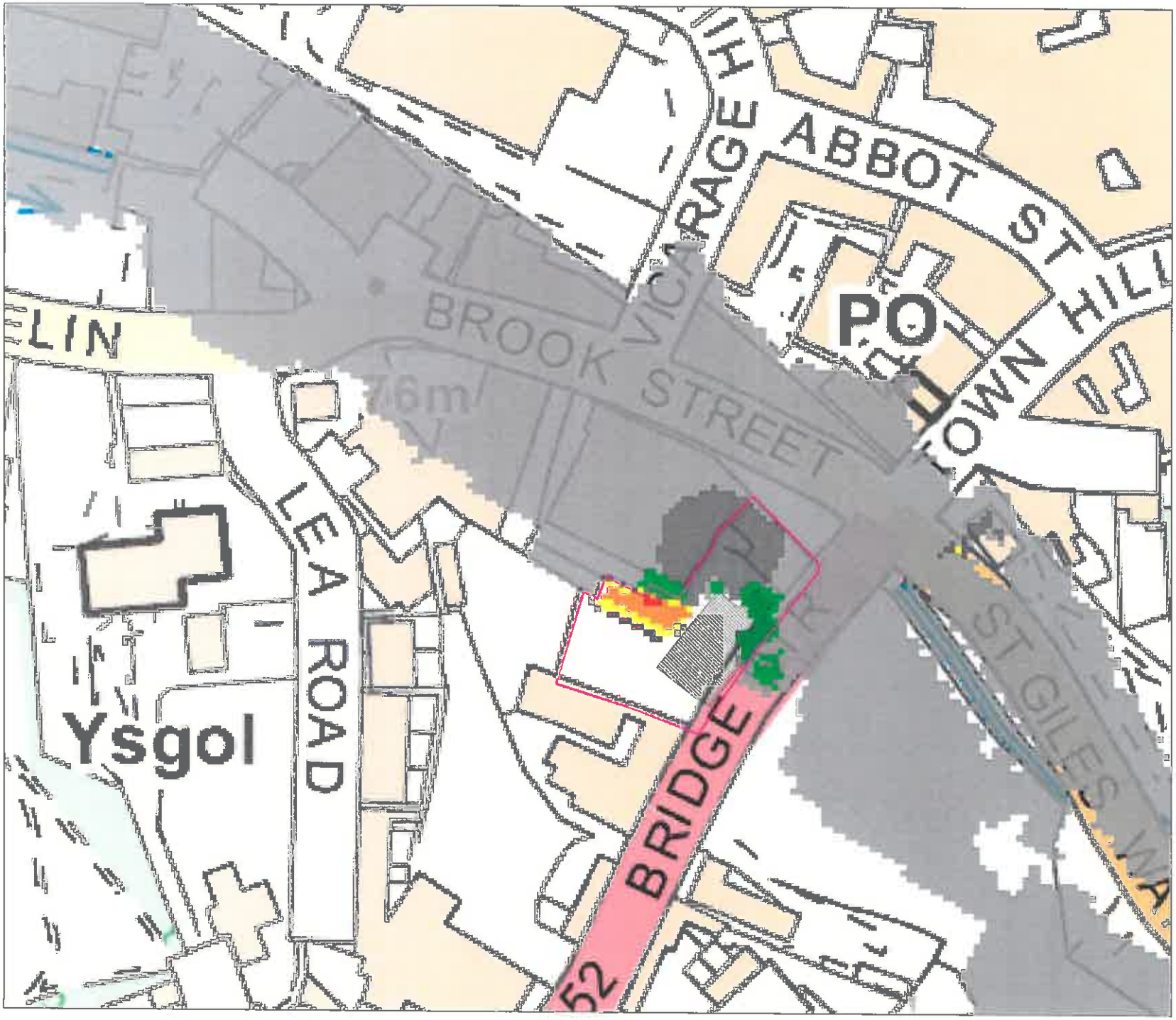
Scale:

Drawn:	Checked:	Date:
AE	RMu	22 August 2018

Drawing No: GwenBLK_WS_4183_009 BLK5_100%_Q1000_0

Rev: A

APPENDIX F:	Model Outputs Plots – Comparison



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KEY:

- Site Location
- Proposed Building

Change in flood depths

- Decrease
- Decrease (5 - 30 mm)
- 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: Lingar Group

Project Title: Bridge Street, Wrexham

Drawing Title: Comparison Plot: 1 in 100 +CC (20%) Annual Probability Event - 100% Blockage Scenario

