PROPOSED DEVELOPMENT AT
215 BRIDGE ROAD, SUTTON BRIDGE, SPALDING, PE12 9SL
FLOOD RISK ASSESSMENT



View from Road

S M Hemmings B Sc C Eng MICE MIWEM,
69 Charlotte Way,
Peterborough,
PE3 9ER

This flood risk assessment has been prepared solely to support the planning application for a development at Bridge Road, Sutton Bridge. 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.

Introduction

An application is due to be made to South Holland District Council for Planning Permission to demolish the existing buildings on the land east of 215 Bridge Road, Sutton Bridge, PE12 9SL and construct one detached and a pair of semi-detached houses on the site.

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

The Planning Application requires a Flood Risk Assessment to be carried out as specified in the Practice Guidance to the National Planning Policy Framework Development and Flood Risk. The site is shown within the defended area of the South Holland District Council's Strategic Flood Risk Assessment (SHDC SFRA) map and is located in the South Holland 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 the area.



It can be seen that the whole of the Sutton Bridge, except for a small area on the north east side of the town, is in Flood Zone 3.

Application Site

The development is located on the western side of the River Welland. The National Grid Reference of the site is 546680 321735.

The location of the site is shown on the plan at the end of this document.

Applying the flood risk vulnerability classification in Table 2 of the Guidance, a development consisting of dwelling houses is classified as "more vulnerable".

Table 3 of the Guidance is shown below:

Flood Zones	Flood Risk Vulnerability Classification				
	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	✓*

Therefore it can be seen that for "More vulnerable" development the sequential and the exception tests need to be applied to the development.

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.

The greater part of the area around Sutton Bridge and Long Sutton, as can be seen from the map on page 2 of this report, is in Flood Zone 3. Therefore it would be difficult to find a similar site for development within the village boundary that is in a lower flood zone.

Taking into account the guidance, it can be seen that it is extremely unlikely that an alternative site with a lower flood risk could be found in the village of Sutton Bridge for this development. The safety of the development will be delivered by ensuring the

floor level of the proposed new dwellings is above predicted residual flood levels for this area.

The South Holland District Council Core Strategy states that there is a limited number of sites outside the town of Spalding available for residential development. Some greenfield land will need to be identified to enable the Council to meet the RSS and Structure Plan requirement for 2021. Therefore there is a requirement for further land to be brought forward and used for residential development.

Therefore I consider that the sequential test has been passed.

Exception Test

The Sequential Test has demonstrated that it is not possible, consistent with wider sustainability objectives, for the development to be located in zones with a lower probability of flooding. Therefore the Exception Test must be applied and for this to be passed:

- It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risks, informed by the Strategic Flood Risk Assessment; and
- A site-specific flood risk assessment must demonstrate that the development will be safe for its lifetime taking into account of the vulnerability of its users, without increasing flood risk elsewhere, and where possible will reduce flood risk overall.

Both parts of this test must be satisfied in order for the development to be considered appropriate in terms of flood risk. There must be robust evidence in support of every part of the test.

The first section will be demonstrated by the Supporting Planning Statement and compliance with South Holland District Council's planning policies.

This flood risk assessment will demonstrate that the development will be safe for its lifetime and it will not increase flood risk elsewhere.

Strategic Flood Risk Assessment

Consultants have produced a Strategic Flood Risk Assessment (SFRA) for the South Holland District Council (SHDC). This document provides details of the flood risk in the Council's area. Reference to the maps in this document give the following information for the flood risk and hazard at the site for the 1% fluvial event and 0.5% tidal event.

The maps illustrate the actual flood hazard which is as follows:

For the present day
Depth of flooding ... zero
Extent of flooding .. Low or medium
Hazard.....zero
Velocity ..... Nil

For year 2115	Depth of flooding ... 0 - 500mm
	Extent of flooding .. High
	Hazard.....Low
	Peak Velocity .. 0 – 0.1m/sec

The maps also illustrate the residual flood hazard which is as follows:-

For the present day	Depth of flooding ... 0 - 500mm
	Extent of flooding .. High
	Hazard.....Low
	Peak Velocity .. 0 – 0.1m/sec
For the year 2115	Depth of flooding ... 0 - 500mm
	Extent of flooding .. High
	Hazard.....Low
	Peak Velocity .. 0 – 0.1m/sec

Figure 16 of the general maps shows that the site is not within the rapid inundation zone.

Tables in the SFRA show the following details of the defence bank on the west side of the tidal section of the River Nene south of the A17 road bridge, at chainage 5.2km.

