# PROPOSED DEVELOPMENT AT WOODHOUSE FARM LODGE, HOLBEACH ROAD, SPALDING, PE12 6JP

# FLOOD RISK ASSESSMENT



View from north of site

S M Hemmings B Sc C Eng MICE MIWEM,

40 Celta Road

Peterborough

PE2 9JD

This flood risk assessment has been prepared solely to support the planning application for a development at Woodhouse Farm Lodge, Holbeach Road, Spalding. 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

A replacement building is proposed at the Woodhouse Farm Lodge on Holbeach Road, Spalding, PE12 6JP to provide additional bedrooms for the hotel. There is an existing timber building on the site which will be demolished, and the new building is proposed on this site. The Lodge is approximately 2 km east of Spalding, and is on the east side of the roundabout between the A151 and the A16 roads.

All of this site is within Flood Zone 3 as shown on the Environment Agency's Flood Zone map.

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 within a defended area as specified on 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 this area.




It can be seen that all of the site is in Flood Zone 3.

## Application Site

The National Grid Reference of the site is 526700 323860.

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.

Applying the flood risk vulnerability classification in Table 2 of the Guidance, a development consisting of hotel accomodation 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 proposed development is an extension to provide additional bedrooms for the existing hotel complex on the site, and as such cannot be located anywhere else except at this location at Holbeach Road, Spalding.

The guidance gives the following advice where an alternative location is not possible, which can be applied to developments such as these:

> When applying the Sequential Test, a pragmatic approach on the availability of alternatives should be taken. For example, in considering planning applications for extensions to existing business premises it might be impractical to suggest that there are more suitable alternative locations for that development elsewhere. For nationally or regionally important infrastructure the area of search to which the Sequential Test could be applied will be wider than the local planning authority boundary.

As can be seen from the map on page 2 of this report all of this area east of Spalding is in flood zone 3. The safety of this development will be delivered by raising the finished ground floor level to be higher than the predicted flood level in a 1 in 1000 year tidal or fluvial event in 2115.

The proposed development complies with all South Holland District Council's planning policies on businesses in the Council's area, and the sequential test policy in the South East Lincolnshire SFRA (March 2017).

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 produced a Strategic Flood Risk Assessment (SFRA) for the South Holland District Council (SHDC) in 2010. This document provides details of the flood

risk in the Council's area. The South East Lincolnshire SFRA gives further guidance on the flood risk. Reference to the maps in this document give the following information for the flood risk and hazard at the site.

The maps in the 2010 SFRA illustrate the actual flood hazard for the 1% fluvial event and 0.5% tidal event.

| | |
|---|---|
| For the present day | Depth of flooding … zero |
| | Extent of flooding .. Low or medium flood probability |
| | Peak Velocity ……. Nil |
| For year 2115 | Depth of flooding … 0-500mm |
| | Extent of flooding….High |
| | Peak Velocity …… 0 – 0.25m/sec |

The maps showing the residual flood hazard were revised in the 2016 update of the South Holland District Council Strategic Flood Risk Assessment which can be found on the website of the South East Lincolnshire Joint Planning Committee. The hazards are as follows for the 1% fluvial or 0.5% tidal event probability:

| | |
|---|---|
| For the present day | Depth of flooding …0 – 250mm |
| | Extent of flooding .. High |
| | Hazard rating…… Less than 0.75 (Low hazard) |
| | Peak Velocity .. 0 – 0.3m/sec |
| For the year 2115 | Depth of flooding … 250mm - 500mm |
| | Extent of flooding .. High |
| | Hazard rating…… 0.75 – 1.25 (Danger for some) |
| | Peak velocity ……. 0.3 – 1.0m/sec |

Figure 16 of the general maps show that the site is not within the rapid inundation zone for the present day and 2115.

Maximum flood level and bank levels in the River Welland

Tables in the 2010 SFRA show the following details of the defence bank on the east side of the tidal section of the River Welland north of the A16 road bridge and 2.7km west of the development site, between chainage 19.8km and 20.8km.

| | 2007 | 2055 | 2115 |
|---|---|---|---|
| Peak 1 in 200 year extreme tide level | 5.98m OD | 6.31m OD | 7.12m OD |
| Peak 1 in 1,000 year extreme tide level | 6.27m OD | 6.60m OD | 7.41m OD |

With an average defence crest level between 7.80 and 7.90 m OD 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 |

Tables in the SFRA show the following details for the defence bank on the east side of the Coronation Channel at chainage 1.5 km which is 2.7km west of the site.

| | 2007 | 2115 |
|---|---|---|
| Peak 1 in 100 year flood level | 4.34m OD | 4.69m OD |
| Peak 1 in 1,000 year flood level | 4.37m OD | 4.69m OD |

The bank levels on this section vary between 5.50m OD and 6.0m OD. Therefore it can be seen there is a minimum freeboard of 800mm to the predicted design maximum levels in 2115.

The Wash banks are at least 20.0 km north of the site. The tidal defences are earth banks with an average level of 7.80m OD. The maximum predicted 1 in 200 year tide level in 2115 in the SFRA is 7.11m OD.

**Information from the Environment Agency**

The Environment Agency has provided predicted flood levels for the Coronation Channel which are taken from the Welland Strategic Catchment Model produced in 2016.

| | 2016 | 2016 with 20% climate change allowance |
|---|---|---|
| Peak 1 in 100 year | 4.52m OD | 4.68m OD |
| Peak 1 in 1,000 year | 4.56m OD | 4.68m OD |

The Environment Agency state:-

- The predicted water levels are “in channel” levels and therefore may not represent the flood level on the flood plain, particularly where the channel is embanked or has raised defences.
- The allowance for climate change in the 2016 model was 20%.

**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 420 metres from the east bank of the Coronation Channel which is maintained by the Environment Agency.

