GeoSmart Information

FloodSmart Plus

Flood Consequence Assessment

Site Address

Land associated with The Boat Inn
Erbistock
Wrexham
LL13 0DL

Grid Reference

335370, 341310

Report Prepared for

Mr Graham Price

Date

2024-07-11

Report Status

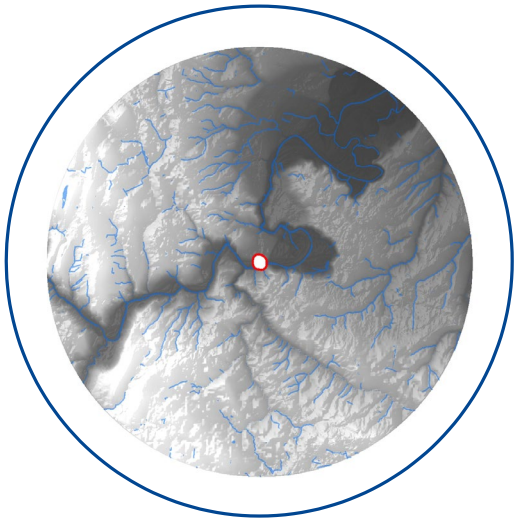
FINAL

Site Area

0.54 ha

Report Reference

82463R1



RISK – Very Low to Low

The Site is located within Flood Zones 1 to 3 and DAM Zones A to C2, which equates a Very Low to Medium risk of fluvial flooding. However, the proposed development is entirely located within Flood Zone 1 / DAM Zone A and has an associated Very Low risk of fluvial flooding.

Surface water (pluvial) flood risks are Very Low to High across the Site; however, the proposed development is located in an area with a Very Low pluvial flood risk.

The risk of groundwater flooding is Negligible to Low, and the risk of flooding from artificial sources (i.e. canals, reservoirs and sewers) is Low.

Mitigation measures are recommended in this report to maintain the risks to an acceptable level over the lifetime of the development.

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1. Executive summary

The Planning Policy Wales (PPW) 12th edition (2024) and Technical Advice Note 15 (TAN 15) (2004) requires Flood Consequence Assessments (FCA) to review flooding from all potential sources. A review has been undertaken of national environmental data sets to assess the potential flood risk to the Site. The review is provided within this concise interpretative report written by an experienced GeoSmart consultant.

It should be noted that the TAN15 (2004) was planned to be updated in June 2023, however, at the time of writing it is understood that this deadline is no longer applicable and a revised TAN is in consultation with the date of publication unknown. The new Flood Map for Planning will supersede the NRW's Development Advice Map (DAM) and the conclusions of this report may change as a result. However, this is yet to be implemented and this report is based upon TAN15 (2004) and DAM.

Site analysis

Source of Flood Risk	Baseline[1]	Area proposed for development[2]	After Mitigation[3]
River (fluvial) flooding	Very Low to Medium	Very Low	Very Low
Sea (coastal/tidal) flooding	Very Low		N/A
Surface water (pluvial) flooding	Very Low to High	Very Low	N/A
Groundwater flooding	Negligible	Negligible to Low	Negligible to Low
Other flood risk factors present (reservoirs)	Yes		N/A
Is any other further work recommended?	Yes (see below)		

1 BASELINE risks assigned for the whole Site, using national risk maps, including the benefit of NRW flood defences.

2 AFTER ANALYSIS modification of risk assessment based on detailed site specific analysis including some or all of the following: flood model data, high resolution mapping, building location, access routes, topographic and CCTV surveys.

3 AFTER MITIGATION risks include risks to the proposed development / asset and occupants if mitigation measures recommended in this report are implemented, including the impacts of climate change.

*N/A indicates where mitigation is not required.

Summary of existing and proposed development

The Site is currently used in part as an overflow car park for the nearby public house (The Boat Inn); the northern part of the Site comprises undeveloped land. Development proposals comprise the construction of a detached single-storey annex containing six bedrooms. The existing car park will be retained.

Summary of flood risks

The flood risks from all sources have been assessed as part of this report and are as follows:

River (fluvial) and Sea (Estuarine/Coastal) flooding

The River Dee is c. 20 m south-east of the Site, from which a fluvial flood risk originates.

According to NRW's Flood Map for Planning, the south-eastern corner of the Site (c. 10% of the Site area) is located within fluvial Flood Zone 3. A further c. 35% of the Site is located within fluvial Flood Zone 2. The remaining c. 55% of the Site area, including the area proposed for development, is located in Flood Zone 1. The existing car park is located within Flood Zones 2 to 3.

The NRW's Development Advice Map (DAM) confirms that the southern c. 55% of the Site, including the existing car park, is located within a DAM Zone C2. The northern c. 45% of the Site, including the area proposed for development, is located within DAM Zone A.

Fluvial flooding previously occurred in the south-east of the Site in January 1964. Flood events also occurred adjacent to the Site in November 2009 and January 2021.

The Site does not benefit from the presence of flood defences.

According to the NRW's Flood Risk Assessment Wales (FRAW) map, which considers the presence of flood defences (albeit, none have been identified within the vicinity of the Site), the Site has a variable risk of fluvial flooding. The risk from Rivers is Medium in the south-east corner (c. 1% of the Site area), Low in the south (c. 40% of the Site area) and Very Low in the remainder of the Site (c. 59% of the Site area). The existing car park is at Low risk and the proposed building is at Very Low risk.

No modelled flood data is available for the River Dee in this area. Therefore, JFLOW modelling and GeoSmart's Flood Analytics mapping, both based on the NRW's Flood Map for Planning, have been used to confirm the maximum flood level at the Site, including the impact of climate change.

- During a 1 in 100 year plus 20% climate change allowance event, the flood level at the Site would be 29.47 mAOD.
- During this event, flood depths would be up to 1.78 m in the south of the Site; however, no flooding is anticipated in the area proposed for development.

Given the above information, a Very Low to Medium risk of fluvial flooding has been identified across the Site. However, a Very Low fluvial flood risk would be appropriate for the area proposed for development.

Surface water (pluvial) flooding

According to NRW's Flood Risk Assessment Wales (FRAW) mapping, the Site has a risk of flooding from surface water and small watercourses ranging from Very Low to High.

- An area of low topography in the south-west of the Site is at Low to High risk of surface water flooding, with isolated ponding anticipated to occur. Flood depths could be up to 0.3 m in all flood scenarios.
- The remainder of the Site, including the area proposed for development, is at Very Low risk of surface water flooding.

Given that the area proposed for development is not anticipated to be impacted by surface water flooding, the surface water flood risk is considered to be Very Low.

Groundwater flooding

Groundwater Flood Risk screening data indicates there is a Negligible potential risk of groundwater flooding at the surface in the vicinity of the Site during a 1 in 100 year event.

- The Site is directly underlain by localised permeable superficial deposits and potentially permeable bedrock, which may be in hydraulic continuity with the nearby River Dee. As such, a shallow groundwater table may be present, which could potentially rise during periods of high river levels; however, given the significant change in ground elevations across the Site, the area proposed for development is unlikely to be impacted (despite the requirement to undertake some excavations into the prevailing landform in order to create a level development platform).

Given the available information, the area proposed for development is considered to have a Negligible to Low risk of groundwater flooding.

Artificial sources of flooding

The risk of flooding from artificial (man-made) sources such as reservoirs, sewers and canals has been assessed:

- The NRW's Risk of Flooding from Reservoir map confirms the Site is at risk of reservoir flooding. However, the potential for a breach of a reservoir to occur and flooding affecting the Site is Low.
- Ordnance Survey (OS) data confirms there are no canals near to the Site.
- There is no Strategic Flood Consequence Assessment (SFCA) for the Wrexham Council area, and therefore no information regarding sewer flooding incidents is available for the Site. However, given the location of the Site within a predominantly agricultural setting, as well as its elevated position relative to nearby developments, the risk of flooding from surcharging sewers is likely to be Very Low.

The risk of flooding from artificial sources is considered to be Low.

The risk to the development has been assessed over its expected 75 year lifetime, including appropriate allowances for the impacts of climate change which could increase the flood risk

to the Site. Risks identified include increases in river flooding and increased potential for surface water flooding, and appropriate mitigation measures are proposed.

Recommendations

Recommendations for flood mitigation are provided below, based upon the proposed development and the flood risk identified at the Site.

- As there is a risk of flooding from fluvial sources in the south of the Site, Finished Floor Levels (FFL) of the proposed development should be set to at least 30.07 mAOD[1]. It is noted that this requirement would be satisfied by the proposed development plans, which have FFLs set at a significantly higher level than the recommended FFL.
- Given that the proposed development includes some excavation below the ground surface and there is a possible source of groundwater flooding, waterproofing of the proposed building should be considered alongside standard flood resilient design and non-return valves on the sewer inlet. French drains and/or pumping systems may also be considered.
- A Flood Warning and Evacuation Plan (FWEP) is recommended to ensure persons using the Site can evacuate safely on receipt of a Flood Warning.
- The Site management should also be signed up to receive NRW Flood Alerts.
- The ongoing management and maintenance of existing and any proposed drainage networks, under the riparian ownership of the developer, should be undertaken in perpetuity with the development.
- A business continuity plan is recommended to reduce risks to people, property and profit.
- A Sustainable Drainage Strategy (SuDS) should be developed for the Site, for effective management of surface water runoff over the lifetime of the proposed development.

GeoSmart recommend the mitigation measures discussed within this report are considered as part of the proposed development where possible and evidence of this is provided to the Local Planning Authority as part of the planning application.

[1] 0.6 m above the 1 in 100 year plus climate change flood level of 29.47 mAOD.

2. Introduction

Background and purpose

A site-specific flood consequence assessment has been undertaken, to assess the flood risk to and from the development Site. This assessment has been undertaken by firstly compiling information concerning the Site and the surrounding area. The information gathered was then used to construct a 'conceptual site model', including an understanding of the appropriateness of the development, as defined in the PPW (2024), and the source(s) of any flood risk present. Finally, a preliminary assessment of the steps that can be taken to manage flood risk to the development was undertaken.

This report has been prepared with reference to the Technical Advice Note (TAN) 15 (2004) which supplements the PPW (2024).

The general approach of PPW, supported by TAN15, is to advise caution in respect of new development in areas at high risk of flooding by setting out a precautionary framework to guide planning decisions. The overarching aim of the precautionary framework is, in order of preference, to:

- Direct new development away from those areas which are at high risk of flooding; and
- Where development is considered to be in high-risk areas (Zone C) only those developments which can be justified on the basis of the tests outlined in Section 6 and Section 7 are located within such areas.

The purpose of this report is to provide clear and pragmatic advice regarding the nature and potential significance of flood hazards which may be present at the Site.

Report scope

A thorough review of a commercially available flood risk report and NRW supplied data has been undertaken, indicating potential sources of flood risk to the Site from rivers and tidal sources, surface run-off (pluvial), groundwater and reservoirs, including historical flood information and modelled flood extent. Appropriate measures are recommended to manage and mitigate the flood risk to the property.

Information obtained from NRW has been used to ascertain local flooding issues and, where appropriate, identify information to support a Justification test and Assessment of Flood Consequences required as part of the PPW (2024). It is noted that a Strategic Flood Consequence Assessment (SFCA) has not been published for the Wrexham Council area.

The existing and future flood risk to and from the Site from all flood sources is assessed in line with current best practice using the best available data. The risk to the development has been assessed over its expected lifetime, including appropriate allowances for the impacts of climate change. Residual risks that remain after the flood risk management and mitigation measures are implemented, are considered with an explanation of how these risks can be managed to keep the users of the development safe over its lifetime.

An indication of whether the Site will potentially increase flood risk elsewhere is provided, including where the proposed development increases the building footprint at the Site. A drainage strategy to control runoff can be commissioned separately if identified as a requirement within this report.

Report limitations

It is noted that the findings presented in this report are based on a desk study of information supplied by third parties. Whilst we assume that all information is representative of past and present conditions, we can offer no guarantee as to its validity and a proportionate programme of site investigations would be required to fully verify these findings.

The basemap used is the OS Street View 1:10,000 scale; however, the Site boundary has been drawn using BlueSky aerial imagery to ensure the correct extent and proportion of the Site is analysed.

This report excludes consideration of potential hazards arising from any activities at the Site other than normal use and occupancy for the intended land uses. Hazards associated with any other activities have not been assessed and must be subject to a specific risk assessment by the parties responsible for those activities.

Datasets

The following table shows the sources of information that have been consulted as part of this report:

Table 1. Datasets consulted to obtain confirmation of sources of flooding and risk

Source of flooding	Datasets consulted			
	Commercial Flood Maps	Local Policy & Guidance Documents*	Natural Resources Wales	OS Data
Historical	X	X	X	
River (fluvial) / Sea (tidal/coastal)	X	X	X	
Surface water (pluvial)	X	X	X	
Groundwater	X	X		

Source of flooding	Datasets consulted			
	Commercial Flood Maps	Local Policy & Guidance Documents*	Natural Resources Wales	OS Data
Sewer		X		
Culvert/bridges		X		X
Reservoir		X	X	

*Local guidance and policy, referenced below, has been consulted to determine local flood conditions and requirements for flood mitigation measures.

Local policy and guidance

For this report, several documents have been consulted for local policy and guidance and relevant information is outlined below:

Wrexham Unitary Development Plan (Wrexham Council, 2005):

Policy EC12

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

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

Policy EC13

Development which would result in an unacceptable adverse impact on the water environment due to additional surface water run-off will not be permitted.

Flood Risk Management Plan: North East Wales (NRW, 2023)

- Storm Christoph (20 January 2021) brought significant rain to all parts of Wales, with the worst impacts affecting North Wales where it recorded one of the wettest 3-day periods on record, with weather fronts bringing persistent rain to these parts. The significant rainfall and river flooding led to the evacuation of some residents in Bangor on Dee and Lower Dee, the collapse of a bridge over the river Clywd and 23 properties flooding in Ruthin, Denbighshire.

Strategic Flood Consequence Assessment:

- No Strategic Flood Consequence Assessment has been identified for the Wrexham Council area

Guidance

Strategic Flood Consequence Assessments are carried out by local authorities, in consultation with the Natural Resources Wales, to assess the flood risk to the area from all sources both now and in the future due to climate change. They are used to inform planning decisions to ensure inappropriate development is avoided (PPW, 2024).

3. Site analysis

Site information

The Site is located in Erbistock in a setting of primarily agricultural land use at National Grid Reference SJ 35370 41310.

Figure 1. Aerial imagery of the Site (Bluesky, 2024)

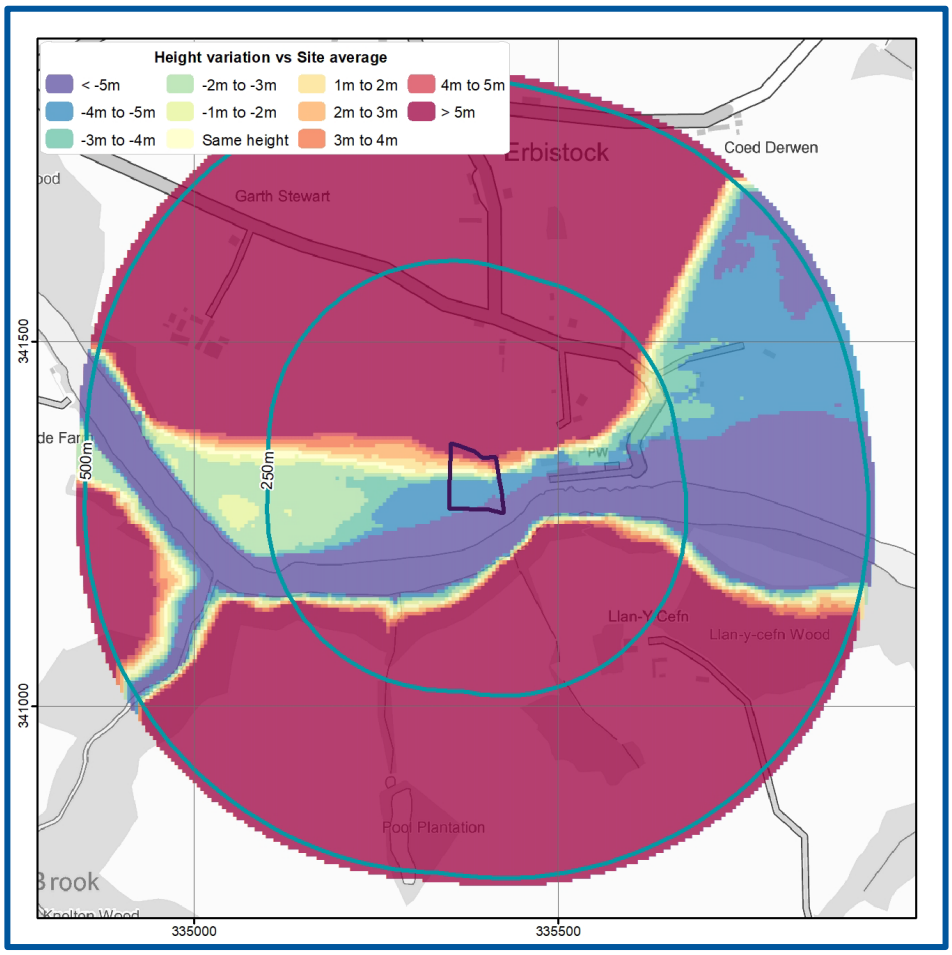


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Figure 2, overleaf, indicates that ground levels within 500m of the Site fall in an easterly / north-easterly direction, following the flow direction of the River Dee.

The general ground levels on the Site are between 27.69 mAOD and 43.74 mAOD, with the Site falling steeply in a southerly direction. This is based on EA elevation data obtained for the Site to a 1 m resolution with a vertical accuracy of ±0.15 m (Appendix B).