	2007	2055	2115
Peak 1 in 200 year extreme tide level	5.86m OD	6.19m OD	7.00m OD
Peak 1 in 1,000 year extreme tide level	6.20m OD	6.53m OD	7.34m OD

The SFRA states the defence type at this point is "No raised Defence" with a defence crest level of 6.95 m OD and the freeboards are as follows:

	2007	2055	2115
Peak 1 in 200 year freeboard	1870mm	1540mm	730mm
Peak 1 in 1,000 year freeboard	1580mm	1250mm	440mm

Further south the defence is an earth bank with crest levels between 5.3km and 5.7km (the outfall of the South Holland Main Drain) of 7.07, 7.1, 7.04, 7.15 and 7.07m OD. However there is a low section adjacent to the bridge itself at a level of 5.95m OD. Levels of the defence north of the A17 bridge are approximately 6.30m OD.

Environment Agency Tidal Breach Hazard Mapping

The Environment Agency published mapping in 2012 which predicts the depths, velocities and hazard for a 1 in 200 year and a 1 in 1000 year breach event in 2115. The maps have been produced by modelling breaches along the whole length of the tidal defences and combining these into one map.

The map of the 1 in 200 year tidal breach hazard in 2115 shows a predicted flood depth of between 0 and 250mm on Bridge Road in front of the property and for the northern part of the site. The southern part of the site has a predicted flood depth of between 250mm and 500mm, and the predicted flood depth in the field south of the site is between 500mm and 1.0 metre. The flood hazard on Bridge Road and for all of the site is between 0.75 and 1.25 which is defined in guidance FD2320 as being "Danger for Some".

The map of the 1 in 1000 year tidal breach hazard in 2115 shows a predicted flood depth of between 0 and 250mm on Bridge Road in front of the property. The predicted flood depth on most of the site is higher at between 500mm and 1.0 metre, and this is the same in the field immediately south of the site. The flood hazard on Bridge Road and the northern part of the site is between 0.75 and 1.25 which is defined in guidance FD2320 as being "Danger for Some", and the southern part of the site increases to between 1.25 and 2.00 which is defined in guidance FD2320 as being "Danger for Most".

The maps supplied by the Environment Agency are reproduced on pages 13 and 14 of this report. A cross section through the site is shown on page 9 of this report with an estimation of the 1 in 200 year flood level.

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 is considered to be very low.

The site is located approximately 1.6 km from the tidal section of the River Nene, which is maintained by the Environment Agency.

There are watercourses in the area that are maintained by South Holland IDB.

Existing Ground Levels

The existing ground levels on the site are shown on page 09 of this report.

It can be seen that levels on the site of the proposed buildings vary from 3.80m OD to 3.99m OD. The level of Bridge Road north of the site is approximately 4.40m OD, and the level in the field south of the site is 3.35m OD.

The ground floor level of No 215 Bridge Road is 3.94m OD.

Potential Sources of Flooding

The potential sources of flooding to the site are:-

1. Failure or overtopping of tidal defences of the River Nene.
2. High water levels in IDB drainage channels.
3. Localised flooding due to failure of highway drainage

1. **Failure or overtopping of tidal defences of the River Nene**

The west bank of the River Nene is approximately 1.6 km east of the site of the proposed development, and the Wash Banks are 10km north of the site at their nearest point. The hazard from the River Nene east of the development site if a breach occurred in the length of bank between the South Holland Main Drain Outfall and the A17 bridge will be considered to be the major risk to the site. If the banks north of the A17 bridge or the Wash banks breached the flood water could reach the site but the resulting flood depths would not be as high as if a breach occurred in the banks directly east of the site.

The predicted levels in the SFRA indicate that the west bank of the River Nene between the A17 road bridge and the South Holland Main Drain Outfall Sluice will not be overtopped unless there is an event greater than 1 in 1000 years at the present time. However in 2115 although it will not be overtopped in a 1 in 200 year event, it will be overtopped in a 1 in 1000 year event.

The maps in the SFRA indicate that the predicted residual depth of flooding in a 1 in 200 year event in 2115 will be between 0 and 500mm, and the breach mapping undertaken by the EA predicts similar flood depths to the site.

The EA breach mapping assumes no attempt is made to immediately repair the breach. It is also likely that the EA will undertake further bank raising within the next 100 years to ensure that there is a continuing 1 in 200 year defence to the Sutton Bridge area.

2. **High Water Levels in IDB drains**

Although the whole of this area is below high tide level in the Wash and the River Nene, the retained water levels in the drainage channels ensure that the risk of flooding is extremely low. South Holland IDB maintains a system of sluices, pumping stations, and drainage channels which convey surface water into the River Nene and the wash and control water levels throughout the South Holland IDB area.

The surface water from this area south of Bridge Road is drained by watercourses that run westwards as far as the west side of Nene Way behind the banks of the River Nene. The watercourse then flows southwards and discharges into the South Holland main Drain just upstream of the Sluice.