The site is located approximately 800 metres east of the tidal section of the River Welland, which has a tidal defence bank which is maintained by the Environment Agency.

The major watercourses in the area are maintained by South Holland IDB.

## Existing Ground Levels

The level of Holbeach Road north of the site is approximately 3.70m OD. The access to the site slopes down to a level of between 2.70m and 2.80m OD which is the level of the gravel access road and the level of the central grass area. The level of the paved area in front of the door to the existing hotel is 2.87m OD and the level of the existing timber building is approximately 3.03m OD.

## Potential Sources of Flooding

The potential sources of flooding to the site are:-

1. Failure or overtopping of tidal defences of the River Welland.
2. Failure or Overtopping of the Coronation Channel.
3. High water levels in IDB drainage channels.
4. Localised flooding in the area.

### 1. Failure or overtopping of tidal defences of the River Welland or the Wash

The nearest section of the east bank of the tidal section of the River Welland is approximately 800 metres north west of the site.

Holbeach Road (A151) immediately north of the site is approximately 850mm higher than the land north and south of the site, and will therefore provide a barrier protecting the site if flood water were to flow south eastwards from a breach in the east bank of the River Welland. If and when the flood level from a breach reached around 3.70 m OD in the area north of Holbeach Road it would flow over the road and start to flood the development site.

The maps of predicted flood depth supplied by the Environment Agency show that most of the site could suffer between 250mm and 500mm in depth following a breach in a 1 in 1000 year event in 2115.

Therefore raising floor levels of the proposed dwelling by approximately 600mm would provide adequate mitigation against this risk which can be considered to be extremely low.

### 2. Failure or Overtopping of the Coronation Channel

The nearest section of the east bank of the fluvial section of the Coronation Channel is approximately 420 metres west of the site.

The SFRA states that the maximum predicted level in the Coronation Channel in a 1 in 1000 year event in 2115 is 4.68m OD. The minimum crest level of the east bank of the Channel is 5.14m OD, which gives a minimum freeboard of 450mm. However, generally there is a freeboard of 600 mm along this bank of the Channel.

If the Channel were to breach water would flow eastwards towards the site. However, it would be retained for a short time by the A16 which is higher than the surrounding land.

Therefore raising floor levels of the proposed dwelling by approximately 600mm would provide adequate mitigation against this risk which can be considered to be extremely low.

### 3. High Water Levels in IDB drains

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

The site is on the northern boundary of the catchment area of Wisemans Pumping Station in the South Holland IDB. There is an IDB maintained drain on the western side of Swindlers Drove which flows southwards for 1.5km then flows eastwards to discharge into the Wheatmere Drain.

The Wheatmere Drain (B35) which is located east of the new A16 road, flows southwards into the South Holland Main Drain (B30). The water level in the South Holland Main Drain is controlled by Wisemans Pumping Station.

Wisemans Pumping Station is operated and maintained in excellent condition by South Holland IDB and the likelihood of flooding due to this source is low. 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. South Holland IDB watercourses generally state that their watercourses provide a standard of 1 in 100 years with a freeboard of 300mm in urban areas. 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.

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.

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

### 4. Localised Flooding in the area

A suitable surface water disposal system will be designed for the development site which will dispose of the water into soakaways or attenuate the flows before they are discharged into the adjoining drain, subject to the consent from South Holland IDB.

The raising of the ground floor levels by approximately 600mm above ground level will adequately mitigate the risk of flooding from this source.

**Extent of known Flooding**

During the preparation of this assessment, no evidence was discovered of the existing house or garden 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 recommendations for flood depths for this flood risk assessment use information from the 2010 South Holland DC SFRA, South East Lincolnshire SFRA ( which was issued in March 2017 and the Environment Agency. 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 19 to 22). It is concluded that no extra mitigation measures are necessary to comply with the new guidance on climate change.

**South East Lincs Advice Matrix**

Advice can be found on the recommended mitigation required by referring to a spreadsheet on the South East Lincolnshire website.

As the development is in flood zone 3 and the predicted flood hazard is 0.75 – 1.25 (Danger for some) reference should be made to Category E8 which shows the following advice for predicted flood depths of between 250mm and 500mm.

*The NPPF requires that proposals are accompanied by a Flood Risk Assessment which contains evidence that appropriate mitigation measures/flood resilience techniques have been incorporated into the development*

*Finished floor levels (FFL) should be informed by the predicted flood depth maps (refer to the relevant 2115 1% fluvial or 0.5% tidal Max Depth Map) and set as required below (single storey proposals must use the 0.1% event, 2115 scenario, for setting FFL):*

*depths of 0.25 - 0.5*

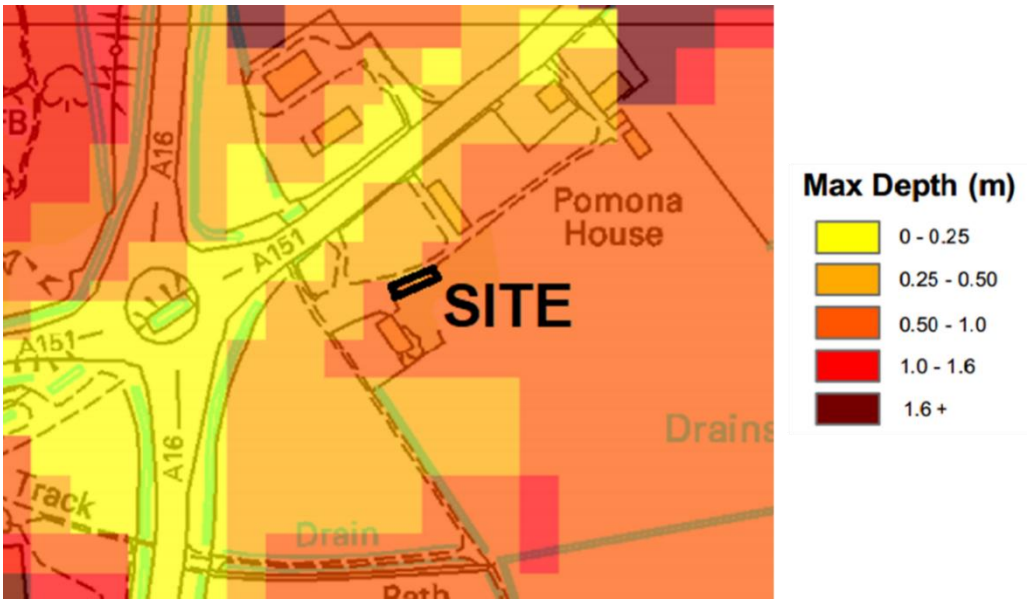
*Finished floor levels must be set 500mm above ground level, with flood resilient construction to a height of 300mm above the predicted flood depth.*

