

**AMBER HOUSE FARM, SUTTERTON DROVE, AMBER HILL,
BOSTON, Lincs PE20 3RS**

FLOOD RISK ASSESSMENT



View from north

S M Hemmings B Sc C Eng MICE MIWEM,
13 Lea Gardens,
Peterborough
PE3 6BY

This flood risk assessment has been prepared to support the planning application at Amber House Farm, Sutterton Drove, Amber Hill, Boston. The author has made every effort to provide an accurate assessment of the flood risk but accepts no liability should the information be found to be incorrect or incomplete, or if it is used for any other purposes other than for which it was originally commissioned.

Introduction

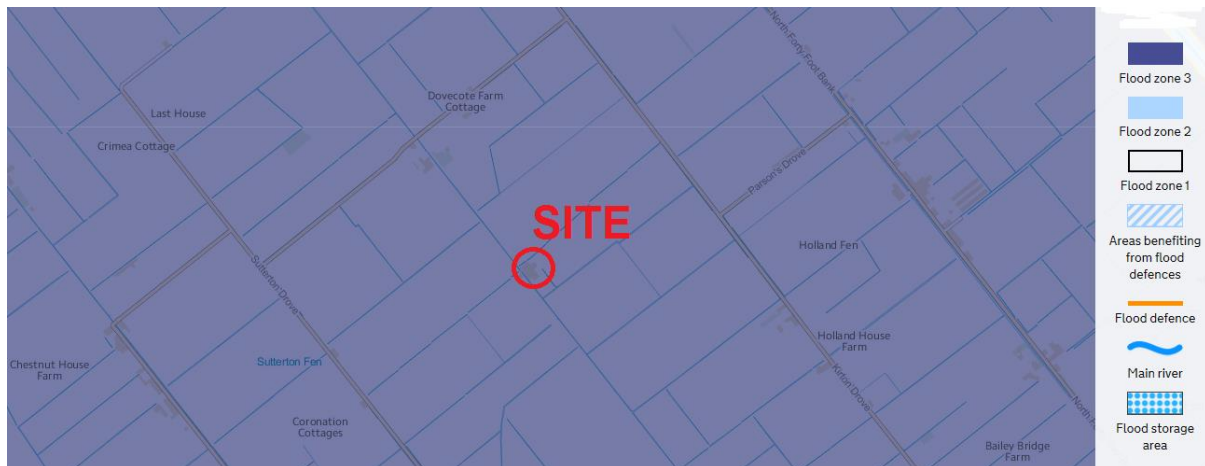
An application has been made to Boston Borough Council for planning permission to construct a potting shed and a greenhouse at Amber House Farm, Sutterton Drive, Amber Hill, Boston, PE20 3RS. The site is situated approximately 12.0 km north west of the centre of Boston.

The site is within Flood Zone 3 as shown on the Environment Agency's Flood Zone map. The flood zone maps do not take into account existing flood defences.

This flood risk assessment has been prepared to enable the Planning Application to be considered by the planning authority. The site is within a defended area as specified in the Boston Borough Council's Strategic Flood Risk Assessment (SHDC SFRA) map and is located in the Black Sluice Internal Drainage Board District.

Environment Agency (EA) Flood Zones

The map below is taken from the Environment agency website and shows the flood zones in this area.



It can be seen that all of this area north of Boston area is in Flood Zone 3.

Application Site

The site is located approximately 2.4 km south west of the River Witham, and is approximately 12km north west of the centre of Boston. The National Grid Reference of the site is 521980 349460.

The position and extent of the site is shown on the plan at the end of this document.

As the site is within a defended area the proposed development can be considered to be within Flood Zone 3(a) as defined in Table 1 of the Technical Guidance.

Table 3 of the Guidance is shown on the next page:

<u>Flood Zones</u>	<u>Flood Risk Vulnerability Classification</u>				
	Essential infrastructure	Highly vulnerable	More vulnerable	Less vulnerable	Water compatible
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	Exception Test required	✓	✓	✓
Zone 3a †	Exception Test required †	X	Exception Test required	✓	✓
Zone 3b *	Exception Test required *	X	X	X	✓*

Referring to the flood risk vulnerability classification in Table 2 of the Guidance, the development of a potting shed and a shed is not on the list. It would seem realistic to classify these as “less vulnerable” and Table 3 of the Guidance (see above) states that this type of development is satisfactory in flood zone 3(a).