The channels maintained by South Holland IDB in urban areas are classified as high priority watercourses and as such receive a higher maintenance priority.

There are possibilities of failure of outfall sluices, but these are mitigated by the high level of maintenance given to these structures by the IDB. If a failure did occur the IDB would immediately be warned of the problem by their telemetry system and take action to repair the fault or to bring in temporary pumps to reduce the risk of any

flooding in the area. Similarly any failures of culverts or other blockages would be dealt with immediately.

IDB systems are designed to provide a freeboard of between 600mm and 1000mm to all land in a 1 in 10 year return period rainfall event. This normally provides a standard of service of between 1 in 50 years and 1 in 100 years against flooding. In an extreme event water levels will rise but this will be a slow process and it would be at least 24 hours before levels were high enough to begin to flood low land in the area, and after this the level of the flood water would need to rise another 1.0 metre before the development site would be affected.

Therefore the risk of flooding from IDB drainage channels can be considered to be extremely low.

3. **Localised Flooding due to failure of highway drainage**

There is an adequate highway drainage system in Bridge Road in the area of the development site. However if for some reason there was a blockage in this system there is a possibility that some flooding could occur in low areas in adjoining properties. The recommended floor levels of the proposed property will be above the level of Station Road which will reduce the risk of this source of flooding.

Extent of known Flooding

During the preparation of this assessment, no evidence was discovered of the site or any of the adjoining properties having been flooded in the past.

Probabilities and Trends of Flooding

The probability of this development flooding from Environment Agency main river is very low. In an extreme event any effect on this location would not be sudden and there would be time for residents to take precautionary measures to limit the impact of any flooding that may occur.

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

The risk of this happening in this case is low and the hazard from any flooding is also low.

Climate Change

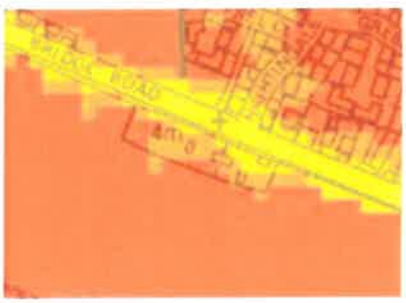
The predictions of flood depths for this flood risk assessment use information provided by the Environment Agency which was produced in 2006. The EA have issued new guidance on recommended contingency allowances for predicted sea level rises, fluvial flows and rainfall intensities which from 19th February 2016 needs to be considered in the FRA. The effects of these new recommendations are considered in

Appendix A of this report (pages 15 to 18). It is concluded that no extra mitigation measures are necessary to comply with the new guidance on climate change.

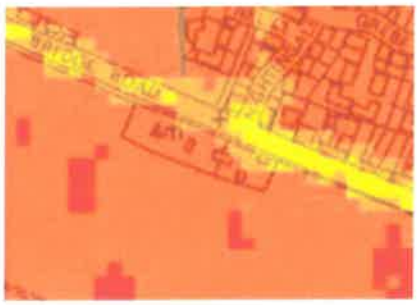
Conclusions

The risk of flooding caused by bank breaches in EA rivers has been considered and shown to be remote. However both the SFRA and the EA mapping predicts that if a breach occurred in the bank of the River Nene east of the development site flooding will occur at this location.

The relevant parts of the EA maps showing predicted depths are shown below:

