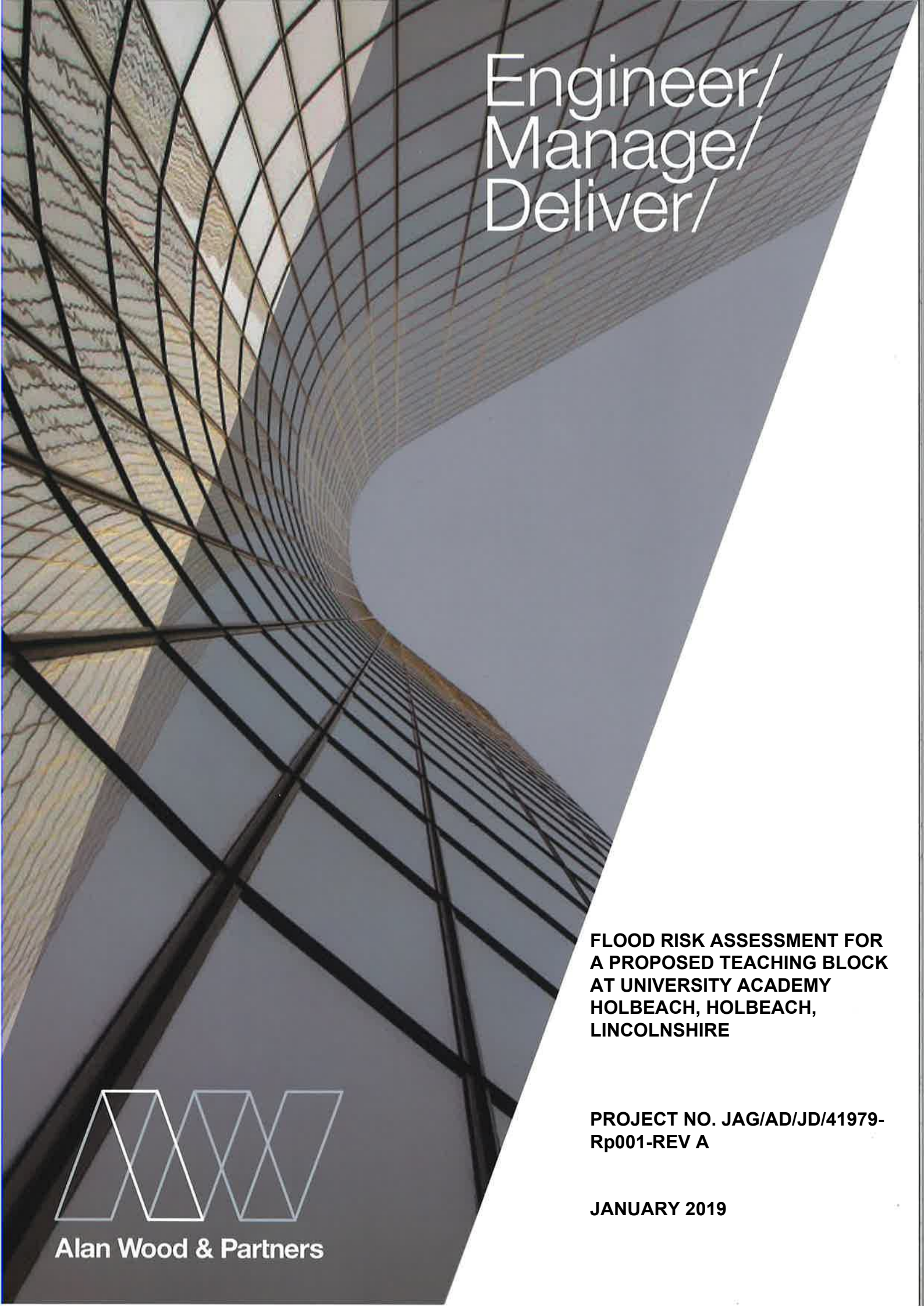




Engineer/ Manage/ Deliver/

**FLOOD RISK ASSESSMENT FOR
A PROPOSED TEACHING BLOCK
AT UNIVERSITY ACADEMY
HOLBEACH, HOLBEACH,
LINCOLNSHIRE**

**PROJECT NO. JAG/AD/JD/41979-
Rp001-REV A**

JANUARY 2019



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**FLOOD RISK ASSESSMENT FOR A PROPOSED TEACHING BLOCK AT
UNIVERSITY ACADEMY HOLBEACH, HOLBEACH, LINCOLNSHIRE**

Prepared by: A Dunn



Signed:

Date: 7th December 2018

Approved by: J Gibson, MEng (Hons), CEng, CWEM MCIWEM
Civil Engineering Director



Signed:

Date: 7th December 2018

Issue	Revision	Revised by	Approved by	Revised Date
A	Flood Mitigation Measures amended	AD	JAG	03.01.19

For the avoidance of doubt, the parties confirm that these conditions of engagement shall not and the parties do not intend that these conditions of engagement shall confer on any party any rights to enforce any term of this Agreement pursuant of the Contracts (Rights of third Parties) Act 1999.

The Appointment of Alan Wood & Partners shall be governed by and construed in all respects in accordance with the laws of England & Wales and each party submits to the exclusive jurisdiction of the Courts of England & Wales.

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APPENDICES

Appendix A : Indicative Layout Drawings

Appendix B : Surface Water Storage Calculations

Appendix C : Environment Agency Flood Data

1.0 **INTRODUCTION**

1.1 **Background**

- 1.1.1 Alan Wood & Partners were commissioned by Lindum BMS on behalf of University Academy Holbeach to prepare a Flood Risk Assessment for a proposed Teaching Block development on land at University Academy Holbeach, Holbeach, Lincolnshire.
- 1.1.2 A Flood Risk (FRA) for the proposed development is required to assess the development's risk from flooding.

1.2 **Layout of Report**

- 1.2.1 Section 1 provides an introduction to the FRA, explains the layout of this FRA and provides an introduction to flood risk and the latest guidance on development and flood risk in England.
- 1.2.2 Section 2 provides an introduction to the site. The site description is based upon a desktop study and information provided by the developer. In order to obtain further information on flood risk, consultation was undertaken with the Environment Agency.
- 1.2.3 Section 3 of this report details the information gathered through the consultation.
- 1.2.4 Section 4 of this report details the development proposals, and considers the development proposals in relation to the current planning policy on development and flood risk in England (and what type of development is considered appropriate in different flood risk zones). National Planning Policy Framework (NPPF): and its associated Technical Guidance (Communities and Local Government, March 2012) is the current planning policy on flood risk in England, and an introduction to NPPF is provided below.
- 1.2.5 Section 5 considers the drainage arrangements for the proposed development. The drainage assessment is based on NPPF, and outlines an indicative foul and surface water drainage strategy.

1.2.6 Section 6 of this report considers the flood risk to site, and the potential for the development proposals to impact on flood risk. The assessment of flood risk is based on the latest planning policy and uses all the information gathered as part of FRA. Based on all the work undertaken as part of the FRA.

1.2.7 Section 7 of this report provides details of any recommendations for further work to mitigate against possible flooding.

1.2.8 Section 8 of this report provides a summary of the report.

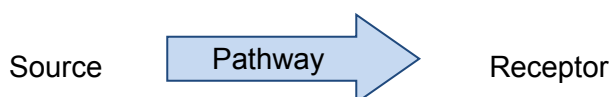
1.3 Flood Risk

1.3.1 Flood risk takes account of both the probability and the consequences of flooding.

1.3.2 Flood risk = probability of flooding x consequences of flooding

1.3.3 Probability is usually interpreted in terms of the return period, e.g. 1 in 100 and 1 in 200 year event, etc. In terms of probability, there is a 1 in 100 (1%) chance of one or more 1 in 100 year floods occurring in a given year. The consequences of flooding depends on how vulnerable a receptor is to flooding.

The components of flood risk can be considered using a source-pathway-receptor model.



1.3.4 Sources constitute flood hazards, which are anything with the potential to cause harm through flooding (e.g. rainfall extreme sea levels, river flows and canals). Pathways represent the mechanism by which the flood hazard would cause harm to a receptor (e.g. overtopping and failure of embankments and flood defences, inadequate drainage and inundation of floodplains). Receptors comprise the people, property, infrastructure and ecosystems that could potentially be affected should a flood occur.

1.4 National Planning Policy Framework

1.4.1 General

1.4.1.1 NPPF and its associated Technical Guidance replaces Planning Policy Statement 25 and provides guidance on how to evaluate sites with respect to flood risk.

1.4.1.2 A summary of the requirements of NPPF is provided below.

1.4.2 Sources of Flooding

1.4.2.1 NPPF requires an assessment to flood risk to consider all forms of flooding and lists six forms of flooding that should be considered as part of a flood risk assessment. These forms of flooding are listed in Table 1, along with an explanation of each form of flooding.

Table1: Forms of Flooding

Flooding From Rivers (Fluvial Flooding)
Watercourses flood when the amount of water in them exceeds the flow capacity of the river channel. Flooding can either develop gradually or rapidly, depending on the characteristics of the catchment. Land use, topography and the development can have a strong influence on flooding from rivers.
Flooding From the Sea (Tidal Flooding)
Flooding to low-lying land from the sea and tidal estuaries is caused by storm surges and high tides. Where tidal defences exist, they can be overtopped or breached during a severe storm, which may be more likely with climate change.
Flooding from Land (Pluvial Flooding)
Intense rainfall, often of short duration, that is unable to soak into the ground or enter drainage systems can run quickly off land and result in local flooding. In developed areas this flood water can be polluted with domestic sewage where foul sewers surcharge and overflow. Local topography and built form can have a strong influence on the direction and depth of flow. The design of development down to a micro-level can influence or exacerbate this. Overland flow paths should be taken into account in spatial planning for urban developments. Flooding can be exacerbated if development increases the percentage of impervious area.

Flooding from Groundwater
Groundwater flooding occurs when groundwater levels rise above ground levels (i.e. groundwater issues). Groundwater flooding is most likely to occur in low-lying areas underlain by permeable rocks (aquifers). Chalk is the most extensive source of groundwater flooding.
Flooding from Sewers
In urban areas, rainwater is frequently drained into sewers. Flooding can occur when sewers are overwhelmed by heavy rainfall, and become blocked. Sewer flooding continues until the water drains away.
Flooding from Other Artificial Sources (i.e. reservoirs, canals, lakes and ponds)
Non-natural or artificial sources of flooding can include reservoirs, canals and lakes. Reservoir or canal flooding may occur as a result of the facility being overwhelmed and /or as a result of dam or bank failure.