Sequential Test

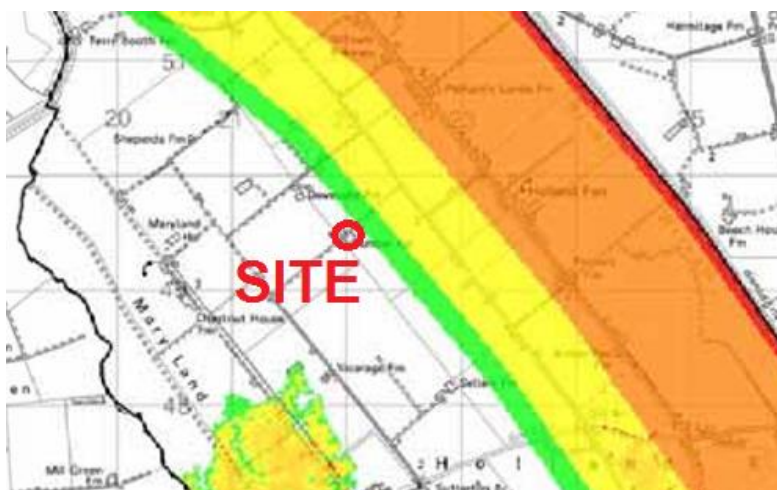
The aim of the Sequential Test, as set out in the Planning Practice Guidance, is to ensure that a sequential approach is followed to steer new development to areas with the lowest probability of flooding. The flood zones as defined in the Strategic Flood Risk Assessment for the area provide the basis for applying the Test. The aim is to steer new development to Flood Zone 1 (areas with a low probability of river or sea flooding). Where there are no reasonably available sites in Flood Zone 1, local planning authorities in their decision making should take into account the flood risk vulnerability of land uses and consider reasonably available sites in Flood Zone 2 (areas with a medium probability of river or sea flooding), applying the Exception Test if required. Only where there are no reasonably available sites in Flood Zones 1 or 2 should the suitability of sites in Flood Zone 3 (areas with a high probability of river or sea flooding) be considered, taking into account the flood risk vulnerability of land uses and applying the Exception Test if required.

As this development for the recreational use of residents of the house then the greenhouse and the potting shed cannot be located at an alternative location.

Strategic Flood Risk Assessment

Consultants have produced a Strategic Flood Risk Assessment (SFRA) for the Boston Borough Council (SHDC). This document provides details of the flood risk in the Council's area.

The SFRA contains maps showing the predicted hazard from flooding. These maps show that the greatest hazard in this area of Amber Hill to be from a breach or overtopping of the fluvial defences of the River Witham. The map below shows the hazards in this area, and it can be seen that there is no predicted hazard on the site of the development.



The SFRA also give more general maps on the relative probability of flooding in this area. As there is now available more detailed mapping from the Environment agency these will be considered in detail.

Information Supplied by the Environment Agency

The Environment Agency have provided maps showing the maximum hazard, depth of flooding and velocity for the 1 in 200 year and the 1 in 1000 year tidal breaching events in 2115, and the results of these are shown below:

	Hazard	Flood Depth	Velocity
1 in 200 year event in 2115	zero	zero	zero
1 in 1000 year event in 2115	zero	zero	zero

The predicted flood extent in a 1 in 1000 year event extends to the southern edge of the site where ground levels are approximately 1.0 metre below the existing ground level around the building itself.

The maps of this flood risk supplied by the Environment Agency are reproduced on pages 13 – 14 of this report.

The Environment Agency has also provided predicted flood levels for the River Witham taken from the modelling that has been carried out for this area.

	Present Day	With 20% allowance for climate change
Peak 1 in 100 year flood level	4.17m OD	4.36m OD
Peak 1 in 1,000 year flood level	4.21m OD	4.37m OD

The Environment Agency has provided predicted flood levels for the Kyme Eau taken from the modelling that has been carried out for this area.

	Present Day	With 20% allowance for climate change
Peak 1 in 100 year flood level	3.87m OD	3.88m OD
Peak 1 in 1,000 year flood level	3.89m OD	3.93m OD

The Environment Agency has provided predicted flood levels for the Head Dyke taken from the modelling that has been carried out for this area.