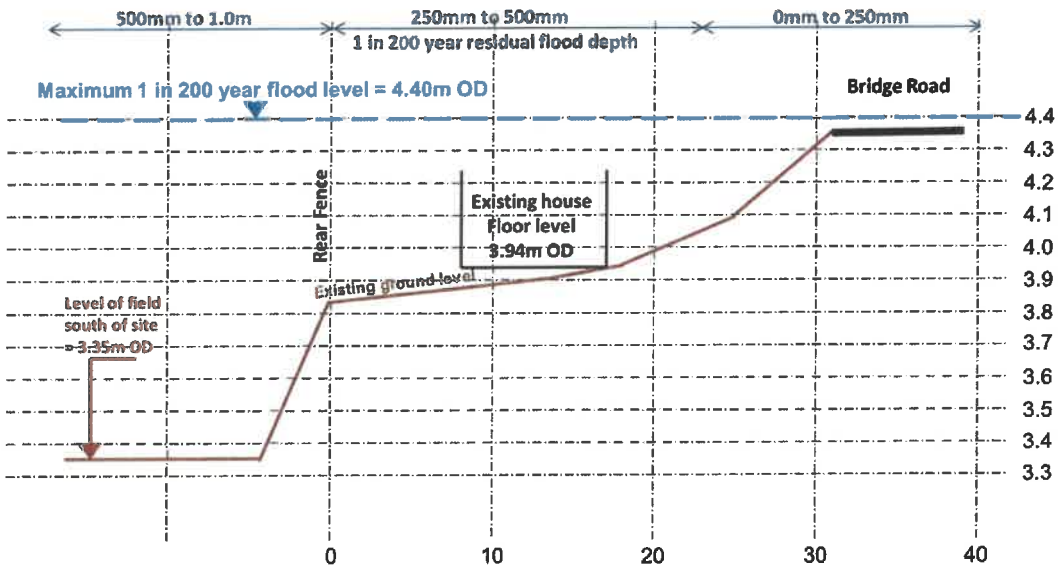


1 in 200 year



1 in 1000 year

A cross section has been drawn from south to north through the development site and the results are shown below. The 1 in 200 year predicted flood depths have been shown and from this the maximum 1 in 200 year flood level in 2115 of 4.40m OD has been computed.



Recommendations

In any area at risk of flooding, even though in this case the risk is extremely low, it is recommended that new dwellings should be of two story construction with all bedrooms at first floor level. This will provide a refuge for residents if the building becomes flooded after a major breach of the tidal bank, and ensure there is no danger to residents when they are asleep.

The ground floor level of the proposed houses should be a minimum of 4.50m OD which is 100mm above the predicted 1 in 200 year flood level in 2115 shown above.

Occupiers of the property should register with the Environment Agency's Floodline Warnings Direct Service. If a very high tide is predicted (greater than 6.50m OD) then the occupiers are advised that they should make preparations to monitor the situation and evacuate the building for the duration of the very high tide. They should drive to the central area of Long Sutton or be advised of a safer place to go.

On site surface water drainage should be discharged into soakaways and these should be designed to BRE Digest 365 and approved under Building regulations.

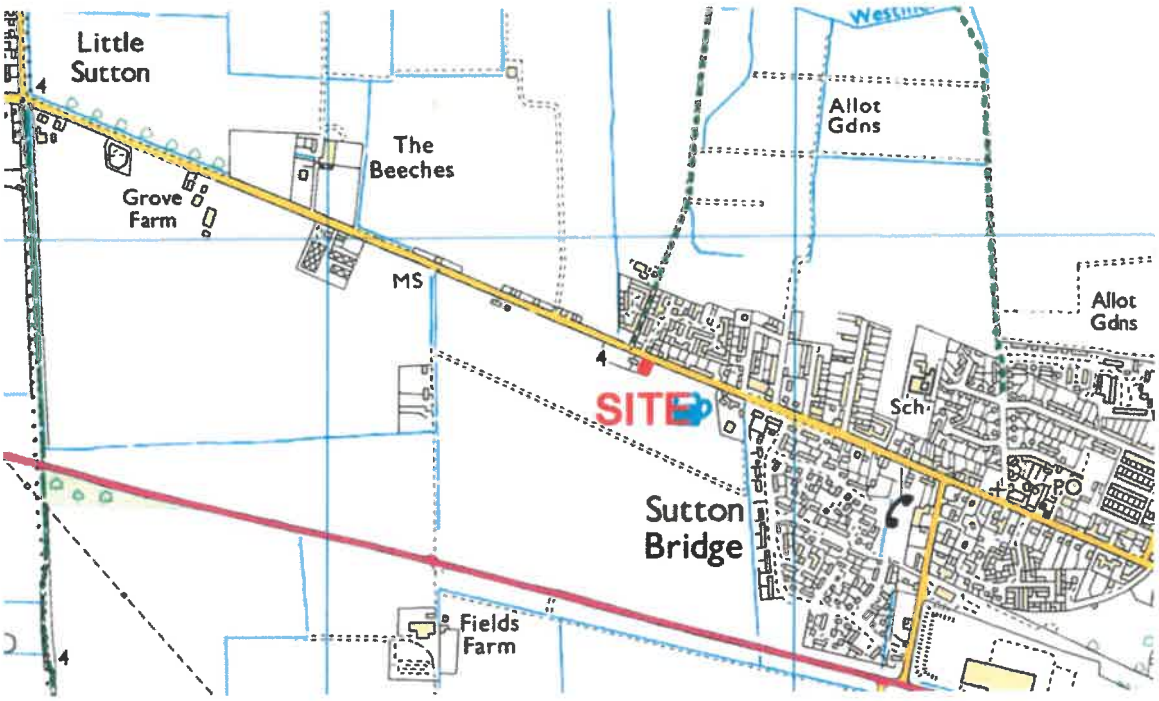
All future owners and occupiers of the building should be given a copy of the Flood Risk Assessment so that they are fully aware of the risk of flooding in this area.