Figure 2. Site Location and Relative Elevations (GeoSmart, 2024)



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Development

The Site is currently used in part as an overflow car park for the nearby public house (The Boat Inn). The north of the Site comprises undeveloped land.

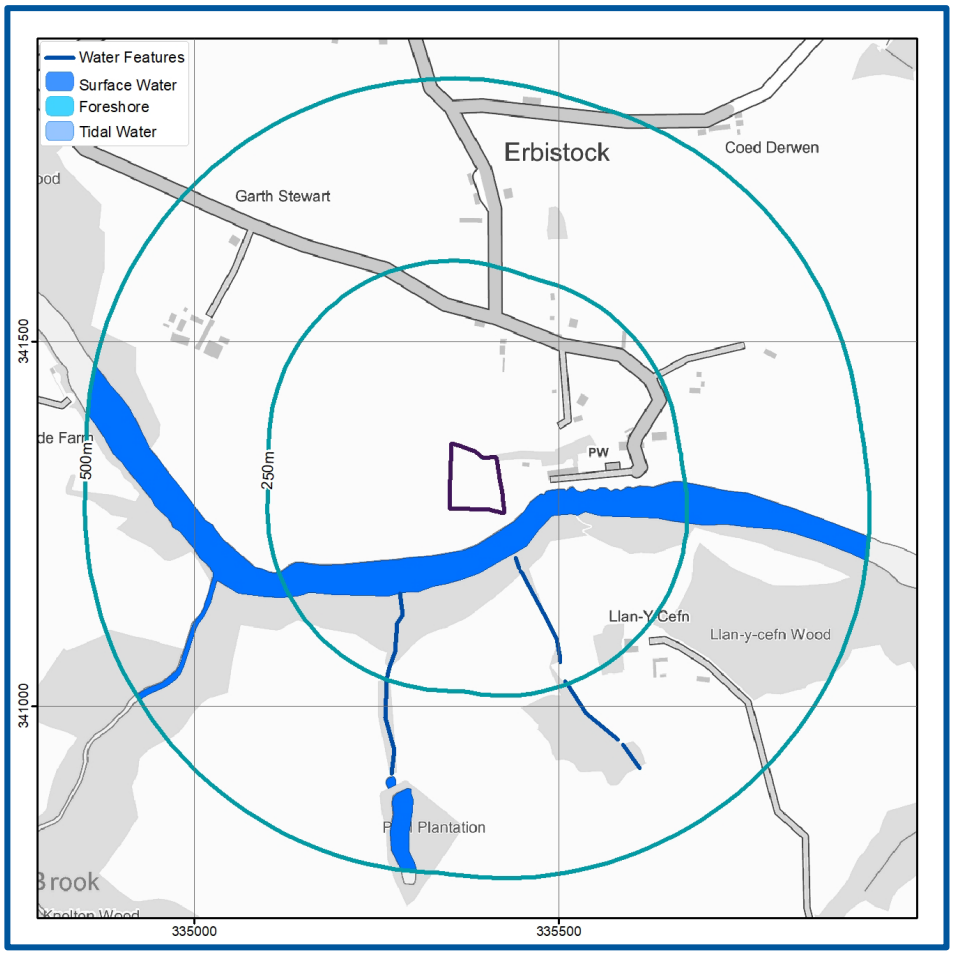
Development proposals comprise the construction of a detached, single-storey annex containing six bedrooms, proposed to be used as hotel accommodation. The existing car park will be retained. Site plans are included within Appendix A.

The development is classed as Highly Vulnerable according to Figure 2 of TAN 15 (2004). The effect of the overall development will result in an increase in the number of occupants and/or users of the Site and will result in the change of use, nature or times of occupation. The estimated lifespan of the development is 75 years.

Hydrological features

According to Ordnance Survey (OS) mapping included in Figure 3, there are numerous surface water features within 500 m of the Site.

Figure 3. Surface water features (OS, 2024)



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The River Dee is located c. 20 m south-east of the Site.

Several unnamed surface watercourses enter the River Dee along its southern bank, c. 60 m south and 140 m south-west of the Site.

The Shell Brook enters the River Dee c. 340 m south-west of the Site.

Numerous ponds are present within the vicinity of the Site, including c. 60 m north-east, c. 80 m south-east, c. 220 m south-east, c. 220 m south, c. 270 m south, c. 310 m south, c. 380 m south-west and c. 390 m south-west. Note that these features are not shown on Figure 3, above, due to their limited extent.

Proximity to relevant infrastructure

The following infrastructure are relevant to the flood risk at the Site:

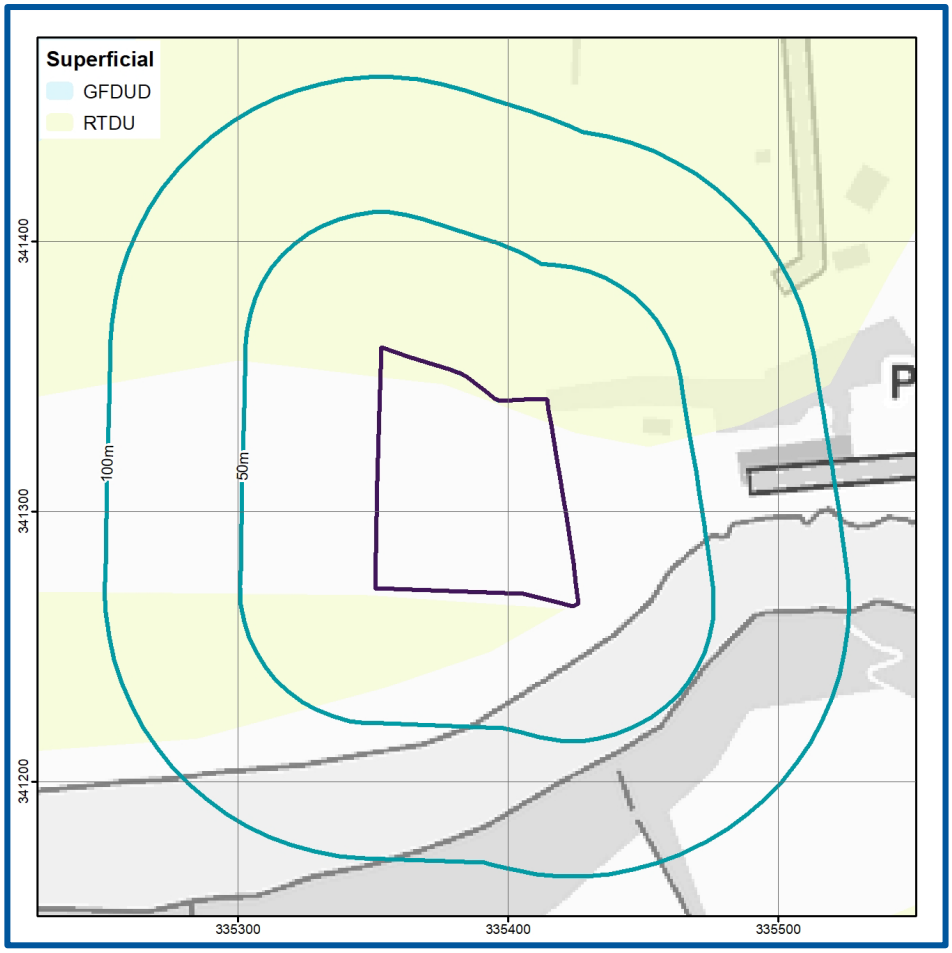
- A sluice on the unnamed watercourse, c. 400 m south;
- A footbridge on the Shell Brook, c. 340 m south-west;
- A weir on the River Dee c. 510 m west.

Hydrogeological features

British Geological Survey (BGS) mapping indicates that the underlying superficial geology (Figure 4) at the north (c. 5%) of the Site consists of Undifferentiated River Terrace Deposits (RTDU), which comprise of sand and gravel and are classified as a Secondary (A) Aquifer (BGS, 2024).

The remaining c. 95% of the Site is not underlain by any superficial deposits.

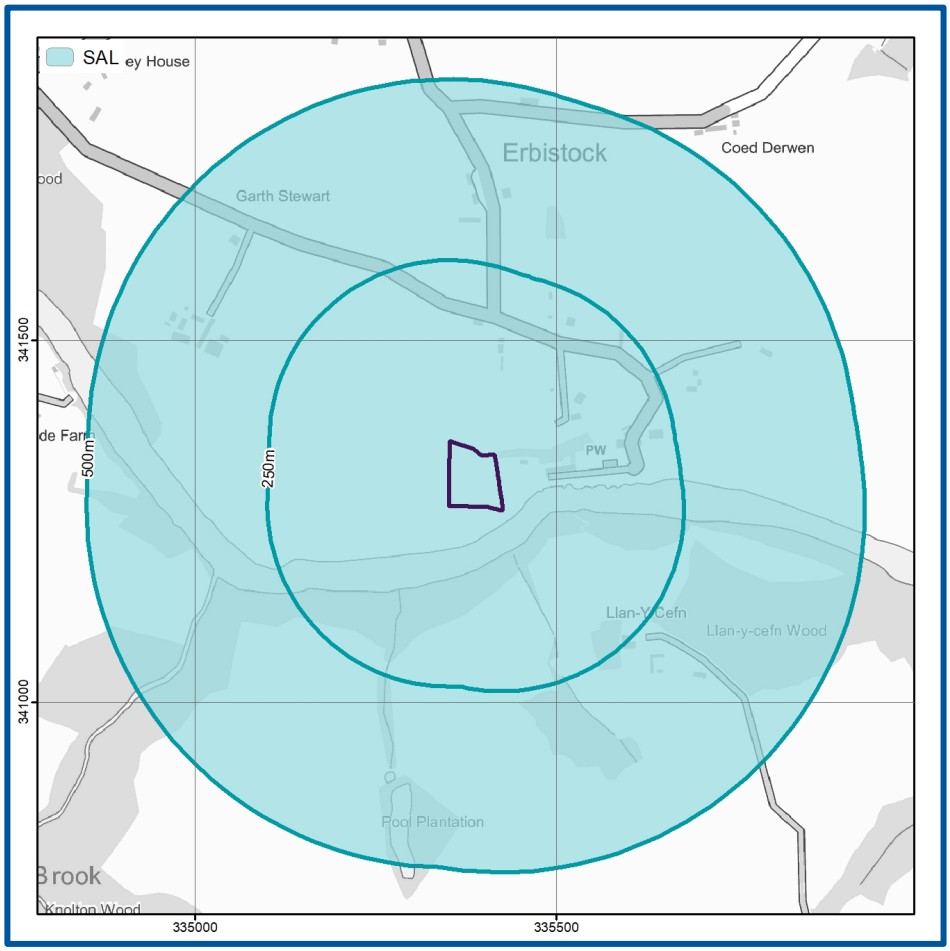
Figure 4. Superficial Geology (BGS, 2024)



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BGS mapping indicates that the underlying bedrock geology (Figure 5) consists of the Salop Formation (SAL), which comprises of mudstone, sandstone and conglomerate, and is classified as a Secondary (A) Aquifer (BGS, 2024).

Figure 5. Bedrock Geology (BGS, 2024)



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Geological conditions

A review of the BGS borehole database (BGS, 2024) indicates that the nearest and most relevant borehole to the Site (ref: SJ34SE9) is located c. 510 m to the east of the Site boundary at an elevation of c. 28.6 mAOD; it is noted that the borehole is located a significant distance from the Site, which may limit its relevance. This borehole indicates that the underlying geology consists of:

- Clayey soil to a depth of c. 0.4 m below ground level (bgl);
- Silty sandy clay with sporadic pebbles to c. 3.6 m bgl;
- Clayey sandy gravel to c. 4.3 m bgl;
- Clay to c. 9.0 m bgl;
- Sandy gravel to c. 10.6 m bgl;

- Clay to c. 10.9 m bgl;
- Sandy marl to c. 11.3 m bgl, at which depth the borehole terminates.

Groundwater

BGS borehole ref: SJ34SE9 struck groundwater at a depth of c. 10 m bgl in February 1978; it is acknowledged that local groundwater levels will be subject to seasonal variations and may also vary with distance from the Site.

4. Flood risk to the development

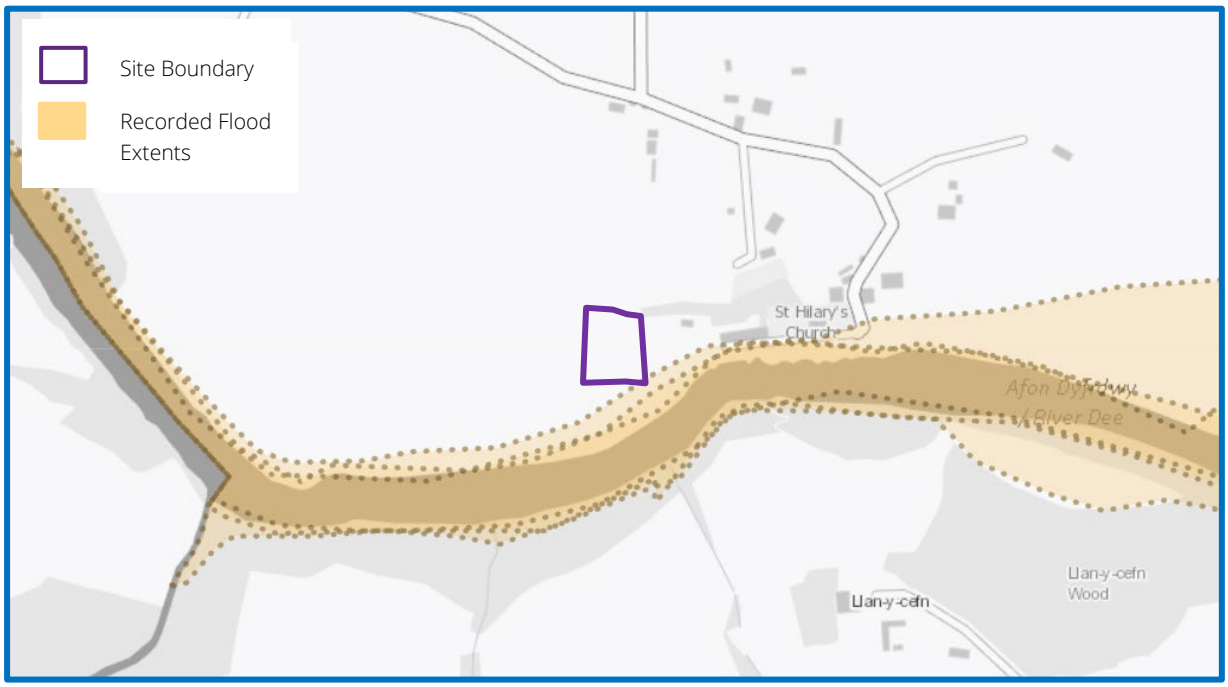
Historical flood events

According to the NRW's Recorded Flood Extents Map (Figure 6), several historical flood events have been recorded at and adjacent to the Site (NRW, 2024):

- Flooding occurred in January 1964 along the River Dee, which likely extended onto the south-east corner of the Site;
- Flooding occurred in November 2009 along the Lower Dee;
- Flooding occurred in January 2021 along the Lower Dee due to Storm Christoph.

The purpose of historical flood data is to provide information on where and why flooding may have occurred in the past. The absence of any recorded events does not mean flooding has never occurred on-Site or that flooding will never occur at the Site.

Figure 6. Historic Flood Event Outline (NRW, 2024)



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Rivers (fluvial) / Sea (coastal) / Estuarine (tidal) flooding

The predominant risk at the Site is from flooding from rivers, termed as fluvial flooding. The Site is located in an inland location and the risk of flooding from coastal and tidal processes are therefore considered to be Very Low.

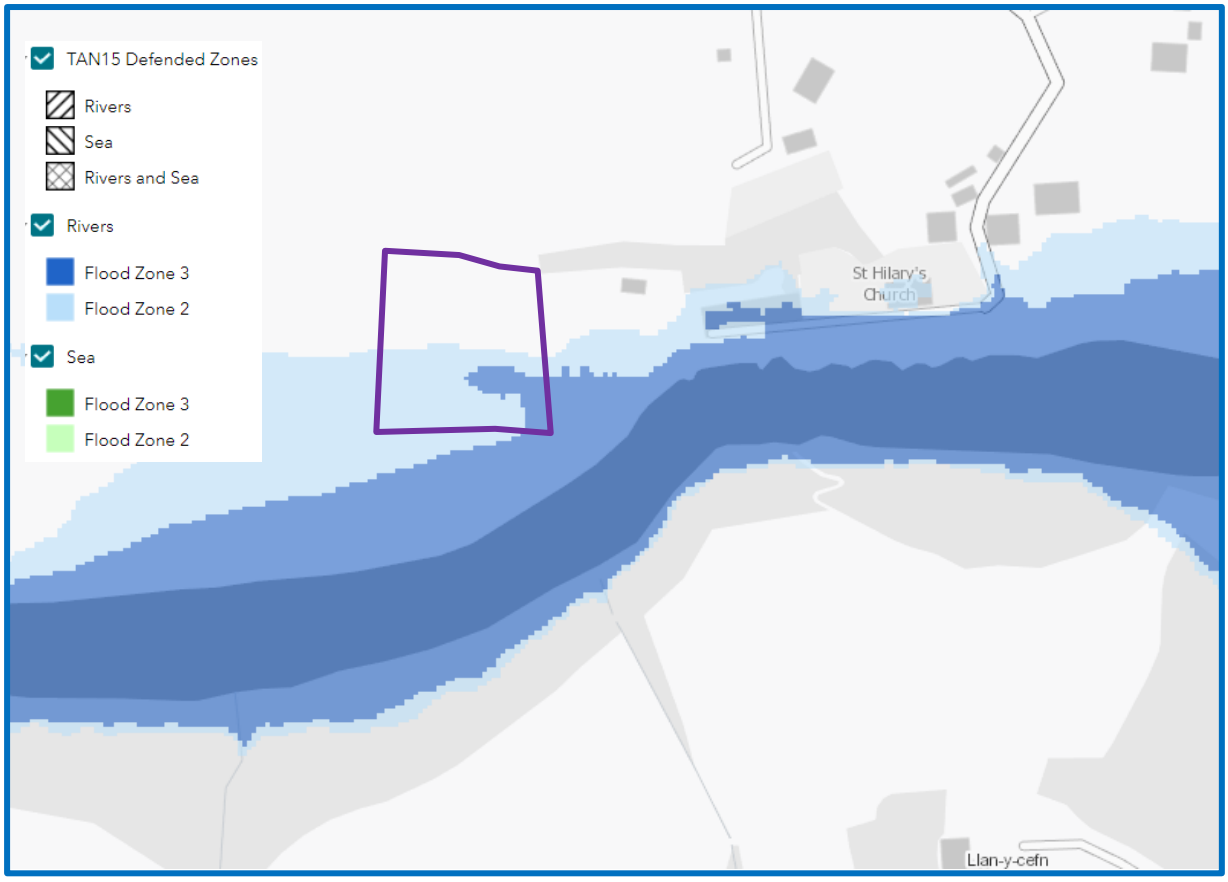
River (fluvial) flooding occurs during times of heavy rainfall or snow melt when watercourses' capacity can be exceeded, over topping the banks and flood defences.