1.4.3 Flood Zones

- 1.4.3.1 For river and sea flooding, NPPF uses four Flood Zones to characterise flood risk. These Flood Zones refer to the probability of river and sea flooding, ignoring the presence of defences, and are detailed in Table 2.

Table 2: Flood Zones

Flood Zone	Definition
1	Low probability (less than 1 in 1,000 annual probability of river or sea flooding in any year (<0.1%).
2	Medium probability (between 1 in 100 and 1 in 1,000 annual probability of river flooding (1%-0.1%) or between 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5%-0.1%) in any year).
3a	High probability (1 in 100 or greater annual probability of river flooding (>1%) in any year or 1 in 200 or greater annual probability of sea flooding (>0.5%) in any given year).
3b	This zone comprises land where water has to flow or be stored in times flood. Land which would flood with an annual probability of 1 in 20 (5%), or is designed to flood in an extreme flood (0.1%) should provide a starting point for discussions to identify functional floodplain.

1.4.4 Vulnerability

1.4.4.1 NPPF classifies the vulnerability of developments to flooding into five categories. These categories are detailed in Table 3.

Table 3: Flood Risk Vulnerability Classification

Flood Risk Vulnerability Classification	Examples of Development Types
Essential Infrastructure	- Essential utility infrastructure including electricity generating power stations and grid and primary substations - Wind turbines
Highly Vulnerable	- Police stations, ambulance stations, fire stations, command centres and telecommunications installations required to be operational during flooding. - Emergency dispersal points. - Basement dwellings. - Caravans, mobile homes and park homes intended for permanent residential use.
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. - Sites used for holiday or short-let caravans and camping.
Less Vulnerable	- Building used for shops, financial, professional and other services, restaurants and cafes, hot foot takeaways, offices, general industry, storage and distribution, non-residential institutions not included in "more vulnerable" and assembly and leisure. - Land and buildings used for agriculture and forestry.
Water Compatible	- Docks, marinas and wharves. - 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.

1.4.4.2 Based on the vulnerability of a development, NPPF states within what Flood Zones(s) the development is appropriate. The flood risk vulnerability and Flood Zone 'compatibility' of developments is summarised in Table 4.

Table 4: Flood Risk Vulnerability and Flood Zone Compatibility

Flood Risk Vulnerability Classification		Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone	1	✓	✓	✓	✓	✓
	2	✓	✓	Exception Test	✓	✓
	3a	Exception Test	✓	x	Exception Test	✓
	3b	Exception Test	✓	x	x	x

1.4.5 The Sequential Test, Exception Test and Sequential Approach

1.4.5.1 The Sequential Test is a risk-based test that should be applied at all stages of development and aims to steer new development to areas with the lowest probability of flooding (Zone 1). This is applied by the Local Planning Authority by means of a Strategic Flood Assessment (SFRA).

1.4.5.2 The SFRA and NPPF may require the Exception Test to be applied to certain forms of new development. The test considers the vulnerability of the new development to flood risk and, to be passed, must demonstrate that:

- There are sustainability benefits that outweigh the flood risk and;
- The new development is safe and does not increase flood risk elsewhere.

1.4.5.3 The Sequential Approach is also a risk based approach to development. In a development site located in several Flood Zones or with other flood risk, the sequential approach directs the most vulnerable types of development towards areas of least risk within the site.

1.4.6 Climate Change

- 1.4.6.1 This is a planning requirement to account for climate change in the proposed design. The recommended allowances should be based on the most relevant guidance from the Environment Agency and the Lead Local Flood Authority.

1.4.7 Sustainable Drainage

- 1.4.7.1 The key planning objectives in NPPF are to appraise, manage and where possible, reduce flood risk. Sustainable Drainage Systems (SuDS) provide an effective way of achieving some of these objectives, and NPPF and Part H of the Building Regulations (DTLR 2002) direct developers towards the use of SuDS wherever possible.

2.0 **EXISTING SITE DESCRIPTION**

2.1 **Location**

2.1.1 The proposed development lies within the University Academy Holbeach, which is located to the west of Penny Hill Road and to the south of the A17 in Holbeach, Lincolnshire.

2.1.2 An aerial photograph is included in Figure 1 below, which identifies the location of the site.



Figure 1: Aerial Photograph

2.1.3 The Ordnance Survey grid reference for the centre of the site development is approximately 535930, 325435.

2.2 **Surrounding Features**

2.2.1 The proposed development lies within the grounds of the University Academy Holbeach Campus.

2.2.2 There are existing university campus buildings to the north, east, south and west of the development site.

- 2.2.3 To the north of the campus is Park Road and an area of grassed landscaping, beyond which is the A17 highway.
- 2.2.4 To the east of the campus is Penny Hill Road, “Old River” (drain) and a residential development beyond.
- 2.2.5 To the south of the campus buildings is a sports ground and a football ground.
- 2.2.6 To the west of the campus is a residential development.
- 2.2.7 To the north west of the campus is Holbeach Primary School.

2.3 Topography

- 2.3.1 A topographic survey of the site which was undertaken for a previous development shows that the existing ground levels over the area of the proposed development vary from approximately 3.07m to 3.13m OD(N).

2.4 Ground Conditions

- 2.4.1 No intrusive ground investigation works have currently been undertaken in respect of the proposed development.
- 2.4.2 However, a desktop study of the British Geological Survey map reveals the local geology to comprises superficial deposits of Alluvium-Clay, Silt and Sand overlaying bedrock comprising West Walton Formation – Mudstone and Siltstone.
- 2.4.3 A local borehole record indicates that silts and silty sands extend to a minimum of 6m below ground level, with ground water encountered at a depth of 3m.
- 2.4.4 Ground conditions in the area of the development are therefore not suitable for soakaways to be used as a means of surface water disposal from the development.
- 2.4.5 A study of the groundwater maps reveals that the site does not overlay an aquifer or lie within a Groundwater Vulnerability Zone.

3.0 CONSULTATION

- 3.1 Consultation has taken place with the Environment Agency in order to obtain relevant information in respect of flood mapping and Product 6 flood data, relevant details of which are included within this report.
- 3.2 Consultation has taken place with the design team in order to obtain information with regard to the development proposals.

4.0 PROPOSED DEVELOPMENT

- 4.1 The proposed development involves the construction of the new Teaching Block to include the following:-
- Construction of new four-storey building to provide classrooms, office, plant room, store rooms, toilet facilities, staircases and corridors etc.
 - Associated services etc.
- 4.2 Indicative layout drawings of the proposed development are included in Appendix A.
- 4.3 In terms of flood risk, the development is classed as 'More Vulnerable' in terms of flood risk vulnerability (Table 3).
- 4.4 In terms of flood zone compatibility, the development is considered to be suitable in Flood Zone 3 (Table 4) subject to an Exception Test being provided. However, as the whole of Holbeach and the surrounding area lies within Flood Zone 3, the provision of an Exception Test should not be applicable.

5.0 DRAINAGE ASSESSMENT

5.1 Surface Water Drainage

- 5.1.1 From the aerial photograph included in Figure 2, it can be seen that the area of the development site currently comprises an area of external paving together with small areas of grassed landscaping.



Figure 2: Aerial Photograph

- 5.1.2 Requirement H3 of the Building Regulations establishes a preferred hierarchy for disposal of surface water disposal. Consideration should firstly be given to soakaway, infiltration, watercourse and sewer in that priority order.
- 5.1.3 The underlying strata in the vicinity of the development is considered to be unsuitable for the disposal of surface water run-off from the development into soakaways or infiltration trenches.
- 5.1.4 The second preferred option would be to discharge the surface water run-off from the development to a watercourse.
- 5.1.5 Whilst there is an open watercourse located to the east of the site, at a distance of approximately 180m the watercourse cannot be accessed without crossing third party land outside the control of the developer.

- 5.1.6 It is therefore proposed that the surface water run-off from the new development is discharged into the existing site drainage network.
- 5.1.7 The new impermeable area of the development has been calculated at approximately 1056m².
- 5.1.8 The existing run-off rate in the area of the new development has been calculated at approximately 11.7 litres per second, based upon the BSEN752 calculations for the existing paved area of 845m² which is currently positively drained, plus the greenfield discharge from the grassed area of 160m².
- 5.1.9 However, to meet the flood risk planning requirements it is unacceptable to discharge flows freely from the proposed development site at an unrestricted rate. Therefore flows from the proposed development are normally limited to the brownfield runoff rate, based on the impermeable contributing area and with a 30% reduction from the current situation to provide a degree of improvement to the drainage network.
- 5.1.10 The brownfield discharge rate from the development would therefore reduce to 8.2 litres per second (11.7 litres per second x 0.7) ignoring the greenfield discharge which is insignificant and consequently this figure has been used as basis for the new drainage design.
- 5.1.11 The required design criteria for new developments is a 1 in 100 year storm event plus an allowance for climate change.
- 5.1.12 It is assumed that the outfall can be achieved by means of a gravity connection to the existing sewer. However, if it is found that this is not possible due to relative levels then a pumped outfall will be required.
- 5.1.13 Lincolnshire County Council SuDS guidance advises that an allowance of 40% is made to account for climate change resulting from global warming.

5.1.14 Based upon the above design criteria, surface water storage calculations have been undertaken in order to assess the likely storage volume of surface water which will be required, details of which are included below:-

30 year storm	-	Volume required 11m ³
100 year storm	-	Volume required 27m ³
+ 40% climate change		(16m ³ of additional storage above the 30 year storm requirement)

5.1.15 The storage volumes will be dictated by the agreed discharge rate and the impermeable area created by the development.

5.1.16 Copies of the surface water storage calculations are included in Appendix B.

5.1.17 To comply with current design requirements the drainage system will need to contain the 30 year storm volume below ground within the drainage network in the form of oversized pipes or an appropriate storage tank, which has been calculated at approximately 11m³.

5.1.18 The additional storage volume required to accommodate the 100 year storm + 40% climate change can be stored above ground on site providing it does not pose a risk of flooding to the development and does not leave the confines of the site, or alternatively can be stored below ground in a suitable storage tank. This storage volume has been calculated at approximately 16m³ (27m³ – 11m³).

5.2 Foul Water Drainage

5.2.1 Based upon the British Code of Practice 'Flows and Loads – 4' and a maximum number of 200 occupants, the peak flow generated by the new development would be approximately 0.2 litres per second.

5.2.2 Allowing for factoring the peak flow rate, the discharge from the development would be less than 1 litre per second.

-
- 5.2.3 It is proposed that the foul water discharge from the development will be connected to the existing site drainage network.
- 5.2.4 It is envisaged that the connection to the existing sewer can be achieved by means of a gravity connection.
- 5.2.5 It is considered that such low rate of discharge would not have any impact on the sewer network.

