REPORT

NPPF Flood Risk Assessment

Land East and West of Grange Farm, Humber Lane, Welwick, East Riding of Yorkshire HU12 0SA

Client: Anthony Booth

Reference: 6732-RHD-ZZ-XX-RP-Z-001

Status: A1/P01.01

Date: 01 July 2022

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Executive Summary

Royal HaskoningDHV has been appointed by Anthony Booth, to undertake a National Planning Policy Framework (NPPF) [1] compliant Flood Risk Assessment (FRA), for the proposed development located at Land East and West of Grange Farm, Humber Lane, Welwick, East Riding of Yorkshire, HU12 0SA.

According to the Flood Risk and Coastal Change Planning Policy Guidance, the proposed development would be classified as a Major Development.

According to Annex 3 of the NPPF, the proposed developments Vulnerability Classification is “More vulnerable”, which consists of the following uses:

“Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.”

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

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

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

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

A summary of the flood risk for the site for each source requiring consideration under the NPPF is presented as Table 1, overleaf.

The Surface Water Drainage Strategy outlined as part of this Flood Risk Assessment, will reduce the peak rate of surface water discharge to a state that should not adversely impact third party properties.

The Flood Risk Assessment has been undertaken in accordance with the requirements of the NPPF, and it can be demonstrated that the development proposals are compatible with the predicted flood risk profile, including climate change allowance over the development lifetime.

It should be noted that the development proposals are not predicted to increase the risk of flooding to others over the development lifetime. Consequently, it is concluded that with regards to the Flood Risk requirements of the NPPF, the development proposals are acceptable.

Table 1: Flood Risk Overview

Criteria	Summary
Site Setting	
Site Address	Land East and West of Grange Farm, Humber Lane, Welwick, East Riding of Yorkshire
Local Authority (ONS)	East Riding of Yorkshire Council
Client Name	Anthony Booth
Redline Site Boundary	15,096 m^2
Ordnance Survey Grid Reference	TA 34512 20842 (6 Figure TA345208)
Fluvial Climate Change Catchment Area	Hull and East Riding
Development Classification	
Major or Minor Development?	Major Development
Vulnerability Classification	More vulnerable
Development Proposals	It is understood that the development is for the change of use of land from agricultural to holiday use including erection of 6 'glamping/safari tents', a camping tent area, associated car park with overnight parking for vans/caravans, erection of a facilities building, and erection of a barn and stables for keeping ducks and chickens, hereafter referred to as the proposed development.
Sequential Test	Based on the flood risk vulnerability and flood zone 'compatibility' table within the flood risk and coastal change guidance (Table 3), the development is classified as Appropriate, and therefore the Exception and Sequential Tests are not required.
Exception Test	
Site Parameters	
Topographic Levels (LiDAR)	Average Topographic Level: 11.4 m AOD Highest Topographic Level: 14.9 mAOD Minimum Topographic Level 8.5 mAOD
Ordinary Watercourses (within 500m)	According to the CEH Rivers data, there is a river (Welwick Drain) located approximately 335m to the west of the site. (Figure 7). Based on the CEH Rivers data, it is considered that there is an extensive network of drains and drainage infrastructure in the areas surrounding the Application Site. These are likely to be IDB drains. There is an existing ditch to the south of the Application Site, based on information provided by the client.
Main Rivers (within 500m)	According to the Environment Agency, Statutory Main River data, there are no Main Rivers within 500m of the site.
BGS Lithology	Superficial Geology: Till, Devensian - Diamicton. Superficial Deposits Bedrock Geology: Flamborough Chalk Formation - Chalk.
BGS Borehole Record	TA32 SW15 is located approximately 156m away from the site. No groundwater indicated..
Intrusive Onsite Ground Investigations	No details of intrusive ground investigations on site have been provided to date.
Flood Risk	
Historic Records	There are is a recorded instances of flooding on the Environment Agency's Historic or Recorded flood data, within 500m of the site. Data provided by the Environment Agency shows historic flood outlines for the East Coast Tidal Event 5th December 2013, which took place within 500m of the site. Flooding occurred
Flood Map for Planning Classification	Flood Zone 1 and is in an area that does not benefit from flood defences.
Tidal Flood Discussion	The Application Site is situated in Flood Zone 1, so is at very low risk of tidal flooding.
Tidal Flood Mitigation	On the basis that the site is not predicted to be at risk from tidal flooding, it will not be necessary to include tidal flood mitigation measures within the developments design.
Fluvial Flood Discussion	The Application Site is situated in Flood Zone 1, so is at very low risk of fluvial flooding.
Fluvial Flood Mitigation	On the basis that the site is not predicted to be at risk from fluvial flooding, it will not be necessary to include fluvial flood mitigation measures within the developments design.

Criteria	Summary
Pluvial Flood Risk	1 in 30: None 1 in 100: None 1 in 1,000: Between 150mm and 300mm
Pluvial Flood Discussion	Based on the Environment Agency's risk of flooding from surface water mapping, the Application Site is classified as being at Low Risk of flooding from surface water.
Pluvial Flood Mitigation	On the basis that the Application Site is predicted to be at low risk from pluvial flooding, it may be necessary to include pluvial flood mitigation measures within the developments design. Mitigation options are discussed in the mitigation section of this document.
Groundwater Flood Risk	The Application Site is considered to be located in an area at low risk from groundwater flooding.
Sewer Flooding Risk	Where sewers exist, there is a residual risk of sewer flooding as a result of either a failure, usually a collapse or blockage, or as a result of the systems capacity being exceeded.
Sewer Flooding Mitigation	Adopting a precautionary approach to the potential for sewer flooding, or other events that exceed the design standard of infrastructure, appropriate mitigation measures should be included in the design of all new buildings, and where practicable in the refurbishment or change of use of existing buildings.
Residual Risk: Flood Defence Breach	Flood Defence Breach: The Application SIte is not located in an area that benefits from the presence of flood defences. Therefore, the Application Site is not indicated to be at risk as consequence of a breach of flood defences.
Residual Risk: Reservoir Failure	Predicted Flood Depth: None The Environment Agency risk of reservoir flooding indicates that the Application Site is not at risk as a result of a modelled reservoir failure.
Canal Failure	According to the CEH Canals data, there are no canals within 500m of the Application Site, therefore it is not anticipated that the site is at risk as a result of a canal breach.
Flood Emergency Response Plan (FERP)	
Is a FERP required?	As the Application Site is not shown to be at risk from tidal or fluvial flooding, a Flood Emergency Response Plan is unlikely to be required.
Offsite Impacts	
Floodplain Displacement	As the Application Site is not shown to be at risk from fluvial flooding, floodplain displacement is unlikely to occur. Therefore, floodplain compensation is not anticipated to be required.
Future Flood Related Permits / Licences	
Access for maintenance of watercourses	It is recommended that an 8m access route be provided to any watercourses, including culverted watercourses. Where crossings of watercourses are required to facilitate access, these should cover as small an area of the watercourse as possible and should permit the free flow of water within the channel.
Flood Risk Activity Permit	A Flood Risk Activity Permit is unlikely to be required.
Ordinary Watercourse Consent	Any works to the ditches or watercourses on site are likely to require Ordinary Watercourse Consent from the Lead Local Flood Authority, or IDB as appropriate.
Public Sewer Licence	Any works within 3m of a public sewer and any new connections shall require the consent of the Public Sewer Authority. Should public sewers be found to cross the site, then discussions with the Public Sewer Authority will be necessary to determine if easements or build over agreements are required.

Table 2: Surface Water Attenuation Requirements

Surface Water Attenuation Requirements	
Proposed Surface Water Discharge Point	It is proposed to discharge surface water runoff generated at the site to the existing pipe crossing the site (details to be confirmed at the detailed design stage), linking two ditches at the respective ends. Discharges subject to Local Planning Authority (LPA) and Environment Agency (EA) approval prior to commencement of construction works.
Proposed Surface Water Discharge Rate	It is proposed to restrict the peak rate of surface water run-off for the 1 in 100 plus climate change event, to the equivalent of the Qbar, where the QBar rate would produce a limiting discharge rate of less than 1 l/s, 1 l/s has been used as the minimum practicable limit. Total Site Area: 1.5 Ha Proposed Hardstanding/Impermeable Areas (including structures, hardstanding and additional conservative 50% of general tent area): 0.71 Ha The proposed drainage strategy includes the use of permeable paving and filter drains. Qbar Rate for Proposed Impermeable Area: 2.9 l/s It is suggested to control runoff at 2.9l/s during the 1:100-year +40% CC rainfall event, through a 39mm orifice plate.
Proposed Attenuation Volume	An initial estimation of the surface water attenuation volume required, to restrict to the proposed surface water discharge rate has been calculated using the HR Wallingford SuDS Tool. The calculations have been undertaken for the 1 in 100 return period storm event, increased by 40% to account for the future predicted impacts of climate change, and the catchment area has been increased by 10% to allow for Urban Creep. Surface Water Attenuation Volume requirement: 462 m^3 Proposed Attenuation Storage Capacity: 464.1 m^3

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1 Introduction

1.1 Purpose of Report

Royal HaskoningDHV has been appointed by Anthony Booth, to undertake a National Planning Policy Framework (NPPF) [1] compliant Flood Risk Assessment (FRA), for the proposed development located at Land East and West of Grange Farm, Humber Lane, Welwick, East Riding of Yorkshire HU12 0SA, hereafter referred to as the Development Proposals.

The purpose of this assessment is to demonstrate that the Development Proposal can be satisfactorily accommodated without worsening flood risk for the area and without placing the development itself at risk of flooding. As per national guidance provided within the NPPF, the Planning Guidance, Flood risk and coastal change [3], DEFRA's National Standards for Sustainable Drainage [4], and Local Guidance and Policy Documents.

The Flood Risk Assessment has been produced in line with the East Riding of Yorkshire Validation Checklist. The Development Proposals require a Flood Risk Assessment at it is a 'development in Flood Zone 1 and would introduce a more vulnerable use on land subject to other sources of flooding.'

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

1.2 Site Location and Development Proposals

The Site is located at Ordnance Survey grid reference TA 34512 20842 (6 Figure Reference TA345208) and the redline boundary includes an area of 15,096 m^2, 1.5 Ha, as indicated on Figure 1.

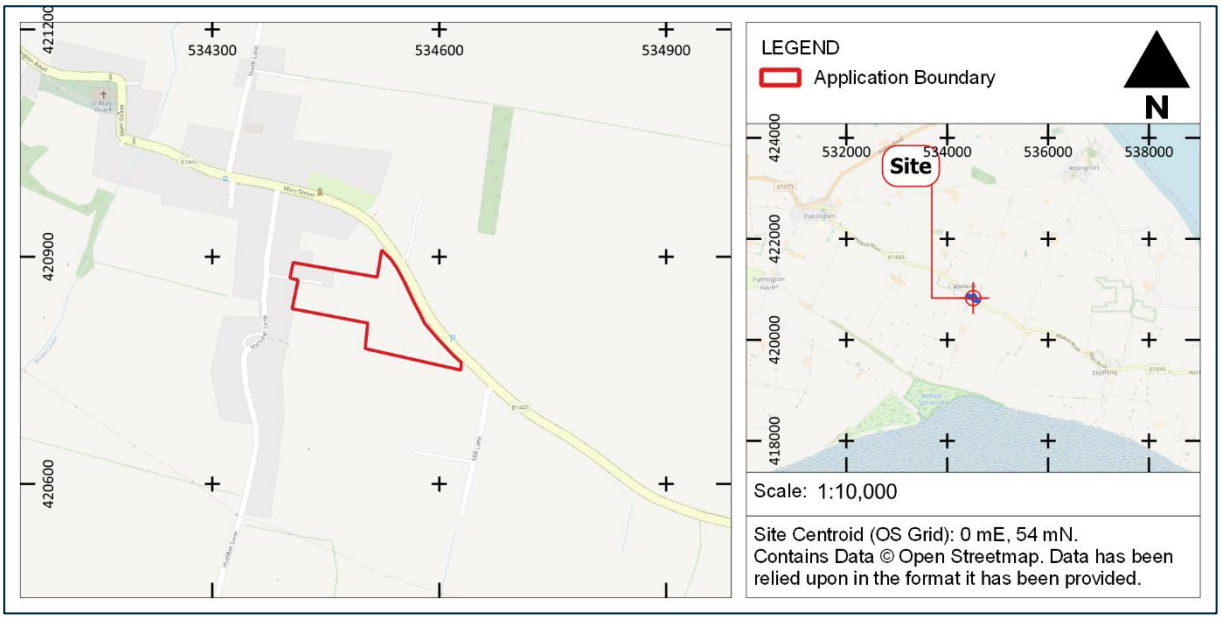

Figure 1: Site Location Plan

It is understood that the development is for the change of use of land from agricultural to holiday use, including of:

- 6 'glamping/safari tents', a camping tent area,
- associated car park with overnight parking for vans/caravans, erection of a facilities building,
- erection of a barn and stables for keeping ducks and chickens, hereafter referred to as the proposed development.

In accordance Flood Risk and Coastal Change Planning Policy Guidance [3], the proposed development would be classified as a Major Development.

1.3 Scope of Assessment

Under Section 14 of the NPPF, a Flood Risk Assessment (FRA) is required for development proposals which meet any of the following conditions:

i. Development in Flood Zones 2 and 3.

ii. In Flood Zone 1, an assessment should accompany all proposals involving: sites of 1 hectare or more;

iii. Land which has been identified by the Environment Agency as having critical drainage problems;

iv. Land identified in a strategic flood risk assessment as being at increased flood risk in future; or,

v. Land that may be subject to other sources of flooding, where its development would introduce a more vulnerable use.

