



Spenbeck Business Park, Balme Road, Cleckheaton, BD19 4EW

NPPF: Flood Risk Assessment

For Diamond Properties Holdings Ltd

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Spenbeck Business Park, Balme Road, Cleckheaton, BD19 4EW

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Client	Diamond Properties Holdings Ltd
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CONTENTS

CONTENTS	i
TABLES & FIGURES	iii
EXECUTIVE SUMMARY	iv
1.0 INTRODUCTION	1
1.1 Background	1
1.2 National Planning Policy Framework (NPPF)	1
1.3 Report Structure	1
2.0 LOCATION & DEVELOPMENT DESCRIPTION	3
2.1 Site Location	3
2.2 Existing Development	3
2.3 Proposed Development	3
2.4 Catchment Hydrology	3
2.5 Ground Levels	3
2.6 Ground Conditions	4
3.0 FLOOD RISK	5
3.1 Sources of Flooding	5
3.2 Environment Agency Data	5
3.3 Kirklees Council	5
3.4 Historic Flooding	5
3.5 Flood Defence Measures	5
3.6 Environment Agency Flood Zones	5
3.7 Calder Catchment Strategic Flood Risk Assessment	7
3.8 Flood Risk Vulnerability	8
3.9 Climate Change	9
3.10 Fluvial (river) Flooding	9
3.11 Tidal (coastal) Flooding	11
3.12 Groundwater Flooding	11
3.13 Surface Water (pluvial) Flooding	11
3.14 Sewer Flooding	12
3.15 Flooding from Artificial Drainage Systems/Infrastructure Failure	12
3.16 Effects of the Development on Flood Risk	13
3.17 Summary of Site Specific Flood Risk Assessment	14
4.0 SURFACE WATER DRAINAGE	16
4.1 Surface Water Management Overview	16
4.2 Surface Water Runoff Rates	16
5.0 RISK MANAGEMENT	17
5.1 Introduction	17
5.2 Finished/Threshold Floor Levels	17
5.3 Flood Resistance Measures	17
5.4 Flood Resilience Measures	18
5.5 Flood Warning and Evacuation	18
5.6 Flood Plan	18
5.7 Safe Access and Egress Route	19
5.8 Flooding Consequences	20
6.0 SEQUENTIAL APPROACH	21
6.1 Sequential Test	21
6.2 Exception Test	22
7.0 SUMMARY AND CONCLUSIONS	23

7.1	Introduction	23
7.2	Flood Risk	23
7.3	Surface Water Drainage	24
7.4	Risk Management	24
7.5	Sequential Approach	25
7.6	Conclusion	26
	APPENDICES	27
	APPENDIX 1 – Existing Site Layout	28
	APPENDIX 2 – Proposed Site Layout	29
	APPENDIX 3 – Environment Agency Correspondence	30

TABLES & FIGURES

Figure 1 - Site Location.....	3
Figure 2 - Ground Levels	4
Figure 3 - Environment Agency Flood Zones	6
Table 1 - Environment Agency Flood Zones and Appropriate Land Use	6
Figure 4 - SFRA Flood Zones.....	8
Table 2 - Flood Risk Vulnerability and Flood Zone 'Compatibility' as identified in Table 3 of the Planning Practice Guidance to the NPPF	9
Table 3 - Peak River Flow Allowances by River Basin District (use 1961 to 1990 baseline)	9
Table 4 - Modelled Water Levels (mAOD) and Flows (m ³ /s)	10
Figure 5 - Rating Curve.....	10
Figure 6 - Environment Agency Surface Water Flood Map	12
Figure 7 - Environment Agency Reservoir Flood Map	13
Table 4 - Risk Posed by Flooding Sources	14
Figure 8 - Safe Access and Egress Route	20

EXECUTIVE SUMMARY

An industrial unit would be expected to remain dry in all but the most extreme conditions. Providing the recommendations made in this FRA are instigated, flood risk from all sources would be minimised, the consequences of flooding are acceptable, and the development would be in accordance with the requirements of the NPPF.

This FRA demonstrates that the proposed development would be operated with minimal risk from flooding, would not increase flood risk elsewhere and is compliant with the requirements of the NPPF. The development should not therefore be precluded on the grounds of flood risk.

1.0 INTRODUCTION

1.1 Background

This Flood Risk Assessment (FRA) has been prepared by KRS Environmental Limited at the request of Diamond Properties Holdings Ltd to support a planning application for the proposed development at the Spenbeck Business Park, Balme Road, Cleckheaton, BD19 4EW. This FRA includes an assessment of the existing and proposed surface water drainage of the site.

This FRA has been carried out in accordance with guidance contained in the National Planning Policy Framework (NPPF)¹ and associated Planning Practice Guidance². This FRA 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 National Planning Policy Framework (NPPF)

One of the key aims of the NPPF 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 FRA is required and should include:

- whether a proposed development is likely to be affected by current or future flooding from all source;
- whether it will increase flood risk elsewhere;
- whether the measures proposed to deal with these effects and risks are appropriate;
- if necessary, provide the evidence to the Local Planning Authority (LPA) that the Sequential Test can be applied; and
- whether the development will be safe and pass part c) of the Exception Test if this is appropriate.

1.3 Report Structure

This FRA has the following report structure:

- Section 2 describes the location area and the existing and proposed development;

¹ Ministry of Housing, Communities and Local Government (2019) National Planning Policy Framework..

² Communities and Local Government (2014) Planning Practice Guidance - Flood Risk and Coastal Change.

- Section 3 outlines the flood risk to the existing and proposed development;
- Section 4 details the proposed surface water drainage for the site and assesses the potential impacts of the proposed development on surface water drainage;
- Section 5 outlines mitigation measures used to reduce the overall level of flood risk;
- Section 6 details the sequential and exception tests; and
- Section 7 presents a summary and conclusions.

2.0 LOCATION & DEVELOPMENT DESCRIPTION

2.1 Site Location

The site is located at the Spenbeck Business Park, Balme Road, Cleckheaton, BD19 4EW (see Figure 1).

