PROPOSED DEVELOPMENT AT HARRINGTON DRIVE, CROWLAND, PETERBOROUGH, PE6 0AT

FLOOD RISK ASSESSMENT



View of site from southern boundary

S M Hemmings B Sc C Eng MICE MIWEM,

13 Lea Gardens,

Peterborough

PE3 6BY.

This flood risk assessment has been prepared solely to support the planning application for a residential development at Harrington Drive, Crowland. 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 planning application is due to be submitted to South Holland District Council for a residential development on land south east of Harrington Drive, Crowland. The site is at present unused agricultural land.

The site of the proposed development 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 North Level 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 that all of the site is in Flood Zone 3.

Application Site

The National Grid Reference of the site is 524115 309380.

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 dwelling houses is classified as "more vulnerable".

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

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 in Flood Zone 3(a) the sequential and exception test needs to be considered.

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 Planning Practice Guidance gives the following advice on how the Sequential Test should be applied:

"For individual planning applications where there has been no sequential testing of the allocations in the development plan, or where the use of the site being proposed is not in accordance with the development plan, the area to apply the Sequential test across will be defined by local circumstances relating to the catchment area for the type of development proposed. For some developments this may be clear, for example, the catchment area for a school. In other cases it may be identified from other Local Plan policies, such as the need for affordable housing within a town centre, or a specific area identified for regeneration. For example, where there are large areas in Flood Zones 2 and 3 (medium to high probability of flooding) and development is needed in those areas to sustain the existing community, sites outside them are unlikely to provide reasonable alternatives".

The guidance on the Environment Agency site states that the search area should be defined. The South East Lincolnshire Housing land Availability Assessment shows Crowland as a small town, and states that the emerging local plan seeks to develop 500 new dwellings in Crowland. Therefore the area of Crowland should be considered as the search area.

There are 39 possible sites that have been considered for development in Crowland in the South East Lincolnshire Strategic Housing Land Availability Assessment which can be found on the website of the South East Lincolnshire Joint Strategic Planning Committee. The site being considered in this report is part of site no Cro002.

Further investigation shows that of the 39 sites considered for development:

6 Sites are in flood zone 1

8 Sites are in flood zone 2

27 Sites are in flood zone 3(a)

Planning Applications have been identified for 17 of these sites and an additional site in Postland Road. The number of dwellings where applications for planning permission have been made are

237 dwellings in flood zones 1 and 2 (all approved)

303 dwellings in flood zone 3(a) (all approved)

Of the sites in flood zone 3(a).

8 dwellings had predicted flood depth of 0 – 500mm

195 dwellings had predicted flood depth of 500mm – 1.0 metre

200 dwellings had predicted flood depth of 1.0 metre – 2.0 metres

Therefore as the flood risk at the proposed site is equal to the flood risk on other sites where 200 dwellings have been approved, and the local plan seeks to provide 500 new dwellings in Crowland, it is considered that the sequential test is 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

The Strategic Flood Risk Assessment (SFRA) written for the South Holland District Council (SHDC) in 2010 provides details of the actual flood risk in the Council's area. This information has not been updated and reference to the maps in this document give the following information for the actual flood risk and hazard at the site 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 … zero
	Extent of flooding…. Low or medium flood probability
	Peak Velocity …… Nil

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 …500mm – 1.0 metre
	Extent of flooding .. High
	Hazard rating…… 1.25 – 2.0 (Danger for some and most)
	Peak Velocity .. 0 – 0.3 metres/second
For the year 2115	Depth of flooding … 1.0 – 2.0 metres
	Extent of flooding .. High
	Hazard rating…… 1.25 – 2.0 (Danger for most)
	Peak Velocity .. 0 – 0.3 metres/second

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 tidal section of the River Welland

Tables in the SFRA show the following details of the predicted flood levels in the tidal section of the River Welland north of the A16 road bridge and 15.3km north 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 of the predicted flood levels in the fluvial section of the River Welland at chainage 13.0 km.