*The applicant is advised to refer to the following document for information on flood resilience and resistance techniques to be included: 'Improving Flood Performance of New Buildings - Flood Resilient Construction' (DCLG 2007).*

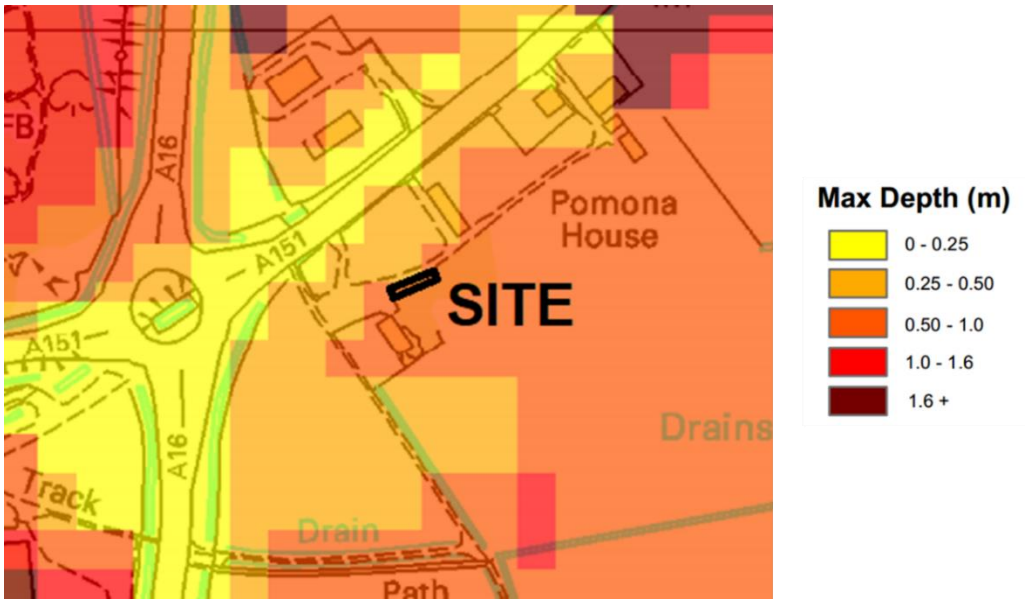
**Conclusions**

All of this area on the eastern side of Spalding is in flood zone 3.

The plan (shown below) of predicted depths of flooding in a 1 in 100 year fluvial or 1 in 200 year tidal event in 2115 shows flood depths of mostly between 250mm and 500mm on the site of the proposed development.




The plan (shown below) of predicted depths of flooding in a 1 in 1000 year fluvial and tidal event in 2115 again shows flood depths of mostly between 250mm and 500mm on the site of the proposed development.



The predicted flood depth on both of the above maps indicate that the building is on the edge of the orange (flood depth 250mm – 500mm) and the dark orange (flood depth 500mm – 1.0 metre. Therefore the predicted flood depth at this location is approximately 500mm. Looking at the levels taken on the site it can be seen that the whole area west of the existing hotel building is between 2.70m and 2.80m OD. Therefore it can be again concluded that the maximum flood level in this area will be 3.30m OD.

Flooding will occur either from a tidal breach to the north of a breach in the east bank of the Coronation channel to the west of the site. In both cases the water on either the north side of the A151 or the west side of the A16 will rise to above 3.60m OD and water will then flow over the road and start flooding onto the site. As all of the land to the south and east of the site is around 2.50m OD the flood water will spread in these directions.

The risk of flooding to the proposed building from IDB drains can be considered low, especially as the floor levels will be raised by 600mm above ground level.

The IDB have adequate arrangements to bring in contractors and use their own staff if a failure of any part of the sluices occurred. If drains become full any flooding that would occur would happen very slowly and affect land at levels of approximately 2.50m OD before the development site. It would be very unlikely to reach a level above 3.00m OD and flood the proposed development.

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

**Recommendations**

In any area at risk of flooding it is preferable that new dwellings should be of two story construction with all bedrooms at first floor level. This is to provide a refuge for residents if the buildings were to become flooded after a major breach of the tidal bank and ensure there is no danger to residents when they are asleep.

The developer has indicated that the building should be a single storey building containing 7 bedrooms. The evidence shows that the predicted depths of flooding in a 1 in 1000 year event will not be greater than the depths predicted for the 1 in 200 year event in 2115, and the maximum depth of flooding on the site would be approximately 500mm. Therefore it is considered that the finished ground floor level of this single storey building should be raised approximately 600mm above the existing ground level on this part of the site, with a level of 3.40m OD which is approximately 370mm above the floor level of the existing timber building.

Flood resilient construction should be included to a height of 300mm above the predicted flood depth.