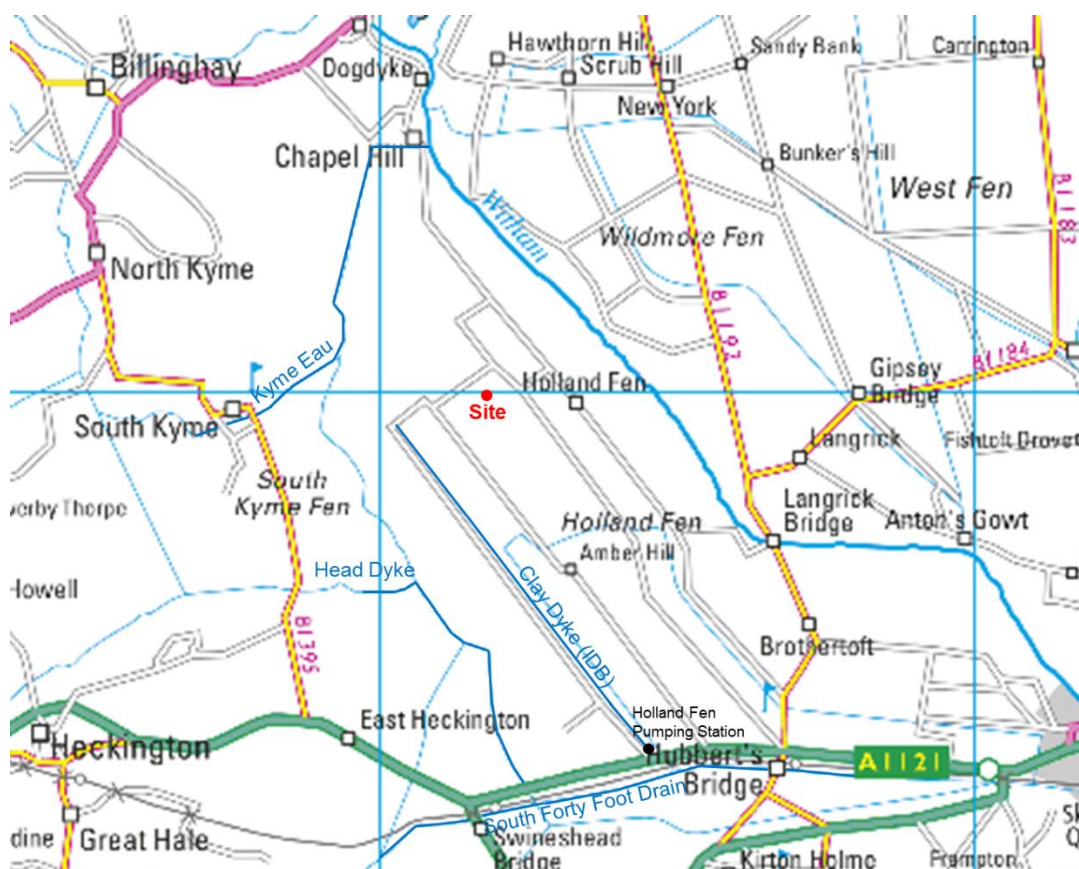
	Present Day	With 20% allowance for climate change
Peak 1 in 100 year flood level	2.82m OD	2.86m OD
Peak 1 in 1,000 year flood level	2.96m OD	2.98m OD

The Environment Agency have provided a map showing modelled flood extents for fluvial events from 5% (1 in 20) to 0.1% (1 in 1000). This map indicates that in a 1 in 1000 year event the southern part of the site, where land levels are approximately 1.0 metre lower, could be flooded, but the barn area and the road are not affected.

Existing Flood Alleviation Measures

The site is within a defended flood plain, as defined in Appendix 1 of the Environment Agency's "Policy and Practice for the Protection of Flood Plains", which is considered to be passive until such time that a flood greater than the defences can withstand occurs. The likelihood of flooding occurring due to overtopping or failures of the defences can be considered to be very low.

The map below shows all of the watercourses in the area that could be a source of flooding to the development site.



The site is located approximately 2.4km south west of the River Witham which is maintained by the Environment Agency.

The site is located approximately 6.5km north of the South Forty Foot Drain which is maintained by the Environment Agency. The South Forty Foot drain is the main arterial watercourse which carries all of the drainage from the area south west of Boston as far as Bourne to the outfall at Black Sluice Pumping Station in Boston where it discharges into the Haven.

The site is located approximately 12km north west of the tidal defences of the Haven which are maintained by the Environment Agency.

The site is located approximately 2.9km north east of the Head Dyke which is maintained by the Environment Agency. Four IDB pumping stations discharge into the Head Dyke which flows into the South Forty Foot Drain east of Swineshead Bridge.

The site is located approximately 2.9km south east of the Kyme Eau which is maintained by the Environment Agency. This watercourse provides drainage for an area of land extending as far as Sleaford and also IDB pumping stations discharge into this watercourse.

The River Witham, the Kyme Eau and the head Dyke are all high level watercourses with earth banks protecting the surrounding land from flooding.

The Black Sluice IDB maintains the arterial drainage system for the area. The drain on the west side of the site is the Fifteen Foot Drain, which is a Drain maintained by the Board.

Existing Ground Levels

There is an ordnance survey bench mark on the building which indicates a level of 2.853m ODN. This is approximately 500mm above ground level and is probably 300mm above the ground floor level of the house, which can be estimated to be 2.55m ODN. It is assumed that the ground around the house is at a level of 2.40m OD and this will slowly slope down south of the house to the levels of the fenland which is approximately 1.0 metre below the level of the house.

