

REPORT

Flood Consequence Assessment

36 Brook Street, Wrexham, LL13 7LL

Client: Violetta Niklas

Reference: 6677-AEA-ZZ-XX-RP-Z-2500

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Executive Summary

Ambiental Environmental Assessments, a company of Royal HaskoningDHV, has been appointed by Violetta Niklas to undertake a Natural Resource Wales compliant Flood Consequence Assessment (FCA) for the Development Proposal located at 36 Brook Street, Wrexham, LL13 7LL.

The proposed development is for the redevelopment of the site to provide partial conversion of the existing mixed use building (retail at ground floor and two flats above) to create five flats with one at ground floor, and retaining part of the retail space.

According to TAN15, this would change the Development Vulnerability classification from Less Vulnerable to Highly Vulnerable.

The key findings of the Flood Consequence Assessment are as follows:

- The site is within Flood Zone C2.
- Fluvial risk is **Low** with the site only being affected by flooding with a <1% annual chance of occurrence. Should an extreme event occur it is possible, taking into account climate change, that the site could flood up to a depth of 0.6m. This does not exceed recommended thresholds.
 - Mitigation measures, signing up for flood alerts, and implementation and distribution of an evacuation plan can all help to reduce the impact of such an event.
- Surface Water risk is **Low**. There is an area of surface water flooding directly in front of the property; however, depths are expected to remain below 150mm, which is below the expected property threshold height. If the property threshold is less than this, it is recommended to raise the threshold to at least 150mm above the ground (and preferably 300mm). Flood mitigation measures (primarily aimed at reducing fluvial risk) also help ensure that the risk posed by surface water flooding is negligible.
- Groundwater risk is **Low**, as the ground conditions are amenable to groundwater flooding; however, no below ground development is planned and the mitigations recommended for fluvial and surface water risk will also mitigate against groundwater flood risk.
- Tidal risk is **Negligible**.
- Residual risk is **Negligible**. The site does not benefit from flood defences, so there is no residual risk of flooding in the event of defence breach or failure. The site is not within the predicted reservoir breach flood outline.

The Flood Consequence Assessment has been undertaken in accordance with the requirements of Natural Resource Wales and it can be demonstrated that the Development Proposals are compatible with the predicted flood risk profile, including climate change allowance over the development lifetime.

The residential nature is shown to be acceptable according to the guidance as it does not exceed frequency of flooding thresholds, flood depth experienced thresholds, and is within a flood alert area with a quick and simple evacuation route available. It should be noted that despite these facts, planning permission is not guaranteed and it may be the case that a reviewing planning officer takes an opposing view. The development has a classification of Highly Vulnerable given the residential use. However if the Developer was concerned about ensuring planning, removing the downstairs residential unit from the plans and only having commercial use on the ground floor would improve the risk profile. To be clear, this change is not required for the development to be considered acceptable from a flood risk viewpoint.

The Development Proposals are not predicted to increase the risk of flooding to others over the development lifetime. Consequently, it is concluded that, with regards to Flood Risk requirements, the Development Proposals are acceptable.

A summary of the flood risk for the Application Site for each source requiring consideration is presented as Table 1.

Table 1: Flood Risk Overview

Criteria	Summary
Site Setting	
Site Address	36 Brook Street, Wrexham, LL13 7LL
Client Name	Violetta Niklas
Redline Site Boundary	105 m ²
Ordnance Survey Grid Reference	333325mE, 350220 mN
Fluvial Climate Change Catchment Area	North West
Development Classification	
Vulnerability Classification	Highly vulnerable
Development Proposals	The development proposal is for the extension to and partial conversion of the existing mixed use building (retail at ground floor and two flats above) to create five flats with one being at ground floor and retaining part of the retail space
Site Parameters	
Topographic Levels (LIDAR)	Average Topographic Level 75.3 m AOD Highest Topographic Level 75.7 m AOD
Ordinary Watercourses (within 500m)	The River Gwenfro runs underneath Wrexham, occasionally daylighting. For most of this it is an ordinary watercourse but becomes a main river around 800m away from the site.
Main Rivers (within 500m)	N/A. River Gwenfro is nearest and is more than 800m distant.
BGS Hydrogeological Setting	Aquifers with flow through fractures and discontinuities: Moderately productivity aquifer
BGS Lithology	Superficial Geology: Glaciofluvial Deposits - Sand and gravel. Bedrock Geology: Etruria Formation - Mudstone.
BGS Borehole Record	There are several nearby boreholes with the nearest being SJ35SW901. There is no indication of groundwater in these sites
Intrusive Onsite Ground Investigations	N/A
Flood Risk	
Historic Records	There are no recorded instances of flooding on Historic or Recorded flood data, within 500m of the site.
Flood Map for Planning Classification	The site is in Flood Zone C2 and is in an area that does not benefit from flood defences.
Tidal Flood Discussion	The development is shown to not be at risk of tidal flooding
Tidal Flood Mitigation	N/A
Fluvial Flood Discussion	The site is at at risk from Low fluvial flooding. The Gwenfro spills out of bank and flows through the town at <1% AEP. During the 0.1% event it is expected (including climate change allowances) to reach a depth of 0.6m on site.
Fluvial Flood Mitigation	Include flood resistant design, raise electrical outlets and other vulnerable electronics off the ground by 0.6m, and implement and distribute a flood warning and evacuation plan to all occupiers.
Surface water Flood Discussion	The Development is shown to be at Low risk of surface water for a 1 in 1000 year event, with predicted flood depths up to 0.3m. An attempt to define the exact flood level for this shows that the site is likely to experience 0.1m of depth from this source of flooding.
Surface water Flood Mitigation	On the basis that the site is predicted to be at risk from surface water flooding, it will be necessary to include surface water flood mitigation measures within the developments design. Mitigation options are discussed in the 'Recommendations' section of this document. In general they rely upon using flood resilient materials and construction methods on the ground floor, and implementing a building threshold of at least 150mm and preferably 300mm where possible.
Groundwater Flood Risk	Low Risk
Sewer Flooding Risk	Where sewers exist, there is a residual risk of sewer flooding as a result of either a failure, usually a collapse or blockage, or as a result of the system's capacity being exceeded.

Criteria	Summary
Sewer Flooding Mitigation	Adopting a precautionary approach to the potential for sewer flooding or other events that exceed the design standard of infrastructure, appropriate mitigation measures should be included in the design of all new buildings and, where practicable, in the refurbishment or change of use of existing buildings.
Residual Risk: Flood Defence Breach	Flood Defence Breach: The site is indicated to not be located in an area that benefits from the presence of flood defences. Therefore, the site is not indicated to be at risk as consequence of a breach of flood defences.
Residual Risk: Reservoir Failure	Predicted Flood Depth: None The Environment Agency risk of reservoir flooding indicates that the site is not at risk as a result of a modelled reservoir failure.
Canal Failure	According to the CEH Canals data, there are no canals within 500m of the site, therefore it is not anticipated that the site is at risk as a result of a canal breach.
Flood Emergency Response Plan (FERP)	
Is a FERP required?	As the Application Site is shown to be at risk from fluvial flooding, a Flood Emergency Response Plan is required. Site occupiers should be made aware of and sign up to the Natural Resource Wales flood alert system (https://naturalresourceswales.gov.uk/flooding/sign-up-to-receive-flood-warnings/). The flood risk evacuation route is to travel south east along Brook St for 40 meters and to turn left onto Vicarage Hill and proceed up this street, out of the floodplain.
Offsite Impacts	
Floodplain Displacement	As the Application Site is not shown to have any change in the ground floor built footprint, floodplain displacement is unlikely to occur. Therefore, floodplain compensation is not anticipated to be required.
Future Flood Related Permits / Licences	
Access for maintenance of watercourses	There are no nearby watercourses.
Flood Risk Activity Permit	A Flood Risk Activity Permit is unlikely to be required.
Ordinary Watercourse Consent	There are no nearby watercourses.
Public Sewer Licence	Any works within 3m of a public sewer and any new connections shall require the consent of the Public Sewer Authority. Should public sewers be found to cross the Application Site, discussions with the Public Sewer Authority will be necessary to determine if easements or build over agreements are required.

1 Introduction

1.1 Overview

Ambiental Environmental Assessments, a company of Royal HaskoningDHV, has been appointed by Violetta Niklas to undertake a Natural Resources Wales (NRW) compliant Flood Consequence Assessment (FCA) for the Development Proposal located at 36 Brook St, Wrexham, Wales, LL13 7LL. The site will hereafter be referred to as the Application Site.

The purpose of this assessment is to demonstrate that the Development Proposal can be satisfactorily accommodated without worsening flood risk for the area and without placing the development itself at risk of flooding. This assessment has been written in accordance with national guidance provided within TAN15, DEFRA's National Standards for Sustainable Drainage [1], and Local Guidance and Policy Documents.

This report relies on information provided by third parties, either because of a direct request for information or through reviewing their published information (usually from internet sources from Government Agencies or established institutions).

The guidance documents and National Planning Policy are also periodically updated. This document has been based on the published guidance at the time of writing.

This document should be periodically reviewed to establish if third party data has been updated or if guidance or legislation has changed. A new appraisal should be undertaken to confirm if the conclusions of this document are still valid.

This document is based on thresholds of risk as outlined in the Flood Risk Regulations [2]; however, risk tolerance is often subjective and individuals may, in some circumstances, require a higher level of flood protection than that required through the guidance.

Please note, where a product or system is referred to in this report, they are provided as an example of the type of product that could be utilised. It is for the contractor to confirm its suitability and to discuss directly with the manufacturer the specific form of installation required.

1.2 Site Location and Description

The Application Site is located at Ordnance Survey grid reference 333,325 E, 350,220 N, and the redline boundary includes an area of approximately 105 m² (0.01 Ha), as indicated on Figure 1.

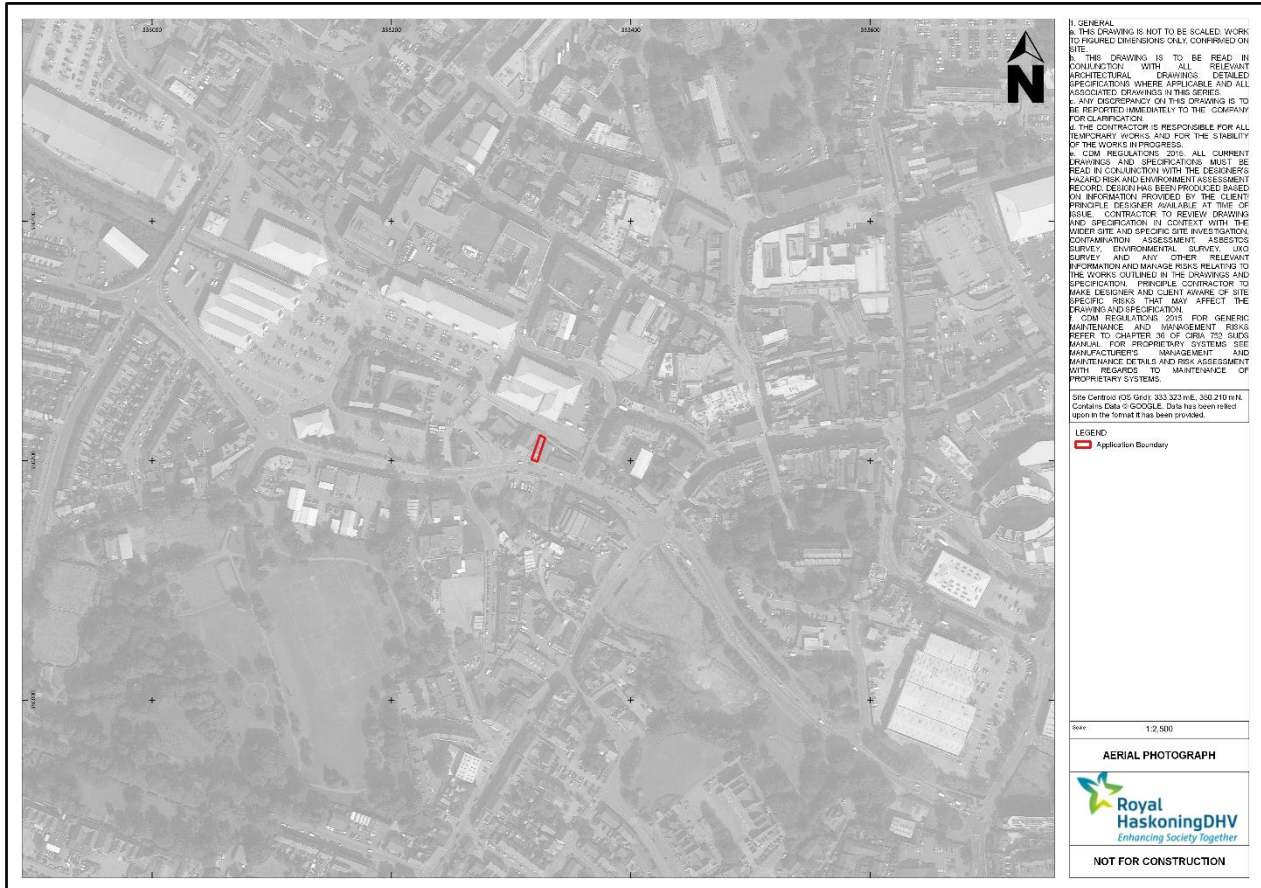


Figure 1: Site Location Plan

1.3 Current Site Usage

The application site is currently a mixed commercial and residential unit formed of a ground floor commercial space and two upstairs residential flats, as shown in Figure 1.