6.0 FLOOD RISK ASSESSMENT

6.1 Flood Zone

- 6.1.1 A copy of the Environment Agency Flood Map for Planning is included in Figure 3 below which identifies the development site to be located within an area designated as Flood Zone 3, (high probability of flooding), comprising land assessed as having a 1 in 100 or greater annual probability of river flooding or a 1 in 200 year or greater annual probability of flooding from the sea.

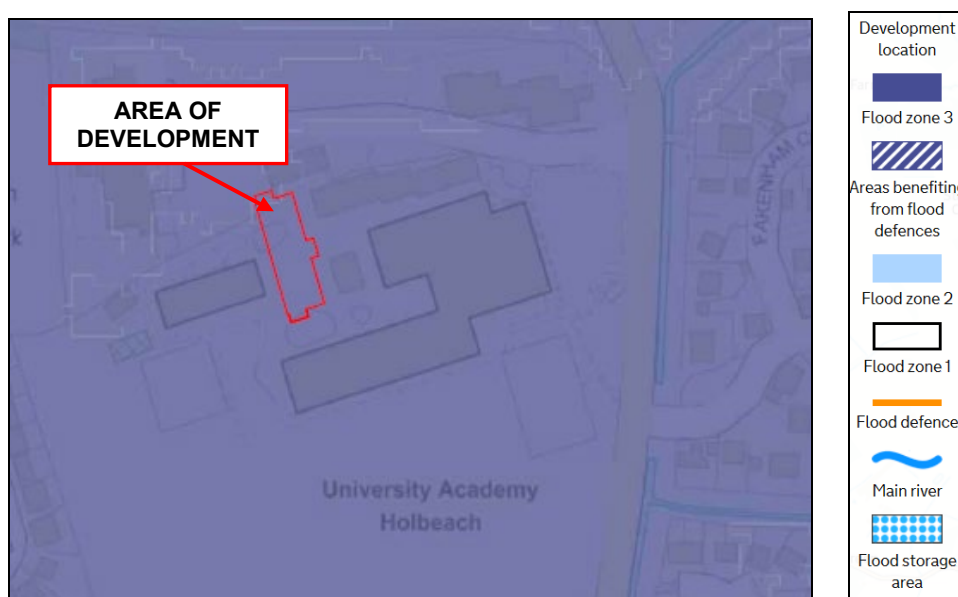


Figure 3: Environment Agency Flood Map for Planning dated December 2018

6.2 Tidal Flooding

- 6.2.1 The site is located at a distance of approximately 11km from the coastline of The Wash which is the main potential source of flooding to the development and approximately 0.5km to the north of The Haven, which is tidally influenced.
- 6.2.2 The predicted 1 in 200 year tidal water level for The Wash is stated as 5.95m OD(N).
- 6.2.3 For a development with a design life of 50 years the predicted sea level rise is 415mm, resulting in a predicted flood level of 6.37m OD(N).

- 6.2.4 A copy of the map produced by the Environment Agency showing the extent of flooding from rivers or the sea is included in Figure 4 below.

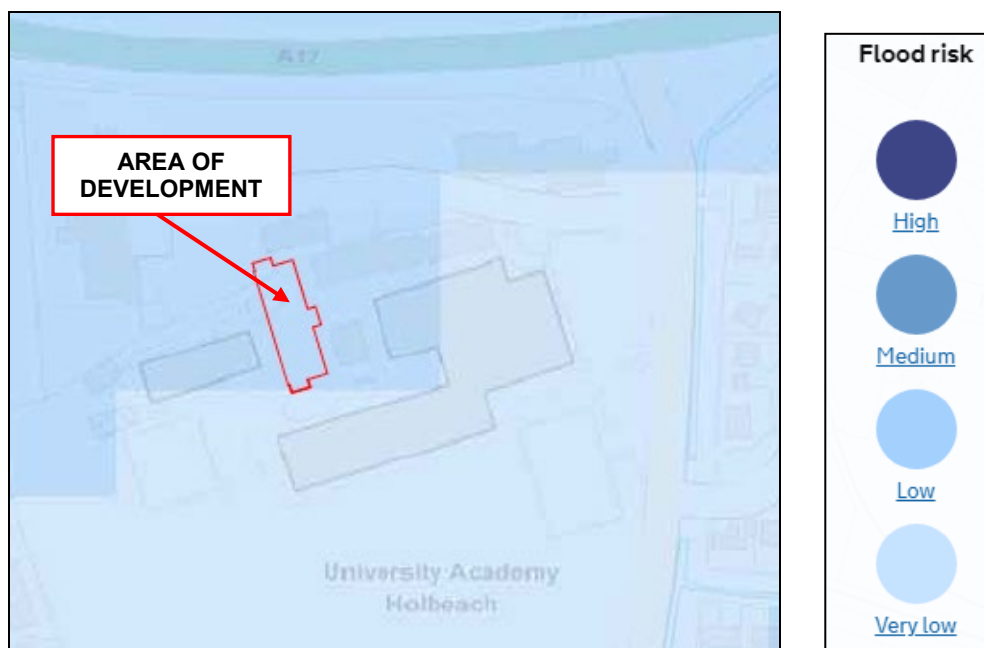


Figure 4: Environment Agency Map dated December 2018 showing the Extent of Flooding from Rivers or the Sea

- 6.2.5 The map shows that the site is considered to be at 'low risk' of flooding.
- 6.2.6 The region is protected by concrete sea defence walls. However, there remains a residual risk of flooding should the defences become breached or overtopped.
- 6.2.7 Flood data has been obtained from the Environment Agency in respect of potential flood risk to the development.
- 6.2.8 A copy of the flood data is included in Appendix C.
- 6.2.9 The data indicates for a situation where there is a breach of the defences, for an annual probability of 1:200 incorporating the predicted sea level rise resulting from global warming, the site lies in an areas which is considered to lie in an area with a hazard rating classed as 'Danger to Some' and in an area likely to flood to a depth of 0.25 to 0.5 metres.

- 6.2.10 Flood mitigation measures will consequently need to be incorporated within the design of the project. Details of such measures are included in Section 7 of this report.

6.3 Fluvial Flooding

- 6.3.1 The River Welland is located approximately 10km to the west of the development site.
- 6.3.2 The River Nene is located approximately 13km to the east of the development site.
- 6.3.3 These watercourses are tidally influenced and consequently the rivers could overtop their banks at periods of high tides.
- 6.3.4 However, with the watercourses being located at such a distance from the development, the likelihood of any such flooding affecting the site is extremely remote.
- 6.3.5 The risk to the development from fluvial flooding is considered to be low and acceptable.

6.4 Flooding from Open Drainage Ditches

- 6.4.1 There are a large number of open drainage ditches in the region which drain the local low-lying land towards the local rivers and the North Sea.
- 6.4.2 The outfalls from the ditches into the local river network are tidally influenced and consequently there is a risk of the ditches overtopping their banks during periods of high tides.
- 6.4.3 The maps produced by the Environment Agency considering flood risk from surface water flooding included in Section 6.5 below do not indicate any risk of flooding to the development.
- 6.4.4 The risk to the development from this potential flood source is considered to be low and acceptable.

6.5 Surface Water Flooding

- 6.5.1 A copy of the Environment Agency map showing the extent of flooding from surface water is included in Figure 5 below.

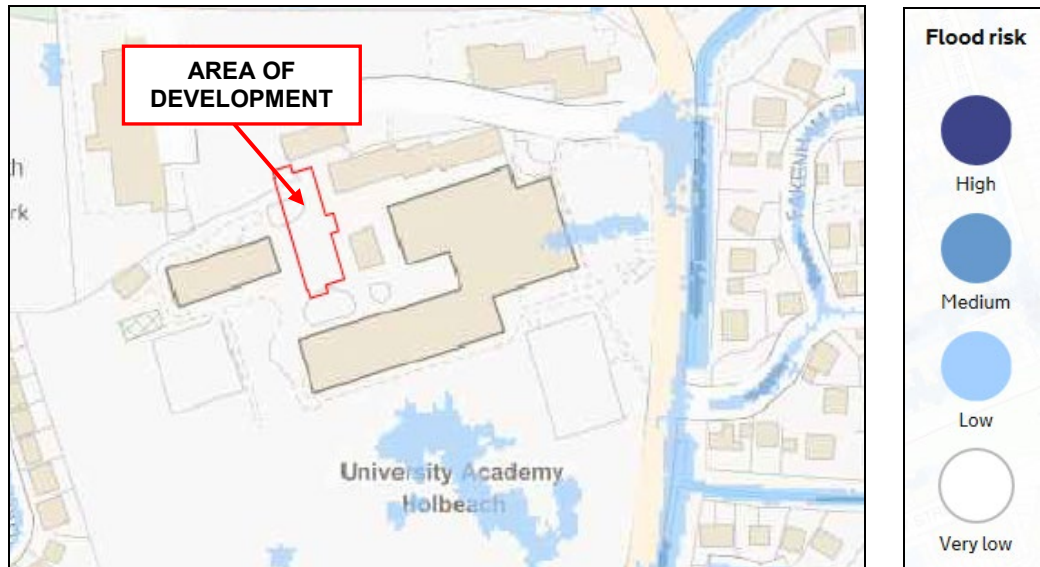


*Figure 5: Environment Agency Map dated December 2018
Showing the Extent of Flooding from Surface Water*

- 6.5.2 The map shows that the site lies in an area which is not considered to be at risk of surface water flooding.
- 6.5.3 The risk to the development from Surface Water flooding is considered to be low and acceptable.

6.6 Flood Risk from Existing Water Mains

- 6.6.1 There are likely to be water mains present in the vicinity of the development site serving the adjacent buildings.
- 6.6.2 There are no known issues with regard to these water mains.
- 6.6.3 The risk to the development from this potential flood source is therefore considered to be low and acceptable.

6.7 Flood Risk from Existing Drainage Sewers

- 6.7.1 There are likely to be existing domestic drainage services serving the adjacent buildings.
- 6.7.2 There are no known issues with regard to the capacity or condition of the existing drainage services.
- 6.7.3 The risk of flooding to the new development from this potential source is considered to be low and acceptable.

6.8 Flooding from Reservoirs, Canals and Other Artificial Sources

- 6.8.1 Investigations indicate that there are no structures in proximity to the development which are likely to pose any risk of flooding.
- 6.8.2 A copy of the map produced by the Environment Agency showing the extent of flooding from reservoirs is included in Figure 6 below.

