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Flood Consequence Assessment

Factory Road, Sandycroft, Deeside, Flintshire, CH5 2QJ

Client:	Chester Wool Company Ltd
Document Type:	Report
Document No.:	TE/1799/FCA
Revision:	1.1
Date:	12/01/2024

Registered Company No. 04638546

Version History

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Revision	Date	Notes	Prepared by	Checked by	Approved by
1.1	12/01/2024	First Draft	Keelan Serjeant	Sean Lee	Sean Lee

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1. Introduction

1.1 Background

This Flood Consequence Assessment (FCA) has been prepared by Tier Consult for the proposed development on Factory Road, Sandycroft, Deeside, Flintshire, CH5 2QJ.

This FCA has been carried out in accordance with guidance contained in Technical Advice Note 15 Development and Flood Risk (TAN15) and associated Development Advice Maps (DAMs). This FCA identifies and assesses the risks of all forms of flooding to and from the development and demonstrates how these flood risks will be managed so that the development remains safe throughout the lifetime, taking climate change into account.

It is recognised that developments which are designed without regard to flood risk may endanger lives, damage property, cause disruption to the wider community, damage the environment, be difficult to insure and require additional expense on remedial works. The development design should be such that future users will not have difficulty obtaining insurance or mortgage finance, or in selling all or part of the development, as a result of flood risk issues.

1.2 Planning Policy Wales

Planning Policy Wales (11th edition), 2021[1], sets out the land use planning policies of the Welsh Government. Chapter 6 'Distinctive and Natural Places' outlines the Welsh Government's objectives in terms of addressing flood risk. The section titled 'Development and Flood Risk the following is stated:

"The climate emergency is likely to increase the risk of flooding as a result of sea-level rises, increased storminess and more intense rainfall. Flooding as a hazard involves the consideration of the potential consequences of flooding, as well as the likelihood of an event occurring. Planning authorities should adopt a precautionary approach of positive avoidance of development in areas of flooding from the sea or from rivers. Surface water flooding will affect choice of location and the layout and design of schemes and these factors should be considered at an early stage in formulating development proposals.

The continued construction of hard engineered flood defences to protect development in areas of floodplain is not sustainable. Government resources for flood and coastal defences are directed at protecting existing developments and are not available to provide defences in anticipation of future development. Account should be taken of shoreline management plans and measures such as managed realignment, the creation of washlands and flood plain restoration as alternatives to engineered flood defences.

Development Advice Maps enable planning authorities to take a strategic approach to flood risk and consider the catchment as a whole by providing a preliminary representation of flood risks, which inform decisions on the location of new development and the requirements necessary to support any

[1] https://www.gov.wales/planning-policy-wales

applications which may be proposed. Together with flood consequences assessments they should assist understanding of how natural and man-made defences work as integral components of places and provide a means by which the cumulative effects of development can begin to be understood. Development should reduce, and must not increase, flood risk arising from river and/or coastal flooding on and off the development site itself. The priority should be to protect the undeveloped or unobstructed floodplain from development and to prevent the cumulative effects of incremental development.

In areas of flood plain currently unobstructed, where water flows in times of flood, built development should be wholly exceptional and limited to essential transport and utilities infrastructure. Such infrastructure should be designed and constructed so as to remain operational even at times of flood, to result in no net loss of floodplain storage, to not impede water flows and to not increase flood risk elsewhere. TAN 15: Development and Flood Risk should be referred to for further policy advice on development and flood risk. It will be important to note that developments located within flood risk areas remain at risk from flooding even if mitigation measures are applied.

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. Development should not cause additional run-off, which can be achieved by controlling surface water as near to the source as possible by the use of SuDS. Care should be taken in places of shallow groundwater or where flooding is caused by combined surface and groundwater processes. In such situations direct infiltration SuDs may not be appropriate. Consultation with drainage bodies and NRW should be undertaken and relevant evidence and information drawn from Area Statements taken into account.

New or improved flood defences in coastal and/or riverside locations should be carefully planned, ensuring all potential environmental effects, both on and off-shore, and relevant Shoreline Management Plan policies are taken into account. Flood defence works can provide opportunities to achieve wider social, economic and environmental benefits, which should be maximised where possible. Nature based solutions should be the first consideration given the opportunity to deliver other multiple benefits, including habitat creation, biodiversity enhancement and water quality improvements. Overall, green infrastructure opportunities can benefit ecosystem resilience and provide opportunities for leisure facilities or renewable energy generation.

The ability of emergency services to respond to flood events should be taken into account when considering if a development in a flood risk area is appropriate. This may involve consultation with emergency planners, local resilience forums and other professional partners such as fire rescue, police and ambulance services."

1.3 Technical Advice Note 15 (TAN15)

Planning Policy Wales is supplemented by a series of Technical Advice Notes (TAN). Technical guidance on development and flood risk is provided by TAN15[2]. TAN15 was introduced in 2004 by the Welsh Assembly Government. It is technical guidance related to development planning and flood risk

[2] https://www.gov.wales/technical-advice-note-tan-15-development-and-flood-risk-2004

using a sequential characterisation of risk based on the Welsh Government's Development and Flood Risk Advice Map (DAM). Its initial requirement is to identify the flood zones and vulnerability classification relevant to the proposed development, based on an assessment of current and future conditions.

One of the key aims of TAN15 is to ensure that flood risk is taken into account at all stages of the planning process; to avoid inappropriate development in areas at risk of flooding and to direct development away from areas of highest risk.

It advises that where new development is exceptionally necessary in areas of higher risk, this should be safe, without increasing flood risk elsewhere, and where possible, reduce flood risk overall. A risk based approach is adopted at stages of the planning process, applying a source pathway receptor model to planning and flood risk. To demonstrate this, an FCA is required and should include:

- whether a proposed development is likely to be affected by current or future flooding from all sources;
- whether it will increase flood risk elsewhere;
- whether the measures proposed to deal with these effects and risks are appropriate; and
- satisfy the justification test, where required, including the acceptability of consequences.

A revised TAN15 is due to be implemented in the near future. This is to be supported by the new Flood Map for Planning (FMfP), which includes climate change information to show how this will affect flood risk extents over the next century. It shows the potential extent of flooding assuming no defences are in place. The coming into force of the new TAN15 and the FMfP has been suspended due to a further consultation on the TAN[3], [4].

The FMfP has no official status for planning purposes at the moment however, Natural Resources Wales may use the FMfP data as the 'best available information' on flood risk to inform their planning advice. As confirmed in the letter from Welsh Government dated 15th December 2021[5], the FMfP represents better and more up-to-date information on areas at flood risk than the DAM.

1.4 Natural Resources Wales

The Flood and Water Management Act 2010 gives Natural Resources Wales a strategic overview role for all forms of flooding and coastal erosion. They also have direct responsibility for the prevention, mitigation and remediation of flood damage for main rivers and coastal areas. Natural Resources Wales is the statutory consultee with regards to flood risk and planning.

Natural Resources Wales Flood Risk Standing Advice and TAN15 have been consulted and reviewed during this FCA. Information regarding the current flood risk at the site, local flood defences and flood water levels has been obtained from Natural Resources Wales. This FCA contains Natural Resources Wales information © Natural Resources Wales and database right. All rights reserved. Additional

[3] https://www.gov.wales/technical-advice-note-tan-15-development-flooding-and-coastal-erosion
[4] https://www.gov.wales/written-statement-tan-15-timeline
[5] https://www.gov.wales/sites/default/files/publications/2021-12/letter-local-authorities-on-the-pause-of-tan-15-15-december-2021.pdf

third-party rights are also be acknowledged - Wallingford Hydrosolutions Ltd. UKCEH and NERC, (UKRI).