1.4 Development Proposals

The development proposal is for the extension to and partial conversion of the existing mixed-use building (retail at ground floor and two flats above) to create five flats, with one being at ground floor, and retaining part of the retail space.

1.5 Development Classification

In accordance with Technical Advice Note 15 (TAN15), the development would be classified as highly vulnerable.

Table 2: Development Classifications

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

2 Scope of Assessment

Appendix 1 (Assessing Flooding Consequences) in TAN15 explains how the potential consequences of a flooding event should be assessed. The objective of an assessment is to develop a full appreciation of:

- The consequences of flooding on the development.
- The consequences of the the development on flood risk elsewhere within the catchment (to a flood probability of 0.1% annual chance of occurrence).
- Whether appropriate mitigation measures can be incorporated within the development design to ensure that the development minimises risk to life, damage to property, and disruption to people.

To further break these objectives down, TAN15 goes on to specify that a Flood Consequence Assessment should include clear and simple descriptions of the following:

- The likely mechanisms of flooding.
- The likely sources of flooding.
- The depths of flooding throughout the site.
- The speed of inundation of the site.
- The rate of rise of floodwaters throughout the site.
- The impact of the development in terms of flood risk on neighbouring properties and elsewhere on the flood plain.

With these objectives in mind, a number of different flooding sources will be assessed:

- i. **Fluvial (River) flooding.** When flows within watercourses exceed the capacity of the watercourse, causing out of bank flows and resulting in flooding of adjacent areas.
- ii. **Groundwater flooding.** Usually, the result of prolonged wet weather, causing groundwater levels to rise sufficiently to either emerge at surface or to cause flooding of below ground infrastructure, such as basements.
- iii. **Surface water flooding.** When rainfall causes overland flow rates and volumes which exceed the capacity of the drainage network, causing flooding to land that is normally dry.
- iv. **Tidal flooding.** When high tide events overtop the shoreline to cause flooding to land behind. This is usually the result of a combination of high tide events and storm surges.

As well as considering the risk of flooding from these primary sources, this FCA will consider the potential impact of a failure of flood defence or reservoir infrastructure; however, as the likelihood of these types of flooding are much lower, they are known as “residual risks”. The residual flood risks to be considered are:

- i. **Reservoir failure.** Although the likelihood of reservoir failure resulting in widespread flooding is extremely low¹ [3], the consequences of such an event need to be considered to inform appropriate emergency planning.
- ii. **Flood defence failure.** The consequence of a failure of part of a flood defence could result in the rapid release of water in an area that would otherwise not be at risk of flooding. If such an event were to occur, there could be very little warning time and therefore it is unlikely that prior evacuation from an area at risk could be achieved.

¹ Environment Minister Richard Benyon said: “While the risk of a reservoir failure is extremely low the safety of the public must remain our top priority and where there is even a small risk we need to make sure that we are prepared.”

3 Relevant Policy and Guidance

This Flood Risk Assessment has been developed in accordance with the guidance and legislation set out in the below documents:

3.1 National Policy

- Water Industry Act (1999) [4]
- EU Water Framework Directive (2000) [5]
- EU Floods Directive (2007) [6]
- The Flood Risk Regulations (2009) [7]
- Flood and Water Management Act (2010) [8]
- The Building Regulations, Part H (2015) [9]
- British Standards, Drain and sewer systems outside buildings (BS EN 752:2017) [10]
- Planning Policy Wales (2021) [11]

3.2 National Guidance

- Non-statutory Sustainable Drainage Technical Standards (2015) [12]
- CiRIA SuDS Manual (C753, 2015) [13]
- Technical Advice Note 15, Development and Flood Risk (2004) [14]

4 Specific Guidance requirements

4.1 Planning Policy Wales

The Welsh Planning Policy outlines some basic requirements that developments must meet in terms of their flood risk attributes. The key statements which pertain to this development are:

“Development should reduce, and must not increase, flood risk arising from river and/or coastal flooding on and off the development site itself.”

“Planning authorities should be aware of the risk of surface water flooding, usually caused by heavy rainfall, and ensure developments are designed and planned to minimise potential impacts.”

Further to these high-level requirements, it is advised to apply the guidance presented in TAN15.

4.2 Technical Advice Note 15 (TAN15)

TAN15 sets out two separate criterion lists which highly vulnerable developments must meet in order to be considered acceptable. The first is the Justification Criteria. If these are all met, then Acceptability Criteria must be considered.

Justification Criteria:

- 1) Should be located only in an area of flood risk which is developed and served by significant infrastructure, including flood defences (Zone C1 of the DAM) AND
- 2) Its location is necessary to assist a local authority regeneration initiative or strategy¹, or contribute to key employment objectives, necessary to sustain an existing settlement or region AND
- 3) The site meets the definition of previously developed land (i.e. it is not a Greenfield site) and concurs with the aims of Planning Policy Wales (i.e. the presumption in favour of sustainable development) AND
- 4) A Flood Consequence Assessment has been produced to demonstrate that the potential consequences of a flood event up to the extreme flood event (1 in 1000 chance of occurring in any year) have been considered and meet the criteria below in order to be considered acceptable.

Acceptability Criteria (has to meet all):

- Flood defences must be shown by the developer to be structurally adequate, particularly under extreme overtopping conditions (i.e. that flood with a 1 in 1000 chance of occurring in any year).
- The cost of future maintenance for all new/approved flood mitigation measures, including defences must be accepted by the developer and agreed with the Environment Agency (now Natural Resources Wales).
- The developer must ensure that future occupiers of the development are aware of the flooding risks and consequences.
- Effective flood warnings are provided at the site
- Escape/evacuation routes are shown by the developer to be operational under all conditions
- Flood emergency plans and procedures produced by the developer must be in place
- The development is designed by the developer to allow the occupier the facility for rapid movement of goods/possessions to areas away from floodwaters.

- Development is designed to minimise structural damage during a flooding event and is flood proofed to enable it to be returned to its prime use quickly in the aftermath of the flood.
- No flooding elsewhere.
- Developer is required to demonstrate that the site is designed to be flood free for the lifetime (A1.5) of development for either a 1 in 100 chance (fluvial) flood event, or a 1 in 200 chance (tidal) flood event including an allowance for climate change (depending on the type of flood risk present) in accordance with table A1.14 (in TAN15).
- In respect of the residual risk to the development, it should be designed so that over its lifetime (A1.5) in an extreme (1 in 1000 chance) event there would be less than 600mm of water on access roads and within properties, the velocity of any water flowing across the development would be less than 0.3 m/second on access roads and 0.15m/second in properties, and the maximum rate of rise of floodwater would not exceed 0.1m/hour

5 Climate Change Allowances

NRW published guidance on climate change allowances for Flood Consequence Assessments with the latest update in September 2021 [15].

The current NRW climate change allowances are classified on how likely that scenario is predicted to occur, based on percentile of the scenario.

An allowance based on the 70th percentile is exceeded by 30% of the projections in the range. At the 95th percentile it is exceeded by 5% of the projections in the range.

For these allowances it is important you do not use a single percentile out of context. For example, while the 70th percentile is the higher central estimate, it does not represent the full range of likely futures. Using this percentile on its own may cause you to under-adapt to climate change.

5.1 Tidal Climate Change Allowances

Tidal Climate Change Allowances are determined by the predicted increase in sea levels. These are determined by regional variations, which are based on the River Basin District under consideration. The sea level rise allowances are reproduced as Table 3 below.

The 2125 Higher Central Climate Change allowance for sea level rise total until 2125 is 1.01m and the Upper End allowance is 1.41m compared to the 1981 to 2000 baseline.

Table 3: Sea level allowances by area for each epoch in mm per year.

Area	Allowance	2000 to 2035 (mm)	2036 to 2065 (mm)	2066 to 2095 (mm)	2096 to 2125 (mm)	Cumulative rise 2000 to 2125 (metres)
North west	Higher central	4.5 (158)	7.3 (219)	10 (300)	11.2 (336)	1.01
North west	Upper end	5.7 (200)	9.9 (297)	14.2 (426)	16.3 (489)	1.41

Based on a 1981 to 2000 baseline, the total sea level rise for each epoch is in brackets

5.2 Fluvial Climate Change Allowances

Fluvial Climate Change Allowances are determined by the predicted increase in peak river flows. These are determined by regional variations, which are based on the management catchments. Management catchments are sub-catchments of river basin districts. Table 4 presents the Peak River flow climate change allowance.

The guidance also sets out which climate change allowance should be used for different development Vulnerability Classifications and these are summarised in TAN 15. The relevant management catchment and allowances for the Application Site are highlighted in bold.

It should be noted that the epochs are based on the change from the baseline of 1981 to 2000. The climate change allowances are as follows:

- 2020 epoch is 2015 to 2039;
- 2040 epoch is 2040 to 2069;
- 2080 epoch is 2070 to 2125.

The Application Site is located in the Dee management catchment. The 2080 Central Climate Change allowance for peak river flows is 20%, compared to the 1981 to 2000 baseline.

It is worth noting that there are small differences in the guidance for the Dee catchment between NRW in Wales and the Environment Agency in England. For this assessment, we have taken the Welsh guidance.

Table 4: Peak river flow climate change allowances by management catchment

Management catchment name	2020s Lower	2020s Central	2020s Upper end	2050s Lower	2050s Central	2050s Upper end	2080s Lower	2080s Central	2080s Upper end
Dee	5%	10%	20%	5%	15%	30%	5%	20%	45%

6 Site Overview

6.1 Topography

Ground levels within the Application Site have been determined by reviewing Environment Agency 2m LiDAR data. On average, the ground levels are 75.3m AOD, with a highest topographic level of 75.7m AOD (see Figure 2).