	2007	2115
Peak 1 in 100 year flood level	4.93m OD	4.96m OD
Peak 1 in 1,000 year flood level	4.96m OD	4.97m OD

The bank levels on this section are 6.25m OD. Therefore it can be seen there is a minimum freeboard of 1200mm to the predicted design maximum levels in 2115.

Information on Surface Water Flooding on Environment Agency Website

The map below shows areas around the site where there is a low risk of surface water flooding. The light blue areas indicate the low risk of up to 300mm of surface water flooding, and the darker blue areas indicate that between 300mm and 900mm of surface water flooding could occur.



It can be seen there is a predicted low risk of up to 300mm of surface water flooding in the southern corner of the site where levels are the lowest on the site.

Existing Flood Alleviation Measures

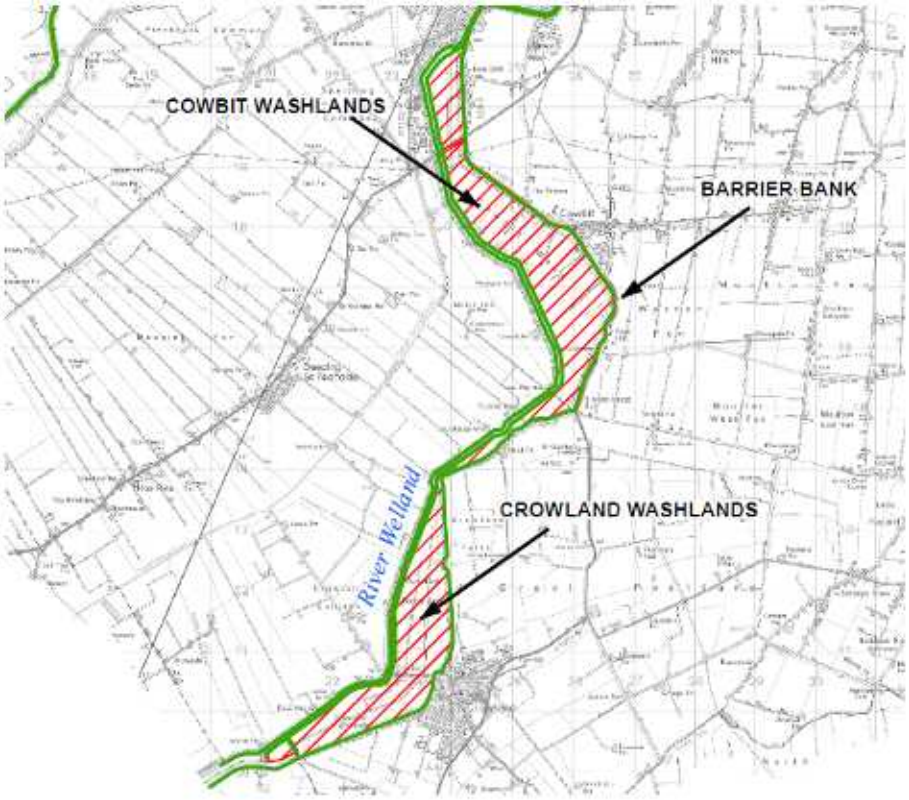
The site is within a defended flood plain, as defined in Appendix 1 of the Environment Agency's "Policy and Practice for the Protection of Flood Plains", which is considered to be passive until such time that a flood greater than the defences can withstand occurs. The likelihood of flooding occurring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

The site is located approximately 15.3 km south of the tidal section of the River Welland, which has a tidal defence bank which is maintained by the Environment Agency.

The site is located approximately 920 metres east of the bank of the Crowland Washes.

The internal watercourses in the area are maintained by North Level IDB.

The section of the River Welland from south of Crowland to the southern outskirts of Spalding has two washlands located on the east side of the River, called Crowland Washlands and Cowbit Washlands. These areas are designed to alleviate very high flows in the River Welland. When the water level in the River Welland reaches a level of approximately 5.00m OD large syphons are activated which discharge excess water onto the Washes. The Barrier Bank is located on the east side of the Washes to contain the water in the Washlands and is the main flood defence bank on the east side of the river.