Recommended precautionary sensitivity ranges for peak rainfall intensities, peak river flows and sea level rise are outlined in the following documents CL-03-16 - Climate Change Allowances for Planning Purposes[6], Flood Consequence Assessments: Climate change allowances[7] and Adapting to Climate Change: Guidance for Flood and Coastal Erosion Risk Management Authorities in Wales[8].

The 9th January 2014 Welsh Government letter to all Chief Planning Officers (CPO) in Wales and CL-03-16 - Climate Change Allowances for Planning Purposes clarifies and refers to the Natural Resources Wales recommendations that the lifetime of development for residential development is 100 years, and for other development it is considered to be 75 years.

1.5 Flintshire County Council

Flintshire County Council is the Local Planning Authority (LPA), the Lead Local Flood Authority (LLFA), the SuDS Approving Body (SAB) and therefore, has responsibilities for 'local flood risk', which includes surface runoff, groundwater and ordinary watercourses. Planning guidance written by Flintshire County Council regarding flood risk was consulted to assess the mitigation policies in place. The Flintshire County Council Preliminary Flood Risk Assessment (PFRA) and Strategic Flood Consequence Assessment (SFCA) which cover the site have been reviewed.

1.6 Welsh Water/Dŵr Cymru

Welsh Water/Dŵr Cymru is responsible for the disposal of wastewater and supply of clean water for this area. Information with regards to sewer and water main flooding contained within the Flintshire County Council PFRA and SFCA has been consulted as part of this FCA. All Water Companies have a statutory obligation to maintain a register of properties/areas which are at risk of flooding from the public sewerage system, and this is shown on the DG5 Flood Register.

[6] https://gov.wales/sites/default/files/publications/2018-11/cl0316-climate-change-allowances.pdf
[7] https://gov.wales/sites/default/files/publications/2018-11/flood-consequence-assessments.pdf
[8] https://www.gov.wales/sites/default/files/publications/2021-09/climate-change-allowances-and-flood-consequence-assessments_0.pdf

2. Location & Description

2.1 Site Location

The site is located on Factory Road, Sandycroft, Deeside, Flintshire, CH5 2QJ (see Figure 2.1). The property is accessed off Factory Road within the heart of the industrial area in Sandycroft.

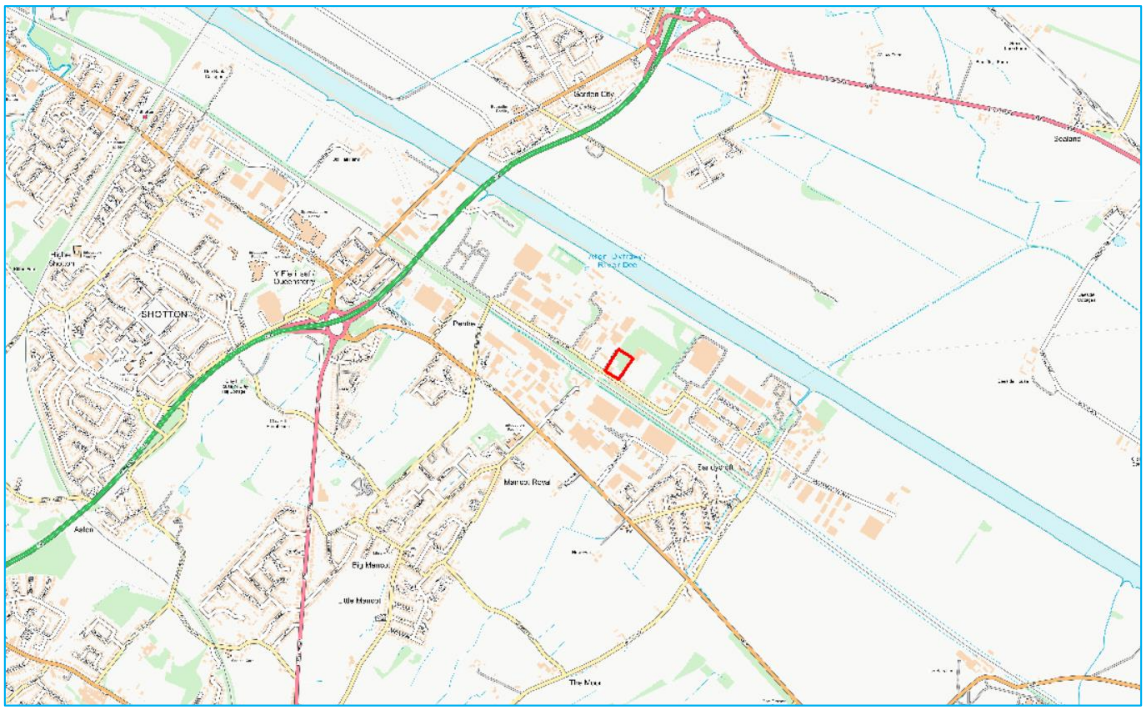

Figure 2.1 - Site Location

2.2 Existing Development

The property comprises an industrial site.

2.3 Proposed Development

The proposed development is for the construction of industrial units, car parking and landscaping.

2.4 Ground Levels

The site ground levels are generally flat with levels between 5.54 metres Above Ordnance Datum (mAOD) and 5.65mAOD.

2.5 Catchment Hydrology/Drainage

The River Dee flows in a north westerly direction approximately 300m to the northeast of the site. This section of the River Dee is tidally dominated and benefits from suitable flood defence measures. Pentre Drain North is culverted adjacent to the northern edge of Chester Road (east), approximately

300m to the southwest of the site. Pentre Drain South West flows in an open channel adjacent to the southern edge of Chester Road (east), 335m to the southwest of the site. There are several small land drains located in the vicinity of the site.

2.6 Ground Conditions

The British Geological Survey (BGS) Map indicates that the site is underlain by Tidal Flat Deposits - clay, silt and sand. Superficial deposits formed up to 2 million years ago in the Quaternary Period. The bedrock deposits underlying the site consist of the Pennine Middle Coal Measures Formation - mudstone, siltstone and sandstone. Sedimentary bedrock formed approximately 310 to 318 million years ago in the Carboniferous Period.

The superficial deposits are classified as a Secondary Aquifer Undifferentiated. This is assigned in cases where it has not been possible to attribute either a category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both a minor and non-aquifer in different locations due to the variable characteristics of the rock type.

The bedrock is classified as a Secondary A Aquifer. These are permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of baseflow to rivers.

3. Assessment of Flood Risk

3.1 Sources of Flooding

All sources of flooding have been considered, these are fluvial (river) flooding, tidal (coastal) flooding, groundwater flooding, surface water (pluvial) flooding, sewer flooding and flooding from artificial drainage systems/infrastructure failure.

3.2 Climate Change

Projections of future climate change, in the UK, indicate more frequent, short-duration, high intensity rainfall and more frequent periods of long duration rainfall. Guidance included within TAN15 recommends that the effects of climate change are incorporated into FCA. Recommended precautionary sensitivity ranges for peak rainfall intensities and peak river flows are outlined in the Welsh Government Guidance, CL-03-16 - Climate change allowances for Planning purposes[9].

The 9th January 2014 Welsh Government letter to all Chief Planning Officers (CPO) in Wales and CL-03-16 - Climate change allowances for Planning purposes clarifies and refers to the Natural Resources Wales recommendations that the lifetime of development for residential development is 100 years, and for other development it is considered to be 75 years (i.e. 2099).