Flood Zones Map

According to the NRW's Flood Map for Planning (Figure 7), the south-eastern corner of the Site (c. 10% of the Site area) is located within a fluvial Flood Zone 3 and is therefore classified as having a High probability of fluvial flooding from the River Dee. A further c. 35% of the Site is located within fluvial Flood Zone 2 and is classified as having a Medium probability of fluvial flooding. The remaining c. 55% of the Site area is located in Flood Zone 1 with a Low probability of fluvial flooding.

The existing car park is located within Flood Zones 2 and 3, whilst the proposed building is located within Flood Zone 1.

Figure 7. NRW Flood Zone mapping (NRW, 2024)



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Please note these Flood Zones are not presently used for planning purposes, but instead provide an indicative extent for the 1 in 100 year / 1 in 200 year and 1 in 1000 year fluvial and tidal events, respectively.

The above Flood Zones will become live once the revised version of TAN15 is published. The Development Advice Map (DAM) is currently the most up to date mapping for planning purposes in line with TAN15 (2004).

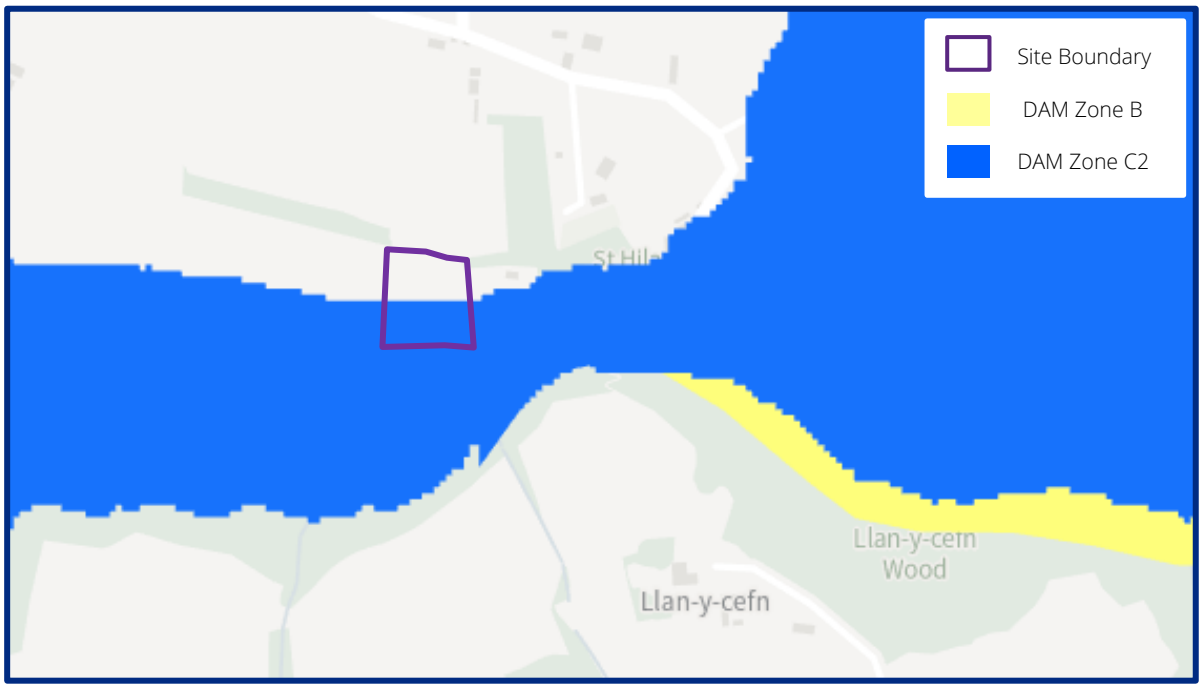
Development Advice Map

The NRW's Development Advice Map (DAM) confirms that the southern c. 55% of the Site, including the existing car park, is located within DAM Zone C2 (Figure 8, overleaf). The remaining c. 45% of the Site, including the position of the proposed building, is located within DAM Zone A (TAN15, 2004).

Table 1. Development Advice Map Classification

Description of Zone	Zone
Considered to be at little or no risk of fluvial or tidal/coastal flooding.	A
Areas known to have been flooded in the past evidenced by sedimentary deposits.	B
Areas of the floodplain which are developed and served by significant infrastructure, including flood defences.	C1
Areas of the floodplain without significant flood defence infrastructure.	C2

Figure 8. Development Advice Map (NRW, 2024)



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Flood defences

Guidance

Sites that are located close to flood defences are likely to be zones where rapid inundation will occur in the event of the flood defences being overtopped or breached. A Site located close to flood defences (within 250 m) may require a more detailed FCA subject to local topography.

According to NRW's Flood Map for Planning, the Site is not located within a TAN15 Defended Zone.

There are no formal flood defences within 1 km of the Site.

Flood Risk including the benefit of defences

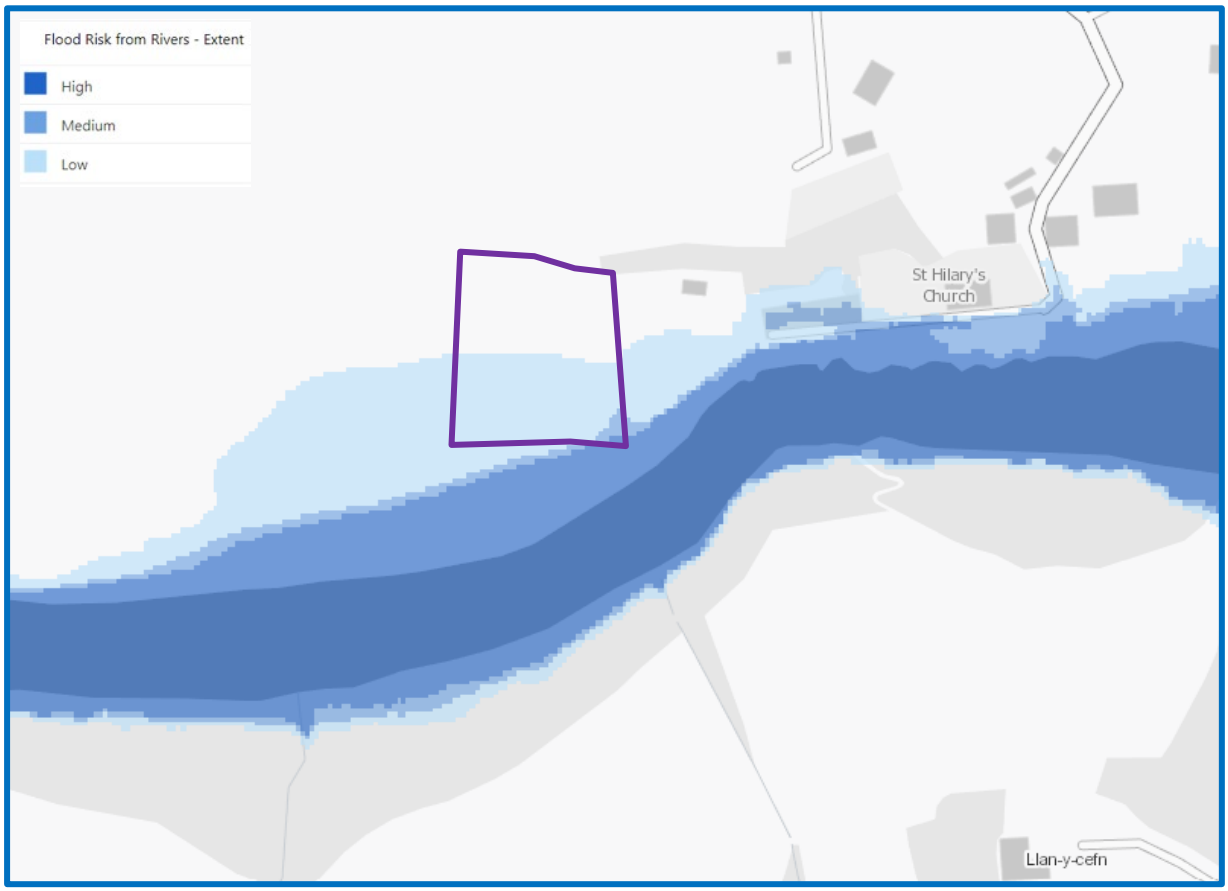
The Flood Risk Assessment Wales (FRAW) maps were published in the Summer of 2020.

The FRAW mapping includes consideration of flood defences that have been built to protect against flooding from rivers and the sea. The defences shown provide different levels of flood protection and this is recognised in the risk classification shown in the Flood Risk Assessment Wales (FRAW) map.

The FRAW maps indicate:

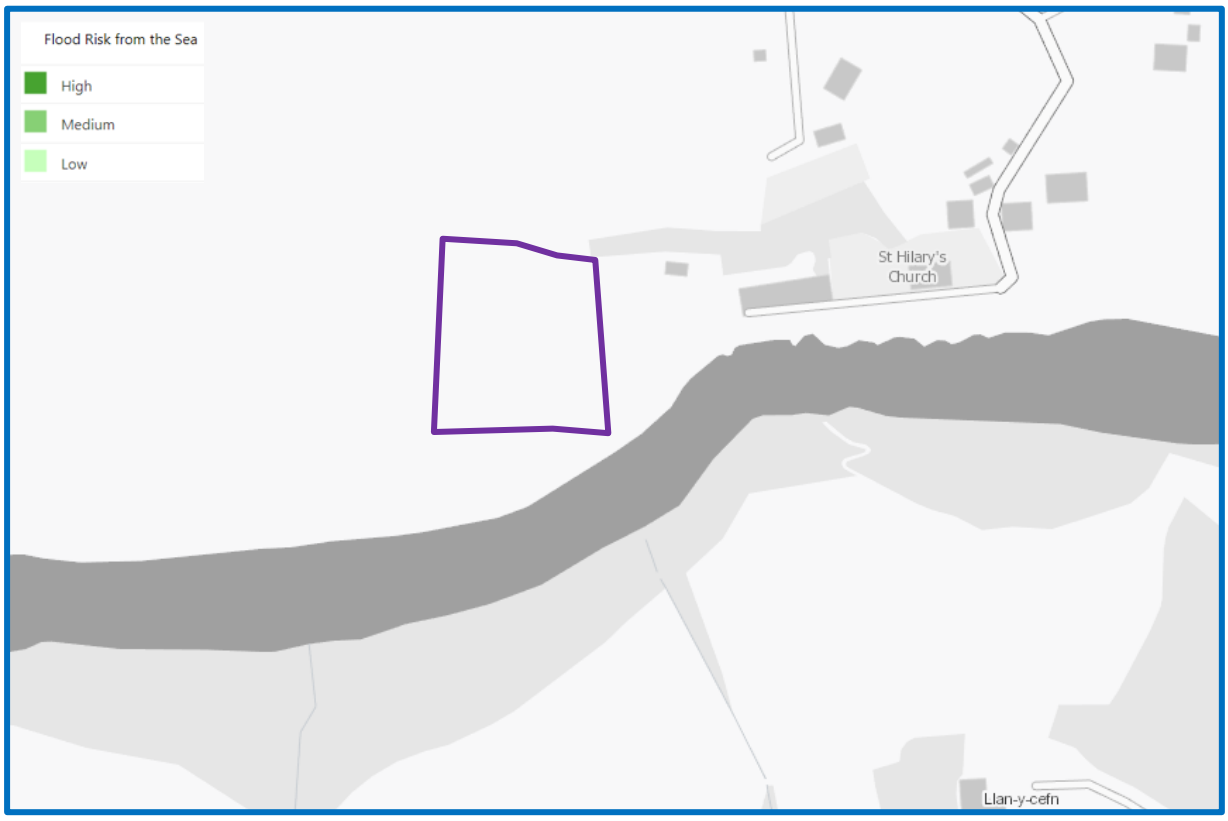
- The flood risk from Rivers is Medium in the south-east corner (c. 1% of the Site area), Low in the southern half of the Site (c. 40% of the Site area) and Very Low in the remainder of the Site (c. 59% of the Site area). The existing car park is at Low risk and the proposed building is at Very Low risk.
- The flood risk from the Sea is Very Low.
- The flood risk from Surface Water and Small Watercourses is variable. An area at Low to High risk is located in the south-west of the Site (totalling c. 5% of the Site area), with the remainder of the Site, including the proposed building, at Very Low risk.

Figure 9. Rivers – FRAW Risk Map (NRW 2024)



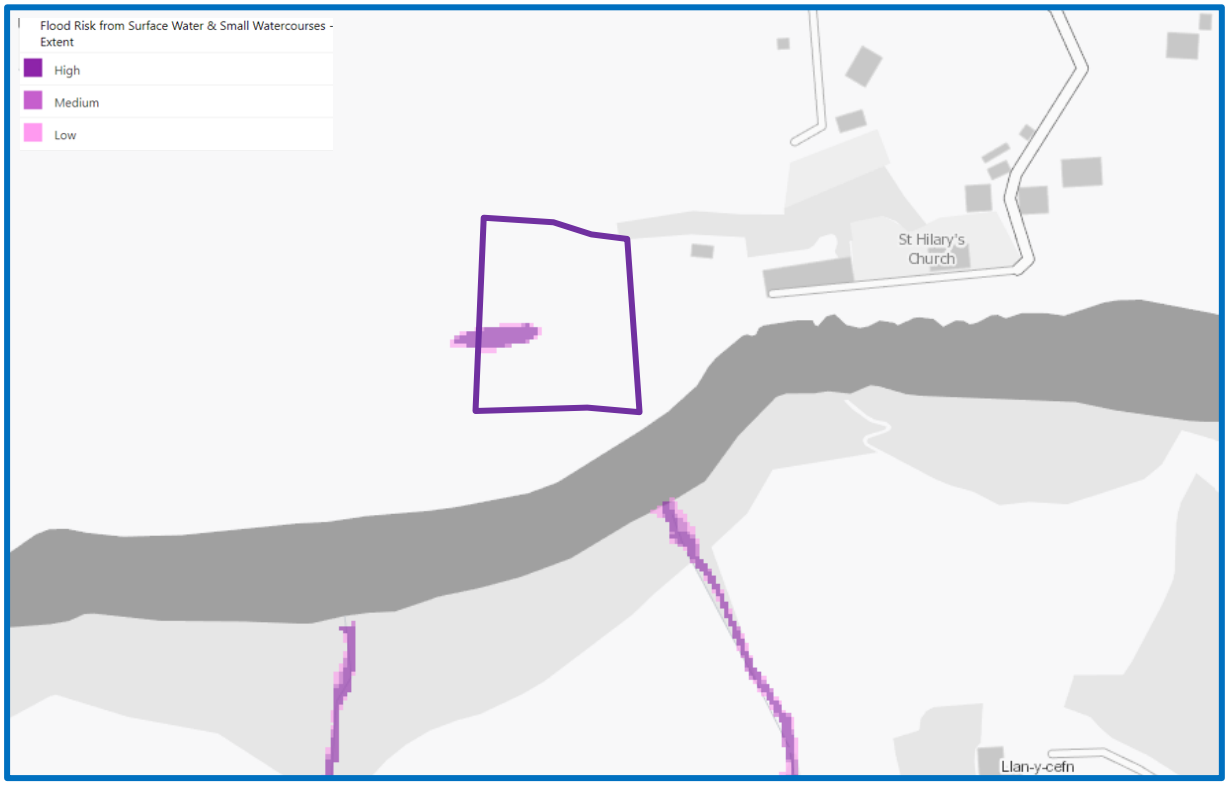
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Figure 10. Sea – FRAW Risk Map (NRW 2024)



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Figure 11. Surface Water and Small Watercourses – FRAW Risk Map (NRW 2024)



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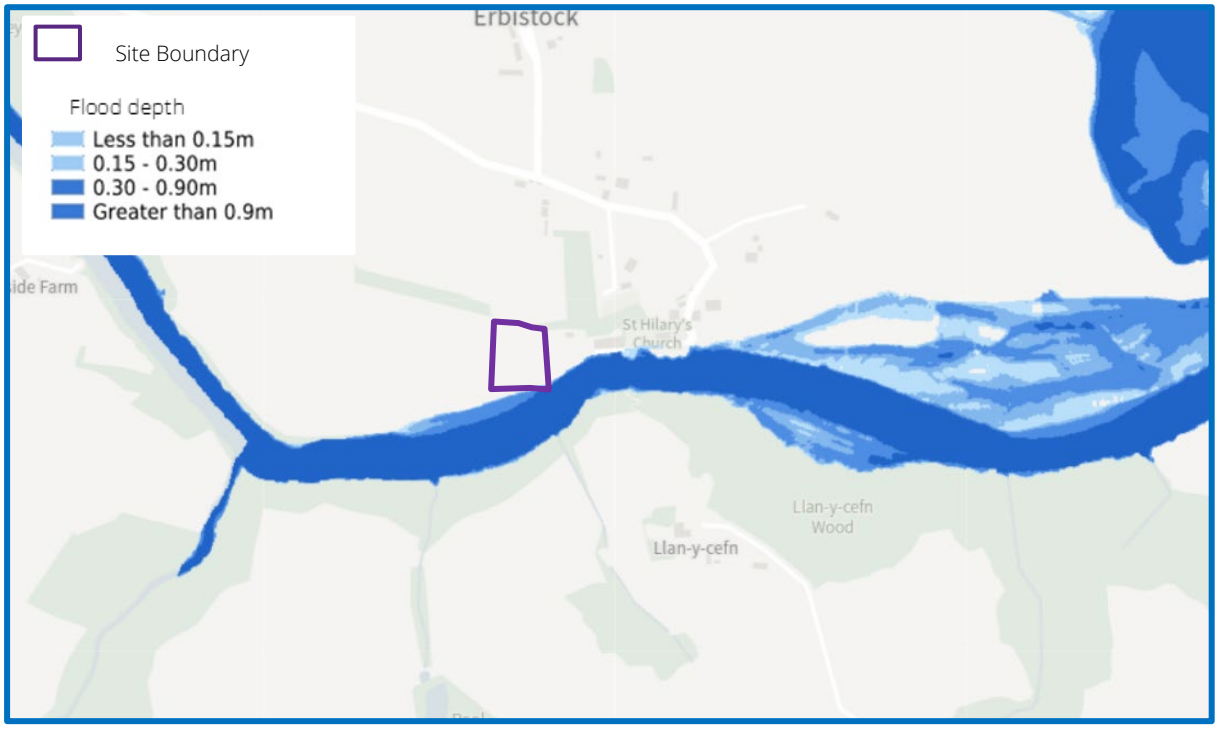
National Flood Hazard Maps

The National Flood Hazard (NFH) maps were published in the Summer of 2020, these show results for an undefended scenario which means the modelling and mapping process explicitly excluded any flood defences.