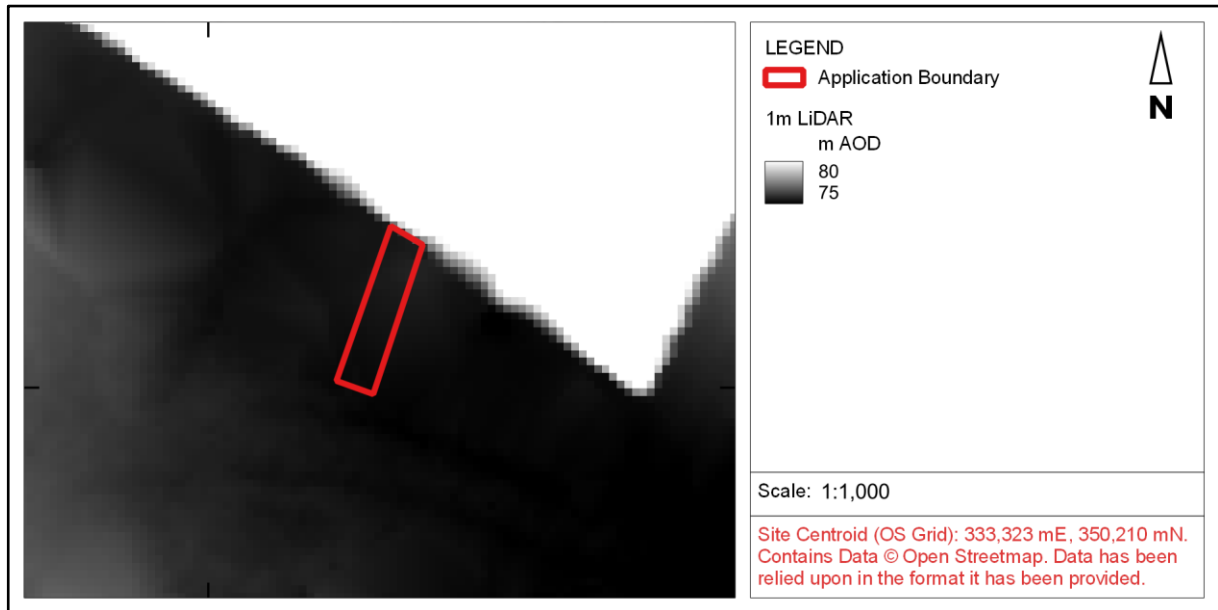


Figure 2: Site Topography

6.2 Site Hydrology

6.2.1 Main Rivers

The nearest main river is the River Gwenfro, which is approximately 1,000m south east of the site.

6.2.2 Ordinary Watercourses

The River Gwenfro is a culverted ordinary watercourse beneath the property, which emerges again to open air approximately within 130m south east of the site (but only gains Main River status further downstream).

6.3 Ground Conditions

6.3.1 British Geological Survey (BGS) Hydrogeological Setting

According to the BGS Hydrogeological Setting data (see Figure 3), the Application Site is within a moderately productive aquifer area. The groundwater flow in the underlying ground is almost entirely through fractures, which tends to impede the amount of flow.

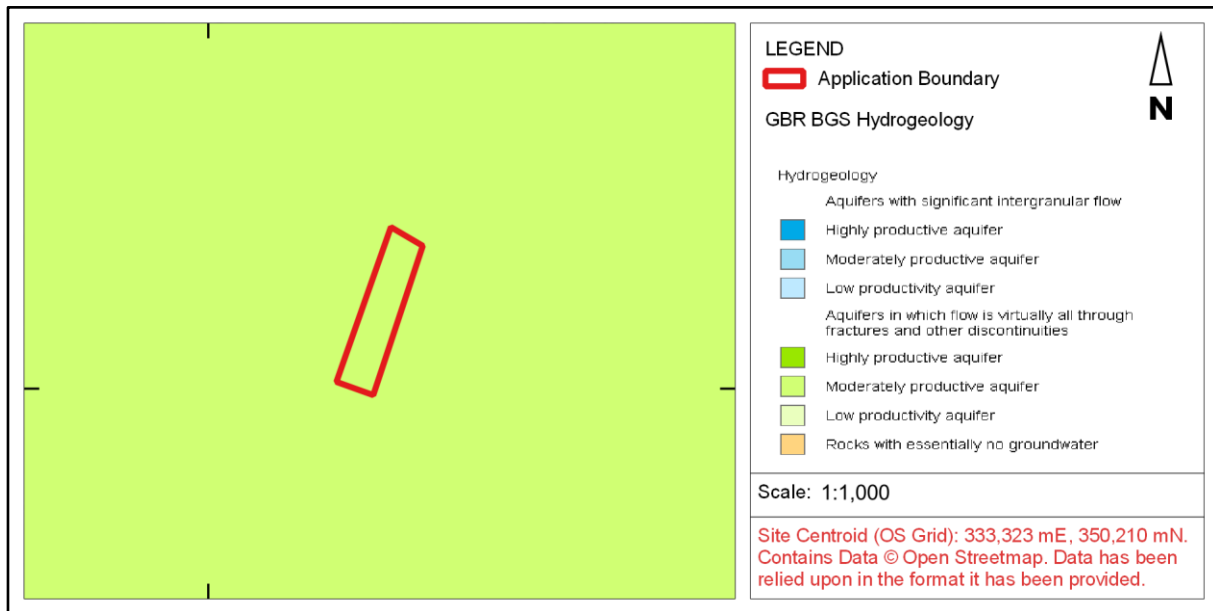


Figure 3: BGS Hydrogeological Setting

6.3.2 British Geological Survey (BGS) Lithology

According to the BGS Lithology, the ground beneath the Application Site has a superficial geology of sand and gravel (Glaciofluvial deposits) and an underlying geology of the Etruria Formation, which consists of mudstone or siltstone.

6.3.3 British Geological Survey (BGS) Borehole

According to the BGS historic borehole records data, the nearest recorded borehole to the Application Site is SJ35SW901 (see Figure 4). There are also several other nearby boreholes. There are mixed indications of groundwater at these sites. Some have water struck only a couple of feet down, whilst others do not encounter any water at all. There is not a record of the preceding conditions, so it is possible that these measurements could have been influenced by either drought or wet antecedent conditions.

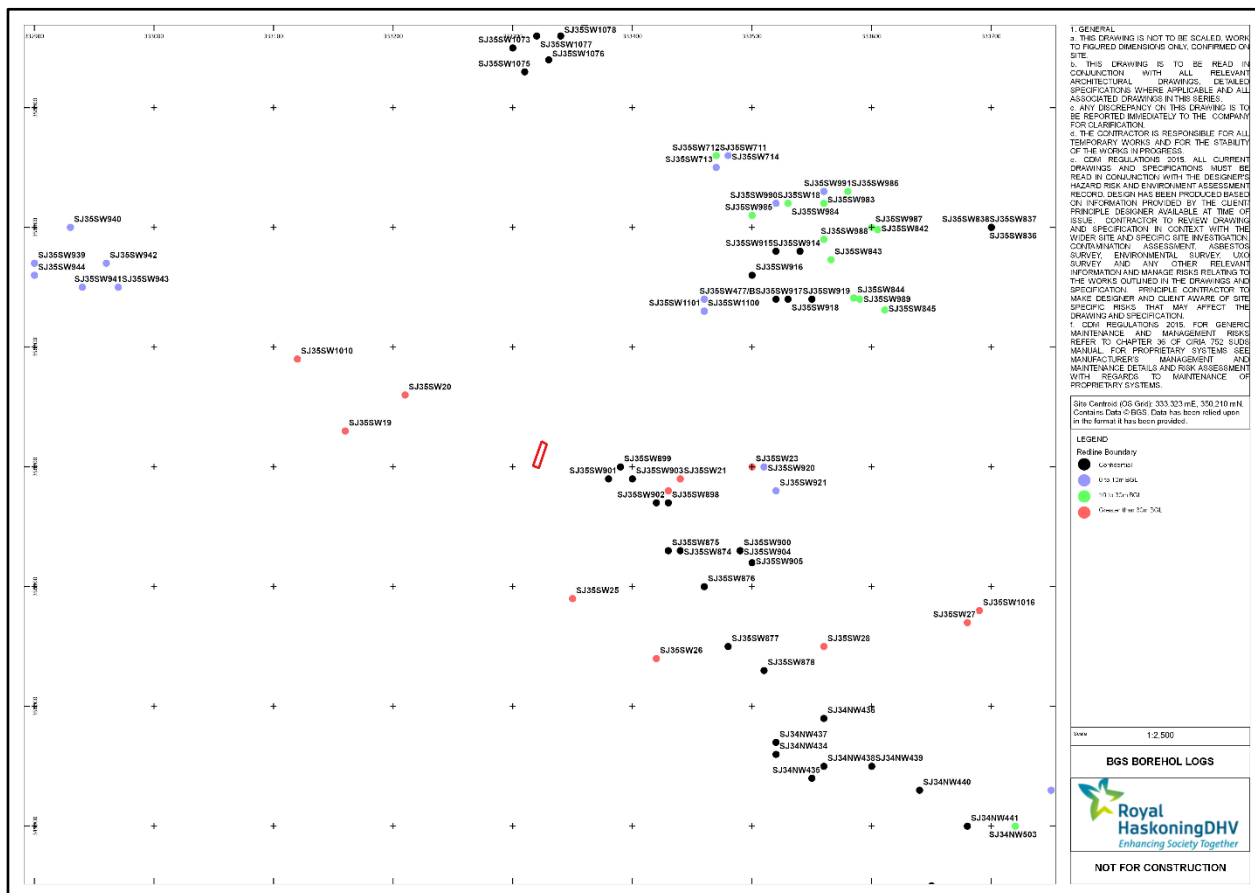


Figure 4: BGS Borehole Records

7 Development Compatibility with Flood Zone

7.1 Development Vulnerability Classification

The vulnerability classifications are summarised in Table 5 (below) and identifies that the Development Proposals are **Highly vulnerable**, as highlighted below.

Table 5: Figure 2 of TAN15, Flood risk vulnerability classification

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

The ground floor development consists of both commercial and residential usage. The commercial usage would be classified as Less Vulnerable. A precautionary approach means that the overall classification would be Highly Vulnerable.

7.2 Flood Zone Classification

The Development Advice map (Figure 5) demonstrates that the Development Proposals are located within Flood Zone C2. This is an area which is at risk of flooding but is not benefitting from flood defences. The site is also in an area which has prior evidence of flooding, as indicated by sedimentary deposits.