3.3 Development Advice Map

The Development Advice Map (DAM) which accompanies TAN15 confirms that the site is located within Zone C1: Areas of the floodplain which are developed and served by significant infrastructure, including flood defences (see Figure 3.1). Flooding at the site would only occur if the flood defences were to be overtopped/breached.

[9] https://www.gov.wales/sites/default/files/publications/2021-09/climate-change-allowances-and-flood-consequence-assessments_0.pdf

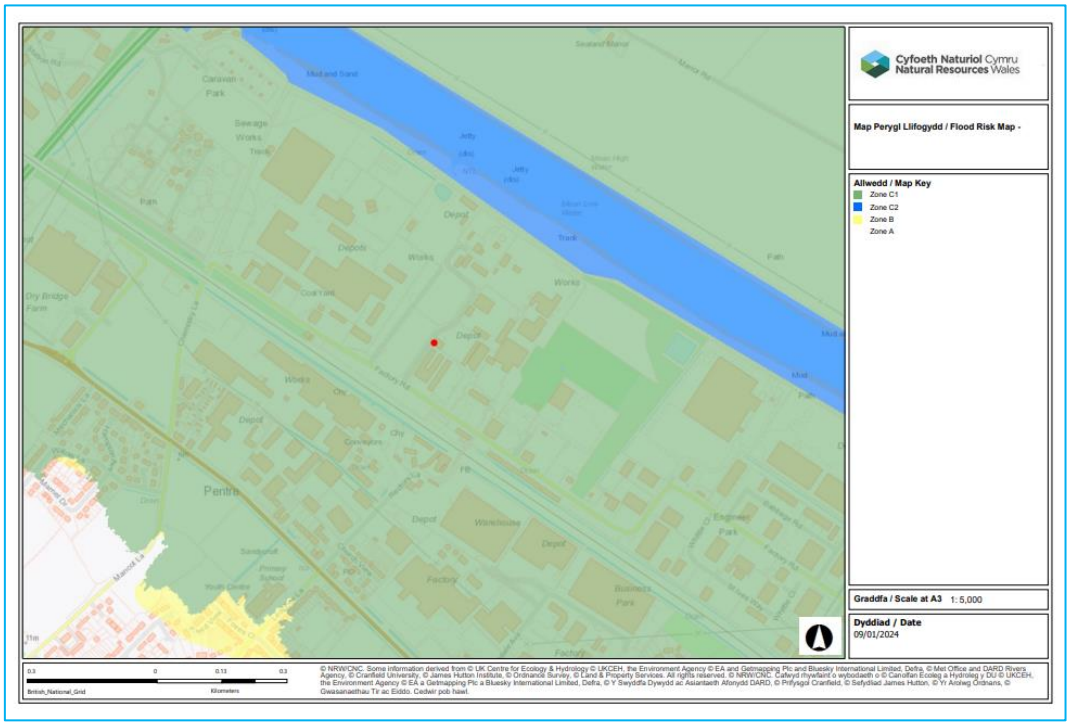

Figure 3.1 - Development Advice Map

Table 3.1 - Development Advice Map Zones

Description of Zone	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.

3.4 Flood Map for Planning

The Flood Map for Planning (FMfP) shows that the site is located within the following Flood Zones:

- Flood Zone 1 for flooding from rivers as shown in Figure 3.2.
- Flood Zone 3 for flooding from the sea as shown in Figure 3.3.
- Flood Zones 1 and 2 for flooding from surface water and small watercourses as shown in Figure 3.4.

Table 3.2 provides details of the FMfP Flood Zones.

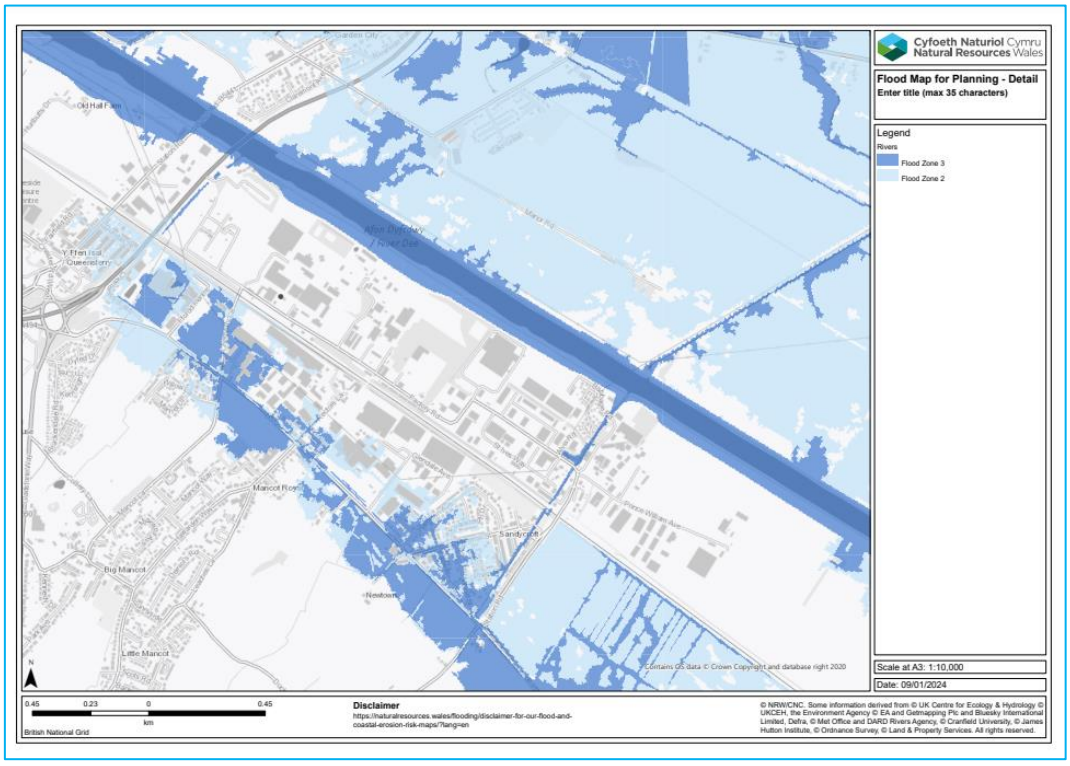

Figure 3.2 - Flood Map for Planning: Rivers

Figure 3.3 - Flood Map for Planning: Sea

Figure 3.4 - Flood Map for Planning: Surface and Small Watercourses

Table 3.2 - Flood Map for Planning Flood Zones

Flood Zone	Explanation
Rivers - Flood Zone 2	Areas with 0.1% to 1% (1 in 1000 to 1 in 100) chance of flooding from rivers in a given year, including the effects of climate change.
Rivers - Flood Zone 3	Areas with more than 1% (1 in 100) chance of flooding from rivers in a given year, including the effects of climate change.
Sea - Flood Zone 2	Areas with 0.1% to 0.5% (1 in 1000 to 1 in 200) chance of flooding from the sea in a given year, including the effects of climate change.
Surface Water and Small Watercourses - Flood Zone 2	Areas with 0.1% to 1% (1 in 1000 to 1 in 100) chance of flooding from surface water and/or small watercourses in a given year, including the effects of climate change.
Surface Water and Small Watercourses - Flood Zone 3	Areas with more than 1% (1 in 100) chance of flooding from surface water and/or small watercourses in a given year, including the effects of climate change.