Existing Ground Levels

A topographical survey has been carried out of the existing land levels in the field in which the proposed dwelling will be located, and this will be submitted as part of the planning application. The levels in the survey have been reproduced on page 12 of this report.

The plan shows levels on the site vary between 1.30m ODN at the northern corner and 0.70m ODN on the southern corner.

The level of the south eastern end Harrington Drive is 1.36m ODN, which is 100mm higher than at the junction with Harrington Way where the level is 1.26m ODN.

Potential Sources of Flooding

The potential sources of flooding to the site are:-

1. Failure or overtopping of the Barrier Bank
2. High water levels in IDB drainage channels.
3. Localised flooding in the area.

1. Overtopping of the Barrier Bank.

The Barrier Bank is the eastern bank of the Crowland Washes. The Washes are only flooded in extreme conditions (around 1 in 50 years) and are used the rest of the time as agricultural land. There are two syphons which operate automatically to allow water to flood on to the Washes and alleviate high water levels in the River Welland. When this occurs the level of water in the washes will quickly rise to approaching 5.00m OD.

If a breach occurred in the Barrier Bank in this scenario then flood water would flow eastwards towards the development site.

The predicted flood levels in the updated SFRA map of the Crowland area are the consequence of a possible breach in the banks of the Welland or the Barrier Bank.

Crowland Washlands have not been flooded for around fifty years and therefore the risk of a breach forming in the Barrier bank is extremely low.

Mitigation will be provided in line with the recommendations in the South East Lincolnshire Advice matrix.

2. Flooding from IDB Drain

The area of the development is drained by the large dyke alongside James Road. The water in this dyke flows north into the North Level IDB's Greenbank Drain. This drain flows in a south easterly direction and discharges into the New South Eau which runs alongside French Drove. It then flows eastwards to the North Level Main Drain and the levels of all these watercourses are controlled by the Pumping Station at Tydd which is approximately 24 km east of Crowland.

North level IDB watercourses normally provide at least a 1 in 50 year standard of service against overtopping and in many cases a 1 in 100 year standard at the present time.

North Level IDB have a policy of monitoring standards of protection in all their catchments and will carry out improvements to pumping stations, sluices and drainage channels to ensure they do not fall due to higher run-offs predicted with climate change.

It is unlikely that any failure of assets such as pumping stations, sluices or drainage channels would lead to overtopping of the watercourse because North Level IDB have an excellent maintenance regime and monitor all assets with a modern telemetry system.

As the new buildings will be raised by at least 1.0 metre above the existing ground level this will provide adequate mitigation against flooding from this source.

3. **Localised Flooding in the area**

A drainage system will need to be constructed to drain the proposed extended section of Harrington Drive. This, along with a satisfactory disposal system for surface water from the roofs of the houses, will reduce the risk of surface water flooding on the site.

As the new buildings will be raised by at least 1.0 metre above the existing ground level this will provide adequate mitigation against flooding from this source.

Extent of known Flooding

During the preparation of this assessment, no evidence was discovered of this area of land 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 workers in the industrial area and visitors to the cemetery to be warned and 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 mostly taken from the South Holland DC SFRA which was last updated in 2010. 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 16 to 19). 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. The flood hazard on this site is shown below:



As the development is in flood zone 3 and the flood hazard is "danger for most" (1.25 – 2.0) reference should be made to Category D8 which states:

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

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)"

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

For flood depths of 1 – 1.6m, Proposals must have a minimum of 2 storeys, with FFL set a minimum of 1 metre above existing ground level, flood resilient construction to a height of 300mm above the predicted flood depth and demountable defences to 600mm above FFL.