Potential Sources of Flooding

The following sources of flooding have been identified:

- 1) Tidal flooding due to overtopping or breaching of the Haven
- 2) Fluvial flooding from overtopping or a breach in the River Welland
- 3) Fluvial flooding from overtopping or a breach in the Kyme Eau
- 4) Fluvial flooding from overtopping or a breach in the South Forty Foot Drain.
- 5) Fluvial flooding from overtopping or a breach in the Head Dyke or the Skerth Drain

- 6) Flooding from the IDB drainage system.
- 7) Flooding from local surface water systems.

1. Tidal Flooding due to overtopping or breaching of the Haven

The north end of the Haven near Grand sluice is 12.0 km south east of the site. The Environment Agency have stated that the predicted tide levels along this section of coastline are as shown below.

	1 in 200 year event	1 in 1000 year event
Burgh Sluice	5.03	5.34
Hobhole	5.93	6.27

The Environment Agency have agreed a one hundred year strategy for the length of the Haven as far as Grand Sluice. This involves the construction of a Barrier to prevent flooding upstream of Black Sluice Pumping Station, and to raise bank levels along the Haven as predicted tide levels increase with climate change to ensure that there is always a 1 in 200 year standard of defence along both banks of the Haven.

As the site is 12 km north of the Haven the risk of flood water resulting from breach in the defences in a 1 in 1000 year event in 2115 reaching the site and rising to a level of above 2.0m OD is remote.

2. Fluvial flooding from overtopping or a breach in the River Witham

The Environment Agency advise that the fluvial defences reducing the risk of flooding to this site consist of earth embankments. They are in fair condition and reduce the risk of flooding to a 20% (1 in 5) chance of occurring in any year.

The Environment Agency have stated that the maximum predicted river level in a 1 in 1000 year event in 2115 is 4.37m OD. This is the greatest source of risk of flood to the site. If flood water flowed westwards towards the site it first crosses the North Forty Foot Drain, which will distribute the flood water north and south across all lower levels of the fen.

The map of flood extents supplied by the Environment Agency does not predict this flood water will affect the site of the building.

3. Fluvial flooding from overtopping or a breach in the Kyme Eau

The fluvial defences reducing the risk of flooding to this site consist of earth embankments. They are in fair condition and reduce the risk of flooding to a 1% (1 in 100) chance of occurring in any year.

With a maximum predicted level in the Kyme Eau of 3.93m OD a breach in the south bank of the Eau would flow towards the development site. However the flood water

would flow into the Clay Dyke and be redirected to flood lower land and this is likely to prevent the flood water rising to a level that would flood the proposed development.

4. Fluvial flooding from overtopping or a breach in the South Forty Foot Drain.

The risk of flooding from the South Forty Foot Drain is approximately 10% (1 in 100) chance in any year. In a greater event than 1 in 10 years the Drain will start to overtop its banks south of Donington, and this flooding will ensure the level of the Drain does not exceed 2.80m OD in the section between Swineshead Bridge and Boston, and the risk of flooding will be extremely low.

Therefore the flood risk from this source to the development site can be discounted.

5. Fluvial flooding from overtopping or a breach in the Head Dyke or the Skerth Drain

The fluvial defences reducing the risk of flooding to this site consist of earth embankments and a flood wall. They are in fair condition and the Environment Agency advise that they reduce the risk of flooding to a 4% (1 in 25) chance of occurring in any year.

The predicted maximum predicted level in this watercourse is 2.98m OD in a 1 in 1000 year event in 2115. This is only 530mm above the proposed ground floor level of the proposed building. Flood water from a breach in the Head Dyke or the Skerth Drain would flow initially into the Clay Dyke, which would then fill up and cause flooding to low lying land in the area.

Therefore it is considered the risk of flooding from this source is remote.

6. Flooding from the IDB drainage system.

The site is within the Holland Fen catchment of the Black Sluice IDB. The levels in this catchment are controlled by Holland Fen Pumping Station which is located at the southern end of Clay Dyke and lifts the water into the South Forty Foot Drain. The Fifteen Foot Drain, which is on the western boundary of the site of the development flows southwards and discharges into the Gill Syke, which flows westwards to the Clay Dyke and then south to the pumping station.

The first pumping station was constructed in 1967 as part of the Black Sluice Major Improvement Scheme. Before this the low lying land, particularly around Gill Syke would be prone to low levels of flooding because the IDB drains depended on gravity drainage into the South Forty Foot Drain. However since 1967 these problems have been resolved and the whole area enjoys good drainage of the land.

The Black Sluice IDB has carried out modelling of this catchment, and have provided predicted water levels following a 1 in 100 year event. These water levels are shown on the plan reproduced on page 12 of this report, and it can be seen that all water levels are at least 1.0 metre above the proposed ground floor level of the new building.