3.5 Flood Risk Vulnerability

Table 3.1 describes the composition and use of the DAM zones to control and manage development. Applying the Flood Risk Vulnerability Classification in Figure 2 of TAN15, the existing and proposed development is classified as 'less vulnerable'. In TAN15 (Section 9.0) appropriate uses have been identified for the DAM zones. The proposed development is classified as 'less vulnerable', TAN15 states that 'less vulnerable' uses are appropriate at this location.

3.6 Historic Flooding

The site is not located within the Natural Resources Wales historic flood outline for this area. The British Hydrological Society "Chronology of British Hydrological Event" has no information on flooding within the vicinity of the site. No other historical records of flooding for the site have been recorded. Therefore, it has been concluded that the site has not historically flooded.

3.7 Existing and Planned Flood Defence Measures

Flood defences are located along River Dee and consist of an embankment which provides a Standard of Protection (SoP) of 1 in 200 years.

3.8 Fluvial (river) Flooding

The DAM and the FMfP show that the site is not at risk of fluvial flooding (see Figures 3.2 and 3.3). The site is also located outside of the Broughton Brook and Queensferry Drain Natural Resources Wales defended and undefended modelled flood outlines.

There is no detailed hydraulic modelling information is available for the small land drains. Figure 3.3 shows that there is no hydraulic connectivity between the small land drains and the site. It can therefore be concluded that the risk of fluvial flooding is not significant.

3.9 Tidal (coastal) Flooding

The River Dee is tidally influenced at this location therefore, tidal flooding from the River Dee poses the primary flood risk to the site. The mechanism for flooding from tidal flooding is generally prolonged episodes of high sea levels, which affords good time for flood warnings to be issued. The likelihood of a rapid water level rise and possible rapid inundation of urban areas posing a risk to life is considered to be minimal with a forewarning of two (2) days of a pending flood event. The site is located within a low risk area where the onset of flooding is very gradual (many hours) as per Flood Risk Assessment Guidance for New Development Phase 2, R&D Technical Report FD2320/TR2.

Defended Scenario

Flood defences protect the site from flooding from the River Dee with a SoP of 1 in 200 years. The Tidal Dee Flood Mapping Study (2020) shows that the site would not be inundated with floodwater for all events up to and including the 1 in 1000 year in 2095 event.

Given that the development lifetime is assumed to be 75 years, climate change should ideally be assessed up to the year 2099; however, the additional 4 year of climate change would equate to 0.046m (11.50mm per year[10]) of additional sea level rise and is unlikely to significantly impact the model results.

The tidal flood defences provide adequate protection against tidal flooding and hence the risk can be said to be 'residual'. Hence the greatest risks would originate from any breach/overtopping scenarios within these defence systems. Therefore, the actual flood risk posed to the site is greater than the 1 in 1000 year in 2099 event.

Breach Scenario

Considerable investment has been made in the provision of the flood defences to protect this stretch of river from tidal flooding. However, the flood defences can only protect up to a point, they may malfunction, can be breached and have a finite structure life. Therefore, there is a residual risk of tidal flooding. Although it is unlikely that a breach in the flood defences would occur.

If the flood defences were not there, the area would be flooded. However, as area of land may benefit from the presence of flood defences even if the flood defences are overtopped, the presence of the flood defences means that the floodwater does not extend as far as it would if the flood defences were not there. Natural Resources Wales consider the breach event to be the design flood event for the site.

Breach modelling has been undertaken by Natural Resources Wales as part of the Tidal Dee Flood Mapping Study (2020) this includes updated undertaken in 2022[11] which the latest climate change guidance[12], published by the Welsh Government. The modelled outputs have been reviewed and the worst case scenario for the site is the closest located breach referred to as the "Pentre" breach within the associated Natural Resources Wales report. It is understood that the location of the Pentre breach

[10] https://www.gov.wales/sites/default/files/publications/2021-09/climate-change-allowances-and-flood-consequence-assessments_0.pdf
[11] Natural Resources Wales, Updating tidal boundaries to current climate change allowances for DeeTidal_2_V4.0_2020 – Development and Flood Risk, 09/11/2022.
[12] Flood Consequences Assessments: Climate change allowances – Welsh Government (Sept. 2021).

(NGR: 332676 368307) was chosen due to known low spots being created on the embankment by illegal motorbike activity in the past. The breach model results are shown in Table 3.3.

The site would not be inundated with floodwater during the breach 1 in 200 year and 1 in 1000 year events due to a breach at Pentre. However, the site may be inundated with floodwater during the 1 in 200 year in 2095 event due to a breach with a water level of 6.20mAOD, as shown in Figure 3.6. Water depths of less than 0.66m will be experienced on the site. Maximum water velocities of 0.60m/s and a significant hazard rating will be experienced.

The site may be inundated with floodwater during the 1 in 1000 year in 2095 event due to a breach with a water level of 6.28mAOD, as shown in Figure 3.7. Water depths of less than 0.74m will be experienced on the site. Maximum water velocities of 0.65m/s and a significant hazard rating will be experienced.

Given that the development lifetime is assumed to be 75 years, climate change should ideally be assessed up to the year 2099; however, the additional 4 year of climate change would equate to 0.046m (11.50mm per year[13]) of additional sea level rise and is unlikely to significantly impact the model results, these are shown in Table 3.3.

Table 3.3 - Natural Resources Wales Breach (Pentre) Model Results

Return Period (yrs)	Water Level (mAOD)	Water Depth (m)		Water Velocity	Hazard Rating
		Minimum	Maximum		
200	Null	Null	Null	Null	Null
1000	Null	Null	Null	Null	Null
200 in 2095	6.20	0.55	0.66	<0.60	<1.75 Significant
1000 in 2095	6.28	0.64	0.74	<0.65	<1.75 Significant
200 in 2099	6.25	0.60	0.71	<0.60	<1.75 Significant
1000 in 2099	6.33	0.69	0.79	<0.65	<1.75 Significant

[13] https://www.gov.wales/sites/default/files/publications/2021-09/climate-change-allowances-and-flood-consequence-assessments_0.pdf

Figure 3.6 - Natural Resources Wales Tidal Dee Flood Mapping Study 1 in 200 year in 2095 Event Flood Outline

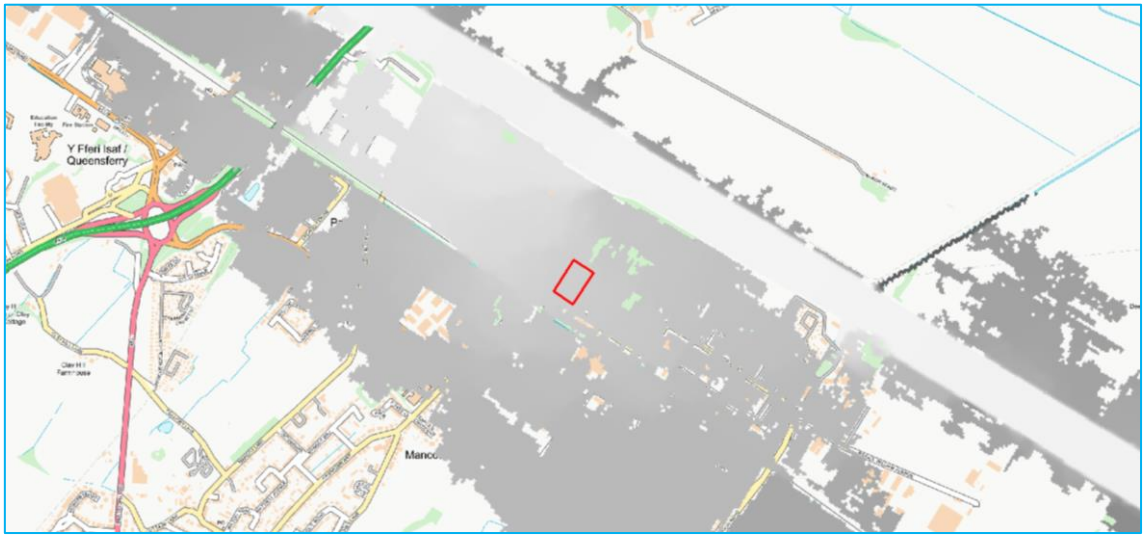

Figure 3.7 - Natural Resources Wales Tidal Dee Flood Mapping Study 1 in 1000 year in 2095 Event Flood Outline

Summary

Tidal flooding poses a very low actual risk to the site. The site is assessed to remain dry in all actual flood events. Therefore, the actual flood risk posed to the site is greater than the 1 in 1000 year in 2099 event.