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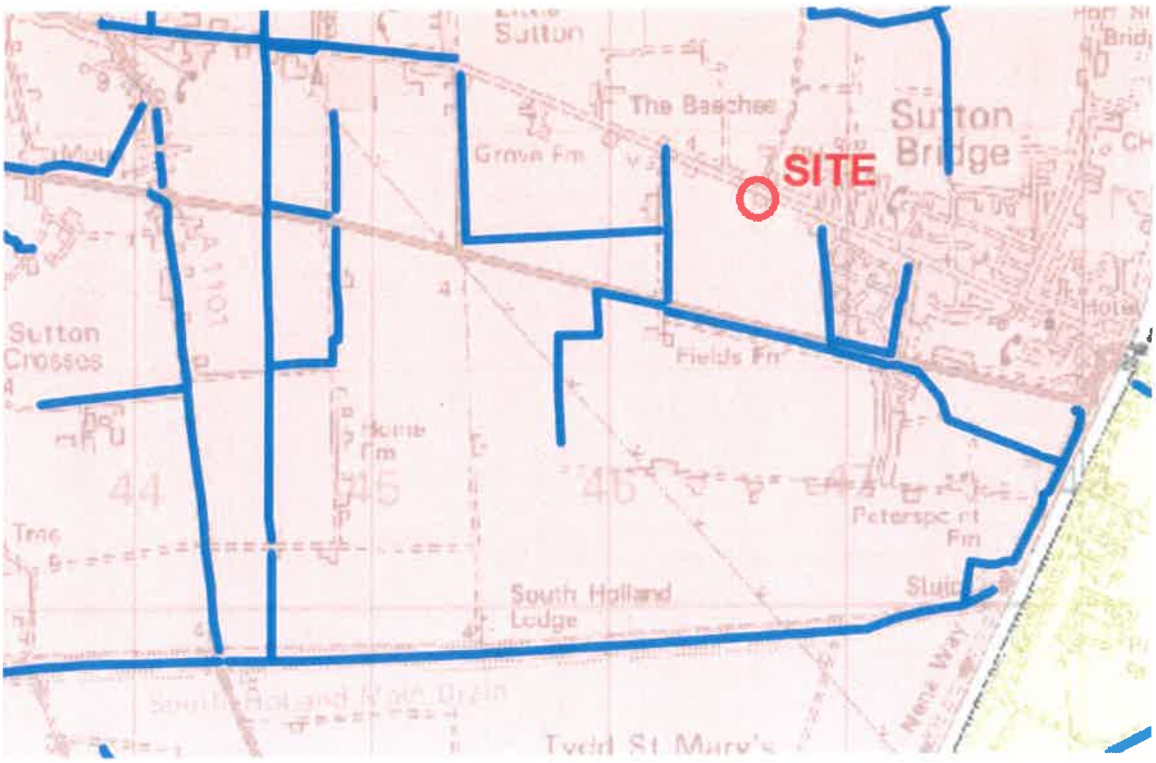
stuart.hemmings@btinternet.com