7. Flooding from local surface water systems.

It is unlikely that any substantial flood depths will occur on the site because of the close proximity of the Fifteen Foot Drain on the west side of the site.

Extent of known Flooding

During the preparation of this assessment, no evidence was discovered of the site or any of the adjoining properties being flooded in the last thirty years.

Probabilities and Trends of Flooding

The probability of this development flooding from Environment Agency main river is very low.

Residual Risk – Extreme Events

The residual risk from extreme events is very low on this site. The major risk to the site is from a breach or overtopping of the tidal defences

Climate Change

The recommendations for flood depths for this flood risk assessment use information provided by the Environment Agency which was produced in 2006. The EA have issued new guidance on recommended contingency allowances for predicted sea rises, fluvial flows and rainfall intensities which from 19th February 2016 needs to be considered in the FRA. The effects of these new recommendations are considered in Appendix A of this report (pages 17 to 20). It is concluded that no extra mitigation measures are necessary to comply with the new guidance on climate change.

Conclusions

The proposed development is not in a functional flood plain as defined by PPS 25.

Although the site is in flood zone 3, the actual risk of the proposed building being flooded from any Environment Agency or IDB watercourse is very low.

The map below is part of the map supplied by the EA showing modelled flood extents. The light purple shading is the extent of a 1 in 1000 year event in 2115.



All of the evidence from the map in the SFRA and the maps of the modelled flood extents supplied by the Environment Agency show that flood water after a breach in

either the River Witham or the Kyme Eau in a 1 in 1000 year event in 2115 could extend onto the southern end of the site where ground levels are similar to the fenland south of the site at a level of approximately 1.40m OD. It is possible that flood water could be approximately 600mm deep in an extreme event, but this would not affect the building with a ground floor level of 2.55m OD.

S M HEMMINGS B Sc C Eng MICE MIWEM

stuart.hemmings@btinternet.com

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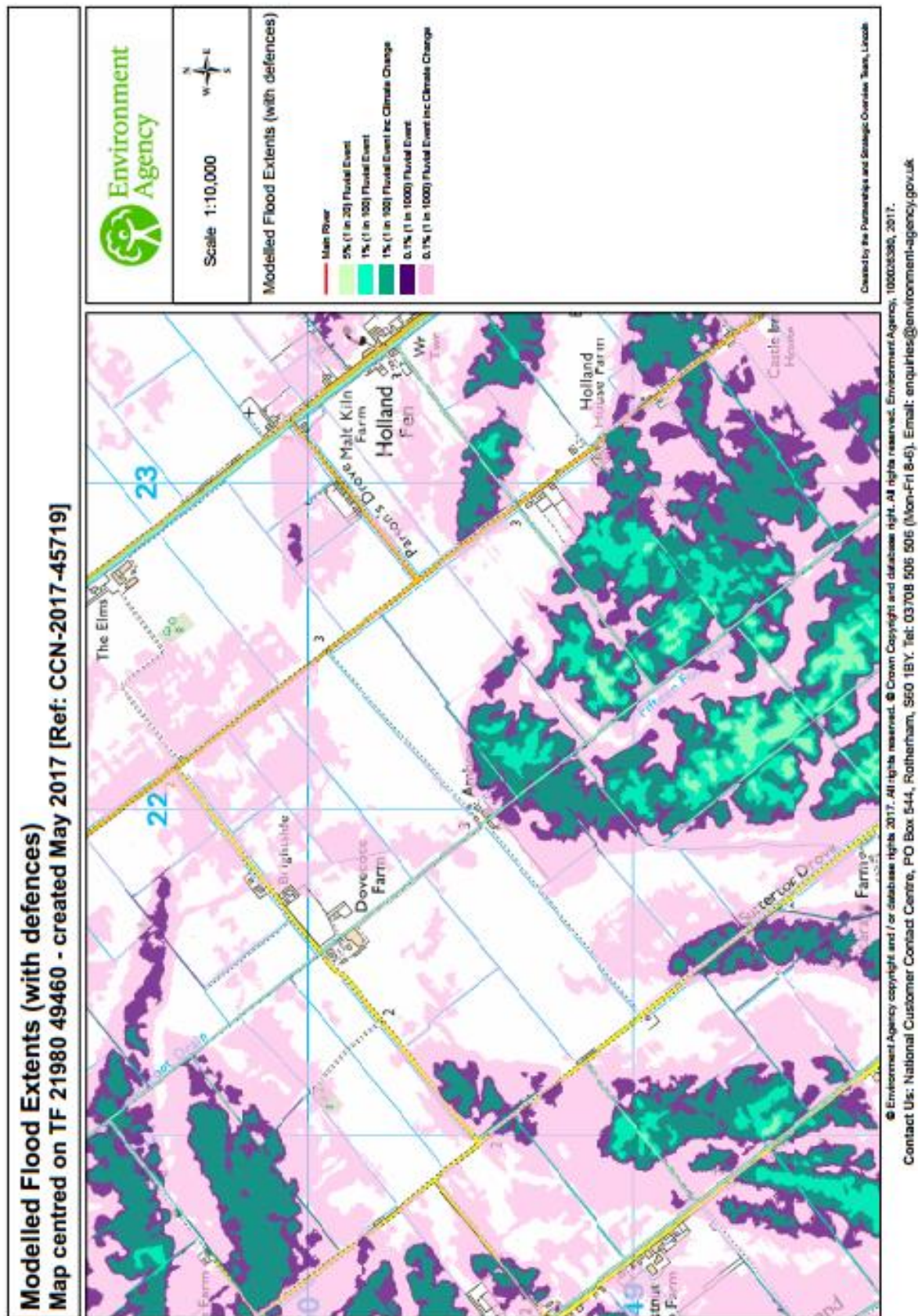
Location Plan