The owner and the operator of the hotel should register with the Environment Agency's Floodline Warnings Direct service. They should also draw up a flood plan for the hotel complex which should include arrangements to close the annex if a flood alert or a flood warning is received.

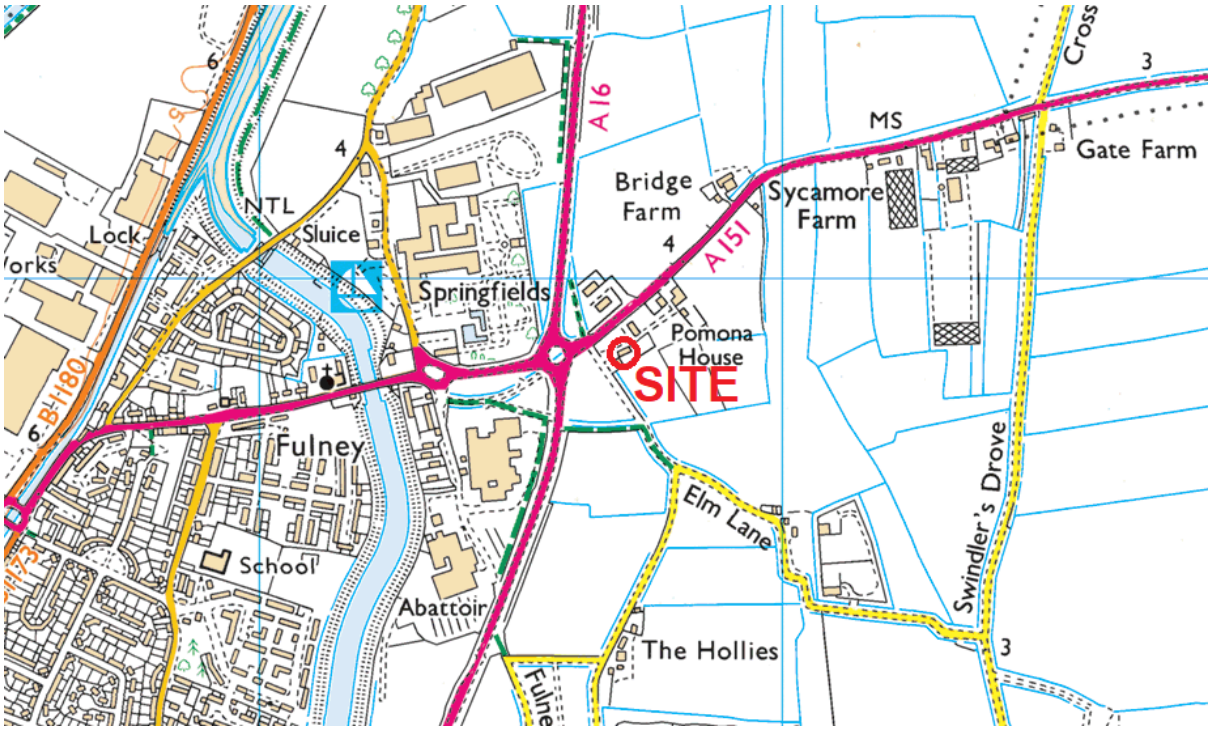
Rainwater from the roofs of the buildings should be discharged if possible into soakaways and these should be designed to BRE Digest 365 and approved under Building regulations. Hardstandings around the buildings and access roads should be constructed with permeable paving.

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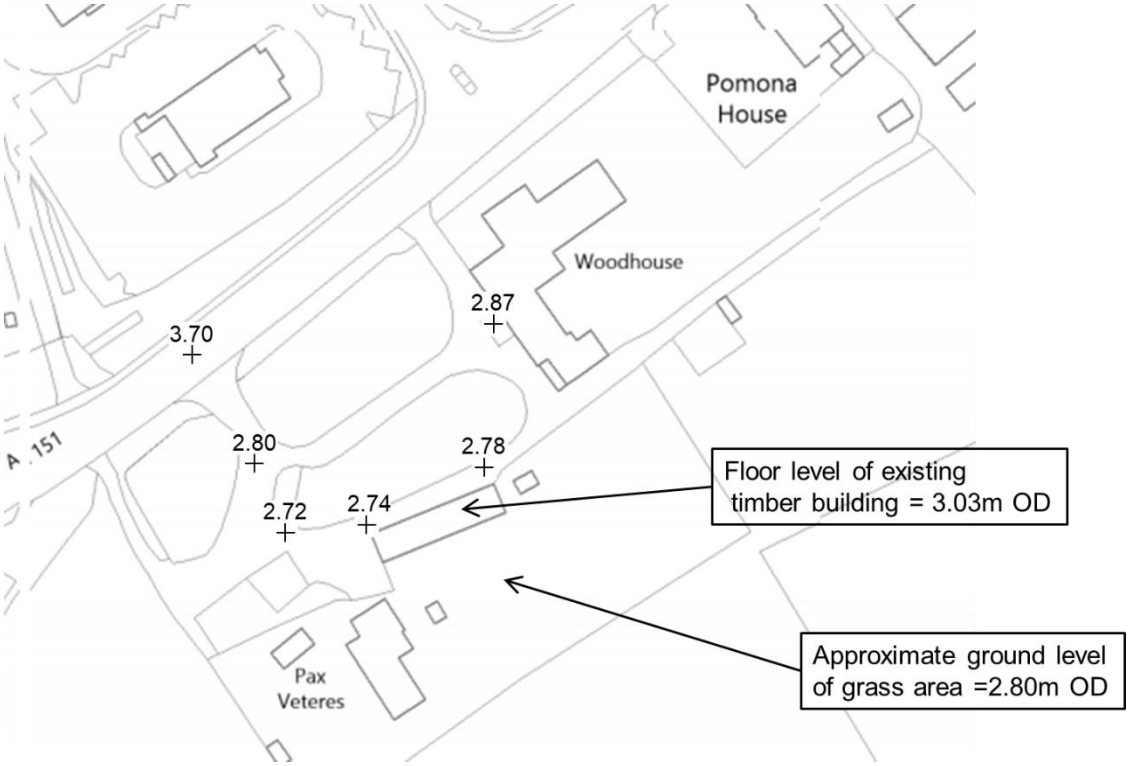
stuart.hemmings@btinternet.com