NFH maps have been included in order to understand the risk of flooding in a worst-case undefended scenario. As the Site does not benefit from defences, the risk shown by the NFH maps would be representative of the risks for the Site.

National Flood Hazard – Fluvial Flood Risk

Figure 12. 1 in 30 year (High risk) map for river flooding (NRW, 2024)



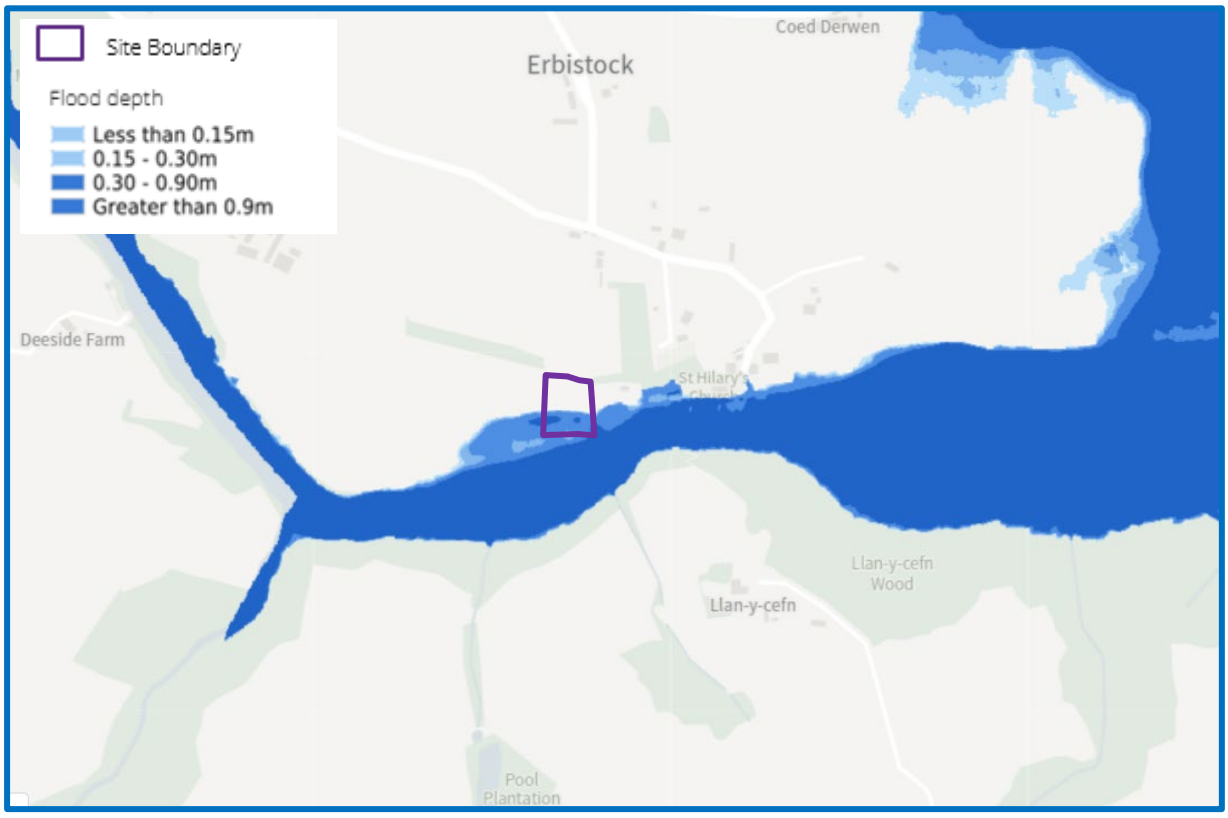
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Figure 13. 1 in 100 year (Medium risk) map for river flooding (NRW, 2024)



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Figure 14. 1 in 1000 year (Low risk) map for river flooding (NRW, 2024)



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In the High risk (1 in 30 year – 3.3% AEP) fluvial scenario (Figure 12), fluvial flooding would occur adjacent to the southern Site boundary. Flood waters could potentially extend onto the south-eastern corner of the Site, with flood depths between 0.3 m and 0.9 m predicted in this area.

In the Medium risk (1 in 100 year – 1% AEP) fluvial scenario (Figure 13), flood waters cover a similar extent as in the High risk scenario. However, the associated flood depths are predicted to exceed 0.9 m.

In the Low risk (1 in 1000 year – 0.1% AEP) fluvial scenario (Figure 14), flood waters would extend across the southern part of the Site, with variable flood depths, reaching above 0.9 m in some areas.

The existing car park would be impacted by flooding in the Low risk scenario, with the majority of flood depths between 0.3 m and 0.9 m in this area; locally flood depths may rise above 0.9 m. The proposed annex building is not predicted to flood during any of the modelled scenarios.

National Flood Hazard – Tidal Flood Risk

Figure 15. 1 in 1000 year (Low risk) map for tidal flooding (NRW, 2024)



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The tidal flood risk maps (including that shown on Figure 15) demonstrate that the Site will not be affected in any tidal flood scenario, up to and including the Low risk (1 in 1000 year) event.

Model data

As the Site is located within the NRW's fluvial floodplain, modelled flood elevation data was requested from NRW. However, a response was received on 19 June 2024, which confirmed that the NRW do not have any detailed models available for this area, and that they have no plans to produce a model.

Therefore, both JFLOW modelling and GeoSmart's Flood Analytics mapping have been used to determine the flood level at the Site. Note that these are both based on the NRW's Flood Map for Planning and therefore the same flood levels have been derived using both methods.

JFLOW modelling

The modelled fluvial flood depth data was created for the 1% and 0.1% annual chance of flooding situations and was produced as a by-product from the 2004 generalised modelling project in 2004, using JFLOW modelling. The purpose of the generalised modelling project was to fill the gaps where there was no detailed local modelled data in 2004, in order to define the extents of Flood Zones for spatial planning. A two-dimensional hydrodynamic model called JFLOW was used to produce this modelled fluvial flood depth data on a 5x5m grid.

Since 2004, local detailed modelling has been used to replace this generalised modelling in many areas to define the extents of Flood Zones. However, the JFLOW dataset in this location has not been updated.

JFLOW was used to produce flood maps for the whole of England and Wales for all catchments greater than 3 sq km in a consistent manner. The method is therefore very generalised and cannot take account of information that may be very significant locally. This might include:

1. Effects of bridges and other structures including flood defences are not taken into account.
2. Errors in the DTM, caused by trees and buildings for example.
3. The effect of reservoirs and urban drainage and other man made influences on the flow regime can only be taken into account in a very general sense in JFLOW.
4. The channel is assumed to be able to take the 2 year flow. This may not be true especially in those modified by man.
5. Hydraulic roughness is assumed to be the same everywhere in JFLOW, but of course it is not.

In light of this, to estimate flood levels at the Site, the EA's 1 m LiDAR data has been compared with the NRW's Flood Zones.

The 1 m LiDAR data has been classified and the highest elevation on the extent of the Flood Zone 3 and 2 has been used to form the basis for the 1 in 100 year and 1 in 1000 year flood events respectively (Figure 16, overleaf)[2]. The following flood levels have been estimated for the Site, using the method described above:

[2] As the calculated flood elevation is based on LiDAR the accuracy of the calculated level is +/- 0.15m.

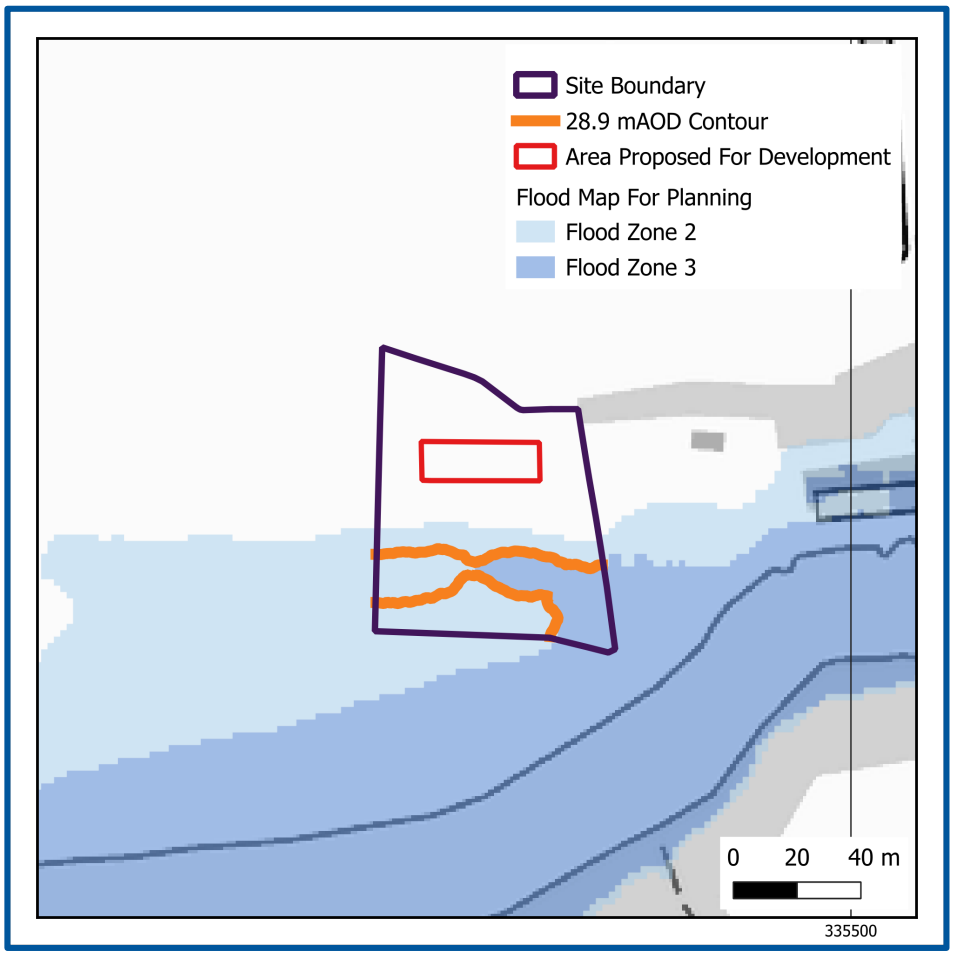
Table 2. Estimated flood levels using LiDAR data

Flood depths & levels	Fluvial scenario	
	1 in 100 year	1 in 1000 year
Estimated flood level (mAOD)	28.90	30.20
Flood depths on-Site (m)*	0.00 to 1.21	0.00 to 2.51
Flood depths in area proposed for development (m)**	0.00	0.00

*Compared to ground levels between 27.69 and 43.74 mAOD at the Site

**Compared to ground levels between 34.07 and 38.45 mAOD in the area of the proposed building

Figure 16. JFLOW modelling (NRW, 2024)



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GeoSmart Flood Analytics

As the Welsh Government has identified the Flood Map for Planning (FMfP) as a more up-to-date flood risk resource than the DAM map, GeoSmart Flood Analytics has been used to analyse flood depths at the Site. The GeoSmart Flooding data layers are designed to identify the likelihood and severity of flooding occurring at any given location within Great Britain for all four main sources of flooding.

It is comprised of flood map layers which are formed upon a high resolution 5 x 5m grid. Individual flood sources of pluvial, fluvial, tidal and groundwater are each provided as separate layers and at three flood return periods. The layers can be used independently to assess risk from a single source or in combination to understand the overall effect of flooding.

The methodology used to produce the FSA dataset for flooding from fluvial and tidal sources uses the NRW's FMfP Flood Zone extents alongside EA's 1m accuracy LiDAR data to calculate the level and depth of flooding. Flooding depths are derived on the assumption that the flood depth is zero at the edge of the flood extent and from this, a triangular interpolation network (TIN) surface is generated which represents the flood surface.

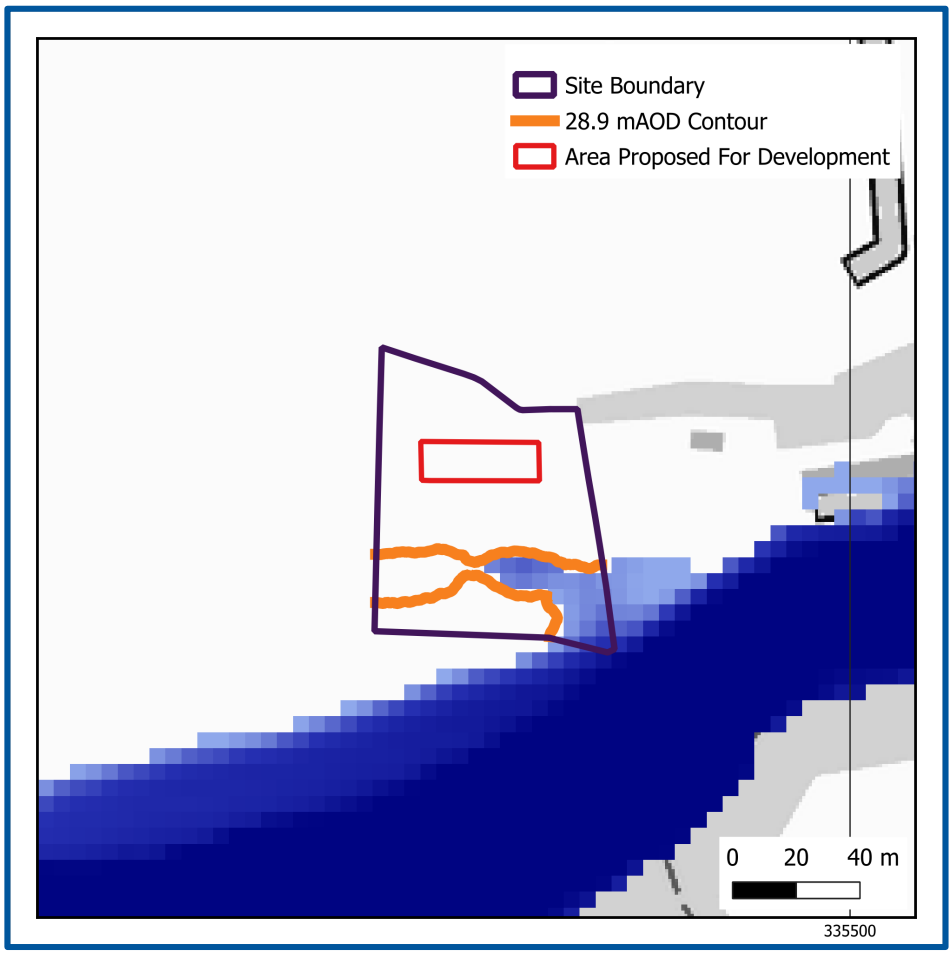
It should be noted that FSA data is only used to calculate flood levels and overall risk at Sites where detailed modelling is not available from the NRW. The following flood levels have been calculated for the undefended 1% AP (1 in 100 year) and 0.1% AP (1 in 1000 year) events:

Table 3. Estimated flood levels using LiDAR data

Flood depths & levels	Fluvial scenario	
	1 in 100 year (Figure 17)	1 in 1000 year (Figure 18)
Estimated flood level (mAOD)	28.90	30.20
Flood depths on-Site (m)*	0.00 to 1.14	0.00 to 3.50
Flood depths in area proposed for development (m)*	0.00	0.00