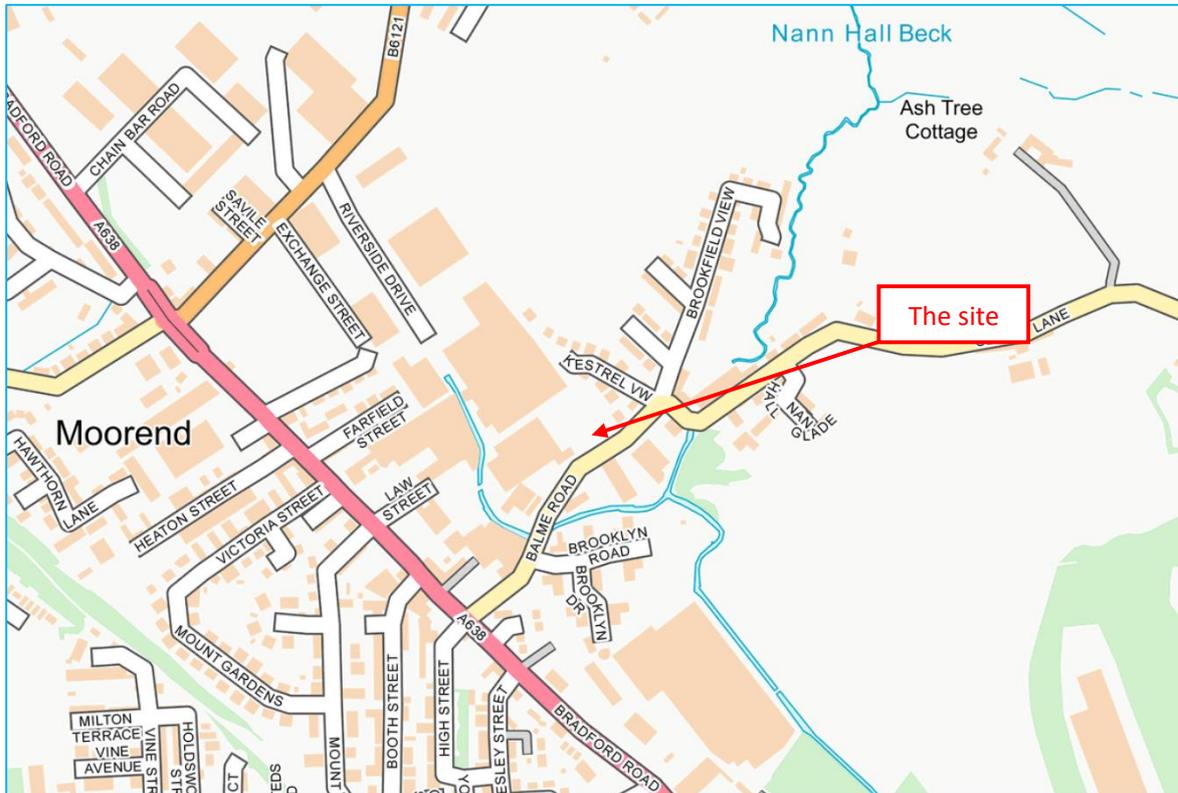


Figure 1 - Site Location

2.2 Existing Development

The site currently consists of a car park (see Appendix 1).

2.3 Proposed Development

It is understood that the development proposals comprise an industrial unit (see Appendix 2). Further details with regard to the proposed development can be found in the accompanying information submitted with the planning application.

2.4 Catchment Hydrology

The River Spen is located approximately 150m to the west of the site.

2.5 Ground Levels

Balme Road adjacent to the site entrance has a ground level of 77.40 to 77.50 metres Above Ordnance Datum (mAOD), the site rises by approximately 1.00m to 78.40 to 78.50mAOD on the existing parking area as shown in Figure 2.



Figure 2 - Ground Levels

2.6 Ground Conditions

Due to the historic use of the site, it is likely that the site is underlain by Made Ground. The British Geological Survey (BGS) map shows that the superficial deposits consist of Alluvium - clay, silt, sand and gravel. Superficial deposits formed up to 2 million years ago in the Quaternary Period in a local environment previously dominated by rivers (U). The bedrock deposits consist of the Pennine Lower Coal Measures Formation - mudstone, siltstone and sandstone. Sedimentary bedrock formed approximately 318 to 319 million years ago in the Carboniferous Period in a local environment previously dominated by swamps, estuaries and deltas.

3.0 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 Environment Agency Data

Information regarding the current flood risk at the application site and local flood defences has been obtained from the Environment Agency (see Appendix 3).

3.3 Kirklees Council

Kirklees Council is the Local Planning Authority (LPA) and the Lead Local Flood Authority (LLFA) and has responsibilities for 'local flood risk', which includes surface runoff, groundwater and ordinary watercourses. Planning guidance written by Kirklees Council regarding flood risk was consulted to assess the mitigation policies in place. In particular, the Calder Catchment Strategic Flood Risk Assessment (SFRA), the Kirklees Council Preliminary Flood Risk Assessment (PFRA), and the Kirklees Council Local Flood Risk Management Strategy which cover the site have been reviewed.

3.4 Historic Flooding

Environment Agency records show that the site and surrounding area has not historically flooded. The British Hydrological Society "Chronology of British Hydrological Events" does not list any records of flooding at the site. There are no other records of anecdotal information of flooding at the site. No other historical records of flooding for the site have been recorded. Therefore, it has been concluded that the site has not flooded in the recent past.

3.5 Flood Defence Measures

There are existing flood defences which protect the site from fluvial flooding from the River Spen. Further property level protection measures will be used to protect the site from flooding these are discussed in Section 5.0.

3.6 Environment Agency Flood Zones

A review of the Environment Agency's Flood Zones indicates that approximately 40% of the site is located within Flood Zone 2 and therefore has a 'medium probability' of flooding with between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% - 0.1%) in any year and approximately 60% of the site is located within Flood Zone 3 and therefore has a 'high probability' of flooding with a 1 in 100 or greater annual probability of river flooding (>1%) in any year, as shown in Figure 3.

Figure 3 shows that approximately 50% of the proposed building will be located within Flood Zone 2 and approximately 50% of the proposed building will be located within Flood Zone 3.

The Flood Zones are the current best information on the extent of the extremes of flooding from rivers or the sea that would occur without the presence of flood defences, because these can be breached, overtopped and may not be in existence for the lifetime of the development. The Environment Agency Flood Zones and acceptable development types are explained in Table 1. Tables 1 and 2 show that some development types are acceptable in Flood Zones 2 and 3.

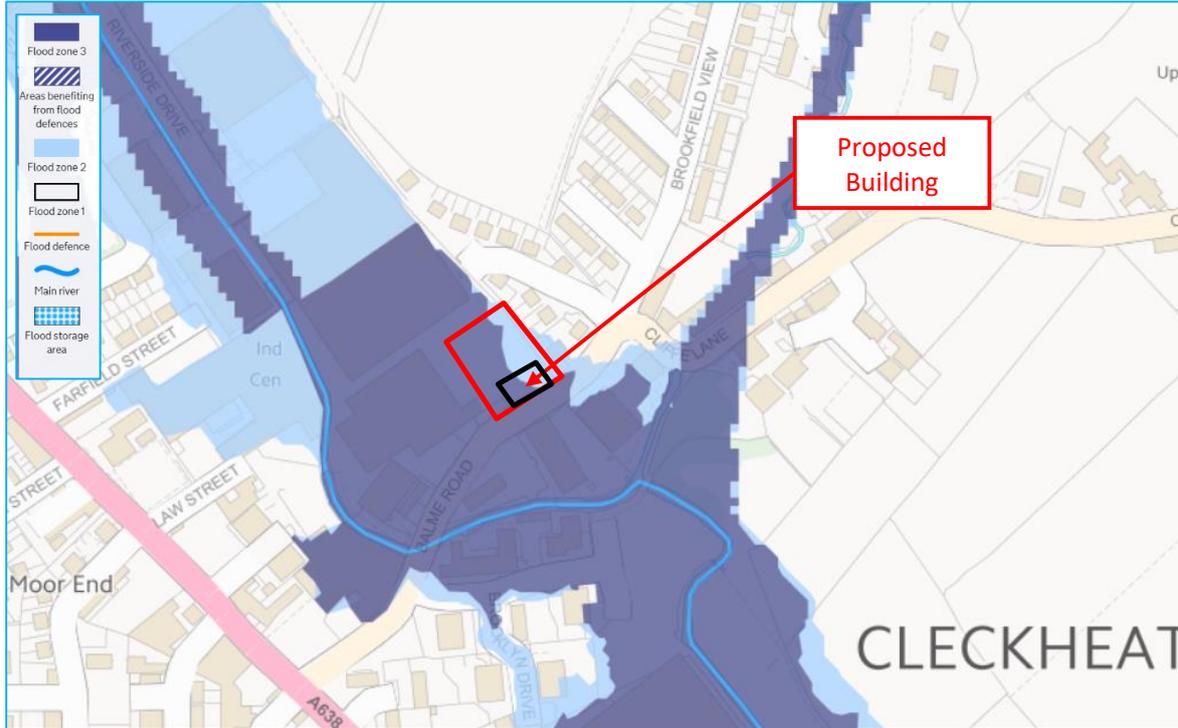


Figure 3 - Environment Agency Flood Zones

Table 1 - Environment Agency Flood Zones and Appropriate Land Use

Flood Zone	Probability	Explanation	Appropriate Land Use
Zone 1	Low	Less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%)	All development types generally acceptable
Zone 2	Medium	Between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% - 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% - 0.1%) in any year	Most development type are generally acceptable
Zone 3a	High	A 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year	Some development types not acceptable
Zone 3b	'Functional Floodplain'	Land where water has to be flow or be stored in times of flood. SFRA's should identify this zone (land which would flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme (0.1% flood, or at another probability to be agreed between the LPA and the Environment Agency, including water conveyance routes)	Some development types not acceptable

3.7 Calder Catchment Strategic Flood Risk Assessment

The Calder Catchment SFRA shows that approximately 40% of the site is located within Flood Zone 2 and therefore has a 'medium probability' of flooding with between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% - 0.1%) in any year and approximately 60% of the site is located within Flood Zone 3a and therefore has a 'high probability' of flooding with a 1 in 100 or greater annual probability of river flooding (>1%) in any year, as shown in Figure 4. The site has been shown not to be located within Flood Zone 3ai or Flood Zone 3b.