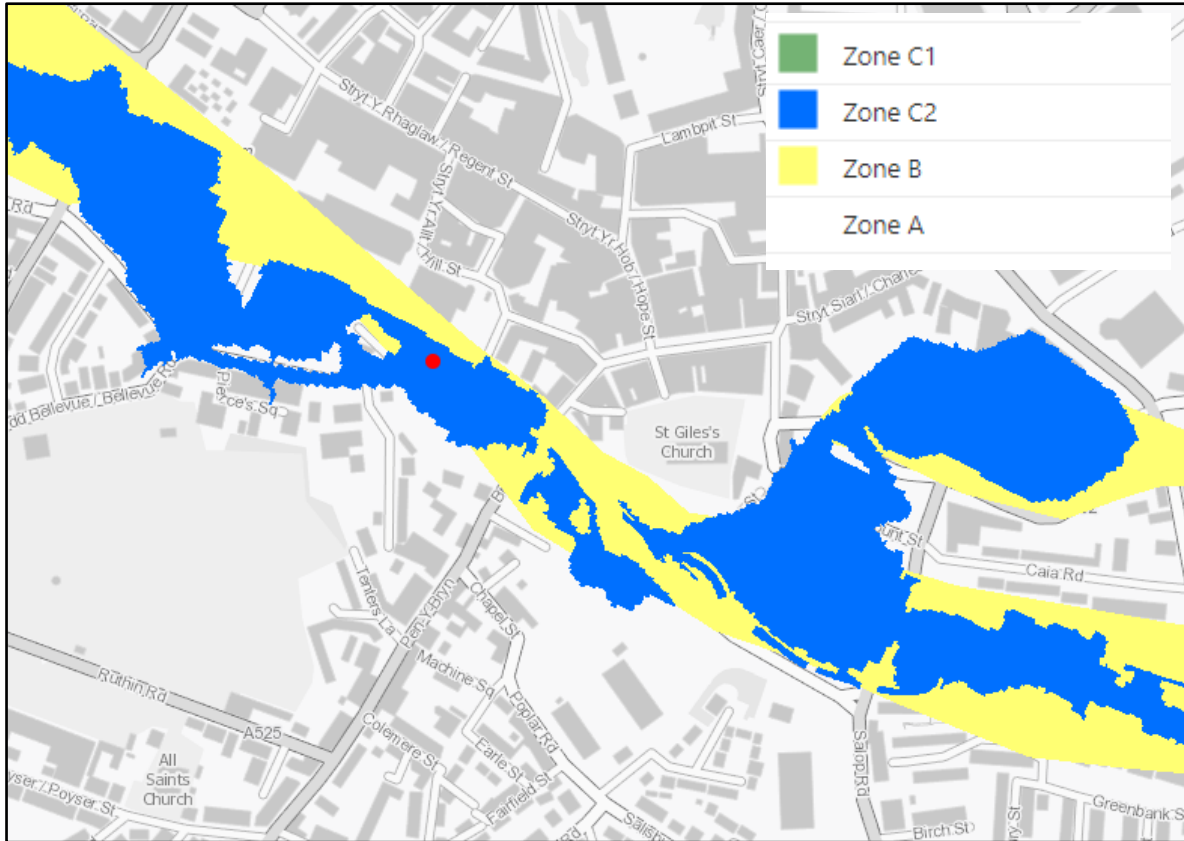


Figure 5: NRW Development Advice map

Figure 1 in TAN15, reproduced in Table 6 below, presents the flood zone definitions.

Table 6: Flood Risk Zones and descriptions

Description of Zone	Flood Zone	Use within the precautionary framework
Considered to be at little or no risk of fluvial or tidal/coastal flooding.	A	Used to indicate that justification test is not applicable and no need to consider flood risk further.
Areas known to have been flooded in the past evidenced by sedimentary deposits.	B	Used as part of a precautionary approach to indicate where site levels should be checked against the extreme (0.1%) flood level. If site levels are greater than the flood levels used to define adjacent extreme flood outline there is no need to consider flood risk further
Based on Environment Agency extreme flood outline, equal to or greater than 0.1% (river, tidal or coastal)	C	Used to indicate that flooding issues should be considered as an integral part of decision making by the application of the justification test including assessment of consequences
Areas of the floodplain which are developed and served by significant infrastructure, including flood defences.	C1	Used to indicate that development can take place subject to application of justification test, including acceptability of consequences.
Areas of the floodplain without significant flood defence infrastructure.	C2	Used to indicate that only less vulnerable development should be considered subject to application of justification test, including acceptability of consequences. Emergency services and highly vulnerable development should not be considered.

7.3 Flood Zone & Vulnerability Compatibility

Given that the Application Site is located within Flood Zone C2 and the Development Proposals are for a Highly Vulnerable development, under TAN15, the Development Proposals may be considered inappropriate. This report aims to demonstrate that after the implementation of mitigation measures the proposal would be appropriate, however this cannot be guaranteed. Were the proposals to be adapted to only have commercial usage on the ground floor, this would lower the risk envelope that the development presents.

8 Flood Risk Overview

8.1 Introduction

The following are the most common forms of flooding. These forms of flooding need to be assessed under the requirements of TAN15 via a Flood Consequence Assessment. The following sub-sections deal with each of these mechanisms in turn.

8.2 River Flooding (Fluvial)

Occurs when a watercourse cannot cope with the water draining into it from the surrounding land. This can happen, for example, when heavy rain falls on an already waterlogged catchment.

8.3 Coastal Flooding (Tidal)

Results from a combination of high tides and stormy conditions. If low atmospheric pressure coincides with a high tide, a tidal surge may happen, which can cause serious flooding.

8.4 Flood Risk Thresholds

TAN15 advice to planning authorities suggests that development should be designed to be flood free during the 1% fluvial flood (i.e. that fluvial flood with a 1 in 100 chance of occurring in any year) and the 0.5% tidal/coastal flood (i.e. 1 in 200 chance in any year event). There is therefore a frequency threshold of flooding, below which flooding of development should not be allowed. The following table provides indicative guidance as to what that frequency threshold could be for different types of development, described in terms of annual probability of occurrence (Table 7):

Table 7: Flood Risk Frequency Thresholds

Type of development	Threshold Frequency (Years)	
	Fluvial	Tidal
Residential	1%	0.5%
Commercial	1%	0.5%
Industrial	1%	0.5%
Emergency Services	0.1%	0.1%
General Infrastructure	1%	0.5%

Beyond the threshold frequency, proposed development would be expected to flood under extreme conditions. However, even with adequate mitigation measures in place, it may still not be sensible to allow particular development to take place. For instance, it would not be sensible for developments to be built in areas where the velocity and depth of floodwaters was such that structural damage was possible or that people could be swept away by the flood. The following table, from paragraph A1.15 in TAN15, provides indicative guidance on what is considered tolerable conditions for different types of developments (Table 8).

Table 8: Flood Risk Thresholds

Type of Development	Maximum depth of flooding (m)	Maximum rate of rise of floodwaters (m/hr)	Maximum speed of inundation of flood risk area (hrs)	Maximum velocity of floodwaters (metres/sec)
Residential	0.6	0.1	4	0.15

Type of Development	Maximum depth of flooding (m)	Maximum rate of rise of floodwaters (m/hr)	Maximum speed of inundation of flood risk area (hrs)	Maximum velocity of floodwaters (metres/sec)
Commercial/Retail	0.6	0.3	2	0.15
Industrial	1	0.3	2	0.3
Emergency Services	0.45	0.1	4	0.15
General Infrastructure	0.6	0.3	2	0.3

8.5 Surface Water (Pluvial)

Occurs when heavy rainfall overwhelms the drainage capacity of the local area. It is difficult to predict and pinpoint, much more so than river or coastal flooding.

8.6 Sewer Flooding

Occurs when sewers are overwhelmed by heavy rainfall or when they become blocked. The likelihood of flooding depends on the capacity of the local sewerage system. Land and property can be flooded with water contaminated with raw sewage as a result. Rivers can also become polluted by sewer overflows.

8.7 Groundwater Flooding

Occurs when water levels in the ground rise above surface levels. It is most likely to occur in areas underlain by permeable rocks, called aquifers. These can be extensive, regional aquifers, such as chalk or sandstone, or may be more local, sand or river gravels in valley bottoms underlain by less permeable rocks.

9 Flood Risk: Historic Records

9.1 Recorded Flooding

The Environment Agency publishes records of historic flooding² and this data has been reviewed. There are no recorded instances of flooding on the Environment Agency's Historic or Recorded flood data, within 850m of the site (Figure 6).

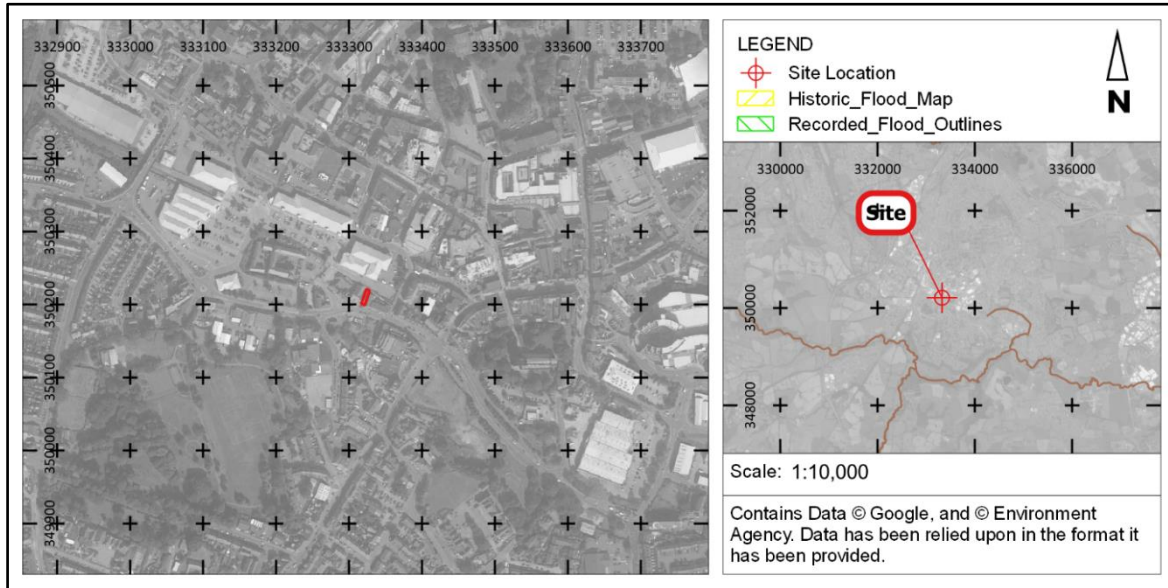


Figure 6: EA Historic and Recorded Flood Outlines

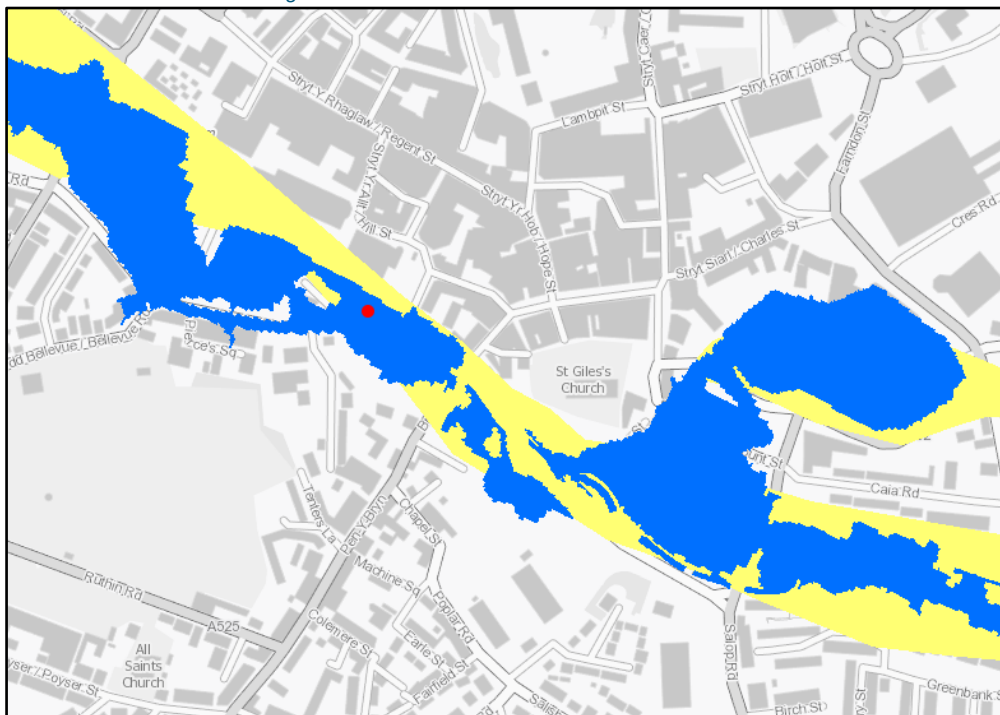


Figure 7: Development Advice Map Flood Outlines (blue is FZ C2, yellow is FZ B)

² [Historic Flood Map - data.gov.uk](https://data.gov.uk)

9.2 Site Owner Recorded Flooding

The site owner has provided no details of flooding having affected the Application Site.

10 Flood Risk: Tidal Flooding

10.1 Tidal Flooding Definition

Tidal flooding results from a combination of high tides and stormy conditions. If low atmospheric pressure coincides with a high tide, a tidal surge may happen, which can cause serious flooding.