29th June 2019

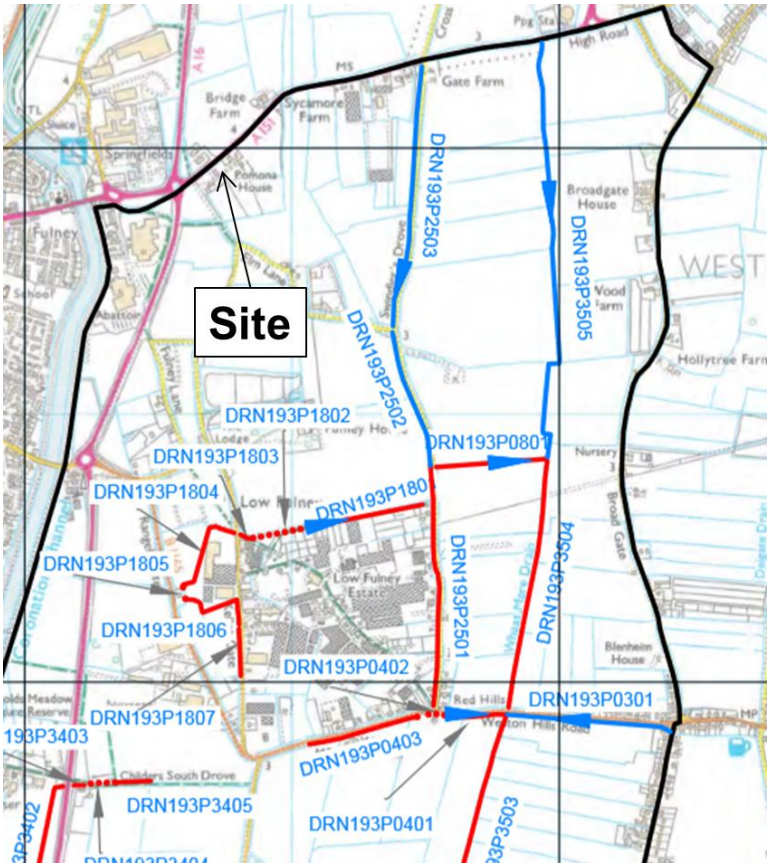
## LOCATION PLAN



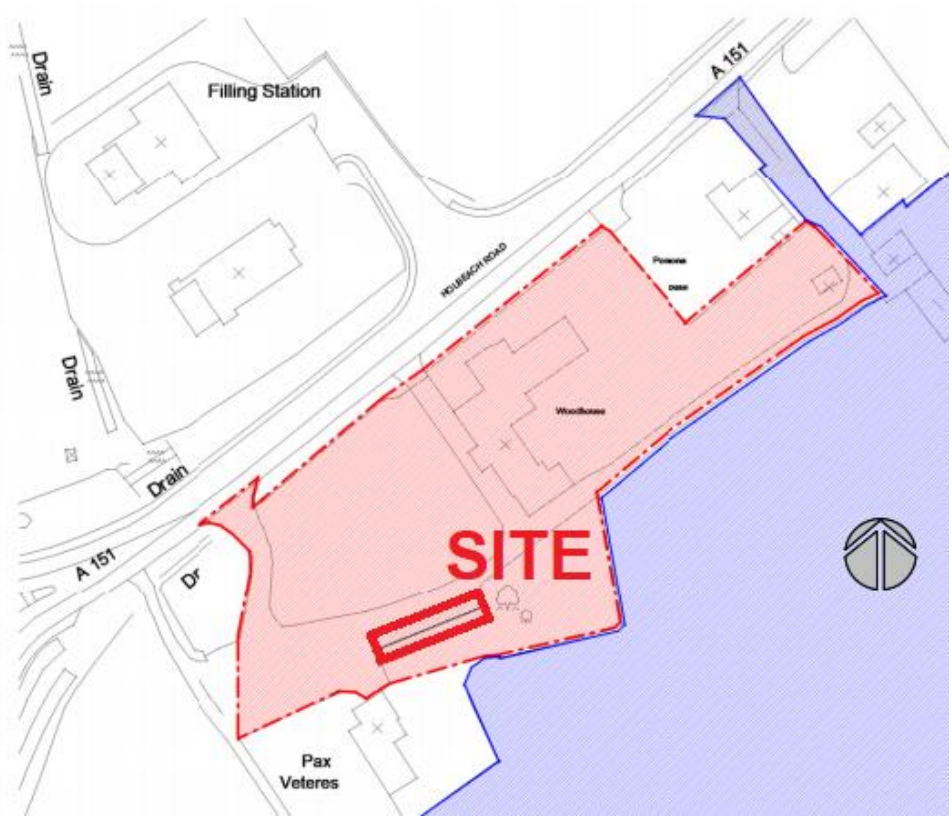