Tidal flooding poses a low residual risk to the site. The site would not be inundated with floodwater during the breach 1 in 200 year and 1 in 1000 year events it is only when climate change is taken into account until 2099 that the site may be inundated with floodwater.

Given the predicted water depths within the site, location of the indicated source of flooding and the factors relating to the developed areas mentioned above it is concluded that the impact of this potential source of flooding to the site is low. Therefore, the risk of flooding from the River Dee is considered to be of medium significance. The risk from the River Dee will be further mitigated by using a number of risk management measures to manage and reduce the overall flood risk at the site (see Section 4.0).

3.10 Groundwater Flooding

Groundwater flooding is defined as the emergence of groundwater at the ground surface or the rising of groundwater into man-made ground under conditions where the normal range of groundwater levels is exceeded. Groundwater flooding tends to occur sporadically in both location and time. When groundwater flooding does occur, it tends to mostly affect low-lying areas, below surface infrastructure and buildings (for example, tunnels, basements and car parks) underlain by permeable rocks (aquifers).

The susceptibility of the site to groundwater flooding, based on the underlying geological conditions, is very low and the site is not located within an area at risk of flooding from groundwater as per the Flintshire County Council SFCA (see Figure 3.8). There are no records of groundwater flooding at or near to the site. It can therefore be concluded that the risk of groundwater flooding is not significant.

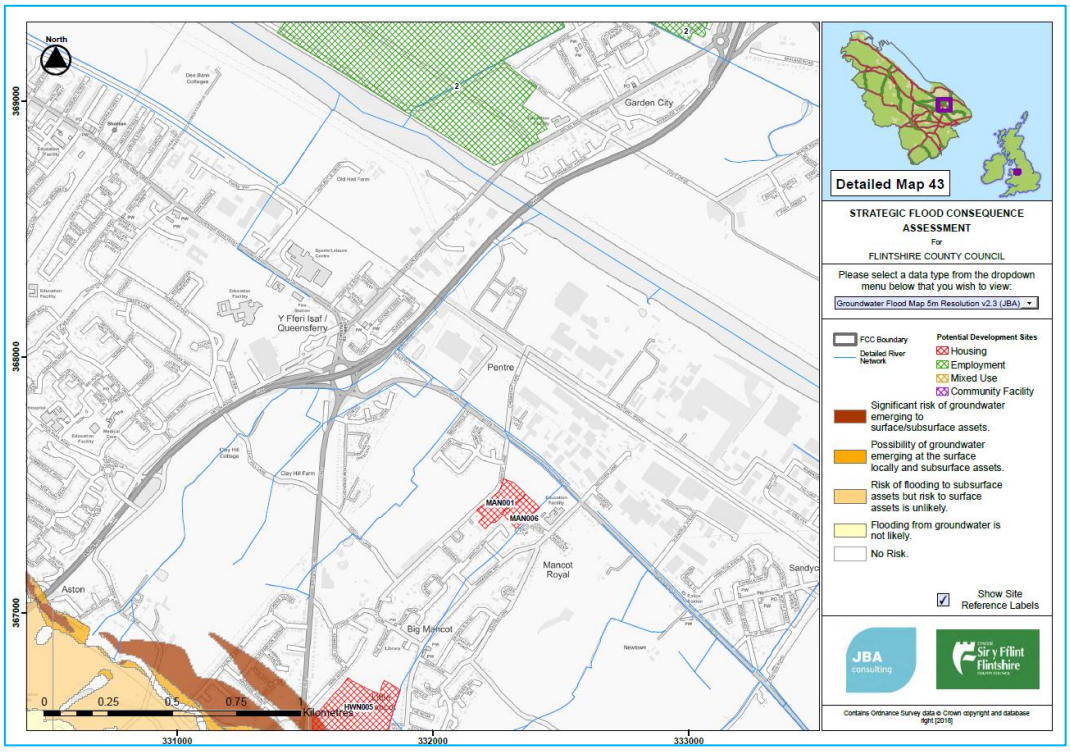

Figure 3.8 - Flintshire County Council SFCA Groundwater Flooding

3.11 Surface Water (pluvial) Flooding

The soil condition at the site and within the vicinity of the site and the topography of the site suggest that the site is relatively well drained and surface water flooding would not be expected to accumulate to any significant depths. Surface water flooding tends to occur sporadically in both location and time such surface water would tend to be confined to the streets around the development.

The FMfP show that the majority of the site is not at risk of surface water flooding (see Figure 3.3). However, a small proportion of the site is located within Flood Zones 2 and 3 for flooding from surface water and small watercourses with a chance of flooding of between 1 in 1000 (0.1%) and greater than 1 in 100 (1%) years, including the effects of climate change. This is associated with low spots and the pond located on the site. It can therefore be concluded that the risk of surface water flooding is of low significance. The risk from surface water will be further mitigated by using a number of risk management measures to manage and reduce the overall flood risk at the site (see Section 4.0).

3.12 Sewer Flooding

Sewer flooding occurs when urban drainage networks become overwhelmed and maximum capacity is reached. This can occur if there is a blockage in the network causing water to back up behind it or if the sheer volume of water draining into the system is too great to be handled. Sewer flooding tends to occur sporadically in both location and time, such flood flows would tend to be confined to the streets around the development.

Any sewer will inevitably have a limited capacity so in extreme conditions there would be surcharges, which may in turn cause flooding. Flood flows could also be generated by burst water mains, but these would tend to be of a restricted and much lower volume than weather generated events and so can be discounted for the purposes of this assessment. Given the design parameters normally used for drainage design in recent times and allowing for some deterioration in the performance of the installed systems, which are likely to have been in place for many years, an appropriate flood risk probability from this source could be assumed to have a return period in the order of 1 in 10 to 1 in 30 years.

The provision of adequate level difference between the ground floors and adjacent ground level would reduce the annual probability of damage to property from this source to 1 in 100 years or less. Therefore, sewer flooding poses a low flood risk to the site. It can therefore be concluded that the risk of sewer flooding is not significant.

3.13 Flooding from Artificial Drainage Systems/Infrastructure Failure

There are no other nearby artificial water bodies including the small ponds, water channels and artificial drainage systems that could be considered a flood risk to the site. The Natural Resources Wales Reservoir flood map shows that the site is not at risk of reservoir flooding (see Figure 3.9). The risk of flooding from these sources is considered to be not significant.