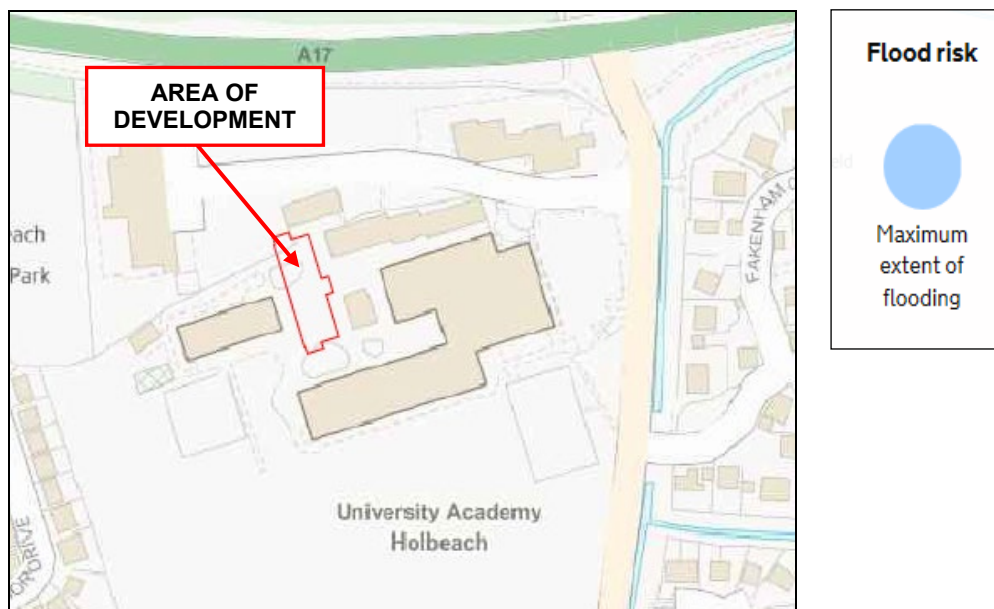


*Figure 6: Environment Agency Map dated December 2018
Showing the Extent of Flooding from Reservoirs*

- 6.8.3 The map shows that the development site lies in an area which is not considered to be at risk from reservoir flooding.

6.8.4 The risk to the development from any such potential flood source is considered to be low and acceptable.

6.9 Groundwater Flooding

6.9.1 Groundwater flooding can occur when the sub-surface water levels are high and emerges above ground level.

6.9.2 There are no proposals to create any basements within the development.

6.9.3 The construction works will not involve deep excavation works and consequently the risk to the development from this potential flood source is considered to be low and acceptable.

7.0 **FLOOD MITIGATION MEASURES**

7.1 **Managerial**

- 7.1.1 The building is shown to be at potential risk of flooding from a breach or overtopping of the coastal defences to the North Sea.
- 7.1.2 If it is not already registered, the campus should be connected to the Environment Agency's 'Flood Direct' flood warning system. This would then ensure that there is sufficient time available for safe evacuation measures to be put in place should this prove necessary.
- 7.1.3 An evacuation plan is to be provided and warning notices displayed in prominent locations within the building to advise occupants of the procedures to follow should a major flood situation occur.
- 7.1.4 The University Academy Holbeach already has an Emergency Procedures Policy in place and the new building will subscribe to this to ensure safe procedures are followed should a flood event occur.

7.2 **Passive Flood Protection**

- 7.2.1 For new development lying in Flood Zone 3 it is normally a requirement to raise the ground floor construction level above the predicted flood level and provide additional flood resilience above floor level.
- 7.2.2 The Environment Agency have advised that for developments shown to be prone to flooding to a depth of 0.25 to 0.5m, the ground floor should be elevated to a height of 500mm above ground level and provide an additional 300mm of flood resilience above floor level.
- 7.2.3 For this development, this would result in a finished ground floor construction level of 3.60m OD(N), with flood resilient construction up to a level of 3.90m OD(N).

7.3 Safe Refuge

- 7.3.1 It is a requirement for safe refuge to be provided within new developments above the predicted flood level to ensure that there will be no requirement for evacuation measures.
- 7.3.2 This requirement has been met as the development incorporates accommodation at first floor level which is above the required refuge level. Access from the ground floor accommodation is provided by means of communal staircases and a passenger lift.

7.4 Flood Resilience

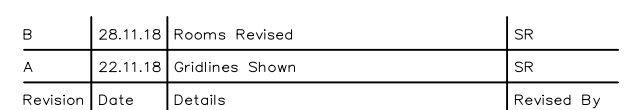
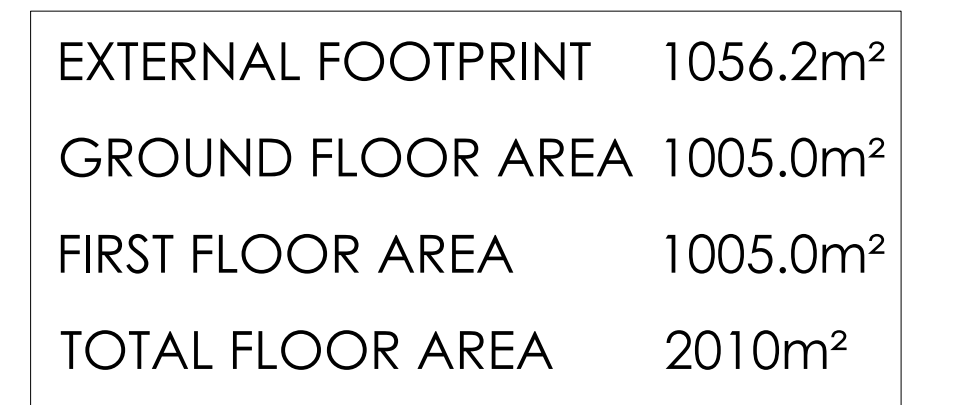
- 7.4.1 Other than doorways there should be no other voids in the external walls within 300mm of finished floor level which could otherwise enable flood waters to enter the building.
- 7.4.2 All new partition walls constructed at ground floor level should be of suitable robust construction or metal stud partitions fixed with plasterboard, with the lower boarding laid horizontally for ease of replacement.
- 7.4.3 All new electrical apparatus or other flood sensitive equipment within the building should be elevated to a minimum of 300mm above finished floor level to prevent damage occurring should flood waters enter the building. All cables should be routed at high level with vertical drops to the fittings.
- 7.4.4 All service entry points must incorporate adequate flood resistant seals or should preferably be located above the flood protection level.
- 7.4.5 All drainage service pipes will need to be fitted with proprietary anti-flood valves to prevent the ingress of flood waters through the drainage network.
- 7.4.6 Floor finishes provided at ground floor level should be suitable for ease of cleaning after flooding without incurring damage.

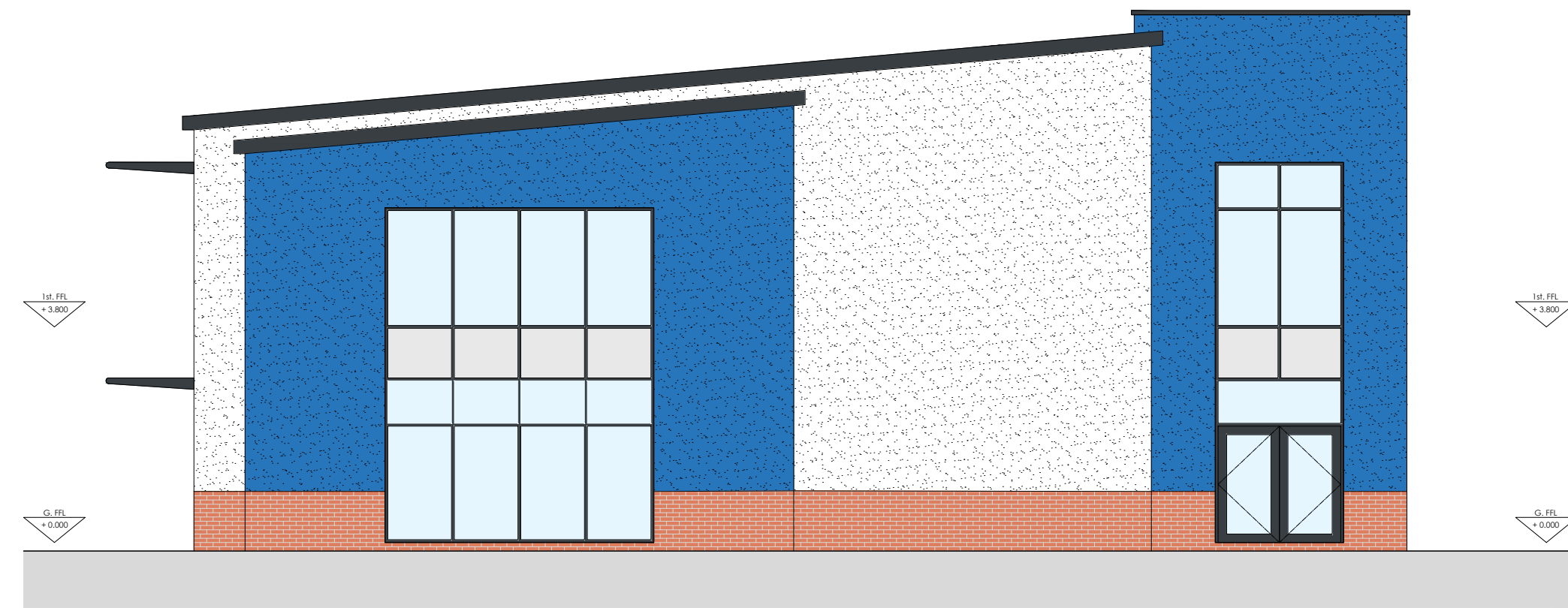
8.0 SUMMARY

- 8.1 This report has been prepared to assess the flood risk implications for a new teaching block at University Academy Holbeach, Holbeach, Lincolnshire.
- 8.2 The site falls in Flood Zone 3a (high flood risk) on the Environment Agency maps and in an area shown to be subject to flooding to a depth between 0.25m to 0.5m and the proposals are considered to include 'More Vulnerable' development.
- 8.3 The primary risk to the site is from tidal flooding from the North Sea resulting from the coastal defences being breached or overtopped during an extreme flood event.
- 8.4 The primary focus for flood risk assessment is to protect life, and then consideration should be given to buildings, contents, operation and re-use. As the scheme is progressed the design should consider exceedance and routing of flows away from the buildings.
- 8.5 Mitigation works are proposed which we consider will reduce the risk to the development from flooding down to an acceptable level.
- 8.6 This report has considered other potential sources of flooding to the site, including groundwater, surface water, existing sewers, water mains and other artificial sources.
- 8.7 Overall, this report demonstrates that the flood risk to the development is reasonable and acceptable.