The NPPF states that a FRA needs consider the risk of flooding to a property or site and demonstrate that the site will be safe over its lifetime (including identification of appropriate mitigation measures). The FRA also needs to demonstrate that the proposals will not increase flood risk to others. The sources of flooding that need to be assessed are, from the following sources:

i. **Fluvial (River) flooding**. When flows within watercourses exceed the capacity of the watercourse causing out of bank flows, resulting in flooding of adjacent areas.

ii. **Groundwater flooding.** Usually, the result of prolonged wet weather causing groundwater levels to rise sufficiently to either emerge at surface or to cause flooding of below ground infrastructure, such as basements.

iii. **Pluvial (Surface Water) flooding**. When rainfall causes overland flow rates and volumes which exceed the capacity of the drainage network, causing flooding to land that is normally dry.

iv. **Tidal flooding.** When high tide events overtop the shoreline to cause flooding to land behind, this is usually the result of a combination of high tide events and storm surges.

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

i. **Reservoir failure**. Although the likelihood of reservoir failure resulting in widespread flooding is extremely low[1] [6], the consequences of such an event need to be considered to inform appropriate emergency planning.

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

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

2 Relevant Policy and Guidance

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

2.1 National Policy

- Water Industry Act (1999) [6]
- EU Water Framework Directive (2000) [7]
- EU Floods Directive (2007) [8]
- The Flood Risk Regulations (2009) [9]
- Flood and Water Management Act (2010) [10]
- The Building Regulations, Part H (2015) [11]
- Town and Country Planning, Development Management Procedure, (England) Order (2015) [12]
- British Standards, Drain and sewer systems outside buildings (BS EN 752:2017) [13]
- National Planning Policy Framework (NPPF, 2021) [1]

2.2 National Guidance

- Non-statutory Sustainable Drainage Technical Standards (2015) [14]
- Flood Risk and Coastal Change Planning Practice Guidance (PPG, 2014) [15]
- CiRIA SuDS Manual (C753, 2015) [16]
- Sector Guidance in relation to the adoption of sewerage assets by sewerage companies in England (October 2019) [17]
- Preparing a Flood Risk Assessment: Standing Advice, Environment Agency, and DEFRA (2022) [18]
- Flood Risk Assessments: Climate Change Allowances, Environment Agency (2020) [19]

2.3 Local Policy

- East Riding of Yorkshire Local Flood Risk Management Strategy (2015) [20]
- East Riding of Yorkshire Preliminary Flood Risk Assessment (2011) [20]
- East Riding of Yorkshire Level 1 Strategic Flood Risk Assessment (2019) [21]

3 Climate Change Allowances

The Environment Agency published guidance on climate change allowances for Flood Risk Assessments in February 2016, with the latest update in October 2021 [19].

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

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

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

3.1 Tidal Climate Change Allowances

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

The Application Site is located in the Humber area of England. The 2125 Higher Central Climate Change allowance for sea level rise total until 2125 is 1.15m, and the Upper End allowance is 1.55m compared to the 1981 to 2000 baseline.

Table 3: Sea level allowances by river basin district for each epoch in mm per year.

Area of England	Allowance	2000 to 2035 (mm)	2036 to 2065 (mm)	2066 to 2095 (mm)	2096 to 2125 (mm)	Cumulative rise 2000 to 2125 (metres)
Anglian	Higher central	5.8 (203)	8.7 (261)	11.6 (348)	13 (390)	1.20
Anglian	Upper end	7 (245)	11.3 (339)	15.8 (474)	18.1 (543)	1.60
South east	Higher central	5.7 (200)	8.7 (261)	11.6 (348)	13.1 (393)	1.20
South east	Upper end	6.9 (242)	11.3 (339)	15.8 (474)	18.2 (546)	1.60
South west	Higher central	5.8 (203)	8.8 (264)	11.7 (351)	13.1 (393)	1.21
South west	Upper end	7 (245)	11.4 (342)	16 (480)	18.4 (552)	1.62
Northumbria	Higher central	4.6 (161)	7.5 (225)	10.1 (303)	11.2 (336)	1.03
Northumbria	Upper end	5.8 (203)	10 (300)	14.3 (429)	16.5 (495)	1.43
Humber	**Higher central**	**5.5 (193)**	**8.4 (252)**	**11.1 (333)**	**12.4 (372)**	**1.15**
Humber	**Upper end**	**6.7 (235)**	**11 (330)**	**15.3 (459)**	**17.6 (528)**	**1.55**
North west	Higher central	4.5 (158)	7.3 (219)	10 (300)	11.2 (336)	1.01
North west	Upper end	5.7 (200)	9.9 (297)	14.2 (426)	16.3 (489)	1.41

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

3.2 Fluvial Climate Change Allowances

Fluvial Climate Change Allowances are determined by the predicted increase in peak river flows. These are determined based on regional variations, which are based on the management catchments. Management sub-catchments are sub-catchments of river basin districts under consideration. An excerpt of the management catchment map is provided below (Figure 2), indicating which sub-catchment the Application Site is in. **Error! Reference source not found.** presents the Peak River flow climate change allowance.

The guidance also sets out which climate change allowance should be used for different development Vulnerability Classifications, and these are summarised in Table 5.

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

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

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

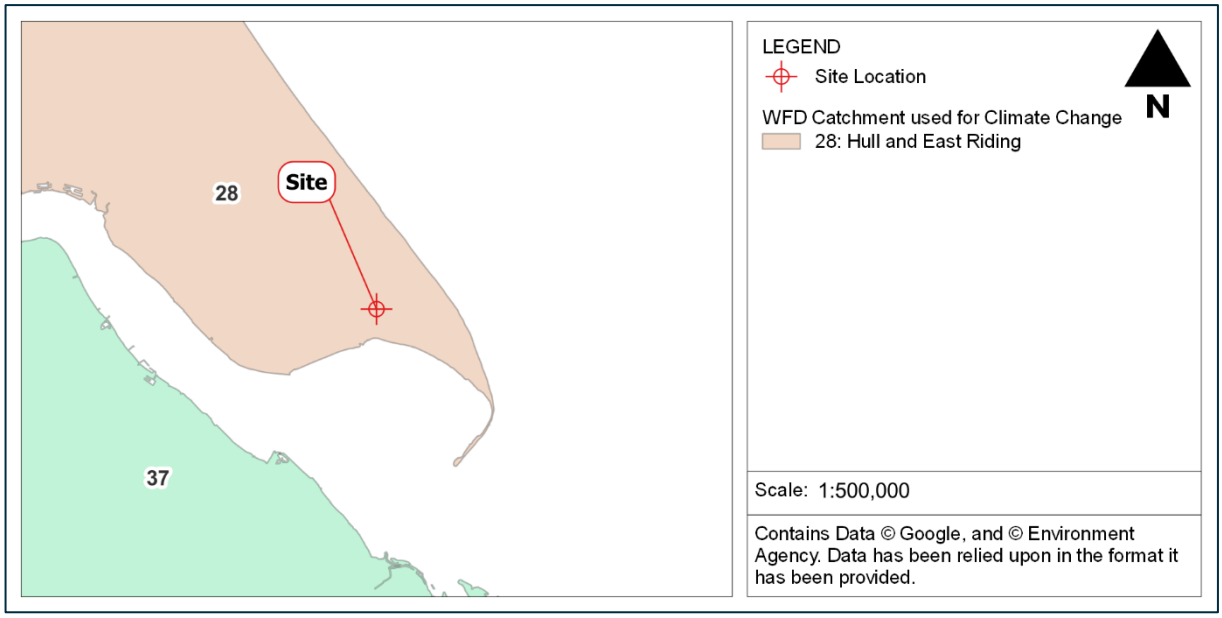

Figure 2: Management Catchments (excerpt)

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

Management catchment name	2020s central	2020s higher central	2020s upper end	2050s central	2050s higher central	2050s upper end	2080s central	2080s higher central	2080s upper end
Hull and East Riding	9%	15%	33%	9%	17%	37%	20%	33%	66%

Table 5: Fluvial climate change allowances to be applied based on development vulnerability.

Vulnerability Classification	Flood Zone 1, 2, or 3a	Flood Zone 3b
Essential Infrastructure	Higher central allowance	Higher Central Allowance
Highly Vulnerable	Central allowance (development should not be permitted in Flood Zone 3a)	Development should not be permitted, but where exceptions are appropriate, Higher Central
More Vulnerable	Central allowance	
Less Vulnerable	Central allowance	
Water Compatible	Central allowance	Central allowance

3.3 Pluvial Climate Change Allowances

Pluvial Climate Change Allowances are determined by the predicted increase in peak rainfall intensity. These are determined by regional variations, which are based on the management catchments. The management catchment map is shown in Figure 2 above. Table 6presents the Peak Rainfall Intensity climate change allowances for this management catchment area.

The guidance also sets out which climate change allowance should be used for different development lifetimes [24]. This guidance is outlined below:

Development with a lifetime beyond 2100

This includes development proposed in applications or local plan allocations.

For flood risk assessments and strategic flood risk assessments assess the upper end allowances. You must do this for both the 1% and 3.3% annual exceedance probability events for the 2070s epoch (2061 to 2125).

Design your development so that for the upper end allowance in the 1% annual exceedance probability event:

- *there is no increase in flood risk elsewhere*
- *your development will be safe from surface water flooding*

Development with a lifetime of between 2061 and 2100

For development with a lifetime between 2061 and 2100 take the same approach but use the central allowance for the 2070s epoch (2061 to 2125).

Development with a lifetime up to 2060

For development with a lifetime up to 2060, take the same approach but use the central allowance for the 2050s epoch (2022 to 2060).

Exceptions

In some locations the allowance for the 2050s epoch is higher than that for the 2070s epoch. If so, and development has a lifetime beyond 2061, use the higher of the two allowances.

The relevant management catchment and allowances for the Application Site are highlighted in bold below.

The Application Site is located in the Hull and East Riding management catchment. Climate Change allowances are based on a 1981 to 2000 baseline.

The upper end Climate Change allowances for peak rainfall intensity in the 2070s epoch are 35% in the 30 year Return Period and 40% in the 100 year Return Period.

Table 6: Peak rainfall intensity allowance in Hull and East Riding management catchment

Annual Exceedance Rainfall Event	2050s central	2050s upper end	2070s central	2070s upper end
3.3 % (30 year RP)	20%	35%	25%	**35%**
1 % (100 year RP)	20%	40%	25%	**40%**

4 Site Parameters

4.1 Site Description

The Site is located at Ordnance Survey grid reference TA 34512 20842 (6 Figure TA345208), and the redline boundary includes an area of 15,096 m^2, 1.5 ha, as indicated on Figure 1.

The Application Site is currently used for agricultural purposes, as shown in Figure *3*.

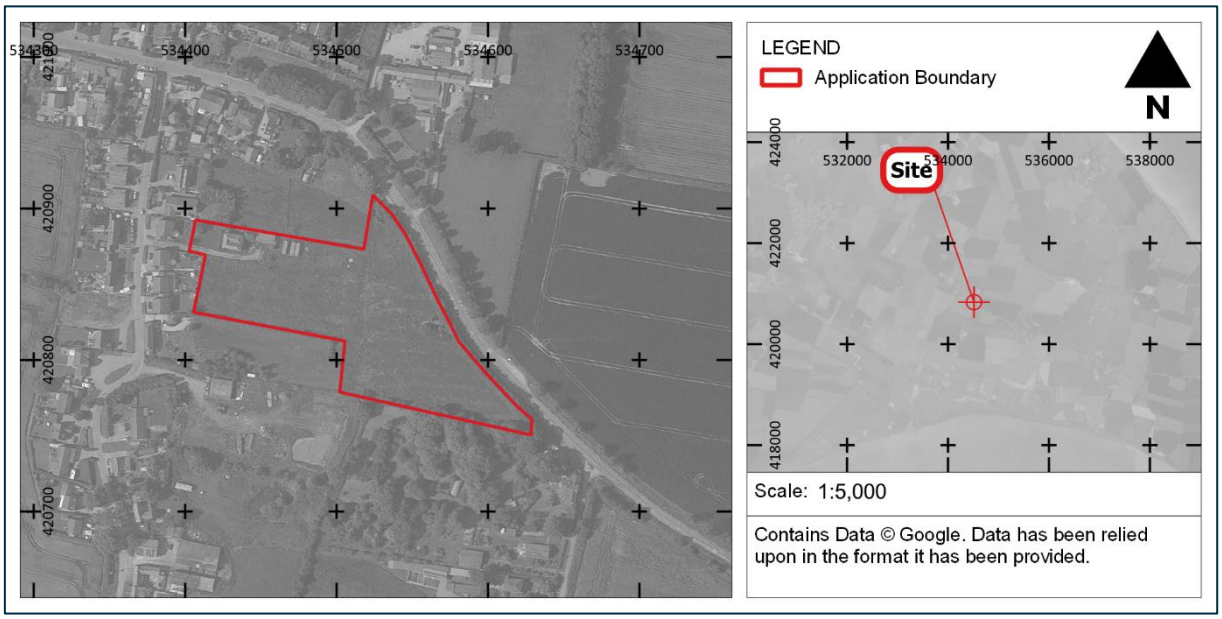

Figure 3: Aerial Photograph

4.2 Site Topography

Ground levels on site have been determined by reviewing Environment Agency 2m LiDAR data and the ground levels are on average 11.4 m AOD, with a highest topographic level of 14.9 mAOD and a minimum topographic level of 8.5 mAOD, see Figure 4.