Figure 4 shows that approximately 50% of the proposed building will be located within Flood Zone 2 and approximately 50% of the proposed building will be located within Flood Zone 3a. The Environment Agency has made the following comments with regards to Flood Zone 3ai:

“Areas to the west of the site which appear largely out of the red line boundary but within the existing and proposed plans show areas of the car park in flood zone 3ai along with the entrance to the site. We ask that the LLFA confirms with the applicant whether this is acceptable under the Calder SFRA policy on 3ai.”

“Proposals within flood zone 3ai will be assessed using criteria in national policy for flood zone 3a but with additional restrictions to reflect the higher risk. The probability of flooding in flood zone 3ai remains the same as the functional floodplain (flood zone 3b) therefore highly or more vulnerable developments would not be appropriate within this zone. In certain circumstances less vulnerable proposals could be justified, subject to a sequential test, such as proposals for an operationally linked extension to an established business or redevelopment with the same or smaller footprint”.

Firstly, the site is not shown to be located within Flood Zone 3ai, areas of the car park shown to be located within Flood Zone 3ai are outside of the site boundary, so this comment is irrelevant. A small proportion of the site entrance may be shown to be located within Flood Zone 3ai, a detailed assessment of Flood Zone 3b has been undertaken in Section 3.10. Furthermore, the proposed development is for a 'less vulnerable' use linked to the existing businesses on the business park.

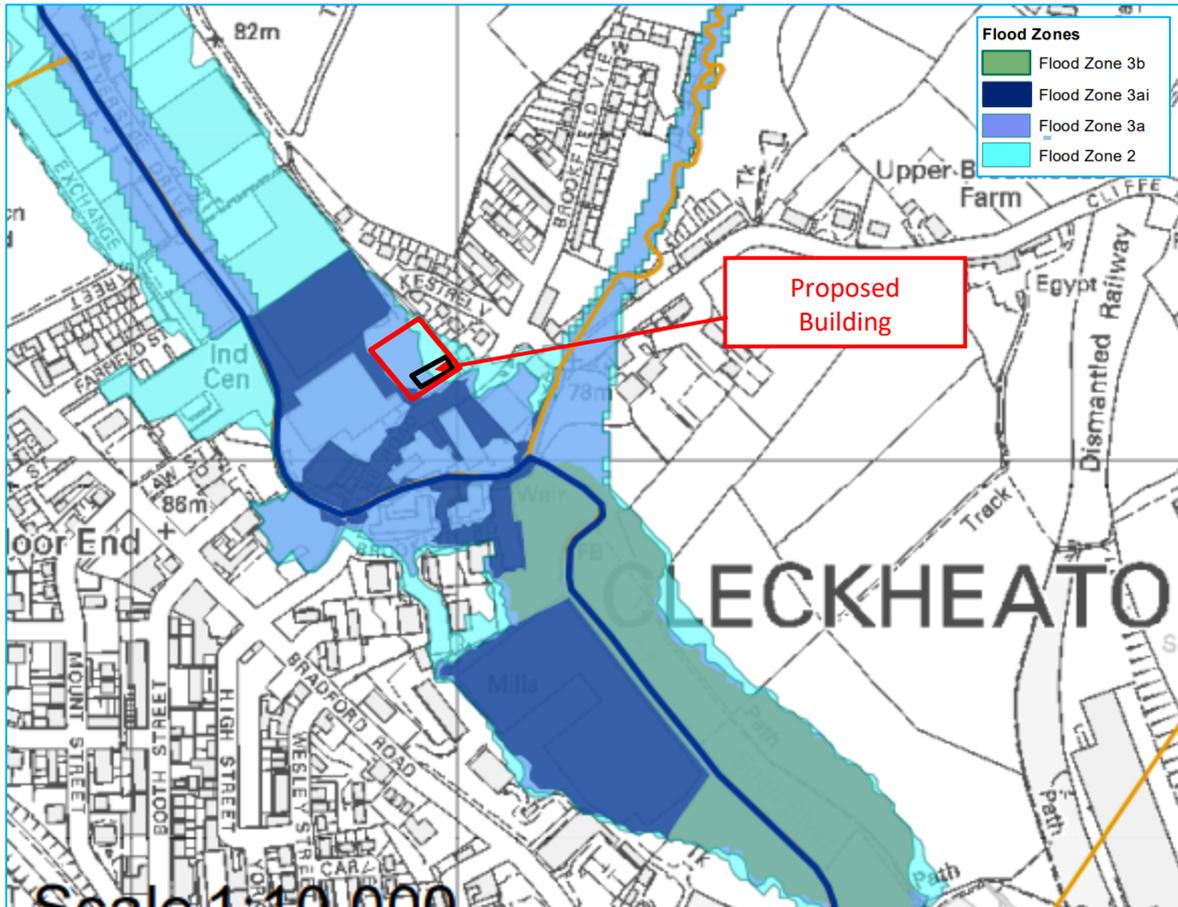


Figure 4 - SFRA Flood Zones

3.8 Flood Risk Vulnerability

In the Planning Practice Guidance to the NPPF, appropriate uses have been identified for the Flood Zones. Applying the Flood Risk Vulnerability Classification in the Planning Practice Guidance to the NPPF, the proposed development is classified as ‘less vulnerable’, ‘less vulnerable’ uses are appropriate within Flood Zones 2 and 3.

The proposed development will not change the vulnerability of the site and introduce ‘more vulnerable’ developments into the floodplain. The proposed development will improve the sites resilience, resistance to flooding and by using property level protection measures to protect the site from flooding the vulnerability of the site will be improved (see Section 5.0).

Table 2 - Flood Risk Vulnerability and Flood Zone 'Compatibility' as identified in Table 3 of the Planning Practice Guidance to the NPPF

Flood Risk Vulnerability Classification	Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	✓	Exception test required	✓	✓
Zone 3a	Exception test required	✓	✗	Exception test required	✓
Zone 3b 'Functional Floodplain'	Exception test required	✓	✗	✗	✗

Key: ✓: Development is appropriate, ✗: Development should not be permitted.

3.9 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 the NPPF recommends that the effects of climate change are incorporated into FRAs. Recommended precautionary sensitivity ranges for peak rainfall intensities and peak river flows are outlined in the Flood risk assessments: climate change allowances guidance³.

Table 3 shows the peak river flow climate change allowances by river basin district. There is reasonable level of certainty that the future impacts of climate change will lie somewhere between the central and upper allowances. The flood risk assessments: climate change allowances guidance recommends that for 'less vulnerable' uses in Flood Zones 2 and 3 that the higher central allowance be used. Therefore, the design flood level for the site is the 1 in 100 year (+30%) event.

Table 3 - Peak River Flow Allowances by River Basin District (use 1961 to 1990 baseline)

River basin district	Allowance category	2015 to 2039	2040 to 2059	2060 to 2119
Humber	Upper end	+20%	+30%	+50%
	High central	+15%	+20%	+30%
	Central	+10%	+15%	+20%

3.10 Fluvial (river) Flooding

The principal flood risk to the site is from fluvial flooding from the River Spen. Table 4 shows the Environment Agency modelled water levels and flows for the site. The predicted water levels from node SPEN01_8387u have been compared to the ground of the site and areas within the vicinity of the site to assess the flood risk at the site in detail. The existing modelled flood and flow data has been used to construct a stage-discharge rating curve, from which a rating equation has been used to calculate the flood levels for the climate change allowances for node SPEN01_8387u (see Figure 5).