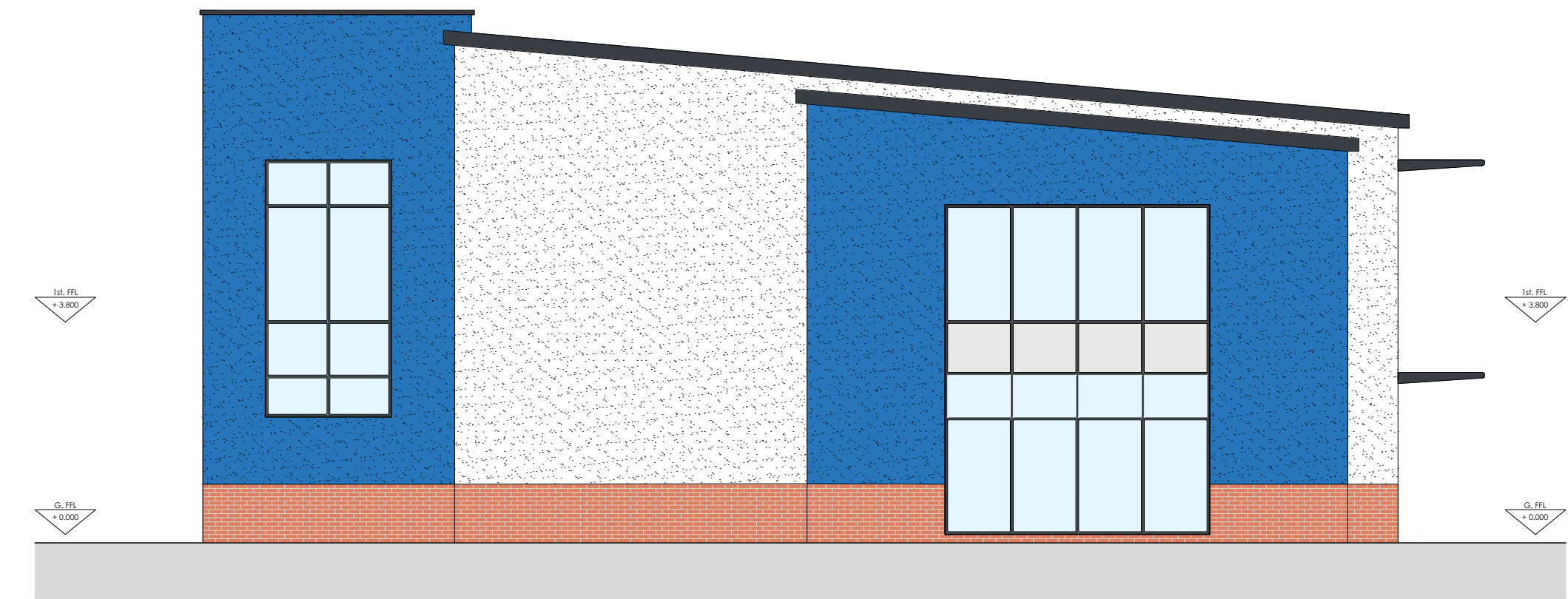
APPENDIX A

Indicative Layout Drawings





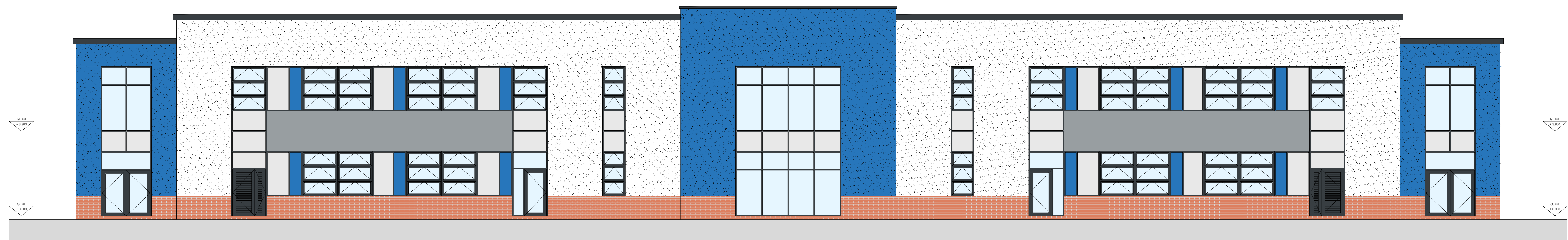
side elevation
1:100



○ side elevation
1:100



○ rear elevation
1:100



front elevation
1:100

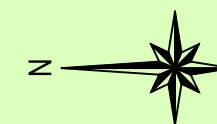
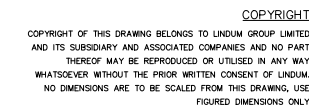
Revision	25/10/18	Brise Soleil Added	SR
Date	Details		Revised By



Lindum Business Park, Station Road, North Hykeham,
Lincoln LN6 3QX

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e: bms@lindumgroup.co.uk

Client	University Academy Holbeach		
Project	New Classroom Block		
Drawing	New Classroom Block Elevations		
Date	Oct 2018		Scale 1:100
Drawn	SR	Checked IH	Size A1
Status	FEASIBILITY		
Drawing No.		Revision	
31468 425 05		A	



ARISE
ABOUT

Proposed Site Plan Option 2

- University Academy Holbeach, New Classroom Block

Revision	Date	Details	Revised By
 Lindum Business Park, Station Road, North Hykeham, Lincoln LN6 3QX t: (01522) 500300 f: (01522) 500377 e: bms@lindumgroup.co.uk			
Client University Academy Holbeach			
Project New Classroom Block			
Drawing Proposed Site Plan Option 2			
Date	Oct 18	Scale	1:500
Drawn	SR	Checked	IH
Size	A3		
Status FEASIBILITY			
Drawing No. 31468 425 07			Revision —

APPENDIX B

Surface Water Storage Calculations

Alan Wood & Partners				Page 1	
341 Beverley Road Hull HU5 1LD		41979 University Academy Holbeach			
Date 05/12/2018 File 41979-M30_Q8.2.srcx		Designed by TW Checked by AD			
Elstree Computing Ltd		Source Control 2018.1			
Summary of Results for 30 year Return Period					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	100.805	0.805	8.2	8.8	O K
30 min Summer	100.844	0.844	8.2	9.3	O K
60 min Summer	100.756	0.756	8.2	8.3	O K
120 min Summer	100.469	0.469	8.2	5.2	O K
180 min Summer	100.277	0.277	8.2	3.0	O K
240 min Summer	100.180	0.180	7.8	2.0	O K
360 min Summer	100.125	0.125	6.4	1.4	O K
480 min Summer	100.105	0.105	5.2	1.2	O K
600 min Summer	100.094	0.094	4.4	1.0	O K
720 min Summer	100.086	0.086	3.8	0.9	O K
960 min Summer	100.075	0.075	3.1	0.8	O K
1440 min Summer	100.063	0.063	2.2	0.7	O K
2160 min Summer	100.052	0.052	1.6	0.6	O K
2880 min Summer	100.046	0.046	1.3	0.5	O K
4320 min Summer	100.039	0.039	0.9	0.4	O K
5760 min Summer	100.035	0.035	0.8	0.4	O K
7200 min Summer	100.032	0.032	0.6	0.3	O K
8640 min Summer	100.029	0.029	0.5	0.3	O K
10080 min Summer	100.028	0.028	0.5	0.3	O K
15 min Winter	100.926	0.926	8.2	10.2	O K
30 min Winter	100.955	0.955	8.2	10.5	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
15 min Summer	71.211	0.0	14.0	14	
30 min Summer	46.390	0.0	18.3	23	
60 min Summer	28.921	0.0	22.8	40	
120 min Summer	17.521	0.0	27.6	72	
180 min Summer	12.939	0.0	30.6	100	
240 min Summer	10.393	0.0	32.7	126	
360 min Summer	7.592	0.0	35.9	184	
480 min Summer	6.076	0.0	38.3	244	
600 min Summer	5.109	0.0	40.2	306	
720 min Summer	4.433	0.0	41.9	366	
960 min Summer	3.541	0.0	44.6	490	
1440 min Summer	2.577	0.0	48.7	720	
2160 min Summer	1.874	0.0	53.1	1100	
2880 min Summer	1.494	0.0	56.5	1428	
4320 min Summer	1.084	0.0	61.5	2136	
5760 min Summer	0.863	0.0	65.2	2856	
7200 min Summer	0.723	0.0	68.3	3592	
8640 min Summer	0.625	0.0	70.9	4320	
10080 min Summer	0.553	0.0	73.2	5072	
15 min Winter	71.211	0.0	15.7	15	
30 min Winter	46.390	0.0	20.5	24	
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Date 05/12/2018 File 41979-M30_Q8.2.srcx		Designed by TW Checked by AD			
Elstree Computing Ltd		Source Control 2018.1			
<u>Summary of Results for 30 year Return Period</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	100.798	0.798	8.2	8.8	O K
120 min Winter	100.355	0.355	8.2	3.9	O K
180 min Winter	100.161	0.161	7.7	1.8	O K
240 min Winter	100.125	0.125	6.4	1.4	O K
360 min Winter	100.099	0.099	4.7	1.1	O K
480 min Winter	100.085	0.085	3.8	0.9	O K
600 min Winter	100.077	0.077	3.2	0.8	O K
720 min Winter	100.071	0.071	2.8	0.8	O K
960 min Winter	100.062	0.062	2.2	0.7	O K
1440 min Winter	100.052	0.052	1.6	0.6	O K
2160 min Winter	100.044	0.044	1.2	0.5	O K
2880 min Winter	100.039	0.039	0.9	0.4	O K
4320 min Winter	100.033	0.033	0.7	0.4	O K
5760 min Winter	100.029	0.029	0.5	0.3	O K
7200 min Winter	100.027	0.027	0.5	0.3	O K
8640 min Winter	100.025	0.025	0.4	0.3	O K
10080 min Winter	100.023	0.023	0.3	0.3	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
60 min Winter	28.921	0.0	25.5	44	
120 min Winter	17.521	0.0	30.9	74	
180 min Winter	12.939	0.0	34.2	98	
240 min Winter	10.393	0.0	36.7	126	
360 min Winter	7.592	0.0	40.2	184	
480 min Winter	6.076	0.0	42.9	246	
600 min Winter	5.109	0.0	45.1	304	
720 min Winter	4.433	0.0	46.9	366	
960 min Winter	3.541	0.0	50.0	490	
1440 min Winter	2.577	0.0	54.6	728	
2160 min Winter	1.874	0.0	59.5	1076	
2880 min Winter	1.494	0.0	63.2	1456	
4320 min Winter	1.084	0.0	68.8	2204	
5760 min Winter	0.863	0.0	73.1	2936	
7200 min Winter	0.723	0.0	76.5	3552	
8640 min Winter	0.625	0.0	79.4	4296	
10080 min Winter	0.553	0.0	81.9	5104	
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341 Beverley Road Hull HU5 1LD	41979 University Academy Holbeach	
Date 05/12/2018 File 41979-M30_Q8.2.srcx	Designed by TW Checked by AD	
Elstree Computing Ltd		Source Control 2018.1