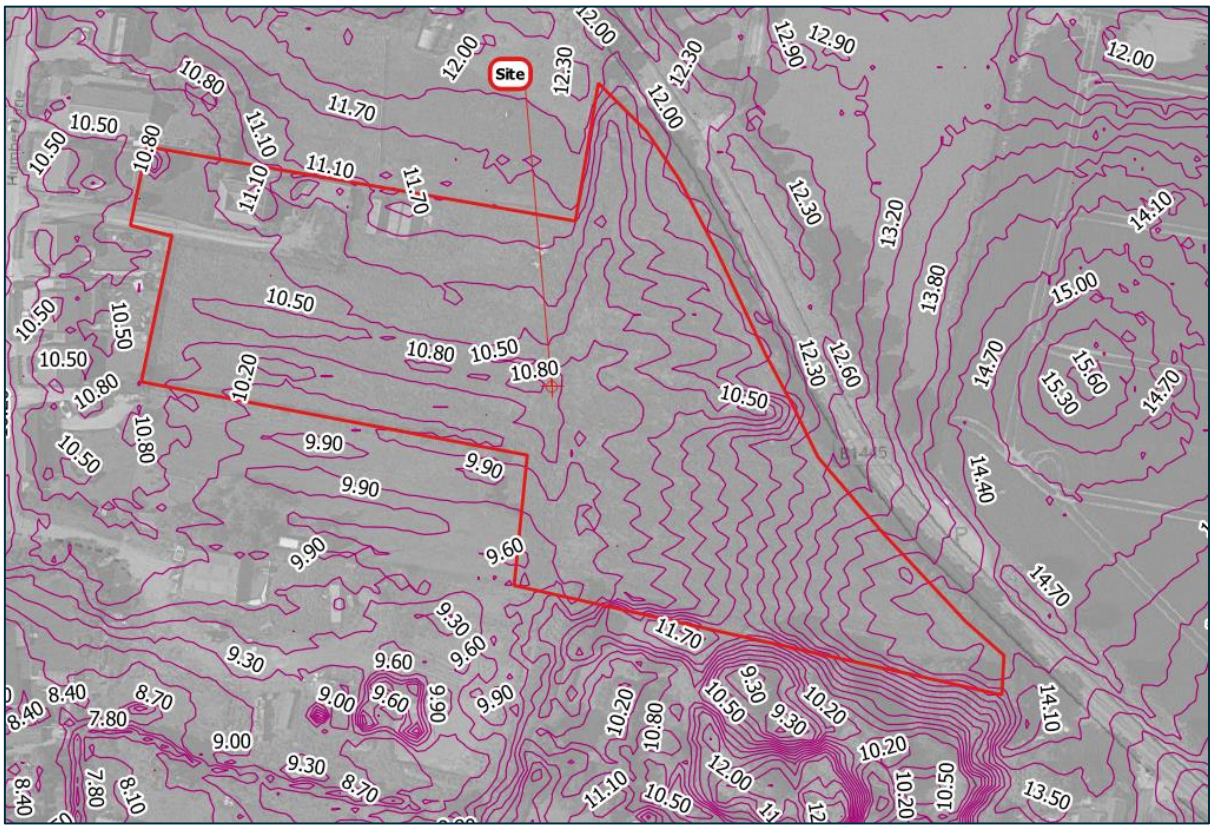

Figure 4: Site Topography

4.3 Site Hydrology

4.3.1 Internal Drainage Board

According to mapping available from the Association of Drainage Authorities internal drainage boards map [22], the site is located outside of a IDB area as indicated on Figure 5. The South Holderness IDB area is in close proximity of the site. Data shows that the topography of the site slope downwards from north to south, therefore it can be considered that the runoff will drain towards the IDB area.

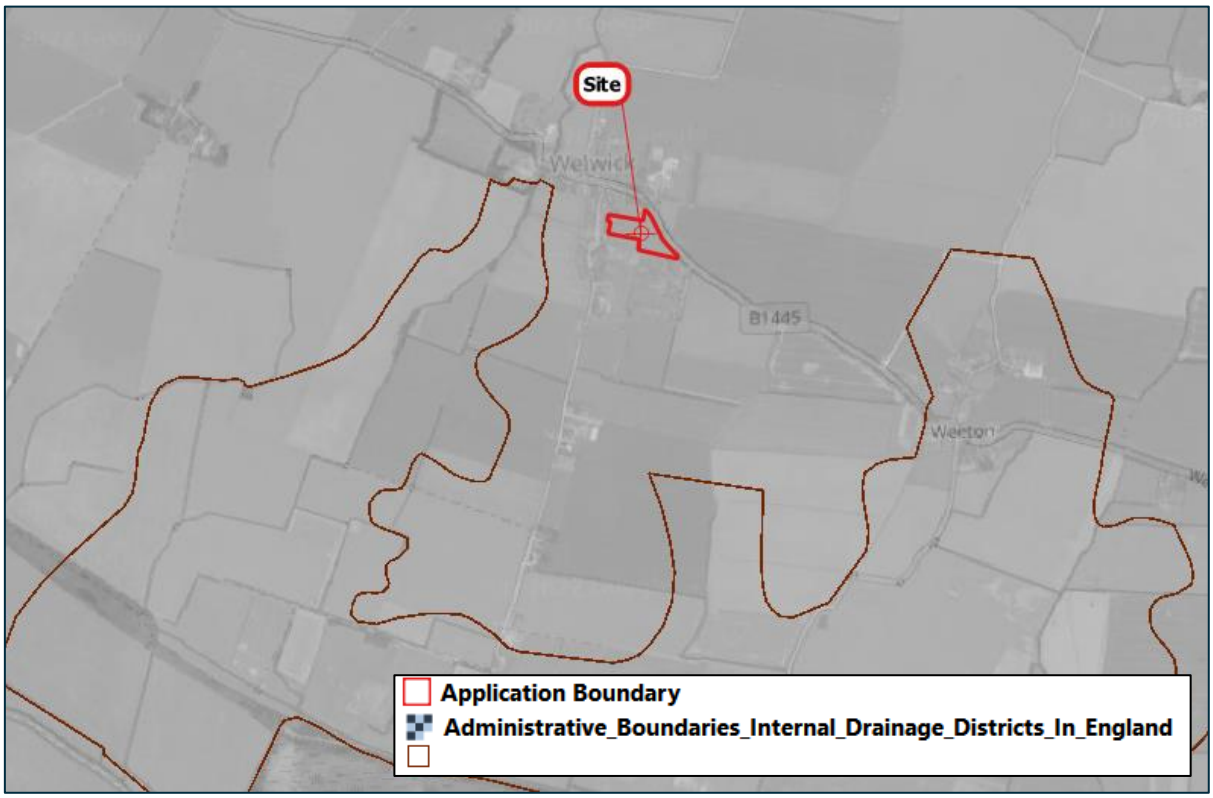

Figure 5: IDB Map

4.3.2 Main Rivers

According to the Environment Agency, Statutory Main River data, there are no Main Rivers within 500m of the site. (Figure *6*).

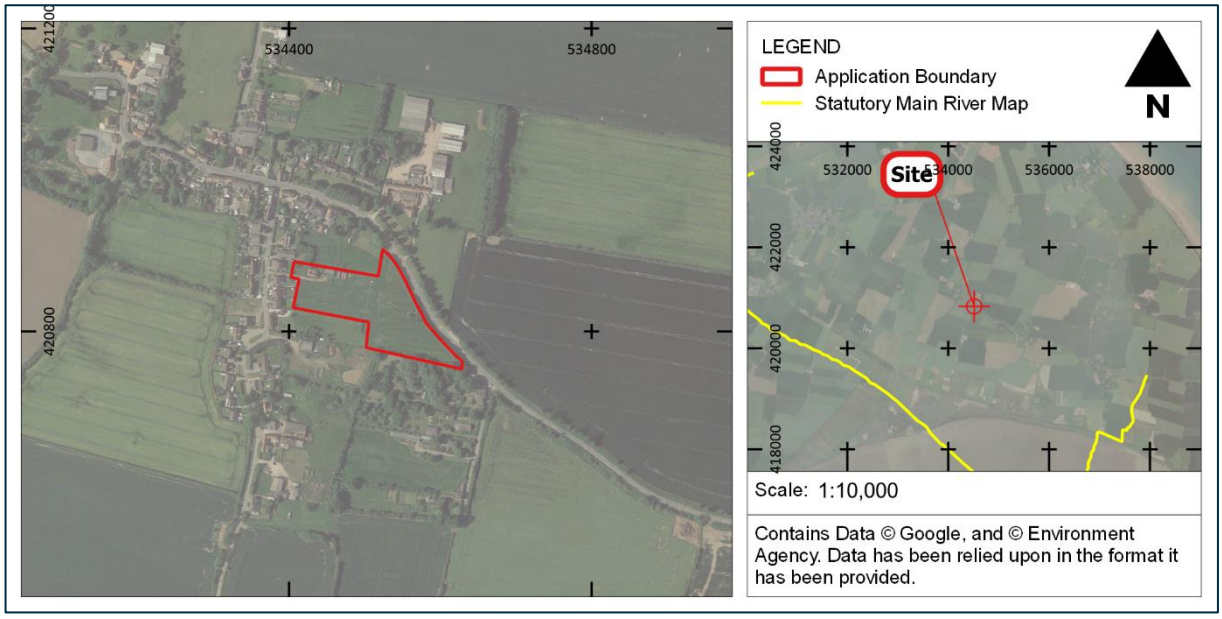

Figure 6: Main Rivers

4.3.3 Ordinary Watercourses

According to the CEH Rivers data, there is a river (Welwick Drain) located approximately 335m to the west of the site. (Figure 7). Based on the CEH Rivers data, it is considered that there is an extensive network of drains and drainage infrastructure in the areas surrounding the Application Site. These are likely to be IDB drains. There is an existing ditch to the south of the Application Site, based on information provided by the client.

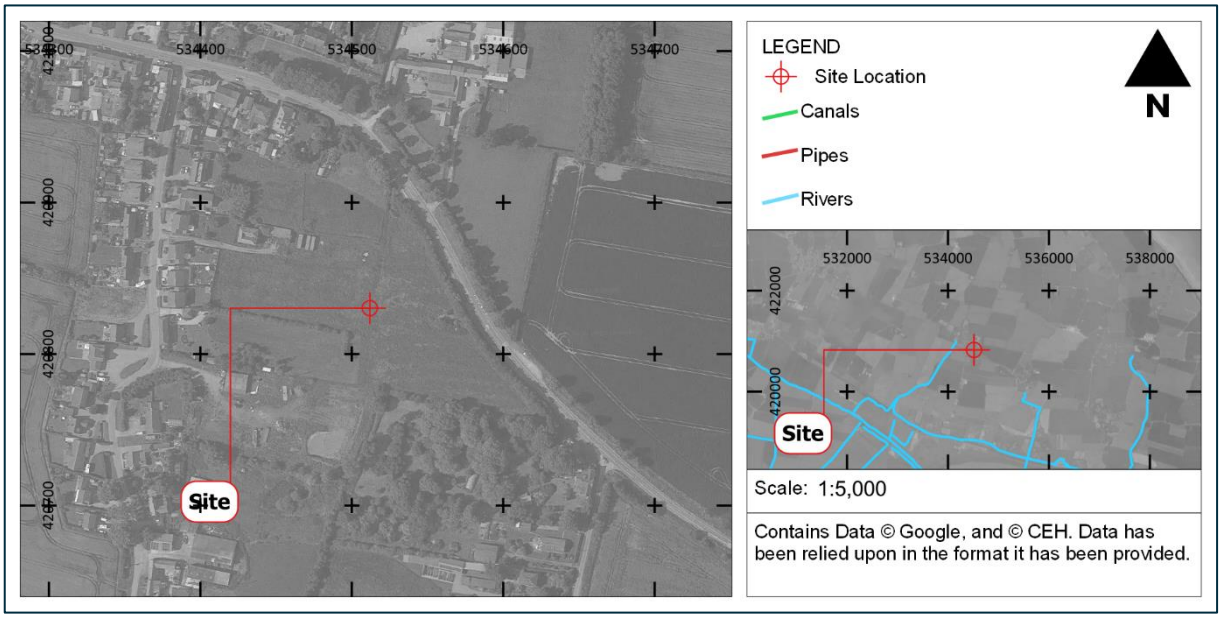

Figure 7: Ordinary Watercourses

4.4 Ground Conditions

4.4.1 BGS Lithology

According to the BGS Lithology the ground beneath the site has the following attributes:

Superficial Geology: Till, Devensian - Diamicton. Superficial Deposits
Bedrock Geology: Flamborough Chalk Formation - Chalk.

4.4.2 BGS Borehole

According to the BGS historic borehole records data, the nearest recorded borehole to the site is; TA32 SW15 is located approximately 156m away from the site. No groundwater indicated.

4.4.3 Intrusive Onsite Ground Investigations

No details of intrusive ground investigations on site have been provided to date.

5 Development Compatibility with Flood Zone

5.1 Development Vulnerability Classification

The vulnerability classifications are summarised in Table 7 (below), which identifies that the Development Proposals are **More vulnerable**.