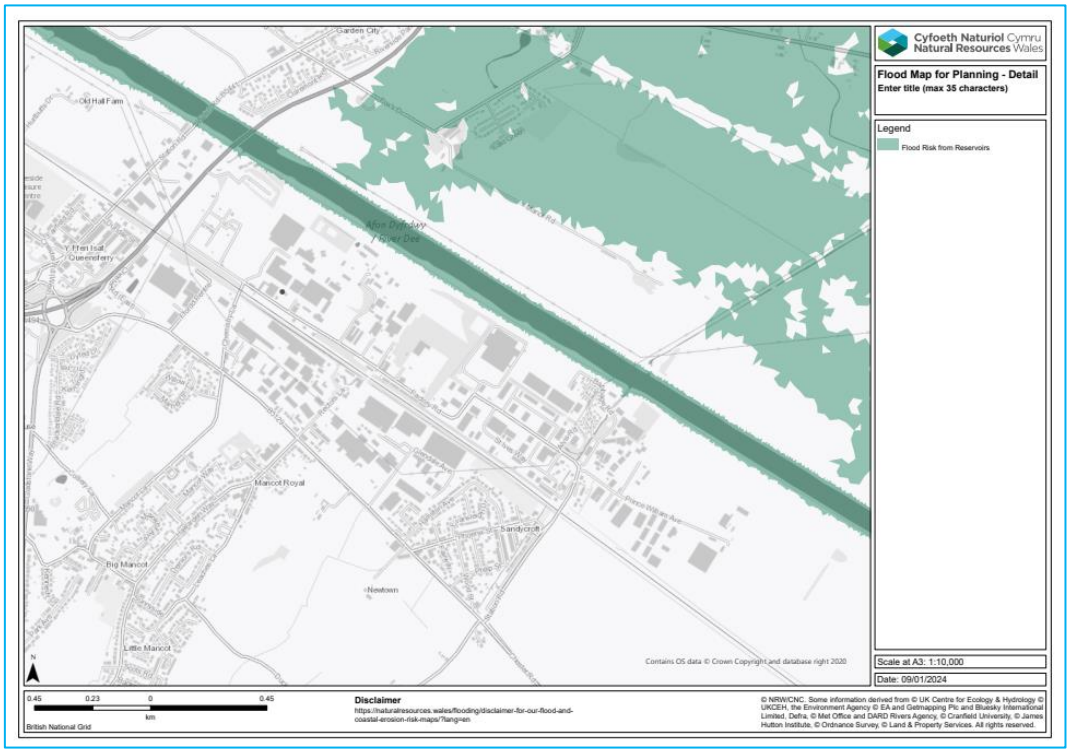

Figure 3.9 - Natural Resources Wales Flood Risk Map: Reservoir

3.14 Effects of the Development on Flood Risk

As a result of the fact the Site is at risk of tidal flooding the proposed ground raising will have no effect on flood risk. Compensatory flood storage is typically not required for tidal flooding. When the extent of flooding from a tidal source is considered, it can be seen that the floodplain is not confined and does in fact extend for some considerable distance. It is therefore concluded that development proposed in the tidal floodplain is unlikely to have an adverse impact on maximum surrounding flood levels and therefore, compensatory flood storage is not required.

Furthermore, the site is currently protected by tidal flood defences. There is therefore currently no presence of flood flow routes or floodplain storage on site. The proposed development would therefore not result in any impedance of flood flows or displacement of existing floodplain with the existing flood defences to be maintained and improved in the future to further ensure the development is not within an area susceptible to flood flows and floodplain in normal operation.

In the context of a catastrophic failure of existing defences, the built area associated with the development would have no material adverse impact on flood flow routes or floodplain displacement in any case given the significant flooding which would be present in the immediate area in this breach scenario.

In summary the proposed development will have no detriment to the flood storage capacity of the site. The overall direction of the movement of water will be maintained within the developed site and surrounding area. The conveyance routes (flow paths) will not be blocked or obstructed. There will

be no increase in the floodwater levels due to the proposed development. There will be no loss in flood storage capacity and no change in the on-site and off-site flood risk. The site proposals have been shown to be in accordance with A1.12 of TAN15.

3.15 Summary of Site-Specific Flood Risk

A summary of the sources of flooding and a review of the risk posed by each source at the site is shown in Table 3.4.

The site is unlikely to flood except in extreme conditions. The primary, but unlikely, flood risk posed to the site is from tidal flooding from the River Dee. The site is located within Flood Zone 3 and therefore has a 'high probability' of flooding, with a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year. The DAM shows that the site is located within Zone C1 - Areas of the floodplain which are developed and served by significant infrastructure, including flood defences. This is used to indicate that development can take place subject to application of justification test, including acceptability of consequences. The FMfP shows that the site is located within Flood Zone 3.

The flood risk indicated on the DAM and FMfP would be a result of a failure, or breach of these defences, causing tidal inundation from the River Dee, furthermore, the site has no history of flooding. The existing and proposed development is classified as 'less vulnerable'. The DAM and FMfP classification therefore indicates that the site is suitable for the proposed use.

Defended Scenario

Flood defences protect the site from flooding from the River Dee with a SoP of 1 in 200 years. The Tidal Dee Flood Mapping Study (2020) shows that the site would not be inundated with floodwater for all events up to and including the 1 in 1000 year in 2095 event.

Given that the development lifetime is assumed to be 75 years, climate change should ideally be assessed up to the year 2099; however, the additional 4 year of climate change would equate to 0.046m (11.50mm per year) of additional sea level rise and is unlikely to significantly impact the model results.

The tidal flood defences provide adequate protection against tidal flooding and hence the risk can be said to be 'residual'. Hence the greatest risks would originate from any breach/overtopping scenarios within these defence systems. Therefore, the actual flood risk posed to the site is greater than the 1 in 1000 year in 2099 event.

Breach Scenario

There is a residual risk of tidal flooding. Although it is unlikely that a breach in the flood defences would occur. Natural Resources Wales consider the breach event to be the design flood event for the site.

Breach modelling has been undertaken by Natural Resources Wales as part of the Tidal Dee Flood Mapping Study (2020) this includes updated undertaken in 2022 which the latest climate change guidance, published by the Welsh Government. The modelled outputs have been reviewed and the worst case scenario for the site is the closest located breach referred to as the "Pentre" breach.

The site would not be inundated with floodwater during the breach 1 in 200 year and 1 in 1000 year events due to a breach at Pentre. However, the site may be inundated with floodwater during the 1 in 200 year in 2095 event due to a breach with a water level of 6.25mAOD. Water depths of less than 0.71m will be experienced on the site. Maximum water velocities of 0.60m/s and a significant hazard rating will be experienced.

The site may be inundated with floodwater during the 1 in 1000 year in 2099 event due to a breach with a water level of 6.33mAOD. Water depths of less than 0.79m will be experienced on the site. Maximum water velocities of 0.65m/s and a significant hazard rating will be experienced.

Summary

Tidal flooding poses a very low actual risk to the site. The site is assessed to remain dry in all actual flood events. Therefore, the actual flood risk posed to the site is greater than the 1 in 1000 year in 2099 event.

Tidal flooding poses a low residual risk to the site. The site would not be inundated with floodwater during the breach 1 in 200 year and 1 in 1000 year events it is only when climate change is taken into account until 2099 that the site may be inundated with floodwater.

Given the predicted water depths within the site, location of the indicated source of flooding and the factors relating to the developed areas mentioned above it is concluded that the impact of this potential source of flooding to the site is low. Therefore, the risk of flooding from the River Dee is considered to be of medium significance. A secondary flooding source has been identified which may pose a low significant risk to the site. This is:

- Surface Water (pluvial) Flooding

The risk from all sources will be further mitigated by using a number of risk management measures to manage and reduce the overall flood risk at the site (see Section 4.0).