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.800	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.105

Time (mins)		Area
From:	To:	(ha)
0	4	0.105

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341 Beverley Road Hull HU5 1LD	41979 University Academy Holbeach	
Date 05/12/2018 File 41979-M30_Q8.2.srcx	Designed by TW Checked by AD	
Elstree Computing Ltd		
Source Control 2018.1		

Model Details

Storage is Online Cover Level (m) 102.000

Tank or Pond Structure

Invert Level (m) 100.000

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	11.0	1.000	11.0	1.001	0.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0133-8200-1000-8200
Design Head (m)	1.000
Design Flow (l/s)	8.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	133
Invert Level (m)	100.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	8.2
Flush-Flo™	0.301	8.2
Kick-Flo®	0.662	6.8
Mean Flow over Head Range	-	7.0

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.8	1.200	8.9	3.000	13.8	7.000	20.6
0.200	7.9	1.400	9.6	3.500	14.8	7.500	21.3
0.300	8.2	1.600	10.2	4.000	15.8	8.000	22.0
0.400	8.1	1.800	10.8	4.500	16.7	8.500	22.7
0.500	7.8	2.000	11.4	5.000	17.6	9.000	23.3
0.600	7.4	2.200	11.9	5.500	18.4	9.500	23.9
0.800	7.4	2.400	12.4	6.000	19.2		
1.000	8.2	2.600	12.9	6.500	19.9		

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341 Beverley Road Hull HU5 1LD			41979 University Academy Holbeach			
Date 05/12/2018 File 41979-M100+40_Q8.2.srcx			Designed by TW Checked by AD			
Elstree Computing Ltd			Source Control 2018.1			
<u>Summary of Results for 100 year Return Period (+40%)</u>						
	Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
	15 min Summer	100.740	0.740	8.2	20.0	O K
	30 min Summer	100.848	0.848	8.2	22.9	O K
	60 min Summer	100.861	0.861	8.2	23.2	O K
	120 min Summer	100.767	0.767	8.2	20.7	O K
	180 min Summer	100.631	0.631	8.2	17.0	O K
	240 min Summer	100.494	0.494	8.2	13.3	O K
	360 min Summer	100.300	0.300	8.2	8.1	O K
	480 min Summer	100.197	0.197	7.9	5.3	O K
	600 min Summer	100.149	0.149	7.5	4.0	O K
	720 min Summer	100.131	0.131	6.7	3.5	O K
	960 min Summer	100.109	0.109	5.4	2.9	O K
	1440 min Summer	100.088	0.088	4.0	2.4	O K
	2160 min Summer	100.072	0.072	2.9	1.9	O K
	2880 min Summer	100.063	0.063	2.3	1.7	O K
	4320 min Summer	100.053	0.053	1.6	1.4	O K
	5760 min Summer	100.047	0.047	1.3	1.3	O K
	7200 min Summer	100.042	0.042	1.1	1.1	O K
	8640 min Summer	100.039	0.039	0.9	1.1	O K
	10080 min Summer	100.036	0.036	0.8	1.0	O K
	15 min Winter	100.843	0.843	8.2	22.8	O K
	30 min Winter	100.975	0.975	8.2	26.3	O K
	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
	15 min Summer	129.089	0.0	25.4	16	
	30 min Summer	84.848	0.0	33.4	28	
	60 min Summer	53.188	0.0	41.9	44	
	120 min Summer	32.259	0.0	50.8	80	
	180 min Summer	23.779	0.0	56.2	112	
	240 min Summer	19.047	0.0	60.0	142	
	360 min Summer	13.827	0.0	65.3	198	
	480 min Summer	11.024	0.0	69.4	254	
	600 min Summer	9.241	0.0	72.8	308	
	720 min Summer	7.997	0.0	75.6	368	
	960 min Summer	6.361	0.0	80.1	490	
	1440 min Summer	4.600	0.0	86.9	732	
	2160 min Summer	3.321	0.0	94.1	1100	
	2880 min Summer	2.633	0.0	99.5	1460	
	4320 min Summer	1.896	0.0	107.5	2164	
	5760 min Summer	1.500	0.0	113.4	2888	
	7200 min Summer	1.251	0.0	118.2	3560	
	8640 min Summer	1.077	0.0	122.2	4400	
	10080 min Summer	0.949	0.0	125.6	5136	
	15 min Winter	129.089	0.0	28.5	16	
	30 min Winter	84.848	0.0	37.4	29	
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Date 05/12/2018 File 41979-M100+40_Q8.2.srcx		Designed by TW Checked by AD			
Elstree Computing Ltd		Source Control 2018.1			
<u>Summary of Results for 100 year Return Period (+40%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	100.980	0.980	8.2	26.5	O K
120 min Winter	100.829	0.829	8.2	22.4	O K
180 min Winter	100.613	0.613	8.2	16.5	O K
240 min Winter	100.409	0.409	8.2	11.0	O K
360 min Winter	100.186	0.186	7.9	5.0	O K
480 min Winter	100.132	0.132	6.7	3.6	O K
600 min Winter	100.114	0.114	5.7	3.1	O K
720 min Winter	100.102	0.102	4.9	2.8	O K
960 min Winter	100.088	0.088	3.9	2.4	O K
1440 min Winter	100.072	0.072	2.9	1.9	O K
2160 min Winter	100.060	0.060	2.1	1.6	O K
2880 min Winter	100.053	0.053	1.6	1.4	O K
4320 min Winter	100.044	0.044	1.2	1.2	O K
5760 min Winter	100.039	0.039	0.9	1.1	O K
7200 min Winter	100.036	0.036	0.8	1.0	O K
8640 min Winter	100.033	0.033	0.7	0.9	O K
10080 min Winter	100.031	0.031	0.6	0.8	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
60 min Winter	53.188	0.0	46.9	48	
120 min Winter	32.259	0.0	56.9	86	
180 min Winter	23.779	0.0	62.9	120	
240 min Winter	19.047	0.0	67.2	148	
360 min Winter	13.827	0.0	73.2	198	
480 min Winter	11.024	0.0	77.8	250	
600 min Winter	9.241	0.0	81.5	308	
720 min Winter	7.997	0.0	84.6	368	
960 min Winter	6.361	0.0	89.8	490	
1440 min Winter	4.600	0.0	97.4	726	
2160 min Winter	3.321	0.0	105.4	1096	
2880 min Winter	2.633	0.0	111.5	1440	
4320 min Winter	1.896	0.0	120.4	2168	
5760 min Winter	1.500	0.0	127.0	2936	
7200 min Winter	1.251	0.0	132.3	3584	
8640 min Winter	1.077	0.0	136.8	4312	
10080 min Winter	0.949	0.0	140.7	4976	
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341 Beverley Road Hull HU5 1LD	41979 University Academy Holbeach	
Date 05/12/2018 File 41979-M100+40_Q8.2.srcx	Designed by TW Checked by AD	
Elstree Computing Ltd		Source Control 2018.1

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.800	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.105

Time (mins)		Area
From:	To:	(ha)
0	4	0.105

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341 Beverley Road Hull HU5 1LD	41979 University Academy Holbeach	
Date 05/12/2018 File 41979-M100+40_Q8.2.srcx	Designed by TW Checked by AD	
Elstree Computing Ltd		
Source Control 2018.1		

Model Details

Storage is Online Cover Level (m) 102.000

Tank or Pond Structure

Invert Level (m) 100.000

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	27.0	1.000	27.0	1.001	0.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0133-8200-1000-8200
Design Head (m)	1.000
Design Flow (l/s)	8.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	133
Invert Level (m)	100.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	8.2
Flush-Flo™	0.301	8.2
Kick-Flo®	0.662	6.8
Mean Flow over Head Range	-	7.0

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.8	1.200	8.9	3.000	13.8	7.000	20.6
0.200	7.9	1.400	9.6	3.500	14.8	7.500	21.3
0.300	8.2	1.600	10.2	4.000	15.8	8.000	22.0
0.400	8.1	1.800	10.8	4.500	16.7	8.500	22.7
0.500	7.8	2.000	11.4	5.000	17.6	9.000	23.3
0.600	7.4	2.200	11.9	5.500	18.4	9.500	23.9
0.800	7.4	2.400	12.4	6.000	19.2		
1.000	8.2	2.600	12.9	6.500	19.9		

APPENDIX C

Environment Agency Flood Data

Morgan Cropp
Morgan.Cropp@alanwood.co.uk

Our ref: CCN/2018/109233

Date: 20 December 2018

Dear Morgan

Provision of Flood Risk Information for Park Road, Holbeach

Thank you for your request to use our flood risk information in the development of the Flood Risk Assessment (FRA) for the above site. The information is set out below and attached. It is important you read any contextual notes on the maps provided.

We aim to review our information on a regular basis, so if you are using this data more than twelve months from the date of this letter, please contact us again to check it is still valid.

Flood Map

The attached map includes the current Flood Map for your area. The Flood Map indicates the area at risk of flooding, **assuming no flood defences exist**, for a flood with a 0.5% chance of occurring in any year for flooding from the sea, or a 1% chance of occurring for fluvial (river) flooding. It also shows the extent of the Extreme Flood Outline which represents the extent of a flood with a 0.1% chance of occurring in any year, or the highest recorded historic extent if greater.

In some locations, such as around the fens and the large coastal floodplains, showing the area at risk of flooding assuming no defences may give a slightly misleading picture in that if there were no flood defences, water would spread out across these large floodplains. This flooding could cover large areas of land but to relatively shallow depths and could leave pockets of locally slightly higher land as isolated dry islands. It is important to understand the actual risk of the flooding to these dry islands, particularly in the event of defence failure.

The Flood Map also shows the location of formal raised flood defences and flood storage reservoirs. It represents areas at risk of flooding for present day only and does not take account of climate change.

The Flood Map only indicates the extent and likelihood of flooding from rivers or the sea. It should also be remembered flooding may occur from other sources such as surface water sewers, road drainage, etc.