24th June 2016

LOCATION PLAN



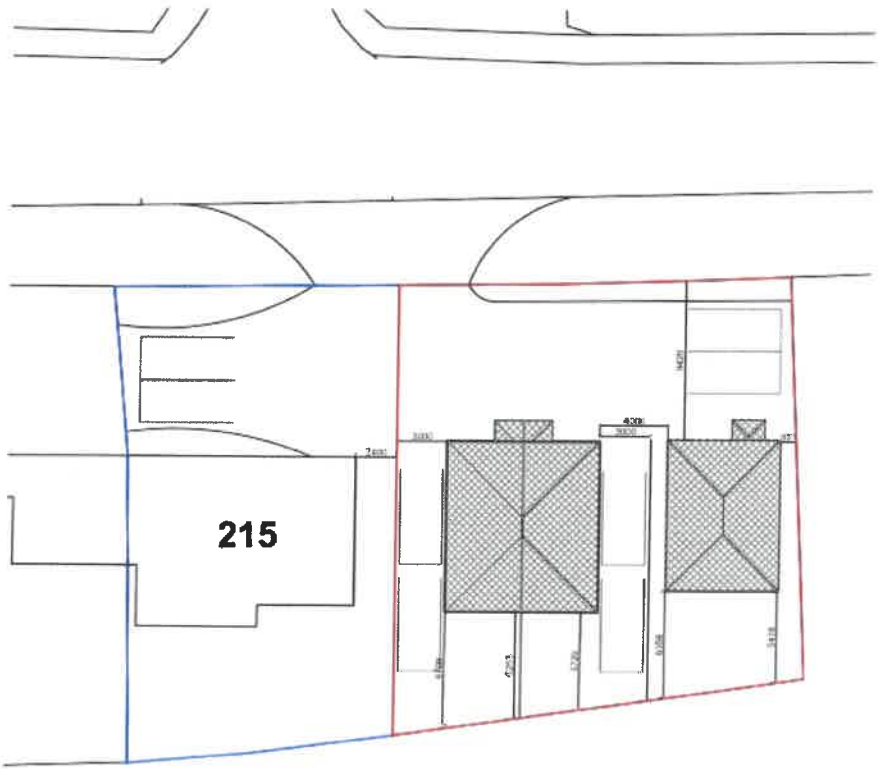
PLAN OF IDB DRAINS

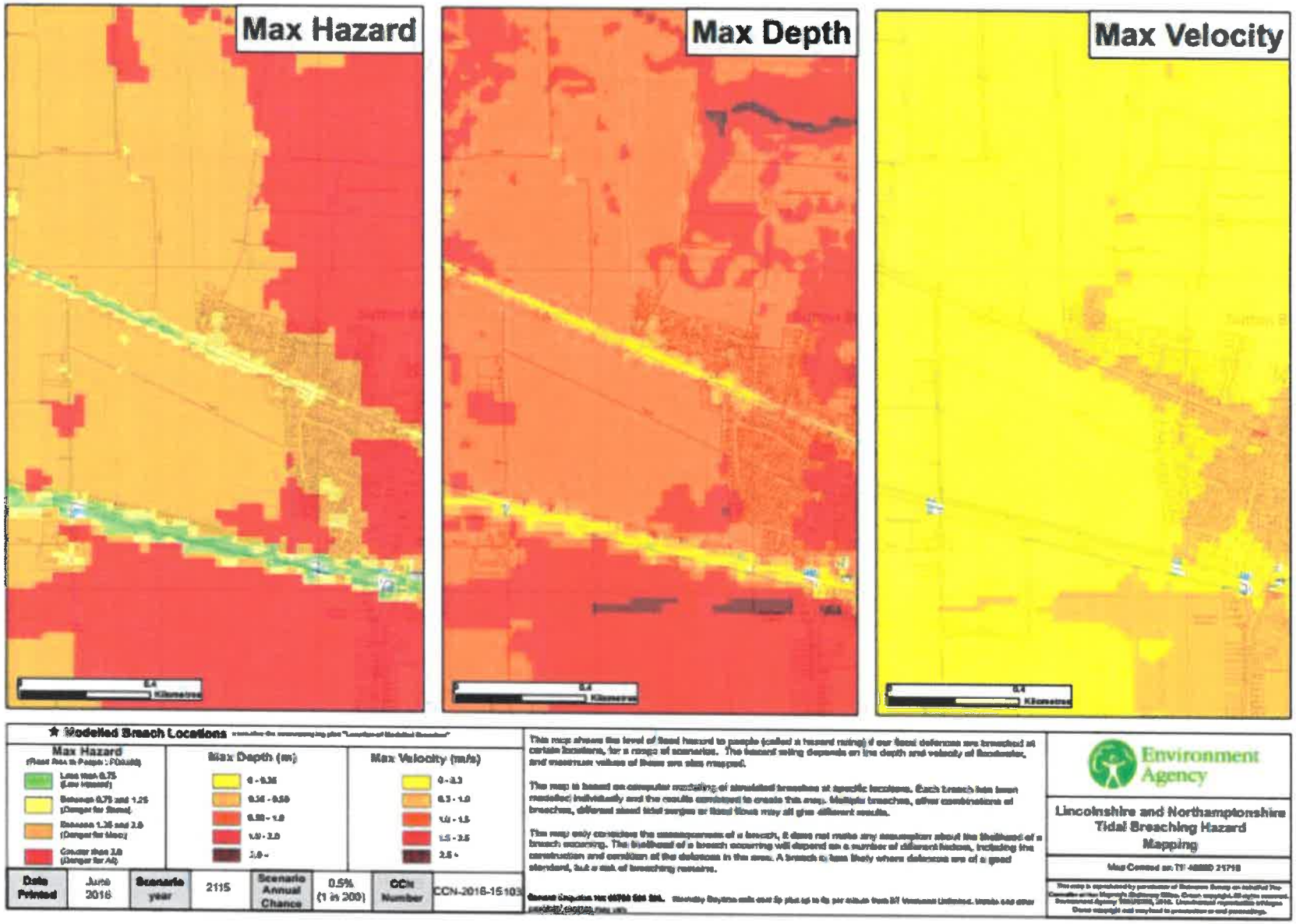


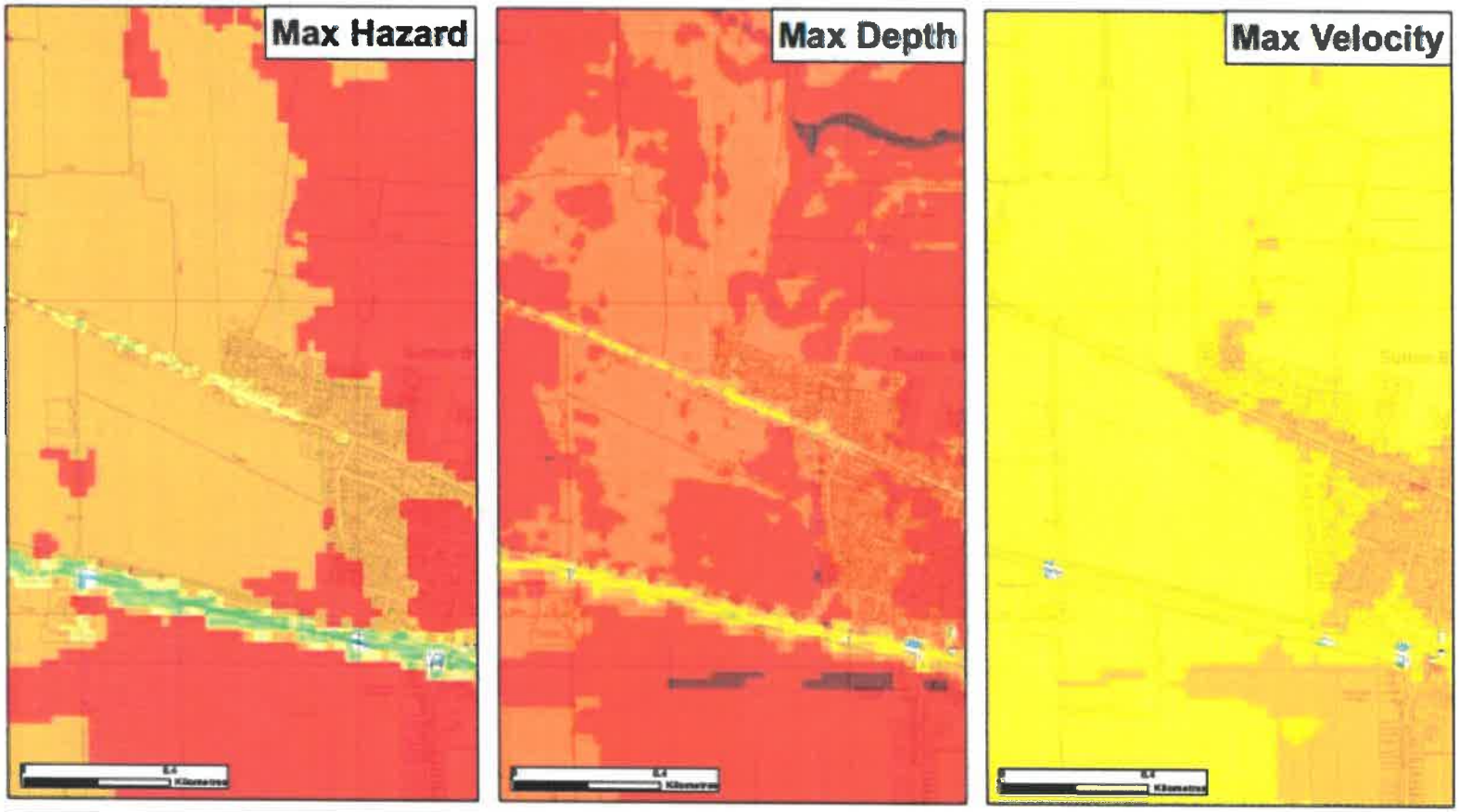
PLAN SHOWING SITE LEVELS



PLAN OF PROPOSED DEVELOPMENT




Max Hazard
Max Depth
Max Velocity
0.4
Kilometres
★ Modelled Breach Locations
Max Hazard
Less than 0.75 (Low Hazard)
Between 0.75 and 1.25 (Danger for Some)
Between 1.25 and 2.0 (Danger for Most)
Greater than 2.0 (Danger for All)
Max Depth (m)
0 - 0.35
0.35 - 0.50
0.50 - 1.0
1.0 - 2.0
2.0 +
Max Velocity (m/s)
0 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.5
2.5 +
Date Printed
June 2016
Scenario year
2115
Scenario Annual Chance
0.5% (1 in 200)
CCN Number
CCN-2016-15103
This map shows the level of flood hazard to people (called a hazard rating) if our flood defences are breached at certain locations, for a range of scenarios. The hazard rating depends on the depth and velocity of floodwater, and maximum values of these are also mapped.
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 mean tidal surges or flood flows may all give different results.
This map only considers the consequences of a breach, it does not make any assumption about the likelihood of a breach occurring. The likelihood of a breach occurring will depend on a number of different factors, including the construction and condition of the defences in the area. A breach is less likely where defences are of a good standard, but a risk of breaching remains.
Environment Agency
Lincolnshire and Northamptonshire Tidal Breaching Hazard Mapping