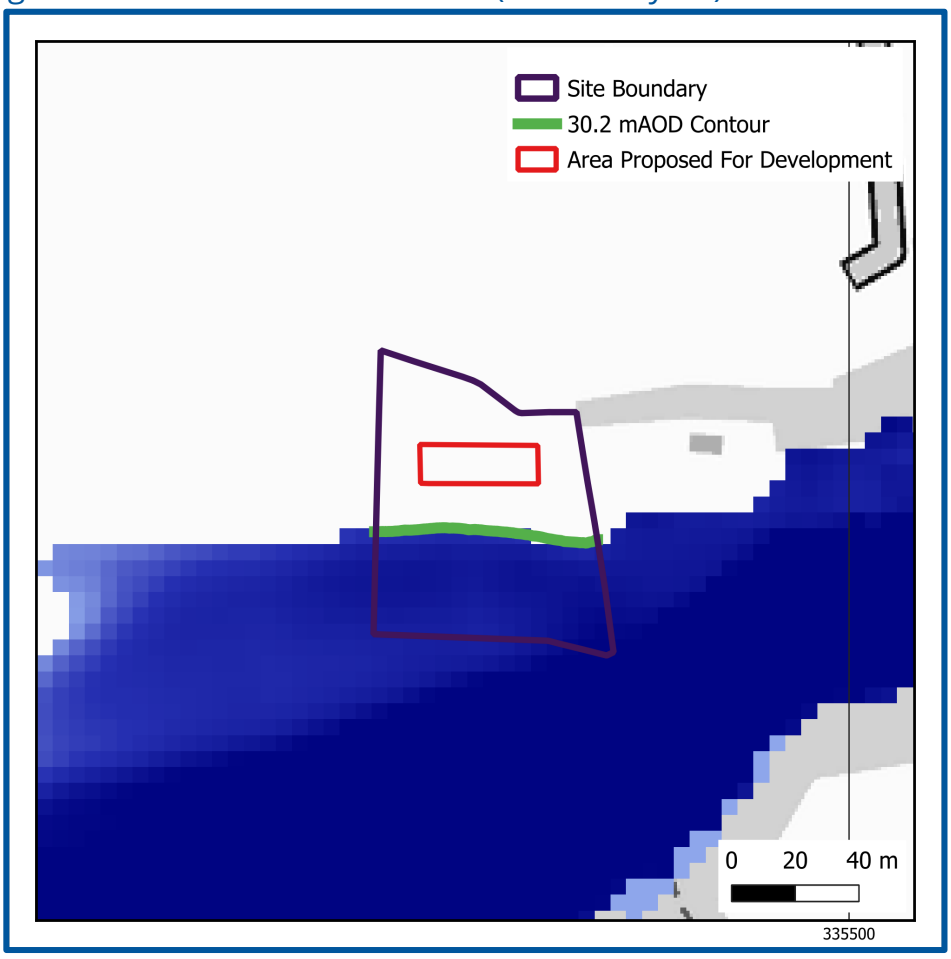
*Taken directly from the flood depths included within the Flood Analytics mapping

Figure 17. Flood extent in the Medium (1 in 100 year) risk scenario



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Figure 18. Flood extent in the Low (1 in 1000 year) risk scenario



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Climate change factors

In accordance with the Welsh Government's Climate Flood Consequences Assessments: Climate change allowances guidance (2021), allowances should be made for the impact of increased river and sea levels and flows to the proposed development.

Due to recent changes in guidance on the allowances for climate change, the 20% increase in river flows should no longer to be used for development design purposes, unless the guidance stipulates this is the correct allowance to use (depending on the river basin and development proposals).

As the Site is located within the Dee River Basin and the proposed development is classed as Highly Vulnerable, where the proposed lifespan is 75 years, the Central (20%) allowance have been used to determine a suitable climate change factor to apply to river data.

The Upper End (45%) allowance has also been included for comparison; however, the Central allowance is considered most appropriate for considering the impacts of climate change at the Site.

Modelled flow and level data has not been provided and so a stage graph has been produced (Appendix C) using the flood levels estimated using the NRW's Flood Map for Planning. The climate change allowances have been derived as a proportion of the 100 year peak flow to the 1 in 1000 year event, using the Flood Studies Report (FSR) (1975) growth curves.

In the Dee region, the 1 in 1000 year event flow is approximately 46% greater than the 1 in 100 year flow; therefore, the following flood levels apply.

Table 4. Estimated flood levels using LiDAR data

Flood depths & levels	Fluvial scenario	
	1 in 100 year + 20% Central allowance	1 in 100 year + 45% Upper End allowance
Estimated flood level (mAOD)	29.47	30.17
Flood depths on-Site (m)*	0.00 to 1.78	0.00 to 2.48
Flood depths in area proposed for development (m)**	0.00	0.00

*Compared to ground levels between 27.69 and 43.74 mAOD at the Site

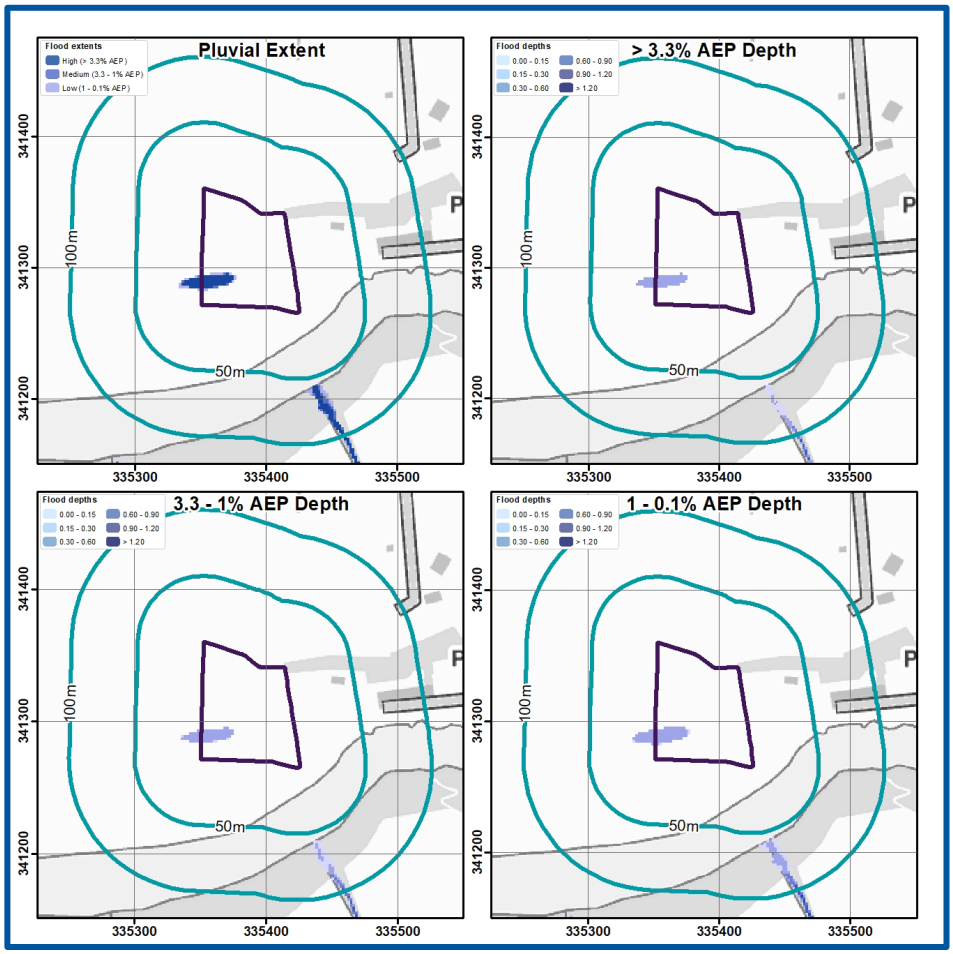
**Compared to ground levels between 34.07 and 38.45 mAOD in the area of the proposed building

Surface water (pluvial) flooding

Surface water flooding occurs when intense rainfall exceeds the infiltration capacity of the ground and overwhelms the drainage systems. It can occur in most locations even at higher elevations and at significant distances from river and tidal floodplains.

- According to the National Flood Hazard Map's Flood Risk from Surface Water and Small Watercourses flood mapping (Figure 19), the Site is at a variable risk of pluvial flooding ranging from Very Low to High.
- An area in the south-west of the Site has a High risk of surface water flooding, the extent of which slightly extends during the Medium and Low risk scenarios. This area infringes into the existing car park.
- The remainder of the Site, including the area proposed for development, has a Very Low risk of flooding.

Figure 19. NRW surface water risk hazard map (NRW, 2024)



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Guidance

According to NRW's surface water flood risk map, areas of the Site are at:

- Very Low risk - chance of flooding of less than 1 in 1000 (0.1%).
- Low risk - chance of flooding of between a 1 in 1000 & 1 in 100 (0.1% and 1%).
- Medium risk - chance of flooding of between a 1 in 100 and 1 in 30 (1% and 3.3%).
- High risk - chance of flooding of greater than 1 in 30 (3.3%).

Figure 19 shows the extent and depth of flooding during multiple modelled flood scenarios. This indicates that flood depths up to 0.3 m could occur within an area of lower lying topography in the Low to High scenarios (i.e., inundation of an isolated depression).

Surface water flooding would not impact access routes to and from the Site in any event.

Guidance

According to NRW's surface water flood risk mapping the following advisory guidance applies to the Site:

Flood Depths:

- 0.15 to 0.3 m - Flooding would: typically exceed kerb height, likely exceed the level of a damp-proof course, cause property flooding in some areas.

Climate change may lead to an increase in rainfall intensity which affects river levels, land and urban drainage systems. Rainfall intensity for small and urban catchments may increase from 5 to 20% (central estimate) or 10 to 40% (upper estimate) over the period to 2115 (NRW, 2024).

Analysis of OS mapping, ground elevation data and the NRW's pluvial mapping confirms the Site is not located on a potential overland flow route.

Any existing and proposed on-Site surface water drainage systems should be designed and maintained appropriately to manage the run-off over the lifetime of the proposed development.

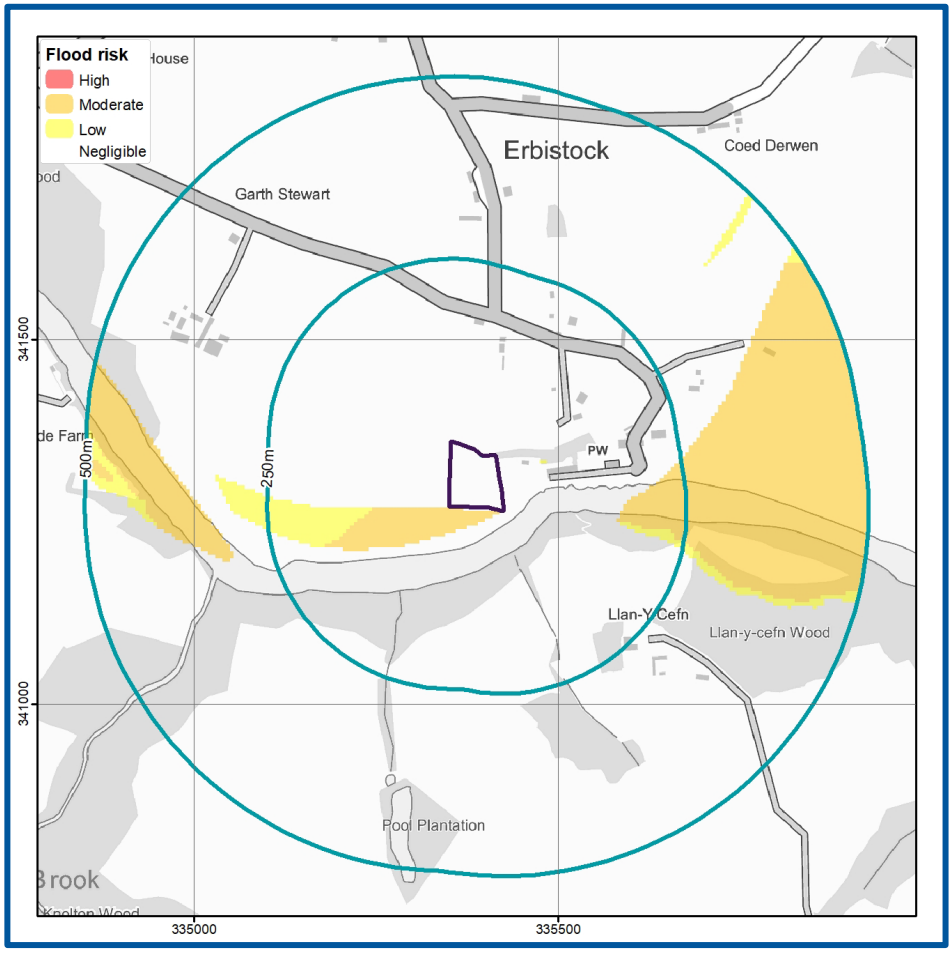
Groundwater flooding

Groundwater flooding occurs when sub-surface water emerges from the ground at the surface or into Made Ground and structures. This may be as a result of persistent rainfall that recharges aquifers until they are full; or may be as a result of high river levels, or tides, driving water through near-surface deposits. Flooding may last a long time compared to surface water flooding, from weeks to months. Hence the amount of damage that is caused to property may be substantially higher.

Groundwater Flood Risk screening data (Figure 20) indicates that there is a Negligible risk of groundwater flooding at surface in the vicinity from permeable bedrock and superficial deposits during a 1 in 100 year event.

It is noted that an area with a Moderate risk of groundwater flooding is mapped adjacent to the southern Site boundary (albeit this is some distance from the proposed building).

Figure 20. GeoSmart GW5 Groundwater Flood Risk Map (GeoSmart, 2024)



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Mapped classes within the screening map combine likelihood, possible severity and the uncertainty associated with predicting the subsurface system. The map is a national scale screening tool to prompt site-specific assessment where the impact of groundwater flooding would have significant adverse consequences. Mapping limitations and a number of local

factors may reduce groundwater flood risk to land and property even where it lies within mapped groundwater flood risk zones, which do not mean that groundwater floods will occur across the whole of the risk area.

A site-specific assessment has been undertaken to refine the groundwater risk screening information on the basis of site-specific datasets (see Section 3), including BGS borehole data and the NRW's fluvial and tidal floodplain data (where available), to develop a conceptual groundwater model. The risk rating is refined further using the vulnerability of receptors including occupants and the existing and proposed Site layout, including the presence of basements and buried infrastructure. The presence of any nearby or on-Site surface water features such as drainage ditches, which could intercept groundwater have also been considered.

The proposed development will involve some excavation below ground level to account for the significant gradient of the Site. It should be noted that the risks are higher for subterranean development, buried infrastructure and soakaway systems, which may be affected by high groundwater levels.

According to a review of the hydrogeology (Section 3), the Site is in part underlain by permeable superficial deposits above potentially permeable bedrock. Groundwater levels may rise in the bedrock and superficial aquifers in a seasonal response to prolonged rainfall recharge which may cause an unusually high peak in groundwater levels during some years.

Groundwater levels may also rise in the bedrock aquifer in response to high river events, due to the potential hydraulic continuity with the nearby River Dee.

Despite the presence of an underlying aquifer the Site would only be at risk of groundwater flooding if the water table reaches the base of the Site development or the ground surface. Given the significant topographic gradient across the Site, it is considered unlikely that any groundwater would emerge in the area proposed for development, which is raised compared to the south of the Site.

BGS borehole ref: SJ34SE9, located c. 510 m east at an elevation of c. 28.6 mAOD, struck groundwater at a depth of c. 10 m bgl in February 1978; it is acknowledged that local groundwater levels will be subject to seasonal variations and may also vary with distance from the Site.

Spring lines have not been identified in close proximity to the Site.

The hydrogeological characteristics suggest there is potential for a groundwater table beneath the Site. The groundwater flood risk is likely to be driven by water levels within the River Dee, which could potentially impact low-lying areas in the south of the Site.

However, the significant change in ground elevations across the Site is likely to limit the potential for any groundwater emergence to occur in the north of the Site (i.e., in the area of proposed development).

The baseline groundwater flood risk rating is Negligible. On the basis of the site-specific assessment, a Negligible to Low risk rating is considered to be appropriate for the area proposed for development.

Guidance

Negligible Risk - There will be a remote possibility that incidence of groundwater flooding could lead to damage to property or harm to other sensitive receptors at, or near, this location.

Low Risk - There will be a remote possibility that incidence of groundwater flooding could lead to damage to property or harm to other sensitive receptors at, or near, this location.

Climate change predictions suggest an increase in the frequency and intensity of extremes in groundwater levels.

- Rainfall recharge patterns will vary regionally resulting in changes to average groundwater levels.
- A rise in peak river levels will lead to a response of increased groundwater levels in adjacent aquifers subject to the predicted climate change increases in peak river level for the local catchment.

The impact of climate change on groundwater levels beneath the Site is linked to the predicted rise in peak river levels and the variation in rainfall recharge, which is uncertain.

Flooding from artificial sources

Artificial sources of flood risk include waterbodies or watercourses that have been amended by means of human intervention rather than natural processes. Examples include reservoirs (and associated water supply infrastructure), docks, sewers and canals. The flooding mechanism associated with flood risk from artificial sources is primarily related to breach or failure of structures (reservoir, lake, sewer, canal, flood storage areas, etc.).

Sewer flooding

An SFCA is not available for the Wrexham Council area. Therefore, no information regarding flooding events from sewers is available for the Site.

However, given the location of the Site within a predominantly agricultural setting, as well as its elevated position relative to nearby developments, the risk of flooding from surcharging sewers is likely to be Very Low.