Table 3.4 - Risk Posed by Flooding Sources

Sources of Flooding	Potential Flood Risk	Potential Source	Probability/Significance
Fluvial (river) Flooding	No	None Reported	Not significant
Tidal (coastal) Flooding	Yes	River Dee	Medium
Groundwater Flooding	No	None Reported	Not significant
Surface Water (pluvial) Flooding	Yes	Low Spots	Low Significance
Sewer Flooding	No	None Reported	Not significant
Flooding from Artificial Drainage Systems/Infrastructure Failure	No	None Reported	Not significant

4. Risk Management

4.1 Introduction

Developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area through the layout, form of the development and the use of flood mitigation measures including SuDS techniques. The flooding sources will have to be mitigated on the site by using a number of techniques, and mitigation strategies to manage and reduce the overall flood risk at the site. These will be used to ensure the development will be safe and there is:

- Minimal risk to life;
- Minimal disruption to people living and working in the area;
- Minimal potential damage to property;
- Minimal impact of the proposed development on flood risk generally; and;
- Minimal disruption to natural heritage.

4.2 Minimum Finished Floor Level

Finished floor levels of the new buildings should be set at a minimum of 6.55mAOD. This provides a freeboard of 300mm above the breach 1 in 200 year in 2099 water level of 6.25mAOD and a freeboard of 220mm above the breach 1 in 1000 year in 2099 water level of 6.33mAOD.

4.3 Ancillary Areas

Ground levels for the remainder of the development platform should be set at a minimum of 6.25mAOD wherever feasible (i.e. above the breach 1 in 200 year in 2099 water level of 6.25mAOD).

4.4 Flood Resilience and Resistance

The development of the layout should always consider that the site is potentially at risk from an extreme event and as such the implementation of flood resilience and resistance methods should be assessed. Relatively simple measures such as raising utility entry points, using first floor or ceiling down electrical circuits and sloping landscaping away from properties can be easily and economically incorporated into the development of the site.

To make the buildings more resistant to seepage the following measures will be incorporated. Sealant will be used around external doors and windows. All external doors and windows will be constructed from durable materials. The floors of the buildings will be constructed from concrete. Any services which pass through the walls of the buildings will be sealed/covered so to not allow floodwater to enter the buildings.

To improve buildings resilience to flooding the following measures will be incorporated. Ceiling down electrical circuits will be used. All electrical wiring, switches, sockets, socket outlets, electrical, and

gas meters etc. will be located a minimum of 450mm above the finished floor levels. The external ground levels will slope away from the buildings thus protecting the buildings against flooding.

4.5 Flood Warning and Evacuation

The site is located in a flood risk area therefore; the development will need to participate in Natural Resources Wales flood warning telephone service. The developer will register contact details with the Natural Resources Wales Flood Warnings Service (Floodline 0845 988 1188) in order to receive Flood Warnings.

Natural Resources Wales operate a free flood warning service providing alerts by phone, text or email when flooding is anticipated providing an opportunity for owners to take necessary precautions, giving enough time for the building to be safely evacuated and mitigation measures to be put in place.

All occupants of the site will be made aware of the Natural Resources Wales Flood Warning telephone number and the Flood Warning Codes and their meaning. The owner of the properties will carry out the role of Flood Warden for the site and ensure they have an understanding of the flood mechanisms of the site and will ensure that the safety of the occupants and visitors will not be compromised.

Natural Resources Wales uses Flood Warnings Codes. They can be issued in any order, usually ending with an 'all clear'. They are issued by Natural Resources Wales through their website and the Flood Warning Service. The flood warning will be passed onto the occupiers and visitors of the site verbally, by telephone and/or in person. It will be ensured that everyone receives the flood warnings when required.

The likelihood of a rapid floodwater level rise and possible rapid inundation of urban areas posing a risk to life is considered to be minimal. This is primarily due to the large system and upper contributing catchment area which allows Natural Resources Wales, with its current flood warning system, to provide forewarning of two (2) days of a pending flood event.

The site is located within a low risk area where the onset of flooding is very gradual (many hours) as per Flood Risk Assessment Guidance for New Development Phase 2, R&D Technical Report FD2320/TR2. The speed of inundation and rate of floodwater rise would be low.

In order for the following evacuation procedures to be effective:

- The site will register contact details with the Natural Resources Wales Flood Warning Service (Floodline 0345 988 1188) in order to receive Flood Warnings/Alerts.

- The flood warning will be passed onto the occupants and visitors of the site verbally, by telephone and/or in person. It will be ensured that everyone receives the flood warnings when required.

4.6 Flood Plan

A Flood Plan outlining the precautions and actions you should take when a flood event is anticipated to help reduce the impact and damage flooding may cause will be developed. Sensible precautions would include raising electrical items, irreplaceable items and sentimental items off the ground or where possible moving them to a higher floor, rolling up carpets and rugs and turning off utilities. In

addition, consider what actions you would take should the property need to be evacuated including access and egress routes and preparing a flood kit in advance containing warm clothing, medication, a torch, food and wellingtons.

The Flood Plan is a 'living' document and therefore should be periodically reviewed and updated to provide advice and guidance to occupants in the event of an extreme flood. The Flood Plan will therefore reduce the vulnerability of the occupants to flooding and makes them aware of the mechanisms of flooding at the site.

The flood levels will be monitored and the occupants/visitors informed when the Flood Plan is to be initiated.

Flood Alert

'Flooding of low-lying land and roads is expected. Be aware, be prepared, watch out!'. The Natural Resources Wales will issue a Flood Alert status when flooding is possible, based upon weather and river/sea conditions.

Be prepared to act on your flood plan. At this stage occupants and visitors should make themselves aware of the Flood Plan and evacuation routes. Prepare a flood kit of essential items. Monitor local water levels and the flood forecast.

Contact Natural Resources Wales Floodline on 0345 988 1188 to get more information should be contacted to get more information, periodically and listen to and watch for weather and flood warnings on local radio and television stations.

Flood Warning

'Flooding of homes and businesses is expected. Act now!'. The Flood Warning alert will be issued when water levels are rising and further rain is expected. The site will be evacuated. Move family, pets and valuables to a safe place.

Safe access and egress, including emergency access can be maintained for vehicles and/or by foot. Water, electricity and gas supplies should be located and switched off before evacuating. Contact Natural Resources Wales Floodline on 0845 988 1188 to get more information should be contacted to get more information, periodically and listen to and watch for weather and flood warnings on local radio and television stations.

Severe Flood Warning

'Severe Flooding is expected. There is extreme danger life and property. Act now!'. If the site has not already been evacuated it will be evacuated immediately. Co-operate with the emergency services and call 999 if immediately in danger. Safe access and egress, including emergency access can be maintained for vehicles and/or by foot.

Contact Natural Resources Wales Floodline on 0845 988 1188 to get more information should be contacted to get more information, periodically and listen to and watch for weather and flood warnings on local radio and television stations.

Warning No Longer in Force

'Flood Watches or Flood Warnings are no longer in force for this area'. Occupants and visitors should contact the LPA to check that it is safe to return to the site. Please be careful water may be around for several days. If there is any doubt that appliances may be water damaged they must be checked before switching the power or gas back on. Contact your insurance company as soon as possible to get their approval before arranging any clean-up or repairs.

4.7 Safe Access and Egress Route

Access routes should be such that occupants can safely access and exit their buildings in design flood conditions. These routes must also provide the emergency services with access to the development during a flood event and enable flood defence authorities to carry out any necessary duties during the period of flood.