10.2 Baseline Tidal Flood Risk

Comparison of the Environment Agency's Coastal Design Sea Levels³ with the ground level at the Application Site is presented in Table 9.

The development is shown to not be at risk of tidal flooding

Table 9: Environment Agency 2018 Coastal Design Sea Levels

Baseline Tidal Flood Risk	1 in 200 RP (Medium Risk)	1 in 1,000 RP (Low Risk)
Coastal Design Sea Level	6.4 mAOD	6.59 mAOD
Average Ground Level at Site	75.3 mAOD	
Predicted Flood Depth (no mitigation)	0m	0m
At risk of tidal flooding?	No	No

10.3 Post Development Tidal Flood Risk

There is no increase in tidal risk post development.

10.4 With Climate Change Tidal Flood Risk

By application of the Environment Agency's climate change allowances, the predicted future tidal flood level can be calculated, as summarised in Table 10.

Table 10: Predicted Tidal Flood Level in 2125 for a range of return periods

Future Tidal Flood Risk	1 in 200 RP (Medium Risk)	1 in 1,000 RP (Low Risk)
Coastal Design Sea Level	6.40 mAOD	6.59 mAOD
Climate Change Allowance (Upper End)	1.41m	
Future Design Sea Level (2125)	7.81 mAOD	8.00 mAOD
Average Ground Level at Site (LiDAR)	75.3 mAOD	
Predicted Flood Depth (no mitigation)	0m	0m
At risk of tidal flooding?	No	No

The current ground level at the Application Site is significantly higher than the predicted future 1 in 1,000 RP with the Climate Change allowance up until 2125. Therefore, the Application Site is at Very Low Risk of tidal flooding

³ <https://data.gov.uk/dataset/73834283-7dc4-488a-9583-a920072d9a9d/coastal-design-sea-levels-coastal-flood-boundary-extreme-sea-levels-2018>

10.5 Mitigation Measures

As the Application Site is not identified as being at risk of tidal flooding, no specific mitigation measures are considered necessary.

10.6 Residual Risk of Tidal Flooding

As the Application Site is not identified as being at risk of tidal flooding the residual flood risk is Very Low.

10.7 Assessed Tidal Flood Risk

Considering the impacts of climate change and the other factors discussed above, the assessed fluvial flood risk over the development lifespan is **Very Low**.

11 Flood Risk: Fluvial Flooding

11.1 Fluvial Flooding Definition

River flooding occurs when a watercourse cannot cope with the water draining into it from the surrounding land. This can happen, for example, when heavy rain falls on an already waterlogged catchment.

11.2 Assessment Methodology

In order to determine the flood risk from fluvial sources, the NRW flood map has been inspected. The greatest flood depth has been compared to the ground level (from LiDAR) to determine the predicted flood level. It should be noted that the fluvial flood map is presented in large bandings of depth. In all cases, the upper value of the band has been used to determine the flood depth. It should be acknowledged that this may result in an over-estimate of flood levels, as it is unlikely that in all cases the peak of the band is reached.

11.3 Baseline Fluvial Flood Risk

NRW mapping shows that the site is at Low risk of fluvial flooding. Low means that each year, this area has a chance of flooding of between 1 in 1000 (0.1%) and 1 in 100 (1%).



Figure 8: Fluvial Risk

The nearest classified main river, the River Gwenfro, starts more than 1000m away. Whilst it is not classified as a main river beyond this, this watercourse does extend up through Wrexham, being culverted beneath the town but occasionally daylighting. It is the Gwenfro which causes the fluvial risk visible in Figure 8.

There are no modelled flood levels available for this area; however, comparing the edge of the flood outline to the LiDAR shows that the expected peak flood level for the 0.1% AEP event is approximately 75.8 mAOD.

Table 11: Environment Agency Fluvial Flood Levels

Baseline Fluvial Flood Risk	1 in 30 RP (High Risk)	1 in 100 RP (Medium Risk)	1 in 1,000 RP (Low Risk)
Predicted Fluvial Flood Levels	N/A	N/A	75.8 mAOD
Average Ground Level at Application Site	75.3 mAOD		
Predicted Flood Depth (no mitigation)	0m	0m	0.5m
At risk of fluvial flooding?	No	No	Yes

11.4 Post Development Fluvial Flood Risk

The development will not increase the level of flood water experienced at the site nor will there be any change to offsite risk. However, the proposal did plan to change the downstairs to include residential usage which raises the risk classification.

11.5 With Climate Change Fluvial Flood Risk

The central climate change estimate for predicted river flow increases is 20% for the Dee catchment. Whilst in reality there is not a 1:1 correlation between increases in flow and increases in depth, taking a conservative approach increases depth at the site from 0.5m to 0.6m, as summarised in Table 12.

Table 12: Predicted Fluvial Flood Level for a range of return periods

Future Fluvial Flood Risk	1 in 20 RP	1 in 100 RP	1 in 1,000 RP
Predicted Fluvial Flood depth (Present Day)	N/A	N/A	0.5 m
Climate Change Allowance (Central Allowance)	20%		
Predicted Fluvial Flood Levels (Climate Change)			75.9 mAOD
Average Ground Level at Site	75.3 mAOD		
Predicted Flood Depth (no mitigation)	0m	0m	0.6m
At risk of fluvial flooding?	No	No	Yes

The current ground level at the Application Site is significantly higher than the predicted future 1 in 100 RP with the Climate Change allowance up until 2080. The 1 in 1000 RP with climate change results in a depth of up to 0.6m, which is within acceptable depth tolerances. Therefore, the Application Site is at Low Risk of fluvial flooding.

11.6 Mitigation Measures

To meet the Justification and Acceptability criteria (laid out in Section 4.2) the developer must:

- Make any occupiers aware of the flood risks and implement an evacuation procedure.
- Be designed to minimise structural damage during a flooding event and be flood proofed to enable it to return to usage quickly post event.
- Not increase flooding elsewhere.
- Ensure that during an extreme event (1 in 1000 chance) there would be less than 600mm of water within the property.

Mitigation measures should include raising plug sockets at least 600mm off the floor, ensuring that vulnerable electronics are raised off floor level, ensuring that occupants are signed up to flood alerts via Natural Resources Wales (<https://naturalresources.wales/flooding/sign-up-to-receive-flood-warnings/>), implementing an evacuation plan and ensuring occupants are aware of what to do if an extreme event were to occur. Additionally, if there is sleeping accommodation on the ground floor, it is recommended to raise the bedroom floor level to provide further protection in the event that an occupier decides not to evacuate.

Exclusion of water from the property would likely not be accepted by NRW, as this would pass on the flood risk and increase the impacts elsewhere.

11.7 Residual Risk of Fluvial Flooding

Risk is made of two components. The first is likelihood of the event, and the second is hazard from the event. The mitigation measures do not change the likelihood of the property inundating however they do lower the hazard and potential damages should the event occur. Therefore, the application site is identified as only having a **Very Low** residual flood risk should the mitigation measures be implemented.

11.8 Assessed Fluvial Flood Risk

The development is to include ground floor residential usage. This increases the risk as the existing building does not have any ground floor sleeping accommodation and there does not seem to be any safe refuge available for any proposed ground floor occupants. The assessed fluvial flood risk is **Very Low** should the mitigation measures be implemented. The initial risk is Low and the mitigation measures serve to reduce this down to Very Low.

12 Flood Risk: Surface Water Flooding

12.1 Surface Water Flooding Definition

Surface water flooding occurs when heavy rainfall overwhelms the drainage capacity of the local area. It is difficult to predict and pinpoint.

12.2 Assessment Methodology

In order to determine the flood risk from surface water sources, the Environment Agency surface water flood map has been inspected. The greatest flood depth has been compared to the ground level (from LiDAR) to determine the predicted surface water flood level. It should be noted that the surface water flood map is presented in large bandings of depth. In all cases, the upper value of the band has been used to determine the flood depth. It should be acknowledged that this may result in an over-estimate of flood levels, as it is unlikely that in all cases the peak of the band is reached.

12.3 Baseline Surface Water Flood Risk

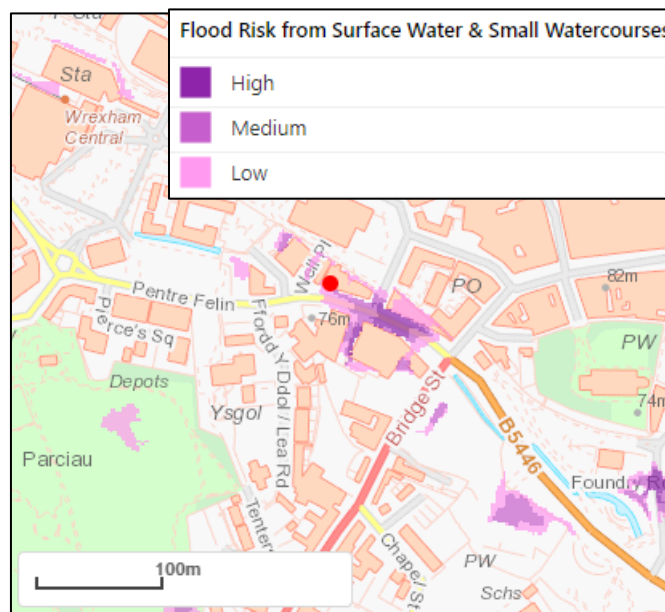


Figure 9: Surface Water Flood risk

Comparison of the NRW surface water flood map with the ground level at sampled point is presented in Table 13.

Table 13: Surface water Flood Levels

Baseline Surface Water Flood Risk	1 in 30 RP (High Risk)	1 in 100 (Medium Risk)	1 in 1,000 RP (Low Risk)
Predicted Flood Depth Band, upper value	N/A	N/A	Between 150mm and 300mm
Sampled Ground Level at worst case flood depth	75.4 mAOD		
Predicted Flood Level (no mitigation)			75.4 mAOD

Baseline Surface Water Flood Risk	1 in 30 RP (High Risk)	1 in 100 (Medium Risk)	1 in 1,000 RP (Low Risk)
At risk of surface water flooding?	No	No	Yes

12.4 Post Development Surface Water Flood Risk

The Development is shown to be at risk of surface water for a 1 in 1,000 year event, with predicted flood depths up to 0.3m. In order to understand this risk further, a sample of the ground level at the edge of the extreme scenario was taken. This shows that the likely maximum flood level is 75.4m AOD. The average ground level at the site is expected to be approximately 75.3m AOD. This presents 0.1m of flood depth to the property.

12.5 With Climate Change Surface Water Flood Risk

The current Environment Agency surface water flood risk maps currently do not incorporate predicted climate change allowances. However, due to the predicted increases in peak rainfall intensity, it is likely that surface water flood depths will increase over the lifetime of the development. Consequently, appropriate surface water mitigation measures will need to consider depths above the present day predicted level.

12.6 Mitigation Measures

On the basis that the site is predicted to be at risk from surface water flooding, it will be necessary to include surface water flood mitigation measures within the developments design. Mitigation options are fully discussed in the 'Recommendations' section of this document, and a property threshold of 0.15m is recommended. This threshold would work in combination with the fluvial protection mitigation measures.

12.7 Residual Risk of Surface Water Flooding

Based on the assessment of surface water flood risk above and taking into consideration the mitigation measures, the residual surface water flood risk is **Very Low**.

12.8 Assessed Surface Water Flood Risk

After considering the impacts of climate change and the other factors, such as mitigations, the assessed surface water flood risk over the development lifespan is **Very Low**.

13 Flood Risk: Groundwater Flooding

13.1 Groundwater Flooding Definition

Groundwater flooding is the emergence of groundwater at the ground surface or into subsurface voids or structures, arising as a result of:

- abnormally high groundwater heads or flows;
- the introduction of an obstruction to groundwater flow; or
- the rebound of previously depressed groundwater levels.