Guidance

Properties classified as “at risk” are those that have suffered, or are likely to suffer, internal flooding from public foul, combined or surface water sewers due to overloading of the sewerage system either once or twice in the ten year reference period. Records held by the sewage utility company provide information relating to reported incidents, the absence of any records does not mean that the Site is not at risk of flooding.

Canal failure

According to Ordnance Survey (OS) mapping, there are no canals within 500 m of the Site.

Water supply infrastructure

Water supply infrastructure is comprised of a piped network to distribute water to private houses or industrial, commercial or institution establishments and other usage points. In urban areas, this represents a particular risk of flooding due to the large amount of water supply infrastructure, its condition and the density of buildings. The risks of flooding to properties from burst water mains cannot be readily assessed.

If more information regarding the condition and history of the water supply infrastructure within the vicinity of the Site is required, then it is advisable to contact the local water supplier (assumed to be Dwr Cymru Welsh Water).

Culverts and bridges

The blockage of watercourses or structures by debris (that is, any material moved by a flowing stream including vegetation, sediment and man-made materials or refuse) reduces flow capacity and raises water levels, potentially increasing the risk of flooding. High water levels can cause saturation, seepage and percolation leading to failure of earth embankments or other structures. Debris accumulations can change flow patterns, leading to scour, sedimentation or structural failure.

Culverts and bridges have not been identified within 50 m of the Site; therefore, there is unlikely to be a flood risk resulting from these structures at the Site.

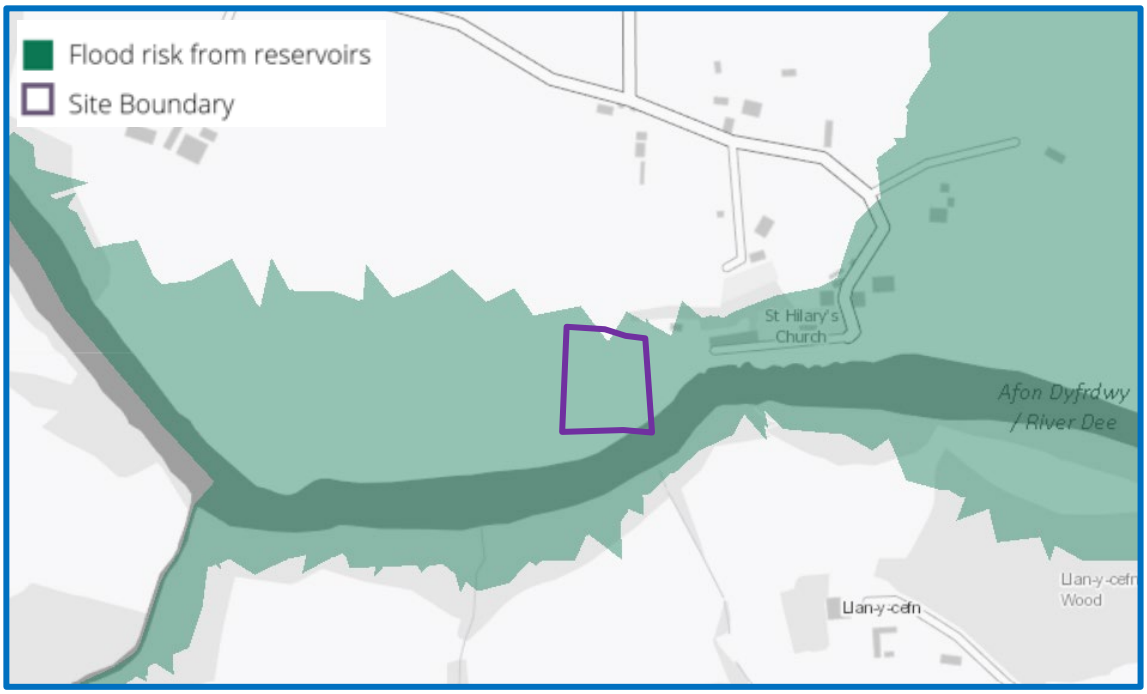
Reservoir flooding

According to the NRW's Flood Risk from Reservoirs mapping the Site is at risk of flooding from reservoirs (Figure 21) (NRW, 2024).

The Site is considered to be at risk of flooding from the following reservoirs:

- Llyn Brenig, 40 km north-west;
- Llyn Tegid (Bala Lake), c. 43 km west;
- Llyn Celyn, c. 47 km west;
- Alwen Reservoir, c. 41 km north-west.

Figure 21. NRW Flood Risk from Reservoirs Flooding (NRW, 2024)



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Guidance

The risk of reservoir flooding is related to the failure of a large reservoir (holding over 25,000 m^3 of water) and is based on the worst-case scenario. Reservoir flooding is extremely unlikely to occur (NRW, 2024).

5. Flood risk from the development

Floodplain storage

Where flood storage from any source of flooding is to be lost as a result of development, on-site level-for-level compensatory storage, accounting for the predicted impacts of climate change over the lifetime of the development, should be provided. Where it is not possible to provide compensatory storage on site, it may be acceptable to provide it off-Site if it is hydraulically and hydrologically linked.

The loss of floodplain storage is less likely to be a concern in areas benefitting from appropriate flood risk management infrastructure or where the source of flood risk is solely tidal.

The Site includes areas within Flood Zones 2 and 3 which are anticipated to be impacted by fluvial flooding. However, the area proposed for development is located within Flood Zone 1, outside the fluvial flood extent. Therefore, there would be no displacement of flood water and compensatory flood storage is not required.

Drainage and run-off

Based on the topography and Very Low surface water flood risk in the vicinity of the Site, interference or interaction with overland flow paths and inflows from offsite is considered unlikely.

The proposed development involves an increase of impermeable surfaces at the Site. An estimation of run-off is therefore required to permit effective Site water management and prevent any increase in flood risk to off-Site receptors from the Site.

The potential surface water run-off generated from the Site during a 1 in 100 year return period should be calculated, using FEH 2022 rainfall data from the online Flood Estimation Handbook (FEH), developed by NERC (2009) and CEH (2016).

The PPW (2024) recommends the effects of climate change are incorporated into FRA's and the recently updated climate change guidance (published in 2016 and updated in 2021) confirms the requirements for inclusion within FRA's.

As the proposed development is for hotel accommodation, the lifespan of the development and requirements for climate change should allow up to the 2115 scenario.

Table 5. Climate change rainfall allowances

Climate change allowances for Wales	Total potential change anticipated by the 2020s	Total potential change anticipated by the 2050s	Total potential change anticipated by the 2080s
Upper end	10%	20%	40%
Central	5%	10%	20%

A separate assessment of surface water runoff may be required, as the Statutory requirements in Wales are to include a SuDS strategy, where development proposals are greater than 100m^2 in size. This is to ensure surface water runoff is managed in accordance with the Welsh Statutory requirements over the lifetime of the proposed development.

Sustainable Drainage System (SuDS)

It is recommended that attenuation of run-off is undertaken on-Site to compensate for proposed increases in impermeable surface areas. Attenuation may comprise the provision of storage within a Sustainable Drainage System (SuDS). SuDS can deliver benefits from improving the management of water quantity, water quality, biodiversity and amenity. Potential SuDS options are presented in the table below, subject to further investigation:

Table 6. SuDS features which may be feasible for the Site

Option	Description
Rainwater harvesting	Rainwater harvesting can collect run-off from the roofs for use in non-potable situations, using water butts for example.
Green roof	Having part/all of the roof as a green roof covered in vegetation can intercept and store a proportion of the rainfall to result in an overall reduction in the amount of surface water run-off generated from a building structure. They comprise a substrate (growth medium) layer which can be seeded with specially selected plants suitable for the local climatic conditions. Beneath the growth medium is a geotextile filter layer which filters out the substrate from entering the aggregate/geo-composite drainage layer below. At the very bottom of the green roofing, a waterproof membrane protects the roof structure below.
Permeable paving	Permeable pavements can be used for driveways, footpaths and parking areas to increase the amount of permeable land cover. Suitable aggregate materials (angular gravels with suitable grading as per CIRIA, 2007) will improve water quality due to their filtration capacity. Plastic geocellular systems beneath these surfaces can increase the void space and therefore storage but do not allow filtration unless they are combined with aggregate material and/or permeable geotextiles.

Option	Description
Soakaways	An excavation filled with gravel within the Site. Surface water run-off is piped to the soakaway.
Attenuation basins/pond	Dry basin or a permanent pond that is designed to hold excess water during a rainfall event.

6. Suitability of the proposed development

The information below outlines the suitability of proposed development in relation to national and local planning policy.

National policy and guidance

The aims of the national planning policies TAN15 (2004) and PPW (2024) are achieved through application of the Justification Test and by assessing Flood Consequences. The key requirements of these are outlined below:

Guidance
Justification Test: New developments should be directed away from Zone C and towards suitable land in Zone A, or Zone B where river or coastal flooding will be less of an issue. In Zone C the tests outlined in sections 6 and 7 of TAN15 will be applied, recognizing, however, that highly vulnerable development and Emergency Services in Zone C2 should not be permitted. All other new development should only be permitted within Zones C1 and C2 if determined by the planning authority to be justified in that location. Assessing Flood Consequences: If a development proposal in Zone C1 or in C2, and if it is defined as being of low vulnerability, it would meet the test outlines in section 6. However, it should be noted that those developments would be more likely to flood and appropriate mitigation would need to be planned accordingly. This section applies to Zone C, and those parts of Zone B where flooding has been identified as a material consideration to allow for localised problems. Assessing whether a development should proceed or not will depend upon whether the consequences of flooding of that development can be managed and reduced to a level which is acceptable for the nature/type of proposed development, including its effects on existing development.

The proposed Site use is for hotel accommodation and is classified as “Highly Vulnerable” development. The Site includes areas located within the Development Advice Map (DAM) Zones A and C2, with the area proposed for development located within DAM Zone A.

Given the proposed development is located within DAM Zone A, the justification test is not applicable. This FCA also confirms that there would not be an increase in flooding elsewhere, given that the proposed development does not result in an increase in building footprint within areas at risk of fluvial flooding.

Table 7. Flood risk vulnerability and flood zone compatibility (taken from TAN15, 2004)

DAM Zone	Development Type	Planning Requirements	Acceptability Criteria	Development Advice
A	Emergency Services, highly vulnerable development, less vulnerable development, other	• Justification test not applicable • Refer to surface water requirements	No increase in flooding elsewhere	No constraints relating to river or coastal flooding, other than to avoid increasing risk elsewhere
B	Emergency services & Highly vulnerable development	• 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 • Refer to surface water requirements	• Acceptable consequences for nature of use • Occupiers aware of flood risk • Escape/Evacuation routes present • Effective flood warning provided • Flood emergency plans and procedures • Flood resistant design • No increase in flooding elsewhere	Generally suitable for most forms of development. Assessments where required, are unlikely to identify consequences that cannot be overcome or managed to an acceptable level. It is unlikely, therefore, that these would result in a refusal of planning consent on the grounds of flooding.
	Less vulnerable development		• Occupiers aware of flood risk • No increase in flooding elsewhere	
	Other	Refer to surface water requirements	No increase in flooding elsewhere	
C1	Emergency services, highly vulnerable development, less vulnerable development	• Application of justification test including acceptability of consequences • Refer to surface water requirements	• Acceptable consequences for nature of use • Flood defences adequate • Agreement for construction and maintenance costs secured • Occupiers aware of flood risk • Escape/evacuation routes present • Effective flood warning provided	Plan allocations and applications for all development can only proceed subject to justification in accordance to section 6 of TAN 15 and acceptability of consequences in accordance to

			• Flood emergency plans and procedures • Flood resistant design • No increase in flooding elsewhere	section 7 and Appendix 1 of TAN 15
	Other	• Application of acceptability of consequences (TAN 15 section 7 and Appendix 1) • Refer to surface water requirements	• Acceptable consequences for nature of use • Occupiers aware of flood risk • Desirable if effective flood warning and evacuation routes/procedure provided depending on nature of proposal • No increase in flooding elsewhere	Plan allocations and applications for development should only be made if considered acceptable in accordance with section 7 and Appendix 1 of TAN 15
C2	Emergency services, highly vulnerable development	The flooding consequences associated with Emergency Services and highly vulnerable developments are not considered to be acceptable. Plan allocations should not be made for such developments and planning applications not proposed		
	Less vulnerable development	• Application of justification test (section 6 of TAN 15), including acceptability of consequences (section 7 and Appendix 1 of TAN 15) • Refer to surface water requirements	• Acceptable consequences for nature of use • Flood defences adequate • Agreement for construction and maintenance costs secured • Occupiers aware of flood risk • Escape/evacuation routes present • Effective flood warning provided • Flood emergency plans and procedures	Plan allocations or applications for less vulnerable development can only proceed subject to justification in accordance with section 6 of TAN 15 and acceptability of consequences in accordance with section 7 and Appendix 1 of TAN 15
	Other	• Application of acceptability of consequences (section 7 and Appendix 1 of TAN 15) • Refer to surface water requirements	• Flood resistant design • No increase in flooding elsewhere • Acceptable consequences for nature of use • Occupiers aware of flood risk • Effective flood warning provided	Plan allocations and applications for development should only be made if considered acceptable in accordance with section 7 and

			• No increase in flooding elsewhere	Appendix 1 of TAN 15.

Environment Agency Flood Risk Standing Advice for Sites located in Flood Zones 2 or 3[3]

For all relevant vulnerable developments (i.e. more vulnerable, less vulnerable and water compatible), advice on the points should be followed:

- Surface water management;
- Access and evacuation; and
- Floor levels.

Surface water management

Plans for the management of surface water need to meet the requirements set out in either the local authority's:

- Surface water management plan where available; OR
- Strategic flood consequence assessment.

They also need to meet the requirements of the approved building regulations Part H: drainage and water disposal. Read section H3 rainwater drainage.

Planning permission is required to use a material that can't absorb water (e.g. impermeable concrete) in a front garden larger than 5 square metres.

Access and evacuation

Details of emergency escape plans should be provided for any parts of a building that are below the estimated flood level:

Plans should show:

- Single storey buildings or ground floors that don't have access to higher floors can access a space above the estimated flood level, e.g. higher ground nearby;
- Basement rooms have clear internal access to an upper level, e.g. a staircase; and
- Occupants can leave the building if there's a flood and there's enough time for them to leave after flood warnings.

Floor levels

The following should be provided:

- Average ground level of the building; and
- Finished floor level of the lowest habitable room in the building.

Ground floor levels should be a minimum of whichever is higher of:

[3] Please note in the absence of an NRW FRSA, the EA guidance (2022) has been used in lieu, providing a clear framework for Flood Risk assessment and mitigation strategies and deemed sufficiently applicable.

- 300 millimeters (mm) above the general ground level of the site; OR
- At least 600 mm above the estimated river or sea flood level.

7. Resilience and mitigation

Based on the flood risk identified at the Site, the national and local policies and guidance and proposed development, the mitigation measures outlined within this section of the report are likely to help protect the development from flooding.

Sea (coastal/tidal) flood mitigation measures

As the Site is not identified as being at risk of flooding from the sea, mitigation measures are not required.

Rivers (fluvial) flood mitigation measures

The Site is located within an area which is affected by flooding from rivers; the following table confirms the flood depths associated with the Site, including the area proposed for development.

Table 8. Estimated flood levels using LiDAR data

Flood depths & levels	Fluvial scenario	
	1 in 100 year + 20% Central allowance	1 in 1000 year
Estimated flood level (mAOD)	29.47	30.20
Flood depths on-Site (m)*	0.00 to 1.78	0.00 to 2.51
Flood depths in area proposed for development (m)**	0.00	0.00

*Compared to ground levels between 27.69 and 43.74 mAOD at the Site

**Compared to ground levels between 34.07 and 38.45 mAOD in the area of the proposed building

Raising minimum floor levels

The vulnerability classification of the Site and the Flood Zone means proposals for the Site fall under the EA's Flood Risk Standing Advice (FRSA) for more vulnerable developments.

In this instance, in line with the NRW's guidance, the recommended minimum Finished Floor Level (FFL) should be set at least 0.6 m above the 1 in 100 year plus 20% allowance for climate change flood level (29.47 mAOD).

Table 9. Recommended Minimum Finished Floor Level Required

Ground Level (mAOD)	Flood Level (mAOD)	Freeboard above Flood Level	Recommended FFL (mAOD)
27.69 to 43.74	29.47	0.6	30.07

As the area proposed for development has ground levels of between 34.07 and 38.45 mAOD, this FFL recommendation would be satisfied by the proposed development. As such, the flood risk to the development would remain at Very Low, and no additional flood resilience or resistance measures specific to fluvial flooding would be required.

Surface water (pluvial) flood mitigation measures

Whilst a Very Low to High risk of surface water flooding has been identified across the Site, the risk of pluvial flooding in the area proposed for development is Very Low. Therefore, mitigation measures are not required.

However, the regular maintenance of any drains and culverts surrounding/on the Site should be undertaken to reduce the flood risk.

A Sustainable Drainage Strategy (SuDS) should be developed for the Site, for effective management of surface water runoff from the proposed development.

Groundwater flood mitigation measures

A Negligible to Low risk of groundwater has been identified at the Site. Given that the proposed development includes some excavation below the ground surface, the following specific measures associated with possible groundwater flooding may be considered:

- Waterproofing / flood resilient design for the proposed annex (including the parts of the structure to be set below the surrounding ground level);
- Interceptor drains;
- Automatic sump to extract flood water; and
- Non-return flap valves on the proposed foul and surface water sewer lines.

If these mitigation measures are implemented this would maintain the flood risk to the development at Negligible to Low.

Reservoir flood mitigation measures

According to NRW data, the nearest reservoir relating to the flood risk at the Site is c. 40 km north-west.