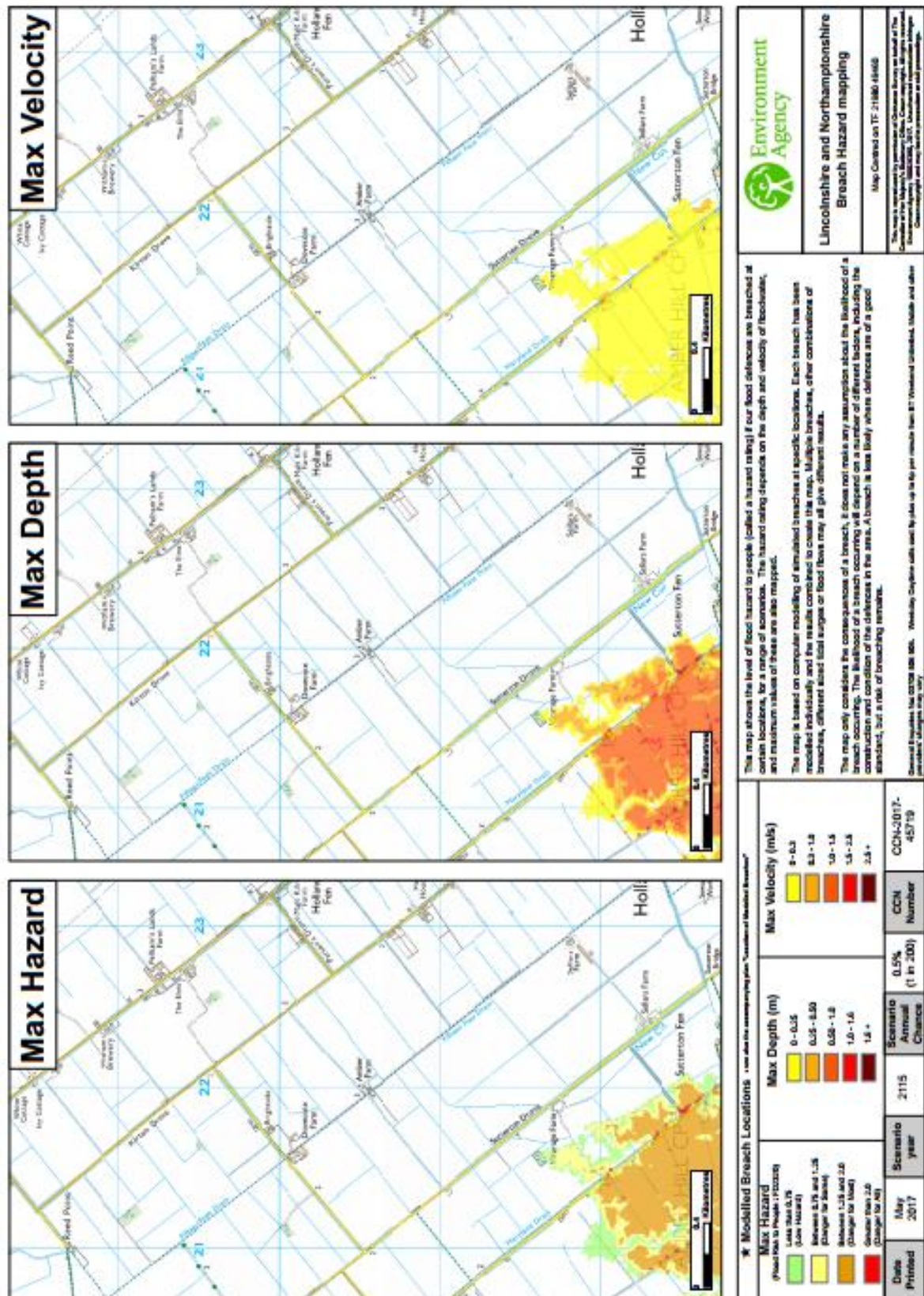
PLAN OF BLACK SLUICE IDB DRAINS AND PREDICTED WATER LEVELS