³ <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances#high-allowances>.

Table 4 - Modelled Water Levels (mAOD) and Flows (m³/s)

Node	Parameter	5	10	25	50	75	100	100 +20%	100 +30%	100 +50%	1000
SPEN01 _8565	Water Level	78.89	79.06	79.24	79.36	79.42	79.46	79.62	N/A	N/A	80.33
	Flow	10.69	12.19	14.18	15.72	16.62	17.21	19.96	N/A	N/A	25.37
SPEN01 _8387u	Water Level	77.78	77.92	78.08	78.17	78.20	78.23	78.31	78.43	78.60	78.58
	Flow	10.69	12.20	14.46	15.53	16.30	16.87	19.07	21.93	25.31	26.15
SPEN01 _8210	Water Level	77.15	77.21	77.27	77.31	77.33	77.34	77.40	N/A	N/A	77.58
	Flow	10.69	12.11	13.78	14.78	15.30	15.63	16.98	N/A	N/A	20.75

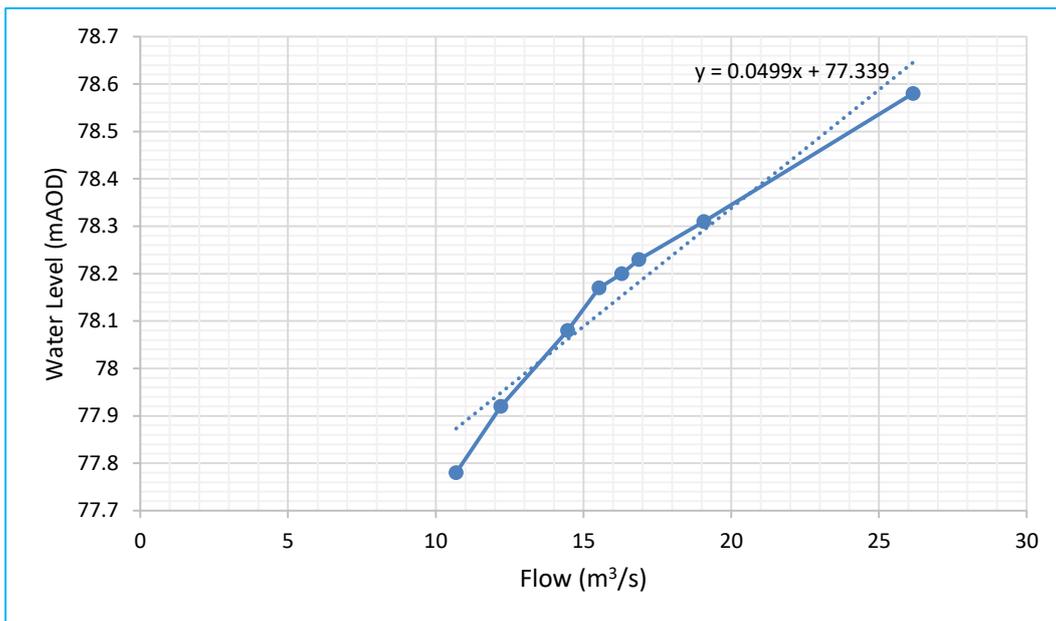


Figure 5 - Rating Curve

Water levels have been modelled at 78.23mAOD during the 1 in 100 year event, the site minimum ground level is 78.40mAOD therefore, the site will not be inundated with floodwater for all events up to and including the 1 in 100 year event. The site will be flood free during the 1 in 100 year event. This confirms that the site is not located within Flood Zone 3b or Flood Zone 3ai.

Water levels have been modelled at 78.43mAOD and 78.58mAOD during the 1 in 100 year (+30%) and 1 in 1000 year events, respectively. Therefore, the site may be inundated with floodwater, to a depth of 0.03m and 0.18m during the 1 in 100 year (+30%) and 1 in 1000 year events, respectively.

The likelihood of a rapid river level rise and possible rapid inundation of urban areas posing a risk to life is considered to be minimal. 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.

Using a conservative estimate of water velocity of 0.30m/s and a maximum water depth of 0.03m any flooding would result in a 'low' flood hazard with a 'flood zone with shallow flowing water or deep standing water' during the 1 in 100 year (+30%) event, as per Table 4 of the Supplementary Note on Flood Hazard Ratings and Thresholds for Development Planning and Control Purpose - Clarification of

the Table 13.1 of FD2320/TR2 and Figure 3.2 of FD/2321/TR1. It should be noted that this is the most conservative estimate of surface water flood risk. The flood risk from surface water is of a minor nature with low water depths and velocities being experienced.

Flood risk to the site from fluvial sources can be considered to be limited, as the site is located 150m away from the River Spen. Any overbank flow would follow the contours of the surrounding area and would flow away from the site rather than flowing towards the site. The flood risk can also be considered to be limited due to the difference in elevations. The ground levels of the site are located a minimum of 0.50m above the normal water level of the River Spen.

Any resulting flooding would be expected to be very infrequent and to have a low predicted depth. Therefore, the risk of fluvial flooding from the River Spen is considered to be of **medium significance**. The risk of fluvial flooding will be further managed and mitigated by using a number of property level protection measures to manage and reduce the overall flood risk at the site (see Section 5.0).

3.11 Tidal (coastal) Flooding

The site is not located within the vicinity of tidal flooding sources and the risk of tidal flooding is considered to be **not significant**.

3.12 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 risk from groundwater flooding is negligible. Therefore, the risk of flooding from groundwater flooding is considered to be **not significant**.

3.13 Surface Water (pluvial) Flooding

The site is not situated near to large areas of poor permeability or areas with the geology and/or topography which may result in surface water flooding. The site surroundings are relatively flat and there are no large catchments that would tend to generate surface water runoff towards the site. Surface water flow flooding tends to occur sporadically in both location and time such surface water flows would tend to be confined to the streets around the development.

The Environment Agency Surface Water flood map shows that the site has a low risk of surface water flooding with a chance of flooding between 1 in 100 (1%) and 1 in 1000 (0.1%) years (see Figure 6), this may result in water depths of less than 300mm. Using a conservative estimate of water velocity of 0.25m/s and a maximum water depth of 300mm any flooding would result in a 'low' flood hazard with a 'flood zone with shallow flowing water or deep standing water' as per Table 4 of the Supplementary Note on Flood Hazard Ratings and Thresholds for Development Planning and Control Purpose - Clarification of the Table 13.1 of FD2320/TR2 and Figure 3.2 of FD/2321/TR1. It should be noted that this is the most conservative estimate of surface water flood risk. The flood risk from surface water is of a minor nature with low water depths and velocities being experienced.

Any resulting flooding would be expected to be very infrequent and to have a low predicted depth. Therefore, the risk of flooding from surface water flooding is considered to be of **low significance**. The risk from this source will be further mitigated by using a number of property level protection measures to manage and reduce the overall flood risk at the site (see Section 5.0).