## PLAN OF SITE LEVELS



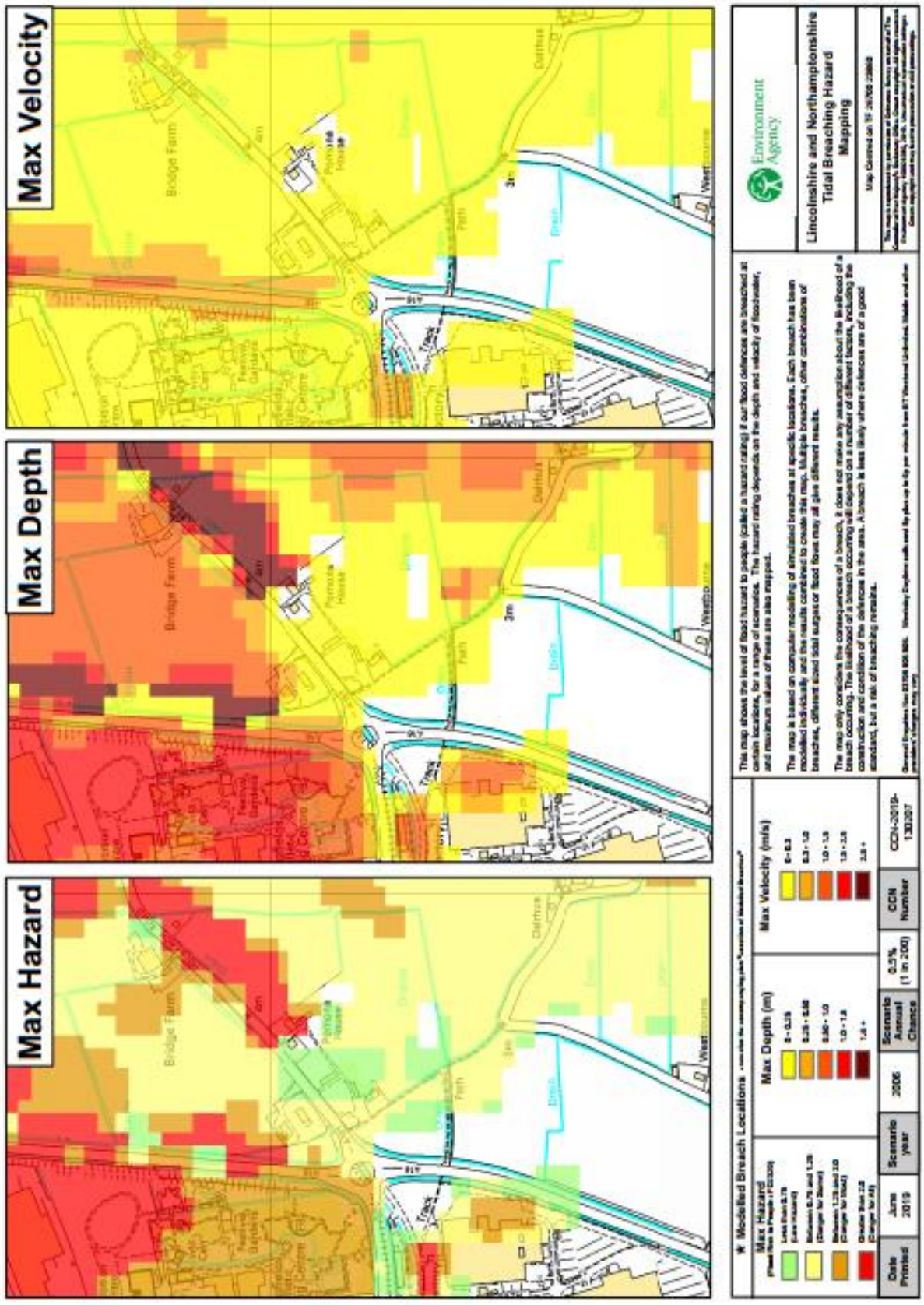
## PLAN OF IDB DRAINS



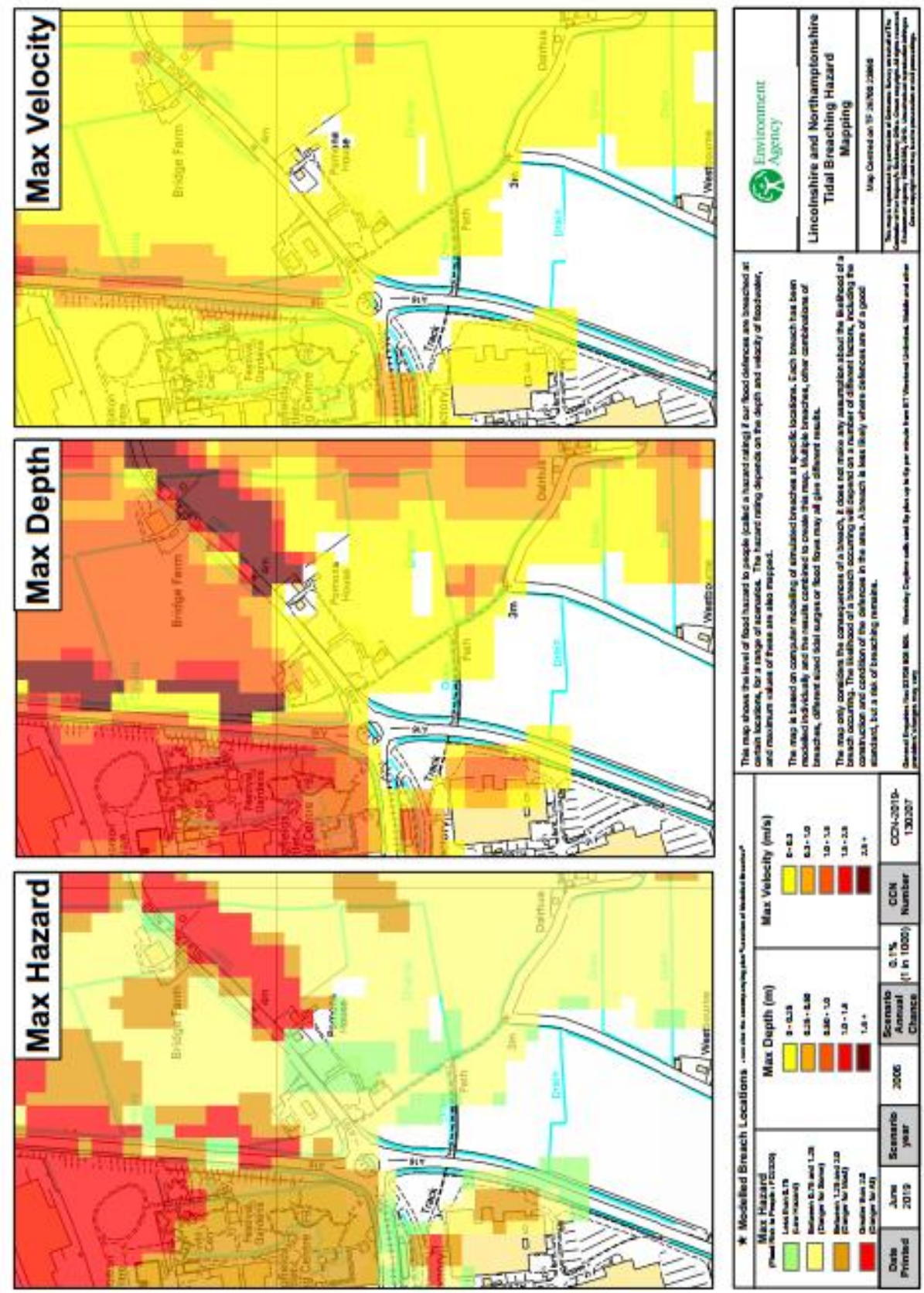