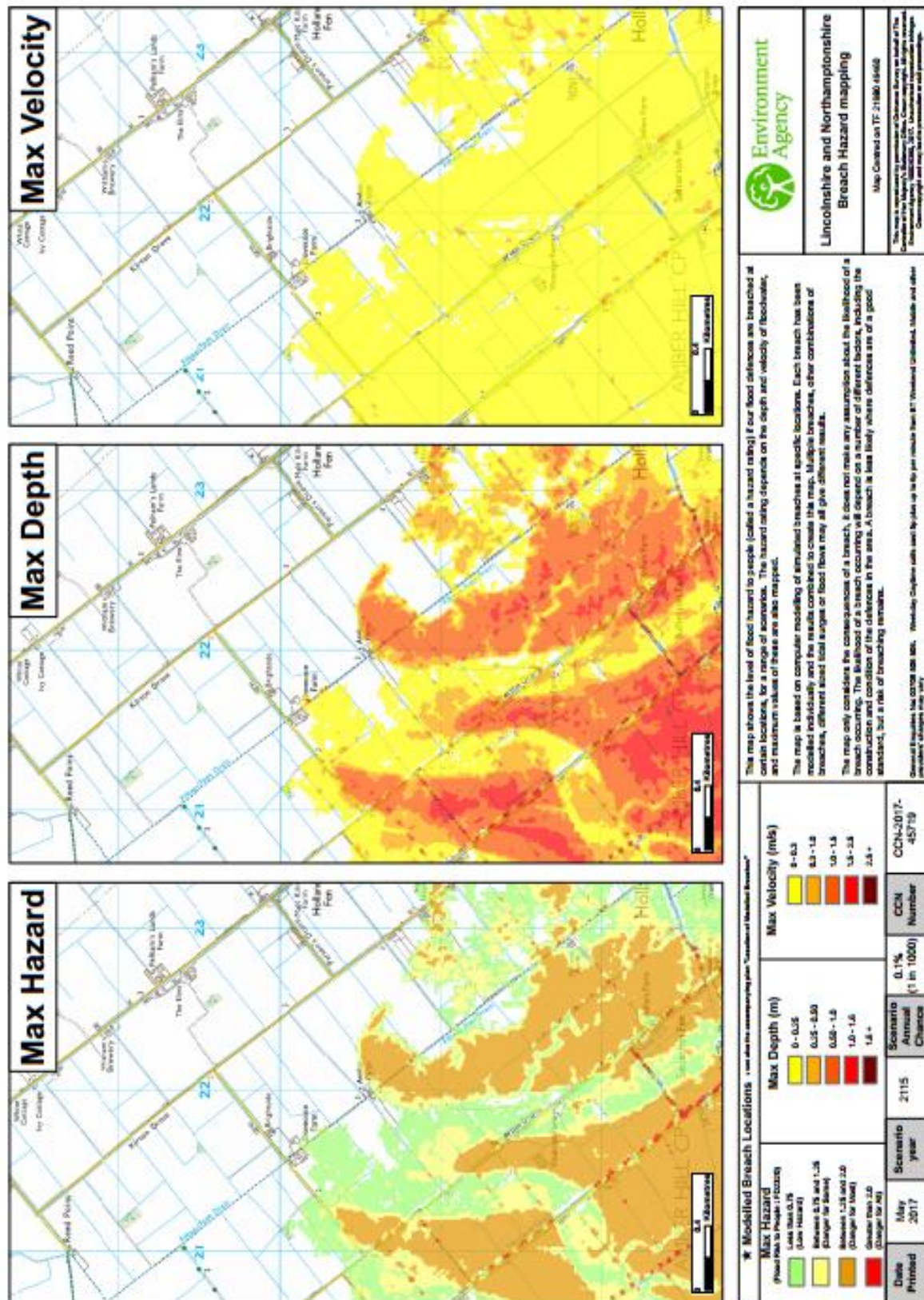
ENVIRONMENT AGENCY MAP OF MODELLLED FLOOD EXTENTS



1 in 200 year Flood Risk from Breaching in 2115



1 in 1000 year Flood Risk from Breaching in 2115



APPENDIX A CLIMATE CHANGE

The Environment Agency has issued revised guidance on climate change and have now stated that the new predictions should be considered and incorporated into all flood risk assessments produced after 19th February 2016.

The maps issued by the EA were produced in 2006 and used the climate change impacts published by Defra in October 2006 which are reproduced below.