Table 7: Annex 3 of the NPPF, Flood risk vulnerability classification

Classification	Description
Essential infrastructure	Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk. Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including electricity generating power stations and grid and primary substations; and water treatment works that need to remain operational in times of flood. Wind turbines.
Highly vulnerable	Police and ambulance stations; fire stations and command centres; telecommunications installations required to be operational during flooding. Emergency dispersal points. Basement dwellings. Caravans, mobile homes and park homes intended for permanent residential use. Installations requiring hazardous substances consent. (Where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as 'Essential Infrastructure')
More vulnerable	Hospitals. Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels. Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels. Non–residential uses for health services, nurseries and educational establishments. Landfill* and sites used for waste management facilities for hazardous waste. **Sites used for holiday or short-let caravans and camping**, subject to a specific warning and evacuation plan.
Less vulnerable	Police, ambulance and fire stations which are not required to be operational during flooding. Buildings used for shops; financial, professional and other services; restaurants, cafes and hot food takeaways; offices; general industry, storage and distribution; non-residential institutions not included in the 'more vulnerable' class; and assembly and leisure. Land and buildings used for agriculture and forestry. Waste treatment (except landfill* and hazardous waste facilities). Minerals working and processing (except for sand and gravel working). Water treatment works which do not need to remain operational during times of flood. Sewage treatment works, if adequate measures to control pollution and manage sewage during flooding events are in place.
Water-compatible development	Flood control infrastructure. Water transmission infrastructure and pumping stations. Sewage transmission infrastructure and pumping stations. Sand and gravel working. Docks, marinas and wharves. Navigation facilities. Ministry of Defence defence installations. Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. Water-based recreation (excluding sleeping accommodation). Lifeguard and coastguard stations. Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms. Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to a specific warning and evacuation plan.

5.2 Flood Zone Classification

The EA Flood Map for Planning (Figure 8) demonstrates that the Application Site is located within an area defined as Flood Zone 1.

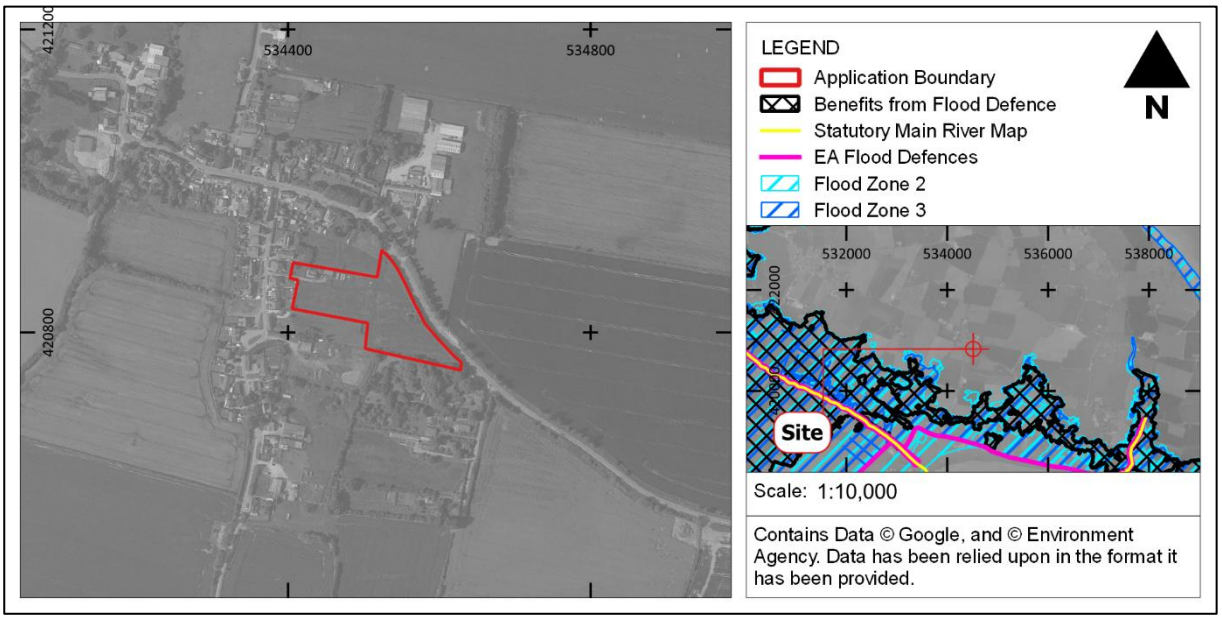

Figure 8: EA Flood Map for Planning

Table 2 of the Flood Risk and Coastal Change Guidance [3], reproduced in Table 8, presents the flood zone definitions.

Table 8: Flood Risk and Coastal Change, Table 1

Flood Zone	Description
1	Low Probability. This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).
2	Medium Probability. This zone comprises land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% to 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% to 0.1%) in any year.
3a	High Probability. This zone comprises land assessed as having 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.
3b	The Functional Floodplain. This zone comprises land where water has to flow or be stored in times of flood. SFRA's should identify this Flood 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 EA, including water conveyance routes).

5.3 Flood Zone & Vulnerability Compatibility

The NPPF Sequential Test: Flood Risk Vulnerability and Flood Zone 'Compatibility' Table 3 is summarised below as Table 9.

Table 9: The Sequential Test: Flood Risk Vulnerability and Flood Zone 'Compatibility' Table as specified by NPPF.

	Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
Flood Zone 1	Appropriate	Appropriate	**Appropriate**	Appropriate	Appropriate
Flood Zone 2	Appropriate	Exception Test Required	Appropriate	Appropriate	Appropriate
Flood Zone 3a	Exception Test Required	Not Appropriate	Exception Test Required	Appropriate	Appropriate
Flood Zone 3b (Functional Floodplain)	Exception Test Required	Not Appropriate	Not Appropriate	Not Appropriate	Appropriate

Given the Application Site is located within Flood Zone 1 and the Development Proposals are for More vulnerable development, under the NPPF, the Development Proposals are considered appropriate and do not require Exception Testing or Sequential Testing.

6 Flood Risk: Historic Records

6.1 Assessment Methodology

In order to assess if the site has previously been affected by flooding, the following data sources have been inspected:

- Environment Agency Historic Flood Maps
- Environment Agency Recorded Flood Outlines
- Strategic Flood Risk Assessment.

If these sources of data do not return any records of flooding, it is concluded that the site has not been recorded as having flooded.

6.2 Environment Agency Recorded Flooding

The Environment Agency publishes records of historic flooding[2], and this data has been reviewed. The Historic mapping (Figure 9) indicates that the site has not been affected by historical flooding. Data provided by the Environment Agency shows historic flood outlines for the East Coast Tidal Event 5th December 2013, which took place within 500m of the site.

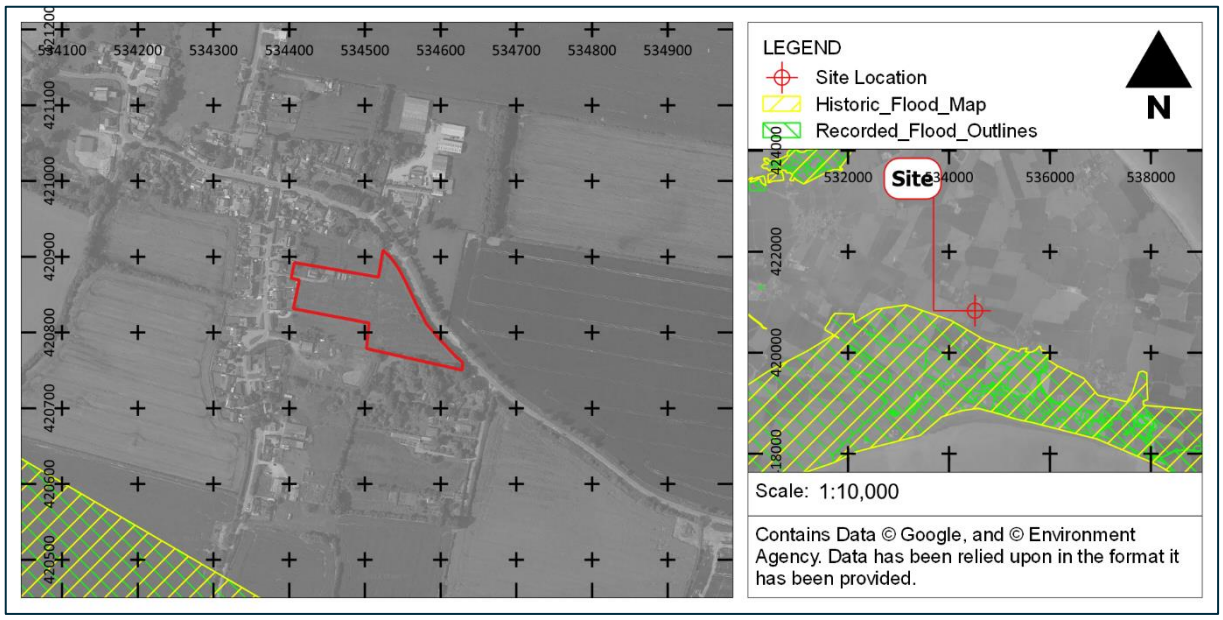

Figure 9: EA Historic and Recorded Flood Outlines

6.3 Public Sewer Authority Recorded Flooding

The Strategic Flood Risk Assessment collects information regarding Historic Flooding from the sewer network. The local sewer authority is Yorkshire water. The East Riding of Yorkshire Strategic Flood Risk Assessment (2019) does not identify that sewer flooding has taken place within Welwick, the nearest town to the Application Site. Furthermore, the Application Site is located on agricultural land, so it is considered unlikely that it would've been affected by sewer flooding in the past.

[2] *Historic Flood Map - data.gov.uk*

7 Flood Risk: Tidal Flooding

7.1 Tidal Flooding Definition

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

7.2 Assessment Methodology

The Environment Agency's Flood Map for Planning (Figure 8) has been assessed, to understand whether the Application Site is in an area at risk of tidal flooding.

7.3 Baseline Tidal Flood Risk

The Application Site is in Flood Zone 1 and is located approximately 3.4km inland from the nearest part of the coastline. The Environment Agency's flood level information has not been provided, as the Application Site is located in Flood Zone 1. The Application Site is located in close proximity to Welwick Drain, which is considered to be a tidal, due to its proximity to the coast.

A comparison of ground levels has been undertaken between ground levels at the Application Site and along the banks of Welwick Drain, to determine whether the Application Site is located above potential flood extents.

The average ground levels are approximately 11.4m AOD on site and 7.8 mAOD along the river-bank . This displays that the site is located above the floodplain and therefore is considered to be above potential flood extents. Subsequently, the Application Site is considered to be at low risk from tidal flooding.

7.4 With Climate Change Tidal Flood Risk

Climate change is expected to raise sea levels and increase tidal flooding in the future. The surrounding area and site could be at increased risk from tidal flooding in the future due to the impacts of climate change.

By application of the Environment Agency's climate change allowances, the predicted future tidal flood level can be calculated, as summarised in Table 10. The Environment Agency's Coastal Design Sea Levels have been used for this analysis.

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

Future Tidal Flood Risk	1 in 200 RP (Medium Risk	1 in 1,000 RP (Low Risk)
Coastal Design Sea Level	3.74 mAOD	3.92 mAOD
Future Design Sea Level (2072) Assume 50 year design life (2022-2072) – Higher central	4.13 mAOD	4.31mAOD
Future Design Sea level (2072) Assume 50 year design life (2022-2072) – Upper End	4.25 mAOD	4.43 mAOD
Average Ground Level at Site (LiDAR)	11.4 mAOD	
Predicted Flood Depth (no mitigation)	The site is situated above the future design sea level	The site is situated above the future design sea level.
At risk of tidal flooding?	No	No

The average ground level within the Application Site is topographically greater (by 6.11m) than the predicted future 1 in 200 year tidal event with the Climate Change allowance up until 2125. Therefore, the Application Site is at Very Low Risk of tidal flooding

7.5 Mitigation Measures

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

7.6 Residual Risk of Tidal Flooding

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

7.7 Assessed Tidal Flood Risk

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

8 Flood Risk: Fluvial Flooding

8.1 Fluvial Flooding Definition

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

8.2 Assessment Methodology

The Environment Agency's Flood Map for Planning (see Figure 8) has been assessed, to understand whether the Application Site is in an area at risk of fluvial or tidal flooding.

8.3 Baseline Fluvial Flood Risk

The Application Site is located in Flood Zone 1 according to the Environment Agency's Flood Map for Planning. Furthermore, it is considered that the dominant flood risk to the surrounding area is tidal, due to the proximity of the site to the coastline (approximately 3.4 km). The Environment Agency's flood level information has not been provided as the site is located in Flood Zone 1. Subsequently, the Application Site is considered to be at low risk of flooding from fluvial sources.

8.4 Post Development Fluvial Flood Risk

Post development, the fluvial flood risk is considered to be low risk, as the Application Site is located in Flood Zone 1 and the ground level on site is situated above potential flood extents.

8.5 With Climate Change Fluvial Flood Risk

Climate change is expected to increase fluvial flood risk as river levels raise. The surrounding area could be affected by flooding in the future. As the site is located in Flood Zone 1, the overall climate change fluvial flood risk is considered to be low risk.

8.6 Mitigation Measures

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

8.7 Residual Risk of Fluvial Flooding

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

8.8 Assessed Fluvial Flood Risk

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

9 Flood Risk: Surface Water Flooding

9.1 Surface Water Flooding Definition

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

9.2 Assessment Methodology

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

9.3 Baseline Surface Water Flood Risk

Data provided by the Environment Agency has been used to assess the surface water flood risk to the Application Site.

The Application Site is not at risk from flooding in the modelled 1:30 year (see Figure 10) or 1:100 year (see Figure 11) surface water flood events.

The Development Proposals are at risk from surface water flooding in a 1:1000 year (see Figure 12) surface water flood event. A small section of the centre of the site could experience flood depths up to 300mm. Data provided by the Environment Agency shows that there is a surface water flow path which runs through the centre of the site.

From reviewing the topography of the Application Site and based on information from the client, it is understood that there is an existing ditch to the south of the site. There is also a 10 inch pipe passing through the centre of the site, which connects to the existing ditch, as well as an existing pond on site. This is discussed further in Section 14 – Surface Water Drainage Strategy.