Groundwater flooding most commonly occurs in unconfined aquifers; either major aquifers from which considerable amounts of water can be discharged or in shallow permeable sediments. Flooding locations are typically near areas of natural groundwater discharge, such as river valleys and spring lines.

13.2 Baseline Groundwater Flood Risk

By reviewing the British Geological Survey AStGW, the Development site is classified as having high vulnerability for groundwater flooding to occur (**High Risk**).

13.3 Post Development Groundwater Flood Risk

Based on the existing topography and the scale of the Application Site, it is anticipated that earthworks will not need to be undertaken.

13.4 With Climate Change Groundwater Flood Risk

According to the UK Groundwater Forum⁴, the effects of the predicted impacts of climate change may include:

- a long term decline in groundwater storage;
- increased frequency and severity of groundwater droughts;
- increased frequency and severity of groundwater-related floods;
- mobilisation of pollutants due to seasonally high water tables;
- saline intrusion in coastal aquifers, due to sea level rise and resource reduction.

These impacts cannot be locally managed and would need a catchment wide resource management plan to mitigate the risks.

13.5 Mitigation Measures

As the Application Site is identified as being at risk of groundwater flooding, specific mitigation measures are considered necessary. Although the Development Proposals do not currently include any references to below ground habitation the risk of groundwater flooding means that any future below ground amendments are discouraged.

Perched groundwater may be present below areas of the Application Site and could be encountered during the below ground civil engineering works. The perched groundwater, if encountered, would need to be

⁴ Groundwater Resources and Climate Change, http://www.groundwateruk.org/Groundwater_resources_climate_change.aspx#:~:text=The%20effects%20of%20climate%20change,th%20UK%20therefore%20may%20include%3A&text=increased%20frequency%20and%20severity%20of,to%20seasonally%20high%20water%20tables

mitigated for by appropriate construction techniques and in accordance with an appropriate method statement, to ensure Health and Safety and Environmental permitting requirements are satisfied.

As groundwater flooding can potentially originate within buildings it is recommended to raise electrical by 600mm and also position any vulnerable electronics above ground level.

13.6 Residual Risk of Groundwater Flooding

Based on the assessment of groundwater flood risk above and taking into consideration the mitigation measures, the residual groundwater flood risk is **Low**.

13.7 Assessed Groundwater Flood Risk

Considering the impacts of climate change and the other factors discussed above, the assessed groundwater flood risk over the development lifespan is **Low**.

14 Residual Flood Risk

Residual risks are those remaining after applying the sequential approach to the location of development and taking mitigating actions. Examples of residual flood risk include:

- the failure of flood management infrastructure, such as a breach of a raised flood defence, blockage of a surface water conveyance system, overtopping of an upstream storage area or failure of a pumped drainage system;
- failure of a reservoir, or;
- a severe flood event that exceeds a flood management design standard, such as a flood that overtops a raised flood defence, or an intense rainfall event which the drainage system cannot cope with.

14.1 Flood Defence Breach

14.1.1 Flood Defence Breach Definition

The consequence of a failure of part of a flood defence could result in the rapid release of water in an area that would otherwise not be at risk of flooding. If such an event were to occur, there could be very little warning time. Therefore, it is unlikely that prior evacuation from an area at risk could be achieved.

14.1.2 Flood Defence Breach Analysis

The Application Site is not in an area that benefits from flood defences therefore, the Application Site is not at residual risk of a flood defence breach and no specific mitigation measures are required.

14.2 Reservoir Failure

14.2.1 Reservoir Flooding Definition

The emergency response of a partial structural failure of the Toddbrook Reservoir (2019) indicates the level of significance attached to the potential consequences of a dam failure. The response to the Toddbrook Reservoir incident and evacuation of residents within the potential hazard area demonstrates that reasonable and co-ordinated steps can be taken to manage the residual risk of reservoir flooding.

In the unlikely event that a reservoir dam was to fail, a large volume of water would escape at once, with little or no warning. According to the EA, there has been no loss of life in the UK from reservoir flooding since 1925.

All large reservoirs must be inspected and supervised by reservoir panel engineers, as detailed by the enforcement authority for the Reservoirs Act 1975 in England. NRW are responsible to ensure that reservoirs are inspected regularly and to ensure that essential safety work is carried out.

As reservoir flooding is unlikely and the modelled flood depths are based on the worst-case scenario, flooding from this source may be considered as a relatively low risk. Through the management of the risks via the reservoir act and the work of Natural Resource Wales, the risk of reservoir flooding can be considered to have been reduced to as low a level as practical.

14.2.2 Assessment Methodology

Natural Resource Wales has published mapping that indicates whether an area is at risk of reservoir flooding under two conditions:

- 1 When river levels are normal;

2 When there is also flooding from the rivers.

14.2.3 Reservoir Flood Risk Analysis

The NRW risk of reservoir flooding mapping indicates that the site is not at risk as a result of a modelled reservoir failure. (Figure 10).



Figure 10: Risk of Reservoir Flooding

14.3 Canal Failure

Canal Failure could result in flooding if a section of raised canal, either on an embankment or on a viaduct, was to fail.

As the Application Site is not within 1km of a raised canal, it is considered that the residual risk of canal flooding is very low.

15 Flood Warning & Emergency Plan

The site is within a Flood Alert Area (Figure 11) and experiences low risk of fluvial flooding. Additionally, there is surface water flooding at the front of the property. As such, a Flood Warning & Emergency Plan is considered necessary to support the development proposals.

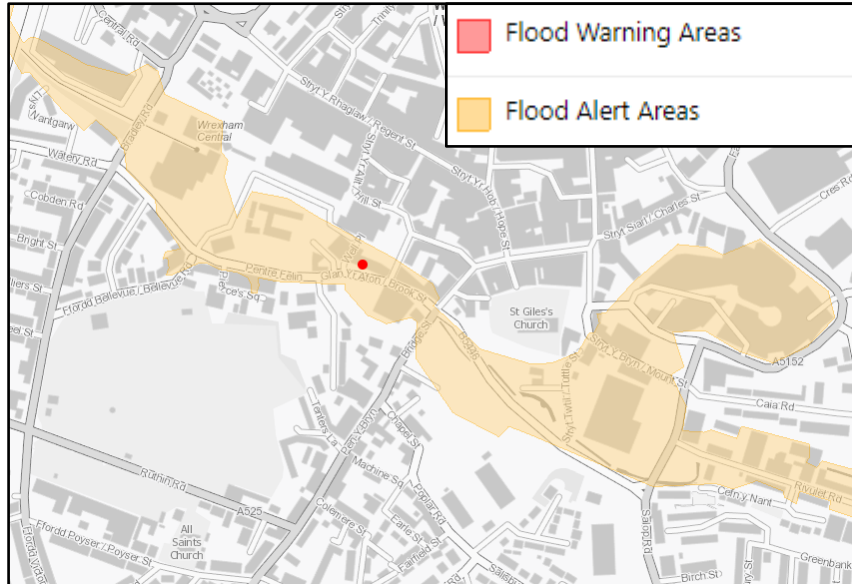


Figure 11: Flood Alert Area



Figure 12: Proposed Evacuation Route

Given the location of the site, the onset of flooding is likely to be rapid. Site users are therefore recommended to sign up to the NRW Flood Alert service: (<https://naturalresourceswales.gov.uk/flooding/sign-up-to-receive-flood-warning/>). If an alert is issued and evacuation recommended, then the preferred route is to go south-east along Brook Street for 40 metres before turning left (north) onto Vicarage Hill and proceeding along that road for another 40 metres until out of the floodplain. This route minimises the amount of time that users will be potentially exposed to floodwaters whilst ensuring that there is further access to transport links at the end of the evacuation route.

16 Off Site Impacts

16.1 Impact to Flood Risk Elsewhere

The Development Proposals will not displace flood waters, as the proposals relate to internal change of use and so do not increase the built footprint and will not increase flood risk to others.

The Development Proposals are not predicted to impact groundwater flows, and as such will not alter the groundwater flood risk in the area.

The Application Site is not at residual risk of flooding either from a breach in defences or from a breach in a reservoir.

The site proposals do not change the built footprint, and so therefore do not impact the amount of surface water runoff generated.

Therefore, there will be negligible change to flood risk elsewhere as a result of the Development Proposals.

17 Recommendations

17.1 Flood Resilient Construction Techniques

Based on the findings of this assessment, it is recommended that the client should incorporate the following mitigation measures:

17.1.1 Construction

- Structures exposed to flood depths of greater than 600mm depth of floodwater are at risk of structural failure. Therefore, the Development Proposals should be designed to accommodate loadings associated with the predicted depth of floodwater;
- Basement and ground floor internal render to be waterproof;
- Ground floor to be solid (i.e. concrete floors), where possible, with waterproof membrane;
- Damp proof membranes should be included within the design of the building, to minimise the passage of water through ground floors. Impermeable polythene membranes should be at least 1200 gauge to minimise ripping. Effective methods of joining membrane sections are overlaps of 300mm, and also taping (mastic tape with an overlap of 50mm minimum). Care should be taken not to stretch the membrane in order to retain a waterproof layer;
- All floors to be finished with waterproof screed (where possible);
- Wall cavities to be filled with closed-cell foam throughout;
- Exterior ventilation outlets, utility points and air bricks to be fitted with removable waterproof covers;
- External walls to be resistant to flooding to at least 900mm above external ground level;
- Exterior ventilation outlets, utility points and air bricks to be fitted with removable waterproof covers;
- Utilise waterproof seals on the doors/windows of the new building, to minimise flood water ingress during a flood event; and
- Ground floor threshold levels to be raised at least 150mm above external ground levels, to mitigate against extreme overland flows.

17.1.2 Interior Fittings

- Kitchen units to be of solid, water resistant material;
- Units to be raised on legs above plinth; and,
- Use of MDF carpentry (i.e. skirting, architrave, built-in storage) to be avoided at the ground floor level.

17.1.3 Electrical Connections

- Ground floor electrical main ring to be run at least 900mm above external ground level;
- Electrical incomer and meter to be situated at least 900mm above external ground level; and,
- Bringing down electrical services from ceilings on the ground floor (where possible).

17.1.4 Gas / Water Supply

- Boilers, control and water storage / immersion to be installed at least 900mm above external ground level and, where possible, to be installed at first floor level or above;
- Gas meter to be installed at least 900mm above external ground level; and,
- All plumbing insulation to be of closed-cell design.

17.1.5 Drainage

- Maintenance responsibilities should clearly identify which assets would be private and which would be public;
- Manhole / Inspection chamber covers to be secured;
- Anti-syphon fitted to all toilets; and,
- Non-return valves on sewers to be installed separately on the foul and surface water systems, to prevent back-flow and “self-flooding”.

17.1.6 Flood Warning & Emergency Plan

As detailed within Section 15 of this report, it is concluded that there is a need for a Flood Emergency Plan.

17.1.7 Safe Access and Egress

The EA Flood Hazard Ratings (guidance set out in FD2120/TR2 and FD2321/TR1) as well as the HR Wallingford and Environment Agency (May 2008) ‘Supplementary Note on flood hazard ratings and thresholds for development planning and control purpose’ outline the requirements for safe access and egress.

The EA Flood Hazard Rating is categorised as follows:

- Very low hazard: use caution
- Danger for some: includes children, the elderly and the infirm
- Danger for most: includes the general public
- Danger for all: includes emergency services

Appropriate access and egress has been considered as part of the Flood Warning & Emergency Plan contained in Appendix D.

17.2 Post Planning Consents

Following Planning Consent, several Post Planning Consents may be required, which are likely to be informed by the findings of this document.

17.2.1 Flood Risk Activity Permit

Any works within 8m of a fluvial Main River or 16m of a tidal watercourse will require an Environment Agency Flood Risk Activity Permit. These are usually obtained post planning, once the detailed design of the proposed activities has been developed to a substantially complete status, including method statements for the proposed works to be undertaken.