History of Flooding

With regards to the history of flooding I can advise we do not have any records of flooding in this area. It is possible other flooding may have occurred we do not have records for, and other organisations, such as the Local Authority or Internal Drainage Boards, may have records.

Tidal Flood Risk Information

Tidal Defence Information

The tidal defences protecting this site consist of earth embankments. They are in fair condition and reduce the risk of flooding to a 0.67% (1 in 150) chance of occurring in any year. We inspect these defences routinely to ensure potential defects are identified.

Tidal Flood Levels

The attached table shows our current best estimate for extreme tide levels.

Levels for the Humber Estuary have an assessment date of 2014, with others having an assessment date of 2006, which should be used in any consideration of future increases due to climate change.

Modelled Hazard Mapping

For certain locations we have carried out modelling to map the maximum values of flood depth, velocity and hazard rating (danger to people) resulting from overtopping and / or breaching of defences at specific locations for a number of scenarios.

At present this information is available along the full coastal / tidal floodplain, except the tidal Witham Haven in Boston (upstream of Hobhole) where only breaching and not overtopping has been modelled and the tidal River Welland upstream of Fosdyke Bridge where neither breaching nor overtopping are available. Hazard mapping is also available for fluvial flood risk in Northampton, Lincoln, Brigg, Wainfleet and some isolated rural locations.

The number of locations we have this information for is expected to increase in time.

Hazard Mapping – Breaching

The attached maps show the maximum values of flood depth, velocity and hazard rating (danger to people) resulting from breaching of the defences at specific locations for the scenarios below. For some locations the breach mapping also includes flooding from overtopping if this is expected in that scenario. The location of modelled tidal breaches is shown on a separate attached map.

- Year 2115 1% (1 in 100) chance / 0.5% (1 in 200) chance
- Year 2115 0.1% (1 in 1000) chance

Your site is not affected by breaching of the defences for the present day (2006) scenarios.

Development Planning

If you have requested this information to help inform a development proposal, then you should note the information on GOV.UK on the use of our information for Flood Risk Assessments. We recommend that you undertake a formal pre-application enquiry using the form available from the website.

<https://www.gov.uk/planning-applications-assessing-flood-risk>

<https://www.gov.uk/government/publications/pre-planning-application-enquiry-form-preliminary-opinion>

Climate change will increase flood risk due to overtopping of defences. Please note the climate change data included has an allowance for 20% increase in flow. Updated guidance on how climate change could affect flood risk to new development - 'Flood risk assessments: climate change allowances' was published on GOV.UK in February 2016. The appropriate updated climate change allowance should be applied in a Flood Risk Assessment.

You should also consult the Strategic Flood Risk Assessment produced by your local planning authority.

Supporting Information

Please see the Standard Notice or licence for details of permitted use. The Standard Notice can be found at the link below.

<http://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/>

We respond to requests for recorded information we hold under the Freedom of Information Act 2000 (FOIA) and the associated Environmental Information Regulations 2004 (EIR).

Further information on flood risk can be found on the GOV.UK website at:

<https://www.gov.uk/browse/environment-countryside/flooding-extreme-weather>

Other Flood Risk Management Authorities

The information provided with this letter relates to flood risk from main river or the sea. Additional information may be available from your Lead Local Flood Authority (ie county council or unitary authority) or, where they exist, the Internal Drainage Board.

Further Contact

I hope we have correctly interpreted your request. If you are not satisfied with our response to your request for information, you can contact us within two calendar months to ask for our decision to be reviewed.

If you have any queries or would like to discuss the content of this letter further please contact Emily Holroyd using the details below.

Yours sincerely,



FOR Alastair Windler

Partnerships and Strategic Overview Team Leader - Welland and Nene

Team dial 020 302 53535

E-mail PSOWN@environment-agency.gov.uk

Enc.

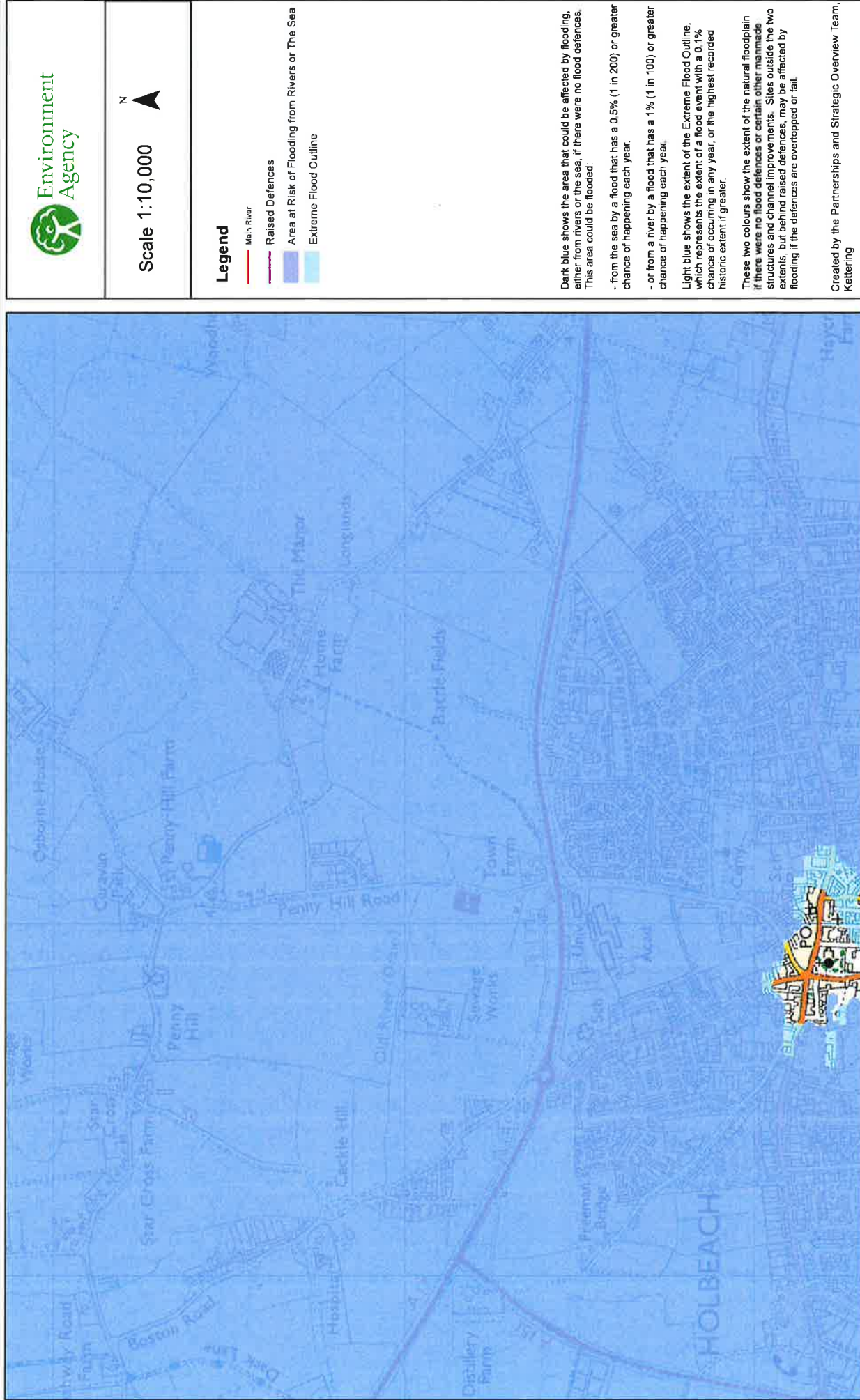
Flood Map

Estimated Tide Levels

Tidal Breach Locations Map

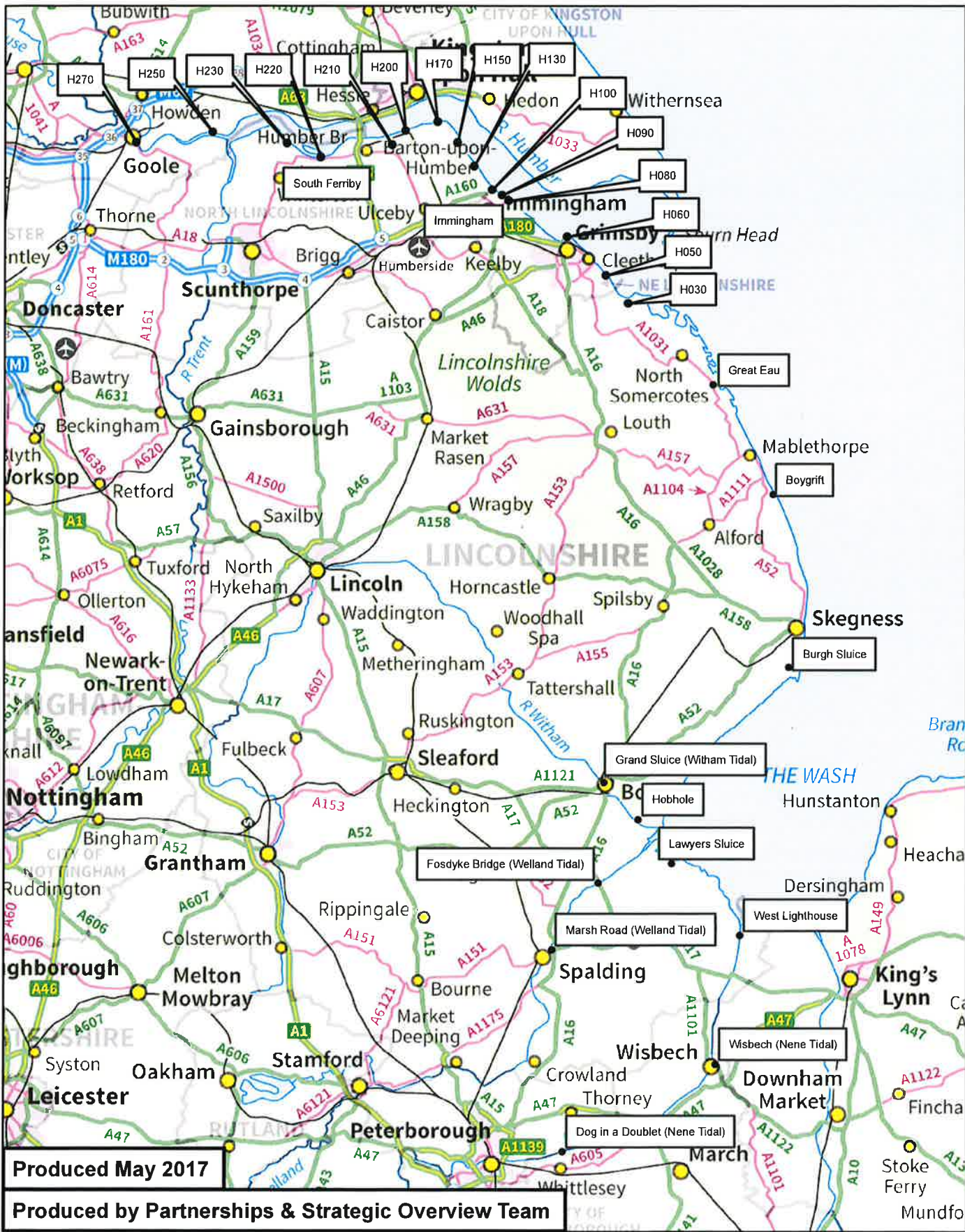
Hazard Mapping – Breaching (2 maps)