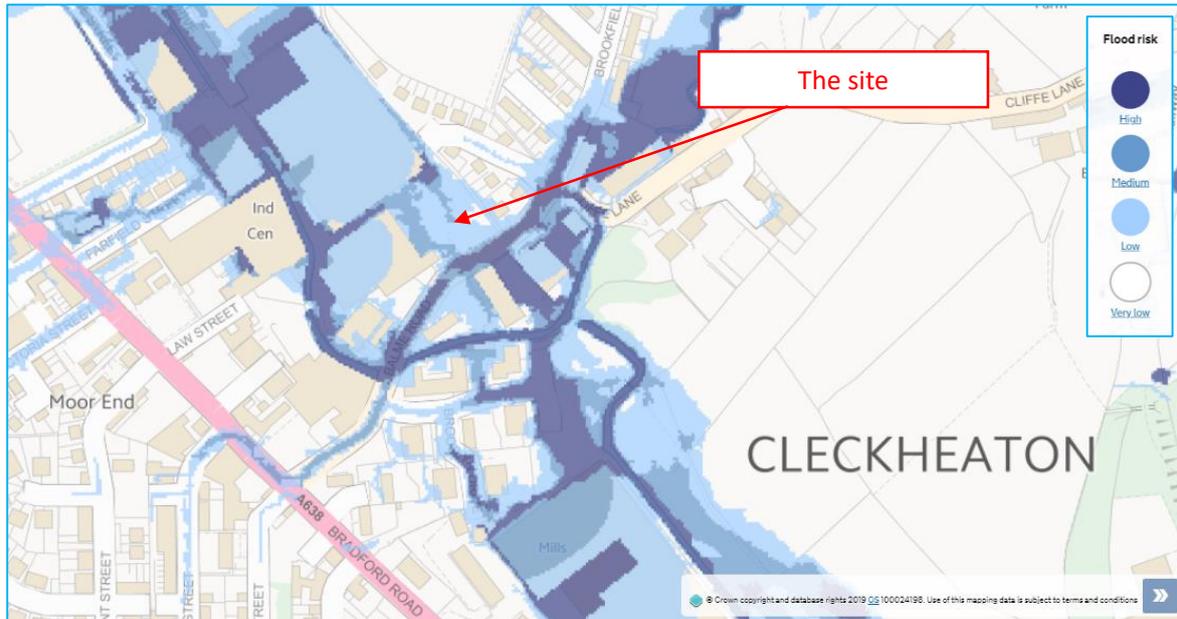


Figure 6 - Environment Agency Surface Water Flood Map

3.14 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.

Sewers 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, the risk of flooding from sewer flooding is considered to be of **low significance**. The risk from this source will be further mitigated by using a number of property level protection measures to manage and reduce the overall flood risk at the site (see Section 5.0).

3.15 Flooding from Artificial Drainage Systems/Infrastructure Failure

The site is located within the vicinity of reservoirs. Figure 7 shows that the site is at risk of flooding from reservoir failure. This map shows the largest area that might be flooded if a reservoir were to fail and release the water it holds.

The Environment Agency Reservoir flood map has been prepared for emergency planning purposes and for this reason they reflect a worst case scenario. Since this is a prediction of a worst case scenario, it's unlikely that any actual flood would be this large.

Reservoir flooding is extremely unlikely; reservoirs in the UK have a very good safety record. There has been no loss of life in the UK from reservoir flooding since 1925. Since then reservoir safety legislation has been introduced to make sure reservoirs are well maintained.

The hazard is well managed through effective legislation and it is unlikely that the impact zone downstream of these reservoirs should not allow the proposed development. Reservoir flooding poses a very low flood risk to the site therefore, the risk of flooding from reservoir flooding is considered to be **not significant**.

There are no other nearby artificial water bodies, reservoirs, water channels and artificial drainage systems that could be considered a flood risk to the site. The risk of flooding from artificial drainage systems/infrastructure failure is considered to be **not significant**.

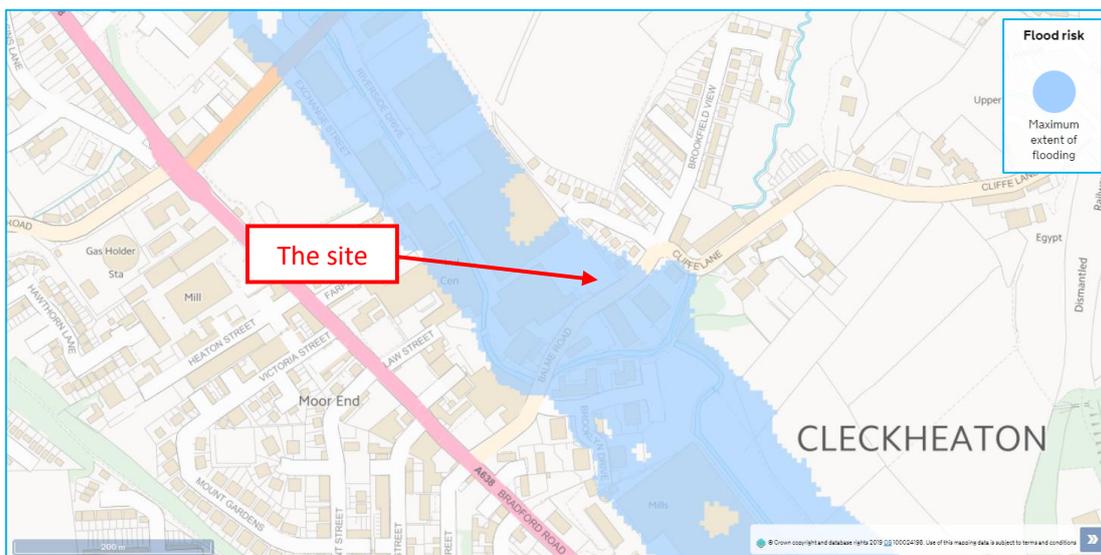


Figure 7 - Environment Agency Reservoir Flood Map

3.16 Effects of the Development on Flood Risk

The volume of displaced floodwater the proposed development, has been calculated for the 1 in 100 year (+35%) event using a water level of 78.43mAOD and a ground level at the location of the proposed building of 78.40mAOD. Consequently, this has enabled the impact of the proposed development on flood storage capacity to be assessed and calculated. The ground floor area of the proposed building is 279m², a small amount of land raising will also occur to allow the finished floor levels to be raised, the proposed development will displace a total of 8.37m³. The maximum flood depth change for a flood cell resulting from additional water from an adjacent area can be estimated by using the following formula:

$$\delta H = - \delta v / A$$

where: δH = change of flood depth within the flood cell (m)

δv = change of flood volume in the site, -ve for loss (m³)

A = plan area of flood cell (less the site plan area) (m²)

The formula above assumes that the flood cell plan area does not change as a result of the additional flood volume. This is a reasonable approximation for large cells and small changes of volume and

depth. It is also a conservative assumption as it allows all any volume change to result in depth change alone.

Using the Environment Agency Flood Zones, an estimation of the area of Flood Zone 3 within the vicinity of the site has been calculated to be a minimum of 30,000m². Using the parameters estimated above, the expected decrease of flood depth within the flood cell is 0.000279m or 0.279mm.

These results would therefore not increase floodwater levels by a calculable amount. This estimated flood level rise is considered to be very small and within the normal tolerance range for river modelling expected on a river catchment type. Chapter 7 of the Environment Agency's Fluvial Design Guide identifies an expected model tolerance of +/- 0.250m or 250mm for flood defences and +/- 0.500m or 500mm for broad scale modelling. On this basis it can be seen that the expected increases are well within the expected tolerance range. 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 flood water levels due to the proposed development.

It can be concluded that the anticipated flood depth increase caused by the proposed development is negligible and not likely to result in increased flood risk within the adjacent flood cell and provision of compensatory storage is not necessary in this case.

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. The topography of the site will not be altered therefore; the overland flow routes will not be altered. The proposed development proposes minimal new structures and will therefore allow floodwater to pass through the site with no effect on the conveyance routes.

3.17 Summary of Site Specific Flood Risk Assessment

A summary of the sources of flooding and a review of the risk posed by each source at the site is shown in Table 5.

Table 4 - Risk Posed by Flooding Sources

Sources of Flooding	Potential Flood Risk	Potential Source	Probability/Significance
Fluvial Flooding	Yes	River Spen	Medium
Tidal Flooding	No	None Reported	None
Groundwater Flooding	No	None Reported	None
Surface Water Flooding	Yes	Poor Permeability	Low
Sewer Flooding	Yes	Local Sewers	Low
Flooding from Artificial Drainage Systems/Infrastructure Failure	No	None Reported	None

The site is unlikely to flood except in extreme conditions. The primary, but unlikely, flood risk to the site is from fluvial flooding from the River Spen.

Approximately 40% of the site is located within Flood Zone 2 and therefore has a 'medium probability' of flooding with between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% - 0.1%) in any year and approximately 60% of the site is located within Flood Zone 3 and therefore has a 'high probability' of flooding with a 1 in 100 or greater annual probability of river flooding (>1%) in any year.