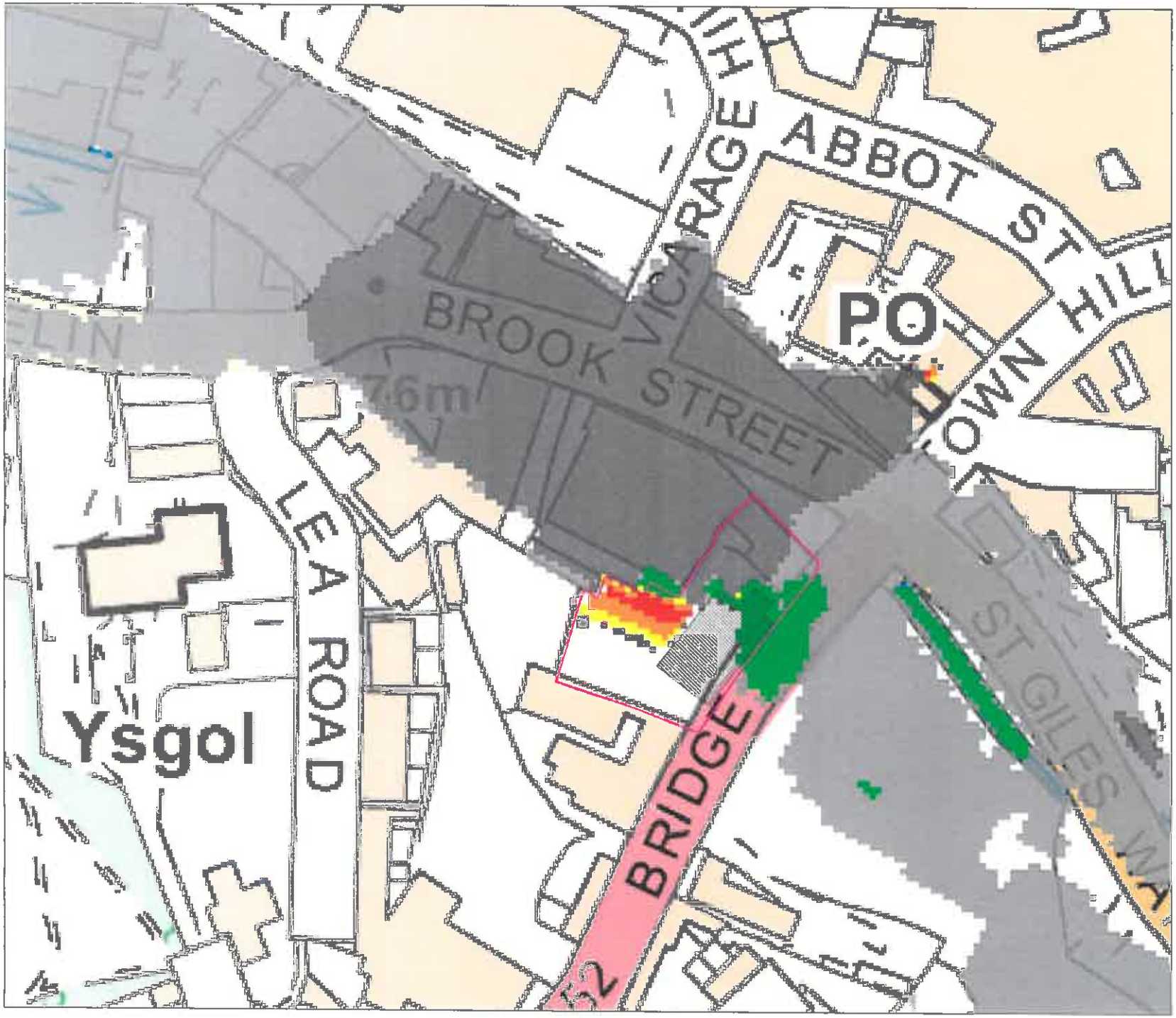
Map Orientation: N

Scale: 0 10 20 metres

Drawn:	Checked:	Date:
AE	RMu	20 August 2018

Drawing No: 4163_009-006_BLKS_100_Q100CC20

Rev: A



Notes:

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KEY:

- Site Location
- Proposed Building

Change in flood depths

- Decrease
- Decrease (5 - 30 mm)
- 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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W: www.weetwood.net

Client: Lingar Group

Project Title: Bridge Street, Wrexham

Drawing Title: Comparison Plot: 1 in 1,000 Annual Probability Event - 100% Blockage Scenario

Map Orientation: N

Scale: 0 10 20 metres

Drawn:	Checked:	Date:
AE	RMu	20 August 2018

Drawing No: 4183_009-006_BLKS_100_Q1000

Rev: A

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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
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