Flood Map centred on TF 36192 25908 - created December 2018 [Ref: CCN-2018-109233]



Tidal Level Location Map

Lincolnshire & Northamptonshire Area

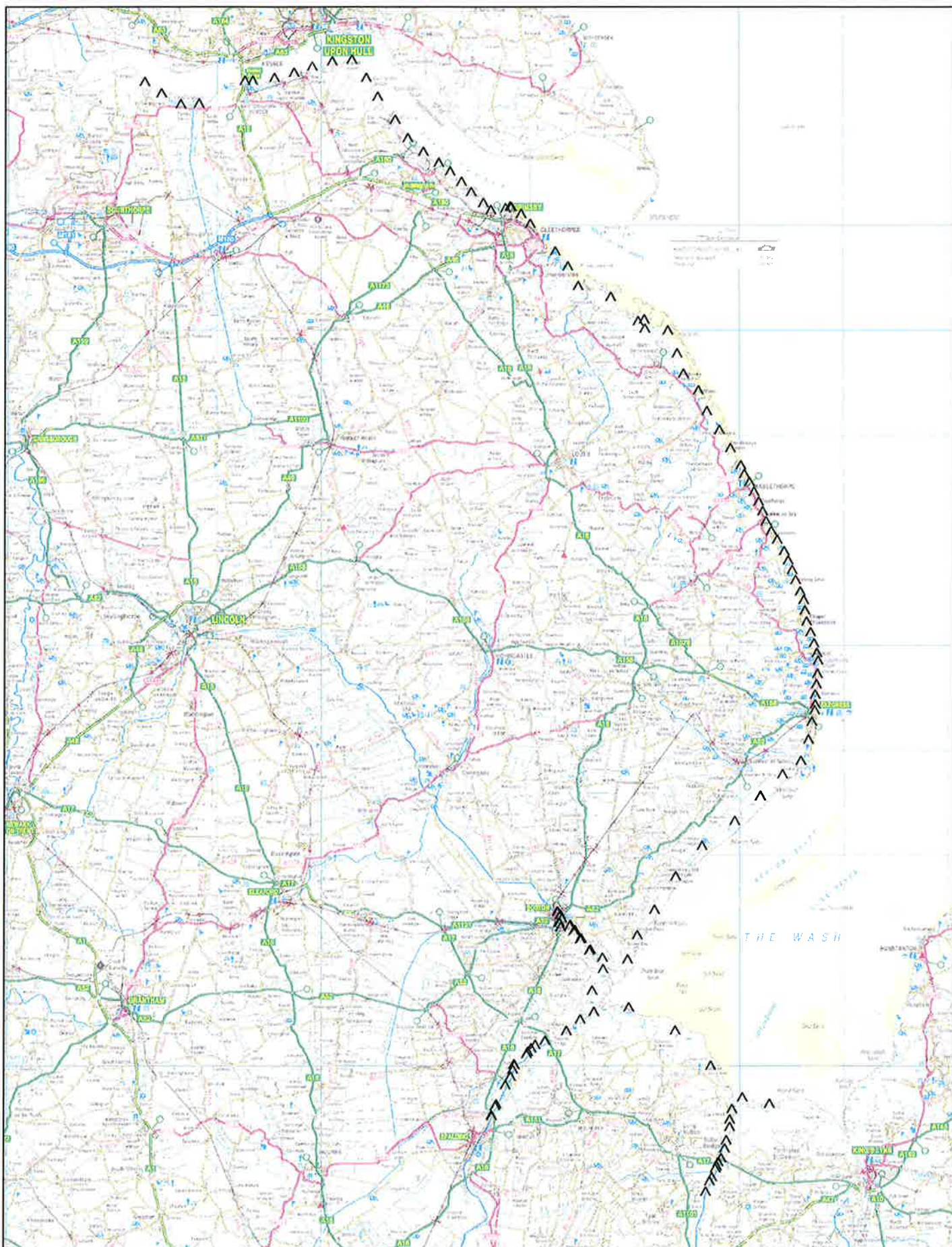


Tidal Water Levels for the South Humber, East Coast and The Wash

The table below shows still water levels for locations, from the above location map, around the South Humber Estuary, East Coast and The Wash. It is important to note the following:

- The base date for the data is 2014 for the South Humber and 2006 for the East Coast and The Wash.
- The data are still water levels. Depending on the use of the data it may be necessary to consider wave heights and / or joint probability analysis of water level and other variables.
- The water level quoted is the 'Best Estimate' water level. Depending on the use of the data it may be necessary to carry out sensitivity testing. Upper and Lower 95% confidence bandings are available upon request.
- Levels for other annual chance scenarios are available if required.

Ref	Location	Easting	Northing	Annual Chance (1 in x) of Tide Level					
				metres ODN					
				1	10	50	100	200	1000
HUMBER									
H030	Tetney	535420	403180	3.94	4.29	4.56	4.69	4.82	5.15
H050	Buck Beck	532700	406580	4.03	4.36	4.62	4.74	4.87	5.18
H060	Grimsby	527878	411346	4.10	4.43	4.70	4.82	4.95	5.27
H080	Haborough Marsh	520790	415740	4.26	4.61	4.88	5.01	5.14	5.47
H090	Immingham	519141	417449	4.26	4.61	4.88	5.01	5.14	5.47
H100	South Killingholme	518700	417120	4.41	4.77	5.05	5.18	5.32	5.66
H130	North Killingholme	516530	420000	4.51	4.87	5.15	5.28	5.42	5.77
H150	East Halton	514450	422870	4.59	4.96	5.25	5.39	5.53	5.89
H170	Goxhill	511970	425440	4.67	5.04	5.34	5.47	5.61	5.95
H200	New Holland	508020	424330	4.87	5.26	5.55	5.68	5.81	6.12
H210	Barrow Haven	506380	422620	4.92	5.31	5.60	5.73	5.86	6.17
H220	Ferriby	497550	421150	5.04	5.42	5.67	5.77	5.86	6.04
H230	Winterton	493420	422830	5.14	5.51	5.74	5.83	5.90	6.02
H250	Blacktoft	484247	424190	5.25	5.62	5.83	5.90	5.96	6.04
H270	Goole	474857	422960	5.46	5.85	6.07	6.15	6.21	6.29
East Coast									
~	Great Eau	545500	393800	3.80	4.19	4.46	4.57	4.69	4.96
~	Boygrift	553300	379800	3.84	4.24	4.53	4.65	4.77	5.05
~	Burgh Sluice	555190	358620	4.26	4.45	4.76	4.90	5.03	5.34
Wash									
~	Hobhole	536610	339940	4.82	5.30	5.64	5.78	5.93	6.27
~	Lawyers Sluice	540750	334550	4.84	5.32	5.66	5.80	5.95	6.29
~	West Lighthouse	549150	325750	4.88	5.37	5.71	5.86	6.01	6.35
~	Grand Sluice	532400	344500	4.88	5.33	5.65	5.78	5.93	~
~	Fosdyke Bridge	531700	332200	4.91	5.38	5.71	5.85	5.99	~
~	Marsh Road	526000	324000	5.04	5.44	5.73	5.85	5.98	~
~	Wisbech	546100	310000	4.83	5.25	5.53	5.66	5.78	~
~	Dog In Doublet	527300	299300	3.67	4.00	4.22	4.32	4.42	~



^ Modelled Breach Locations

0 3.5 7 14 Kilometres

This map indicates the location of where we have modelled the consequence of breaches in the defences along the coastline and tidal rivers. We have mapped the the maximum values of Hazard Rating (Danger to People), Depth and Velocity.

We have not assumed that all breaches occur at the same time, but have modelled each breach individually and overlaid the results to find the maximum values.

Our modelling only considers the consequences of a breach, it does not make any assumption about the likelihood of a breach occurring. Our defences generally provide a good standard of flood defence but a risk of breaching remains.

Please contact the Environment Agency for information on how these maps are used in the management of flood risk.

General Enquiries No: 03708 506 506.
Weekday daytime call cost 5p plus up to 6ppm from BT Weekend Unlimited. Mobile and other providers charges may vary



Produced by the Partnership and Strategic Overview Team, Lincoln
General Enquiries No: 03708 506 506

Northern Area Tidal Hazard Mapping

Location of Modelled Breaches

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Max Hazard

Map showing Max Hazard areas (red squares) and other locations (blue squares) in the Penny Hill and Battlefields regions. The map includes a scale bar (0 to 0.4 Kilometres) and a legend.

[illegible]

This map illustrates the spatial distribution of maximum velocity along the River Great Ouse. The river is shown as a prominent feature, with its course marked by a thick line. The surrounding landscape is characterized by a mix of agricultural fields, urban areas, and a railway line. The map includes a scale bar indicating distances in Kilometres (0.4 km).

Max Hazard (Flood Risk to People: FD2320)	Max Depth (m)	Max Velocity (m/s)
--	---------------	--------------------

Between 0.75 and 1.25
(Danger for Severe)

(Danger for Most)

Greater than 2.0

Date	December	Sc
Printed	2018	

0 - 0.25

0.50 - 1.0
1.0 - 1.5

Scenario

15 Annual

0 - 0.3

1,0 - 1,5

--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

CCN Number	CCN-2
1092	

CCN-2018-109233	CCN Number
-----------------	------------

0.1%
(1 in 1000)

2115

Scenario	Year
----------	------

September 2018	S
----------------	---

Dec 20

Date _____
Printer _____

The map is based on computer modelling of simulated breaches at specific locations. Each breach has been modelled individually and the results combined to create this map. Multiple breaches, other combinations of breaches, different sized tidal surges or flood flows may all give different results.

General Enquiries No. 03708 506 506. Weekday Daytime calls cost 5p plus up to 5p per minute from BT Weekend Unlimited. Mobile and other providers' charges may vary

Map Centred on TF 36192 25908

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