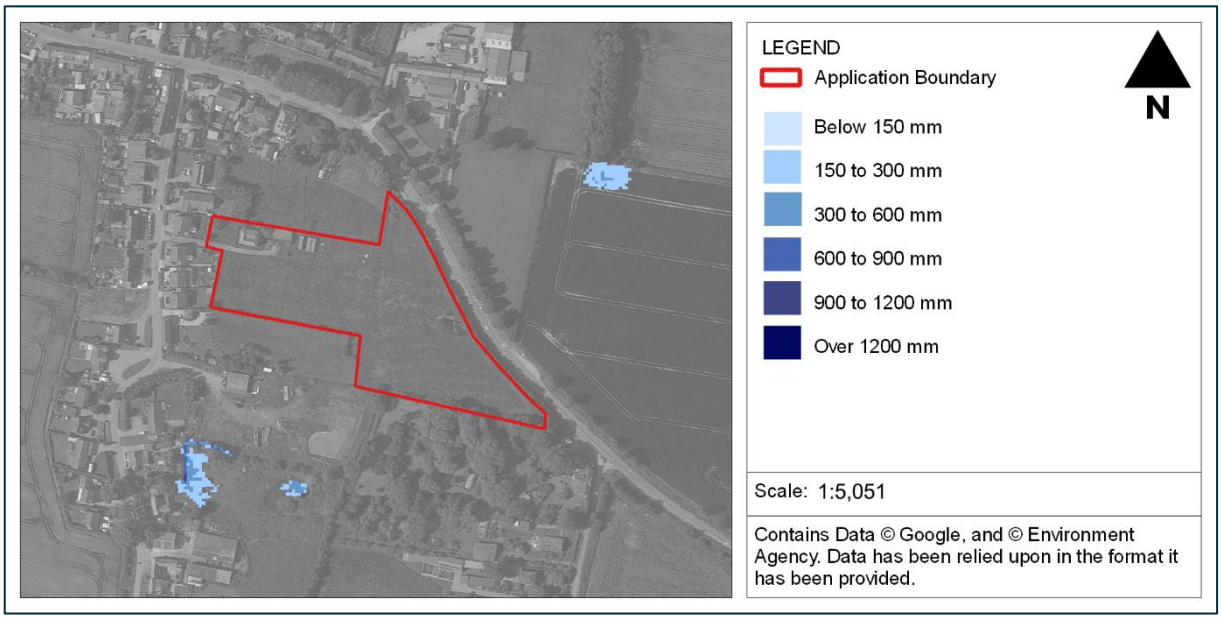

Figure 10: 1:30 Year Surface Water Flood Event

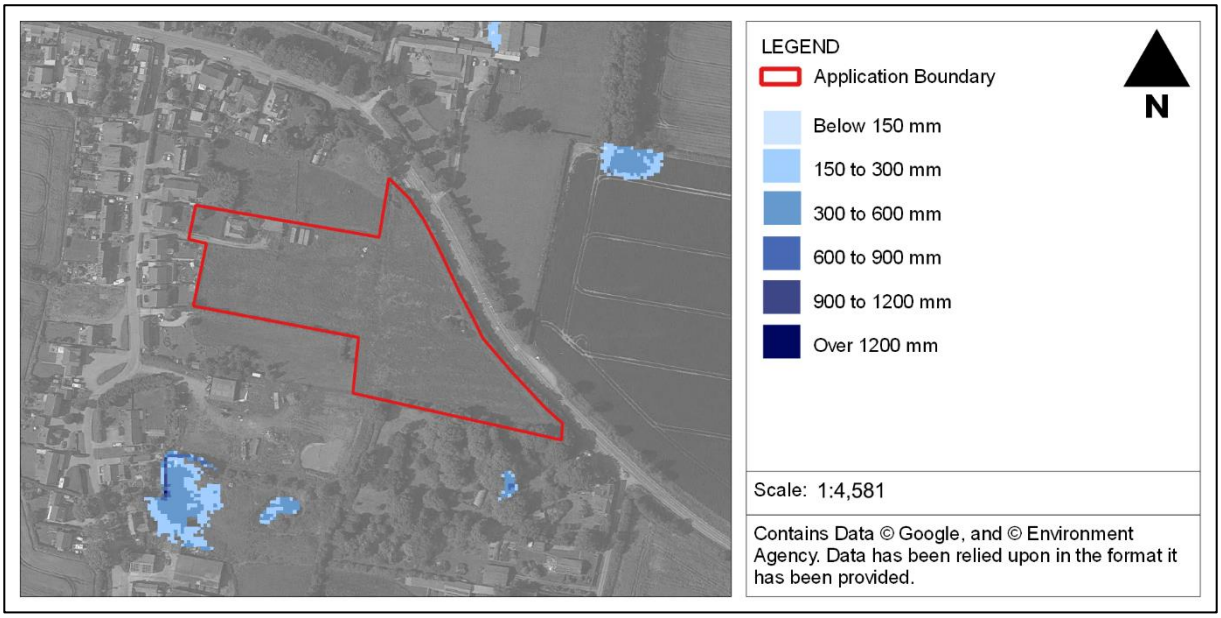

Figure 11: 1:100 Surface Water Flood Event

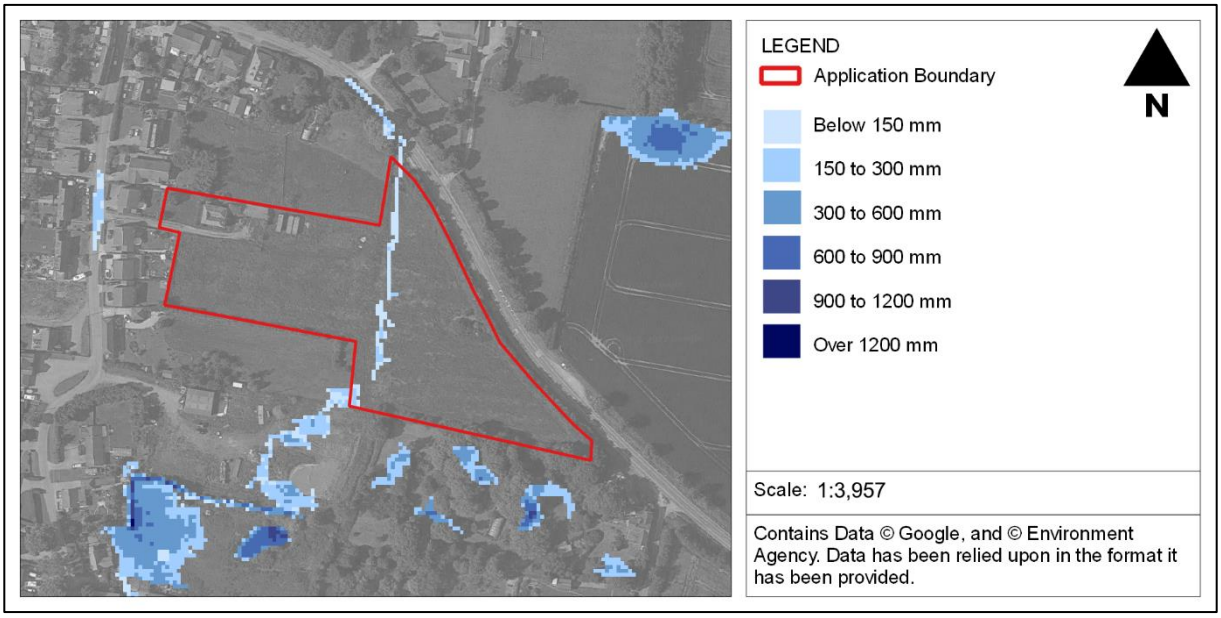

Figure 12: 1:1,000 Surface Water Flood Event

9.4 Post Development Surface Water Flood Risk

The Development Proposals will alter the ability of surface water runoff to drain on site, due to the addition of hard surfaces from the proposed car parking area and building facilities. Therefore, surface water runoff will need to be managed on site. The proposed drainage strategy is discussed in Section 13 and will minimise the impact of the Development Proposals on surface water flood risk to both the site and surrounding area.

Furthermore, it is recommended that tents are located outside of the flow path passing through the centre of the site shown in Figure 12.

9.5 With Climate Change Surface Water Flood Risk

Climate change is expected to increase surface water flood risk as storm intensities and rainfall patterns increase. There is a risk that the Development Proposals could be at increased risk of surface water flooding in the future due to climate change. The surface water drainage strategy will be designed for a 1:100 + 40% rainfall event and will therefore aim to mitigate against climate change surface water flood risk.

9.6 Mitigation Measures

As the Application Site is identified as being at low risk of surface water flooding, no specific mitigation measures are considered necessary, in addition to the proposed drainage strategy.

9.7 Residual Risk of Surface Water Flooding

As the Application Site is identified as being at low risk of surface water flooding and taking into the account the surface water drainage strategy (see section 17) the residual flood risk is Low.

9.8 Assessed Surface Water Flood Risk

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

10 Flood Risk: Groundwater Flooding

10.1 Groundwater Flooding Definition

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

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

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

10.2 Assessment Methodology

The British Geological Survey's Susceptibility to Groundwater Flooding datasets have been used to assess the groundwater flood risk posed to the Application Site, under the following categories:

- Unaffected by groundwater flood risk;
- Limited potential for groundwater flooding to occur (Low risk);
- Potential for groundwater flooding of property situated below ground level (Medium risk);
- Potential for groundwater flooding to occur at surface (High risk);

10.3 Baseline Groundwater Flood Risk

Using data provided by the British Geological Survey, the Application Site is located in an area with *'limited potential for groundwater flooding to occur'* (**Error! Reference source not found.**). Subsequently, it can be considered that the Development Proposals are at low risk from groundwater flooding.

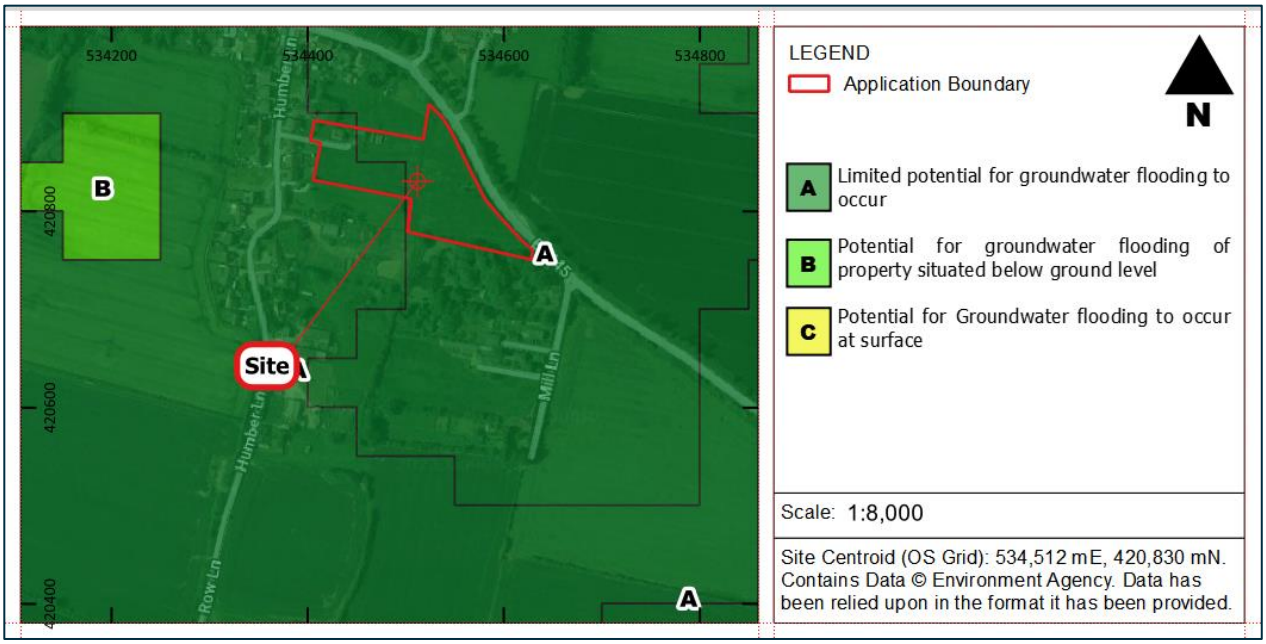

Figure 13: British Geological Survey Groundwater Susceptibility Map

The East Riding of Yorkshire Council SFRA (2019) have provided a flood map for the local area (Figure 14). The data provided shows that the Application Site is located in an area identified as having no risk and less than <25% susceptible to groundwater flooding. Therefore, the Application Site can be considered to be at low risk from groundwater flooding.