17.2.2 Ordinary Watercourse Consent

Any works within 8m of an Ordinary Watercourse will require Ordinary Watercourse Consent from either the LLFA or, where present, an IDB. These are usually obtained post planning, once the detailed design of the proposed activities has been developed to a substantially complete status

17.2.3 Development within 3m of a Public Sewer

Based on the current information, the Development Proposals are not within 3m of a Public Sewer and therefore easements are unlikely to be required. This should be confirmed with the Public Sewer Authority.

17.2.4 Sewer Connection

Any new sewer connection to the public sewer should be agreed with the Public Sewer Authority, prior to starting work on site.

18 Conclusions

Ambiental Environmental Assessments, a company of Royal HaskoningDHV, has been appointed by Violetta Niklas to undertake a Natural Resource Wales compliant Flood Consequence Assessment (FCA) for the Development Proposal located at 36 Brook Street, Wrexham, LL13 7LL.

The proposed development is for the redevelopment of the site to provide partial conversion of the existing mixed use building (retail at ground floor and two flats above) to create five flats with one at ground floor, and retaining part of the retail space.

According to TAN15 this would change the Development Vulnerability classification from Less Vulnerable to Highly Vulnerable.

The key findings of the Flood Consequence Assessment are as follows:

- The site is within Flood Zone C2.
- Fluvial risk is **Low** with the site only being affected by flooding with a <1% annual chance of occurrence. Should an extreme event occur it is possible, taking into account climate change, that the site could flood up to a depth of 0.6m. This does not exceed recommended thresholds.
 - Mitigation measures, signing up for flood alerts, and implementation and distribution of an evacuation plan can all help to reduce the impact of such an event.
- Surface Water risk is **Low**. There is an area of surface water flooding directly in front of the property however depths are expected to remain below 150mm which is below the expected property threshold height. If the property threshold is less than this it is recommended to raise the threshold to at least 150mm above the ground. Flood mitigation measures (primarily aimed at reducing fluvial risk) also help ensure that the risk posed by surface water flooding is negligible.
- Groundwater risk is **Low** as the ground conditions are amenable to groundwater flooding however no below ground development is planned and the mitigations recommended for fluvial and surface water risk will also mitigate against groundwater flood risk.
- Tidal risk is **Negligible**.
- Residual risk is **Negligible**. The site does not benefit from flood defences, so there is no residual risk of flooding in the event of defence breach or failure. The site is not within the predicted reservoir breach flood outline.

The Flood Consequence Assessment has been undertaken in accordance with the requirements of Natural Resource Wales and it can be demonstrated that the Development Proposals are compatible with the predicted flood risk profile, including climate change allowance over the development lifetime.

The residential nature is shown to be acceptable according to the guidance as it does not exceed frequency of flooding thresholds, flood depth experienced thresholds, and is within a flood alert area with a quick and simple evacuation route available. However it should be noted that despite these facts, planning permission is not guaranteed and it may be the case that a reviewing planning officer takes an opposing view. The development has a classification of Highly Vulnerable given the residential use. However if the Developer was concerned about ensuring planning, removing the downstairs residential unit from the plans and only having commercial use on the ground floor would improve the risk profile. To be clear, this change is not required for the development to be considered acceptable from a flood risk viewpoint.

The Development Proposals are not predicted to increase the risk of flooding to others over the development lifetime. Consequently, it is concluded that, with regards to Flood Risk requirements, the Development Proposals are acceptable.

19 Glossary

Term	Definition
AEP	Annual Exceedance Probability is the probability of a rainfall or tidal event occurring within any one year. For example, an event of a 100 year return period has an AEP of 1:100 or 1%.
Courant Number	A function of the amount of fluid that crosses the cell in a given time-step. For 2d modelling the Courant Number generally needs to be less than 10 and typically around 5 or less for real-world applications.
Flood Defences	Artificial structures maintained to a set operational level designed to protect land people and property from Tidal and Fluvial flood sources to an established chance of happening in any year threshold.
Flood Source: Fluvial (River)	When flows within watercourses exceed the capacity of the watercourse causing out of bank flows.
Flood Source: Groundwater	Groundwater flooding is usually the result of prolonged wet weather causing groundwater levels to rise sufficiently to either emerge at surface or to cause flooding of below ground infrastructure, such as basements.
Flood Source: Surface water	When rainfall causes overland flows which exceed the capacity of the drainage network, causing flooding to land that is normally dry.
Flood Source: Tidal	When high tide events overtop the shoreline to cause flooding to land behind.
Flood Zone 1	Low Probability. Land defined as having a less than 1:1000 annual probability of flooding from tidal and fluvial sources.
Flood Zone 2	Medium Probability. Land defined as having a risk of fluvial flooding between 1:100 annual probability and 1:1000 annual probability. Or Land defined as having a risk of tidal flooding between 1:200 annual probability and 1:1000 annual probability.
Flood Zone 3 (A)	High Probability. Land defined as having a fluvial risk of 1:100 annual probability or greater. Or a tidal risk of 1:200 annual probability or greater.
Flood Zone 3 (B)	Functional Floodplain. Defined by SFRA's as areas where floodwater is stored during lower AEP events, typically the 1:20 annual probability.
Flood Zone Map	The Environment Agency has produced a mapping data set which covers England and provides the general extents of Flood Zones 1, 2, and 3. However the national data set available online does not differentiate between Flood Zone 3 (A) and 3 (B).
Freeboard	In flood risk management Freeboard is a term used to identify the vertical difference between the design flood level, and the design height of any flood mitigation measures. For instance if a pond had bank heights of 9.0m and the water level was at 8.6m the freeboard would be 0.4m (9.0-8.6)
LiDAR	"Light Detection and Ranging (LIDAR) is an airborne mapping technique, which uses a laser to measure the distance between the aircraft and the ground. Up to 500,000 measurements per second are made of the ground, allowing highly detailed terrain models to be generated at spatial resolutions of between 25cm and 2 metres." EA LiDAR
Main River	Defined on the Main River map and relate to rivers on which the Environment Agency have powers to carry out flood defence works.
m AOD	Metres Above Ordnance Datum.
OS	Ordnance Survey
Ordinary Watercourse	A watercourse which does not form part of a Main River, works on Ordinary Watercourses usually require consent from either the Lead Local Flood Authority, or the Internal Drainage Board (where one exists).

Term	Definition
Qbar	Qbar is the mean annual maximum flow rate, for a catchment which has an equivalent return period of 1 in 2.3 years
Return Period	The return period of a flood might be 100 years; otherwise expressed as its probability of occurring being 1 in 100, or 1% in any one year. If a flood with such a return period occurs, then this does not mean the next will occur in about one hundred years' time - instead, it means that, in any given year, there is a 1% chance that it will happen, regardless of when the last similar event was. Or, put differently, it is 10 times less likely to occur than a flood with a return period of 10 years (or a probability of 10%).
SuDS	Sustainable Drainage Systems, which are designed to manage surface water flows in order to mimic the Greenfield run-off from an undeveloped site.
Urban Creep	Urban creep is the conversion of permeable surfaces to impermeable over time e.g. surfacing of front gardens to provide additional parking spaces, extensions to existing buildings, creation of large patio areas.

Appendix

A. Development Proposals

Appendix

B. Third Party Data

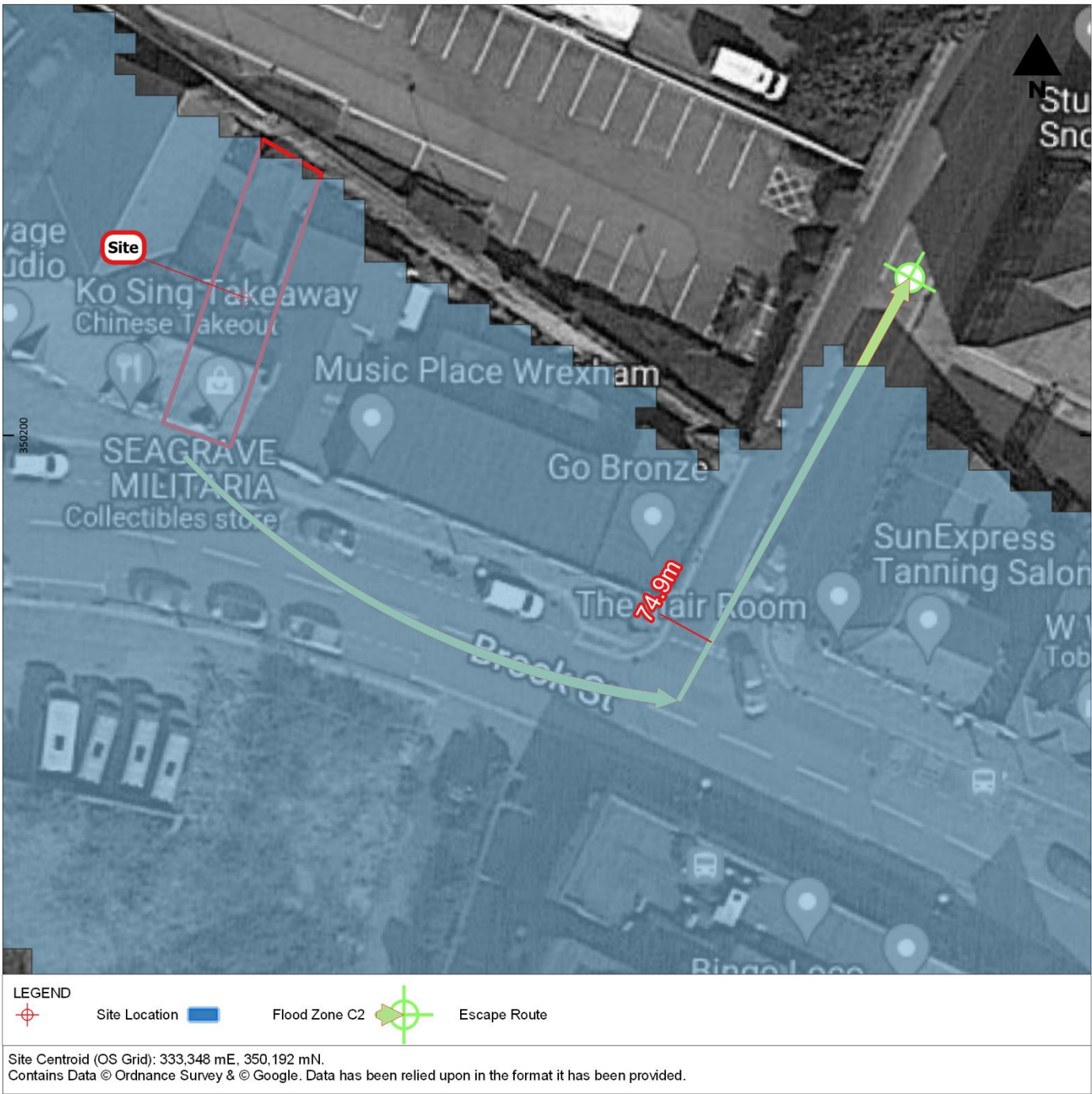
Appendix

C. Calculations

Appendix

D. Drawings

Flood Warning & Emergency Plan, 36 Brook Street, Wrexham



	On receipt of a FLOOD ALERT occupiers should update themselves with the Flood Emergency Plan and ensure all procedures are understood
	On receipt of a FLOOD WARNING the occupiers should be prepared to evacuate.
	On receipt of a SEVERE FLOOD WARNING , the occupiers should evacuate the site unless directly instructed by the Emergency Services. The site should remain closed until the flood warning has been lifted
	Natural Resource Wales, Floodline: 0345 988 1188
	Wrexham Council: 01978 292000 Help with evacuation Police 101, or if an emergency 999. Keep calls short!
	Radio Stations with Flood Warnings BBC Radio Wales - FM: 93 – 104 MHz; AM: 882

Leave site via the front door and exit to Brook Street. Proceed along Brook Street and take the first left, up Vicarage Hill. Proceed up the hill, out of the floodplain.