There would be a relatively high rate and onset of flooding associated with a reservoir breach. It is unlikely that safe access could be achieved unless a long warning period was provided. Therefore, occupants should get to the highest level of the Site as possible and contact the emergency services.

Other flood risk mitigation measures

As the Site is not identified as at risk from other sources, mitigation measures are not required.

Residual flood risk mitigation measures

The risk to the Site has been assessed from all sources of flooding and appropriate mitigation and management measures proposed to keep the users of the development safe over its lifetime. There is however a residual risk of flooding associated with the potential for failure of mitigation measures if regular maintenance and upkeep isn't undertaken. If mitigation measures are not implemented or maintained, the risk to the development will remain as the baseline risk.

Further flood mitigation information

More information on flood resistance, resilience and water entry can be found here: http://www.planningportal.gov.uk/uploads/br/flood_performance.pdf

www.knowyourfloodrisk.co.uk

Emergency evacuation - safe access / egress and safe refuge

Emergency evacuation to land outside of the floodplain should be provided if feasible. Where this is not possible, 'highly vulnerable' developments and, where possible, development in general (including basements), should have internal stair access to an area of safe refuge within the building to a level higher than the maximum likely water level. An area of safe refuge should be sufficient in size for all potential users and be reasonably accessible to the emergency services.

Emergency evacuation from the development and the Site should only be undertaken in strict accordance with any evacuation plans produced for the Site, with an understanding of the flood risks at the Site including available mitigation, the vulnerability of occupants and preferred evacuation routes.

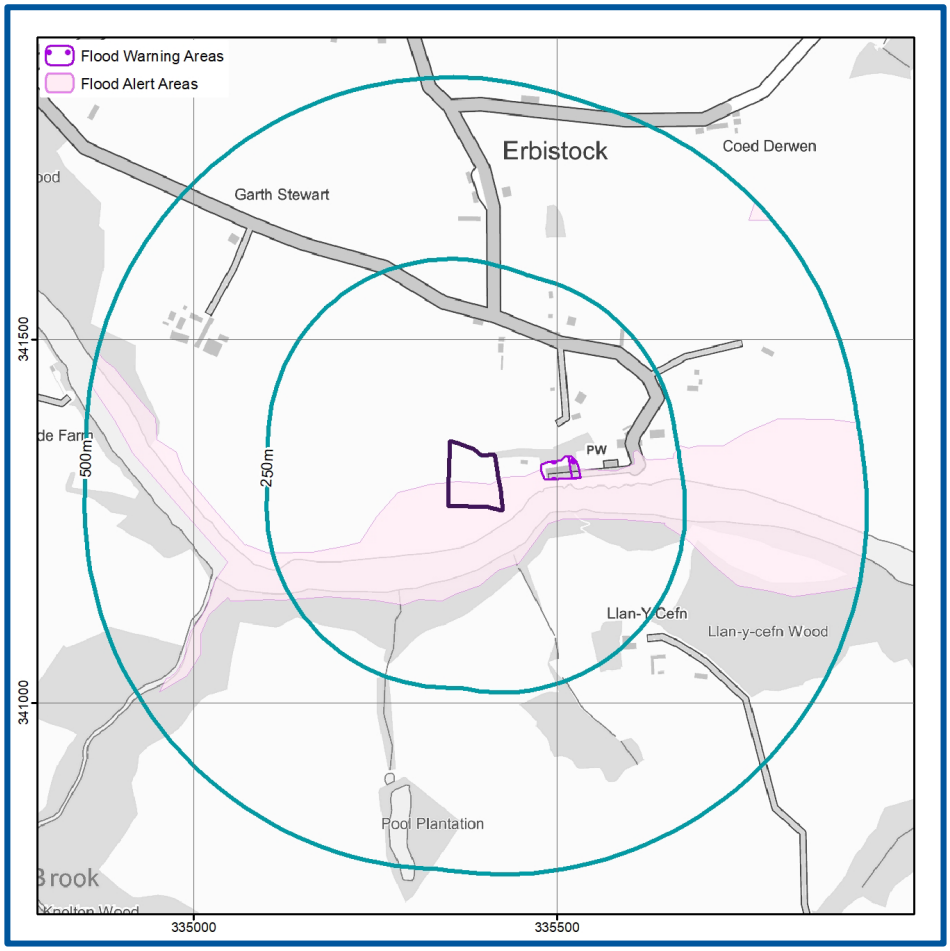
Flood warnings

The NRW operates a flood warning service in all areas at risk of flooding; this is available on their website: https://www.gov.uk/check-flood-risk. The Site is located within an NRW Flood Alerts area (ref: 101WAFLD10; quick dial code: 501019) so is able to receive alerts (Figure 22). All warnings are also available through the NRW's 24 hour Floodline Service (0345 988 1188).

An NRW Flood Warnings area is noted to cover the Boat Inn (c. 60 m east; ref: 101FWFWN201; quick dial code: 192102) which may also be applicable to the Site.

The NRW aims to issue Flood Warnings 2 hours in advance of a flood event. Flood Warnings can provide adequate time to enable protection of property and evacuation from a Site, reducing risk to life and property.

Figure 22. NRW Flood Warning Coverage for the local area (NRW, 2024).



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Emergency evacuation

Where possible, a safe access and egress route with a 'very low' hazard rating from areas within the floodplain to an area wholly outside the 1 in 100 year flood event including an allowance for climate change should be demonstrated.

Based on the NRW's Flood Zone mapping, the northern end of the Site is located within Flood Zone 1 and is not anticipated to flood. However, egress from the Site could be impacted by flood waters and therefore evacuation would still be recommended.

The nearest dry area would be c. 190 m east along the highway. It is recommended that the Site management prepare to evacuate guests as soon as an NRW Flood Warning / Alert is issued in order to completely avoid flood waters.

On-Site refuge

Evacuation should be the primary action in preference; however, safe refuge could be sought within the proposed annex building, as this is located significantly above the flood level.

Other relevant information

A Business Continuity and Flood Warning and Evacuation Plan (BCFWEP) is recommended to reduce risks to people, property and profit.

Site management should be signed up to receive NRW's Flood Alerts.

Registration to the Natural Resource Wales flood warning scheme can be done by following this link: https://www.gov.uk/sign-up-for-flood-warnings.

It is recommended that main communication lines required for contacting the emergency services, electricity sockets/meters, water supply and first aid stations and supplies are not compromised by flood waters. Where possible these should all be raised above the extreme flood level.

8. Conclusions and recommendations

Table 10. Risk ratings following Site analysis

Source of Flood Risk	Baseline[1]	Area proposed for development[2]	After Mitigation[3]
River (fluvial) flooding	Very Low to Medium	Very Low	Very Low
Sea (coastal/tidal) flooding	Very Low		N/A
Surface water (pluvial) flooding	Very Low to High	Very Low	N/A
Groundwater flooding	Negligible	Negligible to Low	Negligible to Low
Other flood risk factors present (reservoirs)	Yes		N/A
Is any other further work recommended?	Yes (see below)		

1 BASELINE risks assigned for the whole Site, using national risk maps, including the benefit of NRW flood defences.

2 AFTER ANALYSIS modification of risk assessment based on detailed site specific analysis including some or all of the following: flood model data, high resolution mapping, building location, access routes, topographic and CCTV surveys.

3 AFTER MITIGATION risks include risks to the proposed development / asset and occupants if mitigation measures recommended in this report are implemented, including the impacts of climate change.

*N/A indicates where mitigation is not required.

Table 11 provides a summary of where the responses to key questions are discussed in this report. Highly Vulnerable developments in a DAM Zone A are acceptable according to TAN15 (2004) and providing the recommended mitigation measures are put in place (see previous sections) it is likely that flood risk to this Site will be reduced to an acceptable level.

Table 11. Summary of responses to key questions in the report

Key sources of flood risks identified	Groundwater and reservoirs (see Section 4).
Are standard mitigation measures likely to provide protection from flooding to/from the Site?	Yes (see Section 7).
Is any further work recommended?	Yes (see executive summary and Section 7).

9. References and glossary

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GeoSmart Information

Glossary

General terms

BGS	British Geological Survey
NRW	National Resource Wales
GeoSmart groundwater flood risk model	GeoSmart's national groundwater flood risk model takes advantage of all the available data and provides a preliminary indication of groundwater flood risk on a 50m grid covering England and Wales. The model indicates the risk of the water table coming within 1 m of the ground surface for an indicative 1 in 100 year return period scenario.
Dry-Island	An area considered at low risk of flooding (e.g. In a Flood Zone 1) that is entirely surrounded by areas at higher risk of flooding (e.g. Flood Zone 2 and 3)
Flood resilience	Flood resilience or wet-proofing accepts that water will enter the building, but through careful design will minimise damage and allow the re-occupancy of the building quickly. Mitigation measures that reduce the damage to a property caused by flooding can include water entry strategies, raising electrical sockets off the floor, hard flooring.
Flood resistance	Flood resistance, or dry-proofing, stops water entering a building. Mitigation measures that prevent or reduce the likelihood of water entering a property can include raising flood levels or installation of sandbags.
Flood Zone 1	This zone has less than a 0.1% annual probability of river flooding
Flood Zone 2	This zone has between 0.1 and 1% annual probability of river flooding and between 0.1% and 0.5 % annual probability sea flooding
Flood Zone 3	This zone has more than a 1% annual probability of river flooding and 0.5% annual probability of sea flooding
Functional Flood Plain	An area of land where water has to flow or be stored in times of flood.
Hydrologic model	A computer model that simulates surface run-off or fluvial flow. The typical accuracy of hydrologic models such as this is ±0.25m for estimating flood levels at particular locations.
OS	Ordnance Survey
Residual Flood Risk	The flood risk remaining after taking mitigating actions.
SFCA	Strategic Flood Consequence Assessment. This is a brief flood risk assessment provided by the local council

SuDS	A Sustainable drainage system (SuDS) is designed to replicate, as closely as possible, the natural drainage from the Site (before development) to ensure that the flood risk downstream of the Site does not increase as a result of the land being developed. SuDS also significantly improve the quality of water leaving the Site and can also improve the amenity and biodiversity that a Site has to offer. There are a range of SuDS options available to provide effective surface water management that intercept and store excess run-off. Sites over 1 Ha will usually require a sustainable drainage assessment if planning permission is required. The current proposal is that from April 2014 for more than a single dwelling the drainage system will require approval from the SuDS Approval Board (SABs).

Aquifer Types

Principal aquifer	These are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale.
Secondary A aquifer	Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.
Secondary B aquifer	Predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering.
Secondary undifferentiated	Has been assigned in cases where it has not been possible to attribute either category A or B to a rock type due to the variable characteristics of the rock type.
Unproductive Strata	These are rock layers or drift deposits with low permeability that has negligible significance for water supply or river base flow.

Data Sources

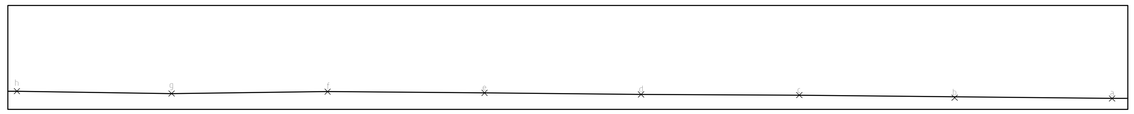
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Bedrock & Superficial Geology	Contains British Geological Survey materials © NERC 2024 Ordnance Survey data © Crown copyright and database right 2024
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Flood Risk (Groundwater)	GeoSmart, BGS & OS GW5 (v2.4) Map (GeoSmart, 2024) Contains British Geological Survey materials © NERC 2024 Ordnance Survey data © Crown copyright and database right 2024
Location Plan	Contains Ordnance Survey data © Crown copyright and database right 2024
Topographic Data	OS LiDAR/EA Contains Ordnance Survey data © Crown copyright and database right 2024 Natural Resource Wales copyright and database rights 2024

10. Appendices

GeoSmart Information

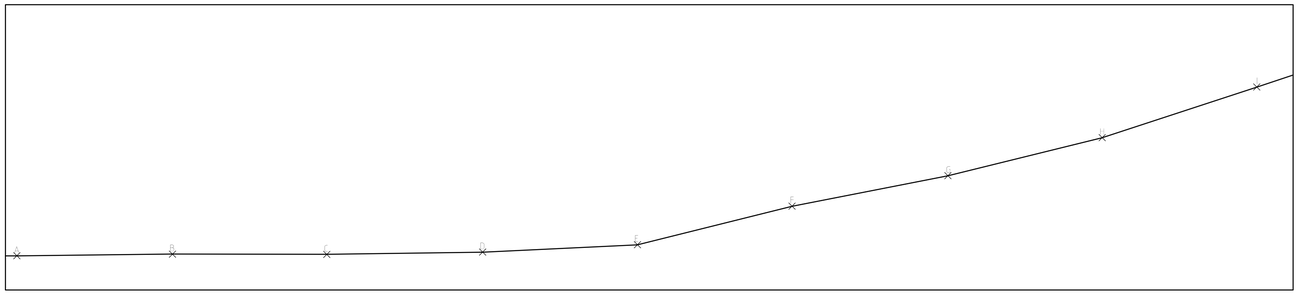
Appendix A

Site plans



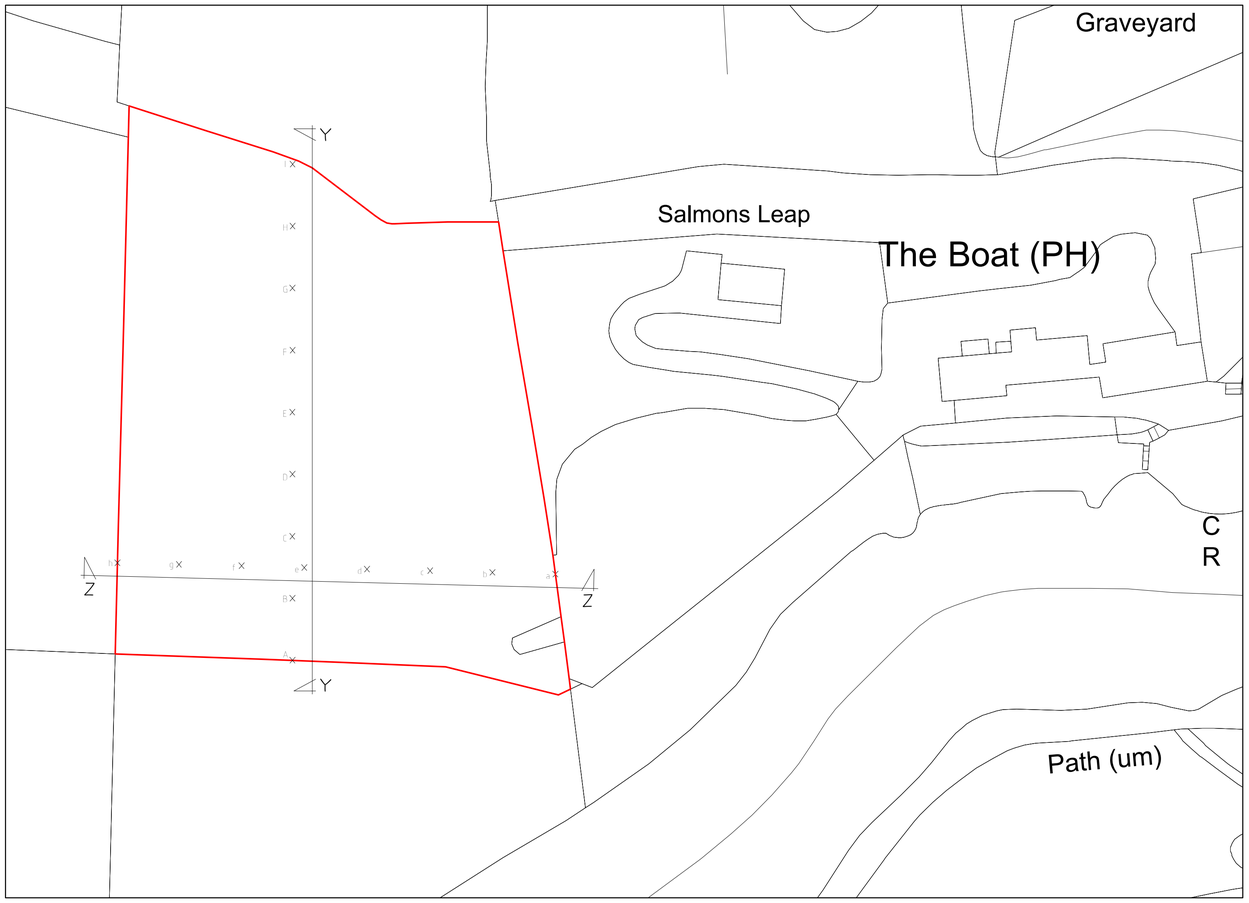
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a	10.000
b	10.100
c	10.215
d	10.259
e	10.364
f	10.438
g	10.317
h	10.471

Section Z-Z 1:200

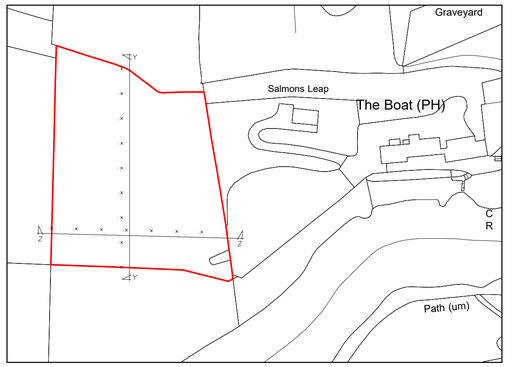


Point	Level
A	10.000
B	10.113
C	10.095
D	10.241
E	10.715
F	13.205
G	15.167
H	17.618
I	20.888