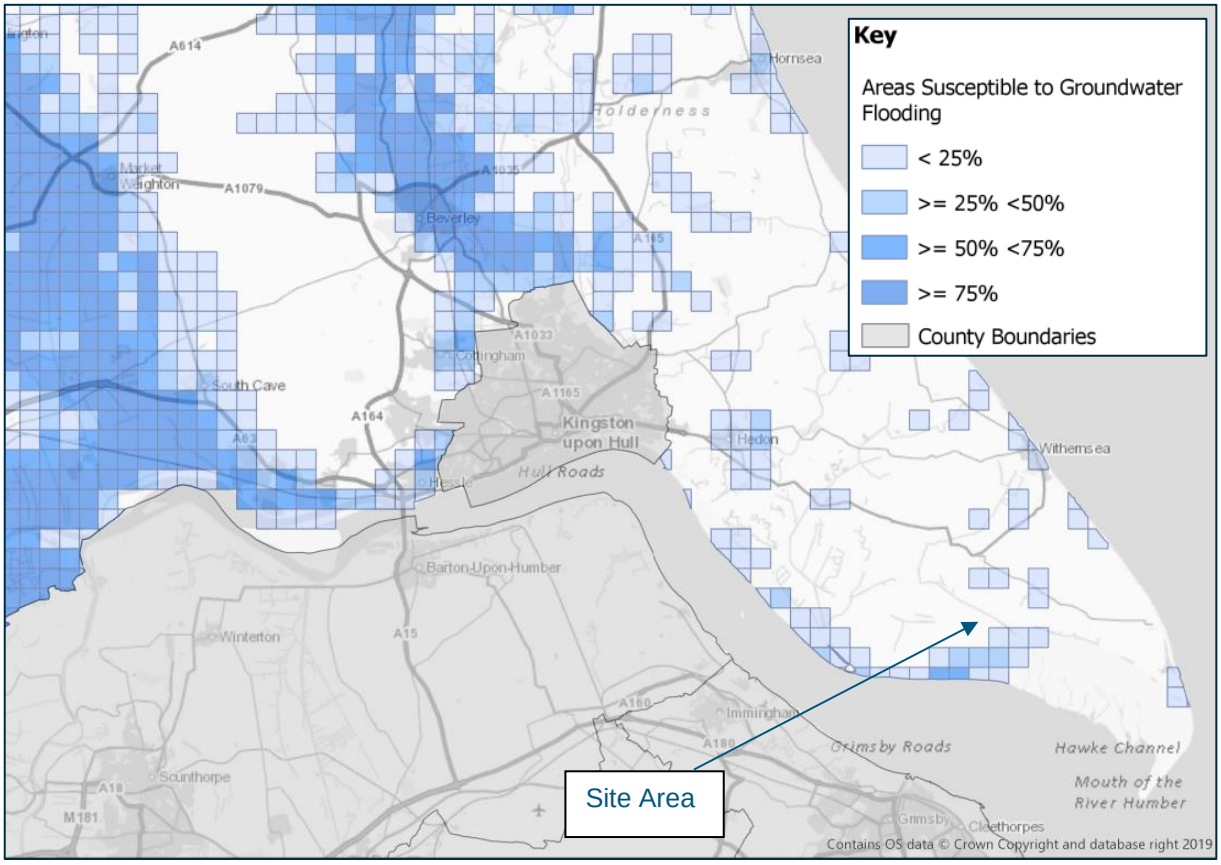

Figure 14 East Riding of Yorkshire SFRA Groundwater Susceptibility Map

10.4 Post Development Groundwater Flood Risk

If earthworks are required on site, it is recommended that onsite intrusive testing is undertaken to verify that the finished ground level (or base of construction depth) is raised sufficiently above groundwater resources.

10.5 With Climate Change Groundwater Flood Risk

According to the UK Groundwater Forum[3], the effects of the predicted impacts of climate change may include:

- a long term decline in groundwater storage
- increased frequency and severity of groundwater droughts
- increased frequency and severity of groundwater-related floods

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

- mobilisation of pollutants due to seasonally high water tables
- saline intrusion in coastal aquifers, due to sea level rise and resource reduction

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

10.6 Mitigation Measures

As the Application Site is identified as being at low risk of groundwater flooding, no specific mitigation measures are considered necessary.

10.7 Residual Risk of Groundwater Flooding

As the Application Site is identified as being at low risk of groundwater flooding, the residual flood risk is Low.

10.8 Assessed Groundwater Flood Risk

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

11 Flood Risk: Sewer Flooding

11.1 Sewer Flooding Definition

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

11.2 Assessment Methodology

The East Riding of Yorkshire SFRA states:

New sewer systems are typically designed to accommodate the 3.3% AEP storm with flooding at the ground surface in accordance with sewers for adoption. However, many of the existing sewers were not built for this specification. These sewers can become overloaded as new development adds to the load on the network.

Even where sewers are built to the current specification, they may become overwhelmed by events with a higher magnitude. Sewer flooding can also be caused due to blockages, collapses of equipment (e.g. pumping station) failure.

Many of the systems in East Riding were constructed prior to the introduction of the now required design standard of 3.3% AEP (1 in 30 years). The limitations of the East Riding sewer system were highlighted in 2007, when the existing drainage structure and public sewers were overwhelmed by the prolonged and heavy rainfall. However, since then, Yorkshire Water have undertaken work to update and improve the sewer system in East Riding.

The SFRA further highlights that the many sewer systems within East Riding have been overwhelmed and reached full capacity during previous flood events. The East Riding SFRA has not identified if the site has been affected by sewer flooding in the past.

11.3 Baseline Sewer Flood Risk

The East Riding of Yorkshire SFRA does not identify that sewer flooding has taken place within Welwick and as the site is located on agricultural land, the overall sewer risk is considered to be low.

11.4 Post Development Sewer Flood Risk

The proposed foul drainage strategy for the Development Proposals is discussed in Section 14 of this report. This is summarised below:

- It is recommended that any private existing drains are surveyed by CCTV and, if possible, reused in the drainage scheme of the proposed development.
- It is considered unlikely that a gravity discharge solution for the entire development would be feasible.
- It is recommended that a new foul water network and wastewater treatment system is provided to discharge treated wastewater to the piped watercourse within the site's boundaries.
- The wastewater treatment system (Kingspan Biodisk or similar device) should be sized to the maximum anticipated population size of each type of structure/region and residential or commercial treatment systems be installed for each particular use case.

- Treated wastewater discharges to watercourses or ditches are subject to approval by the Local Authority and EA.

11.5 With Climate Change Sewer Flood Risk

Climate change is expected to increase sewer flooding as drainage capacity are exceeded, however as the site is located on agricultural land, the sewer flood risk is considered to be low.

11.6 Mitigation Measures

To minimise the potential for sewer flooding, foul and surface water sewer systems should be kept separate, and non-return valves or similar protection measures should be installed to prevent the public sewers from surcharging into the lateral drains serving properties.

Where possible, the finished floor levels of new buildings should be set at least 150mm above the surrounding ground level, and landscaping and ground levels should be designed to fall away from buildings, other points of access.

11.7 Residual Risk of Sewer Flooding

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

11.8 Assessed Sewer Flood Risk

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

12 Residual Flood Risk

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

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

12.1 Flood Defence Breach

The Application Site is not in an area that benefits from flood defences according to the EA Flood Map for Planning, as shown in Figure *15* below. Therefore, the Site is not at residual risk of a flood defence breach and no specific mitigation measures are required.

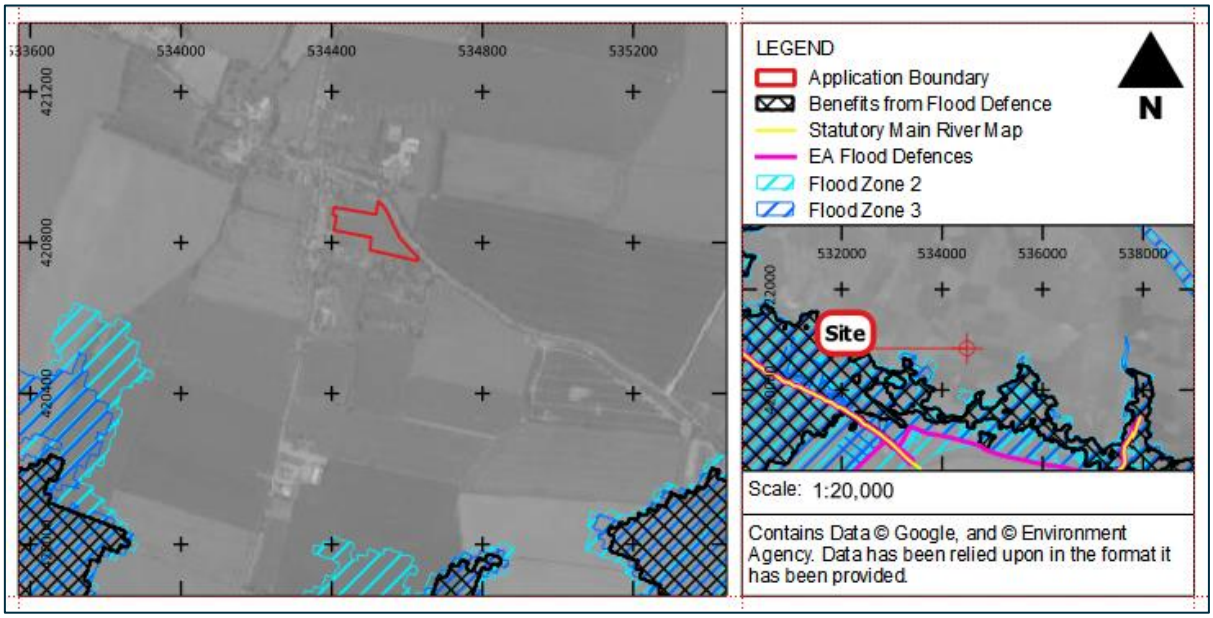

Figure 15*: EA Flood Map for Planning - Flood Defences*

12.2 Reservoir Failure

The EA Risk from Reservoir Map (Figure 16) demonstrates that the Application Site is outside of the predicted flood extents in the event of reservoir flooding. Therefore, the Site is not at risk of reservoir flooding, and no specific mitigation measures are required.

Figure 16: Environment Agency, Risk of Reservoir Flooding

12.3 Canal Failure

Canal Failure could result in flooding if a section of raised canal, either on an embankment or on a viaduct was to fail. As the Application Site is not within 1km of a raised canal, it is considered that the residual risk of canal flooding is low.

13 Surface Water Drainage Strategy

13.1 Introduction

A key component of the Flood Risk provisions of the NPPF are the requirements that proposals do not increase the risk of flooding to others. Where development proposals increase the amount of hardstanding (roofs, roads, car parks, service yards, etc.), the amount of rainfall that is converted to surface water flow is greater than that which would have been generated as a result of the rain falling on an area of open land. The cumulative impact of creating more hardstanding areas within a catchment can therefore result in more surface water within the drainage system, which can contribute to local flooding. In this case, the focus will be to provide mitigation (surface water storage) to offset the predicted increases in rainfall as a result of climate change and to reduce the risk of surface water flooding to the site and the surrounding area.

A central component of the Surface Water Drainage Strategy (SWDS) is to demonstrate how the increases in impermeable surfaces and the associated increases in surface water run-off will be mitigated. Fundamentally, the SWDS needs to demonstrate that:

- The total rate of surface water discharged from the site will not be greater post development than it was predevelopment; and,
- The water quality discharged from the site will not be polluted, by particles and other material mobilised from the ground surfaces as a result of rainfall events.

The above objectives are achieved through the provision of surface water storage (attenuation) and the provision of Sustainable Drainage Systems (SuDS).

SuDS components should be designed to accommodate and dispose of runoff from storms, without causing flooding to properties up to and including the 1:100 year, including an allowance for the current predicted impacts of climate change which increase peak rainfall intensities by 40% (Upper End allowance in 100 year RP 2070s epoch for the Hull and East Riding management catchment, where the site is located).

Under the requirements of the non-statutory technical standards for SuDS, practicable peak surface water discharge rates should be limited to as close to the pre-development (greenfield) surface water run-off rate as possible.

The Development should utilise sustainable drainage systems unless there are practical reasons for not doing so and should aim to provide betterment and ensure that surface water run-off is managed as close to its source as possible. Drainage should be designed and implemented in ways that deliver other policy objectives of this Plan, including water use efficiency and quality, biodiversity, amenity and recreation.

As DEFRA Report ‘Rainfall runoff management for Developments’ recommends the design principle is to limit the runoff for events of similar frequency of occurrence to the same peak rate of run off as that which takes place from greenfield sites. However, there are two situations where the greenfield flow rate is not actually applied to define the limiting discharge rates:

a) The limit of discharges based on QBAR that are less than 1 l/s/ha for permeable sites as this is seen as being an unreasonable requirement (producing very large storage volumes). QBAR is then set to 1 l/s/ha;

b) Small sites would require impractically small controls to achieve the required flow rates where these are calculated to be less than 5 l/s.

In order to limit flows to as close as possible to the respective Greenfield runoff rates, the use of orifice plates is recommended. Sub-chapter 20.5 section c) of The SuDS Manual (C753) specifies that the minimum diameter outflow control for orifice plates for permeable pavements can be 20mm – due to the runoff flowing through a 6-20mm clean crushed stone aggregate (CCA) trapping all objects greater than

20mm in diameter. The orifice plates should also be provided with a filter mesh and the manhole access cover sealed.

The non-statutory technical guidance for SuDS identifies that an allowance for urban creep (10% increase in area), should be allowed for, to accommodate future increases in hardstanding over the development lifetime.

13.2 Existing Drainage Infrastructure and Watercourses

Based on the CEH Rivers data, it is considered that there is an extensive network of drains and drainage infrastructure in the areas surrounding the Application Site. These are likely to be IDB drains. Based on information provided by the client and topographic data, there is an existing ditch to the north and south of the Application Site. According to the client, the ditches are linked by a 10 inch pipe, as shown on the proposed drainage layout in Appendix D.

The existing pipe will be surveyed at the detailed design stage to determine the exact depth and condition of the pipe to inform if repair/replacement is needed and the construction design process.

According to the sewer asset plan provided by Yorkshire Water, a combined sewer is located in Humber Lane (road to the west of the site) and at the junction of Mill Lane and Main Street.

It is assumed that private foul water sewers are present near the existing houses. It is recommended that the existing foul connections are surveyed by CCTV and, if possible, reused in the foul water drainage scheme of the proposed development - if gravity discharge of treated wastewater to the watercourse is not feasible.

All discharges to the sewers or watercourse must be approved by the Local Authority and EA prior to commencement of construction works on site.

13.3 Geology and Infiltration Potential

According to the BGS online service mapping, the bedrock underlying the site is Flamborough Chalk Formation - Chalk. The superficial deposits have been recorded on the BGS maps as Till, Devensian - Diamicton.