## SITE PLAN



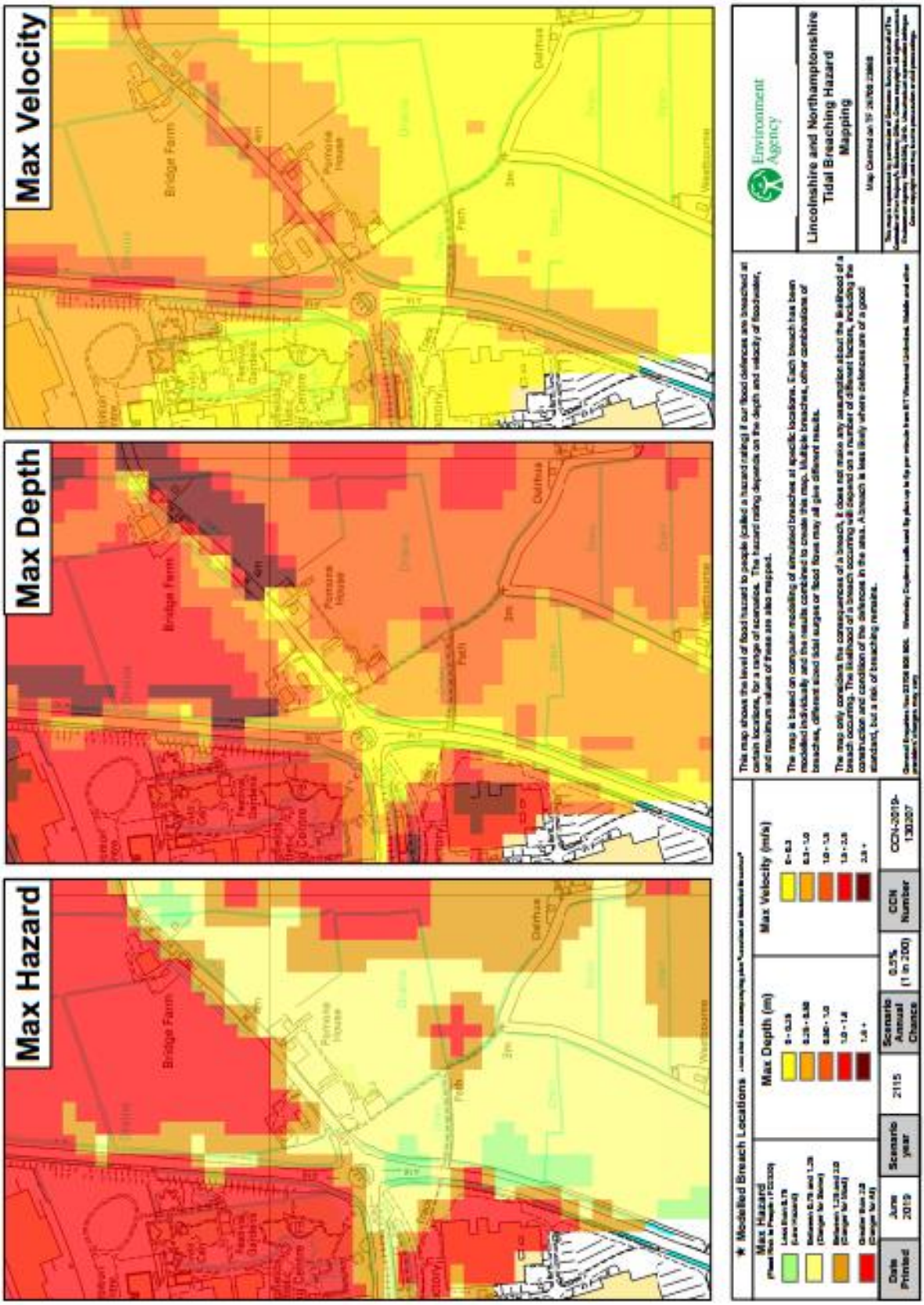
## Environment Agency 1 in 200 year Flood Risk from Breaching in 2006