Under no circumstances should site users enter flood water unless being assisted by emergency services.

The Site should not be reoccupied until the flood warnings have been lifted, or it has been deemed safe to do so, by the emergency services.

Evacuation Route 0.1 mile, 1 minute drive, 2 minute walk
DESTINATION POSTCODE: **LL13 7HN**

 THIS ADVICE SHOULD BE FOLLOWED UNLESS DIRECTED TO TAKE DIFFERENT ACTIONS BY EMERGENCY RESPONDERS (BLUE LIGHT RESPONDERS). **OBEY ALL DIRECTIONS FROM EMERGENCY (BLUE LIGHT) RESPONDERS.**

The emergency services become the first responders during a flood event.

The instructions they give should be followed at all times, even if it contradicts the details of this FWEP.

Firstly, stay calm. This Flood Warning and Emergency Plan (FWEP) has been produced to help you make the right choices in the event of the flood. It has been produced using the best available predictions of flooding, with the intention of keeping you and everyone within the development at 10 Wych Elm, Harlow, London, safe and away from harm.

Driving through floodwaters can be dangerous, do not attempt to drive through floodwaters if you are unable to see the kerb or raised footway, as this indicates that the depth of water is likely to be greater than 150mm, a car can float in 300mm of floodwater.

Check your flood risk:

<https://flood-warning-information.service.gov.uk/long-term-flood-risk>



On receipt of a **FLOOD ALERT** all management staff should familiarise themselves with the flood evacuation plan, and make sure that the processes are in place to alert all staff to the situation.

Local news outlets and radio stations should be monitored to receive up-to-date information.

Alert both current visitors, and those scheduled to arrive, of the situation. Prepare to evacuate if necessary.



On receipt of a **FLOOD WARNING** management staff should alert all staff of the current situation. Measures should be taken to ensure that any important/hazardous materials are moved to a higher level and large loose items (that could float in a flood) are secured.

The site manager should prepare to close the site if necessary. Alert scheduled visitors/contractors etc. that they should not enter the site. Be Prepared to follow instruction from the Emergency Services.

If vulnerable people are on site, it is advised that they are evacuated at this time, to avoid putting them at increased risk, should a severe flood warning be issued.



On receipt of a **SEVERE FLOOD WARNING** site users should remain attentive to local media forecasts and news bulletins. The site should be closed, and everyone should be evacuated.

A temporary refuge has been identified on the plan, but if individuals have access to shelter not at risk of flooding (either their own property, or that of friends or family) that can provide refuge they should make use of their own facilities. This reduces the burden on emergency refuges. As part of the plan preparation it should be identified who is likely to require use of the emergency refuge.

Unless directed to do so by emergency personnel (blue light responders) no attempt to exit the Site should be made if flooding is evident on any of the access routes. The safest course of action is to remain on site and await assistance, at first floor level or above.

If such a flood occurs management staff will contact the emergency services to alert them to the presence of people requiring evacuation.

Contact with floodwater should be avoided, as it can contain untreated sewage, or other contaminants. Flood waters can obscure hazards below the surface, sharp objects, open manholes, and therefore should be treated as a hazard.

Once temporary refuge has been achieved, a register of people present should be taken, and someone should be appointed as the Primary Flood Co-ordinator. This person should co-ordinate with the local emergency services, as appropriate. All mobile phone calls should be kept short in order to enable capacity on the network.

Use of individual mobile phones should be discouraged, this is to free-up service on the network for emergency calls and use by emergency service personnel. This can also preserve battery life, to provide additional back-ups should the need arise.

Flood warnings - know what to do?



**FLOOD
ALERT**

PREPARE

- Prepare a bag that includes medicines and insurance documents
- Visit flood-warning-information.service.gov.uk



**FLOOD
WARNING**

ACT

- Turn off gas, water and electricity
- Move things upstairs or to safety
- Move family, pets and car to safety



**SEVERE
FLOOD
WARNING**

SURVIVE

- Call 999 if in immediate danger
- Follow advice from emergency services
- Keep yourself and your family safe

flood-warning-information.service.gov.uk/what-to-do-in-a-flood

Floodline on 0345 988 1188

#floodaware



Appendix

E. Designers Risk Assessment

Designers Risk Assessment

Date: 15 November 2022
Our reference: 6677-AEA-ZZ-XX-FN-C-5000
Classification: Project related

Risk (5 = Very High, 4 = High, 3 = Moderate, 2 = Low, 1 = Very Low)	Impact [a]	Likelihood [b]	Total Risk [a*b]	Advice / Mitigation (Mitigation only needed for risks > 9)	Residual Impact [c]	Mitigated Likelihood [d]	Residual Risk [c*d]
Working near water. Working near water is a hazardous activity with the potential for fatal accidents.	5	5	25	Appropriate safety briefings and training for any operatives / site visitors when working near water.	4	2	8
Working in a confined space. A confined space is a place which is substantially enclosed (though not always entirely), and where serious injury can occur from hazardous substances or conditions within the space or nearby, i.e., inspections chambers / culverts.	4	5	20	Confined space entry only to be conducted by confined space qualified personnel.	4	1	4
Working on live drainage infrastructure. Exposure to potential contaminants (syngases, hydrocarbons) or biological agents (fungi, parasites, rodents, leptospirosis) within the drainage infrastructure	3	5	15	All works on live drainage systems must be undertaken by suitably qualified and experienced contractors.	3	1	3
Deep excavations for drainage assets. To provide new drainage infrastructure, inspection chambers and pipe runs may be greater than 2m. Risks include: + Conflict with unknown services + Deep excavation, risk of collapse + Exposure of public too deep excavations + Risk of flooding of excavation	4	2	8	Appropriate temporary works to be designed by competent designer, prior to undertaking any deep excavations.	3	1	3
Working within an area at risk of flooding. Portions of the site are identified as being at risk of flooding for a range of annual exceedance probabilities. Risks include: + Loss of plant or equipment in floodwaters + Loss of containment of hazardous materials if flooded (silos / stockpiles) + Risk to people from flood waters	3	2	6	Use of a Flood Warning and Evacuation Plan during construction.	2	2	4
Disposal of debris / waste within existing drainage system. All debris removed from drainage systems shall be hazardous, due to the risk of contamination with hydrocarbons / metals.	3	4	12	Clearance of material from existing drainage infrastructure to be undertaken by competent contractor, licenced to dispose of hazardous waste.	2	2	4
Lifting Inspection Chamber Covers. Risks associated with Manual Handling Risk of damaged / defective covers	3	4	12	Appropriate training and equipment to be used when lifting covers. If cover is noted to be defective, temporary protection measures to be implemented until an appropriate permanent replacement can be installed. Asset owner to be notified immediately.	2	2	4
Drainage Jetting / CCTV. Potential for the public to be exposed to open chambers Slipping hazard associated with jetting operations. Risk of pressurised water / debris causing injury to operators and the public.	4	4	16	Any CCTV Drainage / Jetting works to be undertaken in an area segregated from the public, and suitable signage and barriers deployed as appropriate.	2	1	2
Swale side slopes. Swale side slopes to be set to 1 in 3, but this needs to be confirmed as acceptable by suitable geo-technical studies	2	2	4	No specific mitigation measures needed	2	2	4
Existing utilities. Risk of encountering live above and or below ground utility services and causing harm to individual(s) and affecting services of existing properties	3	3	9	Appropriate site investigations should be undertaken, including for example the use of CAT scanners, to determine the locations of any below ground utilities or services. Any discrepancies between the mapped locations and the actual locations should be recorded.	2	2	4
Below ground obstructions. Previously developed sites may have buried obstructions (foundations / filled in basements) not in evidence from site walk-over / topographic survey	4	2	8	No specific mitigation measures needed – however if below ground obstructions are noted these should be recorded	2	2	4
Perched Groundwater. Localised perched groundwater could be present within impermeable soil strata.	2	2	4	No specific mitigation measures needed – however if groundwater is encountered advice should be sought from a Geo-technical Engineer	2	2	4
Seasonal groundwater variation. Groundwater fluctuation within permeable soil material may result in false negative flood risks if groundwater measurements are taken at during 'dry periods'.	2	2	4	No specific mitigation measures needed – however if groundwater is encountered advice should be sought from a Geo-technical Engineer	2	2	4

Risk (5 = Very High, 4 = High, 3 = Moderate, 2 = Low, 1 = Very Low)	Impact [a]	Likelihood [b]	Total Risk [a*b]	Advice / Mitigation (Mitigation only needed for risks > 9)	Residual Impact [c]	Mitigated Likelihood [d]	Residual Risk [c*d]
Flood defence / main river by-laws. Local by-law distances may require a set-back from the top of bank / back of flood defence to facilitate future maintenance / flood protection measures	3	3	9	Any works within the by-law distance of a Main River or Ordinary Watercourse are likely to need consent before the works start.	2	2	4
Culverted Watercourses. Ordinary watercourses may be located within culverts within the site boundary. Stakeholders may have an ambition to de-culvert and provide naturalised channel, which can cause a constraint on developable area.	4	3	8	Any culverted watercourses on site, as a minimum should be protected, and construction activities within 4m of the outside edge of the culvert should be undertaken with reference to a specific risk management plan	2	2	4
Works to the Public Surface Water Sewer Network.	4	3	9	Any connection to the Public Surface Water Sewer system will need to be consented by the Public Sewer Authority (Discharge Consent)	3	2	6
Management of exceedance surface water flows. During exceedance flood events, natural flood management techniques are at risk of failure due to overtopping (and scour) or earthen embankments / slopes	4	2	8	No specific mitigation measures needed – however, if adverse weather is predicted (including weather warnings from the Met Office) then planned construction activities should be reviewed to minimise the risk to operatives, and third parties	4	2	8
Floodplain compensation. If level for level / volume for volume floodplain compensation is required, this will need to be provided in advance of the activities that necessitate the compensation, to ensure no loss of active floodplain during construction.	4	3	12	Any required floodplain compensation must be completed prior to undertaking the construction of structures / landscaping that require floodplain compensation.	2	2	4
Existing Flood Defences. Existing flood defences will need to be maintained and protected throughout the works.	5	4	20	Any works to existing flood defences will need to be consented by the appropriate Risk Management Agency. All works to flood defences should be closely supervised, and a specific plan in place to deal with potential flooding occurring during works to flood defences	4	1	8
Previously developed areas / fly tipping. Demolition waste / fly-tipping has the potential to contain hazardous materials / waste, especially asbestos.	3	2	6	No specific mitigation measures needed – however if fly tipping is encountered this should be reported and cleared by appropriately licenced contractors.	3	2	6
Ground data accuracy. LiDAR data has known deficiencies especially in areas of dense vegetation or rapidly changing terrain (sub-ground service yards / different age wood plantations / multi-grade separated junctions).	4	3	12	Where ground levels are critical, on-site survey should be undertaken to calibrate flood model outputs, before starting construction.	2	2	4
Ordnance Survey Mapping. Ordnance Survey mapping does not record the 'true' property boundary.	4	2	8	No specific mitigation measures needed, where issues are anticipated consultation with the Land Registry may be required to confirm the property boundaries.	2	2	4
Ground works. Unexploded ordnance	5	1	5	No specific mitigation measures needed – if suspected unexploded ordnance is encountered this should be report to the Police as an Emergency, and their advice should be followed.	4	1	4
Electrified Fences (farming). Electrified fences / wires used in farming may not be adequately signed.	2	1	2	No specific mitigation measures needed – however prior to conducting site inspections, a risk briefing from the site operator must be undertaken.	2	1	2