Nearby borehole data on the BGS online mapping indicates the presence of blue clay in the superficial geology.

Given the potential clay and silt texture of the superficial geology at the site, presence of watercourses in the wider area, infiltration SuDS solutions are not deemed feasible as a method of surface water discharge for the proposed development. However, it is recommended to provide permeable geotextiles to the proposed SuDS devices to promote groundwater recharge and vegetation growth.

13.4 Assessment of surface water disposal point

The management of surface water has been considered in respect to the SuDS hierarchy in Table 11, as detailed in Building Regulations Part H and within the CIRIA 753 ‘The SUDS Manual’, Section 3.2.3.

Based on the analysis of the site constraints, it is proposed to discharge surface water runoff generated at the site to the existing pipe crossing the site (details to be confirmed at the detailed design stage). Discharges subject to Local Planning Authority (LPA) and Environment Agency (EA) approval prior to commencement of construction works.

Table 11: CIRIA 753 Table 2, The SuDS Hierarchy (adapted)

Hierarchy (most preferred first)	Suitable?	Comment

1. Store rainwater for later use	Yes	Rainwater harvesting should be considered by the developer and should be used around the site where feasible. Harvested rainwater is not normally accepted to provide large scale storage during specific rainfall events.
2. Discharge to the Ground (Infiltration)	No	Given the potential clay and silt texture of the superficial geology at the site, presence of watercourses in the wider area, infiltration SuDS solutions are not deemed feasible as a method of surface water discharge for the proposed development.
3. Discharge to Surface Water (lake, watercourse, canal, etc.)	Yes	It is recommended that runoff is discharged to the pipe crossing the site (details TBC at the detailed design stage). Discharges subject to LPA and EA approval prior to commencement of construction works.
4. Discharge to Surface Water Sewer, Highway Drain or another Drainage System	No	Discharges to existing pipe takes precedence.
5. Discharge to Combined Sewer		
6. Discharge to Foul Sewer		

13.5 SuDS Selection

The suitability of SuDS components has been assessed (based on Table 12 below) to determine which methods are appropriate to be used within the proposed development.

Table 12: SuDS Selection Matrix

SuDS Component	Description	Constraints and Opportunities	Suitable?
1. Infiltrating SuDS	Infiltration can contribute to reducing runoff rates and volumes while supporting baseflow and groundwater recharge processes. The suitability and infiltration rate depends on the permeability of the surrounding soils.	Given the potential clay and silt texture of the superficial geology at the site, presence of watercourses in the wider area, infiltration SuDS solutions are not deemed feasible as a method of surface water discharge for the proposed development.	No
2. Filter Drains and Filter Strips	Filter drains are shallow trenches filled with stone, gravel that create temporary subsurface storage for the attenuation, conveyance and filtration of surface water runoff. Filter strips are uniformly graded and gently sloping strips of grass or dense vegetation, designed to treat runoff from adjacent impermeable areas by promoting sedimentation, filtration and infiltration.	These are likely to be the most practicable method of draining the proposals.	Yes
3. Permeable Pavement	Pervious surfaces can be used in combination with aggregate sub-base and/or geocellular/modular storage to attenuate and/or infiltrate runoff from surrounding surfaces and roofs. Liners can be used where ground conditions are not suitable for infiltration.	Permeable paving should be provided within suitable hardstanding areas. A clear zone for the provision of utility services should be allowed for outside of the permeable paving. Furthermore, infiltrating paving should be located at least 1.5 m away from proposed and existing building.	Yes
4. Green & Blue Roofs	Green Roofs provide areas of visual benefit, ecological value, enhanced building performance and the reduction of surface water runoff. They are generally more costly to install and maintain than conventional roofs but can	The volume of surface water attenuation achieved by green roofs is limited.	No

SuDS Component	Description	Constraints and Opportunities	Suitable?
	provide many long-term benefits and reduce the on-site storage volumes.		
5. Rainwater Harvesting	Rainwater Harvesting is the collection of rainwater runoff for use. It can be collected form roofs or other impermeable area, stored, treated (where required) and then used as a supply of water for domestic, commercial and industrial properties.	As the volume within a Rain Water Harvesting system does not contribute to the overall attenuation, these systems have not been considered further here. However, opportunities during detailed design should be considered This could be through the provision of water butts.	Yes
6. Swales	Swales are designed to convey, treat and attenuate surface water runoff and provide aesthetic and biodiversity benefits. They can replace conventional pipework as a means of conveying runoff, however space constraints of some sites can make it difficult incorporating them into the design.	Not considered suitable to the site.	No
7. Rills and Channels	Rills and Channels keep runoff on the surface and convey runoff along the surface to downstream SuDS components. They can be incorporated into the design to provide a visually appealing method of conveyance, they also provide effectiveness in pre-treatment removal of silts.		No
8. Bioretention Systems	Bioretention systems can reduce runoff rates and volumes and treat pollution through the use of engineer soils and vegetation. They are particularly effective in delivering interception, but can also be an attractive landscape feature whilst providing habitat and biodiversity.		No
9. Retention Ponds and Wetlands	Ponds and Wetlands are features with a permanent pool of water that provide both attenuation and treatment of surface water runoff. They enhance treatment processes and have great amenity and biodiversity benefits. Often a flow control system at the outfall controls the rates of discharge for a range of water levels during storm events.		No
10. Detention Basins	Detention Basins are landscaped depressions that are usually dry except during and immediately following storm events and can be used as a recreational or other amenity facility. They generally appropriate to manage high volumes of surface water from larger sites such as a neighbourhoods.		No
11. Geocellular Systems	Attenuation storage tanks are used to create a below-ground void space for the temporary storage of surface water before infiltration, controlled release or use. The inherent flexibility in size and shape means they can be tailored to suit	If necessary, these could be provided to complement the other SuDS solutions.	Yes

SuDS Component	Description	Constraints and Opportunities	Suitable?
	the specific characteristics and requirements of any site.		
12. Proprietary Treatment Systems	Proprietary treatment systems are manufactured products that remove specific pollutants from surface water runoff. They are especially useful where site constraints preclude the use of other methods and can be useful in reducing the maintenance requirements of downstream SuDS.	If necessary, these could be provided to complement the other SuDS solutions.	Yes

(Numbered with lowest number representing the most sustainable approach)

Several SuDS components are deemed appropriate to be used in the following SuDS management train. It is recommended to include **Permeable Paving and Filter Drains** as the main SuDS components to manage surface water, as these features will filter runoff as well as provide attenuation volume prior to discharge.

13.5.1 Permeable Paving

Permeable paving is efficient in intercepting debris, hydrocarbons and silt. Unlike other attenuation systems, the pollutants carried within the surface water run-off are filtered out as they pass through the course grade aggregate and sub-base. Once trapped, they are then broken down over time; figures from the Construction Industry Research and Information Association have shown that 60-95% of suspended solids and 70-90% of hydrocarbons are removed by permeable pavements; as such, no further filtration of pollutants will be required. The permeable paving can be lined to provide attenuation volume within the sub-base, or unlined to allow infiltration to the ground beneath.

Depending on the permeability rates of the site various permeable paving may be used to provide full, partial or no infiltration. It is proposed to provide Type B – Permeable Paving with partial infiltration to the subgrade (unaccounted in calculations) prior to discharge to the existing pipe on site. The permeable paving is generally formed by the following layers:

- Permeable Concrete blocks.
- Laying Course Material.
- Geotextile filter.
- Sub-Base: 6-20mm Clean Crushed Stone (600mm depth).
- Geotextile filter.

13.5.2 Filter Drains

Filter drains are gravel filled trenches used primarily for runoff interception, treatment and conveyance. Attenuation storage is rarely used in typical filter drains as the gravel infilling significantly reduces the usable storage of the device. The treatment level offered by this SuDS device is adequate for oils and hard metals however less efficient for fine particles.

13.5.3 Proprietary Treatment Systems

It is suggested to provide silt traps in the manholes downstream of RWPs to reduce the amount of siltation within the SuDS components downstream. Guidance about proper use, installation and maintenance of any proprietary system must be provided by the supplier and incorporated into the site proposals at detailed design stage.

13.6 Water Quality

In order to protect the downstream receiving water body, a key element of SuDS is that they have the potential to improve the quality of surface water discharged from a site. To assess this the "Pollution hazard indices for different land use classifications", provided in the CIRIA SuDS Manual (C753) as Table 26.2 has been reviewed. The indices use four different methods of assessing pollution potential based on the hazard level, total suspended solids (TSS), metals, and Hydro-Carbons.

Adequate treatment must be delivered to the water runoff to remove pollutants through SuDS devices, which are able to provide pollution mitigation. Pollution Hazards and the SuDS Mitigation have been indexed in the CIRIA 753 'The SUDS Manual'.

The Pollution Hazard Indices are summarised in Table 13 (reference: Table 26.3.CIRIA SuDS Manual 2015)

Table 13: Summary of Pollution hazard Indices for different Land Use.

Land Use	Pollution Hazard Level	Total suspended Solids (TSS)	Metals	Hydrocarbons
Other roofs (typically commercial/ industrial roofs)	Low	0.3	0.2	0.05
Commercial car parking and delivery areas	Medium	0.7	0.6	0.7
Standard to be achieved	Medium	1.0	0.8	0.75

From review of the available SuDS which could be implemented, Table 14 assess the potential water quality index score against the most appropriate methods.

The water treatment provided by the permeable paving and filter drains would be enough to remove the pollutants.

The treatment performance of any bespoke devices to be confirmed with the manufacturers and the Local Authority prior to installation.

Table 14: Cumulative Score for Proposed SuDS Management Train

Land Use	Treatment Stage	Total suspended Solids (TSS)	Metals	Hydrocarbons
Permeable Pavement	Primary	0.70	0.60	0.70
Filter Drain	Secondary	0.40	0.40	0.40
Total Provision		1.10	1.00	1.10
Adequate Provision		Yes	Yes	Yes

13.7 Limiting Surface Water Discharge Rate

In accordance with the DEFRA Report 'Rainfall runoff management for Developments', it is proposed to limit the surface water discharge from the site to as close as practicable to the QBAR rate. Calculations of the surface water flow rate are presented in Appendix C and have been undertaken using the WINDES Micro Drainage software.

Based on the plans provided by the client, the proposed impermeable area (0.71 ha) is associated with a Greenfield Runoff Rate (Q_{BAR}) of 2.9 l/s during the 1 in 100 year +40% climate change event. Other results factored for each return period and area of the site are shown in Appendix C.

According to calculations, an attenuation volume of 464.1 m^3 would be required during the 1 in 100 year + 40%CC storm event with outflows limited to 2.9 l/s. It is recommended that this volume is provided in the permeable paving sub-base.

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13.8 Proposed Surface Water Drainage Strategy

The proposed development is for the change of use of land from agricultural to holiday use including erection of 6 'glamping/safari tents', a camping tent area, associated car park with overnight parking for vans/caravans, erection of a facilities building, and erection of a barn and stables.

The existing site is greenfield. Following development, the impermeable area would increase to approximately 0.71ha. The proposed impermeable area includes the fixed structures (ie parking, glamping tents, etc), hardstanding and half of general tent area, assuming maximum occupancy. See proposed plan in Appendix A.

The proposed drainage scheme is for the use of permeable paving, filter drains and an orifice plate flow control to manage runoff post-development. The hardstanding area near the stables was not included in the calculations due its high pollution/blockage risk associated with the activity.

The proposed permeable paving would be provided in the car parking and other hardstanding areas. The proposed permeably paved areas should be provided with a 0.6m deep sub-base (having 0.3 void ration minimum). The proposed filter drains would be located across the sides of the general tent area to intercept and convey flows to the flow control or permeable paving. The flow control would be fitted along the pipe linking the ditches to the north and south of the site and limit flows up to the respective Greenfield QBAR rate for all major rainfall events.

The SuDS system proposed for the new development adheres to the Council's requirement of demonstrating surface water control and attenuation storage on site, with the intention of mitigating the impact on the existing flooding regime.

Subject to final details and landscaping requirements, other SuDS devices should be further assessed at the detailed design stage.

The orifice flow control would consist of a 37mm diameter orifice plate, located at the invert level of the new manhole fitted on the existing 10 inch pipe. The orifice plates should be fitted with pre-screening meshes to reduce the risk of blockages.

Discharges to watercourses are subject to a land drainage approval with the Local Authority.

See more detailed information on the calculation results in Appendix C. Drawings of the proposed drainage strategy are provided in Appendix D.

The proposed SuDS devices, and contributing volumes are presented in Table 15, which demonstrates that a total provision of 464.1m^3, is technically achievable within the scheme, which exceeds the calculated requirement of 462m^3.

Table 15: Surface Water Attenuation Provision

SuDS Element	Footprint	Depth (m)	Void Ratio	Attenuation Volume (m3)
Permeable Pavement	400 (Access Road) 1,660 (Van Space) 220 (Hardstanding in Glamping Area)	0.65 0.65 0.65	30% 30% 30%	78 323.7 42.9
Filter Drain	100	0.65		19.5
			Total Provision	**464.1**

13.9 Maintenance

13.9.1 During Construction

The surface water runoff generated during construction has the potential to have higher concentrations of oils and sediments from heavy machinery and earthworks respectively. As such, it is necessary to devise appropriate surface water management plans tailored to specific construction activities and receptors of runoff. Specific considerations are:

- Provision of appropriate bunding / containment for potentially hazardous materials / chemicals;
- Re-fuelling of plant and equipment to take place only within designated areas, with suitable pollution containment;
- Good house-keeping on site to prevent accidental spillages, and spill kits to be provided as appropriate;
- Vehicle wash down areas / wheel cleaning to be located in areas with appropriate pollution control measures;
- If water/spray dust suppression is needed, the run-off should be directed to a temporary containment area, and should not be allowed to discharge to the borehole soakaways;
- The installed surface water drainage network should be routinely inspected during construction, especially the borehole soakaways; and,
- Suitable protection measures should be in place during construction to protect the watercourse and groundwater resources.