Table 1: Regional net sea level rise allowances

<i>Administrative or Devolved Region</i>	<i>Assumed Vertical Land Movement (mm/yr)</i>	<i>Net Sea-Level Rise (mm/yr)</i>				<i>Previous allowances</i>
		<i>1990-2025</i>	<i>2025-2055</i>	<i>2055-2085</i>	<i>2085-2115</i>	
East of England, East Midlands, London, SE England (south of Flamborough Head)	-0.8	4.0	8.5	12.0	15.0	6mm/yr* constant

Table 2: Indicative Sensitivity Ranges

<i>Parameter</i>	<i>1990-2025</i>	<i>2025-2055</i>	<i>2055-2085</i>	<i>2085-2115</i>
Peak rainfall intensity (preferably for small catchments)	+5%	+10%	+20%	+30%
Peak river flow (preferably for larger catchments)	+10%	+20%		
Offshore wind speed	+5%		+10%	+10%
Extreme wave height	+5%		+10%	+10%

Revised 2016 EA Guidance

Table 1 peak river flow allowances by river basin district (use 1961 to 1990 baseline)

River basin district	Allowance category	Total potential change anticipated for '2020s' (2015 to 39)	Total potential change anticipated for '2050s' (2040 to 2069)	Total potential change anticipated for '2080s' (2070 to 2115)
Anglian	Upper end	25%	35%	65%
	Higher central	15%	20%	35%
	Central	10%	15%	25%

For less vulnerable development in flood zone 3(a) the central and higher central should be used to assess the range of allowances.

Table 2 peak rainfall intensity allowance in small and urban catchments (use 1961 to 1990 baseline)

Applies across all of England	Total potential change anticipated for 2010 to 2039	Total potential change anticipated for 2040 to 2059	Total potential change anticipated for 2060 to 2115
Upper end	10%	20%	40%
Central	5%	10%	20%

Table 3 sea level allowance for each epoch in millimetres (mm) per year with cumulative sea level rise for each epoch in brackets (use 1990 baseline)

Area of England	1990 to 2025	2026 to 2050	2051 to 2080	2081 to 2115	Cumulative rise 1990 to 2115 / metres (m)
East, east midlands, London, south east	4 (140 mm)	8.5 (212.5 mm)	12 (360 mm)	15 (525 mm)	1.24 m

Table 4 offshore wind speed and extreme wave height allowance (use 1990 baseline)

Applies around all the English coast	1990 to 2050	2051 to 2115
Offshore wind speed allowance	+5%	+10%
Offshore wind speed sensitivity test	+10%	+10%
Extreme wave height allowance	+5%	+10%
Extreme wave height sensitivity test	+10%	+10%

Effects on Predictions of Flood Risk in FRA

The FRA has identified three possible sources of flooding where the new climate change recommendations could affect the predictions of flood levels in 2115 at the development site:

- 1) Tidal Flooding from the Haven.
- 2) Flooding from the River Witham, Kyme Eau or the Head Dyke (Fluvial)
- 3) Flooding from IDB drains

1) Tidal Flooding from the Haven or the Wash

The contingency allowance in metres for the years 2055 and 2115 using 1990 as a baseline in the SFRA compared with the guidelines is as follows

Year	2006 guidance	Revised 2016 guidance
2055	0.395	0.412
2115	1.205	1.24

It is unlikely that an increase of 35mm in maximum levels in the Wash will have a significant impact on the conclusion that flood water from the haven is unlikely to effect the site of the development.

2) Flooding from the River Witham, Kyme Eau or the Head Dyke (Fluvial)

As the development is in flood zone 3 and is classed as less vulnerable, the central climate change allowance, which is 25%, should first be considered. After considering the effects of this increase the higher central allowance, which is 35%, should be considered to assess the effect of this.

The EA have been using an allowance of 20% for climate change over the past few years in their assessments and modelling of their systems. The SFRA and it is

assumed the modelled maximum levels and the flood extents also has used this figure of 20%.

The increase to 25% will not significantly change the predictions of the water levels in the River Witham. There are significant flood storage areas both upstream and downstream of Lincoln, and the River is restricted at Lincoln so a significant increase in flows will not result in a significant increase in water levels in the lower reaches near Boston.

The upper end allowance predicting a 35% increase in flows above the 1 in 100 year predicted flows now needs to be considered. These may slightly increase water levels in the River Witham, but will not raise flood levels significantly.

3) Effect on IDB Systems

Black sluice IDB, and all IDB's, are aware that climate change will affect the operations of pumping stations, sluices and drainage channels. Pumping stations and sluices only have a 30 year life and will need to be refurbished or rebuilt within this timespan. It is assumed that Black Sluice IDB will continue to review the modelling they have already carried out and when the Board consider these refurbishments adequate arrangements will be made to incorporate the latest climate change projections in order that Board continues to provide the same standard of service as the present day.

Therefore it is considered that the proposed development is satisfactory on this site.