Max Hazard
Max Depth
Max Velocity
0.5
Kilometres
☆ Modelled Breach Locations
Max Hazard
Max Depth (m)
0 - 0.25
0.25 - 0.50
0.50 - 1.0
1.0 - 2.0
2.0 +
Max Velocity (m/s)
0 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.5
2.5 +
Date Printed
June 2016
Scenario year
2115
Scenario Annual Chance
0.1% (1 in 1000)
CCN Number
CCN-2015-15103
This map shows the level of flood hazard to people (using a hazard rating) if our flood defences are breached at certain locations, for a range of scenarios. The hazard rating depends on the depth and velocity of floodwater, and maximum values of these are also mapped.
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 flood tidal surges or flood flows may all give different results.
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Environment Agency
Lincolnshire and Northamptonshire Tidal Breaching Hazard Mapping
Map Centred on TF 46880 20710

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.

Listed below are the climate change allowances in three documents:

- South Holland SFRA
- EA guidance (2013)
- Revised EA guidance

The recommendations in each document are shown below.

2010 South Holland DC SFRA

The SHDC SFRA states that the the following allowances have been made for climate change:

4.4 Climate Change

Scenarios for the years 2055 and 2115 include for climate change contingency allowances to the amount suggested by PPS25[1]. These allowances are expressed in *Table 2*. Percentage increases are relative to the present-day.

Table 2 – Adopted Climate change contingency allowances

Parameter	Year 2055	Year 2115
Sea level rise (m)	+ 0.33	+ 1.14
Extreme wave height	+ 10%	+ 10%
Peak river flow and volume	+ 20%	+ 20%
Peak rainfall intensity	+ 20%	+30%

Where flows arise from pumping rather than natural run-off, notably in the Vernatt's Drain and for the Fenland subcatchments of the South Forty Foot Drain, peak flow rates for future eras have been taken as equal to current rates since this SFRA assumes all flood risk management measures will remain in their current state.

2013 Guidance to Planners

Guidance to planners was issued by EA in September 2013

Table 1: Recommended contingency allowances for net sea level rises (Net sea level rise (mm per year) relative to 1990)

	1990 to 2025	2025 to 2055	2055 to 2085	2085 to 2115
East of England, east midlands, London, south-east England (south of Flamborough Head)	4.0	8.5	12.0	15.0
South-west England	3.5	8.0	11.5	14.5
North-west England, north-east England (north of Flamborough Head)	2.5	7.0	10.0	13.0

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Table 2: Recommended national precautionary sensitivity ranges for peak rainfall intensity, peak river flow, offshore wind speed and wave height

Parameter	1990 to 2025	2025 to 2055	2055 to 2085	2085 to 2115
Peak rainfall intensity	+5%	+10%	+20%	+30%
Peak river flow	+10%	+20%		
Offshore wind speed	+5%		+10%	
Extreme wave height	+5%		+10%	

been withdrawn (19)

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 more vulnerable development in flood zone 3(a) the higher central and upper end 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 two sources of flooding where the new climate change recommendations could affect the predictions of flood levels in 2115 at the development site:

1) Flooding from the tidal River Nene
2) Flooding from IDB drainage system

1) Flooding from the tidal River Nene

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	SFRA	2013 guidance	Revised 2016 guidance
2055	0.33	0.395	0.412
2115	1.14	1.205	1.24

Therefore it can be seen that the revised guidance increases the maximum allowance for sea rise in 2115 by 100mm. This will not have the effect of increasing the maximum

flood level at the site in a 1 in 200 year breach event in 2115 by 100mm. It will probably be between 10mm and 50mm. An allowance of 100mm has been allowed with the recommendation that the proposed ground floor level will be a minimum level of 4.50m OD.

2) Flooding from IDB watercourses

The contingency allowance for fluvial flows in the SFRA compared with the guidances, assuming a flow in an IDB drainage channel of 5 cumecs, is shown below:

Year	SFRA	2013 guidance	Revised 2016 guidance
1990	5	5	5
2055	6	-	6.325
2115	7.2	6.6	9.3 (+86%)

The revised 2016 guidance figures use the higher central allowance band of figures given in the 2016 guidance. However if the upper end allowance is used the 2115 figure increases to 13.9 cumecs, an increase of 178% over the 1990 figures.

These figures seem to be very high for use in pumped fenland drainage channels, and at first it can be concluded that the overall impact on drainage systems such as the South Holland Main Drain could be very large.

South Holland IDB, and all IDB's, are aware that climate change will affect the operations of pumping stations and drainage channels. Pumping stations only have a 30 year life and will need to be refurbished or rebuilt within this timespan. When the Board plan for these refurbishments adequate arrangements will be made to incorporate the latest climate change projections.