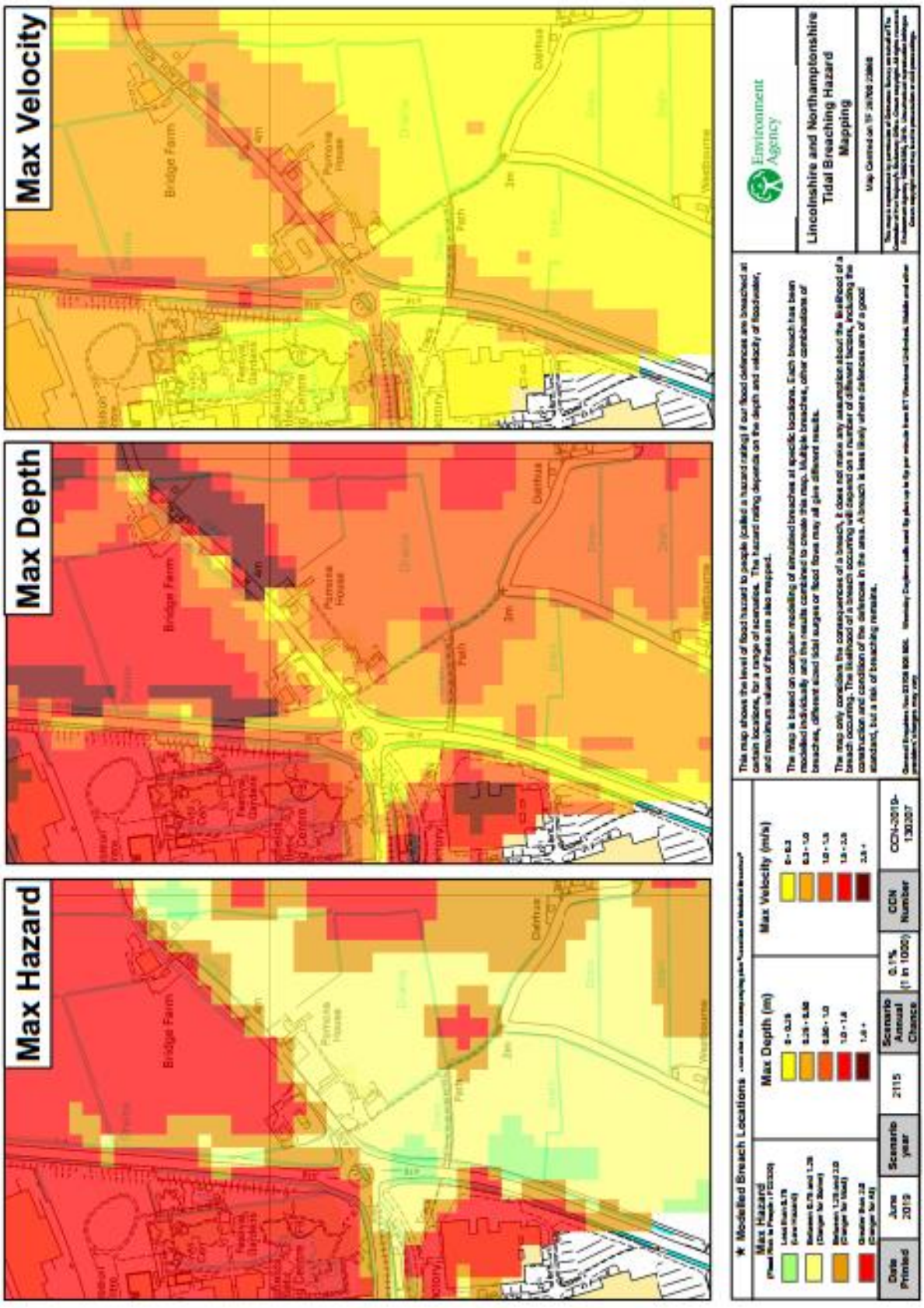
## Environment Agency 1 in 1000 year Flood Risk from Breaching in 2006



## Environment Agency 1 in 200 year Flood Risk from Breaching in 2115



## Environment Agency 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.

Listed below are the climate change allowances in three documents:

- South Holland SFRA
- EA guidance (2013)
- Revised EA guidance
- South East Lincolnshire SFRA (March 2017)

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 |

document is out of date'a

**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% | |

s 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% |

## South East Lincolnshire SFRA (March 2017)

The SE Lincs SFRA States that all FRA's should refer to the revised guidance issued by the EA in 2016.

## Effects on Predictions of Flood Risk in FRA

1) Flooding from Tidal River Welland

The FRA has identified tidal flooding as one source where the new climate change recommendations could affect the predictions of flood levels in 2115 at the development site.

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 for the maps in the SFRA and 40mm for maps issued by the Environment Agency. The small increase shown above will not change the EA map showing predicted flood depth significantly and the mitigation recommended of raising floor levels by approximately 600mm is considered satisfactory.

2) Flooding from Coronation Channel, Barrier Bank and the IDB drainage system

As the development is in flood zone 3 and is classed as more vulnerable, the central climate change allowance, which is 35%, should firstly be considered. After considering the effects of this increase the higher central, which is 65%, 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 SHDC SFRA also has used this figure of 20%. The increase to 35% and 65% will not significantly change the conclusion in the SFRA of what might happen if a breach occurred in the bank of the Coronation Channel. If there are additional flows along this part of the Coronation channel and River Welland it will lead to the storage systems of the Cowbit and Crowland Washes operating and additional overtopping over lower banks rather than any significant increase in levels in the river.

IDB's have been using an allowance of 20% for climate change over the past few years in their assessments and modelling of their systems. Generally IDB's are happy that their systems provide a 1 in 100 year standard to most urban areas at the present time.

South Holland 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 South Holland 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 the Board continues to provide the same standard of service as the present day.

Therefore it is considered that the mitigation proposed for the development, with the recommendation that the floor levels should be raised to a level of approximately 600mm above the existing ground level, is satisfactory.