However, approximately 50% of the proposed building will be located within Flood Zone 2 and approximately 50% of the proposed building will be located within Flood Zone 3.

The Calder Catchment SFRA shows that approximately 40% of the site is located within Flood Zone 2 and therefore has a 'medium probability' of flooding with between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% - 0.1%) in any year and approximately 60% of the site is located within Flood Zone 3a and therefore has a 'high probability' of flooding with a 1 in 100 or greater annual probability of river flooding (>1%) in any year. The site has been shown not to be located within Flood Zone 3ai or Flood Zone 3b.

Approximately 50% of the proposed building will be located within Flood Zone 2 and approximately 50% of the proposed building will be located within Flood Zone 3a. The proposed development is for a 'less vulnerable' use linked to the existing businesses on the business park.

The site will not be inundated with floodwater for all events up to and including the 1 in 100 year event. The site will be flood free during the 1 in 100 year event. This confirms that the site is not located within Flood Zone 3b or Flood Zone 3ai. The site may be inundated with floodwater, to a depth of 0.03m and 0.18m during the 1 in 100 year (+30%) and 1 in 1000 year events, respectively.

Using a conservative estimate of water velocity of 0.30m/s and a maximum water depth of 0.03m any flooding would result in a 'low' flood hazard with a 'flood zone with shallow flowing water or deep standing water' during the 1 in 100 year (+30%) event. Any resulting flooding would be expected to be very infrequent and to have a low predicted depth. Therefore, the risk of fluvial flooding from the River Spen is considered to be of **medium significance**. A number of secondary flooding sources have been identified which may pose a low significant risk to the site. These are:

- Surface Water Flooding
- Sewer Flooding

The flooding sources will only inundate the site to a relatively low water depth and water velocity, will only last a short period of time, in very extreme cases and will not have an impact on the whole of the proposed development site. The proposed development will improve the sites resilience, resistance to flooding and by using property level protection measures to protect the site from flooding the vulnerability of the site will be improved (see Section 5.0).

It can be concluded that the anticipated flood depth increase caused by the proposed development is negligible and not likely to result in increased flood risk within the adjacent flood cell and provision of compensatory storage is not necessary in this case.

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. The topography of the site will not be altered therefore; the overland flow routes will not be altered. The proposed development proposes minimal new structures and will therefore allow floodwater to pass through the site with no effect on the conveyance routes.

4.0 SURFACE WATER DRAINAGE

4.1 Surface Water Management Overview

It is recognised that consideration of flood issues should not be confined to the floodplain. The alteration of natural surface water flow patterns through developments can lead to problems elsewhere in the catchment, particularly flooding downstream. For example, replacing vegetated areas with roofs, roads and other paved areas can increase both the total and the peak flow of surface water runoff from the development site. Changes of land use on previously developed land can also have significant downstream impacts where the existing drainage system may not have sufficient capacity for the additional drainage.

An assessment of the surface water runoff rates has been undertaken, in order to determine the surface water options and attenuation requirements for the site. The assessment considers the impact of the development compared to current conditions. Therefore, the surface water attenuation requirement for the developed site can be determined and reviewed against existing arrangements.

The requirement for managing surface water runoff from developments depends on the pre-developed nature of the site. If it is an undeveloped greenfield site, then the impact of the development will need to be mitigated so that the runoff from the site replicates the natural drainage characteristics of the pre-developed site. In the case of brownfield sites, drainage proposals will be measured against the existing performance of the site, although it is preferable for solutions to provide runoff characteristics that are similar to greenfield behaviour.

The surface water drainage arrangements for any development site should be such that the volumes and peak flow rates of surface water leaving a developed site are no greater than the rates prior to the proposed development, unless specific off-site arrangements are made and result in the same net effect.

It should be acknowledged that the satisfactory collection, control and discharge of surface water runoff are now a principle planning and design consideration. This is reflected in recently implemented guidance and recently released National Sustainable Drainage Systems (SuDS) Standards.

4.2 Surface Water Runoff Rates

It is understood that the existing surface water discharges to the public sewers and the drainage infrastructure at the site efficiently and effectively manages surface water runoff generated at the site. As there is no history of surface water flooding at the site it is likely that the current drainage system is sufficient for the current and proposed site use.

The site is currently occupied by a car park, the ground surface at the location of the site hardstanding. The amount of impermeable surfaces will not change post-application compared to pre-application. The surface water runoff will not increase post-application compared to pre-application and there will be no increase in surface water flood risk to the site and off-site locations.

5.0 RISK MANAGEMENT

5.1 Introduction

The flood risk at this location is considered suitable for 'less vulnerable' developments within the NPPF. In this flood zone, developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area through the layout and form of the development and the use of flood mitigation measures.

A number of techniques and mitigation strategies to manage and reduce the overall flood risk in the area will be used. This will 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.

5.2 Finished/Threshold Floor Levels

The finished floor levels will be raised to 78.73mAOD which provides a freeboard of 300mm above the 1 in 100 year (+30%) water level of 78.43mAOD. It is recognised however that owing to limited headroom constraints, massing, planning policy and Building Regulations it is considered impractical to raise the finished floor levels further. Therefore, in order to mitigate against this, it is recommended that the occupants of the proposed dwelling sign up to receive flood warnings from the Environment Agency and implement a flood evacuation plan to a safe area away from the building during times of flood. It is also proposed that flood protection measures are employed within the building design to reduce the overall risk to the occupants. This is discussed below.

A combination of resistance (proofing) and resilience measures will be included to provide further protection. This is discussed below.

5.3 Flood Resistance Measures

Flood risk can be mitigated through the design of the building. Flood resistance measures are measures that help resist floodwaters entering a property (airbrick covers are an example of a flood resistance measure). Flood resistant measures will be used, including:

- The walls of the building will be thick.
- Concrete floors will be used.
- Sealant will be used around external doors and windows.
- All external doors and windows will be constructed from hard wearing materials.
- All windows will be a minimum of 1000mm above the ground level.
- Fit non-return valves/anti flow valves at last point of inspection chamber before connection to existing drains.
- There will be no air bricks.

5.4 Flood Resilience Measures

Flood resilience measures are designed in such a way as to reduce the cost and time required to reinstate the property should it be flooded (tiled floors are an example of a flood resilience measure). The building will be constructed in such a way that although floodwater may enter the building, elements that are damaged by floodwater can be easily repaired or replaced. This is a form of flood resilience. They are suitable as no other measure is practicable.

Robust materials and finishes will be used, including:

- laying 1 or 2 layers of plasterboards at base of internal studwork construction to ground floors;
- fixings to be galvanised/stainless steel or copper - no mild steel to be used - cause rust/staining or walls;
- water resistant render;
- low permeability paints to be used rather than emulsion - allows walls to dry out quickly;
- cavities insulated with Polyisocyanurate (PIR) closed cell type insulation (e.g. celotex); and
- all electrical wiring, switches, sockets, socket outlets, electrical, and gas meters etc. will be located a minimum of 450mm above the finished floor level at 79.18mAOD which provides a freeboard of 750mm above the 1 in 100 year (+30%) water level of 78.43mAOD.

5.5 Flood Warning and Evacuation

The site is located in a flood risk area therefore; the buildings will participate in the Environment Agency flood warning telephone service. The site will register contact details with the Environment Agency' Flood Warning Service (Floodline 0345 988 1188) in order to receive Flood Warnings.

The Environment Agency 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 Environment Agency Floodline telephone number (Call Floodline on 0345 988 1188) 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.

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

5.6 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.

Residual Risk

If flooding starts to affect the site without any pre-warning i.e. in real time (e.g. through a failure of the flood warning delivery) the following actions will be taken:

- Occupants and visitors should consider evacuating the site.
- If flood levels continue to rise, occupants and visitors are advised to evacuate before safe access is lost. Occupants and visitors should monitor the flood progression and evacuate.