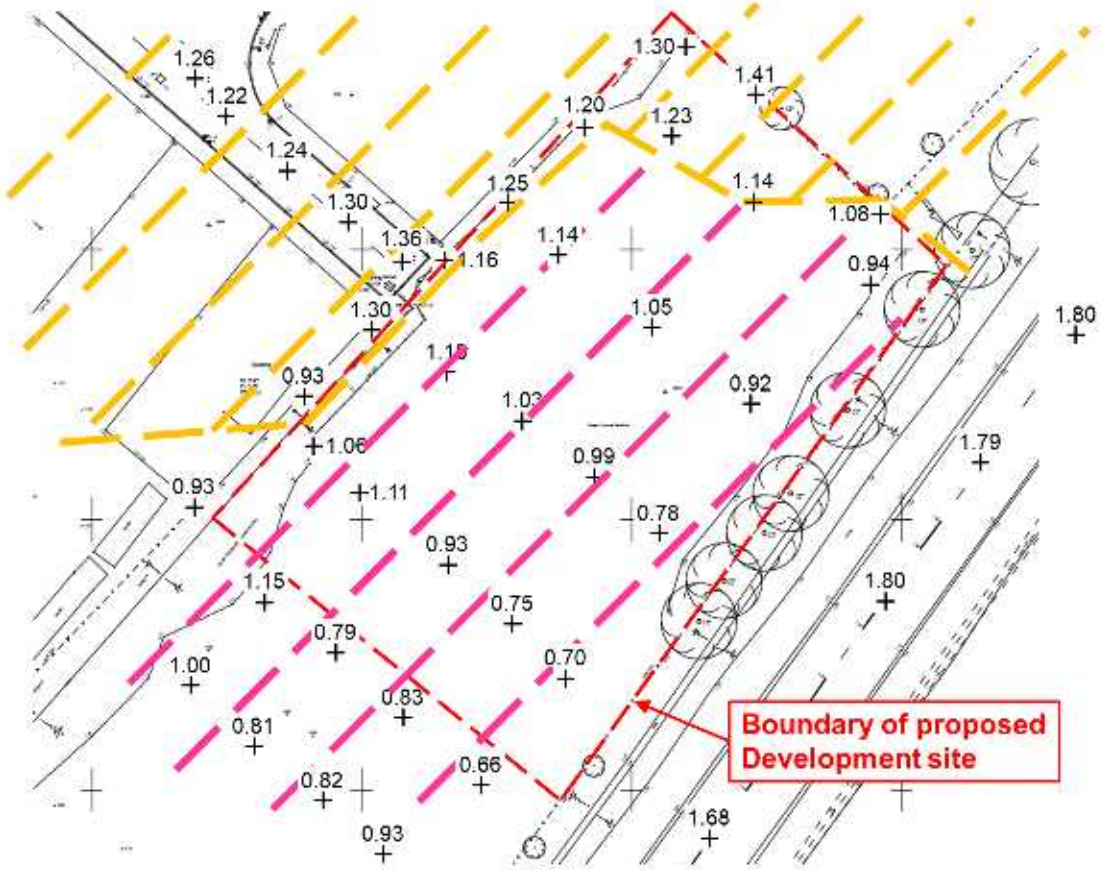
Summary of Predicted Flood Depths to the Site

The plan (shown on the next page) of predicted depths of flooding in a 1 in 100 year event in 2115 in the recently updated SFRA shows the bands of residual flood depths on the site.



It can be seen that the predicted flood depth on most of the site is between 1.0 metre and 2.0 metres.

The results of the above map can be plotted on the map showing land levels as shown below. The orange cross hatching indicates flood depths of between 500mm and 1.0 metre and the crimson cross hatching flood depths of between 1.0 metre and 2.0 metres.



From the above section it can be seen that the predicted flood level on the site is 1.15m OD in a 1 in 100 year event in 2115.

Conclusions

The risk of flooding from a breach in the Barrier bank is extremely low. However the consequence of a breach in this bank is predicted to be flooding on the development site.

The risk of flooding to the building from IDB drains can be considered low compared with the risk of flooding from the River Welland.

The IDB have adequate arrangements to bring in contractors and use their own staff if a failure of any part of the pumping stations or the sluices occurred. If drains become full any flooding that would occur would happen very slowly and affect lower land in the area before the development site. It would be very unlikely to reach a level above 2.15m 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 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 raised to a minimum level of 2.15m ODN, which is approximately 800mm above the average level of the centre line of the Harrington Road adjacent to the site.

Occupiers of the property should register with the Environment Agency's Floodline Warnings Direct Service.