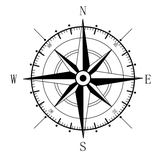
Section Y-Y 1:200



Site Plan 1:500



Location Plan 1:1250



Key

Surrounding Buildings

Application Site

Rev	Date	Detail	Initial

Project:
Land associated with ,
The Boat,
Erbistock,
Wrexham, LL13 0DL

Title: Existing: Site & Location Plan & Section

Scale: (A1) 1:200, 1:500 & 1:1250

Drawn By: E.M.Jackson

Date: June 2022

Drawing No: PL143/001

Sheet: 1 of 1

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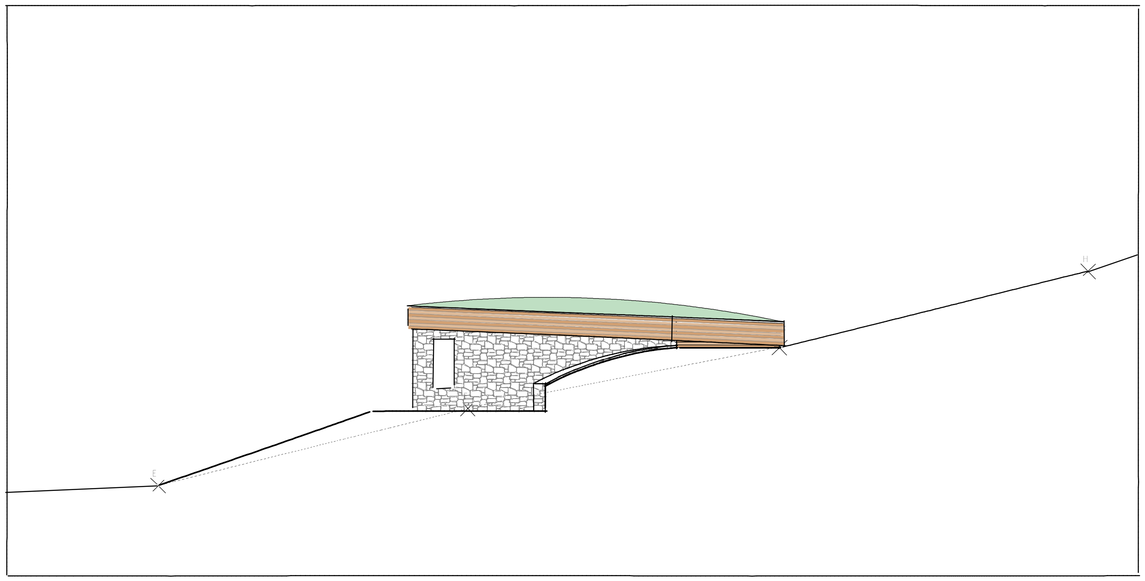
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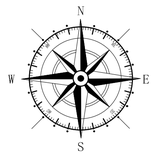
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Site Plan 1:200



Section 1:100



Key

Surrounding Buildings

Application Site

Rev	Date	Detail	Initial
C	08/22	Path and Parking update	AV
B	08/22	Existing Car Park Indicated	SH
A	08/22	Design Amends	DJE

Project:

Land associated with ,
The Boat,
Erbistock,
Wrexham, LL13 0DL

Title: Proposed: Site Plan & Section

Scale: (A1) 1:100 & 1:200

Drawn By: D.J.Edwards

Date: June 2022

Drawing No: PL143/003

Sheet: 1 of 1

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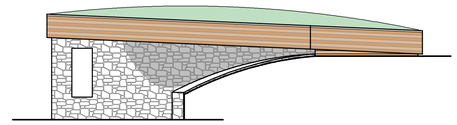
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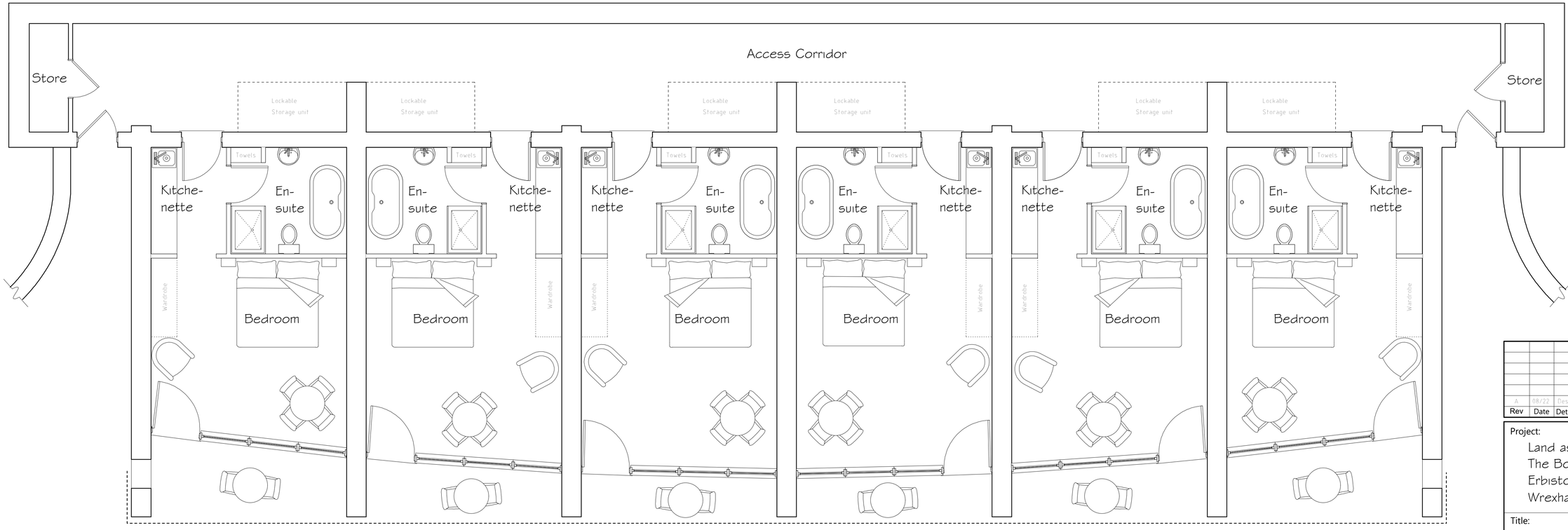
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Front Elevation 1:100



Side Elevation 1:100



Floor Plan 1:50

Rev	Date	Detail	Initial
A	08/22	Design Amends	D.J.E

Project:
Land associated with ,
The Boat,
Erbistock,
Wrexham, LL13 0DL

Title: Proposed

Scale: (A1) 1:50 & 1:100

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Date: June 2022

Drawing No: PL143/002

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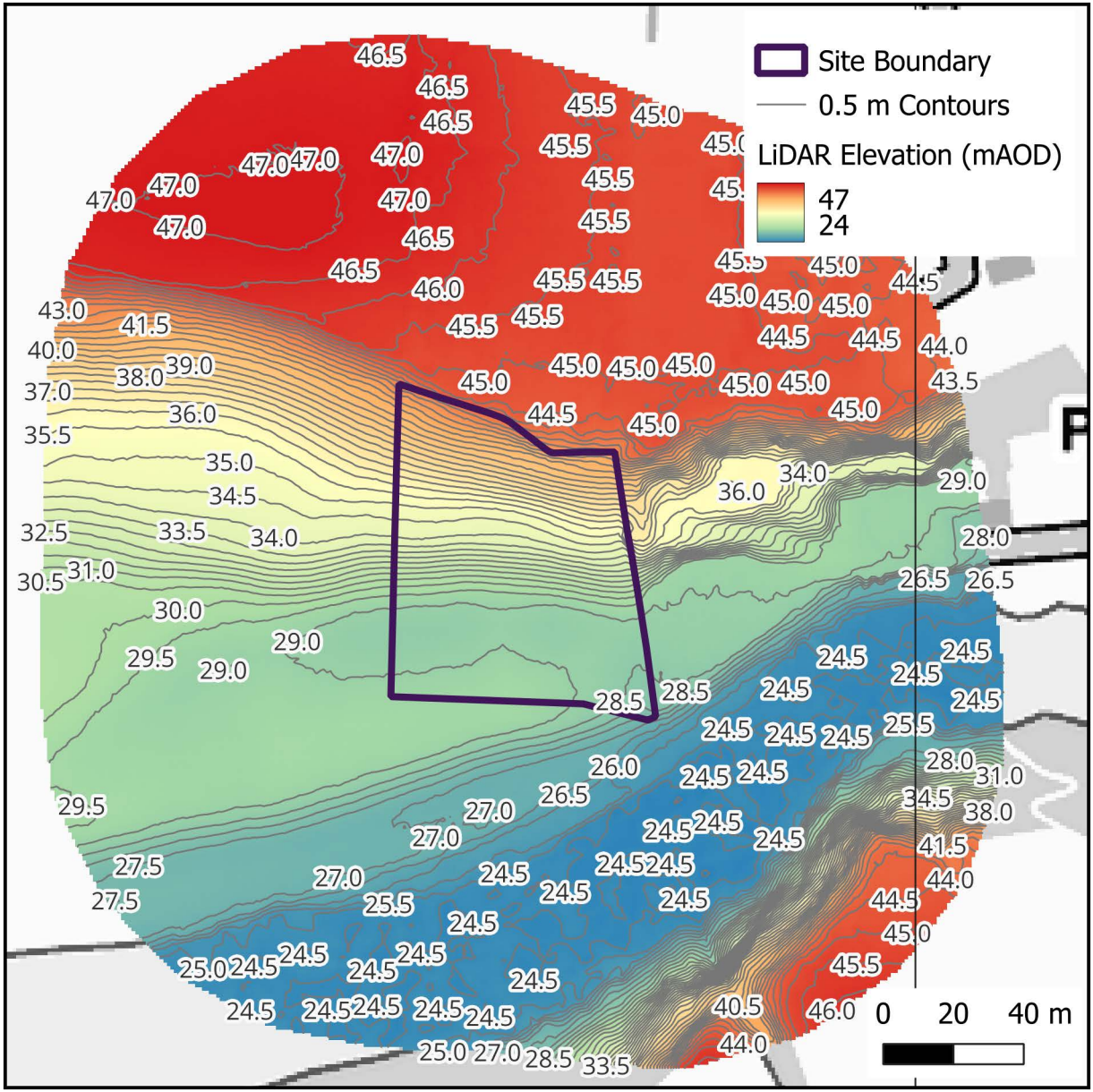
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GeoSmart Information

Appendix B

Natural Resource Wales LiDAR ground elevation data


Site Boundary
0.5 m Contours
LiDAR Elevation (mAOD)
47
24
0
20
40 m
335500

GeoSmart Information

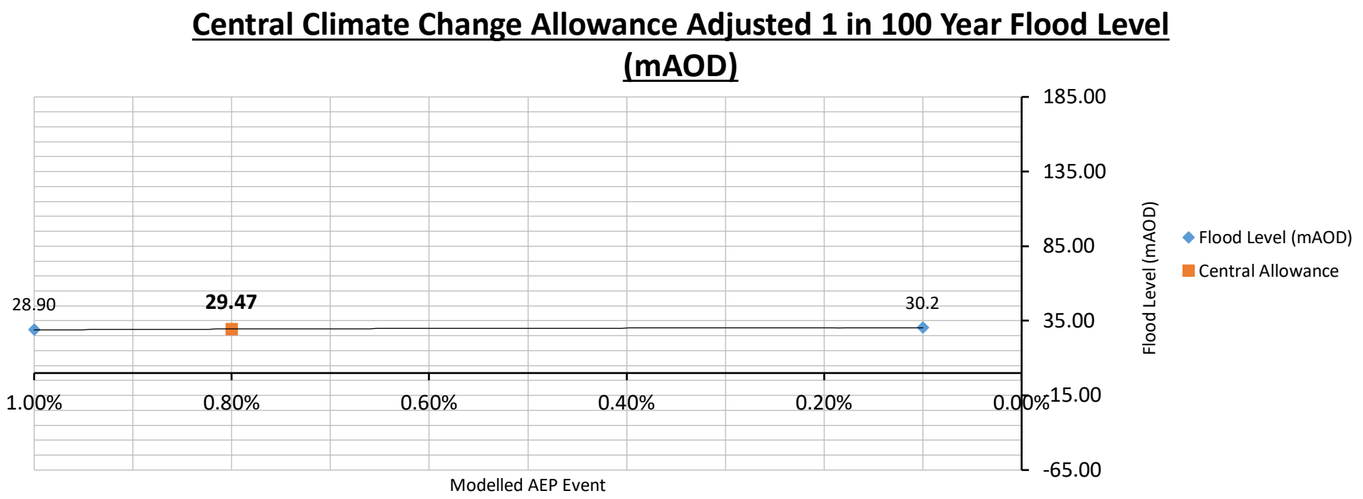
Appendix C

Stage-level discharge graph

Design Flood Level Calculator Fluvial

Development lifespan	75
Development lifespan end	2099

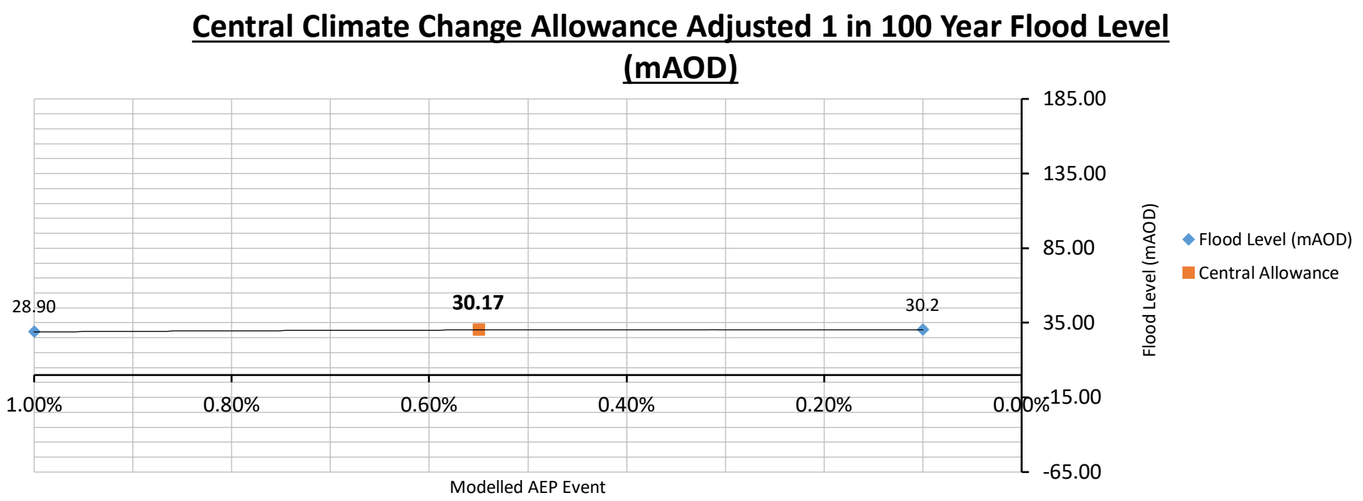
Hydrological region	10
1 in 20 year flood level (mAOD)	
1 in 50 year flood level (mAOD)	
1 in 100 year flood level (mAOD)	28.90
Required climate change allowance (%)	20
1 in 200 year flood level (mAOD)	
1 in 1000 year proportion of 1 in 100 year event	46
1 in 1000 year flood level (mAOD)	30.2
How many years between your provided 1 in 100 year CC % and equivalent 1 in 1000 year %?	26



Design Flood Level Calculator Fluvial

Development lifespan	75
Development lifespan end	2099

Hydrological region	10
1 in 20 year flood level (mAOD)	
1 in 50 year flood level (mAOD)	
1 in 100 year flood level (mAOD)	28.90
Required climate change allowance (%)	45
1 in 200 year flood level (mAOD)	
1 in 1000 year proportion of 1 in 100 year event	46
1 in 1000 year flood level (mAOD)	30.2
How many years between your provided 1 in 100 year CC % and equivalent 1 in 1000 year %?	1



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43-55 Milford Street

Salisbury

Wiltshire SP1 2BP

Tel: 01722 333306

Fax: 01722 332296

Email: admin@tpos.co.uk

You can get more information about the PCCB from www.propertycodes.org.uk. Please ask your search provider if you would like a copy of the search code

Complaints procedure

GeoSmart Information Limited is registered with the Property Codes Compliance Board as a subscriber to the Search Code. A key commitment under the Code is that firms will handle any complaints both speedily and fairly. If you want to make a complaint, we will:

- Acknowledge it within 5 working days of receipt.
- Normally deal with it fully and provide a final response, in writing, within 20 working days of receipt.
- Keep you informed by letter, telephone or e-mail, as you prefer, if we need more time.
- Provide a final response, in writing, at the latest within 40 working days of receipt.
- Liaise, at your request, with anyone acting formally on your behalf.

If you are not satisfied with our final response, or if we exceed the response timescales, you may refer the complaint to The Property Ombudsman scheme (TPOs): Tel: 01722 333306, E-mail: admin@tpos.co.uk.

We will co-operate fully with the Ombudsman during an investigation and comply with his final decision. Complaints should be sent to:

Martin Lucass

Commercial Director

GeoSmart Information Limited

Suite 9-11, 1st Floor,

Old Bank Buildings,

Bellstone, Shrewsbury, SY1 1HU

Tel: 01743 298 100

martinlucass@geosmartinfo.co.uk

11. Terms and conditions, CDM regulations and data limitations

Terms and conditions can be found on our website:

http://geosmartinfo.co.uk/terms-conditions/

CDM regulations can be found on our website:

http://geosmartinfo.co.uk/knowledge-hub/cdm-2015/

Data use and limitations can be found on our website:

http://geosmartinfo.co.uk/data-limitations/