The Flood Warden will monitor flood levels and keep occupants and visitors informed and will decide whether to initiate the Flood Plan. If required a 'safe haven' (see Section 6.2.3) can also be maintained and may be required in very extreme events if a flood warning has not been received.

5.7 Safe Access and Egress Route

The NPPF requires that, where required, safe access and escape is available to/from new developments in flood risk areas. Access routes should be such that occupants can safely access and exit their dwellings 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.

A safe access and egress route, including emergency access can be maintained for vehicles and/or by foot via the site entrance onto Balme Road and then to the east of the site. Balme Road is located within Flood Zone 2 and therefore has a 'medium probability' of flooding with between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% - 0.1%) in any year, as shown in Figure 3.

The likelihood of a rapid river level rise and possible rapid inundation of urban areas posing a risk to life is considered to be minimal. 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.

Using a conservative estimate of water velocity of 0.30m/s and a maximum water depth of 0.03m any flooding would result in a 'low' flood hazard with a 'flood zone with shallow flowing water or deep standing water' during the 1 in 100 year (+30%) event, as per Table 4 of the Supplementary Note on Flood Hazard Ratings and Thresholds for Development Planning and Control Purpose - Clarification of the Table 13.1 of FD2320/TR2 and Figure 3.2 of FD/2321/TR1. It should be noted that this is the most conservative estimate of surface water flood risk. The flood risk from surface water is of a minor nature with low water depths and velocities being experienced.

The Safe Access and Egress Route shown in Figure 8 indicates the exit route that all people (i.e. occupants and visitors) on site should follow once a flood warning has been received. People should make their way to areas outside of the flood zone. Therefore, safe access and egress can be maintained for all events up to and including the 1 in 100 year (+30%) event in accordance with the NPPF and Environment Agency Guidance. People should make their way to areas outside of the flood zone.

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. Facilities such as community centres, shops etc. are located to the north of the site which may be used in the event of a flood event. There may also be large areas than those shown in Figure 3 that are flood free located nearer and within the vicinity of the site.

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 using the route shown in Figure 8.

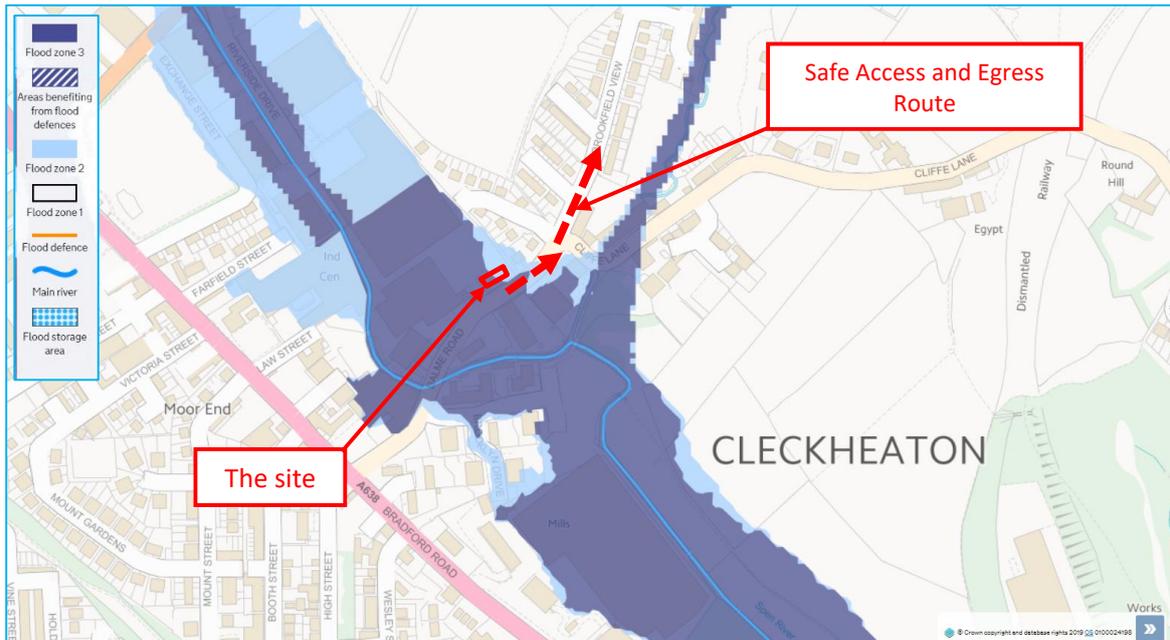


Figure 8 - Safe Access and Egress Route

5.8 Flooding Consequences

The mitigation measures detailed above show that the flood risk can be effectively managed and therefore the consequences of flooding are acceptable. The site is unlikely to flood except in extreme conditions. This takes into account the property level protection measures.

6.0 SEQUENTIAL APPROACH

6.1 Sequential Test

The risk-based Sequential Test in accordance with the NPPF aims to steer new development to areas at the lowest probability of flooding (i.e. Flood Zone 1). However, where an individual proposes to develop a site in an existing flood risk area the consideration of alternative sites is not likely to be a realistic option. The planning applicant should state why there is no alternative available to them to develop.

It is impractical to suggest that there are more suitable locations for this development elsewhere. This is the only site in the ownership of the client and therefore the only site available to them to develop. The cost of buying a similar site and the cost to construct a similar development would make it uneconomical. The proposed development is for an industrial unit. The site proposals cannot be located in another site elsewhere they have to be located at this site which has existing facilities.

Furthermore, the Council's objectives are to sustain and enhance the vitality and viability of the region, and to ensure a wide range of homes to which people have easy access by a range of transport therefore, improving the overall quality of life. This is underpinned by the quality of the physical environment, social well-being and economic and environmental improvements. The Council seeks to grant permission for developments that add to the vitality and viability of the region.

This site will help to regenerate the region and will help to deliver these objectives. This site will help encourage economic impetus that will in turn help deliver a stronger service function and mix of housing uses.

The site proposals remain consistent with the relevant planning policies and are not at odds with the current use of the site and can only enhance and preserve the residential base which currently exists. The site is situated within a long established residential area as identified within the Local Plan, developed area and is an infill development.

The application is for a new, suitable flood-resilient design. The exposure of people and property will be minimised. The proposed development is classified as 'less vulnerable', 'less vulnerable' uses are appropriate within Flood Zone 3 after the completion of a satisfactory FRA. Furthermore, the proposed development is for a 'less vulnerable' use linked to the existing businesses on the business park.

Flood risk at the site will be further mitigated by using a number of property level protection measures to manage and reduce the overall flood risk at the site. The proposed development will improve the sites resilience, resistance to flooding and by using property level protection measures to protect the site from flooding the vulnerability of the site will be improved (see Section 5.0).

Similar buildings on any site outside a Flood Zone will not offer any advantage vis-a-vis flooding. Consequently, application of the Sequential Test demonstrates that there is no measurable advantage to constructing the proposed flats elsewhere.

Application of the Sequential Test requires that there are other suitable sites available that offer less risk in terms of flooding. Development of this site with the floor levels proposed provides greater safety for the occupants than a similar site immediately adjacent to the flood risk area with levels marginally above the design flood risk level.

Hence this proposal provides greater protection to occupants than might be afforded by another notional site. Consequently, the Sequential Test would suggest that this site is one to which

development should be moved, rather than one from which it should directed. Indeed, using a pragmatic approach it is doubtful that the Sequential Test should be applied at all.

Since the publication of Planning Policy Guidance Note 25: Development and flood risk in July 2001 it has been a requirement that planning applications for residential uses located within Flood Zone 3 have to pass the Sequential Test (see para. 30 of PPG25). This was later re-iterated within Planning Policy Statement 25: Development and flood risk published in December 2006 and the NPPF published in March 2012.

A number of planning permissions all located within Flood Zone 3 have been granted by the Council for commercial developments. Therefore, if these sites have been granted planning permission for commercial developments and therefore have passed the Sequential Test the subject site should also be deemed to have passed the Sequential Test as the principle of development for commercial uses within this area has already been decided since the introduction of the Sequential Test. It should be noted that these sites are at a greater risk of flooding from all sources than the subject site.