The buildings should be designed incorporating flood resistant and resilient techniques to allow it to be refurbished after being flooding to a depth of approximately 300mm above the floor level of the new building.

Surface water from the roof of the proposed dwelling should be discharged into soakaways and these should be designed to BRE Digest 365 and approved under Building regulations.

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5th July 2021

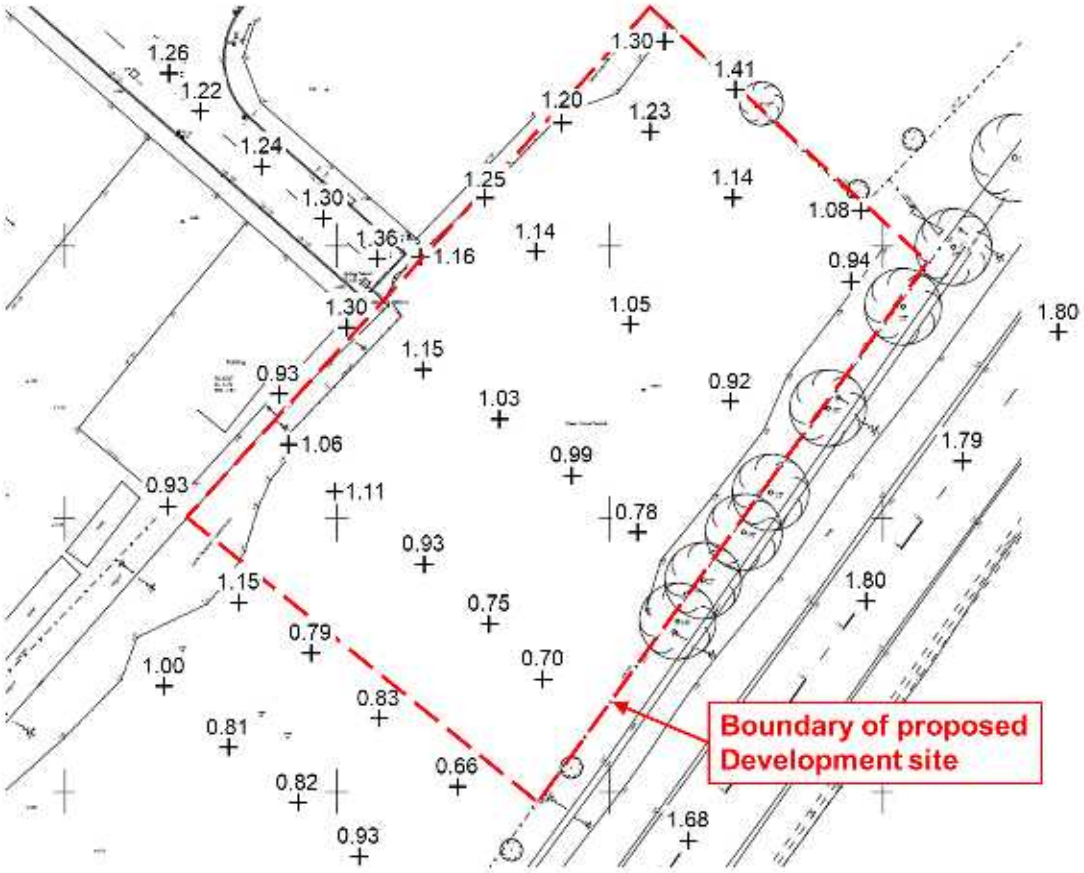
LOCATION PLAN



PLAN OF IDB DRAINS



PLAN SHOWING SITE LEVELS



PLAN OF PROPOSED DEVELOPMENT



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

document is out of date

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 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 report has identified that the main sources of flooding to the proposed development are from the River Welland and the IDB drainage system

As the developments are in flood zone 3 and are classed as less vulnerable, the higher central climate change allowance, which is 35%, should firstly be considered. After considering the effects of this increase the upper end allowance, which is 65%, should be considered.

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 Barrier Bank. If there are additional flows along this part of the 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.

North Level 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 North Level 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 of the proposed dwellings should be raised to a level of 2.15m ODN, is satisfactory.