The access and egress route (i.e. Factory Road) is assessed to remain dry in all actual flood events. During the residual tidal breach scenarios, flooding of the access route may occur during the 1 in 200 year in 2099 and 1 in 1000 year in 2099 events. The implementation of a Flood Plan would focus on evacuating the site prior to the onset of flooding. In the event that the site cannot be safely evacuated, safe refuge should be available within the proposed development, which is to be raised above the maximum modelled water levels.

The likelihood of a rapid water level rise and possible rapid inundation posing a risk to life is considered to be minimal with a forewarning of two (2) days of a pending flood event. The site is located within a low risk area where the onset of flooding is very gradual (many hours) as per Flood Risk Assessment Guidance for New Development Phase 2, R&D Technical Report FD2320/TR2.

In the event of a Flood Warning, vital belongings, including waterproof clothing, necessary medication and essentials for infants and children will be collected. It should be ensured that all occupiers and visitors to the site are accounted for, and then exit the site.

6. Summary and Conclusion

6.1 Introduction

This report presents an FCA in accordance with TAN15 for the proposed development on Factory Road, Sandycroft, Deeside, Flintshire, CH5 2QJ. This FCA identifies and assesses the risks of all forms of flooding to and from the development and demonstrates how these flood risks will need to be managed so that the development remains safe throughout the lifetime, taking climate change into account.

6.2 Flood Risk

The site is unlikely to flood except in extreme conditions. The primary, but unlikely, flood risk posed to the site is from tidal flooding from the River Dee. The site is located within Flood Zone 3 and therefore has a 'high probability' of flooding, with a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year. The DAM shows that the site is located within Zone C1 - Areas of the floodplain which are developed and served by significant infrastructure, including flood defences. This is used to indicate that development can take place subject to application of justification test, including acceptability of consequences. The FMfP shows that the site is located within Flood Zone 3.

The flood risk indicated on the DAM and FMfP would be a result of a failure, or breach of these defences, causing tidal inundation from the River Dee, furthermore, the site has no history of flooding. The existing and proposed development is classified as 'less vulnerable'. The DAM and FMfP classification therefore indicates that the site is suitable for the proposed use.

Defended Scenario

Flood defences protect the site from flooding from the River Dee with a SoP of 1 in 200 years. The Tidal Dee Flood Mapping Study (2020) shows that the site would not be inundated with floodwater for all events up to and including the 1 in 1000 year in 2095 event.

Given that the development lifetime is assumed to be 75 years, climate change should ideally be assessed up to the year 2099; however, the additional 4 year of climate change would equate to 0.046m (11.50mm per year) of additional sea level rise and is unlikely to significantly impact the model results.

The tidal flood defences provide adequate protection against tidal flooding and hence the risk can be said to be 'residual'. Hence the greatest risks would originate from any breach/overtopping scenarios within these defence systems. Therefore, the actual flood risk posed to the site is greater than the 1 in 1000 year in 2099 event.

Breach Scenario

There is a residual risk of tidal flooding. Although it is unlikely that a breach in the flood defences would occur. Natural Resources Wales consider the breach event to be the design flood event for the site.

Breach modelling has been undertaken by Natural Resources Wales as part of the Tidal Dee Flood Mapping Study (2020) this includes updated undertaken in 2022 which the latest climate change guidance, published by the Welsh Government. The modelled outputs have been reviewed and the worst case scenario for the site is the closest located breach referred to as the "Pentre" breach.

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The site may be inundated with floodwater during the 1 in 1000 year in 2099 event due to a breach with a water level of 6.33mAOD. Water depths of less than 0.79m will be experienced on the site. Maximum water velocities of 0.65m/s and a significant hazard rating will be experienced.

Summary

Tidal flooding poses a very low actual risk to the site. The site is assessed to remain dry in all actual flood events. Therefore, the actual flood risk posed to the site is greater than the 1 in 1000 year in 2099 event.

Tidal flooding poses a low residual risk to the site. The site would not be inundated with floodwater during the breach 1 in 200 year and 1 in 1000 year events it is only when climate change is taken into account until 2099 that the site may be inundated with floodwater.

Given the predicted water depths within the site, location of the indicated source of flooding and the factors relating to the developed areas mentioned above it is concluded that the impact of this potential source of flooding to the site is low. Therefore, the risk of flooding from the River Dee is considered to be of medium significance. A secondary flooding source has been identified which may pose a low significant risk to the site. This is:

- Surface Water (pluvial) Flooding

The risk from all sources will be further mitigated by using a number of risk management measures to manage and reduce the overall flood risk at the site.

6.3 Risk Management

The flooding sources will be managed on the site by using a number of mitigation strategies to manage and reduce the overall flood risk at the site and will ensure the development will be safe. Measures to be used comprise:

Minimum Finished Floor Level: Finished floor levels of the new buildings should be set at a minimum of 6.55mAOD. This provides a freeboard of 300mm above the breach 1 in 200 year in 2099 water level of 6.25mAOD and a freeboard of 220mm above the breach 1 in 1000 year in 2099 water level of 6.33mAOD.

Ancillary Areas: Ground levels for the remainder of the development platform should be set at a minimum of 6.25mAOD wherever feasible (i.e. above the breach 1 in 200 year in 2099 water level of 6.25mAOD).

Flood Resilience and Resistance: To make the buildings more resistant to seepage the following measures will be incorporated. Sealant will be used around external doors and windows. All external doors and windows will be constructed from durable materials. The floors of the buildings will be constructed from concrete. Any services which pass through the walls of the buildings will be sealed/covered so to not allow floodwater to enter the buildings.

To improve buildings resilience to flooding the following measures will be incorporated. Ceiling down electrical circuits will be used. All electrical wiring, switches, sockets, socket outlets, electrical, and gas meters etc. will be located a minimum of 450mm above the finished floor levels. The external ground levels will slope away from the buildings thus protecting the buildings against flooding.

Flood Warning and Evacuation: The site is located in a flood risk area therefore; the development will need to participate in Natural Resources Wales flood warning telephone service. The developer will register contact details with the Natural Resources Wales Flood Warnings Service (Floodline 0845 988 1188) in order to receive Flood Warnings.

Flood Plan: A Flood Plan outlining the precautions and actions you should take when a flood event is anticipated to help reduce the impact and damage flooding may cause will be developed.

Safe Access and Egress Route: The access and egress route (i.e. Factory Road) is assessed to remain dry in all actual flood events. During the residual tidal breach scenarios, flooding of the access route may occur during the 1 in 200 year in 2099 and 1 in 1000 year in 2099 events. The implementation of a Flood Plan would focus on evacuating the site prior to the onset of flooding. In the event that the site cannot be safely evacuated, safe refuge should be available within the proposed development, which is to be raised above the maximum modelled water levels.

The likelihood of a rapid water level rise and possible rapid inundation posing a risk to life is considered to be minimal with a forewarning of two (2) days of a pending flood event. The site is located within a low risk area where the onset of flooding is very gradual (many hours) as per Flood Risk Assessment Guidance for New Development Phase 2, R&D Technical Report FD2320/TR2.

In the event of a Flood Warning, vital belongings, including waterproof clothing, necessary medication and essentials for infants and children will be collected. It should be ensured that all occupiers and visitors to the site are accounted for, and then exit the site.

6.4 Conclusion

In conclusion, the proposed development would be expected to remain dry in all but the most extreme conditions. Providing the recommendations made in this FCA are instigated, flood risk from all sources would be minimised. This FCA demonstrates that the proposed development would be operated with minimal risk from flooding, would not increase flood risk elsewhere.