From the above it is shown that there are overriding sustainability reasons for the development to be granted planning permission within Flood Zone 3. The development proposals should therefore be considered by the LPA to satisfy the Sequential Test as set out in the NPPF.

6.2 Exception Test

Applications for 'less vulnerable' uses located within Flood Zones 3 are not subject to the Exception Test as confirmed within Table 2 of this report and Table 3 of the Planning Practice Guidance to the NPPF. Therefore, the Exception Test will not need to be undertaken as part of this planning application.

7.0 SUMMARY AND CONCLUSIONS

7.1 Introduction

This report presents an FRA in accordance with the NPPF for the proposed development at the Spenbeck Business Park, Balme Road, Cleckheaton, BD19 4EW.

This FRA 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.

7.2 Flood Risk

The site is unlikely to flood except in extreme conditions. The primary, but unlikely, flood risk to the site is from fluvial flooding from the River Spen.

Approximately 40% of the site is located within Flood Zone 2 and therefore has a 'medium probability' of flooding with between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% - 0.1%) in any year and approximately 60% of the site is located within Flood Zone 3 and therefore has a 'high probability' of flooding with a 1 in 100 or greater annual probability of river flooding (>1%) in any year. However, approximately 50% of the proposed building will be located within Flood Zone 2 and approximately 50% of the proposed building will be located within Flood Zone 3.

The Calder Catchment SFRA shows that approximately 40% of the site is located within Flood Zone 2 and therefore has a 'medium probability' of flooding with between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% - 0.1%) in any year and approximately 60% of the site is located within Flood Zone 3a and therefore has a 'high probability' of flooding with a 1 in 100 or greater annual probability of river flooding (>1%) in any year. The site has been shown not to be located within Flood Zone 3ai or Flood Zone 3b.

Approximately 50% of the proposed building will be located within Flood Zone 2 and approximately 50% of the proposed building will be located within Flood Zone 3a. The proposed development is for a 'less vulnerable' use linked to the existing businesses on the business park.

The site will not be inundated with floodwater for all events up to and including the 1 in 100 year event. The site will be flood free during the 1 in 100 year event. This confirms that the site is not located within Flood Zone 3b or Flood Zone 3ai. The site may be inundated with floodwater, to a depth of 0.03m and 0.18m during the 1 in 100 year (+30%) and 1 in 1000 year events, respectively.

Using a conservative estimate of water velocity of 0.30m/s and a maximum water depth of 0.03m any flooding would result in a 'low' flood hazard with a 'flood zone with shallow flowing water or deep standing water' during the 1 in 100 year (+30%) event. Any resulting flooding would be expected to be very infrequent and to have a low predicted depth. Therefore, the risk of fluvial flooding from the River Spen is considered to be of **medium significance**. A number of secondary flooding sources have been identified which may pose a low significant risk to the site. These are:

- Surface Water Flooding
- Sewer Flooding

The flooding sources will only inundate the site to a relatively low water depth and water velocity, will only last a short period of time, in very extreme cases and will not have an impact on the whole of the proposed development site. The proposed development will improve the sites resilience, resistance

to flooding and by using property level protection measures to protect the site from flooding the vulnerability of the site will be improved.

It can be concluded that the anticipated flood depth increase caused by the proposed development is negligible and not likely to result in increased flood risk within the adjacent flood cell and provision of compensatory storage is not necessary in this case.

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. The topography of the site will not be altered therefore; the overland flow routes will not be altered. The proposed development proposes minimal new structures and will therefore allow floodwater to pass through the site with no effect on the conveyance routes.

7.3 Surface Water Drainage

It is understood that the existing surface water discharges to the public sewers and the drainage infrastructure at the site efficiently and effectively manages surface water runoff generated at the site. As there is no history of surface water flooding at the site it is likely that the current drainage system is sufficient for the current and proposed site use.

The site is currently occupied by a car park, the ground surface at the location of the site hardstanding. The amount of impermeable surfaces will not change post-application compared to pre-application. The surface water runoff will not increase post-application compared to pre-application and there will be no increase in surface water flood risk to the site and off-site locations.

7.4 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 used:

Finished/Threshold Floor Levels: The finished floor levels will be raised to 78.73mAOD which provides a freeboard of 300mm above the 1 in 100 year (+30%) water level of 78.43mAOD. It is recognised however that owing to limited headroom constraints, massing, planning policy and Building Regulations it is considered impractical to raise the finished floor levels further. Therefore, in order to mitigate against this, it is recommended that the occupants of the proposed dwelling sign up to receive flood warnings from the Environment Agency and implement a flood evacuation plan to a safe area away from the building during times of flood. It is also proposed that flood protection measures are employed within the building design to reduce the overall risk to the occupants. This is discussed below.

A combination of resistance (proofing) and resilience measures will be included to provide further protection. This is discussed below.

Flood Resistance Measures: Flood risk can be mitigated through the design of the building. Flood resistance measures are measures that help resist floodwaters entering a property (airbrick covers are an example of a flood resistance measure). Flood resistant measures will be used, including:

- The walls of the building will be thick.
- Concrete floors will be used.
- Sealant will be used around external doors and windows.
- All external doors and windows will be constructed from hard wearing materials.

- All windows will be a minimum of 1000mm above the ground level.
- Fit non-return valves/anti flow valves at last point of inspection chamber before connection to existing drains.
- There will be no air bricks.

Flood Resilience Measures: Robust materials and finishes will be used, including:

- laying 1 or 2 layers of plasterboards at base of internal studwork construction to ground floors;
- fixings to be galvanised/stainless steel or copper - no mild steel to be used - cause rust/staining or walls;
- water resistant render;
- low permeability paints to be used rather than emulsion - allows walls to dry out quickly;
- cavities insulated with Polyisocyanurate (PIR) closed cell type insulation (e.g. celotex); and
- all electrical wiring, switches, sockets, socket outlets, electrical, and gas meters etc. will be located a minimum of 450mm above the finished floor level at 79.18mAOD which provides a freeboard of 750mm above the 1 in 100 year (+30%) water level of 78.43mAOD.

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 will be developed.

Food Warning and Evacuation: The site is located in a flood risk area therefore; the properties will participate in the Environment Agency flood warning telephone service. The site will register contact details with the Environment Agency' Flood Warnings Service (Floodline 0845 988 1188) in order to receive Flood Warnings.

Safe Access and Egress Route: A safe access and egress route, including emergency access can be maintained for vehicles and/or by foot via the site entrance onto Balme Road and then to the east of the site. Balme Road is located within Flood Zone 2 and therefore has a 'medium probability' of flooding with between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% - 0.1%) in any year.

Using a conservative estimate of water velocity of 0.30m/s and a maximum water depth of 0.03m any flooding would result in a 'low' flood hazard with a 'flood zone with shallow flowing water or deep standing water' during the 1 in 100 year (+30%) event. Any resulting flooding would be expected to be very infrequent and to have a low predicted depth.

The Safe Access and Egress Route indicates the exit route that all people (i.e. occupants and visitors) on site should follow once a flood warning has been received. People should make their way to areas outside of the flood zone. Therefore, safe access and egress can be maintained for all events up to and including the 1 in 100 year (+30%) event in accordance with the NPPF and Environment Agency Guidance. People should make their way to areas outside of the flood zone.

7.5 Sequential Approach

The development proposals should be considered by the LPA to satisfy the Sequential and Exception Tests as set out in the NPPF.

7.6 Conclusion

In conclusion, an industrial unit would be expected to remain dry in all but the most extreme conditions. Providing the recommendations made in this FRA are instigated, flood risk from all sources would be minimised, the consequences of flooding are acceptable, and the development would be in accordance with the requirements of the NPPF.

This FRA demonstrates that the proposed development would be operated with minimal risk from flooding, would not increase flood risk elsewhere and is compliant with the requirements of the NPPF. The development should not therefore be precluded on the grounds of flood risk.