13.9.2 Spillage: Emergency Action

Most spillages on development sites are of compounds that do not pose a serious risk to the environment if they enter the drainage in a slow and controlled manner with time available for natural breakdown in a treatment system. Therefore, small spillages of oil, milk or other known organic substances should be removed where possible using soak mats as recommended by the Environment Agency with residual spillage allowed to bio-remediate in the drainage system.
In the event of a serious spillage, either by volume or of unknown or toxic compounds, then this should be isolated with soil, turf, or fabric and block outlet pipes from chamber(s) downstream of the spillage with a bung(s). (A bung for blocking pipes may be made by wrapping soil or turf in a plastic sheet or close woven fabric.) Contact the Environment Agency (0800 80 70 60) immediately.

13.9.3 Commissioning the Drainage System

A pre-occupation commissioning survey to confirm all elements of the surface water drainage system operate as per the design, should be undertaken. This survey should include a CCTV survey of all below ground drainage assets, if any defects are identified these should be rectified prior to use of the development.

13.9.4 Maintenance Schedule

A maintenance and adoption strategy for the site will need to be developed in conjunction with the site management, the Highway Authority, Public Sewer Authority and the LLFA.

A detailed adoption and maintenance strategy will need to be developed that details the ownership and responsibility of the proposed SuDS devices. As a minimum, the guidance provided in the CIRIA SuDS Manual should be considered in conjunction with the Local SuDS Guidance, and the requirements of the LLFA and the Highway Authority. A summary long-term maintenance schedule is presented as Table 16. This should be updated and expanded as part of the site wide maintenance documentation.

Table 16: Maintenance Schedule

Item	Visual Inspection	Cleanse / De-sludge	CCTV Survey	Comments
Permeable Block Paving	Yearly	'Swept' clean of debris every 2 years.	N/A	Lift blocks and remove sand bedding and replace and re-bed paving – refer to individual manufacturer's recommendations.
Orifice Plate	Every month for the first 3 months and every 6 months thereafter	As necessary & 1 year	10 years	Cleansing to be carried out as necessary and at least every year. Refer to manufacturer's recommendations.
Filter Drains and Filter Strips	Monthly	As required	N/A	Re-seeding / regrading and maintenance to be timed to minimise potential for ecological disruption. Re-seeding should take place in the spring outside of bird nesting season.
Proprietary Treatment Systems / Pumps	In accordance with manufacturer's warranty / recommendations			

13.9.5 Replacement of elements

Should replacement of any element be required this should be undertaken in accordance with the manufacturers specifications, and in a planned and controlled manor. **Working on live drainage systems can pose a health and safety hazard, and should only be undertaken by a competent contractor**.

13.10 Adoption & Ownership

As the SuDS infrastructure will be provided on private land, it is anticipated that a private maintenance contractor would be appointed to maintain the SuDS features. This will be subject to detailed design and further consultation with the LLFA and Public Sewer Authority as appropriate.

13.11 Drainage Exceedance

In the event of drainage system failure under extreme rainfall events or blockage, overland flow may occur within the site. In the event of the development's drainage system failure, the runoff flow will be dictated by topography on site. Indicative flow paths have been indicated on the drainage layout drawing in Appendix D.

14 Foul Water Strategy

It is recommended that any private existing drains are surveyed by CCTV and, if possible, reused in the drainage scheme of the proposed development. Based on the likely location of the existing drains and wider site levels, it is unlikely that a gravity discharge solution for the entire development would be feasible.

In absence of an existing viable foul water discharge system, it is suggested to provide a new foul water network and wastewater treatment system to discharge treated wastewater to the piped watercourse within the site's boundaries. See the proposed indicative foul water network layout in the drainage layout in Appendix D.

The wastewater treatment system (Kingspan Biodisk or similar device) should be sized to the maximum anticipated population size of each type of structure/region and residential or commercial treatment systems be installed for each particular use case.

Treated wastewater discharges to watercourses or ditches are subject to approval by the Local Authority and EA.

15 Recommendations

15.1 Flood Resilient Construction Techniques

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

15.1.1 Drainage

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

15.1.2 Surface Water Management Strategy

For details of the surface water management strategy for this site, please see Section 17 of this report.

15.2 Flood Warning & Emergency Plan

Given the low risk of fluvial, tidal, and surface waterflooding to the Application Site, a Flood Warning & Emergency Plan is not considered necessary to support the Development Proposals. The Application Site is not located in a flood warning area, as shown in Figure 17 below:

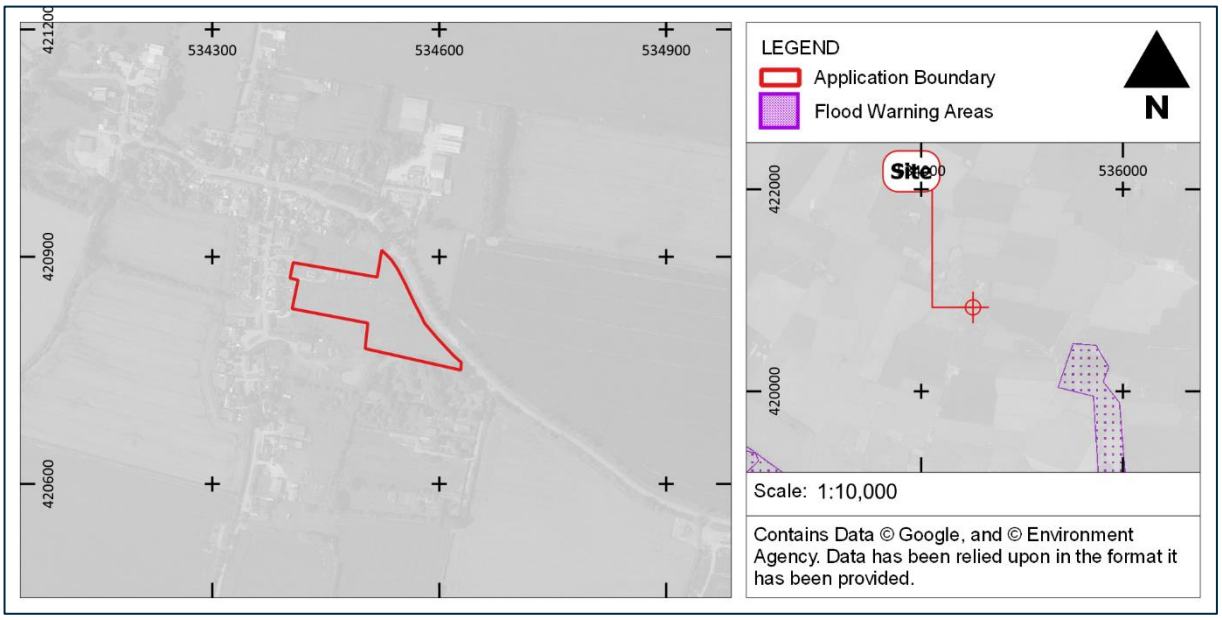

Figure 17 Environment Agency Flood Warning Area Map

15.3 Post Planning Consents

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

15.3.1 Development within 3m of a Public Sewer

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

15.3.2 Sewer Connection

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

16 Conclusions

Royal HaskoningDHV has been appointed by Anthony Booth, to undertake a National Planning Policy Framework (NPPF) [1] compliant Flood Risk Assessment (FRA), for the proposed development located at Land East and West of Grange Farm, Humber Lane, Welwick, East Riding of Yorkshire, HU12 0SA.

According to the Flood Risk and Coastal Change Planning Policy Guidance, the proposed would be classified as a Major Development.

According to Annex 3 of the NPPF, the proposed developments Vulnerability Classification is “More vulnerable”. Which consists of the following uses:

“Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.”

Overall, it can be concluded that the site is at low risk form tidal, fluvial, groundwater and surface water flooding.

A Surface Water Drainage Strategy will accompany the proposed development plans to mitigate against the risk of surface water flooding on site due to development.

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

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

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

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

A summary of the flood risk for the site for each source requiring consideration under the NPPF is presented as Table 1.

The Surface Water Drainage Strategy outlined as part of this Flood Risk Assessment, will reduce the peak rate of surface water discharge to a state that should not adversely impact third party properties.

The Flood Risk Assessment has been undertaken in accordance with the requirements of the NPPF, and it can be demonstrated that the development proposals are compatible with the predicted flood risk profile, including climate change allowance over the development lifetime.

It should be noted that the development proposals are not predicted to increase the risk of flooding to others over the development lifetime. Consequently, it is concluded that with regards to the Flood Risk requirements of the NPPF, the development proposals are acceptable.

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17 Glossary

Term	Definition
AEP	Annual Exceedance Probability is the probability of a rainfall or tidal event occurring within any one year. For example, an event of a 100 year return period has an AEP of 1:100 or 1%.
Courant Number	A function of the amount of fluid that crosses the cell in a given time-step. For 2d modelling the Courant Number generally needs to be less than 10 and typically around 5 or less for real-world applications.
Flood Defences	Artificial structures maintained to a set operational level designed to protect land people and property from Tidal and Fluvial flood sources to an established chance of happening in any year threshold.
Flood Source: Fluvial (River)	When flows within watercourses exceed the capacity of the watercourse causing out of bank flows.
Flood Source: Groundwater	Groundwater flooding is usually the result of prolonged wet weather causing groundwater levels to rise sufficiently to either emerge at surface or to cause flooding of below ground infrastructure, such as basements.
Flood Source: Pluvial	When rainfall causes overland flows which exceed the capacity of the drainage network, causing flooding to land that is normally dry.
Flood Source: Tidal	When high tide events overtop the shoreline to cause flooding to land behind.
Flood Zone 1	Low Probability. Land defined as having a less than 1:1000 annual probability of flooding from tidal and fluvial sources.
Flood Zone 2	Medium Probability. Land defined as having a risk of fluvial flooding between 1:100 annual probability and 1:1000 annual probability. Or Land defined as having a risk of tidal flooding between 1:200 annual probability and 1:1000 annual probability.
Flood Zone 3 (A)	High Probability. Land defined as having a fluvial risk of 1:100 annual probability or greater. Or a tidal risk of 1:200 annual probability or greater.
Flood Zone 3 (B)	Functional Floodplain. Defined by SFRA's as areas where floodwater is stored during lower AEP events, typically the 1:20 annual probability.
Flood Zone Map	The Environment Agency has produced a mapping data set which covers England and provides the general extents of Flood Zones 1, 2, and 3. However the national data set available online does not differentiate between Flood Zone 3 (A) and 3 (B).
Freeboard	In flood risk management Freeboard is a term used to identify the vertical difference between the design flood level, and the design height of any flood mitigation measures. For instance if a pond had bank heights of 9.0m and the water level was at 8.6m the freeboard would be 0.4m (9.0-8.6)
LiDAR	"Light Detection and Ranging (LIDAR) is an airborne mapping technique, which uses a laser to measure the distance between the aircraft and the ground. Up to 500,000 measurements per second are made of the ground, allowing highly detailed terrain models to be generated at spatial resolutions of between 25cm and 2 metres." EA LiDAR
Major Development	Means development involving any one or more of the following: a. the winning and working of minerals or the use of land for mineral-working deposits b. waste development c. the provision of dwellinghouses where – i. the number of dwellinghouses to be provided is 10 or more; or ii. the development is to be carried out on a site having an area of 0.5 hectares or more and is not known whether the development falls within sub-paragraph I(i) d. the provision of a building or buildings where the floor space to be created by the development is 1,000 square metres or more; or e. development carried out on a site having an area of 1 hectare or more.

Term	Definition
Main River	Defined on the Main River map and relate to rivers on which the Environment Agency have powers to carry out flood defence works.
Minor Development	Minor non-residential extensions: industrial/commercial/leisure etc extensions with a footprint less than 250 square metres. Alterations: development that does not increase the size of buildings eg alterations to external appearance. Householder development: For example; sheds, garages, games rooms etc within the curtilage of the existing dwelling, in addition to physical extensions to the existing dwelling itself. This definition excludes any proposed development that would create a separate dwelling within the curtilage of the existing dwelling eg subdivision of houses into flats. Paragraph: 046 Reference ID: 7-046-20140306, Revision date: 06 03 2014 https://www.gov.uk/guidance/flood-risk-and-coastal-change#minor-development-to-flood-risk
m AOD	Metres Above Ordnance Datum.
OS	Ordnance Survey
Ordinary Watercourse	A watercourse which does not form part of a Main River, works on Ordinary Watercourses usually require consent from either the Lead Local Flood Authority, or the Internal Drainage Board (where one exists).
Qbar	Qbar is the mean annual maximum flow rate, for a catchment which has an equivalent return period of 1 in 2.3 years
Return Period	The return period of a flood might be 100 years; otherwise expressed as its probability of occurring being 1 in 100, or 1% in any one year. If a flood with such a return period occurs, then this does not mean the next will occur in about one hundred years' time - instead, it means that, in any given year, there is a 1% chance that it will happen, regardless of when the last similar event was. Or, put differently, it is 10 times less likely to occur than a flood with a return period of 10 years (or a probability of 10%).
SuDS	Sustainable Drainage Systems, which are designed to manage surface water flows in order to mimic the Greenfield run-off from an undeveloped site.
Urban Creep	Urban creep is the conversion of permeable surfaces to impermeable over time e.g. surfacing of front gardens to provide additional parking spaces, extensions to existing buildings, creation of large patio areas.